There's no need to trip over the dog!

Driveway Sentry turns on the lights

Activated by your car's headlights, this "Driveway Sentry" will turn on a driveway or garage light so that you can make a safe exit from your car on the darkest of nights. At the end of five minutes, it will automatically turn the light off again.

by COLIN DAWSON

For those people who normally garage their car at night, there is always a chance of tripping over an unexpected tool box, bicycle, or dog in an attempt to reach a light switch. Even if you don't normally garage your car – and in many cases when you do – there is still the garden path/verandah/front steps/moat (well, your home . . .) to be negotiated. These hazards can be avoided by turning on an exterior light before you leave home, but this is an inefficient solution. The light is on for hours but only required for a few minutes in most cases. Additionally, you must remember to turn it on before you leave.

This Driveway Sentry circuit solves these problems neatly. It was devised by Mr A. Lackey of Collaroy Plateau, NSW.

The Driveway Sentry can be left on permanently, as it senses ambient light and is automatically inhibited during daylight. The circuit is powered, via a transformer, from the same supply as the light and consumes minimal power when it is untriggered. The printed circuit board has provision for a manual trigger switch – remotely located if desired – which will allow the Sentry to be triggered without using the car's headlights. This would, for example, give you five minutes of light to walk from your door to your car and allow you to drive away without worrying about the light.

A cancel switch may also be fitted – again remotely if desired – which can be used to turn off the light when it is no longer needed, but before its normal "on" time has expired. Both these switches are optional, and are shown dotted on the circuit.

How it works

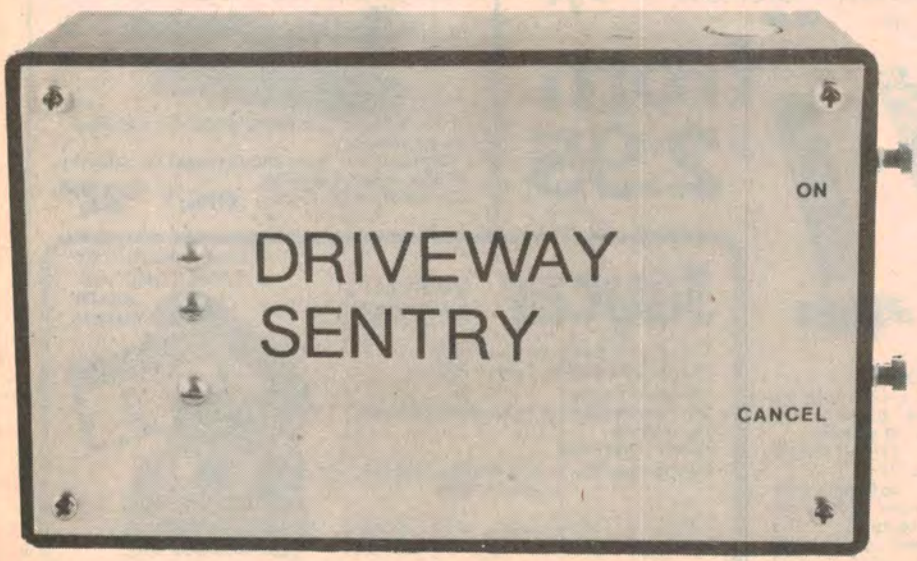
To monitor ambient light conditions and to detect the car headlights, two light dependent resistors (LDRs) are used. As their name suggests, the resistance of these devices varies with the amount of light falling on them. In fact, the resistance of the LDRs specified varies from megohms with no light to a few hundred ohms with bright light. Each LDR faces in a different direction, so that only one of them can detect the relatively directional car headlights.

A 555 – set up as a monostable multivibrator – is used as both a detector and a timer. Provided that the ambient light level is low, any light falling on the headlight-sensing LDR will trigger the 555. Once triggered, it commences a timing cycle (in this case five minutes) during which the controlled light will be on.

