

**SOUNDTRAXX™**  
**DCC** 

**SOUNDTRAXX DCC**  
**DIGITAL SOUND DECODER**  
**LC SERIES**

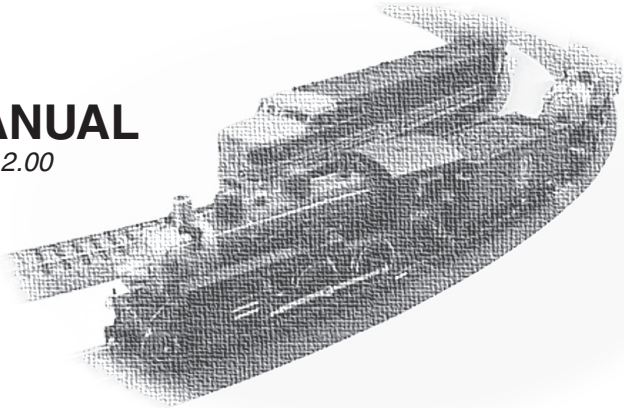
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**LC Series**

**OWNER'S MANUAL**

*Software Release 2.00*

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# Table of Contents

|   |           |
|---|-----------|
| <b>All Aboard .....</b>                                       | <b>4</b>  |
| <b>DSD-LC Features and Specifications .....</b>               | <b>5</b>  |
| <b>Pre-Installation Checklist.....</b>                        | <b>6</b>  |
| <b>Installation.....</b>                                      | <b>7</b>  |
| Step 1. Select Your Locomotive .....                          | 7         |
| Step 2. Test the Motor Stall Current .....                    | 7         |
| Step 3. Plan the Installation .....                           | 8         |
| Step 4. Isolate the Motor .....                               | 10        |
| Step 5. Modify the Tender Body or Locomotive Shell .....      | 11        |
| Step 6. Fit the Speaker .....                                 | 11        |
| Step 7. Secure the Speaker in Place .....                     | 11        |
| Step 8. Install and Wire the Decoder .....                    | 12        |
| Step 9. Test the Installation .....                           | 13        |
| <b>Quick Start .....</b>                                      | <b>14</b> |
| <b>Programming the CVs.....</b>                               | <b>15</b> |
| <b>Programming Methods .....</b>                              | <b>16</b> |
| Step 1: Configuring the Address.....                          | 17        |
| Step 2: Configuring the Decoder .....                         | 18        |
| Step 3: Configuring the Throttle.....                         | 19        |
| Step 4: Configuring for Consist Operation.....                | 22        |
| Step 5: Function Mapping.....                                 | 24        |
| Step 6: Configuring the Lighting Outputs.....                 | 25        |
| Step 7: Configuring the Sound Effects .....                   | 27        |
| Step 8: Miscellaneous Settings .....                          | 30        |
| Step 9: Resetting the CVs or Starting Over.....               | 31        |
| <b>Troubleshooting.....</b>                                   | <b>32</b> |
| <b>Obtaining Technical Support.....</b>                       | <b>33</b> |
| <b>Appendix A - Decimal-Hex-Binary Conversion Table .....</b> | <b>34</b> |
| <b>Appendix B - CV Usage Summary Table .....</b>              | <b>35</b> |
| <b>Service and Warranty Policy.....</b>                       | <b>36</b> |

## ALL ABOARD!

Congratulations on the purchase of your SoundTraxx™ LC Series Digital Sound Decoder™ (DSD-LC). Properly installed, the DSD-LC will provide all the pleasures of high quality, digital onboard sound and the benefits of today's DCC (Digital Command Control) technology. With the proper tools, basic modeling skills and common sense, equipping a locomotive with sound is not difficult. It may, however, be a new experience for you, and you will find that successive installations will go more quickly than the first. Please note that while each decoder is tested thoroughly before it is shipped, we cannot control the correctness or quality of the installation. It is imperative that you follow the directions, and never remove the protective heat shrink from the decoder (if applicable); there are no adjustments or user serviceable parts and this will void your warranty.

This Owner's Manual covers the features, installation, and operation of the following Digital Sound Decoder models with Version 2.0 software:

- DSD-100LC
- DSD-B280LC
- DSD-AT100LC
- DSD-KT100LC
- DSD-LL100LC
- DSD-C628LC

If this is your first decoder installation, this Owner's Manual will provide you with all the information you need to get started. Also available for purchase is the **LC Series Decoder Technical Reference** (PN 140069) written for the experienced user who wishes to have a complete reference for advanced programming techniques.

Technical bulletins covering various topics are also published from time to time, and these, along with the Technical Reference may be downloaded free of charge from our website at [www.soundtraxx.com](http://www.soundtraxx.com).



**CAUTION: The DSD-LC Series of decoders are designed to work at track voltages between 7.5 and 16 volts maximum. On most command stations, this corresponds to a track setting of N or HO. Do NOT use the O or G scale settings!**

**Operating your DSD-LC at voltages greater than 16 volts will void your warranty, produce excessive heat and possible permanent damage to the DSD.**

## DSD-LC FEATURES AND SPECIFICATIONS

The Digital Sound Decoder is designed to be installed onboard a locomotive in conjunction with a miniature speaker to provide the ultimate in realism and control. The DSD-LC integrates a full-featured digital sound system, a Hyperlight™ and a DCC decoder into a single miniature electronic module. The modeler is thus freed of the expense and frustration of trying to fit multiple pieces of equipment into an often space limited locomotive.

### Decoder Features

- *Compatible with NMRA DCC Standards and Recommended Practices as defined by S-9.1, S-9.2, RP-9.1.1, RP-9.2.1, RP-9.2.2, RP-9.2.3 and RP-9.2.4.*
- *Supports short address mode for compatibility with 'simple' systems.*
- *Supports extended address mode for assigning any locomotive number up to 9,999.*
- *Supports advanced consist addressing.*
- *Supports 'Operation Mode Programming', allowing CVs to be changed on the mainline without using a programming track.*

### Throttle Features

- *Supports 14, 28 and 128 speed step modes.*
- *Programmable acceleration, deceleration and starting voltage for prototypical starting and stopping.*
- *Use of standard and alternate speed tables*
- *The LC-Series Digital Sound Decoders are suitable for engines whose stall current does not exceed 1-Amp.*

### Lighting Features

- *Two function outputs for headlight and backup light. (Certain models may have up to two additional outputs.)*
- *Supports "Rule 17" operation.*
- *100mA Current Sink Capacity*
- *Each output may be programmed with one of 15 selectable Hyperlight effects to simulate ditch lights, mars lights, beacons and more (NOTE: DSD-100LC supports on/off and dimmable light effects only).*

### Steam Sound Features

- *Steam Exhaust Chuff*
- *Three Selectable Whistles, representing Light, Medium and Heavy Steam*
- *Bell*
- *Air-pump*
- *Separate Volume Controls for each sound effect.*
- *1-Watt Audio Amplifier*
- *Auto-Exhaust™ allows chuff to be synchronized to the locomotive speed without the complexity of a synchronizing cam.*
- *Dynamic Digital Exhaust™ modifies exhaust volume and cutoff as locomotive load changes.*

### Diesel Sound Features

- *Engine Exhaust and Turbo Whine (if appropriate)*
- *Three Selectable Airhorns, representing popular single-chime, three-chime and 5-chime airhorns*
- *Bell*
- *Dynamic Brakes*
- *Separate Volume Controls for each sound effect*
- *1-Watt Audio Amplifier*

## PRE-INSTALLATION CHECK LIST

It will be a great temptation to begin connecting wires immediately. Before you install your DSD-LC, there are some simple precautions you should take.

**First, read the instruction sheet that came with your decoder carefully! Models do vary and you should not assume the installation of one DSD-LC is identical to another. Then finish reading this Owner's Manual!**

- The DSD-LC should be handled carefully in a static-free environment. To discharge static electricity, touch a water pipe or grounded, metal surface before handling the decoder.
- Never remove the decoder's protective shrink tubing. First, you will void your warranty and second, you will compromise the decoder's built in thermal management system.
- Never make connections to the decoder while it is powered, Doing so makes for an accident waiting to happen,
- Make sure all electrical connections are insulated. Avoid using electrical tape as it tends to unravel over time. We recommend using heat shrinkable tubing instead.
- Never allow the decoder leads to come in contact with any DCC track wiring except those specifically designed for that purpose.
- Never allow speaker outputs to become shorted together,
- Never allow motor outputs to become shorted together.
- Do not exceed the output ratings for which the decoder is designed.
- Take your time and have fun!

### Tools and Materials You Will Need

In addition to the common hand tools found on most modeler's workbenches, you should have at your disposal:

- Low wattage (under 25 watts) solder iron
- Rosin Core Solder
- Hobby Knife
- High Speed Motor Tool (such as a Dremel)
- Miniature Screwdriver Set
- Diagonal Cutters
- Multi-meter
- Double Sided Tape
- Silicone RTV
- Heat gun
- Assorted sizes of heat-shrink tubing (SoundTraxx PN 810037)
- Insulative Tubing (SoundTraxx PN 810036)

*We also recommend the following items to aid your installation*

**Microconnectors** facilitate easy separation of items like speakers from the locomotive. SoundTraxx offers an economical 2 pin connector (PN 810012) and a 10 pack of mini-micro connector pins and sockets (PN 810058).

SoundTraxx offers two sizes of 1.5 Volt **micro-bulbs** for use with the DSD-LC's lighting effects. PN 810022 is a 1.3mm diameter bulb and PN 810024 is a 2.5mm diameter bulb. Bulbs are also available in economical six-packs.

SoundTraxx offers a variety of high quality, **miniature speakers** suitable for use with the DSD-LC. Choose the largest speaker that can be fit into the locomotive.

|        |                         | SUITABLE SCALES |          |         |         |         |
|--------|-------------------------|-----------------|----------|---------|---------|---------|
| P.N.   | SPEAKER SIZE            | N-Scale         | HO-Scale | S-Scale | O-Scale | G-Scale |
| 810083 | 3/8" Speaker            | ●               | ●        |         |         |         |
| 810089 | 1/2" Speaker            | ●               | ●        |         |         |         |
| 810053 | 3/4" Speaker            | ●               | ●        |         |         |         |
| 810054 | 1" Speaker              |                 | ●        | ●       | ●       |         |
| 810055 | 1-1/2" Speaker          |                 | ●        | ●       | ●       |         |
| 810056 | 2" Speaker              |                 |          | ●       | ●       |         |
| 810087 | 2-1/2" Speaker          |                 |          | ●       | ●       | ●       |
| 810057 | 3" Speaker              |                 |          | ●       | ●       | ●       |
| 810112 | 1.0" X 0.56" Oval       | ●               | ●        | ●       | ●       |         |
| 810113 | 1.38" X 0.63" Oval      |                 | ●        | ●       | ●       |         |
| 810103 | 1.56" X 0.78" Oval      |                 | ●        | ●       | ●       |         |
| 810078 | 1.1" X 1.57" Oval       |                 | ●        | ●       | ●       |         |
| 810086 | 1" X 1" X .38" Edgeport |                 | ●        | ●       | ●       |         |

## INSTALLATION

### Step 1. Select your Locomotive

If this is the first time you have installed sound in a locomotive, then we suggest you choose your locomotive carefully. A few simple precautions will ensure that your first effort produces a great sounding locomotive instead of an intimidating ball of wires:

- *Don't* pick a locomotive whose stall current draw exceeds the rating of the decoder.
- *Do* pick a smooth running locomotive that runs well on straight DC power. A smooth running mechanism is vital for good throttle control and enhances the realism of the sound. Dirty, worn out or binding mechanisms not only overload the decoder, but also will have trouble starting smoothly and will destroy the illusion created by the Auto-Exhaust feature if they barely lurch along at half throttle.
- *Do* start with an engine that is 'sound-ready' if possible, such as an engine with predrilled speaker holes, for example, or diesel with a roomy 'B' unit. The simpler you can make your first installation, the better.
- *Don't* pick a noisy engine, or one, which experiences some arcing or sparking when in operation. The best sound will come from locomotives powered with can motors. Older, open-frame motors may produce an offensive, interference sound.

