



Econami Digital Sound Decoder

Diesel User's Guide

Software Release 1.5**

** 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 Technical Reference

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

Econami Diesel Quick Start Guide

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

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.

You can start using Econami right out of the package without making any adjustments. However, you may adjust settings at any time by making changes to Configuration Variables (CVs). Most DCC decoder and command station manuals call this "programming", though this is misleading and sounds scarier than it is. At no point are you required to learn programming! This user's guide will walk you through operating and programming Econami to its full capacity.

Default Function Assignments

The first time you operate your Tsunami2 decoder, you will be able to activate features and sound effects by simply pressing the appropriate key on your cab or command station console. These are "default" function assignments. 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.

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.

Table A. Default Functions	
Function Key	Effect
F0(f)	Headlight
F0(r)	Backup Light
F1	Bell
F2	Airhorn
F3	Short Airhorn
F4	Dynamic Brakes
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

* Not included in software releases prior to version 1.3



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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.



Note: On Econami UK Diesel Decoders, the F1 key is defaulted to the two-tone airhorn effect, not the bell. The bell is disabled from the factory but can be mapped to any function key using the Flex-Map function mapping feature

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. Econami provides three functions for signaling. Use F2, F3, and F9 to signal prototypically while you operate, as described below.

Press and release F2 to blow the “long” airhorn. Contrary to most function keys, the duration of the airhorn blast is determined by how long you press F2. In other words, the airhorn blast will start when you press F2, and stop when you release F2. Press F3 to issue the single “toot” of the “short” airhorn. The short airhorn will be the same length every time you press F3, unlike the long airhorn.

Note: Function key F2 on the NCE Power Cab command station is on/off or “latching”, i.e., pressing F2 to turn on the function will start the airhorn blast, and pressing F2 again to turn off the function will stop the airhorn blast. To issue momentary airhorn blasts with the NCE Power Cab, press and release the “Horn/Whistle” button instead of using F2.

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 some 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	



Note: On Econami UK Diesel Decoders, the two-tone airhorn effect is mapped to both the F1 and the F2 keys. Turning on F1 will play the higher note of the air horn. Turning on F2 will play the lower note. Turning on F3 will play a “hi-low” signal. The F9 Key is left unmapped from the factory and will not issue any whistle signals in this product.

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Operate the Diesel Prime Mover

To start the diesel engine, simply increase the throttle until the track voltage is such that the engine cranks over several times and settles into a nice idle. Once the engine has reached idle, it will change RPMs automatically in response to changes in the locomotive speed. Alternatively, pressing F5 will ‘start’ the engine and increase the RPMs with subsequent presses. Pressing F6 will cause the sound of the engine shutdown.

Contrary to the way your car works, a 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.

For example, a diesel locomotive climbing a grade at full throttle and maximum engine RPM may only be traveling about 20mph, whereas the engine RPM of your car directly corresponds to how fast you’re traveling. Because of their size (an EMD 645 displaces 645 cubic inches per cylinder!), a diesel engine does not ramp up as quickly as an automobile engine. Even under full throttle acceleration, a typical prototype diesel engine requires between 15 to 25 seconds to reach full RPM and about the same amount of time to return to an idle.

You can start and shut down the prime mover, and elevate and reduce the engine RPM schedule manually with F5 and F6. Each time you turn on F5, the engine RPM will advance to the next level, from notch 1 (idle) to notch 8. Likewise, the engine RPM reduces each time you turn on F6. Turning on F6 when the engine is at an idle will shut down the prime mover. After the shutdown sequence, turning on F5 will start the prime mover and bring the engine to idle.

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

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.



Note: On Econami UK Diesel Decoders, the dynamic brake feature is left unmapped and F4 will not trigger this effect. Refer to the “Function Mapping” section found within the “Advanced Programing” section to configure this effect with Flex-Map Technology.

Apply and Release Brakes

The brakes typically squeal just before the wheels stop turning. Turn on F11 before you decelerate to a stop. Before departing, turn off F11 to release the brakes.

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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.”

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.



Note: On Econami UK Diesel Decoders, turning on F23 before leaving the station will issue a Guard whistle effect, not an “All Aboard!” announcement. After the coach doors slam closed, increase the throttle and depart the station.

Mute Sound Effects

Turn on F8 to mute all sound effects when you need to silence your train. The mute function allows a quick way to turn off sound effects for a phone call, for instance. 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.”

Make an Emergency Stop

Press the emergency stop button to issue the emergency brake application and bring your train to an immediate stop.

Automatic Sound Effects

Econami plays a variety sound effects automatically. Automatic sound effects respond prototypically to aspects of operation such as certain functions and speed settings.

Prime Mover

The prime mover starts when the decoder receives track power and is automatically adjusted by auto-notching and the RPM+ and RPM- functions as you operate. Refer to “Configuring the Decoder,” and “Configuring Sound Effects,” to modify automatic engine exhaust sound effects.

* Not included in software releases prior to version 1.3



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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.”



Note: On Econami UK Diesel Decoders, the poppet valve sound effect is replaced with a Spirax valve sound effect. The operation and adjustment of this feature is that same for both UK and North American products.



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*.

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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.

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	0	0	1	0	0	1	0

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.

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	0	0	1	0	0	1	0
When bit is set to 1, value =							1
Therefore:							= 18

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; $0 \times 1 = 0$ | 4. Bit 4 = 1; $16 \times 1 = 16$ |
| 2. Bit 1 = 1; $2 \times 1 = 2$ | 5. Bits 5-7 = 0; $0 \times 1 = 0$ |
| 3. Bits 2-3 = 0; $0 \times 1 = 0$ | 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
- CVs 2.257-2.515: Indexed CV Page 2

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 is especially helpful when making adjustments to sound effects since you can hear the results of the changes you've made. 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

Some command stations permit you to read the value of a CV and verify its setting during 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.

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.*

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Indexed CVs

The term “indexed CVs” tends to cause confusion and consternation. Simply put, indexed CVs are located on ‘pages’ to help manage the total number of CVs. This is required by the NMRA DCC Standard and works like this:

The standard (S-9.2.2) requires that CVs exceeding CV 256 be contained within “indexed CV pages”. An individual set of CVs from 257-512 is contained within each indexed CV page. Pages are indicated in user documentation by a preceding number. For example, CV 257 on indexed page 1, would be represented as 1.257. CV 257 on indexed page 2 would be represented as 2.257 and so on. This preceding number is also the value to enter into CV 32 to select that page.

Indexed CVs are accessed with the use of two CVs: CV 31 enables indexing when set to a value of 16 (the default value) and CV 32 selects the desired indexed page.

Because of the number of features and options contained within Econami decoders, three pages of indexed CVs are provided:

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.

To access CVs 2.257-2.512:

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

To access CVs 3.257-3.512:

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

To make things easier, Econami CVs are grouped by like function as follows:

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.

CVs 2.257-2.512 are used for adjusting alternate mixer channel volume levels and configuring Dynamic Digital Exhaust CVs. Access CVs 2.289-2.320 for alternate mixer CVs and CVs 2.503-2.512 for DDE control CVs. Refer to “Configuring Throttle and Braking,” “Configuring Sound Effects” and “Configuring Dynamic Digital Exhaust” for more information.



Resetting CVs (Starting Over)

Occasionally, something goes wrong and Econami will not respond as expected. Usually, this is caused by one or more CVs inadvertently being programmed to the wrong value. The CVs can be quickly reset to their factory default values. Follow the steps below to perform either a full or partial CV reset:

1. Turn on track power to the decoder. If you have a SoundTraxx CurrentKeeper™ or another device that maintains power, allow at least two minutes for charging before programming.
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. Turn off track power to the decoder. Wait 5 seconds then return power to the decoder. If you have installed a SoundTraxx CurrentKeeper or another device that maintains track power, ensure that the device is fully discharged (about 3 minutes) before returning power.
4. Wait about 10 seconds after returning power to the decoder. All lights (headlight, backup light or effect lights), as well as the decoder's error light, will flash 16 times to indicate CVs have been successfully reset. Tsunami2 will respond to primary address 3 after all CVs, or CVs 1-128 have been reset.

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

The CV Lock/Unlock feature allows you to program a decoder without the danger of overwriting the programming in another. This is especially useful in installations where multiple decoders are used. For example, if you have installed a function decoder in addition to the sound decoder, you may wish to lock the CVs after programming to prevent accidentally programming one decoder or the other.

CV 15, CV Unlock Code
CV 16, CV Lock Code
CV 30, Error Information

To use the CV Lock feature implemented in CVs 15 and 16, bit 0 of CV 30 must first be set to 1 (the default value is 0). This is to avoid inadvertently locking the decoder when the CV Lock feature is not needed.

CVs 15 and 16 are used for locking and unlocking the decoder. CV 15 is the Unlock Code and may be programmed to any value from 0 to 255 regardless of whether the decoder is locked or unlocked. CV 16 is the Lock Code and may be set to any value from 0 to 7, but only when the decoder is unlocked. Attempts to program CV 16 with a value greater than 7 will be ignored.

The decoder is unlocked when the value in CV 15 matches the value in CV 16. Otherwise the decoder is locked and cannot be programmed in either Operations Mode or Service Mode.



