



# **Railsounds 4.0**

## **INSTALLATION INSTRUCTIONS**

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# 1 Overview

The Lionel Railsounds system is considered by many to be the best locomotive sound system available. The variety of sounds can add an unparalleled degree of realism to almost any locomotive in your roster, regardless of its age.

Due to its relatively small size, Railsounds can be installed into many locomotives or varieties of rolling stock with little difficulty. While these instructions describe specific installation examples, they should serve as guidelines for installation in other applications, as long as there is sufficient mechanical clearance to do so.

## 1.1 What's Supplied

The Railsounds kit you received contains the following components:

- Railsounds Audio Board
- Railsounds Power Supply
- Railsounds Motherboard (steam or diesel)
- Loudspeaker
- Installation Kit

### 1.1.1 Railsounds Circuit Boards

The Railsounds 4.0 System consists of three circuit board components. In addition to providing connections to power and other system components, the Motherboard serves as the platform for the two Lionel Railsounds plug-in boards. Additionally, the diesel/electric version of the Motherboard includes a micro-controller to monitor motor voltage and produce a signal to ramp up and ramp down Diesel RPMs. Steam Chuff rates are produced by different types of external sensors. Battery connections are made to the Railsounds Motherboard by means of an attached battery clip and cable. Note that the steam and diesel versions of the motherboard differ slightly in appearance as well as in function.

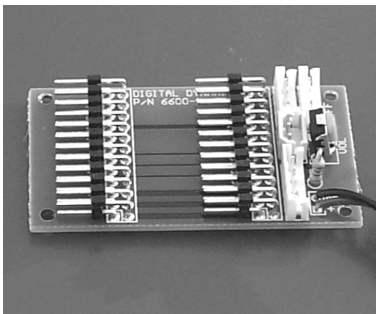


Fig 1a. - Steam Motherboard

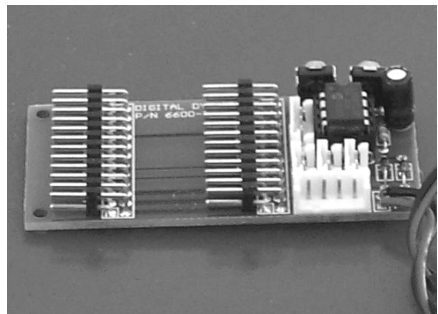


Fig 1b. - Diesel/Electric Motherboard

The Railsounds Power Supply Card plugs into the Motherboard and provides a constant source of voltage for the entire Railsounds system. The remaining circuit component is the Railsounds Audio Card. It consists of a microprocessor, sound ROM, and audio amplifier.

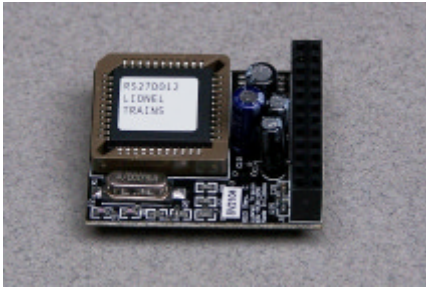


Fig. 2a. Railsounds Audio Board

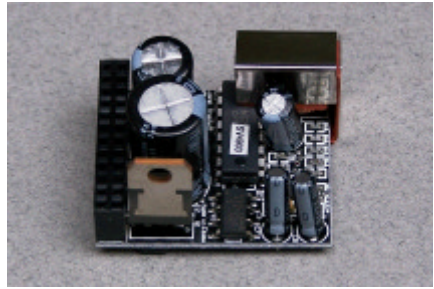


Fig. 2b. Railsounds Power Supply

### **1.1.2 Installation Kit Contents**

In addition to the Railsounds circuit boards, the parts kit contains miscellaneous hardware to help you complete your installation. It includes:

- Reed Switch Assembly and Cable (Steam Version only)
- Two miniature magnets (Steam Version only)
- Power/Signal cable (dual 4-pos. connector w/ RED, BLK, VIO wires)
- VCO/Motor Cable - single 2-pos. connector w/ 2 wires (Diesel Version only)
- Plastic Ty-Wraps
- Double Sided Foam Adhesive Tape Strips

## **1.2 What's Required for Installation**

The following tools are required to perform installation of the Railsounds components:

- Low power soldering iron
- Rosin core solder
- Small wire cutters
- Wire strippers
- Small flat blade screwdriver
- Razor Blade or Exacto Knife
- Clear Silicone Adhesive

## **2 General Installation Instructions**

### **2.1 Engine Preparation and Component Installation**

Survey the interior of the locomotive or tender and determine if there is sufficient space to mount all of the Railsounds components. In most cases, Railsounds will be installed and operated in conjunction with a TMCC unit such as the AC/DC DLX or similar product for full Command Control of all Railsounds features. If necessary, the two systems can be physically located apart. For instance, you can install Command Control Components in a powered locomotive, and then install Railsounds in a non-powered dummy. You can even install the Railsounds system in a piece of rolling stock, provided there is power available from a pickup roller.

