NW2 Drop-In Decoder Configuration List

This page lists all of the configuration variables in one convenient location. The column labeled factory settings is how the decoder is delivered. Use a factory reset, described on page 24 to reset the decoder to the original factory settings. All CV settings are remembered after the battery is disconnected or power is turned off.

CV #	Factory Setting	Value Range	Description
CV1	3	0-99	1-99 Primary Address
CV2	9	0-255	Motor Starting Voltage MSV
CV3	2	0-255	Motor Acceleration Rate
CV4	2	0-255	Motor Deceleration Rate
CV5	255	0-255	Maximum Motor Voltage Vmax
CV6	128	0-255	Mid-point Motor Voltage Vmid
CV8	135	135	CVP Manufacturer ID
CV11	0	0-255	Loss of Signal Timer (seconds)
CV17	0	0-255	Loco Address Hi-Byte
CV18	0	0-255	Loco Address Lo Byte
CV29	2	0-255	Decoder configuration
CV35	0	0-99	F1 Function Key Action
CV36	0	0-99	F2 Function Key Action
CV37	9	0-99	F3 Function Key [RCOUPLR]
CV38	0	0-99	F4 Function Key Action [none]
CV39	1	0-99	F5 Function Key Action [CRUISE]
CV40	3	0-99	F6 Function Key Action [CAB]
CV41	0	0-99	F7 Function Key Action
CV42	0	0-99	F8 Function Key Action
CV43	4	0-99	F9 Function Key Action [AUX]
CV44	6	0-99	F10 Function Key Action [SMOKE]
CV45	5	0-99	F11 Function Key
CV46	0	0-99	F12 Function Key Action
CV56	0	0-255	Bump Amount
CV57	0	0 - 127	Bump duration in us
CV59	3	1-15	Headlites Effect Period (x512ms)
CV60	0	0-15	Headlights Mode 0=normal/autorev
CV61	4	0-15	Headlight Front Effect
CV62	4	0-15	Headlight Rear Effect
CV63	0	0-1	Cruise Mode - 0 Norm, 1=Track
CV64	4	1-16	Cuise Track Rate (ms)
CV65	2	1-3	Cruise Track Step Size
CV200	0	0-16	RF Frequency number
CV201	3	1-15	Light Effect Period (x512ms)
CV202	4	0-15	Cab Special Effect [E1]
CV203	4	0-15	AUX Special Effect [E2]
CV204	4	0-15	not available [E3]
CV205	4	0-15	Smoke Speical Effect [E4]
CV206	120	0-255	Smoke Timer 0=manual
CV213	8	0-99	Function Key 13 [FCOUPLR]
CV214	0	0-99	Function Key 14 Action
CV215	99	0-99	Function Key 15 [Deactivate Cruise]

The CVs inside this red border are new CVs that are not present in older Drop-In decoders

Trouble Reading This Page?
A larger text version starts on page 42.

CV Value	Function Key Action
0	No Function
1	Activate Cruise Control
2	No Function
3	Toggle CAB light on/off [E1]
4	Toggle AUX Light on/off [E2]
5	No Function
6	Toggle SMOKE on/off
7	Dim Headlighs on/off
8	Activate Front Coupler
9	Activate Rear Coupler
15	No Function
99	Deactivate Cruise Control
not listed	reserved

CV Value	Special Lighting Effects
0	Off 0%
1	Dim 6%
2	Dim 25%
3	Dim 50%
4	On 100%
5	Strato Light
6	Oscillating Light
7	FRED
8	Rotary Dome light 1
9	Gyra Light
10	Mars Light
11	Rotary Dome Light 2
12	Strobe Single Pulse
13	Strobe Double Pulse
14	Reserved
15	Random flicker

CV Value	Cruise Control Mode
0	Normal (cruise off with speed change)
1	Tracking mode (Cruise stays on with change)

CV Value	Head/Rear Lites Action
0	Normal, autoreverse
1	Normal with rule17
2	Front headlight on always
3	Front headlight on always with rule17
4	Rear headlight on always
5	Rear headlight on always with rule17
6	Front and Rear both on always
7	Front and Rear both on always with rule17
8	Reversed Auto Reverse (Front to Back)
9	Reversed Auto Reverse with rule 17
10-15	reserved

The AirWire900® Drop-In™ Decoder
For USA-Trains NW2 Cow or Calf Locomotives

NW2 Drop-In Decoder Installation Guide

NW2 Drop-In Decoder User Guide

For Cow Or Calf Installations
Although the photos show the cow installation, the calf installation is nearly identical and actually a bit easier.

NW2 Drop-In Kit Contents
Chassis NW2 Circuit Board
Hood NW2 Circuit Board
2 Hex Standoffs M-F 1/4" 4-40
2 Machine screws   1/4" 4-40
1 Charger Cable
Installation and User Guide

AirWire 900®

XDRIVE Compatible!

How To Use This Booklet

The booklet has 2 sections. The first section describes how to install the Drop-In decoder. The second section describes how to customize the locomotive performance using all of the features of the NW2 Drop-In decoder.

Section 1: Locomotive Disassembly and AirWire Drop-In Decoder Installation

This section starts with the simple task of attaching the appropriate sockets and plugs to the battery and the battery charger. Step-by-step instructions then show how to open up the locomotive and install the battery, optional P8 sound module, speaker and the NW2 Drop-In decoder. Once installed, a quick check is run and then the locomotive is reassembled.

Section 2: Customizing Locomotive Performance

The locomotive will perform properly without any changes to the pre-loaded factory settings for the NW2 Drop-In decoder. However, there may be a few settings you wish to change. The two most common settings changed are the decoder address and the frequency. There are many more settings that are available to customize your NW2 operating performance. You can experiment with the various features and observe how the locomotive responds. At any time, a reset command can be sent from the throttle to reset the decoder back to the original factory settings.

You Will Need A Battery

The NW2 Drop-In Decoder is designed to work with the CVP BAT3. However, you may use any brand of battery in any physical size you have space for. For optimum range, use a battery pack with a 14.8V rating. Higher voltages are OK but range will be impacted due to the increase in motor noise.

Optional Items To Use A Phoenix P8 Sound Module

The Drop-In Decoder is designed to work with the Phoenix P8 sound module. The P8 module requires a separate programming cable and wiring harness. The NW2 will also need a speaker. Obtain these items directly from Phoenix. However, if your loco will not have a sound module installed, please skip all reference to the P8 and its speaker wiring.

### A smart person reads instructions.
A genius follows instructions.

NW2 Drop-In Decoder Absolute Maximum Ratings

Maximum Input Battery Voltage	24 Volts DC
Minimum Input Battery Voltage	10 Volts DC
Maximum Motor Output Current - Pulse	Internally Limited ~ 18A peak
Maximum Continuous Motor Output Current	~ 8 Amps at 25°C @15V
Maximum Smoke Generator Current	3.0 Amp
Maximum Lamp Current (all lamp drivers)	1 Amp
Maximum Coupler Pulse Width	7ms
Maximum Coupler Pulse Amplitude	Internally clamped to 15V
FCC ID	X7J-A10040601

All specifications subject to change without notice

NW2 Drop-In Decoder Hookup Diagram

Except for the two motor connections, all of the NW2 wiring and connectors are shown in this drawing. Because this installation is a bit more involved, having a complete diagram after installation makes subsequent troubleshooting easier. You might remember how the locomotive is wired tomorrow, but what about next month or in 2 years? If you have used the AUX lighting output, draw in the wires and their colors for a permanent record. Don't loose this booklet - it is a useful reference.

Phoenix Sound Part Numbers	
Harness	6002-08
Speaker	2.5SQ
Module	P8
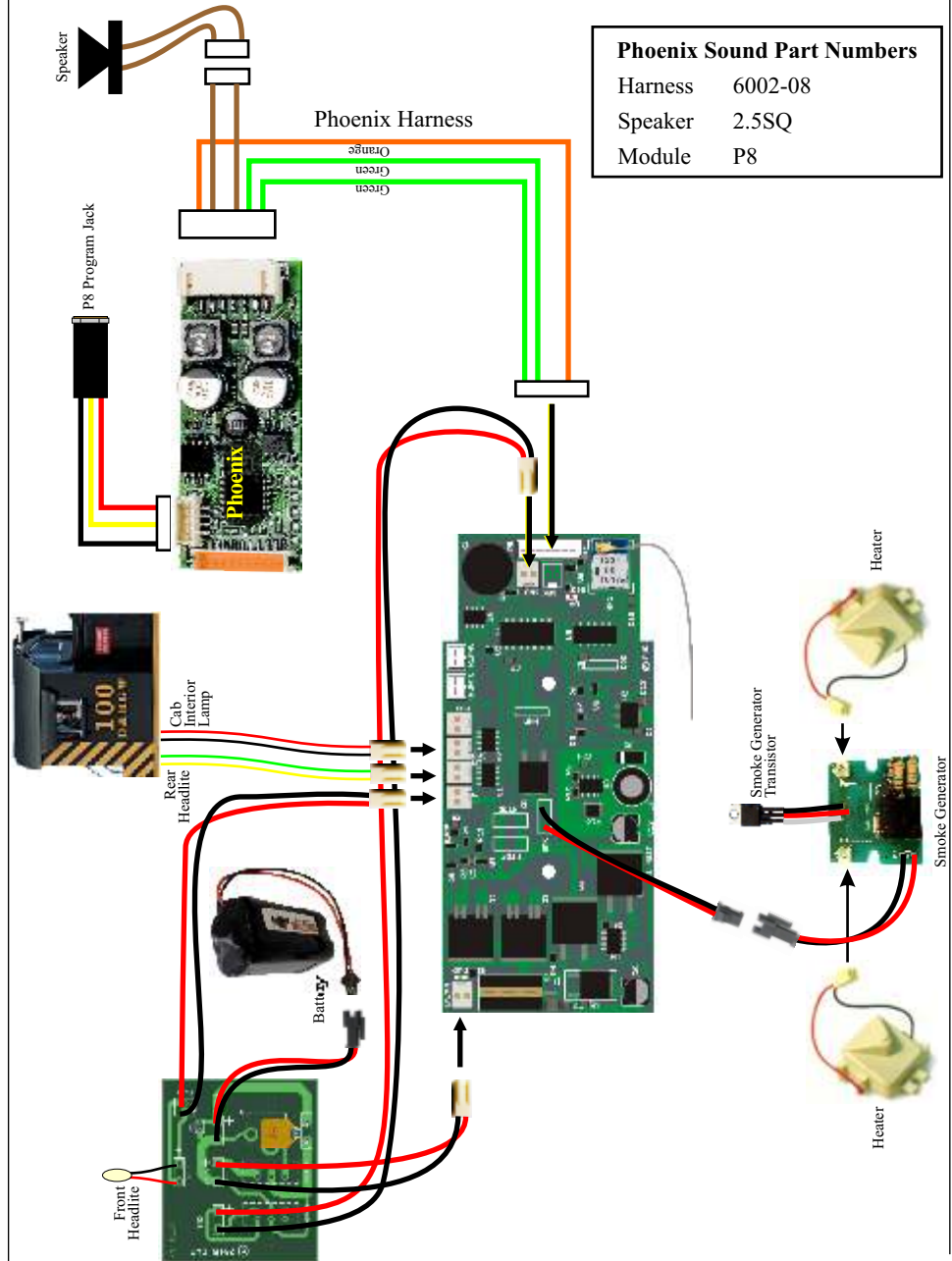
NW2 Drop-In Frequency Listing

The NW2 Drop-In decoder supports all 17 AirWire frequencies numbered 0 to 16. It can be set to any of the available frequencies.

Note - if you are using an older RF1300 throttle, only the first 8 frequencies, from 0 to 7, can be used with NW2 Drop-In decoder.

Number	Frequency (MHz)	Number	Frequency (MHz)
0	921.37	9	924.62
1	919.87	10	923.12
2	915.37	11	918.12
3	912.37	12	916.87
4	909.37	13	913.62
5	907.87	14	910.87
6	906.37	15	904.87
7	903.37	16	916.37
8	926.12		

Warranty and Repair Information

NW2 Drop-In Decoder Warranty And Repair Information

This warranty covers substantial defects in materials and workmanship in the Drop-In decoder.

What This Warranty Does Not Cover

This warranty does not cover any problems which result from improper installation, modifications, battery polarity reversal, improper operation, leaking batteries, excessive battery voltages, excessive motor current draw, connections to 3rd party circuit boards, abuse, accidents, or acts of God such as excessive heat, floods, damage caused by exposure to moisture and rain, lightning, earthquakes, volcanic events, tidal waves or hurricanes.

Warranty Duration

The coverage of this warranty lasts for 90 days. After this period, standard repair rates apply. Depending on the problem, CVP reserves the right to repair or replace.

Repairs and Returns

If you purchased your NW2 decoder from one of our AirWire900 dealers, please call them first. They are your quickest source for answers to questions about NW2 decoder. They are also experts in installation and offer such services should they be required. If you purchased your NW2 decoder *directly* from CVP Products, call us directly. If you have questions regarding the couplers or the sound system, call Phoenix directly.
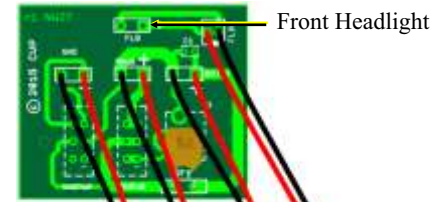
If you are asked to return an item to CVP for service, you must obtain an RMA. Follow the instructions on the website under service and support for how to obtain the RMA as well as addresses plus other helpful tips about sending packages to CVP Products.

Do not send items to us for repair without first obtaining authorization.
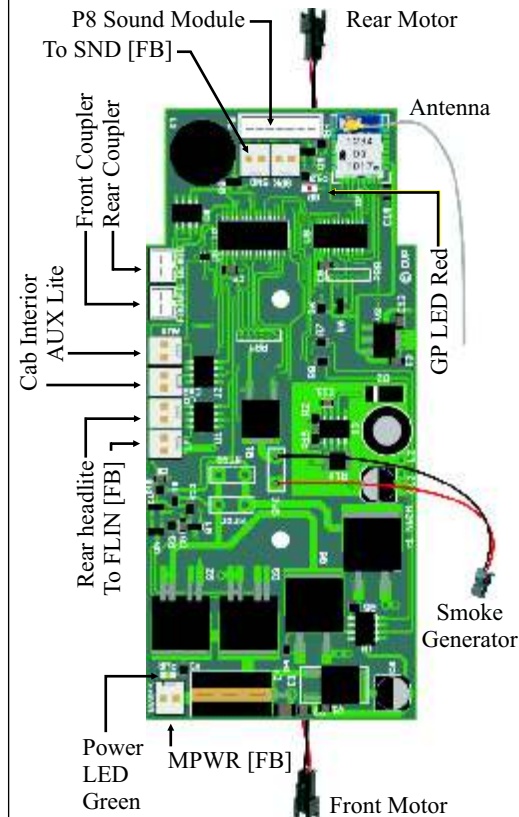
NW2 Drop-In Decoder Familiarization

The NW2 Drop-In Decoder consists of two circuit boards; the main and the front board. **The "Main"** board is mounted on the floor of the chassis. **The "Front"** board mounts behind the radiator hatch on the nose of the locomotive.

FRONT Board [FB]

Front Headlight

To SND [MB]
To MPWR [MB]
To Battery Pack
To FL [MB]

MAIN Board [MB]

P8 Sound Module
To SND [FB]
Rear Motor
Antenna
Front Coupler
Rear Coupler
Cab Interior
AUX Lite
GP LED Red
Rear headlite
To FLIN [FB]
Smoke Generator
Power LED Green
MPWR [FB]
Front Motor

CVP's "BRICK" (BAT3)

The Recommended Battery

The BAT3 is an ideal candidate for powering your NW2 locomotive. The installation instructions will show this battery being used. The BAT3 is rated at 14.8V and 3.4Ahr.

