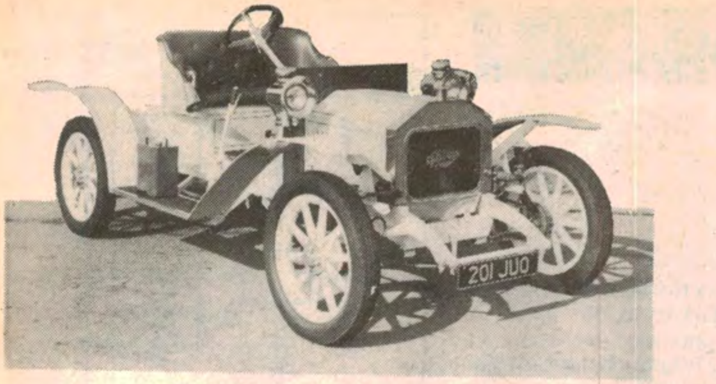


Speed Sentry

Cheaper than a radar detector & more reliable

There is no doubt that there exists an urgent need for greater safety on our roads and that, in the main, this is the responsibility of the individual driver. We believe that our "Speed Sentry" can contribute to greater safety by assisting responsible drivers to drive within the speed limit at all times.

by GERALD COHN

The combination of a well-made road and a comfortable, quiet vehicle can easily lead to gradually increasing road speed, to the point where the prescribed limit is exceeded. By implication, this could lead to a speed which is dangerous without the driver realising it.

The rude awakening comes when we suddenly find ourselves confronted with a dangerous situation: another vehicle which appears out of nowhere; an unanticipated curve in the road for which the speed is too high, and of course the possibility of a siren or flashing blue light or a radar trap.

Another situation with which most drivers can identify is that of returning to a built up area after being on a highway for a period of time. The sudden reduction in speed limit from 100km/hr to 60km/hr makes the latter seem a veritable crawl. It is too easy to allow the speed to slowly increase under this condition, and if too much attention is being paid to the speedo in an effort to keep the speed down, then not enough attention is given to the road. Also a dangerous situation.

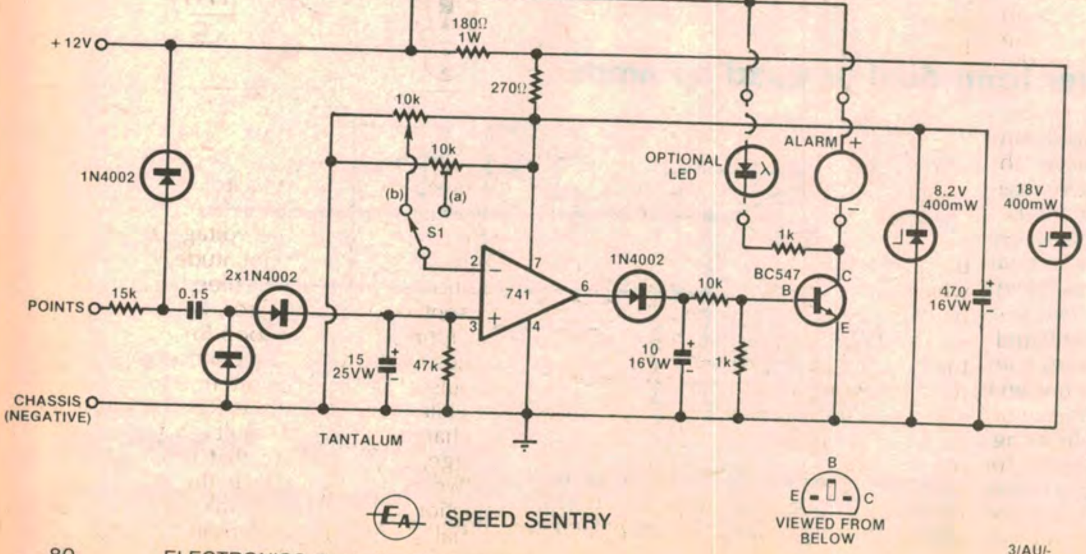
It is to avoid situations like this that we have designed the Speed Sentry. But, as we shall see later, it has another very useful application apart from monitoring your road speed.

It is a simple alarm system that can be set to sound when any maximum speed the driver cares to select is reached or exceeded. It also has a preset position, which can be set to 60km/hr so that a flick of a switch sets it up for use within the metropolitan area.

Our Speed Sentry monitors vehicle speed by measuring the frequency of pulses from the ignition system. If a particular frequency is exceeded, corresponding to a preset vehicle speed, an alarm sounds and continues to sound until the speed drops below the predetermined limit.

The main drawback when using ignition pulses to measure road speed is the fact that only in top gear is the reading a true one. At other gear ratios the alarm will sound when the engine speed reaches the equivalent of the setting for top gear. It may be possible to overcome this, with a manual transmission, by mounting a microswitch on the gear shift quadrant so that the alarm circuit will be active only when top gear is selected.

