



## DCC Decoders for Brass Steam Locomotives

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Copies of this presentation can be found at

<http://www.markschutzer.com>

# Clinic Overview



## Part 3 – Installing DCC decoders

- In the first two parts of these clinics we focused on improving the running characteristics of brass steam locomotives.
- In this third clinic we will modernize the locomotive with the installation of a DCC decoder.
- After presenting some general decoder information I will guide you through a step by step installation example.
- This clinic will show a beginner how to install decoders in brass locomotives.

# DCC Decoders Overview



Electrical pickup review

Typical Instructions

Motors

Decoder selection – size, type, and current rating

Lighting – Incandescent bulbs and LED's

Connectors and wiring techniques

Step by step installation example

Advanced installations - Sound

More examples...

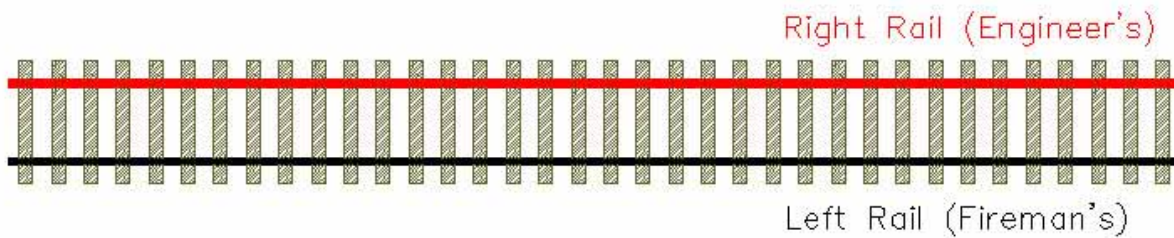
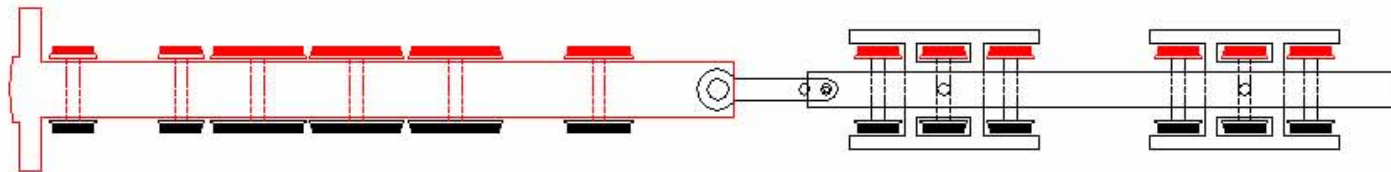
Sources

# Electrical Pickup



Locomotive Frame is connected to right rail.

Tender Frame is connected to left rail.



# Typical Instructions

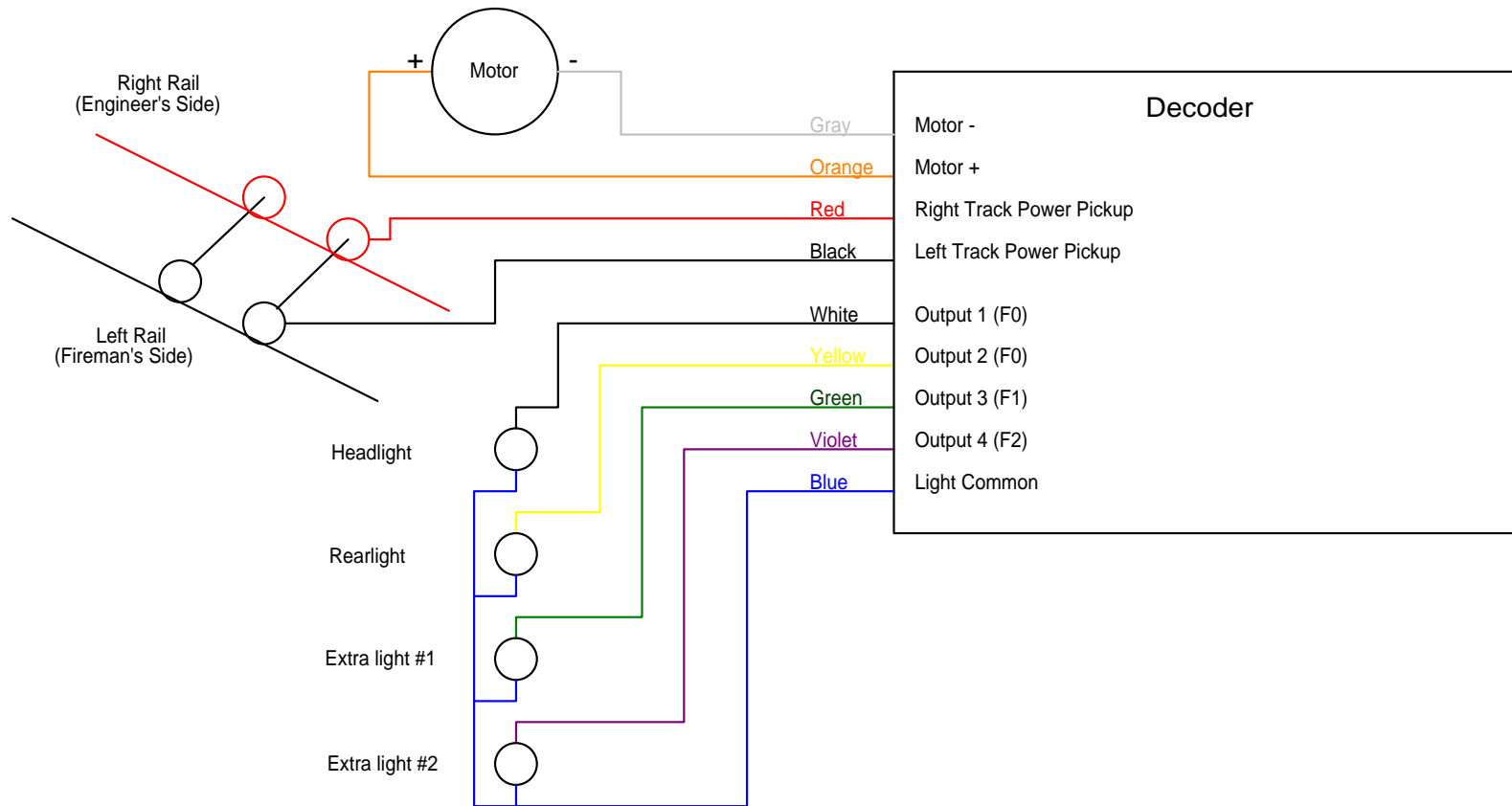


## Generic Instructions

- Mount decoder
- Isolate motor contacts from track and frame
- Wire motor connections
  - Red wire to right rail, Orange wire to motor positive
  - Black wire to left rail, Grey wire to motor negative
- Replace 1.5 volt bulbs or add limiting resistors
- Wire lighting circuits
  - Blue wire is positive common for all function outputs
  - White wire is headlight output (F0 forward)
  - Yellow wire is rear light output (F0 reverse)
  - Green wire is F1 output (if supported)
  - Violet wire is F2 output (if supported)
- Test on the programming track
- Program as desired...



