



## **BRUCE PETRARCA MMR**

**talks about DCC layouts and locomotives.**

I'm just now working with two fellas on their layout designs and DCC systems. They each are asking some of the same questions, so that suggests that other folks may have the similar concerns. This column deal with some of the questions that seem to commonly appear.

***Ball of Confusion was a song by The Temptations in 1970.***

But I see a lot of that in the minds of folks working to get their arms around DCC. Sometimes it comes from a lack of information. Most frequently the source is too much or conflicting information.

Let's work on getting you toward a layout like Frank Baker's [1].

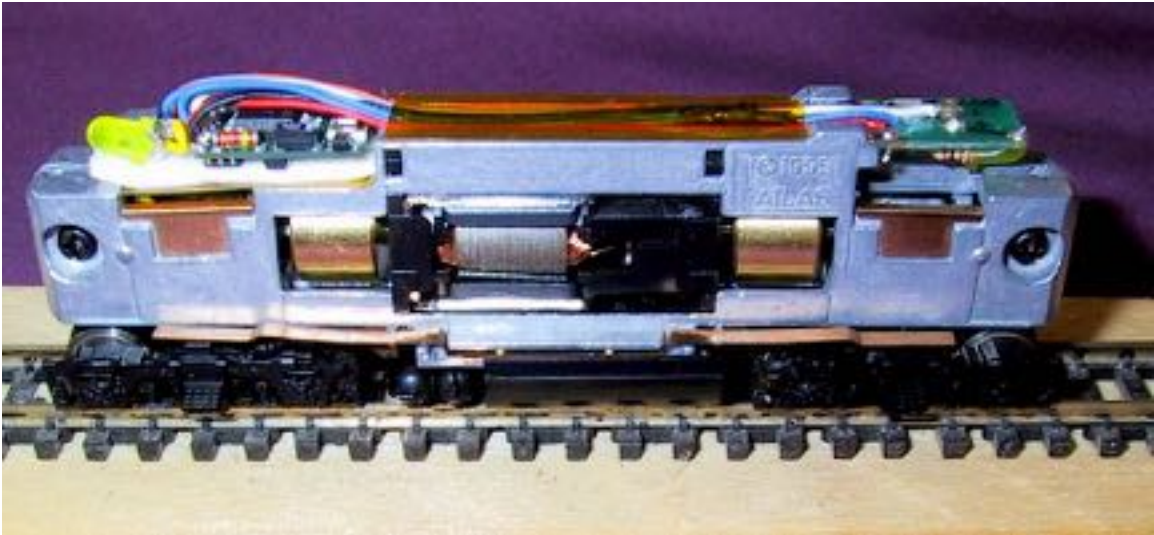
**1. The DCC layout belonging to Frank Baker of Scottsdale AZ. A well planned pike.**



There is a lot of information on the web about DCC. Quite a bit of it was written one to two decades ago. How confused would you get trying to set up your Windows 10 notebook computer working from data for Windows 95 and a desktop machine? Many times folks are unintentionally putting themselves in this position.

