Reversing alarm for your car

Ever had a 'near miss' with a pedestrian or a member of your family while reversing your car or station wagon? This little reversing alarm will let people know, in no uncertain fashion, to watch out when you're reversing.

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ALMOST EVERY driver, some time in their driving career, will back into something while reversing. All you do is wince and say a few expletives deleted if it happens to be the gatepost, garage door, etc, but it's a horrifying experience if you run into a person. Apparently, in a large number of accidents where people are injured while a driver is reversing a car, a friend or member of the family is the victim. Too often, it's a child. Whilst it's not possible to completely eliminate the risk, you can go a long way towards reducing it significantly by alerting people when reverse gear is selected in the vehicle. A loud, attention-getting audible alarm is a good way to do it, hence this project.

Our alarm is intended to be installed at the rear of the vehicle, connected across the 'reversing' lights. Reversing lights have been commonly fitted to vehicles, as part of 'standard' equipment, since about 1968-70. They have been a compulsory fitment in cars (sedans, etc) sold in Australia since January 1972 and 'general purpose' vehicles (off-road types, etc) since January 1973, and in trucks up to 4½ tonnes since July 1973, trucks over 4½ tonnes since July 1975. Reversing alarms for trucks or other vehicles are not a compulsory fitment, but many Japanese trucks have included them for the past few years.

Getting attention

This alarm has been designed to get your attention in two ways. Firstly, it is LOUD . . . *piercing*, in fact. The noise maker is a piezoelectric alarm. These employ a ceramic piezoelectric element and generate an audio signal at a few kilohertz at sound pressure levels *in excess of 90 to 100 dB* a few metres from the alarm. Their electrical energy to sound energy conversion efficiency is very high. They are somewhat directional, but that's fine for this sort of application. A variety of types are available and may be used with this project. However, we suggest you purchase a type which is specified to produce a sound pressure level (spl) of at least 90 dB at 2 m distance from the alarm.

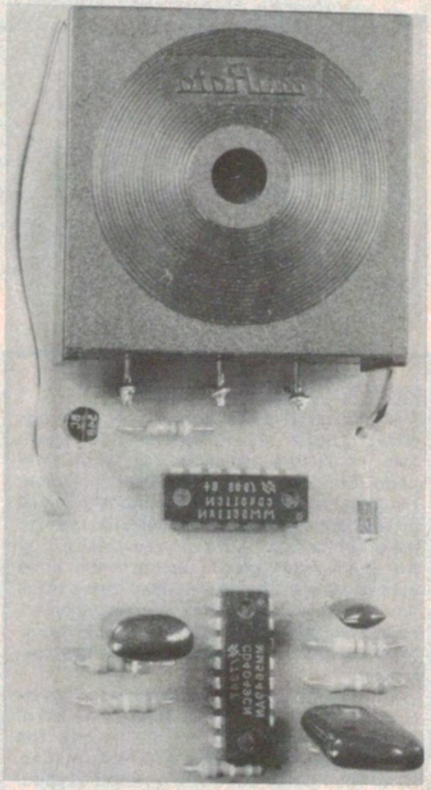
The second attention-getter we have incorporated is to *pulse* the alarm. But, to improve its attention-getting, it is a staccato pulse rate rather than an even rate. The project will work on 6 V or 12 V electrical systems, positive or negative (conventional) 'ground'.

Two CMOS ICs are used. One is a 4049 hex inverting buffer with three pairs of inverters arranged as pulse oscillators, each set to a different pulse rate. Another IC combines outputs of the oscillators to produce the staccato pulse rate. The composite pulses drive a transistor, which turns the piezo alarm on and off.

Construction

While we have designed a printed circuit board for this project it is not essential to use one and the unit could be constructed on matrix board, Uniboard or Veroboard if you wish. However, our construction description applies to the pc board we designed.