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Further, a locked decoder cannot be reset to its factory defaults until it is unlocked. Econami decoders are shipped from the factory with all CVs unlocked, that is, CV 15 and 16 are both set to 0.

Note that if the decoder is unlocked, changing the value in CV 16 will instantly lock the decoder. You must then set CV 15 to the same value as was just programmed into CV 16 to unlock the decoder again. If you use the CV Locking feature for a multi-decoder installation in one model, each decoder must first have its Lock Code set in CV 16 prior to the installation of any other decoders. Otherwise, all the decoders will have the same Lock Code and the feature will not work. First, install one decoder and program its Lock Code. Then install the next decoder and program its Lock Code. Since the first decoder is now locked, it will be unaffected by the programming of the second decoder (unless you accidentally set the Lock Code of the two decoders to the same value. If this happens you will need to disconnect one decoder and start over). Continue in this manner until all decoders have been installed and their Lock Codes have been set.

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, set CV 15 to a different value than 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.

It is a good idea to set up a standardized system so you don't forget the Lock Code settings. You might, for example, set all motor decoders to a CV Lock Value of 1, sound decoders to a value of 2, and function decoders to a value of 3. Keeping CV 15 set to 0 will guarantee the decoder stays locked until you are ready to begin programming.

Example: Using CV Lock/Unlock

Let's say you will be installing motor decoder, a sound decoder, and a function decoder in one locomotive. Using the previously described system, you would first install the motor decoder and set its Lock Code by programming CV 16 to 1. Since CV 15 (CV Unlock Code) is currently set to 0 (the default value), the decoder is immediately locked. Now install the sound decoder and set its Lock Code by programming CV 16 to 2. Since CV 15 is still set to 0, this decoder is also immediately locked. Now install the function decoder and set its Lock Code by programming CV 16 to 3. At this point, all three decoders are installed and locked. Starting with the motor decoder, set CV 15 to 1 to unlock and program the motor decoder. When you are finished, set CV 15 to 2 and program the sound decoder. Finally, set CV 15 to 3 and program the function decoder. When you are done, set CV 15 back to 0 to lock all the decoders.

If You Forget the Lock Code

As there are only eight possible combinations, you can easily determine a forgotten Lock Code using trial and error with the following procedure:

Place the locomotive on the Programming Track and set CV 15 to 0. Then try to read the value in CV 16. If CV 16 does not read back, the decoder is locked. Set CV 15 to 1 and try reading CV 16 once more. Again, if CV 16 does not read back, the decoder is still locked. Program CV 15 to 2 and try reading CV 16 again. Continuing in the manner, you should eventually find the value stored in CV 16 as it can only be programmed from 0 to 7. If you have tried setting CV 15 to all



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eight values from 0 to 7 and the decoder still does not respond, there may be a problem with the installation, the program track, or the decoder itself and further investigation will be required.

To reiterate, 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 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.

If you do not have access to a programming track with read-back capabilities (or are uncertain as to whether it is working properly), you can also use Operations Mode to discover the Lock Code by alternately programming CV 15 and setting another CV to a value where there is a known response. For example, changing CV 128 (Master Volume Control) will provide auditory feedback as to whether the decoder is unlocked by virtue of a change in sound level. Thus, you would begin by setting CV 15 to 0 and then setting CV 128 to 0. If the volume does not fall to 0, the decoder is locked. Then set CV 15 to 1 and try programming CV 128 again. Repeat this process until you find a value for CV 15 that results in a change in sound volume as you change CV 128.

Troubleshooting Tip: Even if you are not planning to use the CV Lock feature, it can still be accidentally activated by inadvertently programming CV 15 or 16 with a non-default value. If you have a decoder that is otherwise working properly (i.e., making sound and responding to throttle commands) but has suddenly stopped accepting CV changes, then first run through the procedure under "If you Forget the Lock Code" to determine if the decoder has been locked.



Basic Programming

Configuring the Address

Like all DCC decoders, Econami responds to primary address 3 right out of the package. Address control CVs allow you to set primary and extended addresses or your choice, which can be useful when matching the decoder's address with the number on the locomotive, for instance.

Address Control CVs

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

Setting Addresses

Econami recognizes either the primary address (also known as the short address) in CV 1 or the extended (long) address in CVs 17-18 (Extended Address). Whether you use the primary or extended address will first depend on whether or not your DCC system uses extended addressing (not all of them do, so if in doubt, see your command station owner's manual.) Second, it will depend on your preferences and the numbering scheme you use for setting your decoder addresses. The extended address has the advantage that you can use all four digits of a locomotive's road number for the decoder address making it easy to remember. Be aware that some DCC systems do not support the full range of available addresses.

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

The extended address is actually made up of two CVs, 17 and 18. Unless you are an experienced user, you should not try to program these CVs individually as a specific protocol is required in order for the decoder to accept the new data (see the *Econami Diesel Technical Reference* for details). Since most command stations that support extended addressing will automatically generate the correct protocol, simply follow their instructions for setting the extended address.

After setting the extended address, set bit 5 of CV 29 (Configuration Data 1) to 1 to enable its usage. 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.



Basic Programming

Configuring the Decoder

After setting the address, we recommend you adjust the settings of CV 29 (Configuration Data 1). CV 29 controls a variety of important settings. It determines locomotive direction, speed-step mode, alternate power source, speed tables, and the decoder address.

Configuring CV 29

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. This operating mode is most useful for setting up diesel engines that ran with the long hood section forward. However, it is also useful for electronically correcting installations where the motor wires were accidentally reversed and avoids dismantling the locomotive a second time.

F0: F0 Location (Speed-Step Mode Select)

Bit 1 (F0) is used to determine the number of speed steps within the throttle range. 14, 28, and 128 speed-step modes are available, and 28/128 speed-step mode has been enabled by default. Select the highest number of speed steps supported by your command station for the most refined throttle operation.

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 a linear or 28-point custom speed table in place of the 3-point 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.



Basic Programming

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

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.



Basic Programming

Configuring Throttle and Braking

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

If this is overwhelming at first glance, don't worry! It's not necessary to change all of them if you don't want to. We've already talked about speed step selection in CV 29.

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 the Start Voltage

Econami provides CV 2, Vstart, to set the starting voltage that is applied to the motor at Speed Step 1, and is used to compensate for inefficiencies in the locomotive's motor and driveline. CV 2 may be programmed with any value between 0 and 255 with each step in value being about 0.5% of the maximum available motor voltage. To calculate the value of CV 2, you can use the formula:

$$\text{Desired Starting Voltage} \\ \text{CV 2} = 255 \times \frac{\text{Desired Starting Voltage}}{\text{Maximum Motor Voltage}}$$

If your DCC system supports Operations Mode Programming, an alternative method for setting Vstart is to turn your throttle to the first speed step and then use the operations mode programming feature to increase the value in CV 2 until the locomotive just begins to move.

Setting Momentum Rates

Econami provides two CVs to simulate the momentum due to train weight. CV 3 (Baseline Acceleration Rate) controls how fast the locomotive responds to increases in throttle settings. CV 4 (Baseline Deceleration Rate) controls how fast the locomotive will respond to decreases in the throttle setting.

Both CVs can be programmed with any value from 0 to 255, with 255 corresponding to the slowest acceleration or deceleration rate. Lower settings yield a more responsive locomotive, which is useful for switching. When both CVs are set to 0, the locomotive will respond nearly instantly to any throttle changes. A setting of 255, on the other hand, will require several minutes for a locomotive to reach full speed from a standing stop. Setting acceleration and deceleration rates can allow the speed of the locomotive to match the sound effects regulated by Dynamic Digital Exhaust.

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.

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.



Basic Programming

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.

Note: When consisting with active momentum and braking rates, ensure the values of CVs 3, 4, & 117 are the same for all units.

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. First, set bit 4 (STE) of CV 29 to 0. Then 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. Use the calculations below to determine starting, mid-point, and maximum voltage settings:

$$V_{start}, V_{mid}, V_{high} = \text{Supply Voltage} \times \text{CV Value} \div 255$$

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, and then increase the value of CV 2 until the model responds to your preferred starting voltage.
2. Set the throttle to a medium speed step, and then increase the value of CV 6 until the model responds to your preferred mid-speed voltage.
3. Set the throttle to the maximum speed step, and then increase the value of CV 5 until the model responds according to your preferred high-speed voltage level.

