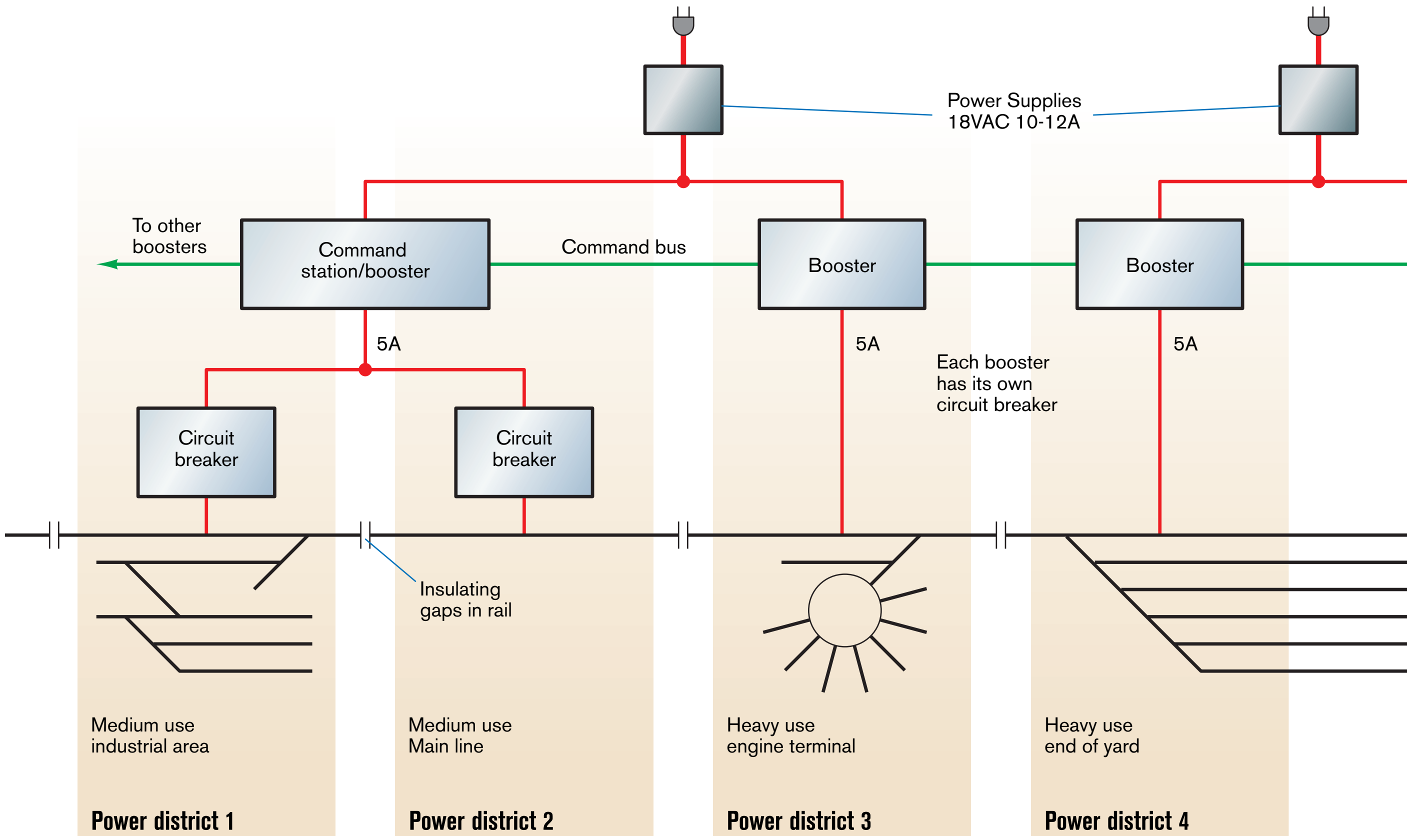

Power districts
for Digital Command Control

Wiring your DCC layout with circuit breakers to limit operating interruptions

By Paul Chandler • Photos by the author

Plain and simple, short circuits happen, and with a Digital Command Control (DCC) system, a short has the potential to disrupt all operators. That's because when one train causes a short, it trips the master circuit breaker, interrupting power to all trains on the layout. Once you clear the short, the circuit breaker resets itself and your trains are back in operation. But these breaks in activity aren't realistic or fun.

