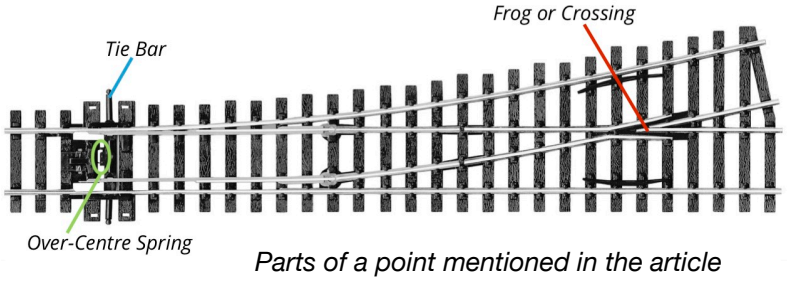
Point Motors

Layouts come in all shapes and sizes but there is one thing that you will always have, points (or switches as they are know in the USA). And if you have points you will need to operate them. This brief overview looks at some of the options.



Parts of a point mentioned in the article

Manual Operation

You can, of course operate the points by hand and many very impressive layouts have done just this. Typically this is done by attaching piece of wood or wire to the tie bar (the part of the point attached to the moving blades) and running that in a tube or channel to the front (the most common arrangement) or back of the layout as appropriate. You will obviously need to be able to move up and down the layout operating points as required. It is probably most appropriate on smaller layouts. We cover switching the polarity of the point frog* elsewhere but, excluding some other external solution, many people will attach a slide switch inline with the wire or rod that is used for frog switching. The position of the rods give a visual indication to the operator of the state of the point and anyway, this type of implementation would generally sit on a layout with little electrical complexity.

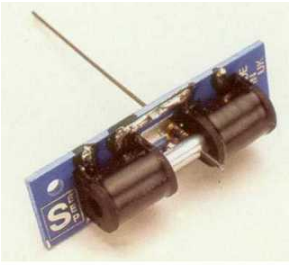
* Frog being the almost universally common term on UK model railways but that part of a point is more correctly known as a Crossing on the prototype.

Solenoid Point Motors

Outside of those limited number of layouts where hand operation is practical you will need to look at point motors. The traditional point motor is a solenoid. This is essentially two electromagnets with a centre operating bar. Providing power to one end energies that magnet and pulls the centre bar in that direction. The centre operating wire passes through the point tie bar and thus the point moves in that direction. Providing power to the other end reverses the point.

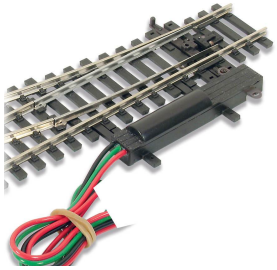
Peco PL10

There are a range of types available, some are illustrated here. The traditional motor is similar to the Peco PL10, although the Gaugemaster SEEP PM-1 has also been around many years and perhaps provides a neater, smaller solution.



SEEP PM-1

Also available for a number of years are side motors mounted on the baseboard top alongside the point. These are neat, easy to fit and pre-wired. However they are very hard to disguise effectively on a scenic board. However they can be very useful in a fiddle yard where they are likely to be accessible.



Peco PL11

In late 2019 Peco intruded the Twistlock motor (PL1000). This is a solenoid motor packaged in a new way to, it is claimed, make it easy to fit, remove and re-install exactly in the right position, often a problem with older type of solenoid motor.

Peco PL1000

Most types have optional add-on switches for switching the frog, providing feedback signals and so on, the SEEP motor has a single built in switch that can become unreliable if used intensively. The

side mounted motor however does not easily lend itself to frog switching with some solution independent of the point motor itself.

Main suppliers of these types of motor in the UK are Peco and Gaugemaster, although Hornby do some as well. These vary in cost from about £6 for a SEEP motor to £12 for a Peco Twistlock. In addition a CDU, as covered below, will almost certainly be required.

There is one very important fact about the electrical characteristics of solenoid point motors. Whilst being operated they can take up to 2A, whether you know anything about electronics or not, let me assure you that in model railway terms this is a lot. If a point solenoid is left powered, even for a few minutes, it will burn out and you will be lucky if this is the limit of the damage.

For this reason it is essential that these are wired with momentary contact switches, these may be non-locking push buttons or toggle switches while Peco and Hornby both make passing contact switches which are appropriate.