# Decoder Wiring





# Motors

# Original Motors



## Original Motors

- Most early motors are open frame types
- Poor slow speed operation
- High starting voltage and current
- Not very efficient
- High slip and stall currents
- Require a higher rated decoder, costing more money \$\$\$
- Sometimes require work to isolate from frame
  
- Replacement strongly recommended!

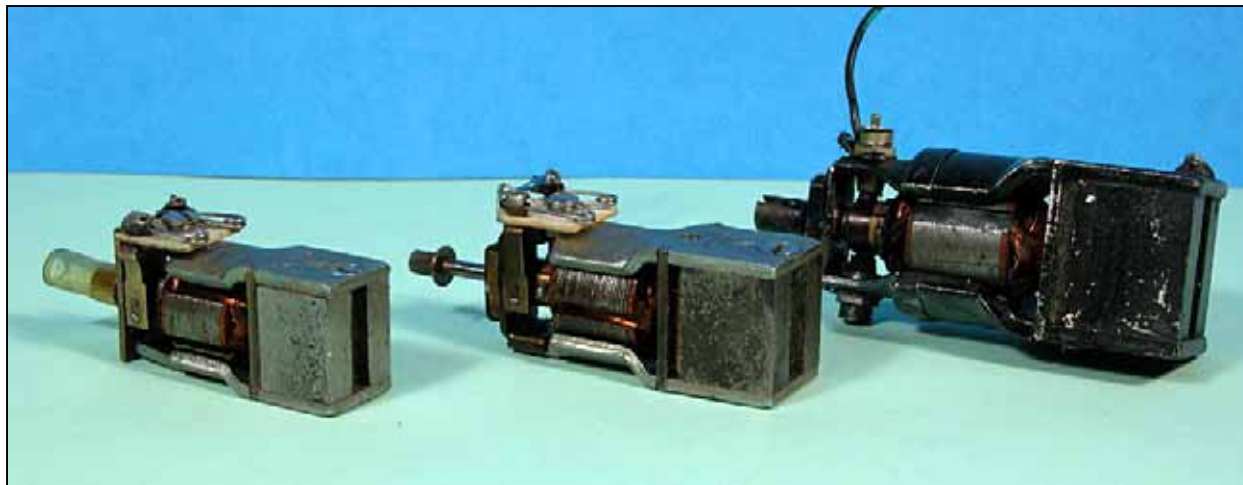


# Original Motors



Some typical open frame motor numbers

Motor Type Open Frame KTM	Free Running Current (Amps) 12 volts	Typical loaded Current (Amps) 12 volts	Stall Current (Amps) 12 volts
Small	0.6	1.0 or more	2.0
Medium	0.6	1.2 or more	2.9 – 3.0
Large	0.7	1.5 or more	> 3.5



# Can Motors



## Can motor advantages

- More efficient, much lower current draw
- Most are skew wound for very good slow speed performance
- Slower starting speeds and excellent slow speed torque
- Better slow speed performance allows lower gearbox ratios to be used reducing the top end noise.
- DCC friendly; isolated terminals, and most HO sized motors have stall currents under or about 1 amp.



# Can Motors



Some typical can motor numbers

Motor Type NWSL	Free Running Current (Amps) 12 volts	Max. Continuous Current (Amps) 12 volts	Stall Current (Amps) 12 volts	Stall Torque (Oz.-in.)
12270-9	0.08	0.25	0.54	0.61
16307-9	0.05	0.34	0.95	0.79
18367-9	0.19	0.40	1.20	2.50
20324-9	0.05	0.36	0.90	1.40

N scale decoders okay for all of these!

- 1 amp continuous rated

# Selecting a decoder



## Choices, choices, choices...

- Decoder rating should be in excess of full slip current at 12 volts
- Sized to fit locomotive
- Feature selection
  - Number of lighting outputs
  - Silent running
  - Torque compensation
  - Back EMF; also known as load compensation, or cruise control
  - Advanced consist support
  - Automation features
  - Sound, Tsunami, Micro Tsunami
- Choose your favorite supplier
- Lots of decoders rated in the 1.0 to 1.3 amp range

# Lighting



## Lighting

- Function outputs are used for lights
- Function 0 is direction sensitive and has 2 outputs associated with it by default. Controls headlight and back up light.
- Almost all decoders have at least 2 function outputs, many have 4 outputs or more.
- Most decoders support a variety of special lighting effects.
- Decoders supply 12.5 volts to the lights
- Modify existing bulbs, several options...
  - Add resistor in line with 1.5 volt bulbs
  - Replace 1.5 volt bulbs with 14 volt bulbs
  - Replace 1.5 volt bulb with sunny white LED and resistor
- Use a spare lighting output to provide a firebox flickering effect.

# Lighting



## Lamps and Resistors

Lamp Type	Current	Resistor
12 to 14 volt bulb	< 50 mA > 50 mA	None 22 ohm, ¼ Watt
1.5 volt bulb	15 mA 30 mA	820 ohm, ¼ Watt 390 ohm, ½ Watt
White LED	3 mA	3300 ohm, ¼ Watt

# Wiring



## Wiring techniques

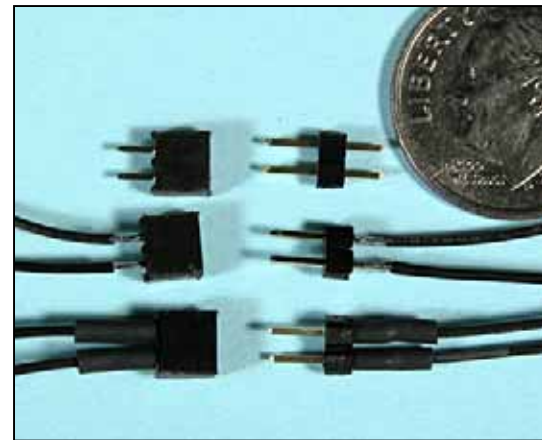
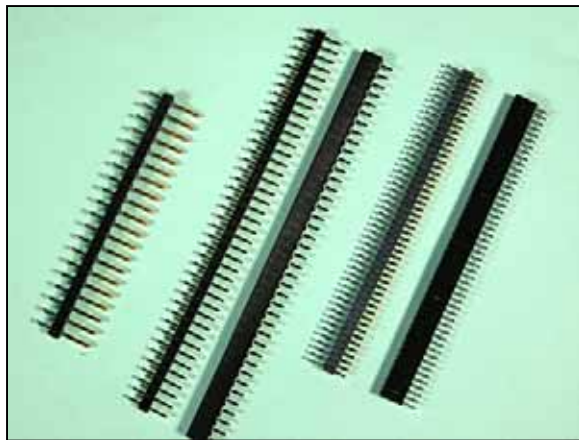
- Install decoder so that boiler can be easily removed
  - Use connectors on wires inside of boiler (headlight)
  - If decoder is captive in boiler use connectors for everything
  - Use connectors for all boiler to tender wiring
- Solder all wire connections
  - Use a water, or Rosin based flux (Not acid based!)
  - Clean off flux with water, or isopropyl alcohol
- Use heat shrink tubing on all exposed connections to keep the wiring both insulated and neat. Get several different sizes.

