WARNING
LAMP UNIT

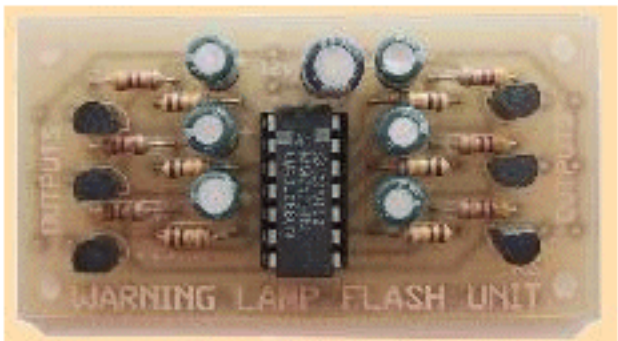
This kit is available from:

Talking Electronics

email Colin Mitchell:

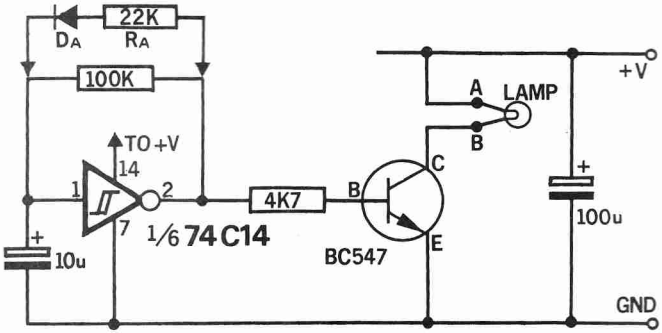
talking@tpg.com.au

for pricing and postage.



WARNING LAMP FLASHING UNIT

A flashing warning-lamp for scale construction sites, road maintenance areas and 'turn indicators' for cars.



This circuit is repeated 6 times on the PC board.

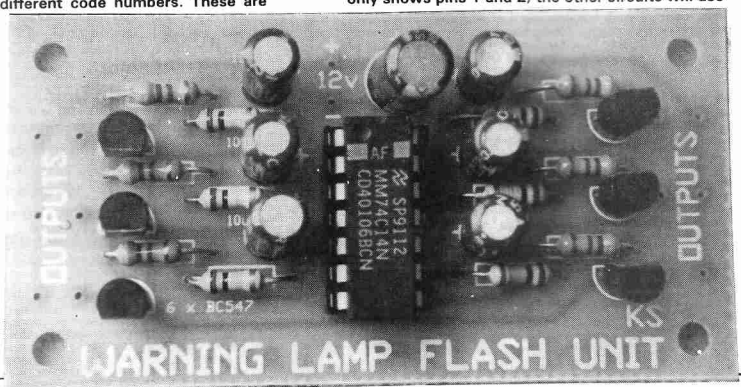
This WARNING LAMP FLASHING UNIT is an ideal first IC project.

It may look complicated at first, but you will notice on the overlay of the PC board, there are six of each component value (except the IC and 100mfd electrolytic).

This is because the board contains six identical circuits, each capable of flashing one lamp. Each circuit is based around a Schmitt Trigger inverter, of which there are six in the chip. This chip is available under several different code numbers. These are **74C14, 40106** and 40014. You must ask for this chip by its number: don't use the letter codes such as HCF, CD and MC as these only indicate the manufacturer of the chip.

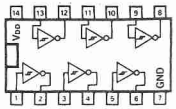
The circuit diagram shows only ONE of these oscillator circuits. The 100mfd capacitor and the power rails are common to the six circuits. In some circuits the power rails are omitted for clarity but they must be connected for the circuit to work!

If you look at the pin-out of the chip, you will see it contains six Schmitt Inverters and since the circuit only shows pins 1 and 2, the other circuits will use



the following pairs: Pins 3 and 4. Pins 5 and 6. Pins 13 and 12. Pins 11 and 10 and finally pins 9 and 8.

On the circuit diagram we have shown two components, DA and RA, these are not shown on the PC board overlay and will be discussed later.



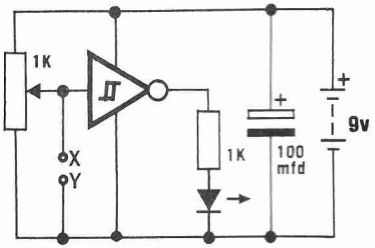
74C14

Pinout of the 74C14

HOW THE CIRCUIT WORKS.

