



INSTALLING A DCC DECODER IN A LOCOMOTIVE

DECODER 202

PROGRAMMING

**By Ernie Little
Prince William Model Railroad Club**

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In Decoder 101 we learned the steps of installing a decoder in a locomotive. In Decoder 101 we covered:

- ❖ Selecting the decoder
- ❖ The sizes of decoders
- ❖ Isolation of the locomotive motor
- ❖ Connection of the decoder to the locomotive motor
- ❖ The NMRA standard on decoder wiring colors
- ❖ Soldering
- ❖ Wiring of the forward and reverse headlights
- ❖ Assigning the decoder a new address

In decoder 202 we will cover how to program the decoder and try to uncover some of the mystery surrounding:

- ❖ Programming a two digit address
- ❖ Programming a four digit address
- ❖ What a CV is and what it means to us

To start, we need to understand how a decoder is programmed and what programming means. Programming seems like a “computer geek” word and with it is associated the phrase “Oh no, I have to be a computer programmer to program the decoder in my locomotive.” But hold on there, it isn’t that bad and you don’t have to have a four year degree in computer programming to program your locomotive’s decoder.

DCC programming is nothing more that “setting” your decoder to your personal favorites list. Just like setting the radio in your car to your favorite stations so all you have to do is push a button to get your favorite stations rather than have to “tune” the station in every time you change stations. All we are doing is telling the decoder what it’s new name (the address) is and what it has to do to run our locomotive the way we want it to run. So what we are doing is customizing the decoder to the locomotive’s components and configuring the decoder so it is “special and unique” from the other decoders it will be on the rails with.

In a nut shell programming the decoder is changing the factory settings of the DCC decoder and other components to get the features and performance you want from your locomotive.

To program a decoder we send commands from the throttle, sometimes called the encoder, to the **COMMAND STATION**, where the commands are packaged then sent to the decoder where the commands are deciphered and sent to the affected components of the locomotive. The command station will store the locomotive’s address and know that it is on the system after you acquire it by selecting the address on your throttle.

When we program, we want to use a **Programming Track** which is a section of track isolated from the main power bus using the system’s service mode to program a decoder’s CV’s. Any electrically isolated section of track can serve as the command station’s low-power programming track by feeding it through a double-pole, double-pole toggle switch. Using a programming track provides us some insurance in that during programming we are only affecting one decoder, not every decoder on the main line. If you want real life action and cause all of your fellow train masters to get mad at you, program on the main line. That way you can reset everyone’s locomotive decoder to

your address and you can control their locomotives without them knowing it !!! This is a bad idea if you want to stay in the train club or keep your fellow train masters around you.

Now, programming can be confusing because there are different modes of programming which are designated as:

- ❖ Service (Broadcast) mode programming, of which there are three types.
 - (a) Paged mode programming,
 - (b) Physical register mode programming, and
 - (c) Direct mode programming.
- ❖ Operations mode programming

What do these terms mean, let's look at each and figure out the differences.

Service (Broadcast) mode programming

Service (broadcast) mode programming is programming all decoders on a specific track at the same time. (This is why you want to use a programming track when you are programming a decoder so that you don't accidentally program all of the decoders on the main line at the same time.) Think of it as a party line and everyone answers the telephone at the same time versus private line where only the party you want to speak to answers the phone when you call.

The **paged mode** programming is a type of service mode programming. With a Digitrax decoder this is the preferred method of programming and works with all Digitrax decoders. It allows commands to be sent to the command station then to the decoder and read back if the command station is capable of reading back to the encoder.

The **physical register mode** programming is a type of service mode programming that only allows you to program certain CVs and only those CVs. The CVs that can be programmed are limited to CV01, 02, 13, 04, and 29. It also permits the reading of CV08 and 09 where the command station will allow this to be done.

The direct mode programming is another type of service mode programming that is used with decoders made by Lentz or perhaps other manufacturers. For this clinic we will be dealing with decoders made by Digitrax..

To keep things simple let's concentrate on using the **paged mode** programming as that mode works with all of the Digitrax decoders.

When we speak of programming we need to remember that the decoder has its' own tiny computer and associated memory. Some of this memory is non-volatile, which means that the decoder remembers what was stored even when the power is turned off. This is the memory that will contain the custom information that we tell it. The memory has many storage locations, which we can think of as "mail slots" which are called CVs. CV stands for **Configuration Variable**. Each "slot" can be thought of as a group of eight switches that can be individually set to either on or off, or represented by two hexadecimal digits. Whoa, what is a hexadecimal digit you say, don't start sweating bullets yet, we will make it simple in a little further on. By programming the CV's to the values that cause the decoder to act the way you want it to you can operate a prototypical locomotive. There are several CV's for a decoder, as an example is the

locomotive's **address** that you need to set so the decoder knows that you are sending commands to it, not one of the others on the main. Think of the locomotive's address as its name when it is on the main line.

