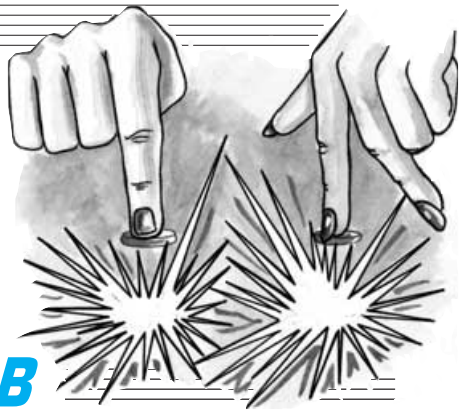
Starter Project

QUIZ GAME INDICATOR



MAX HORSEY AND TOM WEBB

A low-cost fun project that cannot be questioned!

DESIGNED to take the pressure off the chairperson when deciding who pressed their button "first", this latest addition to our Starter Project collection is ideal for the newcomer to electronics and should provide hours of fun.

The Quiz Game Indicator shows which of two contestants presses their button first by blocking the slowest one. The circuit is based around a single i.c. and operates a buzzer and red and green l.e.d.s. The two colours being assigned to the participating teams for identification.

BLOCK DIAGRAM

The circuit is based around two bistables or latching circuits, see block diagram Fig.1. The non-inverted output from each bistable feeds a light-emitting diode (l.e.d.) and buzzer, while an inverted output from each bistable is used to power the controlling pushswitch for the opposing bistable.

Hence, if one button is pressed before the other, the first bistable to latch will disable the opposing pushswitch.

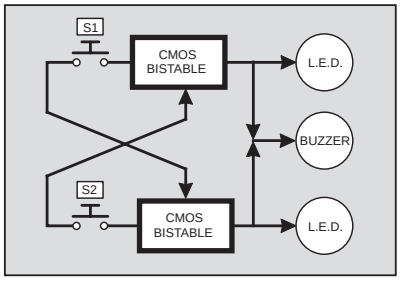


Fig.1. Quiz Game Indicator block diagram.

CIRCUIT DESCRIPTION

The complete circuit diagram for the Quiz Game Indicator, including "contestant" switches and l.e.d.s, is shown in Fig.2. The circuit requires four NOT gates and one of the least expensive methods of achieving this is to use a single i.c. containing four NOR gates connected as shown in Fig. 2. Their inputs are connected together making the NOR gates into the required NOT gates or inverters.

The gates are arranged in pairs with positive feedback, so for example, gates IC1a and IC1b are connected together by joining output pin 3 to input pins 5 and 6. Positive feedback is provided by resistor R1.

If output pin 4 of IC1b is low (0V) this will hold pins 1 and 2 of IC1a low. So IC1a output, pin 3, will be high (positive), making IC1b pins 5 and 6 also high. The two gates will therefore remain in this state.

When power is first applied, the gates may start up in either state, and so it is possible that they will latch with IC1b pin 4 high. This is prevented by means of capacitor C1, which holds pin 1 and pin 2 of IC1a low for an instant at the moment of "switch on".

The same arrangement is used for gates IC1c and IC1d. Hence, at power-up pin 11 will be low.

Power for the pushswitch S2 is obtained from pin 3 of IC1a. At present pin 3 is high, and so S2 is operable. If S2 is pressed, the input to IC1c (pins 8 and 9) will go high causing the output pin 10 to go low, and in turn, causing IC1d output pin 11 to go high. With pin 10 low, switch S1 has no power supply and is therefore inoperable. Hence, if S2 is pressed first, pin 11 will go high and switch S1 is prevented from operating.

The same would have applied if switch S1 had been pressed first, except that pin 3 would have gone low, and S2 would have been inoperable. Note that resistors R1 and R2 are used to latch the respective pairs of gates by applying some positive feedback.

