Model Railroad Hobbyist

DCC IMPULSES

column

BRUCE PETRARCA

Click here for reader comments

This month, I've decided to merge a review of the SoundTraxx Econami 4-amp (ECO-400) diesel decoder with an O-scale installation example. While this is O-scale, as usual, there are some hints and tips along the way that work in all scales.

This loco belongs to a friend. I operate on his O and On30 layout once a quarter or so. His On30 operators are having so much fun with wireless DCC and sound that he decided to convert his standard gauge to DCC by adding a booster and enhancing some of his wiring. He needs a DCC loco for the job. Since this loco [1] has been his workhorse, what better place to start than here?

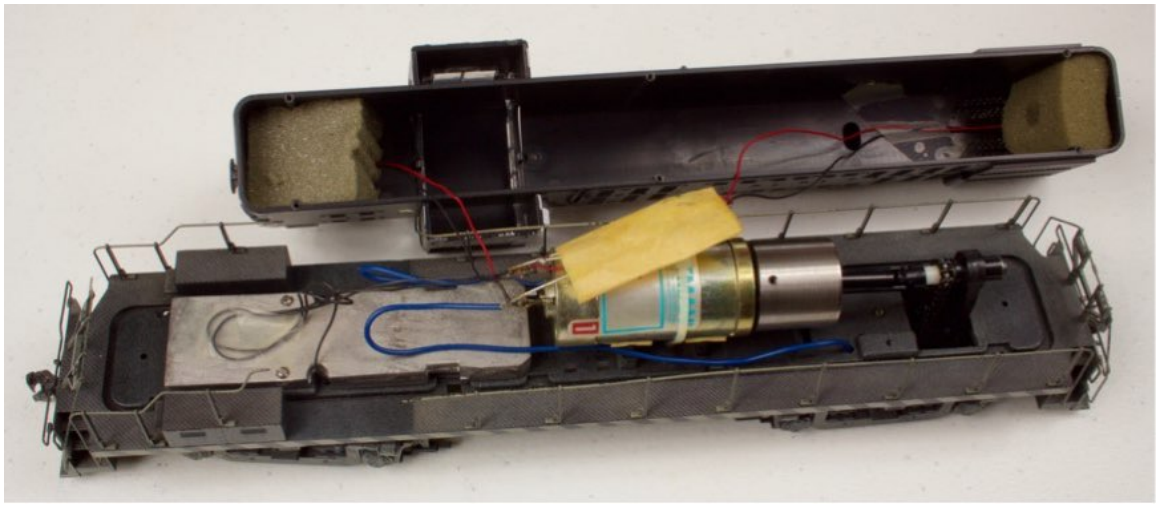
1. Starting point - a well used Weaver RS3 O-scale locomotive

DCC TIPS, TRICKS, AND TECHNIQUES

O-scale Weaver RS3 Econami DCC + sound installation

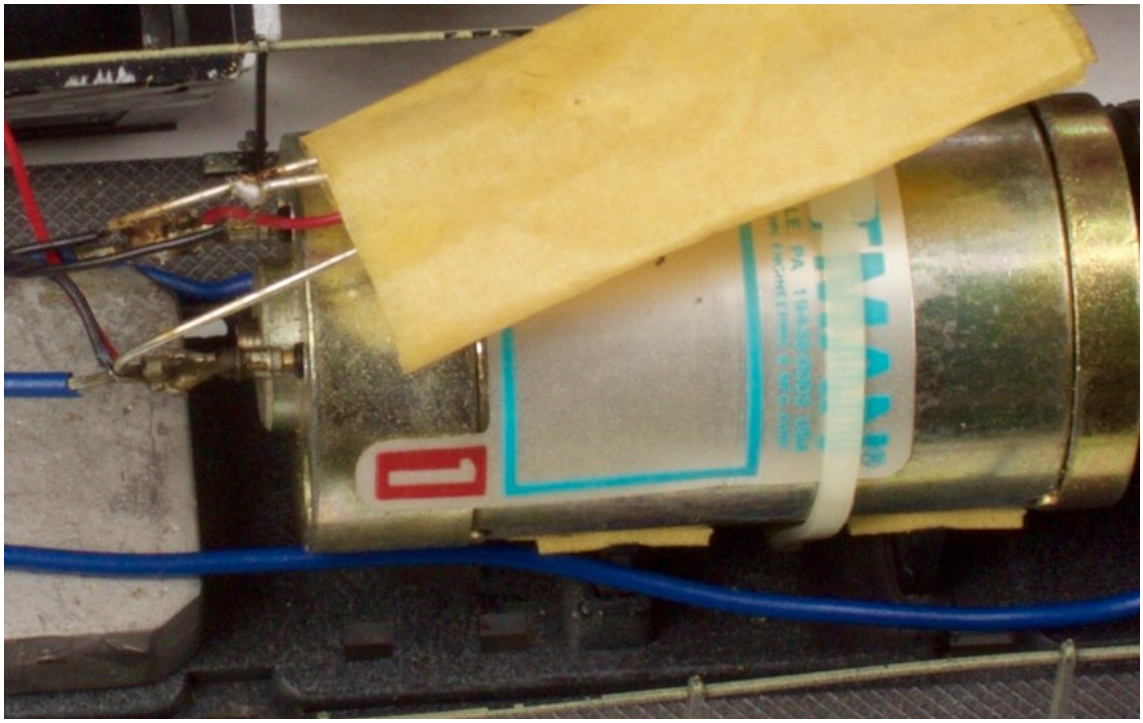
Before jumping into this installation, I recommend you review my first few columns, starting in October 2011. The first few columns deal with tool selection and the necessary supplies and other aspects of DCC and decoder installation.

2. Inside of the Weaver RS3, getting ready to do DCC installation.



First thing, I opened the shell (remove 6 screws from near the trucks and under the fuel tank detail). I found two of my greatest no-nos [2] when I looked inside.

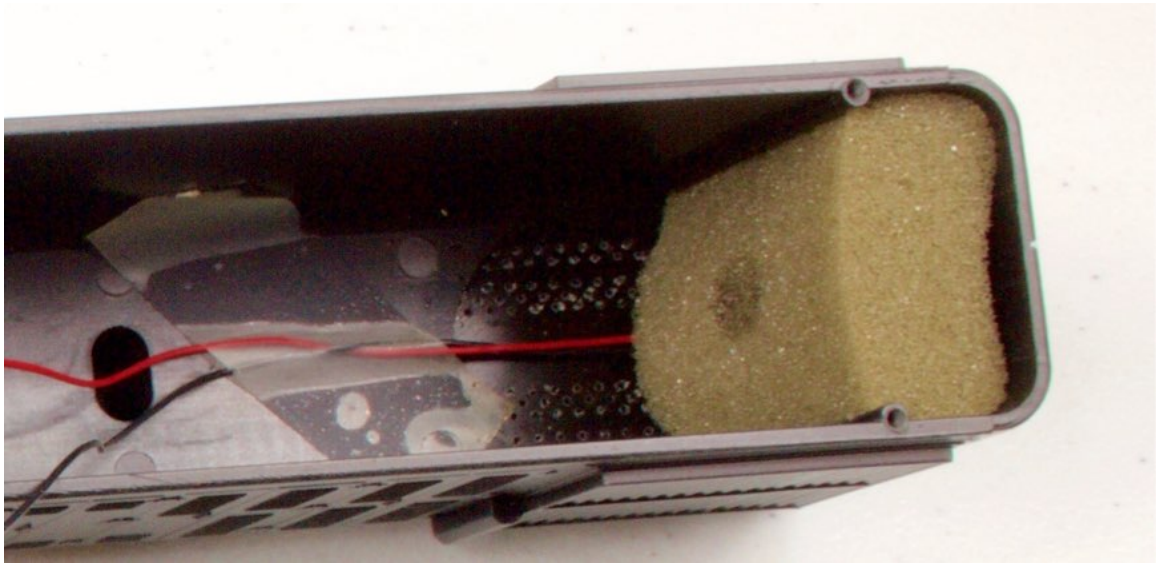
3. Close-up view of the interior, showing the masking tape covering the light steering diodes.



