

INSTALLATION INSTRUCTIONS

for



Railsounds 2.5

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DIGITAL DYNAMICS

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Table of Contents

INTRODUCTION.....	2
INSTALLATION INSTRUCTIONS.....	2
Tools Required	2
What s Supplied	2
Preparation and Component Installation.....	3
Component Location Considerations	3
Loudspeaker Considerations	3
Loudspeaker Mounting	4
Mechanical Installation.....	4
Standalone Railsounds System	4
Installation with a Lionel LCRU	5
Die-Cast Steam Locomotives	6
Electrical Connections.....	6
Loudspeaker	6
Speed Sensor	6
Battery	8
Testing Your Installation.....	9
Adjusting the Speed Sensor	9
Constructing a Loudspeaker Baffle.....	10
Limited Warranty.....	11
Repairs.....	11

Introduction

Please take the time to read and thoroughly understand the instructions in this manual. While it is unlikely that any damage may occur to your engine, improper installation may cause permanent damage to the circuit components. If any wiring instruction is not clear, refer to the wiring diagram to confirm the connection. If you are still unable to understand the particular instruction, call Digital Dynamics for assistance.

A minimum amount of soldering skill is required to perform this installation correctly. If you feel that you do not possess the proper soldering equipment or the expertise, you should refer installation to your dealer or to Digital Dynamics.

If you find that the wiring of your particular engine is different from the examples in this manual, do not attempt installation unless you have some experience with electronic circuits. Instead, contact Digital Dynamics for assistance.

Installation Instructions

A Lionel Railsounds sound system is considered by many to be the best available. The variety of sounds available 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 certain rolling stock with very 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.

Tools Required

- Low power soldering iron
- Rosin core solder
- Small wire cutters
- Small long-nosed pliers
- Wire strippers
- Small flat blade screwdriver
- Small Phillips screwdriver
- Razor Blade or Exacto Knife

What's Supplied

- Railsounds circuit board
- Chuffer Circuit board, Microswitch w/ cable assembly, or Magnetic Reed Switch assembly
- Pre-wired connector assemblies (2)
- Plastic Ty-Wraps
- Wire Nuts
- 1" spacer and washers
- #6 x 1/4 machine screws
- Double Sided Foam Adhesive Tape Strips

Preparation and Component Installation

Carefully remove the body from the locomotive and place it aside where it cannot be damaged. At the same time, remove all 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 locomotive 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 Lionel LCRU board for full Command Control of all Railsounds features. These two boards are designed to mount together and occupy a minimum of space. However, if necessary, they can be physically located apart. For instance, you can install the LCRU in a powered locomotive, and Railsounds in an unpowered dummy. You can even install the Railsounds system in a piece of rolling stock, provided there is power available from a pickup roller.

To connect a remotely mounted Railsounds system to a LCRU, you will need a 3-pin connector assembly available from Digital Dynamics.

Examine the layout of your engine and the circuit components carefully before deciding on the best mounting method for the circuit boards.

Component Location Considerations

In order to install the Railsounds system, the particular engine or rolling stock will need:

Power. This should be a problem only if you are contemplating installation into rolling stock, such as a box car. Certain steam tenders may also lack a power pickup roller. If this is the case, you can make connection between an adjacent powered engine or car via a 3-pin connector available from Digital Dynamics.

Speed Sensor. Unless you are upgrading from a Railsounds I system that already includes an axle mounted speed sensor, you will need to install a speed sensor circuit which translates motor voltage into pulses proportional to engine speed. This sensor circuit must be located in proximity of a motor and the Railsounds board. What this means is that unless you are able to replace the trucks of a piece of rolling stock to include a truck with an axle sensor, it is not practical to mount the board within rolling stock.

Reasonable acoustic properties. The engine should have an opening somewhere in the body to permit sound to radiate outward. Preferably, the speaker can 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 given in Appendix A.

Loudspeaker Considerations

You must give very careful consideration to the selection and location of the loudspeaker. In most cases, there is no existing loudspeaker in the engine, and no hardware to which to mount one. Worst of all, there is usually very little in the way of openings in the engine body or chassis to permit the sound to escape from within the engine.

A loudspeaker is included with the Railsounds kit. However, should the speaker be unsuitable for your installation, use the the electrical specifications below when selecting a different speaker:

Impedance: 8 Ohms

Power: 250 mW minimum, 500mW recommended

You should try to find the most efficient speaker possible, as the sound output level will vary greatly from one speaker type to the next.