Fortunately, you can minimize this type of disruption by dividing your DCC-equipped layout into power districts – electrically isolated sections that have their own protective circuit breakers.

Why divide my layout?

Though DCC offers a more realistic type of train control – being able to run multiple locomotives independently on the same track – the electricity running through the rails of your layout still needs to be properly managed and distributed. Since one of the big selling points of DCC is that you don't need to divide your layout into individual electrical blocks for independent train control, you're probably asking yourself, "why should I do it?"

In addition to minimizing operating disruptions, power districts are also key to DCC power management. If you're running a lot of trains, you'll need to make sure your DCC system can supply all your power needs efficiently and safely. Adding power districts to your layout can help with that. By separating your layout into districts, you divide the total track power available into smaller, more manageable units.

Are boosters and breakers different?

Sometimes modelers confuse boosters and circuit breakers because both interrupt the power in the event of a short. The key thing to remember is that a booster supplies power, but a circuit breaker doesn't.

Many DCC manufacturers offer extra boosters for their systems. [Not all sys-

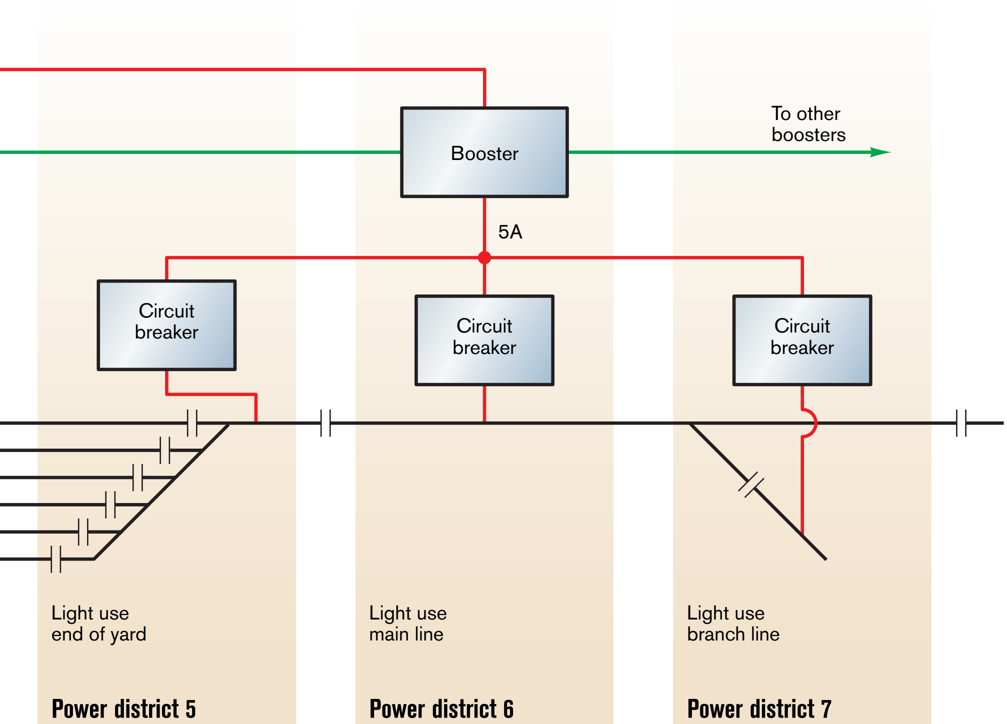

Illustration by Rick Johnson

Managing power on a DCC-equipped layout is important for smooth operation. In this illustration, author Paul Chandler shows several ways you can assign combinations of boosters and circuit breakers to make up power districts, taking into account the power requirements based on traffic patterns.

tems can use additional boosters. Check your owner's manual or with the manufacturer before adding extra boosters to your DCC system. – *Ed*.]. Power boosters have built-in circuit breakers, which either automatically reset themselves after a period of time or require a command from the operator to do so.

There are also a number of DCC circuit breakers available on the market. A breaker is wired in between the booster (or combination command station and booster) and the layout. Some units have more than one breaker, allowing you to use them to control multiple power districts.

If you're looking for a cost-effective approach, several DCC manufacturers have higher-powered boosters available – some up to 10A. One advantage of using a larger booster is that you can divide its output among more circuit-breaker-protected power districts.

