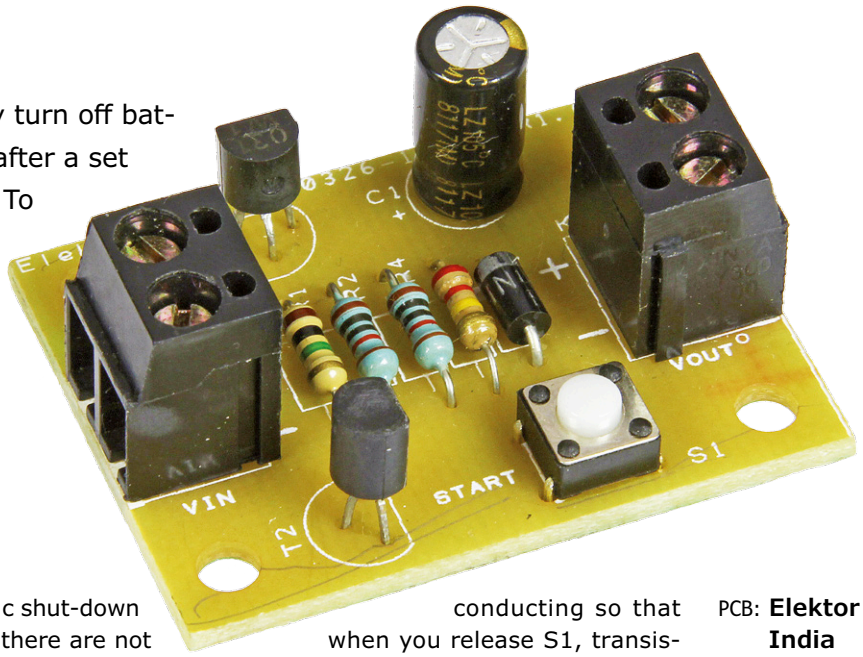
Auto Shutdown

With low quiescent current



Circuits that automatically turn off battery powered equipment after a set period are commonplace. To promote good battery life it's important to make sure that the current draw of such a circuit is as small as possible, especially in its off state!

You can see from the automatic shut-down circuit given in **Figure 1** that there are not too many components needed. Pushbutton S1 is the ON switch. When it's pressed current flows through the base of Darlington T1 and causes it to conduct so that the circuit or load connected at K1 is supplied with energy from V_{IN}. Transistor T2 also starts conducting so that when you release S1, transistor T1 still remains conducting.

Capacitor C1 is now slowly discharging via resistor R4 and when the voltage across R4 falls below 1.2 V, transistor T2 turns off and cuts off current flow to the base of T1 which stops conducting as well. Power to the load

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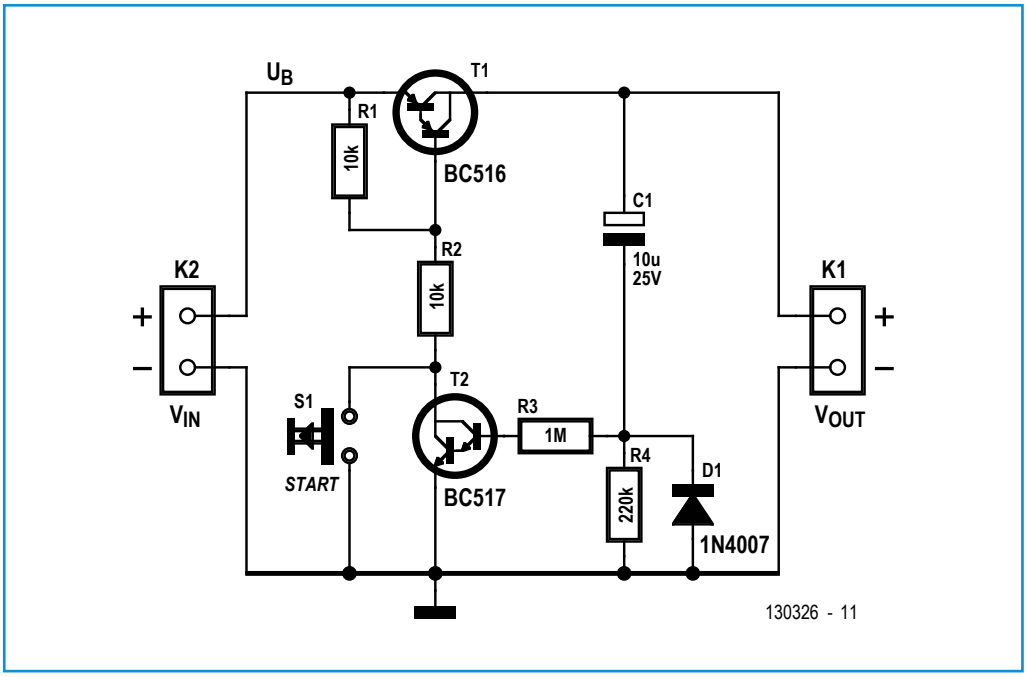
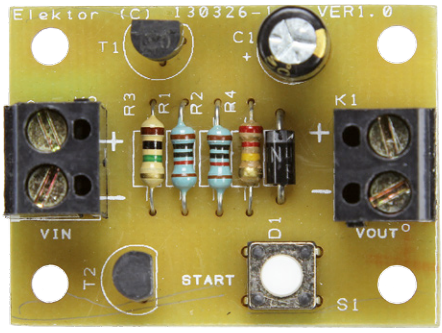


Figure 1.
The low component count gives a tiny quiescent current.

or circuit connected to K1 is turned off and the only energy drawn by the circuit now is the leakage through both transistors which is just a few nanoamps.
The time for the circuit to turn off is given by the RC network time constant. It is proportional to the value of capacitance. By changing the value of C1 (in Farads) you can set the time to shut down *T* (in seconds) by using:

$T = -22 \times 10^4 \times C1 \times \ln(1.2/V_b)$

As you can see, the input voltage level V_b also has an effect on the calculation. The capacitance of an electrolytic capacitor generally has a fairly wide tolerance, if you need a precise time period it may be necessary to try several capacitors before you find one that gives the most accurate period. The Darlington transistors may be replaced with discrete transistors if necessary.
To work through an example we chose an input voltage of 12 V and an ON-time of two minutes. According to the above formula this gives a capacitance value of 237 µF. The nearest real-life value is 220 µF, plugging this value back into the formula gives an ON-time of 112 s.

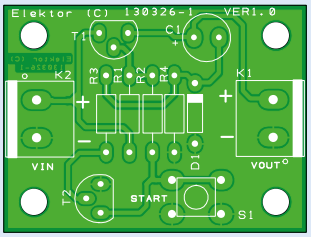


Component List

Resistors
R1,R2 = 10kΩ
R3 = 1MΩ
R4 = 220kΩ

Capacitors
C1 = 10µF (see text)

Semiconductors
T1 = BC516
T2 = BC517
D1 = 1N4007



Miscellaneous
K1,K2 = 2-way screw terminal block, 0.2” pitch
S1 = pushbutton, 1x On contact
PCB # 130326-1

Figure 2.
The neat PCB layout for the Auto Shutdown timer.

Figure 2 shows the small PCB for the complete circuit, with any luck there will be enough space for it to be fitted inside the casing of the switched equipment. When a much longer turn off delay is needed it is possible to fit the bigger capacitor on the underside of the PCB. The BC516 has a V_{CE} max of 30 V and a maximum collector current of 1 A.

(130326)