Model Railroad Hobbyist

DCC IMPULSES

column

BRUCE PETRARCA

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DCC Garden Wiring Tips

This month I'm going to share the experiences I've had wiring my Rocky Mountain Pacific (RMP) garden layout. While I am using DCC, many of the issues dealt with here will affect any track-power layout in the garden and, to some extent, any DCC layout. There should be something for everybody in this column.

1. My desert oasis as I'm wiring the layout in May 2015.

I'm in the desert southwest of the U. S. A. Things that work or don't work for me may or may not be part of whatever you are or need to be doing. Different climates and soil conditions can affect how one goes about garden railroading. I'm hoping that this column will trigger some discussions from folks who work in various climates. Please share what works for you. Just click on the READER COMMENTS button above or at the end.

Long term readers know that I don't publish what I haven't done. I've been suggesting ideas for garden railroaders since I owned Litchfield Station, based on theory. Now I've gotten a chance to wire my own layout and can now speak from personal experience. While the basic advice hasn't materially changed, but I now have some tips to share.

The basics of DCC layout wiring were covered in one of my early MRH columns. Now would be a good time for you to go back and review that column before moving on to the special challenges of garden railroading.

Where I'm headed

Part of the planning portion of any model railroading adventure for many is the "givens and 'druthers." I won't belabor mine here. The most important one to the subject at hand is that I want to use DCC track power on a narrow-gauge Fn3 layout. The goal of the layout is realistic freight and passenger operations, not roundy-round running. The short narrow-gauge trains and the need to switch out all the cars on the train preclude any battery-car form of operation.

2. Here is the RMP Shay dreaming of running above Telluride

From prior layouts, I had enough brass track for my new version, so, that is what I'm using. To achieve adequate performance with the brass track, I plan to experiment with some form of hybrid-drive, where the track power trickle charges a small on-board battery to sustain motion over dropouts of track power. This is ***Stayin' Alive*** on steroids. Perhaps I'll do a future column on this concept.

Setting the standard(s)

Whether one realizes it or not, layouts are built to standards. They may be rigid and formal or not. I find that more formal standards tend to make for more consistent results.

I wrote down a set of electrical standards as I began the layout. Along the way, I modified the written standards. Not to say that everything on the layout completely complies with the final written standards, but the layout is more consistent than it would have been absent a written goal.

Here's what I have for standards as I'm finishing up the wiring:

1. All connections to the bus are soldered.
2. All connections to the track include a soldered terminal, stainless screw and star washer and are coated with anti-corrosion fluid, such as Never Stall.
3. All power districts are protected with electronic circuit breakers.
4. All rail joiners are Split Jaw clamps and the electrical interface is covered with anti-oxidant grease, such as Ox-Guard.
5. Every piece of track will connect to the bus at one end or the other, using the Split Jaw rail clamp screws.
6. Where the track connects in a loop, the bus will not close the loop, but will be open at the far end of the loop.
7. Wiring size conforms to table [3] for maximum length of run vs. AWG
8. All gaps are offset rail-to-rail a few inches or more
9. The yard will be fed off two separate buses (one for each pair of tracks), connecting to the main bus near the yard throat

