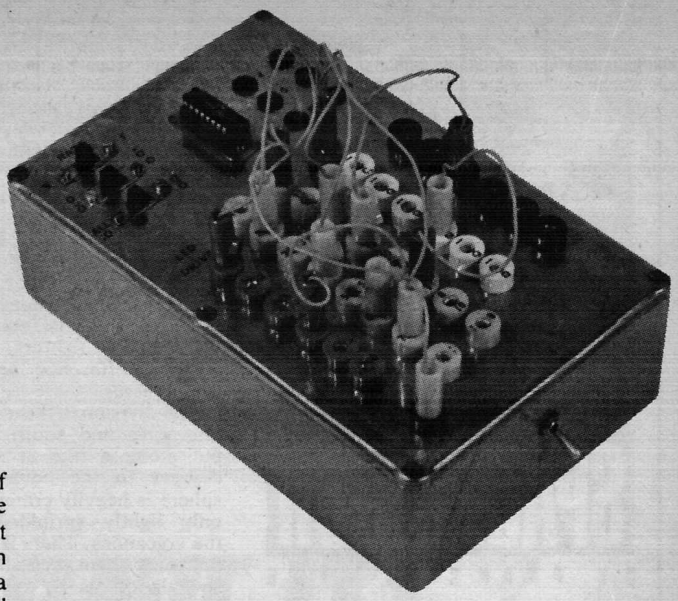
DIGITAL I.C. TESTER

By W.H. DAVIES



IT IS reasonable to assume that many readers of this magazine possess a transistor tester of one type or another and those who do will readily agree that the expense incurred to effect construction has been repaid ten-fold. Primarily, these testers provided a facility for checking packs of untested and unmarked transistors available from component suppliers at reasonable cost and matching pairs of transistors by comparison of h_{fe} measurements.

They also provide a confidence check procedure whereby a transistor can be tested prior to soldering in circuit.

Recent trends in constructional projects indicate the increasing use of logic integrated circuits and a need has arisen for a similar device on which the constructor can test a wide variety of the current range of i.c.s.

The unit described here does this. It provides a means of testing 14 and 16 pin dual-in-line TTL and DTL types, and light emitting diodes (l.e.d.s) provide a visual indication of the logic states. It is constructed in a box, either metal or plastic, the dimensions of which are determined by the physical size of the switches and associated sockets employed, and whether or not the tester is to be powered by internal batteries or from an external source.

It should be noted, however, that the changeover switches used need not be toggle types as small slider switches are available at low cost and these have an acceptable degree of efficiency. Patch cords are used to obtain the necessary combinations required to permit versatility of operation.

COMPONENTS . . .

Resistors

R1	470Ω
R2	470Ω
R3 to R8	330Ω 6 off.
All	$\frac{1}{8}$W 2%

Capacitors

C1, C4	250μF, 10V
C2, C3	125μF 10V

Integrated Circuits

IC1	BP932
IC2	BP936

Diodes

D1 to D6	TIL209 *or* HP5082

Switches

S1, S2, S3	DPDT slider or toggle, 3 off
S4	SPCO on/off switch

Miscellaneous

Sockets SK1 to SK36, 2mm, 36 off. Plugs to suit. Batteries and holder, 4 off U11 or similar. Case, die-cast or plastic, $7\frac{1}{2} \times 4\frac{3}{4} \times 2$in in model. $3\frac{1}{2} \times 2$in Veroboard 0·1in matrix, pins, nuts, bolts, spacers, wire, solder, etc.

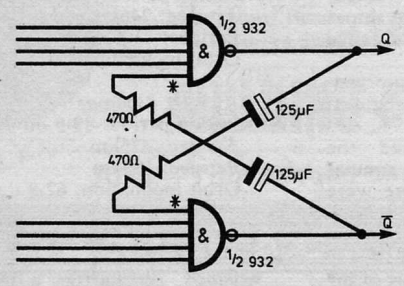


Fig. 1. This basic oscillator circuit can provide two differing frequencies dependent on the values of the two identical capacitors

THE OSCILLATOR

With the exception of a regulated 5V d.c. power supply source, a pre-requisite for the tester is an oscillator capable of providing the necessary Q and $\overline{Q}$ square wave logic. This is achieved by employing a standard multivibrator circuit derived from a DTL 930 series BP932 dual 4-input NAND gate, using the expanders with external R and C components as shown at Fig. 1.