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

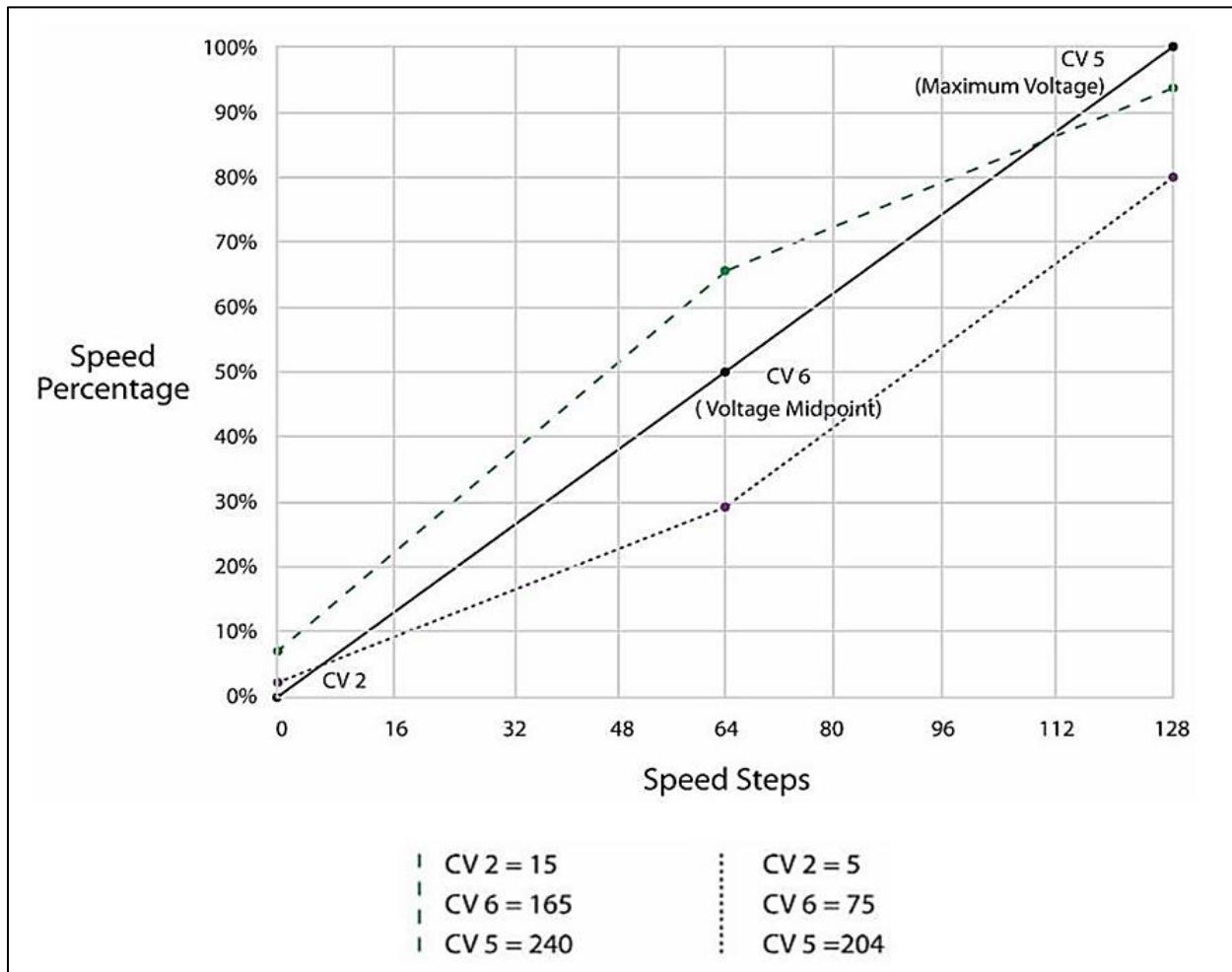
4. Place the unit on the mainline and set the throttle to speed-step 1.
5. Increase the value of CV 2 until the model responds according to your preferred starting voltage level.
6. Set the throttle to the middle speed step.
7. Increase the value of CV 6 until the model responds according to your preferred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



Basic Programming

Use the 3-Point Speed Curve

The figure shown below gives an example of how CVs 2, 5, and 6 can be used to change voltage levels during operation.





Basic Programming

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 then 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 to 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:

$$\text{CV Value} = 255 \times (\%) \div 100$$

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 (STE) of CV 29 to 1 to enable speed tables.
5. Enter a value of 16 into CV 25 to enable the 28-point custom speed table.



Basic Programming

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 \times 0.008
↓
127 = Voltage \times 0.99
128 = Disabled
129 = Voltage \times 1.008
↓
255 = Voltage \times 1.99



Basic Programming

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, and can be controlled using a corresponding function key. This section provides information regarding lighting control CVs, Hyperlight lighting effects, and other lighting features, such as LED Compensation Mode, Grade-Crossing Logic, and phase select.

Enabling Hyperlight Effects and Features

You can use CVs 49-54 to enable Hyperlight lighting effects and features for the headlight, backup light, and FX3-FX6 lighting outputs. This section details each Hyperlight effect and feature and shows you how to customize lighting outputs to fit your operating preferences.

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 the brightness setting in CV 63 when you turn on the dimmer function (F7 by default).

Mars Light

This effect replicates the famous figure-eight sweep pattern of the Mars Light warning beacon.

Pyle-National Gyralite

The Pyle-National Gyralite is similar to the Mars Light, but oscillates in a circular or elliptical pattern.

Oscillating Headlight

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

Single-Flash Strobes 1 and 2

The xenon single-flash strobe 1 effect flashes once during each flash rate timing cycle. The xenon single-flash strobe 2 flashes once during each flash rate timing cycle, but at a slightly faster rate.

Double-Flash Strobe

The xenon double-flash strobe effect emits two rapid flashes of light during each flash rate timing cycle. CV 59 is used to modify the flash rate timing cycle.

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 Effect Select

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
13	Firebox Flicker (Steam)
14	Smart Firebox Flicker (Diesel)
15	Dyno-Light (Diesel)
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 (Steam)
24	Reserved
25	Single-Flash Strobe 2



Basic Programming

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.

Ditch Lights I and II

Ditch lights I and II flash together by default. When Grade-Crossing Logic is enabled, ditch light I assumes a steady “on” state before and after the crossing hold timer countdown. Conversely, ditch light II will remain off before and after the crossing hold timer countdown. To configure alternating ditch lights, set one lighting output to ditch light I or II and enable Grade-Crossing Logic, and then set a second lighting output to the same ditch light and enable Grade-Crossing Logic and phase offset.

FRED (Flashing Rear End Device)

The FRED effect is a flashing red taillight that indicates the rear of the train.

Exhaust Flicker

This effect produces a random flicker whose intensity increases with locomotive speed. This effect is best used by placing a red/orange LED in the exhaust stack. As the locomotive increases speed, it will glow brighter, imitating an increase in sparks and exhaust gases.

Dyno-Light

In a diesel locomotive, the lights will fade on and fade off to simulate the heating and cooling of the bulb filaments.

Auto-Dim Forward and Reverse

The auto-dim forward effect will automatically dim lighting outputs to the dimmer level in CV 63 when in the forward direction, and the auto-dim reverse effect will automatically dim lighting outputs to the dimmer level in CV 63 when in the reverse direction.

Brake Light

The brake light effect is dimmed to the brightness setting in CV 63 when active. The brake light brightness level will be automatically set to 100% when you turn on the independent or train brake function (F11 by default).

On/Off Brightness 1 and 2

The on/off brightness 1 and 2 effects will set lighting outputs to the brightness levels of CVs 61 and 62, respectively.

Emergency Gyralite

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

Phase Offset

Add a value of 32 to the value of flashing Hyperlight effects to set the corresponding lighting output to Phase B from Phase A. Flashing effects set to Phase B will flash opposite of flashing effects set to Phase A, i.e., Phase A turns off when Phase B turns on, and Phase A turns on when Phase B turns off.



Basic Programming

Grade-Crossing Logic

Grade-Crossing Logic allows you to set up lighting functions, the bell, and whistle to automatically simulate encountering grade crossings. Add a value of 64 to enable Grade-Crossing Logic.

Turning on the long whistle function (F2 by default) or the grade-crossing signal function (F9 by default) will start the crossing hold timer countdown and allow lighting effects to assume a flashing state. Shown in Table F, flashing Hyperlight effects will return to an on or off state after the countdown ends. Practice activating Grade-Crossing Logic as your locomotive approaches a grade crossing. You can adjust the crossing hold timer countdown from 0 to 15 seconds by entering a value from 0 to 15 into CV 60 (Grade-Crossing Hold Time).

Table F. Flashing Effect On/Off State

Hyperlight Effect	On/Off State
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	On
Ditch Light II	Off
FRED	Off

To allow the bell to ring during the crossing hold timer countdown, enable the grade-crossing bell in CV 122 (Bell Select). Refer to “Configuring Sound Effects” for more information about the grade-crossing bell.

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. Add a value of 128 to enable LED Compensation Mode for the corresponding lighting output.

Note: Enabling LED Compensation Mode will not change the output voltage. Resistors may still be necessary depending on the board format.



Basic Programming

Adjusting Lighting Output Settings

After configuring Hyperlight effects and features with CVs 49-54, adjust CV 57 (Forward Direction Enable), CV 58 (Reverse Direction Enable), CV 59 (Hyperlight Flash Rate), CV 61 (Brightness Register 1), CV 62 (Brightness Register 2), and CV 63 (Dimmer Level), customize lighting output direction, the Hyperlight flash rate, and brightness levels.

Enabling Lighting Output Directions

CV 57 determines the lighting outputs active in the forward direction, and CV 58 determines lighting outputs active in the reverse direction. Table G shows values used to enable lighting outputs for the forward and reverse directions. To enable lighting outputs for the forward direction, add the values of your preferred lighting outputs and enter the sum into CV 57. To enable lighting outputs for the reverse direction, add the values of your preferred lighting outputs and enter the sum into CV 58.