# Connectors



## Connectors

- Available from Miniaturics
  - Expensive, \$10 dollars for a pair of 2 pin connector sets
- Easy to make from low cost pin strips and sockets
  - Several sizes available
  - Pin spacings of 0.1 inch, 2 mm, 0.05 inches
  - 40 pin strips are best cost value, about \$2 dollars each
  - Cut to the number of pins needed
- Solder wire to pin leads and insulate with heat shrink tubing







## Installation Example

# Decoder Installation Example



Decoder Installation – Max Gray, Ten Wheeler



# Boiler Removal



## Removing the boiler

- The boiler is usually secured to the frame with three screws.
- The front screw usually also secures the pilot trucks in place.
- The two rear screws are either under the cab, or in this case in the back wall of the cab.
- Remove the two cab screws and the pilot truck mounting stud to loosen the boiler.

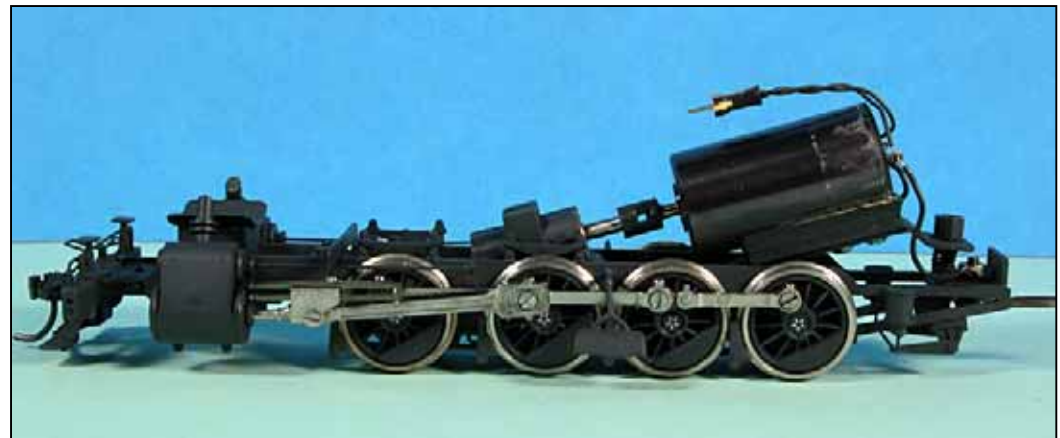
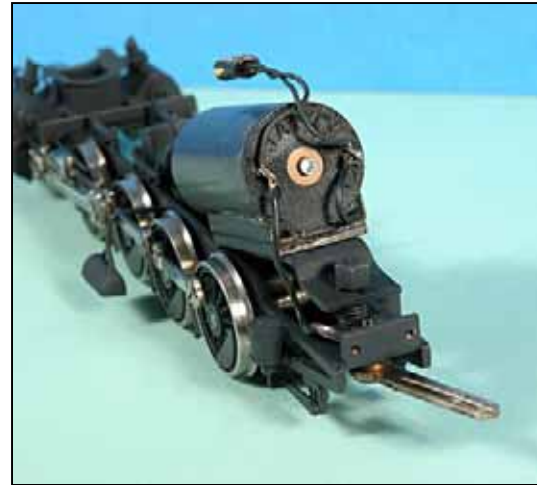


# Boiler Removed



## Boiler Removed

- Note motor wiring, identify right and left rail connections.
- Note headlight connector.

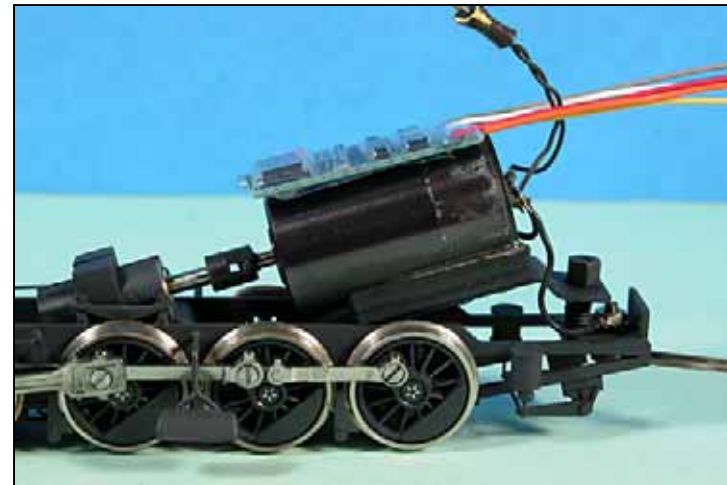
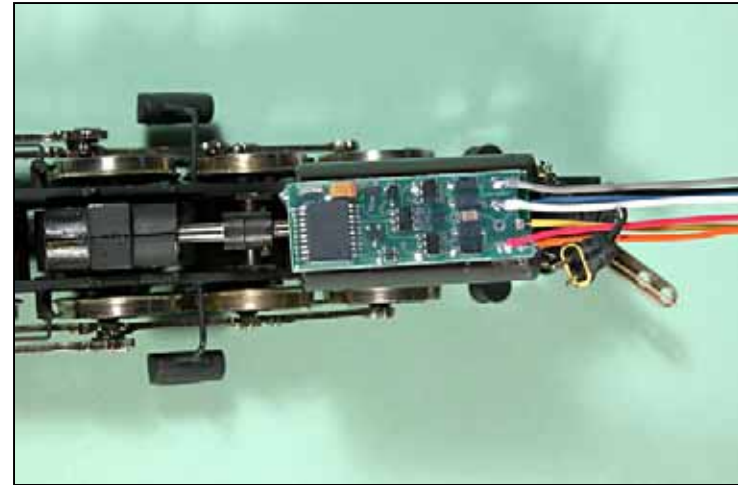


# Decoder Fitting



## Test fit selected decoder

- Decoder N14SR
- Test fit decoder to determine ideal position.
- Usually place decoder on top of motor.
- With decoder in place verify boiler clearance, adjust location as needed.

