PROJECT OF THE MONTH

Making Your Own Pressure-Sensitive Resistors

By Forrest M. Mims

THE conductive plastic foam that provides anti-static protection for MOS transistors and integrated circuits can be used to make pressure-sensitive resistors. The resistance of these do-it-yourself components can range from several tens of kilohms (no pressure) to a few hundred ohms or less (maximum pressure.)

Figure 1 shows just one of many possible ways to assemble a conductive-foam, pressure-sensitive resistor. The basic resistor is simply a sandwich made by placing copper foil conductors on either end of a conductive-foam cylinder or block. If you prefer, you can add embellishments (such as a plunger and return spring) to enhance the utility of the basic pressure-sensitive resistor.

The resistor can have a diameter ranging from that of a pencil eraser to a silver dollar. Copper foil for making the end contacts is available from hobby and craft shops. If you cannot find the foil, an acceptable substitute is unetched, copper-clad circuit board. In both cases, the copper should be buffed with a pencil eraser to prepare it for soldering. When the surface is shiny (*both* sides if you use foil), solder a length of wrapping or small-diameter hookup wire to each end terminal.

Conductive plastic foam is available from many sources. If you don't happen to have any, try requesting a small piece from an electronics supplier or a firm or university that purchases integrated circuits in volume. Conductive foam and copper foil can be cut with scissors or a hobby knife.

You can make a miniature pressure-sensitive resistor by using a $\frac{1}{4}$" mechanical paper punch to cut identical circles of foil and a cylinder of conductive foam. After soldering leads to the foil disks, insert a copper-foam-copper sandwich into a short section of miniature plastic tube like those in which points for lettering pens are sold. Two tiny apertures should be drilled in the side of the tube to provide exit ports for the leads. If you prefer a larger pressure-sensitive resistor, use a sawed off section of a plastic pill bottle and proportionally larger sections of copper and plastic.

Applications for Pressure-Sensitive Resistors. Many applications exist for pressure-sensitive resistors. One possibility is a pressure-sensitive control that functions as a single-axis joystick. Another is a programmable sensor for a weight-sensitive scale. Still another is a simple accelerometer. In this role, a small weight such as a steel nut or lead fishing sinker attached to the upper, moving contact of the pressure-sensitive resistor would provide the necessary mass.

I've devised two simple circuits that illustrate how to use pressure-sensitive resistors in these and other applications. In Fig. 2, the pressure sensitive resistor is connected as the variable time-contant component in a 555-astable-oscillator audio-tone generator. As the pressure on the resistor is increased, its resistance is decreased. This increases the circuit's frequency of oscillation. While this circuit was devised merely to illustrate the use of a pressure-sensitive resistor in a straightforward analog or linear mode, it suggests possible applications in electronic music.

Figure 3 shows how a comparator can be connected to a pressure-sensitive resistor to provide a programmable two-state output. In operation, the switching threshold of the comparator is set by threshold-adjust potentiometer *R3*. Pressure applied to *R1* lowers its resistance, thus increasing the voltage applied to the comparator's noninverting input. When this voltage exceeds the reference voltage determined by *R3*, the comparator output swings to near the positive supply voltage. This turns on *Q1* and illuminates *LED1*.

The circuit in Fig. 3 has practical applications as an input stage to a pressure-sensing logic circuit or microcomputer. Resistor *R3* permits the circuit to be adjusted over a range of sensitivities.

Going Further. Conductive-foam, pressure-sensitive resistors are not as sophisticated as commercial pressure-sensing devices, but they are remarkably cheap and very easy to make. If you would like more information on the subject, Thomas Henry of Transonic Laboratories wrote a brief article entitled "Conductive Foam Forms Reliable Pressure Sensor" In *Electronics* magazine (May 19, 1982, p. 161). ◊

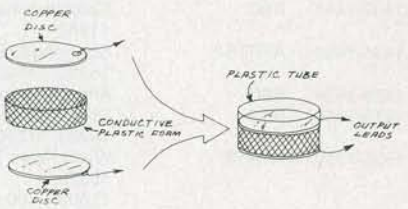

Fig. 1. Pressure-sensitive resistor.

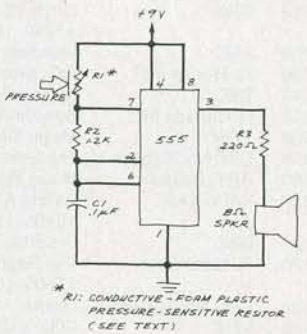

Fig. 2. Tone generator.

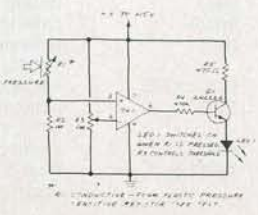

Fig. 3. Pressure-controlled comparator.