Northern Virginia NTRAK "How-To" Article

DECODER CV 29 EXPLAINED

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In the age of modern technology, we tend to forget that basic computer language is made up of a series of zeros and ones, or binary code. Those great looking, 1 MB or more, pictures we take are, in reality, just a lot of zeros and ones stored in a very compact format. Giving a computer instructions in binary code would be very difficult so practical interfaces have been developed. It helps to understand what is going on in these processes.

Looking a little closer the smallest practical binary storage unit, a Byte, has eight bits as in 10101111, but you and I do not speak binary. We have 10 fingers and like to count that way, so we speak digital, and the throttle and command station translates digital to binary to talk to the decoder.

Decoders have "Configuration Variables" (CVs) which allow us to interface with the decoder and provide instructions. Each CV stores one Byte of information. As shown in the table below, each successive bite is zero or an increasing power of 2. Note that we count positions from zero to seven, not one to eight. The other thing that we often miss, is that any number, other than zero, raised to the zero power is one. Don't ask me why, I just do the math. So the first position in our table, is position zero and the value is zero or two raised to the zero power, which is one.

Position	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Power of 2	**2^0**	**2^1**	**2^2**	**2^3**	**2^4**	**2^5**	**2^6**	**2^7**
Binary Value	**1**	**10**	**100**	**1,000**	**10,000**	**100,000**	**1,000,000**	**10,000,000**
Digital Equivalent	**1**	**2**	**4**	**8**	**16**	**32**	**64**	**128**

Add all the values together for binary 11111111 the decimal equivalent is 255. For most CVs we are able to store an instruction to the decoder in the range 0 to 255. For a locomotive with a short address of 90, CV-01 would have a value of 01011010. For the long address two CVs are needed with the values stored in CV -17 and CV-18 and combined to get the long address.

This is all fine so far, but does not explain CV-29. We also need some switches, essentially an on or off position in setting up a decoder. Lets look at "normal direction of travel". For example, we have two locomotives that we want to run together with the same address, one forward and one reverse. We need to set the normal direction of travel for one of these locomotives to reverse.

You could take one locomotive apart and reverse the motor leads to the decoder, a rather impractical solution. Perhaps we could add a small "dip" switch to the bottom of the locomotive. Actually you will see dip switches on some of the lighted passenger cars. While we are at it, there are other functions that need a switch so lets add an 8 position dip switch to the locomotive as shown below.

Hopefully, eight little on-off switches all in a set is starting to look like the Binary Byte of information

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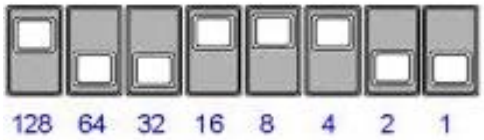
discussed at the start of the article. Going one step further, lets assign a value to each switch. Now all we need to do is somehow shrink this down and get it into the decoder.



Finally, CV-29 comes to the rescue. Unlike most other CVs that store numbers, CV-29's eight positions are used as switchs to give the decoder yes/no, on/off information. I think of CV-29 as a binary dip switch. A much better approach to the problem than any of the other solutions offered.

The following table shows the "function" of each of the CV-29 switches. Digitrax lists five functions controlled by CV-29. It is important to note what actual computer position, or switch, is controlling the function.

Computer Speak	**Digitrax Speak**	**Function and digital value**	**Useful Values**
zero	01	Normal direction of travel—Off (0) is forward and On (1) is reverse	**0** or **1**
one	02	Speed steps—off (0) is 14 step and on (2) is 28/128 step. With a modern decoder we are going to want the better speed control.	Always **2**
Two	03	Analog mode available—OFF(0) it will not run on DC, ON (4) if a DCC signal is not present it will run if DC is applied. Leave it on, it gives more flexibility.	Always **4**
Three		Not used on most US Decoders—always OFF (0). Will never have an ON (8)	Always 0
Four	04	Speed Tables—OFF (0) the decoder increases speed in a straight line. ON(16) you can set 28 individual speed steps—A total of 31 CVs. You are not going to do that with a hand held throttle so leave this one Off.	Normally 0
Five	05	Two digit or four digit address—Off (0) is two Digit and ON (32) is four digit.	**0** or **32**
Six		Not used on US Decoders—So it is always OFF (0). We will never have an ON (64)	Always 0
Seven		Not used on US Decoders—So it is always OFF (0). We will never have an ON (128) (Yes there is a trend here—2 raised to the seventh power is 128.)	Always 0

A new decoder comes with CV-29 set at 00000110 or digital 6. This default value is normal direction of travel is forward, 28/128 speed steps are set, Analog mode is available, speed tables are off, and two digit address is set.

Looking at the table above , there are only two values that most of us will ever want to change, normal direction of travel (0 or 1) and two or four digit address (0 or 32). As shown in the table to the right, there are only 4 values of CV-29 you will ever use with a hand held throttle. So at a show, put the locomotive on the programing track, select CV 29 and feel confident in changing the direction of travel.

Address	**Direction**	**CV-29**
Two Digit	Forward	6
Two Digit	Reverse	7
Four Digit	Forward	38
Four Digit	Reverse	39

If you plan to use speed tables, get a Computer, load JMRI and buy LocoNet interface. If you use JMRI, it handles all the CV-29 settings for you.