The frequency (F) of such a multivibrator is given by the formula:

$$F \simeq \frac{160}{C}$$

where F is expressed in hertz and C in micro-farads.

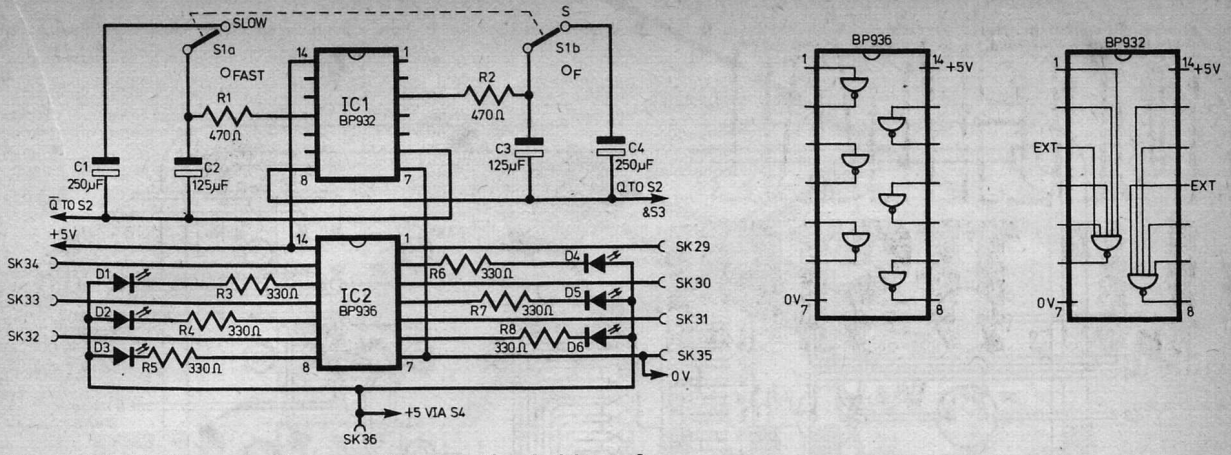


Fig. 2. Circuit diagrams of the oscillator and l.e.d. drive

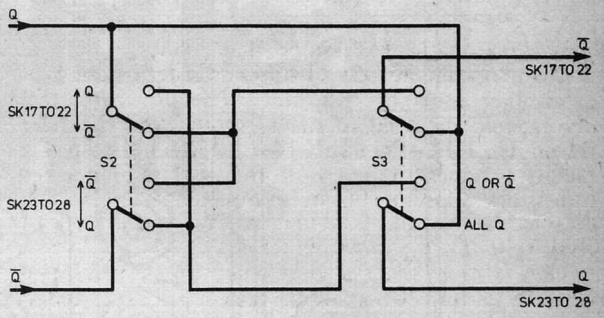


Fig. 3. The Q and Q̄ output switching for the various combinations of Q and Q̄ required

The oscillator, as constructed, provides a choice of fast (F) or slow (S) modes of operation by switching into circuit one of two values of *C*, 125μF or 250μF. The values are chosen so that the two frequencies are 1·28Hz and 0·43Hz respectively. In addition, the Q and Q̄ outputs are switchable so that the available logic may be Q and Q̄ as indicated by the socket labelling on the front panel, reversed Q for Q̄, or all one (Q or Q̄).

The general circuit diagram for the prototype board is shown in Fig. 2. The switch wiring for the Q—Q̄ changeover is shown in Fig. 3.