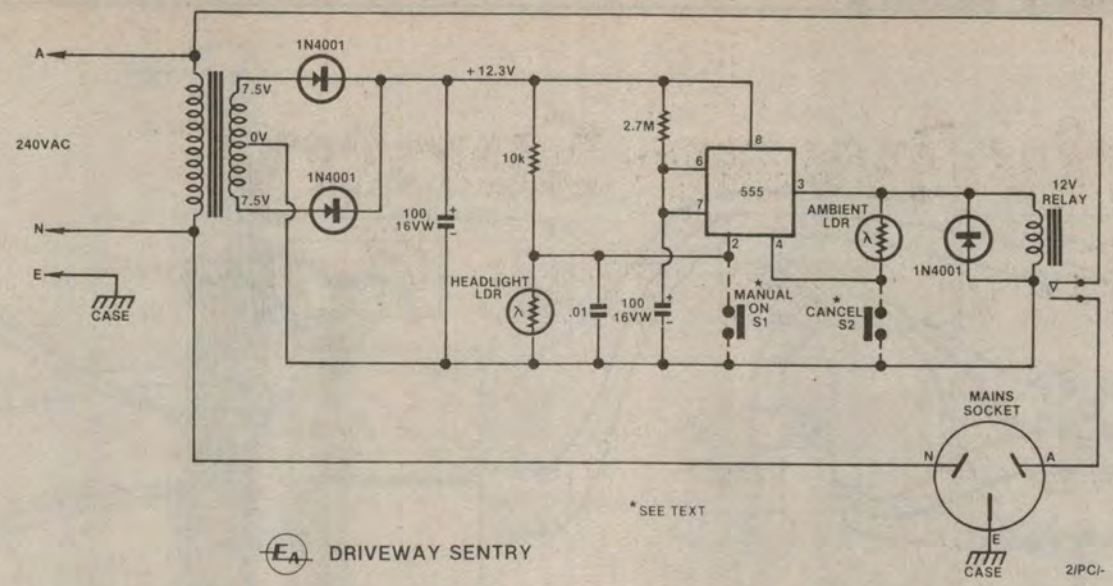
To inhibit the headlight sensing function during high ambient light (daylight) conditions, the reset pin (4) of the 555 is used. When this is held low the trigger function (2) is inhibited, and we hold it low by connecting the ambient light LDR between it and the output pin (3), pin 3 being normally low unless the headlight LDR is illuminated.

Some readers may wonder why we use pin 3 rather than ground, as this would undoubtedly provide an equally effective inhibit. The problem with this is that if the controlled light is anywhere near the Sentry, the ambient sensing LDR will see a "daylight" condition as soon as the light comes on. In this situation the 555 would be "inhibited" and the light promptly extinguished – all within a fraction of a second. If the car headlights continued to trigger the Sentry a flashing effect would result. By connecting the ambient sensing LDR to pin 3, which is high during the 5 minute cycle, the Sentry cannot be "inhibited" once the headlight LDR has triggered pin 2.

The .01μF capacitor across the headlight LDR is a precaution against



The Driveway Sentry is built into a plastic utility case.



Two light dependent resistors and a 555 IC timer form the basis of the circuit.

false triggering due to a sudden increase in ambient light or, more specifically, lightning. Without it, the light from a lightning flash can turn on the controlled light and, while this will do no harm, some people tend to get upset when a lightning flash appears to be having some effect on the household electrical system.

To avoid such false triggering it is essential that the inhibit function take effect before the trigger has time to operate. The .01μF capacitor provides a short time delay in the trigger function. More specifically, it holds pin 2 high for a very brief period after the LDR has reached the trigger threshold, during which time the inhibit function can take effect.

The five minute delay is provided by the 100μF timing capacitor and the 2.7MΩ resistor. Pin 7 (discharge) of the 555 is normally clamped to ground via an internal transistor. This keeps the capacitor discharged and at the same time holds the threshold (pin 6) low. As soon as the trigger (pin 2) is taken low, the clamp is released and the capacitor begins to charge via the 2.7MΩ resistor, with the output (pin 3) going high. When the voltage across C1 exceeds 2/3 supply, pin 6 resets the clamp on pin 7. This causes C1 to discharge very rapidly and the 555 is reset. This cycle takes slightly less than 5 minutes with the components described. Increasing the value of the 2.7MΩ resistor will give a longer cycle and decreasing it a shorter cycle.

