MODEL RAILROADING BASICS 101

Presented by Division 6 of the North Central Region, National Model Railroad Association

Part 3 – Track Wiring & DCC

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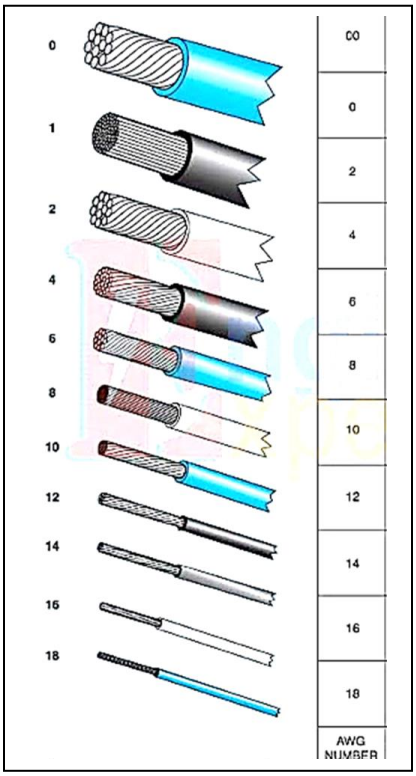
HELLO and welcome to our series of lessons to get YOU, started in a great hobby, MODEL RAILROADING! This third session is about wiring the track and an over-look of what DCC is. As with many subjects in our hobby (and life) there are many ways to do something. These tips are designed to give you some basics and then through research, questions/answers... we hope you will find what best works for you. This handout will cover a bit more than what was actually discussed at our Division 6 meeting. Our meetings are limited on time and these basic subjects could be talked about for a whole meeting. But, we want to give you an overview at the meeting, this handout to take home and do that research and start on your hobby journey. Enjoy!!

There are several considerations for this subject - Type and size of wiring; Wiring connections; Simple wiring; Complex wiring situations; DCC – what it is, DCC wiring and Tools. Let's look at each.....

TYPE AND SIZE OF WIRING



The first thing one needs to consider, is the type of wiring that should be used. AWG stands for American Wire Gauge. Number 1 AWG wire size is large, where as 14 AWG, is smaller. Thus the lower the number is, the larger the wire size, and the higher the number is the smaller the wire size.

No matter if you're wiring your layout for DC, or DCC, the wire size has to be adequate to handle the current (amperage), and the voltage supplied to the rails.

Using solid wire, or Stranded? Stranded (or bundles of smaller wires inside insulated wire) is preferred over "solid wire"! The reason is it is more flexible to work with, and less likely to break connection.

Another factor to consider in buying wire, is the wire insulation of the wire. You want to use wire with PVC (Poly Vinyl Chloride) insulation, which is softer, and has a higher temperature rating. Do Not use house wiring, or Machine Control wiring, with thick insulation for buss wiring. This type is what is typically found at big box stores, such as Home Depot, or Lowes, on spools ranging from 100' to 500' or more. Or, sold by the foot. Electrical Supply firms sell wire with PVC insulation.

To actually connect wires to the track, it is best to solder them to each other. Rail jointers with wire attached is available, but not the best method. To put in track feeders, drill a hole next to the rail between two ties. Feed the wire down through the hole and then bend the wire like this for easy soldering to rails. Then using a soldering iron and thin solder, hold the wire to the rail with the soldering iron and touching the solder to both of them.
A small screwdriver is then used to hold the wire and solder to the rail, as the solder cools. It takes a bit of practice... but once you do a few of these, you can make wire connections almost invisible.

WIRING CONNECTIONS

When wiring a simple layout for a single operating train, two wires from the power pack to the track could be sufficient. However, the train may run slower as it gets further away from the power pack, then speed up again as it gets closer. This is due to the voltage drop of the electricity going through the rails. The drop increases as the distance from the power supply increases. The way to help eliminate that is with BUSS WIRING.