Examine the layout of your engine and the circuit components carefully before deciding on the best mounting method for the circuit boards. Don't forget to allocate space for the loudspeaker.

#### **2.1.1 General Component Location Considerations**

In order to install the Railsounds system, the particular engine or rolling stock must meet three requirements.

#### **2.1.2 Power**

Railsounds needs track power to operate. This should be a concern only if you are contemplating installation into rolling stock, such as a boxcar. Certain steam tenders may also lack a power pickup roller. If this is the case, you can make connection between an adjacent powered engine via a multi-pin connector available from Digital Dynamics.

#### **2.1.3 Location for Loudspeaker**

The engine or rolling stock should have adequate space to firmly mount a 2" loudspeaker along with an opening somewhere in the body or chassis to permit sound to radiate outward. Preferably, the speaker will be mounted directly against this opening, and the rest of the body sealed off to provide a relatively 'air tight' baffle for the speaker. When this is not practical, consider constructing a simple baffle. Instructions to do this are detailed in a later section of this manual.

#### **2.1.4 Speed Sensor Mechanism**

Railsounds is designed to receive input from your engine to provide accurate sounds in response to engine movements. The diesel/electric version of your Railsounds system is equipped with a microprocessor which monitors the voltage applied to the engine's motors. Therefore access to one of the locomotive's motors is required. If the Railsounds unit is placed in a non-powered dummy locomotive, it will be necessary to provide the motor signals through an external connector.

Railsounds Steam systems use a magnetic sensor to produce a chuff signal. The sensor should be located in the locomotive if it is desired to produce chuffs precisely in sync with driver movement, or the sensor may be attached so that it can detect wheel movement of a tender or other rolling stock.

## 3 Diesel Installation

Carefully remove the body from the locomotive and place it aside where it cannot be damaged. At the same time, remove all exposed headlamp bulbs from the chassis so they are not broken during the installation. Place the chassis on a clean, level work surface. Survey the interior of the engine for the best location to mount the Railsounds circuit boards and loudspeaker.

### 3.1 Circuit Board Installation

Once you have determined the locations for all the components, begin by mounting the Motherboard. You may fasten it to the chassis with hardware, or use the supplied adhesive strips. Be sure you are satisfied with the mounting location before applying the strips. Do not forget to provide enough clearance to permit the circuit cards to be removed once the motherboard is fastened into place. Also, you will need to have unrestricted access to the various electrical connections after the board is installed. Once attached to the board or chassis, these strips are very difficult to remove.

If you prefer, you can use mechanical fasteners to mount the board. The Motherboard has a hole in each corner to accommodate a 4-40 screw. However, two of the holes will require a countersunk flathead screw in order to avoid interference with one of the plug-in cards. If you decide to mount the board using screws and nuts, be sure to use small spacers to raise the board above the chassis to prevent electrical short circuits.

#### 3.1.1 Electrical Connections

Electrical connections to Railsounds are made via small multi-pin connectors. Refer to the accompanying table and figure for the description and location of these connections. All necessary pre-wired cable assemblies are included with the installation kit, eliminating the need to solder anything to the Railsounds boards. After the Motherboard and other components have been firmly mounted in place, you can begin making connections to the board.

J1	Supplies power and digital commands to the Railsounds system. The RED wire carries power from the center rail either directly, or through a connector on the AC/DC DLX or other TMCC board. The BLK wire is the chassis common, or outside rail. The VIO wire carries digital commands from the TMCC system.
J2	Loudspeaker connection.
J4	VCO Input. The two leads from J4 connect to the armature (brush) terminals of either an AC or DC motor, allowing diesel RPM rates to increase/decrease with engine speed. The two connections are non-polarized.
J5,J6	Connections for optional oscillating Ditch Lights.
VR1	Volume Control. Allows you to set Railsounds maximum volume for both Conventional or Command Mode.
VR2	Diesel RPM Adjustment

Table 1. Railsounds Diesel Motherboard Connections



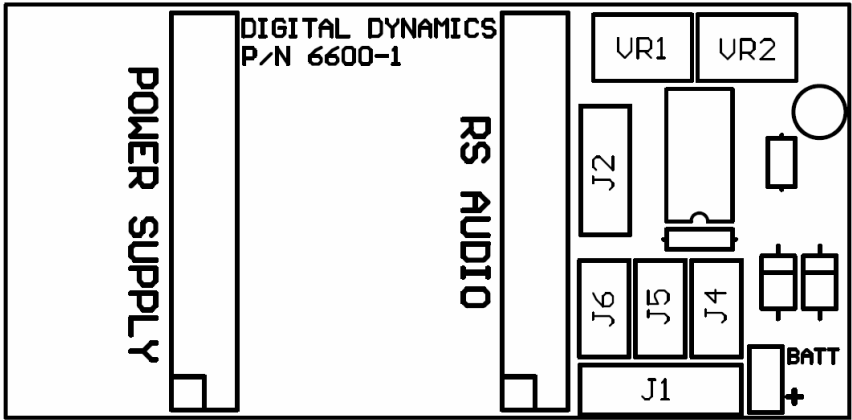


Fig. 3 - Railsounds Diesel Motherboard Layout and Connector Locations

If you are installing Railsounds as a standalone system, i.e. without Trainmaster Command Control, see the section on Railsounds Without Trainmaster Command Control for additional installation steps.