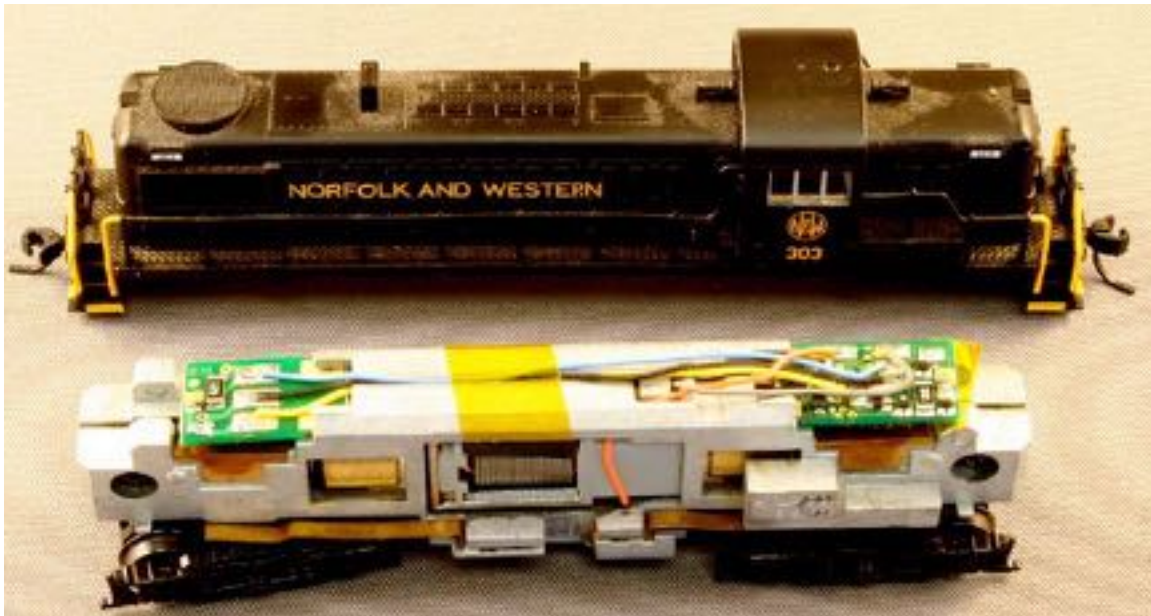
In the first few years of Litchfield Station (founded in 2001), there were amazing changes in DCC awareness and support from manufacturers. One of the first installations I did was in an Atlas N-gauge GP7 [2]. The locomotive was disassembled and the motor isolated from the frame. It used a Lenz LE077XF decoder to replace the rear light board with the rear LED hard wired to the decoder. The front light board was modified to pick up track power and isolate the front LED from the track for DCC control. A lot of work, but it functioned nicely.

**1. A 1995 vintage Atlas N-gauge GP9 with a Lenz LE077XF decoder in an installation I did in 2001.**



Contrast that with an installation from 2008, only seven years later, using the TCS CN style decoder where both boards are supplied and just plug into the locomotive [3]. The motor isolation step was the same between these two installations, but that's about all.

**3. A TCS CN decoder in a N-gauge Atlas RS3, circa 2008. Quite a change from [2] in just over 5 years.**



Imagine trying to do the CN style [3] installation with the instructions for the Lenz installation [2]: instructions for cutting leads to discrete LED when looking at a board with a surface mount LED. Since then, there have been another decade of advancements. Even the digital photography has improved.

Hopefully you can see the need for current information to base your design work upon. In the six-plus years that I've been writing this column, there have been lots of changes, too. Some of what I wrote about early-on is obsolete now. However, I try to write about the basics, not the “newfangled gadgets,” as much as possible to minimize the obsolete data.

One more thought. If you are not a cook, ask someone who is about this. There are iconic dishes that have a large quantity of various recipes for their preparation. How would the dish come out if you used the first half of the ingredients from one recipe and the second half from another recipe and mixed it per the instructions on a third, put it in a pan as sized in a fourth and cooked it per a fifth? That was *per* a fifth, not *drinking* a fifth - which is another issue altogether. Well, following DCC suggestions from several people, or websites, can create similar havoc. Find your guru and work with him. Monogamy is important here, too.

**Planning is a process, not an objective.**

Frequent readers will probably be able to chant my mantra: don't over-plan. I know professional model railroad planners. They've been planning for two or three decades and have yet to lay the first piece of track.

Under-planning can cost money and time, but you will be learning in the process — perhaps how *not* to do your next layout.

I talked about the planning for my two new layouts in my December 2017 column: *Not quite a chainsaw layout* ([model-railroad-hobbyist.com/magazine/mrh2017-12/dcc-impulses](http://model-railroad-hobbyist.com/magazine/mrh2017-12/dcc-impulses)). Some items to consider were explained there.

