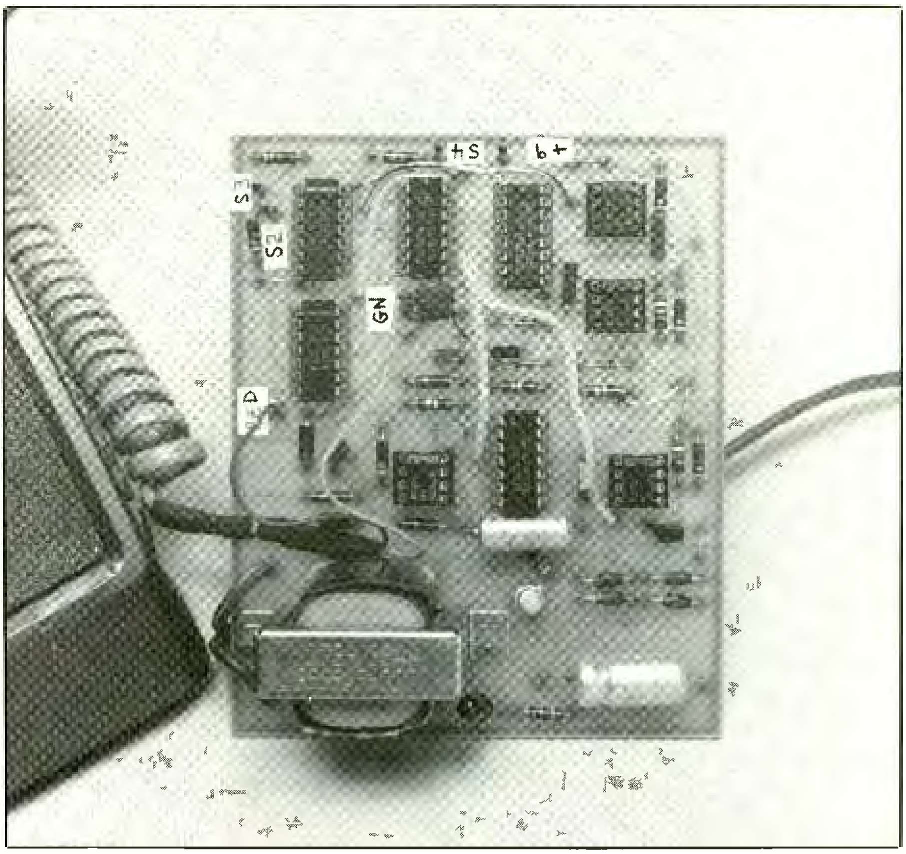
TattleTale

A unique home/office intruder and emergency monitor that you phone to find out if all is well

By Anthony J. Caristi



Have you ever wondered what's happening at home or your office when you're away? Does the thought of a break-in, fire or other calamity worry you? If so, Tattletale can put to rest your anxiety. Just a telephone call puts this project on the line so that it reports to you no matter how far away you might be.

TattleTale monitors and reports on up to three possible emergency situations, completely automatically. It can easily be activated each time you leave your home or office and has a LED that tells you when it is armed.

Emergency situations like break-ins, fire, flood, heating/cooling system failure, etc., can be monitored by connecting three independent normally open switches or thermostats to TattleTale's three sensor terminals. Additionally, a simple modification of the basic circuit lets you use normally closed switches.

With TattleTale armed, all you have to do is telephone the number of the premises being monitored. TattleTale immediately answers the phone and transmits a series of tones or beeps. If you hear one beep every couple of seconds, all is well. However, if you hear two, three or four beeps, one or more sensors have been tripped. The number of beeps you hear tells you the nature of the emergency, allowing you to take the appropriate corrective action. TattleTale continues to report back to you for about a minute and then hangs up and rearms itself. You can check TattleTale's status as many times as you wish.

About the Circuit

As shown in Fig. 1, TattleTale's circuit consists of two basic sections: the logic section composed of all ICs except *IC4* and *IC9* and the remaining circuitry that answers the telephone and places coded pulse tones on the telephone line.