- Identify the Audio Board from Fig. 2a. and insert it into the designated socket on the motherboard. Line up the pins with the connector and push the board forward until it is fully seated.
- Insert the Railsounds Power Supply Board into its socket.
- Connect the leads from J4 to the terminals of one of the engine motors. There is no polarity to observe. For DC Can motors, connect the leads to the two motor terminals. For Lionel AC motors, connect only one of the leads to the motor field terminal. It does not matter which lead is used. After you have made these connections, insert the plug into J4. Before applying power to the Railsounds system, be sure to verify that this plug is inserted into J4. Accidental connection to either J5 or J6 will result in damage to the circuit.
- Connect the power/signal cable to J1. Connect the other end to the AC/DC DLX, LCRU, or other TMCC system.
- Neatly dress all wiring and secure it in place with a cable tie.

### 3.1.2 Optional Ditch Lights

If you ordered Railsounds with the ditch light option and have installed the LED ditch lights on your locomotive, connect them to the Railsounds motherboard at J5 and J6.

The ditch lights are designed to flash alternately whenever the engine horn is activated. At other times, both lights will be illuminated, and can be turned on and off with the CAB-1 [AUX2] button.

The outputs at J5 and J6 are designed to drive white LEDs, and are rated to supply 5VDC at a maximum current of 25mA. This is more than adequate for most white LEDs. If you prefer to use miniature incandescent bulbs, they should not exceed these ratings, or damage to the circuit will result.

LEDs are polarity dependent, and their brightness is determined by the current that passes through them. The circuit below uses a series resistor value of 82 ohms to set the white LED current to 20mA from a 5V source. This will provide excellent brightness with all miniature white LEDs. Yellow LEDs have different electrical characteristics. For the equivalent brightness, use a resistor value of 150 ohms or greater.

Pre-wired LED ditch light kits are available from Digital Dynamics supplied with either yellow or white LEDs.

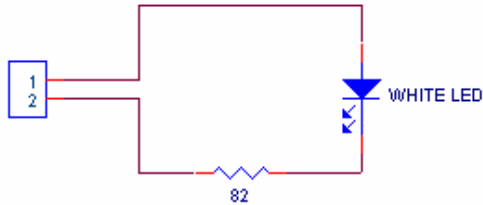


Fig. 4 - Ditch Light Wiring

### **3.2 Loudspeaker Mounting**

Each engine has its own mechanical constraints, and they will dictate where you can mount the loudspeaker. The most convenient and frequently utilized location for speaker mounting in diesel engines is within the fuel tank below the frame. This is either a die-cast or plastic assembly located below the chassis in between the two trucks. Many of the plastic types have grilles molded into them, making installation fairly simple and effective.

Larger engines should have ample room to mount all necessary components, including the speaker, directly on the chassis. For cab type diesel locomotives, or other situations where there is limited space available, consider mounting the speaker to the inside of the shell, behind a grill opening. You can attach the speaker using hot glue or clear silicone adhesive.

To mount the speaker directly on the chassis, apply a bead of clear silicone adhesive to the circumference of the speaker, and gently press it face down to the chassis centered over the chassis opening. Do not press down so hard as to squeeze all of the adhesive out from between the speaker and chassis. Allow the adhesive to cure for a few hours before continuing with the installation.

When mounting the loudspeaker, be sure to orient it so that the cable will reach the appropriate connector on the motherboard. After the loudspeaker is mounted firmly to the chassis, plug it into J2

You can greatly improve the sound of the speaker by mounting it in a baffle. See the instructions in a later section of this manual to for construct an inexpensive, yet effective baffle.

Proceed to section 5 to continue the installation.

## 4 Steam Installation

Carefully remove the body from the locomotive and place it aside where it cannot be damaged. At the same time, remove all exposed headlamp bulbs from the chassis so they are not broken during the installation. Place the chassis on a clean, level work surface. Survey the interior of the engine for the best location to mount the Railsounds circuit boards and loudspeaker.

### 4.1 Circuit Board Installation

Once you have determined the locations for all the components, begin by mounting the Motherboard. You may fasten it to the chassis with hardware, or use the supplied adhesive strips. Be sure you are satisfied with the mounting location before applying the strips. Do not forget to provide enough clearance to permit the circuit cards to be removed once the motherboard is fastened into place. Also, you will need to have unrestricted access to the various electrical connections after the board is installed. Once attached to the board or chassis, these strips are very difficult to remove.

