BUILD
CAR SA

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Is your car in danger of being sideswiped in the street at night? This project detects an approaching car's headlights and automatically turns on the brake lights to warn the driver.

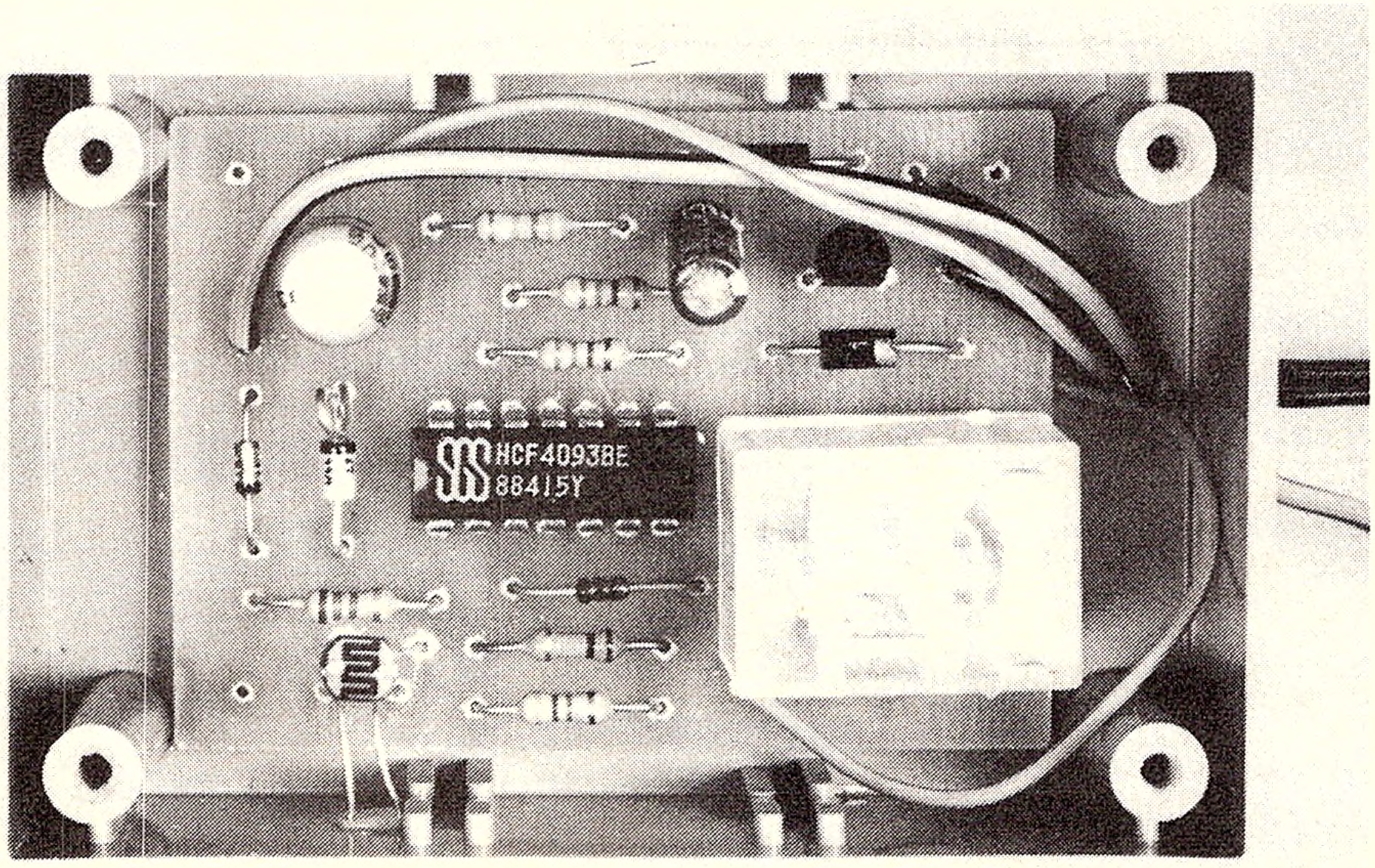
Anyone who parks a car on the street at night is aware of the danger of sideswipes, particularly in wet weather or if the street is poorly lit. The problem is even worse if the parked car is dark in colour, with no reflective brightwork to warn the approaching driver.