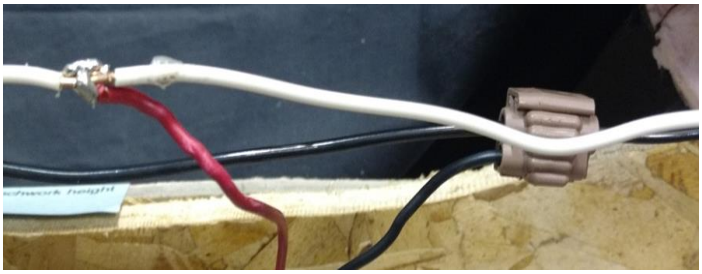
Buss wiring is installing a heavier buss wire following the track. Then running the feeder wires from the buss to the track, spaced 2-3 feet apart. This will get a more even flow of electricity through the rails and train control will be smoother.

We have discussed attaching the wire to the rails, but what about those feeder wires to a buss wire. Well, there are several ways.

1) You can simply solder wires together. By removing some installation on the buss, then wrapping bare feeder wire around the buss and soldering them together, you have a connection. This is fairly permanent, but could be unsoldered if the connection needs to be broken.

2) Suitcase connectors do not require soldering, but are not easily removed. They work by cutting a piece of metal through the insulation of both wires, thus connecting them together. No insulation is needed to be removed!

3) Wire t-tap and spade connectors are another type of connection that does not require soldering and is easily removable, if needed. They are a two piece connection with the t-tap being crimped on the buss wire. Then a spade/blade connector is crimped onto the bare end of the feeder wire and inserted into the t-tap connector. The feeder can be removed from the t-tap easily if required.



Soldered joint

suitcase connector

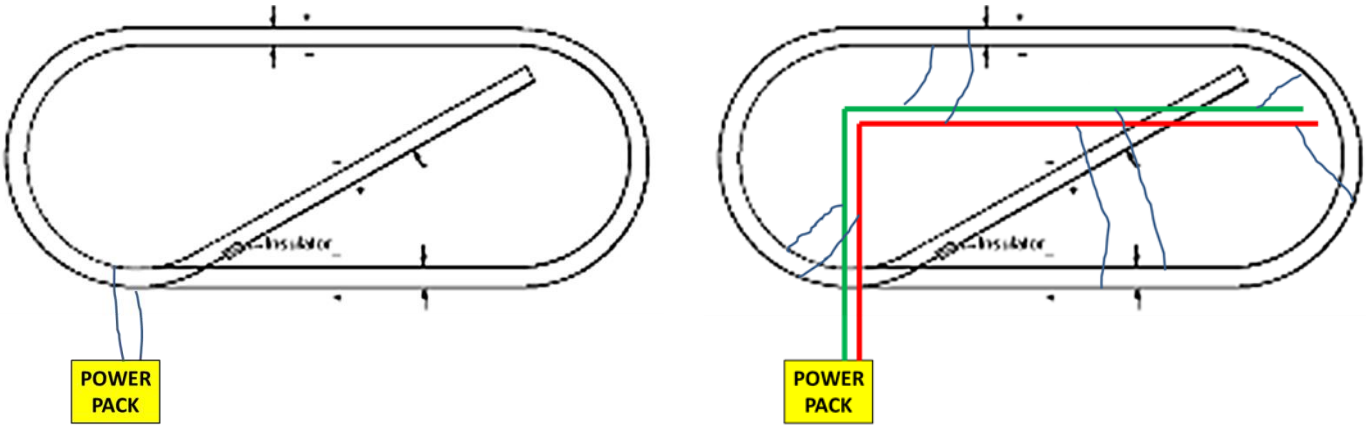
t-tap and spade connectors

There are lots of other types of connectors, but these are the most common and give the greatest flexibility and reliability!

A good friend, Jim Tilley, is able to supply you with quality tools, quality T-Taps, spade connectors, and wire. The connectors he carries are American made, by 3M, whereas the big-box stores sell look-a-likes, that are cheap Chinese made copies, If you want to buy from him, you can contact him at: ***hojim@comcast.net***
Jim owned a wire and terminal wholesale business and purchased all his products direct from manufactures. He sells only to fellow model railroaders.

SIMPLE WIRING

Let's look at some examples of simple wiring on a simple one train layout. In the example below (left) is a typical beginner layout of a loop of track with a siding. Simple wiring of the power pack to the track is usually sufficient for operating the train. The siding can be powered, or isolated with a toggle switch if needed (not shown). With this wiring, we can get that voltage drop when the train gets further away from the power pack.



