SoundTraxx Tsunami2 TSU-1100 Decoder Installation Into HO P2K GP9

Date: June 21 2019

The [SoundTraxx Tsunami2 TSU – 1100](#) sound decoder in combination with SoundTraxx's Mini Cube speaker is a very versatile sound decoder that can be used in many difficult space challenged installations. It's principal

advantage is size (27 x 10.5 x 5mm), and I like that it includes an optional use small capacitor which has bare minimum Keep Alive ability. You can still use a

greater capacitance Current Keeper if you have the space, but the small size of the included capacitor allows installation into cramped quarters. This decoder only has 4 Function outputs as opposed to the Tsunami2 2200 Decoder which has 6. The specifications for the Audio Amplifier:1 Watt, 8-Ohm Load, and motor stall current of 1 Amp, versus 2 watts and 2 amps for the Tsunami2 2200 Decoder are the price you pay for the reduction in decoder size….a good trade off when space is limited! Using the SoundTraxx Mini Cube Speaker is also a space saver. It fits into one side of the cab, and still produces excellent and loud enough sound!

The locomotive model I used for this installation is a LifeLike Proto 2000 GP9. These locomotives had a good reputation for smooth running and motor reliability, but they did have an issue with cracked driver gear axles, prior to Walthers buying out the LifeLike line. See Model Railroader forum information regarding this issue. Prior to undergoing this decoder installation, insure your locomotive is running reliably on DC with no motor or driver gear problems. I encountered cracked axle gears in two of my P2K GP9s, one of which I corrected simply using Cyanoacrylate glue to reinforce the gear axle at the site of the crack. On another loco with the axle gear issue, I replaced the gear with a new one.

The Parts list:

SoundTraxx Tsunami2 TSU-1100 Sound decoder
(With included capacitor)
If purchased separately…Tsunami 220µF Replacement Capacitor
810128 $0.95
This 220µF capacitor helps keep power to the decoder during momentary power losses. For use with decoders that use an external capacitor assembly, such as the TSU-1100 or ECO-100.
Note that there is a good article in June 2019 issue of MRH online magazine on making your own Keep-Alives.
Speaker: SoundTraxx Mini Cube Speaker –
Mini Cube Oval Speaker/Baffle
810154 $14.95
Mini Cube Speaker

This tiny speaker comes with a properly proportioned speaker enclosure and provides great results for space-constrained models!

Dimensions: 16 x 12 x 11.3mm(D)

Frequency Response: 300Hz - 20kHz

Peak Power: 1 Watt

Impedance: 8 Ohms

Note that this is a different speaker than their Mini Cube2 speaker. SoundTraxx recommends this speaker (Mini Cube) be used as two speakers connected in series, (16 ohms impedance) if using with a Tsunami2 – 2200 Decoder, but makes no mention of two speakers in series when recommending this speaker for use with the Tsunami2 – 1100. (See their comments on their web site). I assume the difference is that the TSU-2200 decoder has 2 watts of audio output versus 1 watt for the TSU- 1100 Decoder. I found the single Mini Cube speaker used with the TSU- 1100 decoder worked very well with ample volume and great sound.

2 - 5mm 3.5 volt sunny white LEDs
1 - 5mm 3.5 volt red LED
1 - 3 mm amber LED
3 – 1.5K ohm ½ watt resistors
1 – 1.8K ohm SMD Surface Mount resistor

Kapton tape
30 AWG coloured wire
Heat shrink tubing

A note about my experience with SoundTraxx Mini speakers:
The single Mini Cube Speaker I used in this project with the TSU-1100 1 watt 1 amp Decoder worked very well. Sound quality and volume are excellent. It is very convenient having a speaker Baffle included with the Mini Cube Speaker, and of course the size of the speaker itself when used with the TSU – 1100 decoder saves a lot of space.

In a number of my HO decoder installation projects, I have used SoundTraxx Mini Oval (moderate size and smallest size) speakers, the Mini Cube and the Mini Cube2 speakers, and the Round speakers in Sound Car Installations. I have been

very satisfied with ALL the SoundTraxx speakers I have installed. The small Mini Cube2 speakers (32 ohm impedance) …two in parallel for a total of 16 ohm impedance connected with a TSU – 1100 gave the lowest volume and perhaps the least satisfactory sound ..still great though .. of all the SoundTraxx speakers I have used. See my article "Install SoundTraxx TSU-1100 Decoder in P2K EMDGP38-2" elsewhere on my web site. The SoundTraxx speaker I use the most is 35 x 16mm Oval Speaker

810113 $14.95

35x16 Oval Speaker

If you have more space, this speaker is great for larger models.

Dimensions: 35 x 16 x 8mm(D)

Frequency Response: 250Hz - 13kHz

Peak Power: 2 Watts

Impedance: 8 Ohms

My favourite SoundTraxx speaker is the small Mini Oval, because it will fit in HO narrow hood models: (See my article "Installing a Tsunami2 PNP SoundTraxx Decoder into an Alco RS3 HO locomotive")

25 x 14mm Oval Speaker

810112 $14.95

25x14 Oval Speaker

This small speaker is perfect for narrow hood diesels and anywhere else where space is at a premium.

Dimensions: 25 x 14 x 5.2mm(D)

Frequency Response: 300Hz - 20kHz

Peak Power: 1.5 Watts

Impedance: 8 Ohms

The first issue to solve is **where to put the parts**. As with any HO decoder installation, sometimes available space is the most significant constraint.

