De-Mystifying DCC - A very simple explanation

This is a "One shot approach" to describing DCC and how simple it really can be. Originally published some time ago, it has been extremely popular so I thought we would reproduce it here, unchanged apart from font and print colour!

If you are an individual or club member looking for a simple way to explain or describe DCC, feel free to copy this document. We'd be grateful if you would of course credit it to DCC concepts and refer those who read it to our www.dccconcepts.com *website for further advice and information.*

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A few words from DCCconcepts about the reality of Digital command control, the conversion from DC to DCC and the myths and misunderstandings that surround this exciting well established technology.

Seldom has a concept that was designed to simplify and improve the performance of something as simple as a model railway been so confused & complicated by misinformed marketers, over-enthusiastic supporters and unnecessary new words! We work with DCC every day, operate our own layouts with DCC and install for others, teach DCC subjects regularly, consult on DCC system design and troubleshoot for modellers with problems, so we think we know it pretty well.

Forget the nonsense. DCC is simpler than the luddites will admist and it will transform the quality of running and operations on your layout. Read this page and we are sure you'll understand the basics… and be convinced! (By the way - if you are not, that's still OK… it's a hobby, and you can do whatever you like as long as you enjoy it!)

So… for those that are interested: "What's the big difference?"

With DC control:

Pickups on the locomotive take power from the track directly to the motor. The layout is divided into selectable or isolatable track sections and the controller is connected to individual sections of track as needed.

Running multiple trains needs multiple controllers. The locomotive will change speed and direction based on the controllers varying DC output voltage and the polarity of that section. All locos on the same section of track will react the same way, with no fixed direction relationship between forward and reverse as this is dependent on polarity.

Tuning a locomotives performance with a DC layout is almost impossible without changing gearboxes or motors. Any lights on locomotives or rolling stock will vary with voltage. Low speed means low voltage. Stalling can therefore be quite common unless track is perfect.

With DCC control:

Each locomotive has a "decoder" installed (These are now very small and some are really tiny - they can be as small as your little finger nail). This decoder acts as a receiver for a digital signal created by the controller.

Because every locomotive can be given its own digital address (nothing more complicated than the number on the side of its cab) and will only respond when it is specifically addressed by the controller, the whole layout is treated as a single section of track.

Each locomotive is able to operate independently and there is no unwanted interaction with others, so there is no operational need for separate controllers or isolated sections. Because the controller provides full voltage at all times, loco and coach lighting is always constant, and the availability of higher track voltage means that starting and slow speed running are often significantly better than when the same locomotive runs on DC.
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Continued…

Tuning a loco and changing acceleration, starting performance, momentum and top speed, etc. with DCC can be accomplished by simply changing a few of the instructions given to the motor via the decoder settings.

This is simple to do with the DCC controller, and can be done separately for every locomotive.

These "decoder settings" are called configuration variables, or "CV"s, and are simply relevant numbers entered by the keypad while the locomotive is in a special "programming mode". You manual will explain which numbers to use.

They say I have to rewire my layout for DCC?

Well actually, you don't really. If the layout works well on DC, then it will very probably work well on DCC too. There is a simple test for layout wiring that will remove all doubt and let you get going with a minimum of fuss. Its quick and easy and is called the "Coin test".

Simply disconnect all DC controllers and any other DC related stuff such as electronic track cleaners. Remove all locomotives and connect your DCC system. Turn on all sections and do the following. Place the DCC control box where you can see the overload or short circuit protection light. Now take a coin and walk around the layout, momentarily short circuiting the track every metre / yard or so.

As you do so, watch the overload light… if it always goes off immediately, then the wiring is probably good enough. If it's a bit slow going off or hesitates, then mark that point and after you have finished the test, add another pair of power feed wires to that piece of track. That's it! Now you can start operating with DCC... easy wasn't it.

OK, but I (choose any) "Model in N/O/TT/HO": "I have older locomotives I do want to keep": "I can't afford to convert all my locomotives".

Size isn't an issue - We regularly fit decoders in tiny HO /OO locos and fit them to the smallest of N scale locos too. No problem:

Age isn't an issue - In fact every loco can be converted, Wiring is standardised and anyway… if you want help we can provide it.

If you don't feel comfortable doing it yourself, then we or others in the marketplace can do it for you at a very reasonable cost!

Take your time: Start by adding decoders to a few locos even before you buy the dcc system perhaps. .

You see, a loco with a decoder will work perfectly well on normal DC control too - so you can get a few done early and be ready to operate as soon as you get the DCC control system (In fact, lighting often works better even on DC once a decoder is installed, and loco's often run better then too!).

The image is from our ZEN decoder manual. We included it because it shows all of the standardised DCC colour codes.

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Continued…

I don't want to complicate my life with lots of new digital stuff - or computers on the railway - I just want to run trains!

Good, so do we; and we love DCC!

DCC can be as complex or simple as you want it to be, and you'll still get all the advantages that DCC offers: For example buy any DCC system & simply replace your existing controller - that means disconnecting two wires, and connecting them to the new controller. What can be simpler?

The difference is, you DO have choice. With DC you must break the layout into many electrical sections with appropriate switching, you must have one controller per loco running and you have no choice but to run a large quantity of wire for even a small layout.

With DCC, your layout can be a simple common electrical circuit if you want - or for the wiring enthusiast, the sky is the limit!

They say I only need two wires with DCC. Is that true?

Well... "Yes and No".

At its simplest, you only have one common track circuit (called the power bus) and no section breaks are needed. However as your layout grows, you do at least need to add "droppers" at regular intervals from the rails to the power "bus" wires. That means one common circuit with several points of electrical contact to the rails. Dead easy, but not quite "only two wires". (For a quick look at the right sort of stuff for DCC wiring—look here please)

What's this nonsense about needing heavy wire - why should I use huge cables when even light wire was OK on my DC layout!

Well... actually no, it wasn't. You see it has nothing to do with voltage or current capacity - it's all about voltage drop. (For now we will totally ignore real-world issues like inductance, capacitance and the rest that also affect any wiring that's transmitting asymmetric wave-forms… and can cause serious voltage drop if you do it wrong)

If you take a long length of light wire, connect it to 12v and measure volts at the other end it will always read 12 volts.

However, connect a load such as a car tail-light bulb & measure again - now its only 9 volts... So what changed? The answer is the "load" of the bulb. Add another and it will drop even more…

No big deal when we are working at mains voltage… 3 volts will not be missed—but we are NOT. Voltage drop will be the same no matter what the start voltage is, so if we lose 3 on 240v then we have an OK 237 volts to play with… but if we start with 12… then we have lost 25% of the total. Things will NOT work well then, will they!

It's the same with DCC: However, whilst we can only run one loco at a time with DC, because we can run many locos on DCC we can also make a much heavier load on the wiring.

To make sure we don't have voltage drop, we use heavier wire. That's it in a nutshell: Simple, isn't it.

That's it: A quick run through correcting the usual "DCC Doubters". Lexicon. What is all the fuss about?