



DCC Impulses Column

by Bruce Petrarca

How DCC helps to automate reversing loops.

In my November 2014 column, I discussed circuit protection, both bulbs and circuit breakers. This month, I'm going to start from the circuit breaker portion and discuss auto-reversers.

Reversing sections - real and modeled

When the train travels down the track in one direction with the one side facing an external observer and returns to the same section of track with the opposite side facing the observer, it has passed through a reversing section. Sounds simple.

Prototype and model railroads both have reversing sections:

- Loops [1]
- Wyes [2]
- Turntables [3]

However, model railroads have another, frequently unexpected reversing section: a crossover on a "dog bone" mainline [4].

I'm going to use the term "loop" generically to refer to any reversing section. Please understand that I'm referring to any situation where the polarity of the signal on the track needs to reverse to allow the train to exit. Loops are just the easiest to visualize.

Most track powered model railroads must deal with specialized wiring for loops. When the train enters a loop the polarity of the loop must match the incoming track. While the train is inside the loop, the polarity must change to match the outgoing

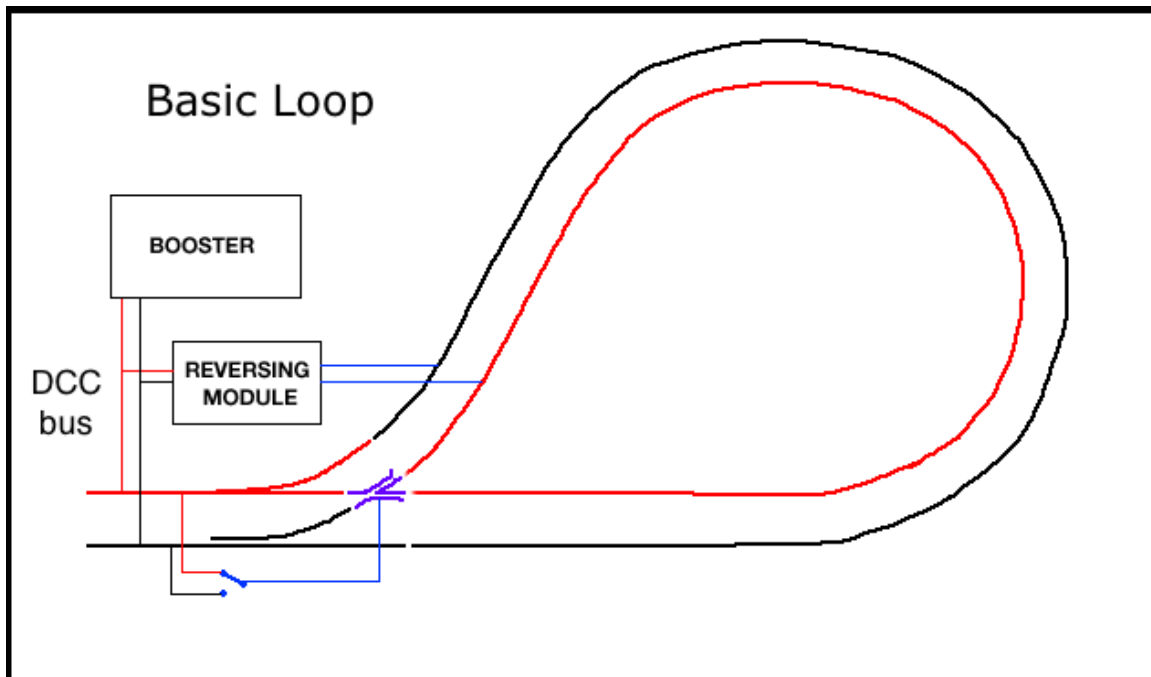
track. This is handled in different ways, depending upon what power source is being utilized.

With O-27 and other 3-rail models, reversing sections do not present an electrical complication. The outside rails are always at the same polarity, so it doesn't matter that they reverse.

However, with 2-rail DC or DCC, precautions must be taken when the track work physically reverses a loco or train. Unless the polarity of the loop reverses while the train is inside it, the train won't exit. Instead, it will short out the power being supplied to it, as the leading wheels cross the interface.