### Step 2. Test the Motor Stall Current

Test the locomotive's stall current to ensure that it is compatible with the DSD-LC you are planning to install.

1. Place the locomotive on a section of track powered by a conventional DC power pack set to 12 volts for N scale, and 14 volts for HO and S scales.
2. Connect a DC ammeter in series with one of the track feeders as shown in Figure 1. If your power pack has built in meters, they may be used for this purpose.
3. While grasping the locomotive to prevent it from taking off, turn the power pack on.
4. Stop the motor from turning by firmly pushing it down into the track or grabbing hold of the flywheel or drive shaft.

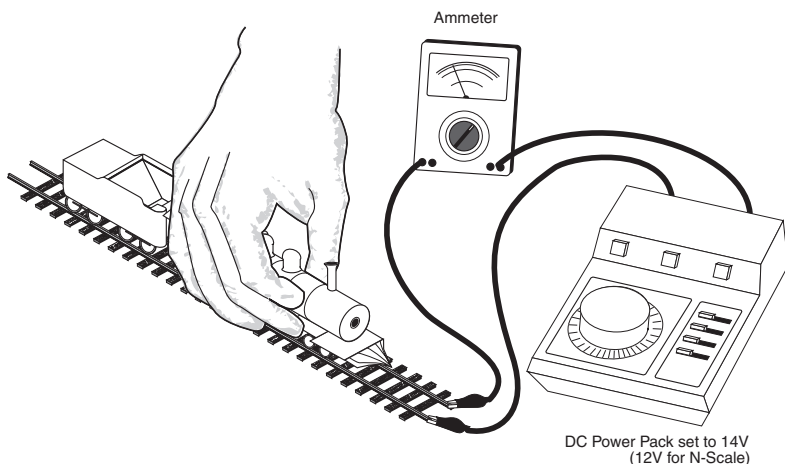


Figure 1 - Current Draw Test

- To ensure the most accurate measurement, be sure that the power pack voltage remains at the voltage set in Step 1 of this test.
- Measure the current the locomotive is drawing while the motor is stalled. This is the stall current and must be less than the decoder's rated capacity.

### Step 3. Plan the Installation

You should give some thought to where the installation of the various DSD-LC components will be within the locomotive before you get started. Figure 2 shows typical installations for a steam and diesel locomotive.

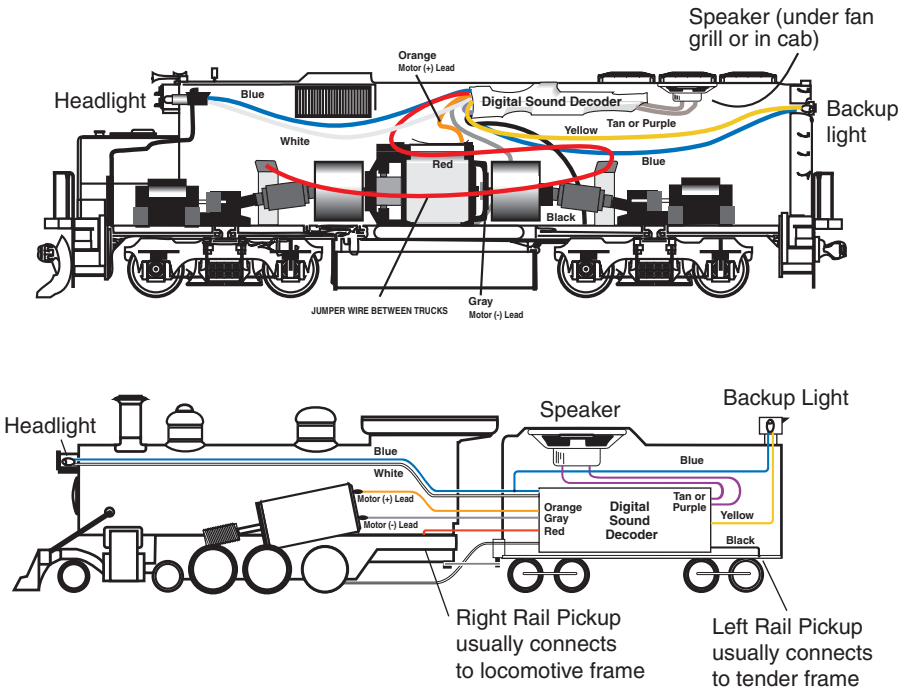


Figure 2 - Typical Sound Installations

### Speaker Considerations

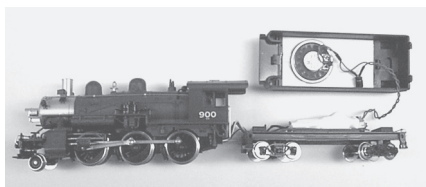
You will want to use the largest speaker possible to get the best volume and bass response.

The decision most critical to the success of your installation will be where to put the speaker. Obviously, the 'where' of speaker installation will depend on the size and type of the locomotive. But when considering the speaker's location, remember that the volume of the speaker will be greatly enhanced when the speaker is fitted into a small airtight enclosure with the front of the speaker open to surrounding air. The reason for this is simple: in order to generate any appreciable sound, the speaker must develop air pressure. Without an enclosure, an opposite pressure behind the speaker cancels any pressure developed by the front of the speaker. The enclosure isolates the front and back surfaces of the speaker, thereby increasing the sound pressure and hence, the volume.

Additionally, the enclosure must be sized proportionally to the speaker such that the volume of air enclosed is several times larger than the speaker diameter. If an enclosure is too small, it will interfere with the speaker operation and although it cannot be made too large, there is a point of

diminishing return. As a rule of thumb, for small speakers, the minimum for the length, width and height should be equal to the speaker diameter. Thus the smallest enclosure for a 1" speaker would be 1" X 1" X 1", while 2" X 2" X 2" would be the smallest size enclosure for a 2" speaker. As this is only a general guideline, exceptions can and must be made in many circumstances.

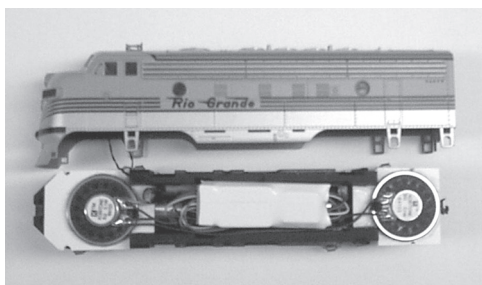
**HOWEVER, the use of a proper speaker enclosure cannot be over emphasized and failure to use one is almost always the cause for poor sound quality.**



*Figure 3 - (Above) A typical speaker installation using the tender as the speaker enclosure.*

In the case of a steam loco tender or a dummy diesel unit, the body shell can serve as the speaker enclosure. In this case, mount the speaker facing down through an opening in the floor or up through an opening in the coal load or perhaps a fan grill.

*Figure 4 - (Right) A typical speaker installation in a powered diesel locomotive. Note the use of two speakers.*



The speaker enclosure need not be fancy and can be fabricated from sheet styrene, bass wood, and even cardboard in a pinch! A 35mm film canister usually produces excellent results, as does a pill bottle or the cardboard tube center of a roll of paper towels. SoundTraxx also offers a self-enclosed speaker (PN 810086) that is useful in extremely tight quarters. The figures below show several types of speaker enclosures.



*Figure 5 - Speaker Enclosures*

### ***Decoder Considerations***

It is normal for the DSD-LC to get warm after periods of extended operation and its thermal overload protection will shut down the audio amplifier if it gets too warm. Therefore, it is important to install the DSD-LC in a location where it can dissipate the most heat. Avoid placing the DSD-LC near heat sources such as the motor or lights.

### ***Lighting Considerations***

Each DSD-LC is equipped with two to four function outputs that are intended to drive headlight,

backup light and special effect lights. The outputs can be independently programmed for a multitude of Hyperlight effects and may be used in a variety of ways. See page 25 for more information. Each output is rated for 100mA.

**Do not exceed this rating!** Be sure that the combined current of all lights as well as the motor stall current measured in Step 2 does not exceed the decoder's current rating.

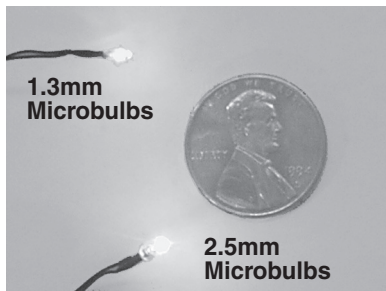


Figure 6 - Microbulbs for use with Hyperlight effects

The DSD-LC lighting outputs may be used with 12-16 volt incandescent lamps or 1.5-volt microbulbs. The DSD-LC is **not** designed for use with LEDs as they may glow faintly even when the function is turned off.



Figure 7 - Mini-connectors can make installation easier

#### **Other Considerations**

Finally, you will need to decide whether or not to hardwire the electrical connections or use a plug-able connector. A connector will allow you to easily separate the components for storage, painting and service easier but also opens the possibility of accidentally damaging the

decoder by reversing the connector during reassembly. Hardwiring the decoder will prevent this possibility at the expense of making separation more difficult.

After you have fully read the installation instructions that came with your decoder, we suggest you draw yourself a schematic showing all connections between the DSD-LC and various sub-components. This will help you determine which type of connector is best suited for your needs.

#### **Step 4. Isolate the Motor**

The two motor brush connections must be electrically isolated so they are driven **exclusively** by the DSD-LC motor outputs. We're not kidding about this!

***Failure to properly isolate the motor will damage your decoder and turn it into an effective, but short-lived smoke generator!***

*In the event you do damage your decoder, simply return it to SoundTraxx along with the service fee (please call for current amount) and we will repair and return it promptly. See our Service and Warranty Policy, page 36.*

Begin motor isolation by removing the body shell from the locomotive and in the case of a steam locomotive, the tender shell as well.

Before you proceed further, it is important to carefully examine the locomotive wiring and determine where each wire goes and what it does. The manufacturer's assembly drawings may be useful here or you may elect to create your own wiring diagram. In particular, you will need to identify the connections to the left and right power pickups as well as the (+) and (-) motor connections. Note: for N, HO, and S scale locos, the positive motor connection is the one connected to the right rail (engineer side) power pickup.

Disconnect all wires leading to both motor terminals. Note that some motor brush connections are made using a spring contact to the chassis. In such cases, it will be necessary to remove or modify the spring contact as well. Be aware that some locomotives may make contact between the motor and frame only when the body is reinstalled.

