

Education Program Basic skills Series



Module Six Wiring

The following pages introduce the essential elements of wiring a model railway

- Tools
- Track power wire connections
- Isolation gaps
- Reversing loops
- Live and dead frog point work (Turnout/switch) wiring
- DC and DCC wiring
- Point (Turnout/switch) motor wiring

Tools

The following tools and equipment are adequate for basic layout wiring



Soldering iron Soldering leads to your track

Rosin core solder Rosin core solder is self fluxing. It is ideal for electrical soldering. The roll pictured was purchased in the early 1990's and still has plenty left.

Diagonal cutters



Cutting wires to length



Wire stripper

For trimming the insulation on leads to allow you to connect the lead to the track or a power supply

Fine files

For cleaning metal surfaces back to bare metal to accept solder



Screw drivers

Securing wires to terminals

Fine nose pliers

For bending leads into shape prior to installation



Power drill or cordless

Drilling holes in road bed for track power leads and in layout frame members for cable ways.



Multimeter

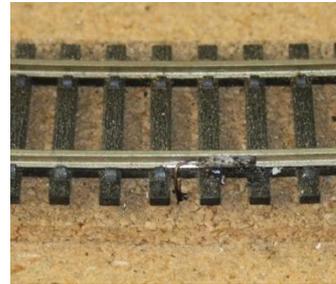
Checking power connections are conducting and insulating gaps are properly located. The analogue meter on the left has the advantage of being able to measure the track voltage on a DCC powered layout.



Track power wiring connections

Smooth train operation relies on clean rails and reliable power to the track. The ideal method of connecting the track power supply to your track to provide reliable power to the track is to solder the leads to your rails. The power leads can be soldered to the track on the work bench or after the track has been laid. Soldering the leads to the outer side of the rails prevent the lead or solder interfering with the wheels of your trains.

The process is simple. The side of the rail is scraped until the metal surface is shiny. The end of a small file is ideal for this purpose. A small deposit of solder is applied to the side of the rail. (Any basic soldering iron is suitable for this work, however the temperature controlled models are worth the extra investment). The end of the power lead is coated with solder. The soldering iron tip is then cleaned with a damp sponge to remove any solder. The end of the power lead is held against the solder on the side of the rail (I've found a bamboo chopstick ideal for this purpose). The cleaned soldering iron is applied to the power lead until the solder melts and joins the power lead to the rail. The chopstick is left holding the power lead in position until the solder has fully hardened. Power leads soldered to the rails as shown in the attached photo are relatively unobtrusive.



Current recommended practice is to solder a lead to each piece of rail. Many existing layouts achieve reliable operation with a power lead connection to the rails every few metres.

Isolation gaps

The control of your layout will require the rails in certain locations to be electrically gapped. This can be done as you lay your track by replacing the metal rail joiner at the required location with an insulating rail joiner or by cutting a gap in the rails after they have been laid.



Live and dead frog point work (Turnout/switch)

The terms "Live" and "Dead" frog denote whether the V of the points are powered or not. Modellers are divided on the subject. Currently manufactured good quality model locomotives with current pick up on all wheels are untroubled by a short length of unpowered rail, especially if the drive is flywheel equipped.

The major difference between "Live" and "Dead" frog point work is the wiring.

Live frog point work wiring

Live frog points need the frog electrically connected to suit the routing of the



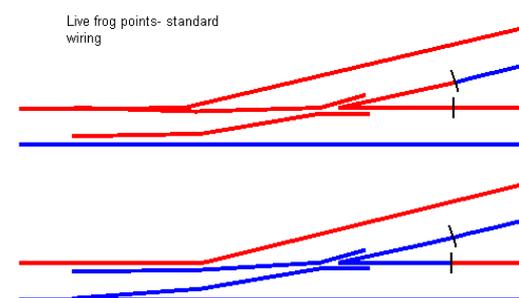
electrically connected to suit the routing of the points.

Switching the live frog can be carried out by contacts on the point work or by external switches. Some point motors have auxiliary contacts to power the point frog. The Peco Electro-frog turnout has embedded wiring to facilitate switching the polarity of the frog.

Live frog point work requires isolation gaps in the rails beyond the point frog in some instances as shown by the attached sketch to prevent short circuits.

Dead frog point work wiring

Dead frog point work does not need external wiring. The only rail gaps required if you use dead frog point work are those needed for sectioning the layout to suit either your DC or DCC control system.