It is available from your AirWire Dealer of direct from CVP Products.

P8 Module, Cable and Speaker

The NW2 Drop-In works with the Phoenix P8 sound module. The P8 plugs into the Drop-In's P8 using the cable supplied by Phoenix - part number 6002-08.

The NW2 does not have a speaker so one will be needed if sound is used. The Phoenix speaker is part number "SP-2.5SQ".

Phoenix Coupler Driver

The NW2 Drop-In includes the driver and sockets for the optional Phoenix couplers. Check the Phoenix website for tips on coupler mounting and use. Contact Phoenix to order couplers.

www.phoenixsound.com

Note: The NW2 coupler driver is not suitable for other brands of remote couplers.

P8 Sound Module Alternative

With the optional XDRIVE board, any brand of NMRA-DCC sound decoder can be used in place of the P8. XDRIVE comes with the Drop-In harness and connectors to fit your favorite DCC sound decoder. The DCC decoder is programmed from the T5000 throttle. Simple to hookup and easy to use.

Verify Battery Pack Connector Polarity

Proper Battery Polarity Is Mandatory

Incorrect polarity will damage the decoder. This is not covered by the decoder warranty. For the Lithium battery, the plus wire is red. The black wire is minus. For the power plug, the plus wire is also red and the minus wire is black.

Locate The Drop-In Battery Input Socket

The motor connector and the battery connectors are the same. DO NOT accidentally plug the battery into the motor connector. This will damage the Drop-In board.

Check The Battery Pack For Proper Polarization

The CVP BAT3 battery pack has a mating plug that is properly polarized for the Drop-In BAT input socket. The drawing shows the red and black wire orientation for both the plug and the socket.

Visually Confirm Wire Color And Polarization

Orient the battery plug and the Drop-In socket as if they were to be inserted. Confirm the wire colors and connector orientation match the picture to the right. Notice that the socket release lever is pointing away from you.

CVP'S BAT3 Battery Pack

From BATT2 Battery

Black Negative Minus

Red Positive Plus, +

Locking Tab Faces Away

Lock Release Lever Faces Away

Red Positive Plus, +

From Drop-In Power Input

If you are using a different battery, you must properly identify the PLUS wire. If you get the polarity wrong, you will damage the Drop-In decoder and the warranty does not cover this. If you are not sure, seek help - don't guess.

Battery Safety

Charging Precautions

- Use only a battery charger designed for 14.8V Lithium-Ion packs.
- Li-ion battery packs must be charged correctly and with the correct charger.
- Improper charging will shorten the pack's lifetime.
- Improper charging may cause overheating, fire or explosion.
- We strongly suggest the use of the matching CVP Smart Charger.
- Never use a conventional DC adapter to charge the battery module.

Battery Protection

- Never drill, puncture or open a lithium battery pack.

Battery Protection

- Never drill, puncture or open a lithium battery pack.

Battery Storage

- Store in a cool, dry and well-ventilated area. Best temperature range is between 32F and 80F.
- Keep away from the fire and sources of high temperatures.
- Avoid storing a discharged battery. To avoid over-discharge, charge the batteries every three months.

Simple Troubleshooting Tips

These tips assume the locomotive has been operating normally for a while.

Locomotive Stops Running - But Resumes Running After A Short Rest

This is likely to be caused by overheating of the motor power drivers. If the drivers overheat, they will automatically shut down and stay off until the power is cycled off, then back on. There is no warning buzzer when this occurs. There is no harm to the decoder, but the drivers need additional ventilation.

Motor Runs For Short Period Then Stops

There are several possible reasons for this - let's start with the easy one first. Make sure the throttle is turned on, is set to the proper frequency and locomotive address. Make sure there isn't an interferring throttle somewhere in the area. Remember that each throttle must be on a different frequency. If all of these are OK, try another throttle. If it too doesn't work, then the cause could be the locomotive.

Reconnect the charger and verify that the charger indicator is visible and green. If the light is red, then the battery is depleted and needs to be recharged.

Tt is possible that a momentary overload tripped the battery or motor driver protection circuits. Cycle the decoder power off then back on and try again. If the problem persists, there may be a problem with one or both of the locomotive motors. There is also a possibility of a faulty battery especially if you obtained it from other than CVP Products. Substitute a different battery and try again.

Another possible cause is a bad battery. Batteries don't last forever plus their actual life can be drastically shortened if the proper charger is not used. Try another battery to verify if the battery is the cause of the problem.

Train Stops When It Is Far Away

This is an easy one. You need to set the NW2 Drop-In decoder "loss of signal" timer, CV11, to a value of 0. Any other value and the locomotive will come to a halt when the throttle signal is gone and the timer has expired. The original factory value is 0 although it might have been inadvertently changed.

Throttle Loses Control When Locomotive Is Far Away

This is just the normal limitation of the radio system. Do not expect the throttle to control the train when it is a thousand yards away. If your railroad is in a large loop, leave the throttle on its original speed setting and let the train come back to you. Once the train is within range, the throttle will once again regain control. Be sure and set the loss of signal timer, CV11, to 0.

Horn Won't Stay On When F2 is Pushed And Held

This is usually caused by a combination of a noisy motors and distant operation and is not actually a problem Instead, it is a new automatic feature of the Drop-In decoder. There is nothing more annoying than a locomotive horn that is stuck on so the Drop-In decoder includes a special feature that prevents stuck horns. If for any reason, the decoder stops receiving throttle commands, and the last command was horn ON, then it will automatically issue a horn OFF command after a preset amount of time. This will occur more frequently as the locomotive moves further and further away from the throttle.

Limited Range

For best performance, the whip antenna should be vertical. Keep all power wiring away from the antenna such as the battery and motor wires. Also, brand new locomotives tend to create a lot of motor interference since the motor brushes are new and not well seated. Range will improve as the locomotive's motor brushes seat better.

Although it is not easy to do, consider adding motor brush noise suppression capacitors to the motors right at the motor's terminals. A 0.1uF ceramic capacitor rated at 50V should be used.

Finally, lower the battery voltage. The NW2 Drop-In decoder is optimized for 14.8 volt Lithium batteries. Higher battery voltages generate much more motor noise.

NW2 Drop-In Decoder CV Value Lists

CV Value	Special Lighting Effects
0	Off 0%
1	Dim 6%
2	Dim 25%
3	Dim 50%
4	On 100%
5	Strato Light
6	Oscillating Light
7	FRED
8	Rotary Dome light 1
9	Gyra Light
10	Mars Light
11	Rotary Dome Light 2
12	Strobe Single Pulse
13	Strobe Double Pulse
14	Reserved
15	Random flicker

CV Value	Cruise Control Mode
0	Normal (cruise off with speed change)
1	Tracking mode (Cruise stays on with change)

CV Value	Head/Rear Lites Action
0	Normal, autoreverse
1	Normal with rule17
2	Front headlight on always
3	Front headlight on always with rule17
4	Rear headlight on always
5	Rear headlight on always with rule17
6	Front and Rear both on always
7	Front and Rear both on always with rule17
8	Reversed Auto Reverse (Front to Back)
9	Reversed Auto Reverse with rule 17
10-15	reserved

Attaching Charger Plug Pigtail To Charger

First, open up the charger box. Inside will be the charger with alligator clips and the AC power cord.

Locate the charger pigtail that came with your AirWire Drop-In decoder. The 2-conductor pigtail comes with stripped wires on one end and a right angle plug on the other.

Charger Pigtail

The pigtail needs to be permanently attached to the charger output wires. This is not difficult and no special tools are needed.

Wire polarity is very important and reversing the polarity could damage the charger or the battery or both. On the pigtail, the plus wire is the wire with the white stripe. The minus wire is the solid black wire. The charger uses the conventional red wire for plus and black for the minus wire.
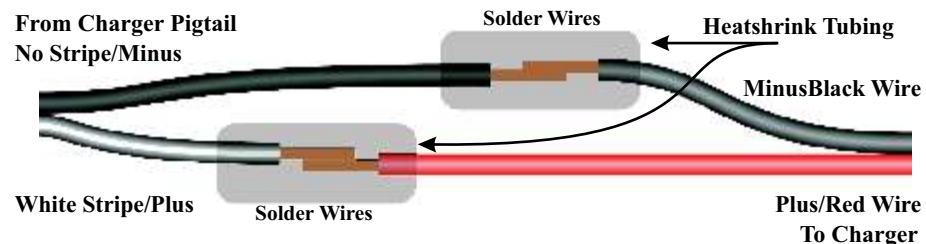
Take the pigtail and separate the 2 wires for about 2 inches. Cut the plus wire so it is 1 inch shorter than the minus wire. Remove about ½ inch of insulation from the plus wire. Twist and apply solder to the twist end of the plus wire. This is called tinning and keeps the twisted wires from unraveling. Next, remove about ½ inch of the insulation from the minus wire. Twist the strands together and touch a tiny bit of solder to the twisted wire.

Take the charger wires and split the red and black wires apart for about 3 inches. Cut off the alligator clips and cut the minus (black) wire so it is shorter than the plus (red) wire. Remove about ½ inch of the insulation from both the black and red ends of the wires. Twist and tin the wires.

If you are using heatshrink tubing to insulate the solder joints, now is the time to slide a piece over the minus wire. Otherwise, use electrical tape to insulate each connection. Overlap or twist together the two minus wires and solder them together. Once the solder joint has cooled, slide the heatshrink over the connection and heat it up to shrink the tubing around the connection. Make sure no wire is visible.

Slide a piece of heatshrink over the plus wire. Overlap or twist together the two plus wires and solder them together. Once the solder joint has cooled, slide the heatshrink over the connection and heat it up to shrink the tubing around the connection. Make sure no wire is visible.

Inspect for proper polarity matching and that no bare wire is visible outside the heatshrink tubing. This completes the wiring.

From Charger Pigtail No Stripe/Minus **Solder Wires** **Heatshrink Tubing**

MinusBlack Wire

White Stripe/Plus **Solder Wires** **Plus/Red Wire To Charger**

Heatshrink tubing may be ordered from Mouser Electronics. Use 0.25 inch diameter tubing with part number 5174-1141. It sells for about $2 and comes in a 4 foot length. www.mouser.com

USA-Trains NW2 Drop-In Installation

Warning: Many parts of the shell and chassis are fragile and easily broken. Especially vulnerable are the steps, doors, windows, cab awnings and side frame assemblies. The horn and bell should be removed before beginning disassembly.

You Must Have The Proper Screwdriver

A thin-shafted, #1 phillips-head screwdriver that is at least 4 inches long is needed to reach deeply recessed screws. The thin shaft is necessary to fit between the wheel and side frame. The one shown below is from General. It is also magnetized which makes removing loose screws easier.

Use A Towel To Create A Soft Work Surface

Spread a couple layers of thick towels on your work surface to serve as a cushion for the locomotive. The top of the locomotive is uneven and is unstable when upside down. The towel will help prevent damage should the loco fall over.

Use A Foam Block To Hold The Screws

Take a rectangular sheet of foam and label it B and F to represent the loco's front and back ends. As each screw is removed, position it in the foam in about the same location where it was removed from the locomotive.


Note that the cab of the NW2 is considered the "back" and the radiator hatch is considered the "front." The Drop-In decoder is set to run "long-hood" forward.

Total Mounting Screw Count Is 12

When all of the mounting screws are removed, there will be a total of 12 screws. When you are done, If your count doesn't match, go back and check to see which ones you missed. The next series of illustrations shows the location of the screws and have been numbered for easy reference.

Remove Fuel Tank - 4 Screws

The first four screws are easy - they hold the fuel tank to the chassis. Remove the 4 screws, lift off the tank and set it aside for now.
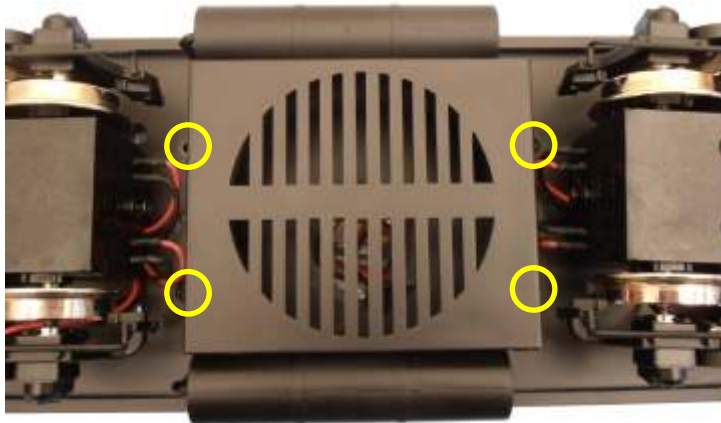
NW2 Drop-In Decoder Configuration Variables List

continued from previous page

CV63	0	0-1	Cruise Mode - 0 Norm, 1=Track
CV64	4	1-16	Cruise Track Rate (ms)
CV65	2	1-3	Cruise Track Step Size
CV200	0	0-16	RF Frequency number
CV201	3	1-15	Light Effect Period (x512ms)
CV202	4	0-15	Cab Special Effect [E1]
CV203	4	0-15	AUX Special Effect [E2]
CV204	*na*	*na*	*not available [E3]*
CV205	4	0-15	Smoke Special Effect [E4]
CV206	120	0-255	Smoke Timer 0=manual
CV213	8	0-99	Function Key 13 [FCOUPLR]
CV214	0	0-99	Function Key 14 Action *[unassigned]*
CV215	99	0-99	Function Key 15 [Deactivate Cruise]

Some CVs are not listed if they are not applicable or not available in the NW2 Drop-In decoder.

