

Chapter One  
**Welcome to Digital  
Command Control.....4**

Chapter Two  
**Setting up a DCC layout.....9**

Chapter Three  
**Wiring tricks ..... 27**

Chapter Four  
**Installing decoders .....39**

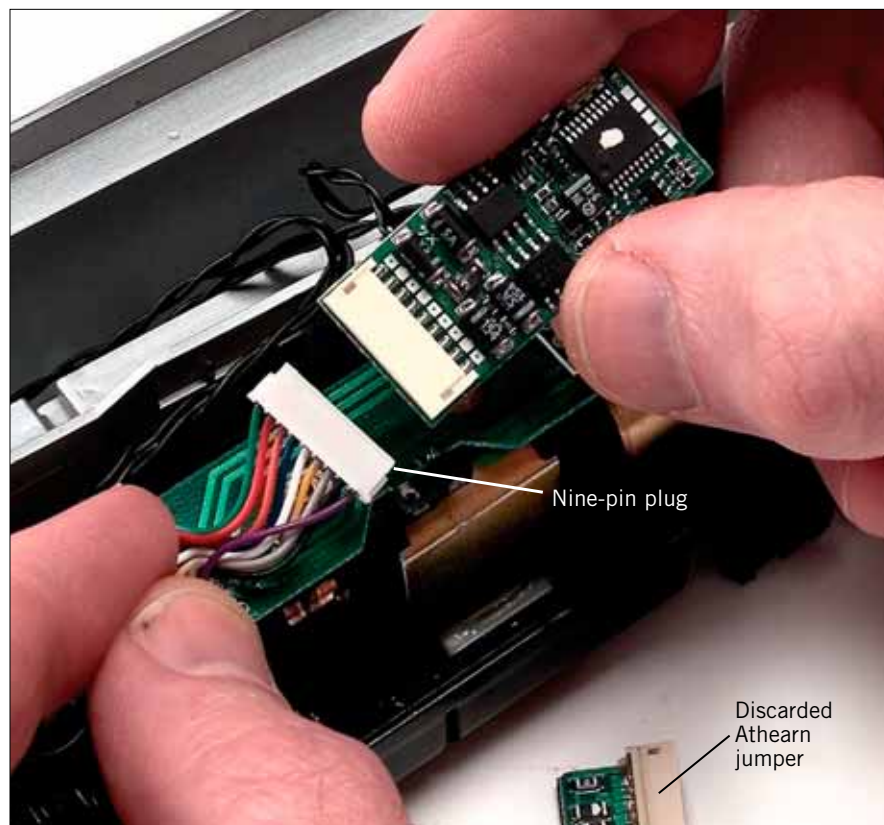
Chapter Five  
**Programming decoders.... 53**

Chapter Six  
**Lighting ..... 63**

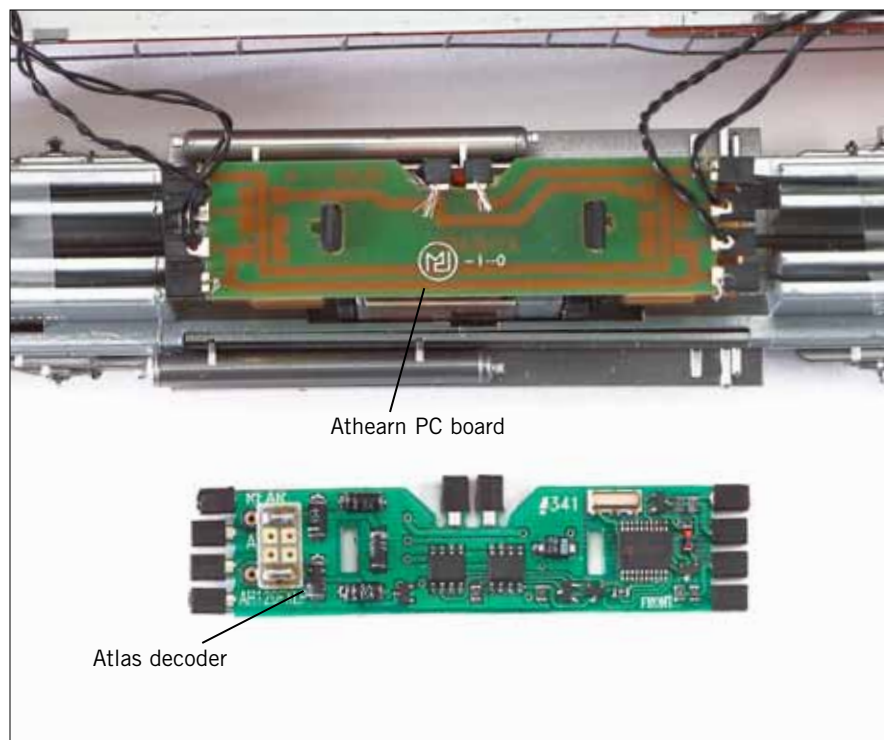
Chapter Seven  
**Sound and DCC ..... 73**

