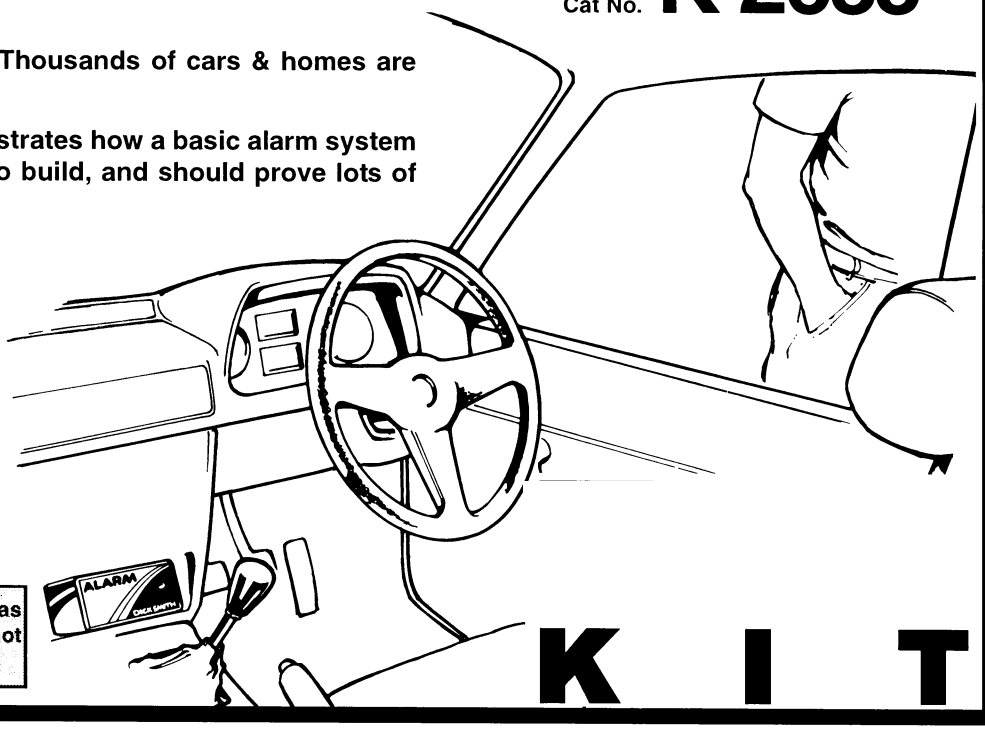
Assembly Manual

Home and Car Alarm

Cat No. **K 2635**

Crime is on the increase! Thousands of cars & homes are broken into each year.

This simple project demonstrates how a basic alarm system operates. It is very easy to build, and should prove lots of fun to experiment with.



Please read Disclaimer carefully as we can only guarantee parts and not the labour content you provide.

K I T

YOU WILL NEED THESE COMPONENTS

Resistors:
R1 220k ohms
R2 100k ohms
R3 1.2M ohms
R4 100k ohms
R5 47k ohms

Capacitors:
C1 0.01uF MKT polyester
C2 0.01uF MKT polyester
C3 0.1uF MKT polyester
C4 22uF 16V tantalum
C5 0.01uF MKT polyester
C6 1000uF 16/25V electrolytic

Semiconductor Devices:
D1 1N4004 diode
D2 1N4004 diode
D3 1N4004 diode
TR1 BC548 NPN transistor
IC1 LM555 / NE555 timer integrated circuit

Miscellaneous:
RLY1 1 Miniature relay with 9V coil, single change over contacts.

Solder, hook-up wire, battery snap & printed circuit board (code ZA1635B).

You will also require a common 9 or 12 volt battery of reasonable capacity (two 9V alkaline batteries in parallel, for example) or some other 9 volt DC power supply (not normally supplied with a kit).

CAPACITOR CODES

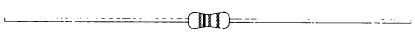
0.01uF	103k / 10nJ
0.1uF	104k / 100nJ

RESISTOR COLOUR CODES

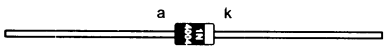
47k ohms	yellow - violet - orange - brown
100k ohms	brown - black - yellow - brown
220k ohms	red - red - yellow - brown
1.2M ohms	brown - red - green - brown

WHAT THEY LOOK LIKE

Resistor

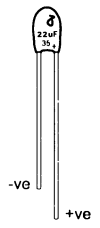


Diode



a - Anode
k - Cathode

Tantalum Capacitor

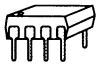


MKT Capacitor

Transistor

e - emitter
b - base
c - collector

IC (Integrated Circuit)



This alarm is very simple to build and operate, because it is controlled by a key switch - it doesn't have complicated timing circuits and setting procedures like many other alarms: a great way to learn the basics.