NOR gate *IC1A* detects when any of the sensor switches, identified as *S2, S3* and *S4*, has been tripped. If no switches are tripped, *IC3A* is enabled and the second output at pin 7 of *IC5* triggers one-shot multivibrator *IC7* via *IC3A* and *IC1B*. If any of the sensor switches is activated, *IC3A* is disabled and one of the succeeding outputs of *IC5* triggers *IC7* in a similar manner.

Astable multivibrator *IC8* operates at about 3 Hz and clocks binary counter *IC5*. The first output, at pin 9, of *IC5* is half the clock frequency and each succeeding output has a period that's twice as long as that of the preceding stages.

The start of the reset pulse generated by *IC7* is determined by the out-

PARTS LIST

Semiconductors
D1 thru D4—1N4001 or similar rectifier diode
D5—1N4004 or similar 300 PIV rectifier diode
D6,D7,D8—1N4148 or similar switching diode
IC1—CD4002B dual 4-input NOR gate
IC2,IC3—CD4081B quad 2-input AND gate
IC4,IC7,IC8,IC9—LM555 timer
IC5—CD4040B 12-stage binary counter
IC6—CD4011B quad 2-input NAND gate
LED1—Light-emitting diode (Radio Shack Cat. No. 276-041 or similar)
Q1—MPSA42 or similar 300-volt silicon npn transistor
Q2—2N3904 or similar silicon npn transistor

Capacitors (15-volt)
C1—1,000-μF electrolytic
C2—0.47-μF ceramic disc
C3—0.22-μF ceramic disc
C5,C6—0.1-μF ceramic disc
C7—47-μF electrolytic
C8,C9,C10—0.01-μF ceramic disc
C4—0.1-μF, 200-volt ceramic or Mylar

Resistors (¼-watt, 5% tolerance)
R1,R2,R3,R18—10,000 ohms
R4—1.5 megohms
R5,R8,R12—1 megohm
R6—390,000 ohms
R7—22 ohms
R9,R10,R11—100,000 ohms
R13—2,200 ohms
R14—150 ohms
R15—39,000 ohms
R16—15,000 ohms
R17—680 ohms

Miscellaneous
F1—1-ampere fuse
S1—Spst slide or toggle switch
S2,S3,S4—sensor switches or thermostats (see text)
T1—6.3-volt, 300-mA transformer (Radio Shack Cat. No. 273-1284A or similar)
Z1—Varistor (Radio Shack Cat. No. 276-570 or similar)
Printed-circuit board or perforated board and suitable soldering or Wire Wrap hardware; sockets for ICs; suitable enclosure; ac line cord with plug; telephone cord with modular plug; panel-mount LED lens clip; rubber grommets; machine hardware; hookup wire; solder; etc.

