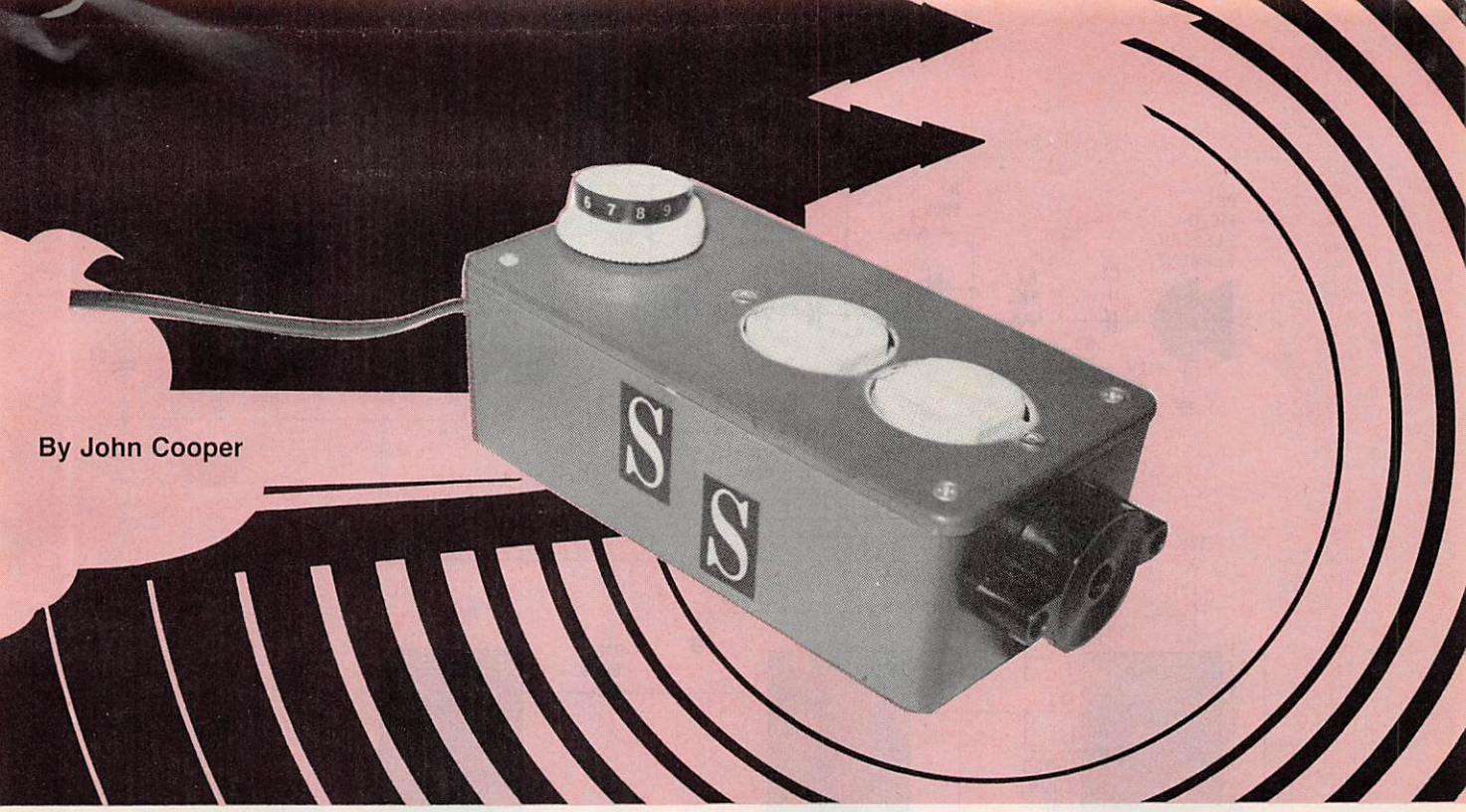


By John Cooper

BUILD THE SOUND SENTRY

This little device senses the creaks from the crunches and sounds an alarm when the noise is from an intruder!

ONE NIGHT WHILE YOU AND THE FAMILY ARE AWAY FROM home a shadowy figure slips quietly up to your back door. He hesitates for a moment as the bark from a distant dog bristles the hair on his neck. Then he goes to work with a small crowbar on the door latch. Suddenly, from within the house the lights come on. Voices are heard! Startled, the sinister intruder dashes away. You find out about the event when you return. A call to the police increased the patrol in your area. Damage to the door—a piece of molding and some scarred paint. That's a cheap price to pay considering the loss you could have suffered.