If you prefer, you can use mechanical fasteners to mount the board. The Motherboard has a hole in each corner to accommodate a 4-40 screw. However, two of the holes will require a countersunk flathead screw in order to avoid interference with one of the plug-in cards. If you decide to mount the board using screws and nuts, be sure to use small spacers to raise the board above the chassis to prevent electrical short circuits.

#### 4.1.1 Electrical Connections

Electrical connections to Railsounds are made via small multi-pin connectors. Refer to the accompanying table and figure for the description and location of these connections. All necessary pre-wired cable assemblies are included with the installation kit, eliminating the need to solder anything to the Railsounds boards. After the Motherboard and other components have been firmly mounted in place, you can begin making connections to the board.

J1	Supplies power and digital commands to the Railsounds system. The RED wire carries power from the center rail either directly, or through a connector on the AC/DC DLX or other TMCC board. The BLK wire is the chassis common, or outside rail. The VIO wire carries digital commands from the TMCC system
J2	Loudspeaker connection.
J4	Marker Lamps. Provides a constant regulated +5V DC with current limited output for direct connection of LED marker lamps.
J5	External Speed Sensor. Connection to magnetic reed switch, hall sensor, or mechanical switch to permit synchronized steam chuffing with wheel and drive rod movement
VR1	Volume Control. Allows you to set Railsounds maximum volume in either Conventional or Command Mode.

Table 2. Railsounds Steam Motherboard Connections

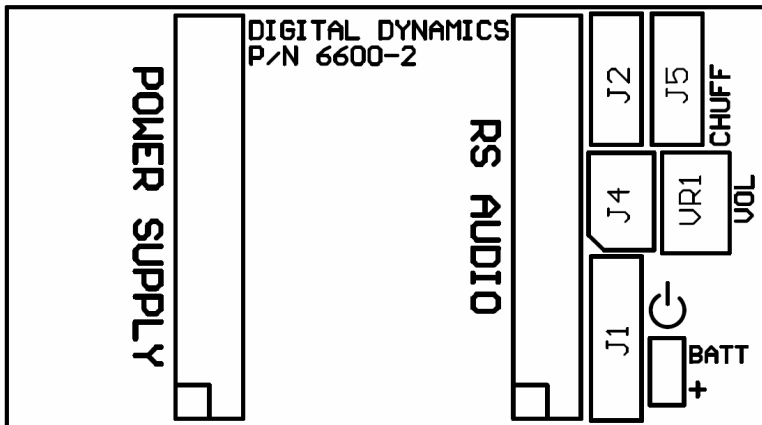


Fig. 5 - Railsounds Steam Motherboard Layout and Connector Locations

If you are installing Railsounds as a standalone system, without Trainmaster Command Control, see the section on Railsounds Without Trainmaster Command Control for additional installation steps.

- Insert the Railsounds Audio Board into the proper socket. Identify the Audio Board from Fig. 2a. Line up the pins with the connector and push the board forward until it is fully seated.
- Insert the Railsounds Power Supply Board into its socket. This board can be identified with the help of figure 2b.
- Connect the power/signal cable to J1. Connect the other end to the AC/DC DLX or LCRU TMCC system.

#### 4.1.2 Railsounds Steam Chuff Control

The standard steam Railsounds system includes a magnetic reed switch and two small, rare earth magnets. When placed on the back side of a locomotive driver or on a tender wheel, the magnets will activate the reed switch each time they come in close proximity to it. If you are upgrading from an older Railsounds system or a Sound of Steam system, your engine may already have a mechanism for generating a chuff signal. The different options are discussed below.

##### 4.1.2.1 Reed Switch with Wheel Mounted Magnets

The reed switch and magnets can be installed either on the locomotive, or on the tender. Note that installation on the locomotive requires that the chuff signal be connected via an optional tether to the Railsounds system installed in the tender.

The reed switch is a narrow glass tube, approximately one inch in length, covered with plastic shrink tubing for protection. The actual switch mechanism is located at the mid-point along the length of the tube. If you allow one of the magnets to come in close proximity, it will align itself right at the switch point. It may be helpful to mark this location with a spot of bright colored paint or with a permanent marker.

A wire is soldered to each end of the switch and terminated at a three position connector that installs into J5 of the steam motherboard. Exercise caution when handling the reed switch. Since it is made of glass, it can be broken easily.

#### 4.1.2.1.1 Mounting the Reed Switch on the Tender

The reed switch assembly is configured to facilitate truck mounting on all types of tenders. By mounting the switch on a tender truck, you will avoid the need to add additional electrical connections between the locomotive and tender.

Determine a suitable location on a truck frame to mount the reed switch. The ideal location will allow a magnet mounted on the back of a wheel to pass within no more than 1/8" from the center of the switch, and at the same time, allow the wires to be routed through the chassis without interfering with movement of the truck.

