Econami Digital Sound Decoder

Diesel User's Guide

Software Release 1.4**

** Previous software versions included

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All Aboard!

Overview

Congratulations on purchasing your SoundTraxx Econami Digital Sound Decoder (DSD) for diesel locomotives! This user's guide shows you how to operate Econami and customize each decoder setting to fit your preferences, while providing some helpful troubleshooting tips along the way.

We suggest referring to the user documents listed below as you read this user's guide.

Econami Installation Guide

Provides instructions and strategies for successful sound installations.

Econami Diesel Quick Start Guide

Gives an overview of the decoder's default settings and highlights some of the features.

Econami Diesel Technical Reference

Offers a chronological list of all included CVs and details showing each adjustable setting.

Econami Diesel Sound Effect Reference

Lists each included sound effect for configuring a prototypical operating experience.

Visit www.soundtraxx.com/manuals.php to download each document contained in the *Econami Diesel Owner's Manual*.

Using Econami for Diesel

The Econami Digital Sound Decoder (DSD) is designed to enhance your model railroading experience, offering you sound just as realistic as your models at an affordable cost. Some of the features discussed within this user's guide include 28-function support, 20 Hyperlight lighting effects, Flex-Map function mapping technology, back-EMF Hyperdrive2 advanced motor control, and auto-manual RPM notching control. Econami also offers selectable airhorns, bells, prime movers, couplers, air compressors, and more in a single decoder.

Your decoder has been preprogrammed so you can start using the default settings without making any adjustments to CVs. However, you may adjust settings at any time by programming CVs. This user's guide will walk you through operating and programming Econami to its full capacity. Refer to the *Econami Diesel Technical Reference* for technical details of each CV.

Default Function Assignments

You can activate default effects with function keys the first time you use Econami. The effects listed in Table A are assigned to function keys F0-F28 by default. This section describes how to activate each effect with function keys.

Note: *You can assign any effect to function keys labeled as "Not Assigned" in Table A with Flex-Map function mapping CVs. Refer to "Configuring Function Mapping" for more information about customizing function assignments.*

Note: *Pressing function keys F0-F28 will toggle functions "on" and "off" and activate effects.*

Table A. Default Functions

Function Key	Effect
F0(f)	Headlight
F0(r)	Backup Light
F1	Bell
F2	Airhorn
F3	Short Airhorn
F4	Dynamic Brake
F5	RPM+
F6	RPM-
F7	Dimmer
F8	Mute
F9	Grade-Crossing Signal
F10	Not Assigned
F11	Brake Squeal/Release
F12	Not Assigned
F13	Coupler, Coupler Release
F14	Switching Mode
F15	Not Assigned
F16	Not Assigned
F17	Not Assigned
F18	Not Assigned
F19	Not Assigned
F20	Not Assigned
F21	Not Assigned
F22	Not Assigned
F23	All Aboard/Coach Doors*
F24	FX3 Function Output
F25	FX4 Function Output
F26	FX5 Function Output**
F27	FX6 Function Output**
F28	Not Assigned

**Available on select formats

Turn On the Lights

Ensure your locomotive is in the forward direction. Then turn on F0 to illuminate the headlight. Reverse the locomotive direction to turn off the headlight and turn on the backup light. Pressing F0 a second time will turn off the headlight and backup light outputs.

Turn on F7 to dim the headlight or backup light before passing oncoming trains, or while waiting on a siding. Press F7 again to return the headlight and backup light outputs to full brightness.

Ring the Bell

Turn on F1 to ring the bell. Press F1 again to stop ringing the bell. The bell is generally rung before moving the locomotive, when approaching crossings, to alert people or equipment near the track, and as a warning signal when necessary.

* Not included in software releases prior to version 1.3

Blow the Airhorn

Signaling can make your operating sessions more fun. Engineers signal to notify passengers, crew, and other trains of common locomotive movements, such as stopping, moving forward, backing up, and approaching grade crossings. Use F2, F3, and F9 to signal prototypically while you operate.

Turn on F2 to blow the "long" airhorn, and press F2 a second time to stop the airhorn blast. Press F3 to issue a single "toot" when you need to make short airhorn blasts. Unlike the long airhorn, the short airhorn is the same length every time you press F3. To issue the long-long-short-long grade-crossing signal automatically, turn on F9 as your locomotive approaches a grade crossing. Refer to Table B to view a few more common signals.

Table B. Whistle Signals — Long = –, Short = ●

Signal	Description
– – ● –	Approaching a grade crossing: hold final blast until crossing is occupied
●	Applying brakes
– –	Releasing brakes, proceeding forward
● ● ●	When moving, stop; when stopped, back up
● ● ● ●	Request signal from trainman
– ● ● ●	Signal flagman to protect rear
– ●	Warning signal: use when approaching areas with obstructed views and when approaching/passing passenger/freight trains
–	Approaching stations, junctions, and railroad crossings at grades

Regulate the Engine RPM Notch

Contrary to the way your car works, diesel engine generates power by turning an electric generator. The generator delivers electricity to traction motors mounted on the axles, which then set the locomotive wheels in motion. The traction motors are able to produce ample rotating power at any speed without needing to shift gears.

The prime mover will start when the decoder receives track power. Then, each time you turn on F5 (RPM+), the engine RPM will advance to a higher notch setting, until you reach notch 8. Likewise, each time you turn on F6 (RPM-), the engine RPM will reduce to a lower notch setting. After the engine RPM is reduced to an idle (notch 1), turning on F6 will shut down the prime mover and fade engine and air compressor sound effects to silence. You then can turn on F5 to start the prime mover and bring the engine to an idle. By default, pressing the emergency stop button will also shut down the prime mover.

F5 Off → On = RPM+	F6 Off → On = RPM-
From Prime Mover Off: 1. Notch 1 (Idle) 2. Notch 2 3. Notch 3 4. Notch 4 5. Notch 5 6. Notch 6 7. Notch 7 8. Notch 8	From Notch 8: 1. Notch 7 2. Notch 6 3. Notch 5 4. Notch 4 5. Notch 3 6. Notch 2 7. Notch 1 (Idle) 8. Prime Mover Off

All Aboard!

Engine RPM and speed are not directly related in the case of a diesel locomotive. For example, a diesel locomotive climbing a grade at full throttle and maximum engine RPM may only be traveling about 20mph, whereas your car's engine RPM directly determines how fast you're traveling. You can adjust the RPM notch prototypically with F5 and F6 when you need to generate more or less power during operation.

Note: *The RPM notch is automatically adjusted in response to the throttle setting. To disable auto-notching and enable manual notching, refer to "Configuring Sound Effects."*

Note: *On select command stations (such as the NCE Power Cab), increasing the throttle setting from zero when the prime mover is off may cause the decoder to immediately bring engine RPM to idle speed and skip the startup sequence. If this occurs, press the emergency stop button to turn the prime mover off, and then increase the throttle until the startup sequence occurs.*

Apply and Release Brakes

The brakes typically squeal just before the wheels stop turning. Turn on F11 before you decelerate to a stop. Press F11 again to release the brakes before departing.

Dynamic Braking

Diesel engines use the electric traction motors as generators to slow the locomotive when descending grades. Dynamic braking saves energy and allows other braking methods to be used less often to prevent them from wearing down as quickly. Accelerate to a moderate speed, and then turn on F4 to engage the dynamic brakes. Press F4 again to release the dynamic brakes. Refer to "Configuring Sound Effects" to select an alternative dynamic braking mode.

Couple and Uncouple

Turn on F13 to engage the coupler as you add cars to your train. When you uncouple, press F13 a second time to open the knuckle and separate the glad hands.

Announce "All Aboard!"

Turn on F23 before leaving the station to issue the conductor's "all aboard!" announcement. After the coach doors slam shut, increase the throttle and depart the station.

Mute Sound Effects

Turn on F8 to mute all sound effects when you want a break from your layout. Press F8 again to return all sound effect volume levels to their prior settings.

Use Switching Mode

To improve throttle control for switching operations, turn on F14 to override all momentum CVs and reduce the current throttle setting by 50%. Press F14 again to reset locomotive speed to the prior speed step and reactivate all momentum CV settings. For more information about momentum CVs, refer to "Configuring Throttle and Braking."

FX Lighting Outputs

If you have additional lights wired to the FX3-FX6 function outputs, use function keys F24-F27 to activate them. Depending on board format, Econami offers up to six lighting outputs to support Hyperlight effects. To select Hyperlight effects for lighting outputs, refer to "Configuring Lighting Outputs."

Emergency Stop

Press the emergency stop button to issue the emergency brake application, shut down the prime mover, and bring your train to an immediate stop.

Automatic Sound Effects

Econami is designed to play certain sound effects automatically during operation. Set the throttle to a non-zero speed step and allow the decoder to operate automatically.

Using Auto-Notching

By default, the engine RPM notch setting will be automatically adjusted in response to throttle increases and decreases. To identify the auto-notching range, gradually increase the throttle from zero to its maximum setting; the engine RPM will advance from notch 1 (idle speed) to notch 8 in response. Then, gradually decrease the throttle to reduce engine RPM from notch 8 to notch 1 until the locomotive is stopped at idle speed.

From notch 2, the engine RPM will transition between notch settings when the throttle is increased or decreased seven speed steps. For example, increasing the throttle from speed-step 0 to speed-step 1 will advance the engine RPM from notch 1 (idle speed) to notch 2. From speed-step 1, increasing the throttle to speed-step 7 will advance the engine RPM from notch 2 to notch 3. Likewise, a throttle increase from speed-step 7 to speed-step 14 will bring engine RPM to notch 4, and so on. Increasing the throttle to speed-step 49 will advance engine RPM to the highest setting (notch 8).

If you're having trouble using auto-notching to regulate sound effects, we suggest the following solutions:

- Adjust the throttle setting more gradually to match the RPM notch to locomotive speed.
- Decrease the auto-notching sensitivity so that sound effects respond to a wider range of throttle increases and decreases. Refer to "Configuring Sound Effects" for more information regarding auto-notching sensitivity.
- Increase momentum settings to match the engine RPM sound effect with the throttle setting. Refer to "Configuring Throttle and Braking" for more information regarding momentum CVs.
- Disable auto-notching and use manual notching to regulate engine RPM with the RPM+ and RPM- function keys separately from the throttle setting. Refer to "Configuring Sound Effects" to disable auto-notching and enable manual notching.

Air Compressor

The air compressor maintains air pressure during operation. To simulate charging the train line, the pump cadence will revert to its most rapid setting every time the coupler function (F13 by default) is turned on, and every third time the F11 brake function is turned on.

Poppet Valve

Listen to each "pop!" of the poppet valve popping-off in the background while the prime mover is running. To adjust the poppet valve release rate, refer to "Configuring Sound Effects."

CV Programming Tutorial

Configuration Variable (CV) is the industry-adopted term for a decoder's user-adjustable memory locations. CVs allow you to adjust various decoder properties and customize your operating experience. The address, audio settings, motor control, lighting effects, and function assignments are just some of the properties you can adjust with CVs. You can modify CVs at any time and the decoder will save your settings even when the power is turned off. If reading about CV programming already has your head spinning, this tutorial will help you understand how CVs work.

At first glance, you may feel overwhelmed by the large number of CVs offered by Econami. Don't worry! You don't need an engineering degree to customize your decoder's settings. Making adjustments is easy, and you can customize settings one CV at a time by referring to this user's guide and the *Econami Diesel Technical Reference*. When in doubt, you can always reset the decoder to factory defaults. Refer to "Resetting CVs" for more information.

Bits and Bytes

All the bits, bytes, and other symbols used in decoder manuals, and differences between command stations can make CV programming difficult to understand. Put simply, each CV contains a value that can be changed, and changing the value of a CV will modify a specific decoder setting. However, knowing a little more about how CV values are represented will help you make the right adjustments. CV values can be represented in the three numeric formats listed below:

Decimal

Decimal representation is the format you will probably use most often. Decimal values are represented using numerals 0-9. Each CV contains a decimal value from 0 to 255.

Binary

Like computers, binary is the numbering system used in Digital Sound Decoders. Binary values are called "bits" and can be represented as either 0 or 1. Each CV contains eight bits, or one "byte." Each CV contains a binary value from 00000000 to 11111111, which easily converts to decimal form.

Hexadecimal

Referred to as "hex," hexadecimal values are represented using characters A-F and numerals 0-9. Each CV contains a hex value from 00 to FF. Hex allows you to represent decimal numbers in fewer digits if your command station has a limiting interface.

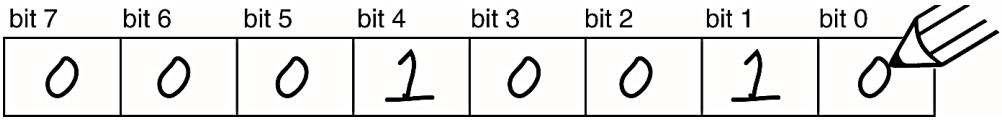
Programming by the Bits

Each CV is made up of eight bits and can be set to decimal values from 0 to 255 or binary values from 00000000 to 11111111. Most CVs contain a single piece of data easily represented in decimal, binary, or hex.

Some CVs use individual bits to control specific features, allowing up to eight features to be controlled using a single CV. You can set each bit to a binary input of 0 or 1 to modify a specific setting. For this reason, "programming by the bits" allows you to make basic adjustments that are on/off, disabled/enabled, etc. Because most DCC systems don't use binary representation, programming by the bits requires you to convert binary values into decimal (or hex) values.

This user's guide represents CV values in decimal form to expedite programming. However, binary is occasionally used to represent CV values in the *Econami Diesel Technical Reference* for CVs that are programmed by the bits. For instance, CV 29 (Configuration Data 1) is programmed by the bits and controls important decoder settings, such as the locomotive direction, the decoder's speed step mode, alternate power source, and speed table setting.

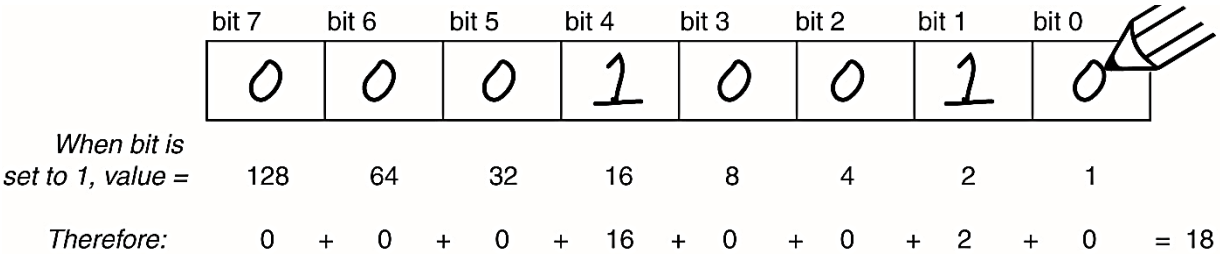
A CV is illustrated below and shows a binary value for each bit. Bits 1 and 4 are set to 1, and bits 0, 2, 3, 5, and 6 are set to 0, which is a binary value of 00010010.



Refer to Appendix A to locate the binary value 00010010 and convert it to a decimal value of 18 (0x12 in hex). Entering a value of 18 into the CV would then adjust the settings contained by each bit according to the binary input 00010010.

Binary-Decimal Conversions

You can convert binary values into decimal form without the conversion chart as well. The decimal value of each bit doubles sequentially (1, 2, 4, 8, 16, etc.) from bit 0 to bit 7. Add the decimal values together for each bit set to 1. The sum is the total decimal value of the CV.



Follow the steps below to convert the binary value 00010010 to decimal form:

1. Identify the bits set to 1; 00010010 indicates bits 1 and 4 are set to 1.
2. Convert bit 1 to its decimal value; bit 1 converts to 2
3. Convert bit 4 to its decimal value; bit 4 converts to 16
4. Add the decimal values of bits 1 and 4; 2 + 16 = 18
5. Enter a value of 18 into the corresponding CV to adjust settings according to the binary value 00010010.

