Personal Intrusion Detector

Lets you know when someone has gone through your important business or personal belongings without authorization

By Charles Shoemaker, D.Ed.

Have you ever wondered if confidential documents stacked on an office desk or in a drawer were examined by unauthorized persons? In the home, too, there are doubtlessly some intrusions you would like to know about, such as someone being in the cookie jar after the evening meal. The Personal Intruder Detector described here is designed to monitor such intrusions.

This handy device looks like an old pill container (or other box) you are using as a paperweight. Arm it and it patiently waits for an unwary intruder to lift it up or tip it over, either of which causes a tell-tale light-emitting diode to blink to let you know that an intrusion has been detected.

Battery powered and very compact, our Personal Intruder Detector is virtually foolproof. Once tripped, the Detector's LED can be extinguished and the project be rearmed only by flipping switches in a specific sequence. Should an intruder disable power to the project, this will tell you that an intrusion has occurred. Our Personal Intrusion Detector is not a preventive device itself; however, it does inform you when it is time to take remedial action.

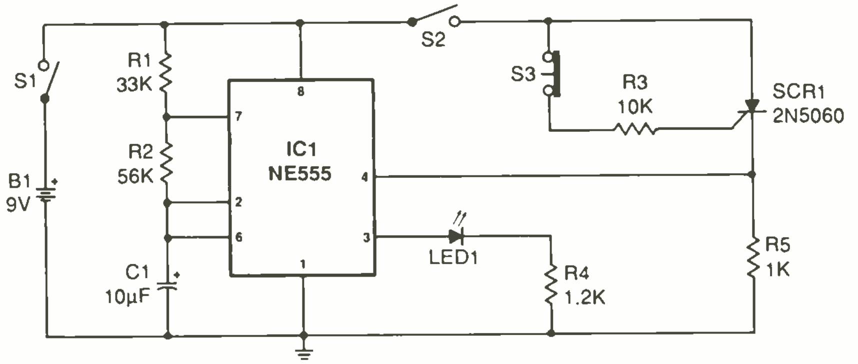
About the Circuit

Shown in Fig. 1 is the complete schematic diagram of the battery-powered Personal Intrusion Detector. The 555 timer chip used for *IC1* in this circuit is configured as a free-running low-speed oscillator that, when enabled, flashes light-emitting diode *LED1* on and off at a predetermined rate. When the output at pin 3 of *IC1* is in the positive cycle of the square wave generated by the timer, current flows from circuit ground through *R4* to light the LED.

Flash rate of the LED is determined with the formula t = 0.7(R1 + R2) × C1 = 0.7(33,000 + 56,000) × 0.00001, or 0.623 second. This works out to about 10 flashes every 6 seconds or so.

Power is applied to the circuit by closing *S1*. The oscillator is disabled when pin 4 of *IC1* is brought to ground through *R5*. This pin is held low (disabled state) because silicon-controlled rectifier *SCR1* blocks current flow to the positive power rail.

ARM switch *S3* is normally closed but is held open by the weight of the project bearing down on its lever (more about this later) when the project is armed and sitting in an upright position. Lifting the project or tip-



PARTS LIST

Semiconductors
IC1—NE555 timer
LED1—Red light-emitting diode
SCR1—SK3950 (RCA) or 2N5060 silicon-controlled rectifier in TO-92 case

Capacitors
C1—10-µF, 15-volt electrolytic

Resistors (¼-watt, 5% tolerance)
R1—33,000 ohms
R2—56,000 ohms
R3—10,000 ohms
R4—1,200 ohms
R5—1,000 ohms

Miscellaneous
B1—9-volt alkaline battery
S1,S2—Miniature pc-mount spst slide switch
S3—Spdt lever switch (Radio Shack Cat. No. 276-016 or equivalent)
Printed-circuit board or perforated board and suitable Wire-Wrap or soldering hardware (see text); suitable enclosure (see text); socket for IC1 (optional); snap connector for B1; nail or rivet (see text); hookup wire; solder; etc.

Fig. 1. Complete schematic diagram of the Personal Intrusion Detector.

