# A SIMPLE TOUCH CONTROL SWITCH

BY GEORGE PETERKA

Single FET amplifier circuit can be used to control relay or other low-current device

A TOUCH control is an electronic switch that can be activated simply by touching a small conductive plate with a fingertip.

Such controls are easy to build and can be used to enhance many projects. They can also be added to an existing circuit, such as forming an alarm "off" switch for a digital clock.

**Circuit Operation.** A basic touch control circuit is shown in Fig. 1A. Essentially, it consists of a FET amplifier with a high input impedance (10 megohms) and a conductive touch plate connected to its gate. Operation occurs when the ambient 60-Hz ac field flooding the area is impressed on the touchplate during the finger contact. This signal is amplified and appears at the drain as a 60-Hz square wave, alternating between ground and supply voltage.

Capacitor *C1* shunts any r-f picked up by the "antenna effect" of the touchplate, while capacitor *C2* acts as a transient suppressor.

The drain of *Q1* can be connected to the alarm-off pin of a clock chip, since most of these ICs require that the alarm-off pin be momentarily connected to the supply voltage to silence the alarm.

The circuit of Fig. 1B uses the same FET input stage, but, via *D1*, rectifies the ac waveform at the *Q1* drain and uses the generated positive voltage to turn on transistor *Q2*. The positive voltage developed across *C3* will keep *Q2* turned on until the capacitor is discharged by base current and resistor *Rx*. The value of this latter resistor determines how rapidly the switch will shut off and should be between 10,000 and 100,000 ohms.

The load on *Q2* can be a low-current relay or a resistor (1000 to 5000 ohms) with the signal generated across the resistor used to turn on a high-power transistor. Using the transistor shown for *Q2*, any device that requires 50 mA or less can be powered.

**Construction.** Any form of construction may be used since the circuit is relatively simple. It should be powered from an ac-line supply for reliable operation.

The touch plate should be relatively small—several square inches are enough. It must be insulated from ground. But it need not be a discrete metal plate; a metal door-knob on a wooden door will suffice. This latter type of touchplate makes an excellent sensor in an alarm project. ◇

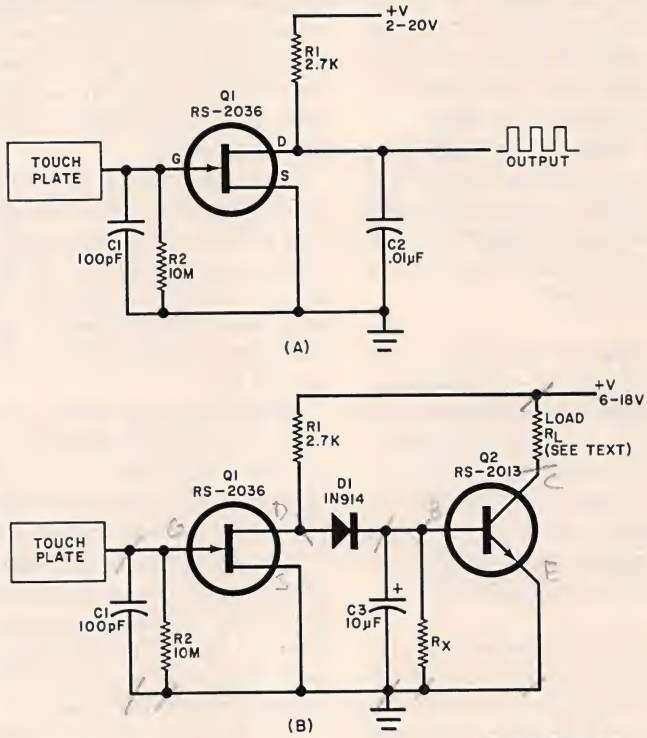



*Fig. 1. At (A), high input impedance FET developes a square-wave output when gate is touched by fingertip. Transistor Q2 (B) is added to drive external devices.*

**PARTS LIST**

C1 — 100-pF, disc
C2 — 0.01-μF, disc
C3 — 10-μF, electrolytic
D1 — 1N914 or similar
Q1 — N-channel FET, RS2036 or similar
Q2 — Npn transistor, RS2013 or similar
R1 — 2700 – ohm resistor
R2 — 10 – megohm resistor
Rx — 10,000 to 100,000 ohms (see text)
Touchplate — see text.
Misc. — Perf board, mounting hardware, power supply, etc.

# OPEN-DOOR "FRIDGE ALARM" STOPS FOOD SPOILAGE AND ENERGY WASTE

REFRIGERATORS are among the hungriest of household appliances in terms of electrical power consumption. Every time a refrigerator door is opened, cold air spills out and the warm air that replaces it must be cooled. Needless to say, it pays in dollars and cents to limit the time the door is open to as brief a period as possible. The low-cost Fridge Alarm described here maybe just what you need to limit the time you study the contents of your refrigerator or your child forgets to close the door.

The Fridge Alarm is a photoelectric device that is activated as soon as the door opens and the refrigerator's light goes on. It sounds an insistent two-tone signal if the door remains open past a given number of seconds.