The first no-no is using masking tape [3] to insulate the diodes that provide directional lighting. It has petrified. In the near future, I could see the tape falling apart, possibly allowing the wires to short across the track. It appears that Weaver manufactured the loco this way.

A similar use of office supplies is the "magic" tape holding down the wires for the light bulbs [4]. The wiring to the lights was so short that the shell could not be moved any further from the base than shown in photo [2]. I later learned from the owner that the idea was to pull the bulbs out of the lenses. Probably he used the “magic” tape when reassembling it from prior work.

4. Close-up view of the interior, showing "magic" tape holding the bulb wires down. Also, notice the holes that the owner had drilled through the front fan grille.



Why am I so harsh on these products? Firstly, they are designed for use in an office environment: moderate temperature and humidity. They don't handle the high heat and reduced humidity found inside an operating loco well. They deteriorate very quickly in harsh environments. Also, the "magic" tape is very easy to tear through, leaving pieces that stick to the shell and are hard to remove.

Okay, back to the installation.

Testing stall current

I didn’t seriously test the loco’s running status, as I’ve seen it run under DC on the owner’s layout several times. I recommend a thorough evaluation of any loco on DC before a DCC installation is begun.

I tested stall current with a power supply adjustable 0 - 3 amps and 0 - 18 volts. I set the current at max and the voltage at 12 V and stopped the motor by holding my finger on the flywheel. The power supply showed a stall current of about 2.75 amps, well within the 4

amp rating for the ECO-400. Running current was in the 1 amp range. The final installation runs fine on my PowerCab (drawing about .4 amps).

Before I opened the loco, I took time to clean the wheels. With the loco upside down in a foam cradle, I used clip leads to connect DC power to the copper pickups in one truck. I applied power from my power supply (could be a power pack) such that the wheels turned at a modest rate. Denatured alcohol was applied with numerous cotton swabs until they came away clean. Then, I actually polished the wheels by turning them against a 600 grit nail polishing stick.

How do I get the sound out?

Long time readers know that I eschew putting speakers in boxes. Well, the owner had drilled a lot of small holes in the front fan grille [4]. This is a perfect location for my "out of the box" speaker baffle design. All I needed to do is find a speaker that will fit the opening, which measures about 30 mm.

I tried several candidates. It is always nice to have a selection of speakers available when you are doing an installation. It makes selection easier than trying to guess what size will work best and buy or order it.

I tried a 27 mm round high-bass speaker and found that it failed to cover all the holes that had been drilled in the grille. If there were no holes yet, I'd use that speaker and make sure that the holes were all inside the annular ring of the speaker mounting. In addition, this speaker would require a bit of shimming, as the cone can move in front of the mounting plane by about 0.04 inches.

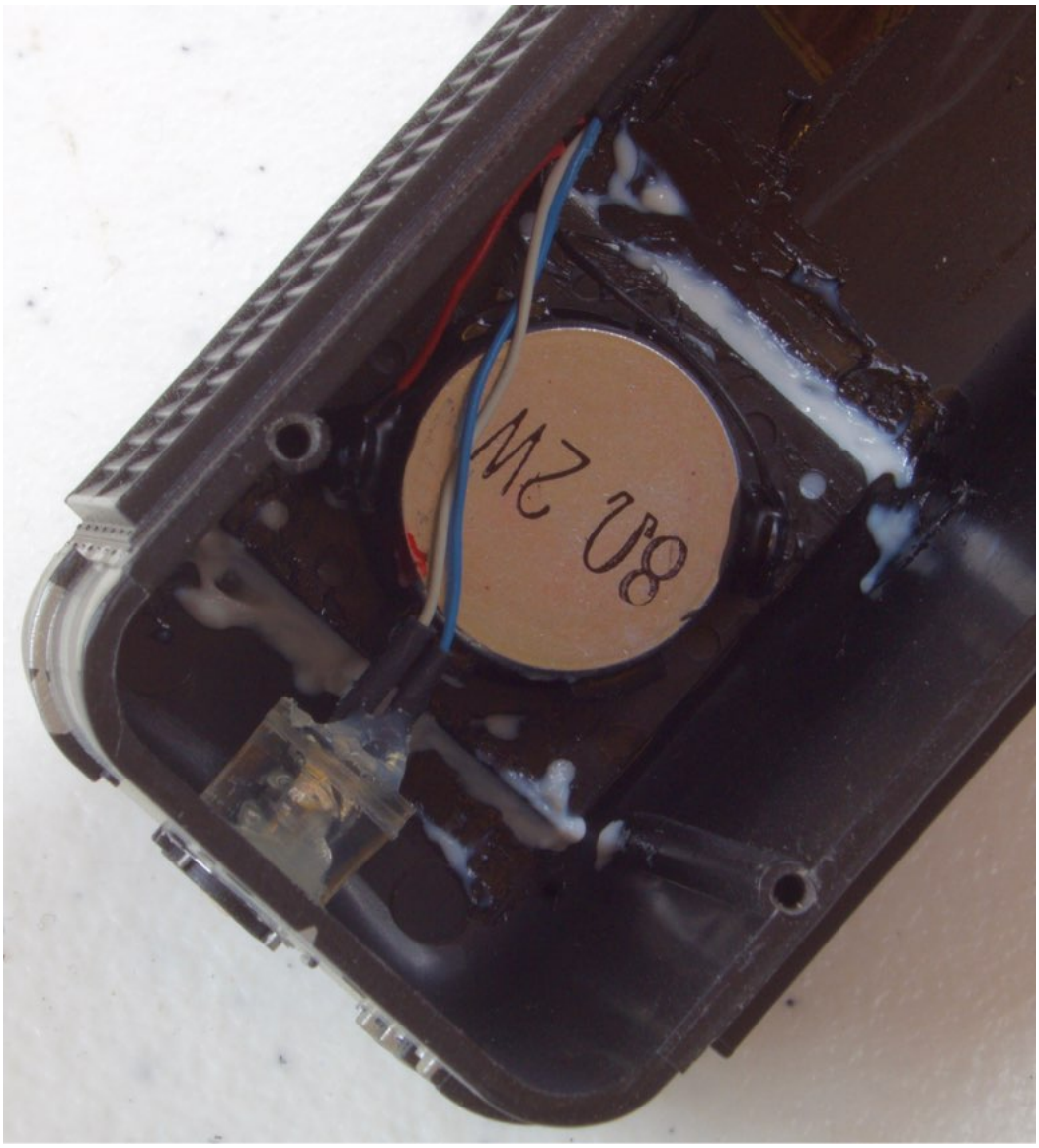
Staying in the round high-bass vein, I tried a 32 mm round and found that it was just too big. It rode up on the rounded sides of the shell.

Next, I tried a 28 mm square high-bass speaker with a plastic frame. It fit nicely between the sides of the shell. The curvature of the shell held it off the roof, providing clearance for the cone.

The space between the speaker and the roof would eventually be filled with caulk [5]. The speaker was glued in place against the shell with MEK, but any styrene cement would suffice. For information on adhesives that I prefer, check out my web site (https://mr-dcc.com/index.php/tips/adhesives).

The speaker selected was rated for 2 watts and the decoder will put out 3 watts. This could be a problem if you ran the volume all the way up. This decoder / speaker combination is so efficient that, with the volume set at about one-quarter, it is still loud in the next room. This probably means that the actual power being delivered to the 2 watt speaker is ½ watt or less. Be cautious if you use a speaker rated less than the decoder. If you hear distortion, especially on the horn or whistle, turn the volume down until the distortion stops.