In the DC world, folks frequently had a DPDT toggle switch that reversed the power between the power-pack and the loop. In operation, the operator would stop the train in the loop. Then the operator would use the toggle switch to reverse the polarity of track and then reverse the polarity of the power-pack that was feeding the track. When the voltage was increased, the train would continue in the same direction as it had been going before the stop.

1. Basic loop - adapted from drawing supplied by Tony Lambert of the A19 MRC in the UK



The fact that DC has polarity is pretty obvious - that's how the trains know which direction to run. Some folks think DCC doesn't have a polarity, inasmuch as you can put a loco on the track and select forward and it will go forward no matter which direction it faces. However, look at [1]. At the frog of the turnout there are opposite

polarities on the track in the loop and on the straight, as soon as the turnout is thrown. If one uses a bulb to test for power, it will light when connected between the red and black sections of the outside rail (at the turnout). So, as soon as a metal wheel hits this gap, the system will short.

The switch contacts in stall motors, such as the Tortoise can automate the reversal of track polarity for either DC or DCC layouts. With DC there is the caveat that the train needs to be stopped when the turnout is activated, otherwise the train will start running backwards as the turnout motor switch reverses the connection to the track. Understand, with DCC there will probably be a bit of hesitation for the short period of time while the switch does not have any power connected to the track.

In other reversing situations, such as wyes, the use of switches tied to the turnouts is not nearly as simple and, therefore, not recommended.

Turnouts have frogs. That is the name for the (blue in [1] and [2]) section of track work where the straight and diverging rails cross. It must be either electrically isolated (Peco calls them Insulfrog) or have its polarity change (Peco Electrofrog) depending upon which direction the train is headed, straight or diverging. It is the right rail in one case and the left rail in the other.

2. Wye - adapted from drawing supplied by Tony Lambert of the A19 MRC in the UK

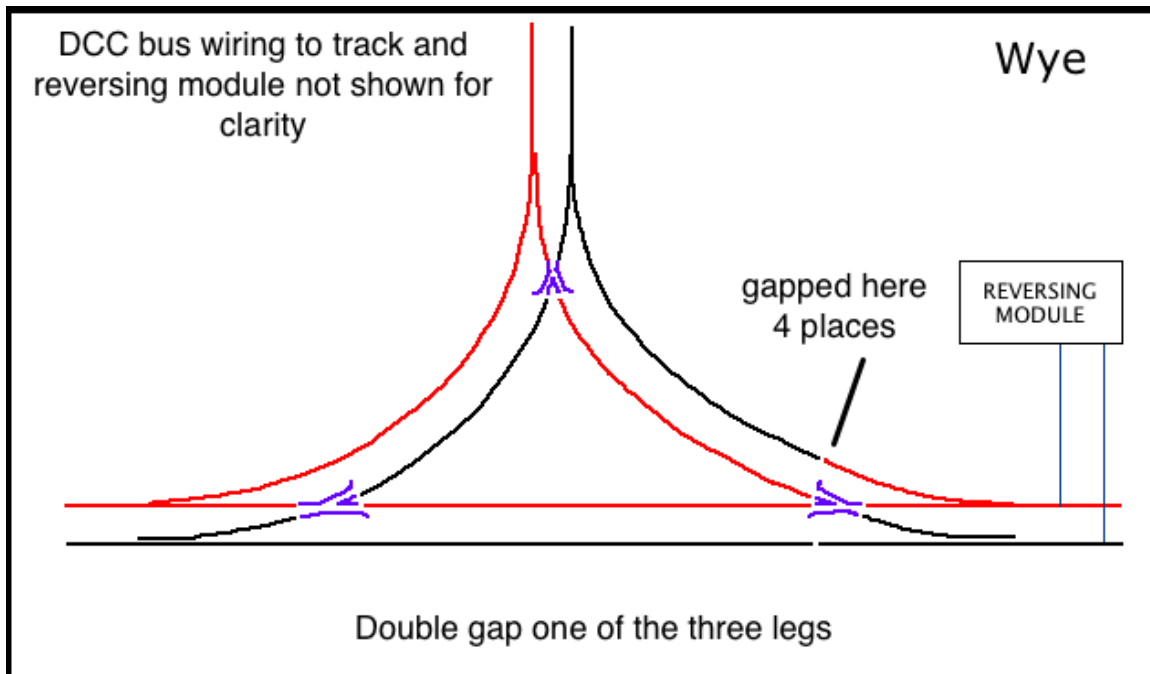


Figure [1] shows a switch for reversing the polarity on an insulated frog. If one is not using both sets of contacts on the switch motor for reversing the track polarity or signaling, one set can be pressed into this service. Another method that is gaining

popularity is the Frog-Juicer product from Tam Valley Depot, which attaches to the DCC bus and to the frog. It matches the polarity of the frog to whatever is needed when the loco crosses over it.

