Protect your most prized possession:

VCR Theft Alarm

That VCR sitting on top of your TV set is a very expensive appliance. It is also portable and marketable, which makes it a prime target for thieves. The simple alarm described here will sound off immediately the VCR is lifted — and it makes a lot of noise. The circuit could also form the basis of a burglar alarm for an entire house.

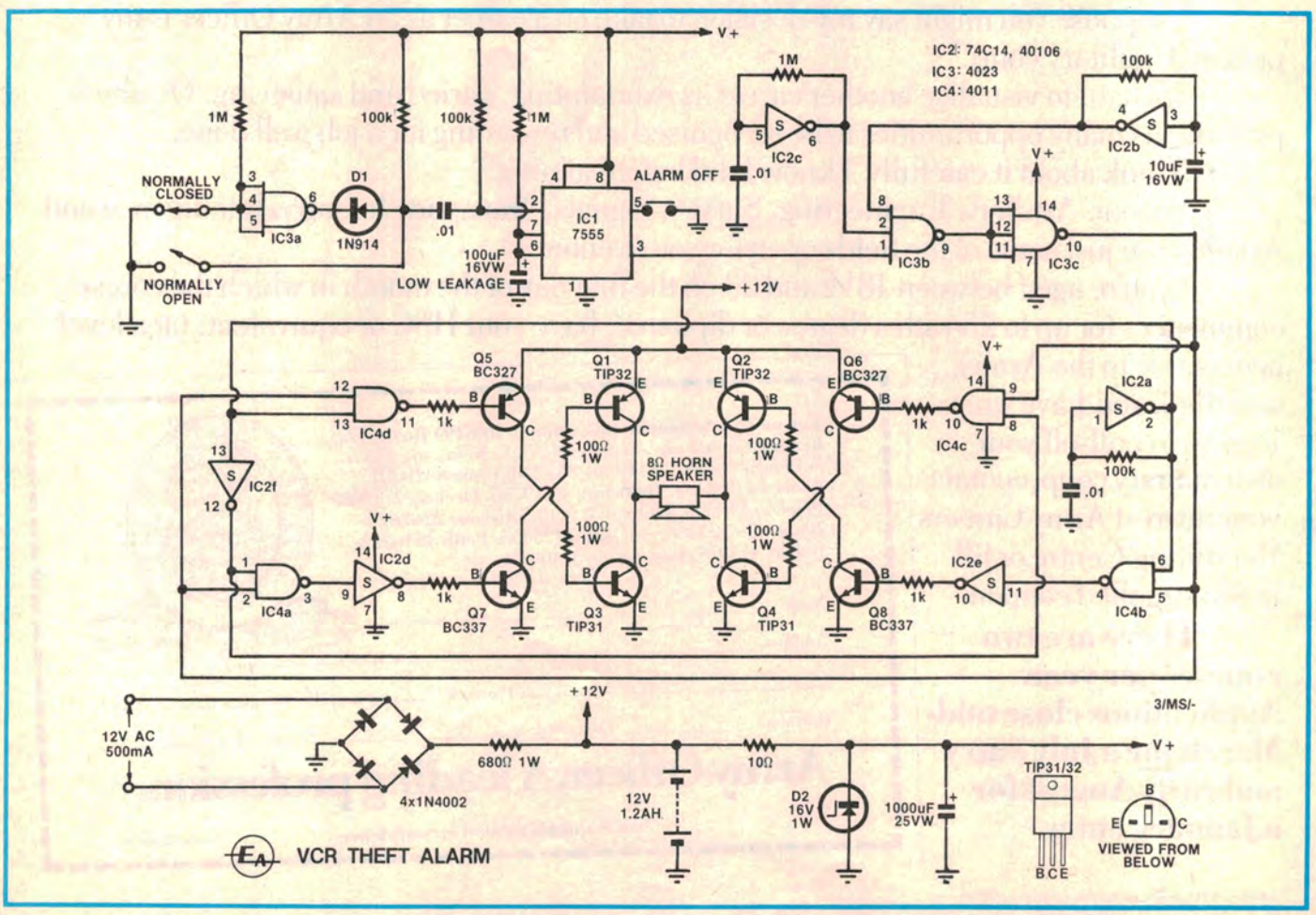
by JOHN CLARKE

Video cassette recorders or VCRs are constantly under the threat of being stolen. Recent figures indicate that VCRs are now the number one item on the burglar shopping list.