5. 28 mm square high-bass speaker mounted inside shell under the (drilled out) fan grille. It is being sealed to the shell with clear caulk. The caulk is currently white, as it was applied just before this photo was taken. Note the white caulk plugging the mounting holes in each corner of the speaker. This keeps the sound constrained to the side of the cone that generated it.



A word about the caulk: I like to use clear caulk. It less obvious from outside the loco than white or colored caulk. Thus, I had to shoot the photo [5] before the caulk dried, as it goes on white and dries clear. You can also see where the caulk is inserted into the mounting screw holes that are not utilized in this installation, but represent a sound leakage path from the front of the speaker to the back. Once the caulk dries, it will be virtually invisible inside the loco. Only its shiny surface will give it away.

How does the sound actually get out? For background, see my August 2012 column and the accompanying video. In this case, half the sound goes up and out of the grille. The other half is forced down through the mechanism and out the truck opening.

Lights?

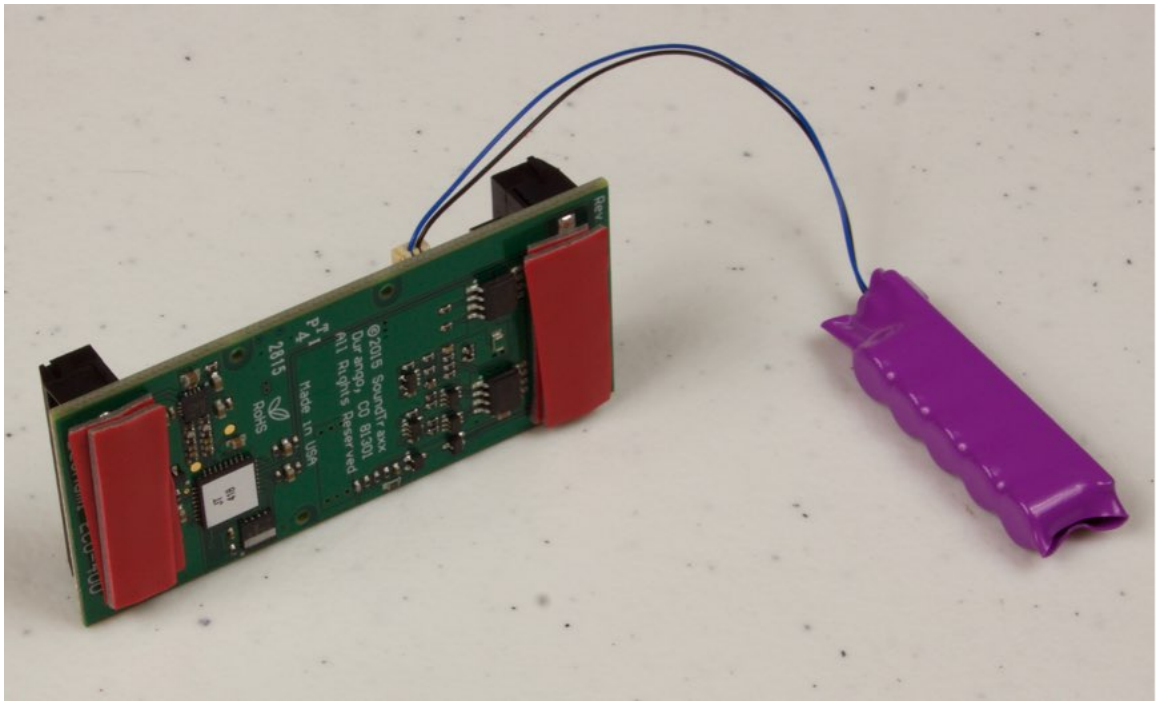
Knowing how much I hate to dig back into locos after I've installed a decoder into them, you will probably be ahead of me and know that I'd install LED lighting.

T1 (3 mm) LEDs fit nicely into the lenses where the bulbs came out. They can be held in place with either clear caulk or canopy cement. I chose warm-white 12 volt LEDs, as no resistors are needed and they have a color consistent with the headlights of this loco's era.

How to mount the decoder?

There was plenty of room for the decoder and a CurrentKeeper energy storage module under the cab end of the shell. The CurrentKeeper module (purple) plugs into the side of the decoder (green board) as shown in [6].

6. Double layer of gray tape (with red backing) on the decoder screw terminals. Raises decoder up from baseplate so chips don't contact metal plate and insulates below screw terminals.



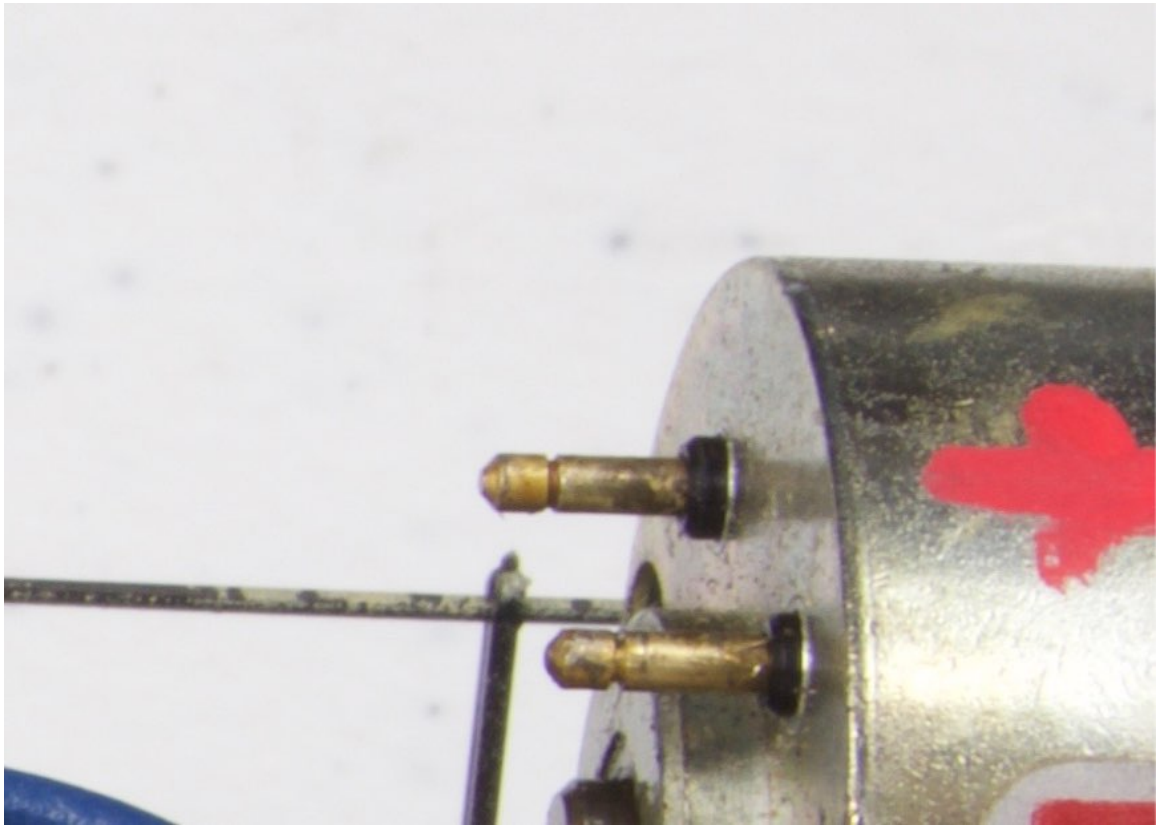
The decoder and CurrentKeeper were mounted [6] using gray tape. A double thickness under the terminal strips serves to prevent contact between components on the decoder board and the metal weight. Covering the screw terminal contacts with the tape insulates them and provides room for some free-air cooling of the components. The overall

installation can be seen in [15]. The decoder will be a tight fit within the shell, especially with the CurrentKeeper connector on the side [13].