This problem has been made worse in recent years by the switch from reflective chrome bumper bars to non-reflective plastic bumpers. These days, it's all too easy for a tired or inattentive driver to be unaware of a parked car — until it's too late.

This simple project is designed to overcome that problem. It mounts on the rear parcel shelf and watches for an approaching car's headlights. As soon as headlights are detected, it turns on the parked car's brake lights to warn the driver in the approaching vehicle.

The brake lights then automatically switch off about five seconds after the car passes.

During the daytime, an additional light sensor disables the circuit to prevent the car's battery from going flat. The circuit is also disabled while the ignition switch is on. This means that the car's brake lights function normally when the car is being driven.



This inside view shows how one of the LDRs (the headlight detector) is arranged to face through the side of the case. The other LDR faces upwards, through the lid.

How it works

Fig.1 shows the circuit of our Automotive Night Safety Light. It's very simple and is based on a 4093 quad Schmitt NAND gate IC.

Let's assume initially that the ignition is off and that both LDR1 and LDR2 are in darkness. This means that both LDRs will have high resistance — up in the region of several megohms, in fact. Pins 5 and 6 of IC1a will thus be pulled low by the 100kΩ resistor and so pin 2 of IC1b will be high.

The other input to IC1b, pin 1, is normally pulled low by the 47kΩ resistor. As a result, pin 3 is high which means that D2 is reverse biased and the circuit is disabled.

Now consider what happens when LDR1 detects an approaching car's headlights. When this happens, the resistance of LDR1 immediately drops to a low value (several hundred ohms) and pin 1

THIS SIMPLE FETY LIGHT

goes high. Because both inputs to IC1b are now high, pin 3 switches low and this sets off a chain reaction through the circuit.

Assuming S1 is closed, D2 is now forward biased and the 10μF capacitor discharges into pin 3. This pulls the inputs to parallel inverter stages IC1c and IC1d low. Their outputs (pins 10 and 11) thus switch high and drive Q1 via 3.3kΩ current limiting resistors. Q1 in turn switches on the relay to activate the brake lights.

The brake lights stay on while ever light shines on LDR1. As soon as the car passes, LDR1's resistance goes high again and pin 3 of IC1b switches high. D2 is now reverse biased and so the 10μF capacitor charges via the 470kΩ resistor towards the positive supply rail.

After about five seconds, the voltage on the capacitor will be high enough to cause IC1c and IC1d to switch low again and turn Q1 off. The brake lights now turn off and the circuit is ready for the next approaching vehicle.

Automatic override

LDR2, D1 and IC1a automatically disable the circuit during daylight hours or if the ignition is turned on. During daylight, LDR2's resistance is low and pins 5 and 6 of IC1a are pulled high. Thus, pin 2 of IC1b is held low and the circuit is disabled.

Similarly, when the ignition is turned on, pins 5 & 6 of IC1a are pulled high via D1 and a 27kΩ resistor. The circuit is then disabled as before.

