A Photonic Door and Window Intrusion Alarm

By Forrest M. Mims

THE circuit in Fig. 1 is the photonic equivalent of a conventional intruder alarm that uses magnet switches to detect open doors and windows. The circuit consists of two 555 timers, the first of which is connected as a free-running oscillator that drives the LED in a slotted optoisolator (or optocoupler) at a frequency given by $1.44/(R1+R2)C1$. Resistor *R3* limits current through the LED to a safe value.

The second 555 is connected as a monostable multivibrator that functions as a missing pulse detector. When the slot in the optoisolator is blocked, pulses from the LED do *not* reach the phototransistor in the optoisolator and the output from the one-shot is *low*.

When the slot is opened, the phototransistor receives pulses from the LED. With the first pulse, the one-shot begins its timing cycle. Its output goes *high* until the timing cycle is completed. The piezoelectric alerter is activated during this time.

The time constant of the one-shot is *R5C2*. If the time constant is adjusted so the timing cycle is *longer* than the interval between incoming pulses from the LED, the output from the one-shot will stay high and the alerter will emit a continuous alarm tone.

If, on the other hand, the timing cycle is *briefer* than the interval between pulses, the one-shot will complete its timing cycle before the next pulse from the LED arrives. This will cause the alerter to emit a pulsating warning tone.

The component values in Fig. 1 have been selected to provide the pulsating output tone because of its attention-getting impact. An added benefit is that in this mode the circuit consumes less current when the alarm is sounding.

Although I used a General Electric H20A1 slotted optoisolator, any LED-phototransistor optoisolator will work. Some of these devices, such as G.E.'s H13B1, have mounting holes. If you cannot locate one of these devices, you can make your own with a phototransistor and an infrared LED. Install the two components facing one another on a small phenolic board. Leave a gap of about 0.25" between them.

To operate this circuit as an intruder alarm, the optoisolator should be installed on the frame of the door or window to be protected. Attach an opaque projection flag such as a small aluminum L-bracket to the door or window so that it rests in the slot of the optoisolator when the door or window is closed. When the door or window is opened, the alarm will sound.

The circuit can be powered by a supply providing from 3 to 15 V. My prototype version, powered by a 9-V transistor radio battery, consumed about 8.5 mA in standby.

Going Further. An obvious simplification of the basic circuit in Fig. 1 is to replace the pair of 555 timers with a 556 dual timer. The circuit in Fig.2 is the result. Though it is functionally identical to the circuit in Fig. 1, I have included it to preclude the possibility of pin errors should you wish to try it.

Other variations are also possible. For example, the piezoelectric alerter can be replaced by a relay (Radio Shack 275-004 or similar) which, in turn, can switch on a siren or other powerful alarm signal. For silent alarms, substitute for the alerter a 270-ohm resistor in series with a red LED. The LED will flash at a rate of a few hertz when the alarm is triggered.

Still another variation is to replace the slotted optoisolator with a reflection-sensing transducer. The sensor, consisting of a LED and phototransistor facing in the same direction, can detect the presence of an object a few millimeters away. If the object is sufficiently reflective (add white tape if it is not), the alarm will sound. When the object is moved away from the sensor, the alarm will cease sounding. This operating mode can be reversed by connecting the alarm between pin 3 of the 555 and V_{cc}. This will cause the sensor to sound the alarm when a door, window or valuable object has been moved away from its detection zone.

Finally, be sure to assemble and install your alarm circuit with care, for the quality of your work will determine the reliability of the alarm. Be sure to not have exposed wires leading to the optoisolator to avoid pickup and replace the battery when necessary to prevent improper operation. ◇

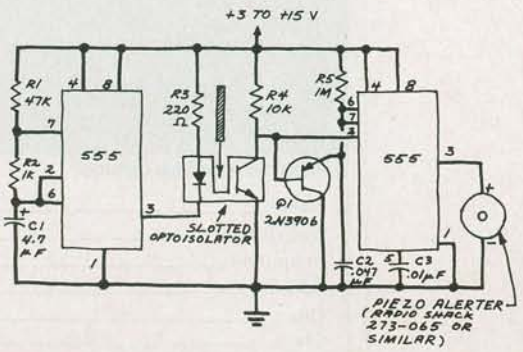

Fig. 1. Schematic of a simple photonic door and window intrusion alarm. Components shown provide a pulsating output tone.

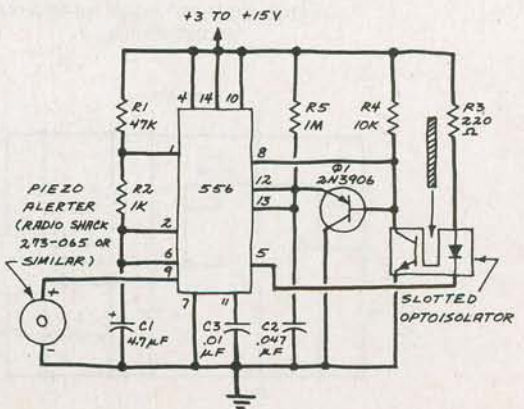

Fig. 2. In a variation of the circuit in Fig. 1, the two 555 timers are replaced by a 556 dual timer as shown here.