

# universal display

It is frequently necessary to have available a numeric display for many projects such as frequency

counters, digital voltmeters etc. It is a tedious and untidy business to build up such displays on matrix board, so Elektor have designed a universal display which should satisfy the requirements of most enthusiasts. The display may be used with seven-segment indicators of the LED or Minitron type.

The universal display is modular in construction and its basic form consists of a board to accommodate two displays and their associated decoders. The system may be extended to any number of digits and decade counter/latch boards may also be added.

The universal display uses the popular 7447 decoder. The display format of this decoder is given in figure 1. However, for digits 6 and 9 the improved format described elsewhere in this issue is employed. This is shown in figure 2. The basic configuration of the decoder with the additional transistors is shown in figure 3 and the complete circuit of a display module for use with LED displays is given in figure 4. That of the Minitron version is shown in figure 5, the only difference being that the Minitron does not require current-limiting resistors in series with each segment.

## Construction

Double-sided boards are employed in the construction of the display module and it may be seen from figures 6 and 7 that components are mounted on both sides of the board. It should be emphasised here that great care is required in the assembly of these boards due to the degree of miniaturisation involved. The soldering iron must have an extremely fine tip and soldering must be done extremely quickly to avoid peeling the fine track from the board. The boards available from Elektor employ plated-through holes, so that it is unnecessary to solder to component leads on both sides of the board. Simply solder on the opposite side of the board to that on which the component is mounted.

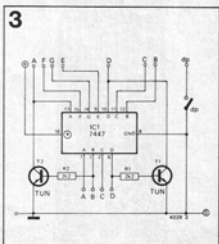
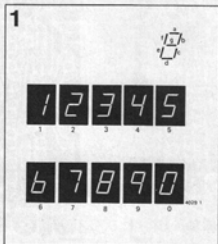
## The counter/latch module

The counter/latch module increases the

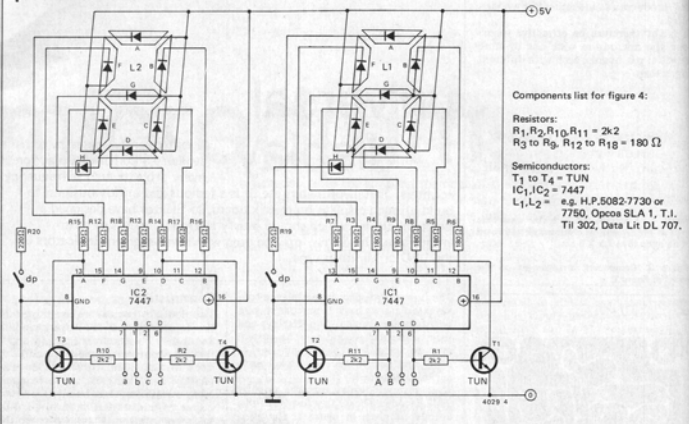
Figure 1. The display format produced by the 7447 decoder.

Figure 2. The improved presentation of the digits 6 and 9 as used in the universal display.

Figure 3. The circuit used with the 7447 to achieve the improved 6 and 9 display.



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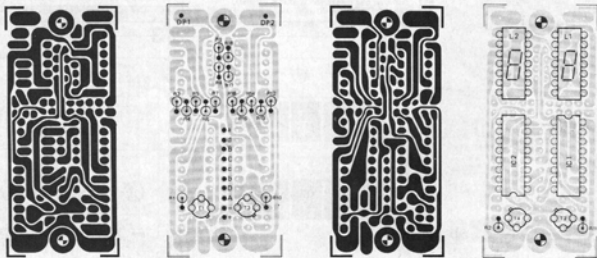


versatility of the universal display to a large extent. The circuit of the module is given in figure 8 and consists of two cascaded 7490 decade counters and two 7475 latches. The operation of these devices will not be discussed in detail as they are extremely commonplace; suffice it to note the following points:

- the latch is enabled by a '1' on the clock input.
- the counter counts on a negative-going edge.
- the counter is reset by a '1' on the reset input.
- for reliable operation of the counter the slope of the pulse edges should be greater than  $2 \text{ V}/\mu\text{sec}$ .

