



Guide to DCC

(Digital Command & Control)

January 2016



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Digital Command & Control (DCC) has progressed a great deal over recent years and can now provide a myriad of actions which can be made to precisely replicate those of the prototypical railway. The first thing to understand is not to be afraid of DCC, a) it will not break your railway or your motive power & b) it is not desperately complicated but is a fun addition to your railway. Whenever in doubt talk to your experts at Garden Railway Specialists.



The Pleasure of a Garden Railway - An LGB Mallet with 9 On

Basically DCC can be seen as affecting two different areas of control, that which manages your motive power units and associated rolling stock; and that which handles the operation of your permanent way, plus the related infrastructure. The control of your motive power can be simply moving the locomotive backwards and forwards, but I can do that with analogue control I hear you “shout” - yes of course you can however DCC gives the added dimension of prototypical control of the acceleration, and deceleration it also allows speed curves to be added to simulate load conditions, this is

particularly appropriate for steam locomotives. Further the most significant advantage is that additional locomotives can be controlled simultaneously, each in a different manner. Thus one locomotive could be slowing to a stop at a station while another could be continuing on the mainline and yet another shunting in the yard. All carried out using one controller and no separate wiring for the area where each locomotive is working.

Of course DCC and motive power is not just limited to movement but other functions can



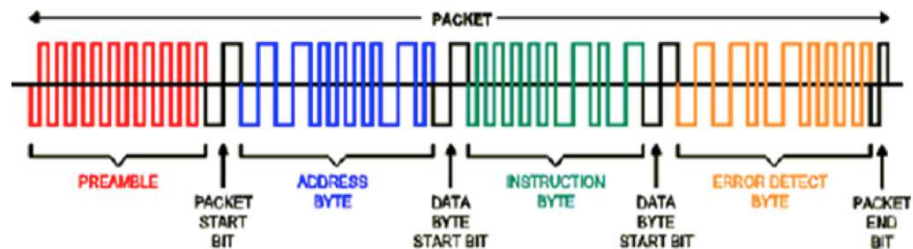
be added, controlled and modified. Typically sound, smoke, lighting and auto-coupling can be added and the functions controlled from the same controller which drives your locomotive. Lighting can also be added to your rolling stock, whether it be coaching stock or freight waggons. Adding lights to your coaches which can be switched from your controller is a delight, as are tail lights on the rear of the brake waggons or a caboose.

Sound is, of course probably the most significant addition to your motive power, whether this is diesel, steam or electric, a realistic sound coming from your locomotive, synchronised with the movement and actions of the motive power unit provides a very special impact to your railway, especially when you have a number of different sound equipped locomotives giving differing sounds and effects for similar actions of the motive power. Haunting whistles, the fireman shovelling, motion clank, diesel engines revving, brake squeal etc., to name but a few of the diverse sounds that can be applied.

If you now add smoke to your sound equipped locomotive, diesel or steam, synchronised with the sound of the engine or the chuffs, you then have realism in the extreme for your railway. A lit train, locomotive and rolling stock; with sound and smoke, in the early evening on your railway can be a magical thing.

Of course DCC can add realism to your permanent way with the control of points, signals and stopping trains appropriately at signals; switching lighting in station buildings etc., plus the addition of reversing, train detection and automatic braking modules, all of which will add that extra bit of realism to your railway and allow you to control it exactly how you wish it to be, using one simple system. Enjoy!

So how does this all happen? Despite the hype and myths the system is really quite straight forward and once fitted will provide numerous variations of effects which are fundamentally only limited by the users' imagination.



DCC Package of Information

The basics for any DCC system include a device which “talks” to the railway - the Central Station - and an additional device which controls the Central Station - The Navigator. All of the devices on your railway whether it is a locomotive, points, signals etc., can be fitted with a decoder, the decoder converses with the Central Station and is unique for each device, hence the Central Station is able to identify each device on your railway and thus control it. In simplest terms The Central Station sends a packet of digital information which addresses a specific locomotive or device, the decoders on the system are listening all of the time and wait to be addressed with the specific address, they have. The addressed loco/device, and only that one, reacts to the information sent. This command, maybe a movement, a sound or lighting control but will all be controlled by the decoder in response to a specific addressed command. Whilst points and other accessories can be fitted with decoders the most common decoder fit is to locomotives and as this is normally the most complex consequently this will be reviewed here.



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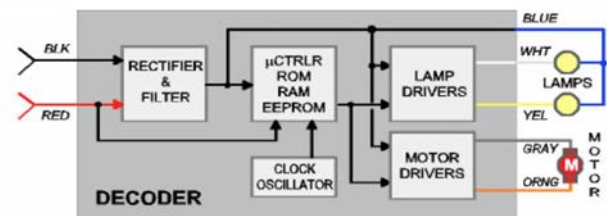
Central Station



Navigator

A locomotive decoder is a micro-processor device which controls voltage outputs to the locomotive motor and to other locomotive accessories, typically smoke units, lights, and auto-couplers.

In addition some decoders also provide sound outputs synchronised with the movement of the locomotive as well as providing added sound effects, such as whistle, horn, bell, coal shovelling, brake squeal etc. The locomotive decoder is a fairly sophisticated device which can have sound downloads which are specific for each locomotive type, whether this is diesel, electric or steam.



The Innards of a Typical Decoder - Fitted in this Case to a Locomotive

How the functions of the decoder work and where they output the voltages to, is defined by downloading Control Variables (CV's) - these are the instructions used by the decoder to formulate how it will carry out the commands of the Central Station. CV's are specific to individual types of locomotives and need to be set to match the requirements of that locomotive. Consequently voltage levels for lighting will need to be set correctly; normally non-LED lighting can be 5volt, 12volt, 18volts or 24volts; clearly setting lighting voltage CV's for 5volt lamps with 24volts is not going to do a lot of good! Likewise with LED lighting, output volts normally need to be approximately 4-5volts with a limiting resistor in series with the LED input. Also note with LEDs polarity is important, incorrect polarity will give no lighting output! Smoke device voltages will also need to have the correct voltages set to match the type of smoke device fitted to the locomotive.