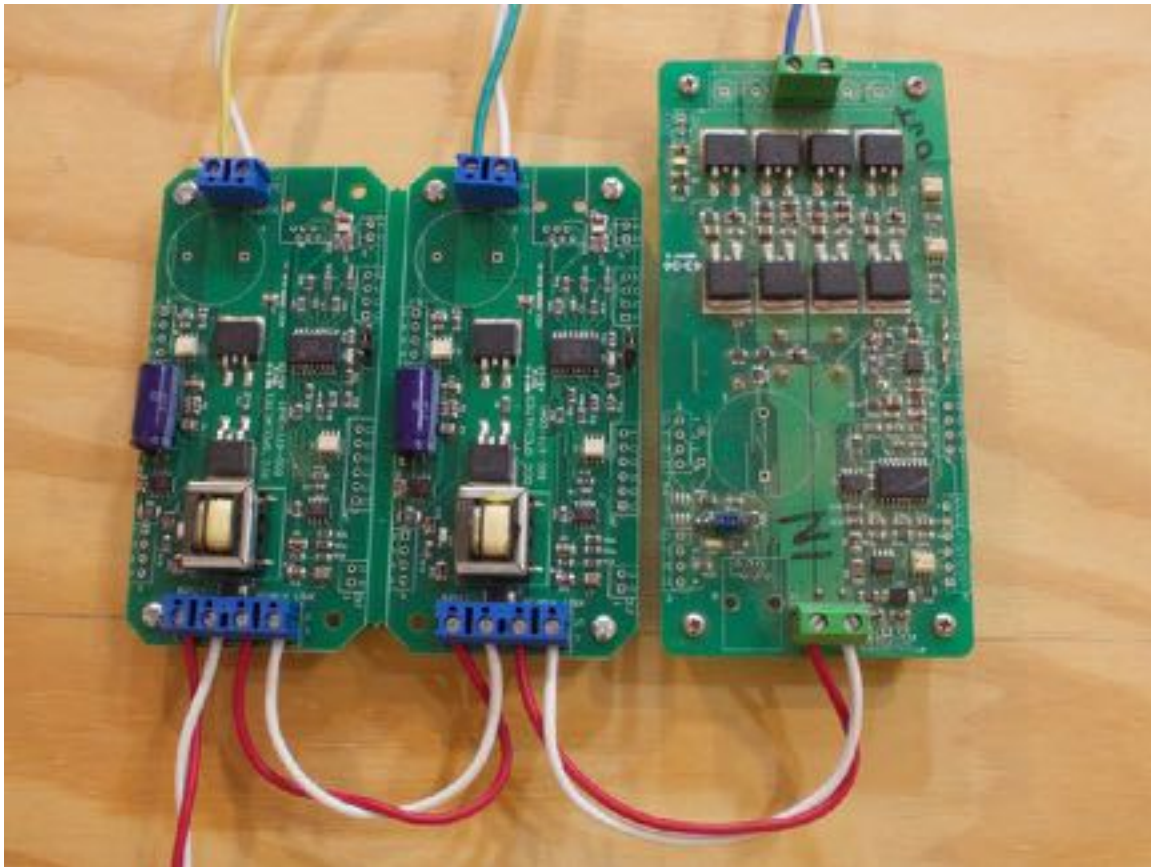
**4. The Hammond yard in the PCMRC ([pcmrc.org](http://pcmrc.org)) layout. This layout was designed for 7 - 10 operators at an operating session. It has 3 boosters and 19 power districts, each with its own PSx circuit breaker.**



One thing I didn't talk about in that column that has an effect on DCC design is the number of operators running at the same time [4]. More locos means more power needed. More operators means more cabs needed. But more insidious is that fun-to-operate layouts are broken into power districts where, as much as possible, every operator has his own power district. Thus, one operator's boo-boos don't bring everybody down. That takes some thinking to get right.

Isolating users will necessitate a circuit protector [5] per district. I discussed circuit protection in my November 2014 column: [model-railroad-hobbyist.com/magazine/mrh-2014-11-nov/di\\_short-protection](http://model-railroad-hobbyist.com/magazine/mrh-2014-11-nov/di_short-protection).

## 5. Two PSx circuit breakers and a PSxAR auto reverser as part of my Rocky Mountain Pacific railroad.



Some of the basics of layout wiring were covered in my third column for *MRH Magazine*: [model-railroad-hobbyist.com/magazine/mrh-2011-12-dec/dcc\\_impulses](http://model-railroad-hobbyist.com/magazine/mrh-2011-12-dec/dcc_impulses) — check it out for nuts-and-bolts information.

