K27 Plug-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 17 to reset the decoder to the original factory settings. Resetting a forgotten frequency uses a new procedure. See page 16 for the details. All CV settings are remembered after the battery is disconnected.

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 [MARKER]
CV44	6	0-99	F10 Function Key Action [SMOKE]
CV45	5	0-99	F11 Function Key [FIREBOX]
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	Marker Special Effect [E2]
CV204	4	0-15	Firebox Special Effect [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]

CV Value	Function Key Action
0	No Function
1	Activate Cruise Control
2	No Function
3	Toggle CAB light on/off
4	Toggle MARKERS on/off
5	Toggle FIREBOX on/off
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

Trouble Reading This Page?
A larger text version starts on page 35.

P.O. Box 835772 Richardson, TX 75083 www.cvpusa.com

The AirWire900® K27 Plug-In™ Decoder
For Bachmann K27 and C19 Locomotives

K27 Plug-In Decoder Installation Guide

K27 Plug-In Decoder User Guide

Suitable Locomotives

The K27 Plug-In will fit the space available in either the Bachmann K27 or the C19 locomotive with the factory installed DCC socket. It will not fit other Bachmann locomotives.

Phoenix Coupler Driver

The K27 Plug-In includes the driver and sockets for the optional Phoenix couplers. The K27 driver is not suitable for other brands of remote couplers.

Plug-In Kit Contents

K27/C19 Plug-In Decoder
Charger Pigtail
Installation and User Guide

Optional Items Not Supplied

Battery & Charger
Speaker
P8 Sound Module
P8 Programming Cable
P8 Harness

How To Use This Booklet

The booklet has 2 main sections. The first section describes how to install the Plug-In decoder. The K27 and the C19 are described separately. The second section describes how to customize the locomotive performance using all of the features of the new Plug-In decoder.

Section 1: Locomotive Disassembly and AirWire Plug-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 install the CVP battery, optional P8 sound module and the K27 Plug-In decoder into the tender. Once installed, a quick check is run and then the tender is is reassembled.

Be sure to select the proper set of installation instructions since the K27 and C19 have different requirements.

Section 2: Customizing Locomotive Performance

Rest assured that the locomotive will perform properly without any changes to the pre-loaded factory settings. But, for maximum enjoyment, experiment with the various features and observe how the locomotive responds. At any time, a reset command can be sent from the throttle to force the decoder back to the original factory settings.

Optional Items - Phoenix P8 Module, Harness, K27 Speaker and Programming Cable

The Plug-In Decoder is designed to work with the Phoenix P8 sound module. The P8 module requires a separate programming cable and wiring harness. The K27 will also need a speaker. Otain these items directly from Phoenix. If your loco will not have a sound ignore all references to the P8. P8 harness part number is 6002-27.

Optional Phoenix Couplers

Contact Phoenix to order couplers. Also check their website for tips on coupler mounting and use.

www.phoenixsound.com

A smart person reads instructions.
A genius follows instructions.

K27 Plug-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) t	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

K27 Plug-In Frequency Listing

The K27 Plug-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 K27 Plug-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

K27 Plug-In Decoder Warranty And Repair Information

This warranty covers substantial defects in materials and workmanship in the Plug-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 K27 decoder from one of our AirWire900 dealers, please call them first. They are your quickest source for answers to questions about K27 decoder. They are also experts in installation and offer such services should they be required. If you purchased your K27 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.

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.

Train Stops When It Is Far Away

This is an easy one. You need to set the K27 Plug-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.

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.

Whistle 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 Plug-In decoder. There is nothing more annoying than a locomotive whistle that is stuck on so the Plug-In decoder includes a special feature that prevents stuck whistles. If for any reason, the decoder stops receiving throttle commands, and the last command was whistle ON, then it will automatically issue a whistle OFF command after a preset amount of time. This will occur more frequently as the locomotive moves further and further away from the throttle.