You can also convert by multiplying binary and decimal values and adding them together:

1. Bit 0 = 0; 0 × 1 = 0
2. Bit 1 = 1; 2 × 1 = 2
3. Bits 2-3 = 0; 0 × 1 = 0
4. Bit 4 = 1; 16 × 1 = 16
5. Bits 5-7 = 0; 0 × 1 = 0
6. 0 + 2 + 0 + 0 + 16 + 0 + 0 + 0 = 18; 00010010 = 18

Introduction to Programming

This section details CV programming modes, reading CVs, accessing indexed CVs, resetting CVs to factory defaults, and locking and unlocking CVs. Due to the varying CV programming methods used by DCC systems, we cannot provide comprehensive instructions that address every command station and must assume you understand the capabilities of your system on some level. Consult your DCC system manual or contact the manufacturer if you need more detailed programming instructions.

Configuration Variable Control CVs
CV 8: Manufacturer ID
CV 15: CV Unlock Code
CV 16: CV Lock ID
CV 30: Error Information
CV 31: CV Index 1
CV 32: CV Index 2
CVs 1.257-1.512: Indexed CV Page 1

The sections of this user's guide are categorized according to each part of decoder operation, from basic to advanced programming, and allows you to configure one group of CVs at a time. When you're comfortable programming one set of CVs, move on to the next category and explore each setting Econami has to offer. Refer to the *Econami Diesel Technical Reference* to for a chronological list of CVs detailing each adjustable setting.

Programming Modes

Econami supports Operations Mode and Service Mode programming.

Operations Mode

Referred to as "Ops Mode" or "programming on the main," Operations Mode allows you to program CVs during operation even when other locomotives and rolling stock are present. Being able to program during operation simplifies re-creating prototypical scenarios. For example, you can increase the momentum of a locomotive after it couples to a train. However, because data cannot be read back from the decoder, programming on the main will not allow you to verify CV values.

Service Mode

Service Mode usually requires connecting the model to a dedicated programmer or placing it on a separate programming track. Econami supports four types of Service Mode instructions:

Address Mode: CV 1 may be modified
Register Mode: CVs 1, 2, 3, 4, 7, 8, and 29 may be modified
Paged Mode: A page register is used to modify any CV indirectly
Direct Mode: All CVs may be directly modified

Reading CVs

There are command stations that permit you to read the value of a CV and verify its setting in Service Mode programming. If you have trouble reading or verifying CVs, there may be a problem within the command station's design rather than with the decoder. Econami will display CV values on the screen of your command station for verification.

Try another programming mode if you experience difficulties programming or reading CVs. Many of the newer DCC systems automatically select the appropriate programming mode and only require you to enter the CV number and desired value. However, some DCC systems may restrict the number of available CVs. If you're having difficulty determining the programming modes supported by your DCC system, refer to the manual or contact the manufacturer.

Note: *Econami does not require a programming track booster, such as the PTB-100.*

Indexed CVs

Econami provides one page of indexed CVs to allow an easy and versatile method of accessing function mapping CVs. The NMRA requires that CVs exceeding CV 256 be contained within "indexed CV pages" (S-9.2.2). In other words, an individual set of CVs 257-512 is contained in each indexed CV page. You can enable indexing with CV 31 (CV Index 1) and CV 32 (CV Index 2), and then access CVs 257-512 from your command station to adjust function mapping settings.

Note: *Each indexed CV page is indicated in user documentation by a preceding number, i.e., Indexed CV Page 1 is indicated as "CVs 1.257-1.512."*

To access CVs 1.257-1.512:

1. Ensure CV 31 is set to a value of 16.
2. Enter a value of 1 into CV 32 to select Indexed CV Page 1.
3. Access CVs 257-512 from your command station.

CVs 1.257-1.512 are used for configuring Flex-Map function mapping CVs. Access CVs 1.257-1.384 for function mapping CVs and CVs 1.385-1.512 for automatic effect configuration. Refer to "Configuring Function Mapping" for more information.

Resetting CVs

Follow the steps below to perform a full or partial CV reset:

1. Deliver track power to the decoder. If the model is already on the mainline, turn the power off and then back on. If you have a SoundTraxx CurrentKeeper™ or another device that maintains power, allow at least one minute before turning the power back on.
2. Enter one of the following values into CV 8 (Manufacturer ID) to perform a full or partial CV reset:

CV 8: Manufacturer ID
8 = Reset All CVs
9 = Reset CVs 1-128
10 = Reset CVs 129-256
11 = Reset CVs 1.257-1.512
12 = Reset CVs 2.257-2.512

3. Wait about six seconds after returning power to the decoder. If the headlight and/or backup light flashes 16 times, CVs have been reset to default values.
4. Start over.

Note: *Continue cycling power to the decoder if the CV reset is unsuccessful. If you are unable to reset CV values, continue to "Locking and Unlocking CVs" to verify the decoder is not locked.*

Locking and Unlocking CVs

Locking and unlocking CVs allows you to program one decoder without changing the settings in another decoder. This can be useful when operating a consist with multiple units equipped with SoundTraxx decoders.

CV 30 (Error Information) is used to enable the CV lock/unlock feature. CV 15 is used to set the unlock code and is the only CV that can be programmed when CVs are locked. CV 16 is used to set the lock code. CVs 15, 16, and 30 are set to 0 by default to disable the CV lock/unlock feature and prevent CVs from being locked by mistake. Follow the steps below to lock and unlock CVs:

1. Enter a value of 1 into CV 30 (Error Information) to enable the CV lock/unlock feature.
2. Enter a value from 0 to 7 into CV 16 to set the lock code.
3. To unlock CVs, set CV 15 to the same value as CV 16.
4. To lock CVs, modify the value of CV 15 or CV 16. Modifying the value of CV 16 will lock access to all CVs except CV 15; set CV 15 to the same value as CV 16 to unlock CVs.

Note: *CV 8 (Manufacturer ID) cannot be used to reset CVs to factory defaults when CVs are locked, i.e., when CV 30 is set to 1 and CVs 15 and 16 are not set to the same value.*

If you're using the CV lock/unlock feature for a multi-decoder installation and all decoders are set to the same address, set the lock code in CV 16 before installing the second decoder to prevent decoders from having the same lock code. We recommend using a system to keep track of lock codes. For example, set the lock code for all motor decoders to 1, sound decoders to 2, and function decoders to 3.

Note: *Some manufacturers allow you to enter a value of 0 into CV 15 to unlock CVs. Consult the corresponding documentation or contact the manufacturer for more information.*

If You Forget the Lock Code

If you can't remember the value of CV 16, follow the steps below to unlock CVs and determine the lock code:

1. Place the model on the programming track and enter a value of 0 into CV 15.
2. Try reading the value of CV 16. If the value is not read back, CVs are locked.
3. Enter a value of 1 into CV 15 and try reading the value of CV 16 again.
4. If the value is not read back, enter a value of 2 into CV 15 and try again.
5. Enter values 3-7 into CV 15 until the value of CV 16 is read back and CVs are unlocked.

If you don't have a programming track that allows CV values to be read back, you can determine the value of CV 16 in Operations Mode. Try adjusting another CV setting as you enter values 0-7 into CV 15 to create a response from the decoder. For example, adjusting the value of CV 128 (Master Volume) will change the master volume level if CVs are unlocked.

If you still can't identify the lock code, there may be a problem with the installation, programming track, or decoder. Contact SoundTraxx customer support if this occurs.

Basic Programming

Configuring the Address

Econami responds to a specific address. Address control CVs allow you to set the decoder's primary address and extended address.

Address Control CVs
CV 1: Primary Address
CVs 17-18: Extended Address

Setting Addresses

Econami recognizes either the primary "short" address in CV 1 (Primary Address) or the extended "long" address in CVs 17-18 (Extended Address). Enter a value from 1 to 127 into CV 1 to set the decoder's primary address. To set the extended address, enter values from 0001 to 9999 into CVs 17-18. We recommend using a model's road number as the extended address to make it easier to remember. Use the primary address if the extended address isn't supported by your DCC system, or contact the manufacturer for more information.

Programming Notes: *You can set the primary and extended addresses in Service Mode at any time. Some DCC systems also allow you to set the address in Operations Mode according to the following restrictions:*

- *If the decoder's primary address is enabled (bit 5 of CV 29 set to 0), only the extended address can be changed in Operations Mode.*
- *If the decoder's extended address is enabled (bit 5 of CV 29 set to 1), only the primary address can be changed in Operations Mode.*

Primary Address

Enter a value from 1 to 127 into CV 1 to set the primary address. All SoundTraxx decoders are set to primary address 3 by default.

Extended Address

CVs 17-18 are used to set the extended address. Using CVs 17-18 to set the extended address is only advised for experienced users. Theder will only accept new data according to a specific protocol. Most command stations that support extended addressing will generate the correct protocol automatically. For more information about CVs 17-18, refer to the ***Econami Diesel Technical Reference***.

After setting CVs 17-18, set bit 5 of CV 29 (Configuration Data 1) to 1 to enable the extended address. If bit 5 of CV 29 is set to 0, the decoder will continue to respond to the primary address. Continue to "Configuring the Decoder" for more information about CV 29.

Configuring the Decoder

Next, you may want to adjust CV 29 (Configuration Data 1). Referring to “CV Programming Tutorial,” CV 29 requires adding individual bit values associated with desired adjustments to find the total CV value. Entering the correct value into CV 29 will modify the decoder’s settings according to a given combination of bit values.

Configuring CV 29

You can adjust the value of CV 29 to configure locomotive direction, speed-step mode, alternate power source, speed table settings, and the decoder address. Add the values of all bits set to 1 in CV 29 and enter the sum into the CV to adjust settings. For information about CVs and entering CV values, refer to “CV Programming Tutorial.”

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	EAM	STE	0	APS	F0	DIR

+1 = Bit 0 (DIR) set to 1
+2 = Bit 1 (F0) set to 1
+4 = Bit 2 (APS) set to 1
+16 = Bit 4 (STE) set to 1
+32 = Bit 5 (EAM) set to 1

DIR: Locomotive Direction

Bit 0 (DIR) is used to determine locomotive direction. Setting bit 0 to 1 will invert direction commands, and the decoder will interpret forward as reverse, and reverse as forward. Invert direction if you have inadvertently soldered the forward motor wire to the reverse lead.

F0: F0 Location (Speed-Step Mode Select)

Bit 1 (F0) is used to determine the number of speed steps within the throttle voltage range. 14, 28, and 128 speed-step modes are available, and 28/128 speed-step mode has been enabled by default (CV 29 = 2). Select the highest number of speed steps supported by your command station for the most refined throttle operation. Setting bit 1 to 0 will enable 14 speed-step mode in place of 28/128 speed-step mode.

APS: Alternate (Analog) Power Source

Setting bit 2 (APS) to 1 will allow the decoder to use an analog power source when a DCC signal is not present. Entering a value of 1 into CV 12 (Alternate Power Source) will enable analog mode (disabled by default). Refer to “Configuring for Analog Mode Operation” for more information.

STE: Speed Table Enable

Setting bit 4 (STE) to 1 will select the 28-point custom speed table in place of a linear speed table. Refer to “Configuring Throttle and Braking” for more information.

EAM: Primary or Extended Address

Bit 5 (EAM) is used for selecting the active address. Setting bit 5 to 1 will enable the primary address. Set the primary address with CV 1 (Primary Address). CVs 17 and 18 (Extended Address) are used to set the extended address. Set bit 5 of CV 29 to 1 to enable the extended address. Refer to the previous section, “Configuring the Address,” for more information about setting the extended address.

Refer to Table C on the following page to view decimal values for CV 29.

Note: *Values in Table C are shown in decimal format. If your command station requires hex inputs, you will need to convert. Refer to Appendix A for conversions.*

Table C. CV 29 Reference

Address Type	Speed Table	Analog Mode	Speed Steps	Direction	CV Value
Primary (CV1)	No	No	14	Normal	0
Primary (CV1)	No	No	14	Reversed	1
Primary (CV1)	No	No	28/128	Normal	2
Primary (CV1)	No	No	28/128	Reversed	3
Primary (CV1)	No	Yes	14	Normal	4
Primary (CV1)	No	Yes	14	Reversed	5
Primary (CV1)	No	Yes	28/128	Normal	6
Primary (CV1)	No	Yes	28/128	Reversed	7
Primary (CV1)	Yes	No	14	Normal	16
Primary (CV1)	Yes	No	14	Reversed	17
Primary (CV1)	Yes	No	28/128	Normal	18
Primary (CV1)	Yes	No	28/128	Reversed	19
Primary (CV1)	Yes	Yes	14	Normal	20
Primary (CV1)	Yes	Yes	14	Reversed	21
Primary (CV1)	Yes	Yes	28/128	Normal	22
Primary (CV1)	Yes	Yes	28/128	Reversed	23
Extended (CV 17:18)	No	No	14	Normal	32
Extended (CV 17:18)	No	No	14	Reversed	33
Extended (CV 17:18)	No	No	28/128	Normal	34
Extended (CV 17:18)	No	No	28/128	Reversed	35
Extended (CV 17:18)	No	Yes	14	Normal	36
Extended (CV 17:18)	No	Yes	14	Reversed	37
Extended (CV 17:18)	No	Yes	28/128	Normal	38
Extended (CV 17:18)	No	Yes	28/128	Reversed	39
Extended (CV 17:18)	Yes	No	14	Normal	48
Extended (CV 17:18)	Yes	No	14	Reversed	49
Extended (CV 17:18)	Yes	No	28/128	Normal	50
Extended (CV 17:18)	Yes	No	28/128	Reversed	51
Extended (CV 17:18)	Yes	Yes	14	Normal	52
Extended (CV 17:18)	Yes	Yes	14	Reversed	53
Extended (CV 17:18)	Yes	Yes	28/128	Normal	54
Extended (CV 17:18)	Yes	Yes	28/128	Reversed	55

Configuring Throttle and Braking

You can customize the decoder's throttle and braking operation to fit your preferences with throttle and braking control CVs. This section details setting acceleration and deceleration rates, adjusting speed table settings, enabling motor trim scaling factors, and setting the brake rate for the F11 brake function.

If this is overwhelming at first glance, don't worry! You don't have to adjust all of the throttle control CVs. This section guides you through adjusting the decoder's throttle and braking one group of CVs at a time to allow you to decide what works best.

Throttle Control CVs
CV 2: Vstart
CV 3: Baseline Acceleration Rate
CV 4: Baseline Deceleration Rate
CV 5: Vhigh
CV 6: Vmid
CV 25: Speed Table Enable
CV 29: Configuration Data 1
CV 66: Forward Motor Trim
CVs 67-94: Custom Speed Table
CV 95: Reverse Motor Trim
CV 117: F11 Brake Rate

Setting Acceleration and Deceleration Rates

You can adjust acceleration and deceleration rates with CV 3 (Baseline Acceleration Rate) and CV 4 (Baseline Deceleration Rate) according to the weight and momentum of the train. Enter values from 0 to 255 into CVs 3 and 4 to determine how quickly the decoder responds to increases and decreases in the throttle setting.

Higher values yield longer acceleration and deceleration rates. When CVs 3 and 4 are set to 0, acceleration and deceleration will respond directly to increases and decreases in the throttle setting. When CVs 3 and 4 are set to 255, it will take the locomotive approximately 3.8 minutes to accelerate from a stop to full speed, and decelerate from full speed to a stop.

When using 14 or 28 speed-step mode, configuring acceleration and deceleration rates will improve the decoder's throttle response. This allows the locomotive to speed up and slow down without lurching from one speed step to the next.