Note that LDR2 must be aimed in a different direction to LDR1, so

PARTS LIST

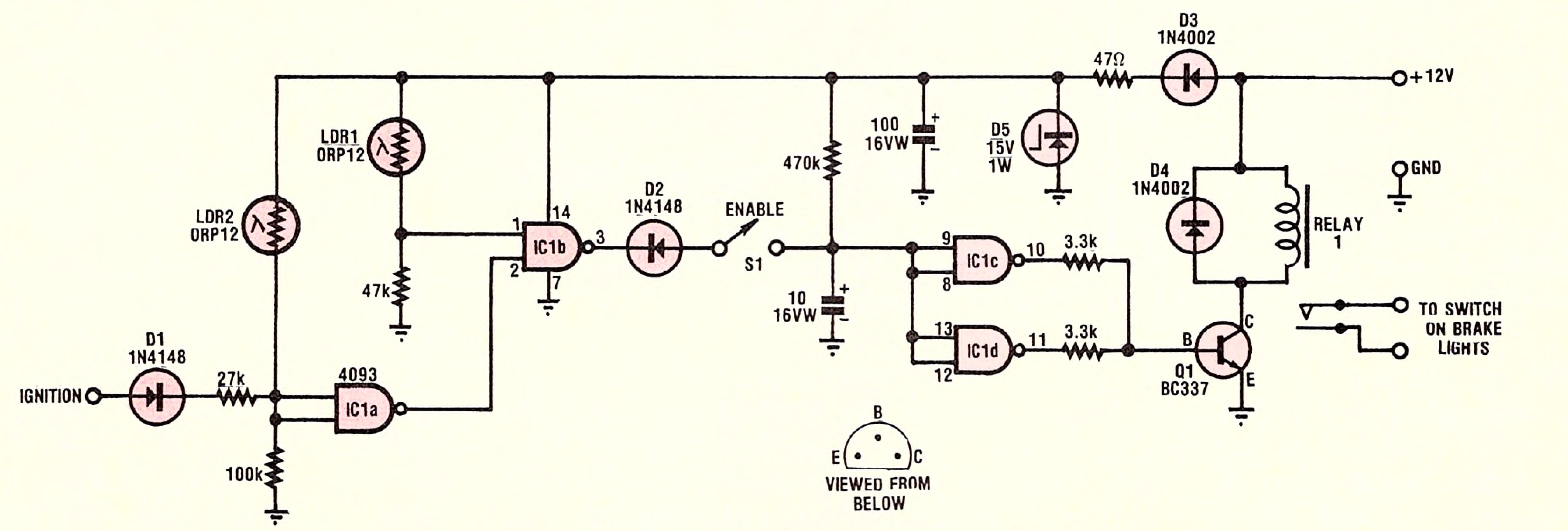
1 plastic case, 83 x 54 x 30mm
1 PCB, code SC05-1-1088-1, 60 x 44mm
1 piece of Veroboard, 62 x 48mm (optional — see text)
1 mini PCB relay, SPDT, 23 x 20 x 15mm
2 ORP12 LDRs
1 SPST switch

Semiconductors
1 4093 quad Schmitt NAND gate
1 BC337 NPN transistor
2 1N4002 1A diodes
2 1N4148, 1N914 diodes
1 15V 1W zener diode

Capacitors
1 100μF 16VW electrolytic capacitor
1 10μF 16VW electrolytic capacitor

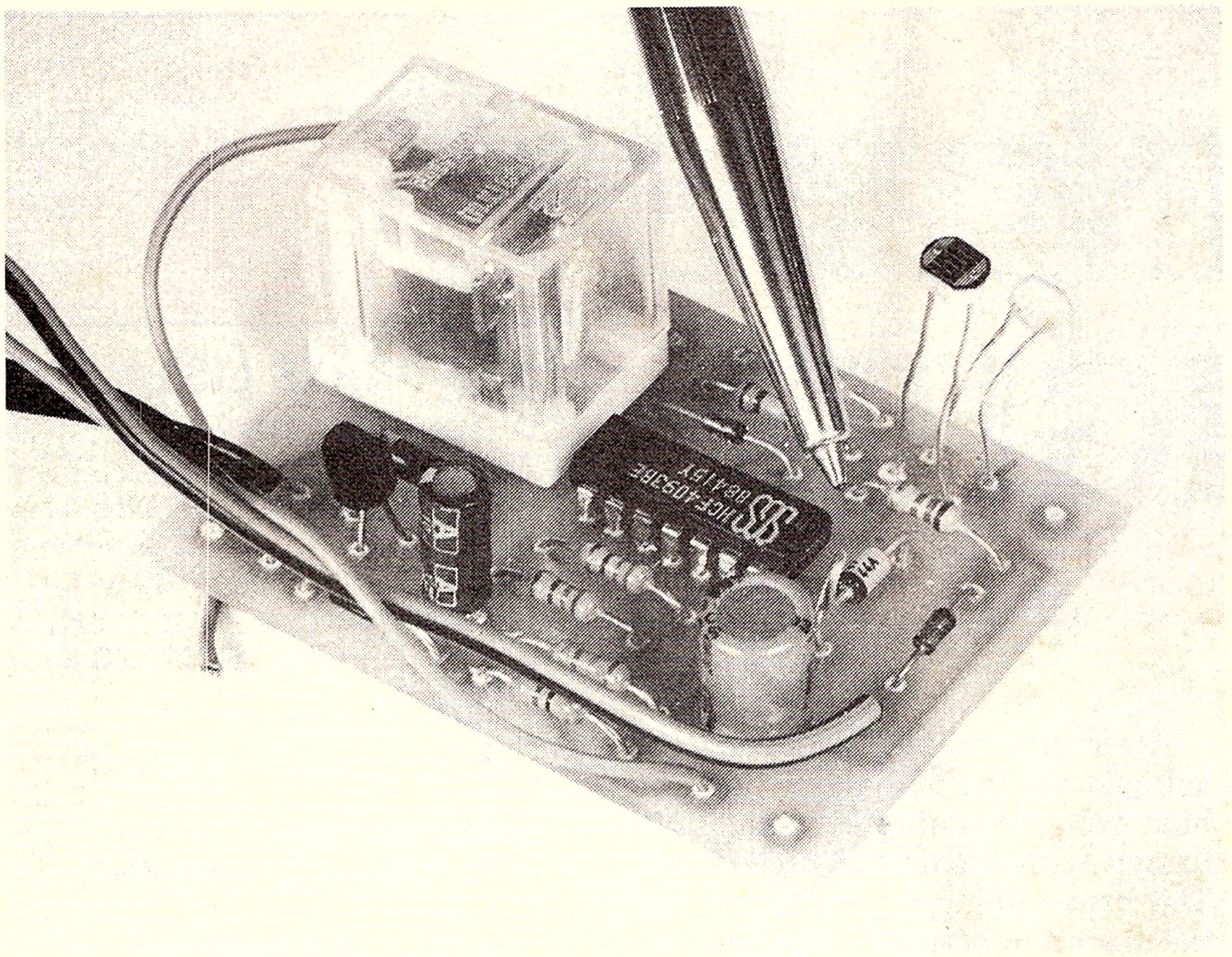
Resistors (0.25W, 5%)
1 x 470kΩ, 1 x 100kΩ, 1 x 47kΩ, 1 x 27kΩ, 2 x 3.3kΩ, 1 x 47Ω