The frequency response of the speaker is not specified although the lower, the better. But, it is rare to find a 2" or 2-1/2" speaker with a low frequency response of less than 300Hz. The upper frequency response of almost any small speaker is adequate for this purpose.

You can greatly improve the sound of the speaker by mounting it in a baffle. See the instructions in Appendix A for constructing an inexpensive, yet effective baffle.

Loudspeaker Mounting

The most convenient and frequently utilized location for speaker mounting in diesel engines is within the fuel tank. This is either a die-cast or plastic assembly located below the chassis and between the two trucks. Many of the plastic types have grilles molded into them, making installation fairly simple and effective.

Larger engines, such as the Trainmaster FM, have ample room to mount all necessary components, including the speaker, on the chassis. The photo below shows all components of the TrainMaster system, including baffled speaker, mounted on the chassis of a 2321 Postwar FM. No drilling or modification of the chassis was performed.

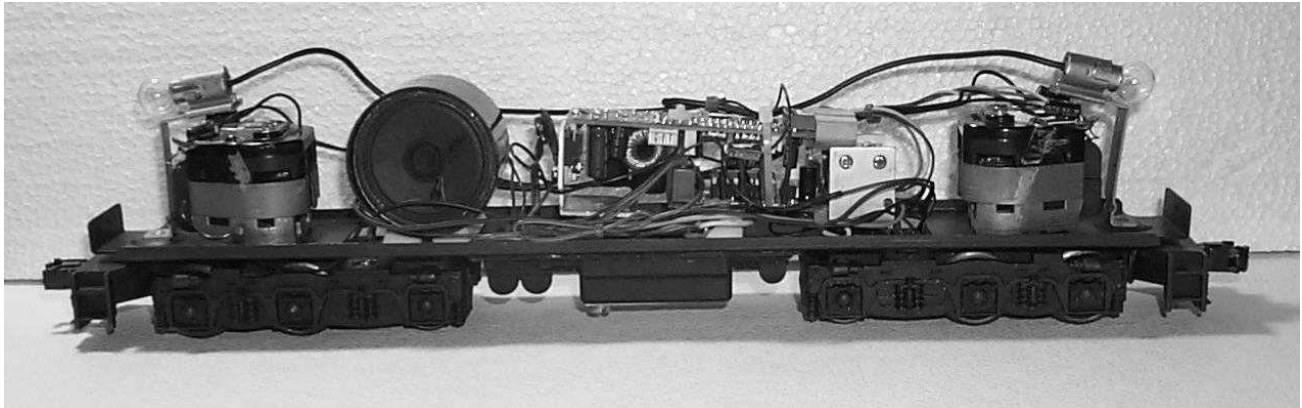


Figure 1. TrainMaster and Railsounds Components Mounted in a Postwar 2321 FM

For F3 type locomotives, consider mounting the speaker to the inside of the shell, behind a grill opening. You can attach the speaker using hot glue or a silicone adhesive.

Mechanical Installation

Standalone Railsounds System

Railsounds can be used with or without the TrainMaster Command Control System, in which case the Railsounds board is mounted by itself and connected only to power, a speaker, and a speed sensor. Depending on the particular engine or piece of rolling stock, you may mount the board in a few different ways.

1. Attach the board to the chassis using the supplied double-sided foam adhesive tape. Place the adhesive strips along the bottom of the circuit board, and press it firmly against the chassis. While the adhesive tape is not easily removed, it can be, if necessary. You may wish to use this method if you do not wish to modify to your engine by drilling holes in its chassis.
2. The metal heatsink of many of the Railsounds circuit boards have a series of pre-drilled holes. You may want to take advantage of existing chassis holes to mount the board by its heatsink, or you may choose to drill the required holes in the chassis. In either case, you can attach the heatsink using #4 sheet metal screws, or by smaller 2-56 machine screws, washers, and nuts.

Installation with a Lionel LCRU

If your engine has sufficient space, you can mount the Railsounds board together with an LCRU. The two boards are designed to mount together using the supplied 1" nylon standoff and nut.