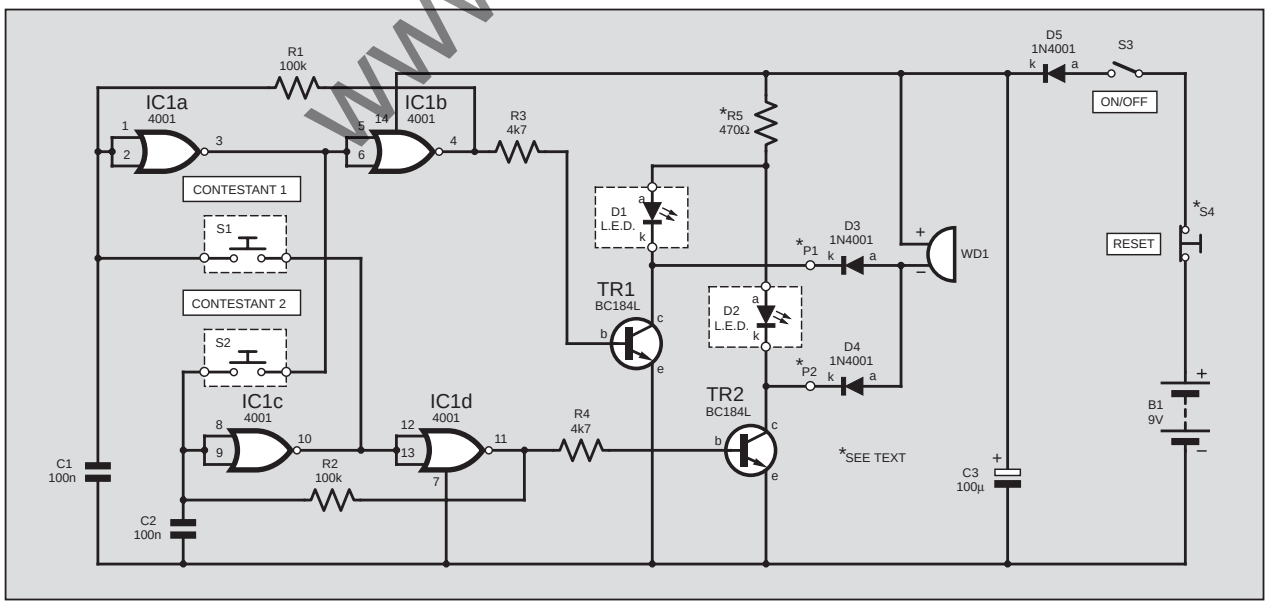


Fig.2. Complete circuit diagram for the Quiz Game Indicator. The l.e.d.s and switches S1 and S2 are housed in separate boxes.

OUTPUT DRIVERS

The output from pin 11 of IC1d is applied, via current limiting resistor R4, to the base (b) of transistor TR2, which then turns on l.e.d. D2. Similarly, output pin 4 of IC1b is connected to TR1 via resistor R3.

The buzzer, WD1, operates when either transistor is turned on, with diodes D3 and D4 used to prevent both the l.e.d.s turning on at the same moment. The single buzzer shown in Fig 2 will sound when either button is pressed.

However, provision has been made for two buzzers with different tones, in which case each of the buzzers is connected between the positive buzzer terminal (+V) and the points labelled *P1* and *P2* respectively. This will be explained fully later.

Power is provided by a 9V battery or a 9V to 12V mains power supply, and capacitor C3 is used for general decoupling. The circuit can be reset by switching off the power supply switch S3. In practice it may be helpful to wire a push-to-break switch (S4) in series with S3 to enable easy resetting. Diode D5 is included in the circuit to protect against wrong supply polarity connections.

CONSTRUCTION

To ease construction and to cut down on the chances of any wiring errors, the main circuit of the Quiz Game Indicator is built on a small printed circuit board (p.c.b.). Only the contestant switches and two l.e.d.s are not mounted on the p.c.b.

The printed circuit board topside component layout and the full size underside copper foil master are shown in Fig.3. The board is available from the *EPE PCB Service*, code 272.

Begin construction of the p.c.b. by inserting a 14-pin d.i.l. socket for IC1, followed by the smallest components such as resistors and diodes. Ensure that the diodes are inserted the correct way round; the band on the diode indicates the cathode (k) end.

