Don't flatten your battery. Build a

Parking lights reminder for your car

Incorporating a pleasant chime sound, our headlight reminder will save you the hassle of a flat car battery. If the headlights or parking lights are on, it will sound as soon as the ignition switch is turned off.

by JOHN CLARKE

During overcast and rainy weather, many motorists switch their parking lights on during the day. While this is a worthwhile safety measure, it's all too easy to forget about the lights at the end of the journey. Many a motorist has returned to his vehicle at the end of the day to find it with a flat battery and the parking lights switched on.

Just ask the NRMA (or RAC) about the number of calls they receive on a rainy day. Most of them are for flat batteries. It can happen to the best of us.

But why wait for the inevitable to happen? By installing this simple circuit, you can avoid the hassle of a flat battery.

Most headlight reminder circuits described in the past use a harsh-sounding buzzer to warn the motorist. Our latest circuit has a simple chime sound that is easy on the ear while still conveying a warning.

An extra feature of the headlight reminder is that the chime sound switches off after about five seconds rather than sounding continuously until the headlights are switched off. This feature allows intentional use of the lights without the reminder circuit continuously objecting.

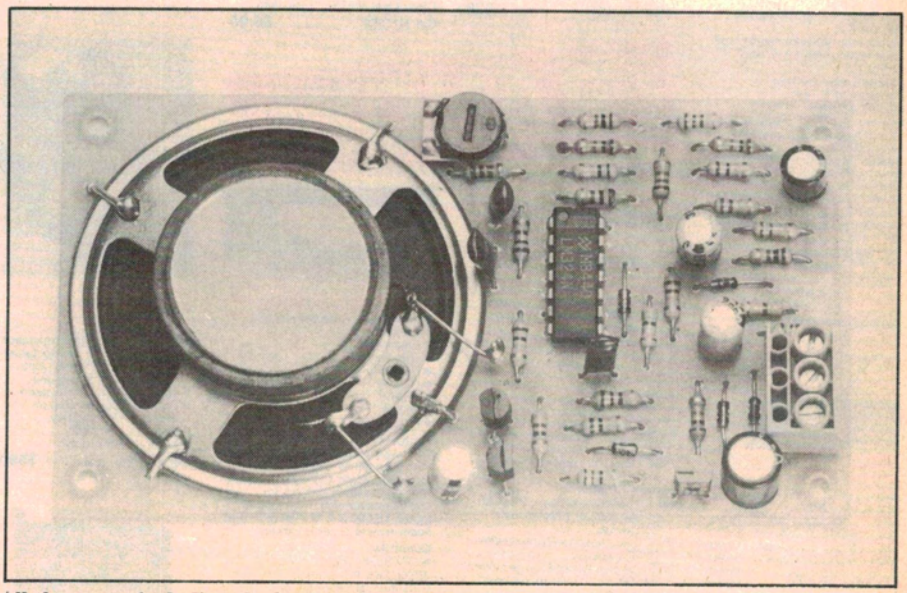
The entire circuit, including the miniature loudspeaker, is contained on a small PC board which is small enough to fit beneath the dashboard. Only three wires are necessary to connect the circuit to the car wiring — one to the headlight switch, one to the ignition switch and one to earth.

