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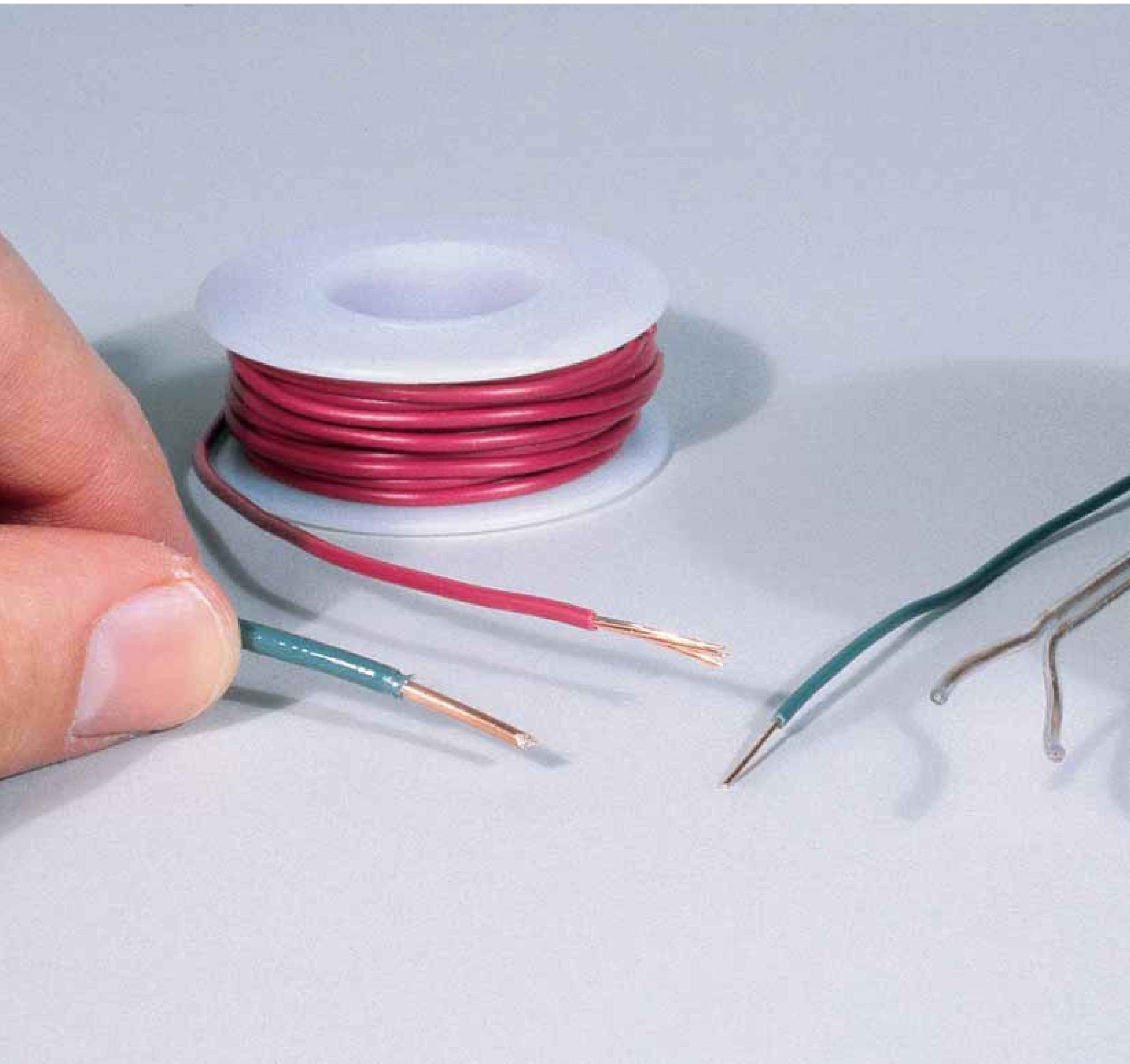
Model Railroader PRODUCTS

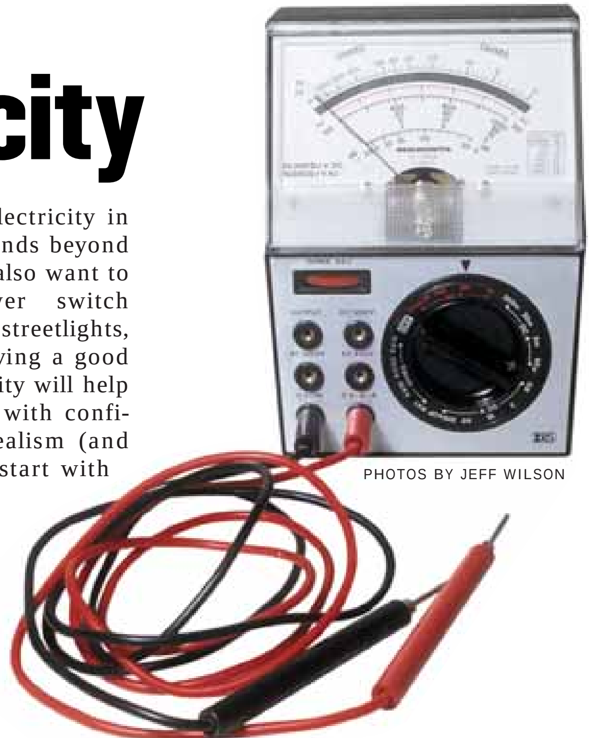
INFORMATION STATION

Basic electricity and control systems



Electricity

Knowing how to use electricity in model railroading extends beyond running trains. You'll also want to use electricity to power switch machines, structure lights, streetlights, and other accessories. Having a good basic knowledge of electricity will help you use these accessories with confidence and improve the realism (and fun) of your layout. Let's start with some basics.



PHOTOS BY JEFF WILSON

Fig. 2 POWER PACK CONNECTIONS. MRC's Tech II has fixed DC terminals for accessories. Power packs also include variable DC (track power) and fixed AC (accessory) terminals. When making connections, always wrap wire clockwise around the terminal screws.

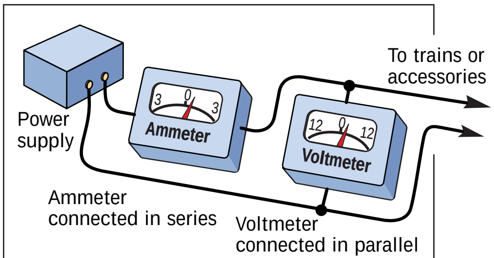


Fig. 3 METER CONNECTIONS

AC vs. DC

Standard house current is alternating current (AC), and although some model trains (notably three-rail O gauge, American Flyer S gauge, and Märklin HO) use AC, most scale model trains use direct current (DC).