Next, verify that each motor terminal is electrically isolated from the left and right rail pickups using an ohm-meter or continuity tester. With your meter set to the ohms scale, touch both meter probes together and note that the meter indicates 0 ohms (short circuit). You don't want to see this indication again! Touch one of the probes to one of the motor brush terminals. Touch the other probe to the locomotive frame, then the left rail power pickup wire, and finally to the right rail power pickup wire. Move the first probe to the other motor brush terminal and repeat the tests. If all tests indicate an open circuit, the motor is properly isolated. Do not proceed further until this is done.

You will also need to disconnect the wires leading to any lights you wish to use. Using an ohm-meter, check that each lamp lead is electrically isolated from the frame as well as the left and right rail pickups.

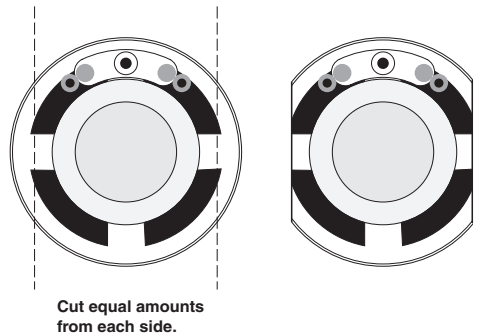
### **Step 5. Modify the Tender Body or Locomotive Shell**

In the case of a steam locomotive, you will probably be mounting the speaker facing down on the tender floor or facing up in the coalbunker. On a diesel model, the speaker is likely to be mounted facing down inside the fuel tank, under the fan grilles or inside the cab. In any event, a certain amount of "body work" may be necessary to accommodate the speaker and decoder. This may include removing weights, mounting brackets, internal bracing and other structural features.

You will probably need to cut an opening in the body shell for the speaker. A series of small holes can be easily drilled and will work as well as one large hole provided the open area is at least one half the area of the speaker cone. In either case, there should be no openings outside or larger than the speaker cone itself.

### **Step 6. Fit the Speaker**

If the speaker is wider than the space in which you intend to install it, it will be necessary to reduce the speaker width to get a proper fit. Determine how much the speaker must be cut down and remove half of that amount from each side of the speaker. If the speaker width must be substantially reduced (i.e., requires cutting into the speaker diaphragm), you may find it easier to simply purchase a smaller speaker – SoundTraxx has a variety of speakers available to suit your needs.



*Figure 8 - Trimming Speaker Cones*

Otherwise, speakers with plastic frames may be trimmed down using a sharp flat file. Speakers with metal frames can be quickly trimmed down using a Dremel or similar tool with an abrasive cut-off wheel. Be sure to wear safety glasses.

As you file or cut down the speaker sides, work slowly and alternate from side to side until the speaker just fits within the body shell. Be careful to remove only the speaker frame and avoid cutting into the diaphragm itself.

### **Step 7. Secure the Speaker in Place**

Once bodywork is complete and the speaker has been fitted in place, it must be secured tightly to the enclosure. For the best sound, an airtight seal is needed around the speaker edge. We have found the best way to hold the speaker in place is to use silicone RTV - it provides the airtight seal needed and unlike epoxy or other hard glues, allows the speaker to be readily

removed in the future. Be careful that you don't get any RTV onto the speaker diaphragm as this will severely distort the sound quality!

### Step 8. Install and Wire the Decoder

*Note: the following instructions are provided as a general guideline. Refer to the installation and wiring instructions that came with your decoder for specific information.*

Begin by securing the decoder in place using double-sided foam tape. Temporarily refit the body shell to ensure that adequate clearance still exists.

When wiring the decoder, trim all wires to reduce unnecessary lead length. This will not only give your installation a neater appearance but also prevent wires from interfering with the drive mechanism and getting pinched between the frame and body shell.

To ensure long-term reliability, solder all connections and insulate with heat shrinkable tubing such as SoundTraxx P.N. 810036.

#### Track Connections

Connect the RED wire to the right(engineer's side) track power pickup and the BLACK wire to the left track power pickup

#### Motor Connections

Connect the ORANGE wire to the motor's (+) terminal and the GRAY wire to the motor's (-) terminal.



Figure 10 - Soldering to Speaker pads (SoundTraxx 3/4" speaker shown)

On smaller speakers, solder the wires to the outside edges of the solder pads as shown in Figure 10.

#### Lighting Connections

12-16V lamps can be directly wired to the function outputs as shown in Figure 9.

If you are using the DSD-LC to drive 1.5V microbulbs, it will be necessary to wire a small current-limiting resistor in series with each of the lamps to prevent them from burning out (see Figure 11). A separate resistor must be used for each bulb even if they are connected to the same output. A 560-ohm,

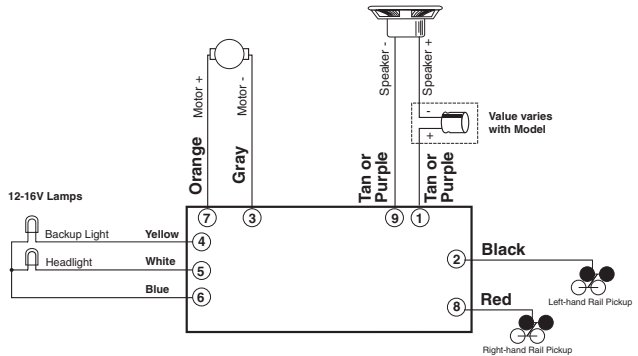


Figure 9 - Wiring Diagram

#### Speaker Connections

*Important: Some DSD-LCs require a capacitor to be wired in series with the speaker. Refer to the instruction sheet for details.*

Connect one of the PURPLE wires to the speaker's (-) terminal. Connect the other PURPLE wire to the speaker's (+) terminal. *NOTE: Some DSD-LC models may be supplied with tan-colored speaker leads. Refer to the wiring instructions provided with your decoder for more information.*

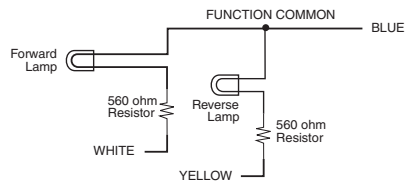


Figure 11 - 1.5 Volt Microbulb Lighting Connections

1/4W resistor is recommended for use with SoundTraxx PN 810022 or 810024 microbulbs, however, you may need to adjust the resistance value to get the desired brightness depending on the output voltage of the command station. Lower resistance will increase the brightness of the lamp.

1. To wire the Headlight, connect one end of the bulb to the decoder's WHITE wire. Wire the other bulb lead to the decoder's BLUE wire.
2. To wire the Backup light, connect one end of the bulb to the decoder's YELLOW wire. Wire the other bulb lead to the decoder's BLUE wire.

Any outputs not used can be left disconnected, but you should cut off and insulate the ends of the wires so they do not come in contact with locomotive or locomotive wiring.

### ***Step 9. Test the Installation***

Now you are ready for the test track! We recommend your test track be fused with a fast-blo fuse appropriately rated for your decoder (i.e. 1 amp decoder, 1 amp fuse). Place the locomotive on the track, and turn on power to the system. Set your controller for locomotive address 3.

You should be able to run the engine in both directions as well as turn the lights on and off with the function keys. You should also hear the steam airpumps running or the diesel engine rpms idling,

If the locomotive does not travel in the appropriate direction, you have reversed the polarity of the motor brush connection. Turn the power off, switch the ORANGE and GRAY motor leads and try again. If everything seems OK at this point, it is time to program the decoder's Configuration Variables to get the desired sound and lighting effects.



**CAUTION: The DSD-LC Series of decoders are designed to work at track voltages between 7.5 and 16 volts maximum. On most command stations, this corresponds to a track setting of N or HO. Do NOT use the O or G scale settings!**

**Operating your DSD-LC at voltages greater than 16 volts will void your warranty, produce excessive heat and possible permanent damage to the DSD.**

## Quick Start

Your SoundTraxx DSD-LC has been shipped with all CVs pre-programmed so you can begin using your locomotive immediately without having to worry about what adjustments to make. The installation instructions that came with your decoder have a table that summarizes the DSD-LC's default operating characteristics as shipped. Let's try it out!

Simply set your controller to Locomotive 3, place the locomotive on the mainline and away you go! Be sure to also set your controller for 28 speed step mode or the headlights may not operate as expected. Now that you have control of your decoder, let's see what happens!

### Ring the Bell

To ring the bell, press F1 on your cab. This is an on/off function, i.e. once on, the bell will continue to ring until you turn it off. Press F1 again to turn it off.

### Blow the Whistle or Airhorn

To activate the Whistle or Airhorn, press F2 on your cab. This function will be activated as long as you hold down the F2 key, i.e. the longer you press the key, the longer the whistle or horn will blow. This also allows you to make short or long signals...try a grade crossing whistle!

### Turn on the Lights

Press F0 on your cab to turn on the Headlight. Reverse locomotive direction and the headlight turns off as the backup light turns on.

While waiting on a siding, you can press F7 to dim the headlight for an oncoming train.

Certain DSD-LC models may have one or two additional Hyperlight outputs designated FX1 and FX2. Press F5 to activate FX1 and F6 to activate FX2. Refer to the instruction sheet that came with your decoder for more information.

### Automatic Sound Functions

Some sound functions happen in response to some action other than pressing a function key.

#### *Steam*

If you have steam decoder, you will hear the exhaust chuff automatically in response to the changes in locomotive speed. The air pumps will pound out a steadily slowing cadence that simulates the build up of air pressure in the brake lines. Rapid deceleration of the locomotive will 'release' air pressure and cause the air pumps to resume pumping.

#### *Diesel*

If you have a diesel decoder, you will hear the engine RPMs ramp up through eight distinct notches as the engine is accelerated and ramp down as the engine is slowed. Pressing Emergency Stop on your cab will shut the diesel engine sound off altogether. Press F4 to activate the Dynamic Brakes!

### Activating other Functions and Effects

Depending on your decoder and the number of function keys provided on your cab, you might have additional functions immediately available for you to activate. The default functions for each decoder are listed on the instruction sheet that came with your decoder. Pressing F8, for example, will mute all sound effects and is useful for silencing an engine when the telephone rings.

As you see, no programming is necessary to begin enjoying your DSD! **However...**

After you have had a chance to play with your DSD-LC for a little while, you may wish to make some changes such as selecting a new address or altering a sound effect. The following section will introduce you to CVs and how and why you might wish to change them.

## PROGRAMMING THE CVs

The final installation step (At last!) is programming the DSD-LC's Configuration Variables or CVs.

### What is a CV?

CV stands for Configuration Variable, which is the industry-adopted term for a decoder's user-programmable memory locations. CVs allow you to customize individual decoder properties such as the address, momentum, throttle response, sound volume and much more. Once a CV has been programmed, the setting will be permanently remembered even after the power has been turned off. A CV can be modified as often as necessary by simply reprogramming it with a new value.

With the large number of CVs available, first inspection of the available options may cause confusion and perhaps a bit of a brain-cramp! Take an aspirin and relax.

***As you have already seen the DSD-LC has been shipped with all CVs pre-programmed so you can begin using your locomotive immediately without having to worry about what adjustments to make.***

The following paragraphs break the DSD-LC CVs into various subsystems so it is only necessary to change a few CV's at a time. As you become comfortable with the DSD-LC's operation, move onto a new section and begin exploring the options and capabilities found there. For more technically inclined users, detailed information on any CV can be found in the **LC Series Decoder Technical Reference** available from your dealer or SoundTraxx for a small charge or from our website for free.

