Practical Layout Wiring

PRACTICAL

LAYOUT

WIRING

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Division 4, MCR/NMRA

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- Wiring
  - Power Bus Wire Selection
  - Track Feed Wire Selection
  - Wire Connections
- Turnouts
  - Commercial Turnouts
  - Scratch Built and Fast Tracks Turnouts
- Reverse Loops and Wyes
- Helpful Information
  - Books
  - Parts Suppliers (other than Hobby Shops)

This clinic covers the practical application of basic wiring techniques to help you have a layout that will operate reliably. Techniques covered are primarily for a DCC layout.

Topics to be Discussed

- Planning
  - Track Plan
  - Schematic
  - Blocks (Power Districts)
- Basic Electricity
  - Ohm's Law
  - Feed Wire and Track Resistance

PLANNING

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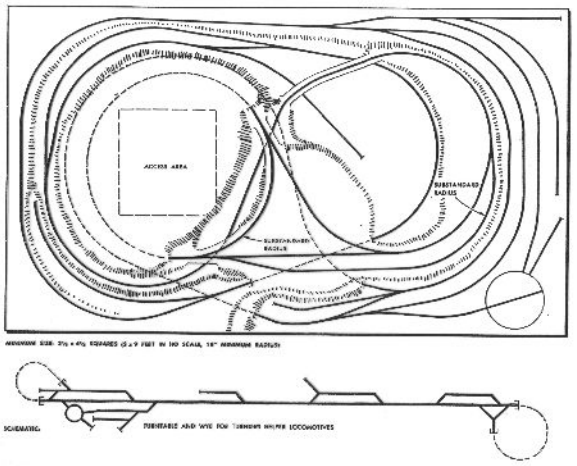
Track Plan and Resulting Schematic



First, determine the direction of travel by assigning the compass point “E” with a direction arrow. This will apply to the whole track plan with the exception of reversing loops.

Then assign The compass points “N” and “S” to the rails. This will identify track connections, and insure that all wiring is uniform.

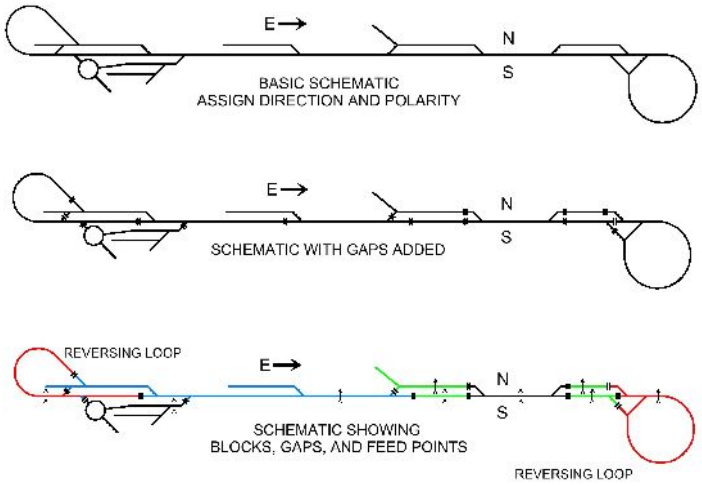
After the gaps have been identified, label all the passing sidings and power feed points. This will make wiring easier.

Planning – Blocks and Gaps

Convert the track plan to a layout schematic

This makes it easier to identify where blocks, gaps and feeds are to be placed. Also makes identification of reverse loops and wyes easier.

To identify track polarity, I prefer to use the points of the compass method.



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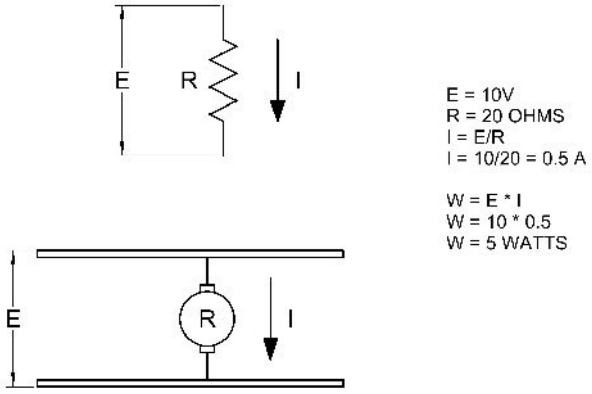
Basic Electricity

Definitions

- Voltage – E – Volt
- Current – I – Ampere
- Resistance – R – Ohm
- Power - W - Watt

From these units of measure, we get Ohm's Law. This allows us to find the value of any one of the units knowing the other two.



EXAMPLE OF OHMS LAW

Ohm's Law

$E = I * R$ $R = E / I$ $I = E / R$

Also related is the formula for calculating power

$W = E * I$ $W = I^2 * R$ $W = E^2 / R$

Why do we want to know something about Voltage, Resistance, and Current?

Knowing something about the relationship between Voltage, Resistance, and Current will help to understand how to achieve a better running layout.

Here are some helpful facts.

Both the track and the feed wires have resistance and therefore behave as resistors (R).

The voltage (E) is the output voltage to the track supplied by the power pack (DC) or booster (DCC)

The amperage (I) is the current draw of the locomotive(s) and lighted cars.

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Fact - Nickel Silver Track is a contributing source of voltage drop in a layout. Nickel Silver is an alloy of Copper, Tin, and Nickel, it has more than 6 times the resistance of Copper. Brass has about 3 times the resistance of Copper.

Fact - Voltage drops in layouts are introduced generally by lack of feed wires to the track, not by inadequate power bus wire size.

Fact - Voltage drops and unreliable operation come from unsoldered rail joiners and/or sections of track with no feed wires.

Some Facts About Wire and Track

Voltage drop for various sizes of bus wires.

For these examples, the round-trip length is 100 ft and the current is 3 amps.

#18 - 2.04V, #16 – 1.21V, #14 – 0.76V, #12 – 0.48V, #10 – 0.30V

Voltage drop for a 3 ft section of *ATLAS* flex track

Applied Voltage = 12VDC, Current = 0.8 A., Load is a 15 OHM resistor.

Code 83 – 0.17 V (170mv)

Code 100 – 0.04 V (40mv.)

Myth - Stranded wire works better for DCC and other command control systems than solid wire. The frequencies used for transmission of the command data to the locomotive are too low for the type of wire to have any effect on performance.

Basic Wiring Methods

Choice of Wire for Power Bus

I prefer stranded wire, because I think it is easier to work with, although solid wire is perfectly OK.

Power Bus wire size

Small - Medium layouts HO and N - #16 or #18

Small - Medium layouts O - #14 or #16

Medium - Large layouts HO and N - #12 or #14

Medium - Large layouts O - #10 or #12

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Basic Wiring Methods

Choice of Wire for Track Feeders

I prefer solid wire for track feeders, although stranded wire works just as well.

For me solid wire is easier to attach to rail

Solid wire is easier to form, and easier to solder

For code 100 rail and larger use #18 or #20 solid

For code 83 rail, use #22 solid

For code 70 rail, use #22 solid

Basic Wiring Methods

Additional Connection Methods

Wirenuts - Terminal Blocks

Myth - Soldered connections are always better than solderless connections

Fact - Solderless connections provide a gas tight reliable connection.