A wye [2] requires that one of the three legs be double gapped on the exit side of its turnout. In this example, the straight and diverging routes of the turnout on the right side of the wye is double gapped.

While model turntables can physically reverse a locomotive, and, perhaps, a single car, they may or may not reverse polarity as they turn. Some will designate a "dead zone" to be oriented where there are not tracks coming into the turntable. This is usually a giveaway that the turntable reverses polarity.

3. Turntable at the Durango round house, September 22, 2003. Bruce Petrarca photo.



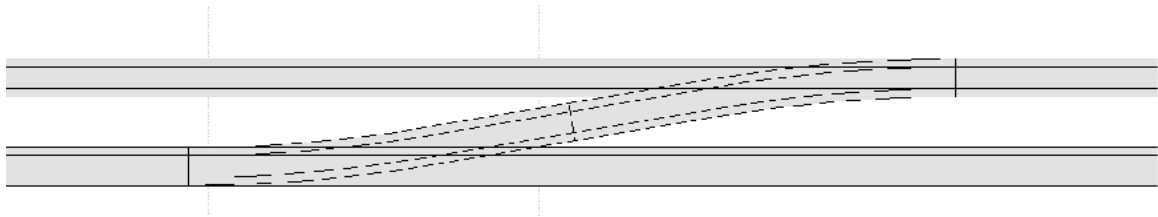
If the turntable does not reverse track polarity as it turns around, an auto-reverser will be needed. More information is on my web site at the bottom of the page on layout wiring (<https://mr-dcc.com/index.php/dcc-info/wiring-for-dcc>).

One of the great things about DCC is the ability to totally automate this reverse switching. Automation is not as simple as just hooking a module up to the reversing loop as [1] would imply. Like so many things in model railroading, a bit of pre-planning can go a long way.

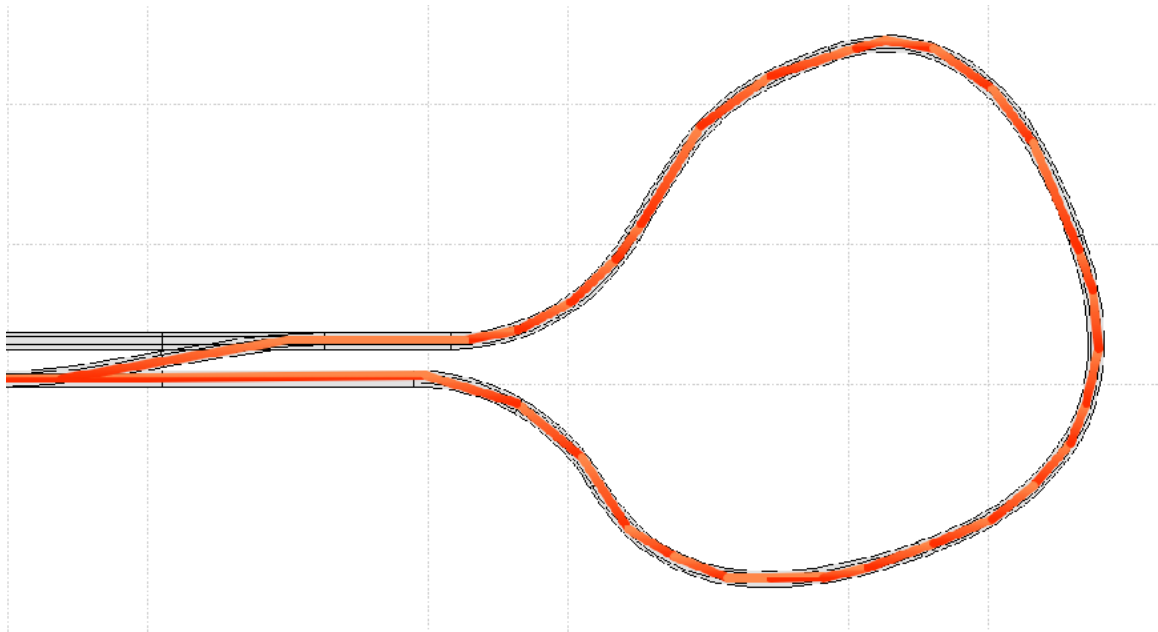
Do I have a reverse section?

