thief suppression in cars

Thefts of cars, or accessories and/or other articles in them, are becoming more and more common. By the same token, anti-theft alarms for cars are becoming more and more of a necessity . . . .
Each of the four different designs described in this article allows for variations on the basic concept; this makes it possible to choose circuits that will suit a large variety of requirements and budgets.

Each year an increasing number of cars are stolen. The majority of them are quickly recovered, but at best they have been abandoned on running out of petrol, and often they are a total write-off, with everything of value removed. Thefts of articles from cars are still more common, especially now that expensive in-car entertainment systems are so popular. When compared with the possible loss of property and/or no-claims bonus, the cost of installing a burglar alarm is negligible, and a number of designs are presented here, which vary in cost from about 10 p to £ 10, and give varying degrees of protection. Even with an alarm installed, however, do not ignore the simple precautions advised by the police. Lock all valuables in the boot, and make sure that all doors and windows are securely fastened.

Circuit No. 1

The simplest of the burglar alarms can be constructed from components that most enthusiasts will have in their junk box. It makes use of the door courtesy light switches and the horn relay, and the only additional components required are three diodes and a hidden switch to activate and de-activate the alarm. However, one door of the car is left unprotected.

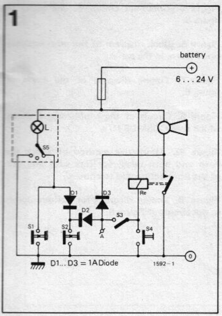
The circuit operates as follows:
S_1 and S_2 are the courtesy light switches. When the hidden switch S_3 is closed, opening the door protected by S_2 causes the horn relay to operate via S_3, D2 and S_2. When the horn relay contacts close the horn sounds and the cathode of D3 is grounded via the relay contacts. This latches the horn relay via S_3 and its own contacts. The horn will continue to sound even if the door is closed, unless S_3 is opened. The door containing S_1 is, of course, not protected, as when S_1 is closed D1 is reverse biased and only the interior light operates.

When the alarm is not armed (S_3 open), D2 prevents the interior light from lighting when the horn button is pressed and D3 prevents the horn from sounding when the interior light is switched on. Additional courtesy light switches (in the case of a four-door car) may be connected in parallel with S_2, and switches to protect glove compartment and other ancillary equipment may be connected between point 'A' and ground.

This simple alarm will provide a fair degree of protection at little cost, but it should be noted that alarms which sound indefinitely after being triggered are illegal in some European countries.

Circuit No. 2 (J. van Kessel)

Figure 2 shows the circuit of a more sophisticated alarm, which protects all the doors and arms itself after the driver has got out of the car. The alarm is activated by a concealed switch S_1. After this switch has been closed the occupants have about 15 seconds to get out of the car and shut the doors. During this time C1 is being charged via R1, R2 and the base-emitter junction of T1. T1 is thus turned on, shorting out C2. When C1 is charged to almost the supply voltage T1 turns off. If now one of the doors is opened the courtesy light switch S_2 closes and C2 charges rapidly via D1 and R3, turning on T2. C3 begins to charge slowly via R5, which gives time for the owner of the car to de-activate the alarm by opening S_1. After about 15 seconds C3 has charged to about 8 volts (with 12 V supply) and T3 turns on. T4 and T5 also turn on and the horn sounds. R8 is effectively connected in parallel with R10 when T5 turns on, reducing the emitter potential of T3 and causing it to turn on even harder. C3 begins to discharge via D4, R7 and T5 until it reaches a potential determined by the new emitter voltage of T3, when T3 turns off. T4 and T5 are turned off, the horn relay drops out and the emitter voltage of T3 rises causing it to turn hard off. (It is apparent, therefore, that T3, T4, and T5 function as a trigger circuit.) C3 begins to charge again and the cycle is repeated. The horn therefore gives repeated short blasts, which (hopefully)



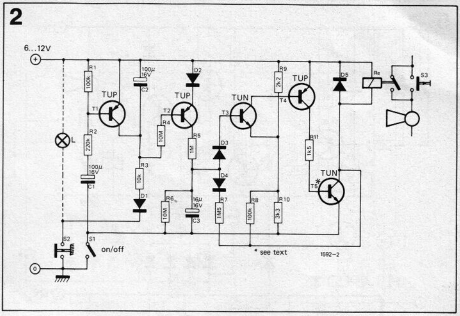


Figure 1. Circuit of the simplest burglar alarm consisting of three diodes and a switch. The door containing S_1 is not protected. Additional door switches should be wired in parallel with S_2, other switches such as boot and glove compartment between point A' and earth.