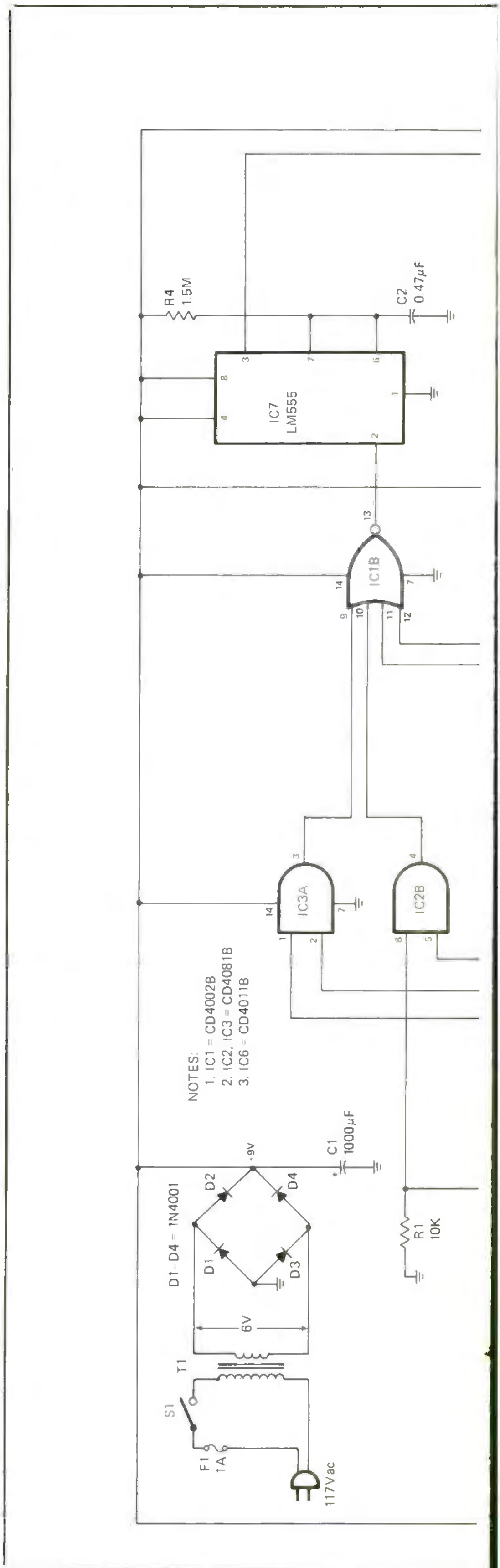
Note: The following items are available from A. Caristi, 69 White Pond Rd., Waldwick, NJ 07463: Pc board for $8.50; IC1 and IC3 for $2.50 each; IC5 for $3.50. Add $1.00 P&H. New Jersey residents, please add state sales tax.

put of *IC5*, which is permitted to pass through AND gates in *IC2* and *IC3* in accordance with the status of the sensor switches. In this way, the count length of *IC5* is controlled by the switches, and pin 9 of *IC5* will have one, two, three or four pulses that are used to enable 200-Hz tone generator *IC9*. Since *IC7* holds *IC8* and *IC5* in reset for 1 or 2 seconds each time it's triggered, tones generated by *IC9* are in groups of one, two, three or four bursts.

To answer the ringing telephone, TattleTale is designed to respond to the 90-volt, 20-Hz ring signal. The flip-flop "latch" composed of *IC6A* and *IC6B* has two stable states. When power is first applied to the circuit, the output at pin 4 of *IC6B* will be high, forward biasing *Q2* and turning on *LED1* to indicate that the circuit is armed and ready.

Any ring signal that appears on the telephone line is applied to pin 1 of *IC6A* and causes the latch to change state. The negative-going output at pin 4 of *IC6B* then triggers one-shot multivibrator *IC4*, causing its pin 3 output to go positive. Forward bias to *Q1* now connects *R14* across the telephone line and answers the call.

Since *IC4* has a time period of about a minute, the circuit will hold the line open for that period of time and then automatically hang up. The negative-going pulse at pin 3 of *IC4* is then used to reset the latch circuit