NW2 Drop-In Decoder CV Value Lists

CV Value	Function Key Action
0	No Function
1	Activate Cruise Control
2	No Function
3	Toggle CAB light on/off
4	Toggle AUX on/off
5	*no action - not available*
6	Toggle SMOKE on/off
7	Dim Headlighs on/off
8	Activate Front Coupler
9	Activate Rear Coupler
15	*no function - not assigned*
99	Deactivate Cruise Control
not listed	reserved

NW2 Drop-In Decoder Configuration Variables List

CV #	Factory Setting	Value Range	Description
CV1	3	0-99	1-99 Primary Address
CV2	9	0-255	Motor Starting Voltage MSV
CV3	2	0-255	Motor Acceleration Rate
CV4	2	0-255	Motor Deceleration Rate
CV5	255	0-255	Maximum Motor Voltage Vmax
CV6	128	0-255	Mid-point Motor Voltage Vmid
CV8	135	135	CVP Manufacturer ID
CV11	0	0-255	Loss of Signal Timer (seconds)
CV17	0	0-255	Loco Address Hi-Byte
CV18	0	0-255	Loco Address Lo Byte
CV29	2	0-255	Decoder configuration
CV35	0	0-99	F1 Function Key Action
CV36	0	0-99	F2 Function Key Action
CV37	9	0-99	F3 Function Key [RCOUPLR]
CV38	0	0-99	F4 Function Key Action [none]
CV39	1	0-99	F5 Function Key Action [CRUISE]
CV40	3	0-99	F6 Function Key Action [CAB]
CV41	0	0-99	F7 Function Key Action
CV42	0	0-99	F8 Function Key Action
CV43	4	0-99	F9 Function Key Action [AUX]
CV44	6	0-99	F10 Function Key Action [SMOKE]
CV45	5	0-99	F11 Function Key [none]
CV46	0	0-99	F12 Function Key Action
CV56	0	0-255	Bump Amount
CV57	0	0 - 127	Bump duration in us
CV59	3	1-15	Headlites Effect Period (x512ms)
CV60	0	0-15	Headlights Mode 0=normal/autorev
CV61	4	0-15	Headlight Front Effect
CV62	4	0-15	Headlight Rear Effect

continued on next page

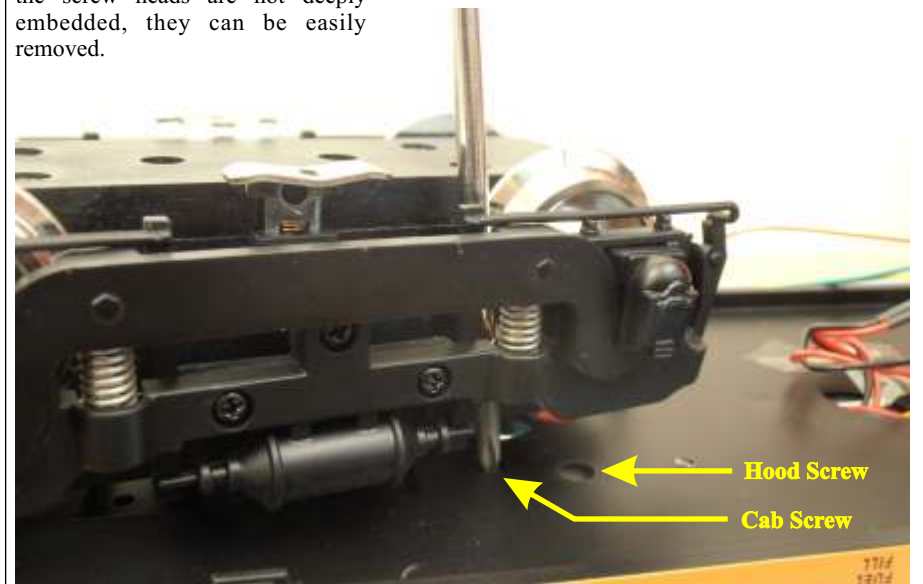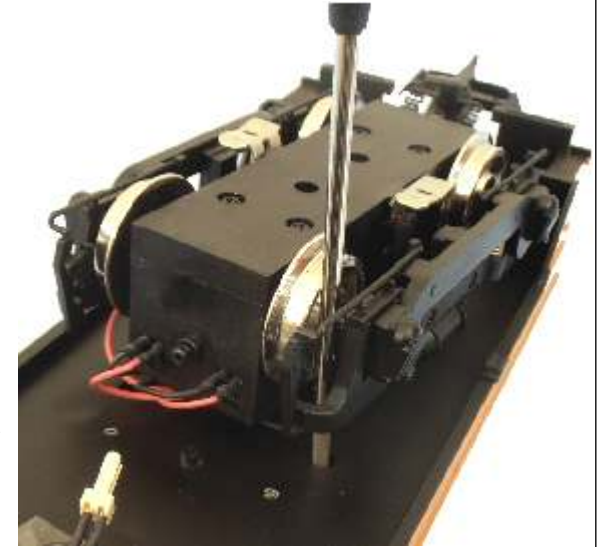# USA-Trains NW2 Drop-In Installation - *continued*

Hood Mounting Screws - 4 Screws

The four mounting screws holding the chassis and hood together are buried deep in recessed tubes and their locations are marked with yellow circles. To reach these screws, the thin-shaft screwdriver must be placed between the side frame and the wheel. Twist the truck to expose the screw locations and remove the 4 screws. Although not required when the proper tool is used, the side frames may be removed for easier access to the mounting locations.

Cab Mounting Screws 4-Screws

There are 4 screws that hold the cab to the chassis and their locations are marked with yellow squares in the top photo. These screws are visible if the rear truck is turned slightly.

The screwdriver will be angled when the screw is engaged. However, since the screw heads are not deeply embedded, they can be easily removed.

Hood Screw

Cab Screw

Separate Cab/Hood From Chassis

Turn the locomotive over onto its wheels. There is a small tab holding the hood to the front of the chassis Do not break the tab (see page 18). Grasp the cab and hood together and lift straight up after disengaging the front tab. Separate the cab and hood held by friction and another small tab on the rear end of the hood (visible in photo on page 19).

Unplug 4-Wire Connector

Remove the white twist ties from the locomotive wiring and discard. Unplug the 4-wire connector from the chassis front circuit board.

Remove Transistor and Heatsink Assembly - 2 Screws

The last item holding the chassis to the hood/cab assembly is the transistor and its connecting wires. The transistor is mounted to a finned heatsink and to the weight with a screw. The finned heatsink uses another screw to hold it to the weight. Remove both screws. Separate the transistor from the screw and ceramic washer. Keep the screw, it will be needed later. Discard the washer. The finned heatsink is no longer needed and may be discarded.

Separate Cab From Hood

Unplug the two white connectors that connect the cab to the circuit board located at the front of the hood. Gently separate the two sections.

Preparing The Cab

The red and black wires that connect to the socket on the back of the cab need to be clipped off. The two wires, attached to a small black plug are not needed and may be discarded. There is no need to remove the socket assembly.
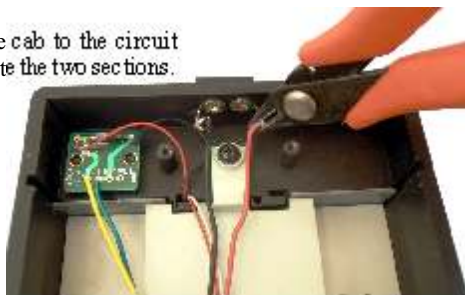
Drill Hole For P8 Program Jack

Note: If you do not plan to install a Phoenix P8 module, please skip forward to the next section.

If you plan to use the Phoenix P8 sound module, you need to install a jack for programming the P8 module.

A 5/16 inch hole is needed for the jack. The photo shows the best location for the jack. It is convenient and allows the programming jack's wiring to reach the P8 sound module.
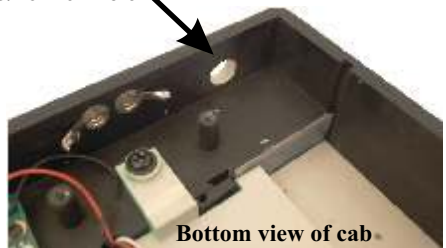
The hole must be drilled in the location shown so the jack will fit the available space and the attached cable will reach the sound module.

Phoenix P8 Program Jack

5/16 inch hole

Bottom view of cab

The table of throttle function key assignments to sound effects works well for most P8 diesel engine installations. You may download a CVP diesel configuration file from the Phoenix website that sets up these and other features in the P8 sound module. You must use the P8 computer interface to make these assignments. These are not programmable from the throttle. However, if you don't like our recommend settings, feel free to change them and experiment - you can't hurt anything.

Function Key Assignments	Sound	NW2 Motion
Function F0	*not available*	Toggle Headlight
Function F1	Bell	*none*
Function F2	Manual Horn	*none*
Function F3	Coupler	Activate Rear Coupler
Function F4	Crossing Horn	*none*
Function F5	All Aboardr	Activate Cruise Control
Function F6	Compressor Startup	Toggle Cab Light
Function F7	Volume Up	*none*
Function F8	Volume Down	*none*
Function F9	Dynamic Brakes	*none*
Function F10	Brake Release	Activate SMOKE
Function F11	Air Pop Valve	*none*
Function F12	Shutdown	*none*
Function F13	*not available*	Activate Front Coupler
Function F14	*not available*	*none*
Function F15	*not available*	Deactivate Cruise Control

Shared CVs Between P8 And NW2 Decoder

P8 Sound Module and NW2 Drop-In Decoder Have Shared CVs

The P8 shares three CV numbers with the NW2 Drop-In decoder. These three CVs perform the same function in both decoders - they set the decoder's address.

The AirWire Throttle automatically programs these three CVs when you program the locomotive address. Except in rare instances, both the P8 and the NW2 decoders are programmed at the same time and to the same address.

If you want to an address of only one decoder, turn off the power switch of the decoder that is not to be changed. Then use SERVICE PRGM to program the decoder.

Except for the address CVs, no other CVs are shared between the P8 and the NW2 decoder. You may issue OPS or SVC programming commands to the NW2 without fear of affecting the P8.

Shared CV Table	P8 Use	NW2 Motion Use
CV1	Short Address	Short Address
CV17	Long Address	Long Address
CV18	Long Address	Long Address

Recommended Phoenix P8 Configuration and Setup

P8 Configuration and Setup Recommendations

These modifications are done with the Phoenix programming software and their PC interface hardware. Only those items that are different than the standard settings are shown. For example, the automatic tooting of the horn and ringing of the bell are turned off. If you like that effect, then don't change the original setting. Once all the changes have been loaded into the P8 module, save the configuration file under the locomotive number before disconnecting the computer interface.

Volume Levels	Was	Recommended
Fwd Horn Volume	90%	0
Rev Horn Volume	100%	0
Stopping Horn Volume	100%	0

Numeric Settings	Was	Recommended
Stopping Bell Speed	20	0
Stopping Bell Duration	8	0
Startup Bell Duration	4	0
Triggered Bell Duration	6	0
Auto Bell Speed Limit	40	0
Bell Holdoff	30	0

Selection Settings	Was	Recommended
Chuff Averaging	Disabled	Disabled
Speed From DCC	Disabled	Disabled
MTS Detection	Enabled	Disabled

Trigger Terminal Assignments	Was	Recommended
Trigger 1	Chuff Pin	<unassigned>
Trigger 2	Manual Whistle Pin	<unassigned>
Trigger 3	Bell Pin	<unassigned>
Trigger 4	Blowdown Pin	<unassigned>
Trigger 5	Station Pin	<unassigned>
Aux Board 1/T1	Drifting Pin	<unassigned>
Aux Board 1/T2	Water Fill Pin	<unassigned>
Aux Board 1/T3	Coal Load Pin	<unassigned>
Aux Board 1/T4	Coupler Pin	<unassigned>
Aux Board 1/T5	Crossing Whistle Pin	<unassigned>
Aux Board 1/T6	<unassigned>	<unassigned>

Free P8 CVP Diesel Config File From Phoenix

You may download a CVP diesel configuration file from the Phoenix website for the above features as well as the function key assignments (page 41) for the P8 sound module.

www.phoenixsound.com/support/download.html

CVP Products does not provide customer support for the P8 sound module. Please contact Phoenix Sound Systems directly via email or phone.

(800) 651-2444 Email:
phoenixsound@phoenixsound.com

NW2 P8 Sound Module Installation

Install P8 Jack

The plastic cab is too thick to use the jack's nut. It will be installed with hot-melt glue. First, remove and discard the nut from the black programming jack. Bend the wires at the small plug so the nut will slip over them and the plug.

Now push the small plug and wire through the newly drilled hole in the cab. Fasten the jack to the cab with hot-melt glue.
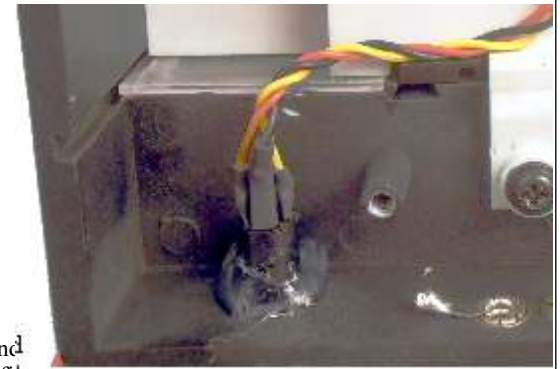

Open Up Hole In Rear of Cab

The large connector between the P8 sound module and the Drop-In decoder will not fit through the small hole at the rear of the cab. This hole needs to be enlarged. Fortunately, the easy way to do this is to simply "daylight" the hole by cutting out the top of it.

Make sure not to cut any of the wires going through the hole.

Use your wire cutters to cut out the wedge of plastic marked with the yellow dotted line. This will provide adequate clearance for the connector to pass through the opening.
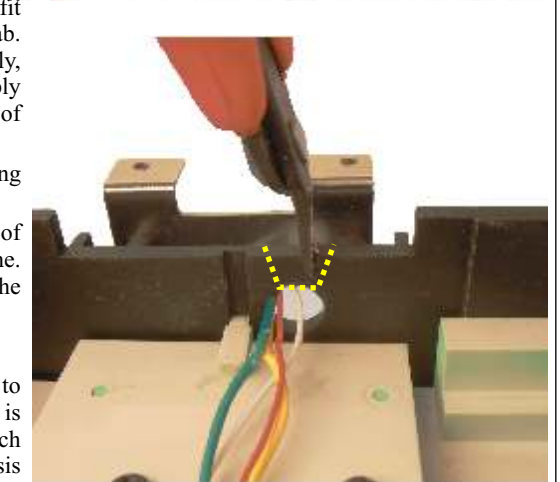
Install The P8 Sound Module

The P8 sound module mounts vertically to the side of the cab near the P8 jack. This is the only location with sufficient space such that the cab can be reattached to the chassis without any interference.

The bottom of the P8 is not level. Use a piece of foam tape mounted in the area shown to build up the area so it is level with the components at the other end of the board. Remove the protective backing from the foam tape. Next, cut a piece of foam tape the length of the module and attach it to the module.

Plug in the P8 connector (having the brown wires) to the module and route the wires out through the hole you opened at the rear of the cab.

Connect the jack's plug to the smaller connector and fold up the wire to fit in the area around the floor of the cab as shown.

Use some hot melt glue to keep the wires in place.

This concludes the cab preparation.

Hood Preparation

The front of the hood contains a small circuit board with various power switches and plugs. This old board will be removed and replaced with a new board that has been designed to fit in the same space and use the same mounting hardware.

Front Circuit Board Removal

Pay attention to how this assembly is removed because the process is reversed to reinstall it. Turn the hood upside down. Open the radiator hatch. The circuit board is held in place by a U shaped plastic channel. Grasp the channel and pull it completely out and set aside.
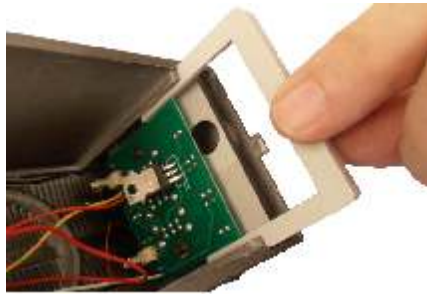
Raise the circuit board and its plastic mounting plate to expose the headlight wires. Use your wire cutters to cut the headlight wires as close to the circuit board as possible. Leave the bulb's wires as long as possible.

With the headlight wires removed, the board and its mounting plate can be removed. Slide the circuit board and its plastic mounting plate out. The radiator door will fall free. If the door doesn't fall free, slightly bend the plastic mounting plate away from the front of the hood while pulling it out.

Remove the two screws that hold the circuit board to the plastic mounting plate. Save the screws. The circuit board will be replaced with a new board and may be discarded

Modifying Plastic Switch Plate

The replacement circuit board contains a charging jack and it is in place of the old board's motor switch. The motor switch hole in the plastic mounting plate will have to be enlarged to fit the jack.

Enlarge the opening with a motor tool. After enlarging the hole, test fit the FRONT circuit board. The dimensions are not critical, but the jack must clear the switch plate.

Original Switch Plate

Hole Enlarged

Replacing 5V Bulb with LED

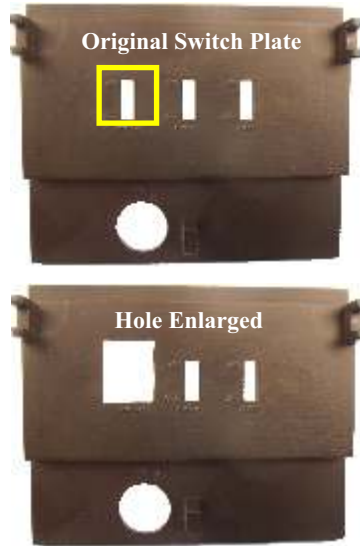## Mount New Circuit Board To Switch Plate

Use the two screws from the old board to mount the new FRONT board to the switch plate. Make sure the switches don't bind and the board is flush to the switch plate. The photos show from start to finish.
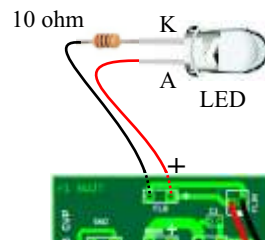
New Switch Functions

The SMOKE switch now controls the Drop-In decoder power. The LIGHT switch now controls the Phoenix P8 module power.