Once you have settled on a mounting location, attach the reed switch to the truck frame with RTV adhesive and allow it to cure. Use an alligator clip or other suitable clamp to hold the switch in place until the adhesive sets. Be sure the switch is in the proper magnetic orientation. For best results, the reed switch should be positioned slightly off-center from the magnet's path. Otherwise, a double-chuff may be generated as the North and South poles of the magnet move past the switch. Placing the switch to one side of the magnet's path will prevent this.

After the adhesive has cured, attach a magnet to the backside of the nearby wheel using a suitable cyanoacrylate adhesive such as Super Glue, or Zap-A-Gap. Be sure that the magnet does not interfere with movement of the wheel. Rotate the wheel and verify that the switch is activated each time the magnet passes near it. You can use an ohmmeter to verify the switch closure.

One magnet will produce the equivalent of two chuffs per locomotive driver revolution, since a tender wheel is usually one-half the diameter of a locomotive driver. If you prefer four chuffs per driver revolution, mount two magnets 180 degrees apart.

Next, route the wires through an opening in the chassis. You may need to temporarily remove the connector from the wires if the opening is small. Be sure to note the connections before removing them. Be sure to leave sufficient slack in the wiring to accommodate free movement of the tender truck.

#### 4.1.2.1.2 Mounting the Reed Switch on the Locomotive

When attached to one of the locomotive driver wheels, perfect synchronization with the movement of the drive rods can be achieved. If desired, multiple magnets can be attached to a driver wheel at 90 or 180 degree intervals to produce two or four chuffs per wheel revolution. Two magnets are provided with the kit. Additional magnets are available from Digital Dynamics.

In order to install the reed switch on the locomotive, you will need to provide an electrical connection from the locomotive mounted reed switch to the tender where the Railsounds system is installed.

After removing the engine boiler, determine a suitable location on the engine frame to mount the reed switch. It should be away from the motor, and no more than 1/4" from the rear surface of the drive wheels. When you are satisfied with a location, attach the reed switch to the engine frame with RTV adhesive and allow it to cure. Use an alligator clip or other suitable clamp to hold the switch in place until the adhesive sets. Be sure the switch is in the proper magnetic orientation. To determine proper switch orientation, allow the switch to come in contact with one of the magnets. Note where the magnet adheres itself to the switch. The switch should then be oriented with this spot facing the rear of the driver wheel.

For best results, the reed switch should be positioned slightly off-center from the magnet's path. Otherwise, a double-chuff may be generated as the North and South poles of the magnet move past the switch. Placing the switch to one side of the magnet's path will prevent this.

After the adhesive has cured, attach one or more magnets to the backside of the driver wheel using a cyanoacrylate adhesive such as Super Glue or Zap-A-Gap. Be sure that there is sufficient between the engine chassis and the driver.

Rotate the wheel and verify that the switch is activated each time the magnet passes near it. You can use an ohmmeter to verify the switch closure.

Next, cut the reed switch wire installed in the center connector position approximately two inches from the connector. The other wire can be cut off right at the connector, since it is not needed. The 2" wire with plug will be spliced to the tender side of the tether and plugged into Railsounds connector J5 to complete the chuff circuit.

Connect one of the reed switch wires to the engine side of the tether. Note that only one of the switch wires needs to be routed through the tether. The remaining wire can be connected to a solid engine ground.

If you are installing a six or eight pin tether, use one of the connections to complete the chuff circuit. Be sure that the wires correctly mate when the tether plugs are mated together. If you are using a 4-pin tether, there are no spare connections available. You will need to add an additional 1-pin tether to complete the connection.

#### **4.1.2.2 Smoke Unit Mounted Reed Switch**

This method is intended for Lionel engines, or other engines having a mechanical smoke unit with a moving piston. It will give the engine the ability to generate precise, smoke synchronized chuffing. Synchronized chuffing is obtained by mounting the reed switch so that it is activated by the vertical motion of the smoke unit lever. Different types of mechanical smoke units will require different mounting techniques.

It may be necessary to use this technique if the engine is equipped with MagneTraction, which will interfere with the operation of a wheel mounted magnet.

Determine a suitable location to mount the reed switch. The selected location should be away from the engine motor, and no more than 1/8" from the path of the magnet. When you are satisfied with its location, attach the reed switch to it's location with clear silicone RTV adhesive and allow it to cure. Be sure the switch is in the proper magnetic orientation. Attach the magnet to the smoke lever using a cyanoacrylate adhesive such as Super Glue or Zap-A-Gap.

Next, cut the reed switch wire installed in the center connector position approximately two inches from the connector. The other wire can be cut off right at the connector, since it is not needed. The 2" wire with plug will be spliced to the tender side of the tether and plugged into Railsounds connector J5 to complete the chuff circuit.

Connect one of the reed switch wires to the engine side of the tether. Note that only one of the switch wires needs to be routed through the tether. The remaining wire can be connected to a solid engine ground.

