

Basic Programming of DCC Locomotives

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For many years, operation of multiple locomotives on the same track required special wiring techniques. The model railroad had to be broken up into blocks so that trains may be individually controlled.

With the advent of Digital Command Control (DCC), operation was no longer restricted to locomotives running one direction on a given track. Each locomotive has the possibility of being individually controlled.

When a new DCC decoder equipped locomotive is purchased, the default address is 3. This address may remain at the default, however if individual control is desired, different addresses must be assigned to each locomotive. At Bremerton Northern Model Railroad (BNMRR), we prefer to refrain from using address 3 (even if that is the locomotive's cab number) to avoid conflicts with newly acquired motive power.

There are three basic types of decoders. The first, referred to as Type 1 (Physical register addressing), is the most primitive type and is found on early 1st generation decoders. Type 1 decoders have only 8 registers or CV's (Configuration Variables). Type 1 decoders can use only "short" address (addresses 1-99 on EasyDCC systems).

Type 2 (Paged register addressing) is the 2nd generation decoder and is much more common. Type 2 decoders support many more CV's. Most type 2 decoders can use both "short" and "long" addresses (0-99 and 100-9999).

Type 3 (Direct addressing) is the latest type of decoder and is usually sold and labeled as "Advanced" or "Supports Extended Packet Formats." These decoders also support both "short" and "long" address (0-99 and 100-9999).

Each brand of DCC Command Station has a particular way of changing the address of a locomotive. Since each is different, the unit's instruction book must be referred too. For example, EasyDCC systems can change a loco's address on the programming track by pressing "SERV/PROG", "LOCO" and entering the new address. For long addresses, the command station will automatically change CV's 17, 18 and 29 appropriately. In addition, most Command Stations allow programming of individual CV's. The Digitrax Chief Manual has three pages on how to change a locomotive address with that system. The Digitrax system does not automatically change CV 29 appropriately; it must be changed by the operator. At this clinic it is assumed that programming is done by programming individual CV's.

Though this programming is best done on a programming track, some command stations allow programming on the main track. If programming on the main is used, there has to be some way to direct the command to the correct locomotive. Example: with EasyDCC, one would press

OPS PRGM and enter the locomotive's address. Then press ENT and then CV. The display will ask for the CV number. Enter the number. Then the display asks you to select value or bit. Select which one you want (I always use value). Next, enter the value desired. Press ENT. If you are finished, press ESC to conclude the programming session. The Digitrax Chief system has a similar, but different procedure to program CV's. To be successful, whether a programming or main track is used, the track and locomotive wheels must be clean.

CV 1 is the location of the primary locomotive address. As indicated above, this starts out as a value of 3. Some decoders and command stations allow addresses up to 127 as a short address. However, here we will limit the addressing to one or two characters. To change the address, simply change the value of CV 1 to the desired number from 1 to 99.

"Long" addresses are saved in two CV's, CV 17 and CV 18. Also, CV 29 must be altered to utilize a long address. To determine the values of CV's 17 and 18, a calculator is best used. For example:

Step	Action	Example
1	Enter the desired engine number on a calculator	1870
2	Add 49152 to the engine number	51022
3	Divide by 256 and enter the whole number in CV17	<u>199</u> .3046875
4	Multiply the whole number by 256 then subtract it from the total in step 2 and enter the result in CV 18.	51022-(199 X 256) = 51022-(50944) = <u>78</u>
		CV 17 = 199
		CV 18 = 78

The above table was developed from the information provided by references 5 and 6. Reference 2 also provides a calculation using only the address and not adding 49152, but was proven to be in error by using a long address on a TCS decoder and checking values in CV's 17 and 18.

