SD70MAC Drop-In Configuration Variables List

This is the list of all CVs used in the USA-Trains SD70MAC Drop-In. The "Orig Value" column shows the original factory value when new or when the decoder is reset.

CV #	Orig Value	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	15	0-99	F4 Function Key Action [DL On]
CV39	1	0-99	F5 Function Key Action [CRUISE]
CV40	3	0-99	F6 Function Key Action [CAB] [E1]
CV41	0	0-99	F7 Function Key Action
CV42	0	0-99	F8 Function Key Action
CV43	4	0-99	F9 Function Key Action [AUX1] [E2]
CV44	2	0-99	F10 Function Key Action [SMOKE]
CV45	5	0-99	F11 Function Key [AUX2] [E3]
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	AUX1 Special Effect [E2]
CV204	4	0-15	AUX2 Special Effect [E3]
CV205	4	0-15	AUX3 Special Effect [E4]
CV206	0	0-255	AUX3 Auto-off Timer [E4]
CV207	3	0-255	DLites Flash period (x256ms)
CV208	0	0-255	DLites Mode (0=On, 1=Off)
CV209	15	0-255	DLites Flash TImeout (seconds)
CV212	3	0-255	Smoke Timout (3 minutes)
CV213	8	0-99	Function Key 13 [FCOUPLR]
CV214	6	0-99	Function Key 14 Action [E4]
CV215	99	0-99	Function Key 15 [Cruise Off]

CV Value	Function Key Action
0	No Function
1	Activate Cruise Control
2	Smoke Enable
3	Toggle CAB Lite [E1] on/off
4	Toggle AUX1 Lite [E2] on/off
5	Toggle AUX2 Lite [E3] on/off
6	Toggle AUX3 Lite [E4] on/off
7	Dim Headlighs on/off [Rule 17]
8	Activate Front Coupler
9	Activate Rear Coupler
10-14	reserved
15	Activate Ditch Lights
99	Deactivate Cruise Control

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 w/speed change)
1	Tracking mode (Cruise stays on)

CV Value	Head/Rear Lites Action
0	Normal, autoreverse
1	Normal with rule17
2	Front headlite on always
3	Front headlite on always w/ rule 17
4	Rear headlite on always
5	Rear headlite on always w/ rule 17
6	Front & Rear both on
7	Front & Rear both on w/ rule 17
8	Swap F to R Auto Reverse
9	Swap F to R Auto Reverse w/ rule 17
10-15	reserved

AirWire900®

NEW

USA-Trains SD70MAC Drop-In™ Decoder Installation Guide

AirWire® 900

Contents

New SD70 Drop-In Decoder (2019)
Charger Pigtail
New SD70 Installation Manual
New Drop-In Users Guide

How To Use This Booklet

Locomotive Disassembly and AirWire Drop-in Decoder Installation. This section starts with the simple task of attaching the charging plug pigtail to battery charger. Step-by-step instructions then show how to disassemble the USA-Trains GP38 diesel locomotive. Removal of the original circuit boards is next. Then, the installation of the Phoenix P8 sound module is described followed by the rather simple task of installing the Drop-In decoder. With the installation done, a quick checkout is run and then the locomotive is reassembled.

Quick Start Instructions

This short section describes how to control the features of the SD70 locomotive using the AirWire throttle. In this section you will find the "cheat sheet" listing the throttle function key assignments for both the locomotive and P8 sound effects.

Some useful items related to changing the Drop-In decoder loco number, changing the decoder frequency and how to reset the Drop-In decoder to its original factory settings finish out the installation manual.

See The Drop-In Users Guide For Applications Tips

Since this manual is used during installation only, and it is specific to the USA-Trains SD70 locomotive, there is a separate Drop-In Users Guide. This guide will have all of the items related to fine tuning and performance optimization, useful application tips and instructions for using the optional ALT lighting features.

Recommended Battery And Charger

The CVP BAT2 is a 14.8V, 6800mAh, Lithium-Ion rechargeable battery. It is an ideal battery for theSD70. The matching smart charger insures maximum lifetime for your battery. The Drop-In decoder comes with a plug to splice onto the charger. The plug matches the socket on the SD70 Drop-In. The BAT2 can be ordered from authorized AirWire dealers or direct from CVP Products. The Smart Charger is available only from CVP Products. **www.cvpusa.com**

Battery 14.8V, 6800mAh	BAT2
Smart Charger	CHARGER1

Phoenix P8 Sound Module, Accessories and Couplers

The Drop-In Decoder is designed to work with the Phoenix P8 sound module. In addition to the sound module, you need a speaker, a P8 Drop-In harness and the Phoenix P8 programming jack. If your installation will not have sound, then you may ignore all steps related to the installation of the P8 sound module. Order these items directly from Phoenix or one of their authorized dealers. **www.phoenixsound.com**

Speaker SP-2.5SQ:	824-660
P8 Drop-In Harness	6002-08 [All Drop-Ins]
P8 Programming Jack	6000-55 [All Drop-Ins]

Phoenix Couplers

Your new Drop-In decoder has sockets to allow the use of a pair of Phoenix solenoid coupler. The couplers can be activated directly from the throttle. No other circuit boards are needed. Order the coupler directly from Phoenix or one of their authorized dealers. **www.phoenixsound.com**

Coupler [Front & Back are same]	CPLRTM

Phoenix P8 Sound Module *continued*

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

When the SD70 Drop-In decoder is programmed with its locomotive number, the attached P8 will also have its loco number changed. The only requirement is that the P8 is powered up so it will receive the programming command.
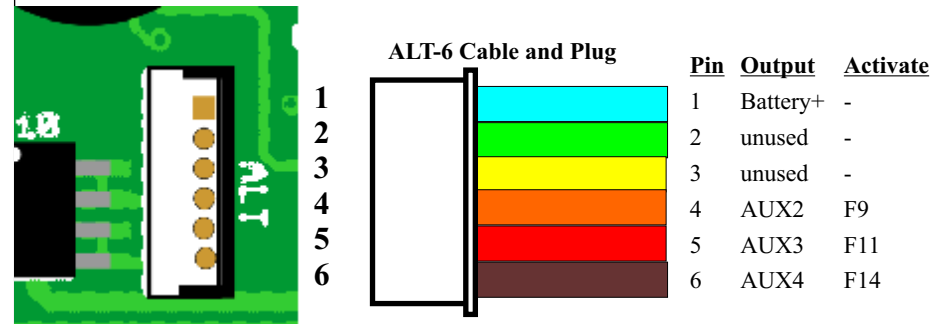
Phoenix P8 Sound Decoder Options Setup

The P8 is a versatile sound decoder with many options and selections. However, there are selections that must be made to achieve the best results with the AirWire Drop-In decoder.

Detailed P8 setup instructions are contained in the Drop-In Decoder Users Guide. Also, be sure and see the P8 manual and read the help screens that are part of the Phoenix programming software.

ALT Lighting Socket Optional Cable and Pinouts

The SD70 Drop-In decoder has 3 extra light drivers available at the small white socket labeled ALT. If you want to use these extra lighting outputs, you will need to purchase the matching cable and plug to fit the socket. Order part number ALT-6. The plug comes with 24 inches of color coded wire. Much more detail about using the extra light drivers is in the Drop-In User Guide.

ALT-6 Cable and Plug

| Pin	Output	Activate
1	Battery+	-
2	unused	-
3	unused	-
4	AUX2	F9
5	AUX3	F11
6	AUX4	F14

Phoenix Front/Rear Coupler Sockets

The SD70 Drop-In decoder includes drivers for two Phoenix solenoid couplers. No extra decoder board is needed. Install the Phoenix coupler on the loco, and insert the coupler's plug into the appropriate socket. The sockets are inside the yellow circle.

The FCP socket is for the front mounted coupler and the RCP socket is for the rear.

