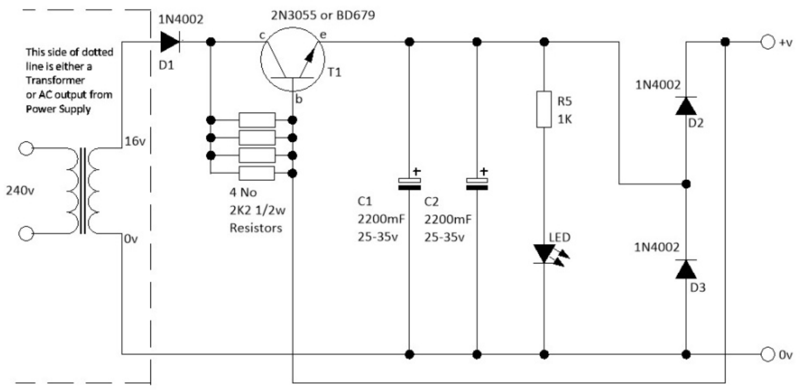
Capacitor Discharge Unit.

Most types of point motors are not in fact motors but are solenoids. When two solenoid coils are placed end to end a forward and reverse motion can be created. A solenoid requires a short sharp punch of current to switch them. These high currents can damage switches and indeed cause points motors to overheat and burn out. A Capacitor discharge unit gets over this problem by supplying this high current as a high energy pulse to the points motor solenoid which in turn operates the points. The purpose of capacitor discharge units is to store up electricity in a capacitor. The electrical charge is released, on throwing a switch, as a pulse of a much larger current. A Capacitor Discharge Unit is normally powered with AC, generally a voltage of around 16 Volts. Note that whether you power the CDU from AC or DC the output of the CDU will be DC. The CDU may be operated from any AC voltage up to 24 volts. Using a high voltage increases the power from a CDU. Operating from 24 volts instead of 12 volts gives 4 times the power.

Why do you need One:

All Model Rail layout have a power source, and this power source has a limited capacity. Not all layouts will require a CDU unit. The best way to judge it is, if your points have problems switching over, then you probable need a CDU. The larger the system the more drain on the power source, also the further away the points are from the power source then the voltage drop is greater. The point motor requires a precise voltage and current to energise it. The CDU achieves both these. As this pulse is short it avoids the problem of motor burn-out, the current burst is over by the time the switch contacts open, thus eliminating the back EMF which can weld the switch contacts together. After the pulse has fired the CDU will not allow recharging of the capacitors until the switch reopens or is released. Then the cycle can start again with the capacitors recharging.

The Circuit:



How it works:

The AC voltage (16v) at the input of the CDU is rectified by D_1. This diode passes every positive half-cycle of the AC and blocks the negative half-cycle. Assuming no solenoid is connected to the CDU, R_1 pulls the base of the Darlington transistor high, switching it ON and allowing current to flow through it (from C to E), to charge the 1000u capacitors. These are the reservoir capacitors that will supply the surge of current to the solenoid. D_2 and D_3 are protection diodes that prevent any back EMF from damaging the transistor or capacitors.

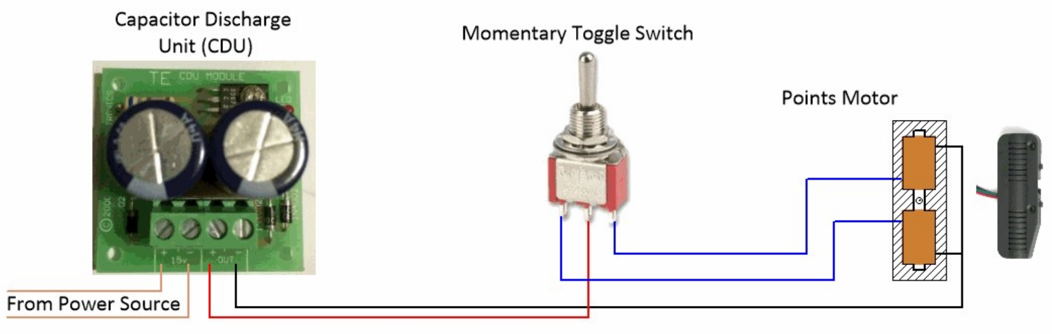
This is what happens when a solenoid is connected across the output of the CDU: The reservoir capacitors will discharge through D_3 into the solenoid. The low impedance of the solenoid (typically 3 ohms) is now holding the base of the transistor LOW, switching it OFF. The only current now flowing is going through R_1 and the solenoid. This current is less than 50mA. The transistor remains OFF preventing the charge-current reaching the solenoid. Removing the solenoid from the output of the CDU will allow the base of the transistor to be pulled HIGH by R_1. The transistor will turn on and charge the reservoir capacitors again, ready for the next operation. Recharge time is less than half a second.