Setting the 3-Point Speed Curve

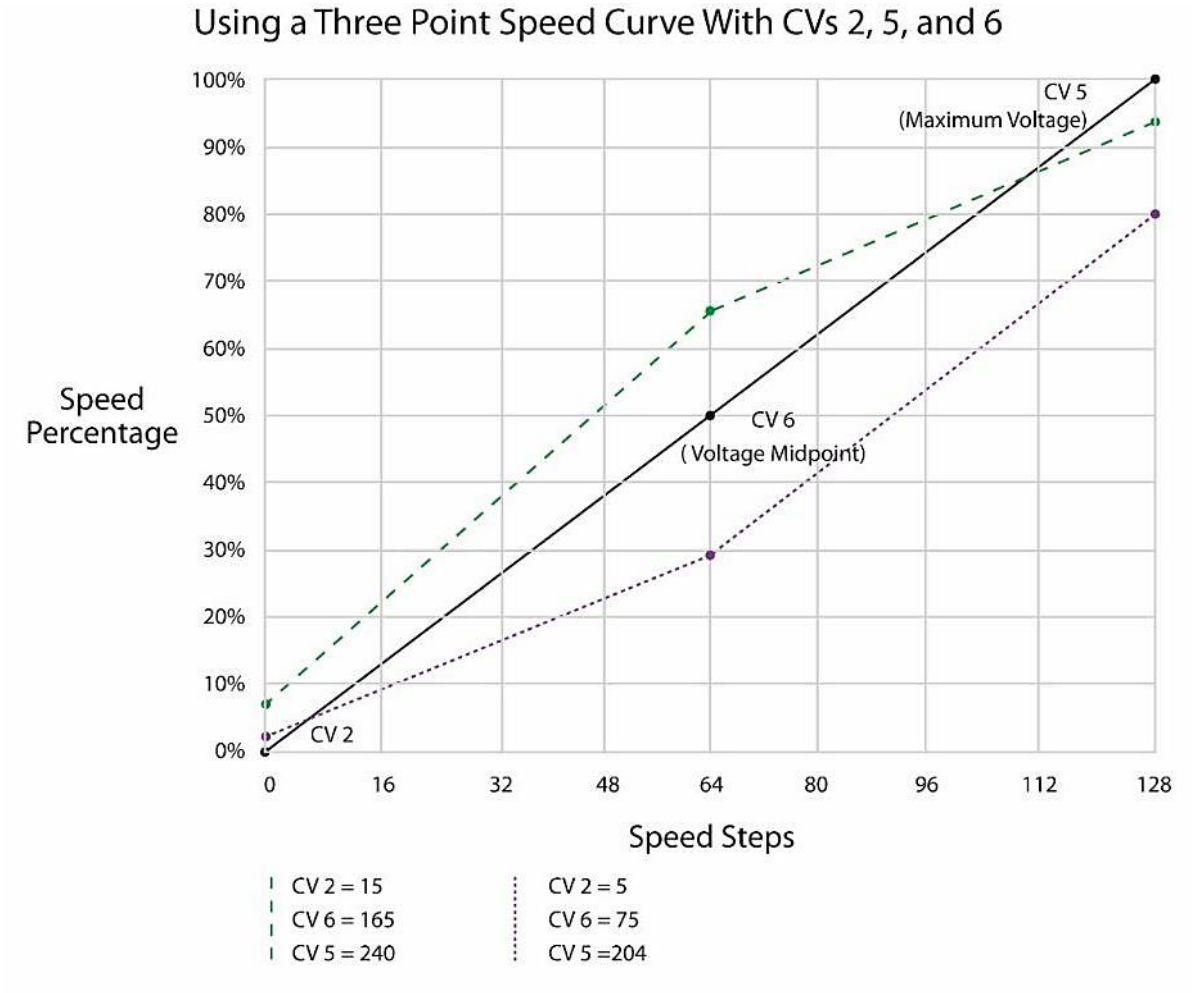
By default, track voltage is distributed to the decoder with no variation in a straight line and the decoder responds instantly to the throttle setting. You can designate the amount of voltage applied at the first, middle, and last speed step with CV 2 (Vstart), CV 5 (Vhigh), and CV 6 (Vmid) to compensate for track power or throttle control inefficiencies. Enter values from 1 to 255 into CVs 2, 5, and 6 to set the 3-point speed curve. Each value is equivalent to roughly 0.5% of the total supply voltage. You can also use the calculations below to determine starting, mid-point, and maximum voltage settings:

Vstart / Vmid / Vhigh = Supply Voltage × CV Value ÷ 255

Note: *Use CV 218 (Analog Mode Motor Start Voltage) to set the starting voltage level for analog mode operation. Refer to "Configuring for Analog Mode Operation" for more information.*

If your system supports Operations Mode, refer to the steps below for an alternative method of setting the 3-point speed curve:

1. Place the unit on the mainline and set the throttle to speed-step 1.
2. Increase the value of CV 2 until the model responds according to your preferred starting voltage level.
3. Set the throttle to the middle speed step.
4. Increase the value of CV 6 until the model responds according to your preferred mid-speed voltage level.
5. Set the throttle to the maximum speed step.
6. Increase the value of CV 5 until the model responds according to your preferred high-speed voltage level.



Setting the Custom Speed Table

Econami offers a custom speed table with 28 adjustable speed points. The 28-point custom speed table is disabled by default. However, you can enable it with CV 25 (Speed Table Enable) and CV 29 (Configuration Data 1), and adjust each speed point with CVs 67-94 (Custom Speed Table). This allows you to speed-match one locomotive to another, set a prototypical speed range, compensate for design flaws in the driveline, or improve switching operations by setting more speed steps to lower speeds and fewer speed steps to higher speeds.

CVs 67-94 correspond to speed points 1-28. Table D shows default values for CVs 67-94, which create a linear speed table when the custom speed table is enabled. Enter values from 0 to 255 into CVs 67-94 adjust each speed point from 0 to 100% of the maximum throttle setting.

The decoder interpolates between speed steps for more refined throttle control when 28/128 speed-step mode is active. Each speed point of the custom speed table corresponds to a number of speed steps. In 14 speed-step mode, each speed point is equivalent to 0.5 speed steps. In 28 speed-step mode, each speed point is equivalent to one speed step. In 128 speed-step mode each speed point is equivalent to 4.5 speed steps.

Table D. 28-Point Speed Table Settings

CV	Value	% of Throttle
67	9	4
68	18	7
69	27	11
70	36	14
71	45	18
72	55	22
73	64	25
74	73	29
75	82	32
76	91	36
77	100	39
78	109	43
79	118	46
80	127	50
81	137	54
82	146	57
83	155	61
84	164	64
85	173	67
86	182	71
87	191	75
88	200	78
89	209	82
90	219	86
91	228	89
92	237	93
93	246	96
94	255	100

Note: *All 28 speed points of the custom speed table must be set when using 14, 28, or 128 speed-step mode to prevent an unpredictable response from the motor when accelerating and decelerating.*

Follow the steps below in reference to Table D to enable the 28-point custom speed table and adjust each speed point with CVs 67-94:

1. Designate each speed point of the 28-point speed table as a percentage from 0 to 100% of the maximum speed.
2. Enter each speed point's percentage into the equation below to determine values for CVs 67-94:

   CV Value = 255 × (% ÷ 100)

3. Enter CV values for speed points 1-28 into CVs 67-94 to configure the 28-point custom speed table.
4. Set bit 4 of CV 29 to 1 to enable the 28-point custom speed table.
5. Ensure CV 25 is set to 0.

Setting Motor Trim

CV 66 (Forward Motor Trim) and CV 95 (Reverse Motor Trim) are used to "trim" the forward and reverse drive voltages when the 28-point custom speed table is enabled. Setting motor trim can help compensate for speed differences between forward and reverse directions. For instance, if the throttle setting is the same in both directions and the locomotive appears to be moving faster in reverse, you can use CVs 66 and 95 to correct the speed difference.

Entering values from 0 to 255 into CVs 66 and 95 will multiply the forward and reverse drive voltages by a scaling factor. Enter values from 1 to 127 to decrease speed. Enter values from 129 to 255 to increase speed. Entering a value of 0 or 128 into CVs 66 and 95 will set the scaling factor to 1 and will not modify the decoder's drive voltage.

Note: *Bit 4 (STE) of CV 29 (Configuration Data 1) must be set to 1 for the motor trim scaling factors in CVs 66 and 95 to modify forward and reverse drive voltages.*

Motor Trim CV Values
0 = Disabled
1 = Voltage × 0.008
↓
127 = Voltage × 0.99
128 = Disabled
129 = Voltage × 1.008
↓
255 = Voltage × 1.99

Configure the F11 Brake

The F11 brake function is not only used to activate the brake squeal sound effect, but can also be configured to simulate the brakes being applied. CV 117 (F11 Brake Rate) is used to set the deceleration rate that will occur when F11 brake function is turned on.

Values from 0 to 255 may be programmed into CV 117. However, these values are interpreted by the decoder as a range from -127 to +127. Furthermore, values from 0 to 127 are interpreted as 0 to +127, whereas values from 128 to 255 are interpreted as 0 to -127. The value (-127 to +127) is added to the value of CV 4 (Baseline Deceleration Rate) and sets the braking rate.

Higher values indicate longer braking rates. We recommend setting CV 3 (Baseline Acceleration Rate) to a minimum value of 20 before setting CV 117 so that the acceleration rate is comparable to the deceleration rate. If the combined value of CVs 4 and 117 is less than 0, or if CV 117 is set to 0 or 128, the F11 brake function will have no effect on the motor.

Configuring Lighting Outputs

Depending on the Econami format, up to six outputs are provided for lighting control. Each output can support a Hyperlight lighting effect, controlled with a corresponding function key. This section provides information regarding lighting control CVs.

Hyperlight Effects and Features

Use CVs 49-63 to configure Hyperlight lighting effects and features. CVs 49-54 correspond to Econami's lighting outputs. Detailed in the following, adjusting CVs 49-63 will modify the effects and features configured to lighting outputs.

On/Off Output

The on/off lighting effect provides on/off control for the corresponding function.

Dimmable On/Off Headlight

The output set to the dimmable headlight will be reduced to 60% brightness when you turn on the F7 dimmer.

Brake Light

The brake light effect is automatically dimmed to the setting in CV 63. However, the brightness level of the brake light returns to 100% when you turn on the F11 brake function.

Mars Light

The Mars light warning beacon follows the famous figure-eight sweep pattern and oscillates more rapidly than the Gyralite.

Pyle-National Gyralite

The Pyle-National Gyralite follows a wide sweep pattern that oscillates at a slower rate than the Mars light.

Emergency Gyralite

The emergency Gyralite follows the same oscillating sweep pattern as the Gyralite, and will automatically disable all active lighting effects.

Oscillating Headlight

The dual-oscillating headlight generates two beams that follow each other in a tight, circular sweep pattern.

Lighting Control CVs
CV 49: Headlight Configuration
CV 50: Backup Light Configuration
CV 51: FX3 Configuration
CV 52: FX4 Configuration
CV 53: FX5 Configuration *
CV 54: FX6 Configuration *
CV 57: Forward Direction Enable
CV 58: Reverse Direction Enable
CV 59: Hyperlight Flash Rate
CV 60: Grade-Crossing Hold Time
CV 61: Brightness Register 1
CV 62: Brightness Register 2
CV 63: Dimmer Level
* Available on select formats

Table E. Hyperlight Select

CV Value	Lighting Effect
0	On/Off Output
1	Dimmable On/Off Headlight
2	Mars Light
3	Pyle-National Gyralite
4	Oscillating Headlight
5	Single-Flash Strobe 1
6	Double-Flash Strobe
7	Western-Cullen Rotary Beacon
8	Prime Stratolite
9	Ditch Light I
10	Ditch Light II
11	FRED
12	Engine Exhaust Flicker (Steam)
13	Firebox Flicker (Steam)
14	Smart Firebox Flicker (Steam)
15	Dyno-Light (Steam)
16	Auto-Dim Forward
17	Auto-Dim Reverse
18	Brake Light
19	On/Off – Brightness 1
20	On/Off – Brightness 2
21	Emergency Gyralite
22	Reserved
23	Ash Pan Flicker
24	Reserved
25	Single-Flash Strobe 2

Single-Flash Strobes 1 and 2
The xenon single-flash strobe 1 effect emits a concentrated flash of light that pulses once per timing cycle. The xenon single-flash strobe 2 emits the same flash of light as the single-flash strobe 1 effect and pulses once per timing cycle at a slightly different flash rate. Configuring each single-flash strobe effect to a function output will allow strobes 1 and 2 to flash in-and-out of sequence. CV 59 (Hyperlight Flash Rate) is used to modify the flash rate timing cycle.

Double-Flash Strobe
The xenon double-flash strobe effect emits two rapid flashes of light once per timing cycle. CV 59 (Hyperlight Flash Rate) is used to modify the flash rate timing cycle.

Western-Cullen D312 Rotary Beacon
The Western-Cullen D312 Rotary Beacon effect follows a revolving reflector and bulb assembly flash-pattern.

Prime Stratolite
The Stratolite is a new version of the rotary beacon. Four individual lamps are arranged in a circular pattern and flash electronically in the clockwise direction. The Stratolite flashes in a mechanical “stepped” fashion, unlike the smooth motion of the rotary beacon.

Type I and Type II Ditch Lights
Both types of ditch lights are identical when operating normally. However, if the Grade-Crossing Logic is activated, type I ditch light will revert to a steady on state when it’s not flashing, and type II will turn off.

FRED (Flashing Rear End Device)
The FRED effect is a flashing red taillight that indicates the rear of the train.

Brightness Register 1
In order to adjust the brightness level of a lighting output, first set any CV from 49 to 54 to the on/off brightness 1 effect. Then, enter a value from 0 to 255 into CV 61 to adjust the brightness level of the corresponding output from 0 to 100%.

Brightness Register 2
In order to adjust the brightness level of a second lighting output, first set any CV from 49 to 54 to the on/off brightness 2 effect. Then, enter a value from 0 to 255 into CV 62 to adjust the brightness level of the corresponding output from 0 to 100%.

Dimmer Level
You can adjust the brightness level of the F7 dimmer function from 0 to 100% by entering a value from 0 to 255 into CV 63.

Auto-Dim Forward and Reverse
Setting CV 49 (Headlight Configuration) to the auto-dim forward effect will automatically dim the headlight when the locomotive is in the forward direction. Setting CV 50 (Backup Light Configuration) to the auto-dim reverse effect will automatically dim the backup light when the locomotive is in the reverse direction.

Grade-Crossing Logic

Set bit 6 (XING) of any lighting effect CV to enable Grade-Crossing Logic. Enable Grade-Crossing Logic, and then turn on the airhorn function key (F2 by default) to signal as the locomotive approaches a crossing. After the airhorn blast, the bell will ring (when the grade-crossing bell has been enabled in CV 122) and lighting effects will switch to a flashing state while the crossing hold timer counts down. Lighting effects return to either an on or off state after the countdown ends.

The crossing hold timer will reset and count down every time you turn on the long airhorn function or grade-crossing function (F9 by default). The Hyperlight lighting effects in Table F will flash while the crossing timer counts down, and revert to either an on or off state when the countdown ends.

Table F. Xing Logic Lighting	
Mars Light	On
Gyralite	On
Oscillating Headlight	On
Single-Flash Strobe 1	Off
Single-Flash Strobe 2	Off
Double-Flash Strobe	Off
D312 Rotary Beacon	Off
Prime Stratolite	Off
Ditch Light I	Off
Ditch Light II	On
FRED	Off

Phase Offset

Set bit 5 (PHSE) of any lighting effect CV to allow the corresponding lighting effect to flash 180 degrees out-of-phase with other lighting effects. Enabling phase offset sets the corresponding lighting output to Phase B from Phase A so that Phase A lighting turns off when Phase B lighting turns on.

LED Compensation Mode

The brightness of an incandescent bulb is determined by voltage, whereas an LED's brightness is determined by current. LED Compensation Mode alters the method of sending current to the LED to balance the LED and incandescent brightness levels. Setting bit 7 of any CV from 49 to 54 will adjust the corresponding lighting output to correct the differing electro-optical properties.

Note: *Setting bit 7 to 1 does not change the output voltage. Resistors may still be necessary depending on the board format.*

Enabling Lighting Output Directions

CV 57 (Forward Direction Enable) and CV 58 (Reverse Direction Enable) allow you to determine the directionality of the headlight, backup light, and FX3-FX6 lighting outputs.

