



## About our DCC columnist



**Bruce Petrarca** is a well-known expert on all things DCC.

[Click here](#) to learn more about Bruce.

# DCC Impulses: Wired Decoder Installation Part 1

## Planning the Install



## Don't heat up the soldering iron yet!

In last month's column I approached layout wiring from a bit of a philosophical viewpoint. Starting this month I'm going to analyze wired decoder installations in a similar fashion.

If you don't plan to hard-wire some decoders in the near future, you may want to skip this column and next month's and we'll see you in March!

This column deals with what I find works best for me. These techniques have lasted for years. There are other ways that work, too. But folks also do a lot of things that don't stand the test of time.

If you read what I say and feel that I'm over the top, you are right! In my prior life I worked in the computer and aerospace industries. Reliability was job #1. That's just the way I'm wired. It only takes a bit more thinking and work to have a really reliable installation.

This column will deal with the tools, supplies and some basic concepts that will help your installations be more

successful. Next month I will discuss specific loco types and their needs.

## Skills

You need to be able to take your loco apart and put it back together and have it work. If you have not successfully torn down and reassembled an engine, I suggest that you try that first. If you can get it apart and back together and have it run well and quietly, then you have the skill and experience in that area to tackle an installation. A thought: why not clean and lube it while you are inside it?

Next, consider your electronic assembly skills. Have you successfully cut, stripped and soldered very small (30 AWG – 0.255 mm diameter) wire? If not, then practice until you are comfortable with this skill before you tackle your prized loco. Decoder wire is available from Digitrax or TCS through your DCC dealer. You will want some for your installations any way!

Depending upon what type of decoder you are installing, you will be shrinking tubing or soldering to contacts on circuit boards or both. Why not practice these skills in advance, too? You can get copper-clad boards from electronic surplus stores for a few dollars. Great practice material!

## Tools

Since you are working on an electronic project here, consider only

tools or supplies that are sold by an electronics store, like Radio Shack, or from a DCC supplier. While building Litchfield Station, when I found a tool that worked well for me at a reasonable price, I put it in stock! You may want to look in Litchfield Station's Tool Crib and Supplies category to see what they are still stocking!

Tools make the job easier. In addition to your normal modeling tools, you will need some specialized electronics tools. While you may not need all these tools and supplies for every installation, they will make most installations easier.

With some careful buying, you can equip yourself with the basic tools for about \$150. However, if you are planning on doing a lot of installs, the tool bill can run appreciably higher.



**Figure 1:** My dirty, old wire strippers are Klein Tools #11047 – specifically designed for 22 AWG to 30 AWG wire.

But, that covers tools for daily use for professional installation work in many scales. I estimate the replacement costs of my tools at about \$4000.

I like:

Wire strippers designed for the small wire found on decoders are essential, in my view. One of mine is shown in figure 1. Adjustable strippers just don't work well, especially on small wire.

Small (4 to 6 inch) needle nose pliers

Small (4 to 6 inch) wire cutters

Tweezers – I like one set with a curved tip and another with a broad tip, in addition to the normal fine point model. I use all these in my general modeling, but really like them for installations.

A soldering station designed for electronic work. **Do NOT use** a soldering gun or large iron! Adjustable or fixed thermostatic temperature control will help. Otherwise, a 25-watt range soldering pencil will do. These units can run from \$25 to well over \$100. I recommend the smallest tip that you can get for your particular iron. Personally, I use a Weller WTCPT soldering station, as shown in figure 2, with a PTS8 tip. This setup is priced toward the high end, but is thermostatic and durable.

A foam cradle helps to protect the shell when you take your loco apart or are working inside the shell. Its use in a recent install is shown in figure 3. Bowser makes them in N-, HO- and O-scale sizes. I often use a size for another scale, as it may work better for what I'm doing. For example, just



Figure 2: The Weller WTCPT soldering station I use. A less expensive unit would suffice, as long as it has a sharp tip (Weller photo).

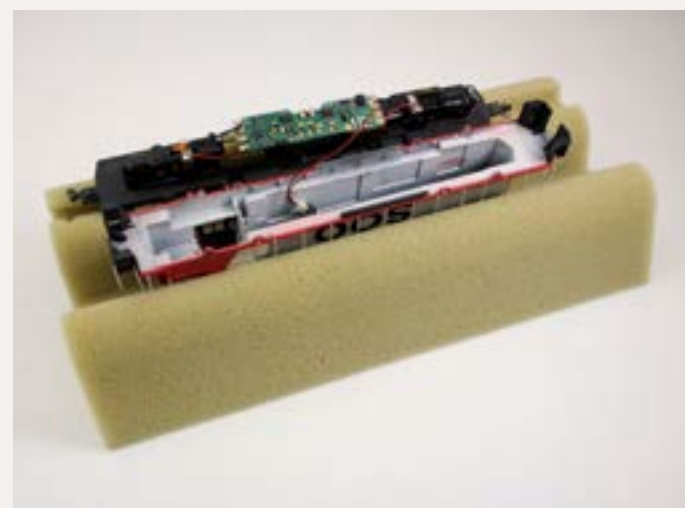


Figure 3: A foam cradle helps to protect your loco shell when you are working on it.

yesterday, I had a G-scale Dash 9 in the O-scale cradle.