Figure 2. A more sophisticated alarm circuit. The door switches are wired in parallel with S_2. L is the interior light.

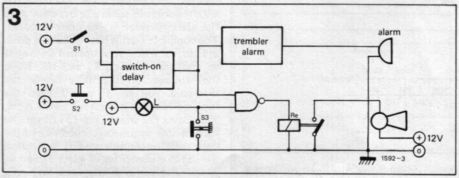
Figure 3. Block diagram of an alarm that can be triggered by a trembler switch as well as door switches. This alarm has no 're-entry' delay and must be de-activated by an external concealed switch.

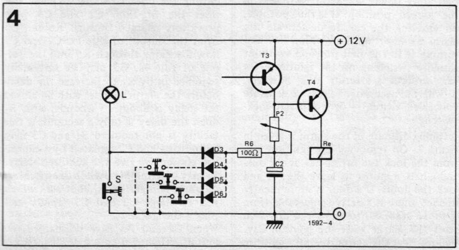
Figure 4. The number of points protected by the alarm may be extended using a diode AND-gate for switches on boot lid, bonnet, glove compartment etc.

will attract more attention than a continuous note.
Even if the car door is subsequently closed it will take a long time for C2 to discharge via R4 into the base of T2. T5 should have a sufficiently high collector current rating for the relay used. If the original car horn relay is used then a power transistor may be needed, and R11 must be reduced to provide sufficient base current.
To use the alarm with a positive earth car it is necessary to substitute all the transistors by their complements (i.e. TUP for TUN) and to reverse the polarity of all electrolytic capacitors and diodes.

Circuit No. 3 (H. Bernstein)

A different approach is adopted in the circuit whose block diagram is given in figure 3. This circuit has a switch-on delay to enable the driver to leave the car, but the alarm sounds immediately one of the doors is opened, thus reducing the possibility of a thief breaking into the car and stealing some article before the alarm goes off. This does mean, of course, that the alarm must be de-activated before the driver enters the car. This may be done by a concealed switch outside the car, or by a reed switch mounted in the windscreen and operated by a magnet carried on the key-ring. This alarm also has a circuit operated by a trembler switch which will operate if the car is rocked or shaken. This will help prevent the theft of such articles as mirrors, fog and spot lamps, and will also operate if an attempt is made to force a door or window. Such switches can be bought, or can easily be home made.
Figure 4 shows the method of connecting switches. S represents the door courtesy light switches. Additional switches may be wired as shown in dotted lines. The diodes form an AND gate and isolate the switches from one another so that they do not interact. A diode is only required in series with each switch that performs some additional function as well as being connected to the alarm system. Thus, when there is a switch in the boot that operates the boot interior light, then a diode is required in series with this to prevent the light being switched on by the other switches. Where a switch is installed solely for the purpose of the alarm (e.g. in the glove compartment) then no diode is required.
The circuit of the complete alarm is given in figure 5. It operates as follows: Before leaving the car S_1 is opened. This initiates the switch-on delay as C1 charges. T1 turns off, which turns off T2 and T3. The alarm is now set. If one of the switches connected to points a-d is closed, C2 is rapidly discharged via R6 and T4 turns on, sounding the horn. The alarm will continue for up to two minutes even if the switch is opened, as C2 charges again.
A separate circuit is included for the





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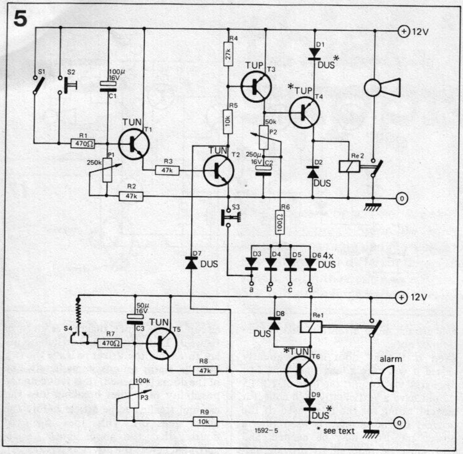

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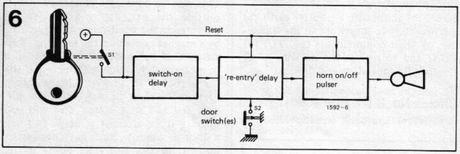

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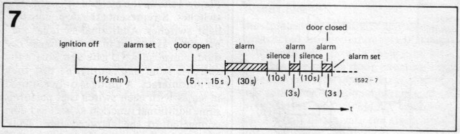

Figure 5. Complete circuit of the alarm of figure 3.

Figure 6. Block diagram of the most sophisticated alarm in the series.