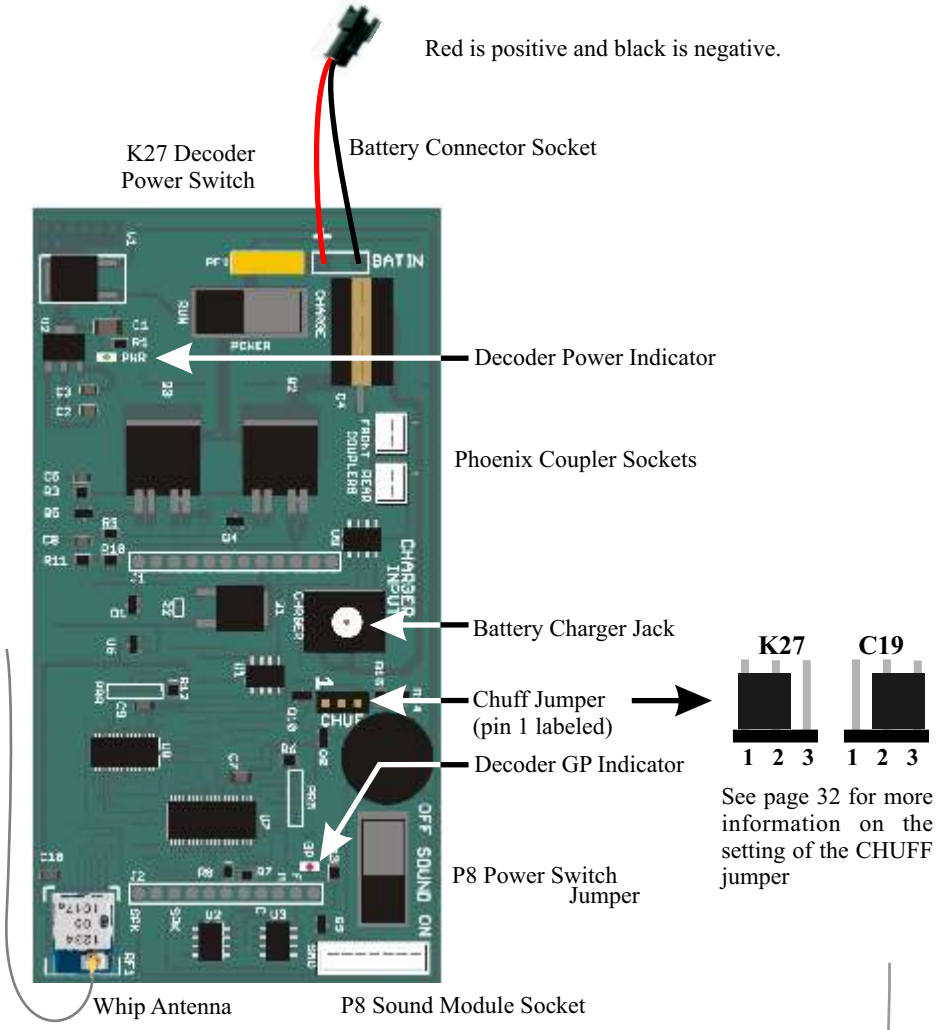
Limited Range

For best performance, the whip antenna should be vertical and above any obstructions. Drill a small hole in the coal load and feed the antenna through the hole. Keep all power wiring away from the antenna such as the battery wires. Brand new locomotives tend to create a lot of motor interference with their new brushes. Range will improve as the locomotive's motor brushes seat better.

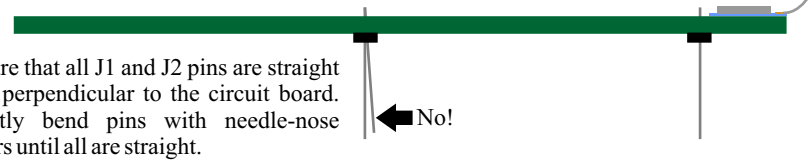
Although it is not easy to do, consider adding motor brush noise suppression capacitors to the motors right at the motor's terminals. A 0.1uF ceramic capacitor rated at 50V should be used.

Finally, lower the battery voltage. The K27 Plug-In decoder is optimized for 14.8 volt Lithium batteries. Higher battery voltages generate much more motor noise.

K27 Plug-In Decoder Familiarization



Antenna Orientation: Gently rotate the gold plug towards towards P8 sound socket and bend it vertical at the junction of the gold connector and the clear plastic whip. Do not cut the antenna. If the antenna plug pops off the jack, push it back on until it snaps in place.



Insure that all J1 and J2 pins are straight and perpendicular to the circuit board. Gently bend pins with needle-nose pliers until all are straight.

A single bent pin will prevent proper insertion of decoder into locomotive DCC socket. After the decoder is inserted into the socket, check for pins that did not go in. A bent pin will miss the socket. If this happens, remove the decoder, straighten the pin and reinsert.

Verify Battery Pack Connector Polarity

Proper Battery Polarity Is Mandatory

Incorrect polarity will damage the decoder. This is not covered by the decoder warranty. The CVP color convention is red for positive or plus and black for negative or minus.

Locate The Plug-In Battery Input Socket

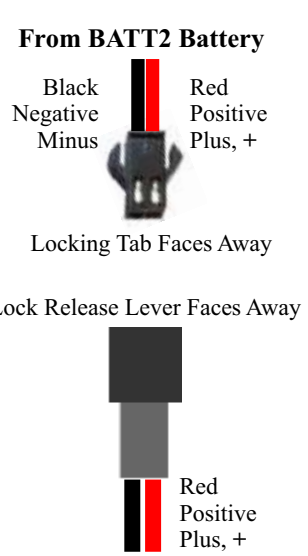
The Plug-In decoder has only one cable attached. This is the battery input connector socket.

Check The Battery Pack For Proper Polarization

The CVP BAT2 battery pack has a mating plug that is properly polarized for the Plug-In BATIN 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 match up when the connectors are oriented as shown in the picture. Notice that the socket release lever is pointing away from you.



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 Storage

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

K27 Plug-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

K27 Plug-In Decoder Configuration Variables List

continued from previous page

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	Marker Special Effect [E2]
CV204	4	0-15	Firebox Special Effect [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]

Some CVs are not listed if they are not applicable or not available in the K27 Plug-In decoder.

K27 Plug-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 MARKERS on/off
5	Toggle FIREBOX on/off
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

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 Plug-In decoder. The 2-conductor pigtail comes with stripped wires on one end and a right angle plug on the other.

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.