How it works

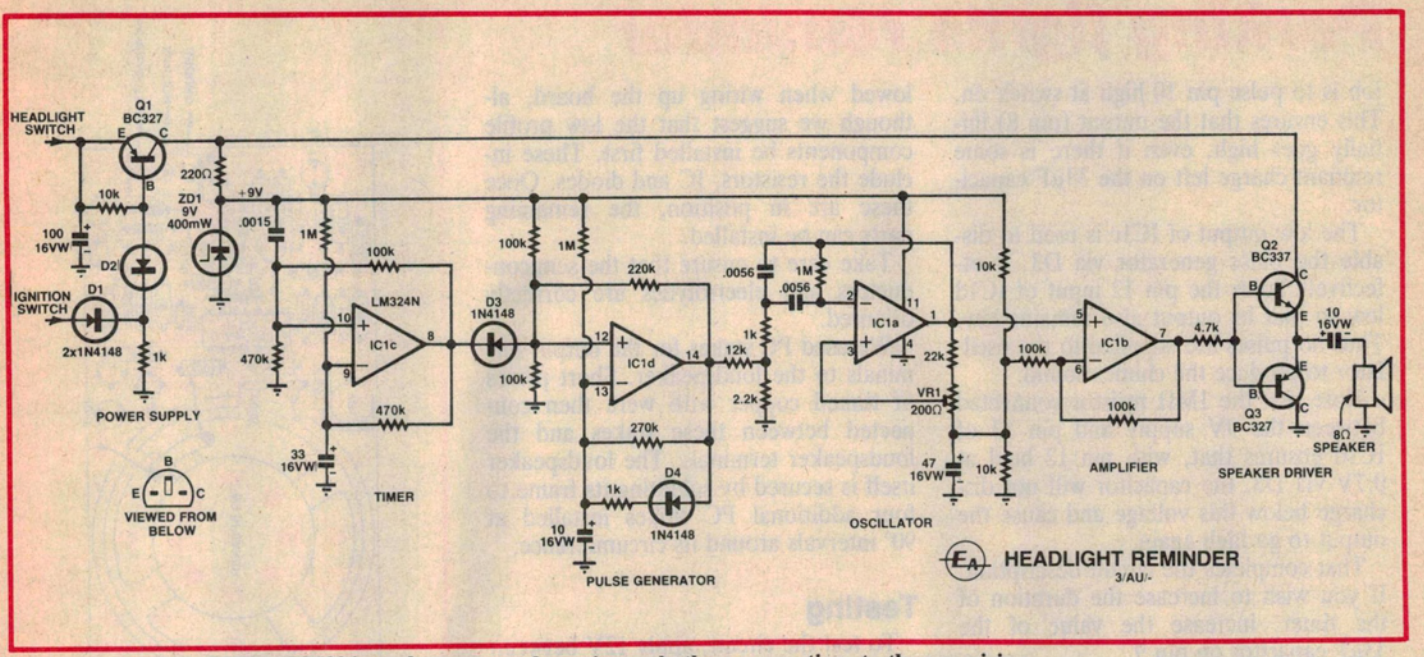
Although the circuit may seem unduly complicated for a headlight reminder, it is entirely based on low-cost easy-to-get parts. A single quad op amp forms the basis of the circuit, along with three transistors, a few diodes and a handful of resistors and capacitors.

The circuit can be divided into several distinct sections: a power supply (Q1), oscillator (IC1a), amplifier (IC1b), a speaker driver stage (Q2 and Q3), timer (IC1c) and a pulse generator (IC1d).

Power for the circuit is derived from the headlight supply of the vehicle. When the headlights are switched on, transistor Q1 turns on due to the base current flowing through diode D2 and the 1kΩ resistor. The battery voltage to



All the parts, including the loudspeaker, are accommodated on a small PCB.



The circuit is based on an LM324 quad op amp and requires only three connections to the car wiring.

the headlights is thus applied to the circuit.

If, however, the ignition switch is on, the voltage at the anode of diode D1 removes bias from Q1 by reverse-biasing D2. Consequently, Q1 is on only when the headlight switch is on and the ignition switch is off.

The 100μF capacitor filters the supply to Q1, while the 10kΩ resistor between the base and emitter ensures that it remains off with no base bias. ZD1, a 9V zener diode, is used to regulate the supply to the op amps.

The oscillator is formed using op amp IC1a. This is connected in a multiple feedback bandpass filter configuration with a centre frequency of about 1kHz. A small amount of positive feedback is supplied from the output via the 22kΩ resistor and VR1 which is adjusted so that the filter is just below the point of oscillation.

Two 10kΩ resistors connected in series across the 9V supply provide bias for the non-inverting input of IC1a. Filtering is via the 47μF electrolytic capacitor.

Whenever a pulse is supplied to the filter input, the filter output will resonate at its centre frequency. Because VR1 is not adjusted for self-sustaining oscillation, the oscillation will gradually die out until there is no signal at the output. Fig.1 shows what happens when the pulse generator sets the filter oscillating. This effect is called ringing.

The output from the oscillator is amplified by op amp IC1b which is connected as a non-inverting amplifier with a gain of two. This, in turn, drives a complementary transistor output stage consisting of Q2 and Q3. The output from this stage is then AC-coupled to the loudspeaker via a 10μF electrolytic capacitor.

The pulse generator consists of IC1d which is connected as a Schmitt trigger oscillator. The hysteresis is set by the 220kΩ resistor between the non-inverting input at pin 12 and the output at pin 14, and the two 100kΩ resistors connected to pin 12 and the supply rails.

Here's how it works: initially, when power is first applied, the 10μF capacitor on pin 13 is discharged and the output of IC1d is high at 9V. The non-inverting input is at about 5.3V. The capacitor now begins to charge via the 1kΩ resistor and diode D4.