Chapter Eight  
**Just the beginning..... 89**

# Decoders for Athearn locomotives



**Fig. 1 Quick-plug.** Athearn's newest ready-to-roll locomotives come with this easy-to-use nine-pin JST connector.



**Fig. 2 Early Genesis engines.** In this group of locomotives, a drop-in decoder replaces the PC board. For this engine, Mike used an Atlas decoder.

Athearn has produced the same reliable HO scale diesel locomotive drive mechanism for a long time, and as a result, many modelers own one or more of these models. Recently, however, the firm has made some changes. Athearn has added printed circuit boards to some of its newer products and developed all-new drive mechanisms for others. Because of these design changes, there is now more than one way to install Digital Command Control (DCC) decoders in Athearn locomotives. Let's look at three of them.

### Newest first

Athearn's CF7 is a good example of one of the firm's newest drives. The model is part of Athearn's ready-to-roll line and comes "DCC quick-plug equipped."

Under the CF7's shell you'll find a PC board mounted on top of the motor. To install a decoder, first remove and discard the small circuit board (Athearn calls it a DCC jumper board) that's attached to a JST nine-pin connector at the end of the wiring harness.

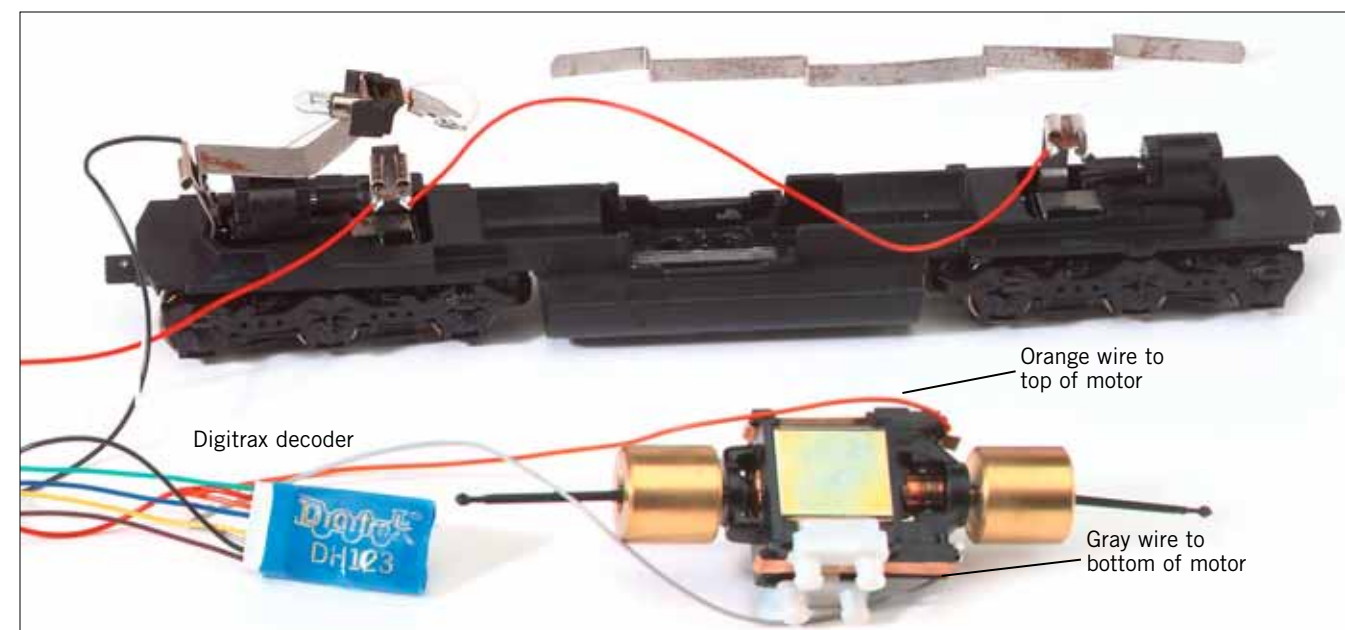
Replace the jumper with any JST nine-pin-plug-equipped decoder, plugging it into the socket, as shown in fig. 1.