### Bits and Bytes

One of the most confusing aspects of programming a CV is figuring out what all the different bits, bytes and x's found on the various decoder manuals (including this one) mean. The problem is compounded further by differences in each command station manufacturer's user interface. For those users unfamiliar with such terms, a short math lesson (ugh!) is in order before proceeding:

Each decoder CV stores a numeric value that can be represented in one of three forms:

**Decimal** - This is the form everyone is familiar with and we use in our day-to-day lives. Numbers are represented as a sequence of digits composed of the numerals 0,1,2,3,4,5,6,7,8, and 9.

**Hexadecimal** - Also referred to as simply "hex", this is a more specialized number representation that, in addition to 0 through 9, also uses the characters A-F. It has the advantage that a given decimal number can be more compactly represented. For example, the decimal number 127 converts to a simple 7F in hex (one less digit). This allows user interfaces with a limited number of digits (i.e., the LCD on your cab) to display a wider range of numbers.

**Binary** - Binary numbers get their name from the fact they use only two digits 0 and 1 called '*bits*' and is the fundamental number system used by all computers including the ones found inside a digital decoder. Because there are only two bit values, it takes more digits to represent a number using binary. The decimal number 127, for example, is written as 01111111 in binary notation. A '*byte*' is a binary number made up of eight bits. And a '*nibble*' is half a byte or four bits. Really! We didn't make that up.

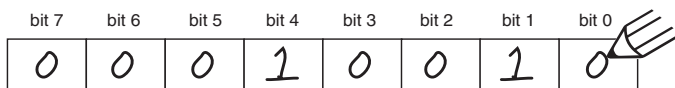
Coincidentally, each CV is made up from one byte or eight bits and can store any number between 0 and 255. Most of the CVs contain a single piece of data that can be easily represented in any of the three forms. i.e., CV 3, the acceleration rate, can be loaded with any value from 0 to 255 and it always affects the same thing - the acceleration rate.

On the other hand, some CVs use individual bits to control different features. This allows up to eight individual features to be controlled by a single CV and is done to conserve the number of CVs. As the bit variables can take on only one of two values 0 and 1 they are usually used for simple variables that are either On or Off, enabled or disabled or something similar. Unfortunately, bit variables are difficult to represent in any form other than binary and still preserve any meaning. Because most DCC system user interfaces don't use binary representation, these numbers are the most difficult to work with and require a tedious series of additions to convert to the decimal or hex form used by most systems.

Whenever possible, we have tried to use the decimal number system in this manual when describing the proper values to program into a given CV. Throughout this manual, a hex number can be distinguished from a decimal number by noting a **0x** prefix. Thus 0x10 is the hex version of sixteen and not ten as one might guess. Binary numbers are represented using a **'b'** suffix. 100b is really the number four and not one hundred.

To further assist the math-impaired, we have provided a handy-dandy conversion table in Appendix A that allows one to quickly convert between decimal, hex and binary.

When working with individual bits such as in CV 29, we suggest the following procedure for determining the correct value to program. Referring to the CV description, write down from left to right the value desired for each individual bit. Consider for example, the case of CV 29. We would like to set this CV so that speed tables are enabled and the 28 speed step mode is in effect. Referring to the **LC Series Decoder Technical Reference**, we see that bit 4 and bit 1 should be set to 1 and all other bits are cleared to zero. Starting with bit 7 and working to the right, we write down the individual bit values and get:



We then look up the binary value 00010010b in Appendix A and see that it corresponds to the decimal value 18 (0x12 in hex). This is the value to use when programming the CV.

### Programming Methods

There are two methods for changing the DSD-LC's CVs:

**Service Mode Programming** - This programming mode usually requires the locomotive to be placed on a special programming track or connected to a dedicated programmer. The DSD-LC is an advanced decoder and supports four types of service mode instructions:

Address Mode - Can change CV 1 (Primary Address) only.

Register Mode - Can change CVs 1,2,3,4,7,8 and 29 only.

Paged Mode - Uses a page register to indirectly modify any CV.

Direct Mode - Can directly change any CV.

**Operations Mode Programming** - Sometimes called 'Ops Mode' or 'Programming on the Main', this programming mode allows the CVs to be changed while the locomotive is operating on the layout even when other locomotives are present. The neat thing about this mode is that the CVs can be changed in the middle of operation allowing the engineer for example, to increase the momentum rate of a locomotive after it couples to a train. The main disadvantage of operations mode programming is that the CV data cannot be read back to verify its value.

*Note: The DSD-LC imposes the restriction that CV 1 cannot be changed in this mode to prevent accidental modification of the locomotive's address during operation.*

## Reading CVs

Certain command stations also allow you to read a CV during Service Mode Programming, which is useful to verify its current setting. If you have trouble reading or verifying CVs, the problem may be due to the design of your command station and not the DSD-LC itself. The DSD-LC and all other decoders communicate back to the command station using what's called an acknowledgment pulse, which is defined in NMRA RP-9.2.3 as "an increased load on the programming track of at least 60mA for at least 5ms." Like most decoders, the DSD-LC generates the acknowledgment pulse by momentarily applying power to the motor. You can often visually verify that the DSD-LC is properly responding to your programmer by observing a slight twitch in the motor shaft when a read or write command is given.

If your DSD-LC is otherwise working properly (i.e., responds properly on the mainline to speed and direction commands) but your command station is having troubles reading CV data from the DSD-LC, it may be due to incompatibilities between the electrical requirements of the DSD-LC (which are different from conventional decoders due to the added audio circuitry) and the electrical characteristics of your programming track. In such an event, we suggest you simply go ahead and program the data into the CVs anyway. Usually the DSD-LC will accept the data and function properly when placed back on the main track. You can also try a different programming mode. If your system supports it, the best way to program the CVs is Operations Mode, as it allows you to immediately see or hear the results of your changes.

It is important to realize that not all programming modes will program all CVs. Additionally, the specific programming mode you use will depend upon the type of DCC system you are using. Some of the newer DCC systems can automatically select the proper programming mode so all you need to do is specify the CV number and its new value. On the other hand, some systems support only a few of the programming modes and may restrict which CVs you can program. If in doubt, refer to your DCC system's manual or contact the manufacturer to determine which methods they support.

## Programming Procedure

As each DCC system is different, the procedure for programming a CV will vary depending upon the system. Unfortunately, we cannot provide detailed instructions to cover every command station and have to assume that you have some level of understanding regarding its capabilities and operating procedures. For specific programming procedures, please consult your DCC system manual.

### Step 1: Configuring the Address

The first group of CVs you will want to change are those that set the DSD-LC's address:

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

The DSD-LC may be set up to recognize either the primary address (also called the short address), which provides a range of 1 to 127 or the extended (long) address, which has a range of 1 to 9999! 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 - 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.

#### *Primary Address*

To use the primary address, simply set CV 1 to the desired address between 1 and 127. *Note: The primary address can only be set in service mode.*

#### *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 DSD-LC to accept the new data (See the **LC Series Decoder 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.

Once the extended address is stored in CV 17 and 18, bit 5 of CV 29 must be set to 1 so the decoder will recognize the extended address format. Otherwise, the decoder will continue to respond only to its primary address. See the next section, Configuring the Decoder.

## Step 2: Configuring the Decoder

The next CV you will want to change is CV 29, Decoder Configuration Byte. CV 29 is one of those complicated bit variables mentioned earlier and is used in conjunction with other CVs to set a multitude of decoder characteristics including:

*Locomotive Direction* - Causes the decoder to invert direction commands so that the locomotive runs in reverse when it receives a command to move forward and vice-versa. 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 tearing apart the locomotive a second time.

*Speed Step Mode Selection* - As it is a digital system, the DSD-LC splits the throttle voltage over its minimum and maximum range into discrete speed steps. The DSD-LC can be configured so there are 14, 28 or 128 individual speed steps. The largest number of steps will give the smoothest throttle response. Be aware that not all DCC systems have the ability to control 28 or 128 speed steps and your choice will depend upon the capabilities of your command station.

*Speed Table* - Sets the decoder to use speed tables specified by CV 25 (see “Configuring the Throttle”, page 19).

*Primary or Extended Address* - Sets the decoder to recognize its primary address in CV 1 or extended address in CV 17:18 (see “Configuring the Address”, above).

To assist the novice user, we have created Table A that lists the correct value for CV 29 to get the desired operating modes. Simply find the row that has the modes you want and program CV 29 with the listed value. The advanced user should refer to the **DSD-LC Technical Reference** for more details. Remember, table values are in decimal. If your command station uses Hexadecimal, you will need to convert the value shown using Appendix A.

| Address Type       | Use Speed Tables? | Speed Steps | Locomotive Direction | CV 29 Value |
|--------------------|-------------------|-------------|----------------------|-------------|
| Primary (CV1)      | No                | 14          | Normal               | 0           |
| Primary (CV1)      | No                | 14          | Reversed             | 1           |
| Primary (CV1)      | No                | 28/128      | Normal               | 2           |
| Primary (CV1)      | No                | 28/128      | Reversed             | 3           |
| Primary (CV1)      | Yes               | 14          | Normal               | 16          |
| Primary (CV1)      | Yes               | 14          | Reversed             | 17          |
| Primary (CV1)      | Yes               | 28/128      | Normal               | 18          |
| Primary (CV1)      | Yes               | 28/128      | Reversed             | 19          |
| Extended (CV17:18) | No                | 14          | Normal               | 32          |
| Extended (CV17:18) | No                | 14          | Reversed             | 33          |
| Extended (CV17:18) | No                | 28/128      | Normal               | 34          |
| Extended (CV17:18) | No                | 28/128      | Reversed             | 35          |
| Extended (CV17:18) | Yes               | 14          | Normal               | 48          |
| Extended (CV17:18) | Yes               | 14          | Reversed             | 49          |
| Extended (CV17:18) | Yes               | 28/128      | Normal               | 50          |
| Extended (CV17:18) | Yes               | 28/128      | Reversed             | 51          |

### Step 3: Configuring the Throttle

There are eight CVs that characterize the DSD-LC's throttle response and 28 more used to create a custom speed table:

- CV 2, VStart
- CV 3, Acceleration Rate
- CV 4, Braking Rate
- CV 9, Motor PWM period
- CV 25, Speed Table Select
- CV 29, Configuration Data
- CV 66, Forward Trim
- CV 95, Reverse Trim
- CV 67-94, Loadable Speed Table

This may sound like a lot of CVs but 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 (Step 2).

#### **Set the Start Voltage**

The DSD-LC 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:

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

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.

#### **Set the Acceleration and Braking Rates**

The DSD-LC provides two CVs to simulate the momentum due to train weight. CV 3, Acceleration Rate, controls how fast the locomotive responds to increases in throttle settings and CV 4, Braking Rate, controls how fast the locomotive will respond to decreases in the throttle setting.

Both CVs can be programmed with any value between 0 and 255 with 255 corresponding to the *slowest* acceleration or braking 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!

The DSD-LC's Dynamic Digital Exhaust feature (see page 28) will be more dramatic with larger CV values and we suggest setting CV 3 and CV 4 to a minimum value of 16 or higher.