Table G. CVs 57-58 Values	
Lighting Output	CV Value
Headlight	+1 to enable
Backup Light	+2 to enable
FX3 Output	+4 to enable
FX4 Output	+8 to enable
FX5 Output	+16 to enable
FX6 Output	+32 to enable

The headlight is disabled in the reverse direction and the backup light is disabled for the forward direction by default, i.e., CV 57 is set to 61 by default and CV 58 is set to 62 by default.

Set the Hyperlight Flash Rate

Adjust the flash rate of flashing Hyperlight effects from the fastest setting to the slowest setting by entering a value from 0 to 15 into CV 59.

Adjust Brightness Registers 1 and 2

Adjust the brightness level of lighting outputs set to the on/off brightness 1 effect from 0% to 100% by entering a value from 0 to 255 into CV 61. Adjust the brightness level of lighting outputs set to the on/off brightness 2 effect from 0% to 100% by entering a value from 0 to 255 into CV 62.

Adjust the Dimmer Level

Adjust the brightness level of the dimmer function (F7 by default) from 0% to 100% by entering a value from 0 to 255 into CV 63. The dimmer level is set to 60% brightness by default.

Example: Alternating Ditch Lights

This example details using CV 51 (FX3 Configuration) and CV 52 (FX4 Configuration) to enable alternating ditch lights for Grade-Crossing Logic. Follow the steps below to set ditch lights to the FX3 and FX4 lighting outputs and allow them to alternate during the crossing hold timer countdown after Grade-Crossing Logic is activated:

1. Add CV values for Grade-Crossing Logic and ditch light I. Add 64 for Grade-Crossing Logic and 9 for ditch light I:

$$64 + 9 = 73$$

2. Enter a value of 73 into CV 51 to set the FX3 lighting output to ditch light I (Phase A) and enable Grade-Crossing Logic. Add a value of 128 for LED Compensation Mode if desired.
3. Add the CV values for Grade-Crossing Logic, phase offset, and ditch light I. Add 64 for Grade-Crossing Logic, 32 for phase offset, and 9 for ditch light I:

$$64 + 32 + 9 = 105$$



Basic Programming

4. Enter a value of 105 into CV 52 to set the FX4 lighting output to ditch light I with phase offset (Phase B) and enable Grade-Crossing Logic. Add a value of 128 for LED Compensation Mode if desired.

As your locomotive approaches a grade crossing, turn on the long airhorn function (F2 by default) to activate Grade-Crossing Logic. Ditch lights will assume a steady “on” state during the airhorn blast, and then the FX3 ditch light (Phase A) will flash opposite of the FX4 ditch light (Phase B) when the crossing hold timer countdown begins. Ditch lights will revert to a steady “on” state after the crossing hold timer countdown ends.

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 turn the headlight and the backup lights on regardless of direction:

1. Note the bit definitions and the decimal value of each bit for CVs 57 and 58 (See Table G.). Bits 0-5 correspond to lighting outputs.
2. Setting all bits (0-5) to 1 in CV 57 will enable all lights in the forward direction. To do this, simply add the decimal values of all the outputs:

$$1 + 2 + 4 + 8 + 16 + 32 = 63$$

3. Enter a value of 63 into CV 57 to enable all lights in the forward direction.
4. Setting all other bits (0-5) to 1 in CV 58 will enable all lights in the reverse direction. To do this, simply add the decimal values of all the outputs:

$$1 + 2 + 4 + 8 + 16 + 32 = 63$$

5. Enter a value of 63 into CV 58 to enable all lights in the reverse direction.

Basic Programming

Configuring Sound Effects

Sound control CVs allow you to fully customize the decoder's sound effects to fit your preferences. All sound effects included in Econami are recordings from actual locomotives and simulate the reality of operating a diesel locomotive. This section shows you how to:

1. Select different prime movers, airhorns, bells, air compressors, and couplers in place of the default sound effects.
2. Customize diesel engine exhaust features, such as auto-start, auto-notching, manual notching, engine interlock, and dynamic braking modes.
3. Adjust the volume levels of primary sound effect mixer channels, and enable quiet mode.

Sound Control CVs

-
- CV 112: Sound Configuration 1
 - CV 113: Quiet Mode Time-Out Period
 - CV 114: Engine Exhaust Control
 - CV 120: Airhorn Select
 - CV 121: Auxiliary Airhorn Select
 - CV 122: Bell Select
 - CV 123: Prime Mover Select
 - CV 124: Air Compressor Select
 - CV 126: Coupler Select
 - CV 128: Master Volume
 - CVs 129-160: Primary Mixer Volume Levels
 - CVs 129-160: Primary Mixer Volume Levels

Selecting Sound Effects

You can select alternate prime movers, airhorns, bells, air compressors, and couplers with sound effect select CVs. You can find the available sound selections on the SoundTraxx website.

Select the Primary Airhorn

Enter a value from 0 to 15 into CV 120 (Airhorn Select) to select your desired primary airhorn. Turn on the long airhorn function (F2 by default) to blow the airhorn and press the function key again to stop the airhorn blast.

CV 120: Airhorn Select



- 0 = Airhorn 1 (default)
- 1 = Airhorn 2
- ↓
- 15 = Airhorn 16

Select the Alternate Airhorn

Use CV 121 (Auxiliary Airhorn Select) to select an alternate airhorn in place of the primary airhorn. The alternate airhorn is disabled by default. However, 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 42 to select the alternate airhorn; the alternate airhorn is disabled when CV 121 is set to a value of 0.

Note: CV 121 is set to 0 by default disable the alternate airhorn. By default, the short airhorn function will issue the short airhorn blast and the long airhorn function will issue the airhorn 1 sound effect.



Note: Econami UK diesel Decoders airhorn select CVs differ from the above charts.

CV 120 is used to select the forward facing airhorn and CV 121 is used to select the rear facing airhorn. Each value selects both the high and low notes for one set of two-tone airhorns. For example, if you set CV 120 (Airhorn Select) to a value of 2 you will hear both the



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high and low tones associated with that particular airhorn selection when the F1 and F2 keys are pressed. If you then set CV 121 (Alternate Airhorn Select) to a different value than 2 and change the locomotive's direction, you will hear a different high and low note when the F1 and F2 keys. This allows you to configure your UK locomotive with prototypical airhorns arrangements for both forward and reverse facing horns.

Select the Bell

Each decoder version has a selection of bells at varying ring rates. Refer to the Sound Selection Reference for the decoder to determine the correct values. Enter the desired value into CV 122 and turn on the bell function (F1 by default) to ring the bell. Press the function key again to stop the bell from ringing. Add a value of 128 to enable the grade-crossing bell. Enabling the grade-crossing bell in CV 122 allows the bell to ring during the crossing hold timer countdown after activating Grade-Crossing Logic with the whistle function (F2 by default). For more information about Grade-Crossing Logic, refer to "Configuring Lighting Outputs."



Note: On Econami UK Diesel Decoders, the F1 key is mapped to the high note of the two-tone airhorn, not the bell. The bell is disabled from the factory but can be mapped to any function key using Flex-Map function mapping technology

Select the Prime Mover

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 |
| ↓ |
| 4 = Prime mover 5 |



Note: Econami UK Diesel Decoders Prime Mover selections differ from the above chart. See the SoundTraxx website for a full list of Econami UK Diesel sound effects.

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

Enter a value from 0 to 2 into CV 126 (Coupler Select) to select your desired coupler. Activate the coupler selected in CV 126 with the couple (F13 by default) and uncouple (F13 by default). Add a value of 128 to invert the uncouple function polarity. Inverting the uncouple function polarity allows the uncouple sound effect to be activated when you turn off the uncouple function.

CV 126: Coupler Select



- | |
|------------------------------|
| 0 = Medium coupler (default) |
| 1 = Heavy coupler |
| 2 = Link-and-pin coupler |

Inverted Uncouple Polarity:

CV 126 + 128

The uncouple function polarity bit must be set in CV 126 in order to activate the uncouple sound effect by turning off the uncouple function. For example, when the couple and uncouple functions are mapped to the same function key and the uncouple function polarity is inverted in CV 126, turning on the couple function with the function key will activate the couple sound effect, and turning off the uncouple function with the function key will activate the uncouple



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sound effect. If the couple and uncouple functions are not mapped to the same function key and the uncouple function polarity is not inverted in CV 126, turning on the couple function will activate the couple sound effect, and turning on the uncouple function will activate the uncouple sound effect. To map effects to function keys F0-F28, Refer to “Configuring Function Mapping.”



Note: Econami UK Diesel Decoders coupler selections differ from the above chart. A fourth option (Buffers) is added with a corresponding value of 3 in CV 126.

Customizing the Diesel Engine

CV 114 (Engine Exhaust Control) is used to customize engine sound effects to fit your operating preferences.

CV 114: Adjust Auto-Notching Sensitivity

Add a value from 1 to 15 to CV 114 to adjust the number of speed steps within each engine RPM notch from 1 to 15. Auto-notching is set to 7 by default, but we recommend a value of 15 when DDE is enabled. You may use the RPM+ (F5 by default) and RPM- (F6 by default) functions to manually adjust the engine RPM notch level during operation when auto-notching is enabled.