The two transistors should also be inserted with care, noting that a BC184L is specified for TR1 and TR2 (a BC184, without the "L" has its leads in a different order). In practice, virtually any small *npn* transistor can be used but take care to insert the leads in the correct order.

The small capacitors C1 and C2 can be fitted either way round, but C3 must be fitted with its positive side as shown in Fig.3. Positive is generally indicated by the longer lead.

SATELLITE LINK

The l.e.d.s and push-to-make switches in the prototype have been fitted into separate satellite or "contestant" cases as shown in Fig.4 and the photographs. Four-core cable is employed to link the master unit with the satellites, and the master (on/off) switch has a Reset push-to-break pushbutton switch (S4) wired in series with it to enable easy resetting of the circuit, ready for the "next question and answer".

When connecting the l.e.d.s observe the correct polarity – the shorter lead normally indicates the cathode (k) and a "flat" usually appears on the body next to this lead. The p.c.b. contains connecting points for

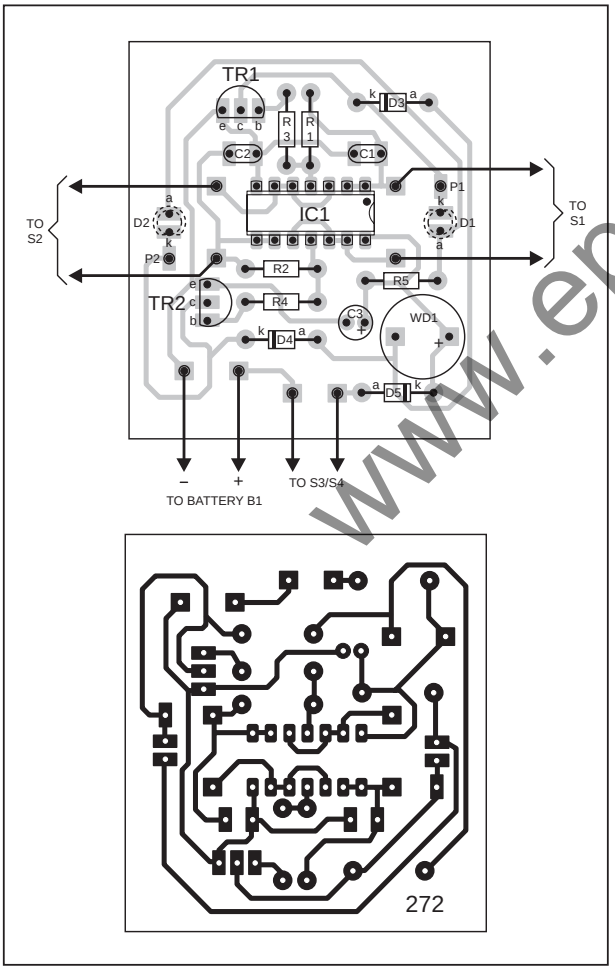


Fig.3. Printed circuit board component layout and full size copper foil master.

COMPONENTS

Resistors

R1, R2	100k (2 off)	See SHOP TALK page
R3, R4	4k7 (2 off)	
R5	470Ω (see text)	

All 0·25W 5% carbon film

Capacitors

C1, C2	100n ceramic (2 off)
C3	100μ radial elec. 25V

Semiconductors

D1	5mm red l.e.d., plus optional one (see text)
D2	5mm green l.e.d., plus optional one (see text)
D3, D4, D5	1N4001 50V 1A rect. diode (3 off)
TR1, TR2	BC184L *npn* gen. purpose transistor (2 off)
IC1	4001B CMOS quad 2-input NOR gate

Miscellaneous

S1, S2	pushbutton switch, push-to-make (2 off)
S3	min. single-pole toggle switch
S4	pushbutton switch, push-to-break (optional – see text)
WD1	3V to 20V piezo electric buzzer, p.c.b. mounting (see text)
B1	9V battery (PP3), with connector clip/leads

Printed circuit board available from the *EPE* Online store, code 272; plastic case, size 100mm x 76mm x 40mm; handheld plastic, snap together case, size 80mm x 55mm x 25mm (2 off); 14-pin d.i.l. socket; 4-core cable, length to choice; multistrand connecting wire; self-adhesive stand-off pillar, for p.c.b. mounting (4 off); solder pins; solder, etc.

