North Raleigh Model Railroad Club

Installing Decoders in N Scale Locomotives
Detailed Instructions

Con-Cor Alco PA-1 and PB-1 Diesel Locomotives

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Introduction

The following detailed description covers installation of a Digitrax DN93 decoder in Con-Cor PA-1 and PB-1 diesels, as actually performed by the author of this publication, and reflects the experiences encountered during those installations. Since multiple units (5) of the same type were converted from analog to digital, the descriptions presented reflect problem resolution and shortcuts developed.

Note that recent issue PA-1s and PB-1s are equipped with a NMRA 8-pin plug for a decoder such as the Digitrax DN143IP, and require only removing the shell, removing the dummy plug and plugging in the decoder.

This is one of the easier DCC conversions to carry out, and is recommended for a first or early-on installation.

The Digitrax DN93 used was the most advanced decoder available at the time of the conversions. Other decoders from Digitrax, Lenz, NCE, TCS, etc. could be used.

The most important factor to remember in performing an analog to digital conversion is to ensure both motor brushes and the decoder orange and gray wires are insulated from the frame. Any contact of the brushes and/or these wires with the frame may result in virtually instant destruction of the decoder.

The first step in the description which follows is to test the decoder for proper operation, following the instructions provided by the manufacturer. The purpose of this step is to ensure any non-operational or dead-on-arrival decoder can be repaired by the manufacturer under warranty.

Retroframes

This installation makes use of the Aztec Manufacturing Company TM3006 Track Master factory frame precision milled to accept a Digitrax decoder, in this case a DN93. Note that a Southern Digital CCPAN Digi-Frame could also be used.

Tools Required

To install the decoder you will need the following tools:

Installing the Decoder

- Small Phillips-head and flat-head screwdrivers
- Wire cutter and stripper
- Soldering iron with fine tipped point, 20 watts maximum
- Fine resin core solder
- Tweezers (hook tipped work best)
- Long-nosed pliers, small
- Paint or magic marker

Modifying the Frame

If you do not wish to purchase one of the Retro-frames, above, you can modify your own existing frame to accept a DCC decoder, but this will be extremely difficult. Space for the decoder must be milled out of the frame, taking care to leave metal in place for the mounting screws. Instructions for this process are beyond the scope of this publication.

Detailed Installation Instruction
Con-Cor Alco PA-1 & PB-1 Diesel Locomotive

Print out this document. As each step in the installation is completed place a "X" or a check-mark through the box. All references to the frame are based on the front being at the top or away from you.

In normal analog (DC) operation, the PA-1/PB-1 locomotives connect to right track power via the upper frame, lower right-half

frame (floor) and the right motor brush, and to left track power via the lower left-half frame (floor) and left motor brush.

If you are converting one of the original PA-1's from the 1960s – early 1970's see the end of this document for the instructions. (This locomotive has a thin top retainer plate on the main frame.)

In Con-Cor's terminology, which will be followed here, the milled frame from Aztec, plus the original frame is called the "mechanism body," the plastic strip underneath is called the "plastic insulating floor" and the metal frames underneath are the left and right "floors."

- ❑ Begin by testing the Digitrax DN93 decoder for proper operation per the instructions provided by Digitrax.
- ❑ If installing the decoder in an PA-1 unit, cut the green and yellow wires to a length of Â½". If installing the decoder in a PB-1 unit cut the white, yellow and green wires to a length of Â½". Do not cut these off at the decoder in case you need them if the decoder is installed in another locomotive in the future. There is plenty of room to store these wires in the retro-frame.

  Note: you can optionally connect both the white and yellow wires to the headlight of a PA-1 unit, if you wish the light to be on when the locomotive is moving in either direction. You can turn the headlight on and off using the appropriate function key on the throttle.
- ❑ Twist the wires that were cut together, and wrap a small piece of insulating tape over the ends so they cannot short against the metal frame.
- ❑ Remove the body shell from the chassis by prying out on the lower sides at the center with fingernails and lifting off. Remove also the fuel tank, and set aside.
- ❑ Remove the screw from the right side of the mechanism body that secures the wire from the headlight diode. Remove the screw from the left floor that secures the wire from the headlight. Set the headlight and diode aside where they will not get damaged.
- ❑ Disassemble the mechanism by removing the 4 screws in the top of the mechanism body. Note that the 2 screws on the left side of the body are in plastic bushings. Set aside the screws and plastic bushings, plastic insulating floor, the left and right floors and the trucks where they will not get damaged.
- ❑ Before removing the motor, make a note of which motor brush contacts the right side of the frame, and place a mark on the motor (piece of tape, dab of paint, etc.) to indicate that side.
- ❑ Before installing the decoder, re-assemble the mechanism using the TrackMaster frame in place of the OEM mechanism body. Install the trucks, floors, plastic insulating floor, etc. - everything except the body parts and headlight. Put the assembly on a test track and make sure the locomotive runs as it should, checking both directions, etc. When operating correctly, disassemble it again as described above.
- ❑ Remove the motor brush contact strips 1/8" from the brush caps.
- ❑ Place the motor back into its mount in the mechanism body, and the decoder into its mounting location on top of the mechanism body. Mark off the length of gray wire needed to reach along the top of the mechanism body, then down the left side to the left motor brush. Add Â¼" then cut, and strip 1/16" insulation from the end. Similarly, mark off the length of orange wire needed to reach along the top of the mechanism body, then down the right side to the right motor brush. Add Â¼" then cut, and strip 1/16" insulation from the end.
- ❑ Reassemble the mechanism. Install the trucks, floors, plastic insulating floor, etc. Make sure the two plastic bushings are in the left set of screw holes. Make sure the motor is installed correctly so the right brush (with the mark previously made) is on the right side of the frame. Do not install the headlight or its mounting screws.
- ❑ Solder the gray decoder wire to the remaining bit of the left brush contact strip, and the orange decoder wire to the remaining bit of the right brush contact strip.