A key switch looks just like the ignition switch in a car: you turn the key one way and the switch is on; back the other way and the switch is off. Key switches are normally installed on or near the front door of the house or, in the case of a car, on the door or hidden somewhere within the vehicle.

Inside the house, connected to any vulnerable door or window, are sensor switches which detect any opening. The sensors are usually 'magnetic reed switches' which we'll explain later.

When you leave the house, you check that all necessary windows and doors are closed, then turn your key in the switch. The circuit is then 'armed', ready to detect any intruders. The main alarm circuit is a 'normally closed' type which means that a small current flows through the sensors whenever the alarm is armed. If any of the sensors are opened, or if the intruder tries to cheat by cutting a wire, the alarm triggers instantly. Any warning device connected (such as a bell, siren module etc) sounds for around 30 seconds, after which time it turns off and the circuit resets (so your neighbours aren't annoyed by the noise!)

There is a secondary 'normally open' circuit, in the alarm, so that you can use under-carpet pressure mats, bedside panic switches etc, should an intruder have gained entry by a method which didn't trigger the door or window switches.

A further feature of this alarm circuit is that it operates normally from the mains supply via an adaptor. However, should an intruder turn off the mains at the fuse box to try to defeat the alarm, a battery stand-by circuit comes into action. So the alarm cannot be disabled: only the legitimate user can turn it off via the key switch.

how it works

Power for this circuit is available from two sources: first is a power adaptor or other power supply operating from the mains; second is a battery back-up should the mains supply fail or be tampered with by an intruder.

So long as the voltage from the adaptor equals or is greater than the battery voltage, the battery is kept isolated by D2. As a diode needs at least 0.6V potential between its anode and cathode to turn on (with the anode the more positive), it does not allow any current to flow from the battery whilever the adaptor is supplying power. This should ensure the batteries have very long life.

When power is turned on (normally via a 'key' switch outside the building), the circuit is armed. No action occurs because the IC shorts out C4, preventing it to charge, and the normally closed switches between TR1's base and emitter stop TR1 from turning on.

The circuit remains in this state until triggered. If one of the normally closed switches is opened (a window or door switch for example), TR1 immediately turns on, taking the collector voltage to a very low level.

If, on the other hand, one of the normally open switches is closed (an intruder stepping on a pressure mat, for example), the collector to TR1 is connected directly to the negative supply (even though TR1 itself remains off).

In either event, the sudden reduction in the voltage at the collector causes a similar voltage drop to be transmitted to the IC via C2. This immediately triggers the IC on, causing current to flow in the relay. The contacts close, allowing whatever alarm device connected to the contacts to operate.

When the IC fires, the short circuit across C4 is removed, allowing it to charge. The charging current is limited by R3. Eventually, (a period of around 30 seconds) the voltage across the capacitor rises above the threshold voltage of pin 6 (pins 6 and 7 are connected together) and the IC is forced off. Thus the relay drops out, and the alarm device stops.

This 'time out' delay has been set at around 30 seconds to comply with noise pollution laws in some states, which do not permit an alarm to sound for more than a few minutes. The time out may be reduced by reducing R3 (and/or C4), or increased by increasing R3/C4.

If the door/window has been left open, the alarm will not re-trigger, thus obeying noise laws. However, if the window/door/etc is closed and subsequently re-opened, the alarm will be triggered again – just as outlined above.