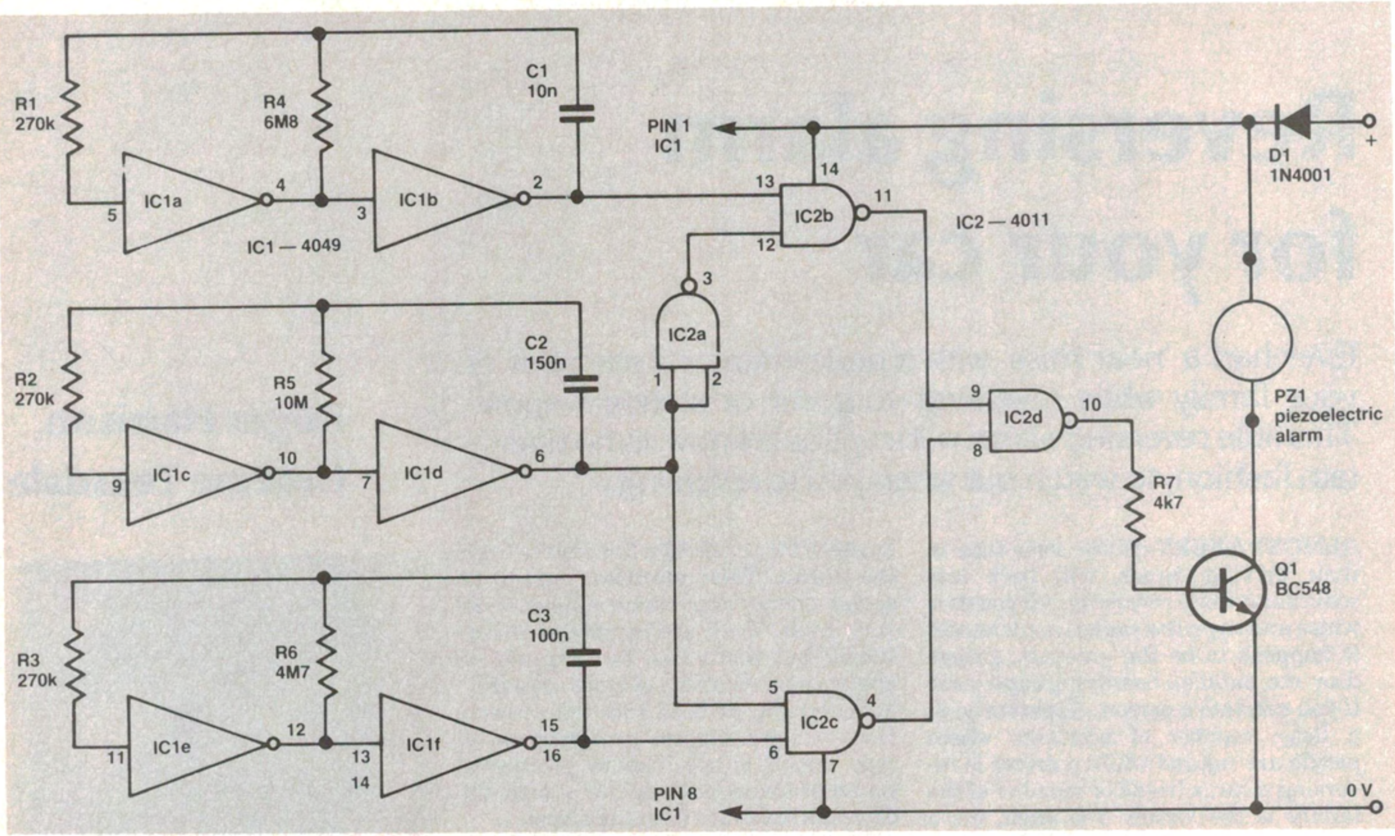
First thing to do is make sure all the component holes are drilled. There's nothing more infuriating than getting most of the components in place only to find one won't fit because the hole is undrilled. It's especially infuriating if you've made the board yourself! Undrilled holes are generally a rarity with commercially-made boards.



Simple, but effective. Built around a piezoelectric alarm, our project will operate on 6 V or 12 V systems.

The next thing is to insert all the resistors and capacitors. As with most projects assembled on pc board, all the components are mounted on the plain side of the board. The resistors and capacitors do not have any particular orientation, but make sure you put the correct values in the right places. Next, ▶

Project 333



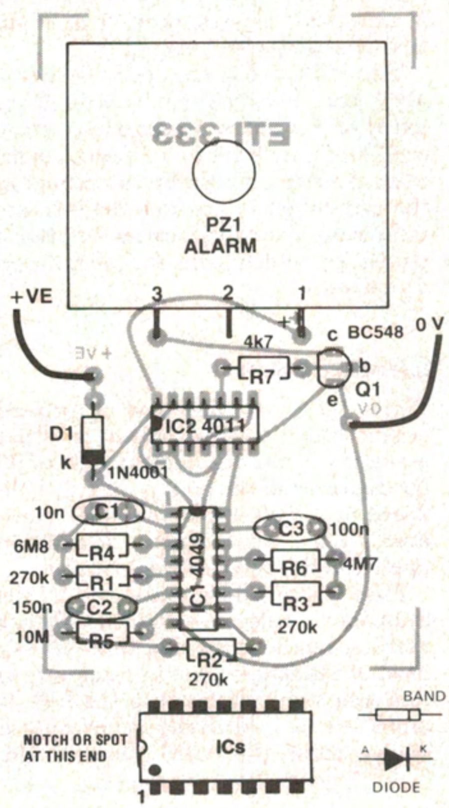
HOW IT WORKS — ETI 333

Three pairs of gates from IC1, a 4049 hex inverting buffer, are arranged as three 'ring-of-two' oscillators, each having a different period. The outputs of these three oscillators are gated together and the composite signal drives the base of Q1. A piezoelectric alarm in the collector of Q1 is thus pulsed on and off by the composite signal. Because the three oscillators are not synchronised their phases are random and an attention-getting staccato sound is produced, something like: beep-beep/bip-bip-bip-bip/beep-bip/beep-bip-bip-bip, etc.