1. Using the 1" nylon spacer and nut, fasten the two boards together, face to face, as shown in the photo below. The LCRU board is on top, connected to the RS 2.5 board with a single nylon standoff. The threaded male portion of the nylon standoff is placed through the component side of the Railsounds. It is a tight fit, and you will need to turn it clockwise while you are pushing it through. The nylon nut is fastened to the back of the board. Do not overtighten the nut, and do not substitute a metal nut, as it will cause a short circuit.

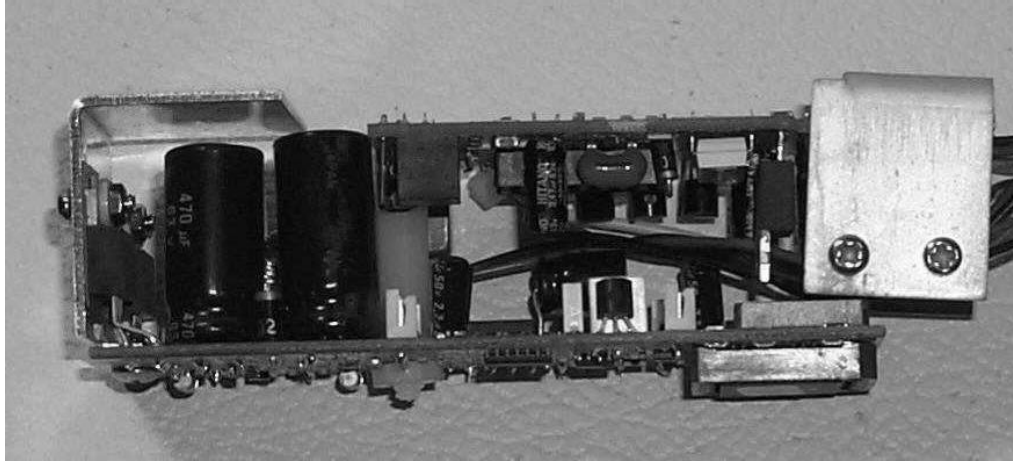


Figure 2. Back to back Mounting of LCRU and RS 2.5 Board

Your kit may have included an aluminum spacer and nylon washers in place of a nylon spacer. In this case, it is **very important that you place the nylon washers in the proper place, or a short circuit will result.**

The aluminum spacer comes pre-attached to the Railsounds board. Note that there is a nylon washer under the screw that holds the spacer in place. When attaching the LCRU, a nylon washer must be placed on top of the spacer to prevent it from contacting the circuit board. The screw may then be placed without a washer.

2. The heatsink of the LCRU board and some of the Railsounds boards have a series of small holes drilled in them. Some Railsounds boards may have extra mounting brackets formed as part of the heatsink. If at all possible, try to make use of these holes to mount the boards to the engine chassis. In some engines, it is possible to use the E-unit bracket as a mounting surface. In others, make use of the chassis holes that become available when the horn or battery bracket is removed. If you do not object to permanently altering the engine, the boards are best mounted by drilling one or two small holes in the chassis, and attaching the to one of the heat sinks with a small (#4 x 1/4") sheet metal screw. Besides making the installation neater, mounting the heatsink to the chassis will help remove excess heat from within the engine body.
3. Use the supplied adhesive tape strips to hold the board firmly to the chassis if there is no means to fasten it with hardware.

Due to space limitations within powered units, it may become necessary to mount the Railsounds components in a dummy engine unit. Usually, there is enough space within a locomotive to mount both the LCRU and Railsounds boards together. However, in some instances, there may not be adequate space to locate these components and a loudspeaker together, particularly in twin motor locomotives. If this is the case, you should consider mounting the Railsounds components in a dummy 'A' or 'B' unit.

Die-Cast Steam Locomotives

For steam locomotive installations, all electronic components are mounted in the tender. Once the air whistle, or other no longer needed components are removed, there is adequate room for an LCRU, Railsounds, and speaker in virtually all mid-sized to large tenders. Note that it is possible to mount the LCRU in larger steam engines such as the 736, 746, etc. This leaves plenty of room in the tender for Railsounds components.

The connection procedure is the same for steam as it is for diesel locomotive types. The differences have to do with connections to the LCRU, and are covered in detail in the LCRU Installation Manual.

Electrical Connections

All connections to the Railsounds board are made via small multi-pin connectors. There are two pre-wired connector assemblies supplied with the kit. These are for connections to the board at P3 and P4. Refer to figure 3 for the locations of these connections. No connectors are provided for the volume control P2, and the sound ON/OFF switch P1. In most cases these are not needed. However, these parts are available optionally from Digital Dynamics.