To remove the shell from the P2K GP9: To remove the shell the couplers do have to be removed. However note that the rear coupler has to be removed by drawing medially rather than forwards and the front coupler cover is glued to the front railing plough bar and can be left on in taking the shell off. Two screws in front of each truck secure the chassis to the shell and these have to be removed. Note that the coupler screw is the longer screw and the screw that looks like a wood screw and is shorter is the one that secures the chassis to the shell.
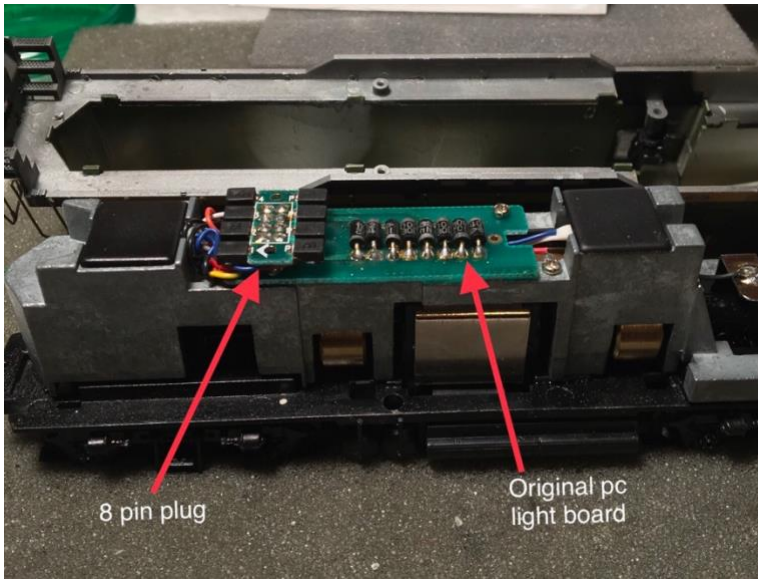
What you see after removing shell
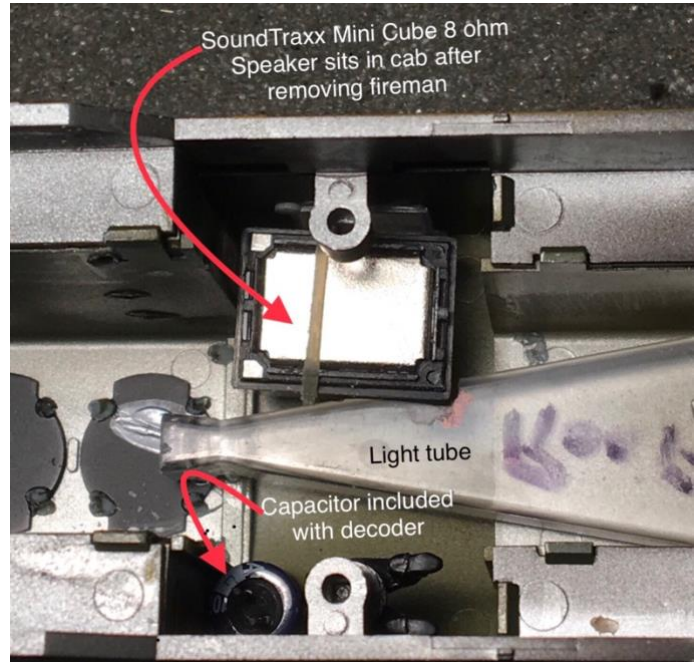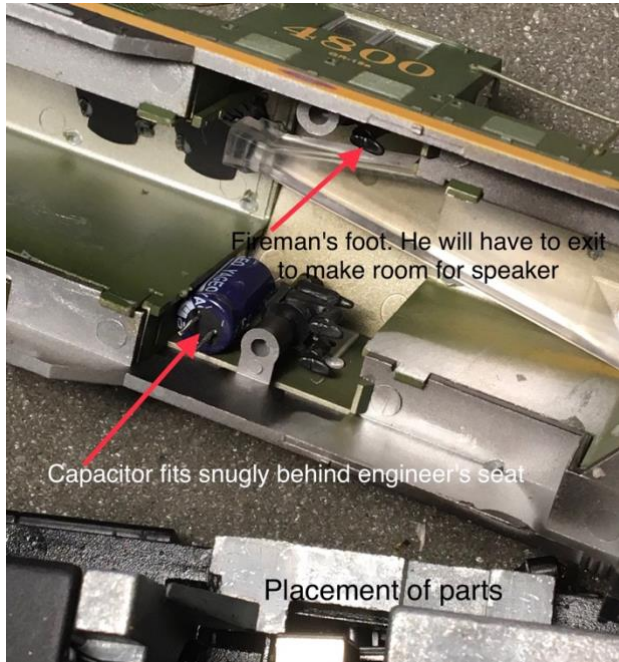

8 pin plug

Original pc light board

The 8 pin plug and the original PC light board are removed. Keep the 8 pin plug for future decoder projects. These are hard to come by. Always remember to label the chassis Front and Rear…this will save confusion later!
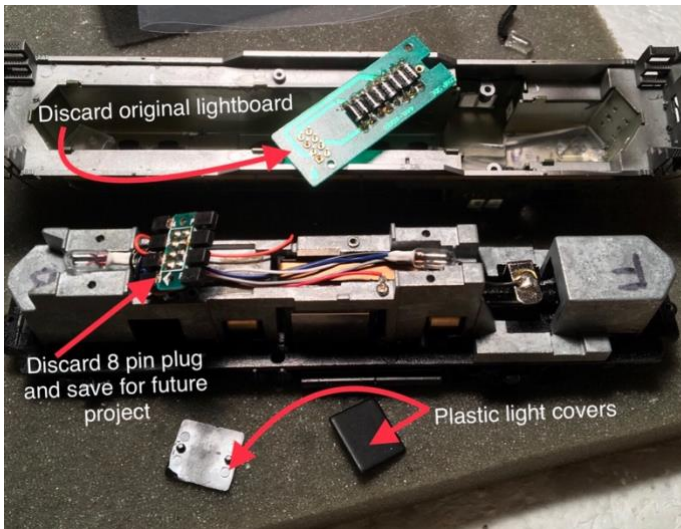
Discard original lightboard

Discard 8 pin plug and save for future project

Plastic light covers

As for placing the parts a bit of trial and error is required. I eventually settled on

Fireman's foot. He will have to exit to make room for speaker

Capacitor fits snugly behind engineer's seat

Placement of parts

SoundTraxx Mini Cube 8 ohm Speaker sits in cab after removing fireman

Light tube

Capacitor included with decoder

placing the speaker and the capacitor one on each side of the cab. Unfortunately

Cut notch in light tube to accommodate cube speaker

for the fireman, he had to go! To allow the Mini Cube Speaker to fit it was necessary to cut a notch in the light tube. See photo above. The decoder and resistors were placed on the top of the locomotive chassis. I also added a Rotary

Green/yellow wire to capacitor

Red wire + right rail track pickup connects to chassis

Black wires from left - rail pickup

All blue wires + common

Resistor board

Rear headlight LED (yellow wire)

Front headlight LED (white wire)