The shortest period oscillator is formed by IC1a, IC1b, R1, R4 and C1. It has a period of about 140 ms (70 ms on, 70 ms off). The longest period oscillator is formed by IC1c, IC1d, R2, R5 and C2. It has a period of about four seconds (2 s on, 2 s off). The last oscillator has a period of only one second and is formed by IC1e, IC1f, R3, R6 and C3.

The four gates from IC2, a 4011 quad NAND, are employed to gate the oscillator outputs together to provide the composite signal. The base of Q1 is driven from the output of IC2d, via R7, which limits the base current to Q1 to an appropriate value.

The piezoelectric alarm may be any suitable type that can operate over a voltage range of five to 15 volts. This type of alarm was chosen as it is very efficient and produces a very loud, high-pitched noise. Diode D1 protects the circuit against damage from reverse-supply connection. The circuit will work over a voltage range from 5 V to 18 V (limited by the operating voltage range of the CMOS ICs).



PARTS LIST — ETI 333

Resistors .... **all ½W, 5%**

R1,2,3	270k
R4	6M8
R5	10M
R6	4M7
R7	4k7

Capacitors

C1	10n greencap
C2	150n greencap
C3	100n greencap

Semiconductors

D1	1N4001,1N4002 or similar
IC1	4049
IC2	4011
Q1	BC548,BC108 or similar

Miscellaneous

PZI — Murata piezoelectric alarm; ETI-333 pc board; wire etc.

Price estimate

We estimate the cost of purchasing all the components for this project will be in the range:

$8 — $10

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project, such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel supplied (if used), etc — whether bought as separate components or made up as a kit.

insert the transistor, Q1. Take care to get it the right way round, otherwise the alarm won't work at all and you may destroy the transistor when you first apply power.

Now you can install the two integrated circuits. As they are CMOS devices handle them only by the ends of the package, not by the pins, and insert them carefully in the board, taking care to orientate them correctly. Identify pin 1 on the package before you take them out of their protective packaging. You'll find a notch in the pin 1 end or an indentation adjacent to pin 1 on the IC package.

When soldering the ICs in place, solder pin 8 and then pin 1 of IC1 first, then pin 7 and pin 14 of IC2. Let the ICs cool down and then solder all the other pins. Use a hot iron with a fine tip and do it quickly. You can pause every few pins to let the ICs cool down before continuing.

Next comes the protection diode, D1. It is important you get this in the right way round, otherwise it may offer no protection at all! The piezo alarm is attached last of all. The Murata type we used has three connections, marked 1, 2 and 3 on the package. Pin 1 connects to the collector of Q1 and pin 3 connects to the pad on the board that goes to the cathode of D1 (it's marked with a '+' on the copper side of the board). Whatever piezo alarm you use, the '+' lead will be identified in some way. We mounted our Murata alarm on the pc board using a double-sided sticky pad.

Testing

Now you can attach leads to the supply +ve and 0 V pads on the board and test the project. Use different coloured wires to identify the leads. Just check, last thing, that all the components are the correct ones and inserted the right way round. You can use an ordinary 6 V or 9 V battery to test the project; it only draws between 20 and 30 mA on 12 V, somewhat less at lower voltages.

All you have to do is connect it up and see if it emits a staccato series of piercing beeps!

If it doesn't, disconnect the supply and check you have the components correctly placed on the board. Check the polarity of D1 and the piezo alarm. Check with a multimeter that the supply is getting to the supply pins on the two ICs. You might also check that the unit is drawing current. Any problems here will give clues to where the fault may lie.

Installation

We'll have to leave the installation details up to you. However, a few pointers may assist. The board may be mounted anywhere convenient and the piezo noise maker put remote from the board, in a spot where it is protected from the weather, but can be readily heard — but *always* at the rear of the vehicle, *facing rearward*. The supply connections from the board should be connected in parallel with one of the reversing lights. In some vehicles, the whole pc board and piezo alarm assembly will fit inside the rear light housing.

Make a trial fitting and test it out before permanently mounting the unit. Make sure it can be heard above other loud sounds (such as a revving car engine a metre or two away). ●