Looking at a loop [1], it is pretty obvious that it is a reversing section. However, as track work gets more complex, it is easy to have reversing sections buried inside the layout and not realize they exist.

4. Dog-bone double track main layout design with a crossover. When you look closely at the crossover [4a], it is hard to see that there is a reversing loop.



When you look at the bigger picture [4b], the section highlighted resembles the basic loop [1].



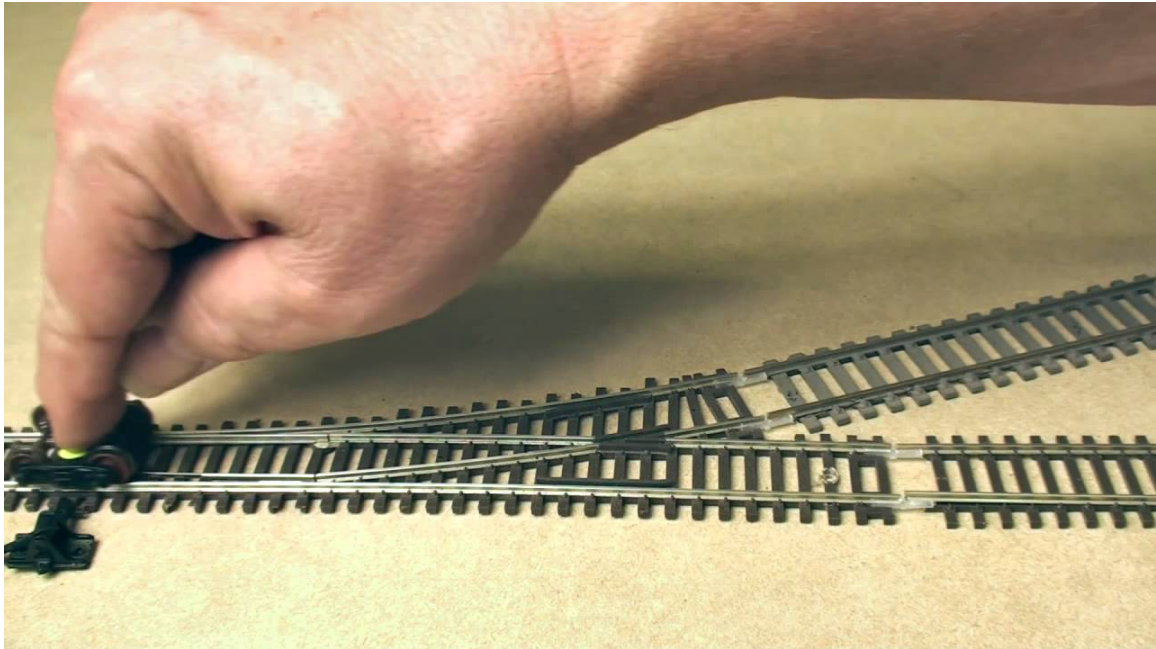
As I mentioned previously, a crossover on a dog bone style layout is a reversing section, but it is not immediately obvious. If you look closely at the crossover [4a], it doesn't seem to be a reversing section. However, zooming out [4b] shows that it really is a loop with a side entrance.

The more complex the track plan, the more difficult it is to see reverse loops.

A Litchfield Station customer showed me an easy way to test a layout. Color one side of a truck, either as part of a car or by itself. Run it around the layout as part of a

train or by hand. If it comes back to the same point on the layout with the side switched [5], it went through a reversing section.

5. Video: Testing a layout with a marked truck



How do auto-reversers work?

Here is where it would be good for you to review the section on circuit breakers in my November 2014 column ([TINY UTL](#)). Auto-reversers connect between the DCC bus and the track in the loop. Whether they connect before or after a circuit breaker will be discussed later in the column.