Wiring

Before removing the DC wiring, I like to mark the side of the motor that is connected to the right rails. This will receive the orange (motor +) power connection. I use a paint marker to put a + mark or red dot next to the proper motor terminal, as shown in [7].

7. Motor polarity mark: a red + mark next to the motor terminals that connected to the right rail when wired for DC.



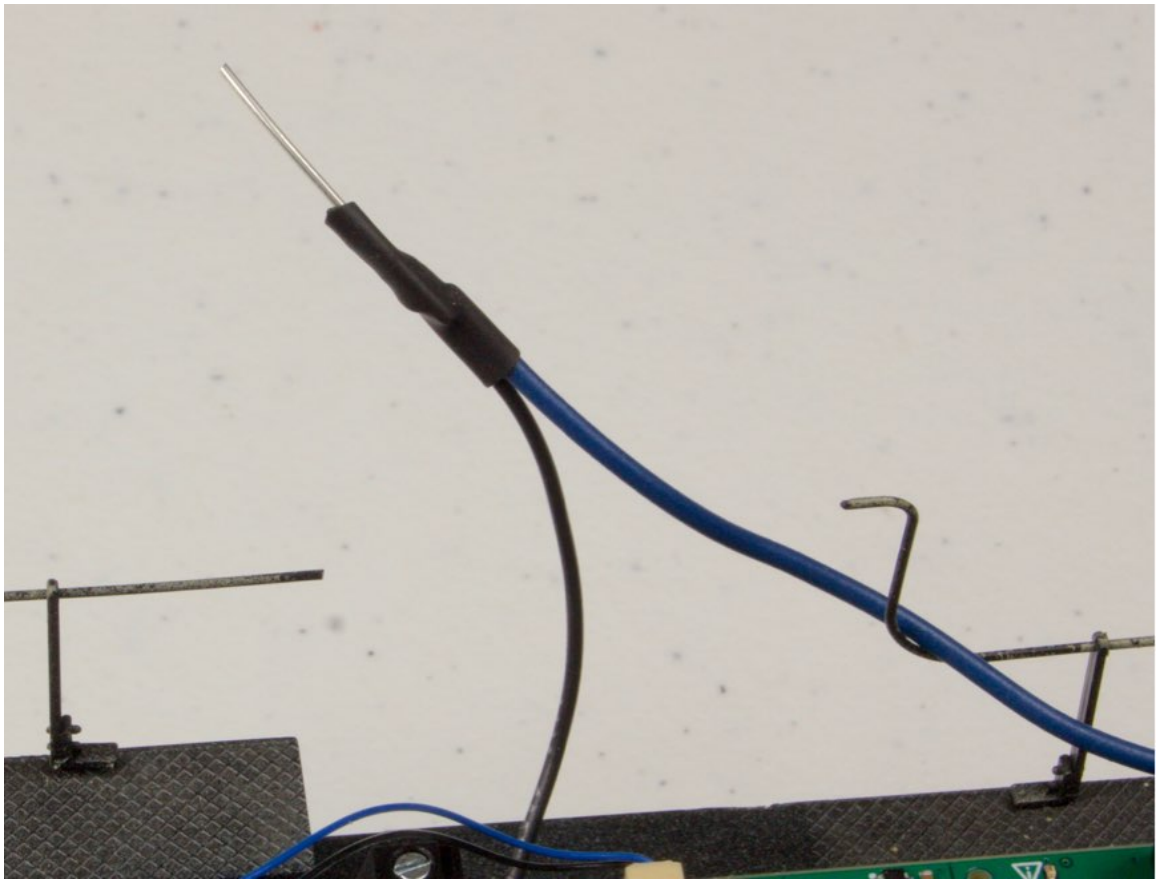
I also found that the rear truck wires were inadequate. If left as is and the locomotive bridged opposite polarity, such as the right side wheels of one truck on the left track and the right side wheels of the other truck on the right track, the entire output of the DCC booster would be across the two wires between the trucks and the decoder until something tripped. This could fry the smaller wire.

The wire from the front trucks was of adequate gauge, but very stiff and not to NMRA color code practices. I left it alone, but would probably replace it as part of a similar future installation.

The rear wire was replaced with 26 AWG wire of proper colors (red and black). I'd have liked a bit larger (22 AWG or so), but 26 was all I had between 30 and 18.

A friend with years of experience using screw terminals for low voltage applications (just what we are doing here) recommends against a practice that I've used in the past: tinning the stranded wire and inserting it into the screw terminal. He says that, over time, the tinned wire will relax and the screw tension will lessen. So, I've been using his ideas and adding solid sections to the stranded wire to make contact with the screw terminal.

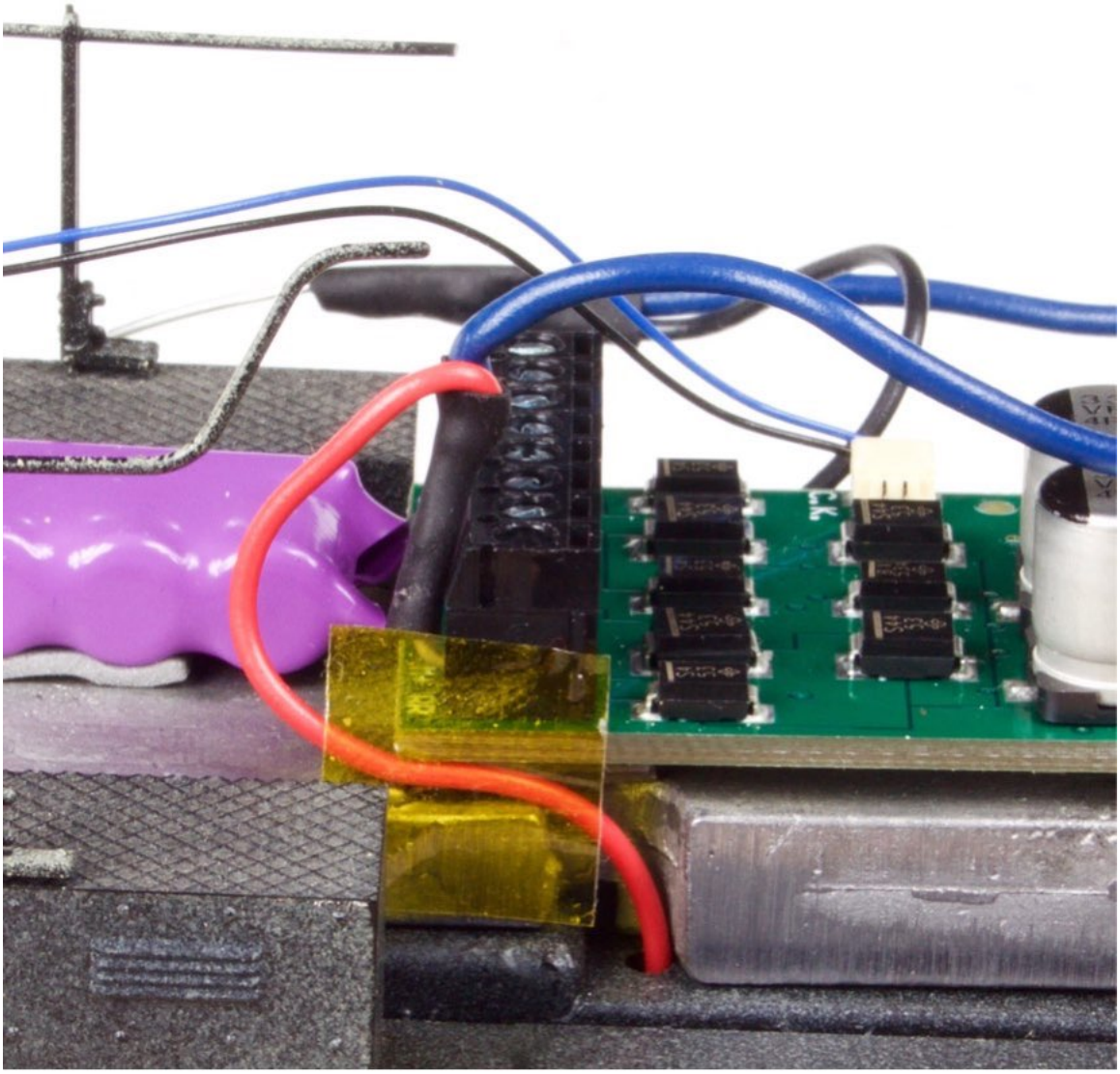
8. Truck wires twisted and soldered to a 20 AWG solid wire for connection to the decoder screw terminals.



