Build this simple touch-sensitive alarm

Based on a single integrated circuit, this simple project can be used in a variety of applications. Just place your hand on a door handle or a metal plate, and the circuit will immediately sound an alarm. We've nicknamed it the "Little Horror Burglar Alarm".

design by RON DE JONG
article by GREG SWAIN

The "Portable Burglar Alarm" – well, that's our official title for this project. And a dull and uninspired title it is too.

It didn't take long for the office wit to think up an alternative title. After hearing the unit in action, he promptly christened it the "Little Horror Burglar Alarm", this title in honour of the "horrible" noise that the unit makes when activated. The new name subsequently stuck to the unit, although some staff members were heard to mutter other names whenever the unit was tested.

But in spite of the flippant nickname, the Portable Burglar Alarm is really a most useful gadget. Essentially, it is a touch-sensitive alarm unit, originally designed to hang on a doorknob and thus monitor the door. Whenever a potential thief touches the doorknob on the other side of the door, the alarm will briefly sound to warn the user (and hopefully scare off the intruder).

The new alarm can thus provide a degree of protection against an intruder in your home, or whenever you stay at a motel/hotel. Readers should note, however, that the unit does have one drawback – because of the way the circuit works, it cannot be used with doors that have a metal door jamb.

While this drawback does limit the usefulness of the device as a burglar alarm, the circuit has many other useful applications. It could, for example, be used as a touch sensitive bedside alarm for a sick person, an attention alarm on shop counters, or adapted for use as a novel door chime. In these applications, the unit is simply wired to a metal touch plate.

THE CIRCUIT

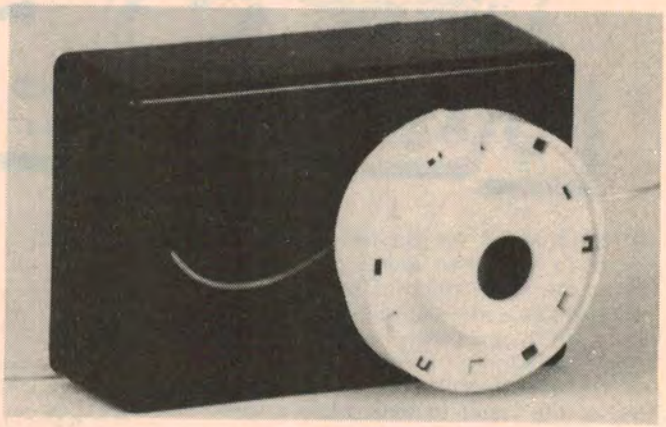
Heart of the circuit is a single 74C14 hex Schmitt trigger inverter IC, together with a piezoelectric alarm unit and a handful of other components.

However, before becoming too involved in the circuit, let's first find out how a Schmitt trigger works.

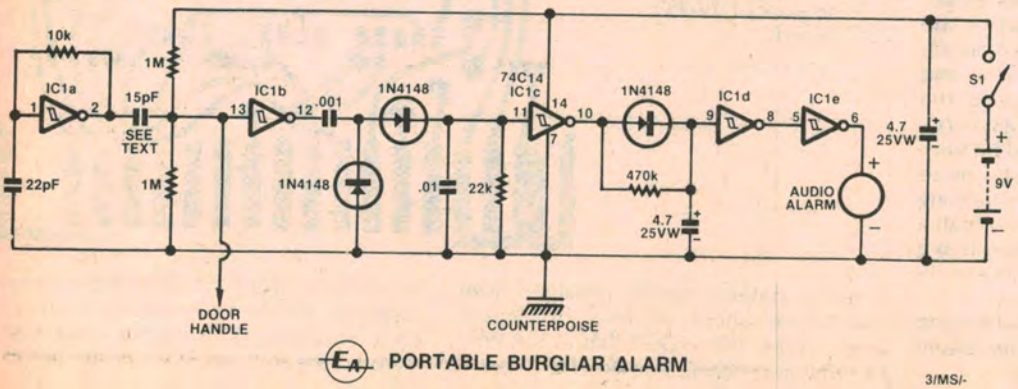
Briefly, a Schmitt trigger is a device with two widely spaced trigger voltages – an upper trigger voltage and a lower trigger voltage. The output of the device changes state only when the applied input voltage is greater than the upper trigger voltage, or less than the lower trigger voltage. Applied input voltages between the two trigger points cause no change in the output, an effect referred to as hysteresis.

The first Schmitt inverter (IC1a), together with its associated 10kΩ feedback resistor and 22pF capacitor, forms a simple oscillator with a nominal frequency around 1MHz. As can be seen from the circuit diagram, the 10kΩ feedback resistor is connected between the input and output of the inverter, while the 22pF capacitor is connected between the input and ground. These components set the oscillator frequency.

Let's initially assume that the input to the inverter is low and that the output is



RIGHT: a plastic zippy box was used to house the prototype. The alarm unit is held in position with epoxy adhesive.