If you are using 14 or 28 Speed Step mode, setting CV 3 and CV 4 to any value greater than 0 will also improve the DSD-LC's throttle response. While it is accelerating or braking, the DSD-LC interpolates between speed steps so in effect, your locomotive will respond as if it were being controlled with 128 speed steps. No more sudden lurching from one speed step to another!

#### **Select the Speed Table**

The DSD-LC provides 14 preset and one loadable speed table that can be used for several purposes:

1. Matching the Auto Exhaust chuffing rate to locomotive speed.
2. Speed matching one locomotive to another.
3. Changing the feel of the throttle. For example, you could configure a switching locomotive so there are more speed steps available at lower speeds for switching and fewer steps at high speeds where the locomotive is seldom operated.
4. Compensating for an improperly designed driveline so the locomotive will operate within its prototypical speed range.

### Preset Speed Tables

CV 25, Speed Table Select, is used to select which speed curve will be used by the DSD. CV 25 may be programmed with any value between 2 and 15 to select one of the preset speed curves shown in Table B. The exact throttle response for each curve is shown graphically below.

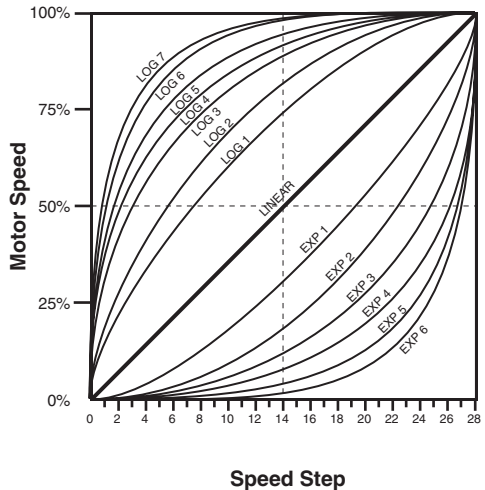
In order for the speed table selection in CV 25 to take effect, bit 4 of CV 29 must be set to 1. Refer to the previous section “Configuring the Decoder” or the **LC Series Decoder Technical Reference** to determine the correct value for CV 29.

### Set the User Loadable Speed Curve

The User Loadable Speed Table allows you to create virtually any throttle response curve you can imagine. You will first need to design and program the Loadable Speed Table. The Loadable Speed Table consists of 28 data points contained in CVs 67 through 94, each defining the *percentage* of motor voltage applied at a give speed step. Each data point can contain a value of 0 to 255 corresponding to 0 to 100% of available motor voltage.

In 28 speed-step mode, each data point directly corresponds to a speed step. In 128 speed-step mode, each data point corresponds to every four and a half speed steps. The motor voltage for intermediate steps is interpolated by the DSD-LC to produce a smooth curve. In 14 speed-step mode, alternate (odd numbered) data points correspond to speed steps 1-14. Important: all 28 data points must be programmed *even for 14 speed-step mode* or an unpredictable throttle response may occur while accelerating or braking.

| Table B. Speed Table Selection |                           |
|--------------------------------|---------------------------|
| CV 25                          | Speed Curve Type          |
| 2                              | Straight Line             |
| 3                              | Logarithmic Curve 1       |
| 4                              | Logarithmic Curve 2       |
| 5                              | Logarithmic Curve 3       |
| 6                              | Logarithmic Curve 4       |
| 7                              | Logarithmic Curve 5       |
| 8                              | Logarithmic Curve 6       |
| 9                              | Logarithmic Curve 7       |
| 10                             | Exponential Curve 1       |
| 11                             | Exponential Curve 2       |
| 12                             | Exponential Curve 3       |
| 13                             | Exponential Curve 4       |
| 14                             | Exponential Curve 5       |
| 15                             | Exponential Curve 6       |
| 16                             | User Loadable Speed Table |



To create a speed curve, begin by assuming the DSD-LC will be operated in 28-speed step mode. Don't worry if you are using another mode - the DSD-LC will automatically take care of the translation between modes.

1. Start by making a table containing 28 entries - one entry for each speed step.
2. For each entry, record the desired throttle response as a percentage of full speed. i.e., 0 to 100%
3. Compute and record the CV value for each step using the following formula:

$$\text{CV Value} = 255 \times \frac{\text{Percentage of Full Speed (from Step 2)}}{100}$$

4. Program CV 67 with the value computed in step 3 for the first data entry (Speed Step 1)
5. Program CV 68 with the value computed in step 3 for the second data entry (Speed Step 2)
6. Repeat step 5 for each of the remaining 26 CVs from CV 69 to CV 94 until they have been programmed with their respective values.
7. Set CV 25 to 16 to select the user loadable speed table.
8. Set bit 4 of CV 29 to 1 to enable speed table use. Refer to the previous section "Configuring the Decoder" to determine the correct value for CV 29.

Table C may be followed as an example and lists the CV values for a straight-line response.

**Adjust the Forward and Reverse Trim**

The DSD-LC provides two CVs for adjusting or 'trimming' the forward and reverse speeds.

CV 66, Forward Trim  
CV 95, Reverse Trim

These CVs multiply all data points in the speed tables by a factor of n/128 (n is the CV value) allowing the overall speed curve to be adjusted up or down without reloading all 28 data points again. These CVs will not have any effect when the speed tables are disabled (i.e., CV 29, bit 4 = 0)

These CVs may contain any value between 0 and 255 Trim values between 129 and 255 will increase speed curve values between 100% and 200% in approximately 1% steps. Trim values between 1 and 127 will decrease speed curve values between 1% and 99%. A value of 128 yields a scaling factor of 1.0 and has no effect on the speed curve.

| CV# | Speed Step | % Full Speed | CV Value |
|-----|------------|--------------|----------|
| 67  | 1          | 4            | 9        |
| 68  | 2          | 7            | 18       |
| 69  | 3          | 11           | 27       |
| 70  | 4          | 14           | 36       |
| 71  | 5          | 18           | 45       |
| 72  | 6          | 22           | 55       |
| 73  | 7          | 25           | 64       |
| 74  | 8          | 39           | 73       |
| 75  | 9          | 32           | 82       |
| 76  | 10         | 36           | 91       |
| 77  | 11         | 39           | 100      |
| 78  | 12         | 43           | 109      |
| 79  | 13         | 46           | 118      |
| 80  | 14         | 50           | 127      |
| 81  | 15         | 54           | 137      |
| 82  | 16         | 57           | 146      |
| 83  | 17         | 61           | 155      |
| 84  | 18         | 64           | 164      |
| 85  | 19         | 67           | 173      |
| 86  | 20         | 71           | 182      |
| 87  | 21         | 75           | 191      |
| 88  | 22         | 78           | 200      |
| 89  | 23         | 82           | 209      |
| 90  | 24         | 86           | 219      |
| 91  | 25         | 89           | 228      |
| 92  | 26         | 93           | 237      |
| 93  | 27         | 96           | 246      |
| 94  | 28         | 100          | 255      |

Using different values for the forward and reverse trim will yield different forward and reverse speeds.

### **Adjust the Motor Drive Frequency**

Virtually all DCC decoders, including the DSD-LC, drive the locomotive motor using a technique called Pulse-Width-Modulation or PWM. PWM works by alternately switching the motor from full off to full on. If the motor is switched fast enough, the speed can be controlled by varying the ratio between the time the motor is on and the time the motor is off. One drawback to PWM is that it can cause the locomotive to buzz, sometimes quite loudly, at low speeds.

To mitigate some of this noise, the DSD-LC provides CV 9, Motor PWM Period to control the frequency at which the motor is switched on and off. By adjusting this CV, one can usually find a drive frequency that is quieter than others.

CV 9 can be programmed with any value between 0 and 230. A CV value between 170 and 190 works well for most locomotives.

### **Step 4: Configuring for Consist Operation**

The DSD-LC supports advanced consist operations which use three related CVs:

- CV 19, Consist Address
- CV 21, Consist Function Enable
- CV 22, Consist F0 Function Enable

### **Consists Explained**

A consist is a group of locomotives that are setup to respond to throttle commands as a single unit. Consists make it easy for one operator to run a double headed steam train or a multi-unit diesel lash-up for example. The consist CVs allow the DSD-LC to recognize a new address assigned to the consist without changing its primary or extended addresses. Additionally, they allow each locomotive in the consist to be run as a single unit but with different function properties allowing for example, only the horn to blow on the lead engine.

### **Consist Address**

Each locomotive in the consist is assigned the same consist address by programming CV 19 with the consist address between 1 and 127. If a locomotive is facing backwards in the consist, it should be programmed with the same consist address plus 128. If the forward facing locomotives are set to consist address 60 for example, the backwards engine must be set to  $60+128 = 188$ . Failure to do this will turn the consist into an angry pushme-pullyou as all locomotives will try to move forward from the perspective of their own cab and a few pulled couplers might result!

To deactivate the consist address and restore normal operation, CV 19 must be reprogrammed to 0.

Note that when the consist address is set, the DSD-LC will continue to respond to instructions sent to its primary or extended address except for speed and direction data.

The DSD-LC will not to respond to operations mode programming commands sent to its consist address. These commands must always be used with the primary or extended address.

### **Consist Function Enable**

CV 21 and 22 allow you to define how each engine individually responds to function commands sent to the consist address. When the consist is enabled, CV 21 controls which of functions 1-8 are active and CV 22 controls the F0 function for forward (F0 (f)) and reverse (F0 (r)).

CV 21 and 22 take effect only when the consist address is set. When function commands are used with the DSD-LC's primary or extended address, all functions will continue to work regardless of the settings of CV 21 and 22.

**Table D. Consist Function Enable**

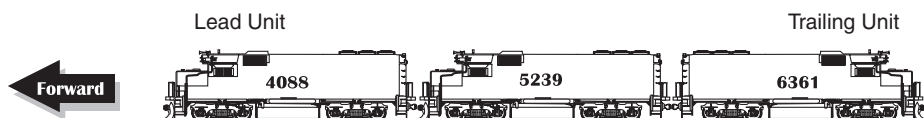
| CV# | F0 (f) | F0 (r) | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8  |
|-----|--------|--------|----|----|----|----|----|----|----|-----|
| 21  |        |        | 1  | 2  | 4  | 8  | 16 | 32 | 64 | 128 |
| 22  | 1      | 2      |    |    |    |    |    |    |    |     |

Use Table D to calculate the correct value for CV 21 and 22. Begin by determining which functions you want active in the consist and circle the number below it. When you are done, add up all the circled numbers in the first row and program the total into CV 21. Add up all the circled numbers in the second row and program CV 22 with the sum.

Note that each DSD-LC in the consist will require a different set of values for CV 21 and 22 depending upon your requirements.