Reversing loops

Regardless of the train control system you adopt; DC or DCC, reversing loops require the same basic set up. The reason is if the polarity of the reversing loop track is correct as a train enters the loop, without the reversing switches shown in the attached diagram, the polarity at the exit of the loop will cause a short circuit.

Both rails at each end of the reversing loop need to have isolation gaps. To prevent short circuits from metal wheels crossing the isolation gaps the train needs to be shorter than the length between the isolation gaps on the reversing loop.

DC control reversing loops

The power leads to the reversing loop track for DC control need to be connected as shown in the diagram. The double pole double throw (DPDT) reversing switches are made by wiring standard DPDT switches as shown in the attached drawing.

DCC reversing loops

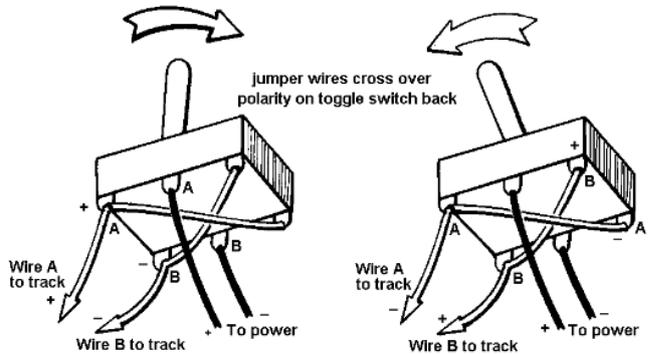
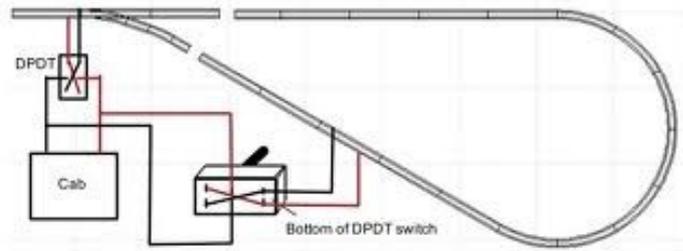
Self switching modules are available to carry out the switching automatically for DCC controlled layouts. The auto reversing modules are set up as per the attached sketch. These modules need to be installed as per the instructions with the unit.

DC wiring

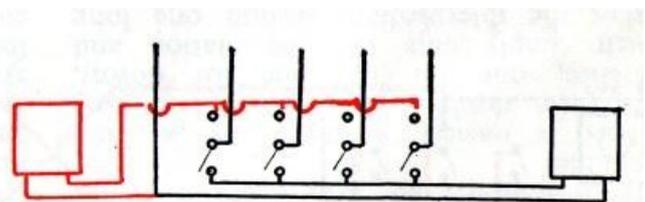
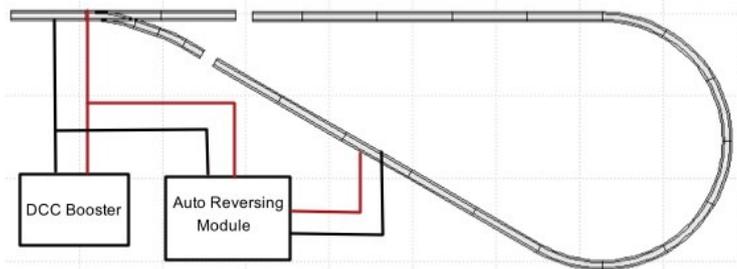
Wiring a layout for DC control requires dividing up the layout into electrically isolated blocks to allow the DC power supplies to control trains in specific locations.

If your DC power controllers are each powered by their own transformer you can use common rail wiring. One lead from the power supply is connected to the common or un-gapped rail. The other lead of the power supply is connected to the track through switches. Using the switches allows you to control a train in a part of your layout without affecting other trains. This is shown in the attached sketch of a two throttle, (the throttles are represented by the red and black squares) four block DC control system suitable for a small layout. From the left the leads are; the common return lead and the controlled leads to the four track sections.

If your DC power controllers are powered from a common transformer you need to gap both rails and connect the power leads to both rails to the power supplies by double pole switches.



DPDT reverse switch wiring



DCC wiring

Wiring a layout for DCC is different to the wiring required for DC. DCC requires both a power supply wiring system and a control wiring system.

