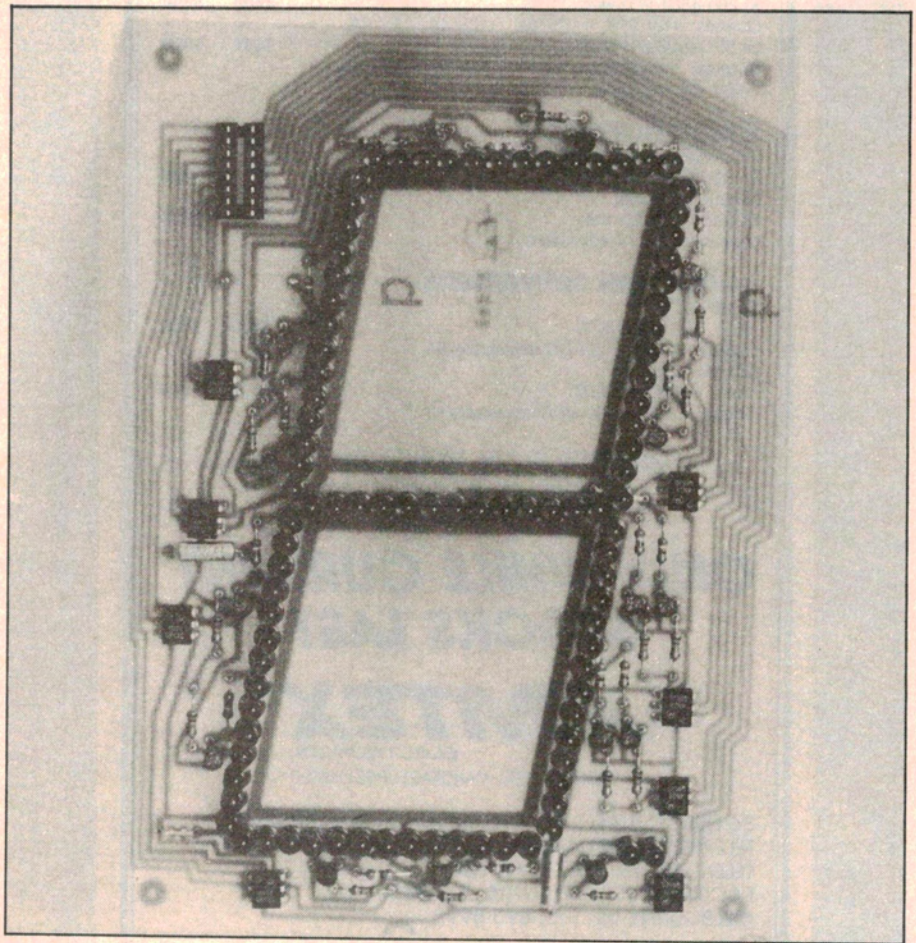
A really BIG LED display module!

Need to produce an LED display that can be seen from a long way off? This single digit 153mm high seven segment LED display module is just what you need. It can be used as a replacement for both common anode and common cathode LED displays, can be either multiplexed or DC driven, and can be provided with a decimal point on either the right or left.

by JOHN CLARKE



You'll need one of these for each digit of a display.

The large LED display module to be described should find use in classrooms and lecture theatres, so that a demonstration can be seen by everyone. A set of the modules can display voltage, temperature or any other parameter simply by using them to replace the LED display in the piece of measuring equipment concerned.

The module should also have application in industry, to indicate process parameters which are important enough to be prominently displayed so that they will be visible over a large area (say a control room). No doubt there will also be novelty applications, such as a large digital clock and an event or elapsed timer for sports grounds and functions.