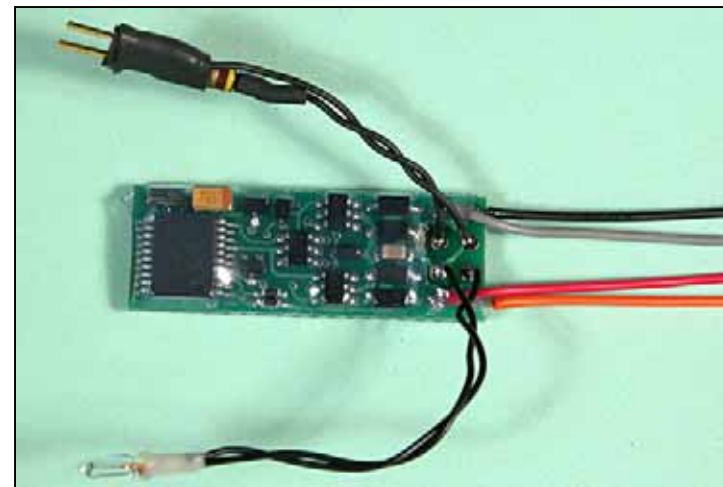
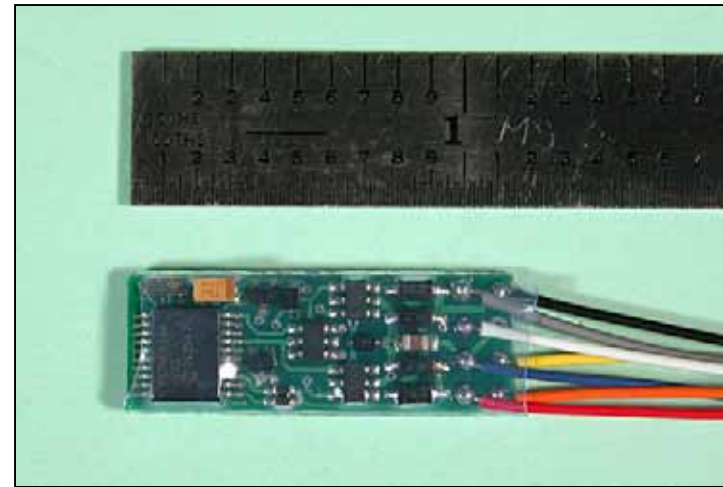


# Decoder Preparation



## Preparing Decoder

- Original decoder shown to right.
- Add resistor to headlight connector.
- Solder headlight connector to decoder.
- Solder firebox flicker light to decoder.
- Use heat shrink tubing to insulate connections.
- Heat shrink decoder (if not already)



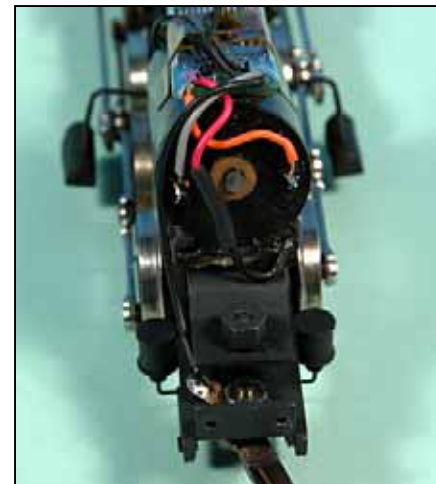


# Motor Wiring



## Wiring Motor Connections

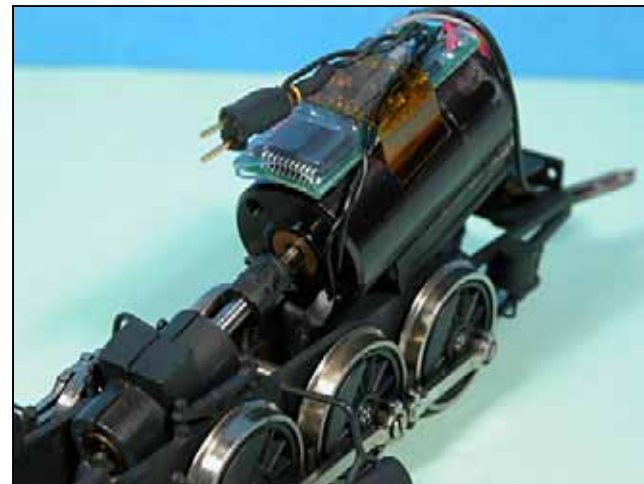
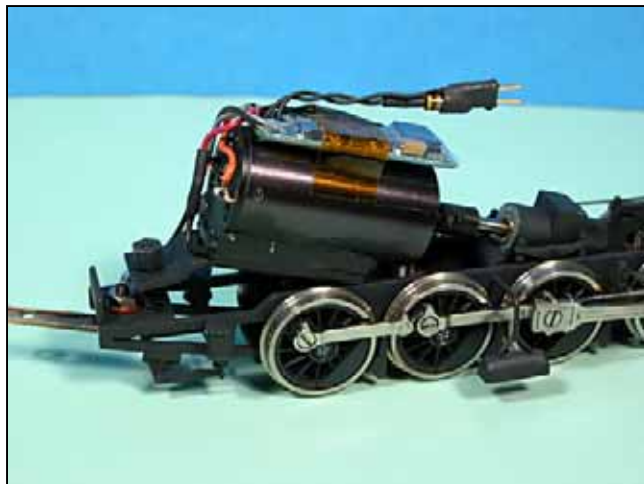
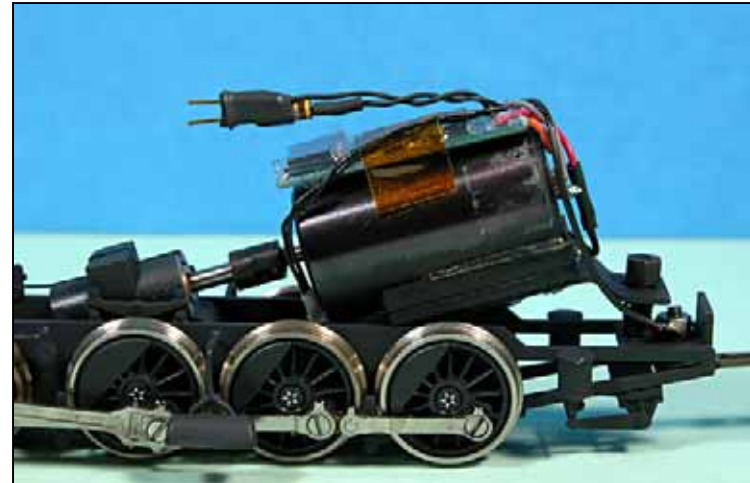
- Reference original motor connections.
- Connect red wire to right side pickup (locomotive frame).
- Connect orange wire to the motor terminal that was connected to the right side rail (frame connection).
- Connect black wire to the tender drawbar.
- Connect grey wire to the motor terminal that was connected to the tender drawbar.



# Installing



Secure decoder with Kapton tape or electrical tape.  
Place firebox flicker light in position.  
Test first on programming track, and then on main.  
Reinstall boiler to complete.  
Recheck operation.