Basic Wiring Methods

Connecting Track Feeders to Power Bus

Soldering

The bus wire has to be stripped at every feed wire connection – tedious

Insulation Displacement Connectors

Scotchloks, a 3M Product

These connectors are my choice for connection of track feeders to the power bus are *Scotchlok* connectors #560, #558, and #905 are examples.

Soldering

Choice of Iron

Use a 40 to 60 watt for general soldering. I use a 60 watt for soldering feed wires to rail, (HO and larger)

A temperature controlled iron is always preferred. I use 700 degree F. tips, although 800 degree F. tips are available. These irons are more expensive than the hobby irons, but I consider them well worth the extra cost.

Solder

Use only 60/40 rosin core such as Kester “44"
DO NOT use acid core

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The trend now, is to use lead free solder. It melts at a higher temperature and your soldering iron will need an 800 degree F. tip.

Flux - I have changed to No-Clean Flux, available as a “flux pen”, *Kester #951*

Technique - Clean surfaces are 90% of a good solder joint. Apply flux, heat joint with a tinned iron, and flow just enough solder into the joint to produce a bright smooth surface.

Wiring The Layout

Common Rail

I do not encourage the use of common rail, the additional wire and effort to use fully isolated blocks far outweighs the cost savings in wire for common rail. Also, if you decide at a later date to convert to DCC, you will need isolated blocks.

Track Connections

Track Feed Wires - I use #18 solid wire for “0”. For “HO” code 100 use #20 or #22. For Code 83 and smaller track use #22.

Wiring The Layout

Marking wires makes identification of block and other circuits easier for troubleshooting.

Wire Markers
Colored Wire
Colored Tape
Under table labeling

Cabling makes the wiring neater and less prone to damage

Ty-Wraps
Twist Ties
Cable Clamps

Wiring The Layout

Placement of Track Feed Wires

Place power drops no more than every three feet, and every gapped section.

Rail Joiners

If you do not solder rail joiners then use a track feed wire at every section of rail. If you solder rail joiners, leave an unsoldered rail joiner and a .03 -.06 in. gap in the rails for thermal expansion. Make sure there is a Track Feed Wire for every section of track connected by an unsoldered rail joiner.

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Wiring The Layout

Command Control - Special Considerations

Choice of wire size for Power Bus

#14 or #12 are the best choices, primarily for cost. Since these are the most common building wire sizes, they are also the most plentiful, and made in the largest volume. I suggest buying a 500 ft reel of #14 or #12 and use color coding to identify wires. I also recommend twisting the feed wires about 3 - 4 twists per foot. This insures the signal integrity of the DCC power connected to the track.

Illustration of Track Feedwire Attachment and *Scotchlok* Application

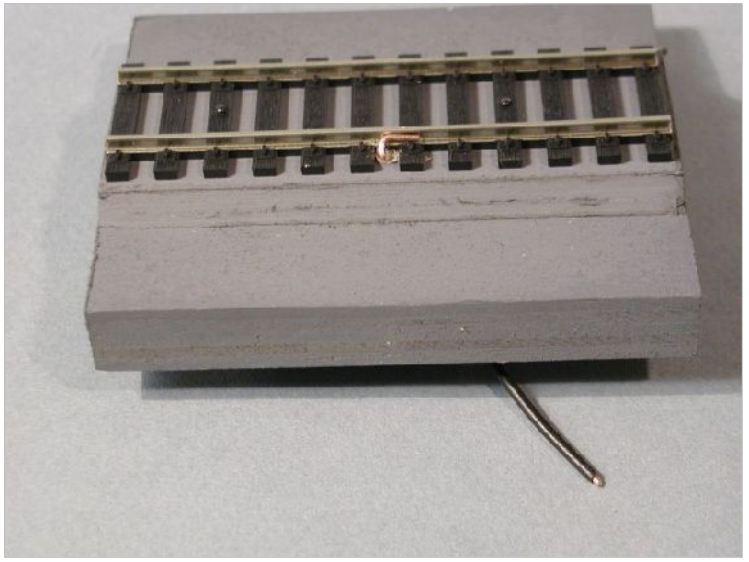
Wiring The Layout

Reversing Loops

Reversing loops are treated the same for DCC as for conventional wiring, however there are automatic reversing loop detectors, that sense the phase of the power when crossing the gap and automatically reverse the phase of the DCC power

Blocks (Power Districts)

Although there is no need to block a layout, I strongly recommend that you take the extra effort to insert blocks. This not only makes troubleshooting easier, but it makes adding additional boosters, electronic circuit breakers and signal detectors easy.



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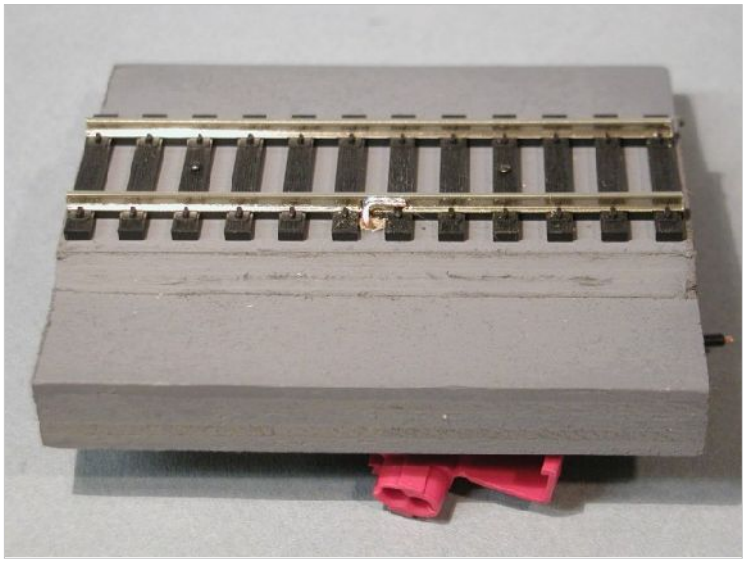

