The Teleguard

Phone accessory automatically calls a preprogrammed telephone number when your burglar/fire alarm or other sensor is tripped

By Anthony J. Caristi

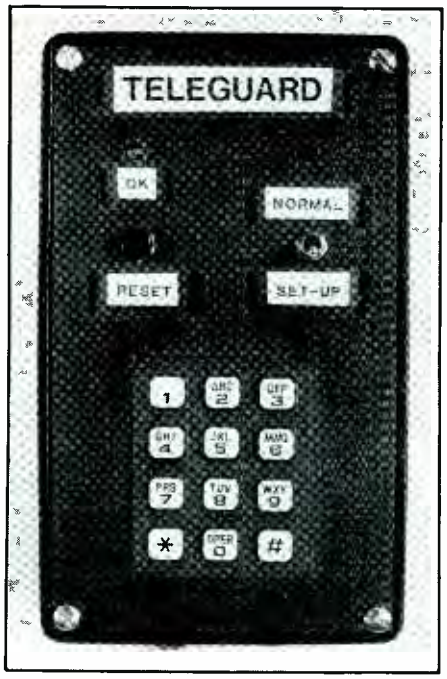
The easy-to-build, low-cost project described here will guard your home or office against a host of emergency situations while you are away—fire, theft, flood, power loss, etc. Upon its activation, it will automatically call a preprogrammed telephone number selected by you and alert the party being called to an emergency with a unique audio tone. The device, called "Teleguard," goes into action whenever a switch is closed. This might be a pushbutton that an invalid presses or the automatic operation of a sensor or thermostat.

Several important features are built into Teleguard to give you peace of mind. For example, the device will repeatedly call the number stored in its memory until it gets an answer, upon which it will transmit its unique "alert" signal. In addition, Teleguard has a power-failure indicator that monitors the ac power line. Should this LED extinguish, you know that power has been interrupted and that you have to reprogram the telephone number into memory to ensure continued protection. (A battery backup supply can be integrated, of course, to maintain operation in case an ac power outage does occur).

Teleguard can be left connected to your telephone line at all times with the assurance that it won't affect normal telephone service. It can also be reprogrammed at any time to dial the number of the location where you or the person you want alerted will be.

About The Circuit

At the heart of Teleguard's circuit (Fig. 1) is *IC3*, a specialized digital integrated circuit that has been designed to replace the standard rotary dial in a telephone. This chip transmits a series of pulses in accordance with a telephone number entered into its on-chip memory bank from a keypad



similar to that found on the familiar pushbutton telephone. Any number, including area code, can be entered.

Once a number is stored in memory, it remains there for as long as power to the circuit is interrupted. However, you can deliberately change it simply by "dialing" in a new telephone number. Doing this replaces any previously entered number. When the circuit is tripped, the number stored in memory is automatically dialed out repeatedly (about every 90 seconds) until Teleguard detects that the party being called has lifted the receiver off the hook at his end.

The timing cycle that controls repeated dialing of the number in memory is provided by *IC1*, an ordinary 555 timer chip operated in its astable mode. When the number is dialed out, the *on* time of the circuit is approximately 60 seconds, while the *off* time is about 30 seconds.

A logic low fed to pin 4 holds *IC1* in the standby (not tripped) mode as long as the protective circuit connected to screw-type terminals, A, B and C of terminal strip *TS1* on Teleguard is intact. (Hookups from the external protective circuits are made from the screw-type terminals selectively, according to whether the circuits are normally-open or normally-closed arrangements. More about the hookups later.) When the external circuit is secure, *IC2* is prevented from oscillating. When the circuit is triggered, by tripping the external protective circuit, *IC1* begins its timing cycle and continues to time out as long as the external circuits tells it an emergency exists.

Taken from pin 3, the output of *IC1* is an inverted pulse that is fed to on/off-hook pin 5 of *IC3*. This pulse tells *IC3* when to begin dialing out its stored number. A logic 0 fed to pin 5 causes *Q1* and *Q2* to switch on and connect *R14* and *LED1* to the telephone lines. The LED lights, indicating that a dialtone is available and outpulsing can begin.