For this project I used a Lenz LE1014-JST decoder. This decoder isn't enclosed in plastic insulation, so you need to insulate the bottom of it with electrical tape. (Don't wrap the decoder in tape, however, or it will overheat.)

The CF7's main circuit board has built-in dropping resistors for the headlights, so you can use the original 1.5V lamps without modification. With the decoder in place, you can replace the shell and programmed locomotive – the job is really that quick!

### Early Genesis models

Another newer Athearn locomotive is the SD75M, representative of its early Genesis-series models. Though this locomotive also has a PC board, it's different from the quick-plug type and has no DCC decoder socket. (The PC board in Athearn's Genesis F unit is similar to the board in the SD75M.)



**Fig. 3 Standard drives.** For older Athearn models, Digitrax makes a decoder with a special harness that simply clips into place.

The SD75M's board has ten terminals, and the wires from the motor, lamps, and trucks are held in place by plastic clips. Several manufacturers make decoders that are drop-in replacements for the original circuit board, including Atlas, Digitrax, TCS, and NCE. I installed an Atlas 340 two-function decoder in this locomotive (see fig. 2).

Begin by removing all the plastic clips and disconnecting the wires from the PC board, noting how all the wires are connected, as all will go back to the same locations on the decoder. After removing and discarding the circuit board, snap the decoder in place on the motor mounting tabs with the front of the decoder facing the locomotive cab. (You might have to file the decoder's circuit board slightly to get a proper fit.) Next, insert the wires from the trucks and the motor into their corresponding holes, and then slip the plastic clips over the terminals to hold the wires firmly in place. (For a better connection, solder the wires to their terminals instead of using the clips.)

The lights on this locomotive use 1.5V lamps, so you'll need to replace them or use a dropping resistor. Each headlight on the Athearn SD75M uses two bulbs.

Starting with the front headlight, wire its lamps in series, and then add a 620 ohm, ¼W resistor to the end of one of the two wires. Connect the headlight wires to the two center terminals on the front end of the decoder. (Make sure you cover all exposed wires with heat-shrink tubing.) Repeat this process for the rear headlight.

Similar to the headlight lamps, you'll need to add an 820 ohm, ¼W resistor in series with each ditch light. I wired the ditch lights to the same decoder lighting terminals as the headlights, but if you're using an Atlas 342 four-function decoder, you can wire the ditch lights for independent operation.

### Standard Athearn models

For standard Athearn models, which pass power through the frame to the motor, you can use a Digitrax DH163AT decoder. This decoder includes a special clip-on wiring harness made for converting older Athearn locomotives to DCC. I installed one of these decoders in an SD40-2, as shown in fig. 3. Following the Digitrax directions, you can install the decoder in less than 10 minutes.