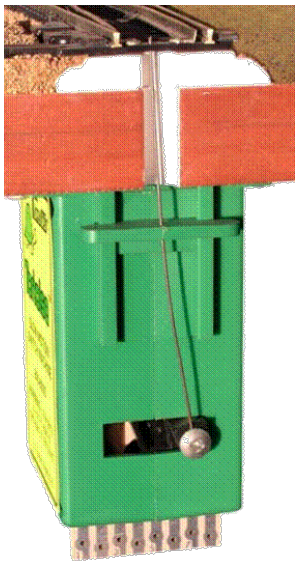
Despite the presence of large currents solenoid motors can still struggle to operate the point. Without going into detail they need to get moving quickly, on first application of power. For this reason almost everyone will recommend the addition of a Capacitor Discharge Unit (CDU). This puts a capacitor across the output such that when the point is operated it adds a short burst of extra power to the solenoid. In most cases this is a must have addition.

Part of the reason that such force is needed is that commercial points have an “over-centre” spring to keep the point blades one side or the other. Overcoming this spring is the issue. As you cannot supply continuous power to the solenoid the spring needs to be retained to keep the point blades in position.

This is one reason why solenoids are very rarely used on hand built track, it doesn’t have the spring, the other is that when they operate, solenoids switch very quickly with a decided bang. You do not want to subject the relatively more delicate nature of hand built track to these forces.

Slow Action Point Motors

Partly to provide more realistic point movement, real points do not, after all, switch instantaneously with a bang but somewhat more slowly, and also to accommodate more delicate track, slow action point motors were developed.

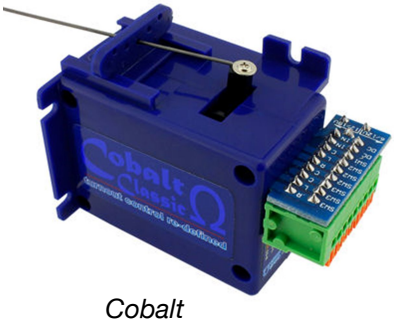


Tortoise

The two most popular slow action motors in the UK are the “Tortoise” from Circuitron and the “Cobalt” from DCCconcepts. Both are “stall” motors. These motors move the point via an operating wire and when it cannot move anymore the motor stops but the current keeps flowing which holds the point in position.

Normally providing continuous current to a motor that is unable to turn is a recipe for disaster, similar to the solenoid above, however stall motors are designed to use a low current, in this case 15-20mA, that doesn’t harm the motor if it cannot move.

Because of this the centre spring of the points are often, sometimes necessarily, removed. The gentle motion gives both a more realistic effect and is easy on hand built track. Both of these motors have 2 SPDT switches built in to control frog switching, control panel feedback or similar.

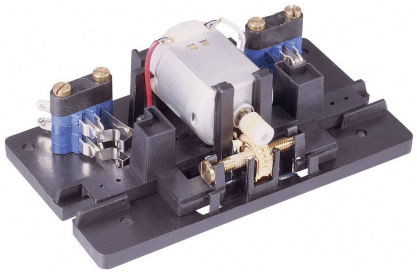


Cobalt

One drawback of these types of motors is the size. The Tortoise is around 83mm deep and the Cobalt 67mm, plus the depth of wires in the connector. This is large for some layouts. In addition

they cover a reasonable surface area, 50mm x 50mm for the Tortoise and 67mm x 48mm for the Cobalt. Also given they need to be aligned such that the throw is across the point tie-bar there are only 2 positions they can sit in. With a number of points close together and under board bracing for the layout it can sometimes be difficult to fit them in.

An apparently similar motor comes from a company called Fulgurex. However, this works in a different way. It still is a DC motor, taking about 200mA, but when it reaches the end of its travel it operates a mechanical switch which disconnects the power supply. This has exactly the same effect as the stall motor types. Because all the switch contacts are accessible, even those controlling the motor, it is possible to do things that are not easily possible with Tortoise and Cobalts such as make points work in sequence, one after the other, from a single switch.



Fulgurex

The main base is still quite wide, 85mm x 50mm, but they are a different shape to the Tortoise and the Cobalt, particularly in height which is 30mm which may make it more applicable in some situations. Having exposed wiring and contacts is a plus in some areas but they can be more susceptible to dust.

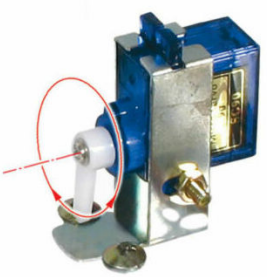
All of these point motors can be bought for around £17 to £19 and work by reversing the power to the motor, so a DPDT switch is required. It should be noted that, again because access to the wiring is available, the Fulgurex can also be operated from a split power supply with both +V and -V voltages around a common 0V which allows the use of a SPDT switch.