As supplied, a small wire is soldered across the pins of P2 on the back side of the circuit board. This is necessary, since no sound will be produced unless this wire is present, or a potentiometer is plugged into P2

The 4-pin connector at P3 supplies power to the Railsounds board as well as digital commands from the LCRU.

1. Using a wire nut or solder connection, connect the RED lead of the 4-pin connector to the pickup roller power lead.
2. Connect the BLACK lead to chassis ground
3. Connect the VIOLET lead to the VIOLET lead of the LCRU. The LCRU VIOLET lead connects to the PROG/RUN switch. Cut this wire at a convenient point, and connect the three ends with a wire nut. If you are using Railsounds in the standalone mode, the VIOLET wire is not connected. Simply wrap the end in electrical tape to prevent short circuits.

Loudspeaker

P4 is the loudspeaker connector. Simply plug in the prewired loudspeaker to this connector.

Railsounds Speed Sensors

Railsounds depends on a sensor to provide engine speed information to the circuit. This information is used to control the chuff rate of steam locomotives and RPM sounds for diesel locomotives. On modern Lionel production, an axle mounted cam is used in conjunction with a microswitch to provide speed related pulses to the circuit. Some tenders and rolling stock use a magnetic Hall Sensor to achieve the same effect.

Your engine may already include a sensor, particularly if you are upgrading from Railsounds I. If this is the case, you only need to plug the sensor into P5 of the RS 2.5 board. See the board illustration for the location of the connector.

In most cases, there is no sensor in the engine you will be working with. Digital Dynamics offers three different methods for RPM control or chuff rate. The most suitable method to employ in your installation is determined by Railsounds circuit board location, engine type, and convenience.

For diesel or electric installations, the Chuffer is the best choice. It is easy to install and to adjust, and can be mounted in any convenient location. For steam installations, there are two choices, the mechanical microswitch, or magnetic reed switch. Each of these options is described in the following section.

