North Raleigh Model Railroad Club

Installing Decoders in N Scale Locomotives
Detailed Instructions

Kato USRA Heavy 2-8-2 Mikado Steam Locomotive

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Table of Contents

Introduction

The following detailed description covers installation of a Digitrax DZ-family decoder in the Kato 2-8-2 Mikado Steam Locomotive, as actually performed by the author of this publication, and reflect the experiences encountered during the installation. (Three locomotives were converted.)

This is one of the more difficult decoder installations to perform, largely because of the difficulty of disassembling the locomotive. It is not not recommended for a first or early on installation. It will take significantly longer than you may expect.

The Digitrax DZ-family decoder was chosen because it provided the required features (headlight and backup lights) and current handling capacity for the locomotive. Other decoders from Digitrax, Lenz, NCE, TCS, etc. can 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 motor brushes in the Kato 2-8-2 are already insulated from the frame and require only soldering the decoder wires to the brush caps, although clearance from the lower brush cap to the frame is minimal.

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.

As you carry out the detailed instructions below, also refer to the assembly diagram and parts list provided by Kato with the locomotive. It will help in laying out the parts and understanding the terminology 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
- Magnifier (one that goes on your head is preferable)

Detailed Installation Instruction
Kato USRA 2-8-2 Mikado Steam 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 right half of the 2-8-2 frame is connected to the right rail and the lower motor brush, and the left half of the frame is connected to the left rail and the upper motor brush. Right and left are defined by looking forward from the cab (engineer on the right, fireman on the left).

This installation makes use of a Digitrax DZ-family decoder. This decoder will be installed in the tender of the locomotive. Track power will be obtained from the tender and the locomotive (via the drawbar), while the motor and headlight leads will pass forward into the locomotive. Placement of the motor and headlight leads is somewhat difficult to ensure no interference

with the flywheel, which extends out the rear of the motor into the firebox, and to keep them as invisible as possible.

If you are installing the decoder in a newly purchased locomotive, do not install the handrails, whistle, bell pop-off valves, pilot braces or tender ladder until after the decoder installation is completed.

If you are installing the decoder in a fully assembled locomotive, you must disconnect the pilot braces and pull the handrails away from the stanchions on the smoke box before the locomotive can be disassembled. The ladder must be removed from the tender before it can be disassembled.

Unfortunately, the diagram and instructions provided by Kato with the locomotive are minimal, and show nothing about disassembly of the locomotive and tender. Only tiny drawings are provided to show where the small parts are to be installed.