Clamping tweezers help hold wires while you solder them.

Heat gun to shrink tubing – I use a unit designed for heating embossing powders. I bought it at a local craft store where it sells for about \$25. Local craft stores run 40% off coupons in the paper, so the price was VERY reasonable.

Volt-ohm-meter – this may be an analog or digital unit. They are frequently called VOM or DVM. Look for one with a low ohms scale (200 ohms max) and a high DC current scale (10 amps max). I use a Velleman DVM850BL, which is widely available for under \$20.

Dremel tool (with cutoff wheels and sanding attachments) for light machining and (with a brass brush) for wheel cleaning.

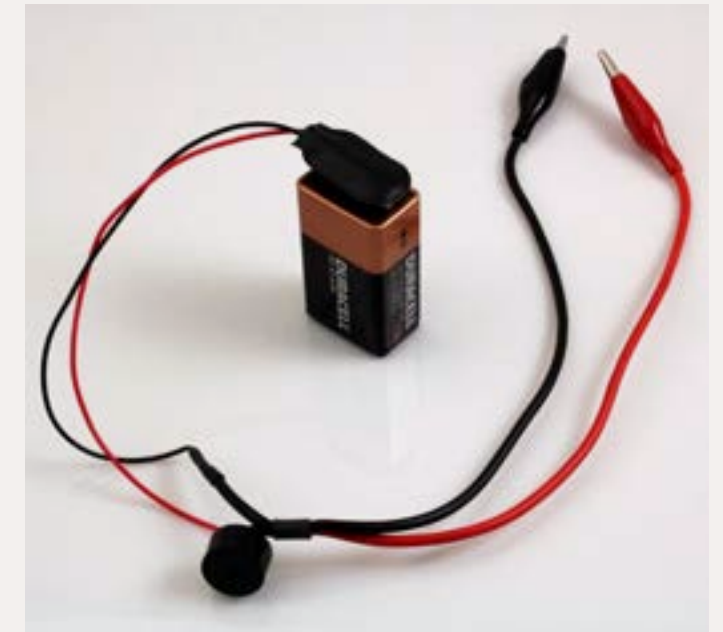


Figure 4: My very useful home-made buzzer.