Massoth XLS Sound Decoder

An additional output use is that for powering auto-couplers which can be fitted both at the front and rear of your motive power, these devices gives the opportunity to uncouple and couple rolling stock automatically using the Navigator.



Massoth Auto-Coupler

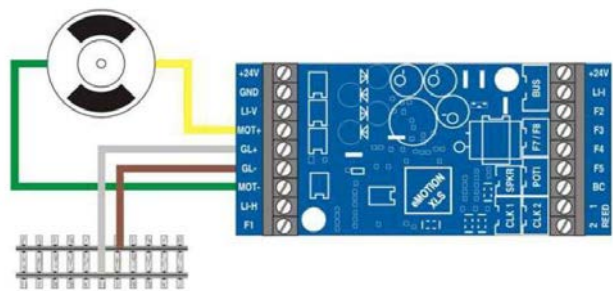
The locomotive address also needs to be set to match your own needs but make sure that two locomotives do not have the same address else you will be trying to run both locomotives simultaneously. A further CV requirement specific to sound for steam motive power is the need to programme the “chuff” rate correctly so that it matches the motion and cylinder outputs, prototypically a 2 cylinder Walschaerts motion locomotive would expect to have 4 “chuffs” per driving wheel revolution.

The CV's are downloaded from decoder manufacturer's online sites and would be loaded to the decoder via a PC module. It is best practice if this is done prior to the decoder being fitted in the locomotive.



PC Module

The sound files, are likewise download from the decoder manufacturer's website and are specific to each locomotive type, while there are a few generic sound files, these are never as good as the correct files for each locomotive. Modern sound files are very effective and give good realistic sounds across the spectrum of possible sound effects and can be modified almost to an infinite degree, dependant of course upon the decoder manufacturer.



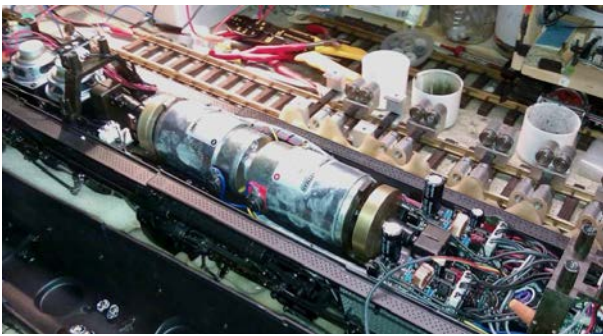
Massoth XLS Decoder installed between the Motor and the Track

The decoder needs to be installed inside the locomotive and positioned electrically so that it is in between the track voltage and the locomotive motor. In a tender locomotive this can be in the tender or inside the boiler/firebox - the position will very much depend upon the original wiring of the locomotive and how straight



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forward it is to modify that wiring. The decoder must be capable of dealing with the current drawn by the motor fitted to your motive power. Large locomotives can draw up to 6 - 8 amps stall current, typically the USA Trains Big Boy which has 2 large Pitman Motors can draw instantaneous current of up to 10amps. It is thus important to choose the correct decoder; 8amp decoders with high current surge protection are available from Massoth.



The Motors for a USA Trains Big Boy

Note it is unadvisable to fit two individual decoders of the same type to one locomotive, as a means of overcoming high current, particularly where there are two motor blocks. It is not possible to programme decoders to behave in exactly the same way and you will end up with one decoder running slightly faster or slower than the other with resultant probable damage being caused to the motor block or gearing.



Massoth XXL 8amp Decoder

This advice specifically refers to “driving” decoders - those which directly control motor speed. There are occasions when a “driving” decoder plus a separate sound decoder will be fitted and while both decoders need to be addressed with the same address only one is actually providing power control to the motors. This is a typical fit where a high current decoder needs to be fitted and as these would normally not be sound equipped an additional sound decoder would also need to be fitted, typically a Phoenix sound system.

There are a number of decoders for large scale railways both sound and none sound equipped from Massoth, Phoenix and Zimo etc. All provide good results although it will be found that differing sound decoder manufacturers have different libraries of sound files so it is a case of identifying the best sound for your locomotive and of course this is down to individual taste and can be very subjective.



Phoenix Sound Card Fit - In the Tender of Aristo C19

As already mentioned decoders can be used for a number of other tasks, typically for providing control of points and crossings, turntables, signals and lighting in your buildings around the railway. All of these functions can be programmed and operated using the same control systems that also drive your locomotives and provide sound etc. (See the GRS Guide to Custom Point Work) [add hyperlink here](#)

With point control, if you have a large number of points it is also possible to set the points in



sequence to provide automatically controlled route setting, over a number of divergent paths, in addition this could be achieved for a number of different locomotives simultaneously - sit back and watch the trains go by!

With the addition of magnets in between the 4 foot it is also possible to programme sound decoders with differing sound effects, to occur at the points on your railway where the magnets are positioned, horn, bells etc. using reed switches on the locomotive.

If you have any questions or problems with DCC or anything else concerning your motive power, rolling stock or permanent way do talk to the experts at Garden Railway Specialists. We provide basic and advance courses on DCC; can carry out decoder installation on your locomotives, programming them to your requirements, as well as offering repair facilities for both analogue and DCC motive power systems, just give us a call, we are happy to help.



Aristo EMD E8 on Final Test with Smoke Working Well

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