### Consist Example

Consider a common diesel lash-up consisting of three engines, #4088, #5239 and #6361. Let's suppose we wish to operate these three engines as a single unit with consist address 40. The dynamic brake (F4) and audio mute (F8) functions should work on all engines. However, we want the headlight (F0(f)), horn (F2) and bell (F1) to only work on the lead unit, #4088, and the backup light (F0(r)) to work only on the trailing unit, #6361. Additionally, the trailing unit is reverse facing.



| Engine Address | 4088   | 5239   | 6361    |
|----------------|--------|--------|---------|
| Direction      | Normal | Normal | Reverse |
| CV 19          | 40     | 40     | 168     |
| CV 21          | 139    | 136    | 136     |
| CV 22          | 1      | 0      | 2       |

#### Engine 4088.

*This is the lead engine. Because it is facing forward, CV19 is simply programmed with 40, the new consist address. Using the Consist Function Enable Table, we program CV 21 with the sum of the values corresponding to F1, F2, F4 and F8 or  $1 + 2 + 8 + 128 = 139$ . Likewise, CV22 is programmed to 1, the value corresponding to F0(f),*

#### Engine 5239.

*This is the middle engine. Because it is also facing forward, CV19 is programmed with the new consist address or 40. Using the Consist Function Enable Table again, we program CV 21 with the sum of the values corresponding to F4 and F8 or  $8 + 128 = 136$ . CV22 is programmed to 0 since no lights are needed on this engine.*

#### Engine 6361.

*This is the trailing engine. Because it is facing backwards, CV19 is programmed with the new consist address,  $40 + 128 = 168$ . Using the Consist Function Enable Table, we program CV 21 with the sum of the values corresponding to F4 and F8 or  $8 + 128 = 136$ . CV22 is programmed to 2, the value corresponding to the backup light, F0(r).*

## Step 5: Function Mapping

### Function Mapping Explained

Function mapping allows the DSD-LC to be reconfigured so that sound effects and function outputs can respond to a different function key input. This is especially useful for users who have throttles with less than eight function keys as now they can pick and choose what effects they can control instead of being restricted to an arbitrary assignment.

There are 10 function mapping CVs - eight CVs, 35-42 are used to assign output control to function keys 1 through 8 respectively.

The other two CVs, 33 and 34 are both for the F0 function. CV 33 controls which outputs are on when F0 is on *and* the locomotive is moving forward. CV 34 controls which outputs are on when F0 is on *and* the locomotive is moving in reverse. If the same output is selected in both CV 33 and CV 34, that function will turn on when the F0 function is on regardless of locomotive direction.

Not all keys can control all outputs or effects. The table below shows which functions can be mapped to which outputs. Note that a function key can be set up to control more than one output and also an output can be controlled by more than one function key. In the second case, if an output is mapped to two function keys, either key will turn that output on, however, the output will not turn off until both function keys have been turned off.

| Function Key | Control CV | Headlight | Backup Light | Whistle/Airhorn | Bell | FX1 | FX2 | Dynamic Brake<br>(Diesel Only) | Reserved | RPMs (+)<br>(Diesel Only) | RPMs (-)<br>(Diesel Only) | Dimmer | Mute |
|--------------|------------|-----------|--------------|-----------------|------|-----|-----|--------------------------------|----------|---------------------------|---------------------------|--------|------|
| 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   |
| F8           | 42         |           |              |                 |      |     |     | 1                              | 2        | 4                         | 8                         | 16     | 32   |

### To determine the correct CV value,

1. Find the column in the function mapping table corresponding to the function or sound effect output you wish to control.
2. Next locate the row corresponding to the function key you wish to use for controlling the selected output.
3. Note the number located in the box at the intersection of the row and column you have selected.
4. Program the CV listed in the row chosen in step 2 with the value found in step 3.

Example 1:

To change F3 to control the FX1 output, locate the number at the intersection of the FX1 column and F3 row, which is 2 and program CV 37 with this value.

Example 2:

A single function key can be used to simultaneously control more than one output or sound effect. Simply program the corresponding CV with the sum of the numbers located under each output or effect to be controlled. To use F3 to control both FX1 and FX2 for example, program CV 37 to 2 + 4 = 6.

**Step 6: Configuring the Lighting Outputs**

Depending on the model, the DSD-LC has two to four function outputs used for controlling the locomotive lights. Each can be set for a variety of special lighting effects or simple on-off lights. In addition, you can use the Grade Crossing Logic to automatically activate the selected lighting effect when the horn or whistle is blown.

| <b>Table F. Hyperlight Control Mode Settings</b> |                           |                |                          |                |
|--|---------------------------|----------------|--------------------------|----------------|
| <b>Effect Type</b>                               | <b>CV Value</b>           |                |                          |                |
|  | <b>Crossing Logic Off</b> |                | <b>Crossing Logic On</b> |                |
|  | <b>Phase A</b>            | <b>Phase B</b> | <b>Phase A</b>           | <b>Phase B</b> |
| On-off   | 0                         | 16             | 32                       | 48             |
| Dimmable   | 1                         | 17             | 33                       | 49             |
| Mars Light                                       | 2                         | 18             | 34                       | 50             |
| Gyalite  | 3                         | 19             | 35                       | 51             |
| Oscillating Headlight                            | 4                         | 20             | 36                       | 52             |
| Single Flash Strobe                              | 5                         | 21             | 37                       | 53             |
| Double Flash Strobe                              | 6                         | 22             | 38                       | 54             |
| D312 Rotary Beacon                               | 7                         | 23             | 39                       | 55             |
| Prime Stratolite                                 | 8                         | 24             | 40                       | 56             |
| Type I Ditch Light                               | 9                         | 25             | 41                       | 57             |
| Type II Ditch Light                              | 10                        | 26             | 42                       | 58             |
| FRED   | 11                        | 27             | 43                       | 59             |
| Engine Exhaust Flicker                           | 12                        | 28             | 44                       | 60             |
| Firebox Flicker                                  | 13                        | 29             | 45                       | 61             |
| Smart Firebox Flicker                            | 14                        | 30             | 46                       | 62             |

The DSD-LC provides up to five CVs for customizing the light effects:

- CV 49, Headlight Control Mode
- CV 50, Backup light Control Mode
- CV 51, FX1 Control Mode
- CV 52, FX2 Control Mode
- CV 59, Flash Rate & Hold Time

**Setting the Hyperlight Effects**

Each lighting output has a corresponding CV that determines its operating characteristics:

*Hyperlight Select* - Each output can be programmed to one of 15 Hyperlight™ Lighting Effects as listed in Table F. (NOTE: The DSD-100LC supports only on/off and dimmable light effects.) Most effects are self-descriptive. A few may need some additional comment:

- The dimmable headlight is normally an on/off output. When the output is on, the power level will be reduced to 60% whenever the dimmer function (F7) is on.
- Type I and II Ditch lights are identical when operating. However, when the grade crossing logic is enabled, the Type I ditch will revert to a steady on state when it is not flashing whereas the Type II lights will turn off.
- The engine exhaust effect produces a random flicker whose intensity is proportional to the engine RPMs and is useful for imitating unmuffled exhaust gases and sparks.

*Phase Select* – Alters the timing of the effect so that the effect is either in sync with the other effects (phase A) or 180 degrees out of phase (phase B). This allows you to have two lights that flash back and forth if desired.

*Grade Crossing Logic* - Causes the lighting effect to become active only when the horn (F2) has been sounded. A typical use would be to cause the ditch lights to flash at a grade crossing. The grade crossing logic can be used with almost all the Hyperlight™ effects. The On-Off, dimmable headlight, FRED and flicker effects will not be affected. When the horn function is released, the other effects will either turn off (strobes and beacons) or revert to a steady on state (mars light, ditch lights, etc.) as appropriate to prototype practice.

*Rule 17 Mode* - Converts the headlight and backup light to independent, non-directional lights. When this mode is active, the headlight is controlled as if it were FX1, Function 5 and the backup light as FX2 or Function 6.

To set the effect, use Table F on the previous page to look up the required setting for each output mode and simply program the corresponding CV with that value. If you wish to use 'Rule 17' mode, add 64 to the table value. Use CV 49 to set the headlight, CV 50 for the backup light, CV 51 for FX1 and CV 52 for FX2. Note that not all DSD-LCs will support all lighting outputs or CVs. Refer to the instruction sheet that came with your decoder for more information.

### **Setting the Flash Rate and Hold Time**

CV 59 is used to adjust the flash rate of the Hyperlight effect and has a range of 0-15 with 15 being the slowest flash rate.

CV 59 is also used to set the Grade Crossing Logic Hold Time, that is, the time an effect will remain flashing after the horn function is released (if the crossing logic is enabled) and has a range of 0-15 seconds.

To calculate the value of CV 59, use the formula:

$$CV\ 59 = \text{Flash Rate} + (\text{Hold Time} \times 16)$$

For example, to set a flash rate of 3 and a hold time of 2 seconds, we calculate  $CV\ 59 = 3 + (2 \times 16) = 3 + 32 = 35$ .

### **Configure Lighting Control Mode**

The DSD-LC supports two modes of headlight operation:

#### ***Automatic Direction Control***

Both the headlight and backup lights are turned on and off using the F0 function. The DSD-LC automatically switches the proper light on depending upon locomotive direction.

For automatic direction control, the headlight is mapped to F0(fwd) by setting CV 33 to 1, and the backup light is mapped to F0(rev) by setting CV 34 to 2. See **Function Mapping** on page 24.

#### ***“Rule 17” Headlight Operation***

This is the more prototypical form of operation and requires the engineer to manually switch each light on or off individually. Thus, it is possible for both lights to be on at the same time.

For Rule 17 Operation, the headlight is mapped to both F0(fwd) and F0(rev) by setting CV 33 and 34 to 1. The F0 key will now control the headlight in both directions.

The backup light is remapped to Function 6 (FX2) by simply setting CV 50 to 64, which enables the Rule 17 Mode. The backup light could also be remapped to a different function key by setting any of CVs 30 through 40 to control FX2.

## Practical Examples:

### Headlight and Firebox Flicker

Consider a small steam engine that does not have a backup light, In such a case, the DSD-LC's extra backup light output can be used to control some other light such as a cab light, number boards or firebox light.

To set the backup light as a firebox effect, we refer to Table F and program CV 50 to 13. At this point the flicker effect is on only when F0 function is on AND the locomotive is reversed, so we use function mapping to activate the effect in the forward direction by setting CV 34 to 3. Now the headlight and firebox lights will both be turned on by the F0 key but the headlight will only work when the engine is moving forward while the firebox light glows in both directions.

### Headlight and Mars Light

Early diesel engines like the EMD F-9 had seldom use for a backup light. This is another case where the DSD-LC's extra backup light output can be used to control some other lighting effect.

To set the backup light as a Mars Light we refer to Table F and program CV 50 to 2. As before, the effect is on only when F0 function is on AND the locomotive is reversed, so we use function mapping to activate the effect in the forward direction by setting CV 33 to 3. Now the headlight and Mars light will both be turned on by the F0 key but only work when the engine is moving forward.

### Flashing Ditch Lights

This time we will use the headlight and backup light outputs to create a pair of Type I ditch lights that alternately flash when the horn is sounded. When the horn is off, the lights will change to a steady 'on' state.

Using Table F, the headlight is set to a Type I ditch light, Phase A with Crossing Logic On by setting CV 49 to 41. To get the lights to flash back and forth, the backup light is set to a Type I ditch light, Phase B with Crossing Logic On by setting CV 50 to 57. Remap both lights to F0(fwd) by setting CV 33 to 3 and CV 34 to 0. Finally, set the flash rate to 7 and the hold time to 4 seconds by setting  $CV\ 59 = 7 + (4 \times 16) = 71$ .

## Step 7: Configuring the Sound Effects

### Bell Settings

The DSD-LC provides two CVs for setting the bell sound effect:



#### CV 114, Bell Ring Rate

CV 114 controls how fast the bell will ring. There are 16 settings, with 0 being the fastest ring rate and 15 being the slowest rate.