The original factory activation settings are throttle key 3 (F3) for the rear coupler and throttle keys *, 3 (F13) for the front coupler. You can change the activation keys if desired.
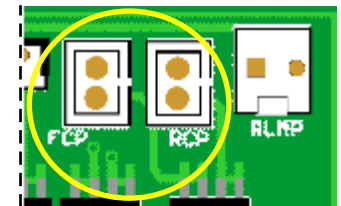
# CV List For Function Key Assignment and Actions

Function Key Assignment	CV#	Reset Value	Function Key Action	CV Value
F1 Function Key Action	CV35	0	No Function	0
F2 Function Key Action	CV36	0	Activate Cruise Control	1
F3 Function Key Action	CV37	9	Smoke Enable	2
F4 Function Key Action	CV38	15	Toggle CAB Lite [E1] on/off	3
F5 Function Key Action	CV39	1	Toggle AUX1 Lite [E2] on/off	4
F6 Function Key Action	CV40	3	Toggle AUX2 Lite [E3] on/off	5
F7 Function Key Action	CV41	0	Toggle E4 [not available] on/off	6
F8 Function Key Action	CV42	0	Dim Headlighs on/off	7
F9 Function Key Action	CV43	4	Activate Front Coupler	8
F10 Function Key Action	CV44	2	Activate Rear Coupler	9
F11 Function Key Action	CV45	5	reserved	10-14
F12 Function Key Action	CV46	0	Activate Ditch Lights	15
F13 Function Key Action	CV213	8	Deactivate Cruise Control	99
F14 Function Key Action	CV214	0		
F15 Function Key Action	CV215	99		

PHOENIX

P8 Programming Jack

Phoenix Part Number 6000-55

C3

Phoenix P8

Phoenix Part Number Drop-In Harness 6002-08

To Speaker

There may be a gray wire adjacent to the orange wire. The gray wire may or may not be present. For Drop-In applications, only the orange wire is needed.

SD70 Drop-In P8SND Socket for P8 Sound Module

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.
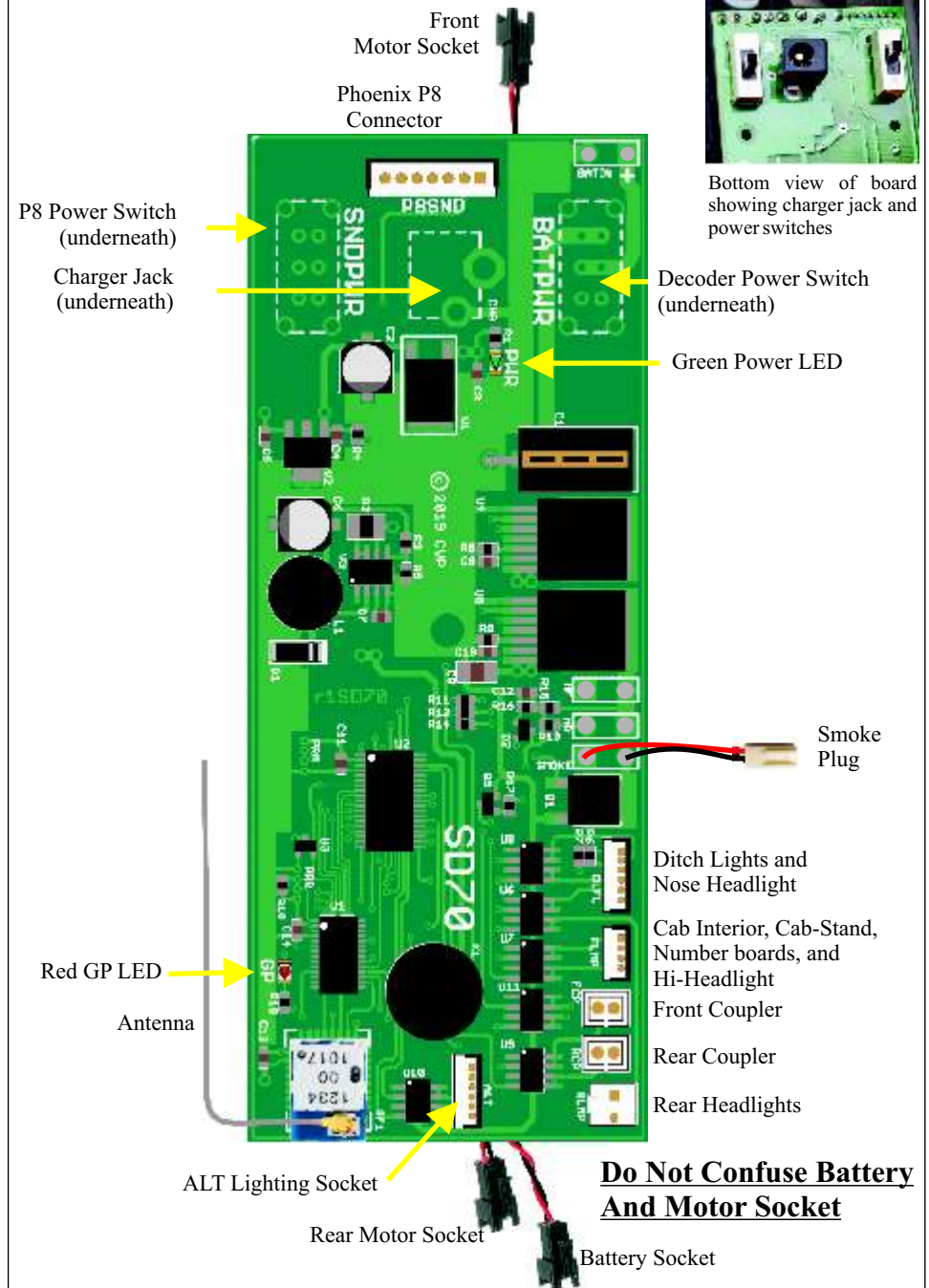
The sockets are polarized and can only be completely inserted when oriented correctly.
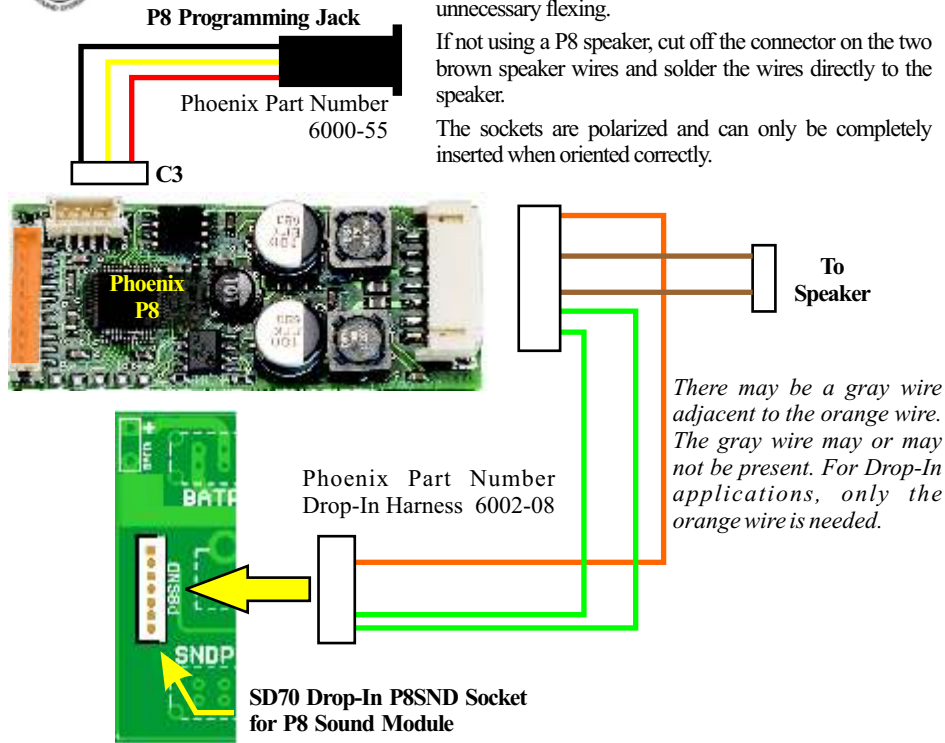
The Drop-In decoder has a dedicated power switch for the P8. The P8 power switch is independent of the Drop-In decoder power switch. When turned on, the P8 is connected directly to the battery. The P8 can be powered while the Drop-In decoder is not.