3. Recommended maximum DCC bus length vs. AWG

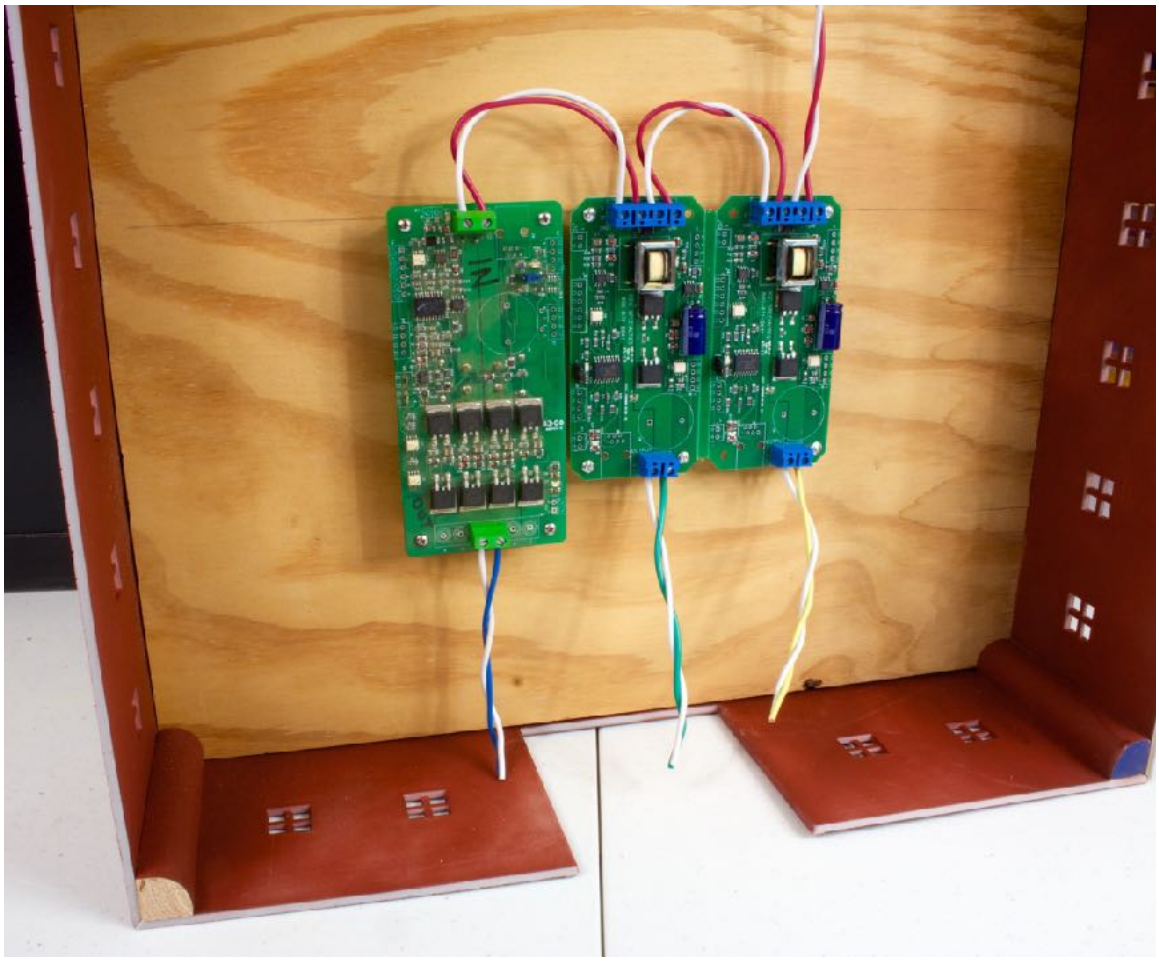
AWG gauge	Maximum Length feet
12	50
14	31.45
16	19.77
18	12.44
20	7.82

Bus design

I'll be using an NCE 10-amp radio system. The layout is divided into three districts: the inner loop, the outer loop and a combined wye and teardrop reversing section. Per standard three above, the booster will feed two PSx circuit breakers and one PSxAR combined auto reverser and circuit breaker.

These electronic modules will be inside a barn [4].

4. Electronics in a barn viewed from the bottom - wires are just for testing and do not conform to the color codes used in this column - an 8-pin connector will be added.