Auto-Notching Sensitivity
CV 114 + 0 = Auto-notching disabled
CV 114 + 1 = 1 speed step
CV 114 + 2 = 2 speed steps
↓
CV 114 + 15 = 15 speed steps

CV 114: Enable Manual Notching

Set the auto-notching sensitivity level to 0 to enable manual notching and disable auto-notching. When manual notching is enabled, the engine RPM notch level will not be automatically adjusted in response to the throttle setting, and you must use the RPM+ and RPM- functions to adjust the engine RPM notch level during operation. Manual notching is intended for simulating the prototypical operation of a diesel locomotive and allows you to change the engine RPM notch level when most appropriate. Manual notching is disabled by default.

CV 114: Enable Engine Interlock

Add a value of 16 to CV 114 to enable engine interlock. When engine interlock is enabled, you must turn on the RPM+ function to start the prime mover before setting the locomotive into motion. Similarly, you will be unable to turn off the prime mover during movement. In other words, the locomotive must be stopped before you start or shut down the prime mover. Engine interlock is disabled by default.

CV 114: Enable Auto-Start

Add a value of 16 to CV 114 to enable engine interlock. When engine interlock is enabled, you must turn on the RPM+ function to start the prime mover before setting the locomotive into motion. Similarly, you will be unable to turn off the prime mover during movement. In other words, the locomotive must be stopped before you start or shut down the prime mover. Engine interlock is disabled by default.

CV 114: Select Dynamic Braking Modes

Selecting a dynamic braking mode will allow the decoder to set the engine RPM to a designated notch level when you turn on the dynamic brake function (F4 by default). Dynamic braking modes are disabled by default.

- Add a value of 64 to CV 114 to allow the decoder to set engine RPM to notch 1 (idle) when you turn on the dynamic brake function.



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- Add a value of 128 to CV 114 to allow the decoder to set engine RPM to notch 4 when you turn on the dynamic brake function.
- Add a value of 192 to CV 114 to allow the decoder to set engine RPM to notch 8 when you turn on the dynamic brake function.

Adjusting 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.

Adjust 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 Primary Mixer Volume Levels

CVs 129-160 (Primary Mixer Volume Levels) are used for setting the volume level of each sound effect, similar to a modern sound studio mixing board. Like CV 128 (Master Volume), values from 0 to 255 may be programmed into mixer channel CVs to adjust volume levels. 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 whistle, for instance, usually creates the loudest sound. Then, adjust the volume levels of the remaining of the sound effects relative to the whistle. When you have all the sound effects to their respective volume levels, adjust the overall volume level with CV 128 as needed.

Adjusting volume levels calls for a certain level of prudence to avoid “clipping” or “limiting,” which occurs when the sum of two or more signals exceeds the capacity of the output channel. Clipping is the clicking or popping sounds you may have heard through a pair of broken headphones. To avoid clipping, consider the sounds you play at the same time and make sure their volume levels aren’t set too high. For example, the whistle 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.

Refer to Table H on the next page to view default values for CVs 128-160.



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Table H. Primary Mixer Volume Levels

CV	Sound Effect	Default Value
129	Airhorn	225
130	Bell	85
131	Prime Mover	150
132	Air Compressor	100
133	Dynamic Brake	125
134	Radiator Fans	75
135	Reserved	0
136	Reserved	0
137	Coupler	128
138	Reserved	128
139	Brake Squeal	100
140	Brake Release	70
141	Reserved	0
142	Reserved	0
143	Poppet Valve	60
144	Reserved	0
145	Reserved	0
146	Reserved	0
147	Reserved	0
148	Emergency Stop.	70
149	Glad Hand Release	150
150	All Aboard/Coach Doors*	192



Note: on Econami UK Diesel Decoders, both high and low note volumes of the two-tone airhorn are controlled with CV 129. The “all aboard” sound effect is replaced with a Guard whistle effect.

Using Quiet Mode

You can enable quiet mode and set the quiet mode time-out period with CV 113 (Quiet Mode Time-Out Period). When CV 113 is set to a non-zero value, all sound effects will automatically turn off after the time-out period elapses when the throttle is set to zero and all functions are off. Entering values from 0 to 255 into CV 113 will set the time-out period from 1 seconds to 255 seconds. Use the equation below to calculate the quiet mode time-out period:

$$\text{Time-Out Period} = \text{CV } 113 \times 1 \text{ sec.}$$

* Not included in software releases prior to version 1.3



Basic Programming

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 if you're unable to activate them with function keys.

Automatic Sound CVs

CV 193: Auto-Bell On Set Point
CV 195: Coach Door Count
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, i.e., the value for enabling the auto-bell in analog mode is the same as the auto-bell value for DCC.

Table I 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

Enable the 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 126 to set the auto-bell speed step from 1 to 126, 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.

Enable the Auto-Brake

You can adjust the auto-brake sensitivity with CV 196 (Brake 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 sound effect's sensitivity. A value of 1 will activate the brake in response to decreases of 0.10 speed steps/second. A value of 255 will activate the brake in response to decreases of 25.5 speed steps/second:

$$\text{CV Value} = \text{Speed Steps/Second} \div 10$$

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

Note: The best results when using the Auto-Brake feature will occur with some momentum programmed in CV 3 (Baseline Acceleration Rate) and CV 4 (Baseline Deceleration Rate).

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Modifying Automatic Sound Effects

Sound control CVs additionally allow you to modify automatic sound effects, such as the coach door slams that occur after the conductor's "all aboard!" announcement.

Adjust the Coach Door Count

Enter a value from 0 to 15 into CV 195 (Coach Door Count) to adjust the random number of coach door slams that occur with the all aboard/coach doors function. Turn on the all aboard/coach doors function while the locomotive is stopped to activate the conductor's "all aboard!" announcement, followed by the random number of coach doors slams determined by the value of CV 195.

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



Note: On UK Econami Diesel Decoders, turning on F23 before leaving the station will issue a Guard whistle effect, not an "all aboard" announcement.

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.

* Not included in software releases prior to version 1.3



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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.
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:
 - $30 \text{ (seconds)} \div 0.25 = 120$
 - 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



Advanced Programming

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 that can be reproduced. 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.

Setting EQ Frequency Levels

CV 225 (Equalizer Control Register) is used primarily for setting the frequency levels of the equalizer to accommodate a range of speaker sizes. Enter a value from 1 to 4 into CV 225 to select preset cut/boost levels to match the diameter of your speaker diaphragm (smaller than 1” to larger than 4”). When CV 225 is set to a value of 7, you can enter values from 0 to 255 into CVs 226-232 (Cut/Boost Controls) to adjust the cut/boost of each band’s frequency level from +12dB to -12dB. CVs 226-232 are set to values of 128 by default, which indicates a flat response (0dB).

Refer to Table K on the next page to configure EQ Frequency Level CVs 225-232.

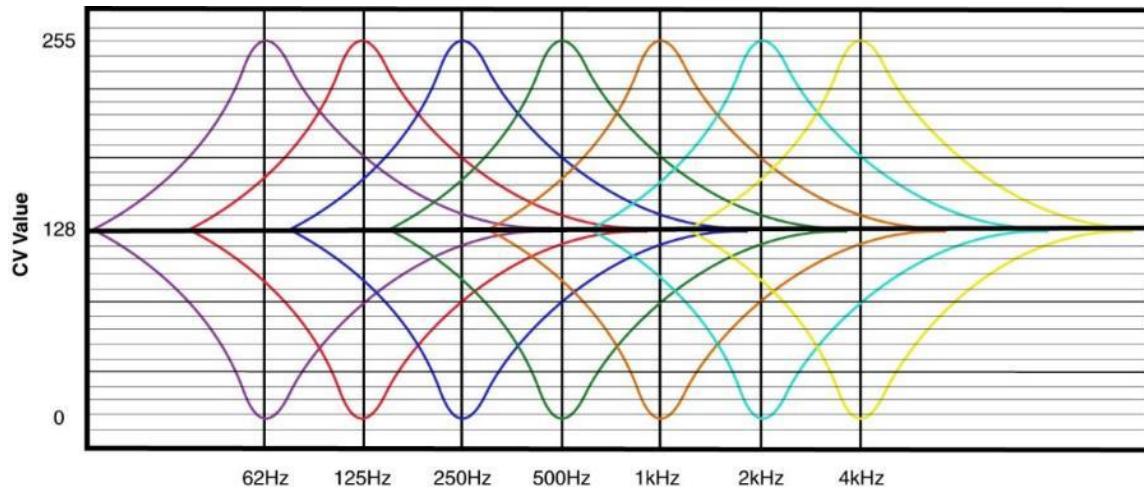
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Table K. EQ Preset Settings

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

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 adjusting the response with one CV will raise or lower the sounds of nearby frequencies as well.



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).

Note: Setting the cut/boost levels in CVs 226-232 to values that are too high may result in poor sound responses or damage the speaker. Ensure that equalizer settings do not exceed your speaker's power rating to avoid this.

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

Advanced Programming

Configuring Function Mapping

Function mapping CVs allow you to reassign any effect to any function key, enable effects to respond automatically to direction and movement changes, map an effect to the emergency stop button, and gives you the option of using NMRA “Legacy” function mapping. It’s easy to customize function assignments to fit any operating preference with Flex-Map function mapping technology!

