Protect your car against thieves with

The Screecher Car Burglar Alarm

Here is a low cost car alarm designed with a new deterrent strategy. Instead of using the alarm to try to draw the attention of passers-by to the felony in progress, this alarm sounds inside the car, to deafen the thief and make it too uncomfortable to proceed with pinching the vehicle.

by COLIN DAWSON & LEO SIMPSON

"Not another car alarm!" we can almost hear you saying. After all, there are dozens of alarms available commercially at keen prices. And for the home constructor, *Electronics Australia* has already published a fine circuit which met eight out of ten NRMA recommendations for car alarms, and which is still available in kit form from several retailers (see EA, May 1984).

We also presented the "Claytons' alarm" which has only the dashboard lamp flasher but no alarm circuitry, in February 1986. This was a neat but dishonest (?) idea which tricked would-be thieves into thinking an alarm was fitted to the car.

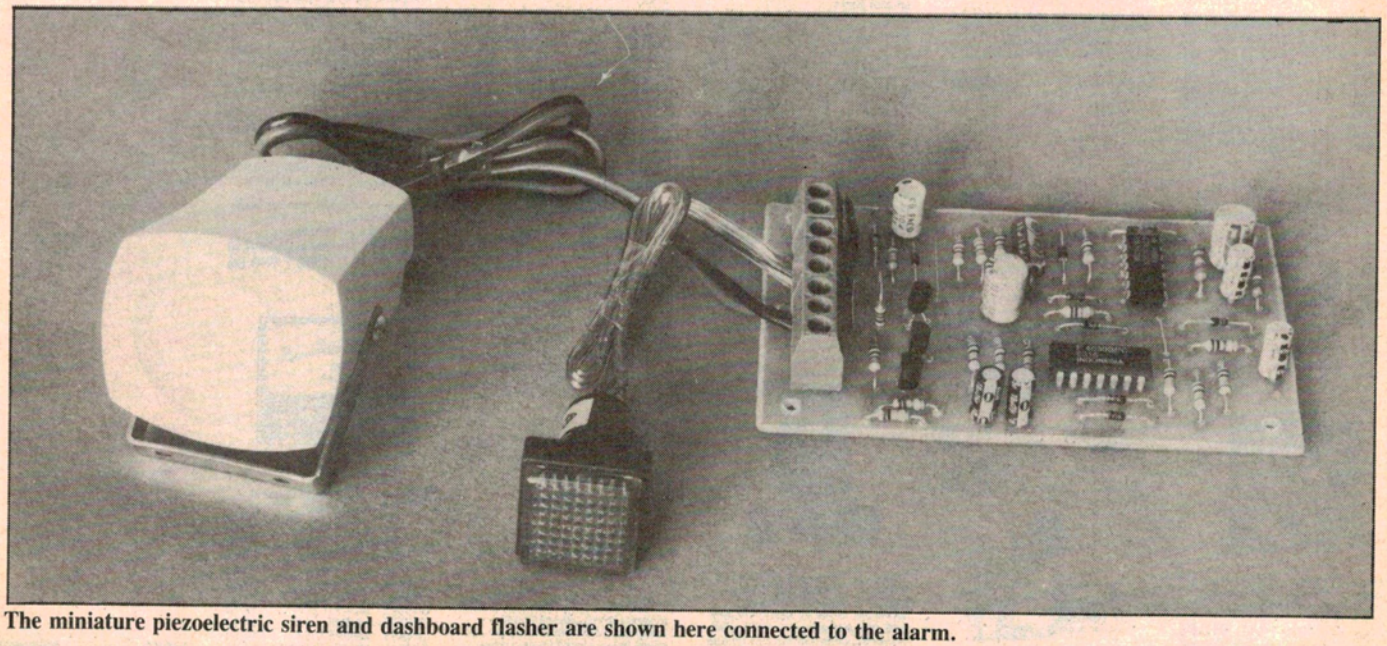
For this new circuit we have come up with a novel and at the same time practical approach. We wanted a more unpleasant and more effective thief deterrent but we also wanted to minimise the problem of false alarms. How many people actually trip their own car alarms when entering the vehicle? We think we have an effective answer to that problem.