Wire Size:

The CDU delivers a short sharp jolt of power to the Motor, and therefore requires the appropriate wire size. The smaller diameter wire suffers from 2 problems, voltage drop due to its diameter and or distance from the CDU to the points, and this could affect the performance of the Point Motor. You should wire from the CDU to the points in either 16/0.2 or 24/0.2 size wire. If you are changing two points at the same time you will be drawing approximately 3 Amps at that point in time, the standard 7/0.2 or 1/0.6 wire will not cope with that so you need a larger wire size. The short piece of wire the motor may come with should have no effect on the overall performance, but keep it as short as possible when using capacitor discharge units.

Basic Wiring:

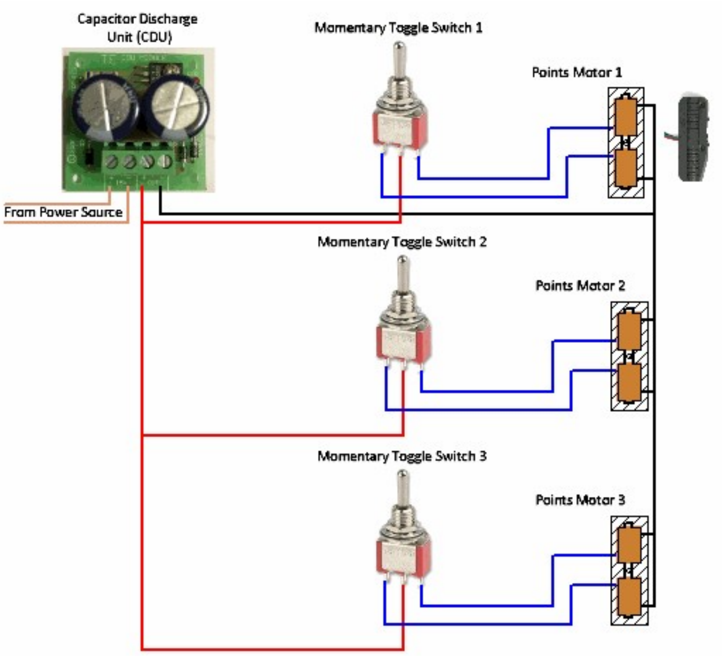
The CDU inputs can be connected to any AC power supply up to 16volts. The most common connection point would probably be the 16V AC auxiliary output usually found on model railway speed controllers. With DC supplies, be sure to connect them with the correct polarity to the CDU. The minimum supply voltage is 12V AC or 15V DC, as below this level the CDU will no longer improve the action of the points. The output terminals are connected to the points switches, with the CDU negative output generally connected to the common, centre point, of the points motors.



The current from the CDU will make the point motor move up or down depending on which coil is energised. Some point motors have four terminals (wires), because each coil has 2 wires. Some point motors such as Seep & Hornby have three because the manufacturer has connected together one end of each coil to give a common return connection.