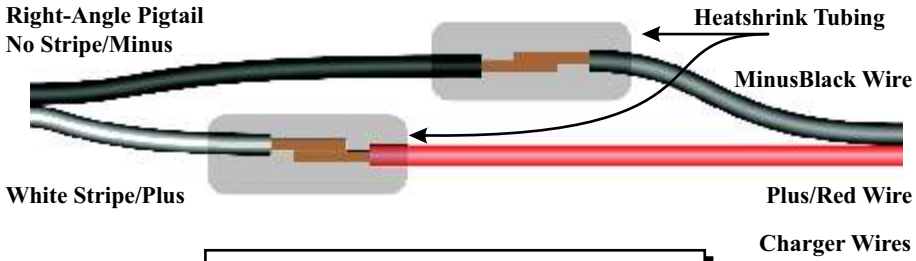
Take the pigtail and separate the 2 wires for about 2 inches. Cut the plus wire so it is 1 inch shorter than the minus wire. Remove about ½ inch of insulation from the plus wire. Twist and apply solder to the twist end of the plus wire. This is called tinning and keeps the twisted wires from unraveling.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



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

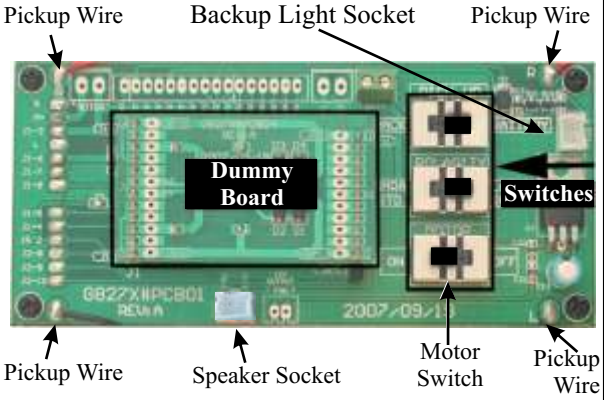
Familiarization With Bachmann K27 Tender DCC Board

When the coal load is removed, the main DCC board is visible.

The **Dummy board** will be removed and in its place, the AirWire K27 plug-in board will be plugged in.

The tender pickup wires can all be clipped off at the top of the solder joint.

The speaker socket will be used to connect the optional Phoenix speaker.

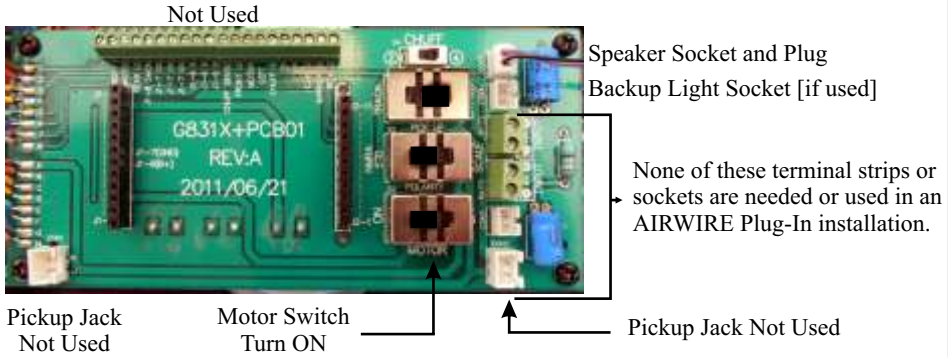


Of the 3 switches, only the MOTOR switch is operational. But, the top switch labeled PICKUP should be set to BATTERY. The middle switch is not used and can be set in either position. The MOTOR switch is used to turn off power to the motor. Since the motor will be controlled by the AirWire board, this switch is permanently placed in the ON position.MOTOR

Familiarization With Bachmann C19 Tender DCC Board

In this picture, the Dummy board has been removed as well as the extraneous “outrigger” board. More details about removing the outrigger are in the C19 installation section.

Of the 3 switches, only the MOTOR switch is operational. But, the top switch labeled PICKUP should be set to BATTERY. The middle switch is not used and can be set in either position. The MOTOR switch is used to turn off power to the motor. Since the motor will be controlled by the AirWire board, this switch is permanently placed in the ON position.



Boiler Switch Settings - Both Locomotives

K27 & C19 Boiler Switch Settings

Since all lights and the smoke generator will be controlled from the throttle, the three switches can all be set to the DCC setting. To keep users from accidentally activating the smoke unit, the SMOKE switch can be set to the OFF position. This will keep the smoke generator disabled, regardless of the throttle setting.

K27 Plug-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 [MARKER]
CV44	6	0-99	F10 Function Key Action [SMOKE]
CV45	5	0-99	F11 Function Key [FIREBOX]
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

Phoenix P8 Sound Module Function Key Assignments

The table of throttle function key assignments to sound effects works well for most P8 steam engine installations. You must use the P8 computer interface to make these assignments. These are not programmable from the throttle.

If you don't like these settings, feel free to change them - you can't hurt anything.

Function Key Assignments	Sound	K27 Motion
Function F0	*not available*	Toggle Headlight
Function F1	Bell	*none*
Function F2	Manual Whistle	*none*
Function F3	Coupler	Activate Rear Coupler
Function F4	Crossing Whistle	*none*
Function F5	Chatter	Activate Cruise Control
Function F6	Water Fill	Toggle Cab Light
Function F7	Volume Up	*none*
Function F8	Volume Down	*none*
Function F9	Blowdown	Toggle Marker Lights
Function F10	Station Announce	Activate SMOKE
Function F11	*none*	Togggle Firebox
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 K27 Decoder

P8 Sound Module and K27 Plug-In Decoder Have Shared CVs

The P8 shares three CV numbers with the K27 Plug-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 K27 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 K27 decoder. You may issue OPS or SVC programming commands to the K27 without fear of affecting the P8.

Shared CV Table	P8 Use	K27 Motion Use
CV1	Short Address	Short Address
CV17	Long Address	Long Address
CV18	Long Address	Long Address

Installing AIRWIRE Plug-In Decoder In Bachmann K27

See page 9 For C19 Locomotive Installation Instructions

Warning: Many parts of the tender are fragile and are easily broken. Especially vulnerable are the steps, backup headlamp, side-frame assemblies, and other attached details.