So, the track connection to the decoder was made by twisting the two leads coming from the truck and soldering them to a piece of 20 AWG solid wire. The connection was covered with 1/16 inch shrink tubing [8].

Once the track wires were prepared [8], they were connected to the decoder. A bit of Kapton tape was used to hold the wire from the rear truck into the space provided so that it won't be pinched by the shell [9].

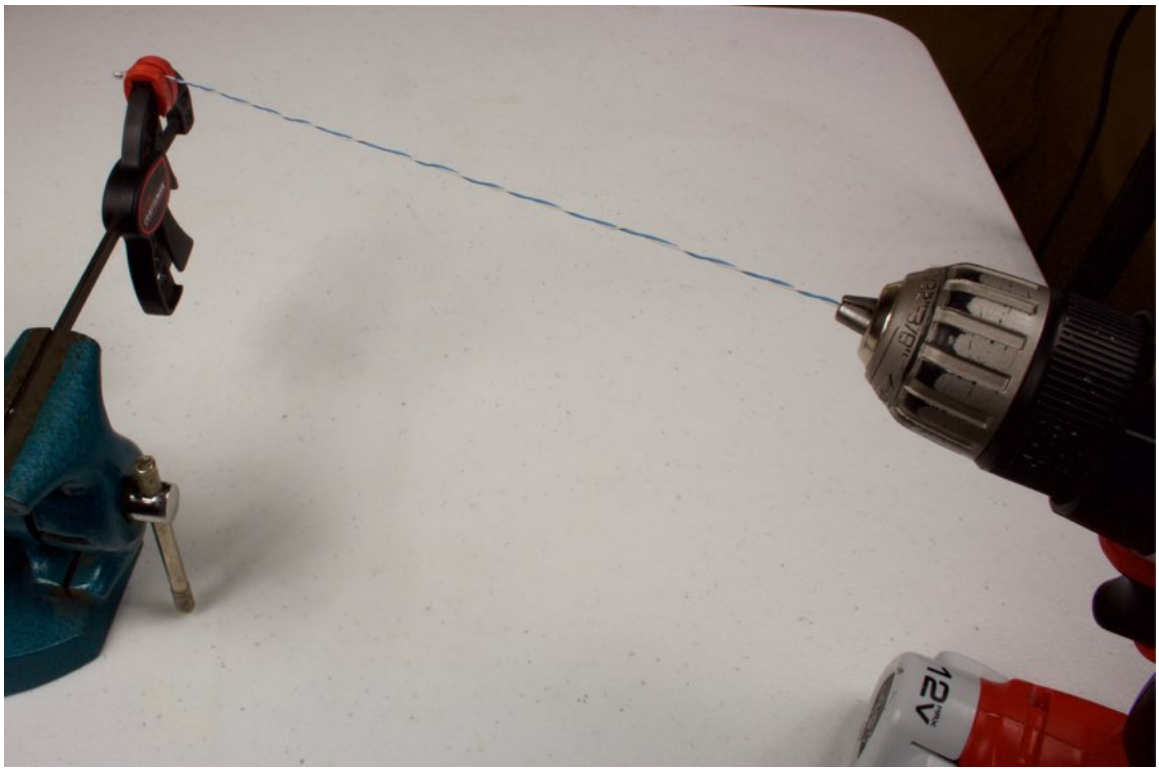
9. Side view of decoder with track wires attached. Kapton (yellow) tape was used to keep the wire in the groove while the shell was installed.



Motor wiring was also done with the 26 AWG wire of proper colors (orange and gray). Orange wire goes to the motor terminal that was identified by the + or dot. The decoder ends got 20 solid AWG tips, too. I connected the orange wire to the decoder on the motor terminal next to where the right rail had previously connected.

LED assemblies were built by putting blue wire (30 AWG) on the long lead of the LED and covering the connection with 3/64 diameter shrink tubing. Similarly, a white or yellow wire was put on the other lead (white for headlight and yellow for rear light). Once the wiring was complete, the wires were twisted slightly with a power drill as shown in [10].

10. LED light wires being twisted with drill. LED is in a clamp attached to vise on left.



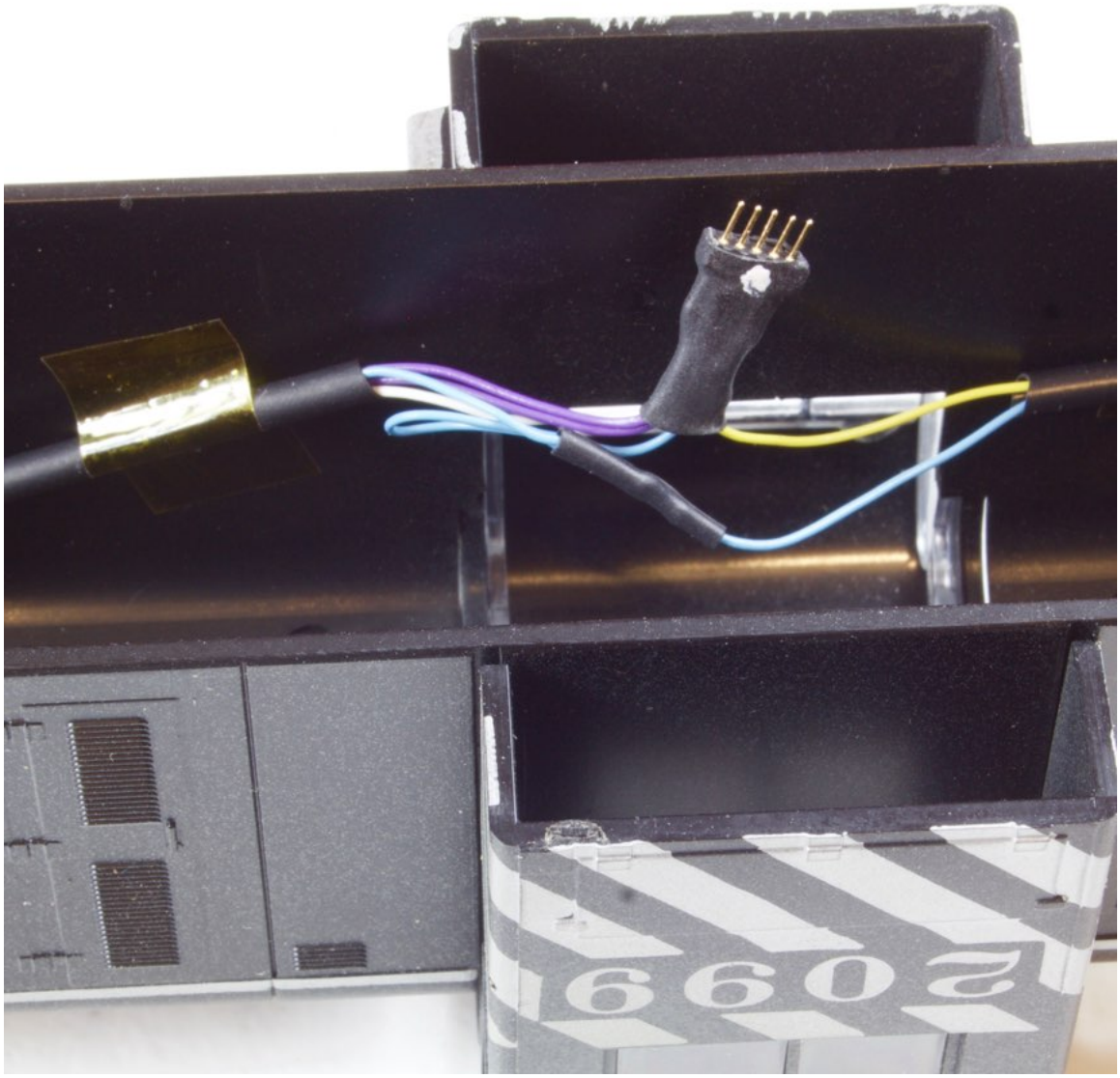
In a similar fashion, the speaker wires were extended using purple wire (30 AWG) and twisted. Since this is a single speaker installation, there was no need to keep track of polarity with respect to the speaker wiring.