A logic 1 fed simultaneously to pins 1 and 18 of *IC3* starts the outpulsing operation. This logic signal is provided by *IC4B, IC4C* and *IC4D*. Delay network *R22/C9* delays the outpulsing signal by one second to allow the telephone line to activate the dialtone when *Q1* switches on. When the 1-second delay time has elapsed, pins 1 and 18 of *IC3* are fed a logic-1 pulse that causes the number in memory to be dialed out. Timer *IC1* holds *IC3* in the operate mode for a total of 60 seconds to permit the dialed number time to ring and the party being called to answer.

When the *on* time of *IC1* ends, *IC3* is returned to the on-hook condition by a logic 1 fed to pin 5. This disconnects the called party. About 30 seconds later, *IC1* returns to the *on* state and the cycle repeats.

Oscillator *IC5* generates the audio signal tone that alerts the called party to an emergency situation at Teleguard's end of the line. With *IC5* enabled only during the *on* time of *IC1*, no tone is generated, so there is no interference with normal telephone operation.

An additional memory circuit is built into Teleguard to provide indication that the telephone number stored in memory is not lost due to a temporary power failure. This is provided by *IC2C* and *IC2D*, which are connected as a bistable or latch circuit. When line power is first applied to Teleguard, pin 10 of *IC2* is held low by means of the delay voltage applied to pin 12, the result of the finite charge time of *C8*. Thus, *Q3* and power-line monitor *LED2* will be off. After programming the desired telephone number into Teleguard's memory bank, you can turn on *LED2* by pressing and releasing RESET switch *S1*. This causes *LED2* to light and indicate an OK condition, meaning that the number is now stored in memory. Should there be an interruption of power to Teleguard at any time thereafer, *LED2* will extingiush and remain off, even if power is restored to the circuit. If you note that *LED2* if off at any time, this tells you that the number held in memory has been lost and must be reprogrammed into *IC3* from the keypad.

The keypad used in this project is a simple 3×4 switch arrangement, as shown in Fig. 2. It contains four row and three column (R1 through R4 and C1 through C3) "output" lines that connect to *IC3* as shown. A common output connection is not required with this arrangement. This type of keypad is the commonest type made. It can be salvaged from an old calculator or Touch Tone telephone or purchased new from any number of electronics parts suppliers.

Pressing any button on the matrix-type keypad shorts one column to one row output line. With the 3×4 matrix shown in Fig. 2, there are 12 possible row/column combinations, 10 for the numerals 1 through 0, one for the * symbol and one for the # symbol. Note that this is the same arrangement used on pushbutton telephones.

Power for Teleguard is supplied by the ac line. Incoming 117 volts ac is stepped down by *T1* to 6.3 volts ac