### How do I control my turnouts?

I know this isn't the first thing that folks think to discuss when they are planning a DCC layout, but it can be pivotal. Let's look at the ways to control turnouts:

**Ground throws** or other manual methods put no demand on the DCC system. They are difficult to use to route power for the turnout frogs, unlike many of the turnout motors (such as the Tortoise) that contain a switch that can adjust polarity for powered frogs.

**Servo motors** are becoming more popular, as the most cost effective method of electrical turnout control. There are even servo motors now available that

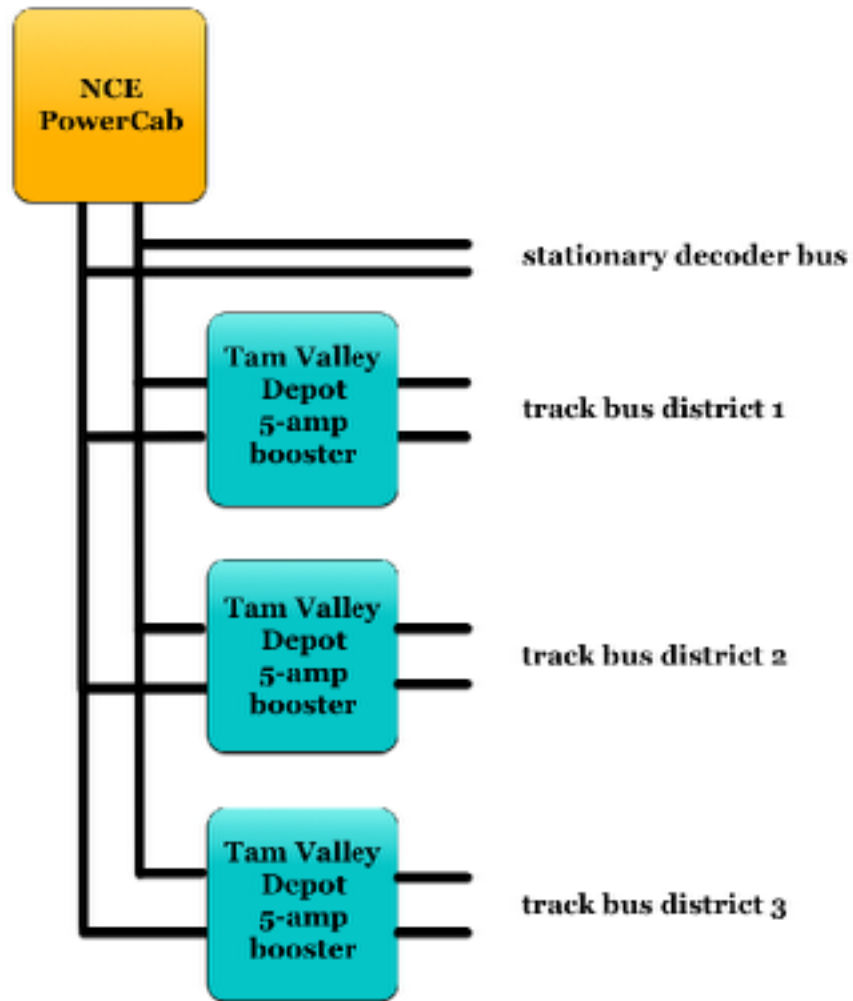
have 5-amp micro-switches mounted to drive signals or set frog polarity. Servos can be driven off an external power supply (removing their load from the DCC system) or decoders powered and controlled off the DCC system.

**Stall motors**, such as the Tortoise or Switchmaster, to name two, draw power (admittedly only 0.01 amp) when they are stalled at each end of their throw. They may draw a bit more when they are moving. Some stationary decoders can only be powered from the DCC bus. This will put the added load on the DCC system. Fifty Tortoise machines will draw (50 x 0.01 amp =) ½ amp from the DCC system. That's about the same as an additional locomotive.

Some stationary decoders allow external power input to avoid loading the DCC system with this overhead. This means one more set of wires to run around the layout.