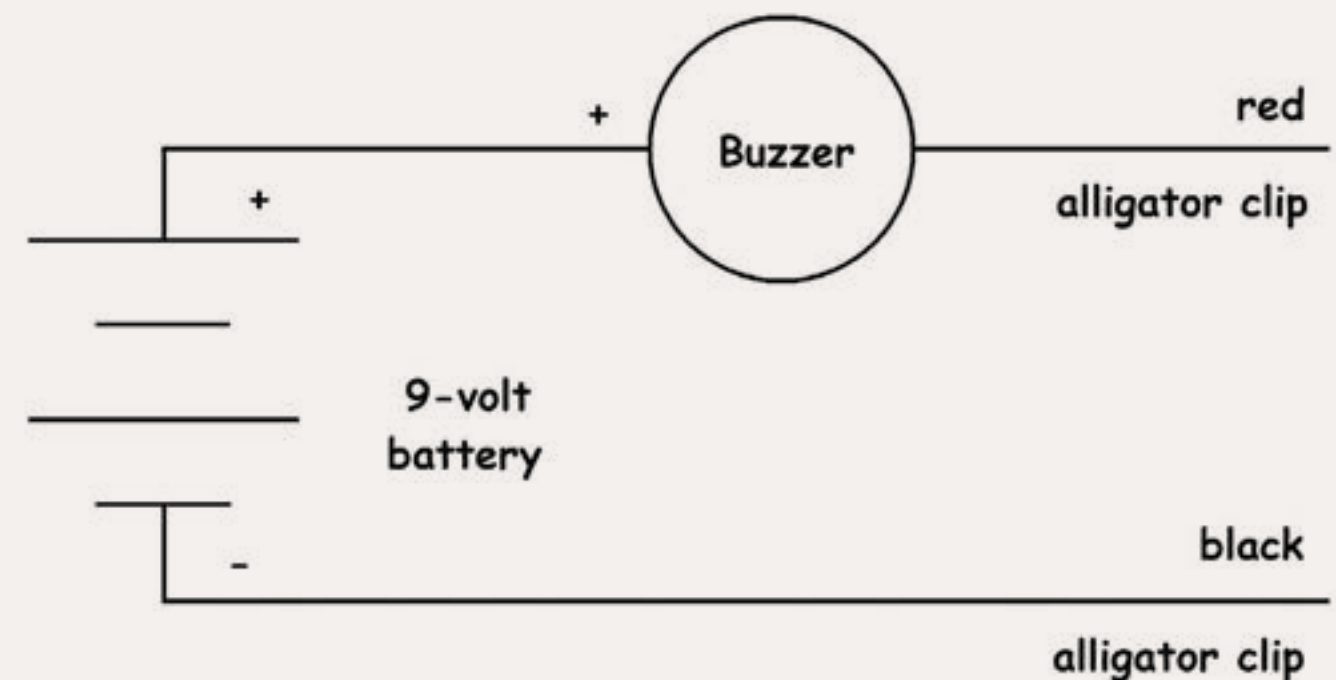


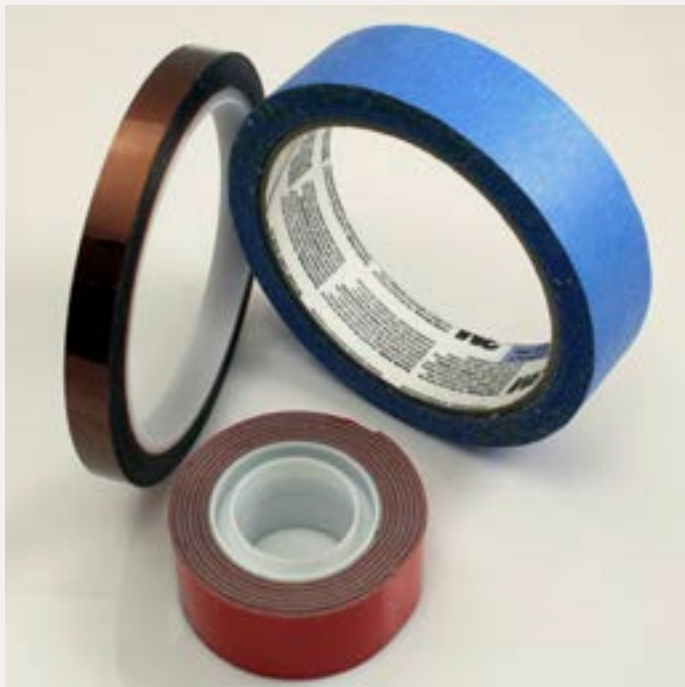
Figure 5: Schematic for my buzzer.

Buzzer – I have a buzzer that I bought from a surplus store wired to a 9-volt battery and a set of alligator clips as a continuity tester. My DVM has a buzzer setting that works in a pinch, but is very quiet, so I use my little buzzer frequently. You can see its simplicity in figures 4 and 5 previous page.

End Mill or Belt Sander – One or the other or both are needed if you get into some installations that require reducing the size of the loco weights to make room for the decoder or speaker(s).

## Supplies

In addition to the tools, you will need some supplies. For safety, don't buy any of these supplies from a hardware or home improvement store. Many of the things they sell are for plumbing



**Figure 6: Tapes that I use. Kapton and Gray stay in the loco when I'm done – the blue comes out!**

and have acid flux – which is damaging to electronics! Again, an electronics store or your DCC supplier is the place to shop!

Solder – I like 60/40 solder with rosin flux imbedded. The trend today is away from tin-lead solder. I find it harder to make a good connection with the more expensive lead-free solders. So, I recommend you buy the traditional solder while you can. Get the smallest diameter solder you can find. Smaller makes for better control of the quantity applied. My favorite is 0.022 inch (0.56 mm) in diameter.

Shrink Tubing – the cleanest and simplest way to insulate your connections is with shrink. I use a collection of sizes from 3/64 to 3/16 inch, with 3/64 and 1/16 being the most commonly used.

Kapton Tape – this is MIL-SPEC insulating tape. Kapton is a Dupont trademark. The tape is semi-transparent yellow gold, as shown in figure 6. I use the 0.001-inch thick version in three sizes from ¼ to ½ inch wide. It isn't very sticky, but it does hold. It won't break down with heat. I demonstrate that by putting some tape on a ceramic tile. Then I build a pool of molten solder on it. When the solder cools, I knock the blob off and clean the residual flux with denatured alcohol. There won't even be a mark where the solder was. If you can only have one width, go with 3/8 inch for HO-scale and ¼ inch for N-scale.