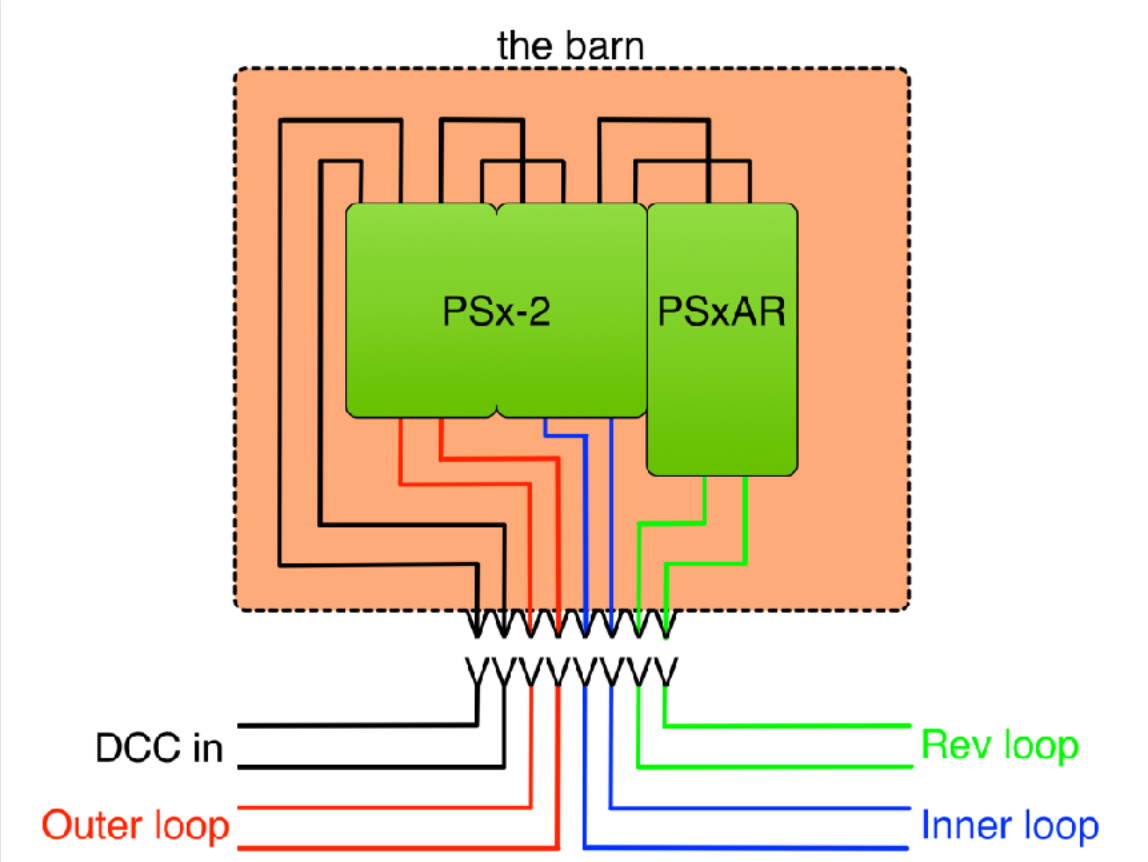


I added a plywood floor for the loft and the electronics will mount there. Using an 8-pin Cinch Jones connector, the barn will plug into a socket slightly above ground level.

A dummy plug inserted into the socket will keep it clean and dry when the barn is not in place. The barn can be brought inside, along with the other DCC electronics, when not in use. The dummy plug will connect all three track buses to the booster,

so that trains can be run on most of the layout without the barn in place. The limitation is to stay off the green wye area. The green part of the outside loop is fine, just not the teardrop.