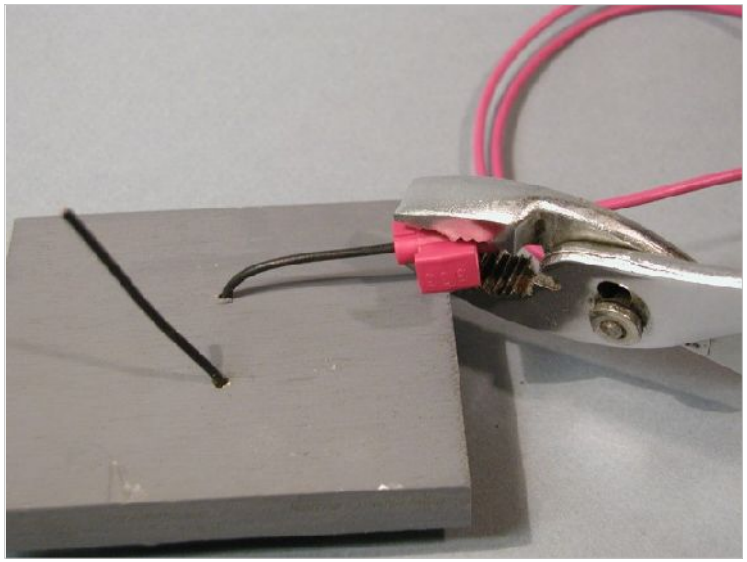

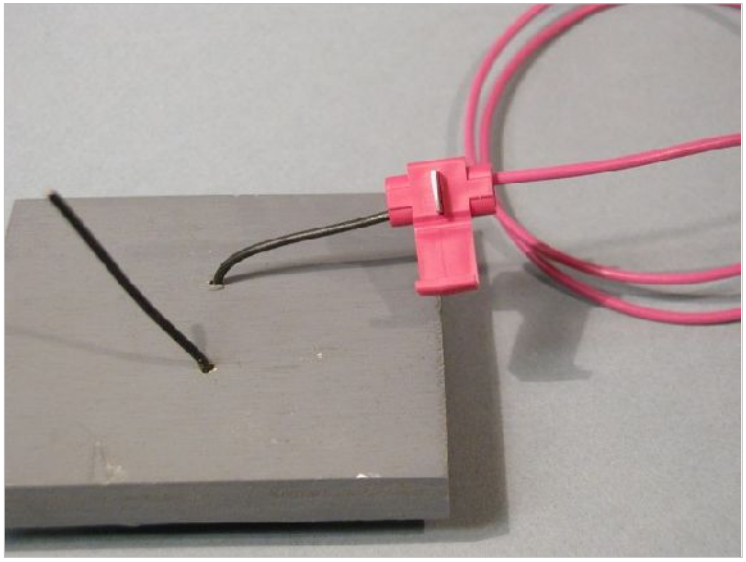

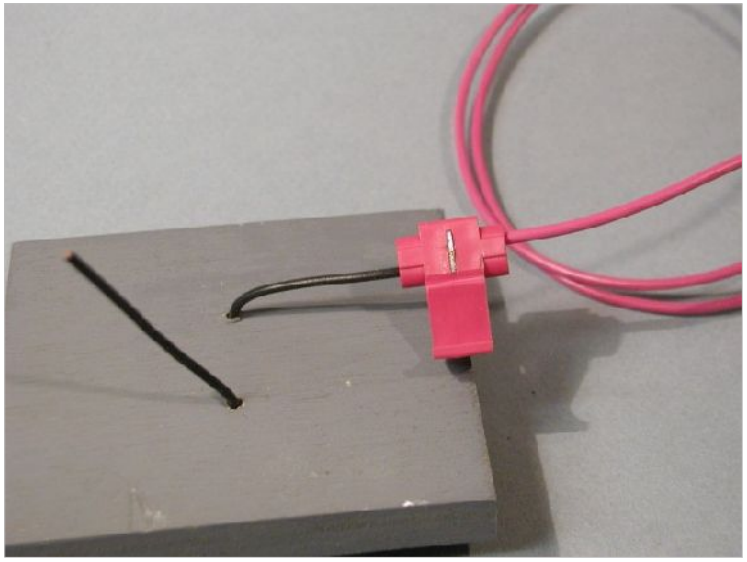

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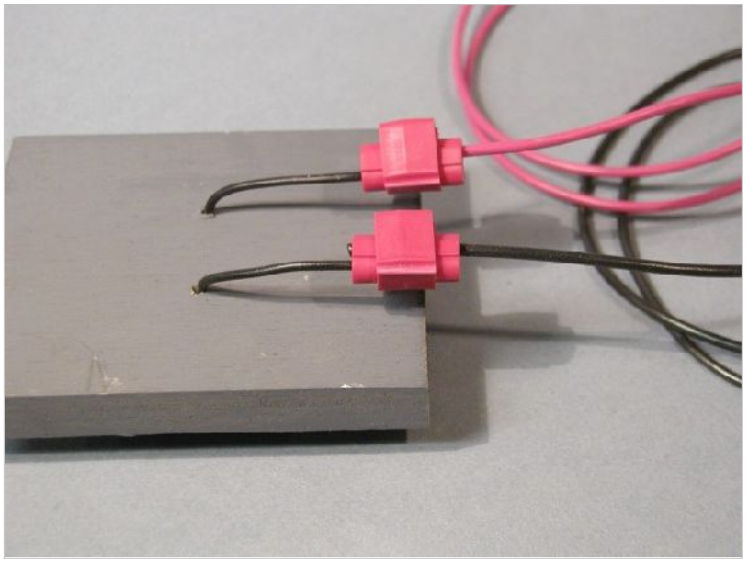
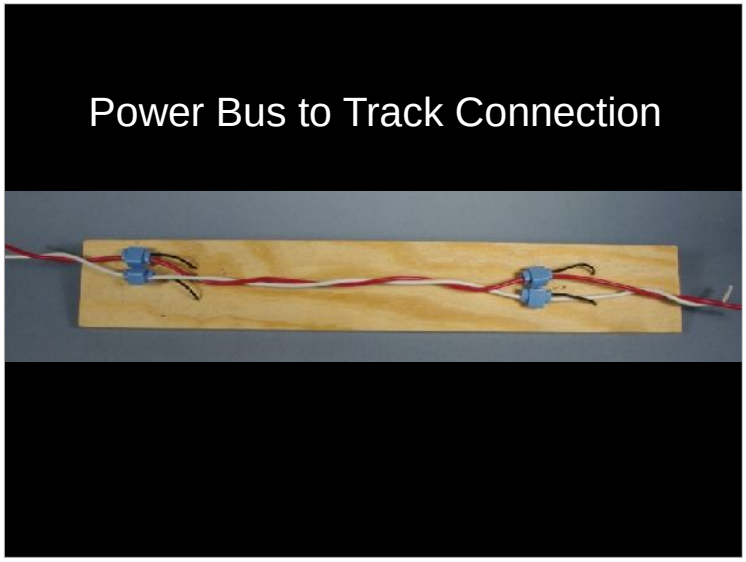
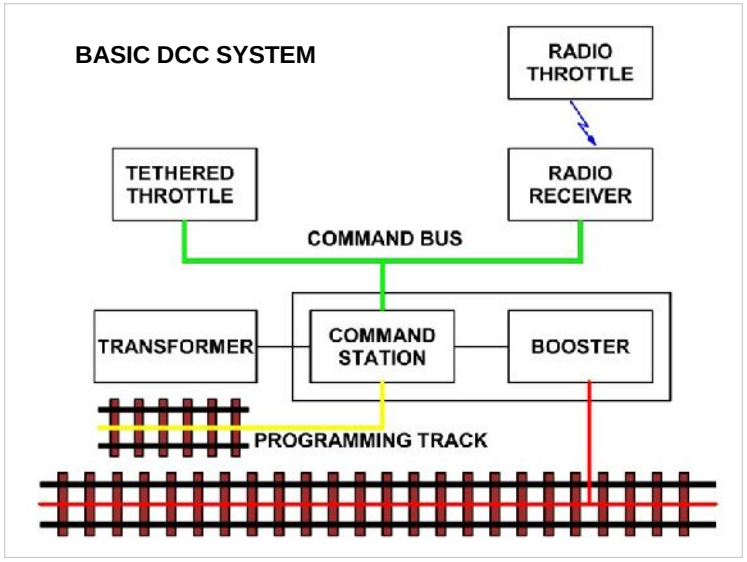


