Reaction Tester

Here's a 'game' project, adapted from a design sent to us by a reader. It provides a novel way of testing your reactions — and it's fun, too!

THERE ARE ONLY a limited number of ways you can use a 4017 and a 555. Or so we thought.

We used to think that the stockpile of possible ways of combining the two ICs had been exhausted until we opened the mail one morning and saw this ingenious idea for an electronic game from A. Trafford (see Fig. 1).

The game has, as its main feature, a row of coloured LEDs. When you switch on; the bottom LED lights up, ready for play. When the 'GO' button is pressed the light moves up the row. The idea is to get the light as far up the row as possible — the higher up the row, the higher your score — but not past LED5. You see, LED5 gives maximum score (+20 points) and if the light goes further up than this you lose points.

Finally, if the light goes further then LED9 (-20 points) another LED (LED10—LOSE) lights up, and stays on until you reset the game.

Now, as far as we're concerned, this game must definitely be the very last way that these two ICs can possibly be used together — or do you know different?

Construction

Following the printed circuit board (PCB) overlay details in Fig. 2, insert and solder all components into the board, starting with the low-level components (ie, resistors, IC sockets). Solder in PCB pins at all connection points.

Next, insert and solder the two capacitors making sure capacitor C1 is the right way round.

Push the two ICs into their sockets, and insert and solder the thyristor SCR1 into place making sure that the polarity of all semiconductors is correct.

Now, mark and drill the case for switch SW2 and fit it into position.

Using double-sided, self-adhesive pads, stick the 9V battery and the PCB to the bottom of the case.

Finally, wire up your project, following the connection details of Fig. 2. A tip to help prevent your project becoming a 'bird's nest' is to wire each switch or push-button separately, twisting the leads before soldering. Similarly the 11 wires connecting the PCB to the LEDs should be twisted together.

PARTS LIST

RESISTORS (All ¼W, 5%)

R1	2k2
R2,7	10k
R3	18k
R4	27k
R5	39k
R6	47k
R8	22k
R9	820R
R10	470R

CAPACITORS

C1	1u, 10V electrolytic
C2	100n polyester

SEMICONDUCTORS

IC1	555 timer
IC2	4017 counter
SCR1	C103 thyristor
LED1-4	0.2" green LEDs
LED5	0.2" orange LED
LED6-9	0.2" yellow LEDs
LED10	0.2" red LED

MISCELLANEOUS

SW1	single-pole, six-way rotary switch
SW2	single-pole, double-throw biased toggle switch
SW3	single-pole, single-throw toggle switch
PB1	single-pole, push-to-make release-to-break switch
Case to suit	
Knob to suit	
Battery + clip	

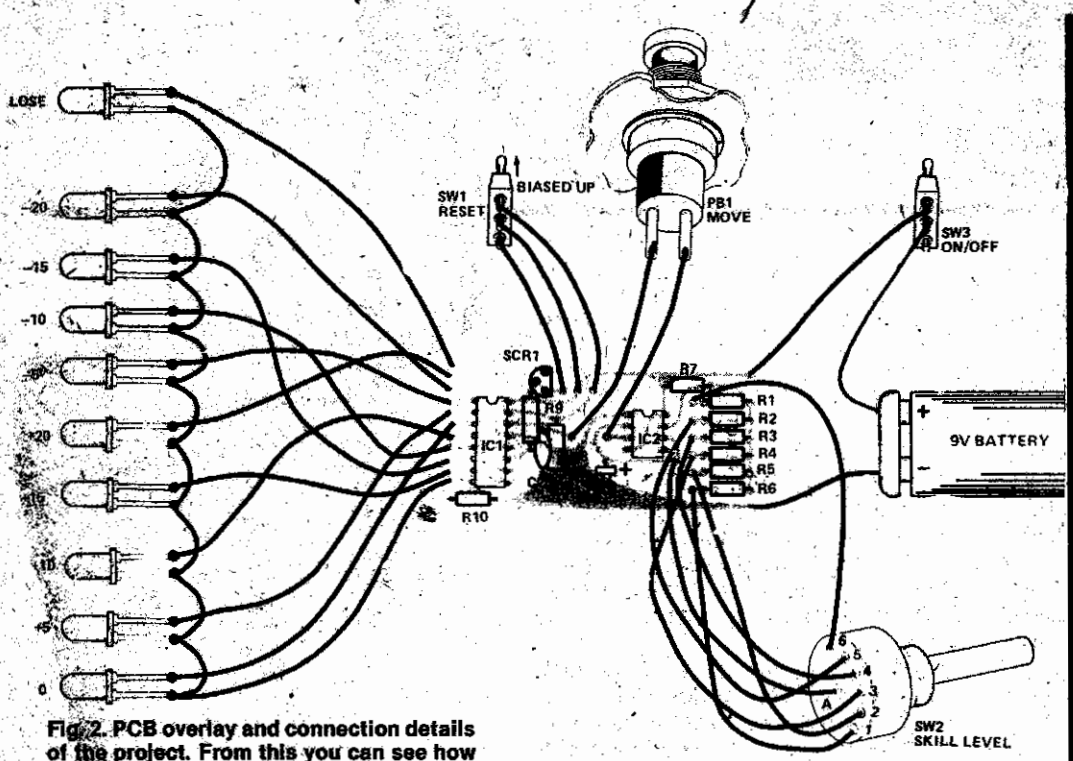
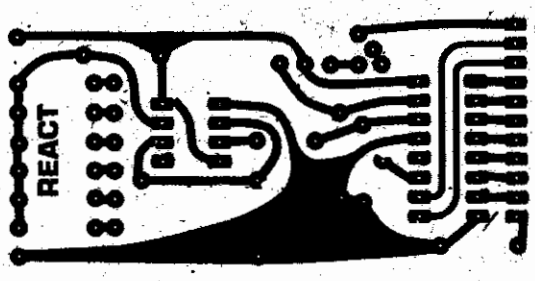