Approx. Cost Guidance Only* $22.40** ***excluding cases & batts.

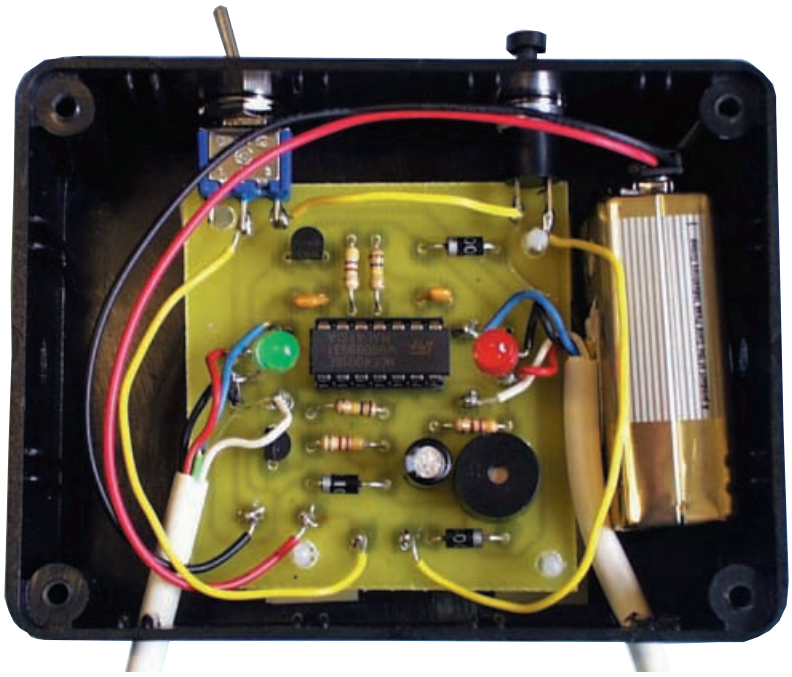
a single buzzer. If two buzzers are required, the positive side of each should be connected as shown in Fig.5, and the negative side of each buzzer connected to pins *P1* and *P2* respectively. If buzzers with different tones are obtained, the tone will indicate who pressed the button first.

When the circuit board has been completed IC1 should be inserted into its socket. Take care when handling any CMOS i.c. since it is static sensitive and may be damaged if handled without first earthing yourself by touching an earthed metal object. Note that pin 1 of the i.c. is indicated by a dot or notch; check that the i.c. is fitted the correct way round, see Fig.3.

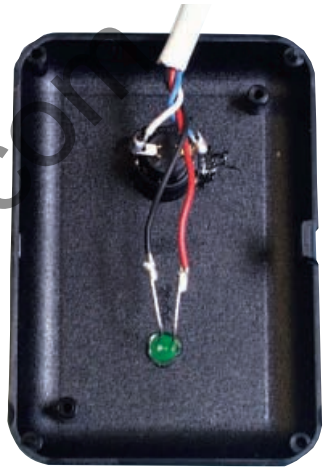
CASING-UP

The prototype Quiz Game Indicator is housed in three enclosures, a main case and two satellites as shown in the photographs. Begin preparation of the cases by drilling all the holes required for the l.e.d.s and interconnecting leads.

The satellite cases house the pushbutton switches S1 and S2 and can also house the l.e.d.s if desired, in which case four-core cable is used to link the main box with the satellites. If l.e.d.s are also required in the main box, they can be wired in parallel with l.e.d.s D1 and D2. In this case the value of resistor R5 should be reduced to say 220 ohms.



Layout of components inside the prototype master unit.



Wiring to the handset pushswitch and l.e.d.