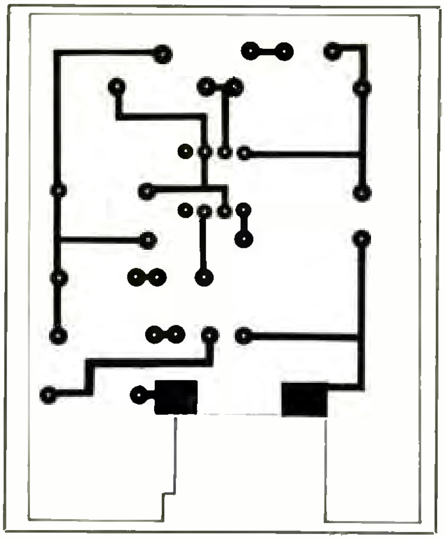


Fig. 2. Actual-size etching-and-drilling guide for project's printed-circuit board.

ping it over on its side removes the weight holding the switch open and automatically closes *S3*. This completes the gate circuit of the SCR to ground and allows current to flow from ground through *R5* to *SCR1*'s gate and *R3* to the positive rail. In turn, this causes current to flow through *SCR1*. When this occurs, *R5* drops about 8.28 volts, enabling the oscillator and causing *LED1* to flash.

When gated on, *SCR1* latches in the energized state by the dc holding current. Therefore, repositioning the project in its upright position will *not* return the Alarm to its armed condition. Once tripped, the project remains energized until power is switched off by opening *S1*.

The circuit is very sensitive, which accounts for inclusion of *S2*. This switch isolates the enabling circuit until it is finally set in the armed mode. When arming the project, *S2* is the last switch to be set.

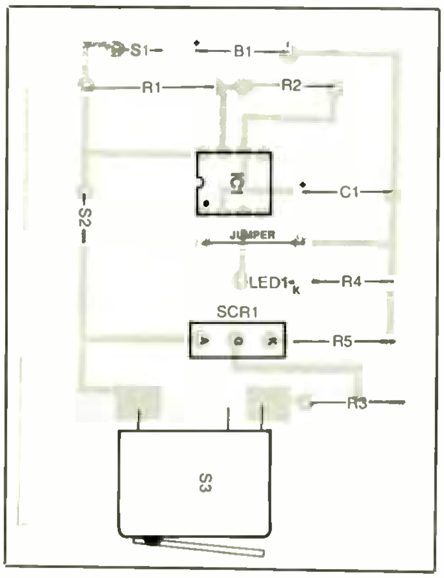


Fig. 3. Wiring guide for pc board. Use this as a rough guide to component layout if project is assembled on perforated board.

Construction

Component layout is not critical. Therefore, just about any traditional wiring technique can be used to build this project. If you wish, you can fabricate a printed-circuit board for it, using the actual-size etching-and-drilling guide shown in Fig. 2. Alternatively, you can use perforated board that has holes on 0.1-inch centers and suitable Wire Wrap or soldering hardware. Whichever approach you use, however, it is a good idea to use a socket for *IC1*.

This project's pc board is so simple that its resist pattern can be laid out directly on the copper side of the blank using Radio Shack's Cat. No. 276-1577 or other dry-transfer resist patterns. In fact, if you wish, you can even lay out the resist pattern free-hand using a resist pen.

From here on, we will assume that pc construction is being used. Refer to Fig. 3 for wiring instructions for this board. (Note: If you use perforated board, use the Fig. 3 wiring diagram as a rough guide to component layout and refer back to Fig. 1 for wiring details.)

You will note in Fig. 2 that a rectangular cutout must be made in one end of the pc board, which adds to the fabrication task. Make this cutout after etching and trimming to size the board but before drilling any holes. The best way to make the cutout is with a nibbling tool, though you can use a coping saw or even a Moto-Tool with a thin saw or abrasive wheel. Smooth the edges of the cutout with a fine file.

Start wiring the board by installing and soldering into place the IC socket. Do *not* install the IC in the socket until after the preliminary voltage check has been performed. Then install and solder into place the resistors and capacitor. Make certain that the capacitor is properly oriented before soldering its leads to the copper pads on the bottom of the board.

Next, identify the leads of the SCR. (The RCA SK3950 device specified for *SCR1* is housed inside a TO-92 case, which conserves space on the circuit-board layout. If you cannot find this particular SCR, try to obtain a substitute that has the same case.) Plug the leads of the SCR into the holes in the board provided for them and solder them into place. Similarly, identify the leads of the LED. Plug them into the appropriate holes in the board and solder.