Double-sided (gray) tape – 3M Scotch 4011 Exterior Mounting Tape is its official name. It has a red backing as seen in figure 6. Other brands may work. I have only used Scotch and it is reliable! This double-sided tape is what I use to stick decoders down. The "life test" for this came with a G-scale installation I did a few years ago. I installed a NCE D808-SR decoder with a 30-amp stall rating into a USA GP loco. The loco ran outdoors in the Phoenix area for about a year. Here the internal temperatures push 200°F in the summer. The decoder output transistors toasted themselves. When I removed the decoder the clear shrink tubing over the transistors was black from



**Figure 7: Caulk is one of my favorite adhesives; I use it for more things than I can count, as you can see by this folded, almost empty, 6-ounce tube.**

the heat. The gray tape next to the toasted shrink-wrap was unfazed!

Masking (blue) tape – this painters' masking tape is shown in figure 6. It is what I use as a second set of hands to hold things in position while I work. I recommend against the brown version, which leaves too much residue behind. **Do not leave this tape in the loco when you are done – heat and time will make it VERY sticky.** The only tapes I leave in a loco are Kapton and the gray tape.

Caulk – nothing fancy, just clear bathtub and tile caulk to use as an adhesive when you stick something that you may want to remove later. I use acrylic caulk instead of the more expensive silicone – nothing to be gained by spending more money. I have the most experience with the Polyseamseal brand, as shown in figure 7. Buy a small (6 ounce) tube, not a caulking gun sized cylinder unless you are planning lots of layout work or have other needs.

Denatured alcohol – in addition to doing a bang-up job getting gunk off wheels, it cleans up solder flux very well! Get it at a home improvement or hardware store.

Decoder wire – Yes, many decoders come with wire. However, there are times that it helps to have (30 AWG stranded) decoder wire in stock. Keep at least the colors that conform to the basic DCC standards: black, red, gray, orange, blue, white and yellow.

Digitrax makes a kit of all nine DCC standard colors. TCS sells individual colors in all the DCC standard colors and a few more.

Flexible wire – I find it very helpful to replace the wire to the trucks on many locos. The factory wire is frequently stiff enough to hamper the motion of the trucks. It also breaks easily. I also use it between steam locos and tenders. I use 29 AWG 51 strand rubber insulated wire (figure 8). It is available from Northwest Short Line dealers. It is good for most S scale and smaller installations – about 1 amp maximum current. Caution, the rubber insulation can chafe easily – possibly causing a short. Use shrink tubing over the insulation where it might be rubbed.

Styrene solvent – MEK (methyl ethyl ketone) is available in quart cans at

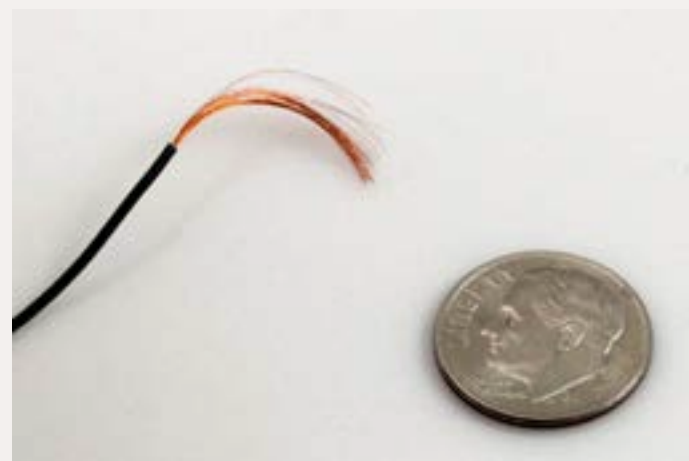


Figure 8: Extremely flexible wire: 29 AWG with rubber insulation and 51 strands of wire. Photo from Litchfield Station; equivalent to NWSL 99007-9.

hardware stores for about the cost of a small bottle of Testors from the hobby shop. Keep your old bottle with the brush in the cap and refill it.

Faller Expert cement – This is a styrene cement that has some specific uses different from MEK. We will talk more about it when we discuss lighting!

De-soldering wick – magic in a roll! The brand name is Solder Wick. There are others that are not as good! You use this to remove solder from a joint you want to undo. It is very good for wires soldered to tabs on circuit boards. You don't need it when unsoldering a wire-to-wire connection. See figure 9 (next page).