Your Sound Sentry is on the job—listening for noises that should not be there when you are away. Once the Sound Sentry is activated, it can switch on interior and exterior lights and activate the audio system. The Sound Sentry is an electronic, sound-activated, sound-selective AC outlet. At the sound of a knock at the door, window breaking, or other sounds not normally heard in an empty house, Sound Sentry turns on a lamp, TV set, a hi-fi in the den, and just about anything else you'd want to be energized to scare away an unwelcome visitor.

Building the Sound Sentry takes an evening or two and requires only a few readily available parts.

How It Works

Figure 1 diagrams the circuit for the Sound Sentry. Sound (noise) is picked up by the sensor element, PE1. A piezoelectric element is shown in the Fig. 1; however, a small crystal microphone or PM loudspeaker will work also.

The output of PE1 drives the inverted input (pin 2) of op-amp U1. A fixed positive voltage is applied to the positive input (pin 3) for the purpose of cancelling input signals caused by ambient noise and induced hum. Network R3-R4-C2 provides approximately 6-volts DC of bias for that purpose. Potentiometer R2 is used to adjust the gain of the U1 amplifier stage and thereby selects the sensitivity of the circuit to noises.

Noise signals from U1 are amplified to cutoff so that a random array of pulses are supplied to the 4017 counter/divider clock input (U4 pin 14) and a clear-counter circuit consisting of a ½-4013 flip-flop, U2-a, and, 555 timer trigger input (U3 pin 2). *(more)*