Special Consideration - Headlight Changed To LED

If you want to swap the standard incandescent bulb that comes with the NW2 for a white LED, now is the time to do so. Before mounting the switch plate and the new board, remove the original bulb from the locomotive. Modify the area behind the LED to hold a 5mm (or 3mm) sized white LED. into the housing behind the lens. A 10 ohm 1/8watt resistor is placed in series with the cathode (K) lead of the LED. Small hookup wire (#26 or #28 AWG)is used to connect the LED anode (A) and resistor to the FL solder pads. The LED's A lead goes to the square pad. Insert the wires from the switch side of the board and solder on the opposite side of the board.

10 ohm — K / A / LED

This is the Phoenix P8 hookup diagram. The wires are somewhat stiff and fragile. Don't subject them to a lot of unnecessary flexing.

If not using a P8 speaker, cut off the connector on the two brown speaker wires and solder the wires directly to the speaker.

The sockets are polarized and can only be completely inserted when oriented correctly.

P8 Program Jack

Speaker

Phoenix P8
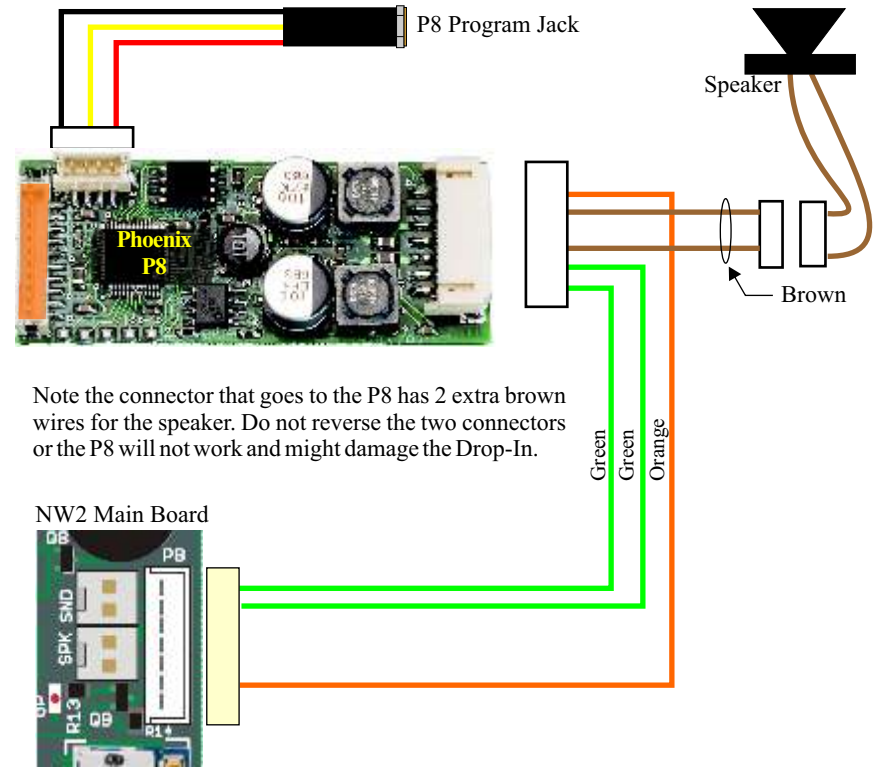
Brown

Note the connector that goes to the P8 has 2 extra brown wires for the speaker. Do not reverse the two connectors or the P8 will not work and might damage the Drop-In.

NW2 Main Board

Green / Green / Orange

P8 Power Switch

The Drop-In decoder has a dedicated power switch for the P8. The P8 power switch is independent of the Drop-In decoder power switch. When turned on, the P8 is connected directly to the battery. The P8 can be powered while the Drop-In decoder is not. Don't forget this fact when you turn the sound volume down low or off. Even if off, the P8 draws power from the battery and it will not automatically turn off. Always use the power switch to shut off the P8.

P8 Address Setup

The P8 is programmed at the same time as the NW2 Drop-In decoder address is programmed but the P8 must be powered on for this to occur. If for any reason, you think the P8 or the Drop-In might not be on the same address, just reprogram the decoder's locomotive address, CV1, from the throttle.

P8 Sound Options Programming

The P8 sound options can only be programmed from the programming and the programming adapter available from Phoenix. See their website for more information.

P8 Technical Support

CVP does not provide technical support for the Phoenix P8 sound module. If you have any troubles with your P8, contact Phoenix for help and support. They will be happy to help you out.

Addtional CVs And Informatoin Not Detailed Elsewhere

Decoder Address **CV1**
Range is 1-9999 . . . . [3]

When SERVICE PROGRAM is used to set the decoder address, the throttle actually sends a group of commands to set CV1, CV17, CV18 and CV29. That is why you hear as many as 3 chirps when CV1 is set to the desired address from 1 to 9999. Do not use address 0, it is not supported.

Loss of Signal Timer (LOS) **CV11**
Range is 0-255 seconds . . . . [0]

Failsafe Operation - If your locomotive goes out of range of the throttle or the throttle is no longer transmitting, you can set the locomotive to either continue running or stop after a preset amount of time. The timer range is 1 seconds to 255 seconds. A value of zero means the locomotive runs forever, or until the battery runs down.

If CV11 = 0 this selects continuous operation. In other words, the locomotive continues to operate at the last received speed command forever. The assumption is that it will eventually come back into range of the locomotive. Another reason to use continuous running is because you want to control several trains with a single throttle. Changing the throttle's address to control a new address means the original address is no longer being used. This is the same as turning the throttle off or going out of range. With the decoder set to operate continuously, the locomotive will continue to run at the last received speed command. To regain control, first set the speed knob and direction close to the locomotive's current speed and then select the new address.

If CV11 value is not equal to zero, then the locomotive will come to a smooth halt after the timer value counts down to zero.

Loco Address High Byte **CV17**
Range is 0-255 . . . . [0]

Loco Address Low Byte **CV18**
Range is 0-255 . . . . [0]

CV17 and CV18 are automatically set based on the setting of CV1 to the desired locomotive address. We do not recommend that manually changing these CVs. Use CV1 when programming the decoder address so they are set automatically.

Decoder Setup **CV29**
Range is 0-255 . . . . [2]

CV29 is a multipurpose CV whose value sets several options at once. The NW2 Drop-In sets this CV automatically for you so there should be no need to change it. However, if you accidentally change it and the locomotive no longer runs, you can either reset it back to a value of 2 or use a factory reset to erase all changes and restore CV29 to is default value of 2.

Decoder Frequency Number **CV200**
Range is 0-16 . . . . [0]

CV200 holds the assigned frequency number for the NW2 Drop-In decoder. If a number larger than 16 is attempted, the decoder rejects it and automatically sets itself to frequency 0. If you have forgotten the frequency, see page 16 for the procedure to temporarily force the NW2 Drop-In to a known frequency.

USA-Trains NW2 Drop-In Installation - *continued*

Soldering Front Light Bulb Wires To FRONT Board

Strip about 1/4 inch from a light bulb wire, twist the strands together and apply a bit of solder. This process is called "tinning" and keeps the strands from fraying and shorting out to adjacent objects. Tin the other wire in the same way.

Headlight Solders Here

Partially insert the FRONT board and switch plate back into the hood with the switches facing forward and the FLB lettering near the headlight. Push it in far enough so you can see the solder pads for the headlight.

Insert the headlight red wire into the FLB square pad (positive) from the switch side of the board and solder on the back side. Insert the black wire into the round pad and solder. If you are careful not to touch the plastic shell , you may also solder from the front side. Tweezers will help hold and position the wires.

Reattach Switch Plate Assembly To The Hood

Slide the switch plate all the way into its correct position. Push the excess headlight wire towards top of the hood. The wires must not foul the switches nor can they be allowed to get between the plate assembly and the hood. Reattach radiator hatch and insure the two pins are capture by the two tabs in the switch plate. Reinsert the U-channel and push it against the roof. If it doesn't fit flush, one of the headlight wires is probably interfering. Reposition the wires and reinsert the U-channel.

The hood work is now complete. Set it aside. It won't be needed until final assembly.

FRONT Board
Switches and Wires Not Shown

Headlight Bulb

Radiator Hatch

Mounting Screw

Switch Plate
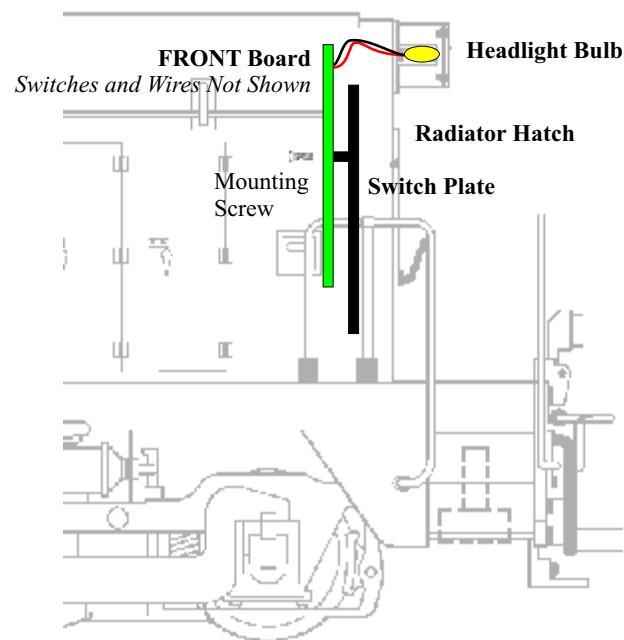
USA-Trains NW2 Drop-In Installation - *continued*

Install Speaker Into Fuel Tank - *Optional and Only If Using P8 Sound Module*

Newer speakers from Phoenix include a two wire plug pre-attached to the speaker. If yours is different, solder the wires to the speaker before mounting it. Hot melt glue is the quickest method to mount the speaker although some people prefer silicone adhesive which takes longer to dry. We like hot-melt glue simply because it is fast.

Since the P8 sound module is in the cab, the speaker should be oriented so its wire and plug favor the cab end of the tank. The cab end can be found by locating the mounting flange with the hole in the middle. The hole is off-center on the left side.Center the speaker in the grill opening before gluing.

Place the hot melt glue nozzle into the speaker's corner mounting hole and squirt out a blob of glue. Slowly pull the nozzle from the hole while continuing to dispense glue. This builds up a small glue "post" that holds the speaker securely to the fuel tank.

Chassis Preparation

Remove the two screws from the **front weight** - this is the weight located at the opposite end of the cab. Both screws and the front weight may be discarded. This freed up space will be for the battery to be installed later.

Remove the two screws, washers and the **center weight.** Keep the center weight and the washers. The two screws may be discarded.

Unplug the motor and pickup wires from the factory circuit boards. Remove the front and rear circuit boards and discard.

Identify the two sets of connectors emerging from the truck. There is one large black connector that has only two wires attached. It is connected to the motor. The other large black connector has 4 wires attached. It connects to the track pickups.

Identify the pickup wire connector. Place your wire cutters inside the escape hole and cut the 4 pickup wires. In the photo, the two motor wires are well out of the way of the wire cutters. *DO NOT accidentally cut the motor wires!*

Turn the locomotive over and rotate the truck. The pickup wires will be visible and easy to reach. Grasp each wire with a pair of needle nose pliers or tweezers and bend it back and forth until it breaks off. There is no need to disassemble the side frames or trucks.

Pickup Wires

Motor Wires
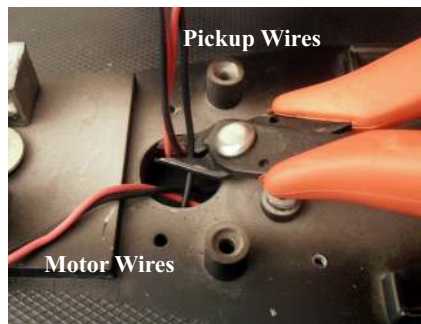
Optional Phoenix Coupler Installation

This is as good a time as any to install the Phoenix couplers. For installation tips, see the Phoenix Sound Systems website. Route the connectors through the chassis and towards the cab end of the locomotive.

Assigning Special Effects To Other NW2 Output Drivers

There are a variety of special effects that can be applied to the CAB and AUX lights as well as the SMOKE generator.

Here's the table of CVs related to the NW2 lighting outputs. The SMOKE effect and timer are included for completeness. The smoke timer was described on page 20. The SMOKE EFFECT factory setting of 4 (100% on) is likely to be the best setting.

Summary Table For NW2 Lighting and Smoke Effect CVs			
CV201	3	1-15	Light Effect Period (x512ms)
CV202	4	0-15	Cab Special Effect [E1]
CV203	4	0-15	AUX Special Effect [E2]
CV204	*na*	*na*	*not available[E3]*
CV205	4	0-15	Smoke Special Effect [E4]
CV206	120	0-255	Smoke Timer 0=manual

To use an effect, first select the CV number for the specific LITE to be changed. Next find the desired effect in the effects table and note its CV value. Finally, load this value into the CV number. The original factory CV value is 4 for each of the LITE effects. This means they turn on at full brightness when activated.

Effect Timing Rate **CV201**
Range is 1-15 . . . . [3]

CAB LITE Effect **CV202**
Range is 0-15 . . . . [4]

AUX Effect **CV203**
Range is 0-15 . . . . [4]

SMOKE Effect **CV205**
Range is 0-15 . . . . [4]

Lighting effects that include a repeating pattern have a variable rate or speed at which the pattern is repeated. The rate or speed at which the pattern is repeated is based on the value set into CV201. Bigger numbers represent slower repeat times. The period CV does not apply when the selected effect is either full bright, dim or random flickering.

A value of 0 shouldn't be used. However, although if you accidentally enter 0, the decoder will automatically change it to a value of 1.

This table summarizes the lighting effects and the CV value to activate the lighting effect. Also shown is whether the timing rate applies to these effects. All of these effects are optimized for LED lighting.

Special Lighting Effects	CV Value	CV201 Applies
Off 0% - *should not be used*	0	No
Dim 6%	1	No
Dim 25%	2	No
Dim 50%	3	No
On 100%	4	No
Strato Light	5	Yes
Oscillating Light	6	Yes
FRED	7	Yes
Rotary Dome light 1	8	Yes
Gyra Light	9	Yes
Mars Light	10	Yes
Rotary Dome Light 2	11	Yes
Strobe Single Pulse	12	Yes
Strobe Double Pulse	13	Yes
Reserved	14	No
Random flicker	15	No

CV Value	Special Lighting Effects
0	Off 0%
1	Dim 6%
2	Dim 25%
3	Dim 50%
4	On 100%
5	Strato Light
6	Oscillating Light
7	FRED
8	Rotary Dome light 1
9	Gyra Light
10	Mars Light
11	Rotary Dome Light 2
12	Strobe Single Pulse
13	Strobe Double Pulse
14	Reserved
15	Random flicker

Multi-Unit Consist Lighting Tip

Here is how to set up a two unit consist that uses the headlight mode feature to automatically turn on the proper headlight depending on the direction of travel.

Multi-Unit Consist With Directional Lighting For Leading and Trailing Units

In this example, there are 2 locomotives that are consisted together. The locomotives all face the same direction. The desire is for the leading unit to have the front headlight on, when in the forward direction and its rear headlight off when going in the reverse direction. For the trailing unit, only the rear headlight is on when going in the reverse direction and the front headlight is off when going forward. The CV numbers and their values are shown for the leading and trailing locomotives. Both locomotives share the same frequency but can have different loco numbers.