BASIC DCC WIRING

- BASIC DCC SYSTEM
- POWER DISTRICT WIRING
- WI-FI THROTTLE





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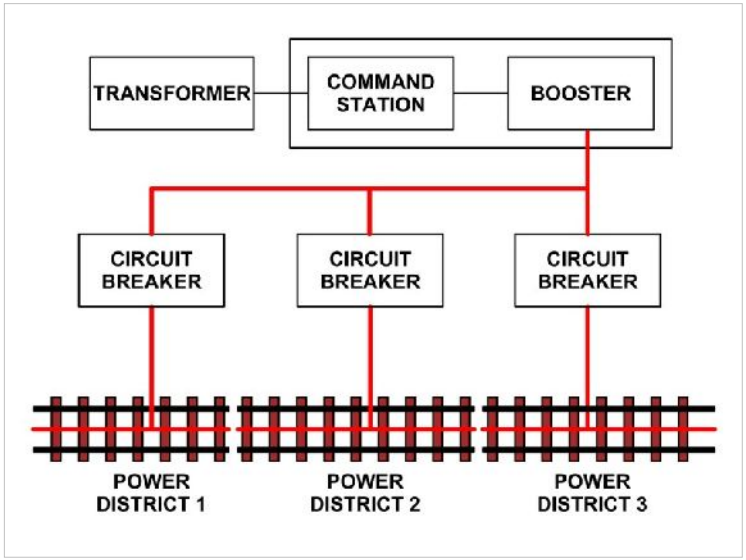

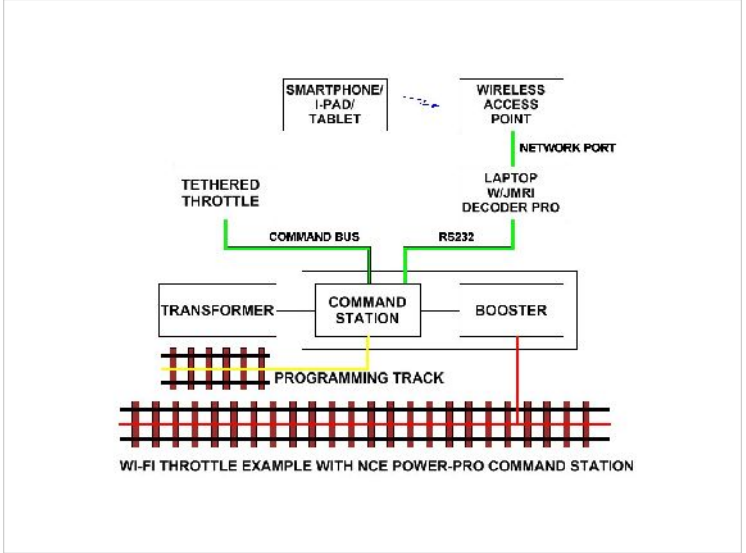

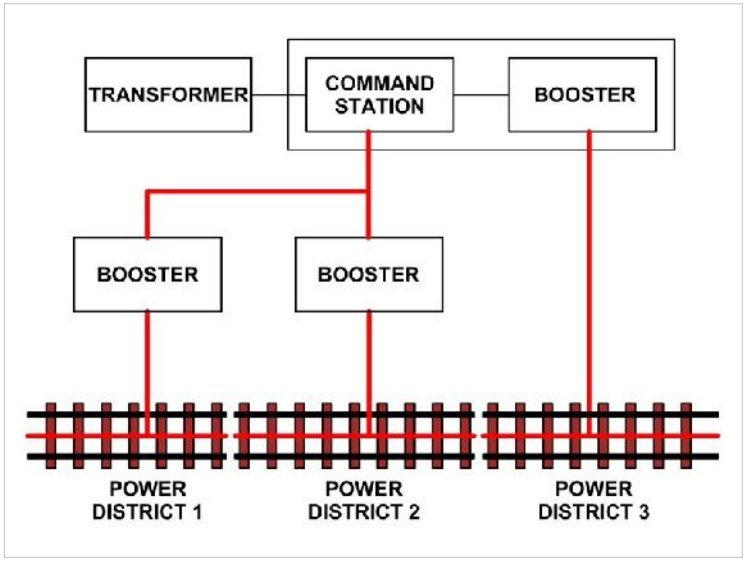

Reverse Loops and Wyes

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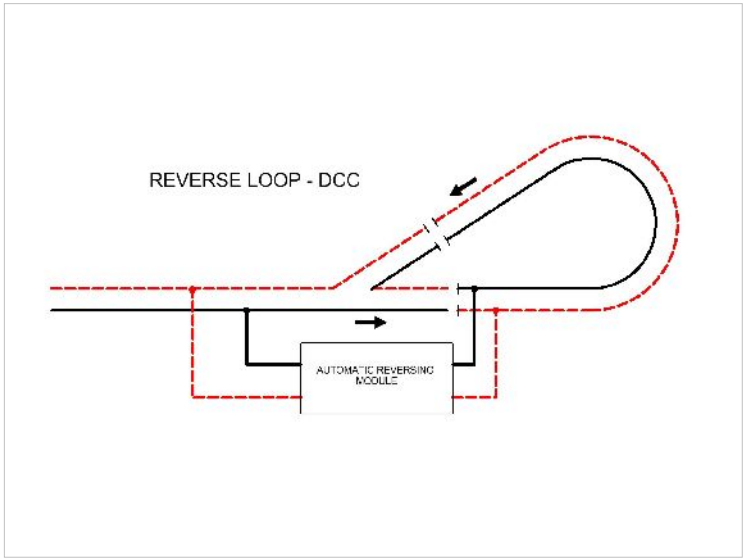