If you are installing a six or eight pin tether, use one of the connections to complete the chuff circuit. Be sure that the wires correctly mate when the tether plugs are mated together. If you are using a 4-pin tether, there are no spare connections available. You will need to install a 1-pin tether to complete the connection.

#### **4.1.2.3 Smoke Unit Mechanical Switch**

Certain Lionel locomotives that came with with 'Sound of Steam' systems have a simple electrical switch mechanism already attached to the smoke unit. The switch consists of a piece of spring metal that makes a connection to ground as the smoke unit piston is driven upward. This mechanism can be used in place of the reed switch if desired. The electrical connections are the same as the smoke mounted reed switch discussed in section 3.1.2.2.

#### **4.1.2.4 Axle Mounted Hall Sensor**

This option is available for Lionel engines that are undergoing upgrade from earlier versions of Railsounds. This method utilizes a magnetically activated Hall sensor mounted on a truck of the tender. A magnetic 'third wheel' is installed on one of the axles in close proximity to the Hall sensor. A chuff signal is produced each time the wheel's magnetic pole rotates in front of it.

There are three wires attached to the Hall Sensor, usually colored GRN, BLU, and YEL. The other ends are usually soldered directly to the older Railsounds 1 or Railsounds 2 boards. If you specified the existing sensor at the time of order, you have received a pre-wired 3-pin connector having the same GRN, BLU, and YEL wires with your kit. Simply splice the three wires from the sensor to the wires of the connector assembly and plug the connector into J5.

The engine chuff rate generated by this method is determined by the magnetic 'third' wheel and cannot be changed.

## **4.2 Loudspeaker Mounting**

Steam installations will utilize the tender for both the Railsounds electronics and loudspeaker. Many locomotive tenders, whether or not they originally had some sort of sound system, have pre-punched holes in the chassis to accommodate a loudspeaker. The best way to mount a speaker in this situation is to apply a bead of clear silicone adhesive to the circumference of the speaker, and gently press it face down to the chassis centered over the holes. Do not press down so hard as to squeeze all of the adhesive out from between the speaker and chassis. Allow the adhesive to cure for a few hours before continuing with the installation.

When mounting the loudspeaker, be sure to orient it so that the cable will reach the appropriate connector on the motherboard.

## **5 Railsounds Without Trainmaster Command Control**

Railsounds can operate as a standalone system without Trainmaster Command Control. You can activate the whistle using your transformers' whistle control. Activation of the bell requires either an add-on bell button, or a transformer equipped with a separate bell activator.

In a conventional operating environment, engine speed is controlled by increasing or decreasing track voltage. Track voltage, in turn, is applied directly to the motors and to the Railsounds VCO circuit to provide increasing and decreasing RPM/Chuff rates as the track voltage is varied.

For a Traditional installation without Trainmaster Control, perform the following steps in addition to those in the previous section.

- Remove the connector from one end of the power cable. This is the cable with a BLK, RED, and VIO wire, with a 4-position connector on each end. Use a pair of cutting pliers to cut the wires off at the connector body.
- Remove approximately 3/8" insulation from the RED wire, and connect it to the wire that leads from the engine center rail pickup roller.
- Likewise strip the insulation from the BLK wire and connect it to a solid chassis common connection.
- Wrap the end of the VIO wire in electrical tape to prevent it coming in contact with any part of the circuitry. This wire is not used for Conventional installations.

### **5.1 Railsounds Battery**

If you plan to operate your Railsounds equipped engine exclusively in a TMCC environment, you do not need to install a battery. The TMCC system uses a constant track voltage, so there will always be adequate voltage present to operate Ralsounds. Engine startup and shutdown sound sequences can be heard as long as they are initiated remotely before track power is shut down.

If you plan to operate the engine in Conventional Mode, you will need to install a 9V alkaline battery. Do not use a rechargeable battery such as a NICAD or NiMH type. Railsounds does not have a charging circuit, and these types of batteries will be depleted quickly.

The purpose of the battery is to prevent sound from being interrupted when track power is cycled or momentarily interrupted for any reason. It will also allow Railsounds to operate when the track voltage is low, a result of running an engine at very low speed. The engine sounds will shut down automatically after power is removed from the engine for more than ten seconds.

The battery is connected to Railsounds via a 2-wire cable with a polarized, snap-on connector. After connecting the battery, secure it to the chassis with a small piece of foam tape. Do not allow the metal case of the battery to contact any of the circuitry.



## 6 Testing Your Installation

Do not place your engine on the track or apply power to it without first verifying that your transformer's circuit breaker is operating normally. The circuit breaker should immediately trip when a load or short circuit exceeding the capacity of the transformer is detected. A small, modern type power controller is the preferred source when testing any electronics installation. These controllers have limited capacity to deliver damaging high currents, and are equipped with solid state circuit breakers that react quickly to faults. An older transformer such as a ZW or KW can deliver extremely high currents, and have very slow internal circuit breakers. If a short circuit is present, a considerable amount of damage can be done to the circuit boards and wiring before a circuit breaker of this type is tripped.