The solution

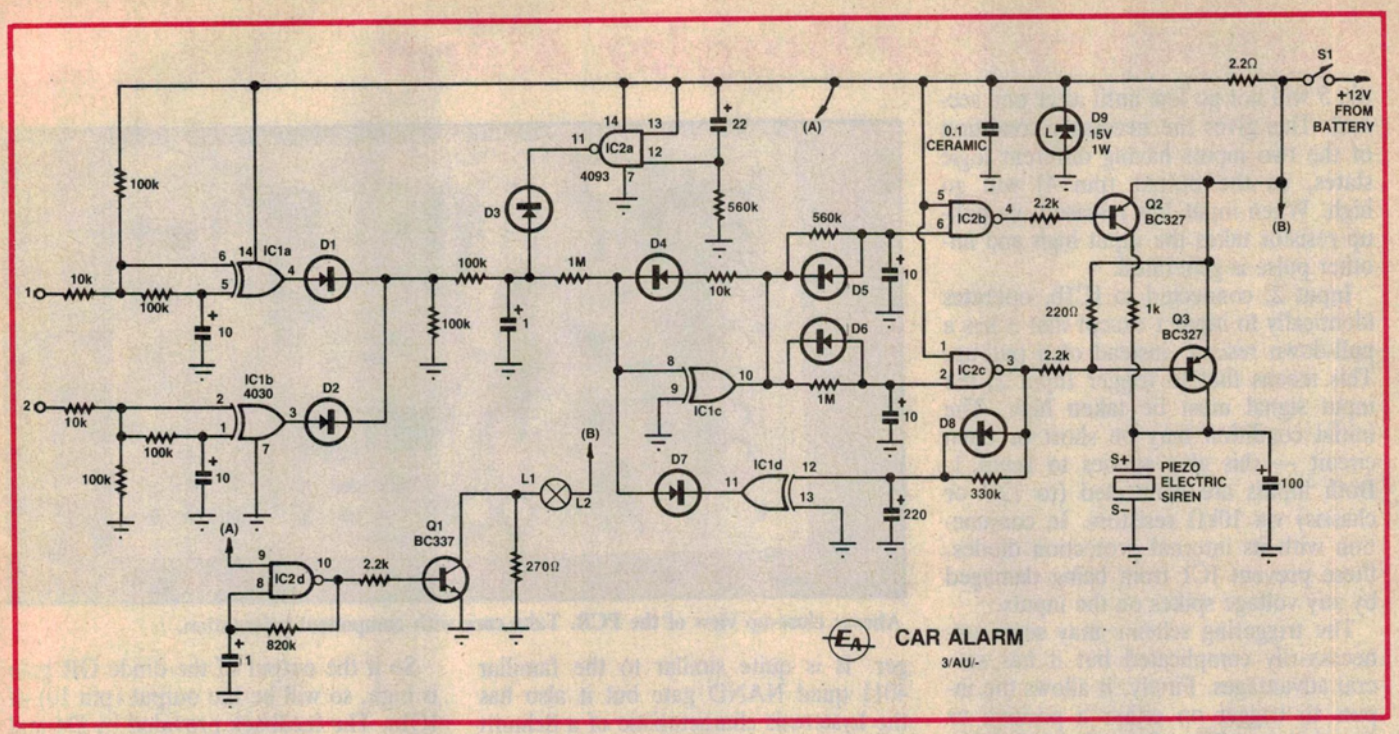
We have called it the "Screecher". Once fitted to your car, this alarm will harass unauthorised drivers with an exceptionally loud siren. It differs from normal alarms in that the siren is actually located in the passenger compartment of the car. It is intended to provide maximum discomfort for the illegal occupant and minimum irritation to nearby residents.

With the car door open, the very effective siren will be quite loud enough to attract anyone in the vicinity but that is not its main purpose. Instead, the aim is to make things unpleasant for the thief — he will want to get out as quickly as possible.

This approach has been made practical by a particularly effective miniature piezoelectric alarm which has recently become available. It is distributed by Arista Electronics Pty Ltd and is avail-



The miniature piezoelectric siren and dashboard flasher are shown here connected to the alarm.



able from kitset suppliers such as Jaycar Electronics.