All of the wires in the shell [15] were routed inside 3/32 shrink tubing. Soda straws could have been used as easily, as the tubing wasn't shrunk onto the wires. The conduit created this way should be held in place with Kapton tape or caulk (with the tubing held in place with masking tape until the caulk cured).

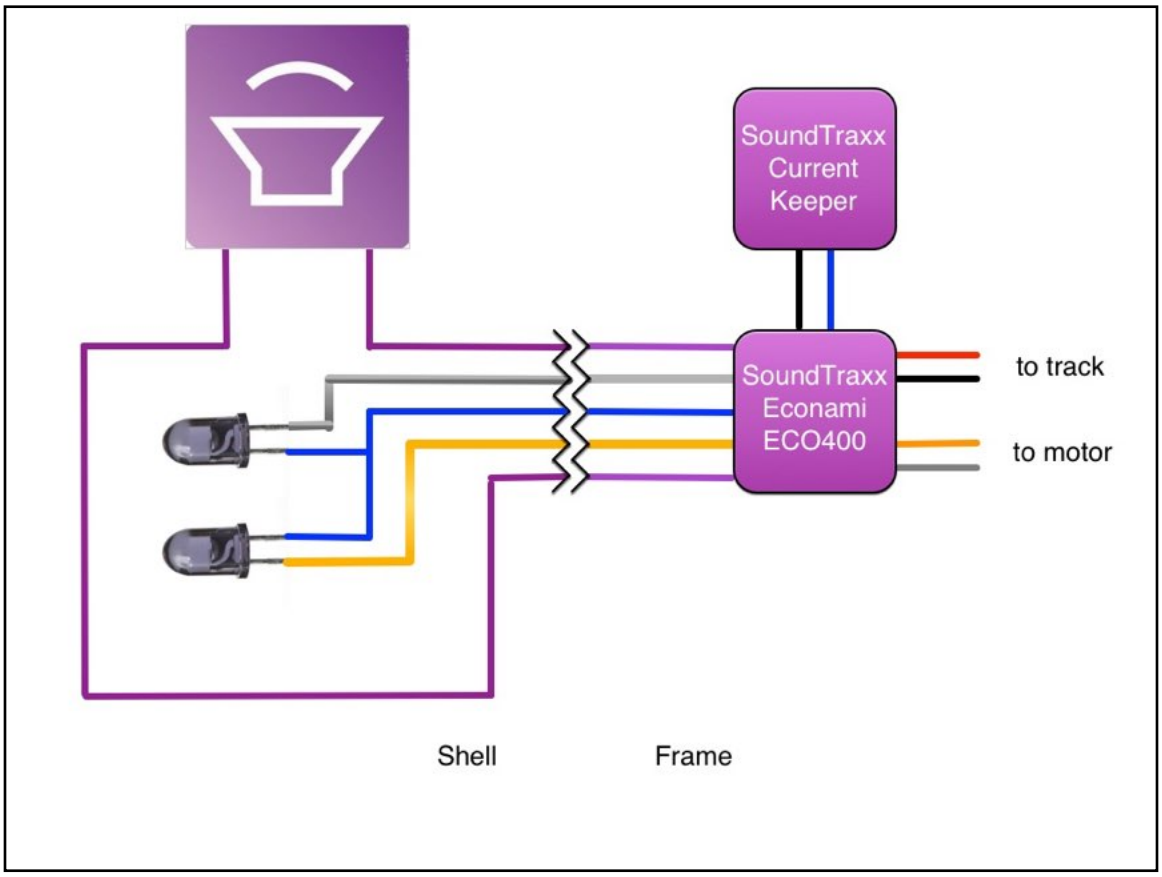
A 5-pin connector was made out of the 50-pin header material by cutting into the 6th position. The pin or socket that came out was kept for another use later. A rotary tool with the sanding drum was used to square up the end of the connector.

The connector was wired per [12] with the male side in the loco shell. The smallest (3/64 inch) shrink tubing was used to insulate the white and yellow leads. Once all connections were made and tested, ¼ inch diameter shrink tubing was slipped over the entire assembly [11] and shrunk in place to provide insulation of all the wires and a neat appearance.

10. 5-pin connector in the shell to connect LEDs and speaker to the main frame. Note white dot to denote polarity.



12. Wiring diagram. Connect the female side to the decoder. Note that reversing the connection only exchanges the front and rear lights. No ill effects will happen if you rotate the connector this way. However, offsetting the connection by one position may damage the decoder, speaker or LEDs.



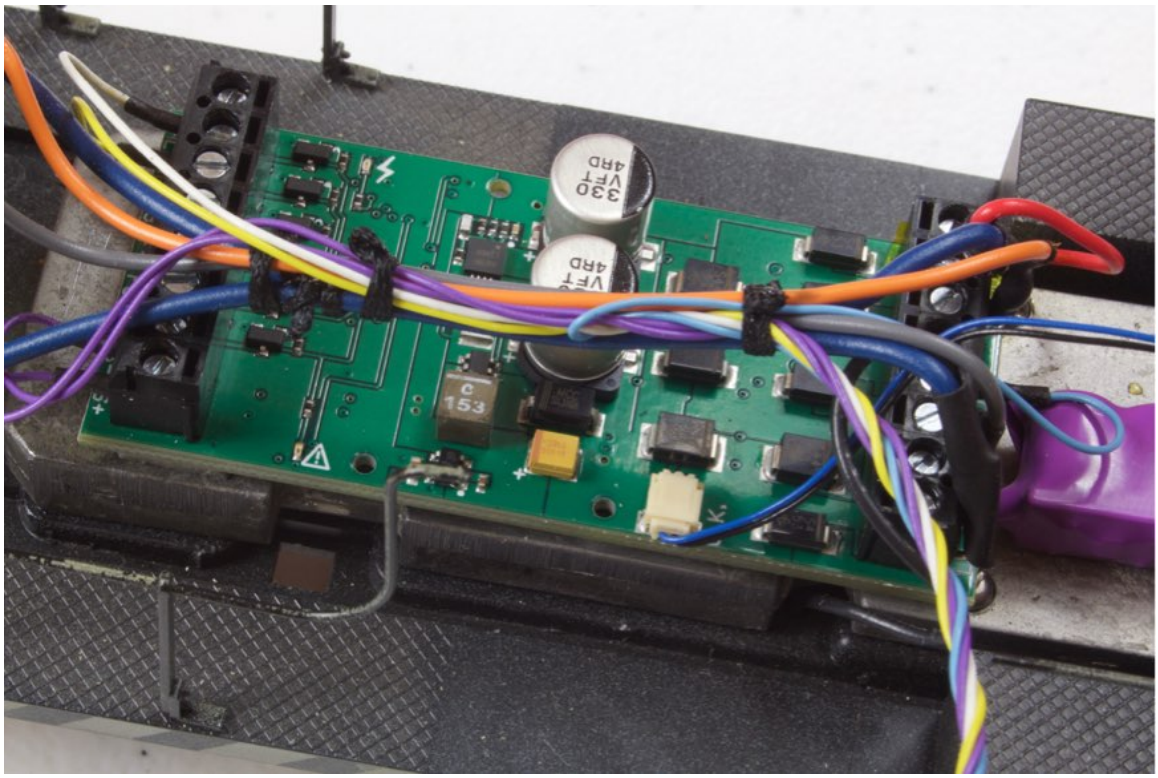
The female connector assembly was built to match the male assembly. The connector pins freed up from cutting the 50-pin header were used on the decoder ends of the wires. The wires were tinned and inserted into the female socket and then the socket heated to melt the solder and make for a solid contact to insert into the decoder terminal. I keep these pins from installations and had enough in my box to do the installation. More sockets could be cut from the header if needed. Absent that, 20 AWG solid wire could be soldered to the decoder ends, as was done for the track and motor connections [8].