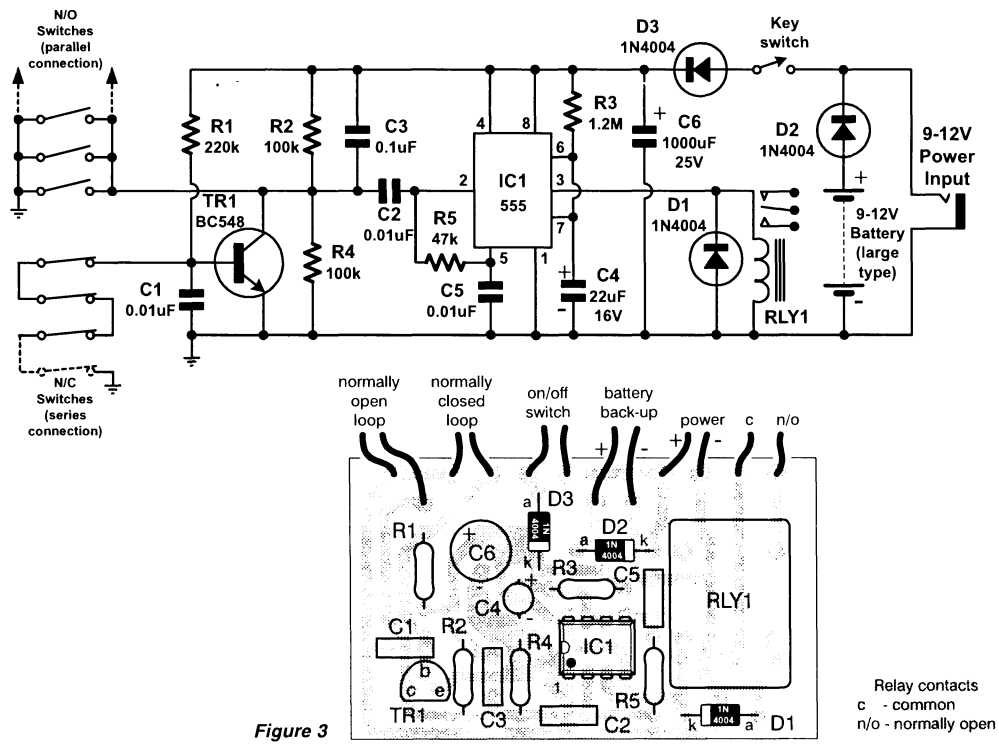


Figure 3

Figure 2 (left): The circuit diagram for the complete home alarm system, showing connection points for the normally open (N.O.) and normally closed (N.C.) switches. The choice of alarm warning device is left to you: a bell, a siren, etc can be switched by the relay on the alarm PCB.

putting it together

Step 1

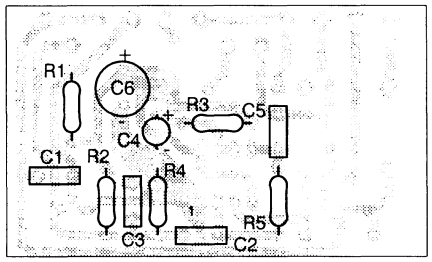
If you have purchased a kit (Cat. No. K 2635), check off the components against the parts list to make sure they are all there and are the correct types and values.

Step 2

If you have not purchased a kit you will need to obtain the components listed and either make a printed circuit board using the component position drawing, or use perforated strip board and the component position drawing as a guide.

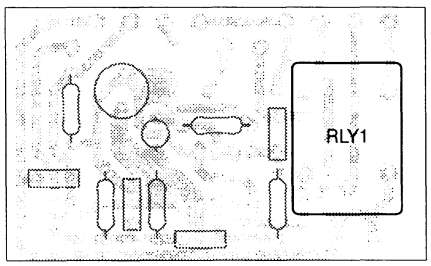
Step 3

Mount the components as shown in the component position drawing. Place and solder the resistors and capacitors first taking extra care with C4 & C6, (the tantalum & electrocytic capacitor). Both are polarised and need to go around the right way. The small '+' sign marks the positive lead position. Check that all the components are positioned neatly and correctly 'dressed' before soldering them in.



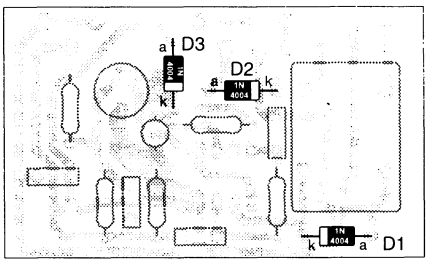
Step 4

Position and solder relay RLY1 after ensuring that you have it correctly oriented. This is simplified by the fact that the five pins will only line up one way.