Flux – many folks say you cannot do a good solder job without flux. I am not one of them. I have a tube of Kester water-soluble flux that I use in extreme cases where I need to clean up a dirty contact or wire – like once a year! I've been doing electronic soldering since I was 7 years old and, yes, if you look at the photo at the front of this column, there is gray hair on my head! Perhaps my 50+ years experience helps me do the job without external flux.

One more comment on soldering supplies. Kester and Alpha are well known names in the electronic soldering industry. I would trust anything sold under their brands for decoder installation use.

### What not to use

I have a few prejudices against certain supplies sometimes used in decoder

ADVERTISEMENT



(727) 457-9227



**HO, DCC & All Scales**  
**Always on SALE**



**Authorized dealer for:**



**Atlas • Bachmann • AccuRail**

**JANUARY Specials**  
**(while supplies last)**



*Click now for more ...*

- **Digitrax systems**
- **Soundtraxx decoders**
- **RailMaster speakers**
- **Kadee products**
- **NCE systems**
- **RailPro HOT!**





**Figure 9: Solder Wick is the magic way to unsolder wires from boards.**

installations by hobbyists, manufacturers and some professional installers.

Office supplies belong in the office, not in your loco.

Scotch Magic Tape or cellophane tape doesn't handle heat well (and your motor gets hot)!

White foam tape breaks down with heat and time and becomes little crumbs that can ruin gear trains. Meanwhile, whatever it was holding is flopping around loose inside the loco.

Cardboard and paper don't handle humidity well and can catch fire.

Vinyl tape (usually black) is a major no-no. It seems like a natural – they call it electrical tape! However, it is thick and doesn't handle heat well. I've opened many locos and found it in a blob at the bottom of the loco,

frequently gumming up the drive train, sometimes dried out. Since it was there to insulate, frequently its departure results in a short circuit.

A few years back, I reworked an N-scale loco. The decoder toasted when the vinyl tape that had been used in the install failed and shorted the motor to the rails. This decoder was supplied with Kapton tape, but the owner chose not to use it and substituted vinyl!

## Motor Isolation

This brings us to one of the most crucial issues in decoder installation, motor isolation.

This term is bandied about quite a bit, but what does it really mean?

The concept of a decoder is that you insert it between the rail pickups and the motor. See figure 10.

The goal is to make sure that there is no electrical path between the motor and either rail.

My suggestion: disconnect the obvious places and then set the loco on a piece of track that isn't part of the layout. Put one connection of your buzzer to the motor and probe both rails with the other buzzer clip. If you get a beep, you aren't isolated. Then, if you think you are isolated,

## ADVERTISEMENTS

Get the Latest Model Railroading News, Tips, Reviews & Opinions

# The SCOTTY MASON SHOW

*The Original Model Railroad Podcast*

- Monthly Interviews
  - Modeler's Spotlight: Top Modeler's Talk
  - Narrow Gauge Modeling w/Chris Lane
  - Contemporary Modeling w/ Mike Rose
- More Product Announcements & Reviews


 Our feed has changed! To get the latest shows, please search Scotty Mason and subscribe to the new feed!

[www.TheModelRailroadPodcast.com](http://www.TheModelRailroadPodcast.com)

*Scott Mason*   *Jimmy Simmons*   *Mike Rose*   *Joe Duckworth*

**RailPro**<sup>TM</sup>  
NEW TECHNOLOGY


 Click here to watch our new video!




For more information visit our Internet site:  
[www.RingEngineering.com](http://www.RingEngineering.com)

connect the buzzer to one wheel and the motor and wiggle the trucks and make sure that there isn't some contact throughout their range of movement.

SoundTraxx puts it bluntly in their Micro-Tsunami Quick Start Guide: ***"Failure to properly isolate the motor will damage your decoder and turn it into an effective, but short-lived, smoke generator."***

I'll get more into the isolation issue as we discuss various types of locos next month.

## Decoder selection

One of the most frequent questions is, "What decoder will fit my . . .?"

Most decoder manufacturers offer suggestions for using their decoders in various models. You may want to start there.

Here are some ideas to help you to decide for yourself.

## Loco specific

I look first for what I call loco-specific decoders. Some decoders are designed for a specific model or series of models.

I find that, while these are frequently promoted as no soldering, drop-in units, they frequently need some wiring help for the best install. So, check with your dealer and see if there is a loco-specific decoder for your application. Or go to the web site of your favorite decoder manufacturer – most have a guide to fitting decoders.

Figure 11 shows the before and after of an installation using an Atlas light board-style decoder. Atlas-style light board decoders fit many locos, but soldering is required.