Commonly used Configuration variables

| Configuration Variable | Variable |
|------------------------|---------------------------------------|
| 01 | Short address |
| 02 | Start voltage |
| 03 | Acceleration rate |
| 04 | Deceleration rate |
| 05 | Maximum voltage |
| 06 | Mid point voltage |
| 07 | Version number |
| 08 | Manufacturer ID |
| 13 | Analog function control |
| 17 | Long address |
| 18 | Long address |
| 19 | Advanced Consist address |
| 21 | Advanced consist function control |
| 22 | Advanced consist headlight control |
| 23 | Advanced consist acceleration control |
| 24 | Advanced consist deceleration control |
| 29 | Configuration register |
| 55-57 | Speed stabilization control |
| 61 | Split field motor configuration |
| 65 | Kick start |
| 66 | Forward trim |
| 67-94 | Speed table |
| 95 | Reverse trim |

Depending upon the command station you have, you may or may not be able to read back the values in the CV locations. Setting the CV values will depend upon the type of encoder you have. Cheat sheets are attached to the back of this handout for each type of Digitrax encoder (throttle).

OK, so you have the decoder installed, are you ready to do a little programming to turn that locomotive into a living machine? Say yes, or you can stop reading here as the rest of the STUFF from here on is on how to program.

First, before we even think about changing any CV's let's check that decoder out and see if it is working and responding to the system. We need place the locomotive on the track and select the address of "03" on our throttle as that is the default address for Digitrax decoders. So how do we do that you say? Let's take a look at that with the three popular Digitrax throttles that are out there:

With DT100-

1. Turn the knob that you want to control the locomotive (left or right knob) about 1/4 of a turn to the right.
2. Press the SEL/SET key to enter the select address mode. (The exp light will be off and the digital display will read "SEL".)
3. Turn a throttle knob up or down until the display shows "03" on the digital display then press the SEL/SET key again. You should see the locomotive's address "03" in the left side of the digital display. The right side (showing the locomotive speed) should show "00" indicating the locomotive is sitting still. You will also see the direction indicator flashing red or green depending upon the knob you are using and the direction the locomotive is set to go.
4. Turn the throttle knob you selected clockwise and you should see the locomotive begin to move.

With the DT300

1. Turn the knob that you want to control the locomotive (left or right knob) about 1/4 of a turn to the right.
2. Press the SELECT key, the active throttle display will begin to flash the Loco icon. You should see SEL in the digital display.
3. Turn the left knob counter-clockwise until the digital display shows "00". Then turn the right knob clockwise or counter clockwise until the display shows "03" then press the SELECT key again. You should see the locomotive's address "03" in the left side of the digital display. The right side (showing the locomotive speed) should show "00" indicating the locomotive is sitting still.
4. Turn the throttle knob you selected clockwise and you should see the locomotive begin to move.

With the DT400

1. Turn the knob that you want to control the locomotive (left or right knob) about 1/4 of a turn to the right.
2. Press the LOCO key, the active throttle display will begin to flash the Loco icon. You should see "Select Loco" in the digital display.
3. Use the keypad to enter "03", or turn the left knob counter-clockwise until the digital display shows "00". Then turn the right knob clockwise or counter clockwise until the display shows "03" then press the LOCO key again. You should see the locomotive's address "03" in the left side of the digital display. The right side (showing the locomotive speed) should show "00" indicating the locomotive is sitting still.
4. Turn the throttle knob you selected clockwise and you should see the locomotive begin to move.

Providing everything is up and running, we are now ready to change the locomotive's address to one we can remember. Most of us will probably want to use the locomotive's identification number. Be careful, we have to remember when you buy that locomotive that there are several "2000" , "4169", etc. out there and there can't e more than ONE locomotive with a particular address on the main line or you will be running someone else's locomotive, or even worse they may be running yours without you knowing it !!!!

Programming a two digit address

Remember how we selected the default decoder address of "03" when we did the checkout. Well to assign a new address all we have to do is put the locomotive on the programming track and go to the programming mode for the particular throttle you have.