Auto-reversers work the same way as electronic circuit breakers. The difference is that when an auto-reverser senses a short, it reverses the polarity to the track rather than disconnecting the track. Some versions will actually perform the circuit breaker function as well. When they sense a short they first reverse the polarity, if the short persists, then they will disconnect the track.

Hints and tricks for smooth operation

Let's talk about how to get smooth, bulletproof operation of a reversing section.

The first criteria is the loop must be longer than the longest possible train. It will probably require its own bus - I call it a reversing sub-bus. There should not be rolling stock entering and leaving the section at the same time. If the auto-reverser is seeing shorts on both ends of the loop it will just toggle back-and-forth and get very confused.

There are lots of discussions on the web about how to cheat this, with plastic wheels, etc. But they are all just patches. If you truly want smooth and reliable operation make sure that there's no possible way for a train to be entering and leaving the loop at the same time. Or for that matter, a second train to be entering the loop when another is leaving.

Similarly, I've seen folks try to save a couple of bucks and run two different loops off the same auto-reverser. Not a good idea. It is just a matter of time before two trains are competing for track controlled by the single module.

The next hint is how the double gapping is achieved. Many modelers get almost anal-retentive on getting the rail joiners directly across from each other. While this is an esthetic thing for conductive joiners, it is counter productive when providing insulated gaps for auto-reversers.

If gaps are directly across from each other, the auto-reverser may be confused. If the wheels hit the gaps at slightly different times, the auto-reverser may sense the first short and reverse in time to catch the second short. The short may persist long enough to shutdown a circuit breaker. Staggering the gaps makes it such that the first wheel to hit a gap activates the auto-reverser. It will be a bit of time before the opposite wheel hits the second gap. No problem.

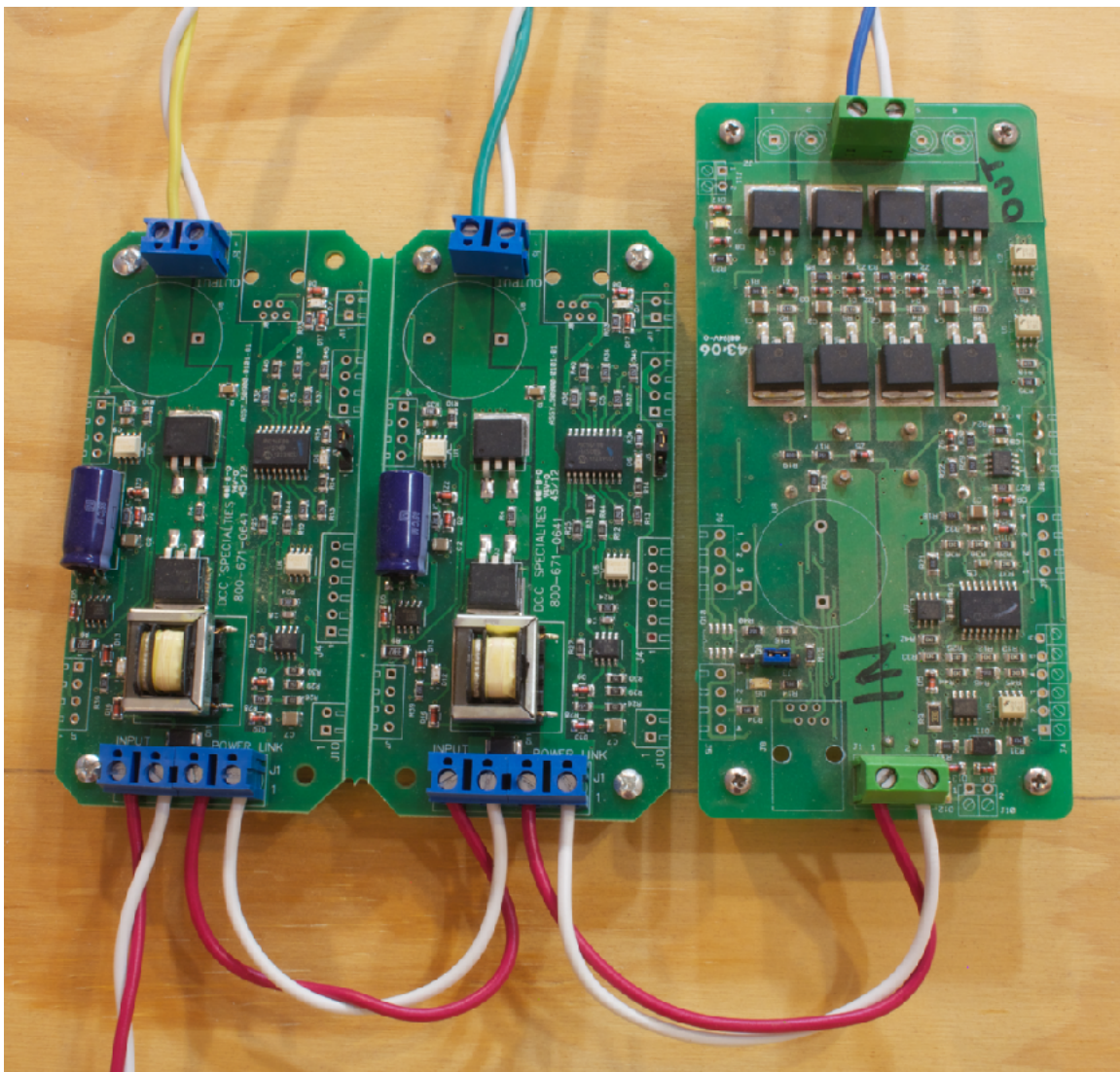
6. Staggered gaps (yellow insulators) on the Rocky Mountain Pacific. Visible in this photo is the black plastic piece that is screwed to the ties on either side of the 3-tie long insulating section to keep the track from walking apart and the power feed coming into the lower mainline track from the bottom of the photo. Bruce Petrarca photo.