Miscellaneous
Hookup wire, solder, connectors etc.

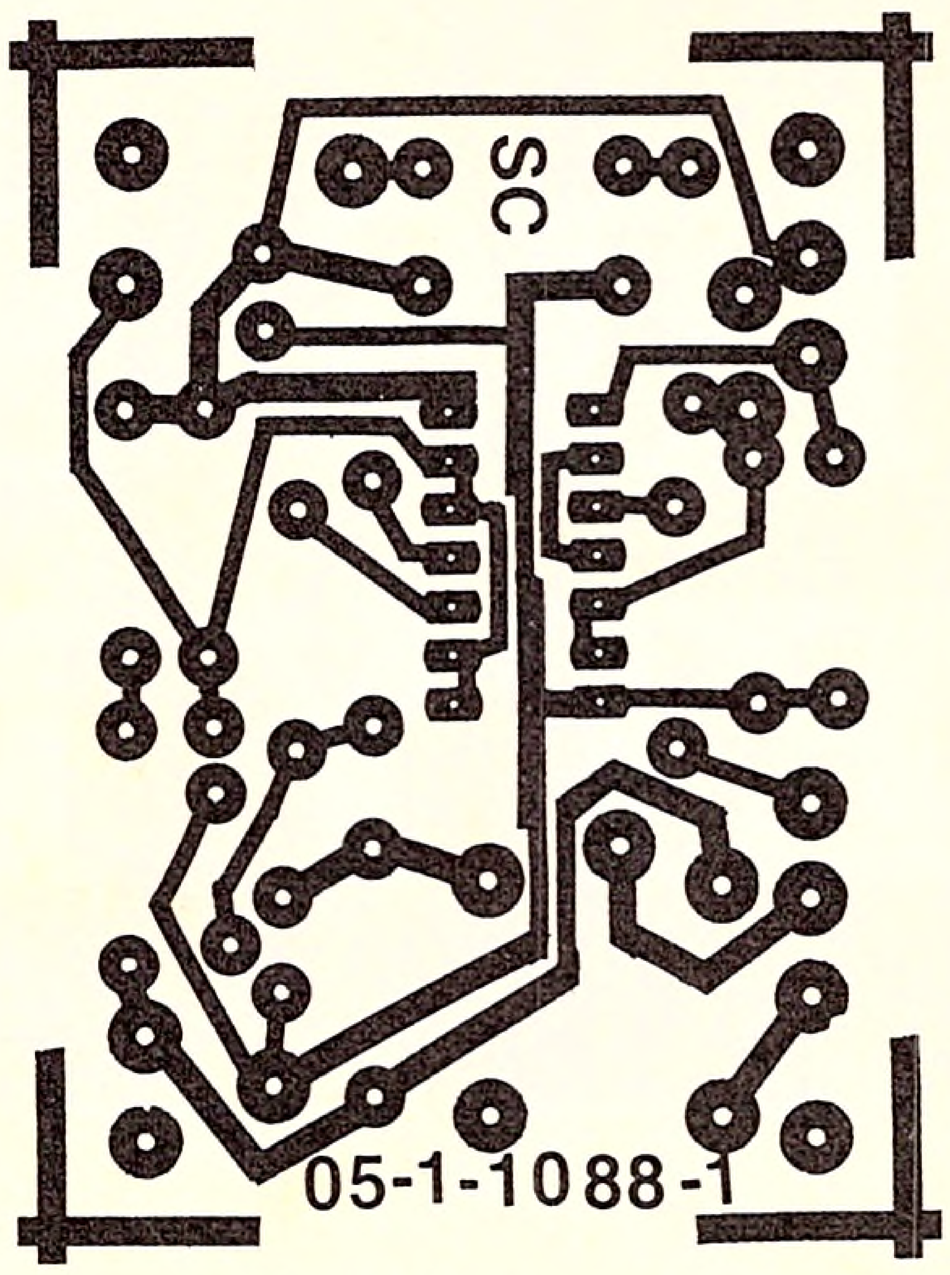


AUTOMOTIVE NIGHT SAFETY LIGHT

Fig.1: the circuit uses a 4093 quad Schmitt NAND gate to provide the logic and to drive transistor Q1. LDR1 is the headlight sensor while LDR2 disables the circuit during daylight hours.



This close-up view of the PCB shows how diode D5 is installed with a loop in one end to give stress relief. Sleeve the leads of the LDRs with plastic tubing to prevent shorts when the board is installed in the case.



Here is the full size artwork for the printed circuit board.

The two LDRs are simply pushed into small holes drilled through the lid and side of the case. Note how the top LDR sits below the surface of the lid so that it cannot pick up light from an approaching car's headlights.

that it cannot "see" an approaching car's headlights. If this were to occur, pin 2 of IC1b would be pulled low each time a car approached and the circuit would be disabled, thus defeating the purpose of the circuit.

The enable switch (S1) allows the circuit to be manually switched off when not required.

Power for the circuit is derived from the car battery. Diode D3 plus the 47Ω resistor and 100μF capacitor provide supply line decoupling. ZD1 clamps any spikes on the supply line. D4's job is to protect Q1 from spikes when the relay turns off.

Construction

If you want to save money, it's quite easy to build the circuit up on a small piece of Veroboard measuring 62 x 45mm. Fig.3 shows the suggested parts layout. You can use an oversize drill to make the necessary cuts in the copper tracks.

Take care when working with Veroboard, though — it's incredibly easy to make a mistake that's hard to find later on. If you're not too confident we suggest that you opt for the printed circuit board version shown in Fig.2. The relevant PCB is coded 05-1-1088-1 and measures 60 x 44mm.

Follow the parts layout diagram carefully when building the board. In particular, make sure that the IC, transistor, diodes and electrolytic capacitors are all correctly oriented. Zener diode D5 should be installed with a loop in one lead to give stress relief (see photo).

The two LDRs should be mounted at full lead length so that they can later be pushed through holes in the case. Sleeve their leads with plastic tubing to prevent shorts when the PCB is later installed in the case.

Construction of the board can now be completed by connecting lengths of insulated hookup wire to the external wiring points. These leads should be made long enough to reach their respective destinations from the rear parcel shelf.