Leading Locomotive	CV#	Value	Trailing Locomotive	CV#	Value
Headlight Mode	CV60	0	Headlight Mode	CV60	0
Front Headlight Effect	CV61	4	Front Headlight Effect	CV61	0
Rear Headlight Effect	CV62	0	Rear Headlight Effect	CV62	4

Attach Fuel Tank To Chassis

Route the speaker wire up though the chassis hole. Install the 4 screws that hold the fuel tank to the chassis. Route the wires out towards the cab end.

Attach The Center Weight

Place the weight back into its original position. Place the two speaker wires away from the mounting posts. Make sure the weight doesn't pinch the wires. Place the washers back over the mounting posts. The two hex 4-40 threaded standoffs will hold the weight to the chassis mounting posts. Carefully screw both standoffs into the plastic posts flush to the washer. Don't over tighten the standoff or there is risk of stripping the soft plastic. If this occurs, remove the standoff, fill the post with Gorilla Glue and reinsert the standoff. When dry the glue will hold the standoff securely.

Install Battery Pack

The battery pack mounts above the front truck where the weight was removed. The truck mounting screw must be free to rotate and must not touch the battery. The simplest solution is to build a stack of foam tape to serve as a mount for the battery.

The low cost 3M double-sided foam tape needs 4 layers to clear the truck. Cut the layers the width of the battery and position the two stacks as shown in the photo. Before mounting the battery, move the motor connector and its wire out of the chassis hole.

Temporarily place the main board over the two mounting posts to help position the battery correctly. Orient the battery with the connection wires facing the cab end and with a small gap between the battery and the main board. After mounting the battery, remove the main board.

Attach Smoke Generator Transistor To Center Weight

Place the hood upside down next to the chassis. Route the transistor from the hood to the center weight. Use one of the old screws to attach the transistor. Screw it down tight since the weight is used as a heatsink for the transistor. Note that the factory installed finned heatsink is omitted.

Take care not to break the three wires where they attach to the board in the hood. The solder joints were not very good on our unit and had to be resoldered. See the next page for closeups of where the wires attach - just in case.
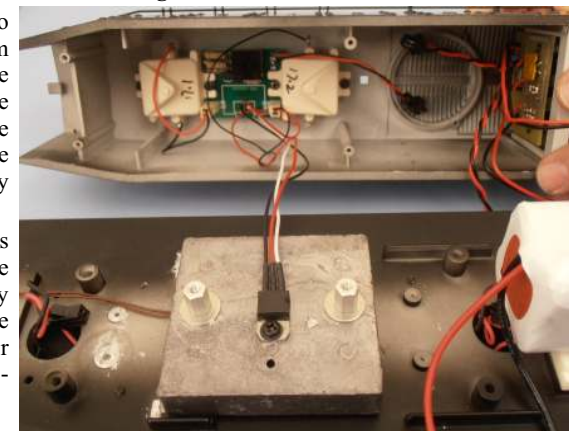
Smoke Generator Transistor Hookup Reference

This section is included just in case one or more of the wires on the transistor break off at the main board. If this happens, its a good bet that all three wires need to be removed, stripped, tinned and resoldered to the smoke generator. Now is a good time to do this since the wires will be flexed a lot as the hood and chassis are reassembled at the conclusion of the installation. W is white, R is red and B is black.

W R B

W R B
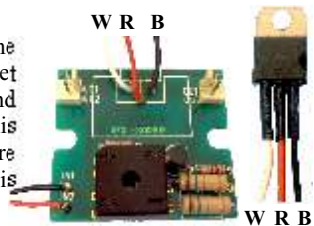
Install The Drop-In Main Board

Orient the main board with the antenna near the cab end. The motor connectors and wires will be between the weight and the Drop-In. Don't pinch the wires between board and mounting post.

Before putting in the mounting screws, connect the front motor connector to the front truck connector. Next connect the rear truck connector to the main board.

Attach the main board with the two 4-40 screws that came with the Drop-In kit. The truck wiring will be bundled with other wires later.

Connect the wire from the hood mounted smoke generator to the smoke generator connector coming from the main board.

Plug the battery into the connector coming from the front board in the hood.

Mount Cab To Chassis and Connect Wires

Orient the cab's wires so they don't get pinched between the cab and the chassis. Slip the cab back on to the chassis.

Plug the speaker connectors together. If used, insert the plugs from the front and rear couplers into the FRONTC and REARC sockets.

Plug in the P8's JST plug into the main board. It is polarized and only fits in one way. Make sure it is plugged in completely. The two green wires will be next to the black buzzer.

Plug the cab interior light (white-red) into the white header labeled CAB on the main board. It is polarized so make sure it plugs in correctly.

Plug the rear headlight (green-yellow) into the white header labeled LR.

Use small 4 inch tie-wraps (buy from Home Depot or Lowes) to bundle the wires together and keep them from getting in the way when reassembling the hood and chassis. When all the wires have been bundled, position them towards the center of the chassis and away from the flange where the hood slips onto the chassis.
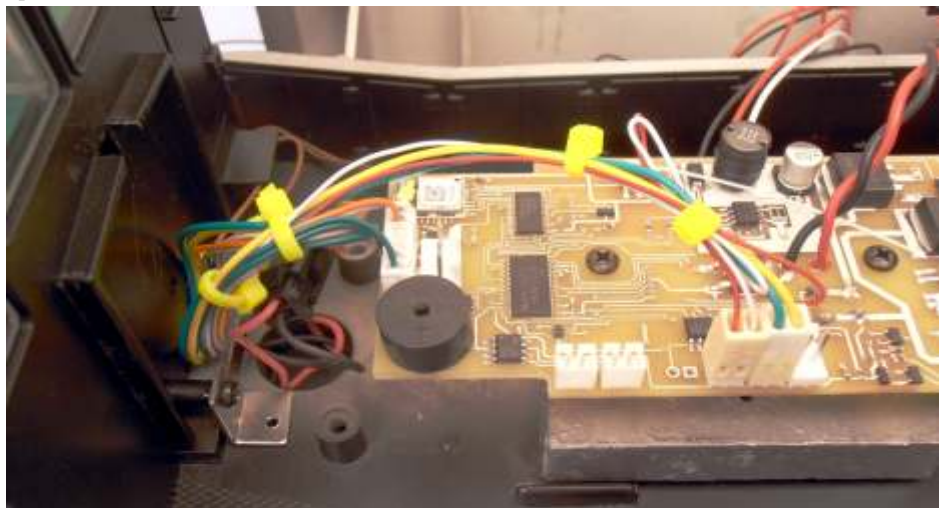
Auto-Dim Headlight Mode [rule 17]: When this option is selected, the headlight automatically dims when the throttle is set to zero speed. When dimmed, the headlight glows at a reduced brightness and without any special effects. Turning up the speed knob automatically restores the headlight and its assigned lighting effect to full brightness. This feature is optimized for white LEDs. Locomotives that use incandescent bulbs for headlights may appear very dim when using this feature.

CV Value	Head/Rear Lites Mode (Action)
0	Normal, autoreverse
1	Normal with rule17
2	Front headlight on always
3	Front headlight on always with rule17
4	Rear headlight on always
5	Rear headlight on always with rule17
6	Front and Rear both on always
7	Front and Rear both on always with rule17
8	Reversed Auto Reverse (Front to Back)
9	Reversed Auto Reverse with rule 17
10-15	reserved

Special Headlight Effects

There are a variety of special lighting effects that can be applied to the NW2 Drop-In decoder's headlights.

To apply an effect, determine which headlight is to have the effect, front or rear or both, find the desired effect in the effects table, note the CV value and then load this value into the CV 61 or 62 or both.

Front Headlight Effect CV61
Range is 0-15 . . . . [4]

Rear Headlight Effect CV62
Range is 0-15 . . . . [4]

Headlights Effect Timing Rate CV59
Range is 1-15 . . . . [3]

Lighting effects that offer a repeating pattern can have the rate or speed at which the pattern is repeated. The rate is based on the value set into CV59. This CV controls the rate of a repeating pattern. Examples of repeating patterns that apply to light effects are Mars and Gyra lights. The period range is 1 to 15 and is in units of 1/2 second. For example a period value of 2 gives a repeating pattern of about once per second. Bigger numbers represent slower repeat times. The period CV does not apply when the selected effect is either full bright, dim or random flickering. A value of 0 shouldn't be used although if you accidentally enter 0, the NW2 Drop-In will automatically change it to a value of 1.

The table on the next page summarizes the lighting effects and the CV value to activate the lighting effect. Also shown is whether the timing rate applies to these effects. All of these effects are optimized for LED lighting.

At any time, you may issue a reset to set all of the decoder CV values back to their original factory settings - don't be afraid to experiment. Nothing can be harmed or damaged.

Customizing Headlight Operation Mode

There are 4 CVs that govern how a headlight operates. These 4 CVs allow headlights to be configured to match your favorite prototype railroad or you can establish your own style.

Each of the CVs will be described followed by various tables of effects that can be assigned to the headlights.

Summary Table For All Headlight Effect CVs			
CV59	3	1-15	Headlites Effect Period (x512ms)
CV60	0	0-15	Headlights Mode 0=normal/autorev
CV61	4	0-15	Headlight Front Effect
CV62	4	0-15	Headlight Rear Effect

The NW2 Drop-In Decoder allows the front headlight and the rear backup light to operate in several different modes. The different modes control if and when the headlight dims and how the headlight and backup light operate. For example, the front headlight and the rear headlight can both be on at the same time or the front headlight can remain on, independent of the direction of travel. How the headlights behave are determined by the value stored in CV60.

Headlight Mode CV60

Range is 0-15. . . . . [0]

As with all setup options, the desired operating mode is selected from a CV value table and the appropriate number is stored in CV60 of the decoder's memory. The mode can be changed at any time.

CV60 only affects the headlight and the backup light operating modes. It has no effect on any other locomotive light.

Special lighting effects can be applied to the front and rear headlights and are described on the next page.

Normal Operation: The front headlight turns on at full brightness and the selected effect, if any, is applied. Normal operation also includes default headlight autoreverse. Autoreverse means that the front headlight is on when the throttle is set for the forward direction and off when set for the reverse direction. Conversely, when using autoreverse, the rear headlight light is off when in the throttle is set for the forward direction and on when set for reverse.

Lights Are Normally Off

When power is first applied to the decoder, all lights are initially off.

Head Lights Are Turned On With F0

To turn headlights on or off the headlights, push the 0 key on your throttle.

USA-Trains NW2 Drop-In Installation - *continued*

Orient Antenna Vertical And Towards Cab

The small whip antenna is attached to a gold colored snap-on connector. This connector rotates freely. Twist the connector until the end with the whip is pointing at the cab. Gently bend the antenna upwards. Leave it in this position for now. It will be tucked under the hood shortly.
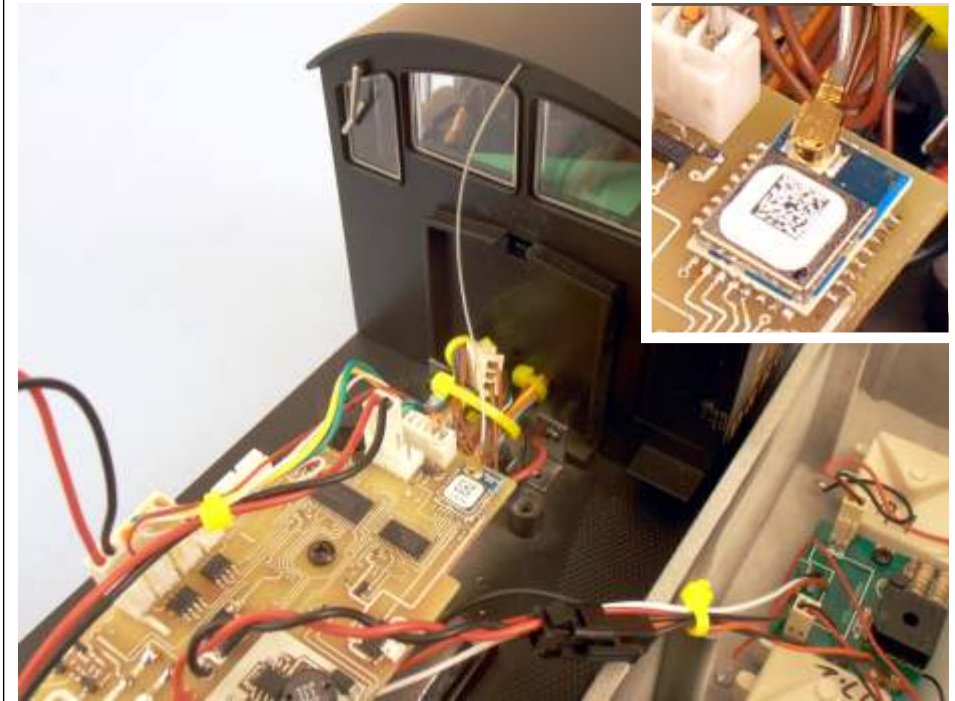
Headlight Connection

Plug in the headlight wire from the front board into the FL socket.

Orient Wires and Bundle Together

Move the hood very close to the chassis and elevate it slightly. Use tie wraps to create and hold wire bundles together. Orient the wire bundles so they run down the center of the chassis.

Use additional tie wraps if needed to persuade the wires to stay towards the center. Small pieces of tape can also be used.

Time For A Quick Test

Before doing the final reassembly, it is a good idea to power up the unit and perform an initial check of the unit.
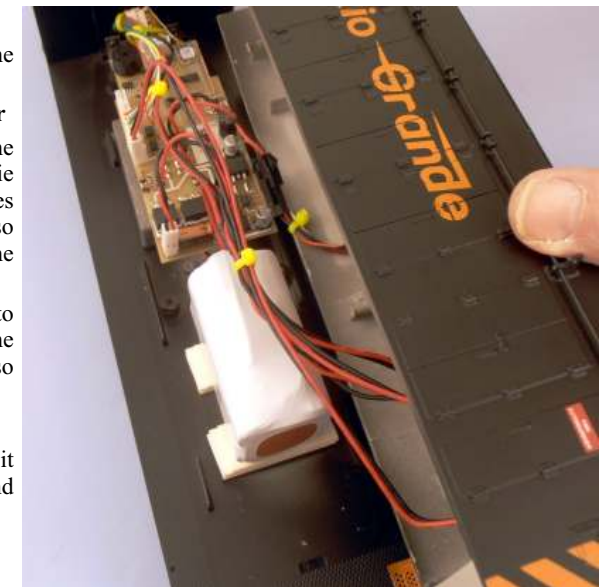
Preliminary Checkout [Assumes Decoder Is On Its Original Factory Settings]

Insure that all connectors are firmly plugged in and latched. Confirm that the battery is plugged in. As delivered from the factory, the Drop-In decoder is set to **locomotive address 3** and **frequency 0.** Also, if your P8 is new and unused it will be on address 3 also.

Turn On The Drop-In Decoder. The two switches under the radiator hatch connect battery power to the Drop-In decoder and power to the P8 sound module. Slide both actuators towards the hood's roof. This is the ON position.

Turn on your AirWire throttle. Set it to address to 3, the frequency to 0 and the speed to 0. See the throttle user guide if this is your first time to use the throttle.

The Green LED Says Power Is On. This also confirms that the battery is wired correctly.

The Red LED Says Throttle Signal Is Being Received. This red LED is labeled GP and is your assurance that NW2 decoder is working correctly and matches the throttle settings.

The P8 sound module power switch is independent of the main decoder power switch. There is no indicator for the P8 power switch. But, when turned on the Phoenix P8 module will make the engine startup sound effects and then return to idle. Push the 2 key on the throttle to blow the horn.

At this point, you have verified that the decoder, battery pack, sound module and speaker hookup are all correct and working normally.