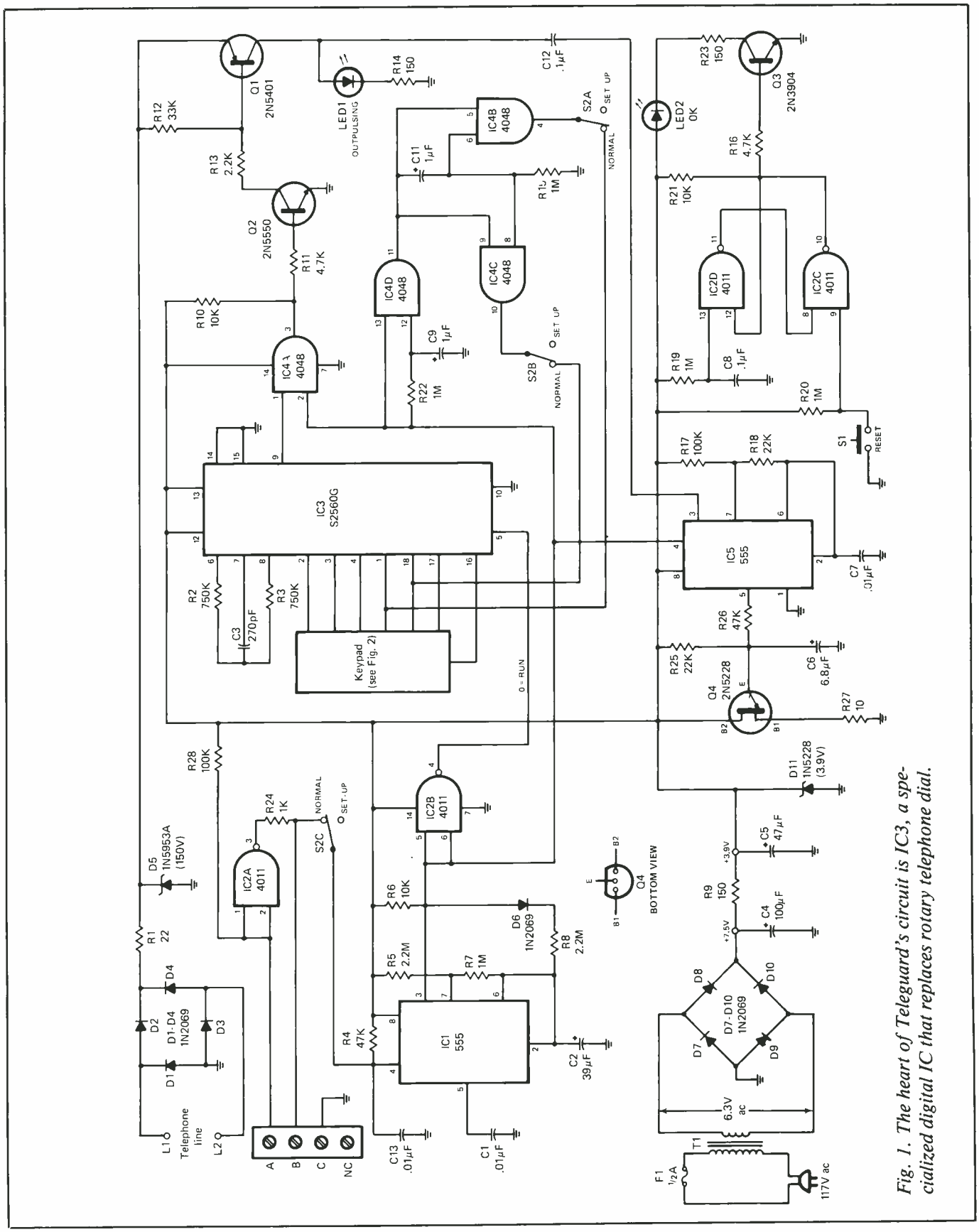


Fig. 1. The heart of Teleguard's circuit is IC3, a specialized digital IC that replaces rotary telephone dial.

PARTS LIST

Semiconductors
D1 thru D4,D6 thru D10—IN2069 or similar silicon diode
D5—1N5953A or similar 150-volt zener diode
D11—1N5228 or similar 3.9-volt zener diode
IC1,IC5—555 timer
IC2—CD4011B quad NAND gate
IC3—S2560G telephone dialer IC (AMI)
IC4—CD4081 quad AND gate
LED1—Red light-emitting diode
LED2—Green light-emitting diode
Q1—2N5401 or similar pnp silicon transistor
Q2—2N5550 or similar npn silicon transistor
Q3—2N3904 or similar npn silicon transistor
Q4—2N4870 or similar unijunction transistor

Capacitors
C1,C7,C10—0.01-μF disc
C2,C5—47-μF, 10-volt electrolytic
C3—270-pF disc
C4—100-μF, 10-volt electrolytic
C6—6.8-μF, 10-volt electrolytic
C8,C12—0.1-μF disc
C9,C11—1-μF, 10-volt electrolytic

Resistors (all ¼-watt, 10%)
R1—22 ohms
R2,R3—750,000 ohms (5% tolerance)
R4,R26—47,000 ohms
R5,R8—2.2 megohms
R6,R10,R21—10,000 ohms
R7,R15,R19,R20,R22—1 megohm
R9,R14,R23—150 ohms
R11, R16—4700 ohms
R12—33,000 ohms
R13—2200 ohms
R17,R28—100,000 ohms
R18,R25—22,000 ohms
R24—1000 ohms
R27—10 ohms