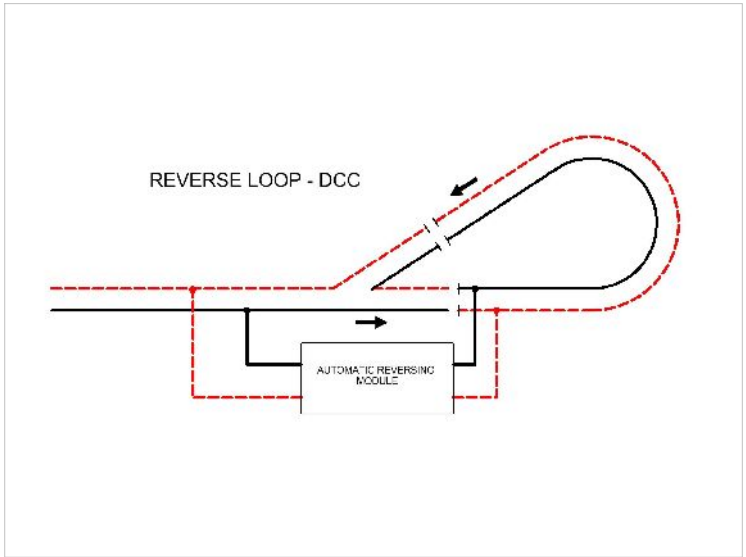

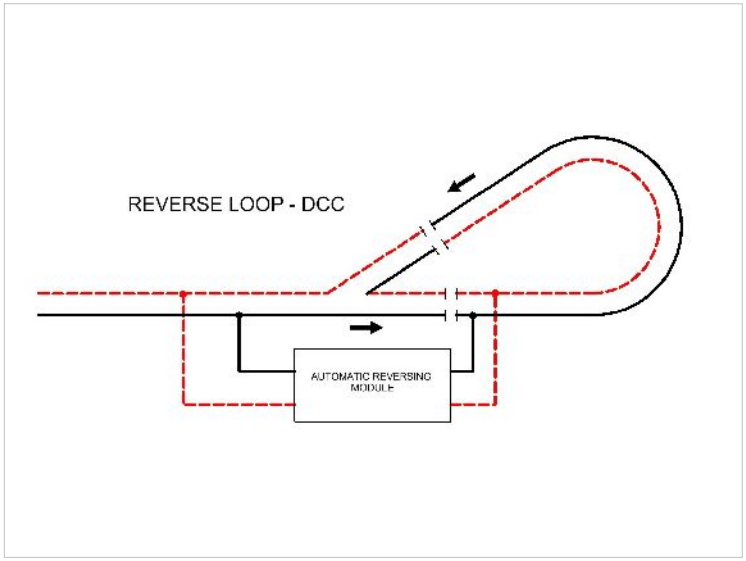

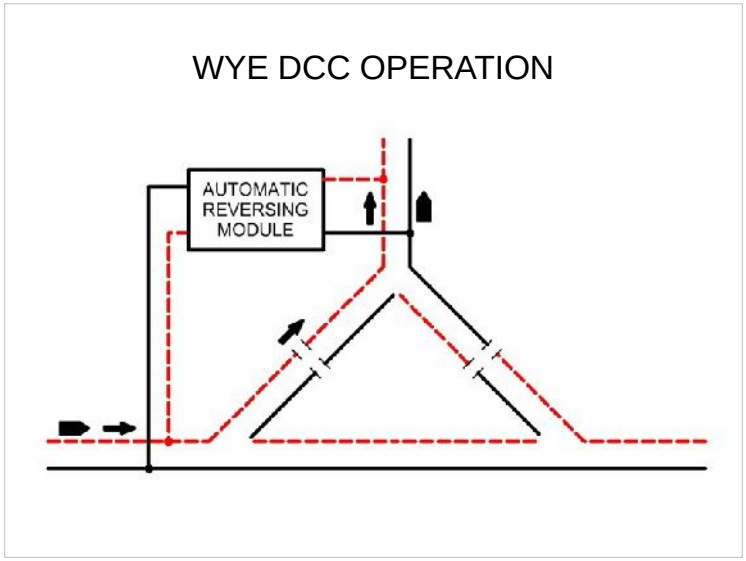

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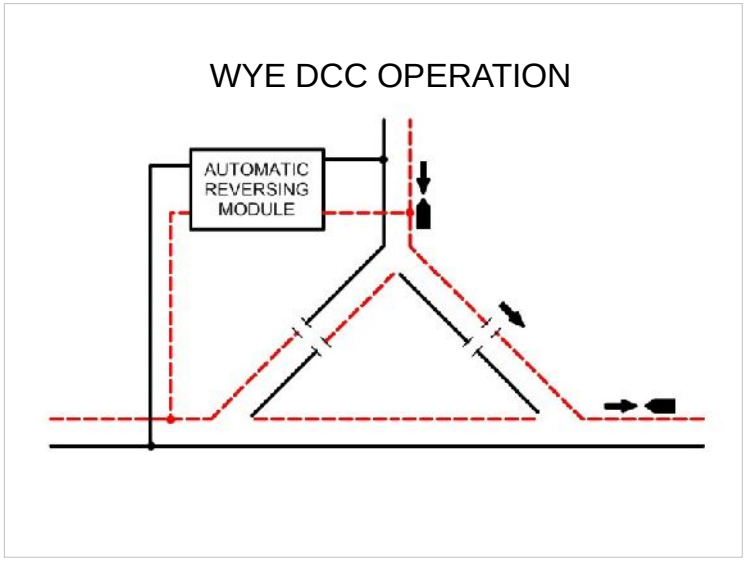