SD70MAC Drop-In Decoder Familiarization

Front Motor Socket

Phoenix P8 Connector

Bottom view of board showing charger jack and power switches

P8 Power Switch (underneath)

Charger Jack (underneath)

Decoder Power Switch (underneath)

Green Power LED

Smoke Plug

Ditch Lights and Nose Headlight

Cab Interior, Cab-Stand, Number boards, and Hi-Headlight

Red GP LED

Front Coupler

Antenna

Rear Coupler

Rear Headlights

ALT Lighting Socket

Do Not Confuse Battery And Motor Socket

Rear Motor Socket

Battery Socket

Actual pigtail lengths are longer than shown to insure easy reach of various connectors and sockets. The rear motor pigtail and the battery pigtail emerge from under the Drop-In circuit board to keep them away from the radio receiver antenna.

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 battery 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 look the same. Be careful. <u>DO NOT</u> accidentally plug the battery into the motor connector. This will damage the Drop-In board.

Check The Battery Pack For Proper Polarization

The CVP BATT2 battery pack has a mating plug that is properly polarized for the Drop-In battery 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 battery 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.

BATT2 Battery Plug

Black
Negative
Minus

Red
Positive
Plus, +

Locking Tab Faces Away

Lock Release Lever Faces Away

Red
Positive
Plus, +

**Drop-In
Battery Input Socket**

**CVP'S BATT2
Battery Pack**

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 battery packs. The voltage must match!
- 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 for optimum results.
- **Never** use a conventional DC adapter to charge the battery pack.

Battery Protection

- Never drill, puncture or open a lithium battery pack.
- Never cut both battery wires at the same time! Removing the battery plug instantly voids the battery warranty.

Off-Season Battery Storage (3 months or more)

- 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 fully discharged or a fully charged battery. If the battery is about 40% to 70% of full charge, it is OK to store it in that condition for about 4 months.

Quick-Start Instructions - *Continued*

Throttle Key	Drop-In Action	P8 Sound Effect
0	Headlights	na
1	na	Bell
2	na	Horn
3	Rear Coupler	Coupler Clank
4	Ditch Lights	Grade Crossing Horn Sequence
5	Cruise Control	Station or other Announcemen
6	Cab,Number Boards	Compressor
7	na	Volume Up
8	na	Volume Down
9	na	Dynamic Brakes
*0	Smoke Generator	Brake Release
*1	na	Air Pop Valve
*2	na	Startup or Shutdown Sound
*3	Fron Coupler	na

Assigning Decoder Actions To Throttle Function Keys

A function key on the throttle is generic. When pressed, it only sends an activate or deactivate command. For example, pushing the throttle's 5 key sends the command "activate function 5." What the decoder does with the function command is determined by the setup inside the decoder (not the throttle).

You can change what your new SD70 decoder does with any of the received function key commands except function 0. Function 0 is fixed and is set to always turn locomotive headlights on or off.

Changing Decoder Function Key Actions

Use this step-by-step sequence to setup what the decoder does when it receives a specific function command. The setup is stored in the decoder's memory. The throttle does not store anything.

The SD70 Drop-In has many memory locations where setups are stored. We use the term CV# where # is a specific memory location. So CV40 means SD70 memory location number 40. The value stored at this location dictates what the decoder does when it receives a throttle's function key command.

Deciding the setup is relatively simple. Start by thinking through what you want your throttle to do to the SD70 decoder. For this example, here's what is wanted:

"On the throttle, when I press the <u>6 key</u> I want to <u>turn on the smoke generator.</u>"

Notice the underline of the important items: which throttle function 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 SD70 Drop-In so that it turns on the smoke generator when F6 is pressed.

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

From the table, the SD70 decoder uses CV40 for F6 .

Step 2: Find the desired action in the "Function Action" table shown on the next page 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 2 is to be used.

Step 3: Turn on the 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 SD70 will not hear the throttle's OPS PROGRAM command.

Step 4: OPS 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 SD70 Drop-In's smoke generator turns on when the throttle's 6 key is pressed.

This same sequence is used to assign or change what any of the available function keys do.

Phoenix P8 Sound Effects Control

The table on the next page assumes you have used the recommended configuration file or have set up the P8 to match our recommended settings (see page 21). If you have not yet configured the P8, the sound effects and throttle activation keys will not match and the sound may shut off after only a few minutes of operation. This is normal if the configuration has not been changed - it is not a Drop-In or sound module problem.

Bell is toggled on and off by F1. Toggle means push and release the F1 key to turn on the bell. To turn off the bell, push F1 again.

Horn is activated by F2. This is a momentary activation which means push to turn on and release to turn off. There is an automatic timer tied to the horn activation. Sometimes, when the horn is activated, it does not receive the turn off command. This can be caused by motor noise, distance from the throttle or momentary jamming. To prevent the horn from being stuck on, the Drop-In decoder will automatically shut off the horn.

Coupler clang is triggered by GP30. Trigger means the sound effect is transitory and sounds each time the key is pressed.

Grade crossing horn is triggered by F4. This is a 15 second recording of a complete grade crossing horn sequence.

"All Aboard" (or hot-box) announcement is triggered by F5.

Compressor start up is triggered by F6. The sound effects runs for a few seconds and then shuts off.

Coupler clang is triggered by F3. Trigger means the sound effect is transitory and sounds each time the key is pressed. This will also open the optional Phoenix rear coupler (if installed.)

Grade crossing horn is triggered by F4. This is a 15 second recording of a complete grade crossing horn sequence.

"All Aboard" station announcement is triggered by F5.

Compressor start up triggered by F6. The sound effects runs for a few seconds and then shuts off.

Volume Up is triggered with F7. To use this feature, push F7 to begin increasing the overall Phoenix sound volume. When the volume reaches the desired level, push F7 to stop and hold the volume setting.

Volume Down is triggered with F8. This works the same as F7 except the volume will begin to decrease when F8 is pushed. Push F8 again to stop and hold the volume setting.

Caution: if the volume is allowed to decrease to 0 or off, the volume will remain at 0 when the power is turned off. When turned back on, you may think there is a problem with the sound when in fact you simply have to push F7 to raise the volume.

Dynamic Brake is toggled with F9.

Brake release sound is triggered with F10.

Air Pop Valve sound effect is triggered with F11.

Diesel Engine Shutdown is triggered with F12. This will initiate the shut down sequence for the diesel engine. You can manually restart the engine by simply pushing F12 again. Note that if the throttle speed setting is not idle, the diesel automatically restart. This applies when the locomotive is standing still too. Any change of the speed control will automatically restart the diesel engine.

Front Coupler activation is done with F13.

This table shows the combined list of the original factory settings for the GP38 Drop-In along with the recommended function key assignments for Phoenix P8 sound module. Black is the effect for the Drop-In decoder and red is the effect for the P8.