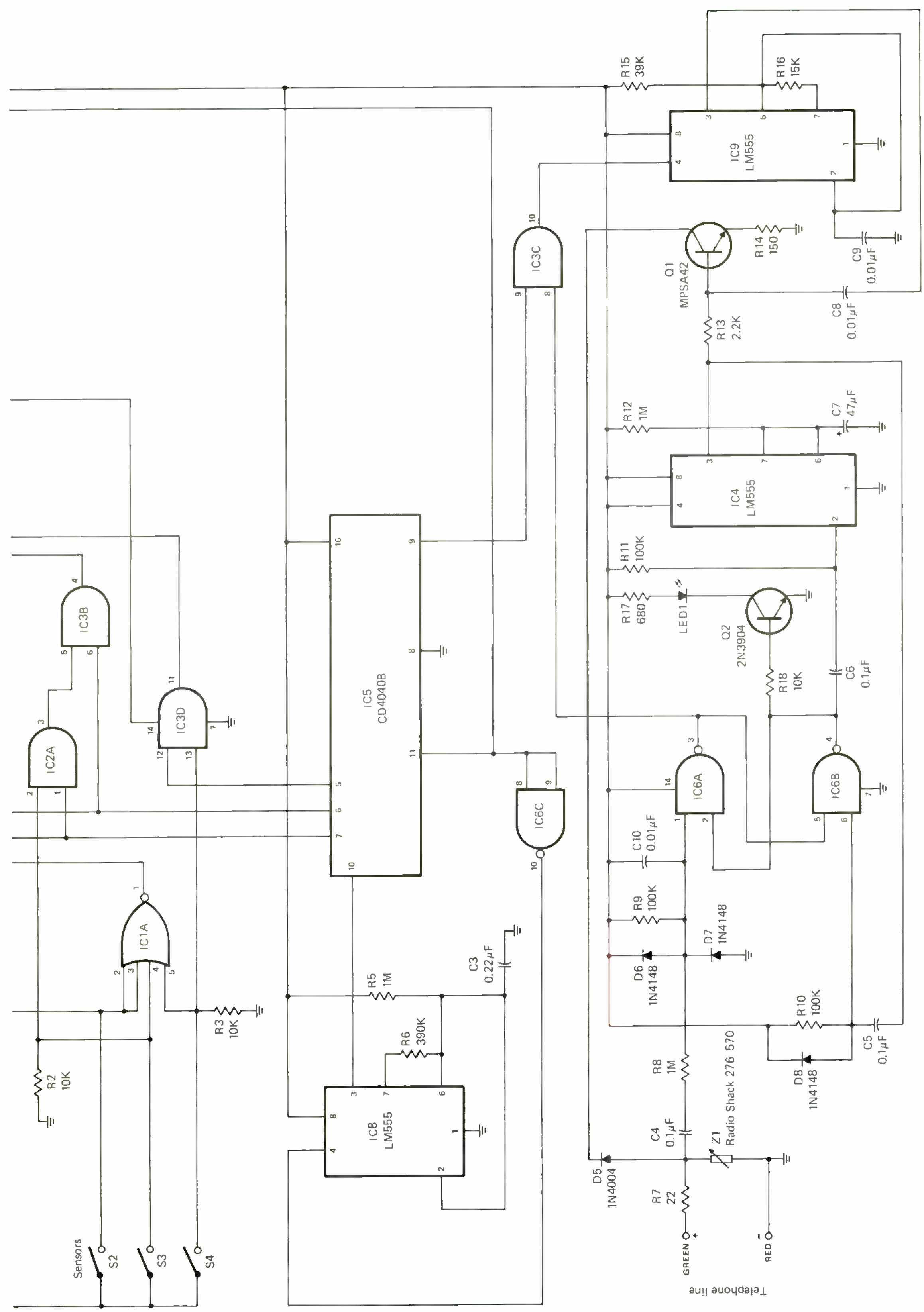


Fig. 1. Schematic diagram of complete project.

to the armed condition so that the project is ready to answer a later call when it arrives.

During the time *Q1* is conducting, tone bursts from *IC9* are fed to the base of the transistor and are thus fed into the telephone line. This provides you with the audio information that indicates the status of the sensor switches connected to TattleTale.

Note that the circuit is designed to work with normally open sensors. If one or more of the sensors you are using is a normally closed type, it can be used only if you add an inverter to the circuit for each. This inverter reverses the logic so that it conforms to the requirements of the basic circuit. Figure 2 illustrates this modification using a normally closed switch and *IC6D* (the spare gate in *IC6*) in place of *S2* in Fig. 1.

Examining Fig. 2, you will note that *R1*, which is normally connected to pins 2 and 3 of *IC1*, now connects to pins 12 and 13 of *IC6D*. With this circuit modification, *S5*, which is used in place of *S2*, must be a normally closed switch. This results in pins 2 and 3 of *IC1* being at logic 0 when no emergency exists, due to the inverting action of *IC6D*.

