Delay system for car courtesy lights

Build this simple circuit for your car

How about this for a neat automotive circuit? When fitted to the interior lighting circuit of your car, it will delay the turn-off of the courtesy lights for a set period after the door closes. It's easy to build, all on a small PC board, and can be fitted to most cars.

by GREG SWAIN

Conjure up in your mind the following fantasy. You've just left an exclusive nightclub on the foreshores of beautiful Sydney harbour. Her expensive French perfume wafts balmily on the still summer night air. You open the door to the Mercedes and she slides into the imported lambswool-covered seat. You shut the door ... and the courtesy light stays on!

You've now got all of 20 seconds to stroll suavely round to the other side of the car before the courtesy lights go out. Just think how impressed she'll be when the lights automatically fade as you drive off.

Whoa! ... steady on. Let's get back to reality. Let's discuss some of the more down-to-earth uses of a courtesy light delay! ...

While courtesy lights provide a welcoming sight when a car door is opened at night, the effect is spoiled immediately one enters the car and pulls the door shut. The light goes out just when you need it to find and fasten the seat belt, identify the ignition key, and locate the ignition lock. Most people (including me) have six or seven keys on the key ring, and finding the ignition key in the dark can be a "real pain".

Of course, there is an internal switch for the courtesy lights, but finding it can be just one more problem in the dark. Think how much nicer it would be if the courtesy lights stayed on long enough to get yourself settled.

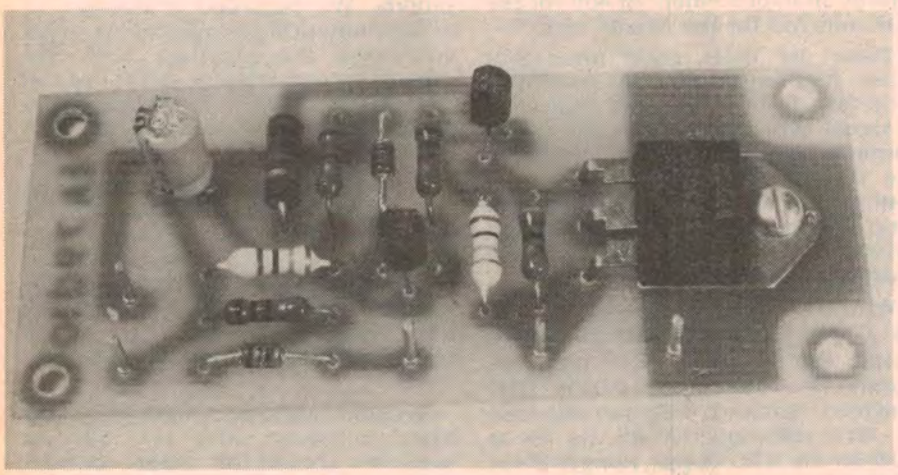
Such a feature would be even more valuable when ushering a guest into your car. The internal switch is seldom accessible from the passenger side of the car, so you have no option but to plunge the car into darkness as the door closes, leaving the guest to fumble for the seat belt in the dark until the driver's door is opened.

This simple circuit overcomes these problems by holding the courtesy lights on for a fixed period after the car door has been closed. As shown, the circuit provides a delay time of approximately 20 seconds, although this can easily be varied to suit the constructor. At the end of the delay period, the lights automatically fade out.

With a simple type of delay circuit, choosing a suitable delay time involves a compromise. If the period chosen is too short, you do not have time to settle in properly; if it is too long, the lights will still be on when you are ready to drive off. While this latter situation is of no consequence during daylight hours, it could be a problem at night.

This leads us to the next feature provided by our delay circuit. The circuit has been designed to interconnect to the headlight switch so that the courtesy lights are switched off automatically whenever the headlights or parking lights are turned on. With the headlight interlock arrangement, the delay time is no longer critical. It can be extended to one minute or more if you so wish.

We found a delay time of 20 seconds to be the best compromise. It provides ample time to get settled in the car, and yet doesn't keep the courtesy lights on for an inordinately long period after the driver leaves the vehicle. It also turns the lights off after a reasonably short period when driving off during daylight hours.



Larger than life size photo of the assembled PC board. A small flag-type heatsink should be fitted to the TIP3055 transistor for loads exceeding 30W.

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

$5

including sales tax. This does not include the cost of miscellaneous items.