With AC, as the name implies, the polarity constantly alternates at 60 cycles per second in the United States. With DC the polarity is constant as the current flows. Direct current allows us to use polarity to control motor direction (very important in running trains), something that can't be done with AC. Figure 1 shows how this works.

On a typical power pack, the variable DC output goes to the track – this is what is adjusted by the speed controller. Most power packs also have fixed AC terminals, and some also have fixed DC terminals (see fig. 2), which put out continuous voltage. These can be used for accessories.

Volts and amperes

It's important to provide the proper voltage to accessories, as too much power can burn out bulbs and motors.

Electricity is measured using volts (V) and amperes (A). I find it easiest to understand each using the analogy of a water supply pipe coming into your house. Volts measure the force of electricity (the pressure gauge on a water pipe) and amps measure the amount of electricity (the water meter).

The water pressure (volts) to your house remains constant, but the volume of water (amps) used varies depending upon how many faucets you have open at a time.

The electricity in your house is at 120V, much too high to use safely for model railroads. Transformers reduce the voltage to the 12 to 18V needed for trains and accessories.

For current, most modern locomotives in HO and N scales use less than .5A, while some older models draw more. Engines in O scale and larger models can use 1A or more. Small devices such as light bulbs require little current, and their current consumption is often measured in milliamps (mA). For reference, one milliamp is a hundredth of an amp (1mA is .01A; 5mA is .05A).

Most power packs and other power supplies are rated in volt-amps (VA), meaning "volts x amps." To convert this to the ampere ratings used by model railroaders, divide the output rating of the power pack by 12, which will give you the pack's amp output rating at 12 volts.

Light bulbs are probably the most commonly used electrical accessories. Most small bulbs draw roughly 10mA (0.1A), while some microbulbs draw less than 5mA.

How do you know if there's enough power for all of your accessories? Add the current required for all accessories and make sure the total is less than the rated limit of your power supply. For example, if you have a 1A power supply

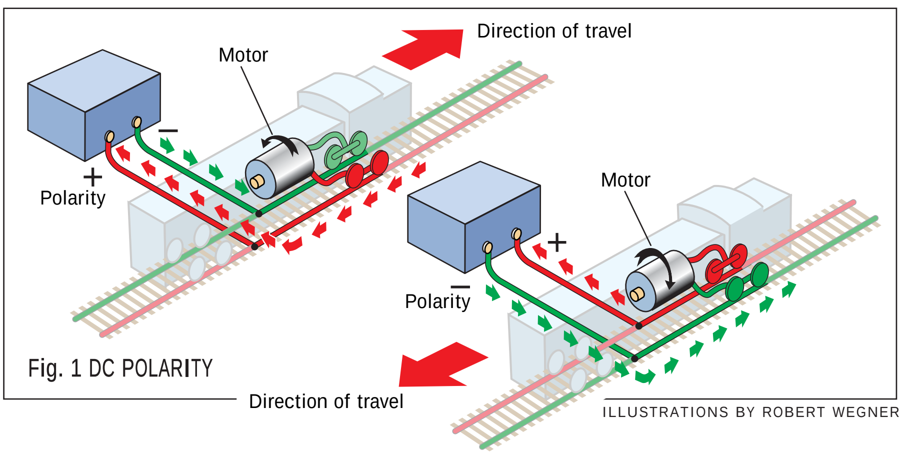


Fig. 1 DC POLARITY

ILLUSTRATIONS BY ROBERT WEGNER

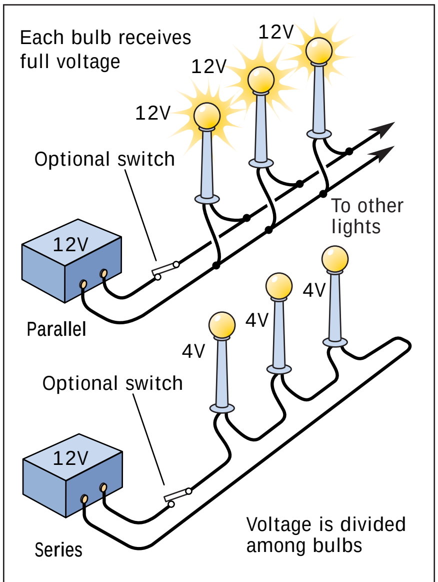


Fig. 4 TYPES OF CIRCUITS

you can use it to power ten 10mA bulbs or 20 5mA bulbs.

You can determine the amount of current a bulb or accessory is drawing and how much voltage is in a circuit with separate meters or a combination volt-ohm-milliammeter (VOM) as shown in the photo on page 54. The proper way to connect a voltmeter and ammeter in a circuit is shown in fig. 3. Don't use a VOM as part of a permanent circuit, as the electronic components of the milliammeter function can be damaged by continuous use.

It's a good idea to have a separate power supply for accessories. With small power packs, the drain of accessories can slow your trains, and increasing the speed of trains can dim your accessory lights.

It's also good practice to operate bulbs at less than their rated voltage (12V for a 15V bulb; 1.2 or 1.3V for a 1.5V bulb). This increases bulb life and lowers the operating temperature, important with plastic models.

Series and parallel

You can connect multiple accessories or bulbs in one of two ways: series or parallel. Figure 4 shows each style, using light bulbs as an example.

Parallel connecting gives each bulb the same voltage, regardless of how many there are. Adding bulbs is easy by wiring them to the main (bus) wires.

Connecting in series (end-to-end) divides the voltage equally among all bulbs. A disadvantage is that if one bulb burns out, the whole string loses power.

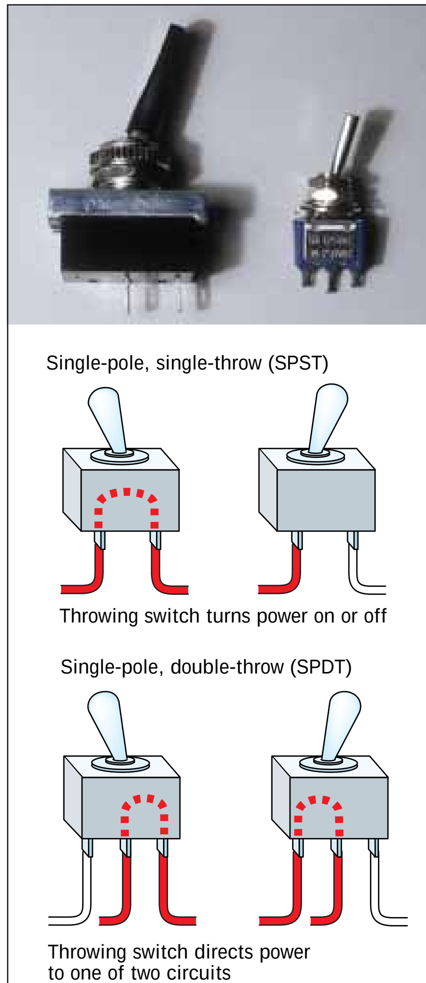


Fig. 5 TOGGLE SWITCHES

Also, you can't add additional bulbs while keeping constant voltage.