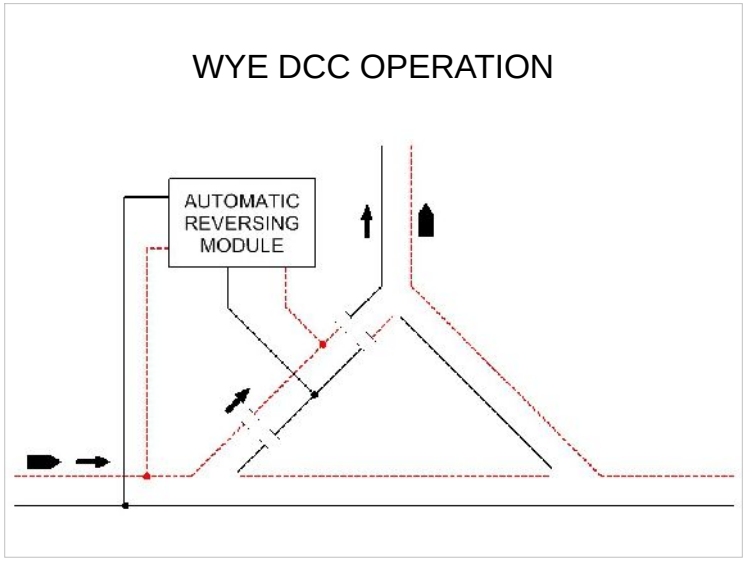

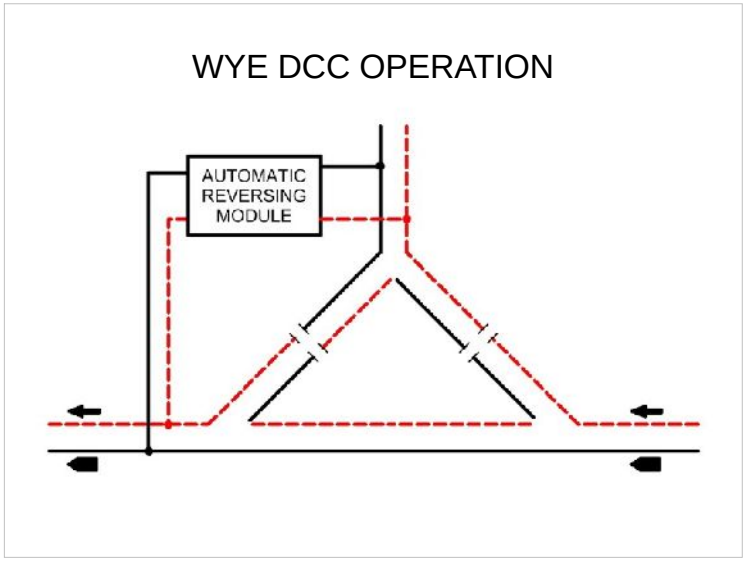

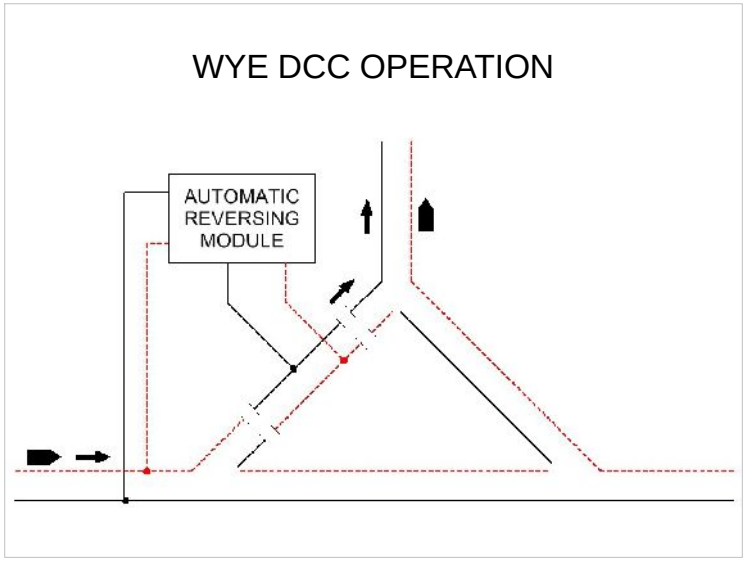

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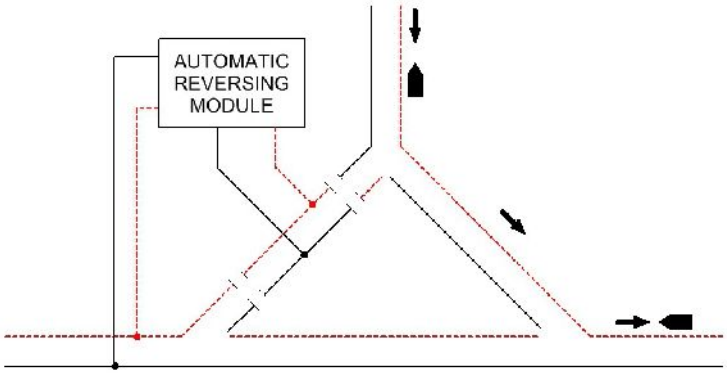
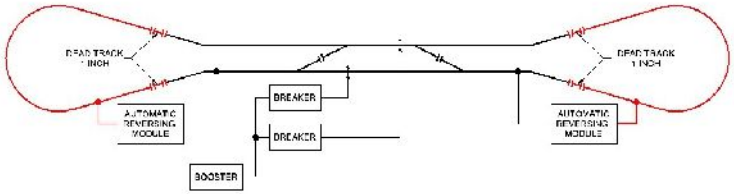
WYE DCC OPERATION

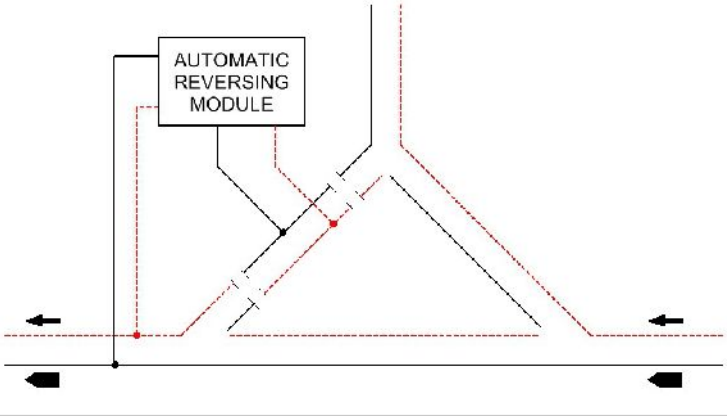


Dogbone layout arranged with reversing loops at both ends.

For a DCC layout connecting the track between the two ends of the dogbone allows for the use of crossovers without changing track polarity. The ends then become reversing loops. The use of automatic reversing modules makes operation seamless without the use of any polarity reversing switches.



WYE DCC OPERATION



- SHINOHARA ORIGINAL
- PECO ELECTROFROG
- NEW WALTHERS-SHINOHARA
- ATLAS CUSTOM LINE
- PECO INSULFROG
- FAST TRACKS

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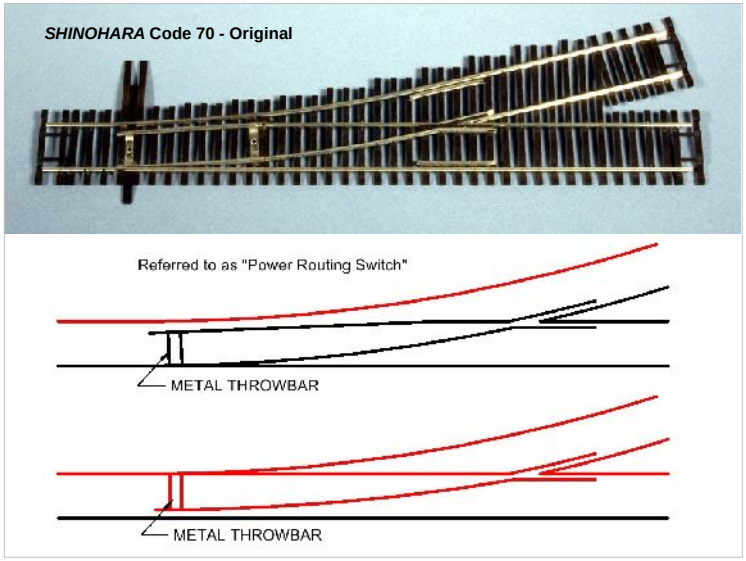

