Converting Model Train Layouts from DC to Digital Command Control

Introduction

Since the 19th century until the 1980s, Analog control (DC) was the only practical way of controlling model trains. Dissatisfied by the limitations of Analog control, enthusiasts had always wanted another method that would fulfill their needs. Early models of DCC were created as early as the 1940s, but they were extremely expensive and not very practical. By 1980s however, technology had developed to the extent that DCC was very much affordable for enthusiasts. Nowadays it has reached the affordability of even more people.

The advent of DCC meant that many people had Analog systems that were incompatible with DCC. Some of them went for conversion to DCC while some didn't think it was worth it. However, nowadays many more people are looking for conversion of their systems into DCC. Here we will discuss how DCC compares with Analog control and what is required to convert an Analog system into a DCC one.

Advantages of DCC over Analog

There are several advantages that DCC has over an Analog control setup. First of all DCC can be used to simultaneously run multiple trains on the same track at the same time and enable them to be controlled independently of one another. Although an Analog setup can also be created for running multiple independent trains on the same train track, it requires the creation of a completely independent power circuit for each different train which would not be viable due to size and practicality concerns.

Another advantage of DCC is that components such as station lights and drawbridges can also draw power from the main power circuit without any hindrance in the running of the trains. If an Analog setup had been used, an independent power source would have to be provided for them which would increase the complexity of the model train setup and make it less flexible to changes.

A DCC system can also be used to provide realistic motion effects to the trains. An example would be a train slowing down as it starts to approach a station as well as it accelerating gently when it leaves the station. The change in speed can be set to be very gradual which will feel very realistic in comparison to the performance of the trains utilizing the Analog setup where a train will go from a complete stop to maximum speed within a couple of seconds which we all know is extremely unrealistic.

Are There Disadvantages of DCC? Perhaps

Although DCC trumps Analog systems in a number of ways, there are some scenarios where DCC will not be worth the effort. The best example would be a scenario of a single train running on a simple track without any powered additional components which would enable an Analog system to perform the same tasks as a DCC system at a fraction of the cost due to the lack of requirement of signal boosters, decoders, etc. Who would want to spend more time and effort if there is a simpler and cheaper way of getting the job done?

How DCC works

Analog controllers are fundamentally different from DCC (Digital Command Control) systems in a number of different of ways. An analog controller is only capable of sending a single analog voltage to the locomotive. This basically means that all components of your model train setup will get the same electrical energy and running multiple independent trains on the same stretch of track is not a possibility.

DCC systems send a pulsed signal to the rails with the pulses containing encoded digital information which is then decoded in order to provide the specified electricity to the train.

A DCC controller (or command station) creates the waveform, while a Booster superimposes the DCC commands onto the power signal fed to the track.

A booster handles the transmission of encoded power waves to your model train components and each component has an independent decoder onboard which translates to different amounts of power being sent to it. This means that different trains running on a single of stretch of your model train tracks will be able to maintain different speeds and be controlled independently without any extra wiring or circuitry. This system is in stark contrast to that of analog control which involves the application of a variable DC voltage at the rails for the enablement of the flow of electricity through the locomotive and the performance of the locomotive is directly proportional to the voltage applied.

What Equipment Changes Will Be Necessary?

If you want to convert your existing Analog setup to a DCC one, there will be a few equipment changes necessary for the transition. In order to commence the transition, it is recommended that you install all your locomotives and other powered accessories with decoders that are compatible with both DCC and Analog systems. If there are budgetary concerns, this step enables you to gradually switch to DCC while keeping your current setup in operation. Even if there are no concerns regarding the investment in your layout, using dual-compatibility decoders will be an advantage if you want to switch back to Analog. Even if you never use an Analog layout again, having an extra capability in the decoder never hurts.

Decoders

Mobile decoders will be attached to those components of the model train setup which have the capability of being in motion, such as locomotives and the steam generators that may be attached to them. Using decoders allows many devices to be controlled with one control station, including locomotives, switches, couplers, and sound effects and steam generators.

Stationary decoders will be attached to fixed components of your layout. Examples of such components include scenery such as signal lights or the speakers at a train station. The motors used in drawbridges can also be fitted with stationary decoders which can be cleverly concealed for a clean setup.