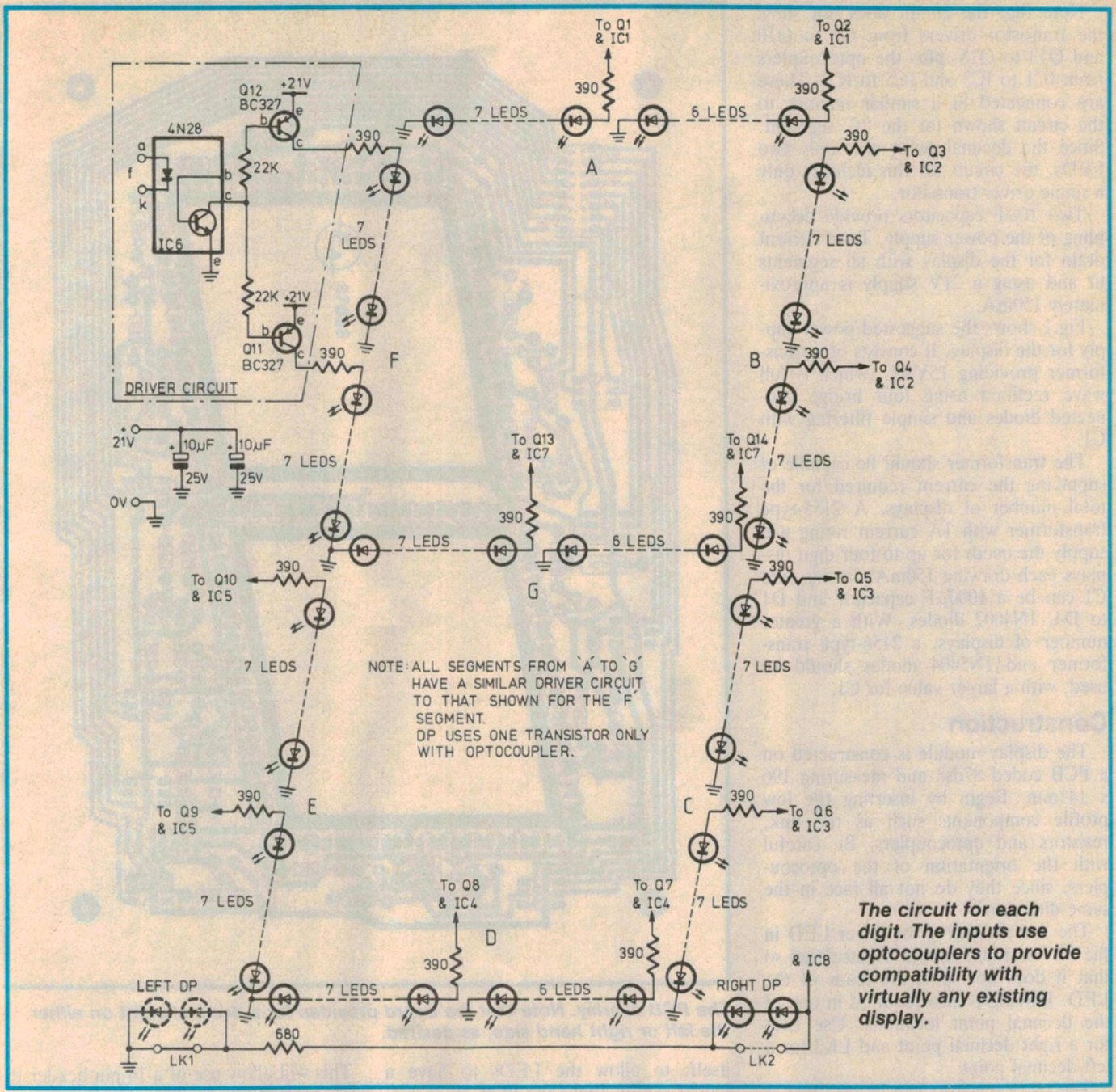
The display module has been designed to be fully compatible with standard smaller seven segment LED displays, of either the common cathode or common anode type. However the display is separately powered, so that its considerably higher power requirements do not cause additional drain on the original LED display circuit.

No modifications are necessary to the original LED display circuit to enable incorporation of the large display. The original display is removed and the inputs of the large display module connected in its place. The secret of this direct compatibility is the use of optocouplers, to isolate the segment and decimal point drivers of the large display.

An optocoupler consists internally of an LED which optically drives a phototransistor. Since it is the optocoupler LED which is driven, instead of the original small LED display, there is direct compatibility between the displays.

The LED terminals to the optocoupler are left free, so that all the optocoupler anodes can be connected to simulate a common anode display or all the cathodes connected for simulation of a common cathode display.

The module's display can be configured for left or right hand decimal points, to match displays with either a



The circuit for each digit. The inputs use optocouplers to provide compatibility with virtually any existing display.

left or right channel decimal point.

The large LED display module has a digit which consists of 95 LEDs, arranged in a standard seven segment format. Two further LEDs are used for the left or right decimal point. The LEDs are arranged on a printed circuit board, with the associated LED driving circuitry located around these LEDs. It is quite easy to mount several of the modules side by side to produce a multi-digit display.

Circuitry

The circuit for the module comprises eight optocouplers which provide the interface between a conventional LED display and the circuit. These optocouplers drive transistors which in turn drive the LEDs forming each large display segment.