All switches in this project mount directly on the pc board. Lever switch *S3* mounts in the cutout at the end of the board, with its toggle facing outward as shown. Take careful note of the orientation of this switch with reference to the pads on the pc board. This spdt switch has both normally-closed and normally-open contacts. You want to wire to the normally-closed contacts. With the switch oriented as shown, the normally-open contact lug will not be wired into the circuit. The other two switches are simply pc-mount devices whose lugs plug into the board's holes and are soldered into place.

Tightly twist together the fine wires at the ends of the battery snap connector's leads and tin with solder. Plug the leads of the snap connector into the holes labeled B1, red into the pad identified with a "+"

sign and black into the pad identified with a "–" sign, and solder both into place. This completes wiring of the circuit-board assembly.

The only other machining required for the pill container used as the project's enclosure is to drill two holes in it. (You can use a different type of container if you wish, such as a small plastic project box.) One hole is for the plunger that operates the lever toggle on *S3*, as shown in Fig. 4, the other for viewing the status of the LED. Be sure to accurately locate both holes before drilling them and make them only large enough to serve their purposes, and use a broadhead nail, tack or rivet as the switch pin. Whichever you use, make it only as long as needed for full travel of the switch lever without tilting the pill container.

Slide the circuit-board assembly into the container and check for proper operation of the lever on *S3*. When you are satisfied that the pill container is properly prepared, proceed to initial checkout.

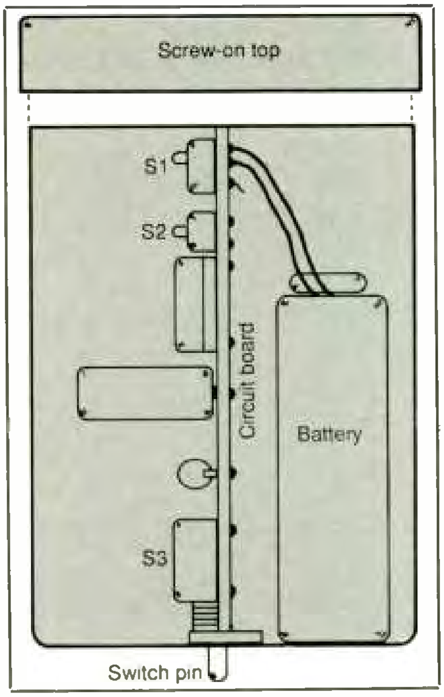


Fig. 4. Circuit-board assembly and battery mount inside plastic pill container. Lever on S3 is held in pressed state by weight of project and protruding shortened nail or rivet.

Checkout & Use

Clip the common lead of a dc voltmeter to the lead of *R1* that is farther away from the center of the board. The timer should *not* be plugged into the IC socket at this time. Plug a 9-volt battery into the battery connector and set *S1* to "on." Touch the meter's "hot" probe tip to pins 2, 6, 7 and 8 of the IC socket and note the reading obtained; it should be +9 volts. Close *S2* and check the potential at the anode of *SCR1*; again, the reading should be +9 volts. If you do not obtain the proper reading at any given point, disconnect the meter, remove the battery from the circuit and rectify the problem before proceeding.

When you are certain the project has been properly wired, power it down and install the 555 timer in its socket. Make sure it is properly oriented, as shown in Fig. 3, and that no pins overhang the socket or fold under between IC and socket.

Place a thin piece of non-conducting foam tape on the bottom of the circuit-board assembly to insulate it from the battery's case. Then slide the assembly and battery into the pill container and position it so that the toggle lever on *S3* operates freely.

You set your Personal Intrusion Detector by placing it upright on a flat surface so that its weight is on the switch pin that opens the normally-closed contacts of *S3*. With *S3* held open, set *S2* and finally *S3* to their "on" positions in that order. This arms the alarm.

Always keep in mind that this detector is very sensitive and that *S2* must be toggled to "on" as the last step in the arming procedure. Of course, *LED1* must be off during the arming operation.

Once the project is armed, any tipping or lifting of its container that causes *S3* to close will enable the oscillator and cause *LED1* to flash. Replacing the container in its original location and orientation will have no effect on the operating status of the alarm. That is, the LED will continue to flash until the circuit is reset. Even if the person who triggers the Detector should open the container and see the switches, he is not likely to know the rearming procedure.

To disarm the Personal Intrusion Detector, you must switch *S2* to its "off" position. This interrupts current flow through *SCR1* and disables the output at pin 3 of *IC1*. Another way to disable the Detector is to switch *S1* to "off," which removes power from the entire circuit. Whenever the alarm is not in use, *S1* should always be set to "off." **ME**