TESTING

When power is first applied and on/off switch S3 closed, the circuit should start up in its reset state. Try pressing one of the contestant pushswitches. The appropriate l.e.d. and buzzer should activate. It should not be possible to activate the other l.e.d. once the first is lit.

Good test points are the output pins of each gate. Begin by connecting the negative lead of a voltmeter to 0V in the circuit, and use the positive lead as a probe.

Each output should be close to 0V or close to the positive rail depending upon its state. Pin 3 should always be at the opposite state to pin 4, and likewise pins 10 and 11 should be in opposite states.

If pin 4 is positive, enough current should flow through resistor R3 to activate transistor TR1. The same applies to pin 11, R4 and TR2. If the base of either transistor is above 0·6V then it should turn on.

This project should finally settle any arguments about "who pressed first" since the chances of the buttons being pressed at exactly the same moment, and hence lighting both l.e.d.s, are very remote. Although, human nature being what it is, it's no guarantee! □

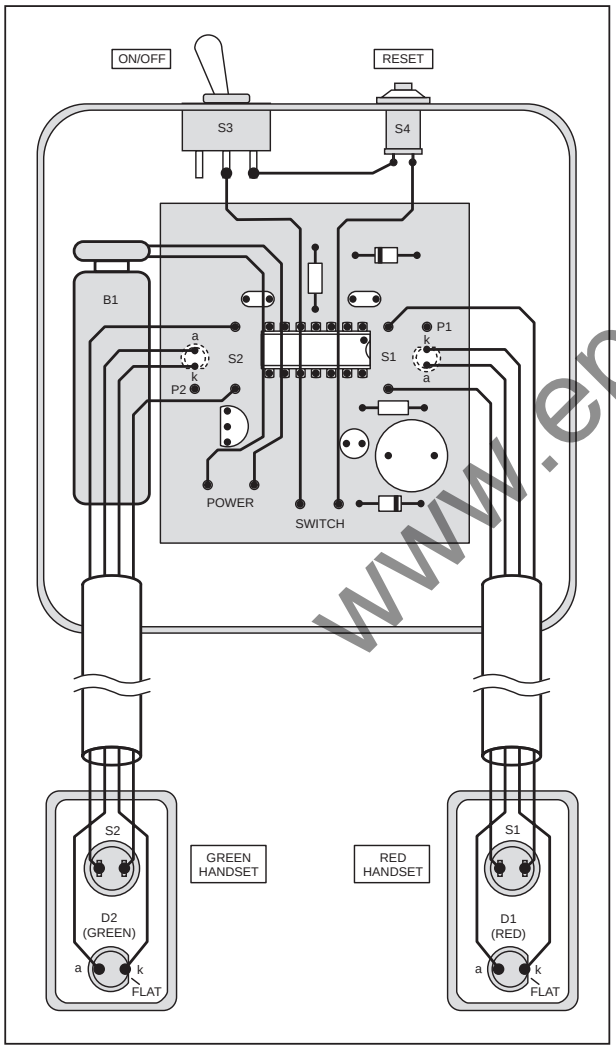


Fig.4. Interwiring between p.c.b. and the two "team" boxes. The main unit l.e.d.s are connected in parallel with l.e.d.s D1 and D2.

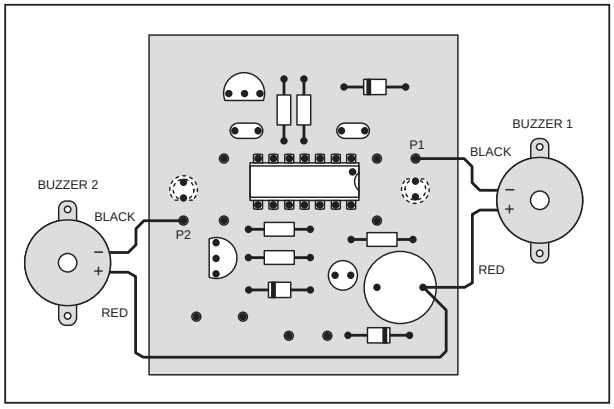


Fig.5. Wiring arrangement for the inclusion of two buzzers.