With the DT100:

1. Press the RUN/STOP AND FUNC/F0 at the same time to enter programming mode.
2. Turn the left knob counterclockwise to change the left digits to show a flashing "Ad" on the screen.
3. Using the right knob turn it until the two digit address you want to use is displayed, for example "27".
4. Press the SEL/SET key to "set" to program the address to the decoder. The display should flash up the programming mode in use and the locomotive should pulse briefly indicating the decoder accepted the address.
5. To run the locomotive you will need to select its' address as covered above. You may need to turn the track power back on depending upon which control station you have.

With the DT300:

1. Press the STOP AND FUNC/F0 keys at the same time to enter programming mode.
2. Turn the left knob counterclockwise to change the left digits to show a flashing "Ad2=???" on the screen.
3. Use the FUNC/F0 key to select the programming mode you wish to use.
4. Using the left knob turn it until the two digit address you want to use is displayed, for example "15".
5. Press the SEL key to "set" to program the address to the decoder. The locomotive should pulse indicating the decoder accepted the address.
6. Press and hold the STOP key and the FUNC/F0 keys at the same time to exit the programming mode.
7. To run the locomotive you will need to select its' address as covered above. You may need to turn the track power back on depending upon which control station you have.

With the DT400:

1. Press the PROG key to enter the programming mode
2. Turn the left knob counterclockwise to change the display to show "Ad2=???".
3. Use the PROG key to select the programming mode you wish to use.
4. Enter the two digit address using the key pad or using the right knob, for example "35".
5. Press the ENTER key, the throttle will beep and display "Ad2=Owr" followed by a blinking square. The locomotive should pulse indicating the decoder accepted the address.
6. Press the EXIT key to leave the programming mode.
7. To run the locomotive you will need to select its' address as covered above. You may need to turn the track power back on depending upon which control station you have.

Programming a four digit address

With the DT100:

1. Press the RUN/STOP AND FUNC/F0 at the same time to enter programming mode.
2. Use the FUNC/F0 key to select the programming mode you want to use.
3. Use the left knob to select CV18 in the left 2 digits of the display.
4. Press the MODE DISP key to read back the decoder's stored value of CV18 (DS100 control station only).
5. Before making any changes, press the MODE DISP key again to force the DS100 to read back the complete 4 digit address already stored, you should see a flashing a 4 digit number, or "Lad" with a moving – indicating the unit is searching for the address. When you see "Lad" you are now in the four digit programming display.
6. Use the left and right knobs to select the four digit address you want to use. The left knob will change the value by one hundred, the right knob will change the value by one.
7. To enter the address into the decoder press the SEL SET key. The display should display "good" and the locomotive should pulse indicating the decoder accepted the address.
8. You will also need to set CV19 to a value of "26" to enable four digit addresses.
9. Press MODE DISP to leave the programming mode.
10. To run the locomotive you will need to select its' address as covered above. You may need to turn the track power back on depending upon which control station you have.

With the DT300:

1. Press the STOP AND FUNC/F0 keys at the same time to enter programming mode.
2. Turn the left knob counterclockwise to change the left digits to show a flashing "Ad2=???" on the screen. Turn the right knob once to change the display to "Ad4=???".
3. Use the FUNC/F0 key to select the programming mode you wish to use.
4. Use the left and right knobs to select the four digit address you want to use. The left knob will change the value by one hundred, the right knob will change the value by one.
5. Press the SEL key to program the address to the decoder The throttle will beep, and display "Ad4=Owr" followed by a blinking square. Then "Ad4on?=Y" which is telling you that you are resetting CV19 to 26. Press the "Y+" key to enable the four digit address. If you don't do this before the throttle times out press the SEL key again, then the "Y+" key.
6. The display will show the four digit address you programmed to the decoder.
7. Press the STOP key to exit programming mode.
11. To run the locomotive you will need to select its' address as covered above. You may need to turn the track power back on depending upon which control station you have.

With the DT400:

1. Press the PROG key to enter the programming mode.
2. If needed, turn the left knob counterclockwise to change the display to show "Ad2=???".
3. Press the right knob once to display "Ad4=???".

4. Use the PROG key to select the programming mode you wish to use.
5. Enter the four digit address using the key pad or using the left and right knobs, for example "1235". Turning the left knob will change the value by hundreds, turning the right knob will change the value by one.
6. Press the ENTER key, the throttle will beep and display "Ad4=Owr" followed by a blinking square. The display will show "Ad4on=Y" which is prompting you to change CV29 to 26 which enables long addresses. Press the "Y+' key. The locomotive should pulse indicating the decoder accepted the address.
7. Press the EXIT key to leave the programming mode.
8. To run the locomotive you will need to select its' address as covered above. You may need to turn the track power back on depending upon which control station you have.