TSU-1100 decoder

Placing the parts
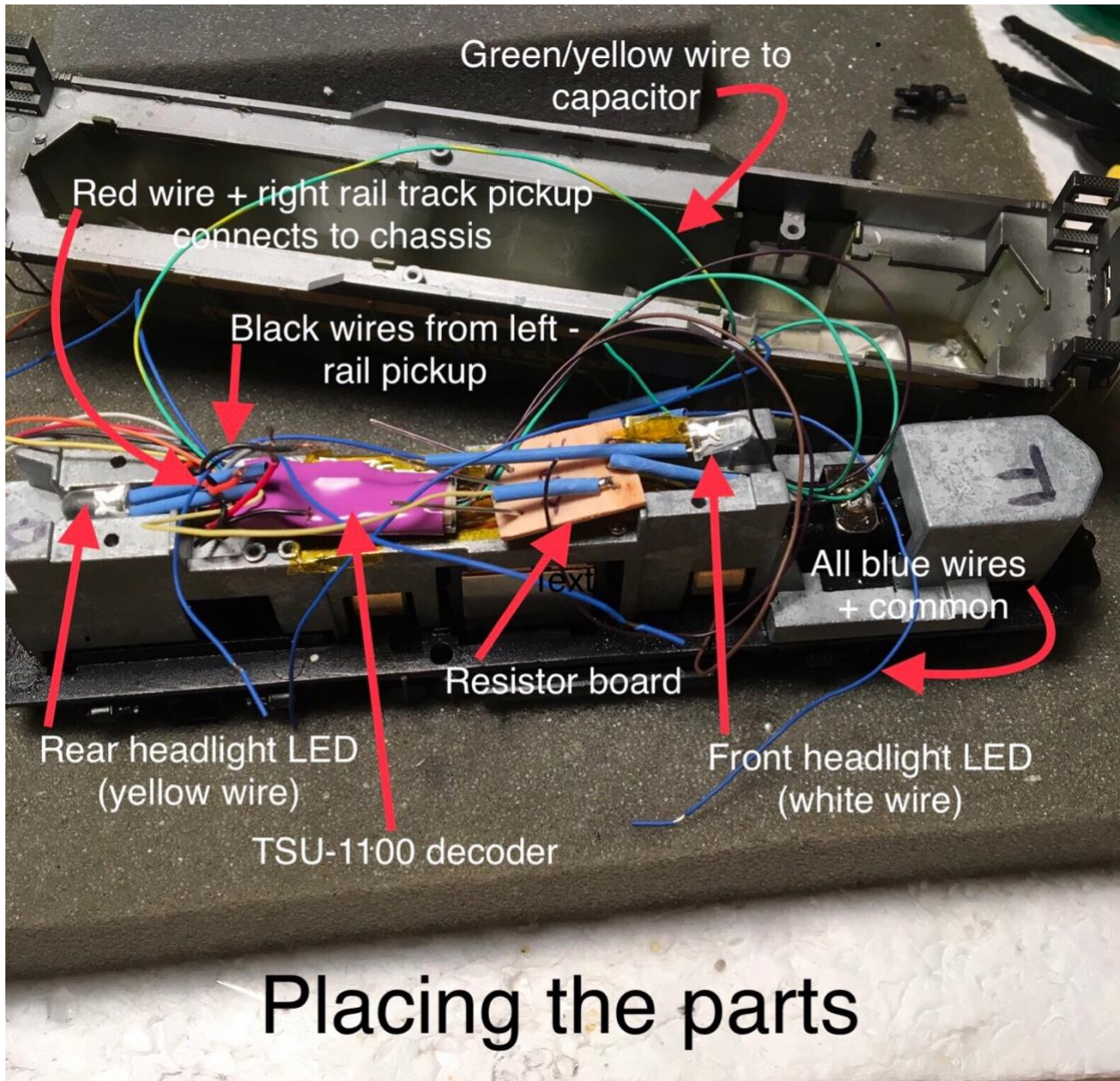
Beacon, using a 5 mm Red LED mounted on the cab roof, actuated by Function 25, and an amber 3 mm LED, for a cabin light, actuated by Function button 24.

On this later Proto 2000 version model, DCC had become well enough established that companies started using the correct NMRA colour codes for wiring. Sure

helps to keep the wires straight. Read more comments about how the wiring is handled in this locomotive further on.

First a word **about the capacitor**. It has a polarity that must be adhered to. The grey/white stripe on the side of the can marks the negative terminal of the
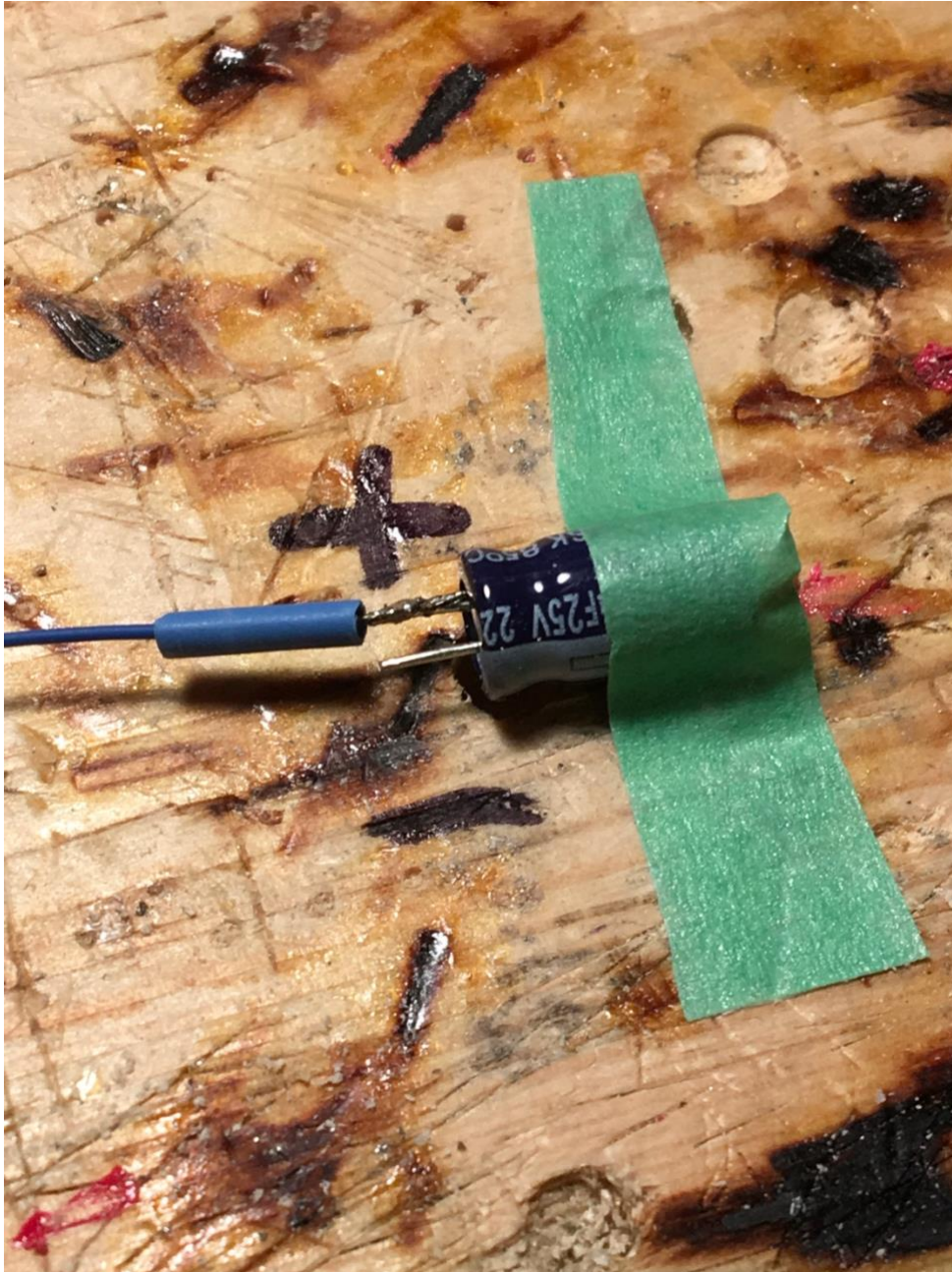
capacitor. This connects to the Green/Yellow striped wire (ground-negative on the decoder). See wiring schematic below on page 9.

The positive terminal connects to the + common blue wire connections from the decoder. I have used heat shrink tubing to insulate the electrical connections.