Multiple Motors:

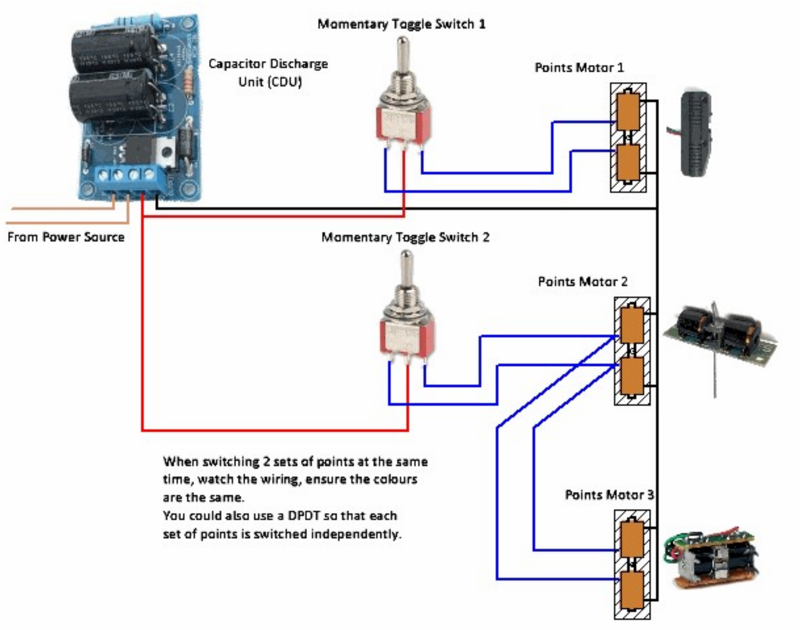
The following picture shows the connection of multiple Point sets. The wiring is basically the same for one as it is for many, just follow the Red and Black wires on the drawing. As you will see the black wire is the common 0v and it runs between all the points and then back to the CDU. This is a good case for a 0v (Negative) Bus Bar, which will be either 24/0.2 or 32/0.2 wire, saves running a separate Negative wire to each set of points. See our Bus Bar section. You cannot run the positive (Red) on a Bus Bar as each set of points requires 2 separate wires.



Multiple & Crossover Points:

The following image shows a single switch used to activate 2 sets of points, this would be in a crossover situation, of in the Fiddle Yard. In this situation you are changing two points at the same time you will be drawing approximately 3 Amps at that switch, the standard 7/0.2 or 1/0.6 wire will not cope with that so you need a larger wire size. The short piece of wire the

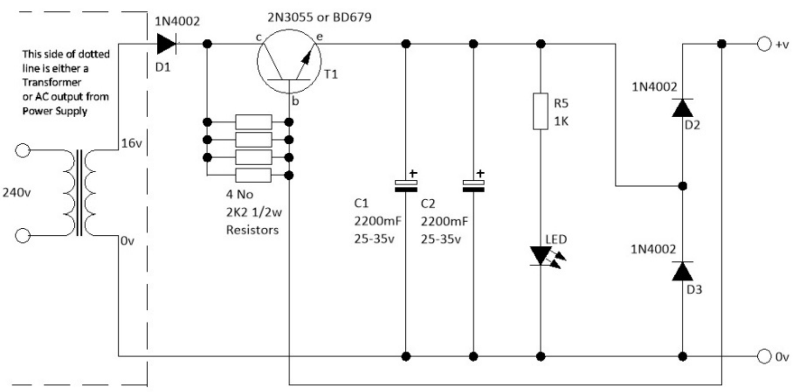
motor may come with should have no effect on the overall performance, but keep it as short as possible when using capacitor discharge units. As you will see the black wire is the common 0v and it run between all the points and then back to the CDU. This is a good case for a 0v (Negative) Bus Bar, which will be either 24/0.2 or 32/0.2 wire, saves running a separate Negative wire to each set of points. See our Bus Bar section. You cannot run the positive (Red) on a Bus Bar as each set of points requires 2 separate wires.
The image also shows a few alternative Point Motor types.