Unfortunately, they are all too readily disposed of, typically in the local pub on a Saturday afternoon ("It fell off the back of a truck, mate"). If genuine, there would have to be a lot of trucks running around with open backs, dropping VCRs every few kilometres! (Frankly, I wouldn't fancy a VCR which had really suffered such a fate.)

There are several ways to lower the chance of VCR theft. Foremost is not to advertise that you own a VCR. This includes being discrete in a room full of strangers or in any public place. An intending thief can quickly be aware of your VCR ownership by overhearing conversation about a video movie. In addition, it is preferable not to mention your address at the shop when the VCR is purchased. Hiring video cassettes presents a problem, since a name and address is normally required. The best that can be done is to deal only with reputable libraries.

At the risk of stating the obvious, the house itself should be made as secure as possible. Doors should be fitted with deadlocks, and windows secured with something better than the customary simple catches. Also, make sure that the



VCR is not readily visible from outside the house. Draw blinds or curtains as necessary.

But, even with all these precautions, a thief can still break into your home and remove the VCR. This is where our VCR Theft Alarm comes into play. The instant the thief lifts the VCR from its normal resting place, the alarm sounds, scaring the thief and, hopefully, alerting neighbours. The alarm sound is particularly vicious; a 1000Hz tone, modulated at 100Hz, and switched on and off at a 1Hz rate.

The system operates from its own battery, normally on trickle charge from the mains, so that even a thief who turns off the mains power will achieve nothing. The battery is a 12V, 1.2Ah sealed lead-acid gel battery, specially designed for such applications and which requires a minimum of maintenance. It is available from Arista Electronics Pty Ltd. Power to charge the battery and supply the system's standing current is provided by the mains, via a 12V AC 500mA plugpack.

Once activated, the alarm will sound for approximately two minutes, then shut down. This is normally long enough to scare a thief, but the time could be increased if desired, as will be explained later. However, be aware that legislation limits the time an alarm may sound, usually to 10 minutes. An Alarm Off switch is fitted to permit shutting it down at any time.

How it works

The alarm sensor is a membrane switch which needs to be kept closed in order to hold the alarm off. It is placed under one of the VCR's mounting feet, so that the weight of the machine holds it closed. Immediately the machine is lifted the circuit opens and the alarm sounds.

The membrane switch is of the type normally used for calculator and similar keyboards. They are supplied as a unit of four, fitted with an eight conductor ribbon and eight pin plug. Where only one switch is required, as in this case, it is a simple matter to cut off the unwanted pads. The one we used is a type K001, available from Hi-Com Unitronics International.

The alarm circuit itself provides two inputs, one for a "normally open" circuit, and one for a "normally closed" circuit. Both provide instant triggering of the alarm with only a momentary closing of the normally open input, or opening of the normally closed input. Only the normally closed input is used in this application, but there is no reason why the normally open input could not also be used, as a backup, in conjunction with a pressure mat or other suitable sensor.

In fact the circuit is quite versatile and there is no reason why it could not form the basis of complete house alarm system. It could be used in conjunction with conventional reed switch/magnet type door and window sensors, connected in series to the normally closed input. Again, the normally open input could serve as a backup.

Another use for pressure sensitive alarms of this kind is in shops where valuable items — including, perhaps, VCRs — need to be on display but present a very tempting target for a thief. Several pressure pads could be used, connected in series, each one protecting a separate item.

The horn is an 8Ω speaker unit with a 130mm diameter flare, and can make a lot of noise. The one we used is available from Dick Smith Electronics and is listed under catalog number C-2705.

The effectiveness of the alarm depends very largely on installation. Ideally the horn speaker should be mounted external to the house so that it will radiate as much sound as possible to the surrounding neighbourhood. The membrane switch and wires leading to and from the main alarm unit should be well concealed so that the thief cannot easily detect their presence and disable the alarm. Details of installation will be discussed later.

The circuit itself can be divided into three sections. Firstly, the inputs and timer comprising IC3a, diode D1 and ICI. The second section is the horn speaker driver circuitry, which uses the remaining ICs from IC2 to IC4 and transistors Q1 to Q8. The final section is the power supply comprising the battery, plugpack, bridge diodes, and the zener D2.

IC1 is the CMOS version of the familiar 555 timer. It is configured as a monostable so that once triggered, its output at pin 3 goes high for the monostable period. This period is nominally 110s, the time the alarm will operate after being triggered. It is determined by the time taken for the 100μF capacitor at pins 6 and 7 to charge via the 1MΩ resistor to two thirds the power supply voltage. This "on" time can be conveniently increased, if necessary, by increasing the value of the 1MΩ resistor.