- ❑ Begin by testing the selected decoder for proper operation per the instructions provided by the manufacturer.
- ❑ Cut the orange, gray, blue and white leads of the decoder to 1". Do not cut the red, black or yellow leads at this time. Do not discard the wires that have been cut from the decoder; they will be used as wiring from the locomotive headlight and motor brushes to the tender.
- ❑ Set the decoder and wires aside for the moment while we tackle the disassembly of the locomotive and tender
- ❑ The first step is to separate the locomotive and tender by disconnecting the drawbar at the locomotive. Kato has issued a technical note describing how to do this:
  - ❑ Begin the drawbar removal with the locomotive and tender upside down, locomotive on left and tender on right, with the tender in line with the locomotive.
  - ❑ Lightly rest the index finger, or thumb, of right hand on the drawbar.
  - ❑ With your left hand thumb and index finger on the outside of the locomotive trailing truck frame, gently angle (lift) the back edge of the truck upward. The trailing truck frame should pop free of the T-shaped pin on the drawbar.
  - ❑ While still holding the locomotive trailing truck up, gently pull the tender straight back from the locomotive. The drawbar will release from the locomotive.
- ❑ Place the tender aside for the moment. We will disassemble and do the wiring installation on the locomotive first.
- ❑ To disassemble the locomotive shell, we will remove the smoke box, boiler shell, boiler weight, walkways, firebox sides, rear steps and the cab. Many of these parts are very fragile, so handle carefully.
- ❑ First, however, if the locomotive has been fully assembled with handrails and pilot braces, these must be removed. Carefully remove the two pilot braces (Kato items C-3 and C-4) and set aside in a safe place. Then carefully remove both handrails and set aside; it is probable that some handrail stanchions will also come off with the handrails so proceed cautiously and place all loose parts in a safe place, like on a saucer or in a plastic bag. The remaining handrail stanchions do not need to be removed.
- ❑ If you are going to install the Micro-Trains 2002 Coupler Conversion Kit, now is a good time to install the coupler in the pilot of the locomotive. (We will do the tender later.)
- ❑ With a small flat-bladed screwdriver, spread the cylinders away from the frame. They do not need to be and should not be removed. Ease them apart until the smoke box shell can be wiggled and pulled forward until it is free. Set the smoke box shell aside, and push the cylinders back together again.
- ❑ Remove the cab by spreading slightly at the sides and lifting up.
- ❑ Remove the rear step assembly by sliding to the rear.
- ❑ Lift the boiler shell up and off. Remove the boiler weight casting.
- ❑ Remove the walkways and firebox sides; the small flat-bladed screwdriver may help here.
- ❑ Place all the removed parts aside in a safe place.
- ❑ Remove the light board from the locomotive frame. To isolate the LED and resistor from the frame (needed for decoder control of the headlight) the printed circuit board traces must be cut on both sides just forward of where they connect to the frame. Use a sharp X-Acto knife for this and check with an ohmmeter to be sure they are actually cut.
- ❑ If you are going to use the existing LED that came with the locomotive, simply solder the loose white wire from the decoder to the light board's left trace just forward of the cut, and the loose decoder blue wire to the light board's right trace, also just forward of the cut in the trace.
- ❑ If you wish to replace the LED supplied with the locomotive with a golden-white LED or with an incandescent bulb do this work now, then connect the white and blue wires as described just above.
- ❑ Remove the plastic frame from over the motor and put in a safe place.
- ❑ Make a mark on the top of the motor (dab of white paint, scratch in the metal, etc.) so it can be replaced in correct

alignment, and the correct decoder wires connected to the appropriate motor brush.

- ❑ Remove the plastic cover over the drive train and put in a safe place.
- ❑ With a Phillips-blade screwdriver, loosen the screws holding the frame together just enough to be able to remove the motor and drive train. Do not remove these screws. Be extremely careful you do not allow the drivers and/or valve gear to fall out while doing this. Leave the locomotive sitting on the work surface as you loosen the screws and lift the motor upwards. The drive train will also raise up as the motor is lifted, but the drive train does not need to be removed from the locomotive. Once the motor comes free, push the drive train back down into place.
- ❑ Carefully remove the brush caps from the motor and place the small springs and brushes in a safe place. Remove the contact strips and discard.
- ❑ Solder the loose gray decoder wire to one brush cap and the loose decoder orange wire to the other. Keep the solder joints small and neat so they do not interfere with the seating of the brush caps in the motor.
- ❑ Insert the brushes, springs and brush caps into the motor, with the brush cap with the gray wire going on the top of the motor, and orange wire on the bottom. Place a piece of insulating (Kapton) tape over the bottom brush cap for security; the clearance between the bottom brush cap and the frame is minimal.
- ❑ Feed the orange wire through the space between the frame halves in the bottom of the motor cavity.
- ❑ Replace the motor in the frame, being careful to align it with the drive train. Be sure everything is in correct alignment and the bearings are properly seated. Turn the flywheel to ensure it turns easily. Tighten the screws holding the frame halves together.
- ❑ Insert the plastic gear cover in place and then place the plastic frame over the motor. Be careful to be sure this is properly in place as it is this frame that keeps the motor insulated from the frame.
- ❑ Put the light board back in place at the front of the frame.
- ❑ Place the locomotive aside while we work on the tender.
- ❑ Disassemble the tender. Snap off the tender shell by holding the undercarriage and gently pulling up. There is a plastic floor which retains the tender's weight and the copper electrical contact strips. With a small flat-blade screwdriver, pry the floor loose. Remove the weight and the copper contact strips.
- ❑ Using a round file file, file about a 1/4" groove from each edge of the plastic floor plate at the center. This should be over the copper contact strips and allows access to the strips.
- ❑ Cut the decoder red and black wires to 1-1/4", strip 1/16" of insulation from the ends, and solder the red wire to the center of one contact strip and the black wire to the center of the other contact strip.