The schematic wiring diagram for the Tsunami2 TSU-1100 Sound decoder
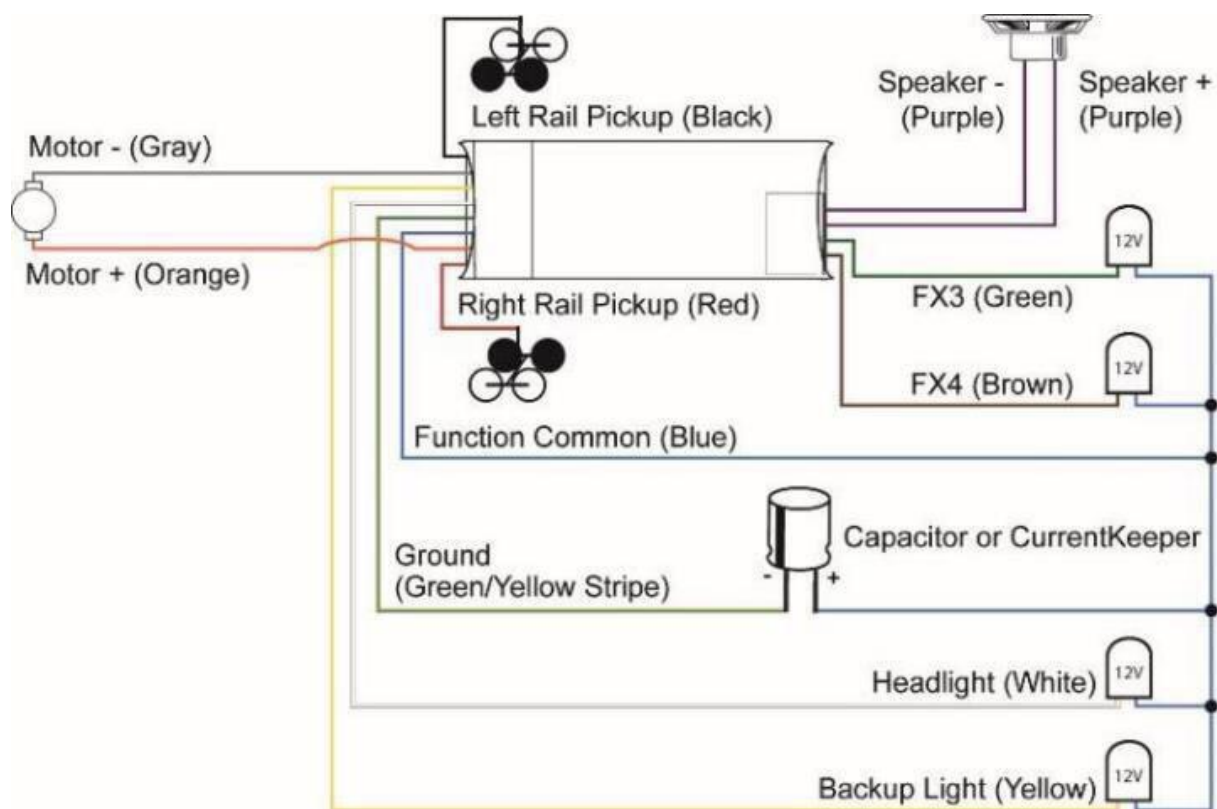
The diagram is supplied by SoundTraxx. The colour codes of the wiring in the P2K GP9 model are correct in keeping with NMRA standards.

The resistor board is used to organize the resistors in an efficient small space. Make these out of a piece of wood tongue depressor. The three current limiting resistors on the board serve the front and rear headlights and the 3 mm amber LED cabin light. To save space in the cab I used a SMD Surface Mount resistor for the Rotary Beacon. See photos below.