Miscellaneous
F1—½-ampere slow-blow fuse
S1—Spst normally-open, momentary-action pushbutton switch
S2—3pst toggle switch
T1—6.3-volt, 100-mA transformer
TS1—4-lug screw-type terminal strip
Keypad—3 × 4 matrix (Industrial Electronic Engineers Inc. No. KS 2585 or similar; see text)
Suitable-size plastic utility box; 6′ or longer telephone cord with modular plug at one end; printed-circuit or perforated board and solder posts; sockets for ICs; holder for F1; ac line cord with plug; ½″ plastic spacers (5); insulating plastic tubing; labeling kit; machine hardware; stranded hookup wire; plastic cable ties; solder; etc.

Note: The following are available from A. Caristi, 69 White Pond Rd., Waldwick, NJ 07463; pc board for $7.25; S2560G for $7.50; 2N5401 for $3.00; 2N5550 for $2.75; 2N4870 for $2.95. Add $1.00 to cover shipping and handling.

and is then rectified by the bridge circuit consisting of *D7* through *D10*. The pulsating dc at the output of the bridge is smoothed to dc by *C4* and *C5* and regulated to +3.9 volts by zener diode *D11*.

Connection to the telephone line is through *L1* and *L2* at the upper left of Fig. 1. This signal is passed through the bridge rectifier composed of *D1* through *D4* to assure that the proper polarity is fed to the telephone line.

Construction

The Teleguard circuit can be assembled on a single-sided printed-circuit board. You can fabricate your own pc board, using the actual-size etching-and-drilling guide shown in Fig. 3, or purchase one ready to use from the source given in the Parts List. Alternatively, you can hand-wire the circuit on perforated board, using solder posts. In either case, it is a good idea to use sockets for all ICs, both to protect them against heat and static damage during assembly and to permit easy troubleshooting in case of circuit failure. Also, if you decide to use perforated board, component layout and orientation should be basically the same as for the pc board (see Fig. 3).

Select a plastic box large enough to comfortably accommodate the project's circuitry. Before wiring the board, set it in the bottom of the box, oriented and positioned as it will be when assembly is complete, and mark the five locations where the mounting holes (indicated by asterisks in the component-layout diagram in Fig. 3) are to be drilled. Remove the circuit board and set it aside. Then drill the holes in the marked locations.

Decide which will be the top and bottom walls of the box. In the bottom wall, drill three holes—one for ac line cord entry, a second for telephone line entry and a final one for mounting the fuse holder. Size these holes as needed. On the top wall of the box will be mounted screw-type terminal strip *TS1*. You will have to use a drill, coping saw and file to cut a slot long and wide enough to provide clearance for the solder lugs and screws on the terminal strip and drill a separate pair of holes to permit the terminal strip to be anchored in place with machine hardware. Route the free ends of the ac and telephone line cords from the outside into the box and tie a knot in each to serve as strain reliefs. Then mount the fuse holder and terminal strip in their respective locations.

The keypad, switches and LEDs mount on the lid of the box. Trace the outline of the keypad's *inner* lip on the lid of the box. Then drill a ¼″ hole in each corner of the traced cutout area, using a coping saw to cut away all unwanted material within the outline, and smooth the edges with a file. Avoid removing too much material; you want the keypad to fit snug in the cutout. Drill the holes for the switches and LEDs, sizing the latter to accommodate panel-mount eyelet clips. Then apply a spot of fast-set epoxy cement at all four corners and midway between the corners of the keypad and press the keypad into its cutout. Allow the cement to fully set before handling the lid assembly.