**About the Circuit**. As shown in Fig. 1, when light strikes its photosensitive surface, *Q1* triggers into conduction and causes *Q2* to saturate. This places pin 1 of *IC1* close to ground potential and allows the timer to start operating (Fig. 2). Since the voltage across *C1* is initially zero, *IC1* is triggered into immediate operation. Timing is controlled by *R8*, *R1*, and *C1*.

During the timing sequence, the output of *IC1* at pin 3 remains high (almost at $V_{CC}$) and keeps *IC2* and *IC3* cut off, since pin 1 of each of these integrated circuits is connected to this line.

Most electrolytic and many aluminum capacitors can have sizable leakage currents. Hence, they should not be used in timing circuits. To avoid this problem, *C1* should be a tantalum capacitor. Using the time constants shown, *R8* can be set for periods of from 4 to 17 seconds. (This range was selected because 8 seconds is about the mean time for access to a refrigerator.) Because *C1* discharges through *D1* and the 15,000-ohm internal resistance of *IC1*, pin 7 is left unconnected.

If the light striking *Q1* is interrupted during the timing cycle, both *Q1* and *Q2* turn off and timing capacitor *C1* rapidly discharges through *D1* and *IC1*, resetting the timer. In darkness, *Q1* has a very high collector-emitter resistance. With *Q2* in cutoff, standby current is extremely low.

Should the light striking *Q1* be constant, the timing cycle will run its course and the output at pin 3 of *IC1* goes low. This effectively grounds pin 1 of both *IC2* and *IC3*, activating these ICs.

Integrated circuits *IC2* and *IC3* are wired to operate as astable multivibrators. The oscillating frequency of *IC2* is about 4 Hz. This 4-Hz signal "modulates" *IC3*, and the output of *IC3* directly drives a small loudspeaker.

The two-tone sound is created by alternately shunting the *IC2* end of *R4* between $V_{CC}$ and ground at a 4-Hz rate. When pin 3 of *IC2* is high, the parallel combination of *R4* and *R5* produces about a 500-Hz tone. When pin 3 is low, *R4* is effectively shunted to ground. This reduces the voltage at pin 7 of *IC3*. Since *C6* must now charge to 80% and then discharge to 40% of this new value to activate the comparators inside *IC3*, about a 330-Hz tone is generated. The two tones alternate at a 4-Hz rate as long as the circuit is activated.

**Construction**. All components, except *B1* (and its optional battery holder) and the small loudspeaker can be mounted on a printed circuit board. The actual-size etching-and-drilling guide and components-placement guide for the pc board are shown in Fig. 3.

The leads of *Q1* can be identified with the aid of an ohmmeter and light source if an unmarked phototransistor is used.

The project can be mounted inside a small translucent box that permits sufficient light to pass through and trigger *Q1* into conduction. Any of the various polyethylene refrigerator-type storage containers on the market will suffice as long as they are large enough to accommodate the circuit. The loudspeaker is best secured to the bottom of the container (after drilling a number of small holes for

***Sounds an alarm after preset time when refrigerator door is left open***

**BY ELLIOT K. RAND**

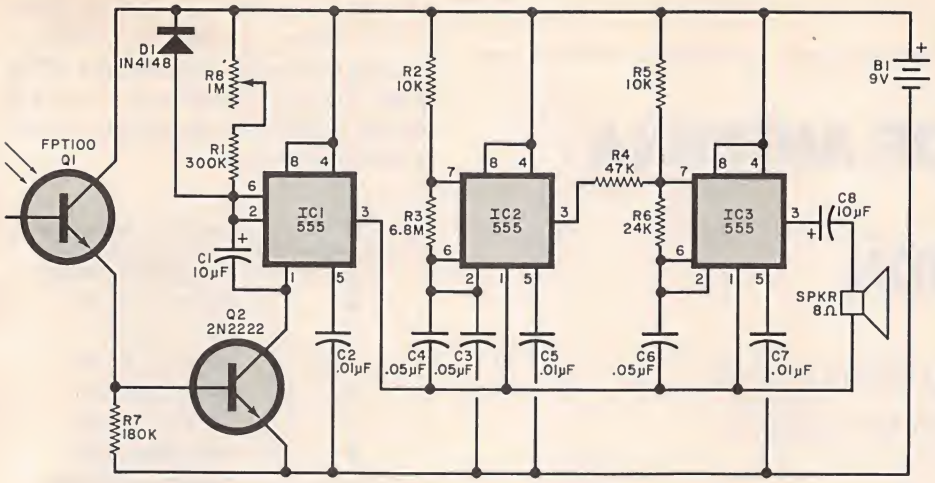



*Fig. 1. Timing action of circuit is initiated by light striking Q1.*

**PARTS LIST**

B1—9-volt battery
C1—10-µF, 25-V tantalum capacitor
C2,C5,C7—0.01-µF disc capacitor
C3,C4,C6—0.05-µF disc capacitor
C8—10-µF, 25-V aluminum capacitor
D1—1N4148 or similar diode
IC1, IC2, IC3—555 timer
Q1—FPT100 or equivalent
Q2—2N2222 or similar transistor
All resistors ¼-watt, 10% tolerance:
R1—300,000 ohms
R2, R5—10,000 ohms
R3—6.8 megohms
R4—47,000 ohms
R6—24,000 ohms
R7—180,000 ohms
R8—1-megohm trimmer potentiometer
SPKR—Miniature 8-ohm loudspeaker
Misc.—Battery holder; translucent plastic refrigerator container (about 3" square); silicone-rubber cement; hookup wire; etc.