The resistor board

The Rotary Beacon

Heat shrink tubing

5 mm red LED

1.8K SMD Surface Mount resistor
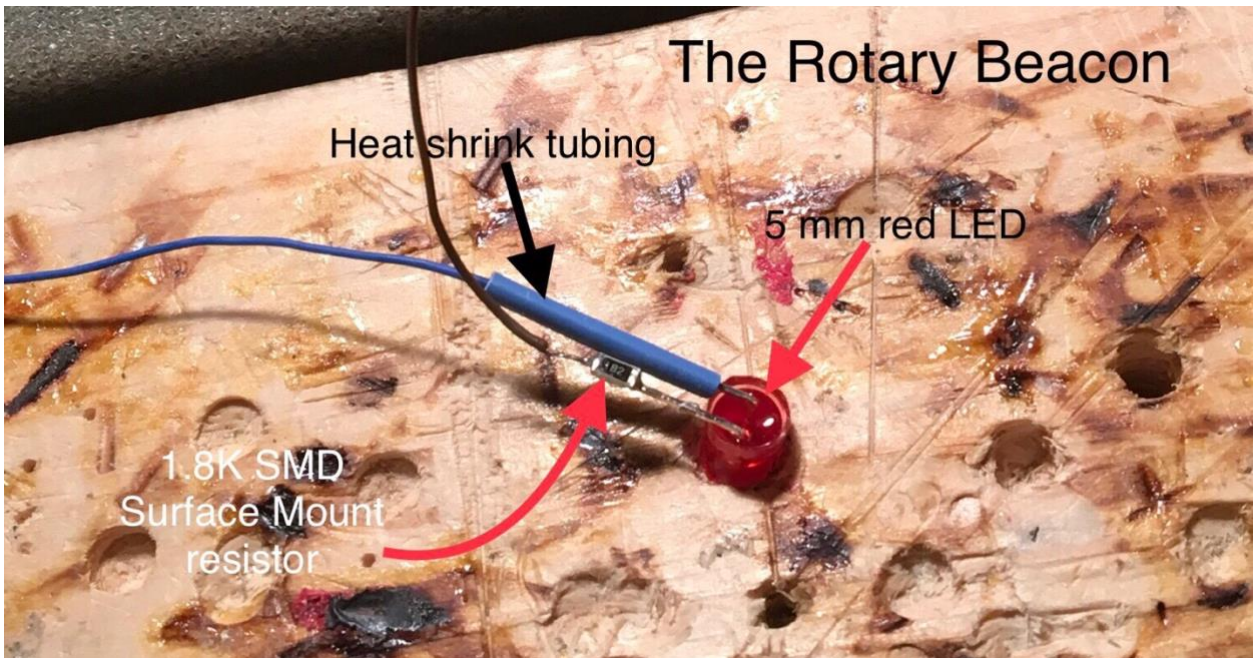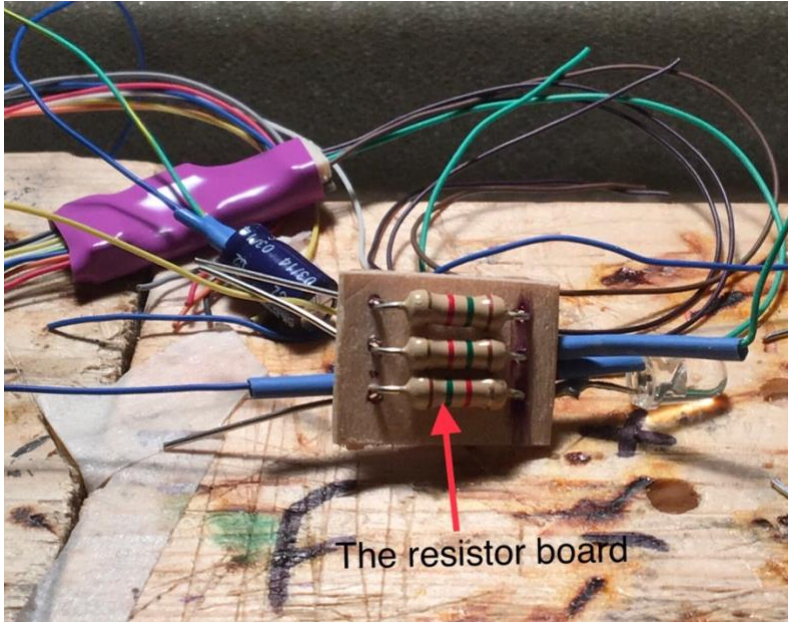
More about the Rotary Beacon:
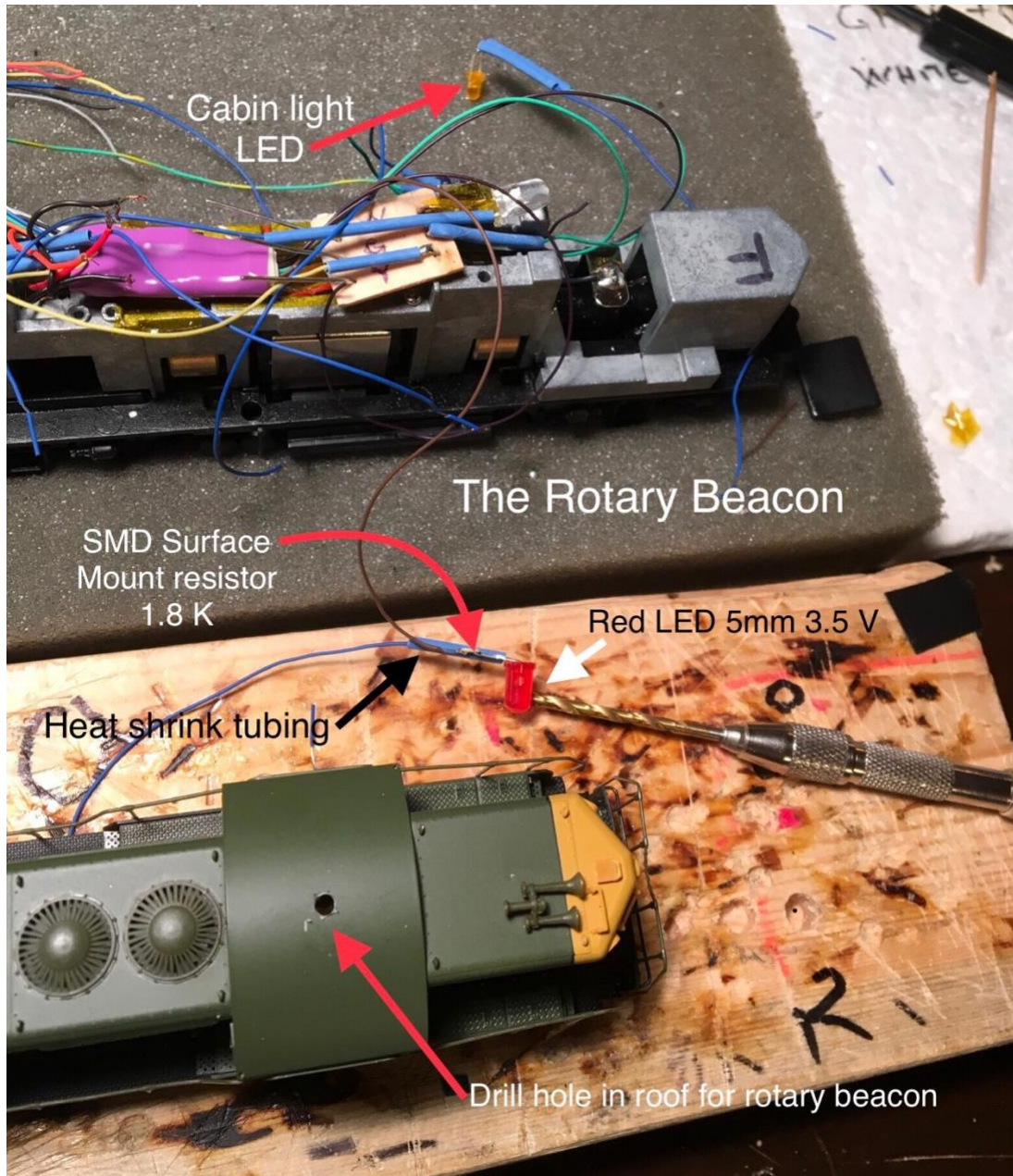
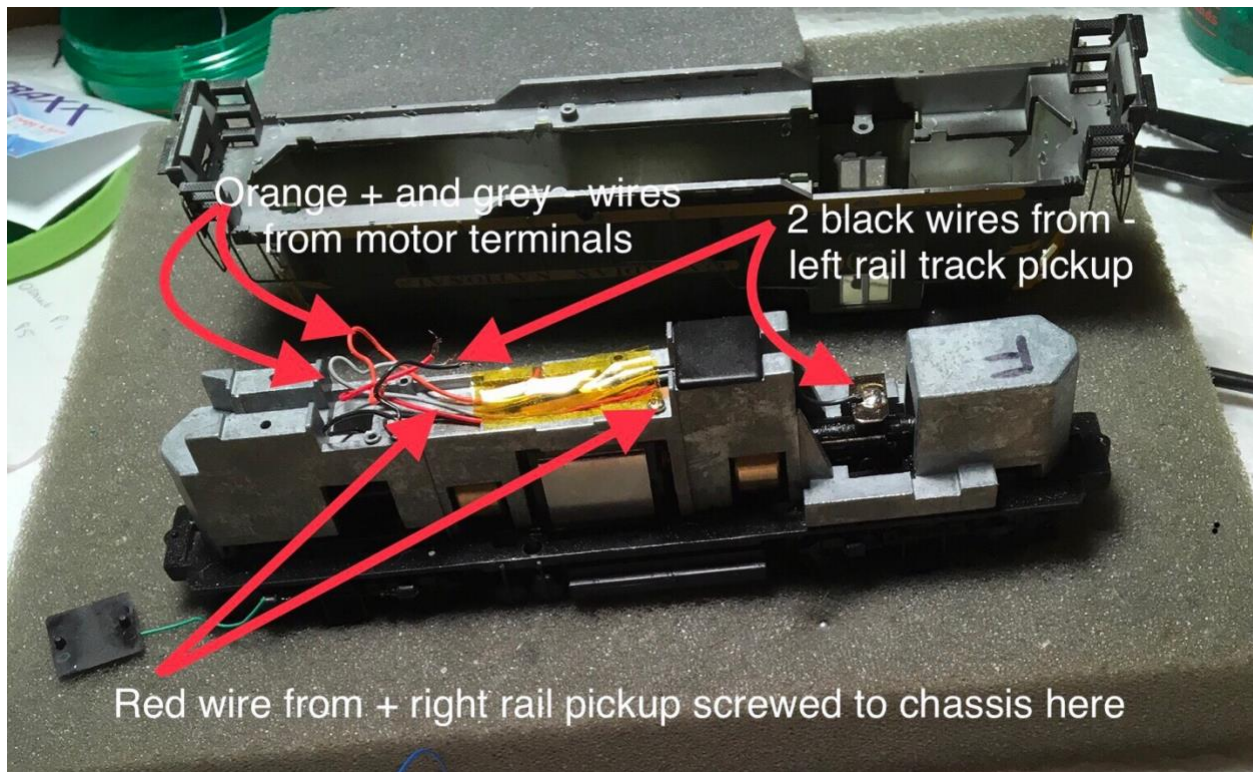Drilling the hole for the Rotary Beacon in the roof of the cab requires some care so as not to crack the plastic of the hood. It is necessary to incrementally use increasing size drill bits, until a hole diameter is made to just allow the LED to be
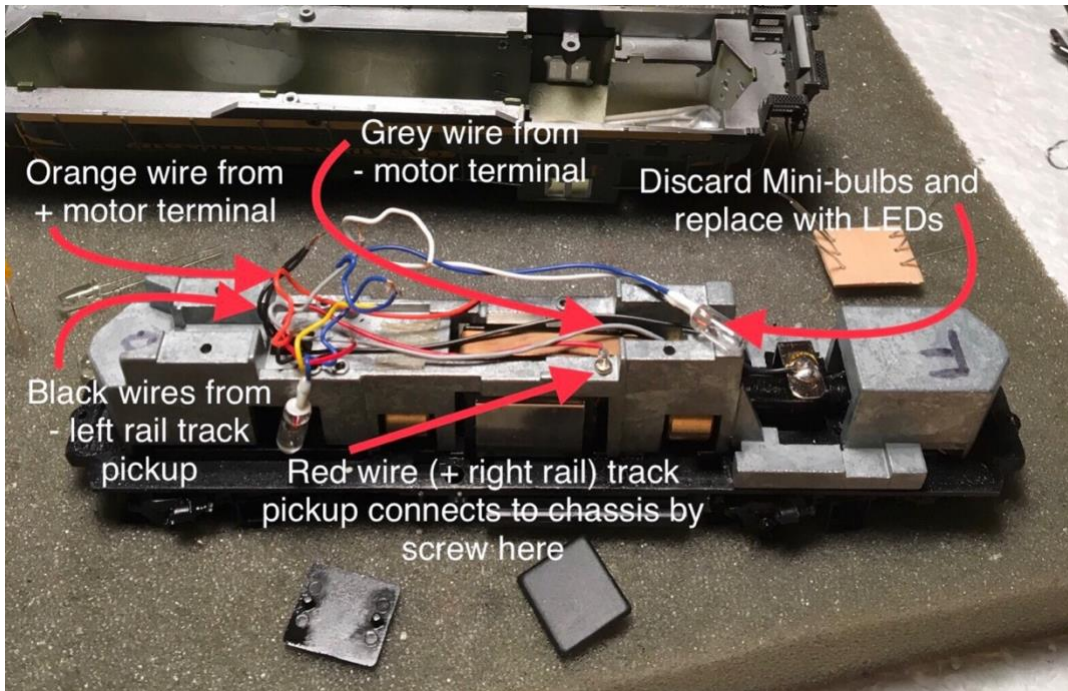
inserted snugly. I did not use glue in case it was ever necessary to replace the LED. The LED and wire connections are applied to the underside of the cab roof and are hidden from view in subsequent photos by the