For any stationary decoder, regardless of the type of turnout motor used, I recommend a “turnout bus” [6] coming directly off a booster to power the decoders in this situation. If you run a turnout, the track circuit breaker opens, removing power from the track. If the stationary decoder is driven off a bus that is still powered, it can be controlled. When the turnout is correctly set, the track circuit breaker can reset, allowing the locomotive to move.

6. Stationary decoders are best served when they come directly off a booster (or system box). Here I have used Tam Valley Depot boosters instead of a single booster and circuit breakers. Less expensive, but with nice performance.



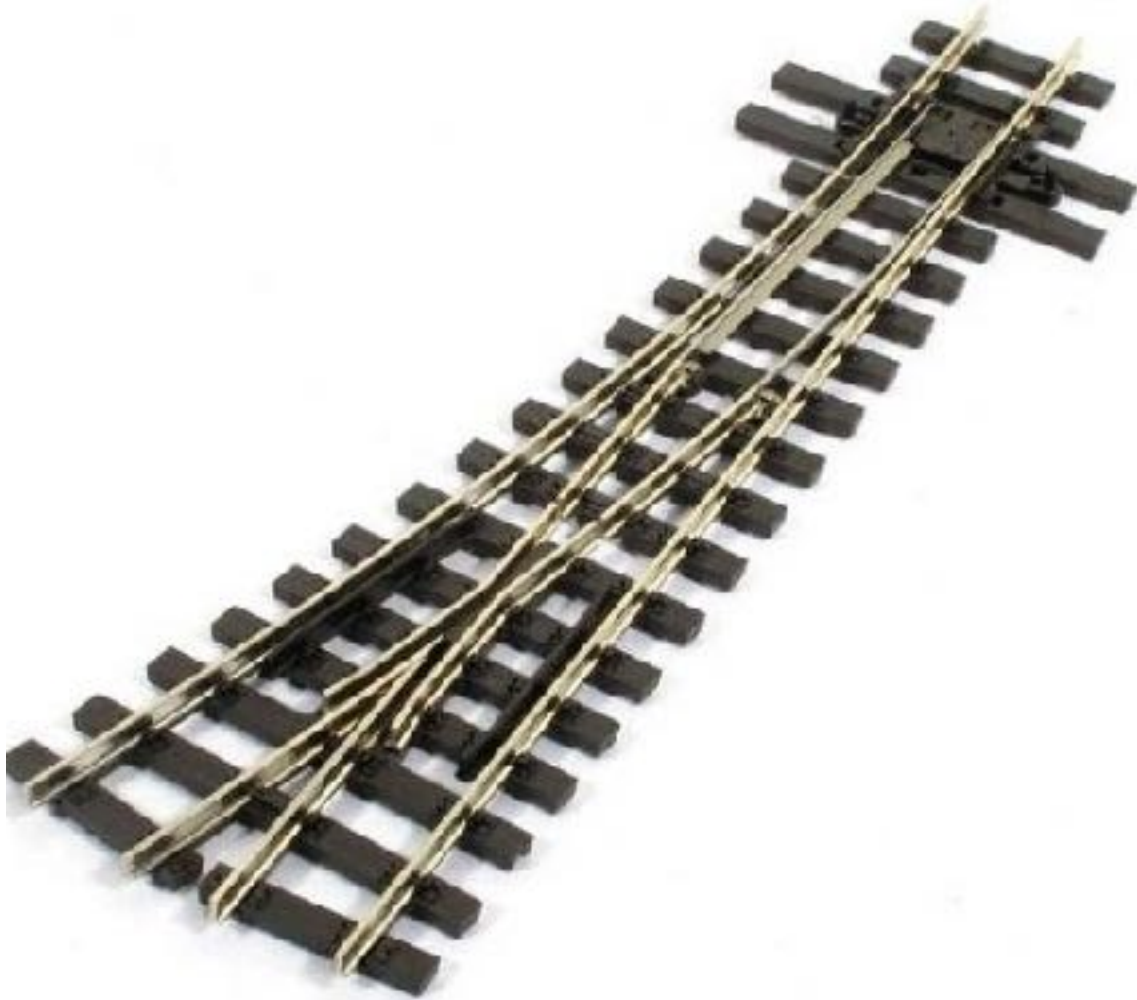
I devoted an entire column to stationary decoders in June of 2015: [model-railroad-hobbyist.com/magazine/mrh-2015-06-jun/di\\_dcc-stationary-decoders](http://model-railroad-hobbyist.com/magazine/mrh-2015-06-jun/di_dcc-stationary-decoders).