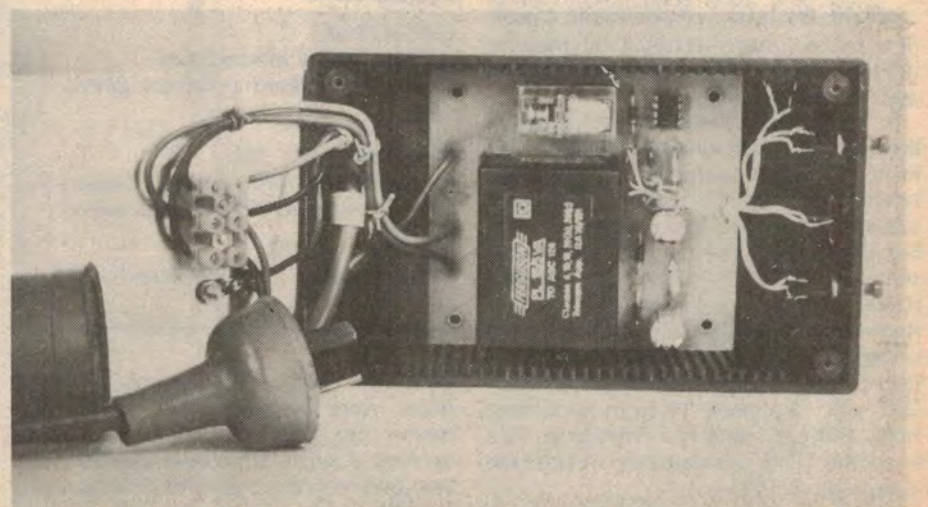
The 555 controls the load via a relay, with a 1N4001 diode across the coil to protect the IC from inductive kickback. Using the normally open contacts of the relay, the active line of the mains supply is switched. For this reason, the relay contacts must be mains rated not only as regards voltage and current, but also as regards insulation. Make sure of this point before selecting a relay. Whilst we anticipate that most constructors would use the Sentry to control a light, you could use any device or appliance as the load – provided that it does not exceed the current rating of the relay contacts. The relay specified has a 5A rating on its contacts.

A 15V centre-tapped transformer supplies power for the circuit. This is a printed board mounting transformer, which minimises the chances of connecting it incorrectly. Its two output windings are connected in series to drive a full-wave rectifier. A 100μF capacitor filters this output and, with the AC voltage peaks and light load on the transformer, delivers about 12.3V.

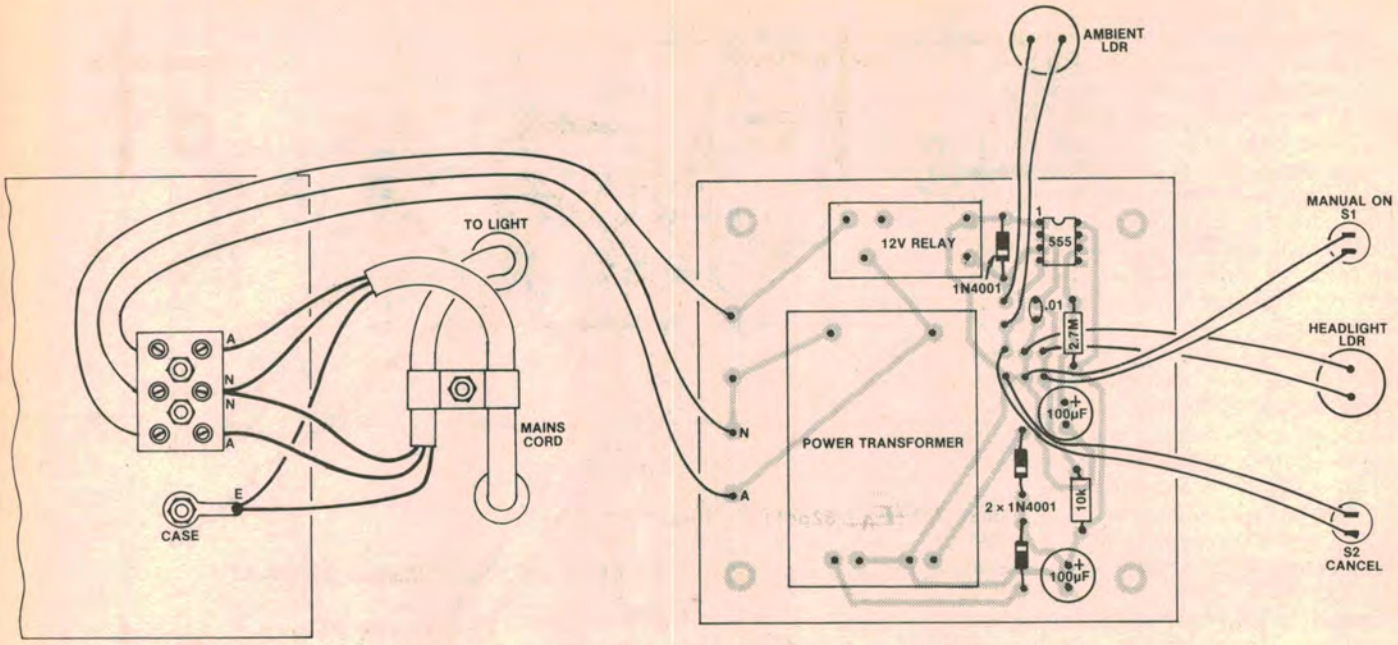
Construction

The printed circuit board used for this project is coded 82pc11 and measures 98 × 87mm. Before mounting any components on the board, check that the relay and transformer pins will fit into their intended mounting holes. If not, now is the time to enlarge them. The first components which should actually be mounted are the two resistors. Next come the three diodes and IC, each one being polarised. The two electrolytics are also polarised, but the greencap is not.