If your system calls for use of more than one normally closed sensor, you must add another chip to the Fig. 2 circuit. This chip can be a CD4011B or a CD4069B. Remember, though, that when using one section of a CD4011B as an inverter, you must connect both inputs together and that digital CMOS chips should never have input terminals that are left floating.

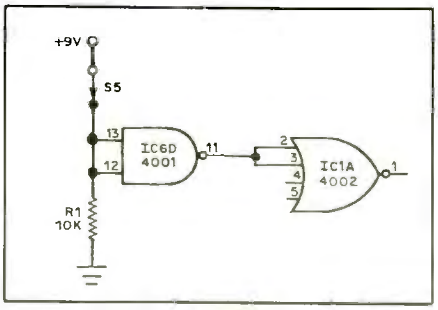


Fig. 2. Circuit modification for using normally closed sensors.

Construction

There's nothing critical about component layout. Therefore, any convenient means of assembly can be used to build Tattletale, including perforated board and soldering or Wire Wrap hardware and, preferably, a printed-circuit board. Use sockets for all ICs.

If you wish to fabricate your own pc board, use the actual-size etching-and-drilling guide shown in Fig. 3. When you're finished fabricating the board, drill a small hole 1½ ″ in from the right and ¼ ″ in from the top edges of the board with the board oriented as shown in Fig. 3. Drill a second small hole about ¼ ″ immediately to the right of the first hole. These two holes will be used to secure the telephone cord to the board to prevent it from pulling loose. If you prefer not to fabricate your own pc board, you can purchase a ready-to-wire one from the source given in the Note at the end of the Parts List.

Referring to Fig. 4, install and solder into place sockets for all ICs. Do *not* install the ICs in the sockets at this time. Next, install the resistors, followed by the capacitors, varistor, diodes, transistors and LED. Make sure the electrolytic capacitors, LED, diodes and transistors are properly oriented before soldering their leads to the pads on the board.

If you plan on installing TattleTale inside an enclosure, don't mount the LED on the enclosure's top. Instead, install 4″ lengths of hookup wire in the holes in the board, preferably using black insulation for the cathode wire and red insulation for the anode wire. Slip over either wire a 1″ to 1½″ length of insulating tubing. Then solder the free ends of the wires to the LED's leads, making sure you observe proper polarity. When the connections have cooled, push the tubing all the way up to the bottom of the LED's case