CV 29 is probably the most influential CV. It allows use of "long" address, speed tables, digital or analog conversion, the number of speed steps, and the direction of the locomotive when going forward. Below is a table for determining the appropriate value of CV 29 (example is for a Loco with the normal direction in forward, 28 speed steps, DC operation enabled, default speed table, and long address):

				Example Value
A	Normal Direction in Forward = 0	Or	Reverse Direction in Forward = 1	0
B	14 speed steps =0	Or	28 speed steps = 2	2
C	Analog (DC) operation disabled = 0	Or	Analog (DC) operation enabled = 4	4
D	Loadable Speed Table inactive = 0	Or	Loadable Speed Table Active = 16	0
E	If address is 99 or less = 0	Or	If address is 100 or more = 32	32
Basic Configuration value of the decoder = total "A" thru "E"				CV 29 = 38

CV's 2, 3, 4, 5, and 6 are best programmed on the main track if that option is available on your command station. Programming on main allows you to immediately see the effect of the change.

CV 2 is the start voltage. Some locomotives need a higher start voltage than others. Setting this CV appropriately allows the locomotive to start as soon as the throttle is advanced to the first step. It's best to leave this at "0" until you get familiar with programming and its effects. The value entered can be anything between 0 and 255. A higher number results in a higher starting voltage. A value of 255 will immediately give the locomotive a jackrabbit start!

CV 3 is the acceleration rate or momentum. The value can be anywhere between 1 and 255. A value of 0 means no delay. Large numbers will give an uncomfortably long delay to throttle changes. I have most of my locomotives set with a CV value of 5 to 15.

CV 4 is the deceleration rate and is similar to CV3. Here, again, I like a value of around 10.

Some sound decoders should have CV 3 and 4 set with some value other than 0 to take advantage of some available sounds. This allows, for instance, the steam chuff to diminish when decelerating, making the locomotive sound closer to a real loco (References 5, 6 and 7).

CV's 5 and 6 and for the speed graph: CV 5 adjusts the top voltage and CV 6 adjusts the mid voltage. Using a value of "0" for both, results in straight line acceleration with the throttle. These CV's are useful when trying to speed match two locomotives.

CV's 7 and 8 are for the manufacturer version number and ID and are not programmable. However, often CV 8 is used for a reset to factory defaults. The decoder instructions will tell you what value to program into CV 8 to reset the decoder. For example, Digitrax DH123 (Reference 8) decoders can be reset by setting C 8 to 008 or 009. See the instructions for alternate ways to affect a decoder reset.

There may be many more CV's in a given decoder. Sometime there are hundreds. Some are defined by NMRA and some by the decoder manufacturer. Most need not be changed from their default values. For example, CV 19 is the consist address. This address is used when the locomotive is in an advance consist. Why the word "consist" is used is questionable. I would think calling the address "multi unit" would be more appropriate.

Some experiences:

Over the years that I have been using DCC, I have found some weird happenings.

One that caused me some concern is I had a locomotive whose headlight wouldn't stay on. I found out that the problem was in the speed steps. I had the command station set at 14 steps for operation, but the locomotive was programmed for 28 steps. Both need to be the same. (Why anyone would want to use 14 steps is beyond me!) The real problem is the command station I was

using at that time would return to its default of 14 steps whenever it was depowered. I didn't realize that was the problem until after I had completely disassembled a Shay locomotive to change the headlights to LED's. Well, at least the headlight is bright now!

I found that some MTH locomotives could not be programmed on a programming track. To program a long address, you have to program CV 17 and 18 as described earlier and then program CV 29 to allow use of the long address.

There was one locomotive with sound that would not accept a long address and have the sound work. I ended up programming a short address just so I could have sound. I put a label underneath the locomotive to indicate the loco's address. I believe this is just a defect in that particular decoder.

References:

1. Easy DCC Installation and operation Manual and Reference Guide, CVP Products, Richardson, TX
2. Train Control Systems Plug-N-Play Decoder Instructions, Train Control Systems, Bloomington Glen, PA
3. Digitrax Decoder Instructions, Digitrax, Panama City, FL
4. Digitrax "Chief" Premium Digitrax Command Control Starter Set Users Manual, Digitrax, Inc, Norcross, GA
5. Tsunami Digital Sound Decoder Technical Reference, SoundTraxx, Durango, CO
6. SoundTraxx DCC Digital Sound Decoder LC Series Owner's Manual, SoundTraxx, Durango, CO
7. Steam Sound User's Guide, SoundTraxx, Durango, CO
8. Digitrax Command Control instruction sheet for DH123 decoders, Digitrax, Panama City, FL