UNIVERSAL SMALL CURRENT REGULATOR FOR LEDs

Benefits Of This Circuit

1. Simple adjustment of LED current (R1)
2. Current (therefore LED brightness) is completely independent of number of LEDs connected.
3. Current (therefore LED brightness) is relatively independent of input voltage.
4. LEDs are protected against voltage reversal.
5. For the circuit to work accurately no component values are crucial.

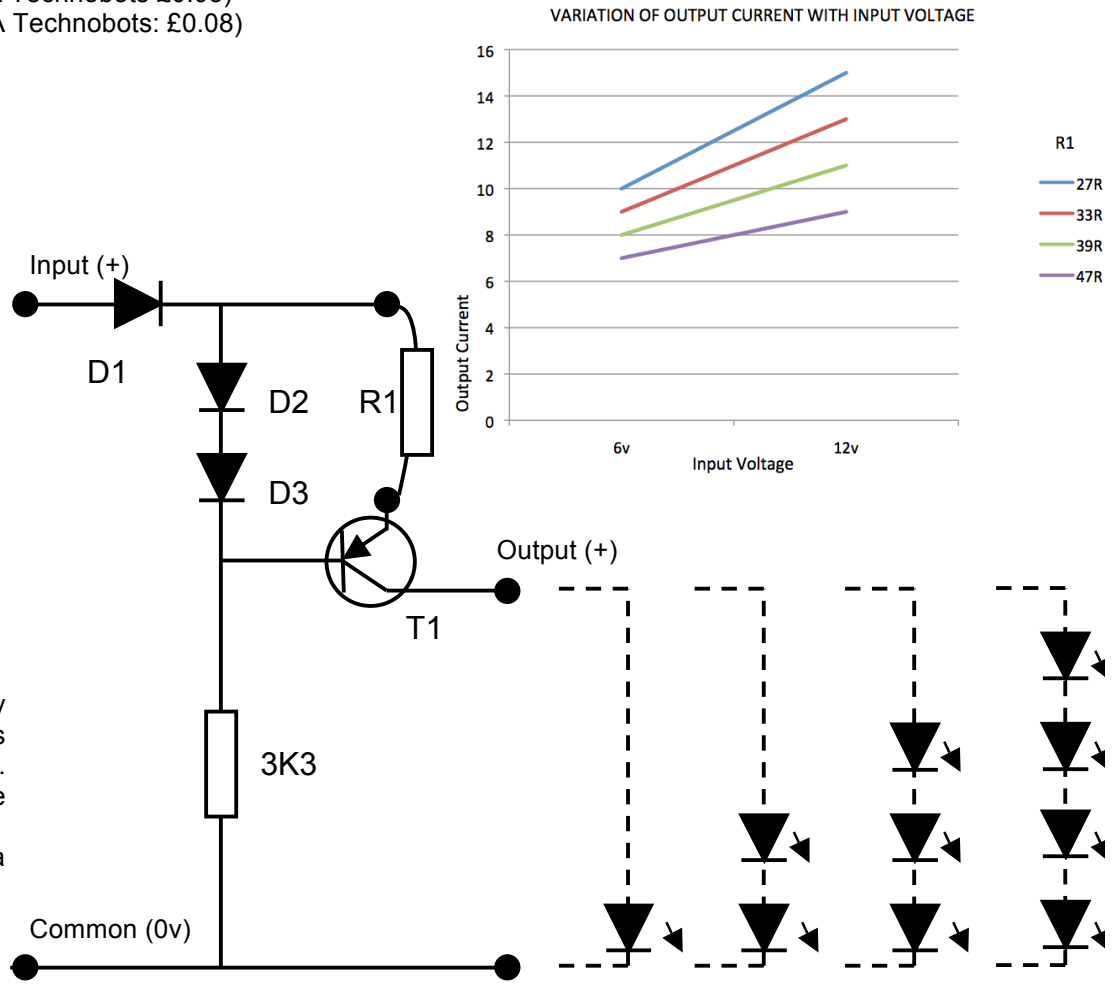
Other Notes

1. As D2 & D3 are not zener diodes and the transistor does not have infinite gain there is a slight variation in output current with input voltage.
2. The circuit needs approx 2½v more than the total of all LED forward voltages to operate.
3. Typically the circuit is used with input 8-16v. If much higher input voltages are used then a higher power output transistor may need to be chosen.

D1, D2, D3 =any cheap silicon diode. eg 1N4448 (150mA Technobots £0.03)
T1 =any cheap **low power** silicon PNP transistor eg 2N3906 (200mA Technobots: £0.08)
3K3 =any cheap resistor in range 2200 – 4700ohms (3300ohms shown)

How This Circuit Works

1. D1 prevents damage to transistor or LEDs and circuit if input is reversed.
2. In order to save cost D2 and D3 act as a 1.2v voltage source (a zener diode is more expensive). I bought 1000 for £2 some years ago.
3. The transistor BE junction requires 0.6v of that 1.2v leaving 0.6v across R1. The output current is therefore 0.6v/R1 (Ohms Law) which varies only slightly with input voltage because of the gain of the transistor (typically 200x). Doubling the input voltage only increases output by a couple of mA.
4. Moving Ohms law around we get: R1 = 0.6v/OutputCurrent.
5. For 6v and 12v input see the graph for typical output currents versus R1.



Types Of LEDs

LEDs are current operated devices and vary a lot. To aid choice of application of this circuit typical LED characteristics might be:

- Red LEDs Normal Brightness requires 10mA (drop1.7v)
- Red LEDs "Super Bright" requires 15mA (drop2.0v)
- Yellow or Green LED "Super Bright" 15mA (drop 2.2v)

Many Choices Of Connecting LEDs To Output

- Choose a value of R1 to suit the **type** of LEDs you are going to use. Any number of similar LEDs may be connected in series **without changing R1**. This is the most significant benefit of this circuit. Four series choices shown. Series/parallel combinations work well but if paralleling choose to double or triple the current accordingly.
- The circuit can cope with a wide range of input voltages eg paralleled from a motor supply circuit. The minimum needed for the desired output current will be:

  Min **Input** voltage = 2+ Max LEDs in chain X LED voltage drop
  For example = 2+ 2 x 1.7v = 5.4v
- Over a large range of motor speeds LED brightness should not vary.

Mass Production

I assemble ten circuits at a time on Veroboard with R1 not fitted until I need to.