# Sound



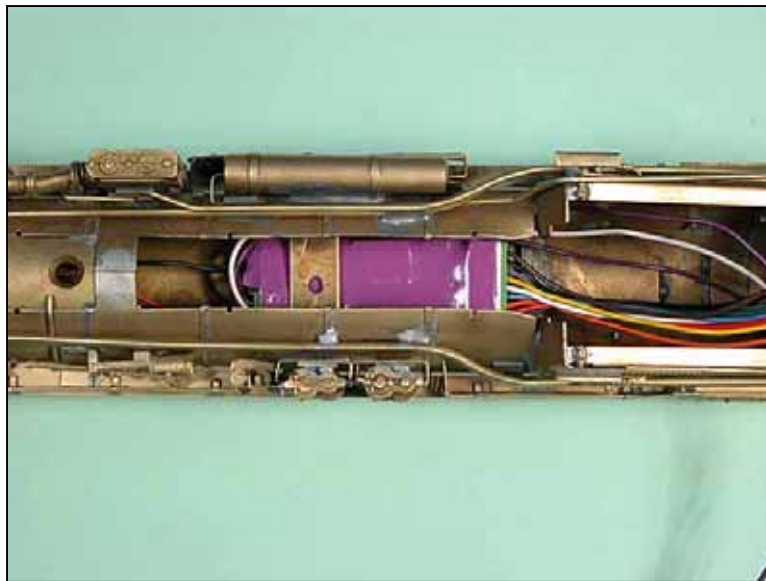
## Sound Decoders

- Sound decoders, Soundtraxx Tsunami, Best in class sound with silent BEMF motor control.
- Installation the same as a regular decoder but with more wires
  - Two additional wires to connect to speaker
  - One wire for optional synchronization cam
- Speaker usually mounted in tender
  - Requires holes to be drilled in tender frame or body
  - Tender shell can act as the speaker enclosure
  - Two wire connector between locomotive and tender
- Optimal chuff synchronization requires a sound cam

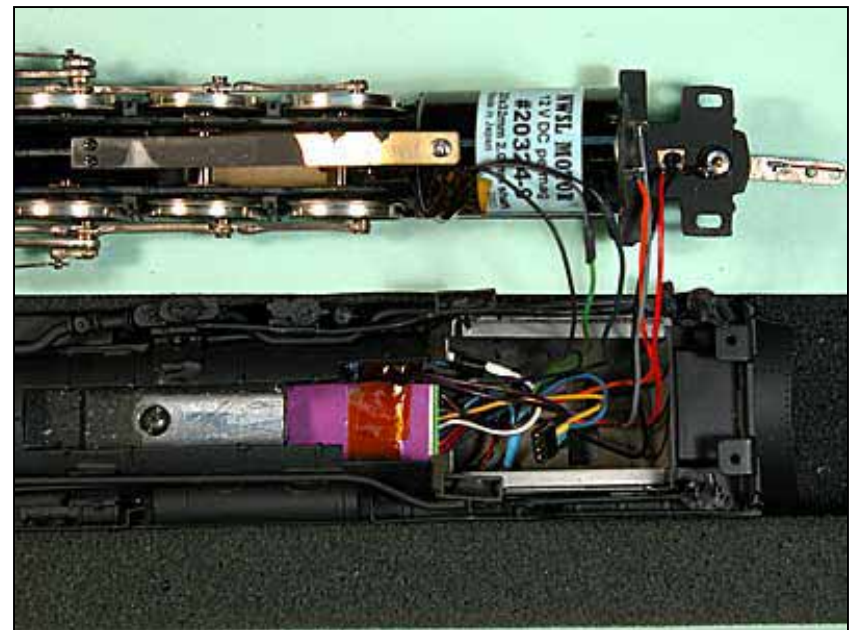
# Sound Decoder Installation



## Tsunami in Boiler



- Decoder tucked up above boiler weight

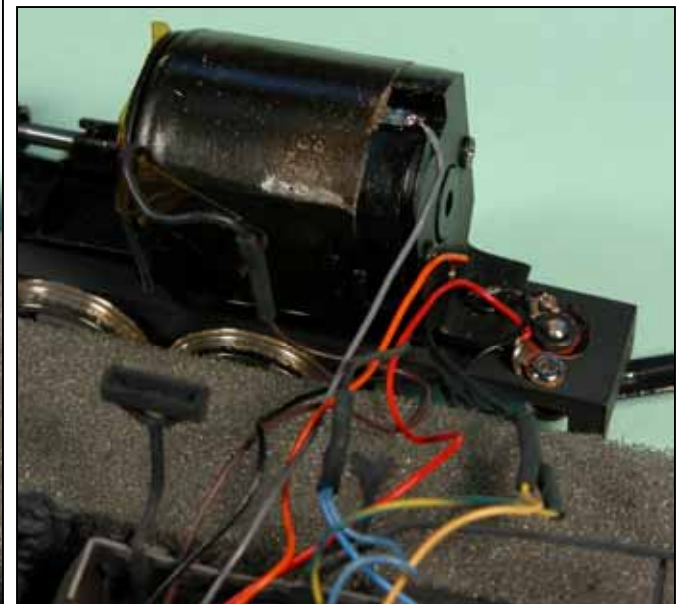
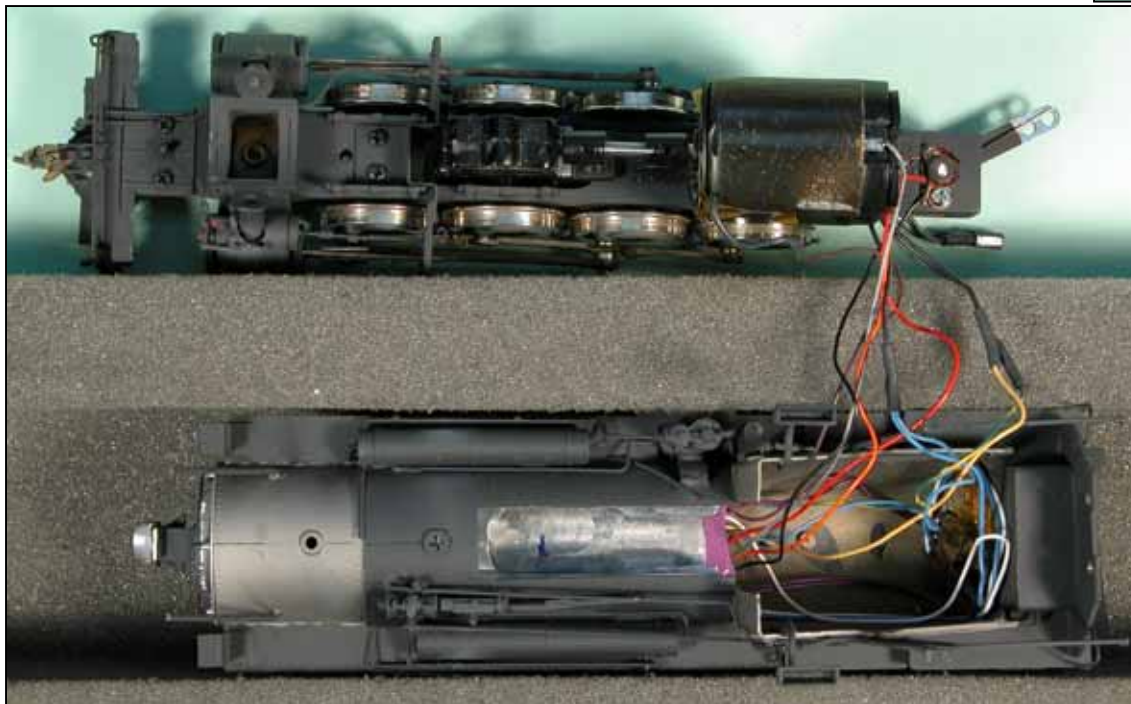
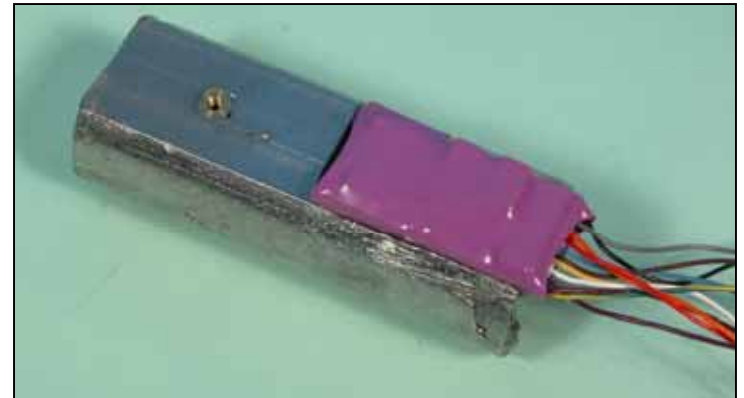