Switches

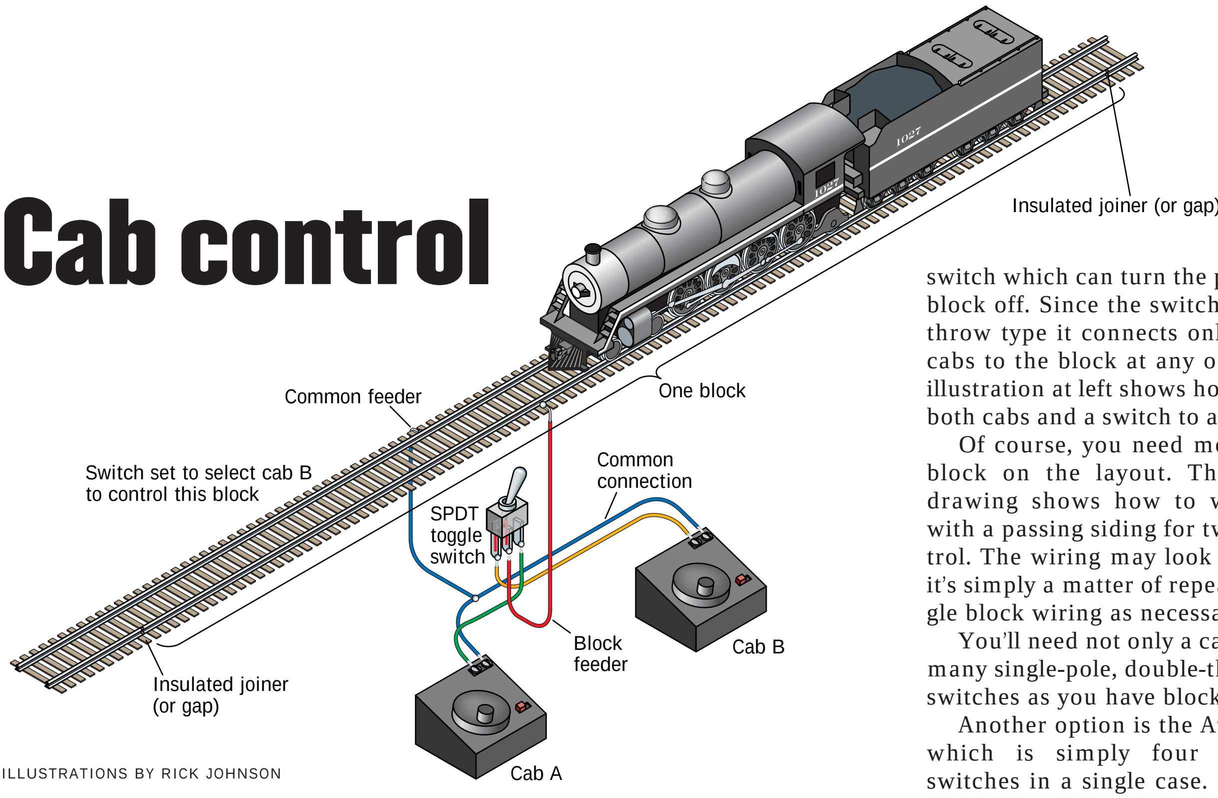
You can turn accessories on and off by turning the power supply on and off, but a better way is with a switch. Figure 5 shows the two styles of toggle switches used on most layouts.

They come in a variety of sizes and styles, with the single-pole, single-throw the simplest type (a basic on-off switch). The number of poles refers to the number of connections that can be made. The number of throws is the number of positions that the switch can be turned to.

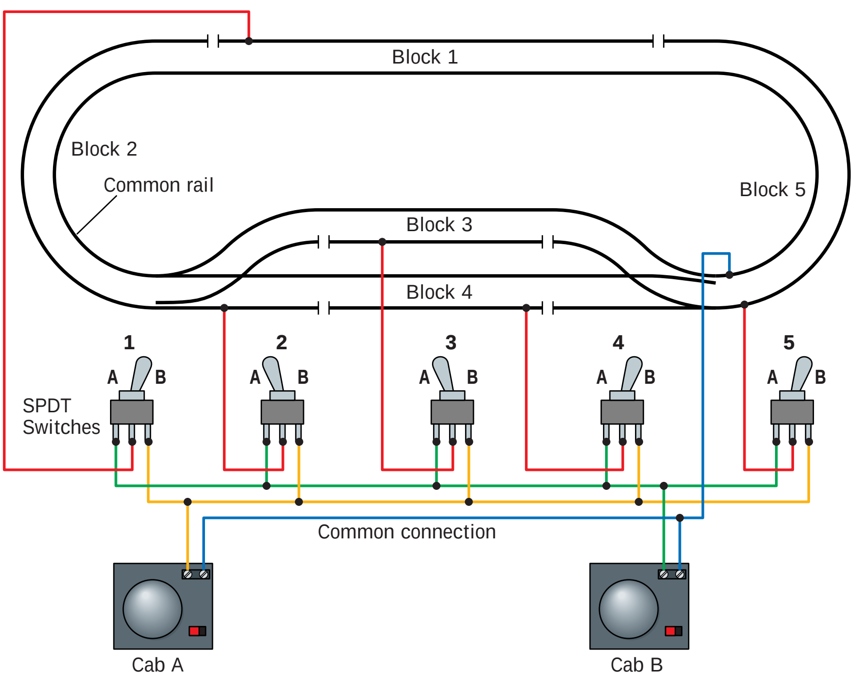
For more detailed information on wiring, see *Easy Model Railroad Wiring: Second Edition* by Andy Sperandeo (published by Kalmbach).

The more comfortable you are with wiring, the more animation and life you'll be able to bring to your layout.

Cab control



ILLUSTRATIONS BY RICK JOHNSON



The only thing better than running one train is running two at the same time. Getting a single train to run around the layout is usually a matter of simply running a pair of wires between the power pack and the track. But simply placing a second locomotive on the track will mean both trains run in the same direction at the same relative speed, so getting independent control of two trains will require some additional wiring, what we commonly call cab control.

Layout wiring

Cab control works by dividing the layout into electrically isolated sections of track, called "blocks." You can do this using plastic insulating rail joiners or by cutting a gap in the rails and filling it with a non-conductive material like styrene. Since you can isolate the track sections by gapping only one rail, the other rail is called the common and is wired to both cabs.