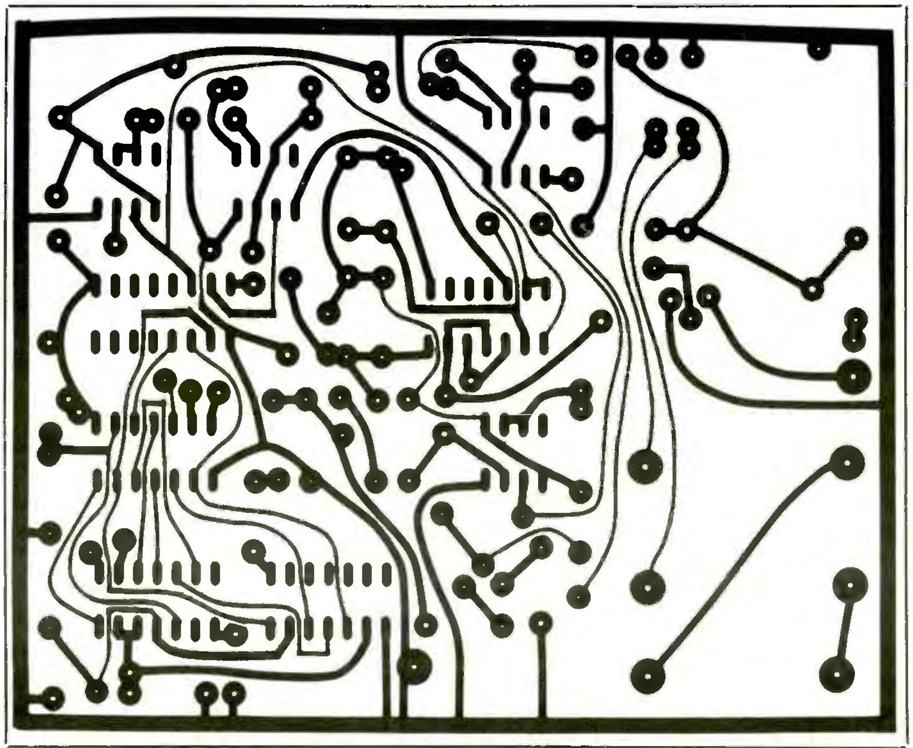


Fig. 3. Actual-size etching-and-drilling guide for fabricating pc board.

to make sure the connections and leads are well insulated from each other.

If you substitute components for those specified in the Parts List, keep in mind that because *Q1* must withstand the 90-volt rms ring signal, the transistor selected for it must have at least a 300-volt collector to emitter rating. The same applies to *D5*.

The Archer power transformer from Radio Shack indentified as *T1* in the Parts List mounts directly on the board as shown in the lead photo and indicated in Fig. 4, without the need for machine hardware to hold it in place. Be sure when you mount the transformer that its primary and secondary winding pins go into the appropriate holes. The pins for the primary and secondary are readily identified on the Archer transformer. If you use a different transformer that doesn't fit on the board, you can mount it on one wall of the enclosure in which you house the project and wire it to the board.

When all components have been installed on the board, you should have no trouble locating the holes for the jumper wires. Use solid bare wire for the shorter jumpers and insulated hookup wire for those that start between *IC1* and *IC3* and between *IC3* and *IC5*.

Trim ¼" of insulation from both ends of four 5"-long lengths of hookup wire. Install and solder these in the board holes identified as S2, S3, S4 and S2,S3,S4. These four wires go to a screw-type terminal strip that serves as the means for connecting the external sensor switches to the main circuitry.

Select a large enough enclosure to accommodate the pc-board assembly, POWER switch, power transformer (if it's going to be mounted off the board), a 4-position screw-type terminal strip and the fuse holder. The last can be a block type holder that mounts inside the enclosure or a more convenient through-the-wall bayonet type.