light tube. The small size SMD Surface Mount resistor allows everything to fit into the cab. There are many programming CV options available using Tsunami2 Hyperlight Effects. See details in the Tsunami2 User Guides, and my own settings for a Western Cullen Rotary Beacon below.
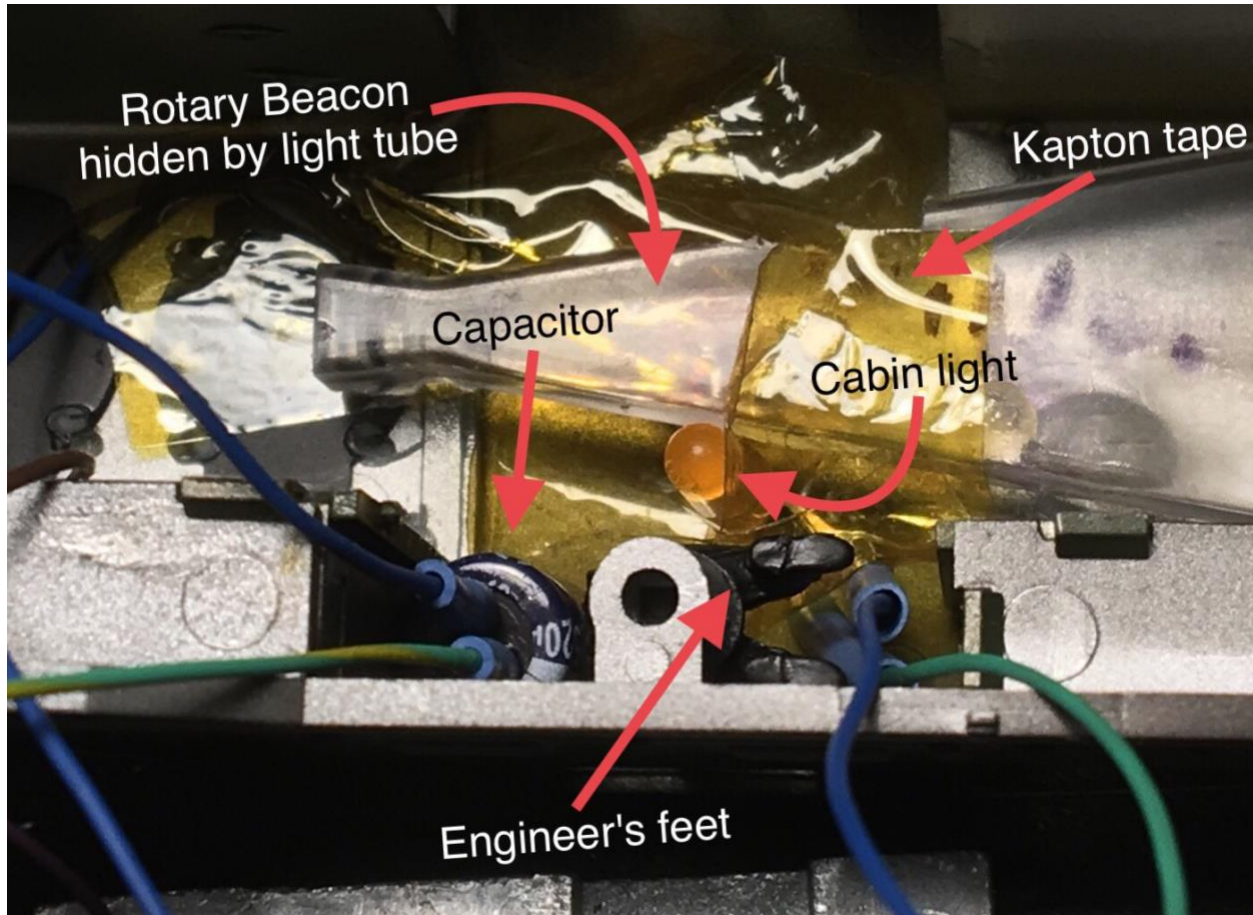
When wiring the motor leads to the decoder it is important to get the polarity of the connections right. By convention, the orange lead off the top motor terminal is positive, and the grey lead off the bottom terminal is negative. On my Proto 2000 model, the orange wire arises from the bottom terminal of the motor, but is the positive terminal, and the grey wire which is the negative terminal arises from the top. These connect to the grey and orange wires of the decoder.