  Do not connect the decoder wires to either end of the contact strips. The stiffness of the decoder wires do not allow the copper strips to flex with the truck, with resultant intermittent contact with the truck wiper. This can cause periodic stalling of the locomotive. (This warning comes from Kato.)
- ❑ Replace the tender weight in its slot in the bottom of the tender.
- ❑ Replace the copper contact strips in their slots on each side of the tender, red to the right and black to the left, with the decoder wires extending out the back. Be sure there is no tension from the decoder wires that would pull these contact strips out of position.
- ❑ Carefully snap the tender plastic floor plate back into position to secure the copper contact strips. Check carefully to ensure they are still in their proper places.
- ❑ It is now time to reconnect the tender to the locomotive with the drawbar. Again we will follow the Kato Technical Note:
  - ❑ Lay the locomotive and tender upside down, with the tender to the right of and in line with the locomotive.
  - ❑ With the index finger of the right hand lightly resting on the midpoint of the drawbar for stability, gently lift the locomotive trailing truck and push the tender/drawbar straight into the locomotive. The drawbar should snap onto the locomotive.
  - ❑ Gently push the locomotive trailing truck back down onto the drawbar, being sure the T-shaped pin inserts into the truck frame.
- ❑ Turn the locomotive and tender right side up, and place so the locomotive is to the right.
- ❑ Bend the decoder red and black wires up against the back of the tender floor plate and lay the decoder in the tender.
- ❑ If you are going to install a backup light in the tender you should do so now so that it can be wired to the decoder in the following steps. Remember that an LED or an incandescent bulb will require a resistor in series with one lead to match the voltage of the device.