Vehicles with automatic transmission also present some problems. Automatic transmission systems fall into two broad categories. Two speed types usually incorporate a wide range torque converter which, because of the coarse range of only two speeds, is used continually to



The circuit consists of a diode charge pump, an op amp comparator and a transistor output stage.

We estimate that the cost of parts for this project is approximately

$12

This includes sales tax.

optimise power transfer for best performance. Consequently, its influence on engine speed due to load and throttle setting is continually varying. Unfortunately, in these circumstances the Speed Sentry's behaviour will be dictated by a varying engine speed not necessarily proportional to road speed.

The second type of automatic transmission (usually a three speed type) incorporates a torque converter with a narrower range than the two speed type. In the top speed position it has the advantage of a mechanical locking device which couples the engine drive shaft to the tail shaft. With this type of automatic transmission, engine speed is proportional to road speed, just as in a manual transmission.

In spite of these minor disadvantages, we felt a device working from the ignition system had the overwhelming advantage of simplicity. There is, however no reason why a sensing device could not be attached to the tail shaft, or the rear axle for that matter. In this way we can constantly monitor our road speed without having to be concerned with the gear selected. There are a number of devices available that would be suitable for this type of sensor such as magnets and Hall Effect devices, reed switches or even an optical arrangement.

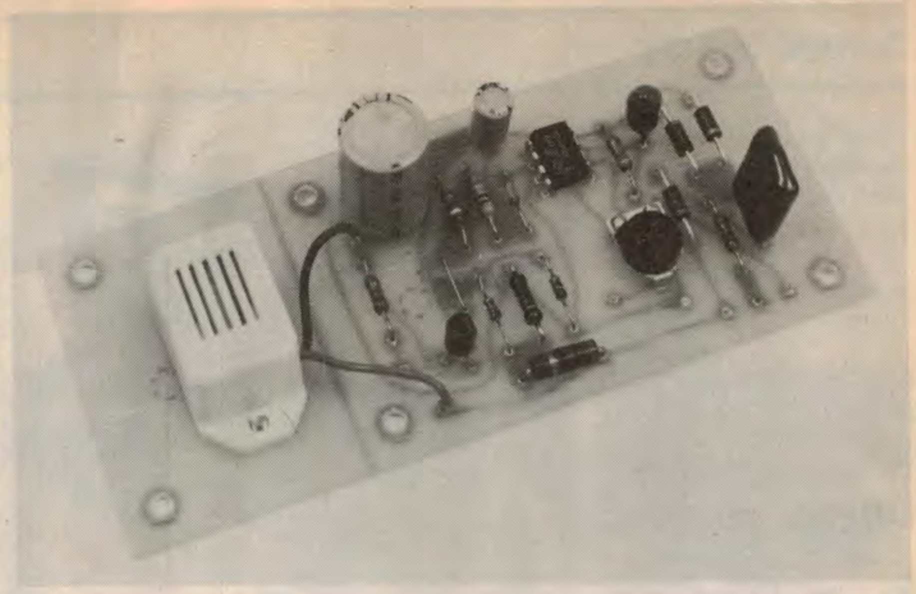
Our unit connects across the distributor contacts, ie, between the points' active terminal and chassis earth. A brief description of how the circuit functions should help readers to understand it.

The pulses from the points are fed to a diode charge pump through a limiting resistor. The output of the diode pump is a DC level that is proportional to the rate of the pulses at its input. This is applied to a comparator circuit which compares the voltage across the capacitor to a fixed reference. The output of the comparator is used to switch a transistor which has an audible alarm device in its collector circuit.

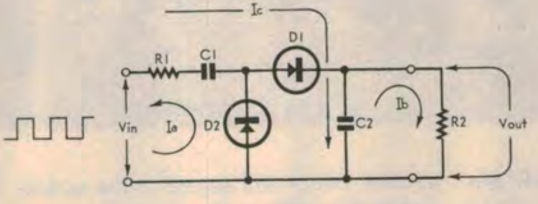
The action of the diode pump circuit may be understood by referring to Fig. 1.

At the input to the diode pump is an RC network consisting of R1 and C1. The purpose of this is to differentiate the pulses from the points. Differentiation is a process whereby the pulses are converted into spikes that are constant in area regardless of the pulses from which they are derived. It is this vital difference between the original pulse, and the spike derived from it, which makes it possible to "count" the pulses, and produce a direct voltage whose value is indicative of the pulse rate.

In order to generate the differentiated spikes, C1 and R1 must be of such value that C1 charges very rapidly on the application of a pulse. It is the brief pulse of current which flows during this charging function that constitutes the spike. Since C1, once charged, cannot pass any more current, then the length of the rectangular input pulse has no effect.