So, I recommend staggering the gaps. The minimum I like to see is ½ inch in HO or smaller scale and an inch in larger scales. There is really no maximum distance - go for what is convenient. Just remember that the length of the loop is the distance between the closest gaps.

I have actually adopted a practice of offsetting gaps every time I need an insulated section. It doesn't matter whether the gap is for district blocking or a reversing loop. Down the road, you may want to turn a block into a reversing loop. The gap shown in [6] is between power districts, not part of a reversing loop. I did the gaps for my loop the same way, though.

7. Wiring circuit breakers and an auto-reverser. Here is the preliminary wiring for the control board for the RMP. See text. Bruce Petrarca photo.



Another "gotcha" can come where you have adjacent districts that are connected to auto-reversers. You need a section between loops that never changes polarity - that

is, wired to the bus not through an auto-reverser. Think about floating boat docks. If you are trying to step from one floating dock to another, it is easier if you can go to a fixed dock in-between. Similarly, if you have two reverser-wired sections next to each other, you can set up a war between the reversers, each one reversing and still seeing a short. Even a few inches of non-reversing track will help.

Choosing an auto-reverser

In my November 2014 column, I recommended circuit breakers between the booster bus and the track bus to protect the rolling stock. Similarly, I prefer to use auto-reversers that contain their own circuit breaker. Amazingly, many auto-reversers do not contain this easy to implement feature.

Auto-reversers with circuit protection are available from DCC Specialties, both the PSx-AR and the OG-AR units. I know of no other auto reverser that includes the circuit protection function, including units from Digitrax, Lenz, NCE, MRC or Tam Valley Depot.

In the photo [7] of my RMP control board, on the left are two PSx circuit breaker modules. On the right is a PSx-AR auto-reverser. Since the PSx-AR combines the auto-reverse and circuit breaker functions, all are wired to the (red & white) DCC booster output. The "daisy chain" feature of the PSx modules makes wiring simple. Note: white is the common color here and will be wired to the same rail in normal running (outside). The white input is connected to the side of the PSx modules that are not interrupted. That is the trace that goes from the input to the output without interruption. Note, too: the wires are slightly twisted - the small amount of capacitance created this way helps reduce interference to the DCC signal.

I hope you feel more confident in designing your layout and installing auto-reversers after this short introduction. Please join us in the discussion that comes out of these columns. Folks always seem to have additional ideas to share. Just click on the Reader Feedback icon at the beginning or the end of the column. While you are there, I encourage you to rate the column. "Awesome" is always appreciated. Thanks.

Until next month, I wish you green boards in all your endeavors. There will be no **Mr. DCC's Workbench** segment this month. This entire column would qualify.