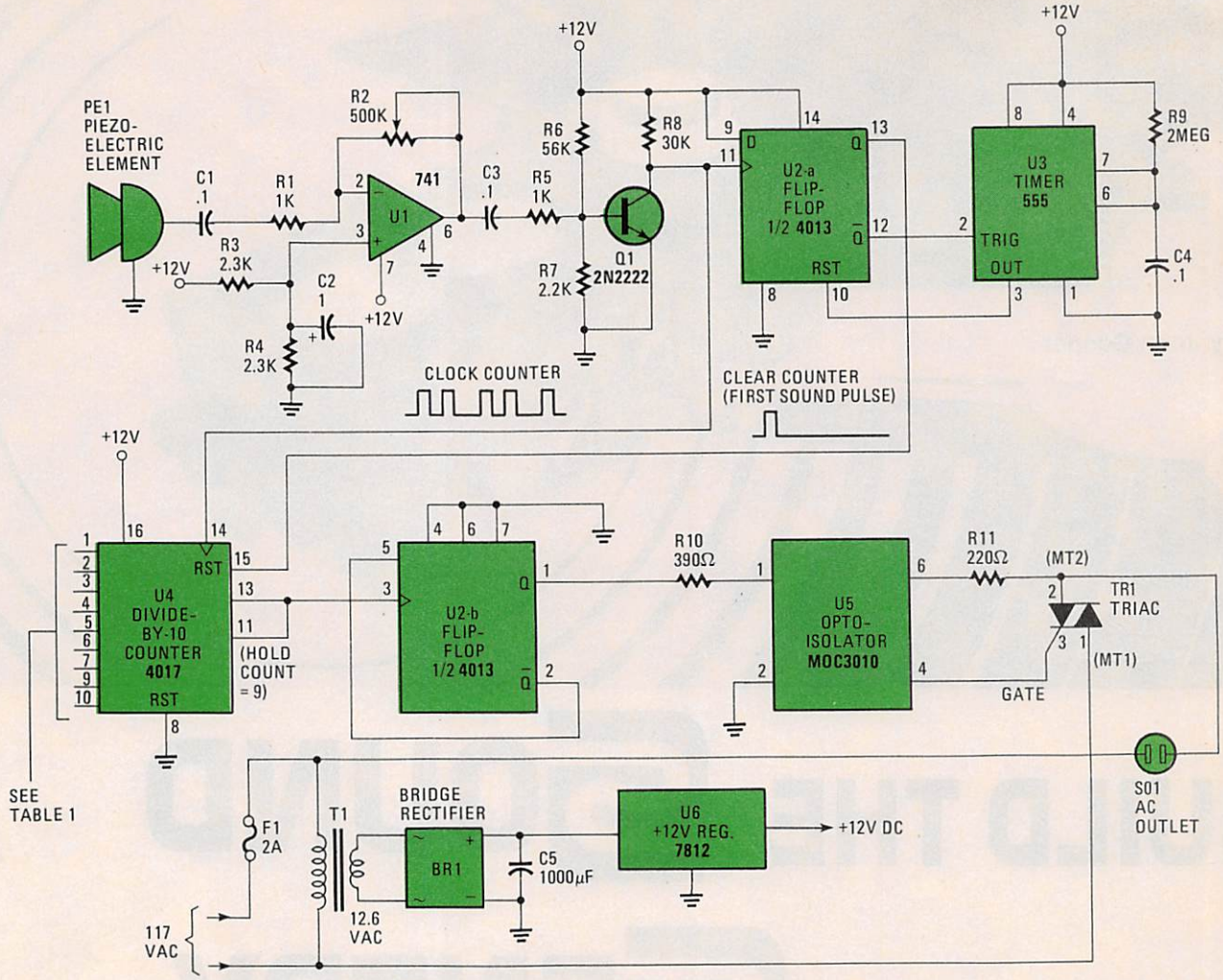
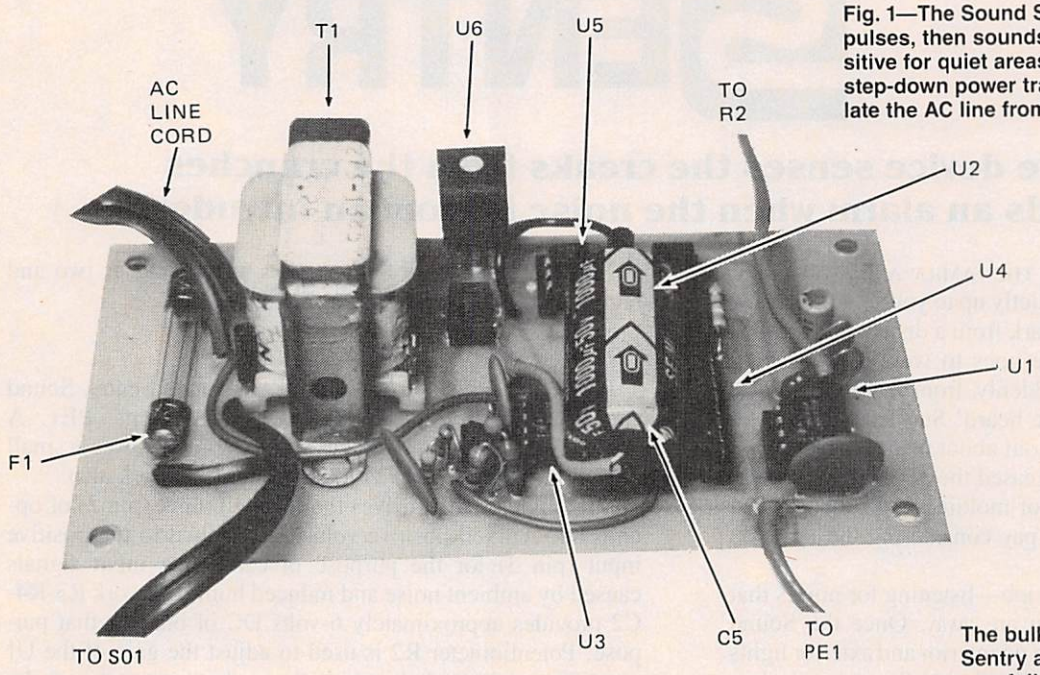


Fig. 1—The Sound Sentry detects and counts noise pulses, then sounds an alarm. You can make it sensitive for quiet areas. The optoisolator (U5) and step-down power transformer (T1) electrically isolate the AC line from the unit's internal circuitry.



The bulk of the parts for the Sound Sentry are soldered or secured to the non-foil side of the printed-circuit board. AC power from the line cord and to the socket (S01) are on the left side of the board. Be careful here when soldering the stranded leads. The triac (D1) is not visible; it is mounted on the foil side of the board under the transformer (T1).

TABLE 1—U4 PULSE COUNT CONNECTION*

Pin	3	2	4	7	10	1	5	6	9	11
Count	0	1	2	3	4	5	6	7	8	9

*Connect pin 13 (ENABLE) to a pin above to obtain desired count.