It will prove easier to connect the low voltage hook-up wire to the board now, rather than after the transformer and relay are mounted. You will need at least four lengths of wire, and an additional four if you are using both optional swit-



View inside the completed Driveway Sentry. Keep mains wiring neat and tidy, and make sure that you earth the lid of the case.



Parts overlay and wiring diagram. Note that the manual override switches (S1 and S2) are optional.

ches. Each piece should be cut to about 80mm in length – they can be trimmed later. The next stage of construction is to prepare the plastic box.

The box measures 158 × 95 × 50mm and the printed circuit board dimensions have been chosen to suit the variety which has three vertical slots on each long side, with notches about 12mm from the bottom, into which the board may be secured. It is available from most dealers and carries a catalog number, moulded into the inside surface, H 0101.

An alternative box is available from Dick Smith Electronics and has multiple vertical slots along each side. This is equally suitable, but the board is marginally too wide and will need to be filed a little to make it fit. If this is done carefully, the board can be made a push fit to make it more secure. It can then be held in place using four small spacers and suitable screws.

A reasonable idea of the physical layout of the components can be gained from the accompanying photographs. Notice that the mains wiring is kept quite separate from the low voltage wiring. For this reason, the two LDRs (and the switches, if used) should be located towards one end of the board. Remember also that the ambient light sensing LDR must face a different direction to the headlight sensing LDR. Each LDR will require a 14.5mm mounting hole, and each switch a 7mm hole. We fixed the LDRs permanently in position using epoxy adhesive.

At the opposite end of the box, two holes are required for the mains cords. The size will depend on the type of grommet used – in our case, 13mm holes were required, and 40mm between the hole centres proved convenient. A single 3mm hole located midway between the two cord holes is used for the cable clamp retaining screw, which should be of the countersunk type.

PARTS LIST

1 PC board, code 82pc11, 98 x 87mm
1 mains transformer, Ferguson PL15/5VA or A&R AL7VA/15
1 12V SPDT relay with 5A 240VAC contacts
1 plastic utility case, 158 x 95 x 50mm
1 3-pin mains plug
1 mains cord socket (in-line)
2 pushbutton switches (optional)
2 rubber grommets
1 length of mains cord to suit
2 cable clamps
1 3-way mains terminal block
3 1N4001 diodes
1 555 timer IC

CAPACITORS
2 100µF/16VW electrolytics
1 .01µF metallised polyester (greencap)

RESISTORS (¼W, 5%)
1 x 2.7MΩ, 1 x 10kΩ, 2 x Light Dependent Resistors (ORP12 or equivalent)

MISCELLANEOUS
Hook-up wire, machine screws and nuts, solder etc.

The length of the mains cords will depend on your chosen location for the Sentry. It should, of course, be protected from the weather. The Sentry will also have to be located in such a position that it will normally fall within the car's headlight beam. If this should prove incompatible with the requirement to protect the device from the weather, it may be necessary to locate the headlight sensing LDR remotely from the rest of the circuit.

The mains terminal block is affixed to the metal lid of the box. Two 3mm holes are required for the machine screws which hold it in place. Locate the terminal block midway between the transformer and the end of the box to reduce the possibility of pinching the wires when fitting the lid. One other 3mm hole is required in the lid for the earth lug.

The earth wire (green or green with a yellow trace) from each cord is soldered to the earth lug. The neutral wires (black or blue) are connected to the same point on the terminal block. The two active (red or brown) wires have separate connections and you must make certain that they go to the correct points.

There are three connections from the terminal block to the printed circuit board – two actives and one neutral. Once again, make certain that the connections are correct. Use wire with mains rated insulation – three lengths cut from a mains cord would be an obvious choice. This completes the internal wiring for the project and the mains cords can now be run through their respective holes. Fit the two cable

clamps and make sure the wires will not be pinched between the lid and box.

A three pin mains plug can now be fitted to the power supply cord. Connect the earth wire (green or green/yellow) to the earth pin first, this pin always being clearly marked. Then connect the active and neutral wires to their respective pins, which are also usually marked. As an extra precaution we have included a wiring diagram showing these connections.