Fig. 2. PCB overlay and connection details of the project. From this you can see how one terminal of each LED (ie, their cathodes) are commoned and connected to resistor R10.



PCB pattern for Reaction Tester Game

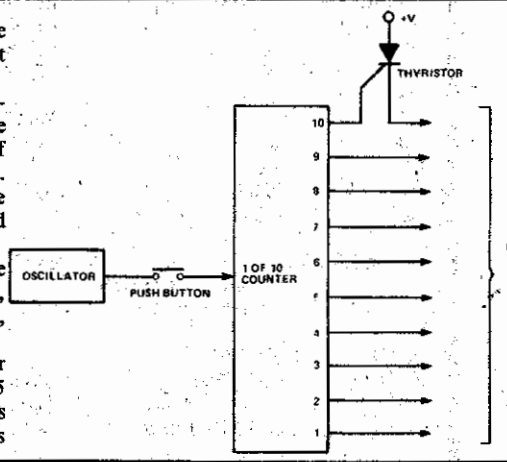
HOW IT WORKS

An oscillator formed by an astable multivibrator continually oscillates at a set frequency.

Pressing the push-button connects the output of the oscillator to the input of a counter, the outputs of which are connected to a row of LEDs. On every positive pulse from the oscillator the counter counts on and lights the next LED.

When the '10' output of the counter turns on it fires a thyristor, which holds LED 10 on, permanently, until power is disconnected.

The astable multivibrator oscillator is configured round a 555 timer. The frequency of oscillation is determined by one of the resistors R1-6, and the chosen resistor is switched into circuit by a switch SW1.



A 4017 (IC2) is used as a '1 of 10 counter' and every time push-button PB1 is pressed, the 4017 counts the output pulses of the 555 oscillator. The first nine outputs of the counter directly drive LEDs which give an indication of the state of the count.

Output 10 is connected to the gate of thyristor SCR1 thereby turning on the thyristor on the count of 10. This thyristor drives LED 10, the LOSE indicator.

Switch SW2 disconnects power from the thyristor, thus turning off LED 10, and also resets the counter to a zero count.