The key to installing decoders in this type of Athearn locomotive is isolating

the motor from the frame. After taking off the shell and discarding the metal strap that connects the top of the motor to each truck, remove the motor itself. It's mounted in white plastic shoes that plug into the frame.

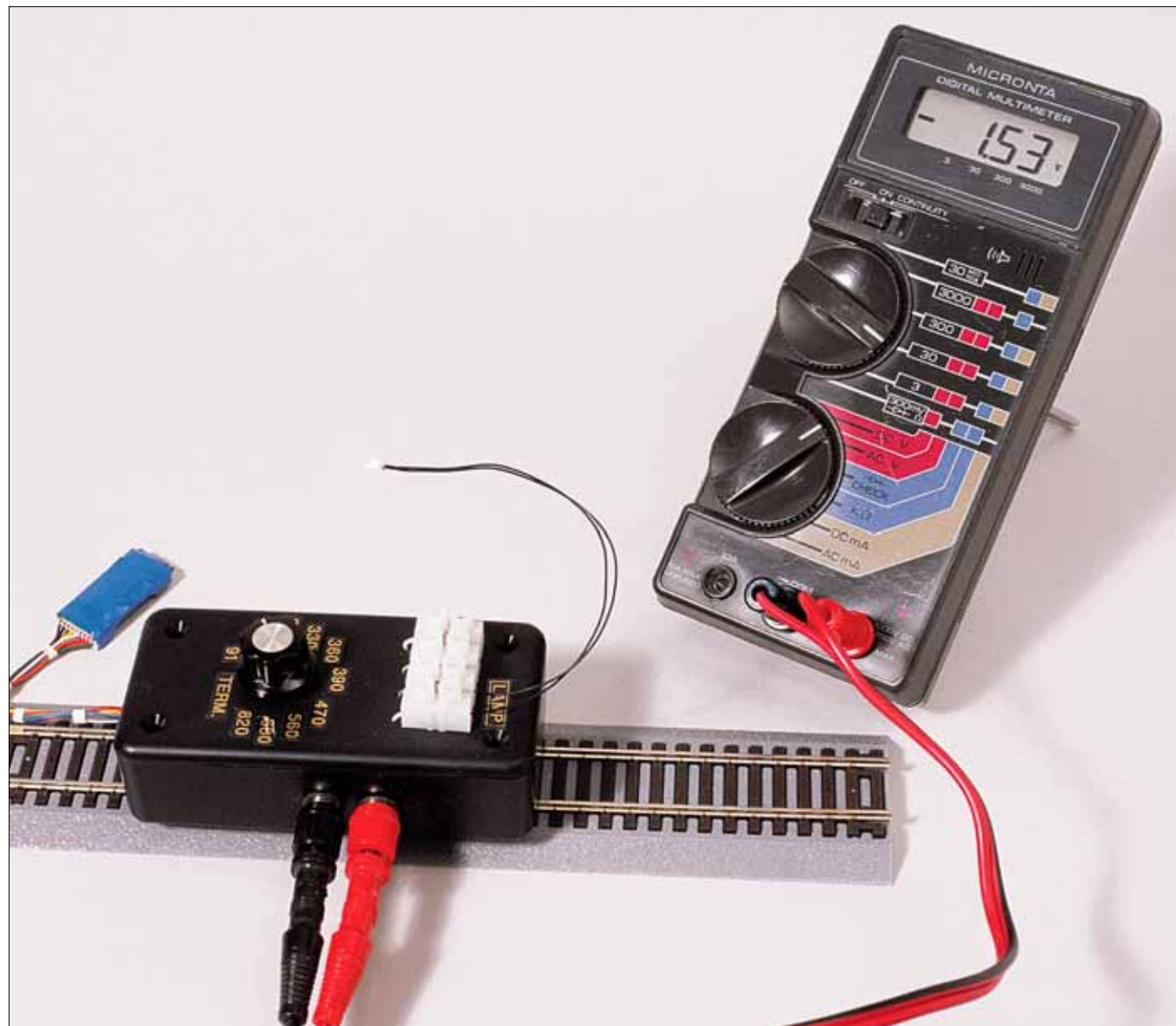
There's a metal clip on the bottom of the motor that makes contact with the frame. Removing this clip and replacing it with one included with the decoder (the one with the gray wire) isolates the motor from the locomotive frame, allowing the decoder to control the motor's speed. Next, attach the rest of the decoder's harness clips to the locomotive following the instruction sheet, and then replace the motor in the frame. You can see the proper position of most of the harness clips in fig. 3.