It is very small, measuring only 39 x 43 x 59mm, and so is able to fit under the dash of even the smallest car. With 12V input, it consumes 150mA and produces a modulated tone at no less than 110dB at one metre. It sounds like a demented monster canary. Any person in our office who has heard it for even a short burst has been staggered — they break into a sweat.

In the confines of a car it would be utterly unbearable, unless you were stone, motherless deaf.

The concept of this alarm is so diabolical that we almost have pity on any car thief who comes up against it. We can imagine complaints to Government health departments along the lines of "I was just trying to rip this car off when it deafened me. It's unfair!" So be it. We are indebted to Arista Electronics Pty Ltd for the idea. They also supplied the sample alarm.

To back up the new siren, we have designed a control circuit which is both cheap and easy to install. More importantly, it provides the features you need most in an alarm. It has a lamp flasher, exit and entry delays, a three-second soft alarm to remind you to turn it off, and of course, automatic resetting.

The three-second soft alarm is an unusual feature for a car alarm, but one that will probably catch on sooner or later. As noted above, it seems to us that the majority of false alarms are caused by the driver forgetting to turn the alarm off. The customary entry delay time of seven seconds is still there — it's just that the alarm starts softly after this period, instead of launching straight into the maximum irritation mode. The soft alarm will give you three seconds warning before things get under way in earnest. The first time it happens, you will be grateful for this feature.

Two inputs are provided. Both respond to a change in state, whether from high to low or vice versa. The sense only becomes important when the input goes open circuit after the triggering action (this does not include door switches).

To keep installation really simple, the circuit just uses a basic on/off switch. More sophisticated circuits use the car's ignition switch to deactivate the alarm. This gives added security, but it complicates installation.

A hidden on/off switch gives reasonable security and is easy to install. When you hear the siren, you'll appreciate that it's an effective deterrent to anyone poking around under the dashboard looking for a switch.

Circuit description

Operation of the circuit is more complicated than its small component count would suggest. With only two ICs and a handful of other parts it provides entry delay, exit delay, alarm timer, lamp flasher and the three-second soft alarm feature.

Each of these circuit functions rely on a simple RC timer, but the interdependence of the sections make the sum much more interesting. Overall, the sequence of operation is as follows: one of the input gates detects a change of state, (ie, low to high or high to low). This produces a trigger pulse which must be longer than 0.1s to activate the circuit (this protects against spurious noise triggering). The input circuit limits all input pulses to a maximum of one second. The input pulse can only activate the following circuitry if the exit delay period has expired.

When an input pulse is latched, it starts two RC timers simultaneously. One of these eventually turns on the soft alarm and the other turns on the full alarm. After about one minute of the full alarm, the circuit will be reset. It can be retriggered immediately.

IC1a and IC1b are the input detectors. IC1 is a 4030 quad two input exclusive-OR gate (XOR). That's rather a mouthful, but you only need to know that each gate's output is high when either of its inputs (but not both) are high. Any other condition gives a low output. So long as the inputs of a XOR gate are different, the output will be high.

Take IC1a. This is ostensibly the negative transition detector (ie, it detects an input change from high to low), because its inputs (pins 5 and 6) are in the high state to begin with. If input 1 is pulled low, pin 6 will go immediately low. Because of the delay imposed by the 100kΩ resistor and 10μF capacitor,