### What about turnouts and frogs?

There are two basic turnout designs: insulated frogs and uninsulated frogs. Peco calls them Insulfrog and Electrofrog, respectively. Model railroaders

tend to use these terms across multiple manufacturers' products, although the names really belong to Peco.

**7. Peco Electrofrog turnout. Note there are no insulating areas around the (v-shaped) frog area. Some insulation must be used in these diverging rails outside the turnout.**



Note: there needs to be some insulation in the frog area, or that V-shaped piece of track will create a rail-to-rail short. If the frog isn't insulated in the construction of the turnout, it must be as part of the installation of the turnout.

The concept of the insulated frog design is that, keeping the insulated section as small as possible, results in minimal loss of power. Notice I said, "minimal" not "no." There will be a power dropout. The effects of this are more noticeable with DCC than they are with DC. Some designs, especially the longer (#8 or so) turnouts, have contacts to connect power to the frog.

**8. Atlas HO code 83 #8 insulated frog turnout. Note the eyelet in the center of the photo, lower part. This is a connection to the insulated (black bands on each end) frog of the turnout. Connecting a TVD Frog Juicer or other polarity switch here keeps the long frog from becoming a dead zone.**



Uninsulated frogs result in longer “frog” sections. These may range from a fraction of an inch to several inches, depending upon where the installer chooses to insulate the rails. Thus, they almost certainly need some method to deliver power to the frog that switches polarity when the turnout changes position.

There are several methods to switch the polarity to the frog.

The most rudimentary is a switch, perhaps linked to the manual throw of the turnout, that sets the polarity. I’ve also seen folks mount a switch on the benchwork that is not tied to the turnout throw. In my experience, operators frequently throw the turnout without throwing the switch and resulting in a short on that section of the layout.

Many of the turnout motors, such as Tortoise, have a switch built in which folks have used to change the polarity of the frog. The issue here is that many DCC systems put out 5 to 8 amps into a short. The contacts on these

switches are usually rated for 1 amp. The end result is that frequent shorting on a given turnout may destroy the switch inside the Tortoise or other brand switch machine.

The most elegant method is to use a specialized autoreverser module that will sense the short and change the polarity of the frog. The most widely used version of this is the Frog Juicer from Tam Valley Depot ([tamvalleydepot.com/products/dccfrogjuicers.html](http://tamvalleydepot.com/products/dccfrogjuicers.html)). They are simple to wire: one wire to each rail and one to the frog. They are almost imperceptible in their operation. However, they are pricey, adding \$10 to \$15 per turnout.

Also, when DCC was in its infancy, track designers were less concerned with an occasional short between the rails caused by a passing wheel. The goal was to make the flange clearance as small as possible to enhance the look of the track. A lot of web pages sprung up with solutions for this shorting to allow DCC operation without hiccoughs. Modern (last decade) track has gotten this right and, for the most part, shorting is not a problem with newly designed turnouts.

One last thought about turnouts for this column. “Power Routing” was common in the DC world. This is the concept of turning off the power to, for example, a siding when the turnout was closed. I eschew this concept for DCC. One, there is no need to turn off the power to the track and, two, the points of a turnout are inadequate to carry the 5 to 8 amps that may be forced through them in the event of a short on the siding.

By the way, I refer to track pieces as “turnouts” to distinguish them from electrical “switches.” I apologize to my UK friends, I cannot get behind the term “points” to describe the entire assembly.

### **How much power do I need?**

This question comes in many forms: “Do I need another booster?”; “How much power do I need?; etc.

Probably from the Citizens Band “booster” amplifiers, there is a misunderstanding that the need for DCC boosters is related to layout size; driving the signal further along the track or bus. Not true. Adequate wiring will distribute the available power over long distances.

Booster power needs are dictated by what the layout (trains, stationary decoders, lights, etc.) are drawing from the DCC bus(es).