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.
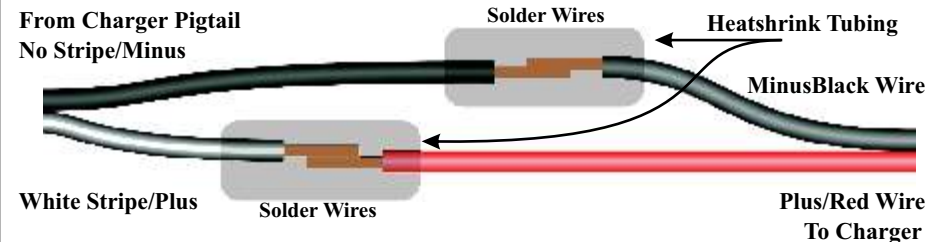
Take the pigtail and separate the 2 wires for about 2 inches. Cut the plus wire so it is 1 inch shorter than the minus wire. Remove about ½ inch of insulation from the plus wire. Twist and apply solder to the twist end of the plus wire. This is called tinning and keeps the twisted wires from unraveling. 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 SD70 Unpacking

If this is your first SD70 locomotive, you may be tempted to remove it from the box like you have all others. DO NOT DO THAT! You risk breaking delicate details located in the front and rear of the locomotive. Pay attention to the orange placards. Find the unpacking instruction sheet. Follow the instructions and carefully remove the foam inserts from the front and back. Once those are out, tilt the box on its side and remove the locomotive. Turn the locomotive upside down on your lap, or other soft surface and remove the packing from the trucks. Make sure you find and remove all of the small blocks of foam from in and around the trucks. If these are not removed, the mechanism will bind and or derail. Save the packing material and box.
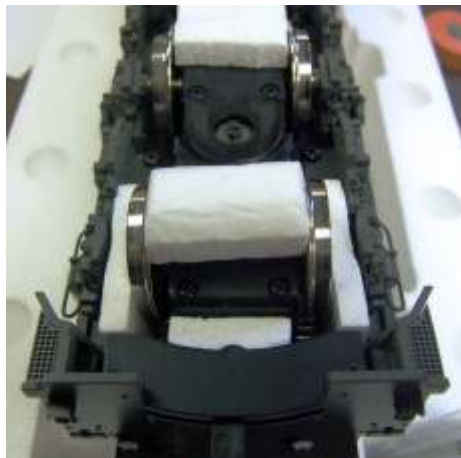
Closing Up and Reassembling *continued*

The top half will seat itself correctly and easily when everything is aligned. It is easy to be off by a small amount which will prevent the two halves from mating. Inspect all around. If resistance is encountered, check for wires on the outside of the mounting posts especially the rear light wires.

Once the two halves are together, turn the locomotive upside down. Once again check for alignment of the two halves. Install the two chassis screws that are hidden by the fuel tank. Next place the tank on the bottom of the chassis and reinstall the 4 mounting screws. To start the screw, first turn it slightly counter-clockwise to get it seated in the threads, then turn it clockwise to tighten. Do not over tighten. Finish the reassembly by installing the remaining screws.
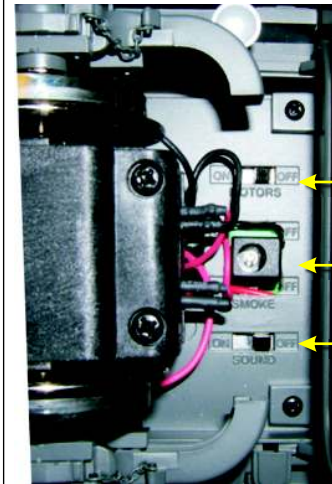
Power Switches And Charger Jack

The switch functions cast into the plastic are reversed for the Drop-In switches. Also, the photo shows the switch actuators pushed towards the fuel tank. This is the OFF position.

Sound Module Power Switch [also shown OFF]

Battery Charger Jack

Phoenix Power Switch [shown in OFF position]

Slide Switch Actuator
Towards Cab = ON

Slide Switch Actuator
Towards Fuel Tank = OFF

SD70 Drop-In Decoder Quick-Start Guide

Locomotive Motion Control

Now that the locomotive is reassembled, its time to begin exploring some of its new features and capabilities. As you become familiar with your locomotive performance, you will undoubtably want to make changes as well as fine tune its operation. Detailed instructions for fine tuning are contained in the accompanying Drop-In User Guide. For now, lets concentrate on basic operation.

Speed and Direction are controlled from the throttle. Use the throttle's knob to change speed. To change direction, push the direction key. "Forward" direction is defined as if you were sitting in the locomotive cab.

Cruise Control activation is easy. Once the locomotive is running at the desired speed, push the throttle's 5 key (this is "function 5" which we abbreviate to F5) to activate cruise control. A beep will be heard when cruise control is activated. To deactivate cruise control simply change the speed or direction. A beep will be heard when cruise control is deactivated. At very slow speeds, you may hear a double beep. This means that the locomotive is going too slow for reliable cruise control so you need to increase the speed slightly and push F5 again.

Headlights And Ditch Lights are toggled on and off with the F0 - which is the throttle's 0 key. The headlights automatically switch between front and rear when direction key is pushed. If set for reverse, the ditch lights are off.

The Number Boards and the Cab Interior Lights are toggled on and off with F6.

Ditch Lights flashing is triggered with F4. They stop flashing automatically in 15 seconds. The flash rate, the flashing time and their condition when turned on with F0 can be changed.

Smoke Generator is toggled on and off with F10. Once turned on, the smoke generator has an automatic 3 minute timeout. The timeout period can be changed.

Changing The Drop-In Decoder's Frequency

1. On the T5000 throttle, press the green menu key twice. Now push the number 4. The throttle is now waiting for the "Configuration Variable" (CV) number and its value. CV200 is the decoder frequency CV. The number stored in CV200 sets the decoder frequency. Allowed frequency numbers are in the range of 0 to 16.

2. Key in 200 and push ENT.

3. Enter the desired frequency number and push ENT. Your loco will chirp once to indicate it received the command and has been set to the new frequency. On the throttle, push ESC to exit the programming mode.

4. Set the throttle to the new frequency. Verify the throttle is set for the new frequency and the loco number. Verify that the loco runs. The frequency number is stored even with the power off.

Resetting Drop-In Decoder To Original Factory Settings

There may come a time when your locomotive no longer responds to what you believe is the correct frequency or locomotive number. Here's how to reset the decoder to its original factory settings of loco number 3 and frequency 0.

Step 1 Turn off **ALL** AirWire throttles. This is very important since it is the of the <u>absence</u> of a throttle signal, plus a <u>decoder power-cycle</u> (turning the decoder's power off and then back) that allows the decoder to be reset.

Step 2 Turn **OFF** the Drop-In decoder if it was powered on.

Step 3 Turn on the Drop-In decoder and <u>wait at least one minute</u>. Do not turn on any throttles during this time. At the end of one minute, the Drop-In chirps 5 times.

Step 4 Turn on your throttle. Set the throttle frequency to 0.

Step 5 - Push the green MENU key twice followed by the 4 key.

Step 6. Push 8 followed by ENT. Now push 1, 3, and 5. Now push ENT. The decoder will chirp indicating it accepted the reset command.

Push ESC then set your throttle to frequency 0 and loco number 3. Verify the locomotive now runs. The P8 sound module is unaffected by the reset command. To put both the Drop-In decoder and the P8 sound module on the same loco number, just program in a new loco number (see page 17).

Closing Up and Reassembling The SD70 Locomotive

Connect Speaker and Programming Jack From The Fuel Tank

Place the fuel tank near its mounting location on the locomotive. Fish the speaker and programming plugs up through the hole in the floor. Don't mount the tank yet.

Carefully turn the chassis right side up. Plug in both the speaker connector and the programming connector.

If you have not yet done so, orient the small whip antenna straight up. Bend it 90 degrees where the wire joins the gold connector. A small piece of tape can attach it to the nearby mounting tube. Keep all wires away from the antenna.

Use tie wraps to keep wiring in place and out of the way of all mounting holes. Make sure all wires are between the mounting tubes. Neatness counts and will prevent troubles and broken wires during locomotive reassembly. The most common problem are broken light wires caused by screws piercing the wires when screwing down the shell to the chassis.

Closing Up The Locomotive

This will take a few minutes so don't rush - take your time. Bring the top half down onto the chassis slowly and carefully. Make sure all wires are **INSIDE** the mounting posts. Don't allow a wire to fall on the outside of the post or you risk pinching it when the top half is mated to the bottom half. Keep them away from the antenna. Look on both sides of the locomotive on the outside. Make sure you can't see any wires. The light wires are usually the ones that escape.

USA-Trains SD70 Disassembly

Warning: Many parts of the shell and chassis are fragile and easily break. Especially vulnerable are the steps, doors, side-frame assemblies, and cab awnings. Gently pull up and remove the horn assembly if it has been installed.