Power wires, or feeders, from each block are connected to an electrical switch which can turn the power to that block off. Since the switch is a double-throw type it connects only one of the cabs to the block at any one time. The illustration at left shows how to connect both cabs and a switch to a single block.

Of course, you need more than one block on the layout. The schematic drawing shows how to wire an oval with a passing siding for two-train control. The wiring may look complex but it's simply a matter of repeating the single block wiring as necessary.

You'll need not only a cab but also as many single-pole, double-throw (SPDT) switches as you have blocks.

Another option is the Atlas Selector, which is simply four SPDT slide switches in a single case. Most modelers, though, prefer to have the switch controlling a particular block mounted on the control panel schematic, making it easier to tell at a glance which block a switch controls.

It's a good idea to test each block as you wire it up as crossed wires are the biggest problem with cab control. And be sure you color code your wiring as it makes the initial wiring and any future alterations or troubleshooting a whole lot easier.

How it works

Once your wiring is complete place one locomotive in block 1 and flip the toggle for that block to cab A. Then place a second locomotive in a different block and flip that toggle to cab B. You should be able to control the two locomotives independently within the individual blocks.

As the trains work their way around the layout turn the next block to the appropriate cab. Turn off the block after you leave it or the next train entering the block will be controlled by the "wrong" cab, leading to that familiar cry of "Someone's got my train!"

While command control (another topic for a later time) takes care of that problem, cab control is still a viable option. For more details on layout wiring see *Easy Model Railroad Wiring* by Andy Sperandeo (Kalmbach Publishing Co.), which includes a detailed explanation of cab control and the associated wiring.

Wiring reverse loops

PHOTO BY JIM FORBES

Without special wiring, turning trains on loops or wyes on your model railroad will cause an electrical short. Fortunately, wiring a reversing section of track is easy. You need only a little electrical know how, some wire, and a toggle switch or two.

Reverse loops – tracks that turn trains around – can add a great deal of operating interest to a layout, but they also require special wiring that goes beyond connecting a pair of wires to the track. Some modelers avoid building layouts that have a return loop or wye, thinking that the wiring is beyond their level of expertise. However, there's no need to fear. Although reverse loops require special wiring, the job is not difficult and can be done quickly.

What qualifies as a reversing track section? The most common is the simple return loop or "balloon track," but wyes and reversing cutoff tracks also qualify as reversing sections and need special wiring. Figure 1 shows four examples.

In some track plans the existence of a return loop isn't as obvious. To check a plan, trace the path of a train around various routes. If a train can wind back to go the opposite direction on a track without reversing the locomotive, then there's a reverse loop.

Without special wiring, a reverse loop will result in a short circuit as fig. 2 shows. This is true regardless of whether you're using a single power pack, a cab-control system with multiple power packs, or Digital Command Control [For more on reverse loops and DCC, see DCC Corner in the August 2003 issue of MODEL RAILROADER Magazine. – *Ed.*], and whether your turnouts are either the all-live or power-routing type.

Fig. 1 TYPES OF REVERSING TRACKS

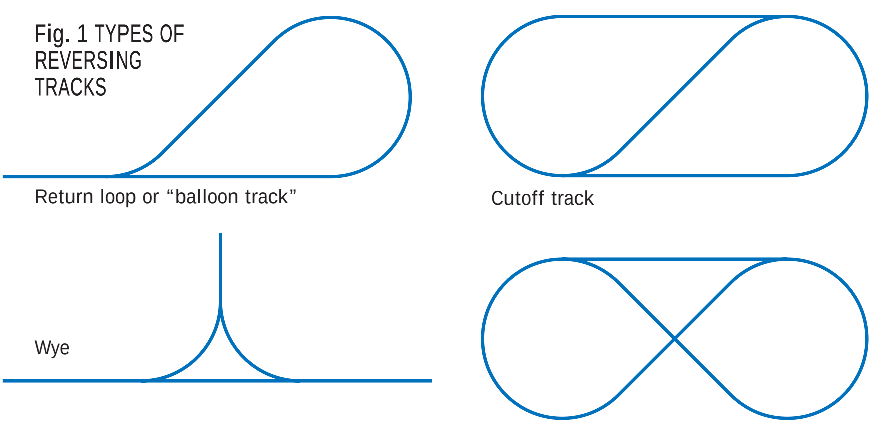
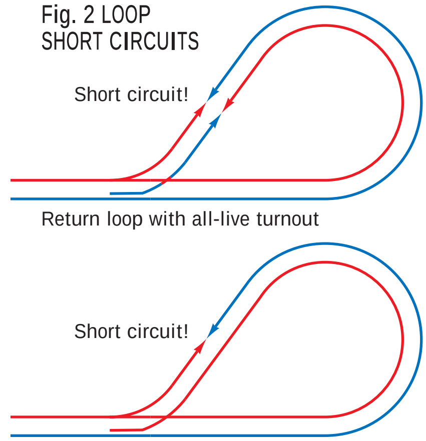


Fig. 2 LOOP SHORT CIRCUITS



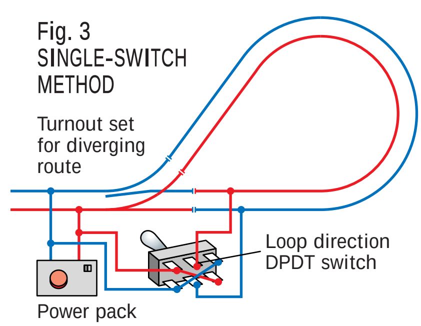
The basic idea in wiring a reverse loop is to isolate the loop itself using insulated rail joiners to make it a separate electrical block. Double-pole, double-throw (DPDT) switches are then used to change the polarity of the loop track, thus avoiding a short circuit. There are two simple methods of wiring loops: One method uses a single DPDT switch; the other uses two switches.

Reversing with one switch

Figure 3 shows the single-switch method. It's the simplest to wire; however, it can be difficult to operate smoothly without bringing the train to a complete stop.

Here's how the single switch works: First set the loop direction switch to match the polarity of the main line, allowing the train to enter the loop. Next, stop the train on the isolated section of track and throw the power pack's reversing switch, the loop switch, and set the loop's turnout to

Fig. 3 SINGLE-SWITCH METHOD



ILLUSTRATIONS BY RICK JOHNSON

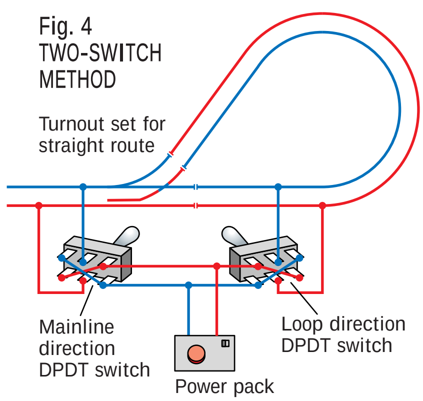
allow the train to exit the loop segment back onto the main line.