Track Wiring Changes

The track wiring required for a DCC setup may be different from an Analog setup in several ways. It all depends on your layout, and how complex you want to get. If you have a simple layout, you can just disconnect your analog power pack and connect the power from your DCC system to the same two connections used with the analog pack. This is the quickest way to make the switch. It is recommended that you create separate *power districts* which are used to handle short circuits, reverse sections, performing block detection, and turntables.

If you have a complex Analog layout, with multiple sections (home-run wiring), then you already have power districts built in!

First of all you will have to check whether your Analog wiring is done using the common-rail method or the home-run method (un-common rail wiring).

In a common-rail setup there will always be one wire that runs across the whole rail network except the reversing sections.

In home-run wiring there will be different blocks of wires that always run in isolation to one another. This isolation is achieved using insulated rail joiners at the block boundaries of both the rails.

In common-rail wiring, only one rail uses an insulated rail joiner while the other rail does not. Also, Single-Pole, Double-Throw switches will be the ones present in a common-rail wired setup whereas in a home-run wiring setup the electrical switches would be of the Double-Pole, Double-Throw type.

If you have an existing Analog setup which has wiring done using the common-rail method and want to convert it into a Digital Command Control setup with multiple power districts, there will be a few steps that you will need to perform. First of all you will have to convert the common-rail setup into a home-run setup. To do this, you will have to create a gap in the common-rail at the same place as the gap in the un-common rail. This step creates the multiple power districts.

Once you have multiple power districts, you can connect your Power Booster and Command Station to the layout. A booster is necessary for each power district. This method provides constant power throughout the track, as well as isolation in case of a short circuit across the tracks. If you are just starting out with a small layout, you may be able to connect the power districts together and hook them up to a single booster. Later, with more trains or a larger layout, you can break out each district and have it powered by a separate booster.

Each booster will have to be connected with the individually wired blocks so that if there is any fault in a single block, the power supply to that block can be stopped while keeping all other blocks operating normally. The command station and the throttle network can then be connected to the Booster units for the DCC system to start operating.

Relative costs

A decent DCC power pack containing a power supply usually costs about $40. A dedicated command station costs in the range of $100 while one with a booster included usually costs about $150-180. A dedicated booster can be bought for about $50 if it is of regular specification while a high-performance model would cost about $125.

A throttle for a DCC system starts at $60 for a basic utility wired model with prices increasing as more functions are added. However there are some devices which combine multiple functions in them such as a Digitrax Zephyr Xtra which includes a booster, command station and a throttle within a single body for about $175. This is a basic model, so be prepared to upgrade as your layout grows.

DCC-based Train Sets

Besides these options, you could also get yourself a DCC kit with all items included that would be necessary for starting a DCC train setup. These sets may vary in price relative to their features.

For example a basic Bachmann train set with a power pack, controller, one or two locomotives and some track would cost between $160-180. The trains in these sets would be rather basic in looks and not feel very realistic.

Other sets contain highly detailed locomotives such as the Bachmann Amtrak Acela DCC Train Set which contains a detailed locomotive with headlights at both ends, plus detailed interiors with specific compartments, such as one for business class. The interior of the train is also illuminated which gives an even more realistic feel. Besides the locomotive there will also be the same accessories such as a power pack, some length of track and a controller. This set costs around $250.

Decoders on the other hand vary in prices depending upon their type and function. Basic 2-turnout DCC decoders, both stationary and mobile usually cost in the region of $30. A sound decoder, meanwhile normally runs for $60-$80. Keep in mind that you will need multiple decoders to run multiple devices thus your expenditure towards decoders will be proportional to the number of devices you want to control.

Review of DCC products

Nowadays there are several DCC products on the market that are focused on different market segments. Here I will review and compare two complete DCC sets in the same price range. The Bachmann Trains Diesel Digital Commander set and its counterpart the Bachmann Trains Digital Commander are both in the range of $175. Both of these sets contain an E-Z Command Control Center which is a controller that is very easy to use and is easily programmable to allow all desired functions to be at your fingertips. Both of

these sets also have a 56" x 38" oval rail track and 2 freight cars and wide-vision caboose.

The difference arises in the locomotives included in the box. The steam version of the set contains a single locomotive which has got an operating headlight while the normal version of the set contains two locomotives, with the downside being that both of them do not have any operational headlights. Thus between these two sets it is up to your preference if you want to go towards a more active model railroad setup or you want to run a single locomotive but with a higher level of detail. Whichever side you choose, due to the presence of DCC you can always expand on the initial layout whenever you feel like it.

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