Servo Point Motors

Using servos to control points (and signals and other moving parts on a layout) has been common among hobbyists for a number of years but until Peco introduced the Smartswitch in 2014 there were no commercial offerings in the UK.

Servos have some useful characteristics, the end points of the movement can be set at any angle within the capabilities of a particular servo, usually about 180° but some can go further. Note that this is not a motor in the conventional sense, with the exception of some very specialised servos they do not go round and round but travel back and forth between two endpoints.

Another key advantage of servos is that the speed is very controllable across a wide range from very slow to very quick. A Peco Smartswitch, as illustrated here, is approximately 45mm (tall) x 13mm (wide) x 30mm (deep), so somewhat less than slow action motors.



Peco Smartswitch

However, servos need some electronics to set up and control the servo once installed so the cost is somewhat more complicated than with other motors.

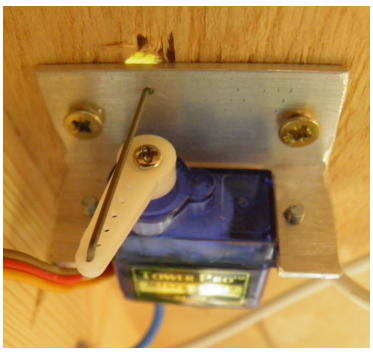
Peco Smart Switch £18.50
Controller for 4 points £35
Starter Kit for 4 point motors and the essential set up board £78

Tam Vally in the USA also do a servo based point motor, but in their case it is a complete offering for a single point, including motor, control board and switch. In the USA this retails at $29.95.

All in all there is little, if any cost benefit in a commercial servo solution compared to a slow action point motor, but it is smaller and, given access to the control software, far more flexible than other offerings.

It is, at this stage, also worth mentioning MERG. This is a group of like minded hobbyists who got together to form a ‘club’ promoting the use of electronics in railway modelling, you can find them at https://www.merg.org.uk if you are interested.

A typical servo can be bought for a few pounds but beware imitations of the good brands. MERG offer a control board, the Servo4, which, as its name suggests, controls 4 servos. Admittedly you have to assemble it yourself but instructions are good and its as straightforward a PCB soldering task as you will see. This board costs less than £5. Servo mounts are available in packs of 6 for less than £8. So, including the cost of the servo the cost per point can be around £5. In addition you may need something for frog switching or other signals, a MERG board for this, plus the easily available relays, will work out at about £1.50 per point.



Servo on a homemade mount

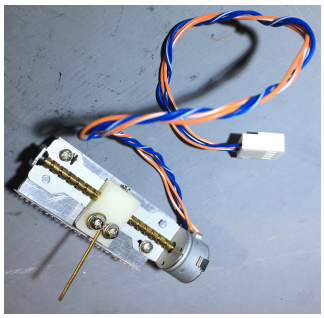
There are ready made control boards available and there are more complex boards ready for DCC or other computer interface from MERG and commercial suppliers.

A whole range of styles and types of servo mounts are available, including the use of a piece of aluminium angle that reduces that cost to a few pence. It is this flexibility, as well as the cost, that makes servos popular for point motors and also signals, gates, etc.

Stepper Motors

Just to show that all point motors have advantages and disadvantages hobbyists are always looking to build something better. This solution is certainly not in the commercial world, at present at least, but shows what can be done looking for alternative solutions.

A stepper motor is unlike a normal motor, it is controlled by software. A pulse to the motor turns it, typically 1.8°, so about 200 steps per revolution. By using the software to set an exact number of pulses it can be made to do an exact number of turns and so, in combination with a linear screw, an operating wire can be made to travel a very exact distance.



A stepper motor, although different, acts in a similar way to a stall motor. Once the operating arm reaches the physical end of its travel, in this case the switch is fully thrown, the mechanical part of the motor stops even if pulses are still sent by the software. This means at the end of any movement, barring any obstruction, the mechanism is exactly where the software is expecting it to be. In practice this means that the operating arm is self aligning, allowing the use of simple mounting under the baseboard such as Velcro.

The example illustrated here is built, including hardware and motor for about £7 per point. Obviously these types of solutions require home built hardware control boards and associated software but they do lend themselves very well to interfacing on layouts using computer based control and the simple mounting makes changing a point motor at an exhibition whilst on show very quick.

Summary

This brief overview just shows some of the options available, there are manufacturers and suppliers available other than those noted here, especially outside the UK. There are also other motorised solutions but this shows the main types and highlights the main pros and cons. The best advice is to find people, probably at your local model railway club, who have used the various solutions and who can show them to you in operation and share their experience.

Roger