Note that the 270kΩ and 1MΩ resistors also help charge the capacitor, but the effect of these is quite small during this part of the cycle.

When the capacitor voltage reaches 5.3V, the output of IC1d goes low and the 10μF capacitor begins discharging via the 270kΩ resistor. The 1kΩ resistor plays no part here since D4 is now reverse biased.

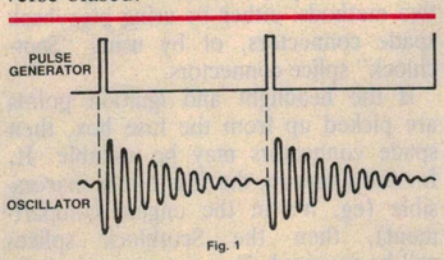


Fig.1: the output waveform from the pulse generator (IC1a).

During the discharge time, pin 12 is at 3.7V due to the low output at pin 14. Thus, when the capacitor voltage reaches 3.7V, the Schmitt output again goes high and so the cycle is repeated indefinitely.

The result of all this electronic skulduggery is a pulse train consisting of short-duration pulses with a relatively long period between them.

These pulses are attenuated by a voltage divider consisting of 12kΩ and 2.2kΩ resistors and applied to the inverting input of the oscillator.

The remaining op amp, IC1c, forms the timer circuit. Its non-inverting input (pin 10) is initially held at 7.4V due to the high output at pin 8 and the voltage divider formed by the 100kΩ and 470kΩ resistors on pin 10.

When power is applied, the 33μF capacitor at pin 9 charges towards the positive supply rail via the 470kΩ and 1MΩ resistors on pin 9. When the voltage reaches 7.4V, the output of IC1c goes low.

Pin 10 is now held at ground potential and the 33μF capacitor discharges via the 470kΩ feedback resistor to 2.9V. Note that it does not completely discharge due to the 1MΩ resistor connected between pin 9 and the 9V rail.

The output of IC1c thus goes low about five seconds after power is applied and remains low while ever this power is left connected. Once this has happened, the timer can only be reset by disconnecting the power (ie, by switching the headlights off).

Note the .0015μF capacitor between pin 10 and the positive supply rail. Its

Parking lights reminder

job is to pulse pin 10 high at switch on. This ensures that the output (pin 8) initially goes high, even if there is some remnant charge left on the 33μF capacitor.

The low output of IC1c is used to disable the pulse generator via D3. It effectively holds the pin 12 input of IC1d low so that its output also remains low. Thus no pulses are supplied to the oscillator to produce the chimes sound.

Note that the 1MΩ resistor connected between the 9V supply and pin 13 of IC1d ensures that, with pin 12 held at 0.7V via D3, the capacitor will not discharge below this voltage and cause the output to go high again.

That completes the circuit description. If you wish to increase the duration of the timer, increase the value of the 33μF capacitor on pin 9.

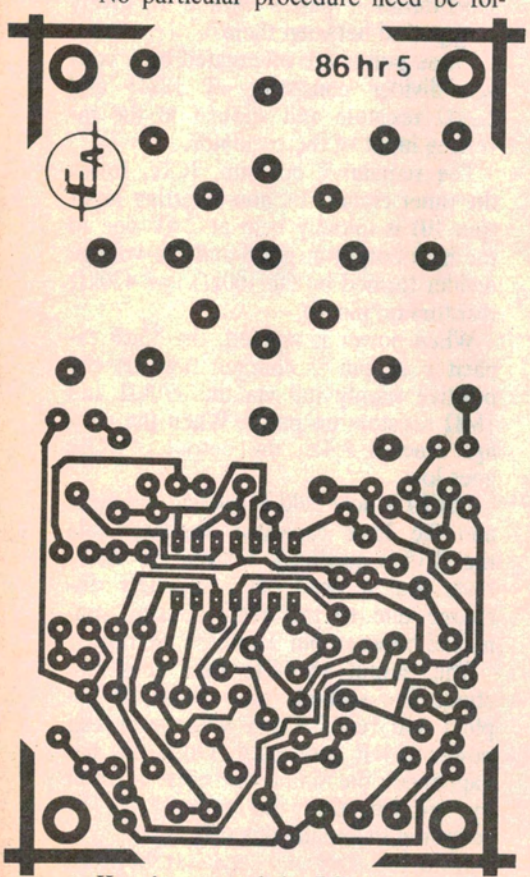
Construction

They don't come much easier to build than this project. The parts are all mounted on a small PC board coded 86hr5 and measuring 59 x 107mm. Construction simply involves installing the parts in the correct locations and soldering the leads.