Setting a bit to 1 will enable the lighting output for the forward or reverse direction, and setting a bit to 0 will disable the lighting output for the forward or reverse direction. CV 57 is set to a value of 253 by default to enable the headlight and disable the backup light for the forward direction. CV 58 is set to a value of 254 by default to enable the backup light and disable the headlight for the reverse direction.

Table […]. Lighting Output Direction Enable	
Bit Definition	**Decimal Value**
Bit 0: Headlight	+1 to enable
Bit 1: Backup Light	+2 to enable
Bit 2: FX3 Output	+4 to enable
Bit 3: FX4 Output	+8 to enable
Bit 4: FX5 Output	+16 to enable
Bit 5: FX6 Output	+32 to enable
Bit 6: Not used	+64
Bit 7: Not used	+128

The default settings of CVs 57 and 58 indicate that the headlight will turn on and the backup light will turn off when direction is changed from reverse to forward, and the headlight will turn off and the backup light will turn on when direction is changed from forward to reverse. Refer to the example on the following page for more information.

Example: Headlight and Backup Light Direction

This example details using CVs 57 and 58 to configure the directionality of the headlight and backup light outputs. Follow the steps below to enable the headlight and disable the backup light for the forward direction, and enable the backup light and disable the headlight for the reverse direction:

1. Note the bit definitions and the decimal value of each bit for CVs 57 and 58. Bits 0-5 correspond to lighting outputs. Bits 6-7 are not used and should always be set to 1.
2. Setting bit 1 to 0 and all other bits to 1 in CV 57 will disable the backup light in the forward direction. To do this, simply subtract the decimal value of bit 1 from 255. Bit 1 converts to a value of 2:

   255 – 2 = 253
3. Enter a value of 253 into CV 57 to disable the backup light in the forward direction.
4. Setting bit 0 to 0 and all other bits to 1 in CV 58 will disable the headlight in the reverse direction. To do this, simply subtract the decimal value of bit 0 from 255. Bit 0 converts to a value of 1:

   255 – 1 = 254
5. Enter a value of 254 into CV 58 to disable the headlight in the reverse direction.

Configuring Sound Effects

This section details adjusting Econami's sound effects using sound control CVs to configure a range of operating preferences. You can select alternate airhorns, bells, air compressors, prime movers, and couplers, customize the RPM notching effect, enable engine interlock, and adjust volume levels. All of Econami's sound effects are recordings from actual locomotives and are intended to simulate operating a diesel engine.

Selecting Sound Effects

"Selecting Sound Effects" details selecting various airhorns, bells, air compressors, and couplers in place of Econami's default sound effects. Sound effect select CVs allow you to interchange and adjust Econami's sound effects to prototypically simulate various preferences.

Sound Effect Select CVs
CV 120: Airhorn Select
CV 121: Auxiliary Airhorn Select
CV 122: Bell Select
CV 124: Air Compressor Select
CV 126: Coupler Select
CV 195: Coach Door Count*
CV 200: Poppet Valve Release Rate

Select the Primary Airhorn

CV 120 is used to select the primary airhorn that will play when you turn on the airhorn function. Set CV 120 to a value from 0 to 15 to select airhorns 1-16. CV 120 has been set to a value of 0 to select airhorn 1 as the default primary airhorn.

CV 120: Airhorn Select
0 = Airhorn 1 (default)
1 = Airhorn 2
↓
15 = Airhorn 16

Select the Alternate Airhorn

Disabled by default, CV 121 is used to select an alternate airhorn sound effect that will play in place of the primary airhorn selection. When enabled, turning on the short airhorn function (F3 by default), and then turning on the long airhorn function (F2 by default) will issue the alternate airhorn sound effect; turn off the long airhorn function to stop the airhorn blast.

CV 121: Auxiliary Airhorn Select
0 = Disabled (default)
1 = Airhorn 1
2 = Airhorn 2
↓
16 = Airhorn 16

Remember, you can activate the alternate airhorn with the long airhorn function *only* when the short airhorn function is turned on. Set CV 121 to a value from 1 to 16 to select the alternate airhorn; the alternate airhorn is disabled when CV 121 is set to a value of 0.

Note: *CVs 120 and 121 have each been preprogrammed to 0 to disable the alternate airhorn. By default, the short airhorn function key issues a short airhorn blast. The short airhorn function will issue the short airhorn blast and the long airhorn function will issue the airhorn 1 sound effect.*

* Not included in software releases prior to version 1.3

Select the Bell

CV 122 (Bell Select) is used to select the bell sound effect, adjust the ring rate, and enable the grade-crossing bell. CV values for selecting each bell variation are provided in Table G. Simply locate the value associated with your preferred bell sound effect, ring rate, and grade-crossing bell preference and enter it into CV 122.

Turning on the bell function (F1 by default) will ring the selected bell at the chosen ring rate. Turning off the bell function will stop the bell from ringing.

Adding a value of 128 to the value of your preferred bell and ring rate will enable the grade-crossing bell. When the grade-crossing bell is enabled and Grade-Crossing Logic is activated, the selected bell will ring for the duration of the crossing hold timer countdown. When Grade-Crossing Logic is enabled, the crossing hold timer will count down each time the long airhorn function (F2 by default) is turned on. Enter a value from 0 to 15 into CV 60 (Grade-Crossing Hold Time) to adjust the duration of the countdown from 0 to 15 seconds. Refer to "Configuring Lighting Outputs" for more information.

Table G. Bell Select

Bell	Ring Rate	Xing Bell Disabled	Xing Bell Enabled
1	Slow	0	128
	Medium-Slow	1	129
	Medium-Fast	2	130
	Fast	3	131
2	Slow	4	132
	Medium-Slow	5	133
	Medium-Fast	6	134
	Fast	7	135
3	Slow	8	136
	Medium-Slow	9	137
	Medium-Fast	10	138
	Fast	11	139
4	Medium-Fast	12	140
5	Slow	13	141
	Medium-Slow	14	142
	Medium-Fast	15	143
	Fast	16	144
6	Slow	17	145
	Medium-Slow	18	146
	Medium-Fast	19	147
	Fast	20	148
7	Medium-Fast	21	149

Select the Air Compressor

CV 124 (Air Compressor Select) is used to select the air compressor sound effect that will be active throughout operation. Programming CV 124 to a value of 1 will select air compressor 2 in place of the air compressor sound effect enabled by default.

CV 124: Air Compressor Select
0 = Air Compressor 1 (default)
1 = Air Compressor 2

Select the Coupler

CV 126 (Coupler Select) is used to select a coupler sound effect that will be activated with the couple/uncouple functions (F13 by default) and configure the uncouple function polarity. The link-and-pin coupler does not include the glad hand release.

CV 126: Coupler Select
0 = Medium
1 = Heavy
2 = Link-and-pin
+128 = Inverted uncouple polarity

By default, CV 126 is set to 128 and the couple and uncouple functions are mapped to F13; the medium coupler is selected and the uncouple function polarity is inverted. This allows you to uncouple by turning off F13 and couple by turning on F13. Entering a value from 128 to 130 into CV 126 will select the coupler sound effect and invert the uncouple function polarity (default).

When CV 126 is set to a value from 0 to 3 and the couple and uncouple functions are mapped to the same function key, turning on the function key will activate the coupling sound effect and turning off the function key will have no effect.

When CV 126 is set to a value from 0 to 3 and the couple and uncouple functions are mapped to separate function keys, turning on the couple function key will activate the coupling sound

effect and turning on the uncouple function key will activate the uncoupling sound effect. Turning off the couple and uncouple function keys will have no effect.

Refer to “Function Mapping” to map the couple and uncouple functions to function keys F0-F28.

Adjust the Coach Door Count*

CV 195 (Coach Door Count) is used to set the random number of coach door slams that will occur with the all aboard/coach doors function (F23 by default). CV 195 is set to 5 by default; turning on the all aboard/coach doors function will activate 1-5 door slams after the conductor’s “all aboard!” phrase. A value of 0 will disable coach door slams.

CV 195: Coach Door Count*
0 = Disabled
1 = 1 door slam
↓
5 = 5 door slams (default)
↓
15 = 15 door slams

Adjust the Poppet Valve Release Rate

CV 200 (Poppet Valve Release Rate) is used to adjust the duration in seconds that occurs between each subsequent “pop!” of the automatic poppet valve sound effect. Enter a value from 1 to 255 into CV 200 to adjust the duration from 1 second to 255 seconds; use higher values when simulating an arid environment, and lower values when simulating a humid environment.

CV 200: Poppet Valve Release Rate
0 = Poppet valve disabled
1 = 1 second
2 = 2 seconds
↓
255 = 255 seconds

* Not included in software releases prior to version 1.3

Customizing Engine Control

You can select an alternate prime mover with CV 123 and customize engine control with CV 114.

Diesel Engine Control CVs
CV 114: Engine Exhaust Control
CV 123: Prime Mover Select

Select Prime Movers

CV 123 (Prime Mover Select) is used to select a prototype-specific prime mover sound effect. Set CV 123 to a value from 0 to 4 to enable your preferred prime mover. You can also elevate and reduce engine RPM with the RPM+ (F5 by default) and RPM- (F6 by default) functions to simulate the engine operating at various intensities.

CV 123: Prime Mover Select
0 = Prime Mover 1 (default)
1 = Prime Mover 2
2 = Prime Mover 3
3 = Prime Mover 4
4 = Prime Mover 5

Auto-Start and Auto-Notching

CV 114 (Engine Exhaust Control) can be used for enabling the auto-start feature and adjusting the auto-notching sensitivity. Auto-start and auto-notching are both enabled by default; the prime mover startup sequence occurs when the decoder receives track voltage (or when increasing the throttle from zero) and the engine RPM notch is controlled automatically according to the throttle setting during operation.

Engine RPM notches are regulated according throttle changes; increasing the throttle a given number of speed steps will advance engine RPM to a higher notch. Table H shows the values that determine the number of speed steps within each notch. Enter the corresponding values into CV 114 to customize the auto-notching feature.

Note: *CV 114 has been set to a value of 39 by default to enable auto-start and auto-notching. Disabling auto-notching will enable manual notching in lieu.*

Table H.
Auto-Notching Sensitivity

CV Value	Speed Steps/Notch
33	1
34	2
35	3
36	4
37	5
38	6
39	7
40	8
41	9
42	10
43	11
44	12
45	13
46	14
47	15

Enable Manual Notching

Manual notching allows you to regulate the engine RPM sound effects with the RPM+ (F5 by default) and RPM- (F6 by default) function keys. Unlike auto-notching and auto-manual notching, engine sound effects will not be automatically adjusted during operation, and will be controlled separately from the throttle setting. You may enable manual notching with or without auto-start. However, when auto-start is disabled, you must to turn on the RPM+ function to start the prime mover (regardless of the throttle setting).

CV 114 has been set to a value of 39 by default to enable auto-start and auto-notching. To enable manual notching with auto-start, set the auto-notching sensitivity level to 0, i.e., enter a value of 32 into CV 114. To disable auto-start and auto-notching, and enable manual notching only, set CV 114 to a value of 0.

Enable Engine Interlock

Furthermore, you can enable engine interlock with CV 114. When enabled, your locomotive be unable to move until you start the prime mover by turning on the RPM+ function. Likewise, you will be unable to turn off the prime mover while the locomotive is in motion. Engine interlock will allow you to avoid accidentally shutting the engine off as you drifting downhill, for instance. Enter a value of 16 into CV 114 to enable engine interlock.

Select the Dynamic Braking Mode

CV 114 can also be used to configure dynamic braking modes. When the dynamic brake function (F4 by default) is turned on, the selected dynamic braking mode will set the engine RPM to a designated notch. Table I shows the dynamic braking modes and the values used for enabling them; add the corresponding value to the total value of CV 114, and use the sum for programming.

Table I. Dynamic Braking Select

Value	Mode	Notch
0	Normal (default)	Normal
64	Idle	Notch 1
128	Half-Speed	Notch 4
192	Full Speed	Notch 8

Modifying Volume Levels

Volume control CVs allow you to set the master volume level for all sound effects, set the volume of each sound effect, and enable quiet mode.

Volume Control CVs

CV 113: Quiet Mode Time-Out Period
CV 128: Master Volume
CVs 129-150: Mixer Channel Vol. Control

Set the Master Volume Level

CV 128 (Master Volume) is used to adjust the volume level of all enabled sound effects, i.e., all mixer channels. Values from 0 to 255 may be programmed into CV 128 to set the volume level from 0 to 100%.

Adjust Mixer Channel Volume Levels

CVs 129-150 (Mixer Channel Volume Control) are used for setting the volume level of each sound effect, similar to a modern sound studio mixing board. Like CV 128 (Master Volume Level), values from 0 to 255 may be programmed into mixer channel CVs to adjust volume levels. Table J shows mixer channel CVs, each corresponding sound effect, and each default value.

For the best sound quality, run the mixer as "hot" as possible by optimizing the volume levels. First determine the sound effect that should be the loudest and set the corresponding CV to around 225. The airhorn, for instance, usually creates the loudest sound. Then, adjust the volume levels of the remaining of the sound effects relative to the airhorn. When you have all the sound effects to their respective volume levels, adjust the overall volume level with CV 128 as needed.

Table J. Mixer Channel Volume Control

Mixer Channel	CV	Sound Effect	Default Value
1	129	Airhorn	225
2	130	Bell	85
3	131	Prime Mover	150
4	132	Air Compressor	100
5	133	Dynamic Brake	125
6	134	Radiator Fans	75
7	135	Reserved	0
8	136	Reserved	0
9	137	Coupler Clank	128
10	138	Reserved	0
11	139	Brake Squeal	100
12	140	Brake Release	70
13	141	Reserved	0
14	142	Reserved	0
15	143	Poppet Valve	60
16	144	Reserved	0
17	145	Reserved	0
18	146	Reserved	0
19	147	Reserved	0
20	148	Emergency Stop	70
21	149	Glad Hand Release	150
22	150	All Aboard/Coach Doors*	192

Adjusting volume levels calls for a certain level of prudence to avoid a phenomenon known as "clipping" or "limiting," which occurs when the sum of two or more signals exceeds the capacity of the output channel. As the name implies, clipping is the sound signal being cut off as it attempts to peak, causing the clicking or popping sounds you may have heard through a pair of broken headphones. To avoid clipping, consider the sounds that are most played at the same time and make sure their volume levels aren't set too high. For example, the airhorn should be as loud as possible without causing clipping. If you start to hear some distortion, lower the volume level accordingly.

Note: *Be sure that your speaker is rated to match the audio amplifier of your decoder. Ratings for each format are available on the packaging and at www.soundtraxx.com. Failure to do so could cause severe damage to your speaker.*

* Not included in software releases prior to version 1.3

Using Quiet Mode

CV 113 (Quiet Mode Time-Out Period) is used to set the quiet mode time-out period. When the throttle is set to zero and all functions are off, all sound effects will automatically deactivate after the quiet mode time-out period elapses. Values from 0 to 255 may be programmed into CV 113 to set the time-out period from 0.25 seconds to 63.75 seconds. You can also calculate the time-out period by using this equation:

Time-Out Period = CV 113 × 0.25

Example: Adjusting Sound Control CVs

Using the information stated previously in this section, this example will guide you through configuring sound according to the following combination of adjustments:

CV 114:	Enable engine interlock Disable auto-start Enable manual notching Select the notch 4 dynamic braking mode
CV 113:	Set the quiet mode time-out period to 30 seconds
CV 120:	Select primary airhorn 2
CV 121:	Select alternate airhorn 1
CV 122:	Select bell 5 with a slow ring rate and enable the grade-crossing bell
CV 123:	Select prime mover 4
CV 124:	Select air compressor 2
CV 126:	Select the heavy coupler with inverted uncouple function polarity
CV 195:	Disable coach door slams*
CV 200:	Set the poppet valve release rate to two minutes

1. Set CV 120 (Airhorn Select) to a value of 1 to select airhorn 2 as the airhorn.
2. Set CV 121 (Auxiliary Airhorn Select) to a value of 1 to select airhorn 1 as the alternate airhorn.
3. Refer to CV values for CV 122 (Bell Select):
    - A value of 13 will select bell 5 with a slow ring rate.
    - Adding a value of 128 will enable the grade-crossing bell: 13 + 128 = 141
    - Set CV 122 to a value of 141.
4. Set CV 123 (Prime Mover Select) to a value of 3 to select prime mover 4.
5. Set CV 124 (Air Compressor Select) to a value of 1 to select air compressor 2.
6. Refer to CV values for CV 126 (Coupler Select):
    - A value of 1 will select the heavy coupler.
    - Adding a value of 128 will invert the uncouple function polarity: 1 + 128 = 129
    - Set CV 126 to a value of 129.
7. Set CV 200 (Poppet Valve Release Rate) to a value of 120 for a two-minute poppet valve release rate.