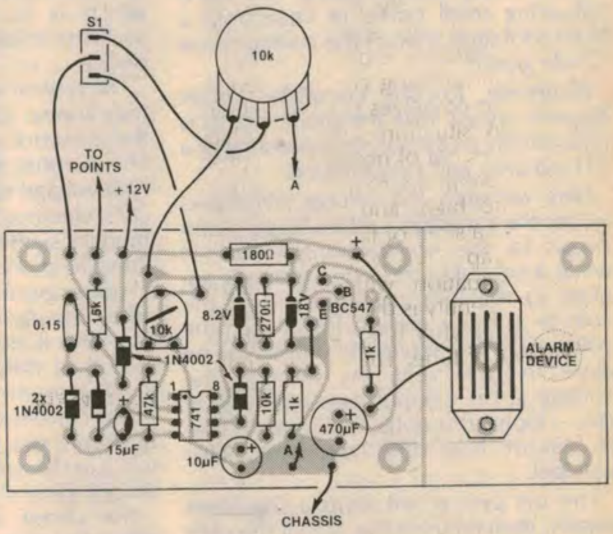
ABOVE: a small PCB accommodates most of the components. The buzzer can be mounted separately if desired, and its section of board cut off.



BASIC CIRCUIT OF A DIODE PUMP

Figure 1

LEFT: How the "diode pump" works. It produces a DC output proportional to the input pulse rate.



RIGHT: Follow this wiring diagram when wiring up the Speed Sentry. Note that a LED indicator circuit can be used in parallel with the buzzer, or substituted for the buzzer altogether.

At the end of the input pulse, C1 must be discharged rapidly, before the next pulse appears. This can only take place through the input (or generator circuit) which ideally, should have zero impedance. Since the generator in this case is a pair of breaker points, this ideal is virtually achieved since they are shorted in the "no spark period".

As each spike is generated, its current path (Ic) is via diode D1 and C2. As a result of this current, C2 will acquire a certain amount of charge and, thus, a certain voltage will be developed across it. With each additional spike, the voltage across the capacitor will rise.

Capacitor C2 would in time, become fully charged, with the voltage across it equal to the spike amplitude, if some method of controlled "bleed" was not present. The load resistor, R2, performs this function (current loop Ib).

Thus, when we feed a continuous train of pulses into C2, they attempt to charge it, while at the same time, R2 attempts to discharge it. The end result is a degree of charge, and a voltage that is a balance between the two. Since the discharge function is fixed by the value of R2, the actual voltage is determined by the

"Sorry guys, but you were exceeding the speed limit by 10km/hr."

variable factor; the rate at which the spikes are fed to C2. Thus the voltage across C2 becomes a direct indication of the rate of the ignition pulses.

The action of this circuit is analogous to a pump – say a water pump – which is delivering small bursts of liquid into a large container. Hence the coined name "diode pump".

Reference to the complete circuit diagram shows that the diode pump is followed by a comparator consisting of a 741 op amp and two trimpots.

Here we apply the voltage developed across the capacitor in the charge pump circuit to the non-inverting input (+) while a variable reference voltage is applied to the inverting input (–). If the voltage at the + input is lower than the voltage at the – input, the output will be close to zero volts. As soon as the voltage at the + input rises over that at the – input, the output will rapidly rise to almost 8.2V (the zener regulator voltage).

The op amp is fed from a regulated supply, derived from the 12V of the car's electrical system. Here we have used an 8.2 volt zener shunt regulator to provide us with a stabilised operating voltage. This is important for reliable operation of the circuit since any voltage changes in the main electrical system (due to the headlights being switched on for example) would result in a change in the reference levels at the inverting input of the op amp.

The output of the op amp is fed to a second diode/capacitor combination which is used to smooth any pulses appearing there. Where the voltage across the capacitor in the charge pump circuit is just at the threshold level of the comparator, pulses will appear at the output, due to the ripple at the input. This ripple is due to the charging and discharging of the capacitor with the input pulses.

This smoothed voltage at the output of the op amp is used to drive transistor Q1 which is a saturating switch for an oscillator-driven buzzer or a piezo alarm device.