The Alarm Off switch functions by pulling the threshold voltage at pin 5 low, thus resetting the timer and shutting off the alarm.

IC1 is triggered by a low going pulse at pin 2, which is normally held high with a 100kΩ pull up resistor. A .01μF capacitor AC couples the signals from the normally open and normally closed alarm inputs to pin 2.

The normally open input is held high

VCR Theft Alarm

by a 100kΩ resistor. When this input is closed, pin 2 of IC1 goes low until the .01μF capacitor charges via the 100kΩ pull up resistor at pin 2. The normally closed input is normally held low (by the membrane switch) and this is inverted by IC3a. As soon as this input goes open circuit, the output of IC3a goes low by virtue of the 1MΩ pull up resistor at its input. D1 conducts and transfers a low pulse to pin 2 of IC1.

The high output from IC1 is used to gate on the horn speaker driver circuit via pin 1 of IC3b, to sound the alarm. The remaining two inputs of IC3b are connected to the outputs of Schmitt trigger oscillators IC2c and IC2b. The first oscillator (IC2c) operates at about 100Hz while IC2b has a nominal frequency of 1Hz. With pin 1 of IC3b high, their outputs are gated through to the output of inverter IC3c and form the gating signal for the horn speaker driver circuit.

This gating signal is connected to one input of NAND gates IC4a, b, c, and d. When the gating signal is low, the NAND gate outputs are high and transistors Q5, Q6, Q3, and Q4 are off. IC2d and IC2e invert the outputs of IC4a and IC4b and so Q7, Q8, Q1, and Q2 are also off. In this state the circuit draws very little current.

A third oscillator, operating at 1kHz — the main alarm sound — is provided by IC2a in a Schmitt trigger configuration. When the gating signal goes high this 1kHz signal is gated through to the transistor driver stages by the IC4 NAND gates. In the case of IC4a and IC4c, the signal is inverted by IC2f before being applied.

The transistor driver stage operates in the push-pull mode. When the output of IC2a goes high, the output of IC2e also goes high and turns on transistors Q8 and Q2. At the same time, the output of IC4d goes low and turns on transistors Q5 and Q3. One side of the horn speaker thus goes to the positive supply rail while the other goes to the negative rail.

Similarly, when the output of IC2a goes low, Q8, Q2, Q5 and Q3 all turn off and Q6, Q4, Q7 and Q1 turn on. In this manner, each side of the horn speaker is switched at a 1kHz rate from one polarity to the other.

This 1kHz tone is modulated at 100Hz by IC2c, while IC2a switches the tone on and off at a 1Hz rate (ie, on for 0.5s and off for 0.5s). The result is an earpiercing alarm tone that is sure to attract attention.

Power for the alarm circuit comes, in the first instance, from the mains via a 12V AC plugpack. This 12V AC is rectified by a bridge rectifier and is then used to trickle charge the battery through a 680Ω limiting resistor. The charge rate is approximately 2mA when the battery is floating, rising somewhat if it is discharged, as by an activated alarm.

This same rail also supplies the quiescent current for the circuit, decoupled by a 10Ω resistor and a 1000μF capacitor. A 16V zener diode is included to protect the circuit from serious voltage rise should the battery be disconnected.

Construction

Construction of the VCR Theft Alarm is relatively straightforward. The parts are mounted on a PCB coded 84a18 and measuring 96 × 76mm. This, with the battery, is housed in a plastic utility case measuring 150 × 90 × 50mm. We used PC stakes for all external connections to the PCB since this facilitates wiring later on. These can be inserted onto the PCB first.

The actual component layout is clearly shown in the accompanying diagram, with the components superimposed on the printed pattern. Follow this carefully and it is difficult to make a mistake. Begin construction by installing the five links, then mount the diodes, resistors and capacitors. Note that the diodes and electrolytic capacitors must be mounted with correct polarity, so check carefully as you proceed. Check the diode type numbers also, to make sure the right ones go in the right place.