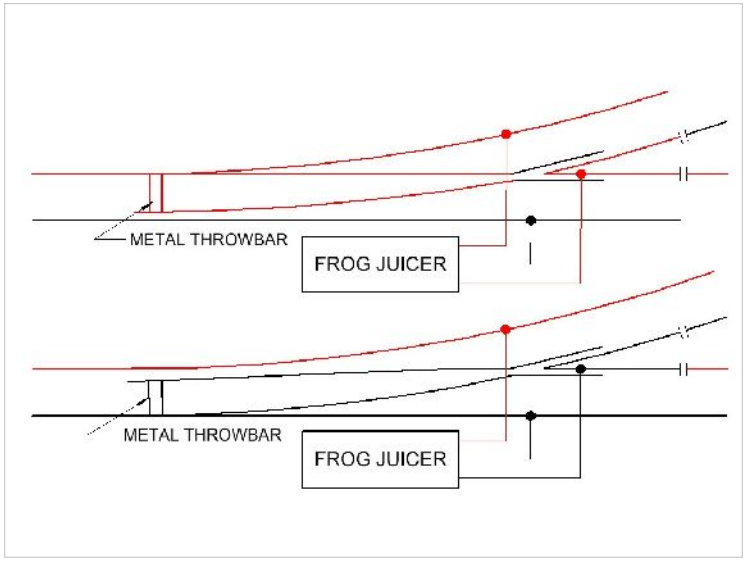

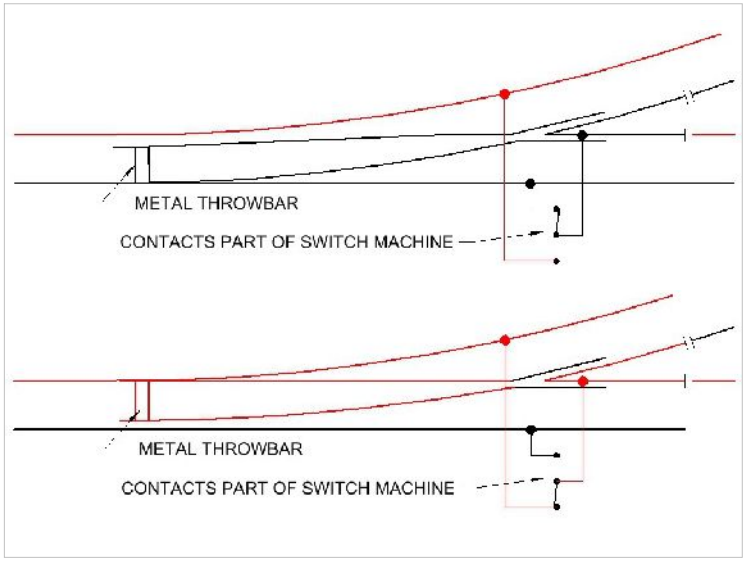

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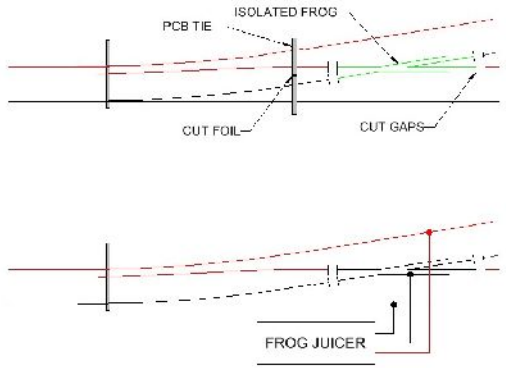
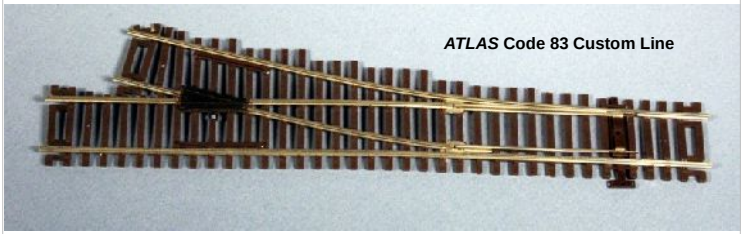
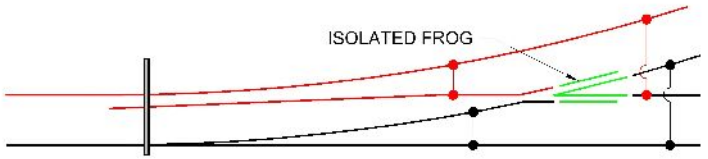
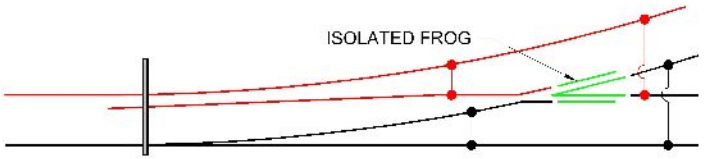
FAST TRACKS

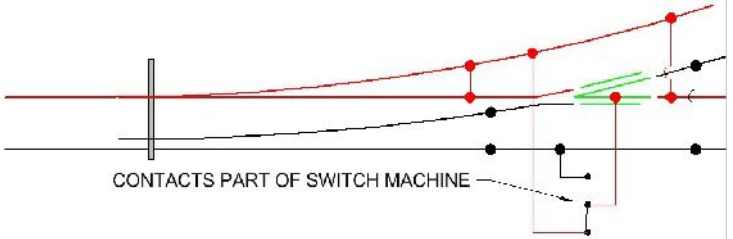


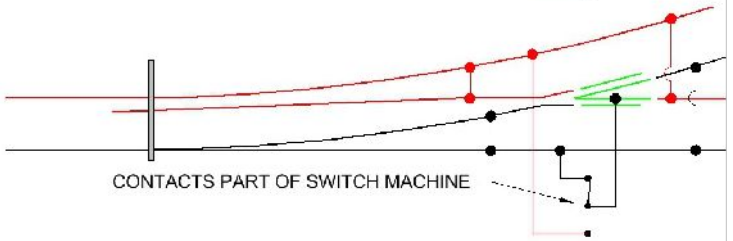






ATLAS CUSTOMLINE





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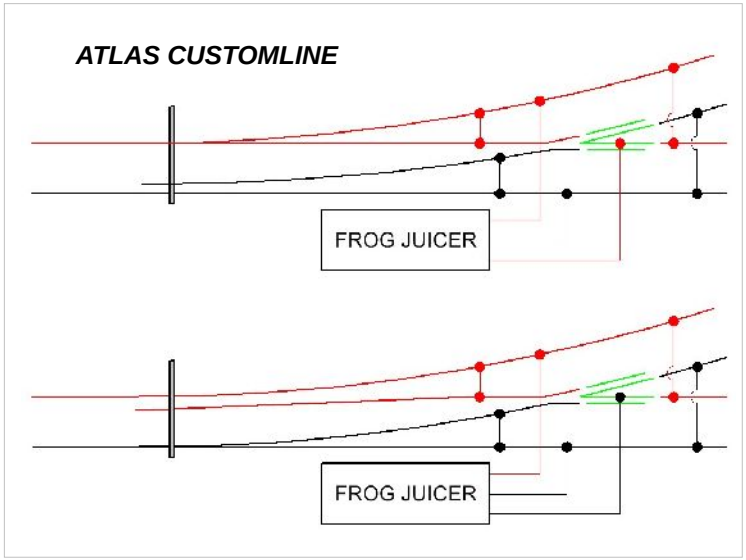
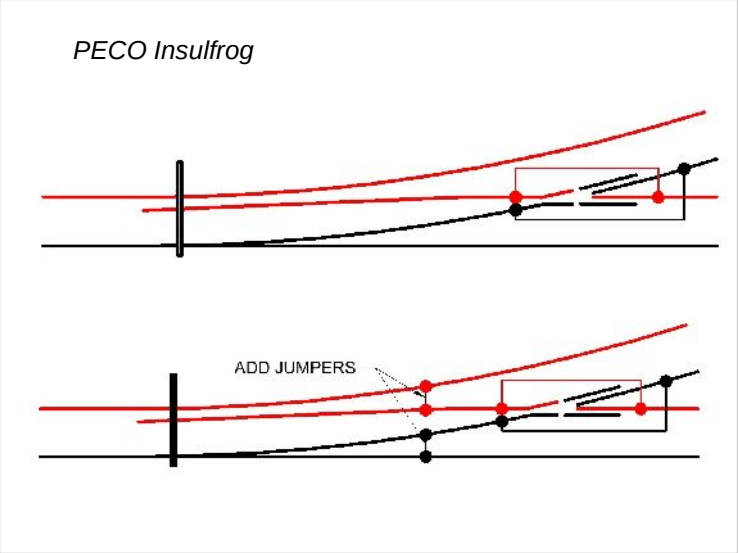
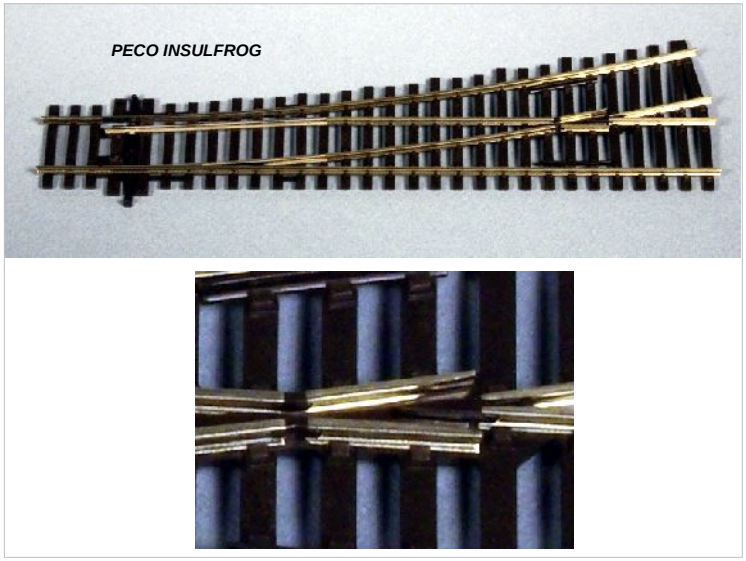
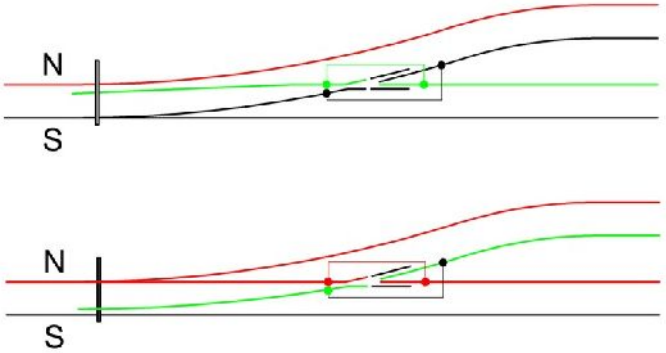