Either version will fit into a small plastic case measuring 83 x 54 x

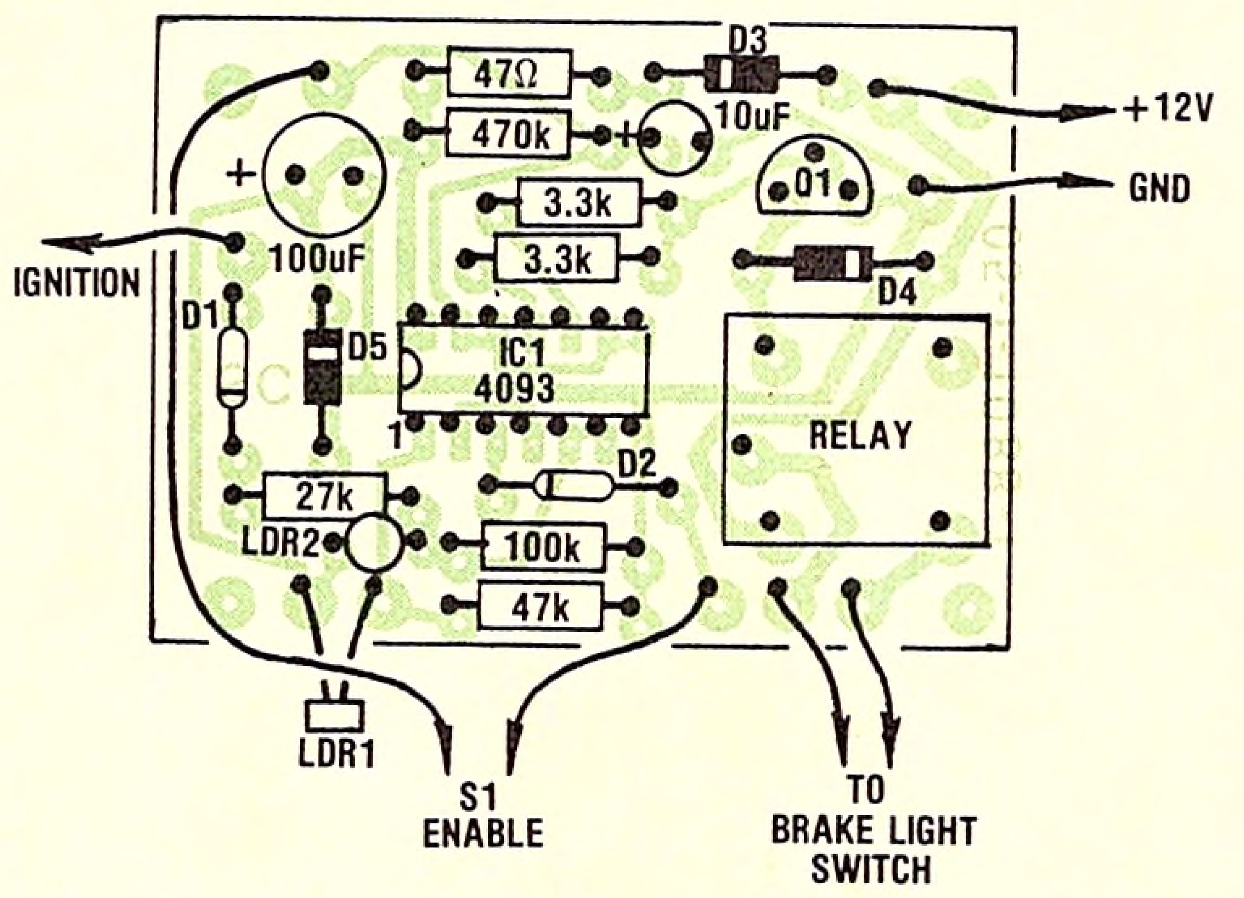


Fig.2: install the parts on the PCB as shown here. Be sure to use the correct diode at each location.