Meanwhile, wire the circuit board according to the component-place-

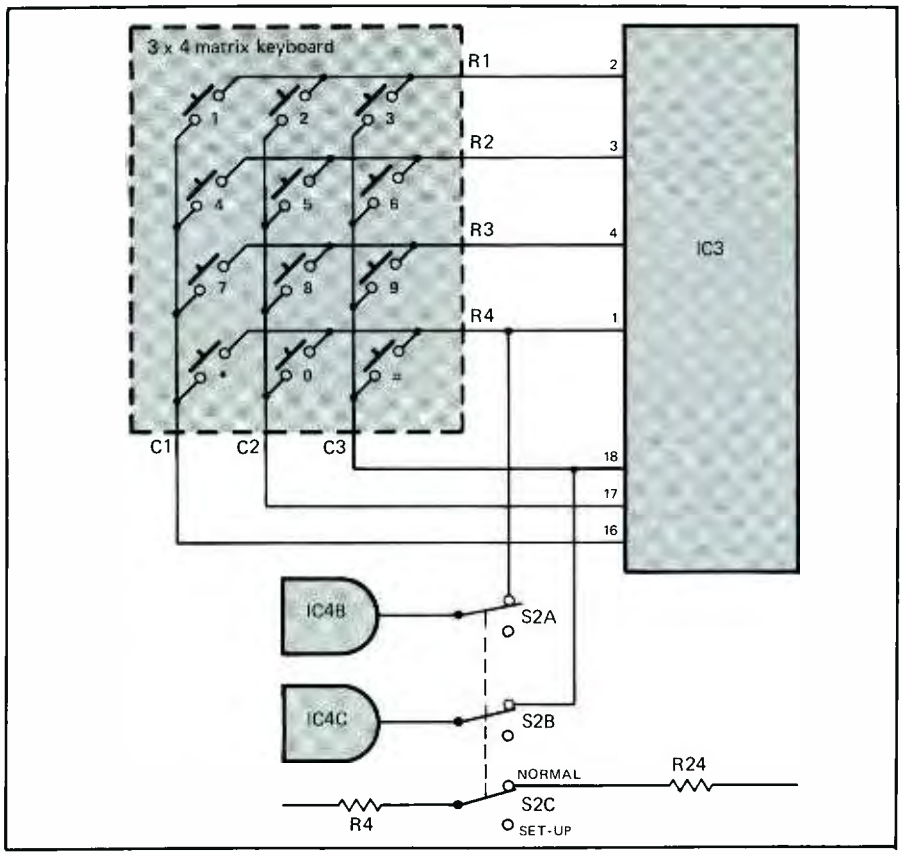


Fig. 2. Calculator-type keypad with 3 × 4 switch matrix connects to IC3 as shown to permit the desired telephone number to be entered into memory.

ment diagram in Fig. 3. Pay strict attention to the orientation of all polarized components (ICs, transistors, diodes and electrolytic capacitors). Also, do *not* install or handle the ICs until all wiring has been completed. Start wiring by installing the resistors on the circuit board, followed by the diodes, IC sockets, capacitors and transistors, in that order. Then loosely mount *T1* in place with machine hardware, plug its primary and secondary leads into the appropriate holes, and solder.

Prepare 19 12″ and three 8″ lengths of stranded hookup wire by stripping ¼″ of insulation from each end. Tightly twist together the fine wires at each end and lightly tin with solder. Install and solder one end of each of the 12″ wires in all holes except those labeled A, B, C, L1, L2 and the unmarked hole between *R17* and *T1* in the Fig. 3 component-placement diagram. Install one end of each of the 8″ wires in holes A, B and C.

Place the circuit board, component side up, to the left of the plastic box. Tightly twist together the fine wires in each conductor of the free end of the ac line cord and lightly tin with solder. Plug one of these wires into the left *T1* primary hole and solder into place. Form a hook in the other wire, slip it into the side lug of the fuse holder, crimp shut and solder. Prepare a 3″ length of heavy-duty standed wire as you did for the 8″ and 12″ wires. Form a hook at one end, slip it into the rear lug of the fuse holder, crimp shut and solder.

Trim away enough insulating outer jacket from the telephone line cord's free end to expose 3″ of insulated conductors. Clip off and discard the black and yellow wires. Strip away ¼″ of insulation from the red and green wires, tightly twist together the fine conductors in each wire, and lightly tin with solder. Plug either wire into the hole labeled *L1* and solder. Plug the other wire into hole *L2* and solder. (The coding of these wires is unimportant, since the *D1* through *D4* bridge in Fig. 1 will deliver the correct polarity signal to the telephone line.)