5. Block diagram of RMP wiring



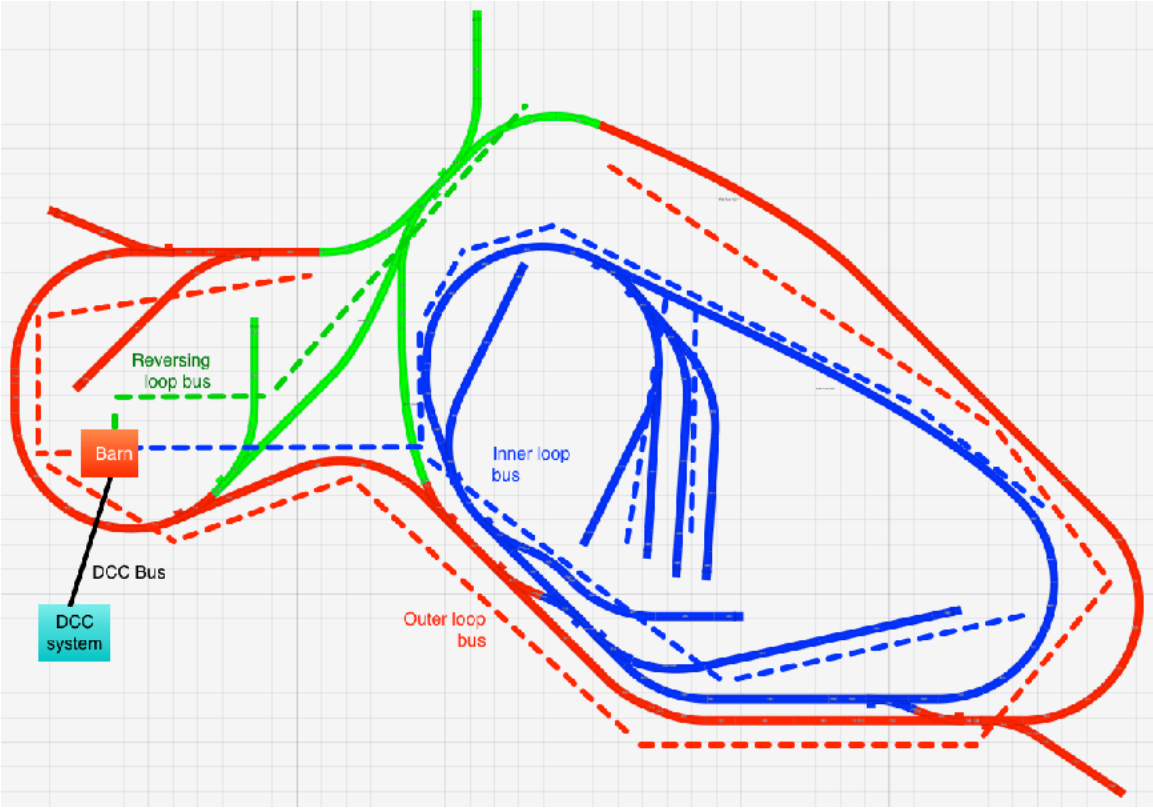
The electrical block diagram is shown in [5]. There are three buses radiating out from the barn, as shown in [6].

The auto-reversing (green) bus covers the middle left section of the layout and breaks the outer loop into two convenient sections.

The outer loop bus (red) runs clockwise a short distance from the barn and then counter-clockwise for the rest of the outer loop.

A (blue) bus comes from the barn directly to the inner loop, where it splits. Each side goes half way around the loop, with no connection on the far side. The buses that feed the yard beak off the loop bus and follows the yard.

6. RMP Track plan, showing the three buses (dashed lines) emanating from the barn and DCC feed (black) coming into barn



Gaps

One of the keys to multiple DCC districts is effective and reliable gaps in both rails. With the expansion and contraction in the garden, keeping these gaps is more difficult than it is inside. Here in AZ, we see track temperature running from just below freezing in winter to 160˚F+ (72˚C+) in summer.

I used the ugly yellow LGB insulators, as they meet the physical requirements that I want. They will be painted with flat brown Krylon paint when I'm done with the wiring and testing. I've used Earth Brown Krylon Camouflage Paint on my track to cut down the bright brass look and make the ties from several vendors the same color.

All gaps are off-set rail-to-rail. Some by a few inches, some by a foot or more.

7. Rail Gaps on the RMP before painting the yellow joiners. Note: black plastic strip screwed to ties to hold gaps together. Note, also: black feed wires connected to Split Jaw clamp with stainless steel socket head screws.

Track wiring

I installed the track and began testing two years ago. During the intervening time, I've been running each of the three sections of the layout with only one feed point. Yes, there were some areas became, as the rail joints began to weather. But it did run okay with one feed per district for a while.