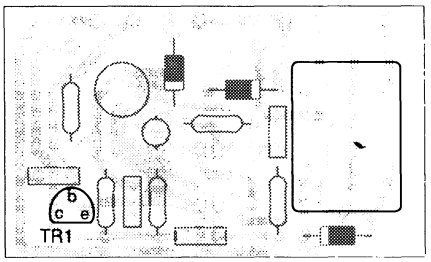
Step 5

Next, position the diodes D1, D2 & D3 taking care to see that they are correctly polarised. Remember, the cathode (K) is the banded end and corresponds to the bar in the circuit diagram. Solder them in taking care not to overheat them.



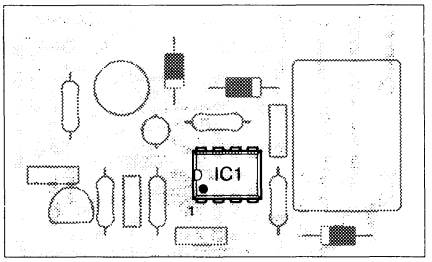
Step 6

TR1, the NPN transistor, is next and care must again be taken to ensure correct polarity with the base connecting to C1 on the PCB. Again, take care not to overheat the transistors when soldering.



Step 7

The 555 timer integrated circuit, IC1, is the last component to be placed and soldered. It is done last to reduce the risk of damage from overheating. Follow these steps each time you place an IC to reduce the chances of error and damage to the device. Insert the integrated circuit into the holes on the PCB until the little shoulders on the pins prevent it from going further: make sure it is the right way around, by noting that pin 1 (the one marked with the circle indented into the top of the IC) is connected to the negative track; then turn the board over and carefully solder each of the pins to the pads making sure that you don't run solder between the pads. See How to Solder for hints on making correctly soldered joints. Inspect the connections to make sure you've soldered them all without shorting out any of the pads and that's it!



Step 8

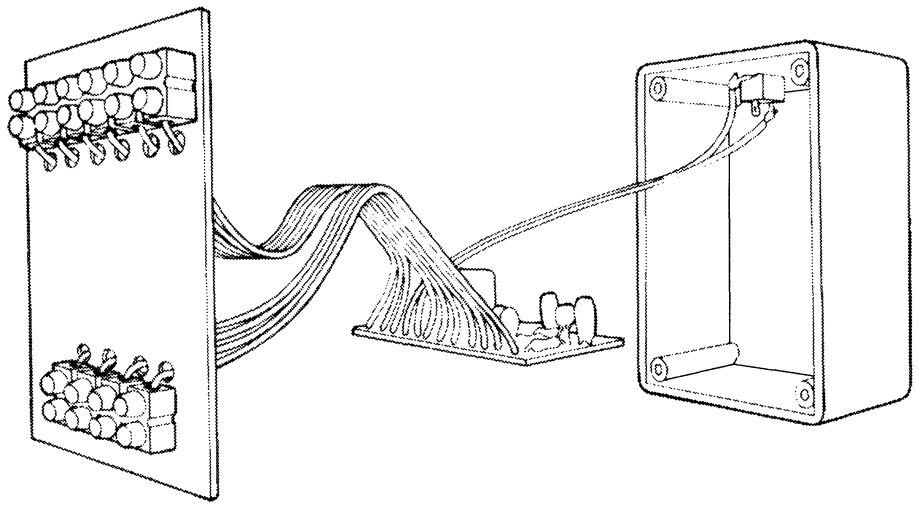
Solder on the battery snap wires, taking care to see that they have the correct polarity: – red (positive) to the pad marked '+' and black to the negative pad marked '-'.

Step 9

Before you connect the battery check again that all the components are in the right place, the correct polarity and soldered properly. Clip off any excess wire and leads.

Step 10

Connect the battery and test the circuit by bridging the key switch pads. This should cause the relay to operate as the normally closed (NC) contacts would still be open (we haven't connected them yet). The relay will stay operated for about 30 seconds and then relax if the circuit is working correctly.



what to do next

First of all, you must decide which use your alarm is going to be put to: a home alarm system or car alarm system. Different connections are required for each purpose.

Home Alarm System

First step is to build the alarm module into a protective case. In a normal home alarm installation, the alarm 'works' are normally hidden away for security (in a cupboard, for example). For this reason, the box need not look 'pretty', more functional.

We assembled the prototype into a zippy box with two mains terminal blocks on the lid for connecting the various leads. A four-way block at one end connects to the sensing loops, while a six-way at the other end connects to the battery, key switch and alarm device. A separate 3.5mm socket is fitted to the case to accommodate the plug from the mains adaptor.