Suggested Tools

You will need thin-shafted, #1 phillips-head screwdriver that is at least 3 inches long to reach the screws. 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.

Removing Tender Shell

First lift off and set aside the plastic coal load. There are 3 screws holding the tender shell to the frame. These are in deep recessed holes and the recommended screwdriver can easily reach them. There are two screws down inside the holes in the front of the tender. There is a 3rd screw down inside the rear water fill hatch cover.

As the shell is slowly lifted, find the red and white wires that connect the rear headlamp to the DCC board. Gently rock the plug back and forth to unplug it from the socket. Don't pull on the wires. Set the shell aside for now.

Remove Dummy Plug Board

Remove the DUMMY plug board from the DCC board by gently prying it out of the socket. Take care not to put excessive lateral force on the board as this might damage the socket. The DUMMY plug board is not needed and may be discarded.

Disconnect the Track Pickup Wires

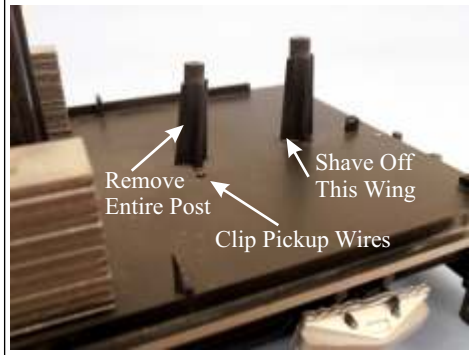
The track pickup wires need to be cut off and discarded. They 4 wires are soldered at each of the 4 corners of the board. You may cut or unsolder the wires from the DCC board. Once each wire is free, clip the other end of the wire at the point were it emerges from the tender's floor. FYI, the wires will be easier to cut if you wait until the DCC board is out of the way as described next. Although not required, the tender axle wipers can be removed to eliminate their drag.

Make Room For Battery

If you are using a different size battery, the tender modifications may be different or not required. These instructions assume the use of the CVP Tenergy 4400mAhr Lithium battery pack.

Use wire cutters to cut the indicated mounting post flush to the tender floor.

Use a motor tool or a hobby knife to shave the inside of the remaining post to insure the battery sits flush to the floor when mounted on its side. Once the battery fits without binding don't mount it yet. It will be mounted once everything else is completed.



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Installing AIRWIRE Plug-In Decoder In Bachmann K27

continued from previous page

Install Optional Speaker

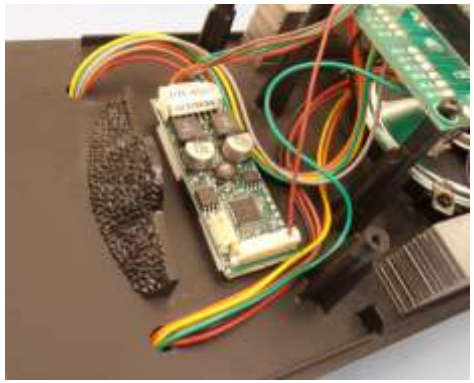
The recommended Phoenix speaker comes with a matching plug to the jack on the locomotive DCC board. The speaker is mounted underneath the DCC board so the board must be temporarily moved out of the way.

Remove the 4 screws holding the DCC board to the tender. Gently move the DCC board out of the way. Take care not to break any of the wires.

Position the speaker in the grill area and use the four mounting screws to secure the speaker to the tender floor.

Reinstall the DCC board. Plug the speaker into the indicated plug on the DCC board.

Mount The P8 Sound Module



First plug in the two connectors of the P8 harness to the sound module. Twist the wires together for easier handling. Directly behind the coal pile on the tender is a perfect place to mount the sound module. Use foam tape to mount the module.

In the photo, the module has been oriented to make it easy to connect the programming cable. Route the wires towards the right side of the tender, between the weights and the DCC board.

A 5/16 inch diameter hole can be drilled into the floor for permanent mounting of the P8 programming cable and jack.

Mount The Battery

Use double sided foam tape to fasten the battery to the floor. If rough handling is expected, consider adding a strap attached to the floor. The strap absorbs impact forces that might cause the tape to let loose of the battery.

Plug In The K27 Decoder

Orient the decoder with the antenna facing the rear of the tender. Plug it into the DCC socket. It only goes in one way. Inspect on both sides to verify all pins are in the socket.

Plug In Battery and P8 Sound Module To K27 Plug-In Decoder

Plug in both the battery and the P8 sound module. When making connections, be sure that excess wire doesn't touch the speaker cone. The sound will be distorted if any wires touch the speaker cone. Use wire ties for a neat appearance.

Don't put the tender shell on until the checkout is completed.

Skip Over to Page 11 For The Quick-Start Checkout Procedure.