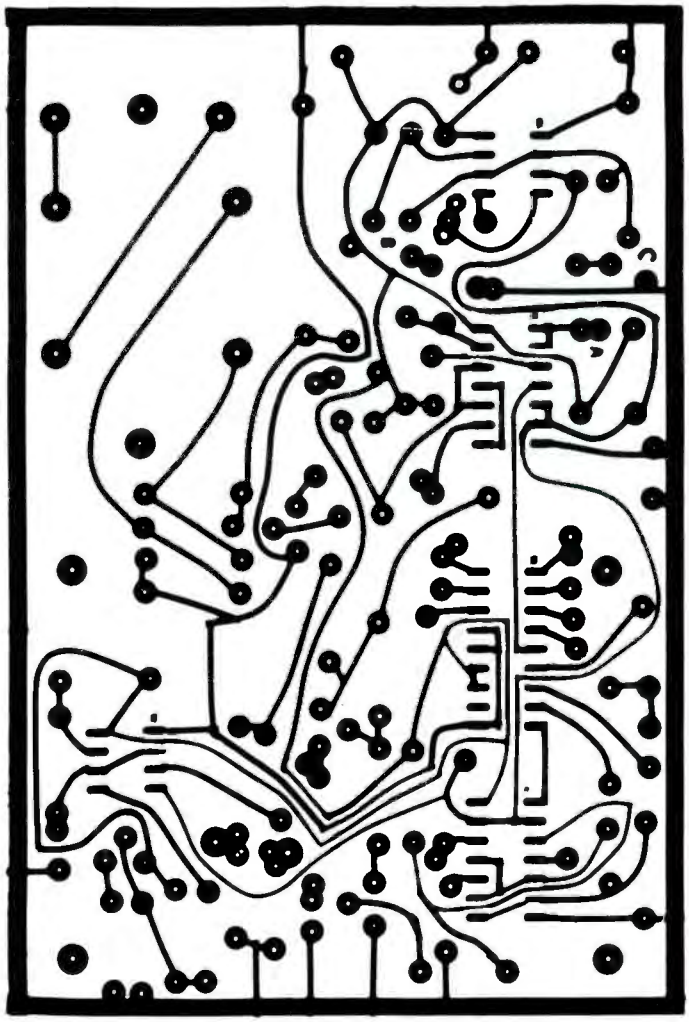
Finish wiring the project by connecting and soldering the free ends of the remaining wires to the board as follows:

From Board Pad	To
S2A	S2A toggle
S2B	S2B toggle
LED1, K	LED1 cathode
LED1, unmarked	LED1 anode
C1	C1 on keypad
C2	C2 on keypad
C3	C3 on keypad
R3	R3 on keypad
R2	R2 on keypad
R1	R1 on keypad
R4	R4 on keypad
S1	S1, either lug
S1	S1, other lug
LED2, K	LED2 cathode
LED2, unmarked	LED2 anode
A	lug A on TS1
B	lug B on TS1
C	lug C on TS1

Before connecting and soldering any of the wires to the leads of *LED1* and *LED2*, slip a 2″ length of insulating sleeving over the wires. Tack-solder the wires to the leads of the LEDs, and push the sleeving up over the connections and bare wire leads to protect against short circuits. Gently press the LEDs into their eyelet clips.

Plug the free end of the stranded wire attached to the rear lug of the fuse connector into the free *T1* primary hole and solder.