PARTS LIST FOR SOUND SENTRY

SEMICONDUCTORS

DB1—Diode bridge rectifier (Radio Shack 276-1161, or equivalent)
PE1—Piezoelectric buzzer used as an audio sensor (Radio Shack 273-064, or equivalent)
Q1—2N2222 OR 2N2222A silicon NPN transistor
TR1—Triac rated at 6-A and 117-volts AC (Radio Shack 276-1001, or equivalent)
U1—741 operational amplifier integrated circuit
U2—4013 dual D flip-flop, integrated circuit
U3—555 timer, integrated circuit
U4—4017 divide-by-10 counter (with 1-of-10 outputs), integrated circuit
U5—MOC3010 opto-isolator (Radio Shack 276-134, or equivalent)
U6—7812 +12-volt regulator integrated circuit, 1 = A

RESISTORS

(All fixed resistors are ¼-watt, 5%, unless otherwise noted)
R1, R5—1000-ohm
R2—500,000-ohm, linear-taper potentiometer
R3, R4, R7—2200-ohm
R6—56,000-ohm
R8—30,000-ohm
R9—2000-ohm
R10—390-ohm
R11—220-ohm, ½-watt

CAPACITORS

C1, C3, C4—0.1-μF ceramic
C2—1-μF, 16-WVDC, electrolytic
C5—1000-μF, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

F1—Fuse, 2A, type 3AG
T1—Miniature, step-down power transformer: 117-volts AC to 12-volts, 300-mA (Radio Shack 273-1385, or equivalent)
Plastic case (Radio Shack 270-223), line cord with molded plug, line-cord strain relief, fuse holder, dual AC outlet, knob, 2-conductor shielded cable, wire, solder, hardware, printed-circuit board material, etc.