How do I determine districts?

There are really two types of power districts: those that are circuit-breaker-protected zones on the layout and those that have their own independent power source (also breaker protected) in the form of a booster. Probably the best way to determine where to place power districts is to take a look at the expected current draw for each operating location on the layout.

For example, a busy yard might have two switchers, one or more trains on the arrival and departure tracks, another train or two passing the yard on the main, and maybe a peddler working nearby local industries. If some or all of these trains have more than one locomotive, you could have 10 to 15 current-drawing units all competing for power in a fairly small area. Even assuming that the locomotives have efficient motors, this type of load could be heavy enough to shut down a DCC system running on a common 5A booster. In this case, adding more circuit-breaker-protected power districts won't solve the problem. You need to add extra power to support the concentration of trains in this location.

By adding extra boosters to your layout, each supplying one or more power districts, you can allocate power where it's needed most. The above illustration shows several ways to use extra boosters, wired in parallel, to power one or more districts and best serve the layout's operating requirements.

As shown in the diagram, high-traffic locations, such as the engine terminal and the left end of the yard, have their own boosters (each with a built-in circuit breaker).

The branch line, on the other hand, is an example where you can use a booster with multiple circuit breakers. Since the branch line seldom has more that one or two locomotives on it at any time, you could supply it and several other lesser-used segments, such as the light end of the yard or a light-duty main line, from one booster.

By dividing a layout into power districts in this manner, and using a combination of boosters and circuit breakers, you can make the most efficient use of available power on any mid- or large-size layout.

Adding direct circuit control

On my layout, I wanted to be able to have direct control of the circuit breakers for each power district. I used breakers called Power Shields. Available in one, two, or four circuit breaker combinations, they are offered by Tony's Train Exchange (www.tonystrains.com).

Each Power Shield is assembled on a printed circuit (PC) board that measures roughly 3" x 4" and is designed to be mounted under the layout. A Power Shield will reset automatically after a short but also offers a manual reset option if you add a single-pole, single-throw (SPST) toggle switch.

By including an additional SPST switch in the circuit, you can turn the power to the district on or off as well. This idea appealed to me as a troubleshooting aid because I could shut power off to the track – either to clear a short or simply work on the layout – without disrupting trains operating in other power districts.

You can also wire light-emitting diodes (LEDs) to a Power Shield, providing a display of the breaker's operating status in a remote location. I combined all of these features into a small control panel, mounting one panel for each district on the fascia of my layout.

Making the control panels

You can make power-district control panels from a variety of materials including metal, hardboard, or styrene. I cut my 2½" x 3" panels from a sheet of .060" aluminum, using a hacksaw as shown in fig. 1. I then squared them up with a disc sander and a flat file.

For each panel, I laid out the two toggle-switch holes (one for track power

Fig. 1 **Making panels.** You can make power district control panels from an assortment of materials. Paul made his from .060" aluminum, which is easy to cut with a hacksaw.

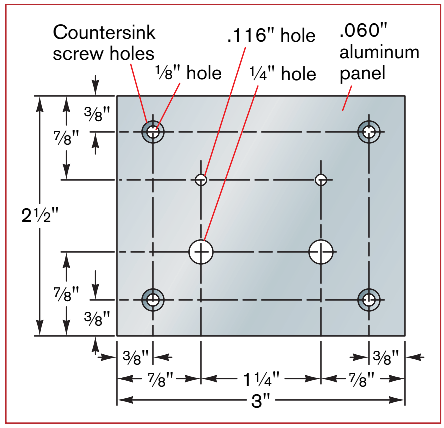

Fig. 2 **Drilling diagram.** After filing and sanding the cut edges, mark the locations for drilling holes on the aluminum surface with a pencil using this illustration as a guide.