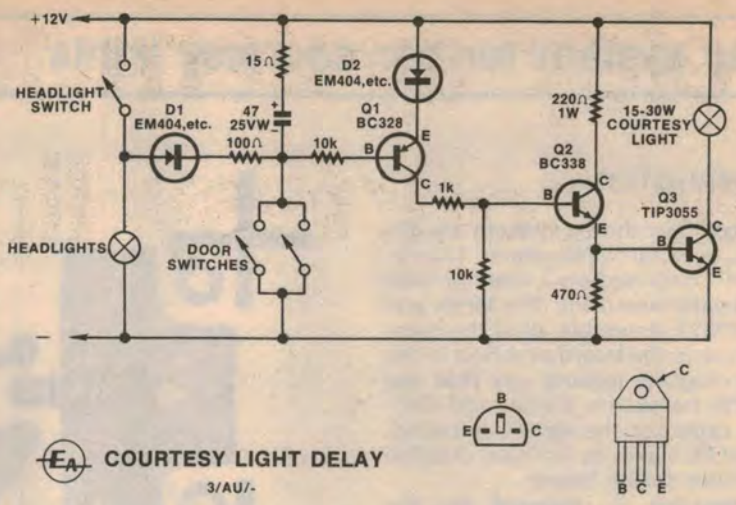
PARTS LIST

1 TIP3055 NPN transistor
1 BC338 NPN transistor
1 BC328 PNP transistor
2 IN4001 or similar silicon power diodes
1 47uF/25VW electrolytic capacitor
1 PCB, 87 x 38mm, code 79d10
5 PC pins

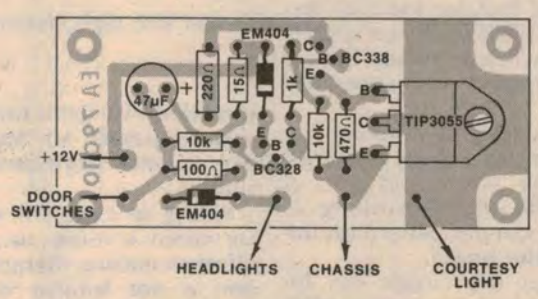
RESISTORS
¼ or ½ watt unless specified
1 x 15 ohm, 1 x 100 ohm, 1 x 220 ohms 1W, 1 x 470 ohms, 1 x 1k, 2 x 10k

MISCELLANEOUS
Hookup wire, 3A fuse and fuseholder, stand-off pillars, machine screws and nuts, automotive connectors, etc.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used provided they are physically compatible.



The circuit uses three low-cost transistors and provides a delay time of approximately 20 seconds. The delay time can be altered by changing the 47uF electrolytic capacitor (see text).



The component overlay diagram. Make sure that all polarised components (transistors, diodes, capacitor) are inserted the right way round.

HOW IT WORKS

Refer now to the circuit. It's really very simple, and uses just three transistors and a handful of other components. It works as follows:

Assuming initially that all switches are open and that the 47uF electrolytic capacitor is discharged, there will be no forward bias on the base of Q1 and no collector current through this transistor. This, in turn, means that both Q2 and Q3 are also held off because Q2 receives no forward bias from Q1.

The 10k and 470 ohm resistors in the base circuits of Q2 and Q3 respectively ensure that these transistors are held completely off, in these conditions.

When one of the door switches is closed (ie, the car door is opened), the 12V supply is connected to the 47uF capacitor via a 15 ohm resistor. The purpose of the resistor is simply to limit the initial charging current through the capacitor to a reasonable level and prevent damage to the door switches. In spite of it, the capacitor charges almost instantaneously.

Regardless of the time needed for the capacitor to charge, Q1 is forward biased immediately the switch closes due to the very low internal impedance of the battery. Initially, the full voltage appears across the 15 ohm resistor then, as the capacitor charges, progressively across the latter until it is fully charged.

With forward bias applied, Q1 conducts, turning on Q2 and Q3 and switching on the courtesy light. When the door switch opens the charge on the 47uF capacitor maintains the forward bias on Q1 until it is discharged. When the capacitor discharges the forward bias to Q1 is removed, Q2 and Q3 turn off, and the courtesy light goes out.

So long as the headlight switch remains open, the capacitor can discharge only through the 10k resistor and the base/emitter junction of transistor Q1. It cannot discharge through the 100 ohm resistor and the headlight circuit because diode D1 is reverse biased. With the capacitor value shown, the courtesy lights should remain on for about 20 seconds.

The delay time can be altered simply by changing the value of the capacitor. As you may expect, the relationship between capacitance and delay time is linear. To increase the delay time to 40 seconds, for example, all you have to do is double the value of the capacitor — 100uF is the nearest preferred value.

Similarly, the delay time can be decreased by decreasing the capacitor value.

Diode D1 and its associated 100 ohm series resistor form the headlight interlock circuitry. If the headlights are turned on during the delay time, diode D1 becomes forward biased and provides a low resistance discharge path for the capacitor which discharges almost instantaneously. The 100 ohm resistor limits the current through the diode to a safe value.