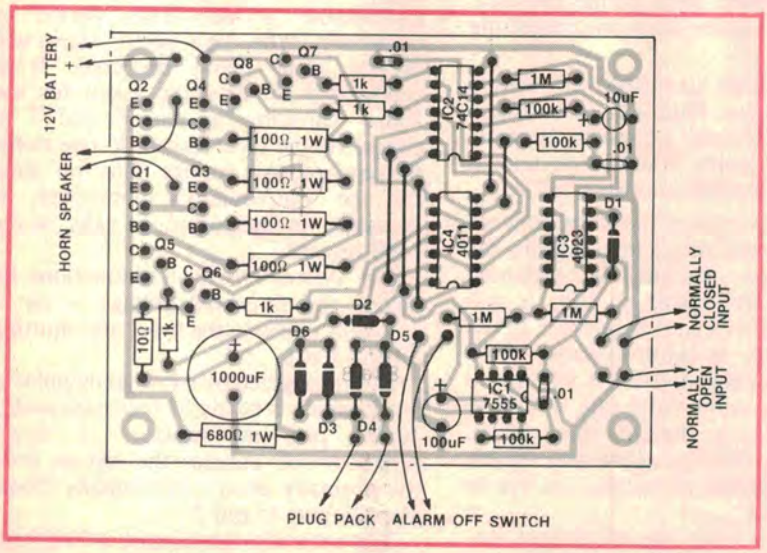
The transistors should be mounted next and should be pushed onto the PCB as far as they will go without stressing the leads. As with the diodes, you will need to refer to the circuit diagram for the type numbers. Make sure you install them the right way around. Assembly is completed by installing the CMOS ICs. When soldering the ICs, solder the power supply pins first to enable the static protection diodes.

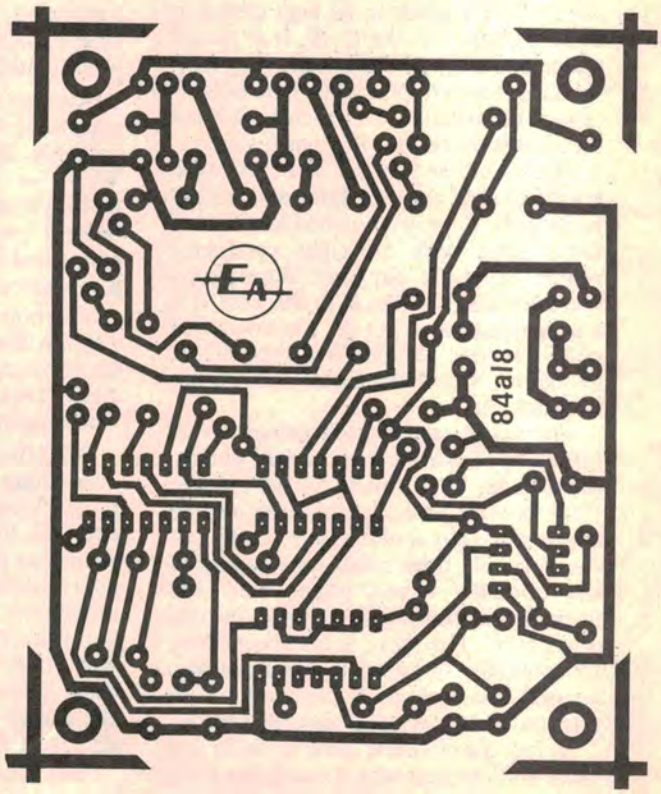
We estimate that the current cost of this project is

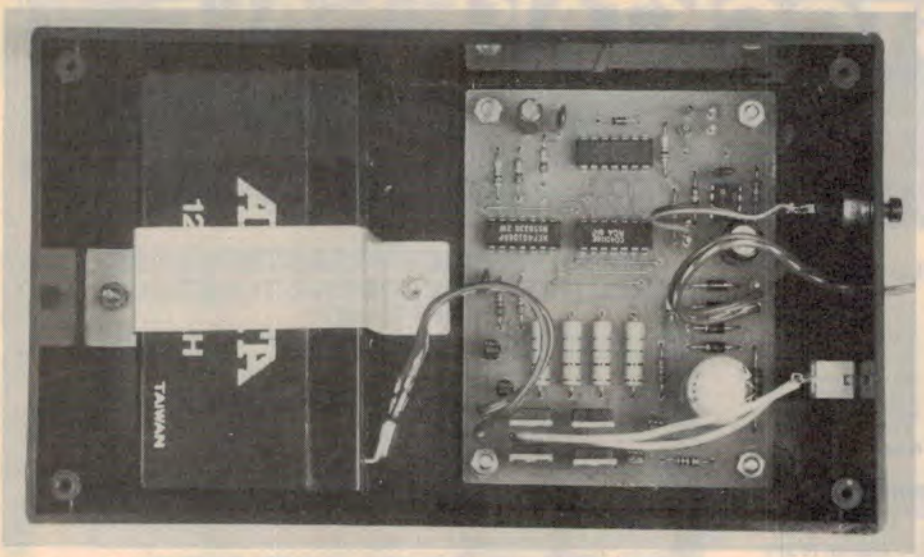
$70

This includes sales tax.