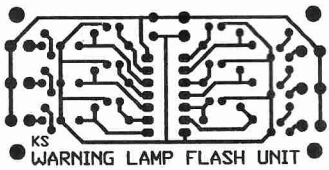
The first component to understand is the 74C14, as it will be used often in this book. This chip contains six Schmitt inverters. Each works as follows:
The Schmitt inverter has two 'threshold' voltages, one at approximately one-third Vcc and the other at approx two-thirds Vcc. (Vcc is the value of the voltage rail).

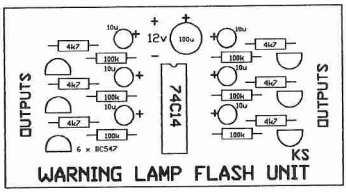
Consider the Schmitt trigger in the circuit below:



Start with the pot 'set' to the positive end of its travel. This puts a logic 1 or HIGH on the input of the inverter. The output of the chip will be the inverse of the input and in this case it will be 0 or LOW. The LED connected to the output will not light. Connect a multimeter (set to its 10-volt range), across points x and y. Turn the pot slowly toward the negative end of its travel. Nothing happens to the output of the circuit until the voltage becomes about one-third Vcc. (about 3.5v). This is called the LOWER THRESHOLD. At this point the output of the inverter goes HIGH and the LED lights.

Continue turning the pot towards 'zero'. Nothing further happens to the output. Slowly turn the pot back towards the positive end of its travel. As the voltage approaches two-thirds Vcc, the output suddenly goes LOW and the LED extinguishes.





PC board and overlay for the Warning Lamp Flashing Unit.

PARTS LIST

6 - 4k7
6 - 22k
6 - 100k
6 - 220k

6 - 10mfd 16v PC electros
1 - 100mfd 16v PC electro.

6 - 1N 914 (1N 4148) diodes
6 - BC 547 transistors
1 - 74c14 Hex Schmitt Trigger IC

1 - 14 pin IC socket

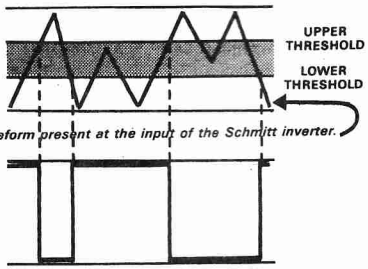
*6 - 6v or 12v mini lamps
6 - 3mm yellow LEDs & 470R
WARNING LAMP FLASHING UNIT PC

*Lamp voltage is determined by the voltage supplied to the project.

This car has a hole drilled as shown to take a 'shaped' indicator LED.

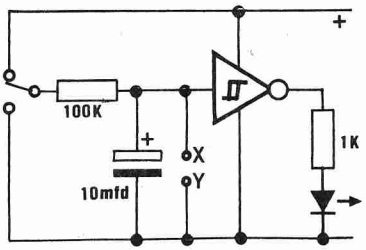
From this it can be seen that when the input voltage is slowly rising from zero to positive, an instant occurs when the output IMMEDIATELY changes from positive to zero. The same occurs when the input is in a 'falling' condition. These 'change-points' are called UPPER and LOWER thresholds.

If we turn the pot very quickly up and down, we will generate a waveform very similar to the following diagram:

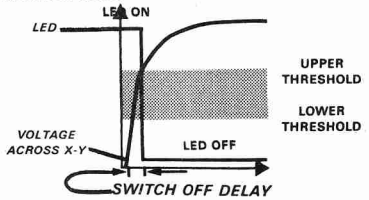


Output of the Schmitt inverter for the above input waveform.

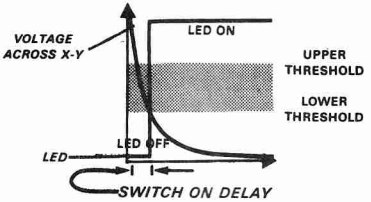
When a random waveform is presented to the input of the chip, the output will rise and fall according to the upper and lower thresholds. The gap between these values is called the HYSTERESIS GAP and is shown shaded on the graph.



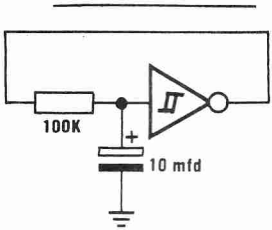
If we add an electrolytic and resistor to the circuit as shown, we produce a DELAY circuit. By taking the switch HIGH a short time-delay will be produced before the LED will go out. This is due to the electrolytic charging via the resistor to the upper threshold value.



