NiCad charger with peak voltage detection

This circuit will fully charge NiCad cells, then switch over automatically to trickle rate, by detecting the slight drop in cell voltage just beyond the full charge. It was developed to charge AA cells, but with slight changes, could be adapted to other cell sizes.

With a battery connected and power first applied, C2 is discharged, so pin 3 of IC1 is low. Pin 2 is high, which drives pin 1 low, so both Q1 and Q2 will be off. This allows Reg.1 to deliver the main 200mA charge to the battery through D5, while R5 supplies 3mA via D4, the main charge indicator. Close S3 for a 500mA main charge current. To alter the main charge current, change R6, R7 or R8.

R14 keeps Q3 turned on, which prevents Reg.2 from operating by grounding its adjust terminal. As the battery voltage rises, C2 charges through R2, and the voltage across C2 follows the increasing battery voltage. For the values of R2 and C2 shown, the capacitor voltage will be about 50mV below the battery voltage.

At full charge, when the battery voltage stops rising, the capacitor voltage catches up to it, and when the voltage on pin 3 is within 2mV of that on pin 2, the output is driven high and latched by D3, which keeps pin 3 high. Q1 now turns on, disabling Reg.1.

This causes Q2 to saturate, which turns off Q3, removing the clamp from the adjust terminal of Reg.2. The circuit now delivers a trickle charge of 21mA to the battery, set by R12. R10 supplies 3mA of this current, via the trickle charge indicator LED D6.

D8 ensures Q3 is off while Q2 is on by keeping the emitter voltage of Q3 higher than its base voltage. Up to about 18 cells can be charged in series, governed by the 32V maximum rating of IC1 (an LM358), and allowing for a 3V voltage drop across the charging circuit.

The 200mA main charge rate is a compromise between the C/3 rates of the 500mAh and 800mAh range of AA cells. The 21mA trickle rate also suits this range, as it should be between 0.02 and 0.05 of the cell capacity. The trickle charge counters self-discharge, and may be left on indefinitely.

Partially discharged cells can also be charged, with the assurance that the main charge will terminate at the right point. (At least one manufacturer claims his cells have very little memory effect.) Should the circuit switch over to trickle rate too soon, try increasing the main charge rate. Also increase either R2 or C2, as this time constant is for a minimum rate of C/3.

If the early changeover keeps occurring, one cell may be peaking before the others, due to lower capacity, so a fixed time charge may be the only solution. The main charge can be restored by pressing S1 and S2 at the same time, which are normally-closed and normally-open pushbuttons respectively.

This will remove the latch from IC1, and most of the charge from C2. D1 and the fuse provide reverse-polarity protection, and D2 is a power-on indicator. The LEDs are 3mm types, and all resistors can be 0.25W 5% types, except R7 (0.5W) and R6 (1W). Reg.1 might need a small heatsink.

This circuit was originally designed to charge Metz 45 packs, but when charging this pack at 500mA or more, connection should be made directly to the battery, via the top terminals, and not to the normal charging pins, as the internal 400mA rated lamp could be damaged.

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