You may wish to add a rear headlight at this point. I soldered the yellow and white wires to a Model Power no. 252 14V grain-of-rice bulb for this purpose.

### Decoders for all

Though the installations are different for these three Athearn models, all are quite easy to do. And, by using locomotive-specific decoders, you can have your engines running in no time. □

# Build a lamp resistance tester by Bob Kosic



**Bob Kosic built this DCC decoder lamp resistance tester to more easily find the best resistance value to use between a decoder and locomotive headlight.** Bob Kosic

A lamp resistance tester lets you easily determine the resistance value that should be placed between a DCC decoder and a headlight bulb to get the best appearance and performance.

With this simple test box, you can easily dial up the correct resistance value while using a digital voltmeter to monitor the voltage across the function output. You can construct the box in one evening with parts readily available from most any RadioShack store.

## Making a tester

A 12-position rotary switch is the heart of my resistance tester. By turning the

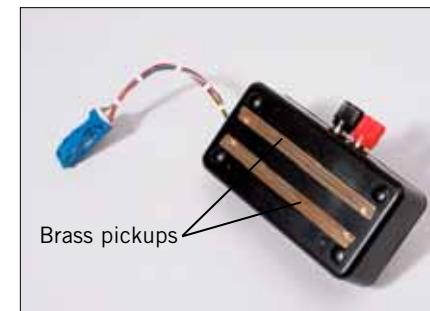
rotary switch to each position, you insert a different resistance value between the decoder output and the bulb. You can mount the components to an experimenter's circuit board, and house everything in a 1" x 2" x 4" plastic experimenter's box.

To attach the bulb leads for testing, you could use a two-position screw terminal or barrier strip; however, it is easier to hook up bulbs with a pair of spring terminal blocks. You can also add a set of terminals attached to one of the rotary switch positions. This

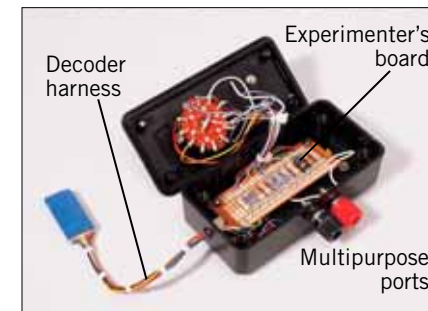
would allow you to insert a resistor of a value not included in the range on the rotary switch.

I mounted multipurpose posts (banana jacks) to the side of the unit. The banana jacks enable me to plug in my digital voltmeter, and place the meter across the decoder output to measure the voltage across the resistor/lamp combination. This is where you will connect the voltmeter.

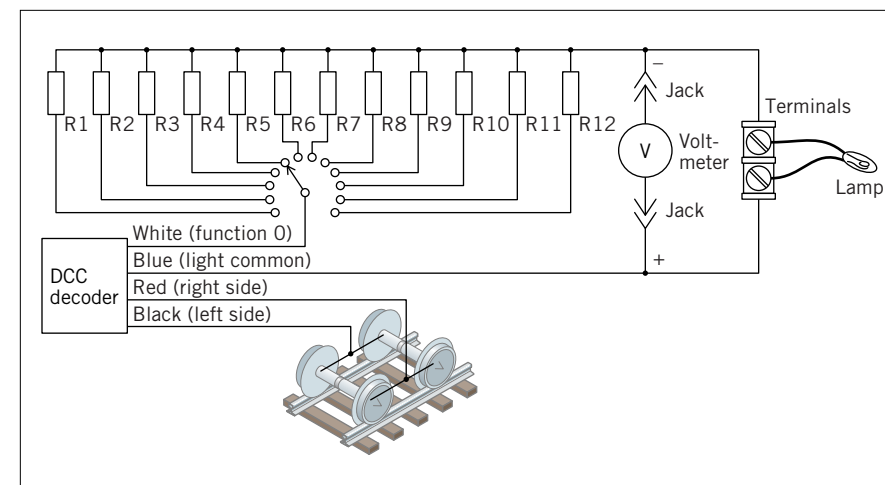
To connect the tester to the track power, I attached a pair of brass pickup strips to the bottom. This lets me set