Change the switch LOW and once again a delay will occur before the LED responds.

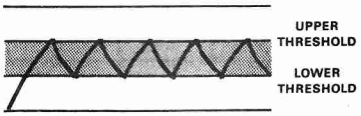


Note that during the delay, the input to the resistor and the output of the inverter are the SAME LOGIC LEVEL.



The Schmitt oscillator.

Instead of triggering the delay via a switch, it can be triggered via its own output. Below is a graph of the result of this arrangement.



The voltage across the capacitor during oscillation.

Output of the Schmitt oscillator.

Initially the capacitor is uncharged and the input of the Schmitt inverter is held LOW. The output of the inverter is therefore HIGH. The capacitor charges via the 100K resistor and when the voltage across it reaches two-thirds Vcc, the output of the inverter goes LOW. Since the 100k is connected to the output of the inverter, it discharges the capacitor until the voltage across the input is one-third Vcc. At this point the output of the inverter goes HIGH again.

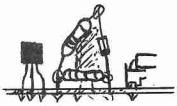
The circuit will continue to cycle indefinitely.

The test circuit now looks very similar to that of the project.

To provide additional output current, the **Schmitt** oscillator drives a buffer transistor (via a **4K7 base** resistor). This is necessary if grain-of-wheat bulbs or more than one LED per output (via current limiting resistors) are to be driven by the unit.

You will notice that each of the oscillators flash with a mark-space ratio very near to 50%. In other words the lamp is lit for the same duration as it is extinguished. With this circuit two LEDs (and their current-limiting resistors) can be connected in parallel to simulate the turn indicators in a scale car. A LED or lamp can also be connected to the circuit to simulate the portable warning lamps around road-side holes. 'Rivet Counters' will immediately say that these roadside lamps run at 10% - 90% mark-space ratio to save battery power. You can get the same effect by adding a modification.

First you must replace the 100K resistor in each oscillator to be modified with a 220K. RA and DA are then soldered across the top of the 220K resistor so that the cathode of DA is facing towards the chip (for all oscillators), as shown in the diagram below. RA is 22K resistor and DA is a 1N914 diode.

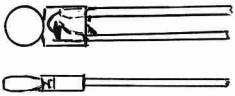


There are six independent flashing circuits on the board. These will flash at slightly different rates due to the slightly different value of each component. The effect produced adds greatly to the realism of your layout, especially when the lamps are placed near each other.

CONSTRUCTION

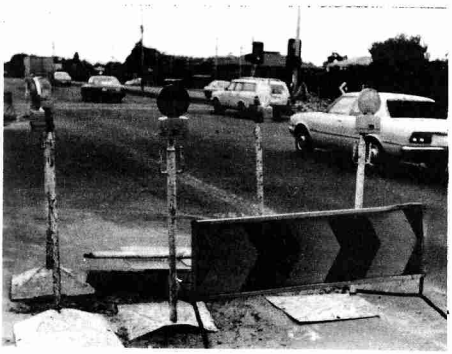
Solder the resistors onto the printed circuit board first, followed by the IC socket. Next solder the transistors and capacitors, making sure their polarity is correct. Finally insert the chip into the socket with the notch near the 100mfd electrolytic.

The unit can be mounted under the base-board of the layout or even on part of the frame. Use fine hookup wire between the board and the lamps. Use a supply voltage to suit the voltage of the lamps. Do not supply the circuit with a voltage above 12v as this can very easily damage the IC.

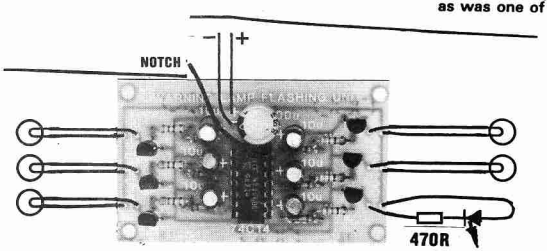


An enlarged view of how to file a 3mm yellow LED to resemble a warning lamp.

This is what the LED will look like after filing. It has been given an undercoat of black paint to prevent light shining through the body of the lamp.



This photo should help you to model realistic warning lamps and stands. There several other types of stands used with these warning lamps. Some warming lamps are also built with red lenses, as was one of these.



This diagram shows how to wire the lamps and LEDs to the PC board. It is important not to forget the 470R to 1K resistor in series with the LED.