You Must Have The Proper Screwdriver

You must have a thin-shafted, #1 phillips-head screwdriver that is at least 4 inches long to reach the screws. The thin shaft is necessary to fit between the wheel and side frame. This one is from General and has a 4 inch long, narrow shaft with a #1 Philips tip. It is also magnetized which comes in handy for pulling the screws from deep recesses.

A Soft Work Surface Pays Big Dividends

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 it fall over.

Use a Foam Block To Hold Screws

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

Total Mounting Screw Count is 16

When all the screws are removed, there will be a total of 16 screws. 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

Remove the 4 screws and set the tank aside for now.

USA-Trains SD70 Disassembly

Front Mounting Screws - 6 Screws

There are two types of screws in this area. Numbers 5 and 6 in blue will need a small jeweler's type Philips screwdriver. These two are small and short - don't loose them. The red circled screws are deep inside hollow columns. The 4 inch long screwdriver must be used to get these out. Once again, as each screw is removed, place it into the foam block.

The number 7 and number 8 holes are well hidden. The yellow arrow points to the hole in which the #8 screw is located. The number 7 screw is on the other side of the truck. Rotate the front set of wheels out of the way to expose the screw hole. Be careful and do not damage the side frame's delicate detail.
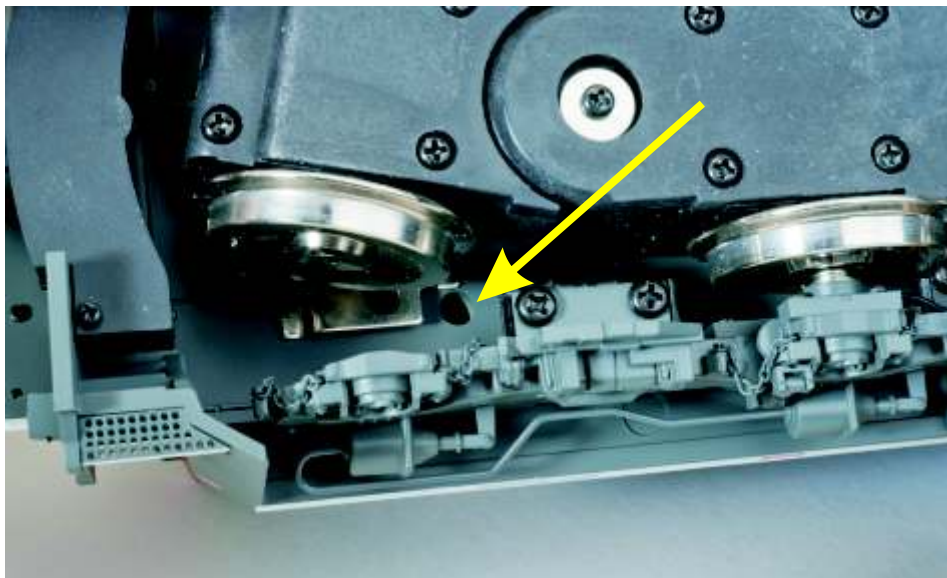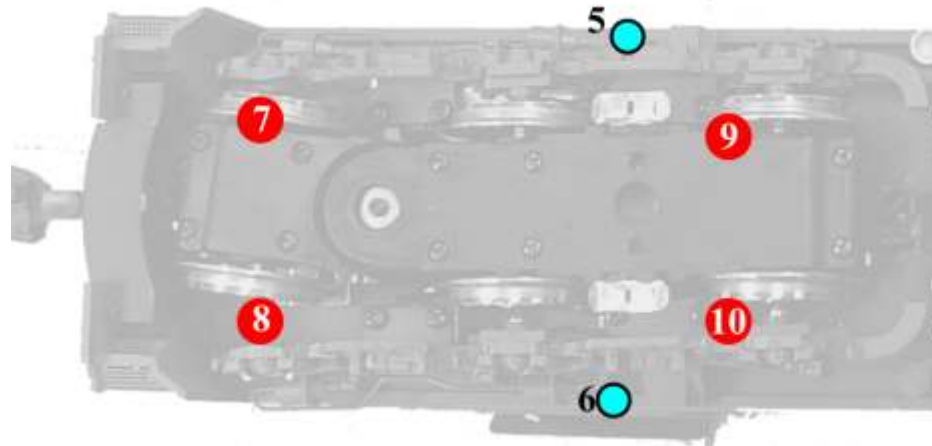
SD70 Drop-In Preliminary Checkout

The next step is to perform a few checks before reassembling the locomotive. These tests assume the locomotive decoder and the P8 sound module are factory fresh and still on their original factory settings of loco address 3 and frequency 0.

1. Turn on your T5000 throttle and set it for address 3. Next, set the T5000 throttle frequency to 0. See your T5000 User Guide for how to do this and how to verify both are set correctly..

2. Turn on both power switches on the SD70 Drop-In decoder. The ON position is with the switch actuators towards the cab. You will hear a short chirp when power is turned on. This is normal.

3. You will hear the Phoenix P8 module turn on (if installed). Don't be alarmed if the sound turns off in a minute or so - that is normal and can be changed. Changing this feature will be discussed later.

4. Locate the green PWR LED on your SD70 Drop-In decoder (see page 3). It will be glowing bright green when the battery is connected and the power switch is turned on.

5. Locate the red GP LED on your SD70 Drop-In decoder. When the red LED is on, it indicates both the throttle and the Drop-In decoder are set for the same frequency.

4. Set the throttle for forward and slowly turn up the speed until the motor start to move. Verify that both motors turn in the same direction and that the loco moves forward. Change the throttle to reverse and check that the locomotive moves in the reverse direction. Set the throttle speed back to zero. Set the throttle direction to forward before continuing. *If the loco goes reverse instead, then the two motor connectors are reversed.*

5. Turn on the locomotive headlight and ditch lights by pushing the 0 key on the throttle. Change the throttle direction and confirm the rear headlight turns on. Set the direction to forward. Leave the headlights on for one more test.

6. Push the 4 key and observe the ditch lights flashing. They will turn off in 15 seconds. Customizing the flash rate and the auto turnoff delay is discussed in the Drop-In User Guide. Push 0 to turn off the headlights. Note: the headlight and ditch lights are off if the throttle is set for reverse.

7. Push the 6 key to turn on the front number boards, the cab interior light and the cab-stand screen. The tiny cab-stand screen is hard to see in normal daylight but can be easily seen when it is dark. Push 6 to turn them off.

8. Push the * key followed by the 0 key. Listen carefully for the smoke generator's fan. Push * and 0 again to turn it off. Since there is no fluid in the generator it can only be run for a few seconds.

9. If you have installed the Phoenix sound decoder, push the 2 key and the P8 horn will sound. If you don't hear anything, push the 7 key to start raising the volume. Push the 7 key again when the volume is at the desired level. Push the 8 key to start lowering the volume. Push the 8 key again when the volumn is at the desired level. The volume setting will be remembered with power turned off.

This concludes the preliminary testing. checkout. The next section describes how to change the locomotive decoder number and its operating frequency.

Changing The Drop-In Decoder's Loco Number

Make sure the P8 Sound module is powered up. This insures that both the decoder and the sound module will be changed to the same loco number.

1. On the T5000 throttle, press the green menu key twice. Now push the number 4. The throttle is now waiting for the "Configuration Variable" (CV) number and its value. CV1 is where the decoder number (address) is stored. The range is from 1 to 9999. The loco's cab number is usually best.

2. Push the number 1 key and push ENT.

3. Key in the decoder's loco number that you want to use. The loco number must be unique. After the numbers have been keyed in, push ENT. You will hear the locomotive chirp two or 3 times indicating it heard the command. At this point, both the P8 sound module and the locomotive are set for the same loco number.

5. Set the throttle to the new loco number and verify that the loco runs on its new number. The loco number is stored even with the power off.