Before placing the locomotive on the track and applying power, carefully inspect all solder connections for short circuits and loose connections. Make sure all wire nuts are tight. Pay particular attention to areas where the circuit board may potentially come in contact with metal parts of the engine. Also, it is important that any unused wires do not come in contact with any part of the circuit or any exposed metal parts. Either cut-off unused wires, or wrap their ends with electrical tape in order to prevent short circuits.

### 6.1 Testing Railsounds with TMCC

1. Remove all other locomotives from the track, and make sure that track power is OFF.
2. Place the locomotive on the track.
3. Hold the locomotive firmly while you apply power to the track. This will prevent possible damage to your locomotive in the event it starts up unexpectedly due to a malfunction or improper installation.
4. Turn on power. Observe that the engine headlamp is lit steadily.
5. Make sure that none of the circuit components, including any wiring, are hot to the touch, and that no smoke or burning odor is present. Otherwise, shut down power immediately.
6. In a TMCC environment, you need to address the engine and initiate the startup sequence before any sound can be heard. On your CAB-1, press [ENG][##], then [BOOST]. Engine startup sounds should now be heard.
7. If the sound is weak or barely audible, rotate the volume control (VR1) counterclockwise until a suitable volume level is reached.
8. Test the horn and bell functions by pressing the appropriate buttons on the CAB-1.
9. Test the coupler sounds by pressing the coupler [F] and [R] buttons. Even if your engine does not have electrocouplers, the sound will be produced.
10. Increase the throttle and listen for steam chuffs, or if a diesel, increasing engine RPM sounds.
11. With the engine moving at a moderate speed, press and hold the [BRAKE] button to verify braking sounds.
12. Bring the engine to a full stop by turning the throttle counter-clockwise.
13. If diesel sounds do not return to idle after a few seconds, you may need to adjust the VCO. There is no similar adjustment necessary for steam engines.
14. Before replacing the shell on the engine, you will want to experiment with the sound level. Bear in mind that the sound level will increase significantly when the shell is replaced on the chassis, and make the adjustment to VR1 accordingly.

## **6.2 Testing Railsounds in Conventional Mode**

1. Remove all other locomotives from the track, and make sure that power is OFF.
2. Place the locomotive on the track.
3. Hold the locomotive firmly while you apply power to the track. This will prevent possible damage to your locomotive in the event it starts up unexpectedly due to a malfunction or improper installation.
4. Turn on power. Observe that the engine headlamp is lit steadily. Engine startup sounds will be heard as soon as track power is applied.
5. If the sound is weak or barely audible, rotate the volume control counterclockwise until a suitable volume level is reached.
6. Press the transformer HORN button to verify horn operation.
7. If you have a Bell button, test the operation of the engine bell.
8. Cycle the engine power to begin engine movement. Listen for steam chuffing or increasing diesel RPM.
9. Bring the engine to a full stop. Chuffing sounds should stop, or diesel RPM should return to idle. Note that braking sounds are not available in Conventional mode.
10. If diesel sounds do not return to idle after a few seconds, you may need to adjust the VCO. There is no adjustment to be made for steam engines.
11. Turn off engine power. The engine sounds should remain on, powered by the 9V battery. After 10 seconds, the shutdown sequence will be initiated and sound will turn off.
12. Before replacing the shell on the engine, you will want to experiment with the sound level. Bear in mind that the sound level will increase significantly when the shell is replaced on the chassis, and make the adjustment to VR1 accordingly.

## **6.3 Adjusting the VCO (Diesel/Electric Only)**

Diesel RPM rate is determined by a microcontroller chip on the Railsounds Motherboard that creates pulses at a rate proportional to the voltage applied to the motors. A speed calibration table is stored in the microcontroller memory allowing it to compensate for non-linear motor characteristics.

A single potentiometer (VR2) determines the maximum RPM rate. There is no adjustment needed for idle speed. Keep in mind that adjustment for diesel engines is not very critical, as there are only two or three speed steps above idle. Use a small flat blade screwdriver to make the adjustment.

### **6.3.1 Adjustment With TMCC**

1. Place the engine on the track, power up the track, and activate Railsounds.
2. Verify that all functions are operating normally.
3. Turn the RPM control to the halfway position.
4. Operate the brake until the engine comes to a full stop. The screeching brakes will sound as the brake button is held down.
5. Adjust the VR2 until the brake sound stops when the engine comes to a full stop. If not properly adjusted, either the brake sound will terminate before the engine is completely stopped, or the brakes will continue to sound after the engine has come to a full stop.

6. A final adjustment may be required if the engine does not reach its maximum RPM rate while running at moderate speed. When properly adjusted, the RPMs should increase as the engine increases speed, and return to idle within a few seconds after the engine is stopped.