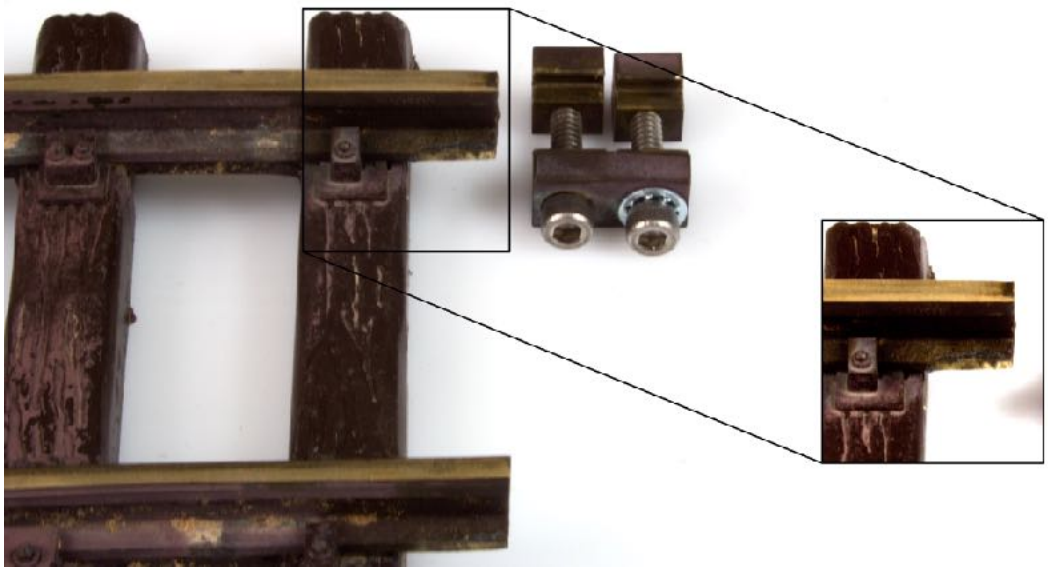
Now, in the final wiring, I'm going for bullet proof. The goal is to have every piece of track connected to a bus. Okay, I admit that there are some sections (usually under 6

inches long) that don't get fed from the bus and rely on power feed from adjoining sections. If they act up, I'll add a power drop to them.

This doesn't mean that I connect the bus to every clamp, just every other one. The rails to both the right and left of the clamp get fed from that clamp.

I'm using high-conductivity brass track that has a cross-sectional area larger than most DCC bus wire. Why the need for so many drops? Well, what the track gives, the rail joiners take away. They only clamp the sides of the rail base. The greatest area of common connection is between the clamp and the bottom of the rail base. This is an area where moisture, corrosion and salts can accumulate, none of which is good for electrical conductivity. Opening up the clamps to add a power drop shows a pretty badly oxidized connection after two years outside.

8. Weathered rail and clamp surfaces after two years in the desert garden. Note in the insert: the small area where the rail clamp keeps the base of the rail clean. That, plus the bottom of the rail, is all that conducts across clamps.



So, I added a standard (#4) to do the joints differently. Now, in addition to polishing the areas of contact between the rail clamp and the track before assembly, I'm coating the mating surfaces with Ox-Guard. This product is available at home improvement stores, hardware stores and online at Amazon (http://www.amazon.com/dp/B000BODU66). This specific part number is a Gardner Bender product designed for electrical connections where aluminum and copper wire meet. My goal is to keep water and salts out of the joint, while keeping it conductive.

9. Gardner Bender Ox-Guard - one ounce tube. Photo from Amazon

For feeders less than a foot long, 18 AWG wire is perfectly acceptable, per table [3]. Black lamp cord from the home improvement store is what I used. I used ring terminals designed for this wire gauge - the red sleeve is used to identify them in the U. S. A. They fit nicely under the 6-32 machine screws on the Split Jaw clamps. I removed the red sleeve by gently pulling on it before I soldered the wire. This makes for fewer colors to hide on the layout. I cut the lamp cord to one foot long sections and soldered the terminals to them [10] on the workbench - so much more comfortable than working on the ground outside. I did not crimp the connections.