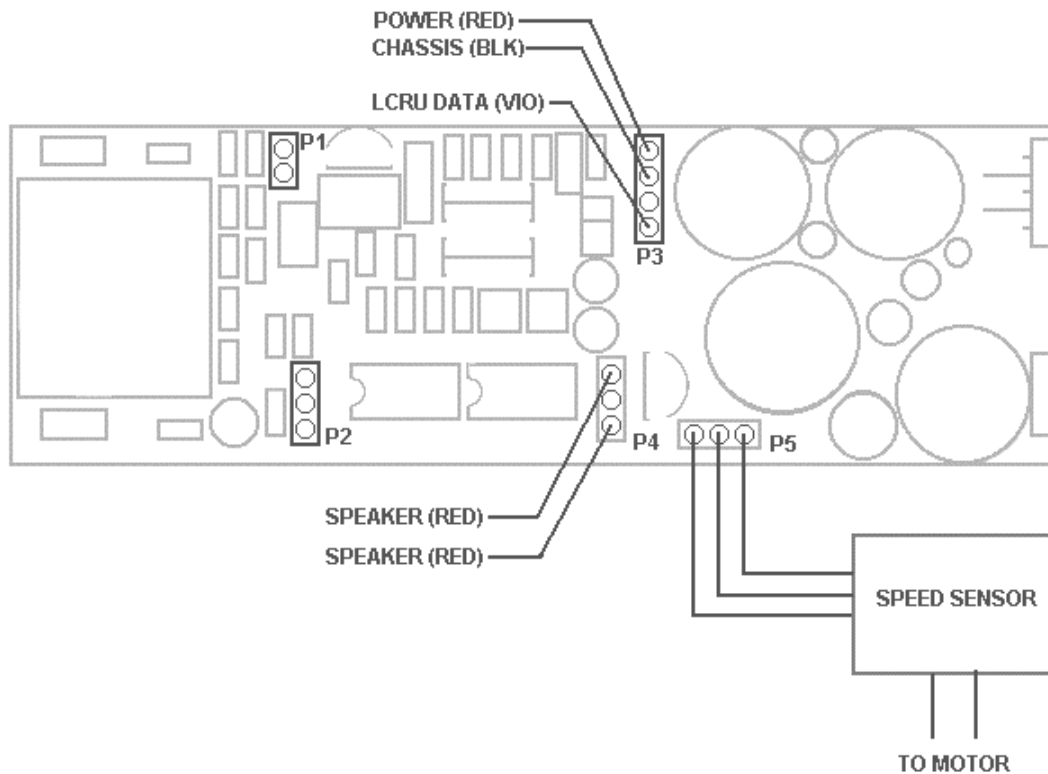


Figure 3. Railsounds 2.5 Wiring Diagram

Chuffer Circuit Option

Since mechanical sensors are not practical for post production upgrades, an electrical equivalent can be used. The "Chuffer" is a small circuit that monitors the voltage applied to the motor, and outputs pulses at a rate related to motor voltage, which is a reasonably good indication of train speed. If you purchased Railsounds for Diesel or Electric engines, a Chuffer circuit is included in the kit.

To install the Chuffer Board:

1. Peel away the adhesive foam tape on the underside of the Chuffer board, and attach it to a convenient location. You may attach it to the back of the Railsounds board, but be sure that there is enough mechanical clearance when the shell is replaced on the engine.
2. Connect one of the unterminated wires from the Chuffer board to the field winding of the motor. The field is the motor center terminal, usually connected to a GREEN wire.
3. Connect the remaining unterminated wire to the lug on the grounded side of the field coil.
4. For DC motors, connect the two leads to the two motor terminals, polarity does not matter.
5. Connect the 3-pin connector from the Chuffer board to P5 on the Railsounds board.

You may need to perform slight electrical adjustments to the board. This procedure is outlined in a later section.

Microswitch Option

This method will enable you to achieve precise, synchronized chuffing when used with any Lionel steam locomotive equipped with a puffing smoke unit. If you ordered your Railsounds board for a steam locomotive, you can specify the Microswitch option at no additional cost

Synchronized chuffing is obtained by mounting the switch in the engine so that it is activated by the vertical motion of the smoke unit lever. You will need to construct a simple mounting bracket to hold the switch firmly in place. You can use scrap brass or aluminum to make a simple bracket that attaches to the large screw located right behind the smoke lever.

Not all steam engines have a smoke lever. In that case, a proximity reed switch and magnet may be the best solution.

The Microswitch comes prefabricated with a cable assembly that simply plugs into P5 of the RS 2.5 board. This cable is provided with a 2-pin connector so it can be connected to a tender installed Railsounds circuit.

Magnetic Reed Switch

For engines without synchronized smoke, or when very precise chuff rates are desired, a magnetic reed switch provides the best solution.

The Reed Switch Kit consists of a pre-wired reed switch and a very small rare-earth magnet. When attached to a driver wheel, the magnet will activate the reed switch each time the wheel completes a rotation. Multiple magnets may be attached to the driver wheel at 90 or 180 degree intervals if realistic, multi-chuff rates are desired.

Exercise caution when handling the reed switch since it is made of glass and can be broken easily.

1. Determine a suitable location on the engine frame to mount the reed switch. The selected location should be away from the engine motor, and less than 1/4" from the rear surface of the drive wheels.
2. Attach the magnet to the rear of the selected driver wheel using a suitable cyanoacrylate adhesive such as Super Glue, or Zap-A-Gap. Be sure that there is sufficient clearance between the engine chassis and the magnet attached to the rear of the driver.
3. Rotate the wheel past the switch and verify that it is activated each time the magnet passes near it. Note that the switch must be oriented in such a way that it is activated by the passing magnetic field. It is very simple to determine proper orientation. Simply allow the switch to come in contact with the magnet. It will align itself to the proper orientation.
4. Use an ohmmeter to verify the switch closure, or simply listen very carefully for a slight clocking sound as the switch is activated.
5. When you are satisfied with its location, attach the reed switch to the engine frame with RTV adhesive and allow it to cure. Be sure the switch is magnetically oriented correctly.
6. Attach the cable to P5 of the Railsounds board. Note that there is already an in-line connector to allow connections to be made between engine and tender.

Battery

A connector for a 9V battery is provided. The only purpose for the battery is to supply power to the Railsounds circuit so it can produce shutdown sounds after power has been removed from the track in Conventional Mode. In Command Mode, you can shut down the engine while track power is present. For this reason, if you will be using the engine primarily in a Command Control environment, you do not need the battery.