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 whistle 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 Whistle Volume	90%	0
Rev Whistle Volume	100%	0
Stopping Whistle 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	Chuff Pin
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>

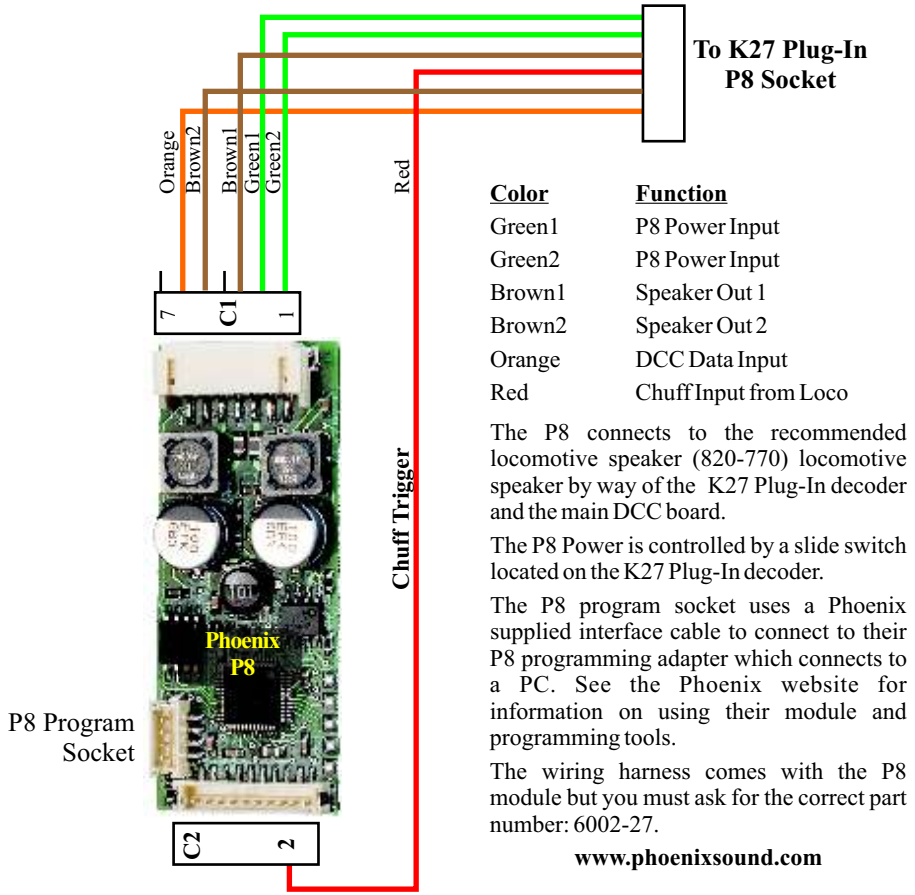
CVP Products does not provide customer support for the P8 sound module. Please contact Phoenix Sound Systems directly via email or phone.

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

Optical Chuff and DCC Speed

The recommended setup has the P8 receiving speed information from the locomotive's built-in optical chuff circuitry. Chuff averaging should be disabled because it is badly out of sync at very slow speeds. If not using the optical chuff circuitry, the selection of "Speed from DCC" should be enabled.

Phoenix P8 Sound Module Hookup and Chuff Jumper Use



Color	Function
Green1	P8 Power Input
Green2	P8 Power Input
Brown1	Speaker Out 1
Brown2	Speaker Out 2
Orange	DCC Data Input
Red	Chuff Input from Loco

The P8 connects to the recommended locomotive speaker (820-770) locomotive speaker by way of the K27 Plug-In decoder and the main DCC board.

The P8 Power is controlled by a slide switch located on the K27 Plug-In decoder.

The P8 program socket uses a Phoenix supplied interface cable to connect to their P8 programming adapter which connects to a PC. See the Phoenix website for information on using their module and programming tools.

The wiring harness comes with the P8 module but you must ask for the correct part number: 6002-27.

www.phoenixsound.com

Chuff Jumper Setting

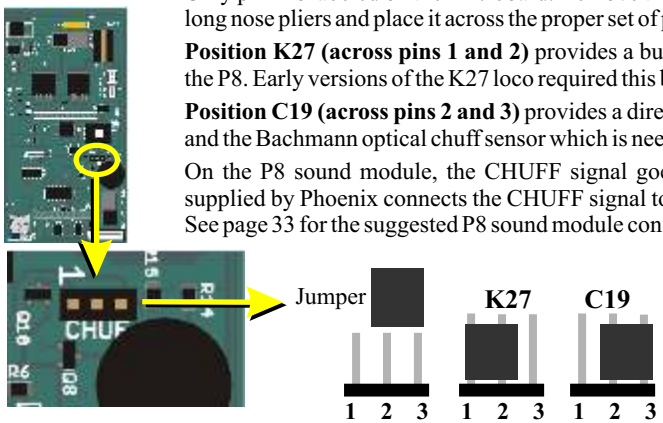
The K27 Plug-In board includes a correction circuit to provide the correct CHUFF trigger to the P8 sound module. Your only task is place the jumper across the correct set of posts.

Only pin 1 is labeled on the K27 board. Remove the jumper with your fingers or long nose pliers and place it across the proper set of posts.

Position K27 (across pins 1 and 2) provides a buffered and inverted trigger to the P8. Early versions of the K27 loco required this buffer.

Position C19 (across pins 2 and 3) provides a direct connection between the P8 and the Bachmann optical chuff sensor which is needed for the C19.

On the P8 sound module, the CHUFF signal goes to Trigger 1. The harness supplied by Phoenix connects the CHUFF signal to C2 pin 2 which is Trigger 1. See page 33 for the suggested P8 sound module configuration.



If your P8 doesn't accept the trigger, be sure to verify that Trigger 1 is the CHUFF source. Also try the other jumper connection. It won't cause and damage to the loco.

Installing AIRWIRE Plug-In Decoder In Bachmann C19

See page 7 For K27 Locomotive Installation Instructions

Warning: Many parts of the tender are fragile and are easily broken. Especially vulnerable are the steps, backup headlamp, side-frame assemblies, and other attached details.