Some of the most popular wired loco-specific decoders fit:

- Many N-scale diesels
- HO Atlas-style light boards
- HO Atlas S-1 to S-4 diesels
- Many HO Life-Like Proto 2000

## Current

All decoders have a current rating. Some rate running current, some rate maximum current, some rate both. What does this all mean?

The current (measured in amps or thousandths of an amp, called milli-amps) drawn through the decoder will cause heat buildup inside the package. If more current is drawn than the decoder is designed for, it will fail.

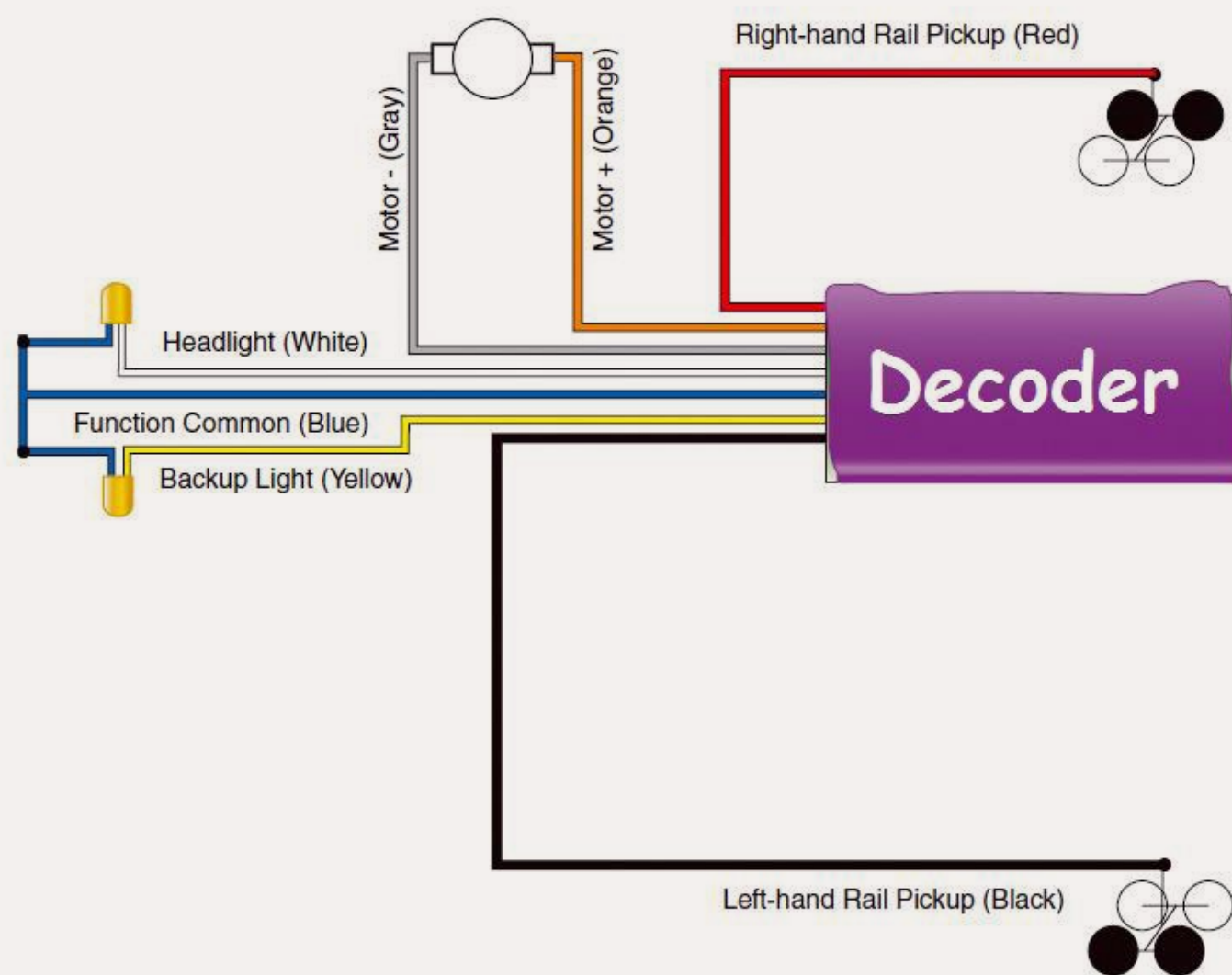


Figure 10: Schematic for DCC decoder connection – adapted from a SoundTraxx drawing