Function Mapping CVs

CV 31: CV Index 1
CV 32: CV Index 2
CVs 33-46: Function Status CVs
CV 57: Forward Direction Enable
CV 58: Reverse Direction Enable
CVs 1.257-1.385: Effect Map Registers
CVs 1.385-1.512: Effect Auxiliary Map Registers

Note: To access *Indexed CV Page 1* with CVs 257-512, CV 31 (CV Index 1) must be set to a value of 16 (default) and CV 32 (CV Index 2) must be set to a value of 1 (default).

Function Mapping with Flex-Map Technology

To complement the decoder’s wide range of effects, Econami puts you in control of all function assignments. Flex-Map CVs determine default function assignments for Econami, and allow you to customize function keys and effects according to a simple and versatile format.

Customize Function Assignments

CVs 1.257-1.384 (Effect Map Registers) are used for function mapping. Each effect corresponds to a CV. The value of each CV determines the F0-F28 function key used to control that effect. Follow the steps below to use CVs 1.257-1.384 for customizing function assignments:

1. Ensure CV 31 (CV Index 1) is set to a value of 16.
2. Enter a value of 1 into CV 32 (CV Index 2) to select Index CV Page 1 as the active indexed CV page and enable access to CVs 1.257-1.384.
3. Access CVs 257-384 from your command station.
4. Enter a value from 0 to 28 into CVs 257-384 to map the corresponding effect to function keys F0-F28.
5. Enter a value of 255 to disable the corresponding effect.

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

Refer to Table L on the next page for a list of CVs 1.257-1.384 and corresponding effects.



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Table L. CVs 1.257-1.384
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: Uncouple
CVs 1.307-1.310: Reserved
CV 1.311: "All Aboard!"/Coach Doors* 
CV 1.312: Reserved
CV 1.313: Airhorn 2* (UK Only) 
CVs 1.314-1.320: Reserved
CV 1.321: E-Brake App.
CVs 1.322-1.384: Reserved

Table M. Default Function Assignments

F0-F28	Effect	CV	Value
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 1.301	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	Grade-Crossing Signal 	CV 1.278	9
F10	Not Assigned	N/A	N/A
F11	F11 Brake	CV 1.275	11
F12	Not Assigned	N/A	N/A
F13	Couple	CV 1.305	13
F13	Uncouple	CV 1.306	13
F14	Half-Speed	CV 1.276	14
F14	Mom. Override	CV 1.277	14
F15	Not Assigned	N/A	N/A
F16	Not Assigned	N/A	N/A
F17	Not Assigned	N/A	N/A
F18	Not Assigned	N/A	N/A
F19	Not Assigned	N/A	N/A
F20	Not Assigned	N/A	N/A
F21	Not Assigned	N/A	N/A
F22	Not Assigned	N/A	N/A
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
F28	Not Assigned	N/A	N/A

 **Note:** On Econami UK Diesel decoders the high note of the two-tone airhorn is mapped using CV 1.297 (Airhorn) and the low note is mapped using CV 1.313 (Airhorn 2). The short airhorn (CV 1.300) is replaced with a "high-low" effect which is mapped to the F3 key by default. The dynamic brake effect is also un-mapped in Econami UK Diesel decoders.

The Econami UK Diesel decoder does not support any other whistle signals besides the "high-low" signal mapped with CV1.301. As no other signals can be played, the F9 key is left unassigned. The Guard whistle sound effect replaces the "all aboard" effect mapped to the F23 key.

* Not included in software releases prior to version 1.3

Advanced Programming

Enabling Automatic Effects

To provide more versatility, Flex-Map function mapping CVs allow you to configure automatic effects that respond to direction and movement. Follow the steps below to enable automatic effects with CVs 1.385-1.512 (Effect Auxiliary Map Registers):

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

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

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

Forward-Standing: Effect is turned on when the locomotive is stopped in the forward direction.

Reverse-Standing: Effect is turned on when the locomotive is stopped in the reverse direction.

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

Table N. Auto-Effect Enable

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

Mapping Effects to the Emergency Stop Button

Any effect can be mapped to the emergency stop button with CVs 1.385-1.512. Follow the steps below to map an effect to the emergency stop button:

1. Ensure CV 31 is set to a value of 16.
2. Enter a value of 1 into CV 32.
3. Enter a value of 16 into CVs 385-512 to map the corresponding effect to the emergency stop button.

Note: Mapping a function to the E-Stop button will not change the Emergency Stop functionality. It will still stop the motor regardless of the effect that has been mapped to it.

Refer to Table O on the next page for a list of CVs 1.385-1.512 and corresponding effects.



Advanced Programming

Table O. CVs 1.385-1.512	
Effect Auxiliary 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: F11 Brake	
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	
CV 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: Couple	
CV 1.434: Uncouple	
CV 1.435-1.438: Reserved	
CV 1.439: All Aboard/Coach Doors (Guard Whistle) *	
CV 1.440: Reserved	
CV 1.441: Airhorn 2* (UK Only)	
CVs 1.442-1.448: Reserved	
CV 1.449: E-Brake App.	
CVs 1.450-1.512: Reserved	



Note: On Econami UK Diesel decoders CV 1.441 has been added to allow for auxiliary mapping of the low note used in the two-tone airhorn effect.

The Econami UK Diesel decoder does not support any other whistle signals besides the “high-low” signal mapped with CV1.428. As no other signals can be played, CVs 1.406-1.409 cannot be mapped to a standing or driving condition.

The Guard whistle sound effect replaces the “all aboard” effect mapped to the F23 key.

* Not included in software releases prior to version 1.3

Advanced Programming

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

You may want to use CVs 1.257-1.384 to map the grade-crossing signal to F4, dynamic brake to F10, and straight-to-eight to F9. Doing so will allow you to activate airhorn functions with F2, F3, and F4 and brake functions with F10, F11, and F12. The following example details mapping the grade-crossing signal (F9 by default), dynamic brake (F4 by default), and straight-to-eight (F10 by default) functions with CV 1.278 (Grade-Crossing Signal Map Register), CV 1.299 (Dynamic Brake Map Register), and CV 1.301 (Straight-to-Eight Map Register):

1. To map the grade-crossing signal next to the long airhorn (F2 by default) and short airhorn (F3 by default), enter a value of 4 into CV 278.
2. To map the dynamic brake next to the independent/train brake (F11 by default), enter a value of 10 into CV 299.
3. To map the straight-to-eight function to F9, enter a value of 9 into CV 301.
4. Activate airhorn functions with F2, F3, and F4.
5. Activate brake functions with F10, F11, and F12.
6. Activate straight-to-eight with F9.

Example: Setting Up Automatic Signals

You may want to use CVs 1.384-1.512 to enable automatic forward, reverse, and stop whistle signals. The following example details setting 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) to enable automatic whistle signals:

1. Enter a value of 1 into CV 407 to enable automatic forward signals when the locomotive is forward-driving.
2. Enter a value of 2 into CV 408 to enable automatic reverse signals when the locomotive is reverse-driving.
3. Enter a value of 12 into CV 409 to enable automatic stop signals when the locomotive is standing (regardless of direction).

Example: Mapping the Emergency Gyralite to the Emergency 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).



Advanced Programming

NMRA Standard 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.

Function Key	CV	HL Output	BL Output	Airhorn	Bell	FX3 Output	FX4 Output	Dynamo	Short Airhorn	Reserved	Reserved	Dimmer	Mute	Reserved	F11 Brake	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:

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



Note: On Econami UK Diesel Decoders, the low note of the tow tone airhorn replaces the "airhorn" effect. The "bell" effect is replaced with the high note of the two-tone airhorn.

Advanced Programming

Configuring Hyperdrive2

Econami features Hyperdrive2 advanced motor control, providing high-frequency and high resolution 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 regulate motor speed in response to back-EMF measurements.

Setting Engine Recovery Speed

Use CV 119 (Max Engine Recovery Speed) to designate the speed the motor will resume after momentary power losses. The recovery speed can be determined as a fixed speed step (absolute limiting) or a fraction of the throttle setting (proportional limiting).

The locomotive speed will start at speed-step 0 after power losses when CV 119 is set to a value of 0 or 128. CV 119 is set to a value of 204 by default. Entering a value from 1 to 127 will designate the recovery speed as a fixed speed step from 1 to 127 (absolute limiting). If the recovery speed step in CV 119 is greater than the last speed step before power loss, the decoder will resume the throttle setting being received from the command station.

CV 119: Max Engine Recovery Speed

0 = Disabled

1 = Speed-step 1

↓
127 = Speed-step 127 (absolute limiting)

128 = Disabled

129 = 1% of throttle setting (proportional limiting)

↓
255 = 100% of throttle setting (proportional limiting)

Entering a value from 129 to 255 will designate the recovery speed as a fraction of the current throttle setting (proportional limiting). Higher values indicate higher speed settings. The decoder calculates the recovery speed after power losses as:

$$\text{Recovery Speed} = (\text{CV 119} \times \text{Speed Step}) \div 127$$

Adjusting 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 operate smoother 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. 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.