We have shown the alarm system powered by a mains adaptor with battery stand-by in case of power failure. The battery can be an external type, such as large 9 volt battery, to give extra life. However, there is plenty of room inside the case if you wish to place a standard 9V (or even two batteries connected in parallel). For longest life, alkaline batteries are recommended.

The sensing devices themselves can be any of a large number of types specifically designed for this purpose. In the 'normally closed' loop one might find tiny magnetic reed switches (these are buried in, or secured to, the window sill/door post using double-sided tape, and are held closed by a small magnet on the window or door itself. If the window/door is opened, the magnet moves away and the switch opens). Alternatively, micro switches, thermal switches, movement sensors, etc, may all be used in this loop. The important thing to remember is that all **normally closed** devices are connected in **series**.

In the normally open loop, such things as pressure mats, panic switches, trap switches, etc may be used. As distinct from the above type, **normally open** devices are connected in **parallel**.

Remember whatever alarm device you choose, it too should have battery back-up if operated from the mains adaptor. There is no point in detecting an intruder if the alarm doesn't sound! It is also a wise move to have the alarm device mounted in a very inaccessible location: the intruder has less chance of disabling it! High up under the eaves of the house is usually satisfactory, particularly if housed in a siren cover.

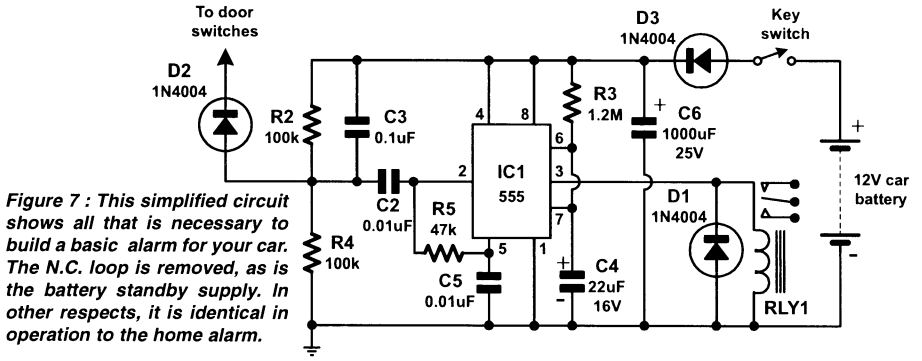


Figure 7 : This simplified circuit shows all that is necessary to build a basic alarm for your car. The N.C. loop is removed, as is the battery standby supply. In other respects, it is identical in operation to the home alarm.

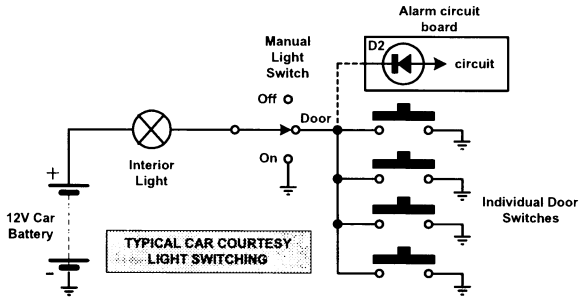


Figure 8 : Most cars are wired in this way: the dotted line shows the wire you need to add to the car's electrical system to obtain triggering for the alarm. This wire links up to the 'cathode' end of D2 on the car alarm PCB.