L.E.D. DRIVE

A BP936 hex inverter with a 330Ω load in series with the output of each gate supplies sufficient drive for the l.e.d.s. Gate inputs are via the l.e.d. drive sockets on the front panel. In Fig. 2 the l.e.d.s are shown as on the board with the i.c.s but in fact they, and switch S1, are mounted on the instrument front panel.

CONSTRUCTION

The oscillator and l.e.d. drive assembly is mounted on one piece of Veroboard measuring 3½in by 2in, with the copper strips running widthwise as in Fig. 4.

Vero pins are used at the various interconnecting points to the front panel and batteries. These provide sufficient anchorage for interconnection wiring and soldering. For the prototype unit the author dismantled an old multisocket connector and used the individual socket elements as female connectors to the Vero pins; this made interconnecting relatively easy.

The switch connections and front panel layout are given at Fig. 5 which shows the wiring diagram for the reverse side of the front panel and the suggested location for the various sockets. The positioning of the oscillator and l.e.d. drive assembly and the battery holder are shown in the accompanying photographs.

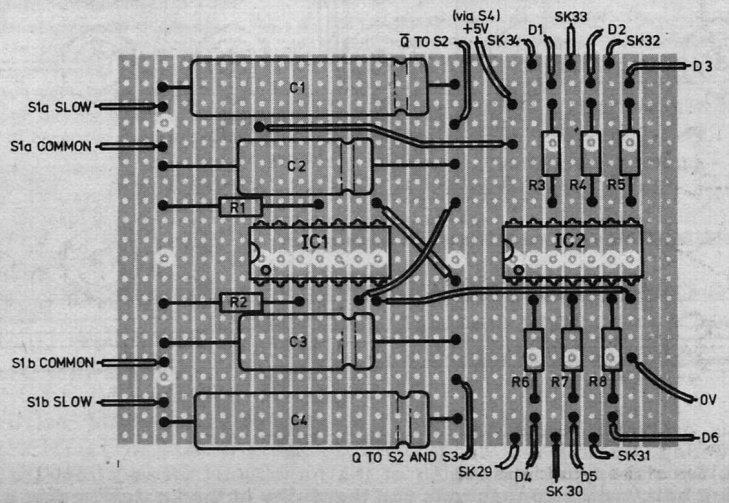


Fig. 4. Component layout and Veroboard cutting details for the oscillator and l.e.d. drive circuitry