### **6.3.2 Conventional Mode Adjustment**

1. Place the engine on the track, and turn up power until Railsounds is heard.
2. Verify that all functions are operating normally.
3. Lower the track voltage as low as possible without causing Railsounds to initiate its shutdown sequence.
4. Wait for the diesel RPM to return to idle.
5. If idle does not resume within five seconds, rotate the RPM control clockwise in small steps, pausing a few seconds each time to wait for idle to return.
6. After Railsounds resumes idle, back the control off slightly. When properly adjusted, the control should be close to the center of its rotation.
7. Operate the engine noting the changes in RPM as the engine accelerates, runs, and is brought to a stop. For most diesels, there should be three distinct RPM rates above idle.
8. A final adjustment may be required if the engine does not reach its maximum RPM rate when running at moderate speed. When properly adjusted, the RPMs should increase as the engine increases speed, and return to idle within a few seconds after the engine is stopped.

## 7 Constructing a Loudspeaker Baffle

Proper baffling of a loudspeaker will greatly enhance its sound. Further, a baffle offers a degree of protection for the speaker and is easier to mount within the locomotive than a bare speaker.

An excellent baffle can be constructed from a 1-1/2" to 2" length of PVC pipe with a diameter matched to the speaker, usually 2" or 2-1/4". A length of heavy duty cardboard tubing can also be used with excellent results.

To construct the baffle from either material:

- Measure the available space for the baffle.
- Using a suitable saw, cut off the required length of tubing. Remove excess material from the cut, and smooth off the end.
- Use the cut length of tubing to trace its circumference on a piece of flat cardboard.
- Cut-out the cardboard circle just traced, and using hot glue, or another suitable, strong, permanent adhesive, attach it to the end of the tube, completely sealing one end off. Place it aside as long as necessary to allow the glue to dry properly. You may also wish to paint it black at this time.
- Using a sharp instrument, punch a small hole in the rear of the baffle to allow the speaker wires to be fed through.
- Feed the two speaker wires through the baffle, and solder them to the speaker.
- Place the loudspeaker in the tube with the cone facing outward. If the speaker is slightly smaller in diameter than the tube, it will fall back into the baffle. If this is the case, you will need to attach a spacer to the rear of the speaker to keep it in place. To do this, apply hot glue or silicon adhesive to both sides of a small piece of styrofoam or cardboard, and attach it to the back of the speaker.
- Spread hot glue on the rear of the foam attachment, and place the speaker in the baffle. Gently press it into place so that the glued spacer makes contact with the rear of the baffle.
- Gently pull the excess speaker wire through the hole in the baffle leaving a small amount of slack inside.
- Seal the hole using silicon caulk or other suitable material.
- Use silicon caulk to seal the speaker into the baffle. Spread a small amount around the circumference of the baffle, sealing the space between the speaker and wall of the baffle.
- Place the speaker assembly aside until all the adhesives have cured.



## **Repairs**

Each and every product has been thoroughly tested before it is shipped. The likelihood that it is not working when it reaches you is very small. Should your product ever need repair, you should return it postpaid and insured directly to Digital Dynamics. If your board is in warranty, it will be repaired and returned to you free of charge. Components manufactured by Digital Dynamics that are outside the Warranty period will be repaired for a service charge of \$20. Lionel components will be replaced at the prevailing price. Do not send the entire locomotive unless you are instructed to do so. Please call or email for return authorization before returning anything.

To obtain return authorization call (203) 778-3599, 4 PM to 8 PM (EST), or by email to [info@digitdynam.com](mailto:info@digitdynam.com).

## **Limited Warranty**

Digital Dynamics warrants to the original consumer purchaser that this product will be free of defects in materials and workmanship for a period of one year from the date of original purchase. This warranty does not cover service, repair, or replacement to correct any damage caused by improper installation, improper connection, external electrical fault, accident, disaster, misuse, abuse, or modifications to the product. All other express or implied warranties, including the implied warranty of merchantability and fitness for a particular purpose, are hereby disclaimed.

If this product is not in good working order as warranted, the sole and exclusive remedy shall be repair or replacement. In no event shall Digital Dynamics, or any dealer, distributor, or authorized installation and/or repair service provider be liable for any damages in excess of the purchase price of the product. This limitation applies to damages of any kind, including but not limited to, direct or indirect damages, lost profits, lost savings or other special, incidental, exemplary or consequential damages whether for breach of contract, tort or otherwise, or whether arising out of the use of or inability to use the product, even if Digital Dynamics, or any dealer, distributor, or service provider has been advised of the possibility of such damages or any claim by any other party. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.

During this one year warranty period, the product will either be repaired or replaced (at our option) without charge to the purchaser, when returned either to the dealer with proof of the date of purchase or directly to Digital Dynamics when returned prepaid and insured with proof of date of purchase.

Some states do not allow limitations on how long an implied warranty lasts, so such limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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