**Assembly of the complete display**  
 The board and layout for the counter/

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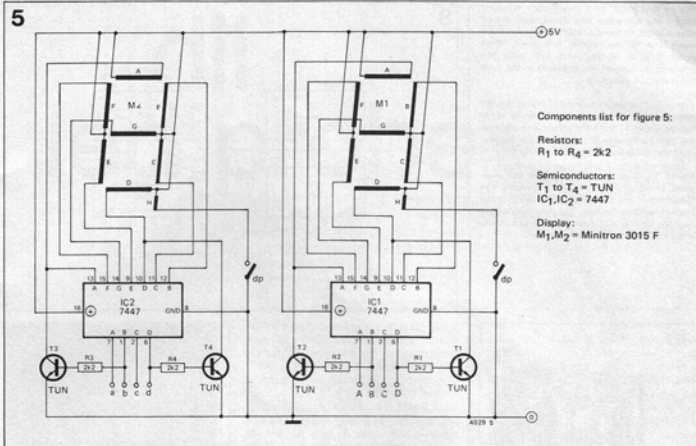


Figure 4. Circuit of the LED version of the universal display. Note that the decimal point series resistor has a higher value than the segment resistors to achieve the same luminous intensity.

Figure 5. The Minitron version of the display which does not require series resistors for the segments. Note that the Minitron has a right-hand decimal point whilst the LED displays used have a left-hand decimal point.

Figure 6. The p.c. board and layout for the LED display. The track shown in feint in the component layouts is the side of the board on which the components are mounted, i.e. the components are mounted directly on top of the track shown.

Figure 7. The board and component layout for the Minitron display. The same remarks apply as for the LED display.

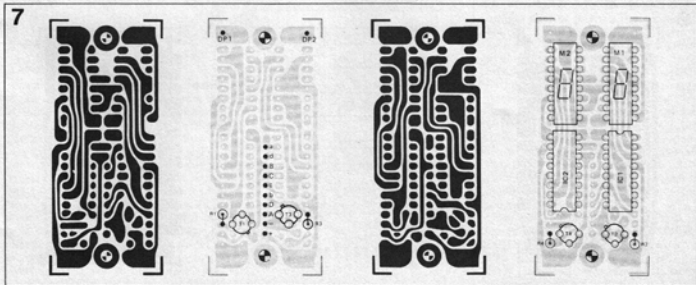
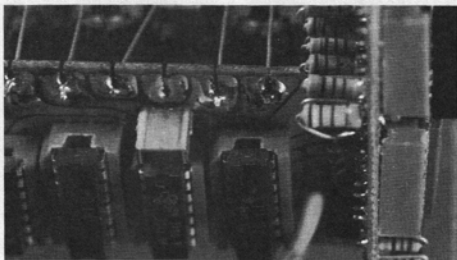
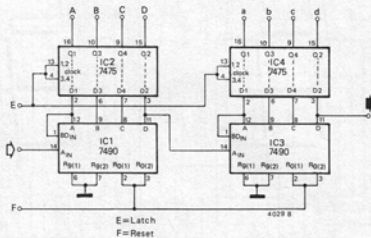


Figure 8. Circuit of a two-decade counter/latch. The necessary interconnections are of course made on the p.c. board. When the reset input is at '0' the counter will count. When input E is at '0' the latch will store the information present on its inputs at the time the transition occurred.

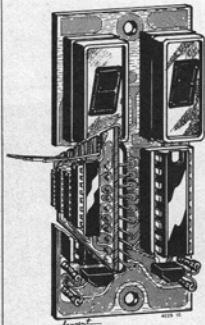
Figure 9. The circuit board and layout for the counter/latch. The same remarks apply as for figures 6 and 7. Note the connection slots on the right-hand edge of the boards for supply, reset and latch-enable busbars.

Figure 10. A cut-away drawing of the complete universal display module showing the mounting of the counter/latch board and the busbars to other decades. The mounting of the counter latch board must be done accurately if several modules are to be cascaded.

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latch module are given in figure 9. The board is double-sided and the same constructional points apply as for the display module.

The assembly of the complete universal display requires some care. The counter/latch board is mounted perpendicular to the back of the display board. The BCD outputs a, b, c, d, A, B, C, D, and the supply connections on the edge of the counter/latch board mate up with the corresponding connections down the middle of the display board. The method of construction is as follows: sufficient right-angle links are made from stout copper wire and soldered to the counter/latch board so that they stick out parallel to the plane of the board but perpendicular to the edge. The links are then pushed through the back of the display board so that the edge of the counter/latch board is flush with it and are then soldered (see figure 10).

#### Interconnection of several boards

Any number of modules may be easily interconnected to form a decade counter of any desired length. The modules are first joined mechanically by using 6 B.A. spacers and short lengths of 6 B.A.



studding through the hole in the corner of the counter/latch boards. All the common interconnections between the boards, i.e. supply connections, counter reset and latch enable are made simply by running a wire bus in the slots on the top edge of the counter/latch boards. The counters are cascaded by connecting a wire link from the output of one stage to the input of the succeeding stage again on the top edge of the counter/latch boards (remember to connect the output of a board to the input of the board to its left). The photograph should make this clear.

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