Now before you embark on the next stage it must be mentioned there are a number of manufacturers who supply CDU's

To Make Your Own:

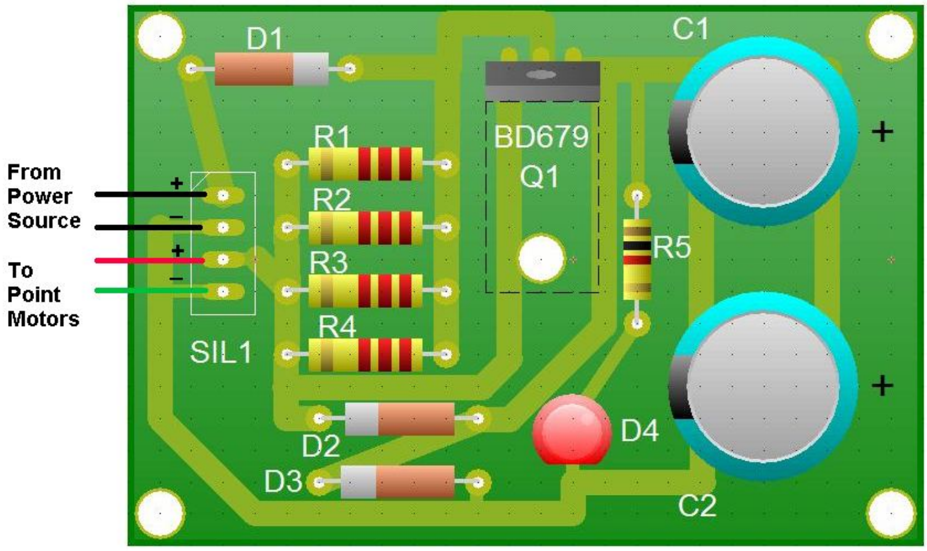
There are many circuits on the market, however they all achieve the same result.
The circuit shown here uses a DB679 Darlington Transistor and two Capacitors rated at 2200mF at 25v.



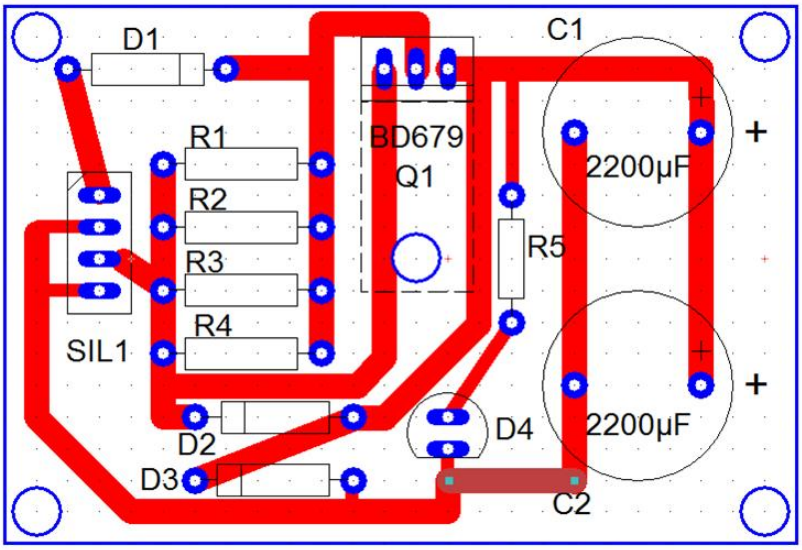
Parts List:

Part No	Description	Qty
D1 - D3	Diode 1N4002	3
LED	Red Led	1
T1	Transistor BD679	1
C1 - C2	Electrolytic Capacitor 2200mF 25v	2
R1 - R4	2k2 Resistor 1/2 watt	4
R5	1K Resistor 1/4 watt	1
PCB	Epoxy resin Board 55 x 38mm	1

Board Layout:

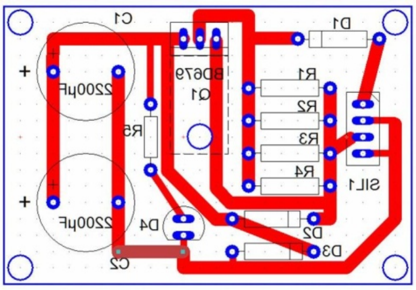


Copper Layout:



Actual Size:

This Image is of the copper track side and the actual size. The support holes are drilled at 3.5mm and the component fixing holes should be drilled at 0.8mm. The transistor has it's own fixing hole so that it can be bolted down to the PCB (optional) Make the track as wide as possible, obviously without touching each other.



Note: Large capacitors hold their charge for a long time when not in a circuit, so there is the possibility of getting a shock from them.

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