* Not included in software releases prior to version 1.3

8. Refer to CV values for CV 114 (Engine Exhaust Control):
    - A value of 16 will enable engine interlock.
    - Adding a value of 128 will disable auto-start and auto-notching, enable engine interlock and manual notching, and select the notch 4 dynamic braking mode: 16 + 128 = 144
    - Set CV 114 to a value of 144.
9. Set CV 195* (Coach Door Count) to 0 to disable the coach door slams sound effect.
10. Calculate the CV 113 value that will enable a 30-second quiet mode time-out period:
    - 30 (seconds) ÷ 0.25 = 120
    - Set CV 113 (Quiet Mode Time-Out Period) to 120 for a 30-second time-out period.

* Not included in software releases prior to version 1.3

Configuring the Equalizer

Econami features a built-in 7-band equalizer that allows you to adjust sound levels according to the parameters of your installation. An equalizer, also called an “EQ,” is similar to what you might use on a home stereo system to “boost” and “cut” sound levels. Equalizers are used most often to correct the response of a given device through adjusting the amplitude of audio signals at specific frequencies. You can adjust the sound responses of seven frequency levels with equalizer control CVs.

Equalizer Control CVs
CV 225: Equalizer Control Register
CV 226: 62Hz Cut/Boost
CV 227: 125Hz Cut/Boost
CV 228: 250Hz Cut/Boost
CV 229: 500Hz Cut/Boost
CV 230: 1kHz Cut/Boost
CV 231: 2kHz Cut/Boost
CV 232: 4kHz Cut/Boost

Using the 7-Band Equalizer

If you aren’t familiar with “dB,” it stands for “decibel,” a logarithmic unit used to measure power or intensity. In this case, dB is used to measure sound pressure and pertains to frequency response. A speaker is limited to the lowest frequency it can successfully reproduce. This is determined primarily by the size of the speaker. For example, reproducing a low frequency sound at a high volume requires moving more air, and hence, a larger speaker diaphragm.

Also keep in mind that the electromagnet underneath the speaker-cone will react to even the deepest bass. This means that a small speaker will still technically respond to low frequency signals, but you might not be able to hear the sound very well because not enough air is able to move through the speaker. In this case, though you may be able to hear it better, turning up the volume isn’t likely to improve the low frequency sound quality, and could cause clipping if the speaker-cone is being pushed beyond its physical capabilities. Removing the inaudible, low frequency sound, or “cutting” frequency levels, will allow the speaker to operate within the limitations of its audio range.

Preset EQ Levels

CV 225 (Equalizer Control Register) is used primarily for setting the frequency levels of the equalizer to accommodate a range of speaker sizes. Values from 1 to 4 may be programmed into CV 225 to select the corresponding speaker size’s preset cut/boost levels. Four preset EQ frequency levels for a range of speaker diaphragm diameters (smaller than 1” to larger than 4”) have been provided to accommodate your installations.

Setting CV 225 to a value of 0 will disable the equalizer, i.e., all frequency levels are set to 0dB. CV 225 can also be used to access the cut/boost levels of the seven bands so that you can customize your own frequency response. Setting CV 225 to a value of 7 will allow you to adjust the boost/cut level of each band by programming CVs 226-232 (Boost/Cut Controls).

On the following page, Table K shows the available CV 225 values for the preset EQ levels and indicates each frequency response (dB) and corresponding value for CVs 226-232 (Boost/Cut Controls).

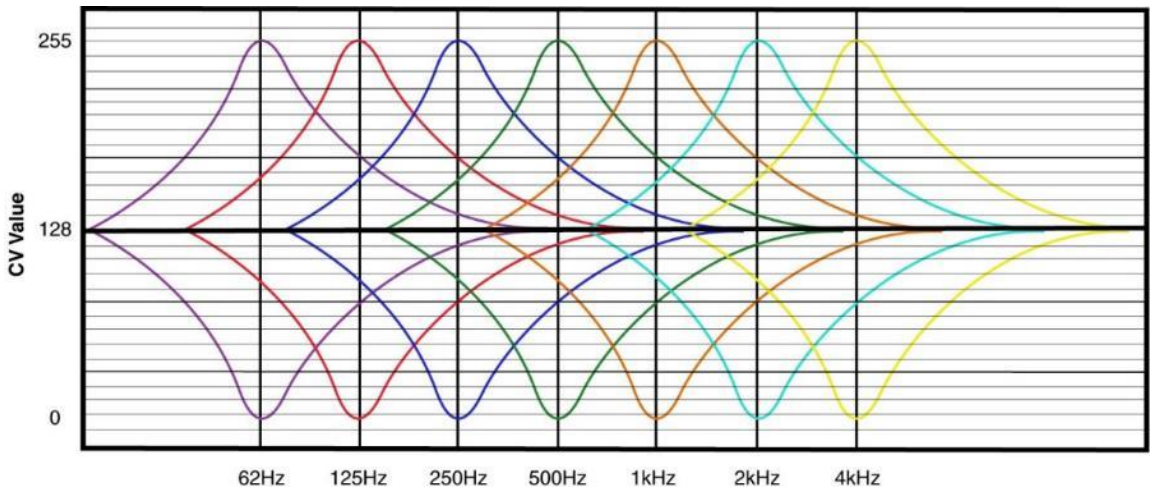
Table K. EQ Preset Settings								Corresponding CV values are shown in red
CV 225 Value	**Description**	**CV 226: 62Hz**	**CV 227: 125Hz**	**CV 228: 250Hz**	**CV 229: 500Hz**	**CV 230: 1kHz**	**CV 231: 2kHz**	**CV 232: 4kHz**
0	Flat	0dB 128	0dB 128	0dB 128	0dB 128	0dB 128	0dB 128	0dB 128
1	Micro Speaker (less than 1”)	-12dB 0	-12dB 0	+7.12 200	+3dB 160	+1.5dB 140	+0.8dB 132	0dB 128
2	Small Speaker (from 1” to 2”)	-6dB 60	-3dB 96	+4.1dB 168	+3dB 160	0dB 128	0dB 128	+0.8dB 132
3	Medium Speaker (from 2” to 4”)	-3dB 96	+4.1dB 168	+2.3dB 148	+1.1dB 136	0dB 128	0dB 128	0dB 128
4	Large Speaker (Larger than 4”)	+6dB 192	+3dB 160	+1.5dB 140	0dB 128	0dB 128	0dB 128	0dB 128
7	User-Adjustable	0-255	0-255	0-255	0-255	0-255	0-255	0-255

Custom EQ Levels

After setting CV 225 (Equalizer Control Register) to a value of 7, CVs 226-232 can be used to adjust the boost/cut of each band’s frequency level from +12dB to -12dB. Set CVs 226-232 to values from 0 to 255 to adjust frequency responses from -12dB to +12dB. A value of 128 indicates a flat response (0dB). Table L shows CV values that correspond to common boost/cut levels.

The graph below indicates the minimum-to-maximum frequency response for each band. Notice the overlap from one frequency band to the next. Keep in mind that, because of this, adjusting the response using one CV will raise or lower the sounds of nearby frequencies as well.

Table L. Boost/Cut Reference	
CV Value	**dB Value**
255	+12dB
224	+9dB
192	+6dB
160	+3dB
128	0dB
96	-3dB
64	-6dB
42	-9dB
0	-12dB



Making adjustments while sounds are playing is the easiest way to set the EQ because you can listen to each response. Because of this, we recommend programming this feature on the mainline. Start with CV 226 and make adjustments until you’re satisfied with each band’s frequency response. Depending upon the speaker you’re using, adjusting the lowest frequency bands may have little or no effect. If this is the case, the audio frequencies are out of the speaker’s range, and we suggest that you set the CV to 0 (-12dB).

Function Mapping

Function mapping CVs allow you to reassign any of Econami's effects to any function key. It's easy to customize function assignments to fit any operating preference with Flex-Map function mapping technology!

Note: *CV 32 (CV Index 2) must be set to a value of 1 (default) to select Indexed CV Page 1 as the active indexed CV page; indexed CVs 1.257-1.512 (Extended Function Mapping CVs) cannot be used when the value of CV 32 is not equal to 1.*

Flex-Map Technology

To complement Econami's wide range of effects, Flex-Map technology puts you in control of all function assignments and provides comprehensive support for 28 function keys by default. Flex-Map function mapping CVs have been preprogrammed to determine default function assignments for Econami, and allow you to customize function keys and effects according to a simple and versatile format.

Table M shows function mapping CVs 1.257-1.385 (Effect Map Registers) for mapping function keys F0-F28 to Econami's effects. Values 0-28 correspond to function keys F0-F28.

Map Effects to F0-F28

Each effect corresponds to a CV. The value of each CV determines the F0-F28 function key used to control that effect:

- 0-28 = F0-F28
- 29-254 are not used
- 255 disables the effect

Value = Function Key
0 = F0 1 = F1 ↓ 28 = F28 29-254 = Reserved 255 = Effect Disabled

Table M.
Effect Map Registers

CV 1.257: Headlight CV 1.258: Backup Light CV 1.259: FX3 Effect CV 1.260: FX4 Effect CV 1.261: FX5 Effect CV 1.262: FX6 Effect
CVs 1.263-1.272: Reserved
CV 1.273: Dimmer CV 1.274: Mute CV 1.275: Brake Function CV 1.276: Half-Speed CV 1.277: Momentum Override CV 1.278: Grade-Crossing Signal CV 1.279: Forward Whistle Signal CV 1.280: Reverse Whistle Signal CV 1.281: Stop Whistle Signal
CVs 1.282-1.284: Reserved
CV 1.285: RPM+ CV 1.286: RPM-
CVs 1.287-1.296: Reserved
CV 1.297: Airhorn CV 1.298: Bell CV 1.299: Dynamic Brake CV 1.300: Short Airhorn
CV 1.301-1.304: Reserved
CV 1.305: Coupler CV 1.306: Coupler Release
CVs 1.307-1.310: Reserved
CV 1.311: All Aboard/Coach Doors*
CVs 1.312-1.320: Reserved
CV 1.321: E-Brake App.
CVs 1.322-1.384: Reserved

* Not included in software releases prior to version 1.3

Control Lighting Direction

CV 57 (Forward Direction Enable) and CV 58 (Reverse Direction Enable) are used to determine the directionality of the headlight, backup light, and FX3-FX6 lighting outputs. Referring to Table M, these outputs must be mapped to function keys with CVs 1.257-1.262. By default, the headlight output is enabled in the forward direction and disabled in the reverse direction, and the backup light is enabled in the reverse direction and disabled in the forward direction. Refer to "Configuring Lighting Outputs" for more information regarding Hyperlight effects and using CVs 49-63 (Lighting Control CVs) to configure lighting outputs.

Configure Automatic Effects

To provide more versatility, Flex-Map function mapping CVs allow you to configure automatic effects that respond to direction and movement. Table N shows CVs 1.385-1.512 (Effect Auxiliary Map Registers), and Table O shows the CV values for configuring automatic effects. CVs 1.385-1.512 allow the corresponding effect to turn on in the following circumstances:

Forward-Driving:
The effect will be automatically turned on when the locomotive is moving in the forward direction.

Reverse-Driving:
The effect will be automatically turned on when the locomotive is moving in the reverse direction.

Forward-Standing:
The effect will be automatically turned on when the locomotive is stopped in the forward direction.

Reverse-Standing:
The effect will be automatically turned on when the locomotive is stopped in the reverse direction.

Table O. Auto-Effects

CV Value	Active When
1	Forward-Driving
2	Reverse-Driving
3	Driving
4	Forward-Standing
5	Forward
6	Forward-Standing, Reverse-Driving
7	Forward, Reverse-Driving
8	Reverse-Standing
9	Reverse-Standing, Forward-Driving
10	Reverse
11	Reverse, Forward-Driving
12	Standing
13	Standing, Forward-Driving
14	Standing, Reverse-Driving
15	Continuously Active

Table N. Effect Aux. Map Registers

CV 1.385: Headlight CV 1.386: Backup Light CV 1.387: FX3 Effect CV 1.388: FX4 Effect CV 1.389: FX5 Effect CV 1.390: FX6 Effect
CVs 1.391-1.400: Reserved
CV 1.401: Dimmer CV 1.402: Mute CV 1.403: Brake Function CV 1.404: Half-Speed CV 1.405: Momentum Override CV 1.406: Grade-Crossing Signal CV 1.407: Forward Whistle Signal CV 1.408: Reverse Whistle Signal CV 1.409: Stop Whistle Signal
CVs 1.410-1.412: Reserved
CV 1.413: RPM+ CV 1.414: RPM-
CVs 1.415-1.424: Reserved
CV 1.425: Airhorn CV 1.426: Bell CV 1.427: Dynamic Brake CV 1.428: Short Airhorn
CV 1.429-1.432: Reserved
CV 1.433: Coupler CV 1.434: Coupler Release
CVs 1.435-1.438: Reserved
CV 1.439: All Aboard/Coach Doors*
CVs 1.440-1.448: Reserved
CV 1.449: E-Brake App.
CVs 1.450-1.512: Reserved

Note: *CVs 1.385-1.512 (bits 0-3) can be set to allow any given combination of auto-effect enable. For instance, a value of 10 will allow the corresponding effect to turn on in the reverse direction regardless of movement, and a value of 3 will allow the corresponding effect to turn on when the locomotive is in motion regardless of direction.*

* Not included in software releases prior to version 1.3

Map Effect to Emergency Stop Button

Bit 4 of CVs 1.385-1.512 can be set to map the corresponding effect to the emergency stop button. However, pressing the emergency stop button will always bring the locomotive to a stop regardless of function mapping. Add a value of 16 to CVs 1.385-1.512 to map the corresponding effect to the emergency stop button.

Note: *To map an effect to the emergency stop button, you must add a value of 16 (bit 4) to the prior value (1-15) of the corresponding CV, and then use the total CV value for programming.*

Function Mapping Defaults

Default values for CVs 1.257-1.512 (Extended Function Mapping CVs) are listed in Table P. Values that are not listed indicate that the associated effect is disabled by default; a value of 255 in CVs 1.257-1.384 (Effect Map Registers) disables Flex-Map function mapping for the corresponding effect, and a value of 0 in CVs 1.385-1.512 (Effect Auxiliary Map Registers) disables automatic control for the corresponding effect. Refer to “Using Econami for Diesel” for each default function assignment’s description.

Flex-Map technology not only simplifies function mapping, it makes it more versatile as well. CVs 1.257-1.512 allow 28-function support for Econami; you can map function keys F0-F28 to any effect, control the directionality of lighting outputs, configure any effect to activate when the locomotive is forward-driving, reverse-driving, forward-standing, and/or reverse-standing, and map an effect to the emergency stop button.

