NEW IDEAS

Proximity power switch

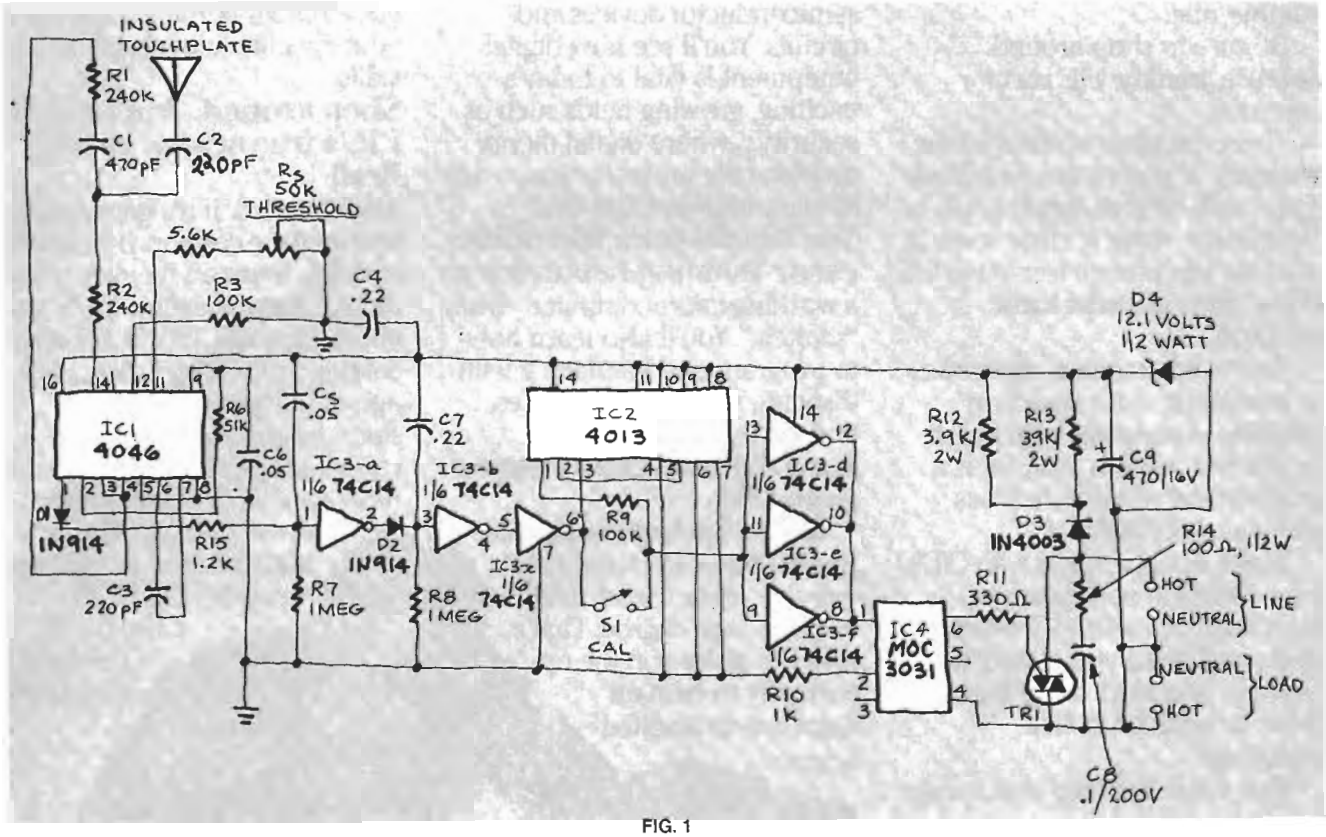

FIG. 1

HOW MANY TIMES HAVE YOU COME YOUR home with your arms loaded down with packages and, after great difficulty, managed to turn on the light? And how often have you wished for an easier way? This month we'll look at a little gadget that allows you to switch an AC device on and off by simply passing a hand (or some other part of the body) near an insulated touchplate.

How it works

The circuit is powered by a 12.1-volt regulated power supply made up of diodes D3 and D4, capacitor C9, and resistors R12 and R13. The AC voltage is picked directly off the AC line and rectified by D3 (half-wave rectifier). The resulting DC voltage is filtered by C9 and regulated by D4, a 12.1-volt Zener.

Turning to the rest of the circuit we have IC1, which is a 4046 PLL (*P*hase-*L*ocked-*L*oop). That IC contains a VCO (*V*oltage-*C*ontrolled-*O*scillator), a source follower, and two phase comparators (which we'll call comparators 1 and 2) with a common input-amplifier. When power is applied to the IC, the VCO outputs a signal at pin 4 that is fed to both comparators via pin 3 for use as a reference. That same signal is also fed to its input at pin 14 through an R-C network consisting of R1, C1, and R2. As long as there's no phase difference detected by the internal phase-comparator between the VCO output and the input signal, the output of IC1 is zero. But when a hand is passed close to the touchplate, body capacitance causes a phase difference. That phase difference is fed to the comparators through the common input amplifier. Comparator 1 now takes that input signal, compares it to the reference and outputs a squarewave signal at pin 2 that is proportional to the difference between the two input signals.

The output of comparator 1 is then filtered and fed to the VCO as an error signal. The error signal causes the VCO to generate an error-correction signal, which is then fed back to the comparators. Comparator 2 then outputs a train or series of pulses that is fed to a pulse-stretching circuit consisting of three of the op-amps contained in IC3, a 74C14 hex Schmitt trigger. (A pulse stretcher is a shaping circuit whose output pulse duration is greater than its input.) The stretcher circuit also provides for debouncing and noise rejection.

After conditioning, the signal is fed to pin 3 of IC2, a 4013 dual D-type flip-flop that's used as a toggle flip-flop for alternate-action switching. By that we mean that the device is turned on or off alternately by the input signal (push on/push off). To accomplish that action, the $\overline{Q}$ output of the flip-flop (pin 2) is fed to its DATA input (pin 5). The logic level at the pin 5 is transferred to its Q output at pin 1 during each positive-going transition of the clock pulse.

At this point, the Q output of the flip-flop is fed to the remaining three inverters

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of the IC3. They are paralleled to provide enough current to drive IC4, an MOC3031 optically-coupled triac driver. When the triac is turned on, current will flow through the triac and the lamp or appliance that is connected to its terminals, turning it on, too.

The touchplate can be made from a one-inch square piece of copper-clad board with a 4-inch piece of wire soldered to it. It should be connected to capacitor C2, as shown. Once you have it all together, the next step is to make sure that it works. To do so, close switch S1 (labeled CAL) and connect a lamp to the load terminals. Now, apply power and adjust potentiometer R5 down from its maximum resistance until the lamp comes on. Bring your hand near the touchplate to insure that the lamp extinguishes. If everything is OK, open S1; the lamp should alternately switch on or off when the touchplate "switch" is activated.

For safer and more stable operation, a low-voltage supply can be used (with R10 adjusted accordingly). However, it will be difficult to mount the switch behind a wall plate if you do that.

OOOOOPS!

A potentially dangerous error worked its way into the proximity power-switch schematic presented in the "New Ideas" column in the May 1984 issue of **Radio-Electronics**. In the lower right-hand corner of Fig. 1, the neutral line is connected directly to the load's hot line, short-circuiting the output. The neutral line should *not* be connected to the hot line. Instead, it should be connected to the circuit ground.(See figure to right.)—*Editor*