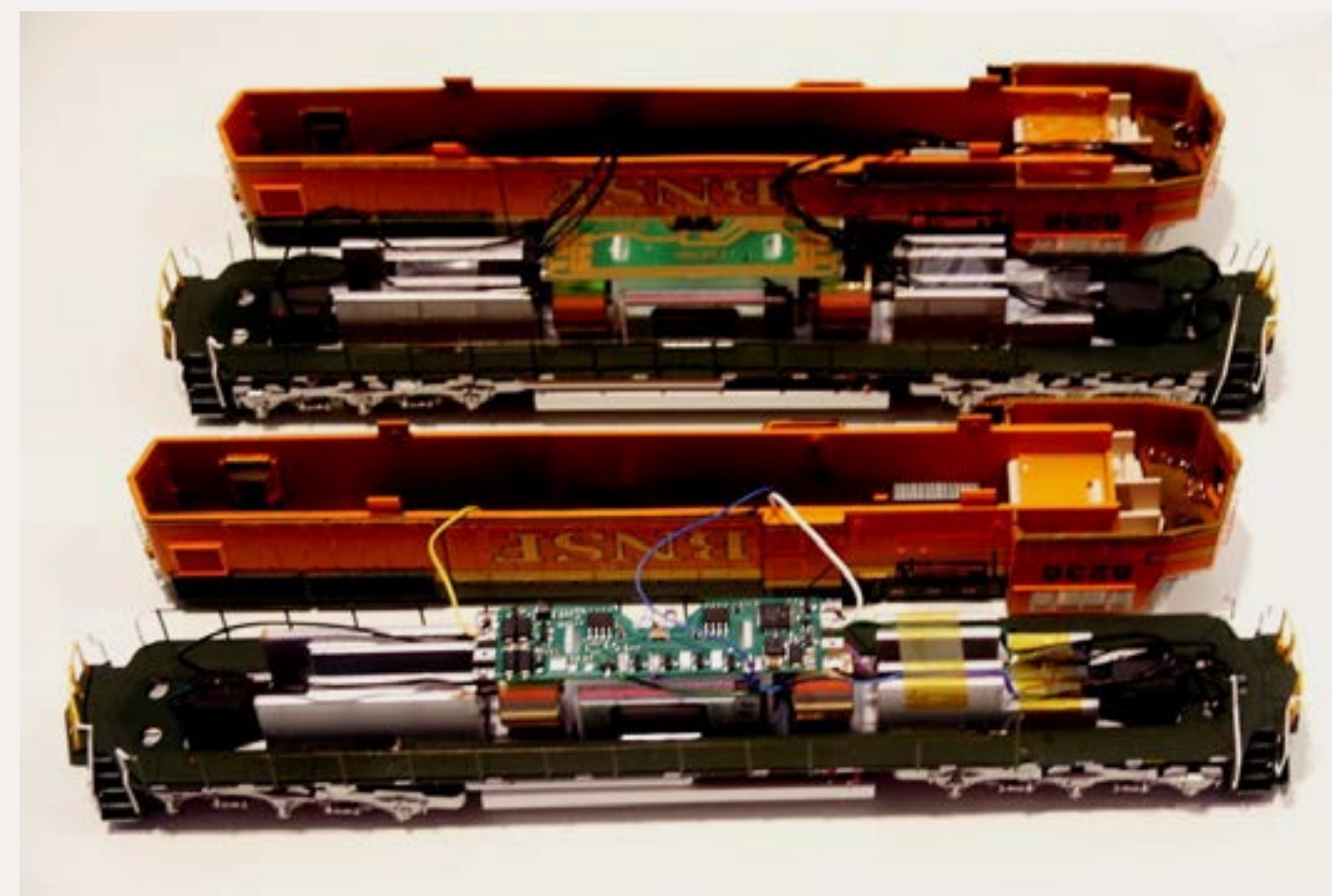


Figure 11: TCS A6X Atlas light board replacement decoder installed in an Athearn Genesis SD-75M loco. Top unit is as delivered. Bottom unit has decoder installed.

This current rating is for all current passing through the decoder: lights, smoke units, motor drive, etc. **This is not just motor current.**

Some decoders sense rising internal temperature and shut off the flow of current before they overheat. This protects the decoder. However, nobody likes to have a loco just stop in the middle of a run!

Others, especially older decoders, won't protect themselves and will slowly fry, frequently leaving abstract art in the form of burn marks on the shrink tubing encasing the decoder.

What you need to do, if you are as anal-retentive as I am, is to measure the stall current and running current of your loco. Then you match your decoder to the results. I have instructions on my web site for this: ([www.mrdccu.com/curriculum/stall.htm](http://www.mrdccu.com/curriculum/stall.htm)). If you do so, you will know that you have chosen a decoder that is adequate to your needs.