DCC power supply wiring system

The DCC power wiring connects the power output from the DCC system to the rails. The power wiring consists of two wires referred to as the track buss. The wires need to be large enough to handle the power output of the DCC system. (most DCC systems have a five amp output) For a reasonable sized layout the DCC track power buss wires should be 2.5 sq mm multi strand wire

The rails are connected to the track power buss by feeder wires. The track feeder wires need to be sized to handle the largest train you intend to run. Currently manufactured model locomotives have a power draw of around a quarter of an amp. A triple headed train will draw less than an amp at full load. Sizing the rail feeder wires to handle an amp is sufficient for N scale, HO scale, OO scale and On30. A reasonable sized wire from the track buss to the rails is 0.5 sq mm multi strand wire.

Fitting isolation switches in the rail feed wiring facilitates fault finding. The layout can be common rail wired. The common rail is connected to one wire of the track power buss. The other rail electrically gapped into isolated sections is connected to the other track buss wire through on off switches.

If your layout is large enough to require more than one DCC booster the track powered by the second booster needs to be fully insulated from the track powered by the original booster by installing isolation gaps in both rails.



DCC control wiring system

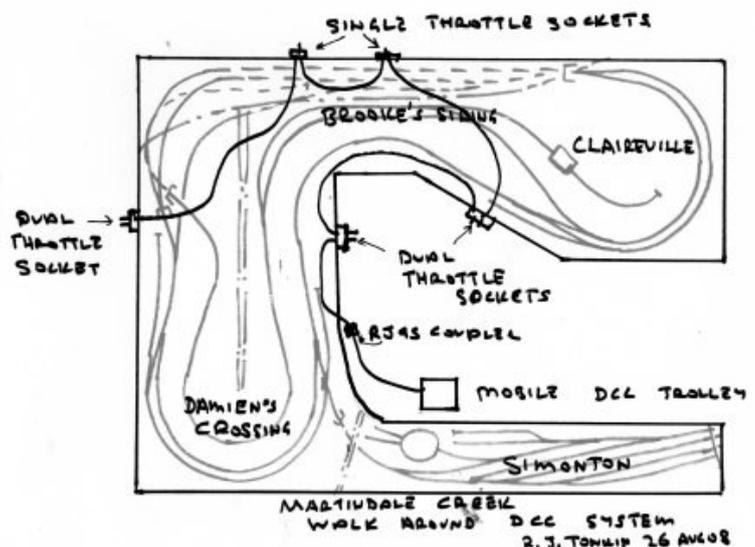
The control wiring system or control buss allows you to operate your layout from a variety of locations. The specific details of the control wiring system depend on the DCC system you choose. Most systems consist of sockets wired in a daisy chain to the DCC command module. You simply plug your DCC throttle into a socket and control your train from there. Most throttle sockets like the one in the photo have an LED to indicate the DCC system is operational.

The multi core or co axial cables required by the control buss of your DCC system can be purchased made up or you can buy the crimping tools to make up the cables yourself.

The location of the throttle sockets around your layout needs to consider where you want to be while operating your layout. The attached sketch shows the throttle socket locations on a medium sized layout.

DCC wireless control

You can use wireless control in place of a DCC control wiring system. A radio base station is connected to your DCC system and the hand held throttles send signals to the DCC system by radio.



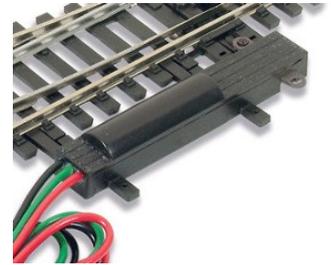
Point (Turnout/ Switch) motor wiring

Remote control of point work adds to the fascination of railway modelling. There are basically three types of point motor, twin coil, stall motor and servo.

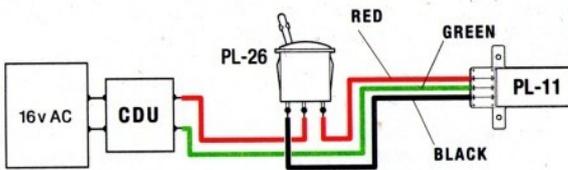
Twin coil point motor wiring

Twin coil point motors have two solenoid coils. These point motors may be mounted adjacent to the point they are controlling or under the layout decking.

Both PECO and Hornby manufacture miniature twin coil point motors that attach directly to the set of points like the real ones as shown in the attached photo.