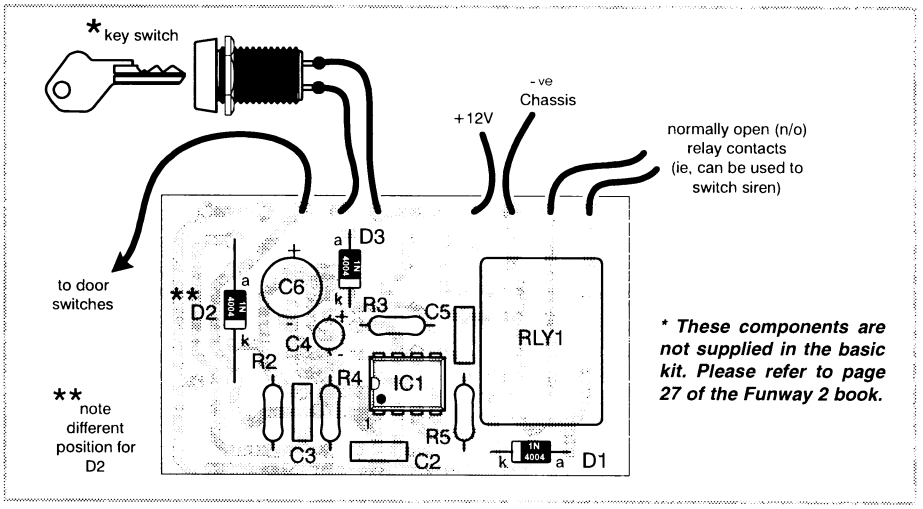


Figure 9 : You can see how much simpler the car alarm is by comparing this PCB to the complete home alarm. Make sure you mount all the components in the right holes or the alarm won't work!

Fitting to a motor vehicle

As this circuit operates quite happily from 12 volts, it is ideal for use as an automotive burglar alarm. In fact, if you fit the siren (project 11) and the flasher (project 1) you'll have quite a neat looking alarm!

In most cars, a courtesy light (sometimes called a dome light or interior light) is fitted, which operates when you open the car doors. This is a benefit if you want to fit an alarm, as it means that part of the wiring (the most difficult part, in fact) has already been done for you. All you have to do is link in to the wire connecting the door switches to the interior light and you have a sensing switch for an alarm system. In 90% of cars, the wiring to the switches is the same: that shown in Fig. 8. As you can see, there may be fitted a 3 position switch which allows for the interior light to be controlled from inside the car. To work with the alarm, this switch would have to be left in the centre position: but as this is the position that most people leave the switch in anyway, this is not seen as a problem.

The wiring of the car burglar alarm can be considerably simplified from the home alarm, while keeping the same PCB. As most sensing switches used in car alarm installation (eg microswitches for bonnet/boot opening detection) can be wired either N.O. or N.C.,we can assume the lot to be N.O. and leave out the N.C. detection loop. This saves R1, TR1 and C1. R2 is retained, and adding diode (D2) in it's new position. A further saving can be made by leaving out the battery stand-by feature: it is not required for this application, unless the vehicle battery is exposed and a thief can cut the wiring. In all other circumstances, the car battery is connected directly to the 'power' terminals on the PCB and omitting the battery stand by feature..

The key switch must be mounted in a position where the thief cannot gain access to the rear of the switch and disable it. Be careful when choosing the mounting position. Connecting the alarm to the car

wiring should not prove too difficult. All you need to do is identify the wire coming from the door switches (they unscrew normally so you can pull one out slightly to see the wire's colour coding), and tap into the wire at some convenient point. If you don't wish to cut and solder the wire, splice connectors are ideal for the purpose: you just place the two wires alongside one another, place the connector over them both, and squeeze with pliers. The connector bites through insulation and connects the wires in an instant.

D2, the 1N4004 diode is now placed in its new position and connects to the door switches. This set-up is only suitable for vehicles with a negative switching door circuit as shown in figure 8.

Notwithstanding anything we've said on this page, if you wish to use the un-modified PCB (the home alarm version) in your car, this is quite in order. Remember, however, that if you do not fit any normally closed sensors, the terminals for the N.C. loop should be kept shorted at all times. D2 will still need to be installed between the door switches & the normally open (N/O) alarm input (ie. cathode side to door switch).

choosing an alarm device

As shown, the alarm circuit ends in relay contacts: the choice of warning device is left to you. The relay contacts act simply as a switch to turn on your alarm device.

In your home....