Now let's look at this same layout with a buss line wiring (upper right picture). The red and green lines are our buss lines, one for positive, one for negative. The feeder wires are then connected from the track to the buss lines, keeping the rails all connected to the SAME buss, inside rail to negative, outside rail to positive. While this is more work and wiring, the train will run better because the electricity flows better to all track sections.

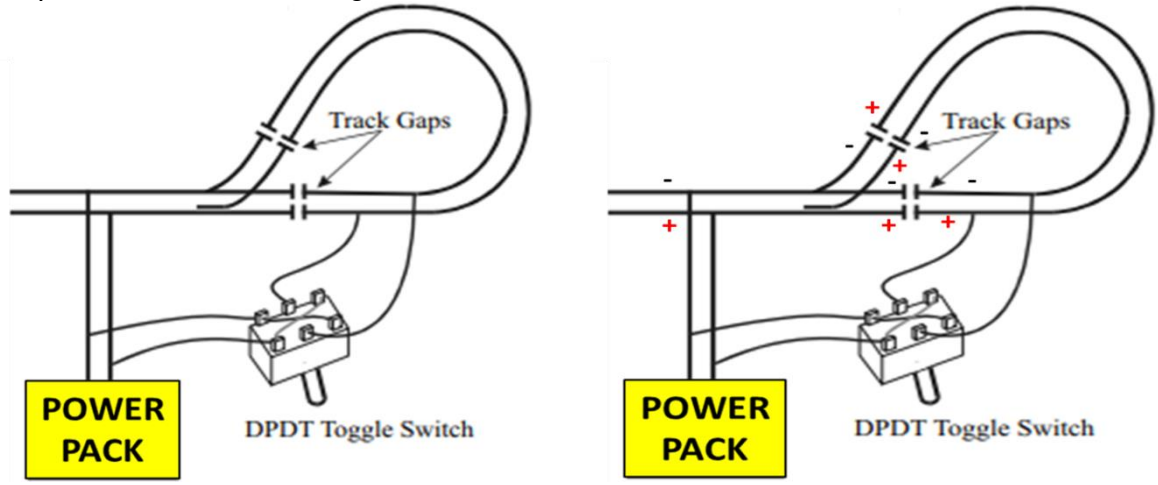
COMPLEX WIRING SITUATIONS

There are several complex wiring situations that must be tackled, depending on your track plan. Reverse loops, Wye's and running several trains at the same time are the few we'll look at.

REVERSE LOOPS

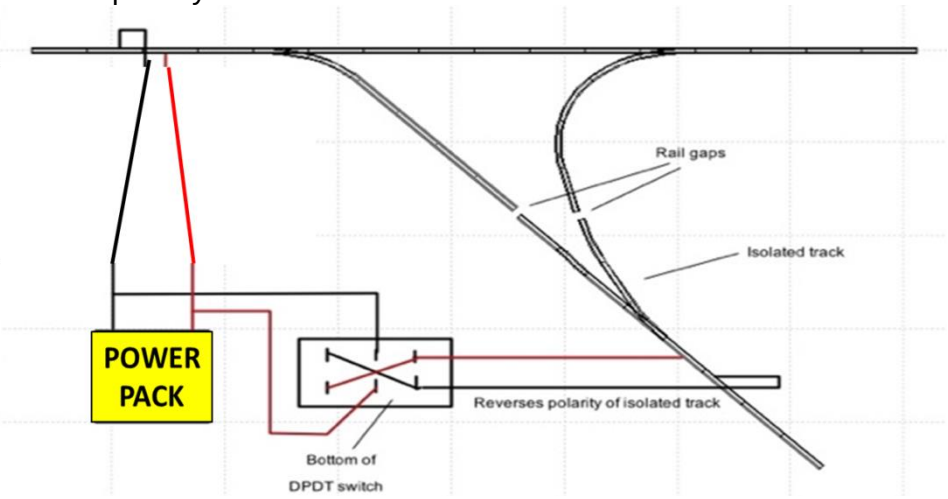
A reverse loop is when the track turns around on itself, making the train go back the way it came. This creates an electrical problem because the track rails, which are positive/negative now connect to each other in the opposite polarity! This cause a short and will damage power packs and locos. With reverse loops, both rails must be "gapped" at each end of the loop. A separate "double-pole / double throw" toggle must be wired to the reverse loop, and thrown while train is stopped in the loop. This changes polarity for the rails, to allow the train to exit the opposite end of the loop. Or, a suitable "Auto-Reversing" circuit board can be used in place of the toggle.