#### CV 121, Bell Volume

CV 121 can be set to any value between 0 and 255, with the minimum volume being 0 (sound is off) and the maximum is 255. The default is 128 or 50% volume.

### Whistle/Airhorn Settings

The DSD-LC provides two CVs for setting the whistle or air horn sound effect:

#### CV 115, Whistle/Airhorn Selection



CV 115 selects a Light, Medium or Heavy whistle (steam) or a single chime, three chime or five chime airhorn (diesels). (See Table G.)

**Table G.  
CV 115, Whistle/Airhorn Selection**

| Whistle/Horn       | CV Value |
|--------------------|----------|
| Light/Single Chime | 0        |
| Medium/3-Chime     | 1        |
| Heavy/5-Chime      | 2        |

### CV 120, Whistle/Horn Volume

CV 120 can be set to any value between 0 and 255, with the minimum volume being 0 (sound is off) and the maximum is 255. The default is 192 or 75% volume.

### Airpump Settings (Steam Only)

The DSD-LC provides two CVs for setting the airpump effect:

#### CV 112, Airpump Sound Effect Enable

CV 112 is used to enable the automatic sounds of the airpump. Additionally, it is used to select whether to use a conventional exhaust chuff or that of an articulated steam engine. Refer to Table H for the correct CV value.

#### CV 123, Airpump Volume

CV 123 can be set to any value between 0 and 255, with the minimum volume being 0 (sound is off) and the maximum is 255. The default is 128 or 50% volume.

**Table H. CV 112, Airpump Selection**

| Airpump | Exhaust Chuff | CV Value |
|---------|---------------|----------|
| Off     | Conventional  | 0        |
| On      | Conventional  | 1        |
| Off     | Articulated   | 128      |
| On      | Articulated   | 129      |

### Dynamic Brake Settings (Diesel Only)

The DSD-LC provides one CV for setting the dynamic brake effect:

#### CV 123, Dynamic Brake Volume

CV 123 can be set to any value between 0 and 255, with the minimum volume being 0 (sound is off) and the maximum is 255. The default is 128 or 50% volume.

### Steam Exhaust Settings

The DSD-LC provides three CVs for setting the Steam Exhaust Chuff sound effect:

#### CV 112, Exhaust Cadence Selection

CV 112 is used to select a conventional or articulated exhaust chuff cadence. It is also used to enable the airpump sounds. Refer to Table H for the correct value to use for this CV.

#### CV116, Auto Exhaust Chuff Rate

The DSD-LC uses Auto-Exhaust synchronization that automatically generates an exhaust chuff rate proportional to the throttle setting. Since every locomotive is different, CV 116 is used to match up the Auto Exhaust rate to the locomotive speed and may be loaded with any value between 0 and 127. Higher values will yield higher chuff rates for a given throttle setting. A typical synchronization rate may be computed as:

$$\text{CV Value} = 115.9 \times \frac{\text{SPD}}{\text{DIA}} \times \text{Gear Ratio}$$

where SPD is the locomotive's top speed in scale miles-per-hour at full throttle and DIA is the locomotive's driver wheel diameter in scale inches, and Gear Ratio is the gear ratio for shays and other geared engines. For conventional steam engines, use a Gear Ratio = 1. The driver diameter can be easily measured with a scale ruler but remember to convert the measurement to scale inches.

If you don't know your locomotive's top speed, you can also estimate it and still get pretty good results. A good rule of thumb is to use 45 MPH for freight locomotives and 70 MPH for passenger engines.

## CV 122, Exhaust Chuff Volume

CV 122 can be set to any value between 0 and 255, with the minimum volume being 0 (sound is off) and the maximum is 255. The default is 128 or 50% volume.

### Hints for Setting Engine Exhaust Chuff Rate

Because most locomotives do not respond linearly (i.e., straight line) to the throttle settings, it can sometimes be difficult finding the magic auto-exhaust chuff rate setting that works across the locomotive's full speed range. We have two procedures for setting the chuff rate that have worked well. The first method is easy to implement and produces good results that should satisfy all but the stodgiest of nitpickers. The second method takes more effort but produces more accurate results.

#### Method 1

*Begin by setting the starting voltage (CV 2) such that the engine begins to barely move at speed step 1. Then increase the throttle setting until the engine is moving at 10-15 scale MPH. Then adjust CV 116 up or down until the chuff rate corresponds to approximately four chuffs per wheel revolution.*

#### Method 2

*This procedure uses the loadable speed curve to compensate for the locomotive's non-linearities. Begin by setting CV 25 = 16, CV 29 = 18 (50 if you are using a long address- see Table A) and CV 116 to the value calculated from the formula above. Set your command station to use 28 speed step mode. Set the throttle to speed step 1 and adjust the first entry in the speed table, CV 67 until the locomotive speed matches the chuff rate. Increase the throttle to speed step 2 and adjust the second entry in the speed table, CV 68 until the locomotive speed once again matches the chuff rate. Repeat this process until you have adjusted the locomotive speed across all 28 speed steps using CVs 67-94.*

## Diesel Exhaust Settings

The DSD-LC provides two CVs for setting the Diesel Exhaust sound effect:

### CV116, Engine Exhaust Control

CV 116 is used to select between manual or automatic engine notching and in the case of the latter, the number of speed steps needed to advance the engine rpm notches.

#### Manual Notching

Manual notching allows the engineer to use the function keys to step the engine rpms up or down independent of the locomotive speed and is more prototypical than automatic notching. With manual notching you can for example, simulate the sound of a train crawling up a hill with diesels running at full power!

Manual notching is selected by setting CV 116 to 0. Additionally, you will have to remap two function keys to the RPM(+) and RPM(-) functions (see **Function Mapping**, page 24). We suggest using the F5 key for RPM(+) and the F6 key for RPM(-) which is accomplished by programming CV 39 to 32 and CV 40 to 64. Of course, you can use other function keys as your needs dictate as well.

#### Manual Notching with Interlock

This mode interlocks the engine rpms and the throttle setting such that

- Locomotive cannot be moved unless the diesel engine has been started.
- Engine cannot be shut off unless locomotive speed is zero.

Besides the fun of forcing the engineer to follow an operating protocol, this mode is also useful in preventing inadvertent engine shutdown while the engine is moving. Interlocked Manual notching is selected by setting CV 116 to 16.

#### Automatic Notching

When automatic notching is enabled, the engine will startup when the throttle is first increased.

It will increase in proportion to the throttle speed. The engine rpms may be shutoff by pressing your command station's emergency stop button once.

Automatic notching is selected by programming CV 116 with any value between 1 and 15 corresponding to the number of speed step changes (in 128 speed step mode) needed to advance the rpms one notch. Thus, a CV setting of 8, will advance the rpms one notch at speed steps 8,16, 24... etc, until it reaches maximum rpms at speed step 64.

### CV 122, Engine Exhaust Volume

CV 122 can be set to any value between 0 and 255, with the minimum volume being 0 (sound is off) and the maximum is 255. The default is 128 or 50% volume.

### Hints for Diesel Engine Sound

If you plan to use automatic notching with 14 or 28 speed step modes, we recommend setting CV 116 with a minimum value of at least three for 28 speed step mode and at least six for 14 speed step mode.

When using automatic notching mode, you may notice the diesel sound lags the locomotive speed. This is because it takes a finite and prototypical amount of time for the diesel engine to spin up and down. Unfortunately, model locomotives accelerate and brake much faster than their life-size counter-parts and the illusion of realism begins to fade when the engine is pulled into a siding with the diesel running at full power. The easy solution to this dilemma is to use the Acceleration (CV 3) and Braking (CV 4) CVs to electronically slow the model locomotive's throttle response. A CV setting of 10 or so should do the trick. Of course, you'll have to learn to compensate for the added momentum and allow yourself plenty of stopping room but then that's half the fun!

## Step 8: Miscellaneous Settings

### CV 11, Packet Timeout Period

CV 11 is used to insure that the DS-LC receives periodic updates from the command station to prevent run-away trains. If the timeout period set by CV 11 elapses without receiving any commands, the DSD-LC will shut off the motor and if the Quiet Bit is enabled (see below) also turn off the sounds effects. CV 11 may be set to any value from 1 to 255 corresponding to a timeout period of 10 to 2550 seconds (42 minutes). Setting CV 11 to 0 will disable the time out feature.

### CV 113, Sound Control Modes

CV 113 set the Dynamic Digital Exhaust (DDE) as well as the Quiet Bit:

*Dynamic Digital Exhaust (steam only)* - The Dynamic Digital Exhaust senses the difference between the actual locomotive speed and the throttle setting, using the information to adjust the volume, cutoff and timbre of the exhaust chuff (steam decoders only). The Dynamic Digital Exhaust feature will be more dramatic when used with some momentum and we suggest setting CV 3 and CV 4 to a minimum value of 16 or higher (see page 19).

*Quiet Bit* - The Quiet bit allows you to choose whether the sound effects are active all the time, or only when the decoder is being used. If the Quiet Bit is ON, sound will be activated to the decoder when it is addressed and will turn off after the packet timeout period has expired (see CV11 above).

**Table I.**  
**CV 113, Sound Control Modes**

| DDE | Quiet Bit | CV Value |
|-----|-----------|----------|
| Off | Off       | 0        |
| Off | On        | 1        |
| On  | Off       | 2        |
| On  | On        | 3        |

Use Table I to determine the proper value for CV 113.

### **Step 9. Resetting CVs or Starting Over**

Occasionally, something goes wrong and the DSD-LC will not respond as expected. Usually, this is caused by one or more CVs being programmed to the wrong value. The CVs can be quickly reset to their factory default values using the following procedure.

1. Program CV 30 to 2 using either Service Mode or Operations Mode.
2. Place locomotive on a powered section of track. If locomotive is already on the mainline, cycle power to the decoder by turning power to the track off and then back on.
3. You should immediately observe the headlight and backup light flashing together. If not, repeat step 1 and 2.
4. After about five seconds, the headlight and backup light will flash back and forth at an increased rate indicating that the CVs have been reset.
5. You may wait another 25 seconds for the DSD to resume normal operation or bypass the waiting period by turning power to the locomotive off and then back on.
6. The DSD-LC should now respond to short address 3 just as it did when it was first unpacked.

## **Trouble Shooting**

If you should have any difficulties with the operation of your DSD-LC, first check this section for hints on trouble shooting. We have found that most problems are caused by an errant CV value and are easily corrected. When all else fails, try resetting the CV values back to their defaults (see Step 9) and try again.

### **Locomotive doesn't run but was working**

- Address has been accidentally changed.
- Consist address (CV 19) was accidentally set.
- CV29 has been changed to select other address.
- Acceleration and braking CVs set to very high values.
- Broken motor wire or track pickup wire.

### **Locomotive never ran**

- See all the above.
- Decoder wired incorrectly.
- Locomotive is not on a DCC powered track. Note: DSD-LC does not work in 'analog' mode.

### **Locomotive runs but makes no sound**

- Mute function (F8) is on.
- Another function is re-mapped to the Mute function.
- Sound Volume CVs (120-123) have been set to zero.
- Speaker wire is broken.
- Speaker capacitor is broken.
- Speaker is burned out.

### **Locomotive runs in a consist but lights and sound effects don't work**

- Consist functions are disabled. Set CV 21 and 22 to activate desired functions (see page 22).