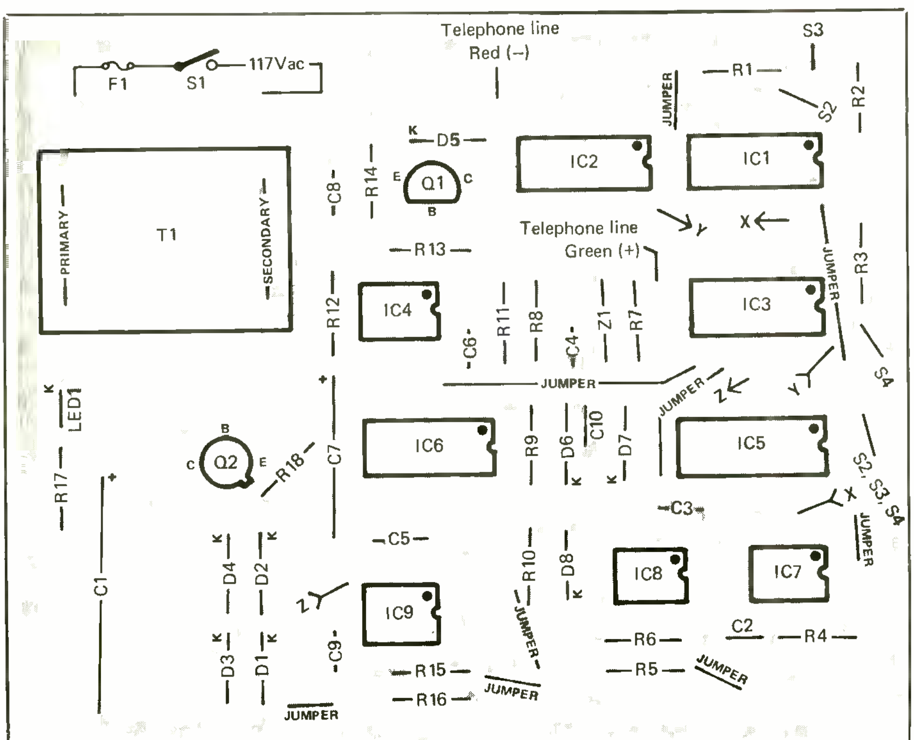


Fig. 4. Components-placement/orientation diagram for wiring pc board.

Machine the enclosure to permit mounting the pc-board assembly on the floor of it. If the power transformer is to be mounted off the board, drill mounting holes for it through the floor or rear wall. Now drill holes through the rear panel for the fuse holder and entry of the telephone and ac power cords and through the front panel for the POWER switch and the LED through the front panel. Then cut a rectangular slot and drill the mounting holes for the screw-type terminal strip through the rear panel.

Deburr all cut and drilled edges with a file. Line the telephone and line cord holes with rubber grommets and drop a panel-mount lens clip into the LED hole, or line it with a small rubber grommet that will hold the LED in place by friction. Prepare the free end of the line cord by separating the two conductors about 5" and trimming away ¼" of insulation from both. Tightly twist together the fine wires in each conductor and sparingly tin with solder.

Similarly, trim ¼" of insulation from the green and red wires at the end of the telephone cord opposite the end that terminates in the modular plug. If spade clips are on the end being prepared, remove and discard them and then trim away the insulation. Sparingly tin the conductors with solder. Slip over the prepared end of the cable a 2" length of small-diameter heat-shrinkable tubing, push it far enough back to leave 3" to 4" of the red and green conductors free and shrink it tight.

Pass the prepared end of the line cord through its grommet-lined hole into the enclosure and tie a knot just beyond the point where the two conductors meet. Then pass the prepared end of the telephone cord through its grommet-lined hole.

Mount the components—not the pc-board assembly— on the enclosure walls in their respective locations. If the transformer you are using must mount off the board and has lugs rather than leads for accessing its windings, connect and solder to its secondary lugs 4″ lengths of heavy stranded hookup wire. If the transformer has wire leads, remove ¼″ of insulation from all of them. Then mount the transformer on the enclosure.

Place the pc-board assembly near the enclosure and insert one conductor of the line cord in the second hole from the right at the top of the board and solder it to the pad. Connect and solder the other line cord conductor to one lug of the POWER switch. Then connect and solder appropriate lengths of wire from the other POWER switch lug to one lug on the fuse holder and from the other lug on the fuse holder to the indicated pad on the pc board. If the power transformer is mounted off the board, connect and solder the free ends of the wires previously installed on the board to its primary and secondary lugs or plug in and solder its leads to the appropriate pads. Make sure you wire the transformer into the circuit properly!

Solder the green and red conductors of the telephone cord as indicated in Fig. 4. Secure it to the board with lacing or other heavy-duty cord, via the two small holes you drilled for this purpose.

Use ¼″ spacers and 6-32 or 4-40 × ¾″ machine hardware to mount the pc-board assembly to the floor of the enclosure. Connect and solder the free ends of the remaining wires coming from the board to the lugs of the terminal strip. Then plug the LED into its lens clip or rubber grommet and install the fuse.

Checkout and Installation

Before putting TattleTale into service, examine it for poorly soldered connections and solder bridges, the latter especially between the closely spaced pads around the IC socket pins. Correct any faulty soldering immediately.