Motor Check: Check for motor operation by very slowly increasing the speed until wheels begin to move. Verify that when the throttle shows a right arrow, the locomotive moves forward. For the NW2, the front of the long hood is considered the front end. Change to reverse and confirm the locomotive moves in the opposite direction. When done, set the speed value to 0.

Headlight Check: On the throttle push and release the 0 key. This sends the Function-0 command to the decoder which turns on the headlights. The Function 0 command will be abbreviated to simply F0. The factory setting for headlights is autoreverse. When the throttle is set for the forward direction, the front headlight is on and the rear headlight is off. When the throttle is set for the revese direction, the rear headlight is on and the front headlight is off.

Cab Interior Light Check: On the throttle, push and release the 6 key. This will command the decoder to turn on the cab light. The cab light stays on regardless of the locos direction.

Smoke Generator Check is omitted at this time since there must be smoke fluid in the reservoir to check it out. For now, verify all the connectors are plugged into the smoke unit and the smoke unit is plugged into the decoder.

Optional Coupler Checkout: If you have mounted the Phoenix couplers, push the 3 key to open the rear coupler. To open the front coupler, push the * key followed by the 3 key. This is function key 13 and is factory assigned to trigger the rear coupler. The assignment can be changed later if desired.

This completes the initial Drop-In Checkout. Reassembly will be the last step.

Original Factory Settings For Function Key Actions	
F0	Toggle Headlight On/Off
F3	Activate Rear Coupler
F5	Activate Cruise Control
F6	Toggle Cab Light On/Off
F9	Toggle AUX Light On/Off
F10	Toggle Smoke Generator On/Off
F11	not assigned
F13	Activate Front Coupler
F15	Deactivate Cruise Control

The NW2 Drop-In decoder comes equipped with a new and advanced cruise control design for maintaining the speed of a locomotive. Just like the cruise control in an automobile, once activated the locomotive will maintain the same average speed independent of the load or the terrain of your layout. It will cruise up hill and down hill as well as snake through tight curves and turnouts while maintaining the same average speed automatically without user's intervention.

New on the NW2 Drop-In are two extra CVs, CV64 and CV65. These allow you to finely tune your cruise control to your specific locomotive.

The NW2 Drop-In is shipped from factory with the cruise control disabled until you activate it with a function key (F5 is the factory default activation key). When activated the decoder will chirp one time. Pressing the function key again will not deactivate the cruise control. Deactivation depends on the selected cruise mode. The cruise mode is explained below. Once deactivated, the cruise control can only be reactivated again by pressing the function key. The decoder chirps each time it goes into or out of cruise control.

Cruise Mode Select **CV63**
Range is 0 - 1 . . . . [0]

There are two different types or modes of cruise control.

Cruise mode 0 (factory default setting), when activated, will hold the locomotive speed constant and independent of the load, grade or track curves. If the throttle speed is change, up or down, or the direction is reversed, cruise control is deactivated. Mode 0 is easy to use. Once the train reaches the desired speed, push F5 (or what ever key you have assigned to activate cruise control) to enable cruise.

Cruise mode-1 is unique in that once cruise is active, you may change the cruising speed without deactivating cruise control. This allows fine tuning of the cruise speed, either higher or lower. As with the other mode, push F5 to enable cruise mode. In this mode, you can make changes to the initial speed using the throttle speed knob. You may increase or decrease the speed. Taking the throttle to 0 or reversing the direction will turn off cruise mode. To turn it back on, just push F5 again. The decoder chirps each time it goes into or out of cruise control.

Cruise Tracking Rate **CV64**
Range is 1 - 16 . . . . [4]

CV64 selects the tracking rate with which the cruise control checks the locomotive speed. The value for CV64 has a range of 1 to 16 and the factory default value is set at 4. The lower the value of CV64 is, the more often the cruise control checks and corrects the locomotive cruise speed. We have found that the optimal setting to be about 4 although you can try different values since your locomotive and layout conditions might be somewhat different than ours.

Cruise Adaptation Step Size **CV65**
Range is 1- 3 . . . . [2]

CV65 is the adaptation step size, which sets the amount of correction when a motor speed adjustment has to be made. The default value of 2 works well for most locomotives. A value of 1 means the speed corrections are finer but it will take longer to adapt to a large change in speed. A value of 3 creates larger corrections and tracks speed changes much faster but with 50% less precision than a value of 2.

CAUTION: Do not use a value of 0 for either CV 64 or 65. If you accidentally use 0, the NW2 Drop-In will automatically reject it and instead use the factory default values.

Don't Use Cruise Control With Mult-unit Consists

If locomotives are in a multiunit consist, cruise-control may fight each other. However, if all locos are relatively closely matched, cruise mode 1 may be the best mode. Experiment to determine which cruise mode works best for your fleet.

Locomotive Speed Matching Tips

Using CV2, CV6 and CV5, you can match the speeds of two or more different locomotives. One important consideration is to determine which locomotive in a consist is the slowest. It is to this slow locomotive that you will match the other members of the consist. Always match a locomotive to the slowest member of the consist since we cannot make a slow locomotive run faster than its top speed. The following examples illustrate some of the possible ways to match up locomotives.

You may find that matching locomotives at the top and mid point speeds is close enough. By all means you may stop if you are happy with the performance after steps 1 and 2. The procedures below allow you to precisely match locomotive speeds at all speed steps, not just two. The penalty is a bit more time but you will be impressed with the results.

Use OPS mode programming to make changes to the CVs.

Step 1: Match locomotives at step 14

Using the slower locomotive as reference, match the faster locomotive to the speed of the slower one at speed step 14 using CV6. Since we are modifying CV6 of the faster locomotive, we should reduce the value of CV6 until it matches the speed of the slower locomotive. At this point, both locomotives should be running at the same speed at speed step 14.

Step 2: Match locomotives at top speed

Using the slower locomotive as reference, match the faster locomotive to the speed of the slower one at speed step 28 using CV5. Since we are modifying CV5 of the faster locomotive, we should reduce the value of CV5 until it matches the speed of the slower locomotive. At this point, both locomotives should be running at the same speed at speed step 28.

Step #3: Fine tuning the top speed setting only (2 methods)

Using the slower locomotive as reference, compare the speed of both locomotives at speed step 21 (middle of the high speed setting). If both locomotives are running at more or less the same speed then no fine tuning is necessary. If not then fine tuning the high speed setting may be done next. There are two ways, using CV5 or CV6 only.

Using CV5 only is the first method and results in minor speed differences at step 28.

Reference Locomotive Is Either Slower or Faster At Step 21: Decrease the value of CV5 of the other locomotive to match the speed of the reference. Conversely, if the reference locomotive is running faster at speed step 21, then increase CV5 of the other locomotive to match the speed of the reference. Using this method can result in minor speed difference in top speed.

Using CV6 is an alternative method and results in minor speed differences at step 14.

Reference locomotive is running slower or faster at at speed step 21, then lower CV6 of the other locomotive to match the speed of the reference. Conversely, if the reference locomotive is running faster at speed step 21, then increase CV6 of the other locomotive to match the speed of the reference.

Step #4: Fine tuning the low speed setting only (2 methods).

Using the slower locomotive as reference, compare the speed of both locomotives at speed step 7 (middle of the low speed setting). If both locomotives are running at more or less the same speed then no fine tuning is necessary. If not then fine tuning the low speed setting may be done next. There are two ways, using CV6 or CV2 only.

Using CV6 is the first method and results in minor speed differences at step 14.

Reference locomotive is running slower at speed step 7: lower CV6 of the other locomotive to match the speed of the reference. Conversely, if the reference locomotive is running faster at speed step 7, then increase CV6 of the other locomotive to match the speed of the reference.

Using CV2 is the alternative method and results in minor speed difference at step 1.

Reference locomotive is running slower at speed step 7: lower CV2 of the other locomotive to match the speed of the reference. Conversely, if the reference locomotive is running faster at speed step 21, then increase CV2 of the other locomotive to match the speed of the reference.

If The Checkout Didn't Pass - Simple Remedies

Green Power LED doesn't turn on: Make sure the Drop-In decoder power switch is on. The power LED does not turn on even though the sound module is operating OK.

Red GP LED flashes slowly: This is your indication that the throttle's frequency doesn't match the decoder's frequency. Set the throttle's frequency to 0.

Sound decoder makes no sound: Be sure to set the P8 power switch in the ON position. Verify that the speaker plug is plugged into the proper socket on the DCC board. Check that a wire has not broken off the speaker. Check that the P8 harness plug is firmly inserted into the Drop-In socket. It only fits one direction. If all this looks OK, push F7 on the throttle which ramps up the volume. Push F7 to stop the ramping and to set the desired loudness. If it is too loud, push F8 to ramp down the volume. Push F8 to stop the ramp down at the desired setting. If the sound module remains silent, it may need to be reprogrammed via the programming cable. See page 20 for a recommended P8 configuration.

Front And Rear Headlights Are Reversed: The front and rear light connectors are reversed on the main board. Swap them around and test again.

Front Headlight Doesn't Turn On: Verify the light is soldered to the Front board. Verify the FLIN connector is plugged into the LF socket.

Rear Head Light Doesn't Turn On: Make sure the connector is plugged into the LR socket. Make the wires connecting the rear headlamp have not been broken during installation. Verify that both pins are firmly in the socket.

Cab Interior Light Doesn't Turn On: Check for a properly seated plug and for broken wires.

Using The Optional AUX Light Output

The AUX LITE output is designed to drive white LEDs. The LED looks best for all of the available lighting effects. Do not use an incandescent lamp.

The AUX Lite output provides a source of 3V and a function key controlled switch to toggle the light on and off.

Throttle function key 9 is preassigned to turn the AUX light on and off but you can change it to any key desired.

Making Connections

The AUX header has two pins. Pin 1 connects to +3V. Pin 2 connects to the AUX LITE driver. An optional 2-wire plug with about 12 inches of wire that matches the decoder's AUX header is available from CVP Products or your dealer. Order part number KK2.

LED Wiring And Limit Resistor

For a white LED, use a 10 ohm resistor in series with the LED as shown in the drawing. This will provide about 20mA of current which is plenty bright. Higher resistance values will decrease the brightness.


10 ohm   K   LED

+ A

To AUX Header
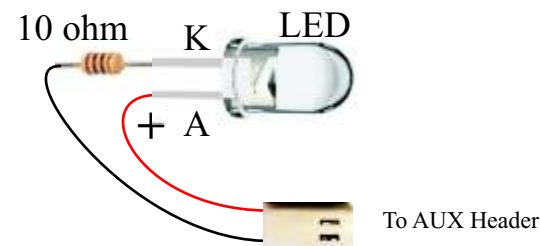
Locomotive Reassembly

This will take a few minutes so don not rush - take your time.

Lift the hood over the chassis while observing the wire bundles. Use a few pieces of scotch tape to hold bundles in the proper location - along the center of the chassis. Keep the wires as far away from the antenna as possible.

The three wires from the smoke generator transistor need to be pushed flat against the main board so they are pinched between the hood and chassis as its lowered into place. Use your thumb to put a hard crease in the wires against the main board.

Move the antenna to be underneath the hood and slide the hood down towards the chassis.
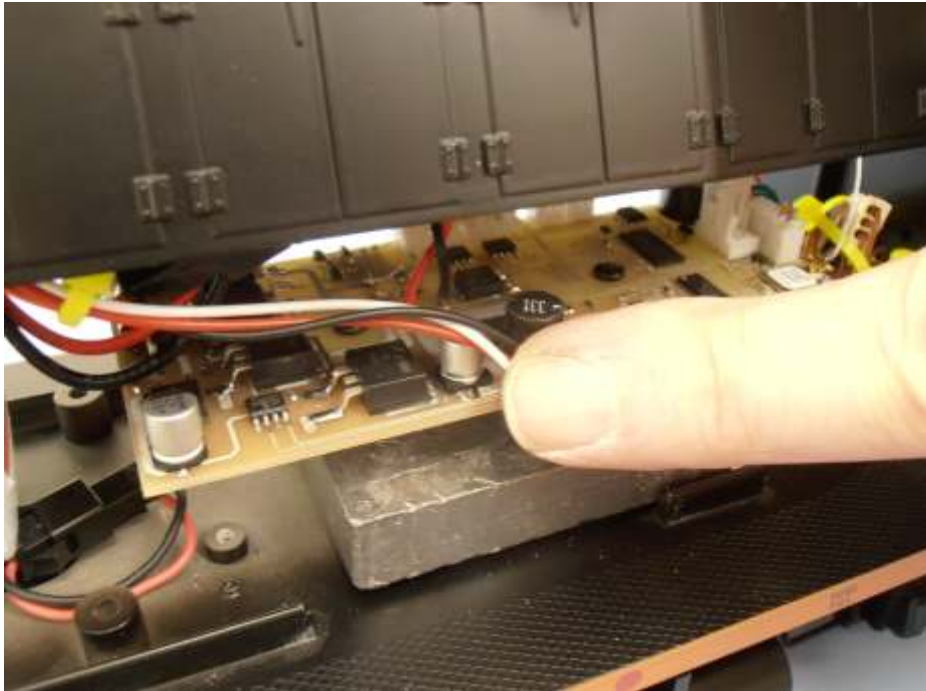
Insert Hood Tab Into Front Of Loco

There is a small tab that holds the front of the hood to the chassis. Tilt the front of the hood down and place the tab into the hole in the chassis. Check between the hood and chassis to verify no wires are hanging out.
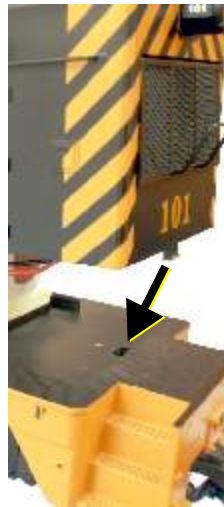
Improve Slow Speed Running With Bumping

Many users assume that CV2 is used to control how the locomotive starts up at slow speeds. However, you should not use CV2 for that purpose. Instead take advantage of the advanced NW2 Drop-In feature of motor bumping.

We have completely redesigned the bumping algorithm to provide for precision slow speed control. The new algorithm uses a sophisticated algorithm that you can customize using CV56 and CV57. The new bumping feature perfectly compliments the ultra high resolution speed curve created with CV2, CV5 and CV6.

With motor bumping, you can achieve silky smooth performance at very low speeds. There are two CVs for this feature, the motor bump value, CV56 and the motor bump duration, CV57. Your NW2 Drop-In will automatically transition from the slow-speed bump to the high resolution speed curve operation as the locomotive gains speed.

Motor Bump Value **CV56**
Range is 0-255 . . . . [0]

This value sets the amount of momentary motor voltage increase, called a bump, applied at each speed step to the help motor overcome friction. It helps get the motor rotating at a lower voltage and/or a lower speed step. Once the locomotive is moving, the bump automatically goes away. A value of 0 turns off the motor bump. A value of 128 will literally apply half of full speed to the motor.

Motor Bump Duration **CV57**
Range is 0-127 . . . . [0]

This value selects the duration of time that the bump value is applied when the bump is active. A value of 0 disables the bump completely, no matter what is set in CV56.

Experimenting With Motor Bumping

To use the motor bump feature, the following procedure is recommended. Be sure to use a throttle that shows the speed step being sent such as the T5000.

Step 1: Set the throttle to speed step 1 and observe the locomotive's wheels. They may or may not be turning.

Step 2: Set CV56 to a value of 15 and CV57 to a value of 50. Observe the locomotive wheels and see if they are now turning. Stop and then return the throttle to step 1. Look for consistent forward motion and make sure that the bump is sufficient for smooth operation over the entire length of the track at speed step 1.

Step 3: If the wheels are not yet turning, increase either CV56 or CV57 or both by a value of 5 and check again. You should make changes to the CV values in increments of 5. Smaller increments may not cause any noticeable changes.