No particular procedure need be followed when wiring up the board, although we suggest that the low profile components be installed first. These include the resistors, IC and diodes. Once these are in position, the remaining parts can be installed.

Take care to ensure that the semiconductors and electrolytics are correctly oriented.

We used PC stakes for the output terminals to the loudspeaker. Short pieces of tinned copper wire were then connected between these stakes and the loudspeaker terminals. The loudspeaker itself is secured by soldering its frame to four additional PC stakes installed at 90° intervals around its circumference.



Here is an actual size PC artwork.

Testing

To test the circuit, apply 12V between the headlight input and ground and check that the IC supply rail is about 9V. This done, adjust trimpot VR1 until the correct chime sound is obtained from the loudspeaker. The correct setting is one where each chime starts out quite loud and gradually dies away. Do not turn the trimpot so far that the circuit oscillates continuously.

After about five seconds, the chimes should stop due to the output of timer IC1c going low. You can reset the circuit simply by removing and then re-applying power.

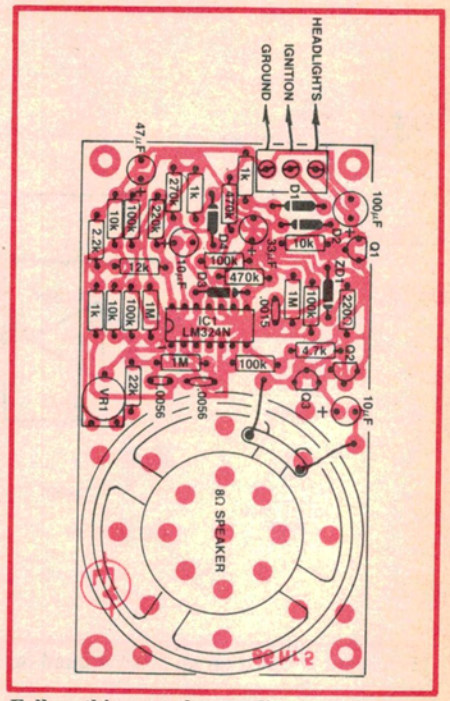
Finally, check that the circuit is disabled if the ignition input is connected to the positive supply rail.

Installation

Although the PCB has been designed to fit into a 130 x 68 x 41mm plastic utility box, it is not strictly necessary to house the unit in this manner. Instead, we suggest that you sandwich the PCB between a couple of pieces of foam rubber which can then be taped together.

The best place to mount the unit is under the dashboard, preferably adjacent to the fuse box. Connections to the vehicle wiring can be made using one of two methods: either by using piggyback spade connectors, or by using "Scotchlock" splice connectors.

If the headlight and ignition points are picked up from the fuse box, then spade connectors may be suitable. If, for some reason, the fuse box is inaccessible (eg, it's in the engine compartment), then the Scothlock splices will be required. You can use your multimeter to track down the appropriate wiring points.



Follow this parts layout diagram when wiring up the Headlight Reminder.

The chassis connection can be made to any convenient point under the dash, but make sure that the point is actually at chassis potential and not insulated.

When installation is complete, switch on the headlights and check that the chimes sound. The chimes should stop after five seconds or if the ignition switch is turned on.

PARTS LIST

1 PC board, code 86hr5, 59 x 107mm
1 55mm 8Ω loudspeaker
1 3-way PCB terminal block
3 lengths of automotive hookup wire

Semiconductors
1 LM324 quad op amp
2 BC327 PNP transistors
1 BC337 NPN transistor
4 1N4148, 1N914 diodes
1 9V 400mW zener diode

Capacitors
1 100μF 16VW PC electrolytic
1 47μF 16VW PC electrolytic
1 33μF 16VW PC electrolytic
2 10μF 16VW electrolytic
2 .0056μF metallised polyester
1 .0015μF metallised polyester

Resistors (¼W, 5%)
3 x 1MΩ, 2 x 470kΩ, 1 x 270kΩ, 1 x 220kΩ, 5 x 100kΩ, 1 x 22kΩ, 1 x 12kΩ, 3 x 10kΩ, 1 x 4.7kΩ, 1 x 2.2kΩ, 3 x 1kΩ, 1 x 220Ω, 1 x 200Ω miniature horizontal trimpot.