Screecher Car Burglar Alarm

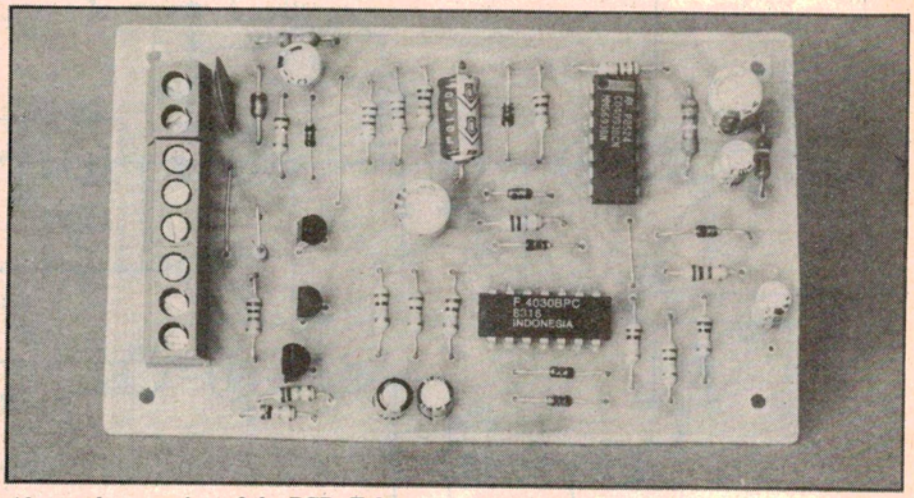
pin 5 will not go low until after one second. This gives the necessary condition of the two inputs having different logic states, so the output (pin 4) will go high. When input 1 is released, its pull-up resistor takes the input high and another pulse is generated.

Input 2, connected to IC1b, operates identically to input 1 except that it has a pull-down resistor instead of a pull-up. This means that to trigger Input 2, the input signal must be taken high. The initial condition may be short or open circuit — this also applies to Input 1. Both inputs are connected (to 12V or chassis) via 10kΩ resistors. In conjunction with its internal protection diodes, these prevent IC1 from being damaged by any voltage spikes on the inputs.

The triggering scheme may seem unnecessarily complicated but it has several advantages. Firstly, it allows the inputs to trigger on either a positive or negative transition. Second, it produces only one pulse with each transistion. This means that the circuit will trigger once when, say, a door is opened — but it will not remain permanently in the triggered state if the door is left open.

The outputs of IC1a and 1b (pins 4 and 3) feed into an OR gate consisting of diodes D1 and D2 and a 100kΩ resistor. The 0.1s protection against spurious signals is provided by the 1μF capacitor and series 100kΩ resistor connected to the output of the diode OR gate. Notice that diode D3 also feeds into this junction. D3 enables the exit delay to be effected.

At this point, the other IC used in this circuit needs to be described. IC2 is a quad two input NAND Schmitt trigger. It is quite similar to the familiar 4011 quad NAND gate but it also has the hysteresis characteristic of a Schmitt trigger device.



Above: close-up view of the PCB. Take care with component orientation.

The exit delay signal is provided by IC2a and its associated components. When power is first applied to the circuit, the 22μF capacitor connected to pin 12 of IC2a immediately begins to charge via the 560kΩ resistor. The voltage developed across the 560kΩ resistor, due to the charging current, holds pin 12 high. While the capacitor charges, the output of IC2a will be low. This provides the exit delay function.

After about 12 seconds, this voltage at pin 12 falls below the lower threshold value and so the output of IC2a goes high. D3 will now be reverse biased, which allows the output of the D1/D2 OR gate to be fed to the input of IC1a via a 1MΩ resistor.

So if the output of the diode OR gate is high, so will be the output (pin 10) of IC1a. The feedback provided by D4 and the 10kΩ resistor will enable IC1c to latch input pulses; ie, its output will then remain high even after the OR gate high signal is removed. In fact, another diode (D7) also feeds into pin 8 of IC1c but this is part of the turn off circuitry and will be discussed later.

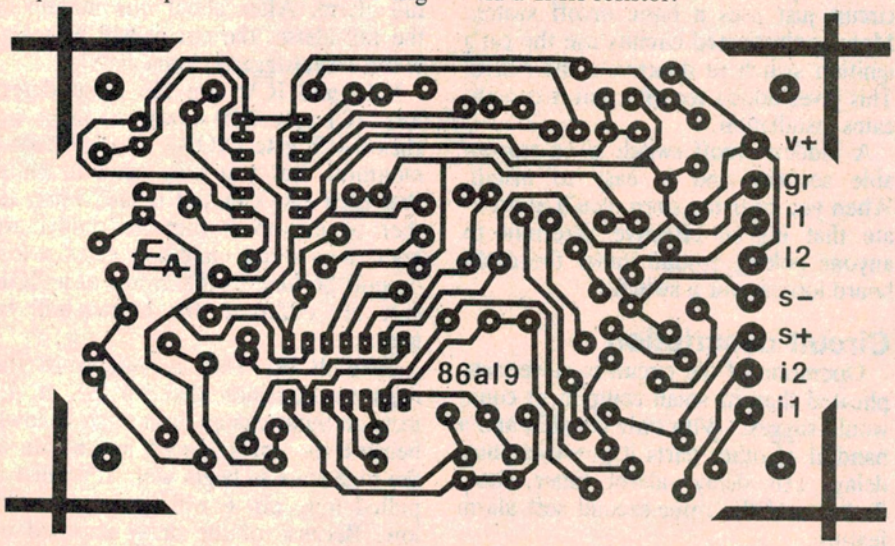
Having latched high, the output of IC1c enables operation of the two entry delay timers. The first of these consists of a 560kΩ resistor and 10μF capacitor connected to the input (pin 6) of IC2b. This is the seven-second timer.