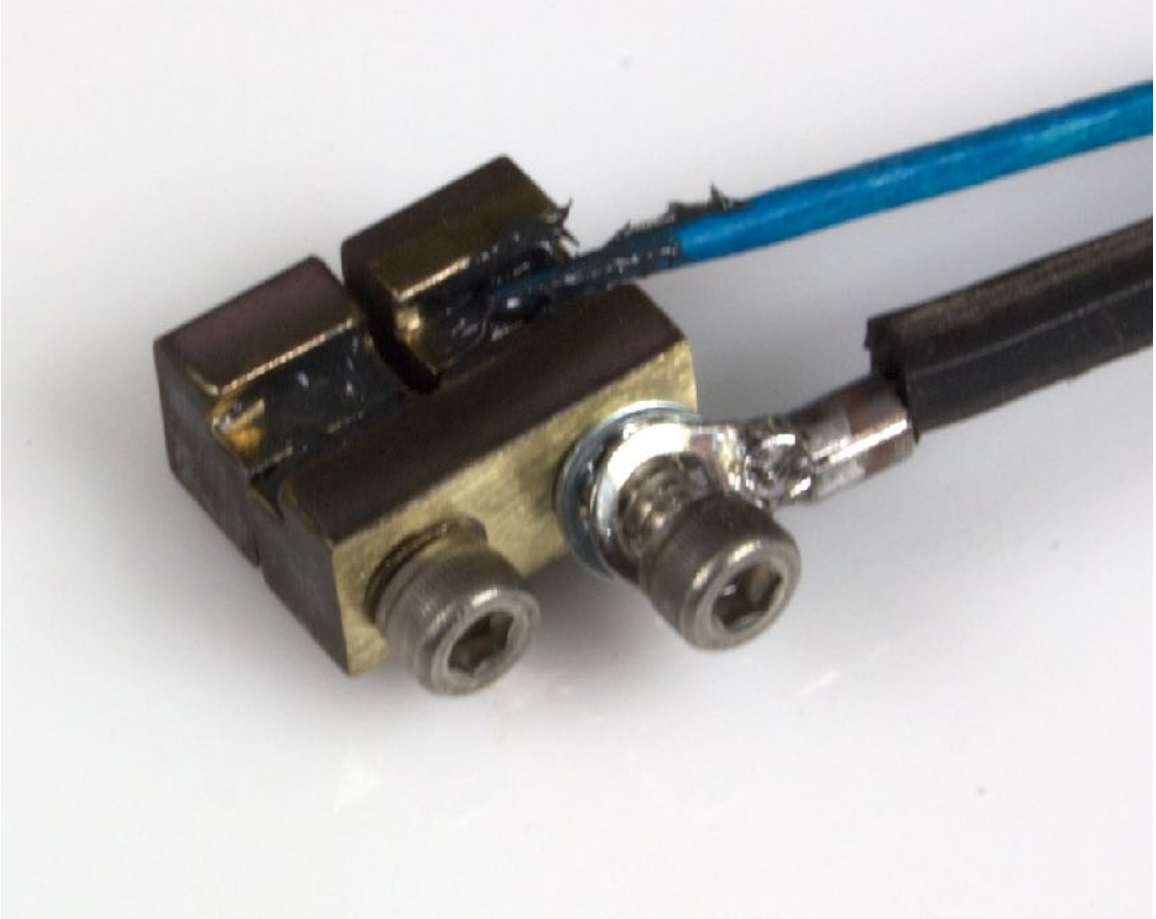
10. Ring terminals for 18 to 22 AWG wire (red sleeve removed) soldered to foot long 18 AWG drop wires

Now for the connection to the track. I like the Split Jaw (http://www.railclamp.com) clamps, but find that the steel screws supplied with them bend when I apply the amount of clamping force that I desire.

So, I replace the screws with 6-32 x ⅝ inch stainless steel socket head machine screws (SCS0610) from MicroFasteners (http://www.microfasteners.com). I also use a #6 internal tooth lock washer (MicroFasteners LWT06) between the ring terminal and the Split Jaw clamp. This lock washer bites into each side a bit and helps with conductivity. I build the assembly [11] and use a toothpick to spread the Ox-Guard on the mating surfaces. I apply Never-Stall to the area in the connection where the brass clamp, stainless screw and plated steel lock washer meet.