Table P. Flex-Map Default Settings	
F0(f) = Headlight	CV 1.257 = 0
F0(r) = Backup Light	CV 1.258 = 0
F1 = Bell	CV 1.298 = 1
F2 = Airhorn	CV 1.297 = 2
F3 = Short Airhorn	CV 1.300 = 3
F4 = Dynamic Brake	CV 1.299 = 4
F5 = RPM+	CV 1.285 = 5
F6 = RPM-	CV 1.286 = 6
F7 = Dimmer	CV 1.273 = 7
F8 = Mute	CV 1.274 = 8
F9 = Xing Signal	CV 1.278 = 9
F11 = Brake Function	CV 1.275 = 11
F13 = Coupler	CV 1.305 = 13
F13 = Coupler Release	CV 1.306 = 13
F14 = Half-Speed	CV 1.276 = 14
F14 = Mom. Override	CV 1.277 = 14
F23 = All Aboard/Coach Doors*	CV 1.311 = 23
F24 = FX3 Output	CV 1.259 = 24
F25 = FX4 Output	CV 1.260 = 25
F26 = FX5 Output	CV 1.261 = 26
F27 = FX6 Output	CV 1.262 = 27
CVs 1.385-1.512	
E-Stop = E-Brake App.	CV 1.449 = 16

* Not included in software releases prior to version 1.3

Flex-Map Examples

The following examples detail using CVs 1.257-1.512 for function mapping, enabling automatic effects, and mapping an effect to the emergency stop button. Before accessing CVs 257-512, ensure CV 31 is set to a value of 16, and enter a value of 1 into CV 32.

Example: Mapping Diesel Functions

Adjusting CVs 1.257-1.384 (Effect Map Registers) to customize function assignments for diesel locomotives is simple. Refer to Table M if needed. In this example, we will configure diesel functions with only two CVs:

1. To map the grade-crossing signal (F9 by default) next to your long and short airhorn functions (F2 and F3 by default), access CV 1.278 (Grade-Crossing Signal Map Register). We want to map the grade-crossing signal to function key F4 to allow all airhorn functions to be activated with F2, F3, and F4.
2. To map the dynamic brake (F4 by default) effect next to the brake function (F11 by default), access CV 1.299 (Dynamic Brake Map Register). We want to map the dynamic brake effect to function key F10.
3. Set CV 1.278 to a value of 4 to map the grade-crossing signal from function key F9 to function key F4 (4 = F4). Now you can activate the long airhorn with F2, the short airhorn with F3, and the grade-crossing signal with F4. This will also replace the dynamic brake function and override the value of CV 1.299.
4. Set CV 1.299 to a value of 10 to map the dynamic brake effect to function key F10 (10 = F10). This will allow you to use the traction motors for dynamic braking when using the F11 brake is not as appropriate for the region or prototype.

Example: Configuring Automatic Signals

In this example, we will adjust CVs 1.385-1.512 (Effect Auxiliary Map Registers) to configure automatic signals. Refer to Table N. to view CV 1.407 (Forward Whistle Signal Auxiliary Map Register), CV 1.408 (Reverse Whistle Signal Auxiliary Map Register), and CV 1.409 (Stop Whistle Signal Auxiliary Map Register):

1. Enable the forward signal to issue an airhorn blast when the locomotive is moving in the forward direction by accessing CV 1.407.
2. Referring to Table O, set CV 1.407 to a value of 1 to enable automatic forward signals when the locomotive is forward-driving.
3. Enable the reverse signal to issue an airhorn blast when the locomotive is moving in the reverse direction by accessing CV 1.408.
4. Referring to Table O, set CV 1.408 to a value of 2 to enable automatic reverse signals when the locomotive is reverse-driving.
5. Enable the stop signal to issue an airhorn blast when the locomotive is stopped by accessing CV 1.409.
6. Referring to Table O, set CV 1.409 to a value of 12 to enable automatic stop signals when the locomotive is standing (regardless of direction).

Example: Mapping Emergency Gyralite to E-Stop Button

You may want to map the emergency Gyralite to add a lighting effect to the emergency brake application effect. The following example details setting the emergency Gyralite to the FX3 lighting output, and mapping the FX3 effect to the emergency stop button:

1. Enter a value of 21 into CV 51 (FX3 Configuration) to set the emergency Gyralite to the FX3 lighting output. Refer to “Configuring Lighting Outputs” for more information.
2. Enter a value of 255 into CV 259 (FX3 Effect Map Register) to disable function control for the FX3 lighting output.
3. To map the emergency Gyralite to the emergency stop button, enter a value of 16 into CV 387 (FX3 Effect Auxiliary Map Register).

NMRA Legacy Function Mapping

CVs 33-46 are function mapping CVs stated in the NMRA Standards for DCC Configuration Variables (S-9.2.2, p.7). CVs 35-46 are used to assign effects to function keys F1-F12, and CVs 33 and 34 are used to assign effects to the F0 function key. If the same effect is selected for both reverse and forward F0 functions, that effect will turn on when the F0 function key is turned on regardless of locomotive direction.

Note: *CVs 33-46 offer a secondary method of function mapping, are preprogrammed to values of 0, and are not used to determine Econami's default function assignments. CVs 1.257-1.512 (Extended Function Mapping CVs) provide default function assignments for 28 function keys and offer comprehensive function mapping support for all of Econami's effects in an uncomplicated and versatile format. However, mapping an effect to a function key (F0(f), F0(r), or F1-F12) using CVs 33-46 will override the corresponding function assignment mapped within CVs 1.257-1.384.*

Table Q. Function Output Map

Function Key	CV	HL Output	BL Output	Airhorn	Bell	FX3 Output	FX4 Output	Dynamic Brake	Short Airhorn	Reserved	Reserved	Dimmer	Mute	Reserved	Reserved	Coupler
F0(f)	**33**	1	2	4	8	16	32	64	128							
F0(r)	**34**	1	2	4	8	16	32	64	128							
F1	**35**	1	2	4	8	16	32	64	128							
F2	**36**	1	2	4	8	16	32	64	128							
F3	**37**				1	2	4	8	16	32	64	128				
F4	**38**				1	2	4	8	16	32	64	128				
F5	**39**				1	2	4	8	16	32	64	128				
F6	**40**				1	2	4	8	16	32	64	128				
F7	**41**							1	2	4	8	16	32	64	128	
F8	**42**							1	2	4	8	16	32	64	128	
F9	**43**							1	2	4	8	16	32	64	128	
F10	**44**								1	2	4	8	16	32	64	128
F11	**45**								1	2	4	8	16	32	64	128
F12	**46**								1	2	4	8	16	32	64	128

Note: *CVs 33-46 are defaulted to zero in order to enable Flex-Map function mapping via CVs 1.257-1.384.*

To determine the correct CV value:

1. Find the column in Table Q that corresponds to your preferred effect.
2. Locate the row that corresponds to your chosen function key.
3. Note the value located in the cell of the row and column you have selected.
4. Set the corresponding CV to the value found in the previous step.

Configuring Hyperdrive2

Econami's Hyperdrive2 system features high-frequency pulse-width modulation (PWM) for silent motor control and a back-electromotive force (back-EMF) sensor to improve low-speed operation and maintain constant speeds. Load compensation and a proportional-integral (PI) control loop allows Econami to sense motor load in response to back-EMF measurements.

Advanced Motor Control CVs
CV 10: EMF Feedback Cutout
CV 209: PID Kp Parameter
CV 210: PID Ki Parameter
CV 212: BEMF Feedback Intensity
CV 211: Low-Speed Compensation
CV 215: BEMF Reference Voltage
CV 216: Motor Speed-Step Deadband*

Control Loop Coefficients

Econami compensates for load changes in response to back-EMF voltage readings that compare motor load to locomotive speed. When a variation between them occurs, a proportional-integral (PI) control loop adjusts the motor voltage to compensate for the difference so that the locomotive's speed remains consistent. Adjust the PI control loop with CV 209 (PID Kp Parameter) and CV 210 (PID Ki Parameter).

Kp Coefficient

CV 209 is used for adjusting the proportional gain of the control loop, and compensates for dynamic changes in the motor load based on the contrast between the throttle setting and motor speed. CV 209 may be programmed with a value from 0 to 255. Higher values indicate higher levels of compensation. However, values that are too high may lead to inconsistencies in motor control.

Ki Coefficient

CV 210 is used for adjusting the integral gain of the control loop, and compensates for static changes in motor load by applying a correction based on the integral difference between the throttle setting and the current motor speed. CV 210 may be set to a value from 0 to 255. Higher values indicate higher levels of compensation and a more sensitive control loop. We suggest setting CV 210 to the lowest value that still provides optimal performance; setting CV 210 to values that are too high may lead to oscillations in locomotive speed.

Note: *Setting CVs 209 and 210 to values of 0 will disable the control loop.*

Strategy for Optimizing Hyperdrive2

Finding the right combination of CV settings requires some experimenting and patience. Be aware that these settings will inherently vary between locomotives. If you happen to make an adjustment to an advanced motor control CV that compromises operation in some way, you can reset CV settings with CV 8. Refer to "Resetting CVs and Starting Over" under "Introduction to Programming" for more information.

Take notes of your CV settings to use them as starting points when configuring other locomotives. Adjusting a particular setting can actually degrade performance, and therefore changes should be made in small increments until you find your preferred result. And remember, Econami's default settings should provide satisfactory performance for most situations.

* Not included in software releases prior to version 1.3

Example: Adjusting the Control Loop

We suggest the following procedure to help fine-tune the CV settings:

1. Make sure all the Hyperdrive2 CVs are set to default values.
2. Set CV 2 (Vstart), CV 5 (Vhigh), and CV 6 (Vmid) to 0.
3. With the locomotive on level track, set the throttle to speed-step 20 (128 speed-step mode).
4. Increase the value of CV 209 until the locomotive's speed becomes varied and choppy.
5. Reduce the value of CV 209 until speed is consistent, smooth, and without variance.
6. Increase the value of CV 210 until you notice the locomotive's speed begin to oscillate.
7. Reduce the value of CV 210 until the oscillation stops.

Set the Load Compensation Curve

CV 10 (EMF Feedback Cutout) and CV 212 (Back-EMF Feedback Intensity) are used to control the amount of load compensation applied to the motor across the throttle range. CV 212 can be set to a value from 0 to 255 to determine the amount of load compensation that is initially applied to the motor. A value of 0 disables load compensation altogether, while a value of 255 corresponds to 100% compensation. CV 10 determines the degree that the load compensation is reduced as the throttle speed is increased.

When CV 10 is set to 0, the amount of load compensation is constant over the entire speed range, according to the value of CV 212. Setting CV 10 between 1 and 127 will determine the speed step at which the load compensation is reduced to 0. Setting CV 10 between 128 and 255 will select a partial load compensation reduction at full speed. The minimum load compensation level at speed-step 128 is calculated and illustrated as follows:

Full-Speed Load Compensation = (CV 10 - 128) ÷ 128

In general, you will want to have full load compensation at low speeds that will gradually reduce to 0 at top speed. Set CV 10 to 126 to achieve this. When operating in a consist, you may need to reduce the value in CV 212 to reduce the low speed load compensation, and therefore avoid pitting the locomotives against each other.

BEMF Reference Voltage

CV 215 (BEMF Reference Voltage) allows you to change the reference voltage for the back-EMF to match the voltage on your track. By matching the back-EMF reference voltage of the decoder with your track voltage, your locomotive will run smoother and more consistently. CV 215 may be programmed with any value from 0 to 255 to set the back-EMF reference voltage from 0 to 25.5 volts.

If you are planning to consist the model with other models equipped with SoundTraxx decoders (such as Tsunami or MC1 and MC2 DCC Mobile Decoders), make sure this value is set to 160, equal to 16 volts, so that the reference voltage is identical to your decoder. To set this CV, simply take the observed voltage on your track and multiply it by 10 to receive the programming value. For example, 12.5 volts would be represented as a CV value of 125.

Adjust Low-Speed Operation

CV 211 (Low-Speed Compensation) is used to compensate for irregularities (if any) that occur during low-speed operation. You may enter values from 0 to 255 into CV 211 to specify the "gain value" that will be applied to the PID motor equation at low speeds.

Increasing the gain value will allow the motor to start running at lower speeds. When CV 211 is set to a value of 255, the effect is applied across the first nine speed steps; the gain value has a decreasing effect upon the motor as speed steps increase. The gain value also advances the starting point at which the PWM is applied to the motor when CV 211 is set to high values. This helps compensate for motors that are more difficult to start.

In the event that you have an efficient motor that already spins at minimal voltages, it is possible that setting the gain value too high could elevate the locomotive's minimum speed, and/or cause a stutter at low speeds while the control loop attempts to slow the motor. If you notice this, reduce the value of CV 211. We suggest setting CV 211 to the lowest value that will still improve low-speed operation.

Set the Motor Speed-Step Deadband*

CV 216 (Motor Speed-Step Deadband) determines the speed step at which the motor output will first respond to voltage and set the locomotive in motion. Entering values from 1 to 127 into CV 216 will set the motor speed-step deadband from speed-step 1 to speed-step 127. Setting CV 216 to higher values will allow the locomotive to remain stationary as the throttle is increased from zero.

Example: Motor Speed Step Deadband and Automatic Whistle Signals

Refer to the following example to configure automatic forward-driving and reverse-driving whistle signals using CV 216:

1. To enable automatic forward-driving whistle signals, set CV 1.407 (Forward Whistle Signal Auxiliary Map Register) to a value of 1.
2. To enable automatic reverse-driving whistle signals, set CV 1.408 (Reverse Whistle Signal Auxiliary Map Register) to a value of 2.
3. To allow forward-driving and reverse-driving whistle signals to be issued after the throttle is increased from zero and before the locomotive begins to move, set CV 216 to a value of 3. The locomotive will begin to move when the throttle is increased from speed-step 3.

* Not included in software releases prior to version 1.3

Configuring Advanced Consist Operation

A consist is several units coupled together to operate as a complete train. In model railroading, “Advanced Consisting” indicates the consist is configured within the decoder rather than through the command station. Consists make it easier for a single operator to run a multi-unit diesel lash-up, for example. Advanced Consist CVs allow the decoder to recognize the consist address, set acceleration and deceleration rates, enable function keys F0-F28, and configure automatic effects for consist operation.

Advanced Consist CVs
CV 19: Consist Address
CV 21: Consist Function Enable 1
CV 22: Consist Function Enable 2
CV 23: Consist Acceleration Rate
CV 24: Consist Deceleration Rate
CV 245: Consist Function Enable 3
CV 246: Consist Function Enable 4
CV 247: Consist Function Enable 5

Set the Consist Address

Programming CV 19 (Consist Address) with a value from 1 to 127 will set the address used by the decoder to recognize all units within the consist that are in the forward direction. Values from 129 to 255 can be used set the address from 1 to 127 for all units in the reverse direction (more common in diesel operations), so make sure all your units are oriented as you’ve intended. Programming CV 19 with a value of 0 or 128 will disable the consist address.

After the consist address has been set, the decoder will still respond to all commands sent to its primary or extended address except speed and direction data. However, the decoder will not respond to programming commands sent to the consist address in Operations Mode. Ops Mode commands are only received when sent to the primary or extended address.

Consist Function Enable

CVs 21, 22, 245, and 246 are used to enable function keys F0-F28 for advanced consist operation. You are only able to use CVs 21-22 and 245-246 when a valid consist address is active within CV 19 (Consist Address).

Note: *The F0-F28 function keys mapped in CVs 1.257-1.384 (Effect Map Registers) can be enabled for advanced consist operation. Refer to “Using Econami for Diesel” to view descriptions of default function assignments. Refer to “Function Mapping” to view default function assignments for CVs 1.257-1.512 and details regarding our Flex-Map technology.*

Enable Functions F0-F28

Each F0-F28 function key corresponds to an individual bit within CVs 21, 22, 245, and 246. Adding bit values associated with your preferred advanced consist functions for each CV is required prior to programming. For information regarding “programming by the bits,” refer to “CV Programming Tutorial.” The following procedure details enabling F0(f), F0(r), and F1-F28 for advanced consist operation:

1. Circle the CV values associated with your preferred F0-F28 function keys.
2. For each CV, add the values together and record the sum in the space provided. You should have four total CV values for enabling your preferred function keys when finished.
3. Program CVs 21, 22, 245, and 246 with their corresponding values to enable your preferred F0-F28 function keys for advanced consist operation.