Front Motor Connector

Battery Connector

Mounting Tubes
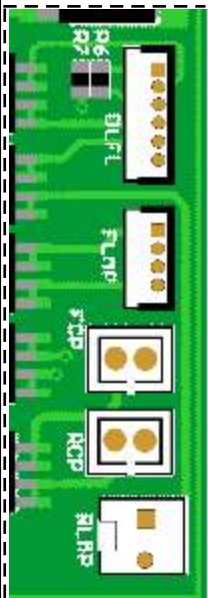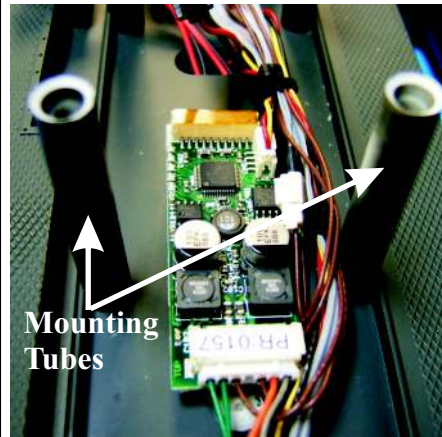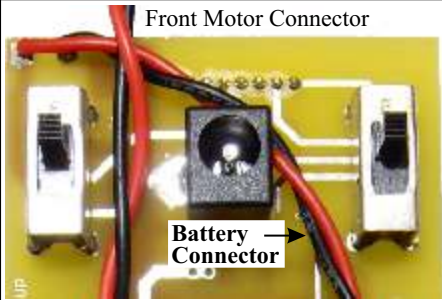
6-wire ribbon cable to front ditch light board

4-wire ribbon cable to cab and front headlight

2-wire connector to rear headlight

Bend antenna vertical

If you have not removed and discarded the track and wheel pickup connector and wires, tape them down to get them out of the way.

Mount The AirWire SD70 Drop-In Decoder

First thing to do is label the battery connector to distinguish it from motor connector. A small piece of tape can be used. The battery connector is closest to the power switches. The front motor connector comes from the middle of the board.

The battery connector wires and the front motor connector wires need to be placed between the switch and charging jack as shown. This insures the Drop-In board can mount flush to the standoffs and the wires don't foul the switches. After placing the Drop-In decoder on the standoffs, make sure the jack and switches fit through the holes and the Drop-In is flush to the 3 mounting posts. Verify the wires beneath the board are clear of the 3 posts. Make sure all connectors going to the rear are *between* the two tall mounting tubes. Use the original 3 screws to mount the Drop-In board.

Plug-In Lighting, Smoke and Motor Connectors

Start with the P8 board connector into the matching white socket labeled P8SND. Next, plug in the front and rear motor connectors.

Bring the shell close to the chassis. Plug in all the lamp connectors. Do not bend the board when pushing in the connectors. Plug in the smoke generator connector.

The last remaining connector is for the battery. Before plugging in the battery, make sure it is the connector you previously labeled. Plug in the battery connectors.

Tidy Up The Wiring

Use the left over twist-ties or miniature wire ties (available from hardware stores) to bundle all wires together. Keep all wires away from the antenna.

Bend the antenna so it is vertical. The small gold socket can be rotated to help position the antenna once it is bent.

Temporarily Plug In Speaker

Before checking the installation, plug the speaker connector into the P8. Don't bother with the programming jack connector at this time, just the speaker.
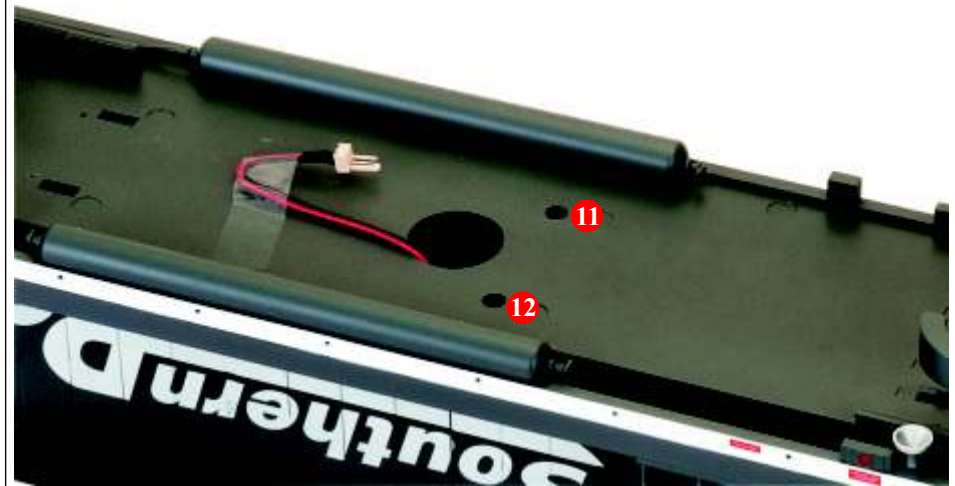
Preliminary Checkout

The next step will be to check the installation and verify correct operation. A throttle will be required for the next set of steps.

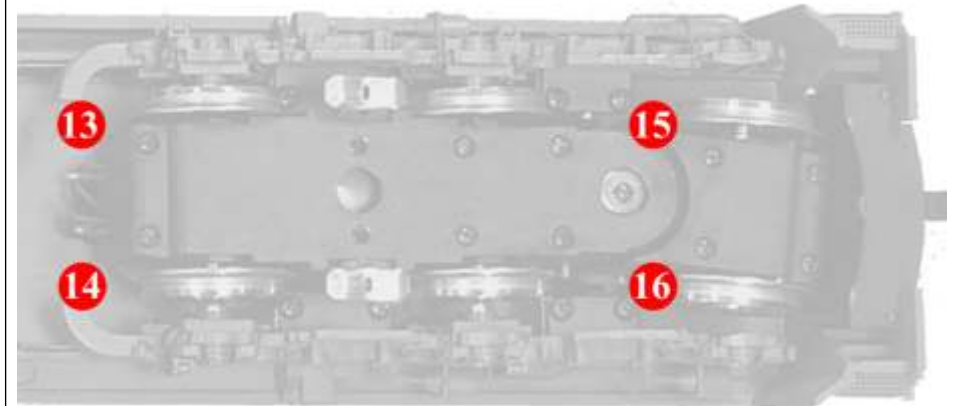## Under Fuel Tank Mounting Screws - 2 Screws

With the fuel tank removed, two additional mounting screw holes are exposed. Use the long shafted driver to remove these screws, # 11 and #12.

Rear End Mounting Screws - 4 Screws

Two of these screws, #15 and #16 will be the most difficult to see and remove because the truck obstructs their access holes. It is the long thin shaft of the screwdriver that does the trick. These will be saved for last.

First locate screw numbers 13 and 14 - these are easy to see. Go ahead and remove them.