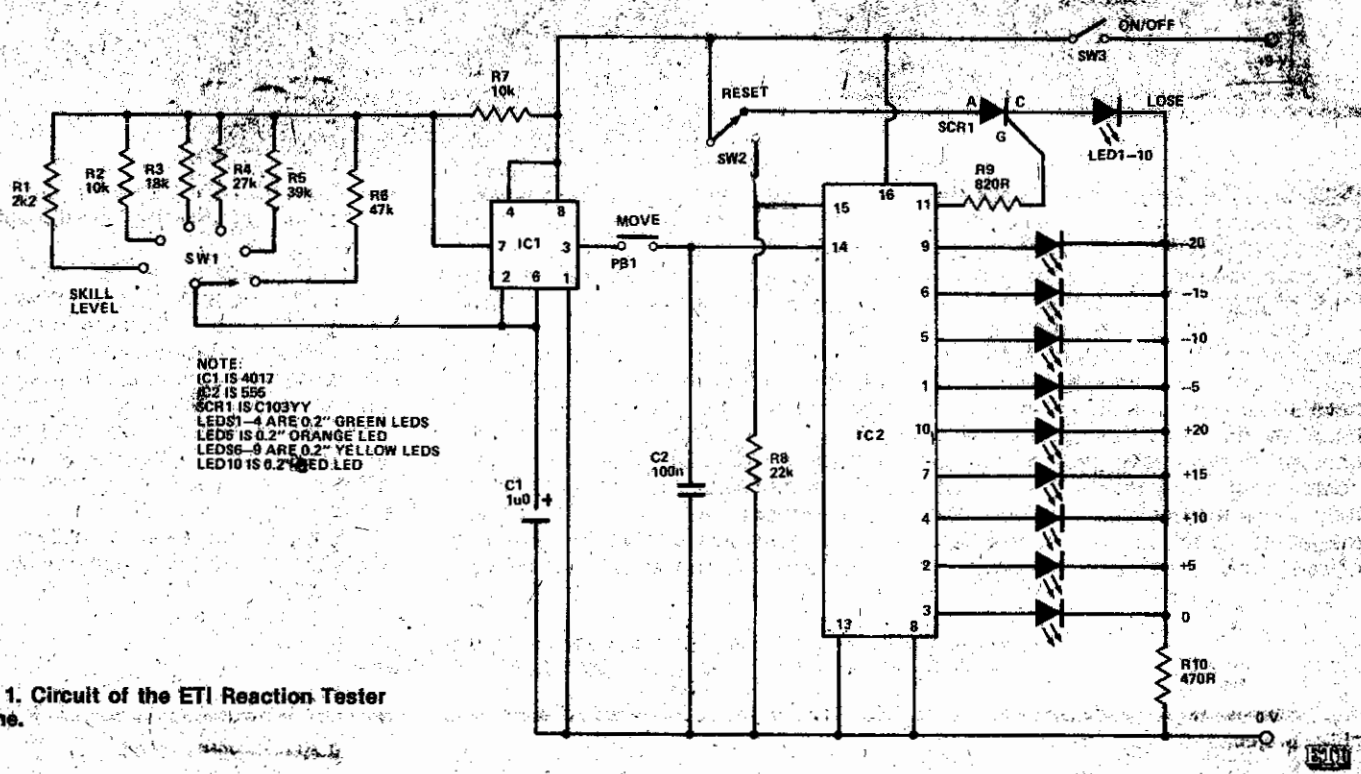
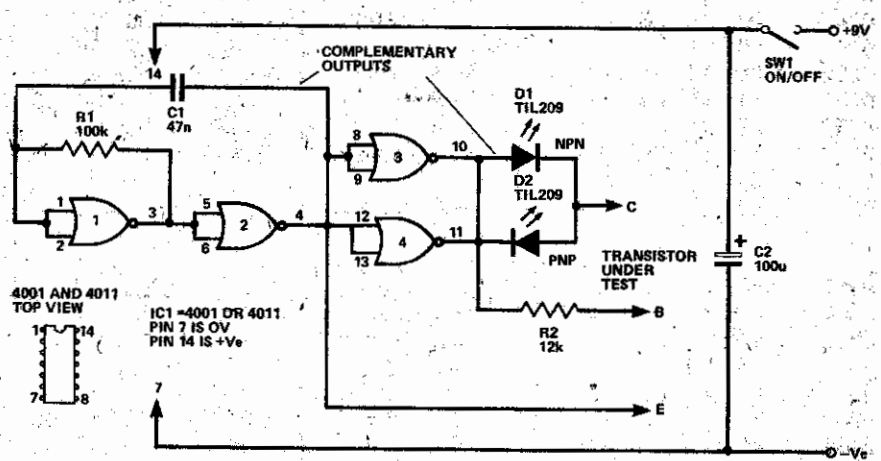


Fig. 1. Circuit of the ETI Reaction Tester Game.

Designer Circuits

QUICK TRANSISTOR CHECKER



This very simple and inexpensive circuit is not designed to measure any transistor performance figures, but is intended for quick testing to show whether or not the test device is functional. The basic method of testing a transistor is to first connect a supply to its emitter and collector terminals and check that no significant current flows. If the base terminal is then given a small forward bias, this will be amplified in the form of a large collector-emitter current.

This circuit is based on a CMOS quad 2 input NAND or NOR gate IC. Either type is suitable as each gate has its two inputs connected together so that it acts as an inverter. The first two inverters are used in conjunction with R1 and C1 as a conventional CMOS oscillator operating at a frequency of a few hundred Hz. The other two inverters are connected in parallel, and fed from the output of the oscillator so that they provide a complementary output. In other words, one output will be positive and the other will be negative except during the brief periods when the outputs change state.

The collector and emitter of the transistor are fed from the outputs via D1 and D2, and the base is fed from one output via R2. If we assume that an NPN device is being tested, when gate 2 output is positive and the other output is negative, the transistor will not be forward biased by R2 (it will be reverse biased in fact) and it should pass no significant collector current. If it is a short circuit device and does pass such a current, this will pass through D2 which will light up and indicate the fault. When the outputs are in the opposite states, the transistor will be forward biased by R2 and should conduct heavily, causing D1 to pass a current and light up. Failure of D1 to come on indicates an open circuit or very low gain device. PNP devices operate with the opposite polarity, and so when testing one of these it is D2 that should switch on, and D1 which should remain off.

Summary

One LED on = functional device, type (ie PNP/NPN) as indicated.
Both LEDs on = short circuited device.
No LEDs on = open circuit or very low gain device.
Diode or rectifier testing (anode to collector, cathode to emitter).
D1 on = functional device.
D2 on = connected with wrong polarity.
Both LEDs on = short circuited device.
No LEDs on = open circuit device.