As shown in the circuit schematic, the "f" segment comprises two sets of seven series connected LEDs. Each set is driven by a BC327 transistor with current limiting using a 390Ω resistor. The base of each transistor is driven via a 22kΩ resistor at the collector of the optocoupler transistor. When the optocoupler LED is powered, the optocoupler transistor turns on to allow base current flow to the BC327 transistors. These transistors switch on and drive the series connected LEDs.

PARTS LIST

1 PCB coded 87ds8, 196 x 141mm
97 5mm red LEDs
15 BC327 PNP transistors
8 4N28 optocouplers
2 10uF 25VW axial electrolytic capacitors
15 22k ohm 0.25W resistors
1 680 ohm 0.25W resistor
14 390 ohm 0.25W resistors
15mm of insulated link wire
1 16 pin socket (optional)
1 16 pin header plug (optional)

Note that the circuit does not show the transistor drivers from Q1 to Q10 and Q13 to Q15, plus the optocouplers from IC1 to IC3 and IC5 to IC8. These are connected in a similar manner to the circuit shown for the "f" segment. Since the decimal point uses only two LEDs, the circuit for this includes only a single driver transistor.

Two 10μF capacitors provide decoupling of the power supply. Total current drain for the display with all segments lit and using a 21V supply is approximately 150mA.

Fig.1 shows the suggested power supply for the display. It consists of a transformer providing 15VAC, which is full wave rectified using four bridge connected diodes and simple filtering with C1.

The transformer should be capable of supplying the current required for the total number of displays. A 2155-type transformer with 1A current rating will supply the needs for up to four digit displays each drawing 150mA. In this case C1 can be a 1000μF capacitor and D1 to D4, 1N4002 diodes. With a greater number of displays, a 2156-type transformer and 1N5404 diodes should be used, with a larger value for C1.

Construction

The display module is constructed on a PCB coded 87ds8 and measuring 196 x 141mm. Begin by inserting the low profile components such as the link, resistors and optocouplers. Be careful with the orientation of the optocouplers, since they do not all face in the same direction.

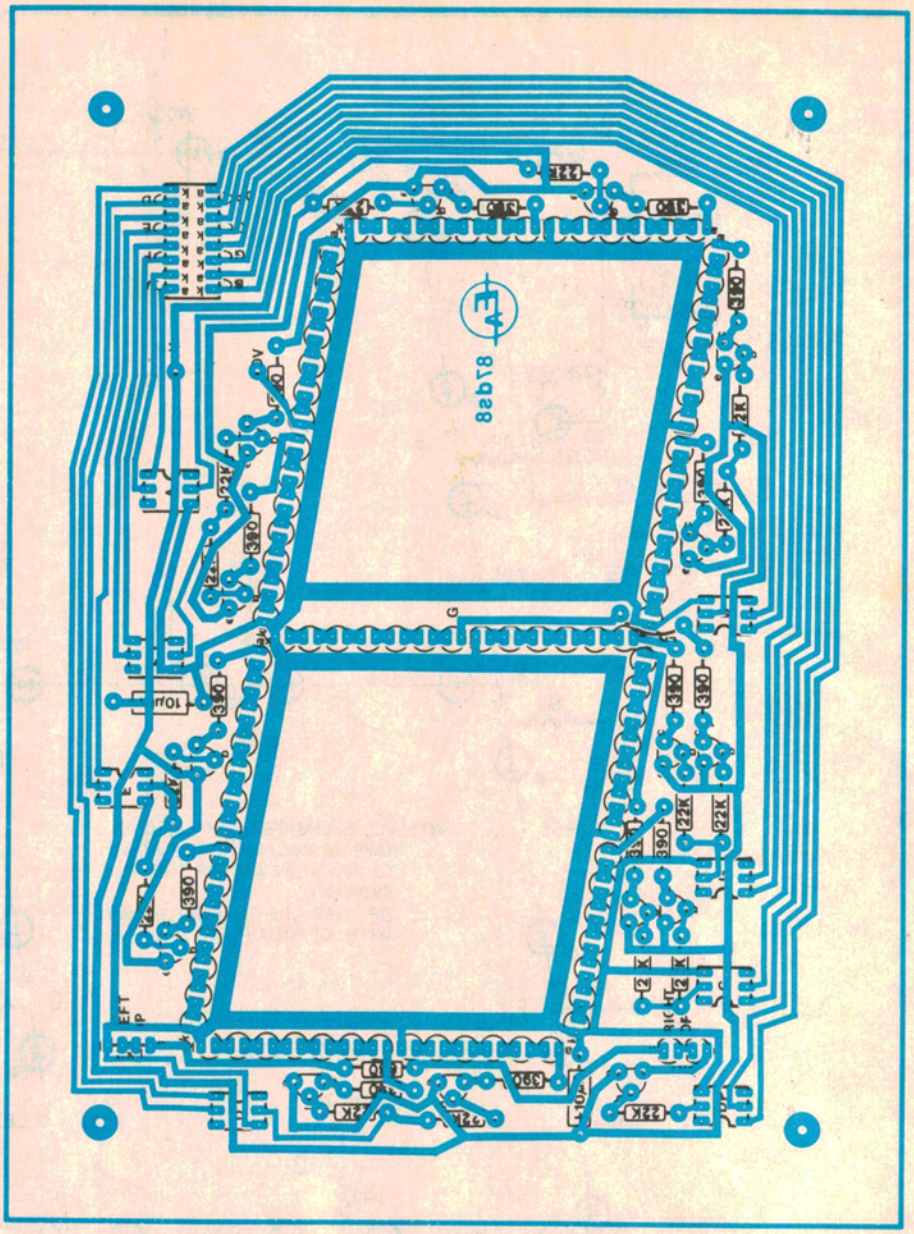
The link straddling the lower LED in the "b" segment should be insulated so that it does not short the leads of the LED. Linking is also required in one of the decimal point locations. Use LK1 for a right decimal point and LK2 for a left decimal point.