- Temporarily run the white and gray wires along the right side of the locomotive frame and tape in place. Run the blue wire along the left side of the boiler and tape in place. The orange wire should be hanging down below the frame.
- The next step is to connect the wires from the locomotive to the decoder wires. In each case the first step will be to place a short length of heat-shrink insulation tubing on each of the decoder wires. Then cut the locomotive leads to an appropriate length and strip 1/8" of insulation off the ends of all decoder and locomotive wires. Then proceed as follows:
  - Connect the orange wire from the locomotive to the decoder orange wire. Solder the connection. Slip the piece of heat-shrink tubing over the joint and heat to shrink the tubing.
  - Connect the gray wire from the locomotive to the decoder gray wire. Solder the connection. Slip the piece of heat-shrink tubing over the joint and heat to shrink the tubing.
  - Connect the white wire from the locomotive light board to the decoder white wire. Solder the connection. Slip the piece of heat-shrink tubing over the joint and heat to shrink the tubing.
  - Connect the blue wire from the locomotive light board to the decoder blue wire. If a backup light is installed on the tender, connect one of the backup light leads to the decoder blue wire. Solder the connection. Slip the piece of heat-shrink tubing over the joint and heat to shrink the tubing.
  - Connect the second wire from the backup light (if installed) to the decoder yellow wire. Solder the connection. Slip the piece of heat-shrink tubing over the joint and heat to shrink the tubing.
- Place the decoder on the tender and temporarily tape in place. If a backup light was installed, also temporarily affix the tender shell to the tender frame.
- Perform a preliminary test of the decoder installation by placing the locomotive on a programming track and verifying that the Command Station, in programming mode, can detect the decoder.
- Perform a preliminary operational test of the decoder installation by placing the locomotive on a test track or the layout and testing with both DC and DCC power. If any problems are encountered, check your work very carefully and resolve any problems. Do not continue with the following steps until all problems have been resolved and the locomotive operates flawlessly on both DC and DCC power.
- The next step is reassembly of the locomotive and tender. When assembling the locomotive you may need to re-position the wires running along the side of the boiler so they do not interfere with locomotive parts such as the walkways, firebox sides and steps. Special care will be taken where these wires run near the edges of the flywheel so no contact is made with the flywheel that could either affect performance of the locomotive or damage the insulation of the wires. During these steps the locomotive should be sitting upright on a flat work surface, and should not be picked up.
- Replace the walkways and firebox sides on the frame by placing into the slots on each side of the frame. Position the wires at the rear end of the walkways so the wires run just inside the walkways against the frame.
- Replace the boiler weight in position, then re-install the boiler shell, carefully fitting it until its snaps into place. Watch carefully the location of the wires at the rear of the frame to ensure the are not moved so they contact the flywheel.
- Replace the rear steps by putting them in their approximate location and sliding forward into place.
- Replace the cab by putting in place and sliding down until its snaps into place. Again check the wires to ensure they are not touching the flywheel.
- Spread the cylinders apart slightly to provide room to slide the firebox into place. Replace the firebox by sliding rearward while wiggling it, until it snaps into place. Press the cylinders back into their proper position.
- Check the fitting of all locomotive body components to make sure they are in their correct alignment and snapped into place. Also check again to be sure the wires do not touch the flywheel. Resolve any problems until alignment is perfect.
- Test operation of the locomotive on a test track or the layout on both DC and DCC power. Resolve any problems before continuing.
- Cut or file a notch in the front center of the tender body at the bottom so the wires from the locomotive can enter. Make sure the edges of this cut are smooth so the insulation on the wires will not be damaged by chafing.
- Either paint the wires from the locomotive or darken them with a magic marker so they will not be overly visible between the locomotive and tender.
- Gather the wires from the locomotive into a bunch being careful not to cause them to contact the flywheel, ensure the decoder and other wires are in place inside the tender body,

and slip on the tender shell so that the wire bunch is in the space of the notch in the front of the tender.

- ❑ Test the locomotive and tender on a test track or the layout with both DC and DCC power. At this point everything should operate flawlessly. 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 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.
- ❑ If installing the Micro-Trains #2002 Coupler Conversion Kit, complete installation of the coupler conversion on the rear tender truck.
- ❑ The digital conversion of the Kato 2-8-2 Mikado locomotive and tender is now complete. The remaining instructions cover installation of the handrails, handrail stanchions, bell, pilot braces, whistle, etc.
- ❑ The Kato instructions are not clear on what stanchions to use where. Starting with the cab and working forward along one side, you will need six of the stanchions marked A7, then one A6, then an A5 lower down. (Two extras of each are provided.) To make the part of each handrail that extends downward conform better to the boiler, curve it around the handle of a hobby knife.
- ❑ Install the handrail stanchions into the boiler. This is a somewhat difficult task because they are so tiny. To handle them, use one of the railings as a tool. Insert it into the stanchion before cutting the stanchion off the sprue. Keep the stanchion on the handrail while using tweezers to insert it in the boiler. Once you have all the stanchions in, you will find it easy to press the wire railing into position.
- ❑ To install the pilot braces, first insert the short-angled end into the deck, then insert the longer-angled end into the boiler. Trying to do it the other way will result in a mangled brace.
- ❑ The bell is assembled from three pieces. First install the bracket into the smoke box front. Using the locomotive itself as a handle, next install the hanger, and last the metal bell.
- ❑ Install the other boiler parts.
- ❑ Install the tender ladder.
- ❑ Perform a final test on the railroad to ensure proper operation.

The conversion and assembly of the locomotive and tender is complete. Enjoy your DCC-equipped locomotive.