Power routing siding using PECO Insulfrog Turnout. This works for DC or DCC. For DCC it is desirable to have both tracks powered all the time.



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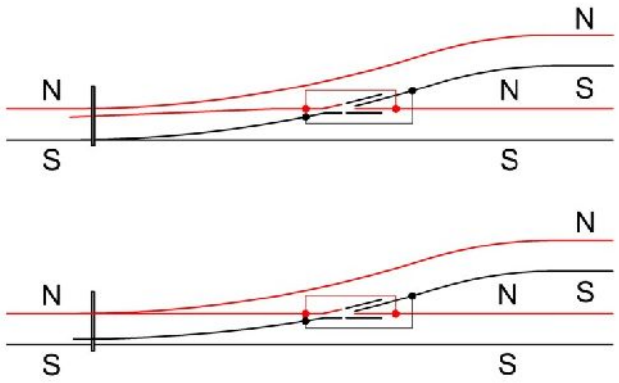
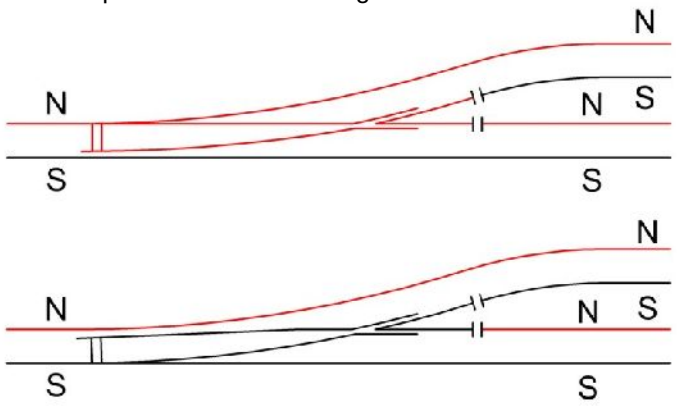
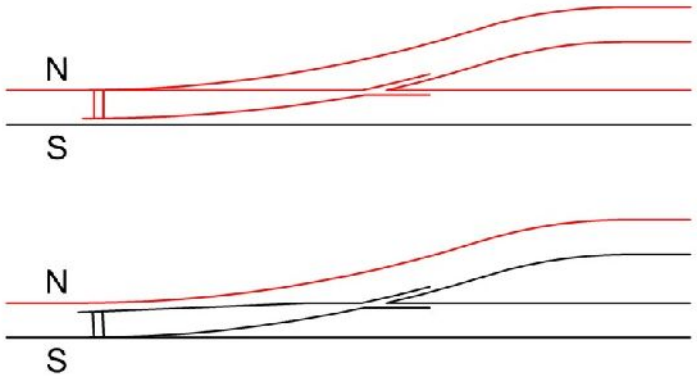
By adding power feeds to the tracks beyond the frog, all tracks are now powered with no changes to the turnouts.



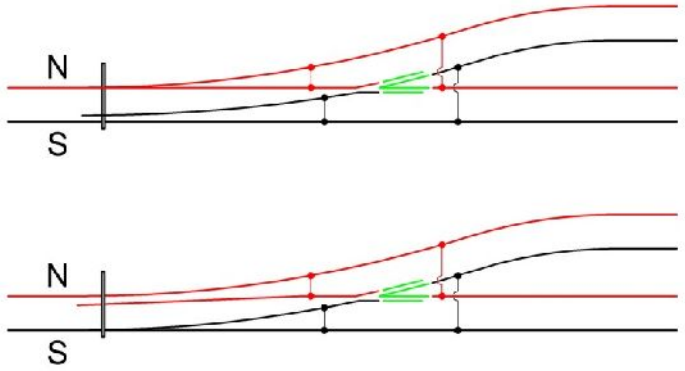
By adding power feeds to the tracks beyond the frog, and adding gaps at the frog all tracks are now powered with no changes to the turnouts.



Power routing siding using original *Shinohara* Turnout. This works for DC or DCC. For DCC it is desirable to have both tracks powered all the time.



Siding using either new *Walthers* or *Atlas Custom Line* turnouts. This works for DC or DCC. All tracks are powered all the time.



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Practical Layout Wiring

Helpful Information

Books

Wiring Your Model Railroad
Larry Puckett
Kalmbach Publishing

Basic DCC Wiring For Your Model Railroad
Mike Polsgrove
Kalmbach Publishing

The DCC Guide
Don Fiehmann
Kalmbach Publishing

Helpful Information

Electrical Handbook For Model Railroads
Vol 1
Paul Mallery
White River Publishing

Electrical Handbook For Model Railroads
Vol 2
Paul Mallery
White River Publishing

Helpful Information

The DCC Guide Second Edition
Don Fiehmann
Kalmbach Publishing

DCC Projects and Applications
Vol 2
Mike Polsgrove with David Popp
Kalmbach Publishing

DCC Projects and Applications
Vol 3
Mike Polsgrove with Cody Grivno
Kalmbach Publishing

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DCC Dealers

Tony's Trains
Pinewood Plaza
57 River Rd. Suite 1023
Essex Jct., VT 05452
Https://tonystrains.com

Litchfield Station LLC
1412 N Central Ave Ste D
Avondale AZ 85323-1316 USA
623-298-7355
www.litchfieldstation.net

Practical Layout Wiring

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Fast Tracks Hobbyworks Inc
312-B St Pactrick St.
P.O. Box 1420
Port Dover, Ontario NOA 1NO Canada
www.handlaidtrack.com

Helpful Information

Mouser Electronics
1000 N Main St
Mansfield, TX 76063
1-800-346-6873
http://www.mouser.com

Digi-Key Corp
701 Brooks Ave. S.
Thief River Falls, MN 56701
1-800-344-4539
http://www.digikey.com

Allied Electronics
1-866-433-5722
http://www.alliedelec.com

Electronic Surplus
8755 Munson Road #6
Mentor, OH 44060
440-205-8388
www.electronicsurplus.com

The complete clinic is available in <pdf> or <ppt> from
Larry Madson lmelect@roadrunner.com

Helpful Information

Parts Suppliers

All Electronics
14928 Oxnard Ave
Van Nuys, CA
1-888-826-5432
http://www.allelectronics.com

Jameco Electronics
1355 Shoreway Road
Belmont, CA 94002
800-831-4242
http://www.jameco.com