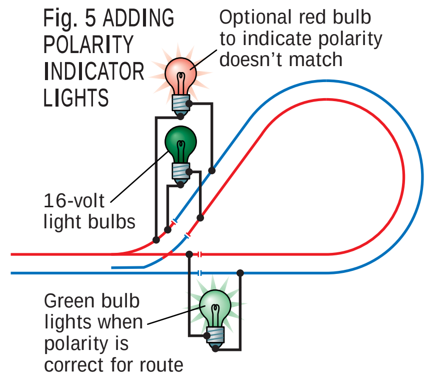
You can try using this method without stopping the train by throwing both the reversing switch and the loop switch at the same time, though it can cause jerky operation.

Reversing with two switches

The better method for layouts with standard DC control is to use two DPDT switches, requiring only a bit more wiring, as shown in fig. 4. The additional switch serves as the mainline direction switch. It lets you change the polarity of the main line independent of the reversing section, eliminating the need for stopping the train (or throwing both switches at once) while the train is in the loop.

A potential problem is that it's impossible with toggle switches alone

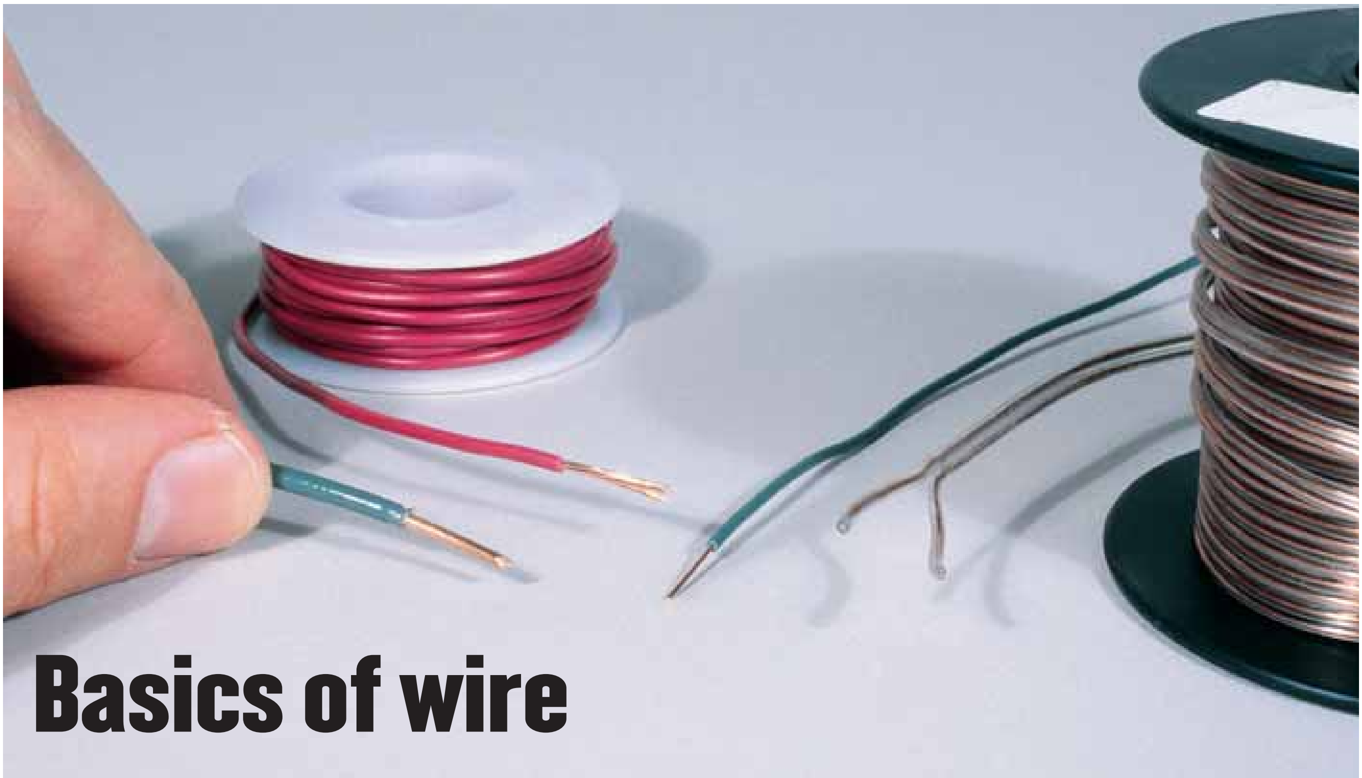




for an operator to determine for which route the polarity is aligned. A simple solution is to use a pair of green 16-volt bulbs wired as fig. 5 shows. Place them on the control panel next to their corresponding routes. Whichever is lighted indicates the correct route.

Another option shown in fig. 5 adds a red bulb to indicate incorrect polarity. These aren't necessary if you're using green bulbs set in a control panel, but you can add a bit of animation to the layout by using both red and green lamps in lineside signals to show operators if the track polarity is correct.

You can also control return loops automatically, but that's a bit beyond this column. For a thorough look at return loops, including details on wiring wyes and incorporating return loops with cab control wiring, see Andy Sperandeo's book *Easy Model Railroad Wiring, Second Edition* (published by Kalmbach).



Basics of wire

Once you begin building a layout you quickly discover you need a lot of wire. Control panels, track feeders, switch machines, lighting, signals, and other accessories will require separate circuits.

Knowing what different types of wire can do, what tools and connectors are available, and what connection options you have besides solder can help you wire your layout more quickly and easily.

Work toward two goals when wiring: First, ensure that every circuit never has a reason to fail. Crawling under a layout to find a broken wire doesn't fit my goal of model railroading being fun. Second, organize and label circuits to make later modifications or troubleshooting easier.

Wire

Insulated copper wire (fig. 1) is the standard for electrical wiring. Wire has two key descriptors: gauge (size) and whether it's stranded or solid.

The size is measured in gauge and indicated by a number, as in 22AWG (American Wire Gauge) or 14AWG. The smaller the number, the larger (in diameter) the wire. The larger the wire, the more current it can handle.

Most 120V (volt) household wiring is 12- and 14-gauge wire. Either will work well for track and other main power supply wires on model railroads. Smaller wire, such as 20 or 22 gauge, is okay for track feeders, but shouldn't be used for long runs, because the voltage will drop more the farther the wire is from the power source compared to heavier wire.