There is a tradeoff between the bump value and the bump duration. If a small bump value is applied, then a longer bump duration will be needed. Or, if a large bump value is used, it can be applied for a shorter duration .

Careful choices of CV56 and CV57 will give not only fine control at slow speeds but allow the full range of precision speed control over the entire speed curve. Think of the motor bump as an added feature that provides an extra boost of energy to get the locomotive moving at low speeds.

New Motors Should Be Broken In Before Using

A new motor usually doesn't have motor brushes that conform well to the circular shaft of the commutator. The brushes tend to draw more than normal current, and exhibit arcing. As a result, the motor causes lots of radio noise and can even trip the NW2 Drop-In over-current protection circuit. To prevent this from occurring, just run the motor for an hour or so at full speed and in each direction. This will seat the motor brushes and greatly reduce radio noise generation.

Motor Acceleration and Deceleration Control

Locomotive inertia and momentum are simulated using CV3 and CV4. Inertia is the rate at which a locomotive accelerates when changing from a slow speed to a higher speed. Contrast that with momentum which is the rate at which a locomotive decelerates from a high speed to a lower speed.

CV3 deals with the rate of acceleration when the speed is increased. In other words how quickly does the operator intend for the locomotive to accelerate. The smaller the value of CV3 the quicker a locomotive will accelerate. Similarly, CV4 deals with the rate of deceleration and the smaller the value of CV4 the quicker the locomotive will decelerate.

Motor Acceleration Rate. CV3
Range is 1-255 . . . . [2]

This CV sets the rate of change of locomotive speed when the throttle speed is increased. This is called the acceleration rate. Small values mean the rate of change is fast. A higher value leads to a slower rate of change.

In most cases, users prefer a *slower* rate of change for the acceleration rate. Common values are 3, 4 and 5. Large values result in extremely long delays for speed changes to take effect which are generally uncomfortable for users. The acceleration rate applies equally in the forward and reverse directions.

Motor Deceleration Rate CV4
Range is 1-255 . . . . [2]

This CV sets the rate of change of speed upon when the throttle speed is decreased. This is called the deceleration rate. Small values mean the rate of change is faster. A higher value leads to a slower rate of change.

In most cases, users prefer a *faster* deceleration rate compared to the acceleration rate. The factory default of 2 is seldom changed. High values will result in extremely long delays for locomotives to slow down. If you imagine your favorite locomotive speeding towards another train, you will want to be able to quickly stop the train. This is why the factory setting of 2 is seldom changed. Users want to slowly start the train, but quickly stop it. The value applies equally in the forward and reverse directions.

GearSaver Protection

If for some reason, you set CV3 or CV4 to 0 in an attempt to achieve instantaneous stop or quick acceleration, NW2 Drop-In will automatically set CV3 or CV4 to 1 instead, in order to protect the locomotive gears from being stripped. So the effective range for CV3 and CV4 is from a value of 1 to 255.

Also, if you reverse the locomotive direction without first stopping it, GearSaver protects you again. In this situation, NW2 Drop-In will ramp the speed down to zero before reversing the direction and

---

Beware Of Large Values

Large values for acceleration or deceleration rates will result in very slow response to throttle changes. Extreme values will result in the locomotive never starting, or, never stopping - neither of which is very comfortable to the operator.


Locomotive Reassembly

The last step is to fasten the cab to the hood. There is another tab on the rear of the hood that inserts into a matching hole on the cab.

The easiest way to do this task is to tilt back the cab, while tilting up the rear end of the hood. This will allow the tab to slide into the hole as the two pieces are pushed flush against the chassis. Once again, check for pinched wires between the chassis and the hood on both sides.

Tab

Push down on both the cab and the hood until they are flush to the chassis floor. If there is any resistance, it will likely due to wires. Inspect are sides of the locomotive for dangling wires. If you find any, partially open the hood and move the wires out of the way.

Finally, reinsert the mounting screws. This completes the NW2 decoder installation.

**Before Using The Locomotive
Fully Charge The Battery**
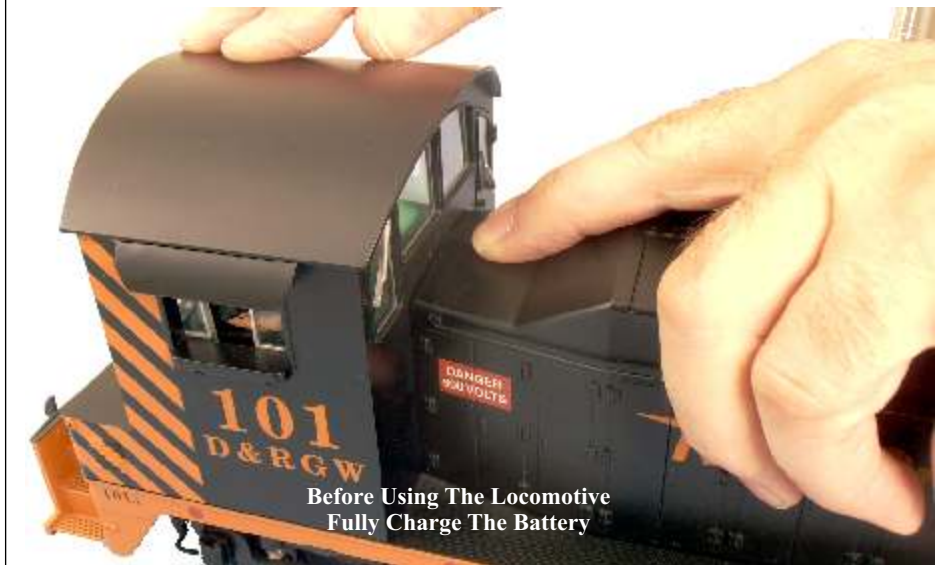
Connecting The Charger and Charging The Battery

The jack for the charger is next to the switches located behind the radiator hatch.

The left switch is the power switch for the NW2 decoder. In the up position, it connects the battery to the motion decoder. In the down position, the decoder is disconnected and the charging jack is connected to the battery.

The right switch is the power switch for the P8 sound module. In the up position, it connects battery power to the sound module. In the down position, it disconnects the sound module from the battery which turns it off.

Both switches must be in the down position to charge the battery.

If using the recommended Lithium battery pack, use the matching smart charger rated at 1 amp. The CVP smart charger is a perfect match to the recommended battery pack.

Battery Charger

Sound Power

Motion Power

Up = Run

Down = Charge or off

Storing The Locomotive

Always place the switches in the down or off position when storing the locomotive. If the sound switch is up or on, the battery will be discharging even if the sound is muted.

If the battery is not used for a long period of time, allow time to allow a full recharge before its first use. This will insure maximum battery life.

Seasonal Storage Recommendations

If is OK to keep the smart battery charger plugged in and powered on. The charger will monitor the battery voltage is keep it fully charged .
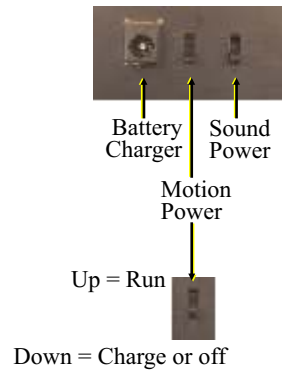
Runtime and Battery Charge Life

How Long Does The Battery Last?

This is a very common question that does not have a simple answer. This is because the answer depends on many factors such as: type of railroad, locomotive condition, temperature, how the railroad is operated, how many cars are pulled, how many hills and so on.

A rough idea of the battery life can be determined by dividing the battery rating which is in Amp-hours (Ahr) by the motor current. For example, the CVP recommended battery pack is rated at 2.6 Amp-hours. In other words, the battery will last about 1 hour if the locomotive pulls 2.6 Amps. Fortunately, the locomotive motors don't usually operate near that value. Under normal operating conditions, you can expect up between 1.5 and 2 hours from one charge.

The Motor Is The Primary Battery Drain

When running on straight and level track at about half of top speed, the USA-Trains NW2 draw between 1 and 2 amps. There is also a brief but high current draw when the locomotive initially begins moving.

Locomotive speed also affects battery drain. The faster the locomotive speed, the faster the battery drain. Slow down and your battery will last longer. If the speed is constant, but more cars are added, the faster the battery drain. But there is a limit to the number of cars that may be pulled.

Lugging down the motor by forcing it to haul too many cars up the hill will very quickly drain the battery. Instead, use multiple locomotives or helpers. Your batteries will last much longer.

Smoke Generator And Battery Drain

The smoke generator will also quickly drain the battery. The little smoke generator consumes about a half amp when running. Also, set the timer to provide sufficient time to create smoke but not so long as to drain the reservoir dry of smoke fluid.

Lighting And Battery Drain

The stock NW2 locomotive uses all incandescent bulbs. When all are on, the battery drain is about 1/4 of an amp. Consider turning off the cab interior light during the day, since it can't been seen.

Locomotive Motion Control and Fine Tuning *continued*

Maximum Motor Voltage Value (Vmax). CV5
 Range is 0-255 . . . . [255]

The top speed voltage (full speed) corresponds to speed step 28 (in a 28 speed step setting). CV5 is used to set this voltage and 255 is the factory default. If a lower top speed is needed, for example in speed matching application, set CV5 to a smaller value. Speed curve #2 lowers the top speed to 155. So at speed step 28, the locomotive is running at 60% of the maximum motor voltage. It should be noted that every speed step from 1 to 28 will be slower accordingly.

Setting CV5 to a value less than CV6 is OK but the resultant speed curve will be an upside down V. Curve #5 on the previous page shows the extreme case with CV5 equal 0 and CV6 equal to 128, The motor will reach top speed at step 14 and then gradually slow down to a stop at step 28.

Customizing The Speed Curve To Your Requirements

Customizing a speed curve is easily done by modifying one or more of the three configuration variables. It helps to visualize the speed curve as having two separate halves as shown in the graph with the split at the 50% throttle speed position. The left half is controlled by CV2 and CV6 and responds to the first 14 speed steps (in the 28 speed step setting). The right half is controlled by CV6 and CV5 and responds to speed steps 15 to 28 (in the 28 speed step setting).

I want finer slow speed control: With CV2 and CV5 unchanged, the step size of speed steps 0 to 14 in the left half of the speed curve can be reduced to give finer control by simply reducing the value of CV6 from the default 128 to a smaller value. For example, by reducing CV6 to 100, each of the 14 steps will be reduced by a value of 2. As a result of reducing CV6 to 100, the step size for speed steps from 15 to 28 in the right half of the speed curve increase by a value of 2. The result is curve #3. Thus, you gain finer speed control at the low end of the throttle range at the expense of bigger steps at the high end. For yard operations, you will find this setting to offer precision slow speed control right when you needed it.

I want finer high speed control: With CV2 and CV5 unchanged, the step size of speed steps 15 to 28 in the right half of the speed curve can be reduced to give finer control by simply increasing the value of CV6 from the default 128 to a larger value. For example, by increasing CV6 to 156, each of the 14 steps will be increased by a value of 2. The result is curve #4. It is important to remember that as a result of increasing CV6 to 156, the step size for steps 0 to 14 in the left half of the speed curve would be increased by a value of 2.

I want both finer speed steps for slow and high speed control: With CV2 unchanged, the step size of speed steps 0 to 28 can be reduced to give finer control by simultaneously reducing the values of CV6 and CV5 to a smaller value. For example, by reducing CV6 from a default of 128 to 100, and CV5 from a default of 255 to 227, the step size for the entire speed curve is now reduced by a value of 2 to give finer control. The result is curve # 2. By reducing CV5 to a smaller value, the top speed at the high end is lower which will result in less torque at high throttle settings.

CV2 has remained unchanged in the above examples. The next set of examples, shows what you can do by modifying CV2. These are not graphed but are discussed to show that you can create an unlimited variety of speed curves using just 3 different CVs.

I want a higher MSV with finer slow and high speed control: With CV5 unchanged, the step size of speed steps 0 to 28 can be reduced to give finer control by simultaneously increasing the values of CV2 and CV6 to a larger value. For example, by increasing CV2 from a default of 9 to 37, and CV6 from a default of 128 to 156, the step size for the entire speed curve is now reduced by a value of 2 to give finer control. By increasing CV2 to a larger value, the MSV is now higher for the low end starting speed of speed step 1.

I want higher MSV and reduced top speed with finer slow and high speed control: With CV6 unchanged, the step size of speed steps 0 to 28 can be reduced to give finer control by simultaneously increasing CV2 to a larger value and reducing CV5 to a smaller value. For example, by increasing CV2 from a default of 9 to 37, and reducing CV5 from a default of 255 to 227, the step size for the entire speed curve is now reduced by a value of 2 to give finer control. This also results in a reduced top speed at speed step 28 and an increased starting speed at speed step 1.

There are 3 CVs that determine how the locomotive motor responds to a throttle speed command. Following the NMRA-DCC standard, these are: CV2 (Vstart or motor-starting-voltage MSV) CV6 (Vmid), and CV5 (Vmax). The full scale motor voltage value ranges from 0 to 255 so these 3 variables also have a value range of 0 to 255. You may set these values to suit your desired locomotive performance as well as to help with speed matching of different locomotives.
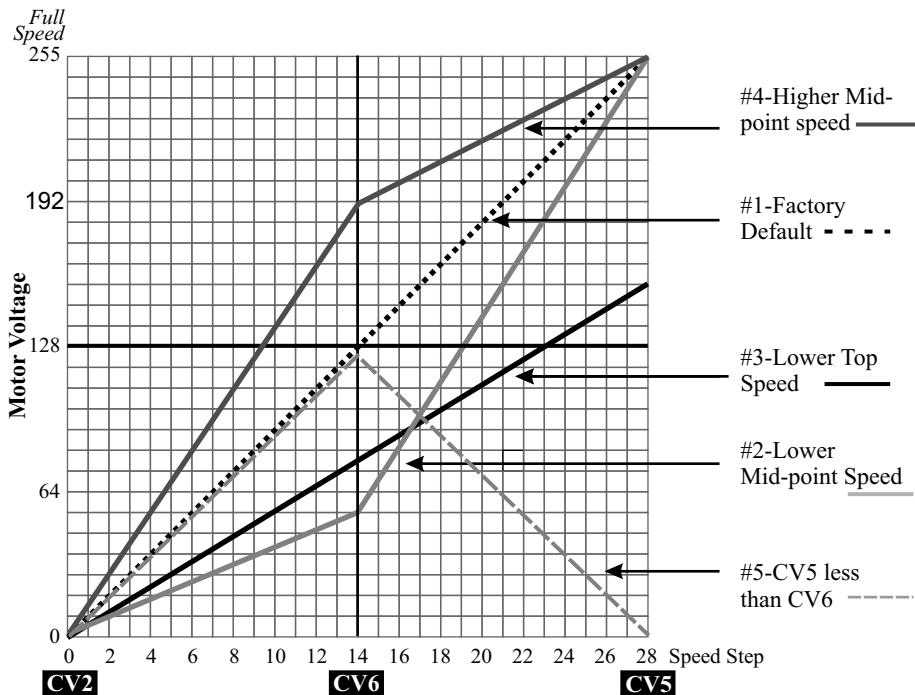
Note: regardless of the throttle's speed step setting, the NW2 Drop-In will automatically adjust for the 14 speed step or the 28 speed step settings.

Motor Starting Voltage Value (MSV) **CV2**
Range is 0-255 . . . . [9]

CV2 sets the MSV of the motor voltage that corresponds to speed step 1 (in a 28 speed step setting). This is the first speed step from off, or zero voltage. You can decide if you wish the motor to be moving at a good rate of speed or just barely moving by changing the MSV. A small MSV value means only a small extra increase in motor voltage. A larger MSV value means the motor receives a higher motor voltage. Also consider modifying the motor bumping feature described on page 24 since the two settings are somewhat interactive.