Parts list

RadioShack
271-1321 1,000 Ω ¼-watt resistor
275-324 high-current single-pole single throw switch (2)
276-301 red 5mm light-emitting diode (LED)
276-304 green 5mm light-emitting diode (LED)

Tony's Train Exchange
Power Shield DCC circuit breaker

Miscellaneous
.060" aluminum sheet
½" no. 4 wood screws (4)
24AWG wire (2 colors)

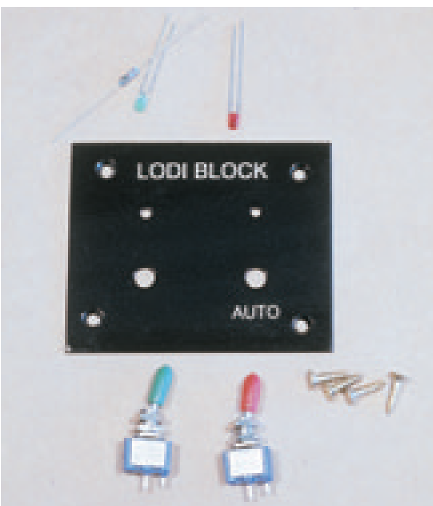

Fig. 3 **Painting and labeling.** Paul painted his panels with a high-gloss black enamel paint and lettered them with custom decals he made on his home computer.

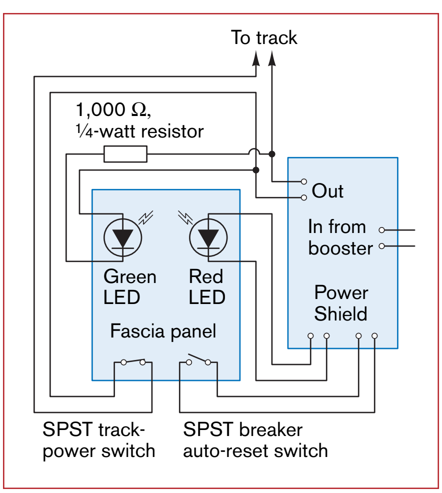

Fig. 4 **Wiring diagram.** When wiring the panel's lights and switches, make sure to check the Power Shield's instruction manual before making any connections to the PC board.

and the other for manually resetting the circuit breaker) and the two status LEDs, as shown in fig. 2. I then drilled the holes accordingly. At this time, I also drilled the four ⅛" holes for the mounting screws.

Next, I removed all surface scratches by sanding the aluminum plate with 150-grit emery cloth. I then washed the panels thoroughly before painting them.

I sprayed my panels with a gloss black enamel paint, but you could also spray them with clear lacquer if you prefer the aluminum color.

To letter the panels, I used decals I made on my own computer. You could also use peel-and-stick vinyl letters or dry-transfer lettering. Figure 3 shows my painted and lettered panel. If you use decals or dry-transfers, make sure you seal them with a clear coat as they will need to stand up to a lot of operator "finger traffic."

Wiring

Follow the wiring diagram in fig. 4 to connect the switches and LEDs. Make sure you double-check the wiring connections and instructions in the Power Shield owner's manual before soldering wires to the PC board. For all connections, I used 24AWG wire.

Each circuit breaker on the Power Shield has a pair of output terminals for a remote red LED. There are also terminals on the PC board to install an on-off switch for each breaker. Following the Power Shield directions, wire this switch so that when it's in the off position the circuit breaker is set to automatic control – it resets itself once a short is cleared. When the switch is in the on position, you'll need to manually reset the breaker – that is, return it to the automatic setting which allows it to reset itself.

Similarly, there are two more terminals that allow you to turn the track power on or off in the district controlled. The green LED is a pilot light for the track power, and it's wired in parallel with the track output terminals. Make sure you include a 1,000Ω, ¼-watt resistor in series with either leg of the LED to step down the current.

The factory setting for a Power Shield causes it to trip when the load exceeds 3.8 amps for 10 milliseconds, but you can change the trip current and breaker response time (sensitivity) by installing jumpers across different combinations of terminals, following the manufacturer's instructions.

So what have we accomplished?

With power supplies spread out to match the loads across all the districts, you can run your fleet of locomotives with confidence. You can also rest easy knowing that occasional short circuits from operator error will affect only the few trains in a given district and not bring your entire railroad to a screeching halt. And, you now have the flexibility to manually shut off a district when you need to work on the track.

Adding power districts to your layout is an easy way to get a smoother-running model railroad. MR

Paul Chandler is a first-time contributor to Model Railroader *magazine. He is a "nearly retired" architect and home-builder residing in Tucson, Ariz. Paul got his start in the hobby when he bought a Globe streamliner set in 1954 with money from his paper route.*

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