In the picture... you see that we have placed gaps, or rail insulators on the looped section of track. This isolates this section from the main track and now has no electricity flowing to it. Note on the second picture, how the polarity loops back on itself, causing a short.



WYE TRACK

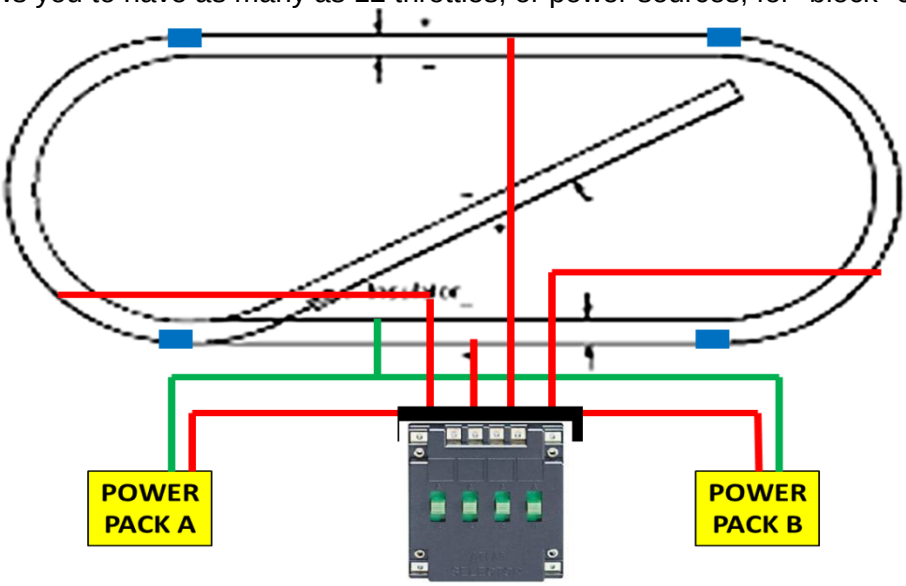
A wye track is similar to a reverse loop in wiring. The “tail” of the wye needs to be isolated and a DPDT switch installed to control the track polarity.



MULTIPLE TRAIN CONTROL – CAB CONTROL

You have advanced a bit and now you want to run two trains on your layout. Is that possible? YES!!
If you want to run more than one train over the entire layout, you must use two or more power sources, and you must wire it for "Block Control", or otherwise known as "Cab Control"! A "Block" of track has one, or both rails isolated at each end of it, and is isolated between turnouts. In this case, you can use Atlas selector switches (pictured), and other control switches they sell, to divide the layout into "blocks", to route the power from one power pack, or another. These are OK for small layouts 4X8, or a little larger.

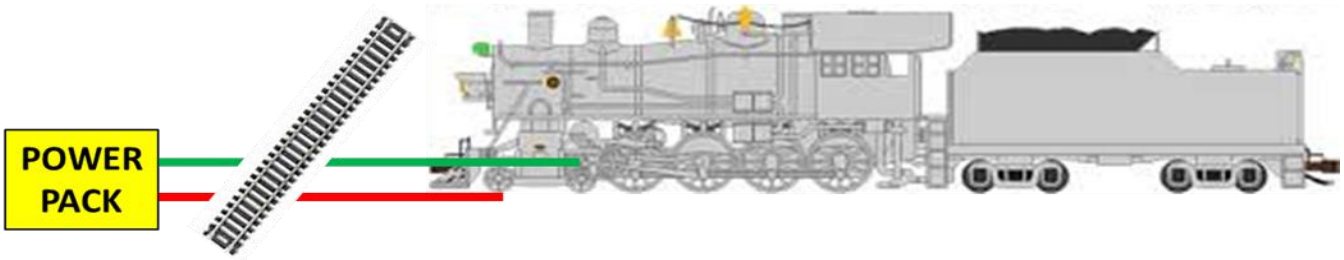
In my case, I found these to wear out in time, and not make reliable contact, after quite a bit of use. So, on most of my later layouts I built, I used a good grade of industrial "Double Throw / Double Pole, Center Off Toggles", or "On / Off / On' switches, mounted in control panels with the "Track Diagram" painted on it. But, this limits you to only 2 Throttles! Later, I up graded my panels to 2-pole, "adjustable" 12-position Rotary switches, which allows you to have as many as 12 throttles, or power sources, for "block" control.