The first question to answer is: “What is the maximum number of locos that I expect to be able to move at any one time?” Multiply that number by the average or maximum (more conservative) run current for your fleet to know how many amps you will need for the locos.

If you are powering your turnout motors from the DCC system, add in the power that they will draw.

Add in for lighted cars, which can be as much as  $\frac{1}{4}$  amp per car.

Add in for lighted buildings or other electricity-consuming layout items.

Take this number and multiply by 1.5 to 2 to allow for future expansion and a safety margin. That’s the total amps you will need.

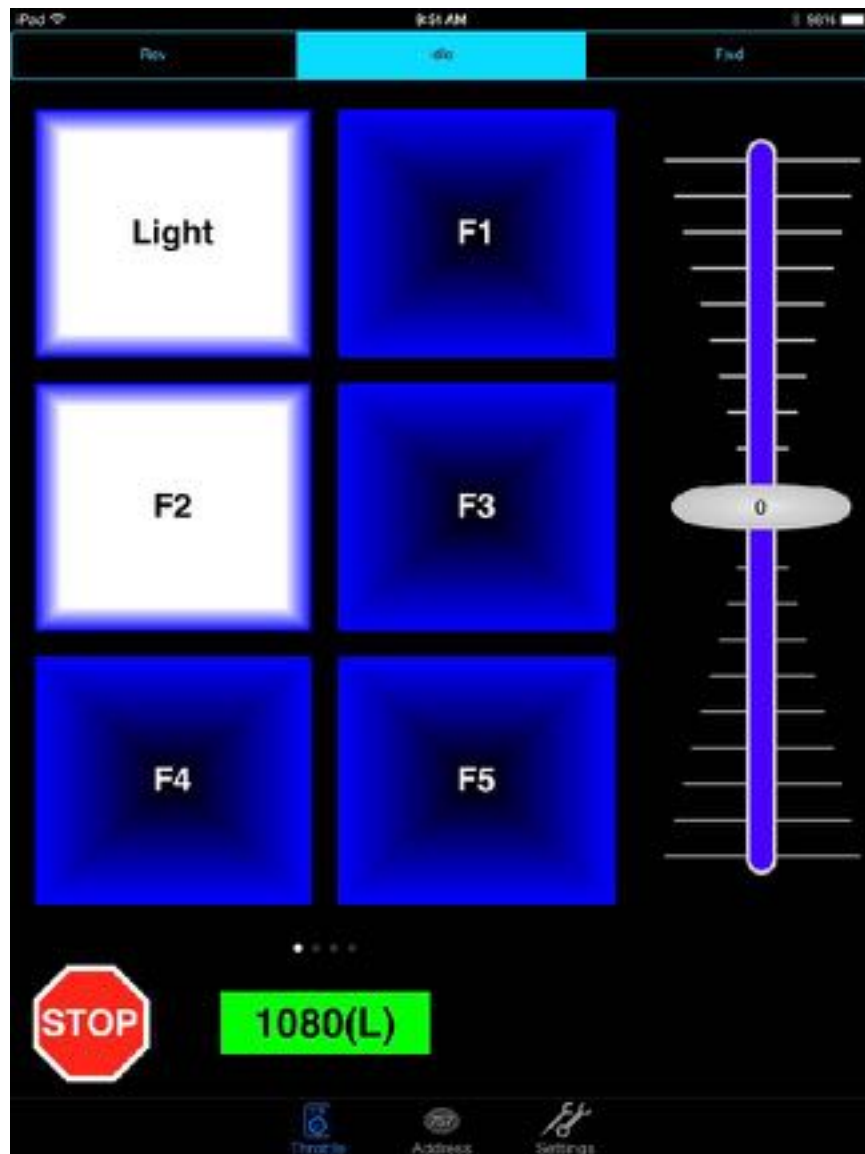
Divide this up into boosters and districts, as I previously described.

### **Do I use radio cabs?**

Not being tethered to the layout makes running trains more realistic. DCC has offered wireless options for many years. The mechanisms and features vary from manufacturer to manufacturer. Some options are radio and infrared (for areas where radio is not legal). There are even some cabs that will work with more than one brand of DCC system.