Remove the hardware loosely securing the transformer to the circuit board. Feed five 6-32 × 1″ machine screws through the mounting holes in the bottom of the box from the outside. (Be sure to keep *T1* from swinging free as you do this; otherwise, its leads may tear loose from the board.) Slide a ⅜″ or ½″ plastic spacer over each screw end. Now align the screw ends with the holes in the circuit



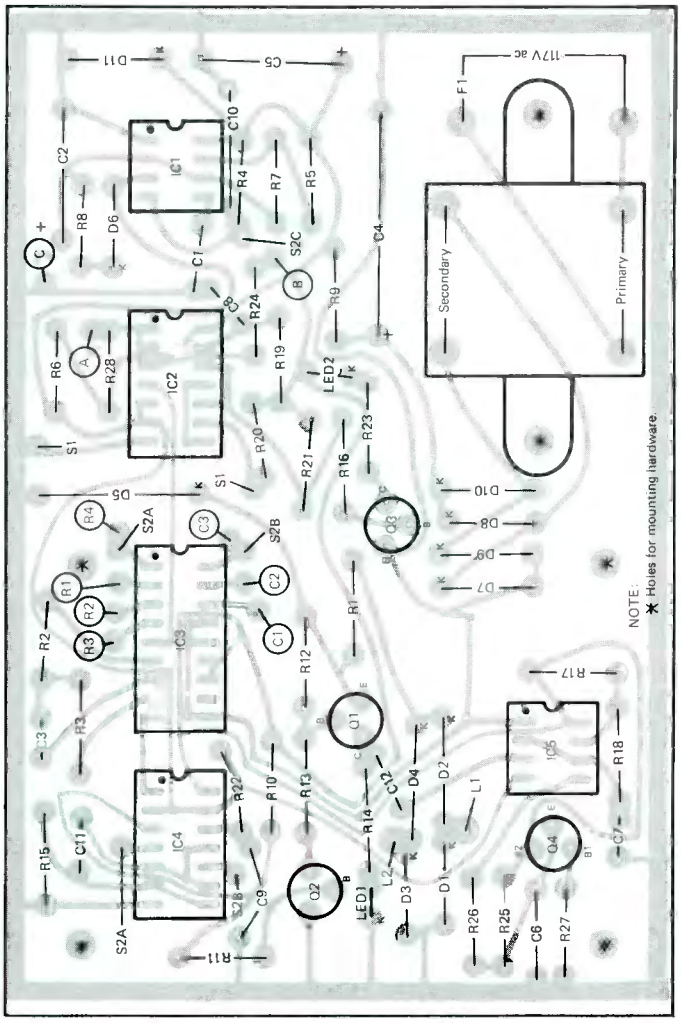


Fig. 3. Shown above is the full-size etching-and-drilling guide for Teleguard's printed-circuit board. The component's placement diagram at right can be used for wiring the pc board or an alternative perforated board.

board and push home. Drop a lockwasher onto each screw end and start a 6-32 nut on each. Gently tighten the hardware.

Checkout

Before you attempt to put Teleguard into service, you should perform some preliminary voltage checks with a dc voltmeter. Plug the line cord into an ac receptacle. Then, being careful to avoid touching any part of *T1*'s primary circuit, measure the voltage across *C4* and *C5*. You should obtain readings of about 7.5 and 3.9 volts, respectively. Clip the meter's common lead to the negative (ground) side of *C2* and measure the voltages at pin 8 of *IC1* and *IC5*, pin 14 of *IC2* and *IC4*, and pins 12 and 13 of *IC3*. In all cases, the readings should be 3.9 volts. If you obtain the proper results, disconnect the meter from the circuit and unplug Teleguard from the ac line.

Allow *C4* and *C5* to fully discharge. Then install the ICs in their respective sockets, referring to Fig. 1 for identifications and the component-placement diagram in Fig. 3 for locations and orientations. Practice the usual safety procedures when handling the ICs, since some of them are CMOS devices that are easily damaged by static electricity discharges. Place the lid assembly on the box and secure it in place with the supplied hardware. Finish assembly by labeling *S1* with the legend RESET, *S2* with the legends NORMAL and SET-UP, *LED1* with the legend OUTPULSING, and *LED2* with the legend OK. Use a dry-transfer lettering kit or a plastic tape labeler for this operation. If you use the dry-transfer method, spray two or three *light* coats of clear lacquer over it to protect the legends from scratching and peeling. Be sure to wait until each coat of lacquer is dry before spraying the next.

This completes part 1. Next month, we'll finish up with checkout and give installation details. **ME**