You will want to wire the female connector to the decoder: Blue to V+; White to HL; Yellow to RL; one purple to each of the speaker connections. Plug the male and female sides of the connection together and put a white dot on one side so that it will be easy to identify the mating sides when attaching the shell to the frame [10] & [15].

I've recently gone back to an ages-old electronic technique: waxed lacing cord. I found some on Amazon (see supplies list). This waxed product can be used [13] to hold wires together in a bunch. The heavy wires coming from the front truck to the rear of the

decoder provide an excellent backbone for all the wires crossing the decoder. I wrap the cord around the bundle twice and tie it with a knot, either overhand or square. A quick touch of the soldering iron to the free end will melt it away and seal the knot - no cutting required. In [13] you can see several knots. I tied them off as I went and then put a final pair on each side to neaten up the result.

13. Close up of decoder area. Note routing of CurrentKeeper wires (small blue and black) to allow clearance for shell. Lacing cord is used to bundle wires together.



Finalizing the installation

Before assembly, there was one more issue. The owner wanted a figure installed in the engineer's seat. The Grizzly Mountain figure he supplied was glued (using caulk) inside the shell with his arm hanging over the edge. It is slightly visible outside the loco. It is shown in [14] with the cab section of the shell removed to show details.

14. Engineer figure installed on the right side of the cab.

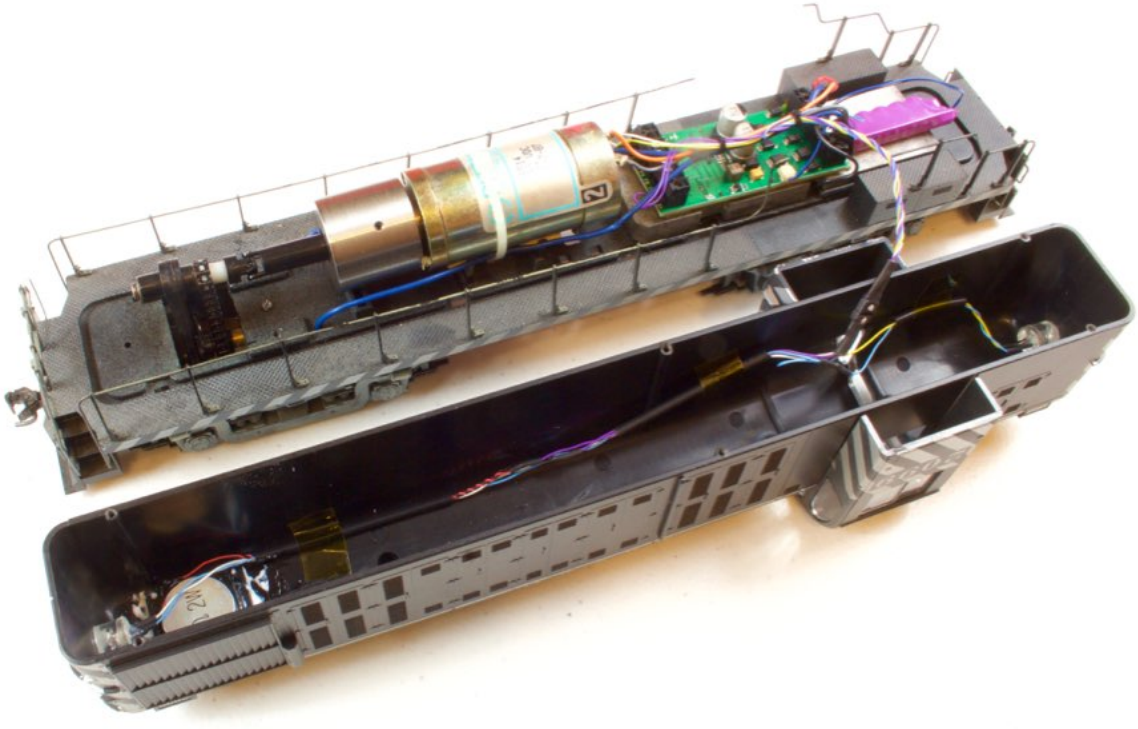
Along the way all exposed friction points were lubed with Nano-Oil. The 5-weight product was used to seep into tight places. Once the 5-weight had soaked in, 10-weight was applied for permanence of lubrication. The 85-weight product was used on the chain and sprockets.

Never Stall was applied to the sliding electrical contact between the pickup copper contact and the wheels. This will lubricate and promote electrical conductivity.

The shell was set on top of the frame and the loco was tested. The programming track was the first stop. I verified that I could write and read by changing the address to 99 short and 2099 long with the long address active. Those changes showed that there was unlikely to be a major wiring error.

While I was there, I changed the motor sound to the ALCO 244, by setting CV 123 to 4.

15. Overall view of completed installation



Econami evaluation

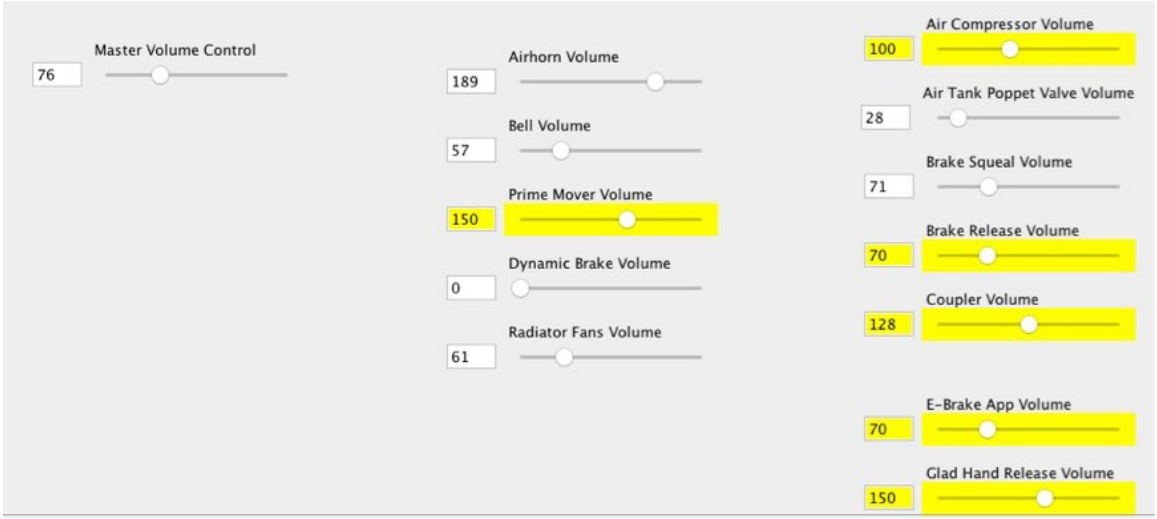
When the loco was closed and fired up, the full, rich sound of an ALCO starting filling the room. I kid you not. It was devastatingly loud.