That said, the current trend for layouts that are designed for more than one or two operators is to using smart phone throttles via JMRI [9]. This is very popular with clubs. Saving, literally, thousands of dollars by not supplying radio cabs for the club members.

9. WiThrottle App allows connection between an iPhone and a DCC system through the JMRI suite of programs.

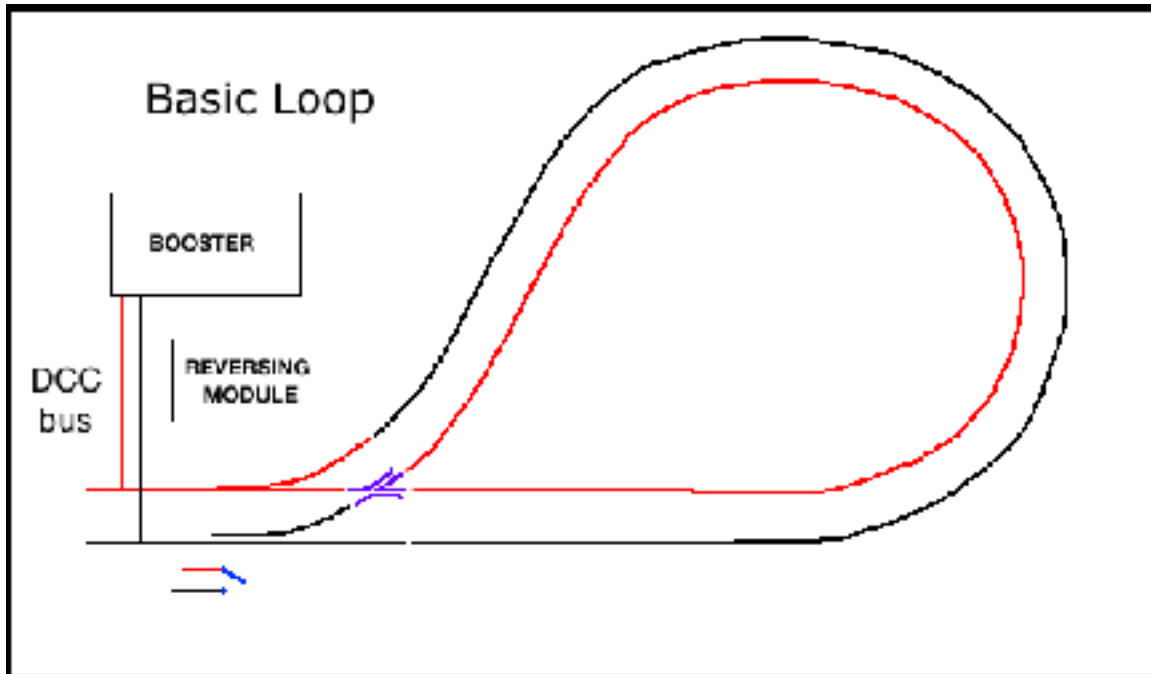


I understand the motivation of using phones, but I still favor knobs. However, any wireless cab is better than a wired cab.

### **What are the rules for reversing loops?**

I'll cover this quickly. Reversing track work includes loops [10], dogbones, and turntables. The track within a reversing section needs to be longer than the longest consist you plan to put through it. A quality autoreverser will help make the running through the reverser fun, not a hassle.

10. A basic reversing loop. In real life, these can become much more complicated. Note the function of a Frog Juicer as shown by the (blue) switch connected to the (purple) frog.



I recommend the gaps (both rails) for the reversing loop be staggered a fraction of an inch to several inches [11].

11. Insulating gaps (yellow) on both rails of my garden layout. Note the about 4 inch stagger between the two rails.



For more information, check out my January 2015 column: [model-railroad-hobbyist.com/magazine/mrh-2015-01-jan/di\\_dcc-reversing-loops](http://model-railroad-hobbyist.com/magazine/mrh-2015-01-jan/di_dcc-reversing-loops).

This isn't comprehensive, but hopefully this quick trip through some details will inspire folks to move on with their DCC implementation. We'll be discussing issues on the blog for this column. Please share your ideas with us all. I'd love to hear what you think. 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.