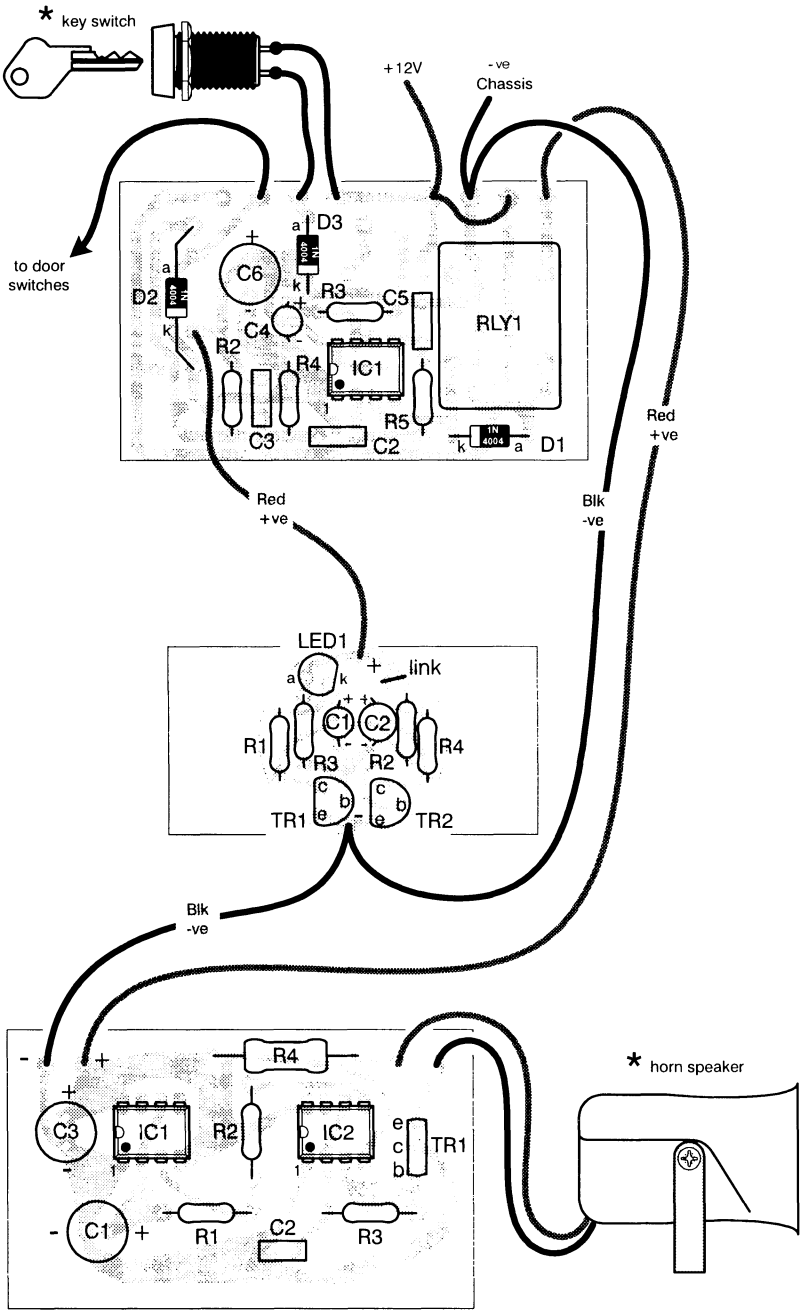
The easiest, simplest and probably one of the best alarms for the home is a siren. These normally operate from a low voltage and thus can be switched safely by the relay. If the siren you obtain operates from a higher voltage, or if the current it draws is beyond the capacity of the relay contacts, you will need to use another relay, switched by the one on the PCB. (See 'Using Relays' page 27 in this book).

An alternative is to build the siren in the next project (project 11) and connect it to the alarm relay. As we will mention in the siren project, an efficient horn speaker will give a good, loud blast: enough to scare even the most determined felon away!

In a car...

Most people immediately imagine that the car horn is the best warning device in a car. In some ways, they're right: the horn is already 'in situ', all that needs to be done is connect the alarm to it.

But here are where the disadvantages come in. There are a number of methods of connecting car horns used, and it often takes an expert to fathom them out.



** These components are not supplied in the basic kit. Please refer to page 27 of the Funway 2 book..*

Figure 10: A complete car alarm system using three 'Fun Way' projects: the alarm module itself, the flashing LED (to act as a deterrent), and, should the worst happen, the siren, with an efficient horn speaker to give a warning.
The three printed circuit boards can all be fitted in the same Zippy box; however, the LED PCB is smaller than the other two and will need to be glued into position. It could be glued onto the front panel of the box, so the LED can poke out through a hole in the panel.
Wiring between the three PCB's is quite simple; the alarm and flasher PCB's are both controlled by the key switch. The siren PCB is switched via the relay.
Mount the horn speaker underneath the bonnet, or in some other location which is both hard to get at for the thief, but allows the sound to escape.

