

Power

LT1110 SUPPLIES 6 VOLTS AT 550mA FROM 2 AA NiCAD CELLS

by Steve Pietkiewicz

The LT1110 micropower DC-DC converter can provide 5V at 150mA when operating from two AA alkaline cells. The internal switch $V_{CE(SAT)}$ sets this power limit. Even with an external low drop switch, more power is not realistically possible. The internal impedance (typically 200m Ω fresh and 500m Ω at end-of-life) of alkaline AA cells limits peak obtainable battery power. Conversely, nickel-cadmium cells have a constant internal impedance (35m Ω –50m Ω) for AA size) that increases only when the cell is completely

discharged. This allows power to be drawn from the cell at a far greater rate. The circuit in Figure 8 uses two AA NiCad cells to supply 6 volts at 550mA. The circuit, developed for pagers with transmit capability, runs at full output current for 15 minutes with two Gates Millennium AA NiCad cells. With a 250mA load, the circuit runs for 36 minutes (see Figure 9). Less heat is generated with a reduced load, resulting in the watt-hour difference observable above.

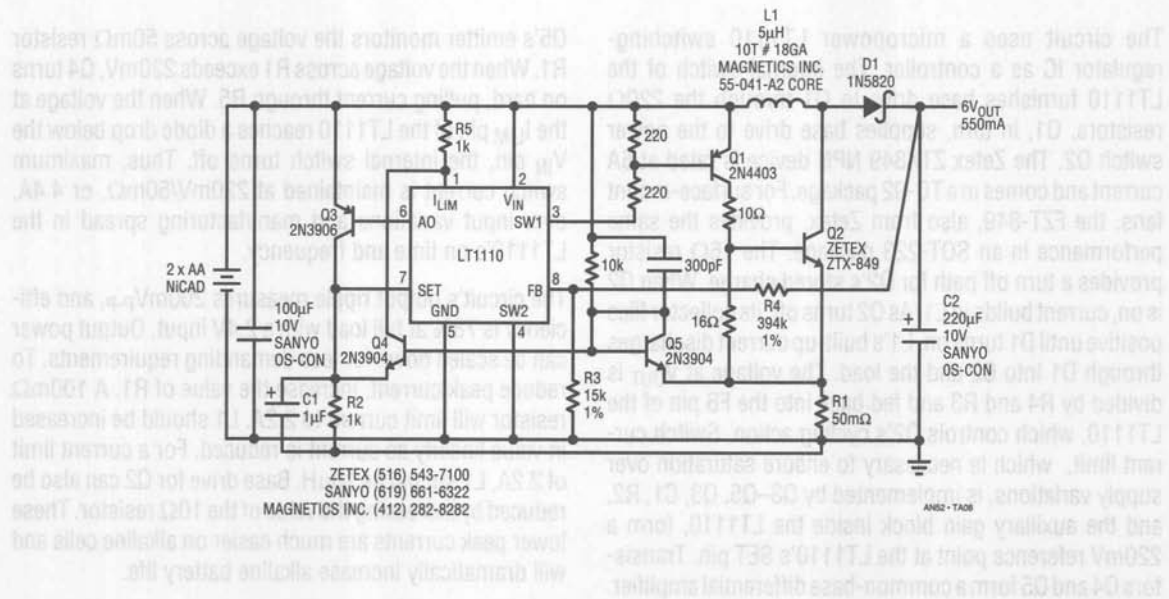


Figure 8. Schematic Diagram, 2 AA NiCad to +6 Volt Converter

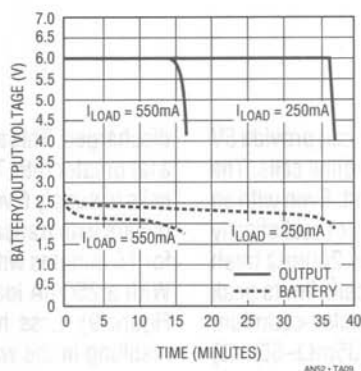


Figure 9. Operating Time at $I_{LOAD} = 550mA$ and $250mA$

The circuit uses a micropower LT1110 switching-regulator IC as a controller. The internal switch of the LT1110 furnishes base drive to Q1 through the 220 Ω resistors. Q1, in turn, supplies base drive to the power switch Q2. The Zetex ZTX849 NPN device is rated at 5A current and comes in a TO-92 package. For surface-mount fans, the FZT-849, also from Zetex, provides the same performance in an SOT-223 package. The 16 Ω resistor provides a turn off path for Q2's stored charge. When Q2 is on, current builds in L1. As Q2 turns off, its collector flies positive until D1 turns on. L1's built-up current discharges through D1 into C2 and the load. The voltage at V_{OUT} is divided by R4 and R3 and fed back into the FB pin of the LT1110, which controls Q2's cycling action. Switch current limit, which is necessary to ensure saturation over supply variations, is implemented by Q3-Q5. Q3, C1, R2, and the auxiliary gain block inside the LT1110, form a 220mV reference point at the LT1110's SET pin. Transistors Q4 and Q5 form a common-base differential amplifier.

Q5's emitter monitors the voltage across 50m Ω resistor R1. When the voltage across R1 exceeds 220mV, Q4 turns on hard, pulling current through R5. When the voltage at the I_{LIM} pin of the LT1110 reaches a diode drop below the V_{IN} pin, the internal switch turns off. Thus, maximum switch current is maintained at 220mV/50m Ω , or 4.4A, over input variations and manufacturing spread in the LT1110's on time and frequency.

The circuit's output ripple measures 200mV_{p-p}, and efficiency is 78% at full load with a 2.4V input. Output power can be scaled down for less demanding requirements. To reduce peak current, increase the value of R1. A 100m Ω resistor will limit current to 2.2A. L1 should be increased in value linearly as current is reduced. For a current limit of 2.2A, L1 should be 10 μ H. Base drive for Q2 can also be reduced by increasing the value of the 10 Ω resistor. These lower peak currents are much easier on alkaline cells and will dramatically increase alkaline battery life.