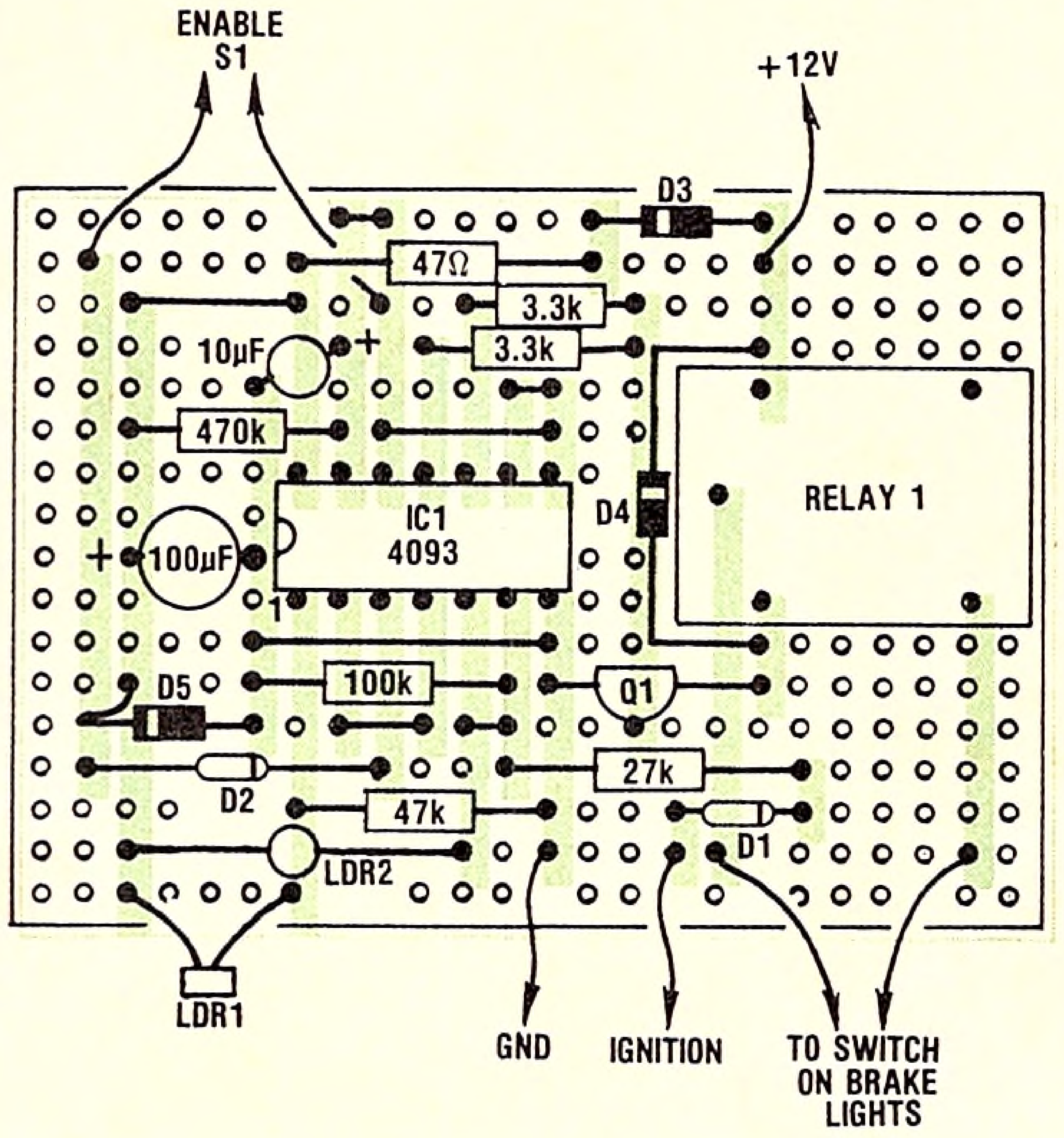