Orange + and grey- wires from motor terminals

2 black wires from - left rail track pickup

Red wire from + right rail pickup screwed to chassis here

Also note that on this model, the negative black leads arise off the left side truck pickups getting power from the left (negative) rail, and the right positive rail feeds power via pickups on the right side of the trucks that connect directly to the metal chassis. Thus there is a single red lead connected by screw to the chassis, supplying the track power to the decoder from the positive right rail. By convention, in DC, when the locomotive moves forward (forward rotation of the motor) the right rail is positive, and the left rail is negative. If ever you find the direction of rotation of the motor and therefore the direction of motion of the loco to be reversed, you can switch the leads connecting to the motor terminals (recommended) or you can program CV 29 to correct this.

Grey wire from - motor terminal

Orange wire from + motor terminal

Discard Mini-bulbs and replace with LEDs

Black wires from - left rail track pickup

Red wire (+ right rail) track pickup connects to chassis by screw here

Wiring completed, let's get the shell back on!

Mini Cube speaker

Rotary Beacon hidden under Light tube

Cabin light

Capacitor

Kapton tape to secure components

Ready to put the shell back on!
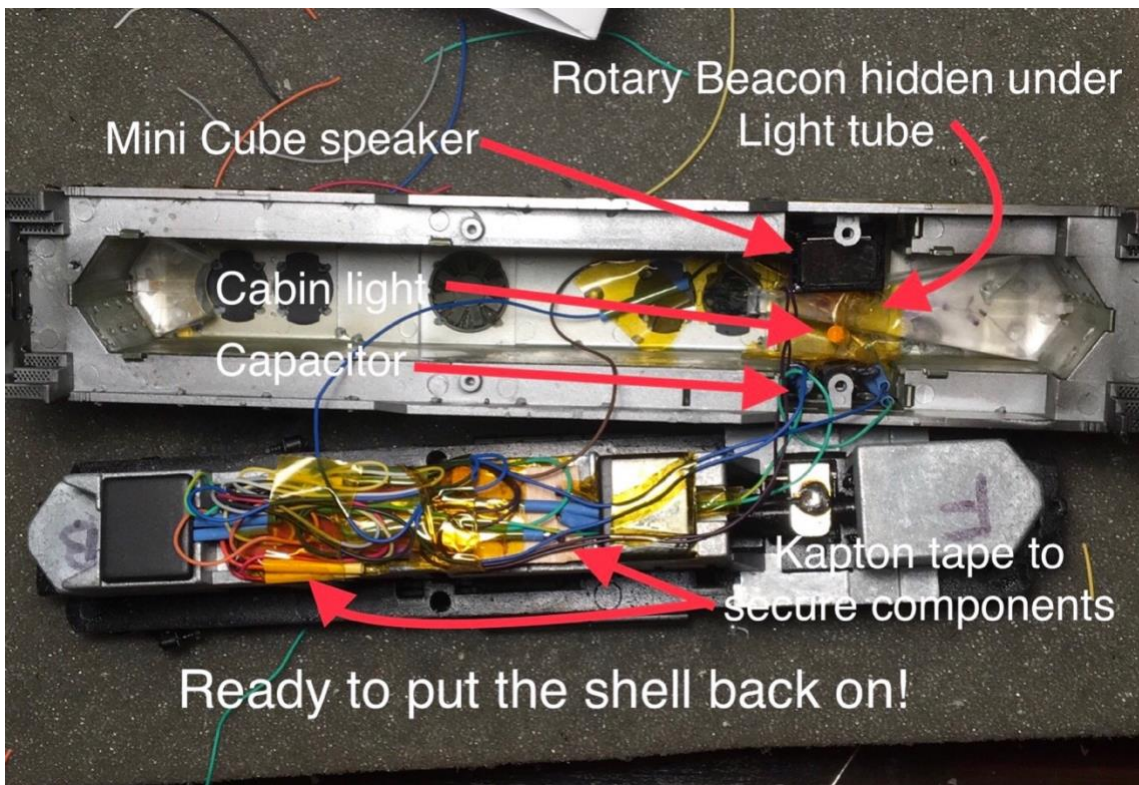
Programming the CVs

Some people believe the most fun installing a decoder is programming the CVs to make your locomotive prototypical. I agree! Following are some of the CV settings I have used on this project. I use NCE PH Pro 5 Amp and PH Pro Cab for my CV programming. See the Tsunami2 User Guide, and the Tsunami2 Technical Reference manuals for more help and information.

CN 4800 GP9 TSU1100 + Capacitor Install Date: May 31 2019
CV 128 Master Volume Level factory Value 192 Left at 192 to protect Speaker.
Speaker = SoundTraxx Mini Cube - 1 watt 8 ohm impedance range = 0-255. TSU - 1100 Amplifier power output - 1 watt 8 ohm load.

Manufacture: 141
Decoder version: 071
Address: Long 4800 Short 3 Long address activated
DC mode disabled
Set up Config:
  Direction bit = normal
  Speed steps equal 28
  Speed table standard

CV 2 Start Voltage 0
CV 6 Mid voltage 128
CV 5 Max Voltage 255
Acceleration 75
Deceleration 75

CV 128 = 192 (Master Volume)
CV 129 = 200 Air horn volume (makes less distortion) Factory Value was 225
CV 120 = 28 Air Horn. Leslie S3L

Calibrated DDE:
CV 114 = 47
CV 32 = 2

CV 512 = 16
Calibrate CVs 2.503 and 2.504 = 255

Current settings for DDE and Hyperdrive2 Motor Control CVs:
Dynamic Digital Exhaust DDE
These are the pertinent CVs:
DDE Control CVs
CV 2.503: DDE Load Offset
CV 2.504: DDE Load Slope
For diesel:
Prime mover low and high volume limits are added to the volume level in CV 131
(Prime Mover Primary Mixer Channel)
CV 2.507: DDE Prime Mover Volume Limit Default = 0
CV 2.508: DDE Prime Mover High Volume Limit Default = 255
Time constants: Determine how quickly the DDE processor reacts to changes in
load and speed
CV 2.509: DDE Attack Time Constant
CV 2.510: DDE Release Time Constant
CV 2.511: DDE Throttle Sensitivity
CV 2.512: DDE Load Sensitivity