Advanced Motor Control CVs

- CV 10: EMF Feedback Cutout
- CV 119: Max Engine Recovery Speed
- CV 209: PID Kp Parameter
- CV 210: PID Ki Parameter
- CV 211: Low-Speed Compensation
- CV 212: BEMF Feedback Intensity
- CV 215: BEMF Reference Voltage
- CV 216: Motor Speed-Step Deadband
- CV 217: Motor Control Register

Advanced Programming

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 (Manufacturer ID). Refer to "Introduction to Programming" for more information.

Use your CV settings 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, the decoder's default settings should provide satisfactory performance for most situations.

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.
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.

Advanced Programming

Setting 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 126 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:

$$\text{BEMF Intensity} = \text{CV 212} \times (1 - (\text{speed step} \div \text{CV 10})) \div 255$$

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 60 to 255 to set the back-EMF reference Voltage from 6 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 that the value entered in CV215 is equal to the observed voltage of the track output from your command station, so that the reference voltage is identical to your other decoders. To set this CV, simply take the observed voltage on your track and multiply it by 10 to calculate the programming value. For example, 12.5 Volts would be represented as a CV value of 125.

Setting the Motor Speed-Step Deadband*

CV 216 (Motor Speed-Step Deadband) determines the speed step at which voltage is first applied to the motor to set the locomotive in motion. Entering values from 1 to 126 into CV 216 will set the motor speed-step deadband from speed-step 1 to speed-step 126. 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.

* Not included in software releases prior to version 1.3



Advanced Programming

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 at speed-step 3.

Enabling Back-EMF and Auto-Stop

Back EMF is enabled by default to better regulate the operation of the motor. Disabling back-EMF control will deactivate all back-EMF regulated automatic features, such as Dynamic Digital Exhaust. Enter a value of 8 to enable auto-stop. Enabling auto-stop will bring the locomotive to a stop for 500ms before changing direction.

Configuring Advanced Consist Operation

A consist is made up of several units that are coupled together to operate as a complete train. In model railroading, “Advanced Consisting” means that the decoder is used to configure the consist, instead of the command station. Consists allow an easy way for a single operator to run a multi-unit lash-up, for example. You can use advanced consist CVs to determine the decoder’s consist address, set consist acceleration and deceleration rates, enable function keys F0-F28, and configure automatic effects.

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
-

Setting the Consist Address

Entering a value from 1 to 127 into CV 19 (Consist Address) will set the consist address from 1 to 127 for all units in the forward direction. Entering values from 129 to 255 into CV 19 will set the consist address from 1 to 127 for all units in the reverse direction (more common in diesel operations). Because the consist address is specific to direction, ensure all units are correctly oriented. Entering a value of 0 or 128 into CV 19 will disable the consist address.

After setting the consist address, the decoder will still respond to the active primary or extended address for all commands except speed and direction data. The decoder will not recognize programming commands sent to the consist address in Operations Mode, and will only respond to programming commands sent to the decoder’s primary or extended address.

Enabling Consist Functions

CV 21 (Consist Function Enable 1), CV 22 (Consist Function Enable 2), CV 245 (Consist Function Enable 3), and CV 246 (Consist Function Enable 4) allow you to enable functions for advanced consist operation when a valid consist address is active in CV 19.

Note: You can enable the effects mapped to function keys in CVs 1.257-1.384 (Effect Map Registers) for advanced consist operation with CVs 21, 22, 245, and 246. Refer to “Using Econami” to default function assignments for F0-F28, and refer to “Configuring Function Mapping” to customize Flex-Map function mapping CVs.

Follow the steps on the next page to enable functions for advanced consist operation.

Advanced Programming

Consist Function Enable 1-4

The following procedure details enabling effects mapped to 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. Enter each value into CVs 21, 22, 245, and 246 to enable your preferred functions 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 = _____

Advanced Programming

Setting Consist Momentum Rates

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.

Enabling Consist Automatic Effects

To provide more versatility, CV 247 (Consist Function Enable 5) 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 Q shows the CV values for configuring effects to respond according to the following circumstances:

Forward-Driving: Effect is turned on when the consist is moving in the forward direction.

Reverse-Driving: Effect is turned on when the consist is moving in the reverse direction.

Forward-Standing: Effect is turned on when the consist is stopped in the forward direction.

Reverse-Standing: Effect is turned on when the consist is stopped in the reverse direction.

Emergency Stop: Effect is turned on when the consist receives an Emergency Stop command.

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

Table Q. CV 247 Auto-Effect Enable

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
16	Emergency Stop Button pressed

Advanced Programming

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.

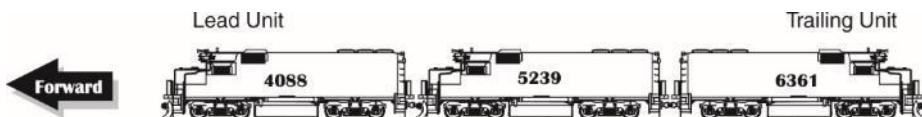


Table S. Consist Example					
No.4088		No.5239		No.6361	
Direction: Normal		Direction: Normal		Direction: Inverted	
CV 19 Value	40	CV 19 Value	40	CV 19 Value	168
CV 21 Value	139	CV 21 Value	136	CV 21 Value	136
CV 22 Value	1	CV 22 Value	0	CV 22 Value	2

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 Econami is designed to be operated in DCC, you can still use a conventional powerpack on a DC layout. The decoder operates entirely in response to track voltage when analog mode is enabled. Keep this in mind when configuring analog mode operation to take full advantage of the features offered by Econami.

Note: *Analog mode is disabled by default.*

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 219: Analog Mode Engine Start Voltage
 - CV 241: Analog Mode Function Enable 3
 - CV 242: Analog Mode Function Enable 4
 - CV 243: Analog Mode Function Enable 5
-

Enabling Analog Mode

To enable analog mode, first enter a value of 1 into CV 12 (Alternate Power Source), then set bit 2 (APS) of CV 29 (Configuration Data 1) to 1. This will allow the decoder to receive an analog power source when a DCC signal is not available. For more information about adjusting the settings of CV 29, refer to “Configuring the Decoder.”

Operating in Analog Mode

When analog mode is enabled, the decoder will be inoperative until track voltage is received from the powerpack. Increasing the throttle setting to roughly 6 Volts will deliver enough voltage to power the decoder’s internal circuitry and activate automatic sound effects while the locomotive is stopped. Increasing the throttle setting to roughly 8 Volts will set the locomotion in motion. You may use the throttle to control locomotive speed from this point. Keep in mind that you can only change direction when the locomotive is stopped. To improve low-voltage operation, the decoder automatically adjusts motor processes and sound effect volume in response to back-EMF voltage measurements to compensate for changes in motor load. Refer to “Configuring Hyperdrive2” for more information about motor control.

Note: *Do not exceed the input voltage rating of the decoder as stated on the product packaging. This will permanently damage the decoder! Decrease the throttle setting to zero immediately if this occurs. Refer to “Troubleshooting” to view each error code.*

Enabling Analog Mode Functions

When operating in analog mode, the effects mapped to function keys F0-F28 will turn on automatically when track voltage is received, and will stay on until track voltage is removed. CV 13 (Analog Mode Function Enable 1), CV 14 (Analog Mode Function Enable 2), CV 241 (Analog Mode Function Enable 3), and CV 242 (Analog Mode Function Enable 4) allow you to enable functions in analog mode. The decoder will automatically turn on all functions enabled for analog mode when track voltage is received.

Note: *You can enable the effects mapped to function keys in CVs 1.257-1.384 (Effect Map Registers) for analog mode operation with CVs 13, 14, 241, and 242. Refer to “Using Econami” to default function assignments for F0-F28, and refer to “Configuring Function Mapping” to customize Flex-Map function mapping CVs.*

Follow the steps on the next page to enable functions for analog mode operation.



Miscellaneous Features

Analog Mode Function Enable 1-4

The following procedure details enabling effects mapped to F0(f), F0(r), and F1-F28 for analog mode operation:

1. Circle the CV values associated with your preferred effects mapped to function keys F0-F28.
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. Enter each value into CVs 13, 14, 241, and 242 to enable your preferred functions for analog mode operation.

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 = _____



Miscellaneous Features

Enabling Analog Mode Automatic Effects

To provide more versatility, CV 243 (Analog Mode Function Enable 5) 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 S shows the CV values for configuring effects to respond according to the following circumstances:

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

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

Forward-Standing: Effect is turned on when the locomotive is stopped in the forward direction.

Reverse-Standing: Effect is turned on when the locomotive is stopped in the reverse direction.

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

Table S. CV 243 Auto-Effect Enable	
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

Set the Analog Mode Start Voltage

CV 218 (Analog Mode Motor Start Voltage) can be used to set the track voltage level at which power is applied to the motor to avoid the “motor-boating” effects that sometimes occur when using marginal powerpacks.

Entering a value of 0 into CV 218 will set the starting voltage to 6V. Entering a value of 255 into CV 218 will set the starting voltage to the maximum setting. Set CV 218 to the lowest value that still achieves desired results. The motor will not start when the voltage level in CV 218 is set to an excessively high value.