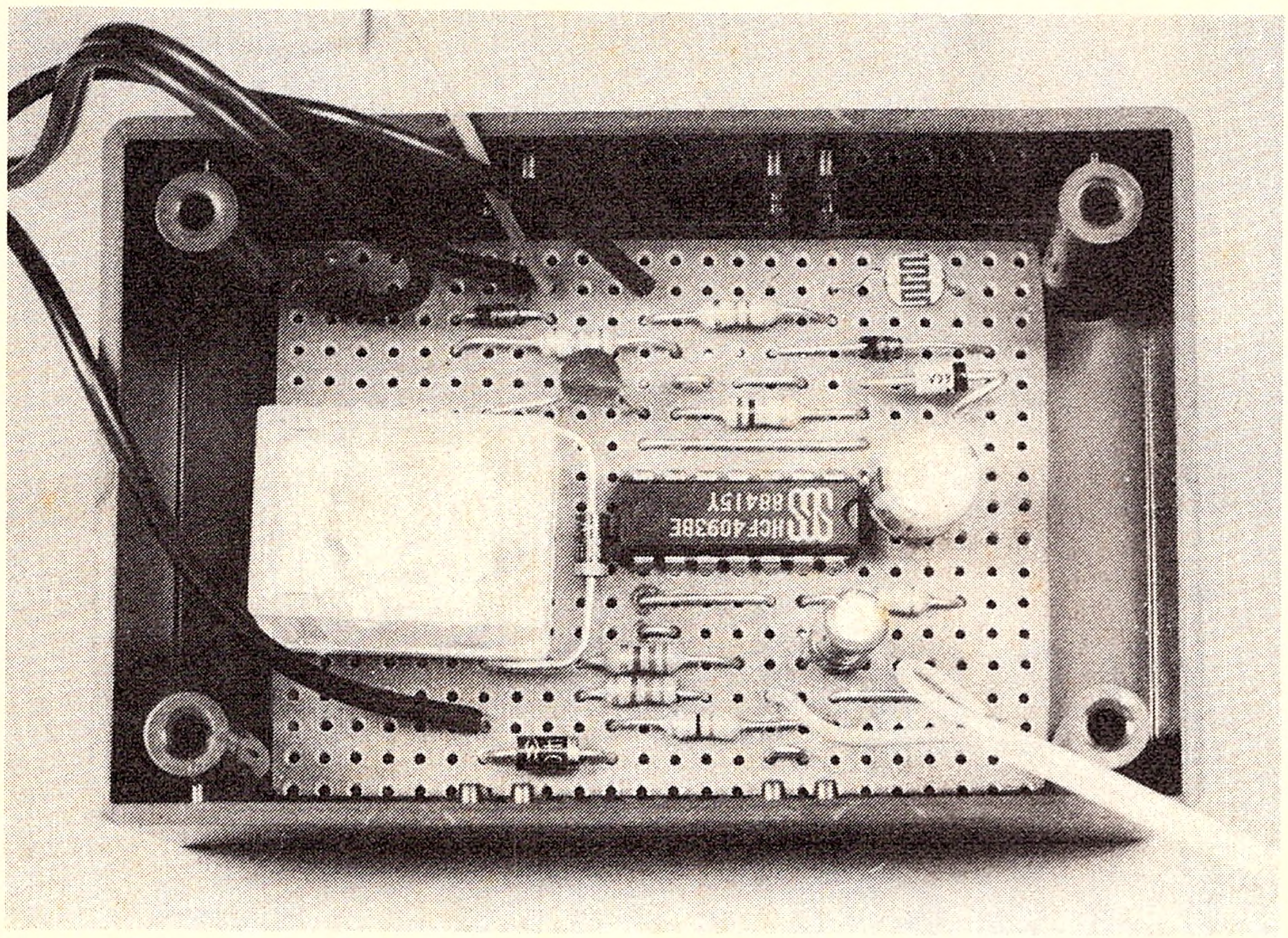


