Get 5 V from One Exhausted Alkaline Cell

Juice it to the max

Every day we throw away tons of supposedly empty 1.5-volt alkaline (“dry”) cells. Triggered by the waste caused by my battery-powered equipment failing to work with partially discharged cells, I designed a circuit to step up the voltage of one exhausted cell to around 5 V for use in another application. Say, to make an LED light, keep a lightweight microcontroller buzzing, or power remote sensors that do not demand much energy… Until that battery, like The Parrot, is **dead**.

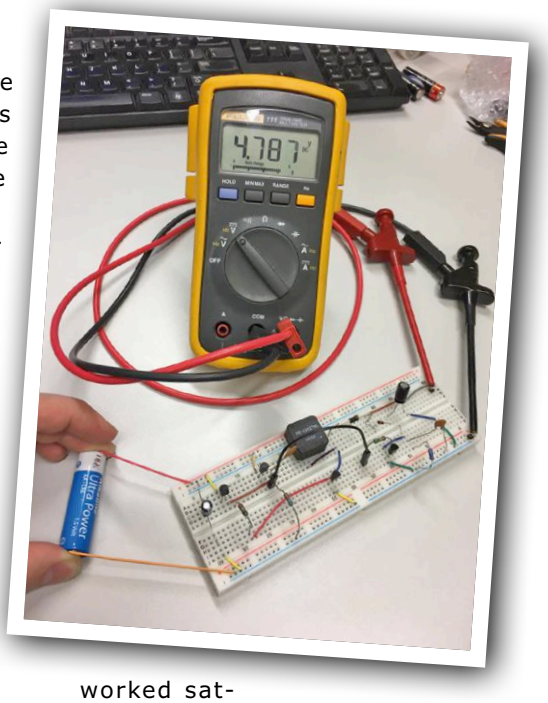
By **Juan Canton** (México)

This self-oscillating voltage step-up converter supplies an output voltage just under 5 volts from a battery voltage down to about 0.8 volts. At about 60% efficiency and just 5 mA of output current it’s is not a wonder of efficiency but that was not the intention. Really, the author was after juicing exhausted 1.5-V batteries to the maximum using components readily available to him at low or even no cost, as part of an experiment.

The critical factors in the circuit are inductor L1 and the transistors. On the latter, you might think the 2N3906 and 2N3904 are the TUP and TUN of the Americas and can be substituted by BC560 and BC550-ish devices at the drop of a hat. No cigar, at least that’s what Elektor Labs users reported. The stray capacitance and other device parameters will play tricks on you.

In essence you are looking at an oscillator T1-T2-L1-C1 controlled to some extent by T4 in terms of the output voltage appearing on K1. Coil (not: choke) L1 is the energy storage device, helped by C2 as a reservoir and smoothing device.

Of the “interesting” parts, the 1N4732A is a ‘voltage regulator diode’ specified by NXP for nominally 4.7 V, 53 mA I_{fwd}, and 10 µA I_{rev} at 1 V V_{rev}. L1 then is a true inductor, not a choke. Our labs trainee’s selection of the part worked satisfactorily with a promise of better results by using a slightly higher value. Do experiment and give it a try. The PE52627NL from Pulse Engineering (#1209550 at Farnell) is specified for 0.78 ohms max. DC resistance. It’s a low-profile and compact device.



The 1N5817 is a 1-amp Schottky (i.e. low-dropout) rectifier diode. Do not use a regular silicon 1N400x in this position as it will waste output voltage.

Interestingly, you can power the circuit with a higher voltage without exceeding the output voltage and the load coming to grief — the network that regulates the output voltage will stop the oscillation. All within limits of course.

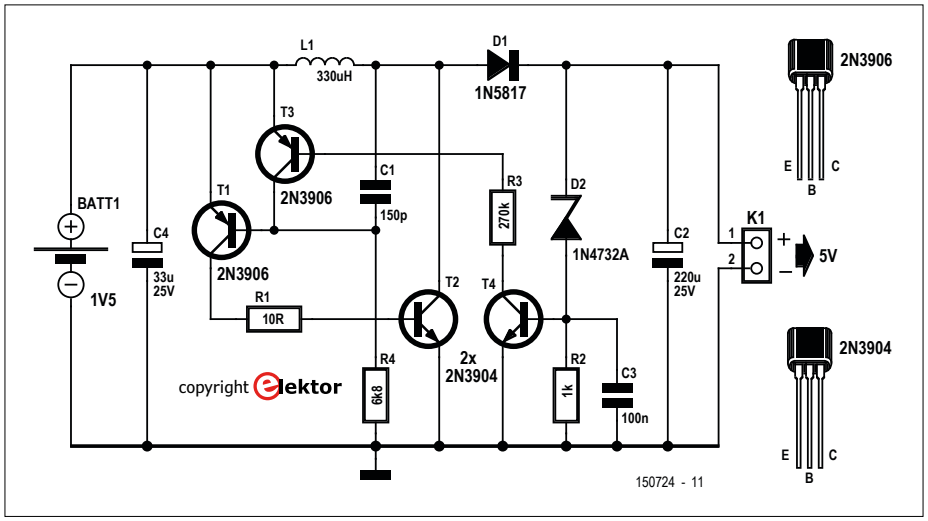


Figure 1. An experimental 5-V step-up converter for exhausted 1.5-volt batteries.

(150724)