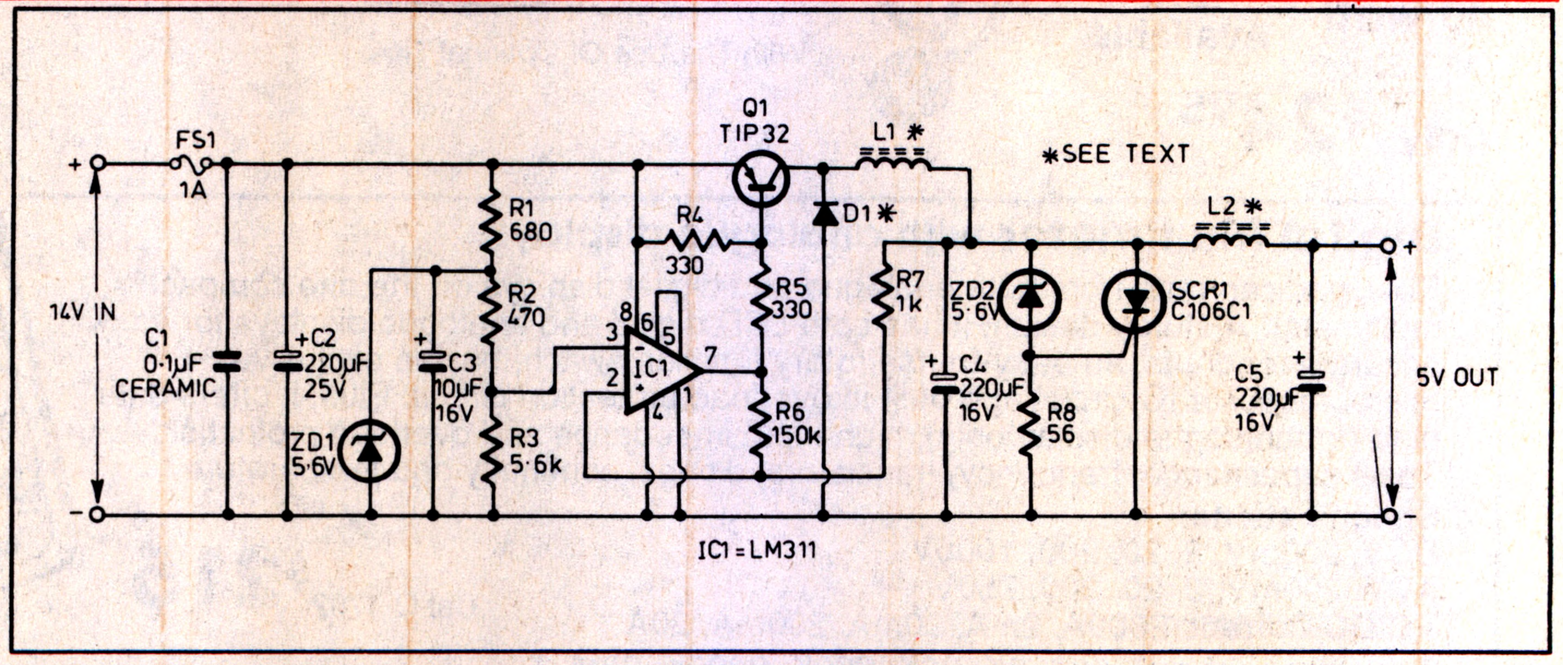
Efficient +5V regulator

When you need to run a board full of current-hungry 5V digital ICs from a relatively high supply voltage, using a traditional linear 5V IC regulator might well mean dissipating much more power in the regulator's heatsink than in the load itself. That's why I designed this simple switch-mode regulator circuit.

By using it to replace a 7805, I was able to reduce the regulator input current (at 14V) from 950mA to 480mA, with a regulator efficiency of just under 80%.



Comparator IC1 (LM311), via R7, compares the voltage across C4 with 5V derived from zener diode ZD1. Depending on whether it's below or above, it turns switching transistor Q1 on or off.

Resistor R6 provides a small amount of hysteresis to ensure operation at an appropriate frequency, about 17kHz in the original.

Diode D1 is a high speed 1A 40V Schottky barrier rectifier (Tandy Cat. No. 276-1165) which maintains the current flow in inductor L1 during the periods that Q1 is in the off state. A 1N4936 should also work, but at reduced efficiency. Inductor L2 and capacitor C5 form a low-pass filter to reduce the approximately 70mV p-p ripple across C4 to less than 10mV p-p at the output.

Under normal conditions zener diode ZD2, resistor R8 and silicon controlled rectifier SCR1 do nothing at all; but in the event of a fault which causes the output voltage to increase above 6.2V, SCR1 triggers and 'crowbars' the output, blowing the fuse and protecting the load.

Inductors L1 and L2 are wound on small iron powder toroids, Dick Smith Cat. No. R-5410. Since — apparently — these won't be stocked in future, Jaycar Cat. No. LF-1240 looks like a suitable alternative. L1 is 100 turns and L2 is 75 turns of 0.5mm enamelled copper wire.

This circuit can deliver at least 1A output, and should be adaptable for other input and output voltages, provided that transistor Q1's base current is kept at about 40mA and ZD1's power dissipation is about 50mW.

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