Note: The following items are available from Rand Laboratories, P.O. Box 468, Cape Canaveral, FL 32920: complete kit of parts including drilled case for $9.95 postpaid. Also available; pc board only, $4.25 postpaid. Florida residents, please add sales tax.

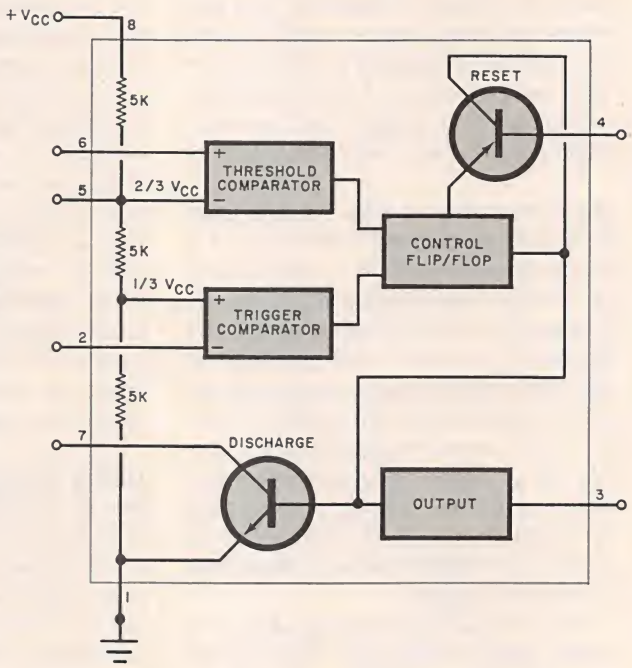
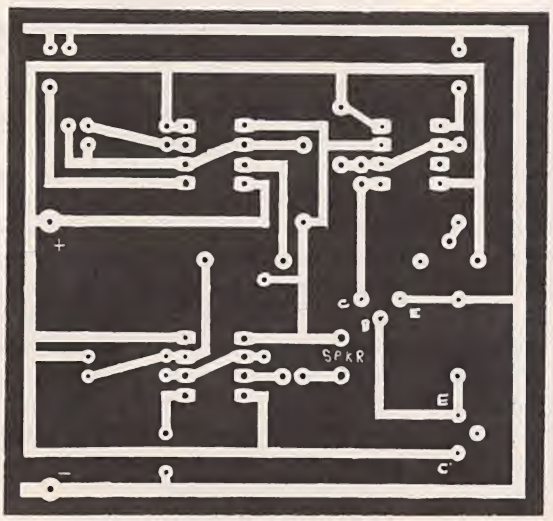



*Fig. 2. Block diagram of principal circuits in the 555 IC. In this case, one 555 is used as timer, and two as astable multivibrators.*

the sound to escape down through the shelf) with silicone-rubber cement. The speaker and pc board are interconnected with #20 wire so that the board can be positioned to allow maximum exposure of Q1 to the lamp.

The assembled alarm can be tested by placing it in a darkened location and shining a light on it. After a several-second delay, the alarm should sound. Count the number of seconds between the time the light goes on and the alarm sounds. Adjust *R8* as needed for the desired delay between the two events.

Place the Fridge Alarm inside your refrigerator in a location where it will receive the maximum amount of light from the refrigerator's lamp. Make sure it is in a location where there will be no possibility of liquid spills on it. Equally important, make sure that the selected location will obviate any possibility of obstructing the light. ◇



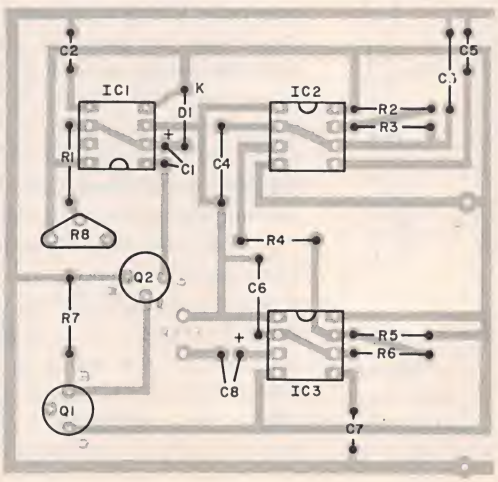




*Fig. 3. Components are mounted on board as shown at left and enclosed in a translucent box.*