USA-Trains SD70 Disassembly

Last 2 Rear End Mounting Screws - 2 Screws

Last two screw access holes are located under the front truck. However, the truck can not be rotated out of the way. Instead, slide the screwdriver between the side frame and the wheel. You may need to put a bit of pressure on the side frame to get it into the hole. A little bit of extra pressure will allow it into the hole. Let the head of the screw center in the tool and then unscrew it. If you are using a magnetized tool, you can try and lift out the screw. However, as you get close to the wheels, the magnet inside the motor may snatch away the screw and stick it to the side of the truck. Be sure and retrieve the screw before continuing.
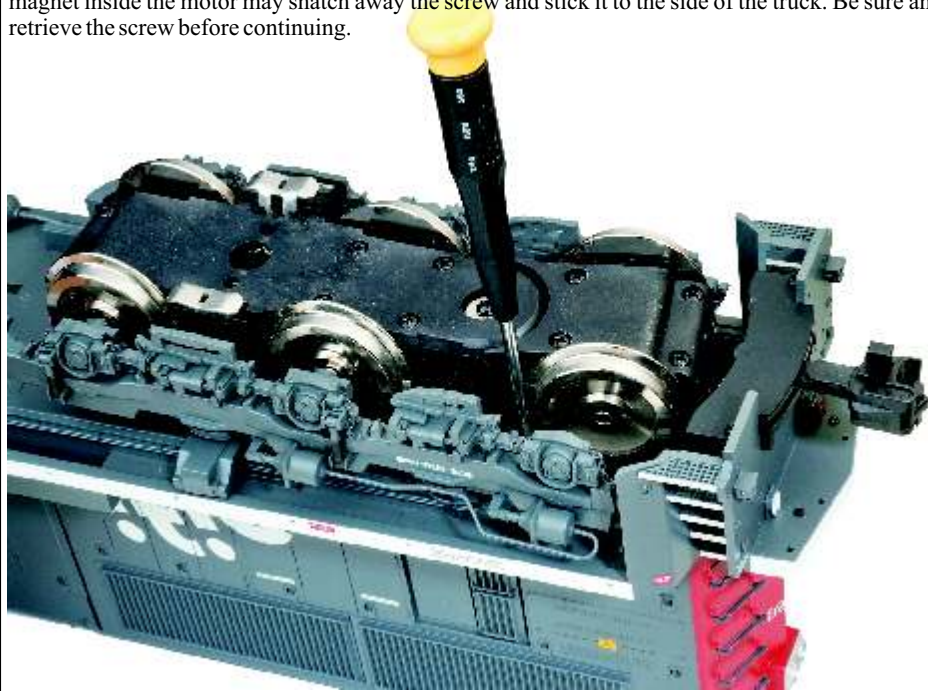
That concludes the screw removal. The top chassis half is now separated from the bottom chassis half. Count the screws and make sure there are a total of 16. If you don't have that many, compare your block of foam to the photo. You'll quickly see which ones you missed.

Speaker And P8 Interface Jack Mounting

For the next step, the fuel tank is fitted with a speaker and the Phoenix P8 sound module interface jack. If you are not using a sound decoder, skip the next two pages.

P8 Interface Jack Installation

The Phoenix P8 sound module uses a programming jack to connect it to a PC for editing and downloading of sound files. The programming jack is installed into the fuel tank for easy access. For fast mounting, use quick-set epoxy or hot-melt glue.

The end of the fuel tank facing the rear truck is where to drill the hole. Put the hole about half way up the tank and favoring one side. This makes it easier to plug in the programming jack. Drill a 5/16 inch hole for the jack. Remove any burrs from around the hole.

The fuel tank walls are too thick for the jack's threads so remove the nut from the jack and discard. Push the small plug and wire through the fuel tank hole. Use either epoxy or hot-melt glue to permanently mount the jack.

P8 Speaker Mounting

Newer speakers from Phoenix have a two wire plug 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 silicon adhesive which takes longer to dry.


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. Finally, place a small amount of glue around gaps between the speaker and the mounting area for best sound reproduction.

# Mounting Phoenix P8 Sound Module

Mount P8 Sound Module

The P8 is placed in the free area between the Drop-In and the battery pack. Use double-stick tape to hold it in place. Orient the module as shown below. The white, right angle connector on the end of the P8 needs to face towards the cab.
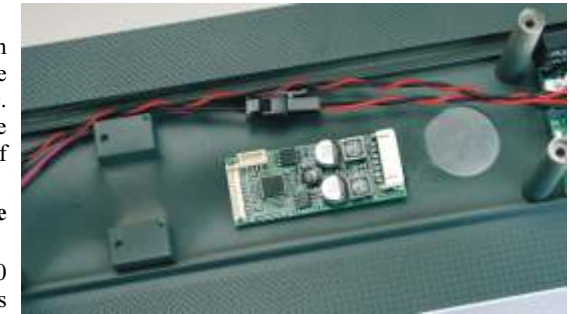
Plug in the 6-wire P8 Cable To The Right Angle Connector

The cable connects the P8 to the SD70 Drop-In decoder and two other wires from the connector go to the speaker. The cable is stiff. Use a couple of small pieces to hold the cable to the floor. A small piece placed of foam tape, between the power switch and the charger jack holes, will insure the wires are not pinched when the Drop-In is mounted.


The other end of the P8 cable goes to the Drop-In. The smaller connector with brown wires goes to the speaker socket and are not shown in this image.
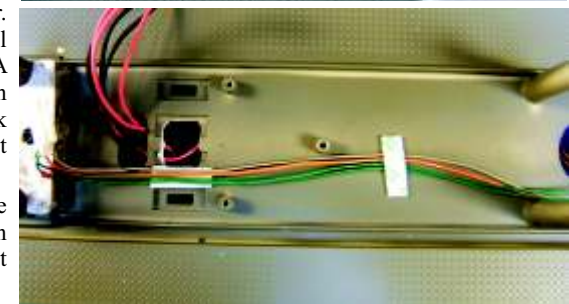
Enlarge Switch Hole And Mount Battery

Enlarge Switch Opening In Chassis Floor

Take a look at the bottom of the Drop-In board. Notice the two switches and jack. The switches fit the holes in the locomotive floor exactly. However, the hole into which the jack fits needs to be enlarged.

Mark the location for the jack using a sharp tool. Use a hobby knife or Dremel tool with a routing bit to enlarge the hole so the jack fits through the hole without binding.
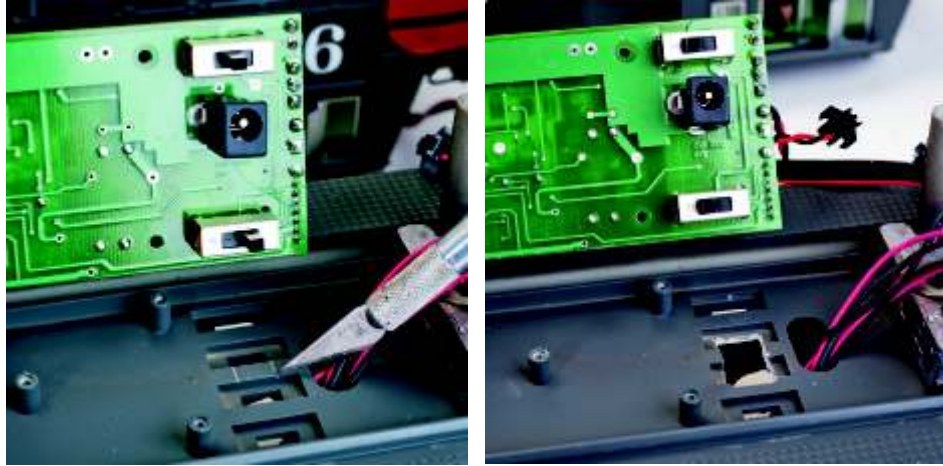

Make Room For The Battery

This installation makes use of the standard CVP Lithium battery pack. The small size yet high power capacity makes for a simple installation. After removing the weight, the battery is mounted over the rear truck on double stick foam tape.

First unscrew the two outer screws. The center screw holds the truck - do not remove it. Once the weight is removed, trim flush to the floor, the two plastic posts. Flush-cutting wire cutters make this easy.

The battery is mounted to the floor using double-stick foam tape. Be sure to apply several layers of tape so the battery does not obstruct or sit on the truck mounting screw. Mount the battery between the posts onto the tape and press down firmly. For added strength, a small dab of hot melt glue can also be used but keep the glue away from the truck mounting screw.