I hit speed step one on my PowerCab and the loco crept along the track in forward and reverse.

Time to fire up DecoderPro and make some adjustments. You will need version 4.1.1 or later to have the Econami definitions.

I tamed the sound a bit. The adjustments shown in [16] were the first cut. I'll probably diddle a bit from there, perhaps taking the overall level down more to comply with the five-foot rule. With these settings, I can hear the loco in the next room.

16. First cut at sound levels - DecoderPro screen shot.



Equalizer

The equalizer is a fine feature, in my opinion. I've never adjusted individual levels in all of the Tsunamis and Econamis that I've installed. The presets are adequate. They are designed to adjust the low bass and treble to get the best sound out of various speaker sizes without overloading the speaker.

17. SoundTraxx Econami Electrical Tech Reference information about CV 225.

EQ0-EQ2: Equalizer Presets
0 = Flat (equalizer disabled)
1 = Micro speaker (smaller than 1")
2 = Small speaker (from 1" to 2")
3 = Medium speaker (from 2" to 4")
4 = Large speaker (larger than 4")
5 = Not used
6 = Not used
7 = User-adjustable (CVs 226-232)

0: Not used

Additional Information
Setting CV 225 to a value from 1 to 4 will adjust the 7-band equalizer frequency response according to speaker size.

Setting CV 225 to a value of 7 allows the boost/cut levels of the 7-band equalizer to be adjusted using CVs 226-232. Setting CV 225 to a value of 0 will disable the equalizer, i.e., all frequency levels will be set to 0dB (flat).

The equalizer is controlled with CV 225 [17]. I find that a setting of 1 to 3 in CV 225 gives the best sound for most speakers. This installation would up with CV 225 = 2. This

makes sense as I'm using a speaker right at 1 inch, but it is a high-bass design and I find that you can go up one speaker size with high-bass speakers.

I had to look that up, as I used DecoderPro to set the CV and don't try to remember what CV does what for various decoders.

Support Documentation

The one page card that accompanies an Econami decoder is barely adequate to show the connections and cover a few key CV settings. Full documentation is downloadable from the SoundTraxx web site.

Indexed CVs

The Econami introduced indexed CVs for the first time in a SoundTraxx product. Other manufacturers have used them for a few years, such as ESU (LokSound) and QSI. They are a way of overcoming an old DCC standard limitation of CVs at 256. Recent changes have expanded the total up to 512, but older systems still have the 256 limit.

In the literature you will find the normal CVs, such as CV 1, CV 29, CV 123. But also, you'll find CVs such as 1.257. This is shorthand for indexed CVs. To set CV 1.257 to a value of 100 follow these steps. Set CV 32 = 1 then set CV 257 = 100. Once you try a few, you'll get the hang of it. Personally, I don't want to deal with the issue and I let DecoderPro do the work.

Summary

I like the Econami and I like it in this loco. The sounds are crisp and accurate. It runs well at low speed without tweaking. It performed exactly as I expected, based on my experience with the ECO-100 product.

I did limit the top speed and the maximum volume for indoor use. Since this decoder will work with moderate garden locos, I expect the default settings are more in line with what would be needed in that environment.

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.

Parts	
Item	**Part Number**
ECO-400 diesel DCC + sound decoder	SoundTraxx 678-882005
CurrentKeeper energy storage module	SoundTraxx 678-810140
High-bass speaker: 28 mm square plastic	Litchfield Station SP-28SHB-08 or Railmaster
12 volt warm-white LEDs (qty 2)	Litchfield Station LED-3WW-12V
50 pin header stock (male and female)	Litchfield Station 575-500101 and 575-501101
Figure - Grizzly Mountain Engineering	owner supplied

O-scale Weaver RS3 Econami DCC + sound installation

Supplies	
Item	**Where I get it**
Caulk clear (Polyseamseal is my choice)	amazon.com/dp/B004Y6WWPW or Home improvement store
Cotton swabs	amazon.com/dp/B00028LZ0Y or “Dollar store”
Denatured alcohol	amazon.com/dp/B0090QFFJQ or Home improvement store
Nail polishing stick - 600 git	amazon.com/dp/B0002C72BG or Sally Beauty
Emery boards	amazon.com/dp/B00LOL4QXG or “Dollar store”
Kapton tape 1/2 inch x 0.001 thick	litchfieldstation.com/xcart/product.php?productid=999003138
Lacing cord, waxed	amazon.com/dp/B00NAOHSP8
MEK or other styrene solvent	amazon.com/dp/B00C1U2TYM or Hobby shop or Home improvement store
Nano-Oil: 5 weight, 10 weight, 85 weight	litchfieldstation.com/xcart/product.php?productid=999007592
Never-Stall	litchfieldstation.com/xcart/product.php?productid=999003384
Paint pen	amazon.com/dp/B002Q0S478 or Art supply
Shrink Tubing: diameters: 3/64 inch; 1/16 inch; 3/32 inch; ¼ inch	litchfieldstation.com/xcart/product.php?productid=999002714
Solder 60/40 rosin core	litchfieldstation.com/xcart/product.php?productid=999003041 or electronics store
Tape - grey - 3M outdoor mounting tape	amazon.com/dp/B00004Z4BV
wire 20 AWG solid (strip insulation off)	allelectronics.com/make-a-store/item/20gy-25s/20-ga-gray-hook-up-wire-25-solid/1.html
wire 26 AWG: stranded: red, black, gray, orange	allelectronics.com/make-a-store/category/825470/wire/cable/stranded-hook-up-wire-25-roll/1.html
wire 30 AWG; white, yellow, blue, purple	litchfieldstation.com/xcart/product.php?productid=2450009

Tools	
Item	**Where I get it**
Diagonal cutters	amazon.com/dp/B0002BBZ4M
Foam Cradle	litchfieldstation.com/xcart/product.php?productid=999005493
heat gun	michaels.com/10107547.html#q=embossing+heat+gun
Jeweler's screwdriver set	amazon.com/dp/B000NZ5QGK
needle nose pliers	amazon.com/dp/B004UNFE9U
One hand clamp	amazon.com/dp/B00002244V
Power Supply adjustable 18 V 3 A	mpja.com/0-18VDC-0-3-A-Variable-Benchtop-Power-Supply/productinfo/29600%20PS
Rotary tool and sanding drum	amazon.com/dp/B008DRY5AI
Soldering station	litchfieldstation.com/xcart/product.php?productid=999002741
Turntable for pottery making or sculpting	dickblick.com/products/activa-sculpting-wheel or dickblick.com/products/amaco-no-5-decorating-wheel
Tweezers: cured, straight, clamping	digikey.com/product-search/en?s=4381&FV=fff40013%2Cfff8034d%2Cfffc0048&mnonly=0&newproducts=0&ColumnSort=0&page=1&stock=1&quantity=0&ptm=0&fid=0&pageSize=25
Vise	amazon.com/dp/B005JVK1GS
Wire strippers for 22 AWG to 30 AWG	litchfieldstation.com/xcart/product.php?productid=340001

Mr. DCC's Workshop

Keeping your wire neat

It is great to have a choice of wires when you are installing decoders. Different sizes and colors make safe and professional looking installations easier.

I buy larger gauge wires by the spool, but a spool of 30 AWG is a lot of wire. So I buy the 10- or 20-foot packages. They give me lots of wire for many installations and reduce the amount of space needed to store wire. But I've had a dickens of a time keeping them neat. Then I hit on an idea.

I wrap the wire around my hand and tuck the resulting hank into a piece of shrink tubing. I find that the 3/8 inch diameter gives a nice fit. I keep them in a storage tray and have all the colors together when I need them.