The device consists of an oscillator driving a rectifier circuit via Schmitt trigger IC1b, together with Schmitt triggers IC1c, IC1d and IC1e. When the metal door handle is touched, the input to IC1c goes low and the alarm turns on.

PORTABLE BURGLAR ALARM

3/MS/-

high. The capacitor on the input will now charge up via the feedback resistor until it reaches the upper trigger voltage and switches the output of the inverter low. At this point, the capacitor discharges via the resistor into the output until its voltage reaches the lower trigger point. The inverter then switches over again, and so the process continues indefinitely.

The oscillator output passes via a 15pF capacitor to a second Schmitt inverter, IC1b, which in turn is AC-coupled to a full-wave rectifier circuit. As long as the door handle (or metal plate) is left untouched, the oscillator output will alternately switch the input to IC1b above and below its two trigger voltages. IC1b's output will thus switch alternately low and high at the clock rate to drive the rectifier circuit.

The output of the rectifier charges a .01μF capacitor to almost full supply voltage, thus holding the input of IC1c

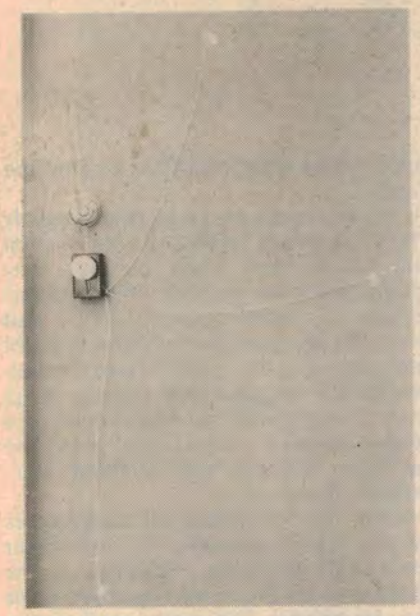
PARTS LIST

1 audio alarm, Dick Smith L-7024 or similar
1 PC board, 81ma4, 53 × 43mm
1 zippy box, 83 x 54 x 28mm
1 SPDT miniature toggle switch
1 9V battery, Eveready 216 or similar
1 battery clip to suit above
1 74C14 CMOS hex Schmitt trigger
3 1N4148 signal diodes
2 4.7μF 25VW electrolytic capacitor
1 .01μF greencap (metallised polyester) capacitor
1 .001μF greencap
1 22pF polystyrene or ceramic capacitor
1 15pF polystyrene or ceramic capacitor
2 1MΩ resistors
1 470kΩ resistor
1 22kΩ resistor
1 10kΩ resistor
MISCELLANEOUS
Solder lugs, 22 SWG tinned copper wire
2 metres hook-up wire.

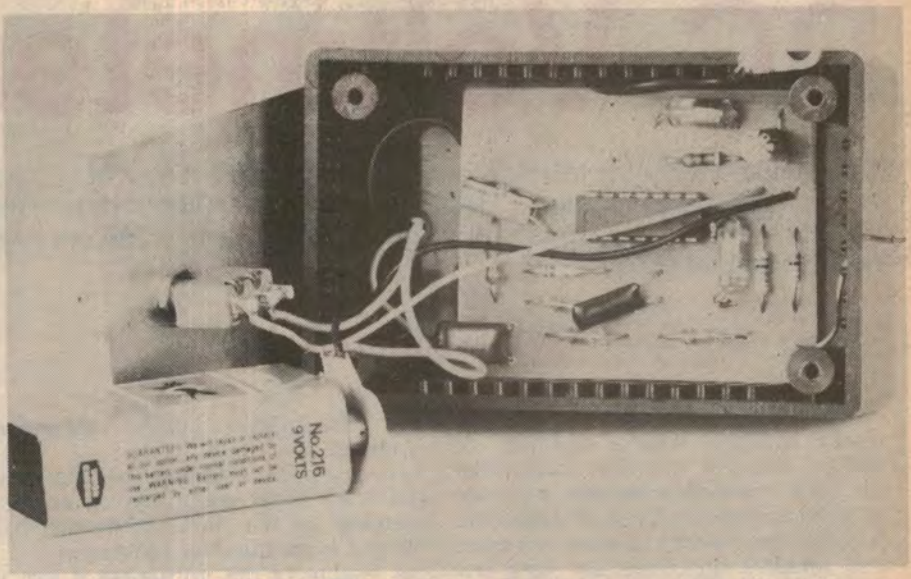
above its upper trigger voltage. As a result, the outputs of IC1c, IC1d and IC1e will be low, high and low respectively, and the alarm will be off.

If, however, the door handle or metal plate is touched, most of the signal from the oscillator will be capacitively shunted to the counterpoise which forms a pseudo earth. Pin 13 of IC1b will now be held at half supply voltage by the two 1MΩ bias resistors (ie between the two trigger voltages) and the output (pin 12) will thus remain either high or low.