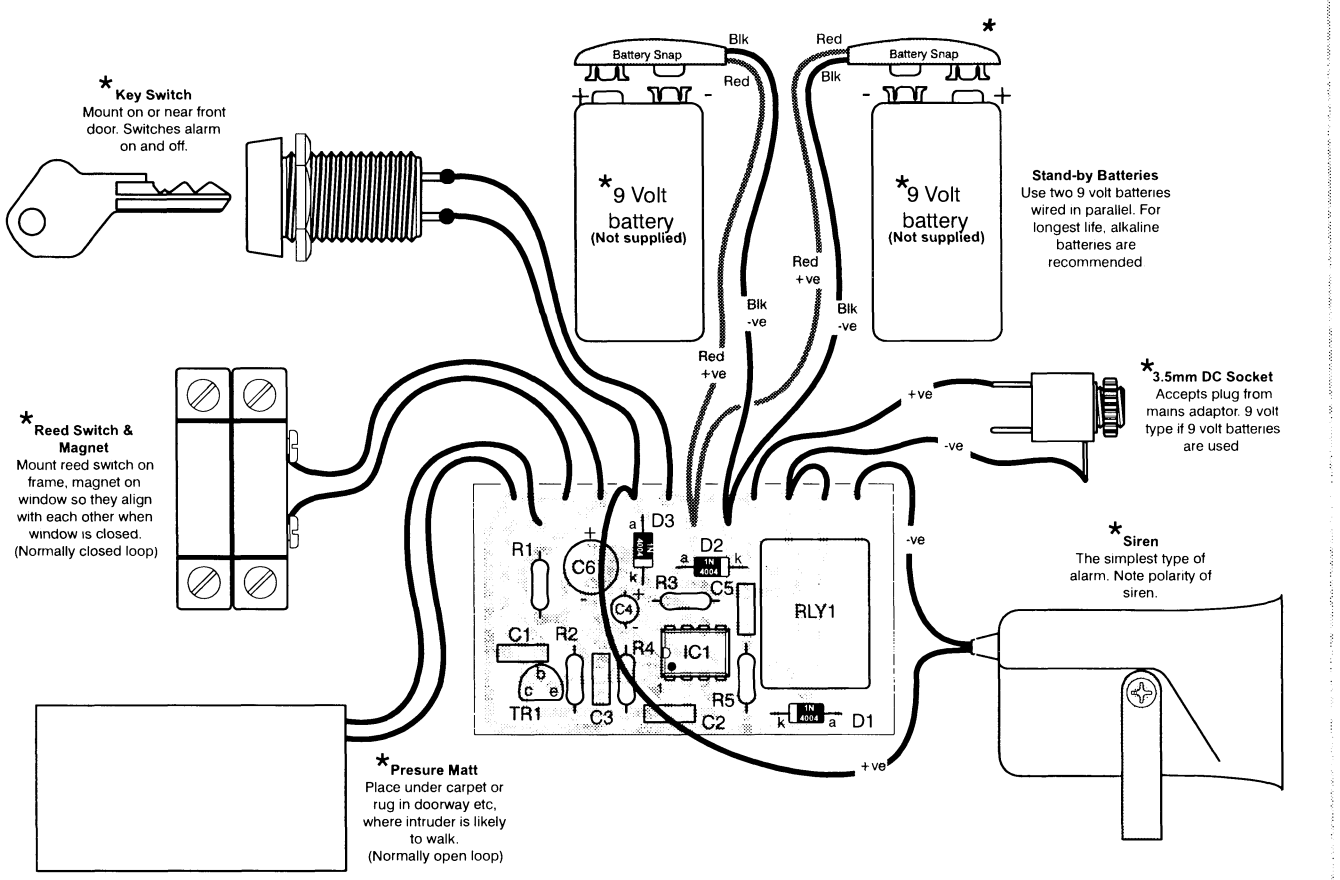
Admittedly, most cars these days have the horn connected to the battery positive, with the horn button completing the negative supply when pressed.

But there are many cars that are wired opposite to this. And some cars use horn relays as well: just to complicate the issue!

Another problem lies in the fact that the simple on-board relay we use in the alarm will not handle the very heavy current drawn by a car horn. A separate horn relay would need to be fitted to control the horn in any case.

If you think you are capable of using the car horn for an alarm, be careful. Consult the vehicle service manual for a circuit diagram before going ahead. Sounds complicated, doesn't it?

That's why we recommend fitting the system shown in figure 10: it has the alarm module, flasher and siren module – all in one neat package!



NOTE: Only the components shown on the PCB are supplied with the alarm kit (Cat. No. K 2635)

**Not supplied with kit. (Only one battery snap supplied with kit).*

Figure 4