CV 21: Consist Function Enable 1

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	F8	F7	F6	F5	F4	F3	F2	F1
CV Value	128	64	32	16	8	4	2	1

CV 21 Value = _____

CV 22: Consist Function Enable 2

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	0	0	F12	F11	F10	F9	F0(r)	F0(f)
CV Value	0	0	32	16	8	4	2	1

CV 22 Value = _____

CV 245: Consist Function Enable 3

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	F20	F19	F18	F17	F16	F15	F14	F13
CV Value	128	64	32	16	8	4	2	1

CV 245 Value = _____

CV 246: Consist Function Enable 4

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	F28	F27	F26	F25	F24	F23	F22	F21
CV Value	128	64	32	16	8	4	2	1

CV 246 Value = _____

Consist Inertia Control

CVs 23 (Consist Acceleration Rate) and 24 (Consist Deceleration Rate) are used to set the acceleration and deceleration rates for consists when a valid consist address is active. Like CVs 3 (Baseline Acceleration Rate) and 4 (Baseline Deceleration Rate), CVs 23 and 24 are used to determine the time it will take the consist to accelerate to full speed from a stop and come to a stop from full speed. Values from 0 to 255 may be programmed into each CV, though they are interpreted by the decoder as values from -127 to +127. Furthermore, values from 0 to 127 are interpreted as 0 to +127, whereas values from 128 to 255 are interpreted as 0 to -127.

Consist acceleration and deceleration values from -127 to +127 are then added to the baseline acceleration and deceleration rates. In other words, the value of CV 23 is added to the value of CV 3 to create the consist acceleration *offset*, and the values of CVs 24 and 4 are added to create the consist deceleration *offset*. For example, if the value of CV 3 is 100, programming CV 23 with a value of 200 would adjust, or *offset*, the consist acceleration rate by -73, making the combined value of CVs 3 and 23 equal to 27.

When the sum of CVs 23 and 3 equals 255, it will take approximately 3.8 minutes for the consist to accelerate to full speed from a complete stop. Likewise, when the sum of CVs 24 and 4 is 255, it will take 3.8 minutes to come to a complete stop from full speed. Programming values of 0 and 128 into CVs 23 and 24 will have no effect on acceleration or deceleration. Also, if the sums of CVs 23 and 3 and CVs 24 and 4 are each equal to 255, programming CVs 23 and 24 with positive values will not change the consist acceleration or deceleration rate because CV registers cannot contain values exceeding 255. Similarly, if CVs 3 and 4 are set to 0, programming CVs 23 and 24 with values from 128 to 255 (0 to -127) will have no effect because CV registers cannot contain negative values.

Configuring Automatic Effects

To provide more versatility, CV 247 can be used in conjunction with Flex-Map function mapping CVs to allow automatic effect configuration for advanced consist operation. Automatic effects will respond to direction and movement when enabled. Table R shows the CV values for configuring effects to respond according to the following circumstances:

Forward-Driving: The corresponding effect will be active when the locomotive is moving in the forward direction.

Reverse-Driving: The corresponding effect will be active when the locomotive is moving in the reverse direction.

Forward-Standing: The corresponding effect will be active when the locomotive is stopped in the forward direction.

Reverse-Standing: The corresponding effect will be active when the locomotive is stopped in the reverse direction.

Note: *CV 247 can be set to allow any given combination of auto-effect enable. For instance, a value of 10 will allow the corresponding effect to turn on in the reverse direction regardless of movement, and a value of 3 will allow the corresponding effect to turn on when the locomotive is in motion regardless of direction.*

Table R. CV 247 Values

CV Value	Active When
1	Forward-Driving
2	Reverse-Driving
3	Driving
4	Forward-Standing
5	Forward
6	Forward-Standing, Reverse-Driving
7	Forward, Reverse-Driving
8	Reverse-Standing
9	Reverse-Standing, Forward-Driving
10	Reverse
11	Reverse, Forward-Driving
12	Standing
13	Standing, Forward-Driving
14	Standing, Reverse-Driving
15	Continuously Active

Consist Example

Consider a common diesel lash-up consisting of three engines: Nos. 4088, 5239, and 6361. Suppose you want to operate these three engines as a single unit with consist address 40. We're going to enable the dynamic brake (F4 by default) and mute (F8 by default) functions for all engines, the headlight (F0(f) by default), airhorn (F2 by default), and bell (F1 by default) for the lead unit, and the backup light (F0(r) by default) for the trailing unit.

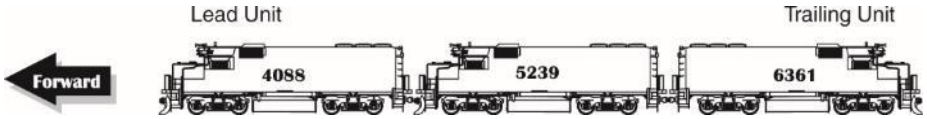


Table S. Consist Example					
No.4088 Direction: Normal		**No.5239** Direction: Normal		**No.6361** Direction: Inverted	
CV 19 Value	40	CV 19 Value	40	CV 19 Value	168
CV 21 Value	139	CV 21 Value	136	CV 21 Value	136
CV 22 Value	1	CV 22 Value	0	CV 22 Value	2

Lead Engine No.4088:

1. Program CV 19 with a value of 40 to set the consist address.
2. Determine the values for CVs 21 and 22. Remember, we want to enable the bell, airhorn, dynamic brake, and mute functions with CV 21, and the headlight function with CV 22.
3. To enable F1, F2, F4, and F8, add the corresponding CV 21 bits together: 1 + 2 + 8 + 128 = 139. Set CV 21 to a value of 139 to enable the bell, airhorn, dynamic brake, and mute functions.
4. To enable the headlight (F0(f) by default), set CV 22 to a value of 1.

Engine No.5239:

1. Program CV 19 with a value of 40 to set the consist address for the middle engine.
2. Determine the CV values for CV 21. Remember, we want to enable the dynamic brake and mute functions.
3. To enable F4 and F8, add the corresponding CV 21 bits together: 8 + 128 = 136. Set CV 21 to a value of 136 to enable the dynamic brake and mute functions.

Trailing Engine No.6361

1. Because the trailing engine is in reverse, we need to set CV 19 to a new consist address to invert direction: 40 + 128 = 168.
2. Determine the CV values for CV 21 and 22. Remember, we want to enable the dynamic brake and mute functions with CV 21, and the backup light with CV 22.
3. To enable F4 and F8, add the corresponding CV 21 bits together: 8+ 128 = 136. Set CV 21 to a value of 136 to enable the dynamic brake and mute functions.
4. To enable the backup light (F0(r) by default), set CV 22 to a value of 2.

Miscellaneous Features

Configuring Analog Mode Operation

Although it's designed specifically as a DCC decoder, you can operate Econami with a conventional powerpack on a DC-powered layout within limitations. When analog mode is enabled, the decoder will operate entirely in response to track voltage. Keep this in mind throughout this section in order to take full advantage of analog mode operation and receive the most realistic performance from your Econami decoder.

Analog Mode CVs
CV 12: Alternate Power Source
CV 13: Analog Mode Function Enable 1
CV 14: Analog Mode Function Enable 2
CV 29: Configuration Data 1
CV 218: Analog Mode Motor Start Voltage
CV 241: Analog Mode Function Enable 3
CV 242: Analog Mode Function Enable 4
CV 243: Analog Mode Function Enable 5

Configuring Analog Mode

To enable analog mode operation, first set CV 12 (Alternate Power Source) to a value of 1 to allow the decoder to employ an alternate power source. You must also program CV 29 (Configuration Data 1) to enable analog mode. Refer to Table C in the section "Configuring the Decoder" to locate your preferred CV 29 value that will enable analog mode operation. Bit 2 (APS) of CV 29 (bit 2 = 4) must be set for the decoder to accept an analog power source.

Operating in Analog Mode

The decoder will be inactive when the powerpack's throttle setting is zero and/or voltage is not being received. To improve low-voltage operation, the volume level is automatically adjusted according to the back-EMF voltage measurements. The throttle must be increased to roughly 5 volts to power Econami's internal circuitry. It's at this point that automatic sounds, such as the poppet valve and air compressor, will begin to play in the background. Increasing the throttle to around 7.5 volts will then set the locomotive in motion, and speed can be adjusted with the throttle setting. Keep in mind that the direction can only be changed while the locomotive is stopped.

The back-EMF sensor is employed in analog mode to make continuous adjustments to compensate for motor load. Refer to "Configuring Hyperdrive2" for more information regarding advanced motor control. Be careful not to exceed the input voltage rating of 27 volts. The decoder is designed to shut down and flash Error Code 10 when track voltage exceeds 21 volts. If this occurs, decrease the throttle immediately. Refer to "Troubleshooting" for more information regarding error codes.

Analog Mode Function Enable

CVs 13, 14, 241, and 242 are used to enable function keys F0-F28 for analog mode operation. Each F0-F28 function key corresponds to an individual bit within CVs 13, 14, 241, and 242. Adding bit values associated with your preferred analog mode functions for each CV is required prior to programming:

1. Circle the CV values associated with your preferred F0-F28 function keys.
2. For each CV, add the values together and record the sum in the space provided. You should have four total CV values for enabling your preferred function keys when finished.
3. Program CVs 13, 14, 241, and 242 with their corresponding values to enable your preferred F0-F28 function keys for analog mode operation.

Note: *The F0-F28 function keys mapped in CVs 1.257-1.384 (Effect Map Registers) can be enabled for analog mode operation. Refer to "Using Econami for Diesel" to view descriptions of default function assignments and "Function Mapping" to view defaults for CVs 1.257-1.512.*

CV 13: Analog Mode Function Enable 1

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	F8	F7	F6	F5	F4	F3	F2	F1
CV Value	128	64	32	16	8	4	2	1

CV 13 Value = _____

CV 14: Analog Mode Function Enable 2

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	0	0	F12	F11	F10	F9	F0(r)	F0(f)
CV Value	0	0	32	16	8	4	2	1

CV 14 Value = _____

CV 241: Analog Mode Function Enable 3

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	F20	F19	F18	F17	F16	F15	F14	F13
CV Value	128	64	32	16	8	4	2	1

CV 241 Value = _____

CV 242: Analog Mode Function Enable 4

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Function	F28	F27	F26	F25	F24	F23	F22	F21
CV Value	128	64	32	16	8	4	2	1

CV 242 Value = _____

Configuring Automatic Effects

To provide more versatility, CV 243 can be used in conjunction with Flex-Map function mapping CVs to allow automatic effect configuration for analog mode operation. Automatic effects will respond to direction and movement when enabled. Table T shows the CV values for configuring effects to respond according to the following circumstances:

Forward-Driving: The corresponding effect will be active when the locomotive is moving in the forward direction.

Reverse-Driving: The corresponding effect will be active when the locomotive is moving in the reverse direction.

Forward-Standing: The corresponding effect will be active when the locomotive is stopped in the forward direction.

Reverse-Standing: The corresponding effect will be active when the locomotive is stopped in the reverse direction.

Note: *CV 243 can be set to allow any given combination of auto-effect enable. For instance, a value of 10 will allow the corresponding effect to turn on in the reverse direction regardless of movement, and a value of 3 will allow the corresponding effect to turn on when the locomotive is in motion regardless of direction.*

Table T. CV 243 Values

CV Value	Active When
1	Forward-Driving
2	Reverse-Driving
3	Driving
4	Forward-Standing
5	Forward
6	Forward-Standing, Reverse-Driving
7	Forward, Reverse-Driving
8	Reverse-Standing
9	Reverse-Standing, Forward-Driving
10	Reverse
11	Reverse, Forward-Driving
12	Standing
13	Standing, Forward-Driving
14	Standing, Reverse-Driving
15	Continuously Active

Analog Mode Starting Voltage

CV 218 (Analog Mode Motor Start Voltage) can be used to set the voltage level at which power is applied by the decoder to avoid the “motor-boating” effects that sometimes occur when using marginal powerpacks. A value from 0 to 255 may be programmed into CV 218 to set the starting voltage applied to the motor as a fraction of the total supply voltage, i.e., from 0 to 100% of the supply voltage. You can calculate the analog mode starting voltage using this formula:

Starting Voltage = Supply Voltage × CV 218 ÷ 255

Note: *Econami preforms better in analog mode when a higher quality, electronically regulated powerpack is used to supply filtered DC power. Using older rheostat-style or pulse powerpacks will make operation erratic and should not be used to power Econami-equipped installations in analog mode. If your powerpack has a pulse power switch, make sure that it is turned off.*

Configuring Automatic Sound

With corresponding automatic sound CVs, you can configure auto-effects for DCC and analog mode operation. Auto-sound CVs can help compensate for lack of function control in analog mode. This is most useful in DCC mode if you have limited function control. You can enable automatic effects (such as the F11 brake) if you're unable to use a function key.

Automatic Sound CVs
CV 193: Auto-Bell On Set Point
CV 194: Auto-Bell On Time
CV 196: Brake Squeal Sensitivity
CV 197: Analog Mode Auto-Sound Enable
CV 198: DCC Mode Auto-Sound Enable

Auto-Sound Enable

CV 197 (Analog Mode Auto-Sound Enable) is used for enabling automatic sound for analog mode, and CV 198 (DCC Mode Auto-Sound Enable) is used for enabling automatic sound for DCC mode. The CV values and sound effects for both registers are identical, e.g., the value for enabling the auto-bell in analog mode is the same as the auto-bell value for DCC.

Table U shows values for CVs 197 and 198 used to enable automatic effects. For each auto-sound effect you want to enable, add the CV values together and program the sum into CV 197 for analog mode, or into CV 198 for DCC mode. Refer to "CV Programming Tutorial" for more information regarding calculating CV values.

Table U. Auto-Sounds

Value	Sound Effect
2	Auto-Bell
4	Auto-Brake Squeal

Auto-Bell

In addition to CVs 197 and 198, you will need to set CVs 193 (Auto-Bell On Set Point) and 194 (Auto-Bell On Time) to configure the auto-bell sound effect. CV 193 is used to determine the speed step at which the bell sound effect will be automatically turned on and CV 194 (Auto-Bell On Time) is used to adjust the duration in seconds that elapses before the bell sound effect will be automatically turned off. CV 193 may be programmed with values from 1 to 127 to set the auto-bell speed step from 1 to 127, i.e., each value corresponds to a speed step (1 = speed-step 1; 2 = speed-step 2; 108 = speed-step 108, etc.). Then program CV 194 to determine when the bell will stop ringing. Program a value from 1 to 255 into CV 194 to set the duration from 1 to 255 seconds.

Auto-Brake Squeal

The point the auto-brake squeal is activated can be adjusted with CV 196 (Brake Squeal Sensitivity). In DCC mode, the decoder interprets this as the rate of throttle decrease. In analog mode, the decoder interprets it as the rate of voltage decrease. Values from 1 to 255 determine the brake squeal sound effect's sensitivity. A value of 1 will activate the brake squeal in response to decreases of 0.10 speed steps/second. A value of 255 will activate the brake squeal in response to decreases of 25.5 speed steps/second:

CV Value = Speed Steps/Second ÷ 10

We suggest using trial and error when determining the auto-brake squeal sensitivity. In other words, program CV 196 with higher and lower values and then increase and decrease the throttle setting until the auto-brake squeal is activated according to your preferences. A value of 0 indicates the auto-brake squeal is disabled.

Troubleshooting

If you have any difficulties operating your Econami Digital Sound Decoder, refer to this section first before doing anything else. We find that most problems are caused by errant CV values and can be easily corrected. If you are unable to locate the CV that is causing the problem, try resetting the CV values back to their defaults. Refer to “Resetting CVs and Starting Over” in the “Introduction to Programming” section for more information.

The locomotive was running, but isn’t anymore:

- The decoder’s address has been accidentally changed.
- CV 19 (Consist Address) has been inadvertently set.
- CV 29 (Configuration Data 1) has been programmed to select other address.
- CV 3 (Baseline Acceleration Rate) and/or CV 4 (Baseline Deceleration Rate) have been set to values that are too high.
- Broken motor wire or track pickup wire.

Tip: *Check the decoder’s pilot light to confirm that track power is present.*

The locomotive isn’t running, and never has:

- Refer to the information above.
- The decoder has been wired incorrectly.