Initially, the output of IC2b (pin 4) will be high because the input is low (due to zero charge on the 10μF capacitor). When the 10μF capacitor has charged sufficiently, the output of IC2b will go low and Q2 will be turned on, to drive the alarm siren via a 1kΩ resistor. This provides the soft alarm feature.

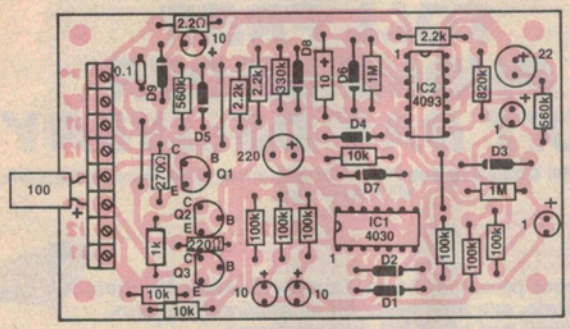
Some three seconds later, the 10μF capacitor connected to pin 2 of IC2c will have charged sufficiently to cause pin 3 to go low and turn Q3 on. This drives the siren alarm directly, which gives maximum loudness (and pain).

Notice that the output of IC2a (pin 3) is also connected to a 330kΩ resistor. This is part of the alarm timer IC1d. The 220μF capacitor begins to charge via the 330kΩ resistor and when it has reached a sufficient voltage, IC1d changes state with its output going low. D7 is now forward biased and pulls pin 8 of IC1c low. This releases the latched condition of IC1c.

So that the circuit will reset instantly, diodes D5 and D6 bypass each of the exit delay timer charge resistors. Diode



Here is an actual size reproduction of the PC artwork.



Follow this layout diagram carefully when installing the parts on the PCB.

PARTS LIST

1 PCB, 110 x 61mm, code 86a19
1 piezoelectric siren, (Jaycar Cat. No. LA-5255 or equivalent)
1 dashboard warning lamp to suit
1 single pole single throw (SPST) switch
1 8-way PCB mounting terminal block

Semiconductors

1 4030 quad 2-input XOR gate
1 4093 quad 2-input NAND Schmitt trigger
2 BC327 PNP transistors
1 BC337 NPN transistor
8 1N4148 diodes
1 15V, 1W zener diode

Capacitors

1 220μF 16VW electrolytic
1 100μF 16VW electrolytic
1 22μF 16VW electrolytic
4 10μF 16VW electrolytic
2 1μF 16VW electrolytic
1 0.1μF disc ceramic

Resistors (0.25W, 5%)

2 x 1MΩ, 1 x 820kΩ, 2 x 560kΩ, 1 x 330kΩ, 6 x 100kΩ, 3 x 10kΩ, 3 x 2.2kΩ, 1 x 1kΩ, 1 x 270Ω, 1 x 220Ω, 1 x 2.2Ω

D8 does the same for the main alarm timer IC1d. This ensures repeatable characteristics, even if the alarm is re-triggered immediately.

If you prefer, second and subsequent triggering may operate with reduced entry delay by eliminating diodes D5 and D6. D8 is essential though, as it ensures constant alarm time operation for subsequent triggering.