Need A Smaller Battery

Because of the small size of the C19 tender, the CVP BAT3 is used. The BAT3 has 4 cells arranged as two groups of two mounted side by side.

Although the running time will be less with the smaller battery, you can use a trailing car to hold a much larger battery pack. Run time depends on how the locomotive is used (heavy or light load), the type of railroad (hilly or flat) and the age of the locomotive. On a flat layout with a medium car load, the 3400mAhr pack will last about 2 hours. Additional run time tips are on page 13.

The BAT3 is a Lithium-Ion rechargeable battery. It is rated at 14.8 volts and has a capacity of 3.4Ah. Be sure to get our matching smart charger for maximum battery life.

Confirm Battery Plug Polarity Matches Decoder BATIN Socket

Suggested Tools

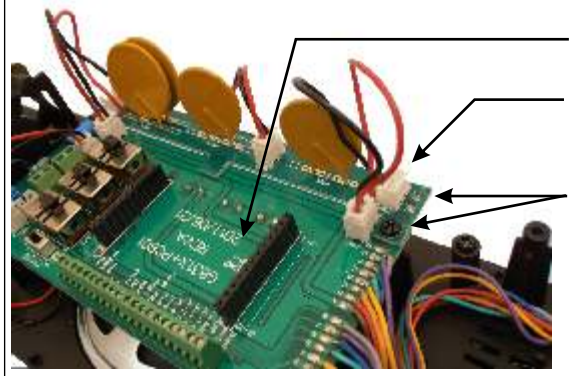
You will need a thin-shafted, #1 phillips-head screwdriver that is at least 3 inches long to reach the screws. This one is from General and has a 4 inch long, narrow shaft with a #1 Philips tip. It is also magnetized which comes in handy for pulling the screws from deep recesses.

Removing Tender Shell

First lift off and set aside the plastic coal load. Next, unplug and disconnect the backup light if present (some tenders don't have a backup light). Don't pull on the wires, pull on the plastic plug.

There are 3 screws holding the tender shell to the frame. These are in deep recessed holes and the recommended screwdriver can easily reach them. There are two screws down inside the holes in the front of the tender. There is a 3rd screw down inside the water refill hatch cover.

Wiggle the shell free of the floor. Set the shell aside for now.



The wires soldered to the end of the DCC board are easily broken so don't bend or flex them excessively

continued on next page

Installing AIRWIRE Plug-In Decoder In Bachmann C19

continued from previous page

Remove Dummy Plug

Remove the DUMMY plug from the DCC board by gently prying it out of the socket. Take care not to put excessive lateral force on the board as this might damage the socket. The DUMMY plug is not needed and may be discarded.

Remove The "Outrigger" Board

There is another board attached to the main DCC board. It is not needed for the AirWire installation so it needs to be removed. Unplug all of the cables connecting the long narrow board with the big yellow disks to the main DCC board. Remove the two screws holding the board to the main board. Keep the screws - don't loose them.

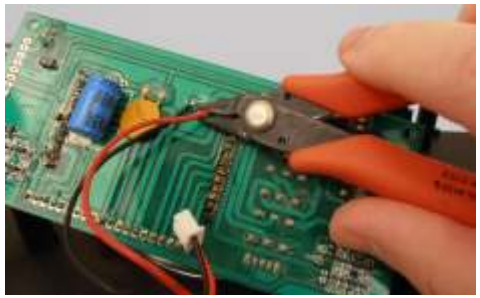
Disconnect the Track Pickup Wires

There are two sets of track pickup wires that were plugged into the outrigger board. These are not needed and the excess wire and the matching plug should be clipped flush to the tender floor. Although not required, the tender's axle wipers can be removed to eliminate their drag.

Remove and Discard The Fan

The K27 Plug-In decoder does not need a fan so it can be removed. First, unplug the fan from the DCC board. Remove the two screws holding the fan's bracket to the tender floor. The fan may be discarded.

Remove Power Plug From DCC Board



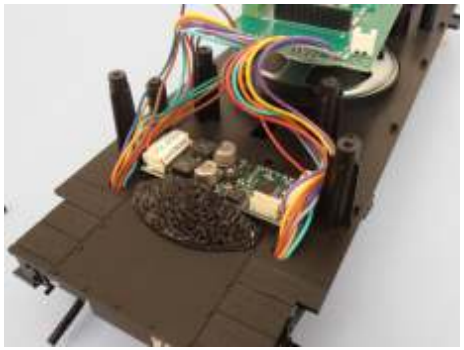
There is a separate power plug that is used to connect the DCC board to the outrigger board. It is no longer need and needs to be removed.

Remove the remaining two screws from the DCC board and tilt it upward to expose the bottom.

Peel off the hot melt glue where the wires attach to the board. You may either clip the wire or unsolder it. The plug and wire may be discarded.

Mounting the P8 Sound Module

First plug in the two connectors of the P8 harness to the sound module. Twist the wires together for easier handling. Directly behind the coal pile on the tender is a perfect place to mount the sound module. Use foam tape to mount the module.



In the photo, the module has been oriented with the programming jack facing forward. This makes it easier to connect the programming cable. Route the wire harness towards the back of the tender. Make sure it doesn't touch the speaker cone. A 5/16 inch diameter hole can be drilled into the floor for permanent mounting of the P8 programming cable and jack.

Plug In The K27 Decoder

Orient the decoder with the antenna facing the rear of the tender. Plug it into the DCC socket. It only goes in one way. Inspect on both sides to verify all pins are in the socket. Bend the antenna vertical.