The locomotive is running, but isn’t producing sound:

- The mute function (F8 by default) is turned on.
- Another function has been remapped to the mute function.
- Volume control CVs (CVs 128-160) have been set to zero.
- The speaker wire is broken.
- The speaker is burned-out.

The locomotive is running in a consist, but without sound and lighting:

- The consist functions are disabled. Refer to “Consist Function Enable” under the section “Configuring for Advanced Consist Operation” to enable your preferred functions for consist operation.

The lights are flickering on and off:

- The decoder is set to 14 speed-step mode, while the command station is set to 28 or 128 speed-step mode.

The lights aren’t working:

- The decoder is set to 28 or 128 speed-step mode, while the command station is set to 14 speed-step mode.
- The function mapping CVs have been improperly configured.
- Lightbulbs are burned-out.
- If you’re using 1.5 volt micro-bulbs, the resistor value is too large.
- The lamp wires are broken.

Tip: *Check the decoder’s diagnostic light to confirm that the decoder is responding to the headlight command when locomotive is in the forward direction.*

Troubleshooting

The locomotive is sitting and both headlights are flashing:

- Refer to the following section, “Diagnostic Lamps.”

Sound works for a while, and then stops working:

- The amplifier is overheating. Lower the volume.
- The decoder is overheating. Lower the track voltage.
- The speaker is damaged. Replace speaker.

A “crackly” sound is coming from the speaker:

- The volume has been set too high for the speaker to successfully reproduce the audio signal.
- The speaker is not baffled properly.
- The speaker wire is loose.
- The speaker is damaged.

The decoder cannot be programmed:

- The programming track has insufficient power. Try using Operations Mode.
- All CVs are locked. Refer to “Locking and Unlocking CVs” in the “Introduction to Programming” section for more information regarding unlocking CVs.

Diagnostic Lamps

There are a blue and a red LED on the circuit board that may help you identify and resolve problems.

Pilot Light

The blue pilot light indicates that the decoder is receiving power. If this light is not illuminated, it may indicate an improperly wired decoder. It could also indicate a loose wire, poor track pickups, no output from the command station, or another wiring problem on your layout.

Fault Light

When the decoder encounters a fault, the red fault light and all installed lighting will flash an allotted number of times to report an error code. The number of times the light flashes corresponds to a specific error.

Error Codes

Shown below are the error codes that indicate problems that can easily be solved.

Error 9 – Over-Temperature Fault

An over-temperature fault indicates the core temperature of the decoder has exceeded its capacity. An onboard temperature sensor is employed to send an error code and deactivate sound and motor processes when the core temperature reaches 80° C (176° F). Sound and motor settings resume when the core temperature cools to 5.5° C (42° F). An over-temperature fault is usually due to inadequate ventilation or using a motor load that exceeds the decoder’s rating.

Error 10 – Over-Voltage Fault
Voltage is monitored during normal operation to automatically deactivate sound and motor processes when voltage reaches 23 volts. Settings resume when the voltage is reduced to 21 volts.

Note: *Econami's absolute maximum voltage input is 27 volts! Track voltages exceeding 27 volts may cause permanent damage to the decoder.*

Error 12 – Motor Overload Fault
The motor current is monitored during normal operation to automatically deactivate motor processes when the current exceeds 150% of the decoder's rating. Power is returned to the motor after 100ms. The motor remains inactive if current-overload persists.

Error 13 – Function Overload Fault
The decoder monitors the collective current of all physical function outputs during operation. All physical functions are deactivated when the current exceeds 100 mA. Power is then returned to the function outputs after 100ms. If the current-overload persists, function outputs remain inactive.

Error 16 – CV Reset
This error code indicates that a CV reset has occurred and all settings have been set to default.

Additional Error Codes
Although rare, the decoder may also report the following error codes, of which cannot be remedied and require factory repair:

Error 1 – COP Timer Reset
Error 2 – Software Fault
Error 5 – EEROM Checksum Failure

If you're still having difficulties, please contact our customer service department:

SoundTraxx Customer Service Department
141 Burnett Drive
Durango, CO 81301
Telephone: (970) 259-0690
Fax: (970) 259-0691
Email: support@soundtraxx.com

Appendix A:
Decimal-Hex-Binary Conversions

DECIMAL	HEX	BINARY (76543210)	DECIMAL	HEX	BINARY (76543210)	DECIMAL	HEX	BINARY (76543210)	DECIMAL	HEX	BINARY (76543210)
0	00	00000000	64	40	01000000	128	80	10000000	192	C0	11000000
1	01	00000001	65	41	01000001	129	81	10000001	193	C1	11000001
2	02	00000010	66	42	01000010	130	82	10000010	194	C2	11000010
3	03	00000011	67	43	01000011	131	83	10000011	195	C3	11000011
4	04	00000100	68	44	01000100	132	84	10000100	196	C4	11000100
5	05	00000101	69	45	01000101	133	85	10000101	197	C5	11000101
6	06	00000110	70	46	01000110	134	86	10000110	198	C6	11000110
7	07	00000111	71	47	01000111	135	87	10000111	199	C7	11000111
8	08	00001000	72	48	01001000	136	88	10001000	200	C8	11001000
9	09	00001001	73	49	01001001	137	89	10001001	201	C9	11001001
10	0A	00001010	74	4A	01001010	138	8A	10001010	202	CA	11001010
11	0B	00001011	75	4B	01001011	139	8B	10001011	203	CB	11001011
12	0C	00001100	76	4C	01001100	140	8C	10001100	204	CC	11001100
13	0D	00001101	77	4D	01001101	141	8D	10001101	205	CD	11001101
14	0E	00001110	78	4E	01001110	142	8E	10001110	206	CE	11001110
15	0F	00001111	79	4F	01001111	143	8F	10001111	207	CF	11001111
16	10	00010000	80	50	01010000	144	90	10010000	208	D0	11010000
17	11	00010001	81	51	01010001	145	91	10010001	209	D1	11010001
18	12	00010010	82	52	01010010	146	92	10010010	210	D2	11010010
19	13	00010011	83	53	01010011	147	93	10010011	211	D3	11010011
20	14	00010100	84	54	01010100	148	94	10010100	212	D4	11010100
21	15	00010101	85	55	01010101	149	95	10010101	213	D5	11010101
22	16	00010110	86	56	01010110	150	96	10010110	214	D6	11010110
23	17	00010111	87	57	01010111	151	97	10010111	215	D7	11010111
24	18	00011000	88	58	01011000	152	98	10011000	216	D8	11011000
25	19	00011001	89	59	01011001	153	99	10011001	217	D9	11011001
26	1A	00011010	90	5A	01011010	154	9A	10011010	218	DA	11011010
27	1B	00011011	91	5B	01011011	155	9B	10011011	219	DB	11011011
28	1C	00011100	92	5C	01011100	156	9C	10011100	220	DC	11011100
29	1D	00011101	93	5D	01011101	157	9D	10011101	221	DD	11011101
30	1E	00011110	94	5E	01011110	158	9E	10011110	222	DE	11011110
31	1F	00011111	95	5F	01011111	159	9F	10011111	223	DF	11011111
32	20	00100000	96	60	01100000	160	A0	10100000	224	E0	11100000
33	21	00100001	97	61	01100001	161	A1	10100001	225	E1	11100001
34	22	00100010	98	62	01100010	162	A2	10100010	226	E2	11100010
35	23	00100011	99	63	01100011	163	A3	10100011	227	E3	11100011
36	24	00100100	100	64	01100100	164	A4	10100100	228	E4	11100100
37	25	00100101	101	65	01100101	165	A5	10100101	229	E5	11100101
38	26	00100110	102	66	01100110	166	A6	10100110	230	E6	11100110
39	27	00100111	103	67	01100111	167	A7	10100111	231	E7	11100111
40	28	00101000	104	68	01101000	168	A8	10101000	232	E8	11101000
41	29	00101001	105	69	01101001	169	A9	10101001	233	E9	11101001
42	2A	00101010	106	6A	01101010	170	AA	10101010	234	EA	11101010
43	2B	00101011	107	6B	01101011	171	AB	10101011	235	EB	11101011
44	2C	00101100	108	6C	01101100	172	AC	10101100	236	EC	11101100
45	2D	00101101	109	6D	01101101	173	AD	10101101	237	ED	11101101
46	2E	00101110	110	6E	01101110	174	AE	10101110	238	EE	11101110
47	2F	00101111	111	6F	01101111	175	AF	10101111	239	EF	11101111
48	30	00110000	112	70	01110000	176	B0	10110000	240	F0	11110000
49	31	00110001	113	71	01110001	177	B1	10110001	241	F1	11110001
50	32	00110010	114	72	01110010	178	B2	10110010	242	F2	11110010
51	33	00110011	115	73	01110011	179	B3	10110011	243	F3	11110011
52	34	00110100	116	74	01110100	180	B4	10110100	244	F4	11110100
53	35	00110101	117	75	01110101	181	B5	10110101	245	F5	11110101
54	36	00110110	118	76	01110110	182	B6	10110110	246	F6	11110110
55	37	00110111	119	77	01110111	183	B7	10110111	247	F7	11110111
56	38	00111000	120	78	01111000	184	B8	10111000	248	F8	11111000
57	39	00111001	121	79	01111001	185	B9	10111001	249	F9	11111001
58	3A	00111010	122	7A	01111010	186	BA	10111010	250	FA	11111010
59	3B	00111011	123	7B	01111011	187	BB	10111011	251	FB	11111011
60	3C	00111100	124	7C	01111100	188	BC	10111100	252	FC	11111100
61	3D	00111101	125	7D	01111101	189	BD	10111101	253	FD	11111101
62	3E	00111110	126	7E	01111110	190	BE	10111110	254	FE	11111110
63	3F	00111111	127	7F	01111111	191	BF	10111111	255	FF	11111111

Appendix B: Econami Diesel CV Reference

Primary CVs	Speed Table CVs
CV 1: Primary Address	CV 66: Forward Motor Trim
CV 2: Vstart	CVs 67-94: Custom Speed Table
CV 3: Baseline Acceleration Rate	CV 95: Reverse Motor Trim
CV 4: Baseline Deceleration Rate	**User Information CVs**
CV 5: Vhigh	CV 105: User Identifier 1
CV 6: Vmid	CV 106: User Identifier 2
CV 7: Manufacturer Version (Read-Only)	**Sound Control CVs**
CV 8: Manufacturer ID	CV 113: Quiet Mode Time-Out Period
CV 10: EMF Feedback Cutout	CV 114: Engine Exhaust Control
CV 11: Packet Time-Out Value	CV 117: F11 Brake Rate
CV 12: Alternate Power Source	CV 119: Max Engine Recovery Speed
CV 13: Analog Mode Function Enable 1	CV 120: Airhorn Select
CV 14: Analog Mode Function Enable 2	CV 121: Auxiliary Airhorn Select
CV 15: CV Unlock Code	CV 122: Bell Select
CV 16: CV Lock ID	CV 123: Prime Mover Select
CVs 17-18: Extended Address	CV 124: Air Compressor Select
CV 19: Consist Address	CV 126: Coupler Select
CV 21: Consist Function Enable 1	CV 128: Master Volume
CV 22: Consist Function Enable 2	CVs 129-150: Mixer Channel Volume Control
CV 23: Consist Acceleration Rate	CV 193: Auto-Bell On Set Point
CV 24: Consist Deceleration Rate	CV 194: Auto-Bell On Time
CV 25: Speed Table Enable	CV 195: Coach Door Count*
CV 29: Configuration Data 1	CV 196: Brake Squeal Sensitivity
CV 30: Error Information	CV 197: Analog Mode Auto-Sound Enable
CV 31: CV Index 1 (Read-Only)	CV 198: DCC Mode Auto-Sound Enable
CV 32: CV Index 2	CV 200: Poppet Valve Release Rate
CV 33: F0(f) Output Location	**Advanced Motor Control CVs**
CV 34: F0(r) Output Location	CV 209: PID Kp Parameter
CV 35: F1 Output Location	CV 210: PID Ki Parameter
CV 36: F2 Output Location	CV 211: Low-Speed Compensation
CV 37: F3 Output Location	CV 212: BEMF Feedback Intensity
CV 38: F4 Output Location	CV 213: BEMF Sample Period
CV 39: F5 Output Location	CV 214: BEMF Sample Aperture Time
CV 40: F6 Output Location	CV 215: BEMF Reference Voltage
CV 41: F7 Output Location	CV 216: Motor Speed Step Deadband*
CV 42: F8 Output Location	CV 217: Motor Control Register
CV 43: F9 Output Location	CV 218: Analog Mode Motor Start Voltage
CV 44: F10 Output Location	**7-Band Equalizer CVs**
CV 45: F11 Output Location	CV 225: Equalizer Control Register
CV 46: F12 Output Location	CVs 226-232: Cut/Boost Controls
Lighting Effect CVs	**Analog Function Enable CVs**
CV 49: Headlight Effect Select	CV 241: Analog Mode Function Enable 3
CV 50: Backup Light Effect Select	CV 242: Analog Mode Function Enable 4
CV 51-54: FX3-FX6 Effect Select	CV 243: Analog Mode Function Enable 5
CV 57: Forward Direction Enable	**Consist Function Enable CVs**
CV 58: Reverse Direction Enable	CV 245: Consist Function Enable 3
CV 59: Hyperlight Flash Rate	CV 246: Consist Function Enable 4
CV 60: Grade-Crossing Hold Time	CV 247: Consist Function Enable 5
CV 61: Brightness Register 1	**Index Page 1: Extended Function Mapping CVs**
CV 62: Brightness Register 2	CVs 1.257-1.384: Effect Map Registers
CV 63: Dimmer Level	CVs 1.385-1.512: Effect Auxiliary Map Registers

* Not included in software releases prior to version 1.3

Appendix C: License Agreement

Please read this license agreement carefully before opening the package that contains the Econami Digital Sound Decoder. Breaking the seal on the package indicates your acceptance of these license terms. If you have received the Econami Digital Sound Decoder pre-installed from your dealer, then use of the product indicates your acceptance of the agreement. If you do not agree with the terms, you should return the package unopened to the dealer from whom you received the package within thirty (30) days and your money will be refunded.

SoundTraxx Software License Agreement

SoundTraxx provides the computer software/firmware embedded within the Econami Digital Sound Decoder and any modifications, updates, revisions or enhancements received by you from SoundTraxx or its dealers and licenses its use within the terms set below:

A. You are granted a nonexclusive, nontransferable license to use the software/firmware included with your Econami sound system only with the Econami sound system hardware that you purchased.

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Appendix D:
Service and Warranty Policy

90-Day Safety-Net Service Warranty

Each SoundTraxx Digital Sound Decoder is tested thoroughly before it is shipped and warranted to be in good working order and free of manufacturing defects. However, in the event that a mistake does occur during installation, SoundTraxx will cover the repair under our Safety-Net Service Warranty. If during the first ninety (90) days you damage your Digital Sound Decoder or it fails to operate, SoundTraxx will repair or replace the system free-of-charge if:

- The original sales receipt showing purchase from an authorized SoundTraxx dealer accompanies the decoder. Receipt must show purchase date to be within the last 90 days. Your original receipt will be returned with your repaired unit.

- There is no damage resulting from unauthorized repairs or modifications. This includes, but is not limited to:
    - Removing the shrink tubing from the decoder
    - Drilling or enlarging circuit board holes
    - Cutting or trimming the circuit board

- The Digital Sound Decoder is returned properly packaged, postage paid and insured; SoundTraxx is not responsible for product lost or damaged in transit.

Limits of Liability

The foregoing shall constitute the sole and exclusive remedy of any owner of this product for breach of warranty including the implied warranties of merchantability and fitness. IN NO EVENT SHALL SOUNDTRAXX BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES OR FOR THE REPRESENTATIONS OF RETAIL SELLERS.

See the “Support” section on our website at www.soundtraxx.com for complete warranty information.

Contacting Support

Our service department is available Monday-Friday, from 9am to 5pm (Mountain Time).

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