First calibrate DDE: (Active)
(Soundtraxx recommend you automatically calibrate Dynamic Digital Exhaust load
compensation settings before adjusting throttle and braking control CVs.)
CV 31 = 16 (default) CV Index 1 (This should not be changed)
MUST USE OPS MODE PROGRAMMING ON MAIN
(You can read indexed CVs on the Programming track but don't write CVs on the
Programming track..write values using Program on Main if using the PH PRO
5Amp system)
Ensure CV 114 (Engine Exhaust Control) is set to a value of 47 .
CV 32 = 2 (Changes to indexed CVs Page 2)
CV 2.512 = 16 DDE Load Sensitivity (after you change to indexed CV page 2 by
setting CV 32 to 2, you now just choose 512..which is now indexed CV 2.512)
Now 'calibrate' the specific loco Motor by putting it on a straight and level track
(loco only ... no freight cars) and running down the track at speed steps set to 1

and then 25 - 40 or whatever you anticipate to be your normal fastest running speed, and entering the appropriate values into CVs 503 and 504.
calibrate the nominal low-speed load level.
CV 2.503 = 255 at Speed Step 1 (DDE Load Offset)
calibrate the nominal high-speed load level.
CV 2.504 = 255 at Speed Step 25 -40 (DDE Load Slope)
To increase or decrease sensitivity after calibration just enter value more or less into CV 2.512

CV 2.507 = 255   Default Value = 0 (Prime Mover)
Try CV 2.507 =175 Date:Jun 1 2019 (sounds better..more obvious)
CV 2.508 = 255   Default Value = 255
CV 2.509 = 215   Default Value = 215. (Time) 0=instant response
Try CV 2.509=175 Date: Jun 1 2019
CV 2.510 = 215   Default Value = 215
CV 2.511 = 255 Default Value = 10. (Throttle Sensitivity)
(a value of 0 into CV 2.511 will disable DDE throttle sensing)
CV 2.512 = 255 Default Value = 0. (Load Sensitivity)
Left CVs 2.511 and 2.512 = 255 as this seems to sound best.
Entering a value of 0 into CV 2.512 will disable DDE load sensing and sound effects will not be modified when the motor is impeded. Setting CV 2.512 to 255 indicates that the prime mover sound effect will be most sensitive to changes in motor load.

BEMF Intensity = CV 212 x (1 – (speed step ÷ CV 10)) ÷ 255
When CV 10 is set to 0, only the value in CV 212 is used.
CV 10 = 126 did not seem to work well. Should CV 10 be set to its default of 0.

Now set the appropriate Motor Control CVs.
CV 209 = 48. (Default) Kp Coefficient
Values from 0 to 255 may be entered to specify a gain factor for the proportional coefficient of the PID motor control equation to optimize back-EMF control algorithms to complement a given installation.
CV 210 = 25 or 30? (25) Ki Coefficient affects DDE. Original =16
CV 210=25 Date: Jun 1 2019 ...does this make start more jerky???

To specify a gain factor for the integral coefficient of the PID motor control equation.

CV 211 = 255 (Slow Speed Compensation)

CV 211 is set to a value of 255, the effect is applied across the first nine speed steps; also advances the starting point at which the PWM (Pulse Width Modulation) is applied to the motor. This helps compensate for motors that are more difficult to start... suggest setting CV 211 to the lowest value that will still improve low-speed operation. Default Value = 180.

CV 211=180 (Date: May 4 2019)

CV 212 = 255 (BEMF Feedback Intensity - 255. ..0 disables load compensation) what is default? (Date: May 4 2019)

Default Value = 255

Setting CV 212 to a value of 0 will disable load compensation.

Date Jun 10 2019: CVs 10 and 212 left at default values of 0 and 255 respectively.

CV 215 = 120 (Back EMF Reference Voltage Default = 150) ...for track voltage of 12 Volts..check this (Jun 10 2019)? THIS MADE A BIG DIFFERENCE IN DDE EFFECT..NOW MORE PRONOUNCED! after changing from 150 to 120.

CV 217 = 10 (BEMF Enable - Auto-Stop Enable)

CV 217: Motor Control Register

Default Value = 10

Setting bit 1 (BEMF) to 1 will enable back-EMF motor control.

Setting bit 3 (STP) to 1 will enable the auto-stop feature. When auto-stop is enabled, direction commands will bring the motor to a full stop for a duration of 500ms before the decoder changes locomotive direction.

So I assume on Tsunami2 decoder Back EMF and Auto Stop are enabled by default

Independent Brake

CV 117- 140 (manual suggests 178) Independent

   CV 118- 100 Train Brake. Manual suggests value of 100 for more gradual braking rate for Train Brake.

   CV 116 - 140 Dynamic Brake. Manual suggests value of 60 for a gradual braking rate. applying dynamic brakes will not bring the locomotive to a stop.

Date: Jun 10 2019 Used Dec Pro to change function button 7 from Dimmer to Independent or Train Brake for locomotive CN4800. Used Function Mapping Screen. These CVs are indexed (CV 1.273) so have to use Program on Main because NCE does not allow writing to indexed CVs on the Programming track.

Enabling Automatic Effects

Date: Jun 1 2019

REMEMBER YOU CAN ONLY WRITE INDEXED CVs USING PROGRAM ON MAIN!

Configure automatic effects that respond to direction and movement. Follow the steps below to enable automatic effects with CVs 1.385-1.512 (Effect Auxiliary Map Registers):

1. Ensure CV 31 is set to a value of 16.
2. Enter a value of 1 into CV 32.
3. Access CVs 385-512 from your command station and refer to the descriptions and CV values below to enable automatic effects.

Forward-Driving: Effect is turned on when the locomotive is moving in the forward direction. Add 1

Reverse-Driving: Effect is turned on when the locomotive is moving in the reverse direction. Add 2

CV 1.407: **Forward Whistle Signal** Default: 0?

For example bit 0 of CVs 1.385-1.512 references FWDD Forward-Driving:

FWDD: Forward-Driving

0 = Effect activated by function key only

1 = Effect active when moving in forward direction

CV 1.407=1 Date:Jun 1 2019

CV 1.408: **Reverse Whistle Signal** Default: 0 means only activated by the function button.

Bit 1 of CV 1.385 - 1.512 references REVD Reverse-Driving.

Set bit 1 of CV 1.408 to 1 by adding 2 to CV 1.408 which will turn on the reverse whistle when loco starts up in reverse.

CV 1.408=2 Date: Jun 1 2019

CV 1.409: **Stop Whistle Signal**. Default: 0

Added value of 12 to the Stop whistle signal to set bit 2 FWDS Forward-Standing (add value of 4) and set bit 3 REVS Reverse-Standing on by adding value of 8 so total value put in CV 1.409 = 12, to have Stop whistle blow automatically on stopping either from forward or reverse. Disable these automatic functions so they only operate from the function keys by changing the values of the appropriate CVs to 0.

CV 1.409 = 12 Date: Jun 1 2019

Programmed FX4 Function output - Function button 25 CV 52 =135. **Western Cullen Rotary Beacon.** Date Jun 1 2019 (7 + 128 = 135) 128= LED Compensation

FX3 = **Cabin light** Function button F24

 Date: Jun 10 2019. Note Glitch: In Yard 3, pressed F5 while running. Then seemed to have lost momentum, and max speed was about 10 to 15? Brake was instant jolt. Brought back to program track and read CVs...3 and 4 still 75, and speed CVs still 0,128, and 255. Turned off power and then on again. All again normal after a decoder reboot. Not sure what happened?

Doug Dyer
Victoria BC

CN

CN Spiritwood Subdivision