Solid wire should be the first preference for most applications. It's easy to strip and prepare for soldering and

Fig. 1 WIRE. Many types and sizes of wire are available. Shown here are 14-gauge solid, 18-gauge stranded, 22-gauge solid, and two-conductor 24-gauge solid (speaker wire).

Fig. 2 TOOLS. Small and large (6" and 8") wire cutters and a combination wire stripper/crimper are vital for working with wire.

Fig. 3 SOLDERING IRON. A 30-watt pencil-type iron with stand and rosin-core solder will handle most soldering jobs.

Fig. 4 COMMON JOINTS. For a T-shaped joint, wrap the feeder wire around the main wire. For splices, wrap the wires around each other.

can be used with crimp-on terminals. Use stranded wire where flexibility is important.

You can find smaller sizes of wire at electronics stores such as Radio Shack as well as many hobby shops. For heavier wire, check hardware stores or home improvement centers. Heavy wire can be purchased either by the foot or in spools of 100 to 500 feet.

Wire cutters and strippers

Several tools are handy – make that necessary – for working with wire. A good pair of cutters like those in fig. 2 will stay sharp for a long time, but never use them to cut piano wire or other steel wire or the cutting edge will be damaged.

A wire stripper is indispensible. See fig. 2. Many modelers try to get by without one, but the first time you use a good wire stripper you'll wonder why you wasted so much time whittling insulation with a knife. Wire strippers make an otherwise tedious job fast and easy.

Crimping tools enable you to use many types of wire connectors. Many strippers are combined with a crimping tool, such as the one in fig. 2.

Soldering

Soldering makes solid connections, and if done properly the joint will be as strong as the wire itself. A pencil-type iron rated at 25 or 30 watts (see fig. 3) works well for smaller wires, but the larger pistol-style soldering guns are handy for heavy wire. I prefer a pencil-type iron – it provides enough heat for most applications.

Keep the soldering iron tip clean and tinned with a light coat of solder. Have a damp sponge handy and periodically wipe the hot tip on it to keep it clean.

The best solder for model railroad wiring is rosin core 60/40 (60 percent tin/40 percent lead), although there are now many lead-free solders available. Never use acid-core solder for wiring, as electricity flowing through the joint will cause corrosion.

Figure 4 shows two of the most common solder joints. Whichever joint you use, the technique is the same. Place the iron at the joint as in fig. 5. Once the joint – "work" – is hot, touch the solder to the work – not to the iron – until the solder flows freely through it.

Remove the iron and keep the work still until the solder sets. A good solder joint should be shiny. The solder should flow around all of the wires with no clumping. See fig. 6.

If the work moves while the solder is still liquid, the solder will appear crystallized and the joint won't be solid. If this happens, reheat the work until the solder flows again.

Be sure to cover all solder joints. Leaving them exposed is an invitation to a short circuit or other problem. The best way to do this is with heat-shrink insulation tubing. Figure 7 shows how to do this. Thread a length of tubing onto the wire before soldering the joint. Once the joint is made, slide the tubing into place. Rub the side of a soldering iron (not the tip) against the tubing and it will shrink tightly around the wire.

You can also use vinyl electrical tape to protect joints, but this tape has a habit of unraveling over time.

Spade and other connectors

Whenever a wire needs to be connected to a screw terminal (such as on a power pack or terminal strip) you can add a spade connector as in fig. 8.

Strip the end of the wire, ensuring none of the bare wire will be exposed beyond the connector. Slip the spade into place, then use a crimping tool to fasten it. Figure 9 shows a couple of other crimp-on connectors, including butt splices and ring terminals.

Terminal strips (fig. 8) are available in many shapes and sizes. They're great for simplifying wiring on modular or sectional layouts and can minimize solder joints on other layouts.

Suitcase or tap-in connectors (fig. 10) allow you to connect a feeder into a bus wire without having to strip either wire. Snap the connector in place on the bus wire, slide the feeder into its slot in the connector, and use a channel lock pliers to clamp the metal piece into place. The metal strip cuts through the insulation, making contact with the two wires.

Many brands of suitcase connectors, also known as "insulation displacement

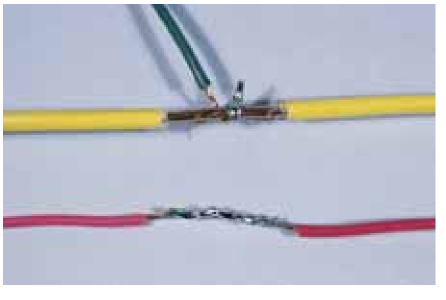


Fig. 6 COMPLETED JOINTS. Joints should be shiny with the solder melted within both wires. The T-shaped joint is a poor joint – the solder only flowed onto the feeder wire, a sign that the larger wire did not get hot enough.

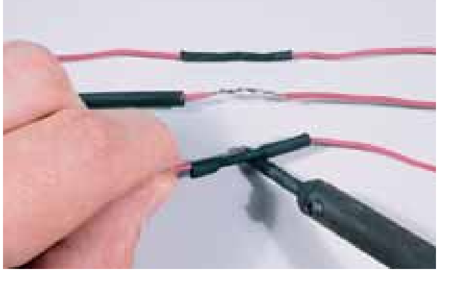


Fig. 7 HEAT-SHRINK TUBING. A finished joint is shown at top. Be sure to thread the tubing onto the wire before soldering the joint. Rub the tubing with the side of the iron, not the tip, to make it shrink.

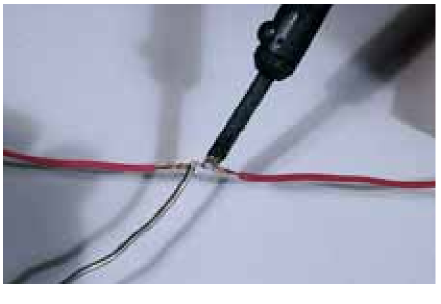


Fig. 5 SOLDERING. Heat both wires with the iron, then touch the solder to the wires (not the iron). The solder should flow into the joint.

Fig. 8 CRIMPING. Add spade or other terminals to wire by threading them onto the stripped end and crimping them in place.

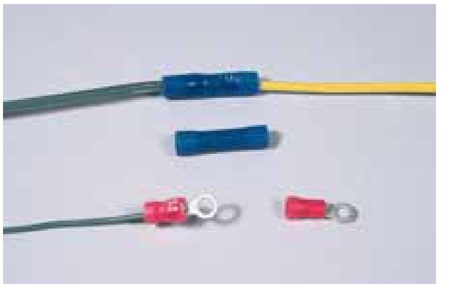


Fig. 9 OTHER CRIMPED CONNECTIONS. Butt joints, as well as ring terminals, can be added using a crimping tool.

connectors" or "IDCs" are available. I prefer 3M's Scotchlok brand because the metal strip cuts through in two locations, providing better electrical contact.