### **Lights flicker on and off**

- Decoder is in 14 speed step mode and command station is set to 28 speed steps.

### **Lights do not work**

- Decoder is in 28/128 speed step mode and command station is set to 14 speed steps.
- Function mapping is improperly set.
- Burned out light bulbs.
- If using 1.5 volt micro-bulbs, resistor value is too large.
- Broken lamp wires.

### **Locomotive just sits and flashes both headlights.**

- CVs are being reset to defaults. Wait 30 seconds and the DSD should respond to address 3.

### **Sound works for a while then quits**

- Amplifier is overheating, lower sound volume.
- Amplifier is overheating, lower track voltage.
- Speaker is damaged. Replace speaker.

### **Speaker sounds 'crackly'.**

- Sound volume is too high for speaker.
- Speaker is not properly baffled.
- Speaker wire is loose.
- Speaker is damaged.

**Functions 5, 6, 7 and 8 do not work**

- Program CV 30 to 4.

**Command Station cannot program CVs above 99.**

- CVs 112 to 123 may be programmed as if they were CVs 49 through 60 by setting CV 30 to 1. When CV 30 = 1, the data in CV49-60 will be temporarily replaced by data in CV 112-123. The original data in CV 49-60 remains unchanged and can be restored by setting CV30 back to 0. Table J shows the relationship between the two sets of CVs. Example: to program CV 120 (whistle volume), set CV 30 to 1, then program CV 57 to the new value. The original data in CV57 will not change but CV120 will. When you are finished, set CV 30 back to 0.

| <b>CV Accessed when CV 30=0</b> | <b>CV Accessed when CV 30=1</b> |
|---------------------------------|---------------------------------|
| CV 49                           | CV 112                          |
| CV 50                           | CV 113                          |
| CV 51                           | CV 114                          |
| CV 52                           | CV 115                          |
| CV 53                           | CV 116                          |
| CV 54                           | CV 117                          |
| CV 55                           | CV 118                          |
| CV 56                           | CV 119                          |
| CV 57                           | CV 120                          |
| CV 58                           | CV 121                          |
| CV 59                           | CV 122                          |
| CV 60                           | CV 123                          |

**Obtaining Technical Support**

We're here to help! If you have a specific problem or question, please contact our technical support staff. Before calling, please have the following information ready:

- Model Number
- Software Version Number (identified on the product packaging or by reading CV 7)
- Hardware Version (identified on product packaging)
- Make and Model of your Command Station

Land: SoundTraxx, 210 Rock Point Drive, Durango CO 81301  
Phone: 970-259-0690  
Fax: 970-259-0691  
Email: [www.soundtraxx.com](http://www.soundtraxx.com)  
Website: [support@soundtraxx.com](mailto:support@soundtraxx.com)  
Hours: Monday-Friday, 9:00AM to 5:30PM, Mountain Standard Time

**APPENDIX A  
DECIMAL-HEX-BINARY CONVERSION TABLE**

| DECIMAL | HEX | BINARY<br>(76543210) | DECIMAL | HEX | BINARY<br>(76543210) | DECIMAL | HEX | BINARY<br>(76543210) | DECIMAL | HEX | BINARY<br>(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 - DSD-LC CV USAGE SUMMARY TABLE

| CV #     | Description                             | Default Value          |
|----------|---|------------------------|
| CV 1     | Primary Address                         | 3                      |
| CV 2     | Vstart                                  | 7                      |
| CV 3     | Baseline Acceleration Rate              | 0                      |
| CV 4     | Baseline Braking Rate                   | 0                      |
| CV 7     | Manufacturer Version                    | Varies                 |
| CV 8     | Manufacturer ID                         | 141                    |
| CV 9     | PWM Period                              | 180                    |
| CV 11    | Packet time-out value                   | 0                      |
| CV 17,18 | Extended address                        | 0003                   |
| CV 19    | Consist Address                         | 0                      |
| CV 21    | Consist Function Active 1               | 0                      |
| CV 22    | Consist Function Active 2               | 0                      |
| CV 23    | Consist acceleration rate               | 0                      |
| CV 24    | Consist Braking Rate                    | 0                      |
| CV 25    | Speed Table/Mid range speed select      | 0                      |
| CV 29    | Configuration Data 1                    | 2                      |
| CV 30    | Error information                       | 0                      |
| CV 33    | FL (f) Output location                  | 1                      |
| CV 34    | FL (r) Output location                  | 2                      |
| CV 35    | F1 Output location                      | 8                      |
| CV 36    | F2 Output location                      | 4                      |
| CV 37    | F3 Output location                      | 0                      |
| CV 38    | F4 Output location                      | 8                      |
| CV 39    | F5 Output location                      | 2                      |
| CV 40    | F6 Output location                      | 4                      |
| CV 41    | F7 Output location                      | 16                     |
| CV 42    | F8 Output location                      | 32                     |
| CV 49    | HL Hyperlight Select                    | 01                     |
| CV 50    | BL Hyperlight Select                    | 01                     |
| CV 51    | FX1 Hyperlight Select                   | 01                     |
| CV 52    | FX2 Hyperlight Select                   | 01                     |
| CV 59    | Flash rate/Hold time                    | 66                     |
| CV 66    | Forward Trim                            | 128                    |
| CV 67-94 | Speed Table                             | See Table C            |
| CV 95    | Reverse Trim                            | 128                    |
| CV 112   | Sound Configuration 1 (Auto enable)     | 1                      |
| CV 113   | Sound Configuration 2 (Control Modes)   | 2                      |
| CV 114   | Sound Configuration 3 (Bell Ring Rate)  | 4                      |
| CV 115   | Sound Configuration 4 (Whistle Select)  | 1                      |
| CV 116   | Sound Configuration 5 (Exhaust Control) | 8 (diesel), 64 (steam) |
| CV 120   | Whistle/Horn Volume                     | 192                    |
| CV 121   | Bell Volume                             | 128                    |
| CV 122   | Exhaust Volume                          | 128                    |
| CV 123   | Background Sound Volume                 | 128                    |

## SERVICE AND WARRANTY POLICY

### SOUNDTRAXX 90-DAY 'SAFETY NET' WARRANTY

Each SoundTraxx Digital Sound Decoder is tested thoroughly before it is shipped and warranted to be in good working order and free of manufacturing defects. However, in the event that a mistake does occur during installation, SoundTraxx will cover the repair under our 'Safety-Net' Service Warranty.

If during the first ninety (90) days you damage your Digital Sound Decoder or it fails to operate, SoundTraxx will repair or replace the system free of charge if:

1. The original sales receipt showing purchase from an authorized SoundTraxx dealer accompanies the decoder. Receipt must show purchase date to be within the last 90 days. Your original receipt will be returned with your repaired unit.
2. There is no damage resulting from unauthorized repairs or modifications. This includes but is not limited to:
  - Removing the shrink tubing from the decoder
  - Drilling or enlarging circuit board holes
  - Cutting or trimming the circuit board
3. The Digital Sound Decoder is returned properly packaged, postage paid and insured - SoundTraxx is not responsible for product lost or damaged in transit.

### Exclusions

Onboard locomotive speakers are not covered by this warranty. This warranty does not cover damage resulting from accidents, fire, floods, or other acts of God.

### 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.

### Warranty Procedure

1. Return the Digital Sound Decoder with your dated sales receipt, properly packaged, postage paid and insured. SoundTraxx is not responsible for product lost or damaged in transit.
2. To help expedite your repair, complete a Service Request Form available from our website at [www.soundtraxx.com/support](http://www.soundtraxx.com/support) or by contacting our Customer Service Department. This allows our technicians to more quickly isolate the problem and perform the necessary repairs.
3. Please make sure you include a daytime phone number in case we should need to contact you regarding your repair. Your repaired decoder will be returned via UPS Ground (no P.O. Boxes please!). Decoders being shipped to foreign addresses will be shipped via U.S. Airmail.

**Important!** Return only the Digital Sound Decoder. Under no circumstances should you send your locomotive (or other model) to us, as we cannot assume any liability for their safe return.

### Non-Warranty Repairs

Digital Sound Decoders needing repairs after the ninety (90) day warranty period will be repaired at prevailing service rates. Rates are published on our website or can be obtained through our Customer Service Department.

### Out-of-Warranty Repair Procedure

To obtain service for Digital Sound Decoders which do not qualify as Warranty Repairs:

1. Return the decoder, properly packaged, postage paid and insured. SoundTraxx is not responsible for product lost or damaged in transit.
2. To help expedite your repair, complete a Service Request Form available from our website at [www.soundtraxx.com/support](http://www.soundtraxx.com/support) or by contacting our Customer Service Department. This allows our technicians to more quickly isolate the problem and perform the necessary repairs.
3. Please make sure you include a daytime phone number in case we should need to contact you regarding your repair.
4. Please include a check or money order in U.S. dollars drawn on a U.S. bank according to the posted rates, or provide a credit card number and expiration date (MC or VISA, please!). Posted rates include shipping via UPS (no P.O. Boxes please!). Decoders being shipped to foreign addresses will be shipped via U.S. Airmail. If no payment is included with the repair, no work will begin until you have contacted the Customer Service Department.
5. While a rare occasion, in the instance a decoder is determined to be un-repairable, the system will be returned to you at no charge, with no repairs made. Optionally, the cost of a standard repair may be applied

to the purchase of a replacement decoder. Purchase must be made directly through the factory.

6. A large percentage of Digital Sound Decoders that are returned are not defective or damaged at all, but have been incorrectly programmed or misused. Digital Sound Decoders returned that are found to be in good working condition will be returned less a \$10.00 charge plus the cost of return shipping. To avoid this, please follow our easy troubleshooting procedures which can be found in this manual and on our website before returning a sound system for repair.

For prompt factory service, contact:

SoundTraxx Service Department  
210 Rock Point Drive  
Durango, CO 81301  
Telephone (970) 259-0690  
Fax (970) 259-0691  
Email: [support@soundtraxx.com](mailto:support@soundtraxx.com)

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***The Age of Steam Railroad Museum***

P.O. Box 153259, Dallas, TX 75315  
(214) 428-0101

***The Burlington Northern Santa Fe Railroad***

Dallas, TX

***The Cumbres & Toltec Scenic Railroad***

Box 789, Chama, NM 87520  
(505) 756-2151

***The Durango & Silverton Railroad***

Main Street, Durango, CO 81301  
(970) 247-2733

***The East Broad Top Railroad & Coal Co.***

P.O. Box 158, Rt. 994, Rockhill Furnace, PA 17249  
(814) 447-3011

***The Georgetown Loop Railroad***

P.O. Box 27, Georgetown, CO 80444  
(303) 569-2403

***Harzer Schmalspurbahnen***

Wernigerode, Germany  
0 39 43/5 58-0

***The Leadville, Colorado & Southern***

P.O. Box 916, Leadville, CO 80461  
(719) 486-3936

***The Nevada Northern Railway Museum***

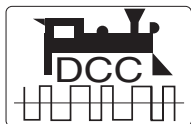
P.O. Box 150040, East Ely, NV 89315  
(702) 289-2085

***The Portola Railroad Museum***

P.O. Box 608, Portola, CA 96122  
(530) 832-4532

# NOTES

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COMPATIBLE WITH  
THE NMRA DCC STANDARDS  
AND RECOMMENDED  
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