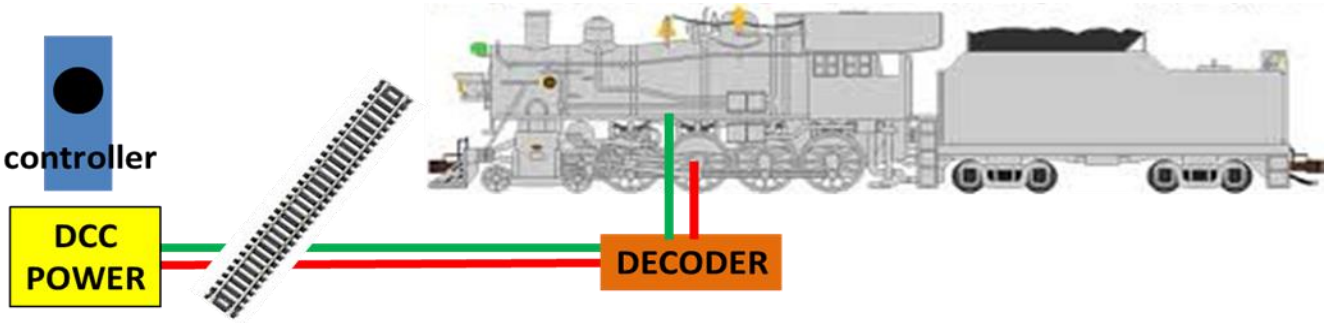
DC Analog wiring for block control, requires more wiring. Although, if there are NO Reverse loops on the layout, then most of the layout can be "common" rail wired, having one continuous rail, all wired from one buss wire, and feeders. While the other rail has all wires being run through toggles, or rotary switches, to the blocked (or gapped) rail, to select the same power source your running with. This was the way most large home layouts, were operated in the past.
Disadvantages to DC-Analog:
With this type of control, you always have to align the switch for the cab, or throttle your running with to each block, to let the train your running progress around the layout! Uses more wiring also, and all wires should be numbered, or color coded, to trace in case of a break in the circuit.

DCC? WHAT IS IT?

DCC stand for Digital Command Control. Where DC-analog was known as Block Control because the track was sectioned into blocks, DCC does not need blocks and we can run many trains on the same track with total independent control. Think... radio control trains!! That is what DCC is all about.



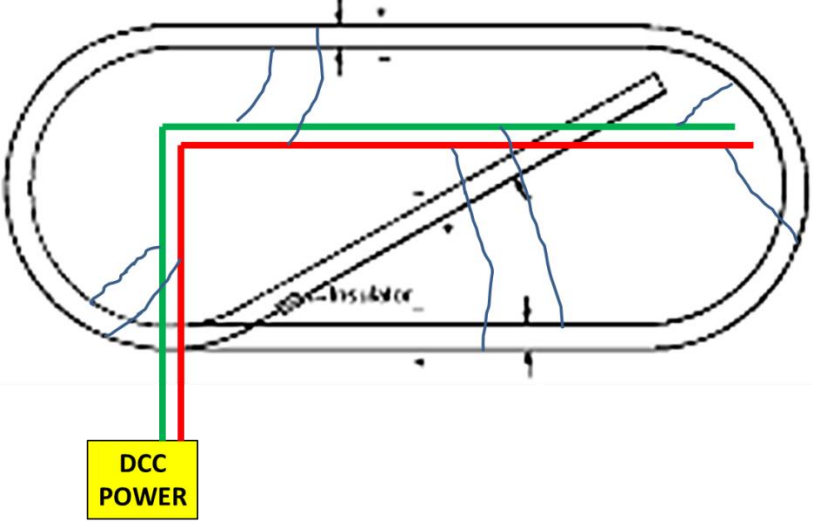
As the picture shows – DC analog has power to the track that then goes to the logo directly. DCC is different –