Plug In Battery and Sound Decoder

Plug in both the battery and the P8 sound module to the K27 decoder. When making connections, be sure that excess wire doesn't touch the speaker cone. The sound will be distorted if any wires touch the speaker cone. Use wire ties for a neat appearance.

Don't put the tender shell on until the checkout is completed.

Go to the next page - you are ready to begin the checkout procedure.

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 K27 Plug-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 K27 Plug-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 K27 Plug-In to a known frequency.

Assigning Special Effects To Other K27 Output Drivers

There are a variety of special effects that can be applied to the CAB, MARKERS and FIREBOX lights as well as the SMOKE generator. Once again, although most effects don't apply to the steam locomotives, the flicker effect can be applied to the firebox to make for a much more interesting and random flickering effect. But before starting, here's the table of CVs related to the K27 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 K27 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	Marker Special Effect [E2]
CV204	4	0-15	Firebox Special Effect [E3]
CV205	4	0-15	Smoke Speical Effect [E4]
CV206	120	0-255	Smoke Timer 0=manual

To use an effect, first select the proper CV number for the specific LITE. 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]

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

FIREBOX Effect **CV204**
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%	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

Checkout and Quick-Start Instructions

Connect the tender to the boiler. Insure that all connectors are firmly plugged in and latched. Confirm that the battery is plugged in. Leave the tender shell off for now although you can connect the backup light if you want to check it out too. As delivered from the factory, the Plug-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.

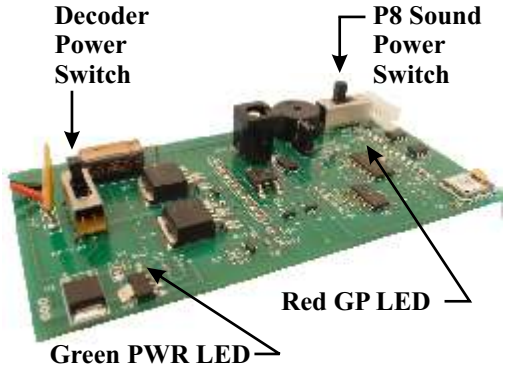
Chuff Jumper: For the K27, the jumper is across pins 1 and 2. For the C19, the jumper is across pins 2 and 3.

Verify that the battery is plugged in.

Turn on your 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.

Turn on the decoder power switch. The green PWR LED will turn on indicating the battery has been connected properly.

Turn on the P8 Sound power switch if a P8 sound module is connected. The P8 sound module power switch is independent of the main decoder power switch. There is no indicator for the P8 power switch.



With the throttle and the Plug-In decoder both powered on, the red GP LED will be on. Also, the Phoenix P8 module will turn on and make engine startup sound effects.

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

Motor Check: Check for motor operation by very slowly increasing the speed until wheels begin to move. If the motor does not operate, set the motor control switch on the main DCC board to on - see page 6.

Headlight Check: On the throttle push and release the 0 key. This sends the Function-0 command to the decoder which turns on the headlight. The Function 0 command will be abbreviated to simply F0.

Now change the throttle's direction switch and the backup light will turn on (unless your tender doesn't have a back up light or it is not connected since it is part of the tender shell.) Push F0 to turn off the headlight.

Markers Check: Push F9 on to activate the front marker lights. Push F9 to turn them off.

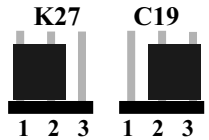
Firebox Check: Push F11 to turn on the firebox. Since this is a two digit function number, you first push the * key followed by the 1 key. This two key combination is how you activate functions above 9. To turn off the firebox, push * followed by the 1 key.

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 Marker Lights On/Off
F10	Toggle Smoke Generator On/Off
F11	Toggle Firebox On/Off
F13	Activate Front Coupler
F15	Deactivate Cruise Control

Chuff Jumper Setting

See page 32 for more details about the use of this jumper.

K27 Loco Across 1 and 2
C19 Loco Across 2 and 3



Checkout and Quick-Start Instructions *continued*

Cab Light: Push F6 to turn the cab light on or off. The cab light is very dim and barely visible in regular room light. It is not visible outdoors except at night.

Smoke Generator Check: First put a few drops of smoke fluid in the reservoir. Push F10 (* key followed by the 0 key).This activates the heater inside the smoke reservoir and smoke will emerge in a minute or so. Beware that some early K27 locos have a fan in the boiler that tends to suck the smoke away from the stack. So don't worry if wisps of smoke come out the cab - this is normal.

Optional Coupler Activation Check: Be sure the Phoenix coupler is plugged into the appropriate socket on the Plug-In board. Push F3 to activate the rear coupler. Push F13 to activate the front coupler.

Sound Board Checkout: By now, it will be obvious if your P8 is working. But, some changes in its setup are needed. See page 20 for details on the CVP recommended P8 configuration.

This concludes the checkout of your K27/C19 Plug-In decoder installation. Reinstall the tender shell.

If The Checkout Didn't Pass - Simple Remedies

Green Power LED doesn't turn on: Make sure the Plug-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 Plug-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.

Motor Doesn't Run: Make sure the MOTOR switch on the main DCC board is set to the ON position. See page 6.

Lights and/or Smoke Don't Turn On: Make sure all of the switches located in the nose of the boiler are set to the DCC position.

No Chuffing: Check the for correct positioning of the CHUFF jumper setting (see page 32). Also check the P8 module configuration and the P8 wiring harness.

