DESIGNER'S NOTEBOOK

Over-voltage indicator

I GET A GREAT DEAL OF MAIL ASKING for circuits that can add to the well being of batteries. People want to know how to keep them charged, how to prevent memory effects in Ni-Cd's, how to watch out for dying cells, and so on. I thought I had covered just about every possibility until I got a letter asking for a circuit that could be used to indicate an overvoltage condition.

There are many circuits that could do the job, but this is one occasion when simpler is better. You can get LM3914's and LM3915's (bar/dot display drivers) at low prices these days, but if you use one of them, you're still faced with the problem of setting it up for a specific voltage. Not only that, but an LM3914 (or a '15) may be a classic case of overkill.

The minimalist approach

If all you need is a circuit that will light an LED, sound an alarm, etc., when a particular voltage level is reached, the easiest way to get the job done is with the circuit shown in Fig. 1. It has the whole range of good things—it's simple, it's straightforward, it costs next to nothing to put together, and it's totally bulletproof.

It works like this. When the voltage across potentiometer R3 reaches a particular level, Zener diode D1 will start conducting and turn on the transistor. That, in turn, will light the LED. Resistor R2 limits the current through the LED and R1 does the same for the Zener diode. The accuracy of the circuit is mostly a function of how finely you can tune R3. You can use just about any control you want, but a small multi-turn PC-mount device will provide the greatest precision.

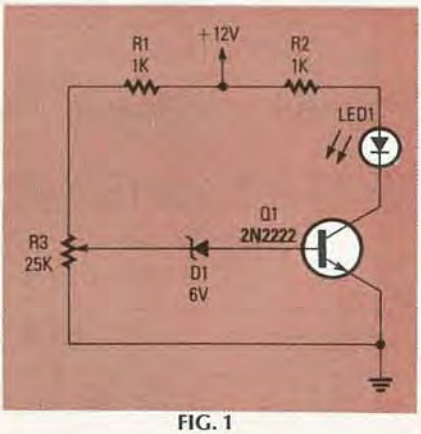

FIG. 1

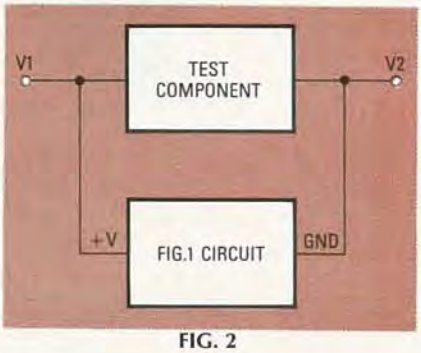

FIG. 2

By using a variable-voltage power supply, you should be able to set the circuit to trigger within less than a tenth of a volt of the target voltage. The Zener you use isn't critical. For most applications, a ¼-watt unit will do. The transistor can be any small-signal NPN type. The circuit is so small that it can be installed easily in the case of just about anything. If you want to keep an eye on more than one voltage, you can build several circuits on the same board.

Although the output device is

shown as an LED, you can couple just about anything to it by using the transistor to drive a relay.

The values shown in the schematic are set to work with power supplies as high as 12 volts. Exceeding that value will require some component changes, but basic circuit operation remains the same. A ¼-watt Zener will probably suffice, but its breakdown voltage should be about half the maximum voltage you expect to apply to the circuit. And R1 should be chosen using Ohm's Law, to make sure that Zener current is kept within the diode's limits.

The same restrictions apply to the transistor. Make sure that its rated collector-emitter voltage exceeds any voltage you expect to apply to the circuit.

Advanced uses

One consequence of keeping the circuit so simple is that it's very fast, so you can use it for other things. For example, you can have the transistor switch in some sort of circuitry to drop the voltage in your circuit to a safe level. And a bit of thought should let you add to the circuit and make an electronic fuse.

That's possible because the overvoltage indicator draws very little current. Ordinarily you would connect it across the battery or power supply. But, because it uses so little power, you can use it to monitor the voltage just about anywhere in a circuit.

Figure 2 illustrates the basic idea. Even though the monitor is designed to sense excess voltage, it can sense excess current flow by monitoring the voltage across a component. Make sure that V1 exceeds V2 by at least six volts; otherwise you may have to use a different Zener. **R-E**