DCC is actually running AC Voltage through the rails, with the "command" signal to the receiver (Decoder) in each locomotive - fast/slow, forward/reverse. The decoder is installed IN the loco. The receiver (Decoder), then converts the AC voltage to DC for the motor circuit of the decoder. Thus, the elimination of having to control individual blocks of track, with toggle, or rotary switches! As one manufacturer describes it, "Control your Trains, Not your Tracks"! With DCC, you keep using the same Throttle, for controlling the train you're running, no matter where it is on the layout! DCC also give you SOUND!!! Now your trains do not run in silence!

DCC in most cases uses less wiring. 2 Buss wires of different colors 14 AWG or larger, can be run under the layout, or roadbed surface. Then smaller 18 AWG "feeder wires" of the same colors, soldered to the outside of each rail, then run down, and attached to the buss wires below. Run feeder wires from each 3 foot section of flex track. Smaller sections, or pieces of track should also have "jumper" wires run to each rail, from the previous 3 foot section of track, (* so long as it does not connect 2 zones, or power boosters!). By doing this, you ensure good continuity throughout the rails, over the entire layout! My system recommends using minimal of 14 AWG stranded wire for buss wires, and 18 AWG for the feeder wires to the rails!

DCC layouts, should NOT use "common rail wiring"! DCC wiring is buss wiring!



On large layouts, with DCC, it is still necessary to divide the trackwork into "Zones", or "Blocks", because you will find it necessary to have more than one power booster. The more equipment you have with DCC Sound decoders, or cars with lights , etc., if you have only one booster it may trip the overload circuit breaker of the unit, and that will shut down the whole layout!

When using more than one power booster, both rails have to be gapped at each end of the Zone, and must Not be connected to the previous power booster either! So, separate buss wires, and feeder wires, need to be run to each Zone. In this case, if a train derails in one Zone on the layout and shorts out, tripping that power boosters circuit breaker, the ones on other Zones, keep running!

Just remember to keep the buss & feeder wire polarity the same, to each Zone! I recommend using different colored buss & feeder wires, for each Zone, which makes it easier to troubleshoot problems, or open circuits, should they occur! (Power boosters are usually "daisy chained", with data cables on most DCC systems). (See Diagram #1).

To wire Reversing Loops, you need to do the same as for DC wiring, that is both rails, must be gapped at each end of the loop! A "double-throw / double-pole toggle" can be used, or you can purchase a separate "Automatic Reversing Card". I recommend "Tony's", (DCC Specialties) PSXAR reversing units. Two wires from the buss wires go to the "input" side of the circuit, and two wires from the "output" side of the circuit card to the reverse loop! In some DCC Systems, the boosters sometimes now have a reversing circuit built in, check your systems manual!

Another thing that might be necessary, is to have "on / off" toggles, or "kill switches" on your engine tracks, and any storage tracks, to shut off engines & equipment, when not being used. This helps to prevent overloads, in case of a short circuit occurs, and your power booster will not reset!

TIPS & TOOLS OF WIRING

When buying tools to strip wire, or crimp connectors on wire, don't skimp and buy "cheap junk". They will only cause you more grief than they are worth!

Home Depot does carry "commercial Electric" Brand of "T-Strippers", but other brands such as "Klien" are better. The jaws are marked with the wire gauge sizes, and designed only to cut through the insulation, not the wire! Use the appropriate marked slot for the wire size. Below left is a photo showing T-Strippers, a Klien automatic wire stripper, and a "Sta-Kon" crimper. These are the ones to buy, not the cheap adjustable ones, or the stripper / crimper shown in the right photo.

When stripping wire, (bottom picture) make sure it's stripped to the proper length for the terminal your using, and if you nick out more than 1,or 2 strands of wire, cut the end off, and strip it again correctly! When crimping a spade connector, or lug connector on wire, give it a pull test, if it comes off easy, you have a miss-crimp, and will get intermittent continuity from the connection!