DESIGNER'S NOTEBOOK

Charging indicators

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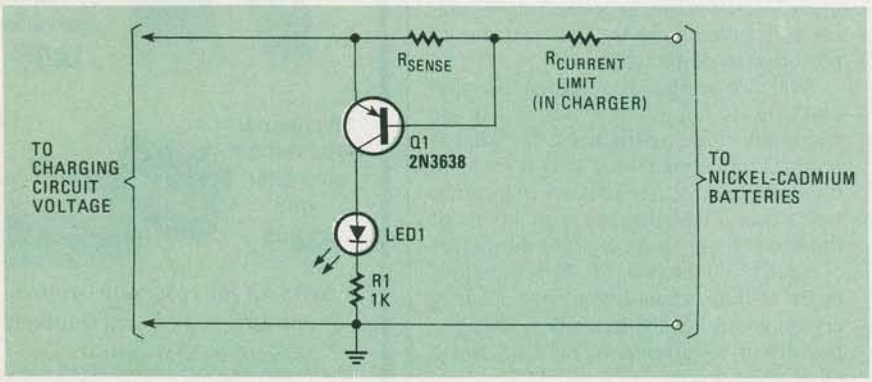

FIG. 1

THE ATTRACTIVENESS OF NICKEL-CADIUM or NiCd batteries for use as power sources, has caused them to begin showing up in many electronic parts catalogs and advertisements. Because they're still relatively expensive when compared with alkaline units, the advertisers in the back of this and other electronics publications offer them at a considerable discount; usually at least 30% off the regular price. And though nickel-cadium batteries don't have the staying power of alkaline cells, being able to recharge them several times makes them extremely attractive for use in battery-powered devices. Also, they provide a constant voltage over the life of the charge, are relatively trouble free, and the charging circuitry for them is easy to design. All in all, if you take good care of them, they'll take good care of you.

However, one constant source of irritation in using NiCd cells has, paradoxically, nothing to do with the batteries. The problem that we're referring to has to do with the charger, or more specifically the charging indicator. The irritation comes from the fact that the indicators are often misleading—they show that the charger is plugged in, but tell you nothing as to whether or not the batteries are actually taking a charge. And that's not all: There's a second source of trouble as well. Let's assume that your charging circuitry doesn't include some sort of automatic changeover to trickle charge after the batteries have reached a certain charge level. If you keep pumping current into them at the same rate, you stand a good chance of blowing them up. Though NiCd cells may be available at discount prices, they're still not exactly cheap enough to destroy.

This month's circuit, shown in Fig. 1, is deceptively simple—it only calls for a handful of parts. But believe me when I say that it can save you a whole bunch of time, trouble, and, most important, money. It gives you a way to make sure that the batteries are really charging and also tells you when they're fully charged.

How it works

In the schematic shown in Fig. 1, transistor Q1 has its base–emitter junction connected across the sensing resistor (R_{SENSE}) on the line carrying the charging current. (Note that $R_{CURRENT\ LIMIT}$ is a part of the charger itself.) When the batteries are put on charge, current flows through the sensing resistor causing a voltage drop to be developed across it, and the resulting voltage turns on the transistor. With the transistor turned on, current flow through it causes the LED to turn on. However, the LED won't light unless the batteries are taking a charge! Sounds simple doesn't it?

Another feature of the circuit is that if the right value is chosen for the sensing resistor, the LED will extinguish when the batteries are fully charged, because of a change in current flow through the circuit. Now, if the LED were part of some opto-isolator arrangement, you could automatically increase the charger's current limiting resistor and cut the charge down to a trickle. Not bad for a handful of parts—and cheap ones at that!

We can't give you a value for the sensing resistor, because that depends on the amount of current needed to charge the batteries. However, *calculating* the resistance value needed is a piece of cake. Because we're using a silicon PNP transistor, it's going to take a voltage drop of about .65 volt to turn it on. The next thing you'll need to know is the charge rate of your unit. (Many chargers have their charge current and voltage printed on the wall transformer.) Once you have that information, the arithmetic is simple. The correct value for the sensing resistor can be found through the simple application of Ohms' law:

$$E = IR$$

$$R_{SENSE} = .65V/I_{CHARGE}$$

The value needed will typically be between 60 and 200 ohms.

Since the current-limiting resistor is usually much larger than 200 ohms, you can ignore the current limiting that the sensing resistor does. But try to keep that value as close to the calculated value as possible, because you want the transistor to turn off when the charging current starts to drop. If you're only interested in making sure that the batteries are really charging, you can forget the sensing resistor and put the transistor right across the current-limiting resistor. The parts for the circuit should cost you less than 50 cents and considering the price of NiCd batteries, that's a really cheap insurance policy! **R-E**

"I don't think I'm going to like that new long-distance saving service."