# Sound Decoder Installation



## Micro Tsunami in a Consolidation

- Decoder tucked up above boiler weight



# Sound Decoder Installation



## Micro Tsunami in a Consolidation

- Keep alive caps in tender



- Speaker in smoke box





# Sound Installation

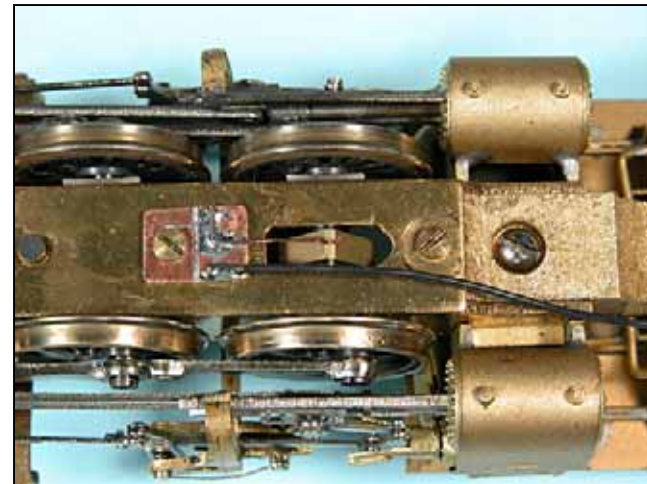
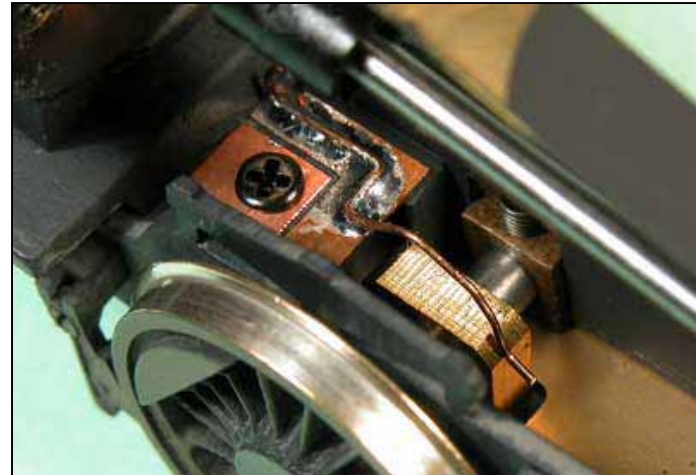


## Additional Sound work

- Sound cams



- Sound cam installation
- Make wiper from small circuit board, use phosphor bronze wire for contact

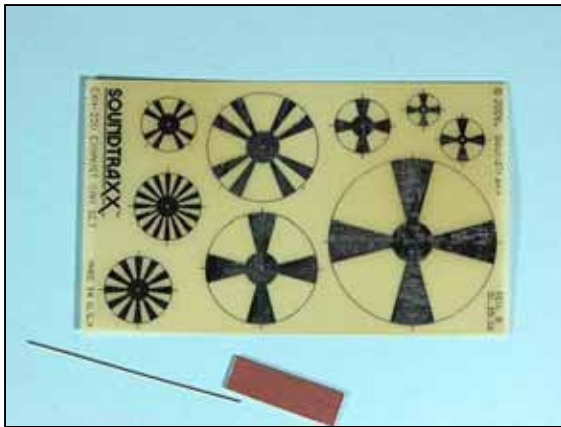


# Sound Installation

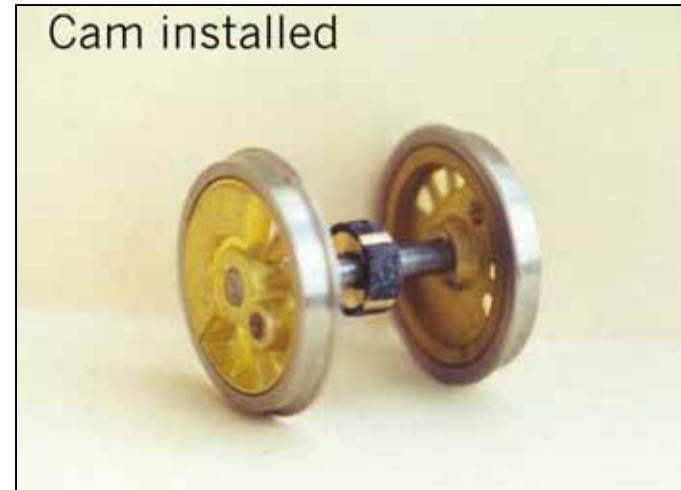


## Other Sound Cam options

- Soundtraxx printed circuit board cams



- Grizzly Mountain Engineering Cams, split cams that attached with conductive Epoxy, wiper kits also available
- No driver pulling required with these cams



# Sound Installation



## Speaker installation

- Usually installed in tender



- Requires drilling hole pattern in tender for sound outlet
- Use the biggest speaker that will fit!