Whether or not IC1b's output is held high or low depends on its state at the moment the signal from the oscillator is interrupted. Either way, it makes no dif-



This view shows how the counterpoise is taped to a door. Unit is hung from the door handle using tinned copper wire.

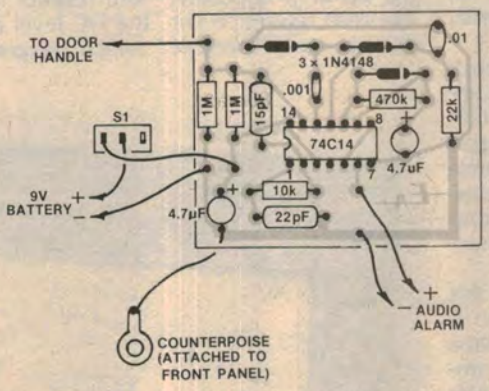


Inside the prototype. Note how several of the capacitors have been pressed against the circuit board to make room for the battery.

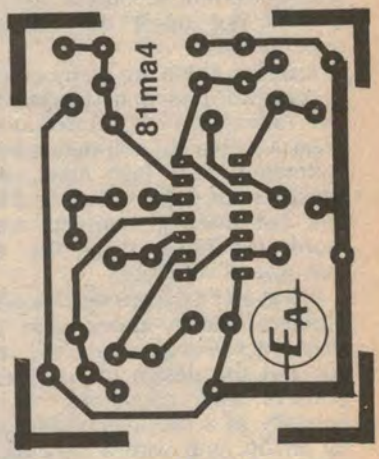
We estimate that the current cost of parts for this project is about

$15

including sales tax.



Above is the wiring diagram while at right is an actual size artwork for the PCB.



ference to the operation of the circuit. As long as IC1b's output is held in one state, no signal can reach the rectifier circircuit to charge the .01µF capacitor.

The .01µF capacitor now discharges via the 22kΩ resistor, pulling pin 11 of IC1c low. This forces pin 10 high, pin 8 (IC1d) low, and pin 6 (IC1e) high to sound the alarm. The alarm will continue to sound for as long as contact is made with the door handle.

Included in the circuit is a simple time delay network consisting of a 4.7µF capacitor, a 470kΩ resistor and a 1N4148 diode. Its purpose is to provide a minimum alarm time should momentary contact only be made with the touch plate. The delay circuit works as follows:

When pin 10 of IC1c goes high, the 4.7µF capacitor is charged to almost the full supply voltage via the diode. If pin 10 subsequently goes low (ie contact with the touch plate ceases), the diode will be reverse biased and pin 9 will initially be held high by the charge on the capacitor. The 4.7µF capacitor then discharges into the output of IC1c via the 470kΩ resistor, reaching the lower trigger voltage of IC1d and shutting of the alarm after about two seconds.

Power for the unit is derived from a single 9V battery, with decoupling provided by a second 4.7µF electrolytic capacitor. An alternative is to use a plugpack supply if you intend using the unit in a fixed installation.

CONSTRUCTION

Commence construction by fitting and soldering the components to the printed circuit board (PCB), as shown in the overlay diagram. This board is coded 80ma4 and measures 53 x 43mm. Pay particular attention to the orientation of the diodes, electrolytic capacitors and IC.

Note the 74C14 is a CMOS device. When soldering it into circuit, earth the soldering iron barrel to the earth track on the board using a small clip lead, and solder the power supply pins (pins 7 and 14) first. These precautions are to prevent possible damage to the IC by static charges.

The assembled PCB, together with the battery, is mounted inside a small plastic zippy box measuring 83 x 54 x 28mm. Use a thin piece of foam rubber to prevent shorts between the battery and circuit board components.

The audio alarm used in the prototype was supplied by Dick Smith Electronics, and carries a catalogue number L-7024. Similar alarms from other retail outlets should also be suitable. Do not use a solid state buzzer though – these require rather more current to drive them than the circuit can deliver.

We simply glued the alarm unit to the rear of the case using epoxy adhesive and drilled a small hole to pass the leads to the PCB. Additional holes were drilled in the lid for the on-off switch and in one

(Continued on p133)

Touch Sensitive Switch . . .

ctd from p69

end of the case for the lead to the touch plate (or door handle).

Note that the circuit earth must be connected to the lid of the case. The best way of doing this is to connect the earth lead to a solder lug. The lug is then held in position under the lid by one of the lid securing screws (see photograph).

Three insulated wires about 60cm long are used to make the counterpoise. These are soldered together at one end to a solder lug which is attached to the lid of the case. In use, the three leads are taped to the inside of the door as shown in the photograph. A length of tinned copper wire is used to make the connection to the door handle.

Finally, if you intend to power the unit from a plugpack supply in a fixed installation, the counterpoise will not be necessary. In this instance, the power supply itself should provide sufficient capacitive coupling to earth. A small piece of scrap aluminium can be used as a touch plate.