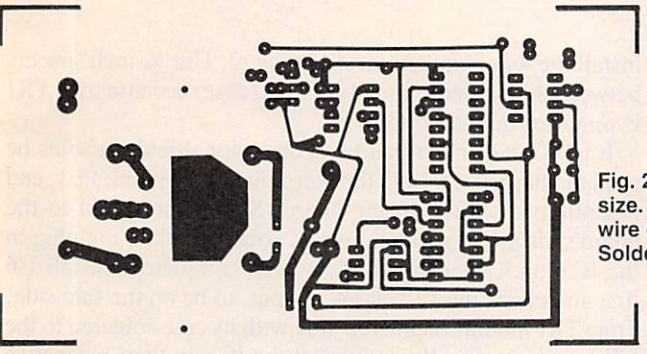
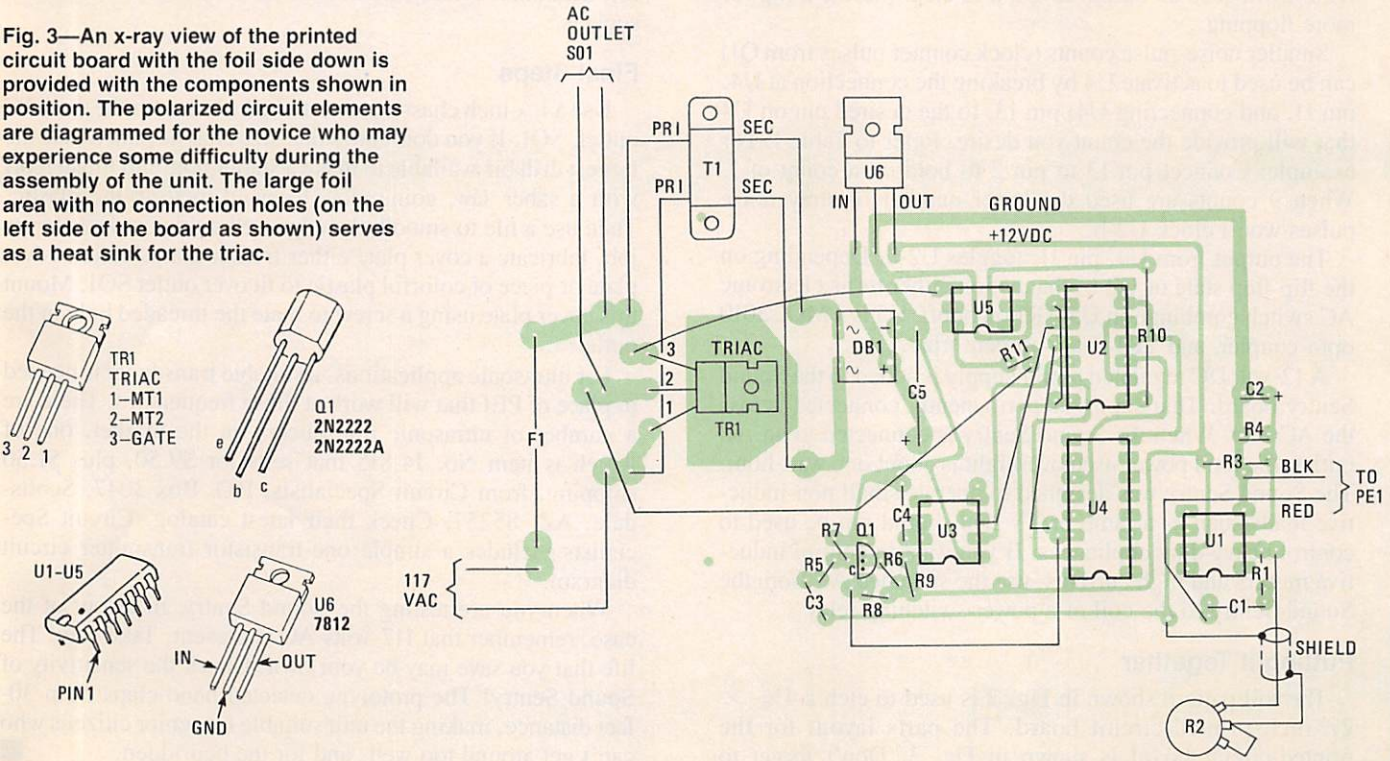
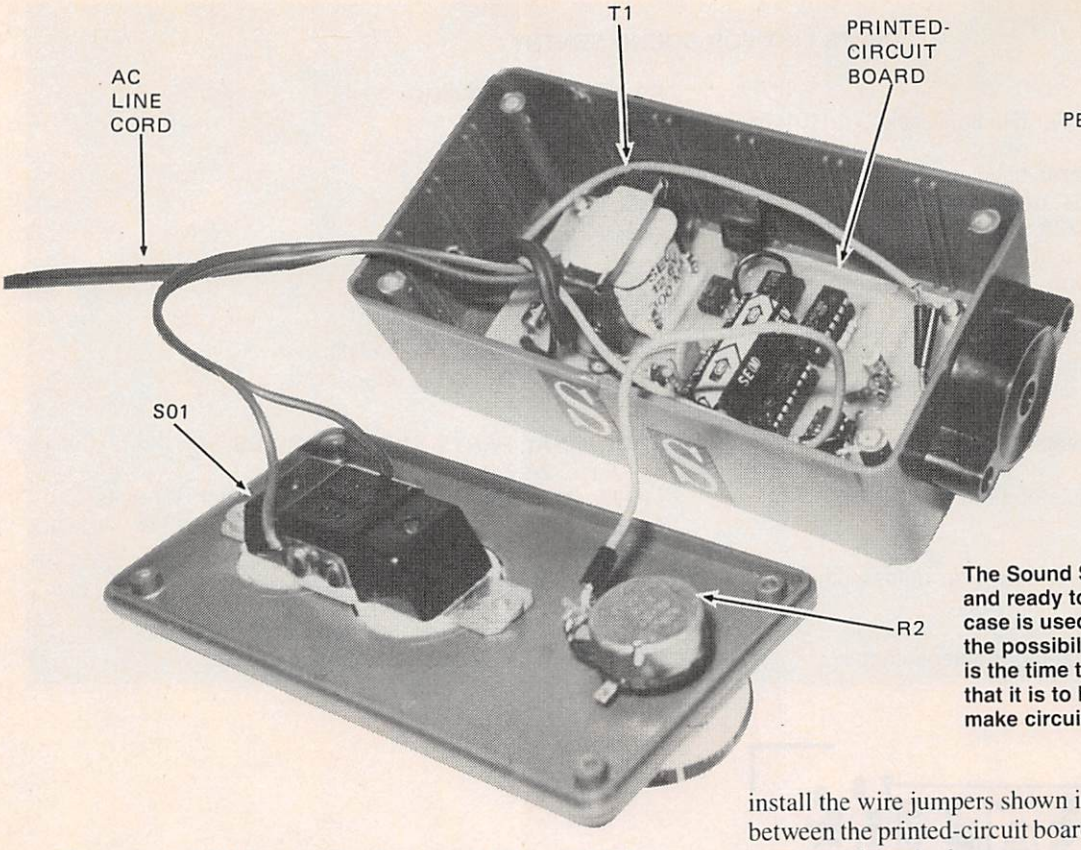


Fig. 2—The foil pattern for the printed-circuit board is supplied same size. Layout of parts is not critical so that should you decide to hard-wire or wire-wrap connections, you should experience no undue difficulties. Solder DIP components directly to the board; there is no need for sockets.