Mid-point Motor Voltage Value (Vmid) **CV6**
Range is 0-255 . . . . [128]

The mid-point voltage, or half speed, corresponds to speed step 14 (in a 28 speed step setting). CV6 is used to set this voltage with 128 being the factory default value. If a lower half speed is needed, for example in speed matching application, set CV6 to a smaller value. Speed curve #3 lowers the half speed to 55. So at speed step 14, the locomotive is running at 25% of the maximum motor voltage. Conversely, if the locomotive is running too slow at speed step 14, CV6 can be raised to increase the half speed.

Changing Decoder Address To Match Loco Cab Number

Address changing is simple and straight forward using the T5000 throttle. On the Drop-In decoder, make sure that the POWER switch is in the RUN position and the SOUND switch is in the ON position. As long as both power switches are set correctly, the Drop-In and the P8 sound decoder will be programmed to the same number at the same time.

The Drop-In decoder address and the P8 sound decoder addresses must match or the throttle function keys will not have control of the sound functions.

1. Turn on the decoder's power switches. The green LED must be on.

2. Turn on the throttle.

3. Verify that the throttle frequency is set to match the decoder frequency [new decoders are on frequency 0].

4. Push throttle 's green MENU key twice. "Push" means to push <u>and</u> release the key.

5. Push 4 to select SVC (crude abbreviation for "service" PROGRAM.

6. Push 1 to select configuration variable (CV) number 1 and push ENT.

7. Enter the desired decoder address and push ENT. Most people use the locomotive cab number. Address 0 is not allowed.

8. Upon pressing ENT, the decoder chirps 2 times for an address from 1 to 99 or 3 times for an address from 100 to 9999. Push the red ESC key to exit the programming mode.

9. Set your throttle to the new decoder address. Set the direction and turn up the speed knob and you are in control.

10. Push the LOCO MEM key twice to store the frequency and decoder address in throttle memory by pushing the LOCO MEM key twice. This is not mandatory but does make it easier to recall the address and automatically set the proper frequency.

Changing The Decoder Frequency

The Drop-In decoder allows frequency selection directly from the throttle. The decoder frequency is remembered even if the battery is disconnected. Any of the 17 available frequencies may be used.

Setting The Frequency - There are 17 unique frequencies available. The frequencies are numbered from 0 to 16 for a total of 17. The desired frequency is stored inside the decoder in configuration variable number 200 which is abbreviated CV200. Service programming is recommended because you don't need to use or remember the locomotive address. Setting the frequency has no affect on the attached P8 decoder.

1. Always confirm the throttle is set to decoder's present frequency [for a new decoder, this is frequency 0].

2. Push MENU twice and then push 4 to select SVC PROGRAM mode..

3. Enter 200 followed by ENT.

4. Enter the frequency number and push ENT. The decoder chirps once to indicate receipt of the new frequency. The frequency number range is 0 to 16.

Note: If you enter a frequency value larger than 16, the decoder will not accept it and, instead, will reset the frequency to 0. It still chirps even if this occurs.

5. Push the red ESC key to cancel SVC PROGRAM mode.

6. Change the throttle to the new frequency. Push MENU, then 3, then enter the new frequency number, then press ENT.

7. Set the throttle to the decoder frequency and drive away.

8. Write the frequency and address on a sticky label and attach it to the locomotive. The bottom of the tender is always a good spot. Although you may remember the frequency next week; how about in 6 months? This record will help you remember.

Optional: push LOCO MEM key twice to store locomotive address along with its new frequency in your throttle.

Customizing Smoke Generator Operation

The NW2 smoke generators are the standard resistor heater and fluid reservoir. Activating the smoke generator with F10, turns on the heater, heats up the fluid which changes to visible smoke.

Allow up to a minute for smoke to begin. Don't overfill the reservoir or it may never smoke.

The Drop-In Has A Built-In Programmable Timer For The Smoke Generator Shut-Off. The shutoff time can be set in seconds from 0 to 255 seconds. The factory setting is 2 minutes. After the timer has expired, the decoder will automatically turn off the smoke generator. It can be re-triggerred by pushing the smoke function key, F10.

CV206 sets the time delay and has a range of 1 to 255 seconds. If CV206 is set to 0, the timer is disabled and the smoke generator can be manually controlled. Once it is turned on with F10, only another push of F10 will turn it off. This is not a recommend setting since it might cause the heater to burn out once the fluid is gone. The default setting 2 minutes.

SMOKE On-Time Duration Timer **CV206**
Range is 0-255 . . . . [120]

Not Enough Smoke Coming Out of The Stack?

The NW2 comes with the older style smoke generator. The older style does not have the small fan to help push the smoke out of the stack like newer USA-Trains diesels. Unfortunately, the factory supplied generator is as good as it gets. So, for better performance, consider using a newer style USA-Trains smoke generator or install an after market smoke generator.

The Drop-In decoder's smoke driver will support up to a 3A load. Naturally, the battery will run down much faster if you like to smoke.

Optional Phoenix Coupler Operation

The Drop-In series decoder includes built-in drivers and matching sockets for two Phoenix "solenoid" style couplers. Function key F3 has the default assignment of activating the rear coupler. Function key F13 has the default assignment of activating the front coupler. Coupler activation can be reassigned to other throttle function keys, especially if your AirWire throttle doesn't support more than 12 functions.

Battery Voltage Range is 8 to 24 volts. However, at lower voltages, the solenoid "snap" will be somewhat weaker and might not release if there is any tension present.

The Activation Pulse is designed to mimic the amount of energy delivered by the Phoenix coupler driver board. The activation pulse is of a fixed time that has been optimized for variable battery voltages.

The Phoenix coupler must not have tension on the knuckle or it will not release. So, similar to the smaller scales, this is called a slack-type coupler. There must be slack in the coupler so the knuckle releases when activated.

To couple back up, open the knuckle and firmly back into the car to be coupled. The knuckle will lock closed upon contact.

Coupler mounting is likely to be where most of the innovation is needed. Although originally designed for truck mounting, body mounting is usually preferred. If you find a good way to mount the coupler on the body, be sure and take pictures and share with us and Phoenix.

Couplers, connecting cables and usage guidelines can be found and ordered on the Phoenix Sound Website. Contact them with questions about their couplers.

www.phoenixsound.com

Function Key Assignment CV Numbers

The table to the rights lists the CV number assigned to each function key.

The CV number is the memory location that holds the value which dictates what happens when the function command is received.

The action value is described in the next table. The bracketed item is the original factory setting.

The new Drop-In decoder supports more functions than our previous decoders.

The extra functions provide additional throttle control of the new Drop-In decoder features such as coupler activation.

Note: Only the T5000 throttles or later models offer more than 12 function commands.

Function Key Action Table	CV#
F1 Function Key Action	CV35
F2 Function Key Action	CV36
F3 Function Key [RCOUPLR]	CV37
F4 Function Key Action [none]	CV38
F5 Function Key Action [CRUISE]	CV39
F6 Function Key Action [CAB]	CV40
F7 Function Key Action	CV41
F8 Function Key Action	CV42
F9 Function Key Action [AUX]	CV43
F10 Function Key Action [SMOKE]	CV44
F11 Function Key Action	CV45
F12 Function Key Action	CV46
F13 Function Key [FCOUPLR]	CV213
F14 Function Key Action	CV214
F15 Function Key [CRUISE OFF]	CV215

Decoder Actions

The table shows all of the decoder actions that may be triggered when a function key on the throttle is pressed. This table is larger than our previous decoders due to the addition of new decoder actions. For example, if a value of 6 is loaded into CV39, pressing function key 5 on the throttle will activate the smoke generator. It is OK for the same action to be assigned to multiple function keys.

CV Value	Function Key Action
0	No Function
1	Activate Cruise Control
2	No Function
3	Toggle CAB light on/off
4	Toggle AUX on/off
5	*no action - not available*
6	Toggle SMOKE on/off
7	Dim Headlighs on/off
8	Activate Front Coupler
9	Activate Rear Coupler
15	No Function
99	Deactivate Cruise Control
not listed	reserved

If You Forget The Locomotive's Frequency

There may come a time when you do not remember the locomotive's frequency. If this happens, use the following technique to reset the Drop-In decoder frequency without changing anything else and without changing the address. If you have forgotten the address as well, you must first set the frequency and then reprogram the decoder with the desired address.

To Reset The Decoder's Frequency

Step 1: Turn off **all** AirWire throttles. This is very important since it is the absence of any throttle signal that forces the decoder to temporarily jump to frequency 0. Also, m*ake sure there are no lurking locomotives, powered up and set to frequency 0. If so, their frequencies will be changed too.*

Step 2: Turn off the NW2 Drop-In if it was powered and then turn it back on.

Step 3: Wait a minimum of one minute. Listen for the 5 second count down chirp. When the chirps stop, the NW2 Drop-In is temporarily on frequency 0. You must wait the full minute before moving to step 4.

Step 4: Turn on your throttle. Set it to frequency 0.

Step 5: Push MENU twice and then push 4 to select SVC PROGRAM mode.

Step 6: Enter 200 followed by ENT.

Step 7: Enter the desired frequency number and push ENT. The decoder chirps once to indicate receipt of the new frequency. The frequency number range is 0 to 16.

> *Note: If you enter a frequency value larger than 16, the decoder will not accept it and, instead, will reset the frequency to 0. It still chirps even if this occurs.*

Step 8: Push ESC to return to the home page. .

Step 9: Turn the Drop-In decoder power switch off, then back on. The Drop-In decoder is now on the new frequency.

Be sure to change the throttle to the new frequency. Push MENU, then 3, then enter the decoder's new frequency number and then press ENT. Set the throttle to the decoder address and drive away.

Notes About The Forgotten Frequency Setting Technique

► The temporary jump to frequency 0 is canceled and normal operation on the original frequency resumes if a throttle is turned on that matches the present Drop-In frequency setting **within one minute** of the decoder's Power switch being turned on (before the count down chirps stop).

► If the Drop-In decoder jumps to frequency 0 because you waited too long to turn on the throttle, just cycle the decoder power and make sure the throttle is turned on within one minute.

► The jump to frequency 0 is temporary and **nothing is changed** in the decoder. However the decoder will stay on frequency 0, until power is cycled or you change the frequency by setting CV200 to a new value. If you don't change the frequency, the decoder will revert back to its previously stored frequency when its power switch is turned off then back on.

► The Drop-In decoder will not jump to frequency 0 if a throttle having a frequency that matches the decoder is turned on within one minute of turning on the decoder even if the address is different. Once the decoder has heard a throttle with a matching frequency, it will not enter the jump mode even if the throttle is turned off.

> You must use the Drop-In decoder's POWER switch when turning the decoder on and off for a "power cycle." If you forget and just turn off the sound decoder's power switch, the Drop-In decoder will not be enter the jump mode. Best practice is to always turn on and off both power switches.

Restoring The Decoder To Original Factory CV Values

There may come a time when the decoder no longer responds to what you believe is the correct frequency, or you don't know its address. The assumption for this procedure is that you **DON'T** know the Drop-In decoder frequency. This procedure will first reset the frequency as well as restore the original factory settings, including address and frequency to the Drop-In decoder.

This procedure will not reset the P8 sound module.

First: Reset the frequency

1. Turn off all AirWire throttles. This is very important since it is the absence of a throttle signal, plus turning the power off and then back on (a power cycle), that allows the decoder to temporarily jump to a specific known frequency, which is frequency 0.

2. Turn off the Drop-In decoder if it was powered on.

3. Turn on the Drop-In decoder and **wait** at least one minute. At the end of the one minute, the Drop-In decoder will chirp 5 times. At the end of the chirps, the decoder will be temporarily receiving on frequency 0.

4. Turn on your throttle, and set it to frequency 0. The address doesn't matter.

5. Push MENU twice and then push 4 for SVC PROGRAM.

6. Push 8 and ENT for CV8.

7. Push 1, 3, 5 and push ENT to issue the factory reset. The decoder will chirp when the command is accepted.

8. Turn off, and then turn back on the Drop-In decoder. The decoder is now set to address 3 and frequency 0. It is set exactly the same as when it left the factory. The P8 sound module has not been changed. To match sound and motion, you must set the address using SVC PROGRAM mode.

This completes the factory reset procedure.

Beware Of Lurking Locomotives When Programming

Beware of Lurking Locomotives When Using SERVICE PROGRAM Mode
SERVICE PROGRAM mode is a broadcast command that can be heard and understood by any other decoder sharing the same frequency as the intended decoder. If another decoder receives the command, it too will be programmed. Play it safe and make sure to turn off all power switches on locomotives not being programmed.

Beware of Other Transmitters
The Drop-In decoder operates in an unlicenced band shared by many other transmitters. These transmitters can and will create interference, intermittent throttle operation or complete failure of one or more of your decoder's 17 frequencies. The sources of these external interfering signals can be from your own home or from adjacent homes and businesses. They can also be from other CVP wireless throttles and controllers.

Here's a list of devices known to have caused interference problems to AirWire900 equipment: wireless devices attached to computers, TV/Radio/Entertainment-center, remote controls, cordless telephones, alarm systems, baby monitors, unlicenced personal communication devices, lawn sprinkler controllers, remote starter switches, cordless light switches, outdoor lighting controllers, toys, wireless headphones, and games. Of course, if you have additional wireless throttles, make sure each is on its own frequency. Two throttles on the same frequency will jam each other.

If you find a strong interfering signal on one or more of your frequencies, don't use those frequencies. Simply select another, different frequency.

Assigning Throttle Function Keys To Decoder Actions

Use this step-by-step sequence to change what the decoder does when it receives a throttle function key command.

The Drop-In decoder has many memory locations so we use the term CV# where # is a specific memory location. So CV40 means Drop-In decoder memory location number 40. The value stored at this location dictates what the Drop-In decoder does when it receives a throttle's function key command.

Always start by thinking through what you want your throttle to do to the Drop-In decoder. For this example, here's what is wanted:

"On the throttle, I want the throttle's 6 key to turn on the smoke generator."

Notice the underline of the important items: which throttle key is to be used, and what the decoder action will be when that key is pushed. For this example, F6 is the throttle's 6 key. Now you are ready to set the Drop-In decoder so that it performs the desired action when F6 is pressed.

Step 1: Find F6 in the Function Key Assignment table on the next page.

From the table, the F6 action is defined by the value in CV40.

Step 2: Find the desired action in the action table and note the value. This will be what is stored in CV40.

For this example, since the smoke generator is to be toggled, which means turned on and off, the CV value of 6 is to be used.

Step 3: Turn on the Drop-In decoder's power. Set your throttle to the decoder's frequency and locomotive address if it has not yet been set. This is very important since if either the frequency or the locomotive address is wrong, the decoder will not hear the throttle's OPS PROGRAM command.

Step 4: SVC PROGRAM CV40 to a value of 2. The decoder will chirp indicating it heard and accepted the command. Escape out of OPS PROGRAM and verify that the decoder's action is correct when the 6 key is pressed on the throttle.

This same sequence is used to assign or change what the function keys will do.

NW2 Drop-In Factory Settings For Functions and Actions

Original Factory Settings For Function Key Actions	
F0	Toggle Headlight On/Off
F1	na
F2	na
F3	Activate Rear Coupler
F4	na
F5	Activate Cruise Control
F6	Toggle Cab Light On/Off
F7	na
F8	na
F9	Toggle AUX On/Off
F10	Toggle Smoke Generator On/Off
F11	na
F12	na
F13	Activate Front Coupler
F14	na
F15	Deactivate Cruise Control

Except for F0, any function key can be reassigned to any action you wish.

In this table, "na" means not assigned.

Programming Methods

There are two types of throttle programming modes: Service Programming (SVC) and Operation Programming (OPS).

If SVC Programming is used, no loco number is needed. However, any loco turned on and using the same frequency also **WILL BE** programmed.

If OPS Programming is used, a loco number must be specified. Because the loco number must match, the OPS Programming mode is the safest mode to use when there are a large number of locos lurking in the area.