Smoke Doesn't Turn On: Make sure the SMOKE switch located in the nose of the boiler is set to DCC. Also, there must be a few drops of smoke fluid in the reservoir and it must first warm up before smoke will appear.

Smoke Doesn't Come Out The Stack: The K27's internal boiler fan may be drawing the smoke away from the stack and it may exit near the cab area. Unfortunately, there is no easy solution if this

Set Boiler Switches

Set all switches on the front of the boiler to DCC. This allows the Plug-In decoder to control these features.

Special Headlight Effects *continued*

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 K27 Plug-In will automatically change it to a value of 1.

The 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.

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.

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

Customizing Headlight Operation Mode *continued*

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 K27 Plug-In decoder's headlights. Many are used for diesel locomotives, but a few are usable with a steam engine. For example, a flickering effect can be added to either the front headlight or the backup light. This might simulate a faulty generator or perhaps an old fashioned oil lamp.

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

continued on next page

Connecting The Charger and Charging The Battery

If the coal load is present, lift it out of the way to expose the decoder.

Set the Plug-In decoder POWER slide switch to the CHARGE position. The black actuator will be closest to the word CHARGE printed on the circuit board. You will also notice the Plug-In's green PWR LED is off.

Set the SOUND power switch to OFF. Remember that the SOUND power is independent of the decoder power switch.

Plug the charger into the jack labeled CHARGER INPUT. It is the only jack that will accept the charger plug. Plug in the AC cable to the charger.

There is a small LED indicator on the charger. It turns from green to red when the battery is charging. When the battery charge is complete, the charging indicator turns back to green.

CVP's smart charger can remain plugged into the decoder with the switch set to CHARGE without fear of damaging the battery.

If the POWER switch is in the CHARGE position (without a charger plugged in) and the SOUND power switch is in the OFF position, the decoder is totally powered off.

Runtime and Battery Charge Life

How Long Do The Batteries 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 4.4 Amp-hours. In other words, the battery will last about 1 hour if the locomotive pulls 4.4 Amps. Fortunately, the locomotive motors will seldom get close to that value. Under normal operating conditions, you can expect up to 3 or 4 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 Bachmann motors draw between 1.0 and 1.5 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 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. Also, slower running decreases the battery drain.

Smoke Generator And Battery Drain

The smoke generator can 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

Since the K27 locomotive uses all LED lights, the battery drain is minimal. However, it is best to turn off all unused or unseen lights, especially in the daytime. For example, the cab overhead light is so dim as to be impractical except at night.

K27 Plug-In Decoder User Guide

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

Most of the lighting effects don't apply to a steam engine. However the flickering effect can be useful in simulating a faulty generator. The flickering effect also makes the firebox light more interesting. Therefore the complete set of effects are described so experiment and enjoy.

The K27 Plug-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.

K27 Plug-In Cruise Control

The K27 Plug-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 K27 Plug-In are two extra CVs, CV64 and CV65. These allow you to finely tune your cruise control to your specific locomotive.

The K27 Plug-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 K27 Plug-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.

Changing Decoder Address To Match Loco Cab Number

Address changing is simple and straight forward using the T5000 throttle. On the Plug-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 Plug-In and the P8 sound decoder will be programmed to the same number at the same time.

The Plug-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 and 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 Plug-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.

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 Plug-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 K27 Plug-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 K27 Plug-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 Plug-In decoder power switch off, then back on. The Plug-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 Plug-In frequency setting **within one minute** of the decoder's Power switch being turned on (before the count down chirps stop).
- If the Plug-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 Plug-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 Plug-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 Plug-In decoder will not be enter the jump mode. Best practice is to always turn on and off both power switches.

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.

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 K27 Plug-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 K27 Plug-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 K27 Plug-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.

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 Plug-In decoder frequency. This procedure will first reset the frequency as well as restore the original factory settings, including address and frequency to the Plug-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 Plug-In decoder if it was powered on.

3. Turn on the Plug-In decoder and **wait** at least one minute. At the end of the one minute, the Plug-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 Plug-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 Plug-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 Plug-In decoder has many memory locations so we use the term CV# where # is a specific memory location. So CV40 means Plug-In decoder memory location number 40. The value stored at this location dictates what the Plug-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 Plug-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 Plug-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 Plug-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.

Original Factory Settings 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 Marker Lights On/Off
F10	Toggle Smoke Generator On/Off
F11	Toggle Firebox On/Off
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.

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, K27 Plug-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, K27 Plug-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 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.

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 Plug-In decoder supports more functions than our previous decoders.

The extra functions provide additional throttle control of the new Plug-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 [MARKER]	CV43
F10 Function Key Action [SMOKE]	CV44
F11 Function Key [FIREBOX]	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 MARKERS on/off
5	Toggle FIREBOX on/off
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

Customizing Smoke Generator Operation

The Bachmann K27 and C19 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 Plug-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]

After Market Smoke Generators
The Plug-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.

Smoke Not Coming Out The Stack
This is a known deficiency in some of the original K27 locomotives. There is a fan deep inside the boiler. It is supposed to cool the motor. Unfortunately, the side effect is to suck smoke away from the stack and blow it out the back of the cab. Without dismantling the boiler, there is not much that can be done. However, there has been a lot of debate about various solutions to this issue in the various online forums. Set your search browser to Bachmann K27 Smoke Problem and check out the entries.

Optional Phoenix Coupler Operation

The Plug-In series decoder includes built-in drivers 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 gently 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 so we can share it with others.

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

www.phoenixsound.com

Motor Control And Speed Curve Fine Tuning

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 K27 Plug-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.