Alternatively, most modern decoders will handle an amp of current (1000 milliamps). Modern HO and N locos draw less than one amp. Even if you have 5 or 6 lights, you probably won't overload the decoder. So, if you just ignore the current rating and install a current-vintage decoder in your modern HO or smaller loco, you will probably not have an issue. If you do, I warned you in the prior paragraph!

Many manufacturers are following TCS' lead and offering to replace decoders that are destroyed on the initial

**“So, if you just ignore the current rating and install a current vintage decoder in your modern HO or smaller loco, you will probably not have an issue.”**

installation. TCS has offered a “one-year, no questions asked” warranty on their decoders since day one. That, coupled with their fine motor control at a reasonable price has made them a favorite amongst my customers.

## **Size**

The next question is whether the decoder will fit in your loco. There is only one sure way to know: measure!

When I burn out a decoder that I can't return for a replacement, I paint it red and keep it in a drawer on the workbench. When I'm planning an install, I drag it out and see if it will fit. Otherwise, rulers, calipers and modeling clay come into play.

Modeling clay? Yes! You can put a blob on top of the weight. Put the shell on and take it off. The clay will be squashed down to show exactly how much room you have!

## **Functions**

This term is confusing to newbies. Here is the quick rundown. A function controls a light, in the simplest terms.

So, let's see: front light, rear light, two ditch lights and a strobe. That's 5 functions.

How about front light, Mars light, rear light and fire box flicker? That would be a minimum of 4 functions, but I'd go for five. Why? I like to set up an alternating firebox flicker with a red and a yellow LED, which takes an additional function.

In the first few generations of decoders, the less expensive units had one or two or three functions. Premium decoders had more. Folks got the idea that additional functions were expensive, when what they were really paying for was mostly the other features. For example, if leather seats are only available on the model of car that includes sunroof, premium stereo and a larger engine, the price for the leather seats could be incorrectly viewed as the total cost for all those other extras.

Manufacturers are learning that folks use functions if they are available, so newer decoders frequently have 6, or even 8 functions.

Select a decoder with adequate functions for your needs. If you goof, all is not lost, as many manufacturers make “function only” decoders that can be added to bring in an additional 1 to 4 functions!

## **Upwardly Mobile**

Earlier, I mentioned that I own a lot of tools. One of my favorites is a turntable that I fashioned from an Amaco

No. 5 Decorating Wheel, as shown in figure 12.

Decorating wheels are designed to spin to allow painting horizontal stripes on pottery.

There are various levels of quality from relatively hard to turn plastic models to the ball-bearing aluminum version that I use.

**“Modeling clay? Yes! You can put a blob on top of the weight. Put the shell on and take it off. The clay will be squashed down to show exactly how much room you have!”**



Figure 12: Amaco No. 5 Decorating Wheel modified by adding foam placemat material to the top surface.

The modification was to apply foam placemat material (glued down with caulk) to the metal top of the turntable. Why? Cushion the surface AND insulate it, so that there isn't a rail-to-rail short when a loco stands on it.

As I was writing this article, I found the exact same model on Dick Blick's web site for under \$30 ([www.dickblick.com/products/amaco-decorating-wheel](http://www.dickblick.com/products/amaco-decorating-wheel)).

Why would you want one? I find two things it does for me.

1) I can put a loco (in a cradle or not) on it and quickly turn it around to work on both sides. I am very right-handed and that lets me quickly get my good hand in action.

2) It raises the work a few inches. Thus, my elbows and shoulders aren't cramped.

Lots of little tools like this make the job easier for one who is doing a lot of installations. But the dollars do really add up!

**“Manufacturers are learning that folks use functions if they are available, so newer decoders frequently have 6, or even 8 functions.”**

## Coming up . . .

Okay, now we have done a lot of the prep work and planning. Next month we talk about various styles of locos and what you need to do to put your decoder into them.

**“Lots of little tools like this make the job easier for one who is doing a lot of installations. But the dollars do really add up!”**



**Remember to visit the MRH website at [mrhmag.com](http://mrhmag.com)!**  
**The MRH family is full of great ideas!**

# Innovative Electronics for Model Railroads

Frog Juicers - Automatic Frog Polarity

Servo Drivers for Turnouts and Semaphores

## TAM VALLEY DEPOT

Great Electronics for Great Model Railroads



Keep your frogs well juiced and always in the right polarity with our DCC Frog Juicers. Just hook up one wire to the frog from our juicers and the electronics do the rest! Thousands of satisfied and happy frogs in all scales swear by them.

[www.TamValleyDepot.com](http://www.TamValleyDepot.com)

[Click here to contact us by email](#)



A  
D  
V  
E  
R  
T  
I  
S  
E  
M  
E  
N  
T