Fig. 3—An x-ray view of the printed circuit board with the foil side down is provided with the components shown in position. The polarized circuit elements are diagrammed for the novice who may experience some difficulty during the assembly of the unit. The large foil area with no connection holes (on the left side of the board as shown) serves as a heat sink for the triac.





The Sound Sentry is shown here all wired and ready to be buttoned up! A plastic case is used to house the unit and reduce the possibility of electric shock. Now is the time to test the unit in the area that it is to be installed. You may want to make circuit changes; see text and Table 1.

The output of Q1 fires single-shot circuit U2-a, and U3 on the first pulse of the noise train of pulses. The single-shot circuit sends a clear counter-pulse (from pin 13 of U2-a) to decade counter U4, pin 15. The pulse-counter stage is now ready to count pulses from the detected sound at PE1. Wired as shown in Fig. 1, pulse-counter U4 will count to nine and hold. The pulses that follow the noise burst will not generate additional clear-counter pulses until a delay determined by R9-C4 provides an output to U2-a to clear the U2-a flip for more flopping.

Smaller noise-pulse counts (clock counter pulses from Q1) can be used to activate U4 by breaking the connection at U4, pin 11, and connecting U4, pin 13, to the desired pin on U4 that will provide the count you desire. Refer to Table 1. For example: Connect pin 13 to pin 2 to hold on a count of 1. When 9 counts are used the lower number of stray noise pulses won't clock U2-b.

The output from U4, pin 11, toggles U2-b. Depending on the flip-flop state of U2-b, that action either turns electronic AC switch combination U5-TR1 on or off. U5 is a MOC3010 opto-coupler, and TR1 is a 6-ampere triac.

A 12-volt DC regulated power supply is added to the Sound Sentry board. That supply is permanently connected across the AC line. When the Sound Sentry is connected to an AC outlet, the total power used overnight is about one watt-hour. The Sound Sentry was designed to operate small non-inductive loads such as a lamp or TV and should not be used to control heavy-duty appliances. If you want to control inductive motors and high currents, use the switched AC from the Sound Sentry to the coil of a power-switching relay.

Putting It Together

The foil pattern shown in Fig. 2 is used to etch a 4¾- × 2½-inch printed-circuit board. The parts layout for the printed-circuit board is shown in Fig. 3. Don't forget to install the wire jumpers shown in Fig. 3. Use ⅜-inch spacers between the printed-circuit board and case, because triac TR1 is mounted on the bottom.

It is recommended that two-conductor shielded cables be used to interconnect both the piezoelectric element, PE1, and potentiometer R2 with the board. Solder the shield to the board's electrical ground. Use IC sockets and do not plug in the IC's until after the unit has been completed. Install U6 first and check the 12-volt DC output, to be on the safe side. Triac TR1 mounts on the foil side with its case soldered to the foil heat sink. Finally, mount all the IC's in their respective sockets.

Final Steps

Use a 1⅜-inch chassis punch to make holes for the dual AC outlet, SO1. If you don't have that size chassis punch, use the largest drill bit available to make a starter hole and finish it off with a saber saw, going slow to avoid melting the plastic. Then use a file to smooth the edges. Should you do a sloppy job, fabricate a cover plate either from a brass, outlet, cover plate or piece of colorful plastic to fit over outlet SO1. Mount this cover plate using a screw to mate the threaded hole in the outlet.

For ultrasonic applications, a suitable transducer is needed in place of PE1 that will work at those frequencies. There are a number of ultrasonic transducers on the market, one of which is item No. J4-815 that sells for $9.50, plus $1.50 shipping, from Circuit Specialists, P.O. Box 3047, Scottsdale, AZ, 85257. Check their latest catalog. Circuit Specialists includes a simple one-transistor transmitter circuit diagram.

When you are testing the Sound Sentry, in or out of the case, remember that 117-volts AC is present. Take care! The life that you save may be your own! Check the sensitivity of Sound Sentry! The prototype detected hand-claps from 30-feet distance, making the unit suitable for senior citizens who can't get around too well, and for the bedridden. ■