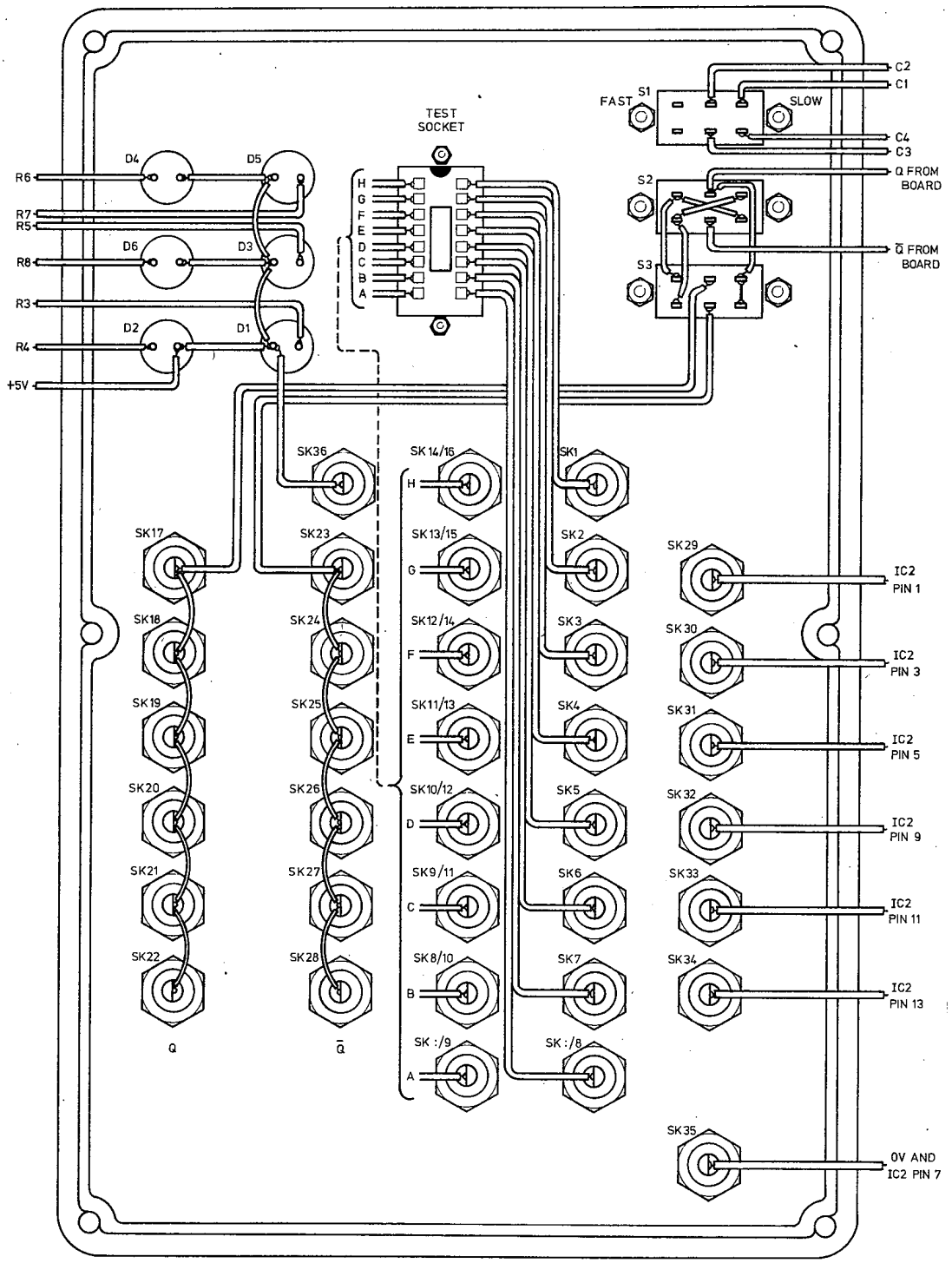


Fig. 5. General layout and wiring of the front panel viewed from the rear showing both switch connections and the wiring of the i.c. test socket patch sockets SK1 to SK14/16

PATCH CORDS

A minimum of 18 patch cords is desirable but not essential. However, at least two of these should be of the triple cord variety, i.e. three cords each having an individual banana plug at one end, but terminated into a common banana plug at the other.

OPERATION

Numbering the l.e.d. inputs 1 to 6 on the front panel from top to bottom, D4 becomes 1, D5 is 2, D6 is 3 and so on.

On completion of the unit it is suggested that the Q and $\overline{Q}$ sockets be tested for correct logic by patching these sockets direct to the l.e.d. drive socket. If the oscillator is functioning correctly the l.e.d.s will follow the logic and flash on and off.

With the patch cords still in this position proceed to test the FAST and SLOW modes of operation by operating the RATE switch. Then check the logic reversal facility by operating the Q—$\overline{Q}$ changeover switch.

Finally check the ALL Q facility by operating Q/$\overline{Q}$—ALL Q switch. If the unit is functioning correctly we may now proceed to the next stage, that of checking known i.c.s and some examples are given.

7404 HEX INVERTER

To test a 7404 TTL hex inverter, patch socket SK14/16 to 5V, SK36, SK7 to 0V SK35, socket SK1 to a Q socket, socket SK2 to l.e.d. drive SK29, and l.e.d. drive SK30 to a $\overline{Q}$ socket. Now insert the 7404 into the holder ensuring that it is correctly positioned for 14 pin d.i.l. operation and switch on power supply.