Connect the feeder wire to the track by installing the clamp [11] to join two sections of rail together.

11. Connection of the feed wire to the Split Jaw rail clamp - note Ox-Guard has been applied to the mating surfaces with the blue toothpick, shown.

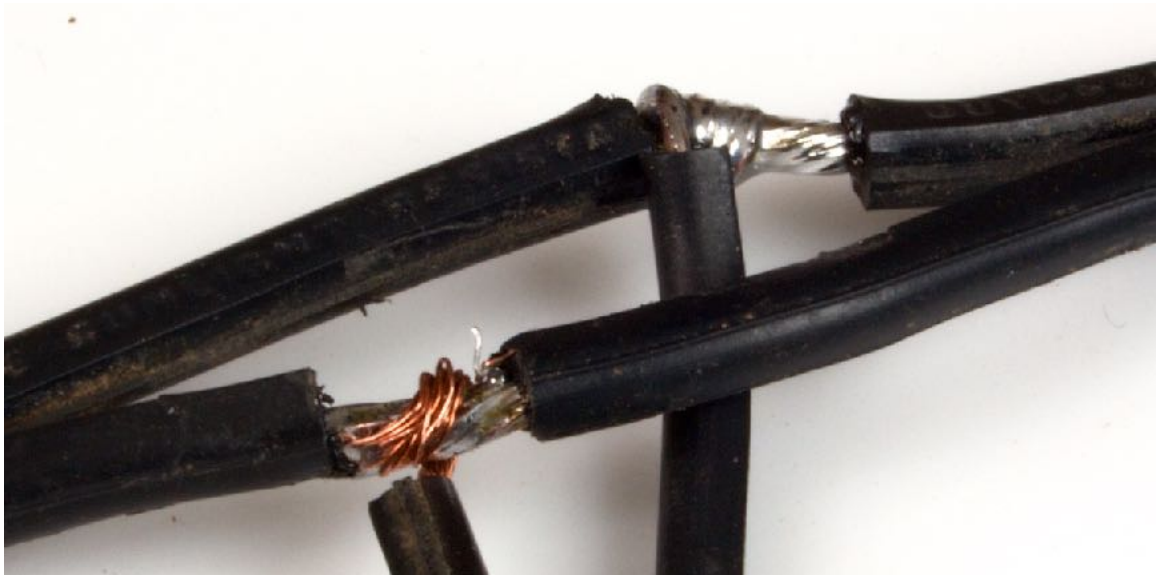


Bus Wire

From table [3], 12 AWG wire was selected for my bus runs, as they are all less than 50 feet. Larger layouts may require larger wire: 10 AWG, or even 8 AWG. Home improvement stores sell double stranded “landscape lighting wire” in several appropriate sizes. This is designed to be buried and to carry high amperage at low voltage (30 volts or less), just like track power, DCC or DC. They have very thick, black insulation and are resistant to chafing.

I do not recommend solid wire in the garden. The landscaping wire is stiff enough as is. Solid wire will be a bigger challenge to keep buried.

12. Connection between drop wires and bus wire. Two joints are shown in the photo. In the upper right is a completely soldered one - note the bright and smooth surface, indicating that enough heat has been used. In the lower left, is a drop wrapped around the tinned bus, ready for soldering.



Splitting the two wire cable allows for room to strip the each wire a bit apart from the other. I use the wire strippers (discussed in the Tools section later) to cut through the insulation. Then I use a set of fine cutters to remove the insulation, being careful not to nick any of the strands of wire.

The bus is tinned before the drop wire is wound several times around the bus wire and soldered [12].

Insulation

I don't insulate my joints. I just bury them. Remember, I live in the desert and the first few inches of unirrigated soil are pretty dry most of the time. There may be a day or two where the electrical leakage through the soil might keep me from running. However, my garden will not be fun to walk in when the soil is that wet, anyway.