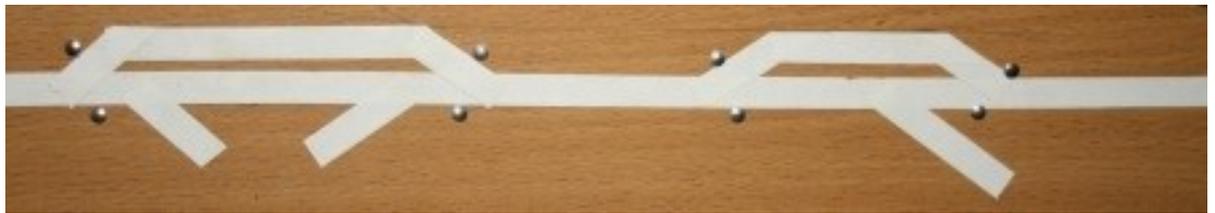


Energising one of the coils momentarily throws the point one way. Energising the other coil momentarily throws the point the other way.



Twin coil point motors are wired as shown in the attached sketch. The momentary contact switch shown in the wiring diagram can be replaced by wiring the point motor leads to studs on a map of the track plan. This arrangement is shown in the attached photo. Only the main line points on this layout are power operated. The industrial siding points are hand operated by

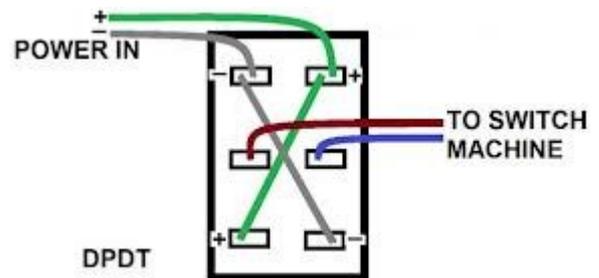
train crews as happens on the real railways. A wander lead actuates the point motor by touching the appropriate stud.



On a larger layout a Capacitor Discharge Unit (CDU) improves the switching action by delivering an instantaneous high current pulse to the switch coil.

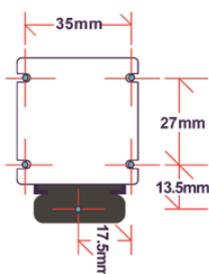
Stall motor wiring

Stall motor point motors are always powered. The DC motor at the heart of the point motor requires DC power for operation.



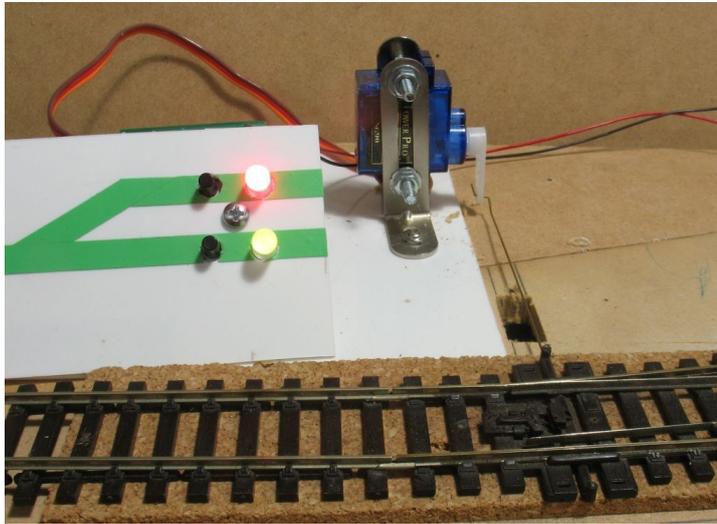
The motor torque holds the point blades in position. The point is thrown by reversing the DC power to the stall point motor. This requires a DPDT switch wired as a reversing switch as shown in the attached sketch.

Stall motor type point motors such as the one shown in the photo and attached installation drawing are larger than twin coil machines. They are usually mounted beneath the layout decking as shown in the attached photo.



Servos

Servos have become smaller and cheaper and are now becoming very popular for point (turnout/switch) operation. Operation is similar to the stall motor but is controlled by a small electronic circuit which determines the arc of movement.



References

NMRA web site Clinics

- o Layout Hints – Turnout tips (Gerry Hopkins MMR)
- o Layout Hints – Switching Switch Stands (John Saxon MMR)
- o A little technical—Using servos