Light emitting diodes D4 and D5 should now flash on and off simultaneously, indicating that the inverter gate is functioning correctly. Repeat the procedure for the remaining five gates, bearing in mind that gate inputs are via sockets SK3, 5, 9, 11 and 13 and gate outputs via sockets SK4, 6, 8, 10 and 12 respectively.

7490 DECADE DIVIDER

Patch socket SK5 to the +5V socket SK36, and socket SK10 to the 0V socket SK35 using a triple lead patch cord. Connect the remaining two leads of this patch cord—one to socket SK2 and one to socket SK6.

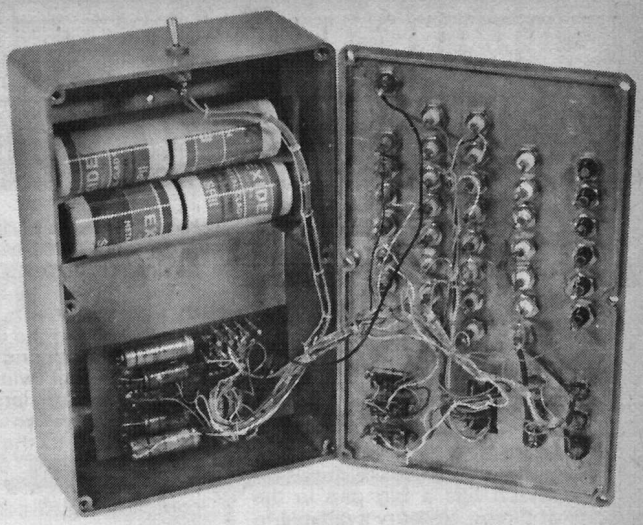
Patch socket SK14 to a Q socket and socket SK12 to socket SK1. Patch socket SK11 to l.e.d. drive SK29, and l.e.d. drive SK30 to a Q socket.

Insert the 7490 ensuring that it is correctly positioned. Switch on power supply.

Diode D4 should light once for every ten pulses of diode D5 indicating that the correct frequency division has taken place.

7413 DUAL 4-INPUT NAND (SCHMITT TRIGGER)

Patch socket SK14/16 to the 5V socket SK36. Patch socket SK7 to the 0V socket SK35. Patch SK1, 2, 4 and 5 to a Q socket and socket SK6 to l.e.d. drive SK29.



Patch l.e.d. drive SK30 to a $\overline{Q}$ socket, and insert the 7413 ensuring that it is correctly positioned. Switch on power supply.

Diodes D4 and D5 should now flash on and off simultaneously indicating that the first 4-input NAND gate is functioning correctly. Repeat the procedure for the second gate substituting socket numbers SK9, 10, 12 and 13 for sockets SK1, 2, 4 and 5, and SK8 for SK6.

7492 DIVIDE-BY-TWELVE

Patch SK5 to the 5V socket SK36. Patch socket SK10 to the 0V socket SK35 using a triple lead patch cord. Connect one of the remaining two leads to socket SK6.

Patch socket SK1 to socket SK12 and l.e.d. drive SK29 to a Q socket. Patch socket SK8 to l.e.d. drive SK30, connect socket SK14 to a Q socket and insert the 7492.

Switch on the power supply and diode D5 will illuminate after six pulses of D4 and remain lit for the next six pulses, indicating that the correct frequency division has taken place.

Sufficient examples have now been given for the constructor to familiarise himself with the capability and operation of the tester and no difficulty should be experienced when testing other devices provided pin connection data and truth tables are available. Some devices such as retriggerable monostables may, in some circumstances, need two external components in the form of an *R* and *C*, but these may easily be connected into circuit for test purposes by wedging the ends of the components into the appropriate sockets with the aid of the banana plugs.

MATERIALS

The two DTL i.c.s BP932 and BP936 used in the oscillator and l.e.d. drive assembly are obtainable from Messrs BI-PAK, or A. W. Marshall and Sons. The case is a normal die-cast box housing all components and the i.c. socket is a normal 16-pin holder with a bezel made up to suit. Of course it may be adhered to the case with Araldite or the like. ★