Battery Sits Over Rear Truck
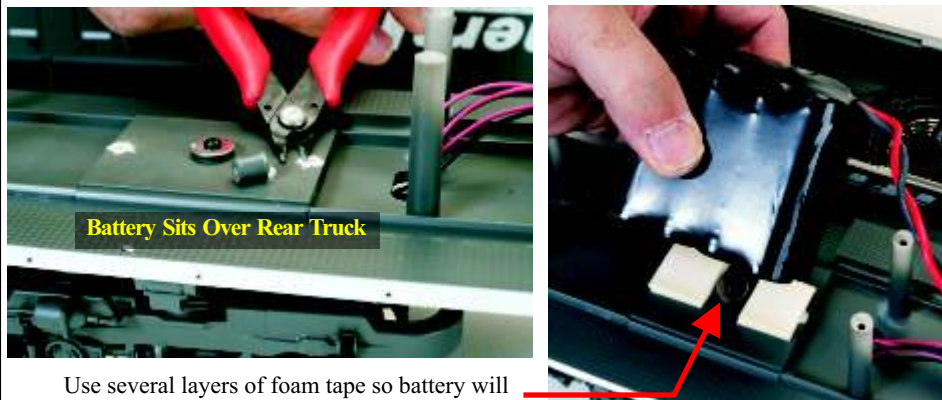
Use several layers of foam tape so battery will not touch truck mounting screw
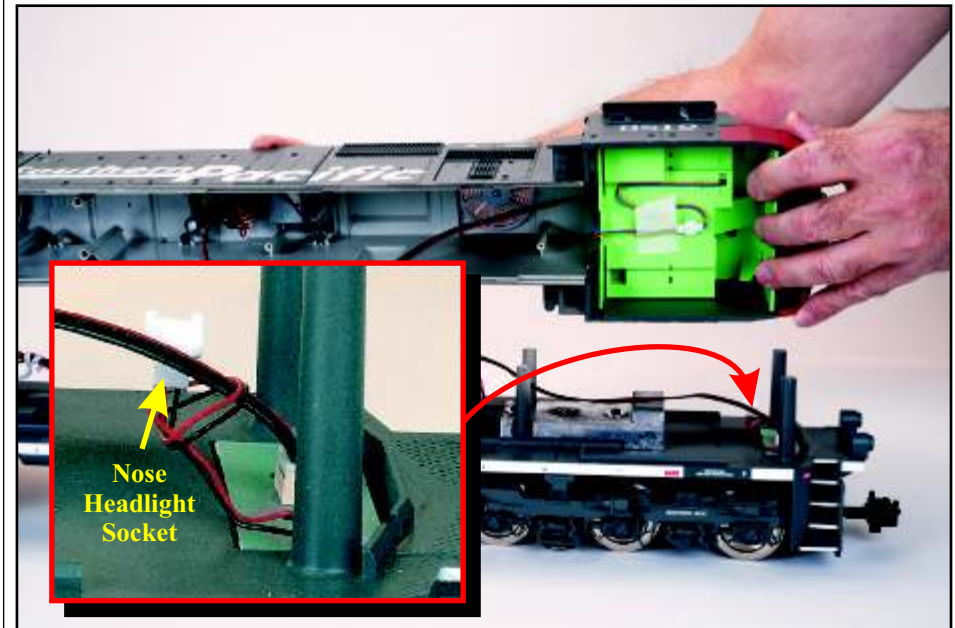
USA-Trains SD70 Disassembly

Separating the Top and Bottom Chassis Halves

"Gently" is the key word for this task. Starting at the back end, gently lift the top half of the chassis away from the bottom. If you feel any resistance, go back and verify all screws have been removed. The two halves should come apart easily. Place the top half on its side. Be careful of the small wires that join the two halves.

Beware Of Fragile Wiring If Your Loco Has Nose Mounted Headlight

The SP locomotive in most of these pictures has a headlight mounted above the cab windows. However, if your locomotive features a nose mounted headlight, there will be a small pair of wires going to the socket with the arrow. These wires are very short and very fragile. You will not be able to lift the top half of the chassis as high as shown. Very carefully disconnect the plug from the socket. DO NOT PULL ON THE WIRES - they break very easily.

Nose Headlight Socket

Unplug All Connectors From Old Circuit Board and Remove The Board

This is relatively easy. Unplug all the connectors from the circuit board. Remove and save the little garbage bag twist ties. These will be used later.

The miniature 4 and 6 wire sockets are held by friction and may seem tight. The easiest method to remove these is to grasp the group of wires near the plug. Next put your thumb on the top of the circuit board to prevent flexing. Now pull upwards while gently rocking the plug from side to side. This will release the plug from the socket.

The small 2-wire connector is easily removed. Grasp the plastic connector and pull upwards. Don't pull on the wires.

Remove the USA-Trains speaker wires (shown on page 9) that go down through the hole in the floor. The connector and wires are not needed and may be discarded.

Unplug the 2-wire plug from the smoke generator mounted to the roof.

Finally, remove the 3 screws holding the circuit board and remove the board. The board is no longer needed but be sure and save the screws to mount the Drop-In decoder.
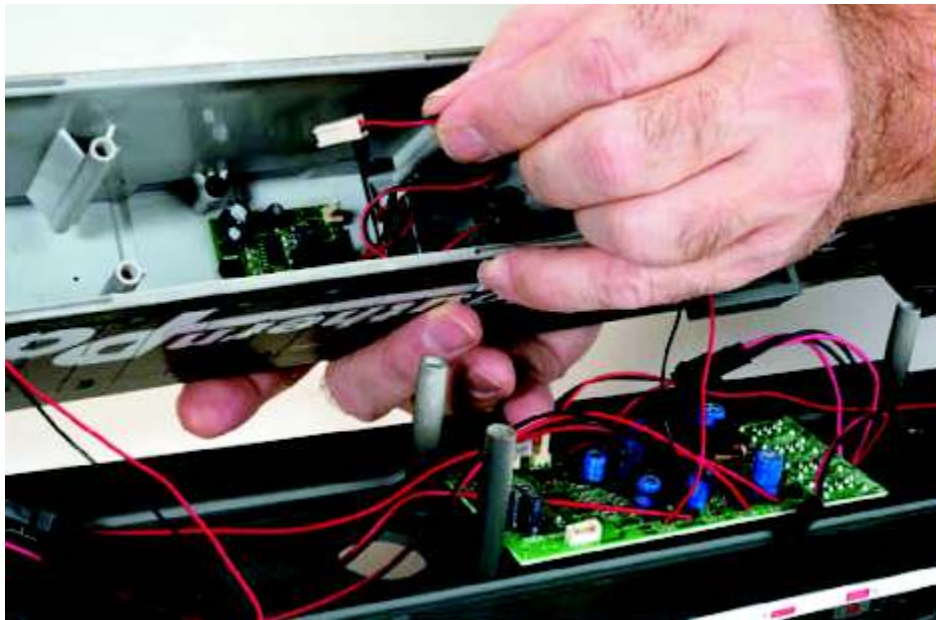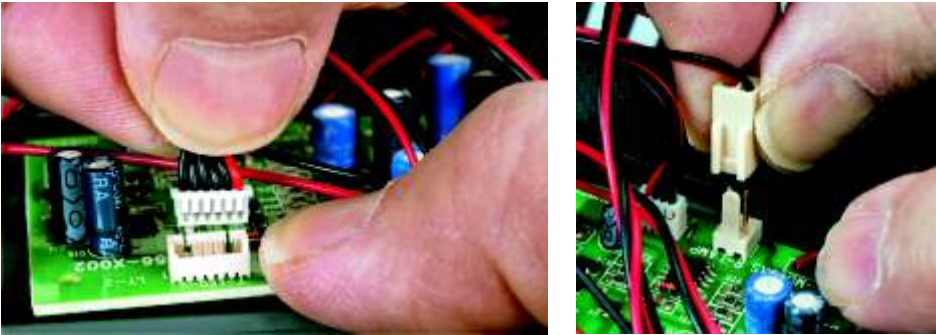
Removing The Front Truck - Optional But Recommended

The front truck and the connecting wires are in the way of the work that needs to be done to enlarge the switch holes. You don't have to remove it, and in fact some of the pictures show that we did not remove the truck. However, it is real easy to nick or break the truck wires so we recommend removing it. It isn't hard.

The articulated front set of wheels on the truck are held to the chassis with a bracket. Swing the wheels towards the side to reveal the bracket screws. Remove the 4 screws holding the bracket. In the picture below, the front right screw has been removed and the rear right screw head is visible. There is another pair of screws on the other side. Leave the wheels and bracket attached. Don't lose the screws.

The lower picture shows the center screw inside the weight that holds the truck assembly to the chassis.

Once the truck wires are unplugged from the circuit board, it is OK to remove the screw and remove the truck. There will be a small metal cylinder inside the weight which serves as a spacer. Don't loose it or the screw.