  Note: always remove the motor brush caps before soldering to them. Then lightly sand them to get a good clean surface, and apply liquid flux. Finally, solder the wires to the brush cap.

  Do not attempt to solder to the motor brush caps while they are still in place in the motor, as too much heat applied to the brush caps during such soldering may melt the plastic brush housing and permanently damage your motor.

  After soldering the wires carefully replace the brush, spring and brush cap into the motor.
- ❑ Place the decoder in its mount on top of the mechanism body, and dress the orange and gray decoder wires around the motor brushes and up the wiring channels. Ensure the brushes and brush contact strips cannot touch the metal mechanism body. Verify this is the case with an ohmmeter. Resolve any problems before continuing.
- ❑ Cut the wire between the headlight and the diode Â½" from the diode. Cut the other wire to the diode at the mounting lug. The diode will not be used.

- Fasten the mounting lug with the headlight still attached to the mechanism body using the original screw. Fasten the other mounting lug to the left floor using the original screw.
- Measure the length of the black decoder lead necessary to reach the mounting lug fastened to the left floor, cut to length and strip 1/16" insulation from the end. Solder to the left mounting lug.
- Measure the length of the right decoder lead necessary to reach the mounting lug fastened to the mechanism body (with the headlight attached to it), cut to length and strip 1/16" insulation from the end. Solder to the headlight mounting lug.
- Using an ohmmeter, verify that there are no short circuits between the decoder orange and gray wires and either frame, not between the left and right floors. Resolve any problems before continuing. Note: a dead short between the left and right floors is probably due to mixing up the metal and plastic screws.
- Ensure the white decoder wire and the unattached headlight wire cannot short against anything, and test the locomotive for analog and digital operation on the layout. Resolve any problems and ensure the mechanism runs perfectly before continuing.

  Note: if the locomotive runs in the wrong direction, the motor may be mounted in the mechanism body upside down. Remove the brush retaining caps and turn the motor over. Replace the brush retaining caps and test again.
- Cut the white decoder wire to a length sufficient to connect to the loose wire from the headlight and strip 1/16" insulation from the end. Strip 1/16" insulation from the end of the headlight wire. Join the two wires together and solder. Insulate the joint.
- Test the locomotive to ensure proper operation of all functions of the decoder. Resolve any problems before continuing.
- Position the headlight in its proper position in the front of the mechanism body. Tape in place, if necessary.

  Note: you may have to paint the inside of the nose of the shell a flat color so that the nose does not "glow" when the headlight is on at the full 12 volts.
- Dress all decoder wires in the wiring channels and tape in place as necessary.
- Replace the body shell on the chassis, then apply the fuel tank from beneath which will snap into place to secure both itself and the shell. The installation is now complete.
- Test the operation of the locomotive on the railroad. It should operate just as if no modifications had been made. Resolve any problems.
- Place the locomotive on the DCC programming track and set the DCC Command Station to the programming mode.
- Program Configuration Variable "CV29" to "06" (for 2-digit addressing or "26" for decoders capable of 4-digit addressing) then program the decoder to the desired address.
- Carry out a final check of the locomotive on the railroad.
- Record the decoder CV's and address, and the reporting marks of the locomotive.

The conversion is complete. Enjoy your DCC-equipped locomotive.

Converting Original 1960s – Early 1970s PA-1

by David Paterson

If you are converting one of the original PA-1s that Con-Cor issued in the late 1960s, early 1970s, the frame construction is totally different from later versions of the locomotive. David Paterson has converted one of these locomotives and offers the following process. The decoder used is the Digitrax DZ121. Use a Dremel cut-off disk for most of the cutting, and a hacksaw for some of the coarser cuts.

1. Disassemble the locomotive, keeping careful track of all parts and placing them in a safe place until needed.
2. Trim 0.125" from the rear of the fuel tank on the fireman's (left) side. Drill for a self-tapping screw. The black lead from the decoder will be fastened here.
3. From the top rear of the main frame, cut away metal to a depth of 0.10" and 0.70" forward from the back of the frame. This is to provide space for the decoder.
4. Cut away metal from the back of the top retainer plate to match the cut-out on the main frame.
5. On the fireman's (left) side of the main frame, cut a slot from the rear edge of the fuel tank to the front edge of the cut-out in (3). This slot must be big enough to accommodate the black wire from the decoder.
6. For the red decoder wire, cut away enough metal from the left rear of the top retainer plate to allow the wire to reach

the left rear screw, and use the screw as the contact to that side of the locomotive.

7. Bottom motor connection: Cut a vertical slot in the inside of the frame, beside the motor brushes, large enough to take a piece of solid insulated wire. Trim the engineer's (right) side rear of the top retainer plate to give enough space for this wire to be led back to the decoder, and fastened to the decoder gray wire. This wire is fastened to the bottom brush holder, and is solid so that it can be kept clear of the rotating armature.
8. Top motor connection: Cut a slot from the decoder to the top motor brush, and fasten the decoder orange wire to the brush holder.

As you reassemble the locomotive, check carefully to ensure that the motor brushes cannot touch any part of the frame.

After you have completed your conversion, you may find that the top speed of the locomotive has been reduced considerably.