The other major part of the circuit is the lamp flasher. This is an inverter oscillator, based on IC2d and oscillating at around 1Hz. It drives a BC337 NPN transistor (Q1), which drives the lamp. The lamp should be of the miniature type with a rating of no more than 150mA. The 270Ω resistor in parallel with Q1 keeps the lamp filament pre-heated in the "off" periods and so reduces transistor dissipation. This part of the circuit operates continuously whenever power is applied.

Power input to the circuit is via the on/off switch and then via a 2.2Ω resistor. Immediately after this resistor is a 15V 1W zener diode which protects the circuitry against any voltage spikes on the car's DC supply line. Such spikes could come from the ignition system or from solenoids or motors.

Construction

The only components not mounted on the PCB are the siren and the lamp. Both are connected to the circuit through an 8-way terminal block. The other terminals are for power and the sense inputs.

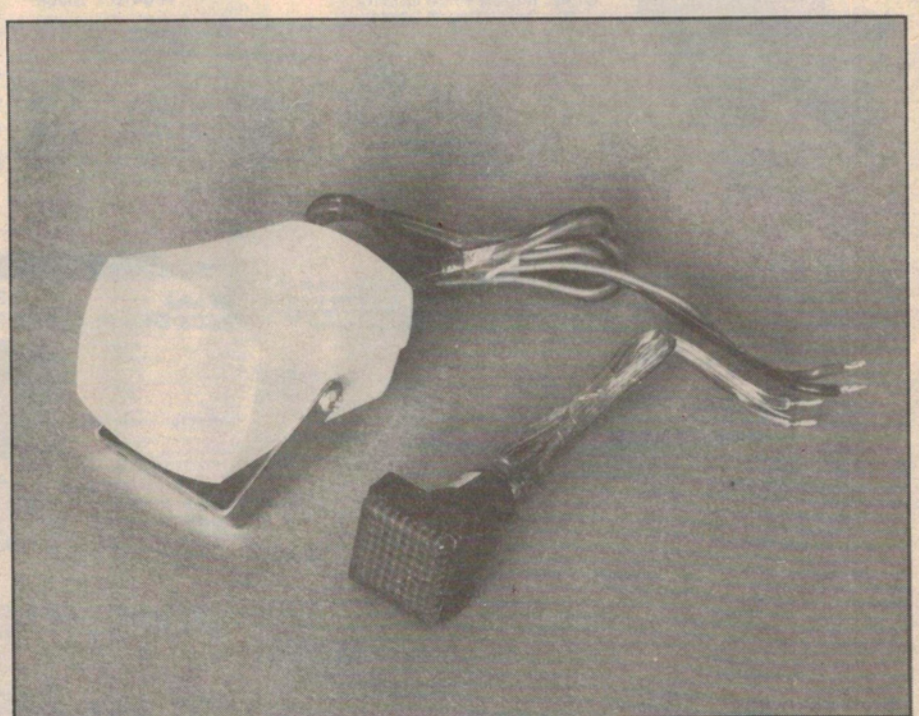
The PCB measures 110 x 61mm and the code number is 86al9. There is no special order for soldering the components in place. Many of the components are polarity-sensitive which means that they will not work unless you put them in the right way around. Follow the overlay diagram exactly. Note that a 100μF capacitor must be connected across the s- and s+ terminals.

The circuit can be housed in a plastic box if you deem it necessary. This would protect it from being short-circuited by metalwork under the dashboard but is strictly optional.

Before installing the alarm, it would be quite easy to test it on the bench. All you need is a battery or power supply of 6V to 12V. By connecting either Input 1 to ground or Input 2 to V+, it can be triggered. Check that the various times are about right (don't forget the exit delay which begins as soon as you connect power).

Prior to testing connect the alarm positive wire to its appropriate terminal through a 1kΩ resistor. This is a temporary measure to mute the alarm. Both of the siren modes will still be apparent, but not so offensive.

Installation can be very simple if you so choose. The only essential connections to the car are ground, +12V and at least one sensor input. For a really quick installation job, Input 1 can be connected to a courtesy light switch (actually, the switch side of the lamp), assuming a negative-chassis vehicle.



The piezoelectric siren is available from kitset suppliers while the square 12V lamp is available from Hi Com Unitronics, 7 President Lane, Caringbah, NSW 2229.