With the ICs still not installed in their sockets, plug the project's line cord into an ac outlet. Connect a dc voltmeter across *C1*, polarity as indicated in Fig. 4, and note the reading, which should be 9 volts. Leave the common probe connected to the negative side of *C1* and touch pin 8 of the 8-pin sockets, pin 14 of the 14-pin sockets and pin 16 of the 16-pin sockets with the positive probe and note the readings. If everything is wired correctly, all readings should be the same as across *C1* (9 volts).

If you obtain the proper readings, disconnect the line cord from the wall socket and allow time for *C1* to fully discharge. Then carefully install the ICs in their respective sockets, making sure that each is oriented as shown in Fig. 4 and that all pins go solidly into their socket contacts.

To check out the circuit, it's best to use an oscilloscope to observe waveforms. However, if you don't have a scope, use a voltmeter that has a 1-megohm or greater input resistance to check the dc levels of slow-moving waveforms.

When you turn on the ac power to TattleTale, the LED should light. With a piece of wire, momentarily short pin 1 of *IC6* to ground. The LED should extinguish and then, after about a minute, come back on. If you don't get the proper response, check the latch circuit by examining pin 4 of *IC6* as you momentarily short to ground first pin 1 and then pin 6 of this IC. This should cause the logic level at pin 4 to go first high and then low.

Check the one-shot action of *IC4* by momentarily shorting pin 2 of this IC to ground while examining the pin 3 output. This should go to about 9 volts when you trigger *IC4* at pin 2. It should then remain at 9 volts for about a minute and then drop back to 0 volt.

Set sensor switch *S4* to the closed position but leave switches *S2* and *S3*

(Continued on page 92)

open. Check pin 9 of *IC5* for four discrete pulses that repeat every second or so. Close *S3* and then *S2* (leaving the other switches open in each case) and check for three and two pulses, respectively. With no sensor switches closed, there should be just one pulse every second or so.

If you don't get the proper response, check the counter chain by temporarily removing *IC7* from its socket and shorting pin 11 of *IC5* to ground. (*Caution:* Always power down before removing or replacing any IC.) This will enable *IC5* to count continuously as it's clocked by *IC8*. You can then follow the waveforms produced by *IC5* through the AND gates in *IC2* and *IC3* to the trigger input at pin 2 of *IC7*.

Momentarily shorting pin 2 of *IC7* to ground and examining the 1-second pulse at pin 3 lets you manually check the one-shot action of this IC. This pulse should go to about 9 volts for a second and then to zero.

Temporarily removing *IC3* and connecting pins 4 and 8 of *IC9* together lets you check for a 2-kHz square wave at pin 3 of this IC.

When TattleTale passes all the above tests, it's ready to be put into service. Disconnect ac power, allow *C1* to fully discharge and replace the ICs in their sockets. Then connect TattleTale to the telephone line via its modular connector. Turn on power to the project and note once again that the LED lights.

To make an operational test, call your number from a telephone not on the same line. You should obtain an immediate answer in the form of a beep every second. Stay on the line until TattleTale disconnects about a minute later.

You can further check operation by closing one of the sensor switches and verifying that the proper number of pulses are being transmitted.

For protection against break-in, you can use any of the readily available magnetically or mechanically operated door and window switches. It's also possible to use a continuous closed-circuit foil loop on window panes, but remember to treat this as a normally closed sensor and make the circuit modification shown in Fig. 2.

To detect fire, heating/cooling system and refrigeration failure, it's easiest to use a suitable thermostat. For heating system failure, use a thermostat whose contacts close when the temperature falls. For fire and refrigeration and cooling failure, use a thermostat whose contacts close on a rise in temperature.

To detect flooding, you can buy or build a float switch that closes when the water level rises. For extra early warning, it's prudent to locate the float switch in a well or depression, such as the bottom of the sump where the pump is located. Be sure, however, that water never touches the electrical connections of your switch.

In Closing

With TattleTale standing duty as your security sentry while you're away from your home or office, you can relax. Any time you want to know what's happening, all you have to do is pick up the telephone, dial the number of the phone in the monitored location and listen for TattleTale's report. **ME**

ADVERTISERS' INDEX