The two capacitors can be installed at this stage, taking note of the correct polarity. The transistors should be installed as closely as possible to the PCB itself, to allow the LEDs to have a higher profile above the PCB.

A 16-pin IC socket can be used for the seven segment and decimal point inputs at the top left side of the PCB. This will allow use of a 16 pin header to be inserted for external connections.

Finally, the LEDs can be installed. Begin by inserting every second LED fully down onto the PCB, taking care that they are orientated correctly. The longer lead is the anode while the flat side on the LED body is the cathode. Solder only one lead for the present, to allow adjustment of the LEDs in a straight line.

Now the in-between LEDs can be inserted. Full insertion onto the PCB for these LEDs is prevented by the plastic rim around the LED base. This is a reasonably attractive arrangement, however some readers may prefer to snip off the rim with side cutters to allow full



The PCB overlay. Note that the board provides for a decimal point on either the left or right hand side, as desired.

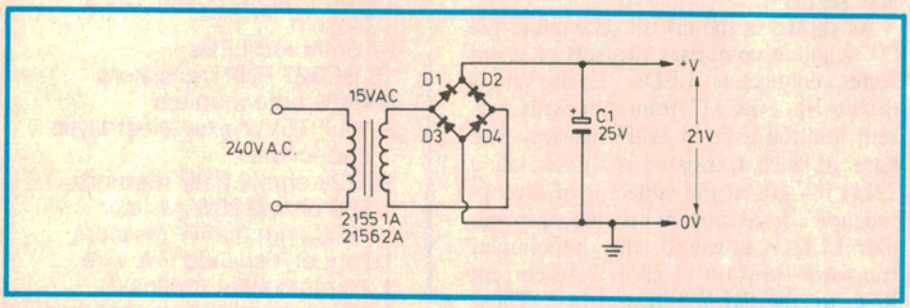
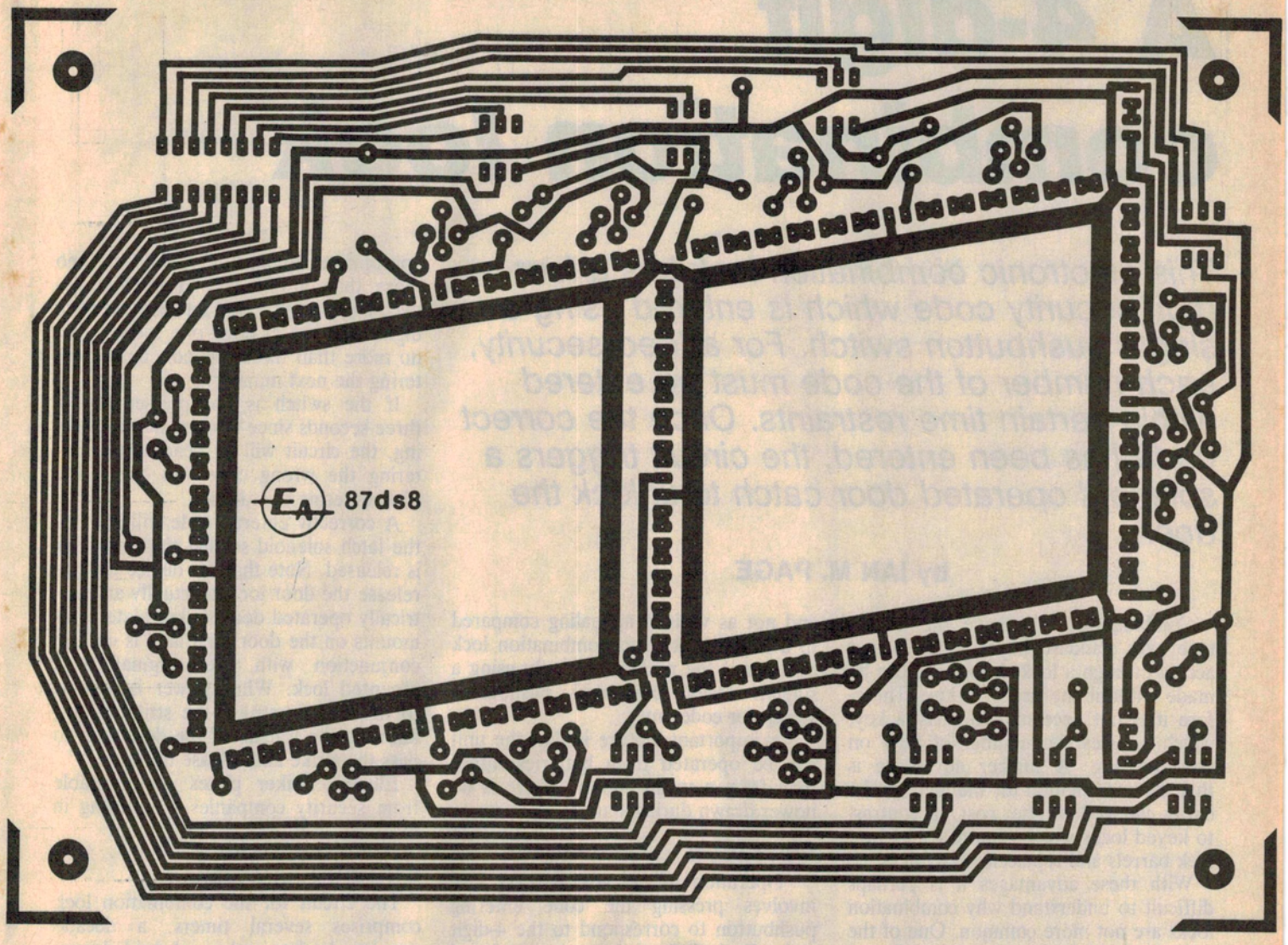


Fig.1: A suggested power supply, capable of running up to 4 digit modules with a 1A transformer or 8 modules with a 2A type.



The PCB pattern itself, reproduced actual size (we just made it!).

insertion on the PCB.

Solder these in position for one lead only and align the LEDs so that each segment is in a straight line. The remaining leads on all the LEDs can now be soldered.

That completes work on the display module PCB.

