The SoundTraxx Guide to DCC

DCC is here and growing.

DCC has been around for years and is a growing segment in the model railroad market. This paper should help you better understand how DCC works and the advantages it can provide over conventional DC operation. This introduction does not address details or manufacturer-specific differences. It is designed to get you started in DCC. Each DCC system will have some differences and advantages, but all brands basically follow the same format and will generally control every brand of DCC decoders.

DCC…What is it?

DCC stands for Digital Command Control as defined by a group of Standards and Recommended Practices set forth by the NMRA (National Model Railroad Association). We'll refer to this as the DCC Standard. This is important because systems that adhere to the Standard have a certain amount of interoperability – you cannot generally mix a DCC system with another non-DCC Digital System. Systems that follow the DCC Standard will typically have the DCC logo or some mention of DCC Compatibility on their packaging. The DCC Standards and Recommended Practices (often called RPs) can be found on the NMRA's website at www.nmra.org.

A DCC system usually includes a power supply and a Command Station, either as one unit or as separate pieces. The Command Station may be a console with controls on it or may be a handheld device. In some cases the DCC system has a Cab, which is a handheld throttle in addition to the Command Station.

In order to run a locomotive with a DCC system, a decoder (a DCC receiver) must be installed in the engine. A decoder is usually fitted into a locomotive or tender (in the case of a steam locomotive).

In some cases the decoder may be used to control accessories. In this case the decoder may be located somewhere on the layout and not in a locomotive.

DCC works by sending a packet of (data) information over the rails. The information will contain all of the data that is generated by the command station and/or cab. The decoder that is located in a locomotive has a unique address. Each decoder in the locomotive can only accept the information included in its address. The information coming over the rails may tell the decoder to increase motor speed or slow down, change direction, blow a horn, turn on lights or whatever features are available in the particular decoder. (In some cases there may be more the one decoder.)

If two locos are on the same address, they will receive the identical information.

To make sure you understand the fundamentals mentioned above, consider this analogy:

We will look at the local postman and his task of delivering mail. Each day he loads up his sack of mail (data or information). The information we produce in DCC is similar to a letter carrier with his or her bag of mail. As he stops at each home (an address), he leaves only the mail that has that address. He then moves on to the next home and drops off the mail (information) that has the proper address. The DCC system does exactly the same thing; it sends only the information pertaining to each locomotive's unique address.

When using a conventional power pack, as voltage increases so does the speed of the locomotive. Changing the track polarity (generally with a 'forward/reverse' switch) changes the direction the locomotive travels. In DCC, the voltage to the rails is constant. Therefore the motor is no longer connected to the track through the locomotive pick ups. The decoder receives the information over the rails and regulates how much voltage the locomotive motor will get, which controls the speed. It also controls the direction of the locomotive as sent by the modeler.

The Advantages of DCC

DCC makes model railroading fun!

DCC offers many advantages over conventional DC operated trains. Using DCC, a railroader can independently operate more than one train on a track at one time. Each train can travel at different speeds and in different directions. Finally, trains can run just like they do in the real world!

One controller can operate multiple trains. All the railroader must do is to change the address from one locomotive to another and he can control a different train. DCC in its basic form does not require block wiring. However, as a layout gets more busy or larger, wiring blocks may come back into play.

DCC can also allow locomotives to sit at idle and have lights turned on or off. If it is sound equipped you can sound a bell and listen to it idle while sitting in a yard or siding. It also permits running more than one locomotive together as a unit (MU'ing or Consisting) to pull a train. In fact, since you can adjust each locomotive's individual operating characteristics, it is now possible run multiple locomotives in a consist and have them run smoothly in tandem.

Operating accessories such as turnouts or signals remotely is another advantage of DCC.

Most Command Stations allow adjustments to enhance locomotive performance or provide the ability to create a route for a train to follow or so that with the touch of one button you can throw multiple turnouts. DCC can provide many other advantages but for sake of brevity we have only named the most important advantages.

Now that you know how DCC works, we can move on to more details about DCC systems.

Programming and Operations

Basically every DCC system has two sides of control. One side is the operational capability which allows a user to run decoder equipped trains and accessories. The other side is the programming capability of the system. Programming is a term used by most manufacturers when talking about how you make adjustments. It is a bit misleading as you don't actually program anything. The manufacturer has already programmed the decoder and you are merely making the selections that best suit your needs. Programming allows the user to change settings such as changing the address, changing system parameters or individual locomotive performance settings. Programming can be done on a program track or on the actual layout (the main line), also known as programming on the main. Not all systems permit programming on the main.

Speed Steps

Speed steps are incremental increases or decreases in the speed of a locomotive. For instance, a Command Station operating at 28 speed-steps has 28 individual steps from stop to top speed. There are 3 commonly used speed steps available: 14, 28 and 128. Early systems operated using 14 or 28 speed-steps, while most of today's systems support up to128 speed steps, providing ultra-fine control - since each speed step increment is very small.

Addressing

As mentioned above, each decoder has an address. When shipped, most decoders are set to address 03. This allows a customer to know its default address and operate it right out of the package without making any adjustments. The exception to this is when a model is shipped with a decoder already installed – it is sometimes set to the road number of the locomotive (the manufacturer will note this!).

Most DCC systems allow the use of addresses from 1 to 9,999. There are two types of addresses. Short addresses range from 1 to 127. Long addresses are accepted to be from 128 to 9,999 and are particularly useful when you wish to match the address to the road number of the locomotive. Not all systems provide both long and short addresses and not all systems allow the maximum number of addresses allowed by the Standard.

Functions

Functions are things we can control to add fun to running our trains. Functions are typically turned on or off. They can control such things as headlamps, number board lights, ditch lights, Gyralites and Mars lights. They can also control sound effects such as horns, bells, brakes, dynamic brakes, air compressors, coal shoveling and coupling. The list goes on and on.

The number of functions varies greatly from system to system. The number of functions in each decoder also varies depending on what it is intended to do. For example, a 2-function decoder may only control a headlight and backup light function, while an 8-function decoder may also control additional lighting functions or sound effects.

CVs

CV stands for Configuration Variable. To keep things simple, a CV is an adjustment. For example, CVs allow you to change the address, adjust the starting voltage, or select from a menu of sound effects. Some decoders have a variety of lighting effects, and CVs that let you change light patterns or flash rates.

Most decoders come with a CV Reference chart. It will tell you the purpose of each CV and how they can be adjusted.

Cabs

A cab, whether part of the console or a handheld device, has a variety of controls. Many have an LCD screen which provides information and feedback. Each will have arrows pointing to the various items on the cab. This is how you control your locomotive and how you program CVs. Cab features and user-interfaces vary greatly from manufacturer to manufacturer.

DCC is getting better all of the time

The latest DCC systems offer many outstanding features. DCC systems start as low as $100 and can go as high as $700. Features such as graphical LCDs and wireless cabs permit modelers to walk freely around their layout while still controlling their engines.

For a bit of added help, see our DCC Glossary. Another way to learn more about DCC is to attend a model train show. Some DCC manufacturers run seminars to help teach you how to use their systems. Magazines and books are another way to learn about DCC. So get on board!

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