Figure 7. Timing diagram of the alarm of figure 6.

Figure 8. Circuit of the sophisticated alarm, which uses COSMOS IC's.

Figure 8a. Alternative method of wiring the horn and horn relay, for cars with one side of the horn connected to chassis.

Figure 9. Timing diagram for various points in the circuit of figure 8.

trembler alarm. T2 grounds the base of T6 via D7 until after the switch-on delay. If the trembler switch S_4 subsequently closes momentarily, C3 rapidly discharges via R7, turning on T5. This turns on T6 and the alarm sounds until C3 has recharged, when T5 turns off. Re-entering the car is accomplished by momentarily closing the concealed switch S_2, which discharges C1 and initiates the switch-on delay so that the driver can enter the car and close S_1, which de-activates the alarm.

Circuit No. 4

A block diagram of the most sophisticated alarm in this series is given in figure 6. In many modern cars with a steering lock there is no need to have a concealed reset switch as a position is often available on the ignition switch that only opens when the switch is in the 'locked' position. It is thus possible, on entering the car, to de-activate the alarm by inserting the ignition key and turning it to the first position (without actually switching on the ignition). On cars without a steering lock, however, it will be necessary to use a separate concealed switch – or a separate lock-switch.

A timing diagram of the alarm is given in figure 7. On removing the ignition key from the lock the driver has about one-and-a-half minutes to leave the car and lock the doors. If a door is subsequently opened there is a delay (adjustable from 5 to 15 seconds) to allow the driver to reset the alarm with the ignition key. Failing this, the alarm operates and the horn will sound continuously for 30 seconds. After this there is ten seconds silence, then short three second blasts with ten seconds silence in between until the alarm is reset or the door is closed. The complete circuit of the alarm is given in figure 8. When S_1 is opened C1 begins to discharge through R1 and R2. When the voltage on C1 falls below the threshold voltage of gate 2 then the flip-flop consisting of gates 1 and 2 is set. This holds the input (pin 13) of gate 4a high, which means that when one of the door switches (represented by S_2) closes, the flip-flop consisting of gates 3a and 4a is set. The alarm is triggered, and even closing the door (opening S_2) will not reset the flip-flop. C2 and C3 were previously charged through R6 and D3 from the output of gate 1a. C2 and C3 now discharge through R5 into the output of gate 4a. C3 may be optionally switched in by S_3 to increase the delay before the alarm sounds. With S_3 closed the delay is about 15 seconds; with S_3 open the delay is only 5 seconds. If this facility is not required S_3 and C3 may be omitted and C2 replaced by a capacitor chosen to give the required delay. S_4 may be a trembler switch or switch(es) on glove compartment, boot etc., which will discharge C2 and C3 rapidly and trigger the alarm.

When C2 and C3 have discharged the output of gate 2b goes high. This takes

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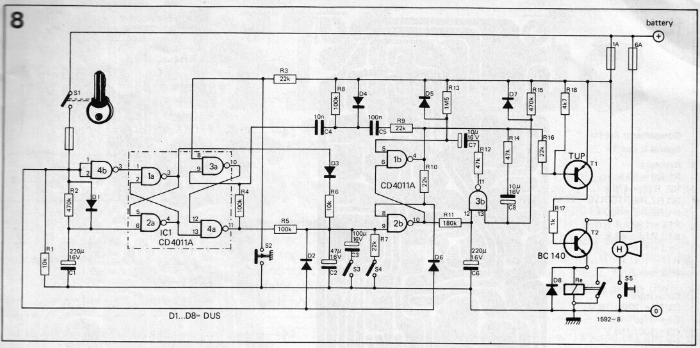

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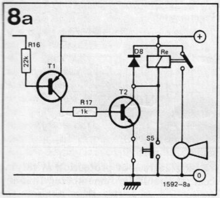

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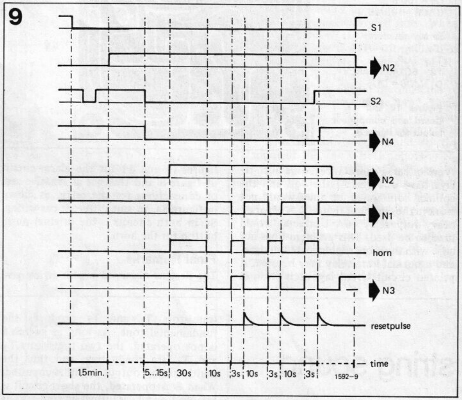

pin 6 of gate 1b high. Since the other input is held high by R13 the output goes low, turning on T1 and T2 and sounding the horn. C8 charges through R14 and R15 in about 3 seconds, taking pin 13 of gate 3b high. Meanwhile C6 slowly charges through R11 and it is this time constant that determines the duration of the initial blast of the horn (about 30 seconds).