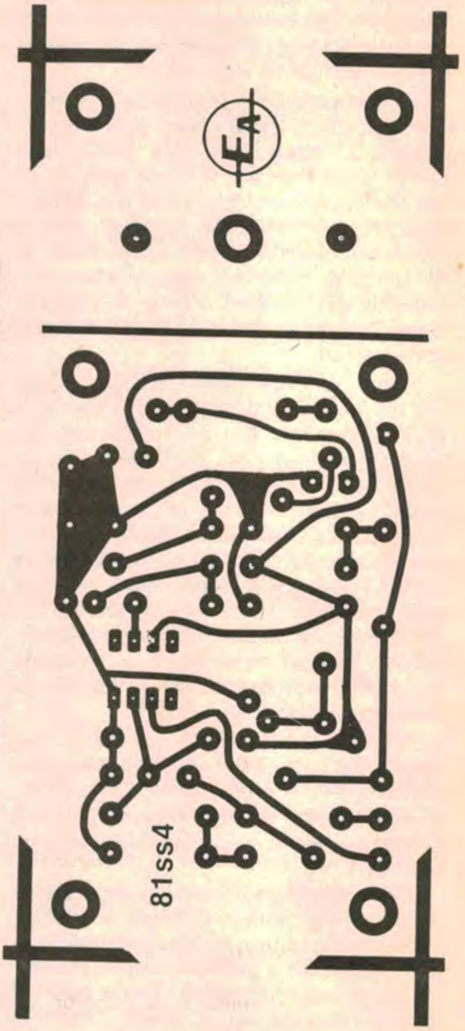
The power supply section of the circuit may appear a little strange at first due to the presence of an 18-volt zener diode. The purpose of the zener is to clip any high voltage spikes that may occur in the car's electrical system. It is not uncommon for such spikes to occur, so this was fitted to protect the op amp IC.

Further protection for the IC is provided by the diode connected to the +12V line. This limits the voltage at the input (pin 3) of the 741 to just slightly more (0.6V) than the nominal battery voltage.

The current drain of the circuit in the quiescent state is around the 5mA mark, while in the activated state (buzzer sounding) it climbs to 25mA.

The circuit would be connected to either the accessories position on the ignition switch or to another part of the wiring that is only active when the engine is running. In this way no power is consumed by the circuit when the car is not being used.

The circuit, as it is drawn, assumes a negative chassis vehicle. (If you have a vehicle with a positive chassis, then all diodes, electrolytic capacitors and the buzzer leads will have to be reversed. The op amp will have to have its supply reversed, and this means cutting the copper tracks leading to the supply pins and using short jumpers to reverse them. The transistor would also have to be replaced with its PNP equivalent.)



The actual size PCB artwork.

We have designed a printed circuit onto which all of the components with the exception of the second potentiometer and the changeover switch are mounted. The board measures 118x52mm and is coded 81ss4. Construction is simple and should not take more than an half an hour or so. The components should be mounted in the usual order; starting with resistors and capacitors, then diodes, transistors and finally the IC. There is one wire link on the board and this should be soldered in at the same time as the resistors are mounted. We have made provision on the board for an additional 1kΩ resistor which allows a series LED to be connected in place of the buzzer, or if desired, in parallel.

The external connections to the board are the power supply, the switch and the external pot. This is shown in the wiring diagram.

We have not mounted the prototype in a box since mounting requirements vary from one make of vehicle to another.

The extra pot and the changeover switch can be mounted on the dash, or, if your car has it, in the centre console. It should be noted that the second pot and the changeover switch are not mandatory to the operation of the circuit. If you wish to have only a single speed setting then the input on the board will suffice. In this case it will be necessary to place a link between the wiper of the trimpot and the trimpot to the op amp.

Once construction has been completed and the unit has been fitted to the car, you should enlist the help of a friend, either as driver or passenger, to set the trimpot.

Get the car moving at a constant speed of say 60km/hr (or any other that may be required) and then set the trimpot so that the buzzer just begins to sound. Now drop the speed back a little and make sure that the buzzer stops. Accelerating up to or just over the preset speed should cause the alarm to sound.

PARTS LIST

1 Printed circuit board 118x52mm (81ss4)
1 buzzer, oscillator driven type
4 1N4002 diodes
1 18V 400mW zener diode
1 8.2V 400mW zener diode
1 BC547 NPN transistor
1 741 operational amplifier
1 LED (optional)
1 single-pole double-throw miniature toggle switch

CAPACITORS
1 0.15uF metallized polyester (greencap)
1 10uF/16VW aluminium electrolytic
1 15uF/25VW tantalum
1 470uF/25VW aluminium electrolytic

RESISTORS (¼W 5% unless specified).
1 x 47kΩ 1 x 10kΩ, 1 x 3.9kΩ, 2 x 1kΩ,
1 x 270Ω 1 x 15kΩ 1W, 1 x 180Ω 1W
1 10kΩ miniature trimpot
1 x 10kΩ linear potentiometer

The same procedure is used to set the second pot, although here the driver can do it while driving along.

It should be noted that top gear must be engaged while these adjustments are being made.

Another use for the unit to keep track of engine revs when running in a new engine. This unit can be set up so that it is triggered when, say, 3000 rpm is exceeded. This will work quite reliably, irrespective of the gear selected. It is just another way to make sure that the new engine is run in properly.

When you have the unit up and running you may like to try out some of the other speed sensing methods mentioned earlier in the article.

Happy and safe motoring!