The reason for the inclusion of diode D2 will not be obvious at first glance. Basically, it has been included to ensure that Q1 and the other transistors turn off completely once the 47uF capacitor is discharged.

Because of the presence of D1, the headlight switch cannot discharge the 47uF capacitor below the forward conduction voltage of the diode, about 0.6V. In practice it can be higher than this due to voltage losses along the headlight lead wiring, depending on where the circuit is tapped into the car's electrical system. Thus it could be that the headlight interlock circuit may not discharge the capacitor below 0.8V or even 1V, at which level it is still capable of holding Q1 in conduction, albeit at a low level.

While the capacitor will discharge eventually the courtesy lights would not go out immediately as required. Diode D2 overcomes this problem. By including it in the emitter circuit of Q1, the voltage required to forward bias the transistor is raised by the junction voltage of the diode (0.6V approx). This means that the voltage at which the transistor will cease conducting is raised to about 1.2V.

Delay system for car courtesy lights

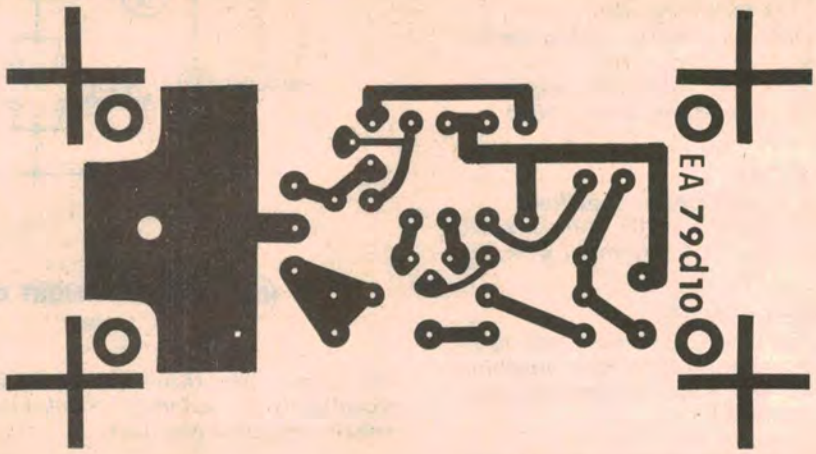
CONSTRUCTION

Construction should present no difficulties, even for the beginner. The circuit is all contained on a small printed circuit board measuring 87 x 38mm and coded 79d10. Assemble all of the components onto the board as shown in the overlay diagram, making sure that you insert the transistors, diodes and electrolytic capacitor the right way round. We used PC stakes to facilitate external connections to the board.

No heatsink is required for the TIP3055 power transistor, at least not for loads up to 30W. The saturation voltage of Q3 is quite low at about 0.2V, so that even when connected to a 30W load the transistor only has to dissipate 0.5W. You should find that for loads of less than 30W, the TIP3055 will run slightly warm to the touch, even when the car door is held open for extended periods.

Note that Q3 should be mounted flat against the PC board and secured with a small machine screw and nut. A modest amount of heatsinking is provided by the copper pattern on the reverse side of the board.

Note also that the circuit can be operated with loads exceeding 30W, provided that Q3 is fitted with an adequate heatsink. For loads up to about 45W, a small flag-type heatsink should suffice.



Actual size reproduction of the PC artwork.

Fitting an extra unit of any kind to a car often involves as much or more effort as making the unit, particularly if one is not familiar with the wiring. However, in this case the job should not be too difficult.

The leads from the door switches are usually found coming over the top of the trim panels forward of the front doors, while the courtesy light lead(s) are usually run up the inside of the windscreen pillar. Assuming that the headlight switch can be easily removed, connections to the headlight circuit are most logically made direct to the switch terminals.

Make sure that the +12V supply is derived from the active side of the switch.

In some cars, however, removal of the headlight switch can be a major undertaking. If this is the case, the +12V supply can be picked up from the fuse panel and the connection to D1 picked up from the headlight dipper circuit. A 3A fuse should be included in the positive supply line to provide protection in the event of circuit malfunction, and all connecting wires should be of reasonably heavy current capacity. Use 23 x 0.19mm cable or heavier.

As to the best place to mount the PC board, that will largely depend on the type of car you own. The most obvious place is somewhere under the dashboard or, alternatively, on the firewall.

Having completed the installation, the unit can be given a final checkout. Check to see that the courtesy lights go out at the end of the delay time, that they go out immediately the headlights are turned on, and that the courtesy light switch on the dashboard still functions in the normal way. You should also check the temperature of the TIP3055 power transistor after the car door has been left open for an extended period, say five or 10 minutes. If it becomes too hot to touch, it should be fitted with a heatsink.