When the voltage on C6 exceeds the threshold voltage of gate 3b the output of this gate goes low, grounding pin 5 of gate 1b through C7 and R12. The output of 1b thus goes high and the horn switches off. C8 now discharges through D7, R14 and the output of gate 1b. C7 slowly charges through R13 and R12, and this time constant determines the 'off' period of the horn (about 10 seconds). When C7 has charged to the threshold voltage of gate 1b the output goes low and the horn again sounds. C8 charges through R14 and R15, and this time constant determines the subsequent 'on' periods of the horn (about 3 seconds).

After this period the output of 3b goes low, grounding pin 5 of gate 1b through R12 and C7, and the whole cycle repeats. Gates 1b and 3b thus form an asymmetric multivibrator which causes the horn to produce short blasts at 10 second intervals. In addition, each time the horn is switched off a differentiating network consisting of R8, R9, C4 and C5 feeds a reset pulse to pin 9 of gate 3a, so that if the doors are closed during the horn 'off' period, the horn will not sound again and the alarm will be re-set.

The disadvantage of this alarm circuit is that it cannot easily be adapted for positive earth cars. On the other hand, it has the advantage that it is insensitive to spurious pulses due to the high noise immunity of COSMOS. The circuit will operate over a wide range of supply voltages without modification (4 to 14 volts), with almost the same delays.

Installation of the alarm

To ensure reliable operation the alarm should be mounted where it cannot be disabled by a thief, but not inside the engine compartment, which gets rather hot for COSMOS. Wiring should be concealed or made as inconspicuous as possible, especially wiring into the engine compartment if the car does not have a bonnet lock. In this case it is also wise to install an alarm switch in the bonnet lid, as otherwise the alarm could be disabled simply by disconnecting the battery. Another (somewhat expensive) possibility would be to power the alarm from a separate battery locked in the boot. Wiring from the battery to the alarm should, of course, be direct, not via the ignition switch, and the simplest way is to run cables from the battery side of the fuse box with in-line fuse holders in them.

When constructing any of these alarms it should be borne in mind that they may need to be adapted to suit particular

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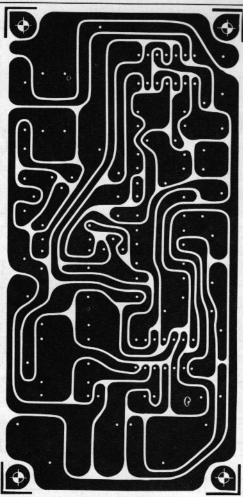

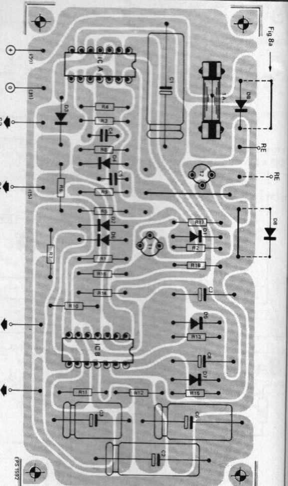

Components list for figures 8 and 11

Resistors:
R1,R6 = 10 k
R2, R15 = 470 k
R3,R7,R9,R10,R16 = 22 k
R4,R5,R8 = 100 k
R11 = 180 k
R12,R14 = 47 k
R13 = 1M5
R17 = 1 k
R18 = 4k7

Capacitors:
C1,C6 = 220µ/16 V
C2 = 47µ/16 V
C3 = 100µ/16 V
C4 = 10 n
C5 = 100 n
C7,C8 = 10µ/16 V

Semiconductors:
ICa,ICb = CD4011A
T1 = TUP
T2 = BC140 or equ.
D1 ... D8 = DUS

Figures 10 and 11. Board and component layout for figure 8.

types of car. For instance, some horn relays have one end of the coil and the contact commoned, so they would not work in the circuit of figure 1. A separate heavy-duty relay (6A contacts) would have to be used. This problem does not arise with the more sophisticated designs, and a normal horn relay may be used. A printed circuit board layout is given in figures 10 and 11 for the alarm circuit of figure 8 and this has alternative sets of connections for the relay, as shown in figure 8a, to suit different car wiring. S_5 in both circuits is the original push-button for the horn.

Final Remarks

The designs discussed in this article give varying degrees of protection at varying cost. It should be remembered that any protection is better than none – the majority of thieves are amateurs and will be deterred by even the simpler circuits described.