Keep it neat

It's tempting to make wire runs as short as possible, but this can create a rat's nest under a layout. I like to route the main track power wires under the main line to keep the track feeders as short as possible.

Label all of your wires, and color-code everything – don't rely on your memory to recall whether the blue wire is the switch machine positive, half of the lighting supply, or the north rail.

When routing wires, use wire staples to hold the wires in place. See fig. 11. Using ordinary staples or wire nails crimped over wires can cut into and damage wire, leading to short circuits and other failures.

Remember the keys to wiring: Keep it neat and do it right the first time. Using the right tools will make wiring less of a chore, and more importantly you'll save time for more important things, such as running trains.

Jeff Wilson is a former associate editor of MODEL RAILROADER.

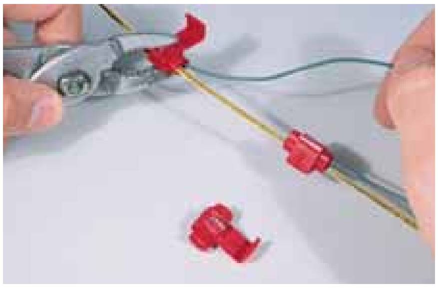


Fig. 10 TAP-IN CONNECTORS. Suitcase or tap-in connectors are made to be used without stripping the wire. Use a channel locks to push the metal strip in place, then close the plastic cover.

Fig. 11 WIRE STAPLES. Keep your wiring neat by using wire staples, which are available in many sizes.

Control panels

Control panels are a great way to centralize all the switches and buttons needed to control everything on the layout in one central location.

Making good-looking control panels may seem hard, but luckily a tool has become very common these days that makes it easy to create neat control panels. Enter the personal computer.

Computer panel theory

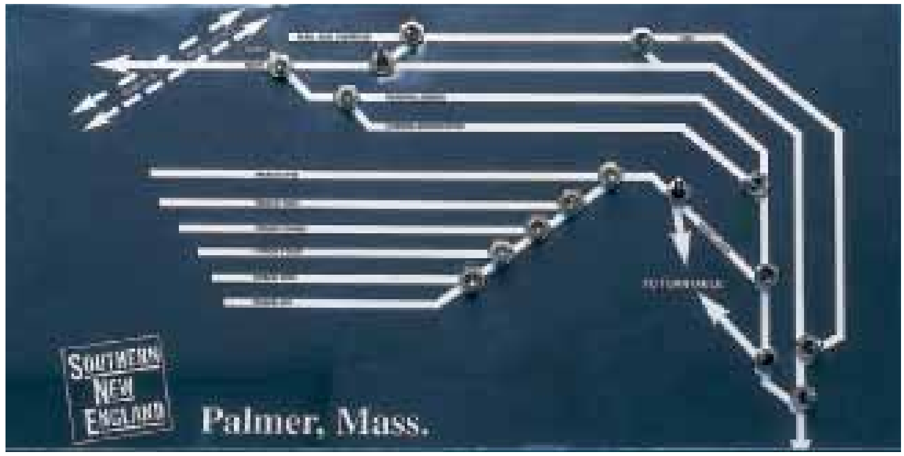
Recently I got serious about adding control panels to my Southern New England. I wanted the panels to be neat and easily understood by operators. I also wanted them to be fairly unobtrusive. I didn't want the control panels to be the first thing catching visitors' eyes when they see my layout.

I've seen some intimidating control panels bolted to the sides of model railroads – and I used to earn my living in the Combat Information Center on an Aegis guided missile cruiser. Perhaps that's where I learned the simpler and easier to understand a control panel is, the better off everyone will be.

To use a buzzword a control panel is an interface between the user and the layout. Perhaps the simplest panel is nothing more than a track diagram with the various tracks labeled so operators will know where to set out or pick up cars – the panel isn't used to control the trains or track. At the other extreme is a control panel with all the throttles, levers, and switches needed to control everything from one central point.

My panels fall somewhere in the middle. With walkaround control I don't need to mount throttles to the panel. I also don't need to worry about block power or cab assignments since I use command control. My panels tell operators what town they're in, identify the various tracks by name, number, or purpose, and localize turnout control in one place.

But even if you're not using command or walkaround control, there's no reason you can't make your control panels the same way I created mine.



PHOTOS BY BILL ZUBACK

Marty prewired the toggles before installing them on the panel.

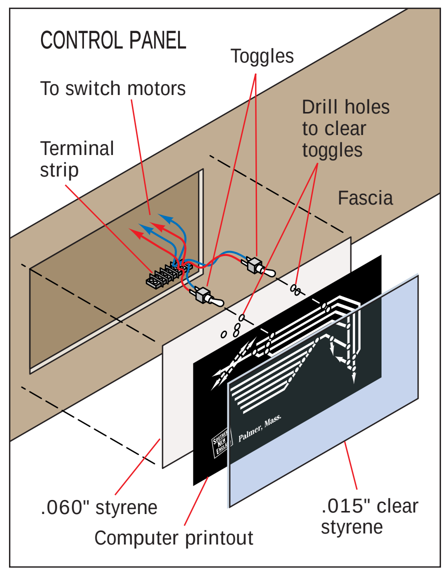


ILLUSTRATION BY RICK JOHNSON

Computer control panels

The illustration shows how I made the panels. I started by using the simple line drawing software on my PC to create a track schematic. The panel shown is for Palmer, one of the more complicated areas on my layout.

I began by drawing a box the size of the control panel and shading it in black. Then I followed the track plan to create a schematic drawing of the location, making sure to leave sufficient finger room for the toggle switches used to control the switch motors. I then identified each track by name or number, just like prototype railroads. This is an easy way to add some real world flavor to any model railroad and makes it easier on operators.

With the drawing complete I printed it in black and white and created a dummy panel from a piece of cardstock. This is a good way to double-check the spacing and location of the switches and lettering. I found I had to move some of the track labels since they would be obscured by the toggles.

I printed the control panel on my laser jet printer and used spray adhesive to apply it to some .060" styrene. Then I drilled holes for the toggles through the styrene. I used the panel as a template to mark the hole locations on a piece of .015" clear styrene. Once I drilled the holes in the clear sheet I installed the toggles and secured the panel to the fascia with small screws.

One tip – run the wires from the panel to a terminal strip under the layout near the panel location. Then run the wires from the terminal strip to the layout. This will help troubleshoot any problems and will make the wiring look much neater.