So this is one place where I cannot recommend other options from personal experience. If I were in almost any other climate, I'd be looking for a way to insulate the joints. Perhaps a liquid electrical tape or some conductive grease filled shrink tubing. Ideas, anyone?

Tools

As in all endeavors, tools and supplies [13] are what makes the job easy.

13. Some of my tools and supplies for wiring in the garden spread out on a cheap white towel to keep them clean and help me find them in the dirt of the garden.

I use wire strippers that have specific sections sized by wire gauge. For this sort of wiring, ones that cover 10 AWG solid to 22 AWG stranded fill the bill nicely. The Tekton 3797 (http://www.amazon.com/dp/B00AZWWY2K) is similar to what I used.

An end cutting plier (the black handled one at the top center of [13]) is very handy to split the landscape wire to allow the strippers in to make their cut(s).

K & S Engineering make two inexpensive soldering irons - in the $10 range. I tried to use one to save carrying my soldering station outside. The result was a bunch of cold solder joints. To remedy the situation, I brought my (expensive) Weller WTCP51 60 watt thermostatic soldering station with a broad tip rated at 800˚F (PTD8) outside. Much better results followed.

The slightest breeze will suck heat away from the joint. So, an abundance of heat is needed and, perhaps, some windscreen to reduce breezes. Don't even try to solder in cold or very windy or rainy conditions.

To clean the weathered track base and Split Jaw clamps, I use a wire brush. The most convenient is a Dremel 535 brass wheel brush in my battery powered rotary tool. I tried an inexpensive similar looking unit. It came in a pack with four other brass

brushes from an online discount tool store. They rate their product for 2500 RPM maximum. I found out why. Even as slowly as my tool could go, the vibration was horrendous. They don't seem to care about balancing the wheel and the stress on the bearings was unbelievable. Stick with the good wheel here. Actually, they are a consumable. I used up several wiring the layout this time - part of the reason for the try at the less expensive version. Use safety glasses, as the little brass wires come out of the tool, as well as debris coming off the track and clamps.

Soldering

The intent here is not to teach you how to solder, but point out some issues that arise when working outside on large wires. A web search brought up a web site that has a pretty good tutorial, including some videos: http://www.aaroncake.net/electronics/solder.htm . There are a myriad of them out there so you can find one that speaks to you.

It is essential to use products designed for electronics: rosin core solder and rosin flux. Plumbing products, such as wire solder and acid paste are a no-no. The recent financial trouble at Radio Shack has removed many local sources for products aimed at electronics. There are always online sellers.

14. Butt splice in bus wire. Lower left has been wrapped with smaller solid wire and soldered - the ends of the smaller wire will be trimmed. The upper right one is wrapped, ready for soldering.

Folks who follow my column know that I eschew solder flux. But you see some flux with my materials [13]. The garden is one place where I keep it at hand. Once wires spend some time in the weather or in the ground, they tend to oxidize even inside the insulation. There is not enough flux in normal solder to overcome the oxidation.

So, when I cut into the insulation and find that the wire is black, I apply flux and tin the wire before I move on. It may take an excess of solder to penetrate the oxidized section and get the solder to flow into the strands. Be sure to shake the excess solder off while it is molten.

Key to reliable wiring is having a good mechanical joint before soldering. The smaller drop wire can be wrapped a few times around the bus wire. For a splice in a bus wire, stagger the joints [14] and make a butt splice. To make a good mechanical joint, wrap a bit of solid wire (18 AWG or so) around the overlapped, tinned wires and solder.

Sharp eyes will see a buzzer and a bit of track amongst my tools [13]. This brings up the issue of color coding. While I promote color coding for indoor layouts, I don't suggest it in the garden. Rather than trying to keep wires straight, I fall back on my buzzer. I put the buzzer across the bus and wire the track. Once the first drop is wired, the bit of rail can be placed across the track to make sure buzzer is connected and functional. With following drops, a quick touch to the bus wire will tell you if you have the correct one (no buzz) or the wrong one (buzzer sounds off).

There was lots of fun stuff to cover this month. 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. Again, this entire column would qualify.