

Team Track Trading

Digital Command Control (DCC)

- What is it, what are the advantages and pitfalls

DCC – What is it?

Conventional model railway controls are based on the well-established principle of varying the voltage to the track and thus to the motor of the locomotive. This is usually achieved by turning a 'knob', which actually controls a potentiometer (some systems use a slider but the principle is the same). This varies the output voltage to the track and thus to the motor. To run fast the voltage is increased, to run slowly the voltage is decreased, to stop the voltage is reduced to zero (or near zero). The voltage range for OO/HO is usually 0-12 volts DC (direct current). This is a direct descendant from the battery powered train sets of the 1950s (and earlier). This system is sometimes known as analogue control.

To control a single train or loco is simple, connect up and turn the knob. Running more than one loco on the track however is more difficult but can, of course, be done by introducing track sections and switches so that each loco can be switched (isolated) when it is not to move.

Digital control has been around in one form or another for about 30 years. Older UK modellers will recall the 'Hornby Zero One' system from the late 1970s. Modern systems are much more flexible and adaptable but use a similar principle.

A constant voltage is applied to the track irrespective of the number of locomotives on the track or where they are. Each locomotive or power unit is fitted with a 'decoder' which acts as the onboard 'section switch' or isolator. The locomotive only moves when its onboard decoder receives the signal from the controller instructing it to switch on. The decoder also 'decodes' the signals from the controller instructing it as to which direction it is to move in and at what speed. Most decoders also have the facility to switch on/off loco lights, this can be done whether the loco is stopped or moving and because the voltage is constant the lights are at constant brightness once selected.

How does it control the speed when we have constant voltage? The controller sends instructions to the selected decoder to allow pulses of the full voltage to pass to the motor. The longer the length of the pulse (known as its pulse width) and the greater the frequency of the pulse results in the greater the speed of the motor. This is exactly what happens with modern diesel and electric locomotives in the prototype world. At full speed the voltage applied to the motor is in effect full voltage all of the time.

It is because each decoder only responds to its own instructions (known as its address) that enables multiple locomotives to work on the same track and even run in the opposite direction (beware of collisions!).

Decoders for use in locomotives are often described as 'mobile' decoders as decoders are also available for use with point motors and signals; these are known as 'stationary' decoders and these function slightly differently in that when selected by the controller they switch the full voltage to the accessory because speed control is not a requirement in these cases.

Advantages of DCC

- 1. Smoother slow running**
- 2. Simpler layout wiring**
- 3. Easier Multiple Controller Operation**
- 4. Walk around control**
- 5. Correct Operation of Loco lights**
- 6. Sound**

1. Smoother slow running

A badly running locomotive will still be a badly running locomotive, miracles do not happen by using DCC however improvements in slow running are definitely achieved by using DCC. This is because of the difference in the operating principles explained above. Conventional DC control permits a low voltage at a small current to pass to the motor when we want to run slowly. In the event there is any 'stiction', dirt or the motor is slightly out of balance (most are not balanced) and the voltage applied is inadequate resulting in the loco stalling.

A DCC equipped loco has the full voltage applied at all times pulsed to the motor, this results in smoother slow running. In my experience this is in itself the biggest single advantage of DCC as even flywheel equipped drives will run even slower under DCC than is possible with conventional DC control resulting in much more realistic shunting moves.

Clean track and clean loco wheels are essential whatever system is used.

2. Simpler Layout wiring

It is claimed that with a DCC system you only need two wires and in principle this is true, just as with the simplest DC system you only need two wires. Where DCC results in real savings in the complexity of the layout wiring is where track layouts are at their most complicated AND where you want to run more than one loco at a time.

Take for example a passenger terminal with adjacent goods yard accessed from the same main line track with multiple point work, crossovers etc. In a conventional DC wired layout you would need to install 'cab control', switches, and isolated sections in order to work a passenger train and shunt at the same time. With a DCC wired layout there are two wires taken to each feed position, no switches, cab control or isolated sections. Any loco can run at any time to any point on the layout. On my own layout 'Kniepe' there are three double slips all in a row with other point-work leading to them enabling very flexible working from passenger side of the station to/from the goods side – very useful for moving locos from the stabling sidings to anywhere!

If you need advice on how to wire a DCC layout just ask, we're glad to help.

3. **Easier Multiple Controller Control**

With Conventional DC control you can wire in two controllers using cab control and section switches but it gets very complicated when three or more controllers are required.

DCC controllers allow you to just plug in another handset, which has all of the facilities of the original. It may be necessary, with some systems, to purchase 'extension plates' but all but the basic units will allow at least two control handsets to be plugged in. Using 'extension plates' does however have the advantage of enabling the additional handset(s) to be mounted away from the base control unit but retaining all control features, an especial advantage on larger layouts or where there is a shunting area remotely located.
4. **Walk around control**

Except for the very basic DCC control systems all will allow the operator to unplug the handset and move to another plug in point and at the same time the loco(s) are still running unaffected. This can be a very useful feature on larger layouts and even on smaller ones when two operators have managed to get their cables twisted! (Yes, it's happened to me). This is a feature our American cousins use extensively on their (usually) large (by UK terms huge) layouts allowing train operators to actually follow their train all around the layout. There are wireless DCC controllers now readily available but I have no experience of them.
5. **Correct operation of lights**

DCC decoders are quoted as being one function, two function or more. This can be confusing as what constitutes a function? In the case of a locomotive that has running lights fitted that change when direction is changed a two function decoder is required to make the lights work properly. This is the one instance where conventional DC beats DCC! In a DC loco there is a rectifier (diode) circuit that prevents the wrong lights coming on in the wrong direction of running, in DCC this needs a signal for forward and one for reverse HOWEVER decoders can be programmed not only to switch the correct lights for each direction but can also dim the lights (even flash) where appropriate – try that with DC control! A one-function decoder (we do not stock them) can only switch on/off the lights irrespective of direction. A loco parked in the platform waiting to depart can have the correct headlights at the appropriate brightness even when stationary. This can be done with DC but with additional complications, it is standard with DCC.
6. **Sound**

Not everyone's cup of tea but excites some folks. Personally I find it wearing at an exhibition particularly when the volume is turned to full to overcome the background noise of the exhibition hall. Sound has a place. I have sound equipped locos and use them in the peace and quiet of the railway room but at half volume maximum. This results in the small speakers not being 'over amplified' resulting in distortion. Factory fitted sound systems are despatched set at full volume (that's how they are tested) and most purchasers do not realise that they can adjust them – read the manual! It is easier to adjust sound, use it and enjoy it with DCC because the sound system can be

adjusted very easily. DC versions are now coming onto the market but these suffer because they are not easily adjusted (if at all)

Sound in the model railway world is an interesting feature but we must recognise that the laws of physics are still valid. Sound quality from a speaker depends on the size of the speaker and the quality of the signal. In N gauge and OO/HO we have to accept that speakers have to be tiny and therefore cannot have the Bass – Treble qualities of our domestic sound systems; accept that and you will not be disappointed BUT hear it before you buy it whenever you can.