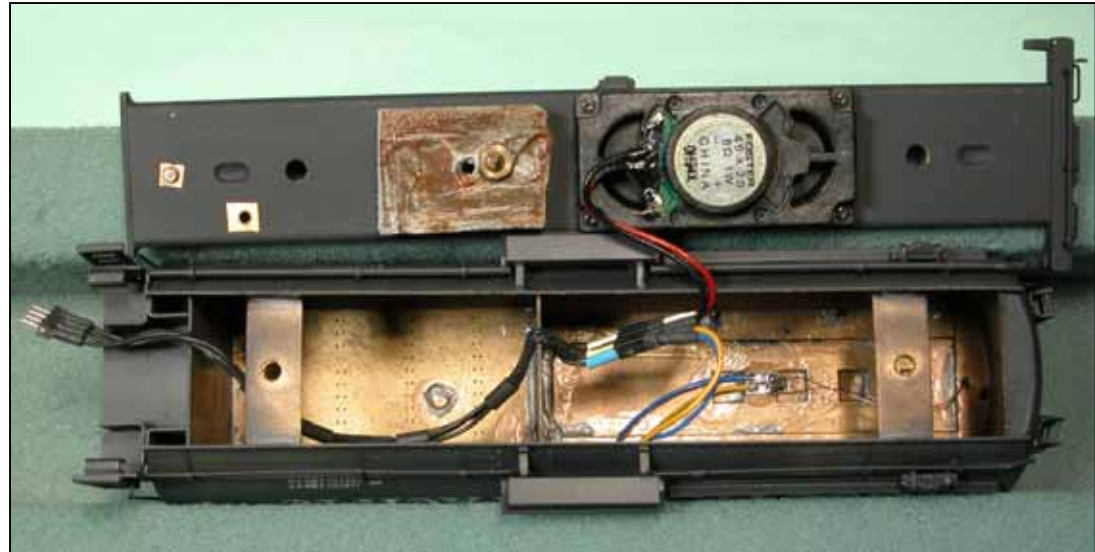


# Sound Installation



## Speakers

- Another example.



- Small speakers allow for mounting in the boiler.



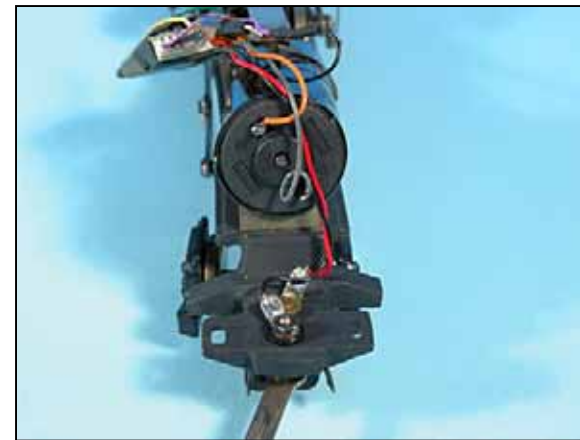
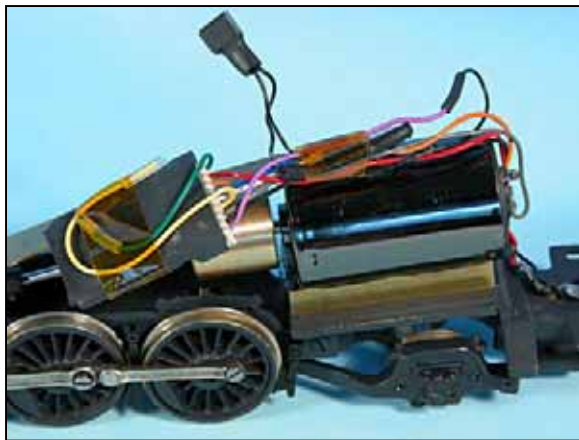
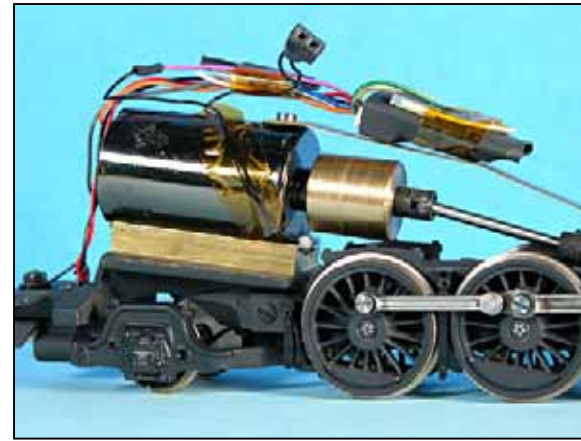
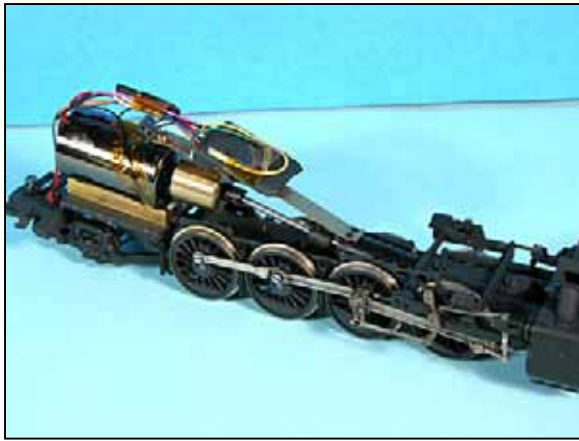