Note: Starting the motor at too low a voltage can cause the voltage from the powerpack to sag, resulting in a condition where the decoder loses power when attempting to power the motor.

$$\text{Starting Voltage} = (\text{CV } 218 \div 10) + 6\text{V}$$

Set the Analog Mode Engine Start Voltage*

CV 219 is used to adjust the voltage level applied to activate engine exhaust sound effects in analog mode. The engine exhaust start voltage is calculated as a fraction of the minimum voltage required to power the decoder (6V). Starting voltage is calculated as:

$$\text{Starting Voltage} = (\text{CV } 219 \div 10) + 6\text{V}$$

Entering a value of 0 into CV 219 will set the engine exhaust start voltage level to 6V. Entering a value of 255 into CV 219 will set the engine exhaust start voltage level to the maximum setting.

* Not included in software releases prior to version 1.3



Miscellaneous Features

CV 218 (Analog Mode Motor Start Voltage) determines the voltage level applied to start the motor in analog mode. Set CV 218 to a value greater than the value of CV 219 to ensure engine exhaust sound effects are activated prior to motor start. If the engine exhaust start voltage level in CV 219 is greater than the motor start voltage level in CV 218, engine exhaust sound effects will be activated when the motor start voltage is reached.

Note: *Econami performs 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.*



Troubleshooting

Sorting Out Decoder Difficulties

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. We suggest you perform your diagnostics with the decoder on the programming track. 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 set 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.
- CV 64 (Master Brightness) has been set to a value of 0.
- Lightbulbs are burned-out.
- If you're using 1.5 volt micro-bulbs, the resistor value is too large.
- The lamp wires are broken.



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

- 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 is one blue and one red LED mounted on the circuit board that act as diagnostic indicators and 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.

Note: *The fault light is connected in series with the decoder’s FX6 output (F27 by default) and will illuminate in a steady “on” state when that function is on. This is not an error code but can be used to check for proper operation of the fault light on a decoder.*



Troubleshooting

Error Codes

Error codes indicate problems that are easily solved. The decoder's error codes are shown below for reference.

Error 10: Over-Voltage Fault

Voltage is monitored during normal operation to automatically deactivate sound and motor processes when voltage exceeds the decoder's voltage limit. Settings resume when the voltage is reduced to within limits and will vary between decoder models.

Note: *The decoder's absolute maximum voltage input varies with decoder model, generally between 22 and 27 volts! Refer to the decoder's packaging for actual voltage limits as exceeding these limits 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 105% of the decoder's rating. Power is returned to the motor after 100ms. The motor remains inactive if current-overload persists.

Error 16: CV Reset

This 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, which cannot be remedied and require factory repair:

Error 5: EEPROM 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)									
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	
CV 5: Vhigh	
CV 6: Vmid	
CV 7: Manufacturer Version (Read-Only)	
CV 8: Manufacturer ID	
CV 10: EMF Feedback Cutout	
CV 11: Packet Time-Out Value	
CV 12: Alternate Power Source	
CV 13: Analog Mode Function Enable 1	
CV 14: Analog Mode Function Enable 2	
CV 15: CV Unlock Code	
CV 16: CV Lock ID	
CVs 17-18: Extended Address	
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 25: Speed Table Enable	
CV 29: Configuration Data 1	
CV 30: Error Information	
CV 31: CV Index 1 (Read-Only)	
CV 32: CV Index 2	
CV 33: F0(f) Output Location	
CV 34: F0(r) Output Location	
CV 35: F1 Output Location	
CV 36: F2 Output Location	
CV 37: F3 Output Location	
CV 38: F4 Output Location	
CV 39: F5 Output Location	
CV 40: F6 Output Location	
CV 41: F7 Output Location	
CV 42: F8 Output Location	
CV 43: F9 Output Location	
CV 44: F10 Output Location	
CV 45: F11 Output Location	
CV 46: F12 Output Location	
Lighting Effect CVs	
CV 49: Headlight Effect Select	
CV 50: Backup Light Effect Select	
CV 51-54: FX3-FX6 Effect Select	
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	
	Speed Table CVs
	CV 66: Forward Motor Trim
	CVs 67-94: Custom Speed Table
	CV 95: Reverse Motor Trim
	User Information CVs
	CV 105: User Identifier 1
	CV 106: User Identifier 2
	Sound Control CVs
	CV 113: Quiet Mode Time-Out Period
	CV 114: Engine Exhaust Control
	CV 117: F11 Brake Rate
	CV 119: Max Engine Recovery Speed
	CV 120: Airhorn Select
	CV 121: Auxiliary Airhorn Select
	CV 122: Bell Select
	CV 123: Prime Mover Select
	CV 124: Air Compressor Select
	CV 126: Coupler Select
	CV 128: Master Volume
	CVs 129-150: Mixer Channel Volume Control
	CV 193: Auto-Bell On Set Point
	CV 194: Auto-Bell On Time
	CV 195: Coach Door Count*
	CV 196: Brake Squeal Sensitivity
	CV 197: Analog Mode Auto-Sound Enable
	CV 198: DCC Mode Auto-Sound Enable
	CV 200: Poppet Valve Release Rate
	Advanced Motor Control CVs
	CV 209: PID Kp Parameter
	CV 210: PID Ki Parameter
	CV 211: Low-Speed Compensation
	CV 212: BEMF Feedback Intensity
	CV 213: BEMF Sample Period
	CV 214: BEMF Sample Aperture Time
	CV 215: BEMF Reference Voltage
	CV 216: Motor Speed Step Deadband*
	CV 217: Motor Control Register
	CV 218: Analog Mode Motor Start Voltage
	CV 218: Analog Mode Engine Start Voltage*
	7-Band Equalizer CVs
	CV 225: Equalizer Control Register
	CVs 226-232: Cut/Boost Controls
	Analog Function Enable CVs
	CV 241: Analog Mode Function Enable 3
	CV 242: Analog Mode Function Enable 4
	CV 243: Analog Mode Function Enable 5
	Consist Function Enable CVs
	CV 245: Consist Function Enable 3
	CV 246: Consist Function Enable 4
	CV 247: Consist Function Enable 5
	Index Page 1: Extended Function Mapping CVs
	CVs 1.257-1.384: Effect Map Registers
	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 your Econami Digital Sound Decoder packaging. Breaking the seal on the packaging indicates you have accepted the license terms detailed herein. If you received the Econami Digital Sound Decoder pre-installed from your dealer, using the product indicates your acceptance of the license terms detailed herein. If you do not agree with the terms, return the unopened package to the dealer within thirty (30) days to receive a refund of purchase.

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.
- B. Title and ownership of the software/firmware, sound recordings, documentation and accompanying materials, if any, and all associated intellectual property rights remain with SoundTraxx.
- C. The structure, organization, and code of the software/firmware are the valuable properties of SoundTraxx. You may not make copies of the hardware, software/firmware, code, or any portions thereof. You are not to modify, adapt, translate, reverse engineer, de-compile, disassemble or create derivative works based on the hardware or software/firmware.
- D. Unauthorized copying of the software/firmware or documentation, or failure to comply with the above restrictions, will result in automatic termination of this Agreement. This Agreement does not grant you any intellectual property rights.



Appendix D: Service and Warranty Policy

90-Day Safety-Net Service Warranty

All SoundTraxx Digital Sound Decoders are tested thoroughly during production and are warranted to be operational and free of manufacturing defects before shipment. However, in the event an error occurs during installation, SoundTraxx will cover the repair under the conditions of our Safety-Net Service Warranty. If you damage the Digital Sound Decoder or it fails to operate within the first ninety (90) days, SoundTraxx will repair or replace the product free-of-charge under the following conditions:

- A. The original sales receipt confirming purchase from an authorized SoundTraxx dealer must accompany the product. The date-of-purchase shown on the receipt must be within the last 90 days. SoundTraxx will return the original receipt with your repaired unit.
- B. The product must show no signs of damage of which resulted from unauthorized repairs or modifications. This includes, but is not limited to:
 - Removal of the shrink tubing from the decoder
 - Drilled or enlarged circuit board holes
 - A cut or trimmed circuit board
- C. The Digital Sound Decoder must be returned properly packaged and insured, with postage paid; SoundTraxx is not responsible for products 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.

Visit www.soundtraxx.com/support to view complete warranty information.

Contacting Support

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

SoundTraxx Customer Service Department

141 Burnett Drive
Durango, CO 81301, USA
Phone: (970) 259-0690
support@soundtraxx.com



Appendix E: Declaration of Conformity

Declaration of Conformity

We, Throttle Up! Corp., dba SoundTraxx, 141 Burnett Drive, Durango, Colorado USA, declare in sole responsibility that the following products:

Product Description

Econami Digital Sound Decoders

Model Numbers

ECO-100, ECO-200, ECO-21PNEM, ECO-PNP

Part Numbers

882001, 882002, 882006, 882004, 882101, 882102, 882106

comply with all relevant regulations of the following directive:

2014/30/EU Electromagnetic Compatibility (EMC Directive)

and that the following harmonized standards have been applied:

EN 55014-1:2006 + A1: 2009 Part 1: Emissions

EN 55014-2:1997 + A2: 2008 Part 2: Immunity