The output cord should be terminated with an in-line mains socket, and the same sequence should be adopted and the same care taken to ensure that the correct connections are made. A wiring diagram for this is also provided.

When you have checked the mains wiring and are sure that all is in order, the Sentry can be tested. Screw the lid on the plastic utility box and, without connecting any load, plug the power cord into a mains socket. At switch on, the 555 may trigger spontaneously (you will know it has triggered by the "click" of the relay pulling in). This is a limitation of the 555, but since the Sentry is intended to be powered continuously, it should not present a problem. If you have fitted a cancel switch, pressing it will cause another click from the relay as it releases. Otherwise, you will have to wait for the duration of the timing cycle.

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

$32

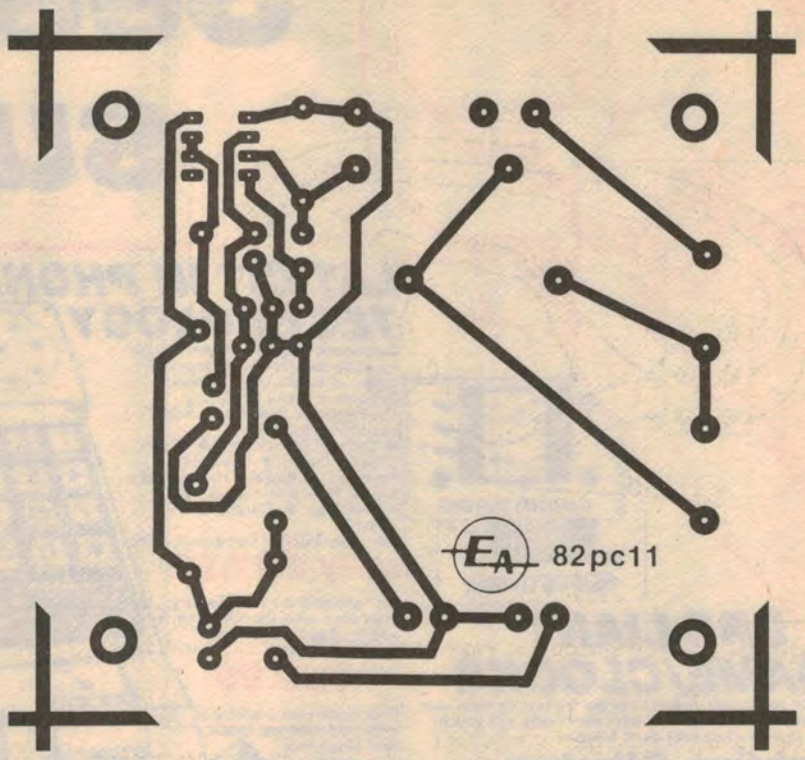
This includes sales tax.

Cover both LDRs with your fingers or a piece of black tape to simulate darkness. If you are working in a reasonably lit environment, briefly uncovering the headlight sensing LDR should cause the relay to pull in. If the ambient light level is not high enough, use a torch to trigger the circuit. Note that the Sentry will not cancel, even after the duration of its timing cycle, if the headlight sensing LDR is not covered again after triggering has occured.

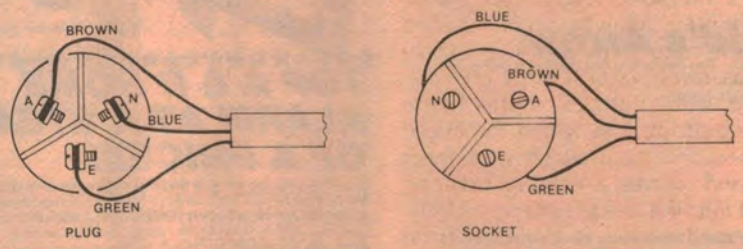
Using the manual trigger switch (where fitted) should cause the relay to pull in, even with the headlight sensing LDR still covered. Uncovering the ambient sensing LDR should prevent the Sentry from being triggered by any means.

Provided that your project operates as per the above description, you can now fit the light (or other load) and repeat the tests. When selecting the final location for the Sentry, some trial and error may be needed to find a position where it is operated by your car's headlights but not by those of passing traffic or by street lamps.

Note that any electrical wiring, other than that which we have described here, will probably transgress supply authority regulations unless performed by a licensed electrician. In any case, if there is any doubt, an electrician or the supply authority should be consulted.



Here is an actual size reproduction of the PCB artwork.



These diagrams show how the mains plug and socket are wired.