Fig.3 (right): here is the suggested parts layout for the Veroboard version. You can use an oversize drill to make the cuts in the tracks.



Be careful when working with Veroboard as it's very easy to make a mistake. Be sure to install all the wire links and take care with component orientation. Note that the LDR circuitry was modified after this photo was taken.

30mm. The board simply sits on the base with the leads emerging from a small hole drilled nearby. It is then held in place by a small piece of foam rubber when the lid is screwed down.

The most critical aspect of the assembly is the orientation of the LDRs. LDR1 (the headlight sensor) must be oriented so that it faces out through the side of the case while LDR2 is mounted on the lid (see photo). You will have to drill and ream out holes in the appropriate locations to accept the LDRs. Make the holes just big enough so that the LDRs are a push fit.

If you make the holes too big, the LDRs can be glued in position from the rear using epoxy resin. Be careful not to cover the faces of the LDRs with epoxy resin, though. Each LDR should be mounted so that its face is flush with the surface of the case.

Installation

The best place to mount this device is on the rear parcel shelf. It should be mounted so that LDR1 in the side of the case looks out through the rear window. The daylight sensor should face upwards so that it will be unaffected by an approaching car's headlights.

If reflected light falling onto the daylight sensor does prove a problem, try mounting the sensor in a tube further down in the case. This would also shield the sensor from street lights.

Power for the unit must be derived from the unswitched +12V rail. The most convenient place to make this connection is at the bootlight switch. Alternatively, you can run a lead through to the fusebox.

The ignition lead can be connected to any point that is switched to +12V by the ignition switch (ie, to the accessories rail). The relay contacts are simply wired in parallel with the brakelight switch.

It's quite easy to find the brakelight switch. It's a pushbutton switch that is actuated by the brake pedal. Install the wiring in a professional manner and terminate all leads in automotive clip connectors (available in automotive accessory shops).

Finally, the enable switch can be installed in any convenient place on the dashboard. An automotive-style push on/push off switch is the best type to use here.

Don't use a switch with an ir tegral light bezel — it will onlv to the current drain fr battery.