Testing requires a power supply of about 21V with current capability of at least 150mA. Connect the positive (+) and ground power terminals for the large display module to the power supply and the cathodes of the optocoupler LEDs to ground. To light a segment, connect a 3.9kΩ resistor between the anode of an optocoupler and the positive supply. This should light the large segment associated with that optocoupler.

Should the segment not light, check for incorrectly orientated or faulty LEDs. Similarly check that all the remaining segments operate.

When the display is used in a multiplexed situation, the resistor values specified will be suitable to give sufficient brightness for up to four digits. To give greater LED brightness, the resistor values for limiting the LED current and base drive to the transistors can be reduced. LED current is calculated assuming that there is a 2V drop across each LED, leaving about 7V across the resistor. The current through the transistor base should be 20 times less than the LED current, to ensure saturation of the transistor.

Note that we are assuming that the current through the optocoupler LED is sufficient to ensure saturation of the phototransistor. This should normally be the case.

Installation

There are four holes located in the corners of the PCB suitable for mounting the display. When more than one digit is used, each PCB can be secured at regular spacing onto a backing plate. To give protection for the diodes and ensure greater visibility, a red Perspex screen can be secured over the front of the display.

Connection of the large LED display to a seven segment LED driver circuit requires knowledge of the pinouts and polarity for the particular LED display involved. The Dick Smith catalog shows pinouts for several of the LED displays, but for greater detail and information on other displays, refer to the manufacturers' optoelectronic data books.