**Bob's tester has brass track power pickup shoes that fit over the railheads, eliminating the need for alligator clips.** Bob Kosic



**Using an experimenter's circuit board makes for neater construction. The voltmeter leads plug into the multipurpose posts.** Bob Kosic



**Bob wired his resistance tester following the diagram shown here.** Bob Kosic

the box across the rails to provide the track power input. I fabricated these strips from 1/8" brass I-beam stock soldered to a base of .016" brass bar stock. I gauged the strips to fit over the railheads and screwed them to the bottom of the box.

## Wiring in the decoder

I use Digitrax decoders in most of my locomotives, so I wired a Digitrax standard JST decoder harness to the box. This lets me plug in the actual decoder I will be using in the locomotive before making the tests.

When wiring the decoder to the tester, leave enough exposed wire so you can easily grasp the harness. Track input is tied directly to the red and black input wires, as shown in the wiring diagram.

On the output side of the decoder, tie the leads of the function 0 (white

output) and the yellow (reverse direction) wires together. This will cause the bulb to light no matter what directional signal the decoder is sending. The blue (common return) wire attaches directly to the voltmeter input jacks and continues to the light bulb terminal.

I labeled the terminals and the resistance value for each rotary switch position with a label maker.

## Tester operation

Now you're ready to find the correct resistor to mate with a bulb. First, turn the rotary switch to the maximum resistance rating. By getting in the habit of doing this first, you will never accidentally burn out a lamp.

Next, connect the bulb across the lamp terminals of the tester. Set your volt/ohmmeter to the DC voltage setting and the scaling to 30V. Plug the

## Materials list

### RadioShack

- 270-1545 mini test clips 1 3/8"
- 270-1802 1" x 2" x 4" plastic project box
- 274-621 two-position push-button terminal
- 274-661 multipurpose posts
- 274-678 miniature eight-position barrier terminal strip
- 275-1385 single-pole, 12-position rotary switch
- 276-148 dual mini board
- RSU 10524320 knob

### K&S Metals

- 230 .016" x 1/4" brass bar stock

### Special Shapes

- 15013 1/8" x 1/8" brass I-beam stock

The following resistors give a good range of values. All values rated at 1/2 watt, 5 percent tolerance. One-fourth watt will work but some bulbs will run warmer. Resistors can be obtained through Digi-Key ([www.digikey.com](http://www.digikey.com)), Jameco Electronics ([www.jameco.com](http://www.jameco.com)), and RadioShack ([www.radioshack.com](http://www.radioshack.com)).

R1 680 Ω	R7 270 Ω
R2 560 Ω	R8 220 Ω
R3 470 Ω	R9 180 Ω
R4 390 Ω	R10 120 Ω
R5 360 Ω	R11 82 Ω
R6 330 Ω	R12 68 Ω

meter probe wires to the tester's meter jacks, as shown in the lead photo.

Place the tester on the rails and select the test box's decoder with your DCC throttle. Turn on function 0 and begin to slowly advance down through the range of resistances until the bulb starts to light. The voltage readings on the meter will increase as the resistance decreases. Stop at each resistance value to let the meter reading stabilize. When the meter reading shows the voltage rating of the bulb, you will have found the correct resistor value. □