If you wish to use a battery, secure it to the chassis with a small piece of foam tape, and press the connector into place. Otherwise, cover the battery terminals with a piece of electrical tape and fasten the wire and connector using a wire-tie.

Testing Your Installation

Before applying power, be absolutely certain there are no bare wires exposed that may come in contact with the circuit. Secure the unused battery connector by placing electrical tape over the contacts. Check again for pinched wires or any areas where there is a possibility of bare metal coming in contact with any part of the circuit.

1. Place the locomotive on the track without the shell attached. This may not be possible if some components are mounted to the shell. If this is the case, do not fasten the shell to the frame.
2. Hold the locomotive firmly while you apply power to the track. This will prevent possible damage to your locomotive in the event it takes off unexpectedly due to a malfunction or improper installation.
3. Turn on power. Observe that the engine headlamp is lit and not flickering.
4. Depending on whether or not the engine is in a TMCC environment, you may not hear startup sounds. If TMCC is not present, you should hear startup sounds a short time after power is applied to the track. Otherwise, in a TMCC environment, you will need to initiate startup with the CAB-1. Press the engine ID, then [BOOST] to begin startup sounds. Be sure the engine ID is properly setup. Refer to the LCRU Installation Manual for engine ID programming.
5. If nothing is heard, immediately shut off power and make sure that none of the circuit components, including the wiring, are hot to the touch, and that no smoke or burning odor is present.

Adjusting the Chuffer Speed Sensor

There are two adjustments to the Chuffer board. The first determines the initial speed at which the circuit begins to operate, or put another way, it is the idle adjustment. This adjustment is made by the trim pot located to the right when facing the two trimmers. The other adjustment is used to set the high speed RPM rate. The two adjustments are somewhat interactive, so you may have to repeat each of the adjustments more than once. There are no adjustments required if you are using the Microswitch or Proximity switch option.

Adjustment for diesel engines is not very critical, as there are only two or three speed steps other than idle.

1. Place the engine on the track with the board oriented so that the trim pots are facing you.
2. Power up the track, and make sure that the engine is at idle. If not, turn the trimmer on the right counter fully counter-clockwise until the engine RPM returns to idle. You may have to wait a few seconds for the adjustment to take effect.
3. Slowly increase the CAB-1 throttle until the engine begins to move. At the same time, you should hear the RPM increase from idle to the first notch. If there is no increase in RPM, return the speed to zero, and adjust the right hand pot a few degrees clockwise and try again.
4. 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. You may have to experiment with the adjustments to achieve the best results.
5. After setting the idle adjustment, the maximum speed adjustment should be set. In most instances, this pot should remain fully counter-clockwise. However, if the engine does not reach the maximum RPM level when running at speed, this control may need adjustment.
6. Hold the engine in place on the track, and turn the power up to full.
7. Adjust the control clockwise a few degrees until the maximum RPM level is reached. You need to wait a few seconds while the engine responds to the adjustment.
8. After making this adjustment, go back and check the idle adjustment, and repeat if necessary.

Appendix A

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. Pre-assembled baffles are available from Digital Dynamics. Call or write for information on availability.

To construct the baffle from either material:

1. Measure the available space for the baffle.
2. Using a suitable saw, cut off the required length of tubing. Remove excess material from the cut, and smooth off the end.
3. Use the cut length of tubing to trace its circumference on a piece of flat cardboard.
4. 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.
5. Using a sharp instrument, punch a small hole in the rear of the baffle to allow the speaker wires to be fed through.
6. Feed the two speaker wires through the baffle, and solder them to the speaker.
7. 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 as shown in the photo below.



8. 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.
10. Gently pull the excess speaker wire through the hole in the baffle leaving a small amount of slack inside.
11. Seal the hole using silicon caulk or other suitable material.
12. 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.
13. Place the speaker assembly aside until all the adhesives have cured.

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.

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. However, if after troubleshooting it yourself you cannot get it to work properly, you should return it along with your engine to Digital Dynamics postage paid. Do not remove the board from the engine, and include a note indicating the problem. Enclose a check for \$20 to cover troubleshooting and return shipping. If you want the parcel insured beyond \$100, enclose an additional \$5.

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. Units out of Warranty will be repaired for a service charge of \$20. 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, 9 AM to 6 PM (EST), or by email to info@digitdynam.com.

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