Digital Command Control

By Cody Grivno
Photos by Jim Forbes
and Carl Swanson

Not long ago, MODEL RAILROADER'S editor Terry Thompson challenged me to convert a small N scale layout to Digital Command Control (DCC). The goal was to see if I could finish the project in an evening.

On the surface this seemed like an easy task. However, all of my own layouts to this point had been direct current (DC) operated, so this was to be my first real experience with DCC.

The layout I had to convert was the Carolina Central, an N scale project layout from 1996. Since the layout had been designed as a beginner's project, the wiring was simple and offered only limited operating potential. With DCC, however, block controls would be unnecessary, and we could enjoy the accessory functions of DCC, such as controllable lighting and sound effects.

After reading the instruction manuals provided with the Atlas Master DCC System, I was ready to begin. So come along and see if I can convert this layout to DCC in an evening. ♁

Bill of materials

- 18 or 20 ga. model railroad wire
- Subminiature double-pole double-throw switch
- Razor saw
- Screwdriver
- Solder
- Soldering iron
- Pin vise
- no. 60 drill bit
- Utility knife
- Wire cutter

► More on our Web site

To see the DCC-controlled Carolina Central in action, visit our Web site www.modelrailroader.com.

6:00 PM

1 MOUNTING THE POWER STATION

The power station (referred to as a "generator" by Atlas) provides the power to the command station and ultimately the trains. I mounted the power station on one of the 1 x 4s used to support the legs of the layout, which also happens to be directly below where the command station will be located. It works best to mount the power station and command station close to each other so you don't have to run long lengths of wire, which might cause a voltage drop and lead to other operational difficulties.

6:12 PM

2 CONNECTING THE POWER STATION AND COMMAND STATION

After I mounted the power station to the layout, I swapped the layout's DC power pack for the command station, mounting it with Velcro fastener strips. This made it easy to remount and work on later. I wired the two units together using different colored wire to make them easy to trace. It's also good practice to tin the ends of the wire (coat them with solder) to prevent any stray pieces from touching other connections and creating a short circuit. DCC systems are much more sensitive to short circuits than DC.

8:18 PM

5 DRILLING A FEEDER WIRE HOLE

Since the original track plan had only one wire running to the interchange track, I needed to add a second wire. That meant I had to drill a feeder wire hole. I used a pin vise and a no. 60 bit on the top of the layout. Don't worry if the hole is too big. You can come back later and fill it in with ballast. In order to run the wire underneath the layout to the command station, I enlarged an already existing opening in the hollow-core door with a utility knife.

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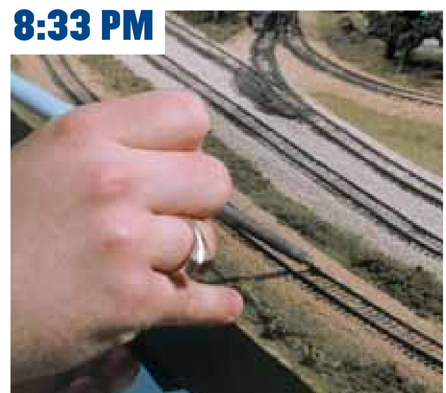

6 SOLDERING THE FEEDER WIRE

With the wire run through the hole, I was ready to solder the feeder wire to the rail. Use caution when soldering the wire to the rail so you don't melt the plastic ties, and be sure to clean any paint off the side of the rail so the solder has a surface to stick to. Once the new connection is cool, use needle files to shape any excess solder to the contour of the rails to prevent derailments. Touch up the soldered area with paint so it blends in with the rest of the rail.

in an evening

Converting an N scale layout to DCC

6:38 PM

3 CUTTING THE RAIL

With the operational hardware in place, the third step is to begin preparing the layout for DCC operations. Start by creating an isolated section of track for programming each locomotive's decoder address. It works best to use a siding or seldom-used track as a programming track. I used a razor saw to cut gaps in the rails on the layout's interchange track. Be sure to cut the gaps carefully so you don't damage nearby rails or scenery. After the gaps were cut, I smoothed out the rough spots with a needle file.

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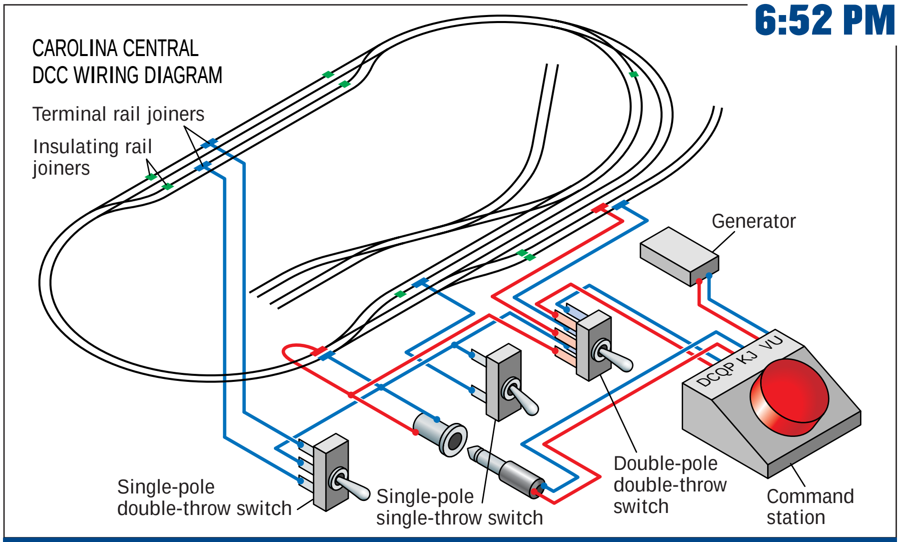

4 ADDING A DOUBLE-POLE DOUBLE-THROW SWITCH

ILLUSTRATION BY RICK JOHNSON

With a double-pole double-throw (DPDT) switch in hand, I was ready to begin the most time-consuming part of this whole project: replacing the single-pole single-throw (SPST) switch with a DPDT switch. The DPDT switch allows you to use the interchange as the programming track.

When the switch is set for programming mode, the isolated section of track can't be operated. Once finished programming a locomotive's decoder, setting the switch to operational mode restores power to the programming track.

9:05 PM

7 RUNNING THE TRAINS

The final step, and the one that lets you know if the wiring was done correctly, is to program the locomotive's decoder address. The steps for programming the locomotive's decoder are included in the instruction manual.

To run multiple locomotives, I had to give each locomotive its own two-digit address. When operating the layout, you can toggle back and forth between the two locomotives to control them independently.

After roughly three hours of work, the Carolina Central has been converted to DCC. Now we can run multiple trains on the layout at the same time, adding to the operational fun of this small layout.