# More Examples

# Examples



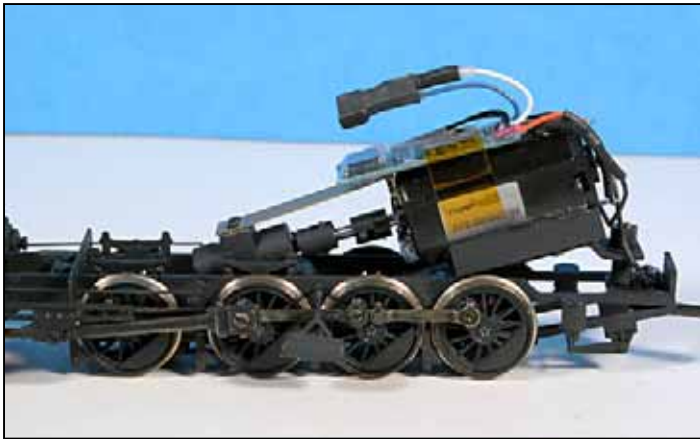
Balboa MT-4, Lenz Gold decoder



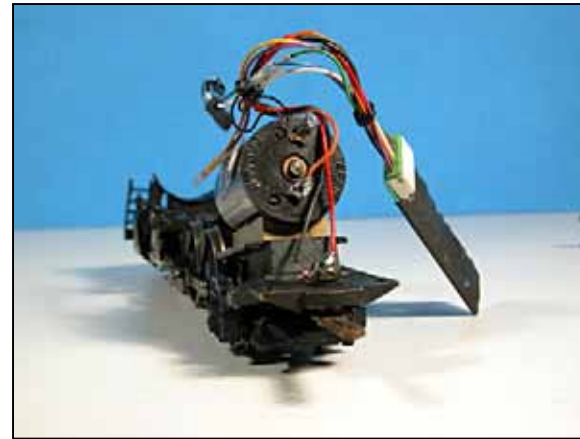
# Examples



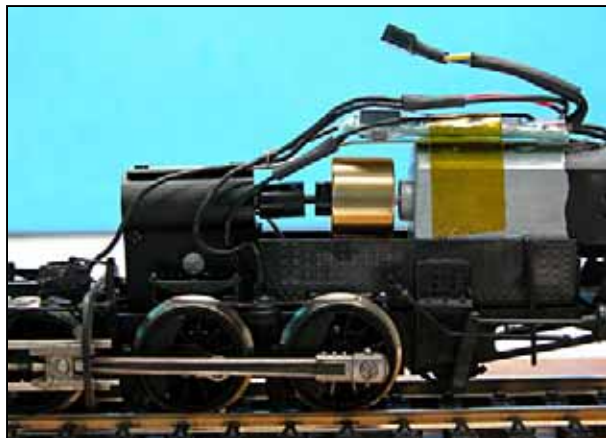
Max Grey TW-8, N14SR decoder



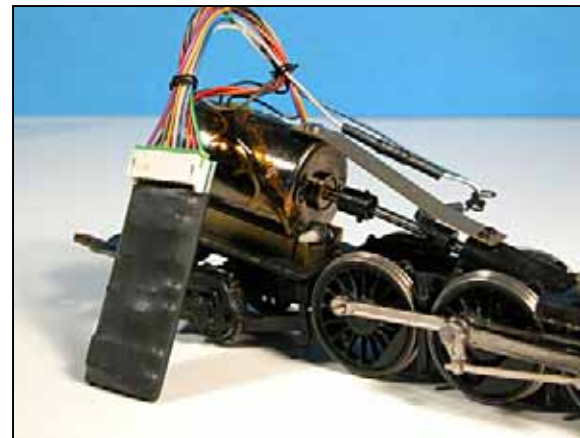
Balboa P-10 #2486, D13SRJ



Westside 0-6-0T, N14SR decoder



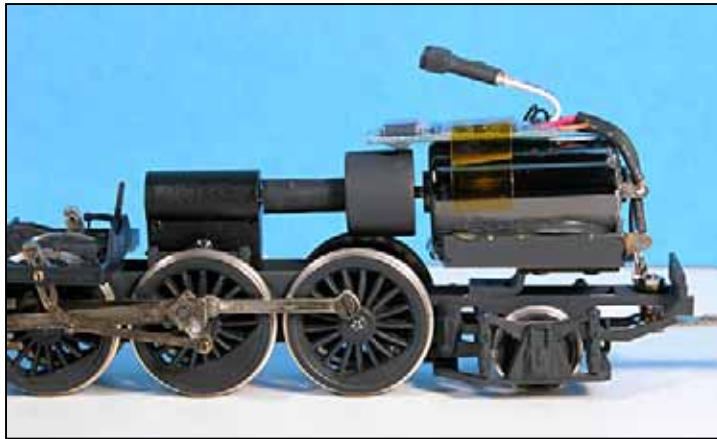
Balboa P-10 #2486, D13SRJ



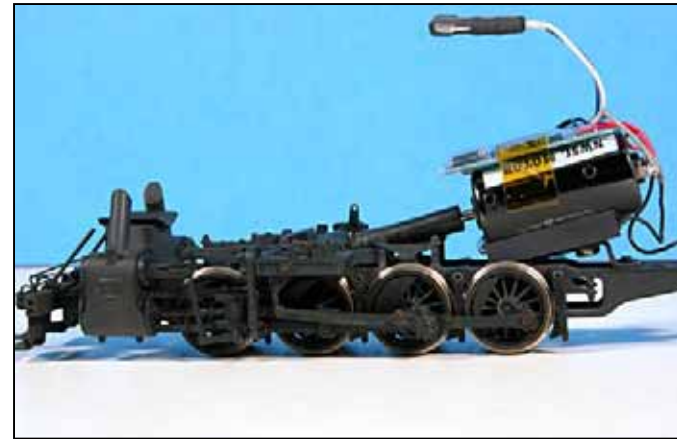
# Examples



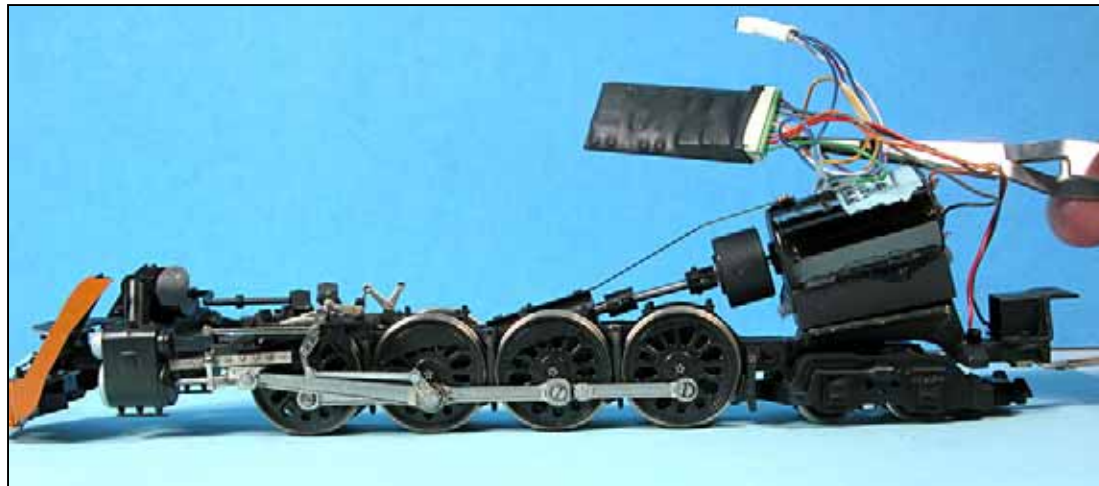
Tenshodo P-5, N14SR decoder



Balboa SE-4, N14SR decoder



Balboa GS-4, D13SRJ decoder



# Tender Mounting



## Decoder mounted in tender

- Required when there is limited room in boiler.
- Install the same as a regular decoder
- More wire connections between boiler and tender
  - Two wires needed for motor (orange and grey)
  - Two wires needed for headlight (white and blue)
  - One wire needed for right (engineer's) rail pickup (red)
  - One additional wire needed for optional firebox effect light
- Up to six wire interconnects makes for big connector
  - Use two 3 pin connectors
- Tender mounting is not recommended unless space constrained
  - Too many interconnect wires



## Sources

## Sources



### Digi-Key Electronics - [www.digikey.com](http://www.digikey.com)

- Resistors
- Heat Shrink tubing
  - Various different sizes, 3/32", 1/16", 1/8", 3/16", etc.
- Pin strip headers / sockets
  - 40 pin 2mm header strip, part number S5800-40-ND
  - 40 pin 2mm socket strip, part number S5751-40-ND
- Kapton tape
- Speakers

### Miniatronics - [www.miniatronics.com](http://www.miniatronics.com)

- Miniature connectors
- Various miniature bulbs, 1.5 volt, 12 volt, and 14 volt flavors

### Richmond Controls - [www.richmondcontrols.com](http://www.richmondcontrols.com)

- Sunny white and golden white LED's, 3mm and 5mm diameter

## Sources



### Grizzly Mountain Engineering – [www.g-m-e.com](http://www.g-m-e.com)

- Sound cams
- Sound pickup wipers
- 2 Pin strip headers / sockets
- Speakers

### Soundtraxx - [www.soundtraxx.com](http://www.soundtraxx.com)

- Decoders, Tsunami, Micro Tsunami
- PC board sound cams
- Speakers





Questions?