Below: parts overlay diagram for the VCR Theft Alarm. Use PC stakes to terminate the external wiring connections. At right is an actual size artwork for the PCB.







View inside the prototype. The battery is secured using a bracket made from scrap aluminium.

Only a small amount of work is needed to prepare the case. The battery lies side on at one end, as shown in the photograph. We made an aluminium bracket to hold the battery securely in position. The PCB is supported on 6mm standoffs and held with machine screws and nuts. Holes must also be drilled for the Alarm Off switch, horn speaker socket, and the plugpack and membrane switch leads.

Any of the four switches of the membrane switch array can be used as the alarm switch. We used the switch nearest the wire exits, in which case pins 4 and 8 are the contact pins (counting from L to R). Peeling back the backing sheet reveals the connections. If this switch is used the remaining three switches can be cut off, leaving the single switch.

Connections to the plug pins are best made by simply soldering the wires directly to them. While this may look somewhat ungainly, and perhaps suggest that it could provide a ready means for a thief to recognise and disable the alarm, this can be avoided. The whole lead and plug assemby is easily hidden under the VCR, so that only a nondescript lead emerges. And if the thief lifts the VCR to investigate . . . . .

Standard hookup wire can be used for short connections, with light figure eight flex for the plugpack and horn connections. Automotive spade sockets can be used to terminate the battery leads. The length of wire required for the plugpack and membrane switch depends upon where the alarm unit is to be positioned in relation to a convenient power point and the VCR.

For the present, and providing the battery is charged, the unit can be tested without the plugpack. Operation of the alarm can be triggered by shorting the normally open and normally closed inputs with a screwdriver. Note that as soon as power is applied to the alarm the horn should sound for about two minutes. The Alarm Off switch can stop this. Test each input for correct operation of the alarm.

Installation

The alarm unit is best installed in a well hidden position at a distance from the VCR. The leads from the alarm unit to the VCR can then run under the carpet and up to the membrane switch. The mounting feet of the VCR are the logical projections to hold the membrane switch closed, but the membrane switch will only close if pressed within the switch pad area. With some VCRs the mounting feet may be too large. By cutting out a small piece of cardboard, smaller than the switch pad area, the mounting feet can be used to press onto this and thence onto the membrane switch.

Ideally, the speaker should be mounted outside the house, but this can present problems. If it can be seen, and reached reasonably easily, an ingenious thief may be able to reach it and disable it. It will be up to the individual to find the best compromise between these conflicting factors. Depending on the construction of the house it may be possible to mount it so that it looks out from under the eaves, without being too obvious, or the leads being accessible. Painting can also help to disguise it. In short, it should be heard but not seen.

PARTS LIST

1 PCB, 96 × 76mm, 84al8
1 plastic utility case, 150 × 90 × 50mm
1 12V 500mA plugpack
1 12V 1.2AH gel rechargeable battery
1 8Ω horn speaker
4 6mm PCB standoffs
12 PC stakes
1 4 key flat keyboard (K001 Hi-Com Unitronics International)
1 piece of aluminium sheet, 180 × 25mm
1 momentary pushbutton switch

Semiconductors
1 7555 CMOS timer
1 74C14, 40106 hex Schmitt trigger
1 4011 quad NAND gate
1 4023 triple NAND gate
2 BC337 NPN transistors
2 BC327 PNP transistors
2 TIP32 PNP transistors
2 TIP31 NPN transistors
4 1N4002 100V diodes
1 1N914, 1N4148 diode
1 16V 1W zener diode

Capacitors
1 1000μF/16VW PC electrolytic
1 100μF/25VW (low leakage) electrolytic
1 10μF/16VW PC electrolytic
3 .01μF metallised polyester

Resistors (¼W, 5% unless stated)
3 × 1MΩ, 4 × 100kΩ, 4 × 1kΩ, 1 680Ω 1W, 4 × 100Ω, 1 × 10Ω

Miscellaneous
Hookup wire, battery connectors, machine screws and nuts, solder etc.