Project 141

LOGIC TRIGGER

Debug complex logic circuitry with this unit.

WHEN USING AN oscilloscope to examine or fault find digital circuitry, it is often desirable to see what happens just before a pulse or edge occurs. An example of this is when measuring the propagation delay in a ripple counter. Here it is easy to trigger on the last output but the edge of the counter input which initiated the change in the output may have occurred over 100 ns earlier. Even with the delay line built into modern oscilloscopes the edge is too early to see.

Triggering on the input waveform allows this edge to be seen but if the output pulse occurs only once every thousand or so pulses it will not be seen. With this unit, the output of all the stages in the divider can be examined and a pulse can be generated anywhere in the cycle. By selecting a pulse very close to, but before, the edge in question and using it to trigger the oscilloscope (use ext trigger) both the clock waveform and output waveform can be seen.

With the advent of microprocessors it has become increasingly difficult to fault find as things happen (e.g. the CE input to a memory may go low) only when a particular address is given. As the address bus is always in motion it is almost impossible to trigger the scope on any one address. Again with this unit the address bus is interrogated along with the necessary write or read lines, and its output can be used to trigger the oscilloscope only when the correct sequencer is received.

SPECIFICATION - ETI 141

Modes	Asynchronous or synchronous
No. of inputs	12 address, 1 clock
Loading	
address	0.4 UL (TTL)
clock	0.4 UL (TTL)
Pulse extension mono	10 ms
Pulse indication	LED
Minimum pulse detectable	<40 ns
Propagation delay	<45 ns
Trigger (synchronous)	positive or negative edge of clock input
Set up time (synchronous) address to clock	<40 ns
Output	logical "1" when input agrees with switch setting and/or clock (synchronous only)
Power requriement	+5V @ 50 mA

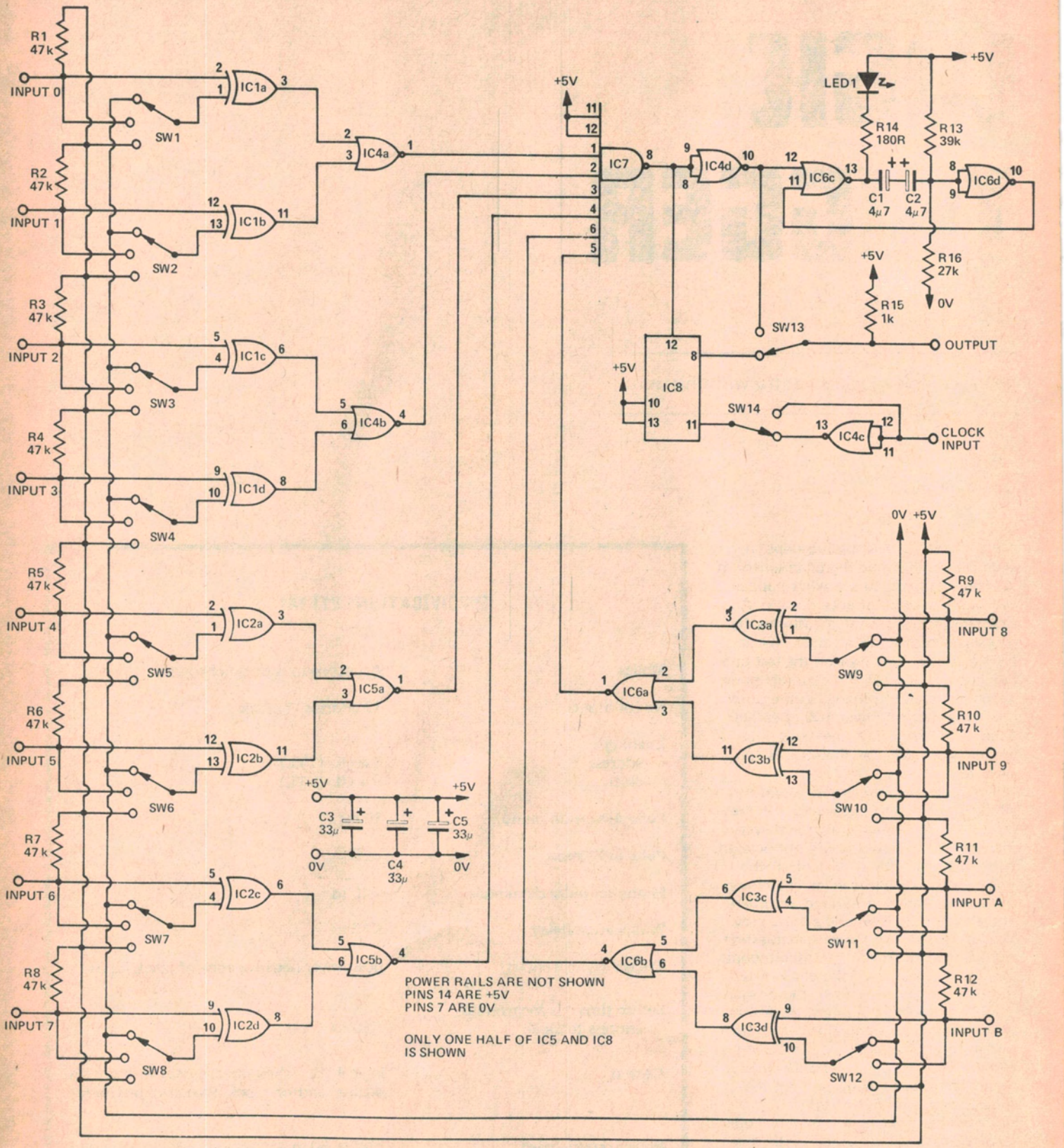


Fig. 1. Circuit diagram of the Logic Trigger.

PARTS LIST – ETI 141

Resistors all ½ W, 5%
R1–R12 . . . . 47k
R13. . . . . 39k
R14. . . . . 180R
R15. . . . . 1k
R16. . . . . 27k

Capacitors
C1,2 . . . . . 4μ7 25V electro
C3–C5 . . . . . 33μ 16V tantalum

Semiconductors
IC1–IC3 . . . . 74LS86
IC4–IC6 . . . . 74LS02
IC7 . . . . . 74LS30
IC8 . . . . . 74LS74
LED 1 . . . . . Red LED

Miscelaneous
PC board ETI 141
Twelve 3 position slide switches
Two 2 position slide switches
Front panel
Box to suit

HOW IT WORKS - ETI 141

The twelve inputs are compared to the levels set on the slide switches SW1-SW12 by the exclusive OR gates IC1-IC3. These ICs have a high output only if the two inputs differ. If they are the same, either both low or both high, the output will be low. If the two inputs are joined together, as when the switches are in the don't care position, the output will always be low.

The outputs from the exclusive OR gates are combined in pairs by the NOR gates IC4-IC6. If the 12 input signals match the preset selection, the output of all 6 NOR gates will be high. If any one is not in agreement with the selection one or more of the NOR gates will have a low output.

These NOR gate outputs are combined by IC7 which is an eight input NAND gate. The output of this gate will low only if all 12 inputs match. The output of this IC is inverted by IC4/d to provide the asynchronous output.

This output also triggers the monostable formed by IC6/c and IC6/d. This gives a 10 ms long pulse to light the LED indicating a pulse was received. If it is a steady state signal the LED will stay on.

The output of the NAND gate, IC7, also joins the data input of IC8 (D type flip flop). This IC is toggled on the positive edge of the clock waveform transfering the data to the output. This is the synchronous output. To allow for either positive or negative synchronization an inverter is used on the clock input and either polarity can be selected by SW13.

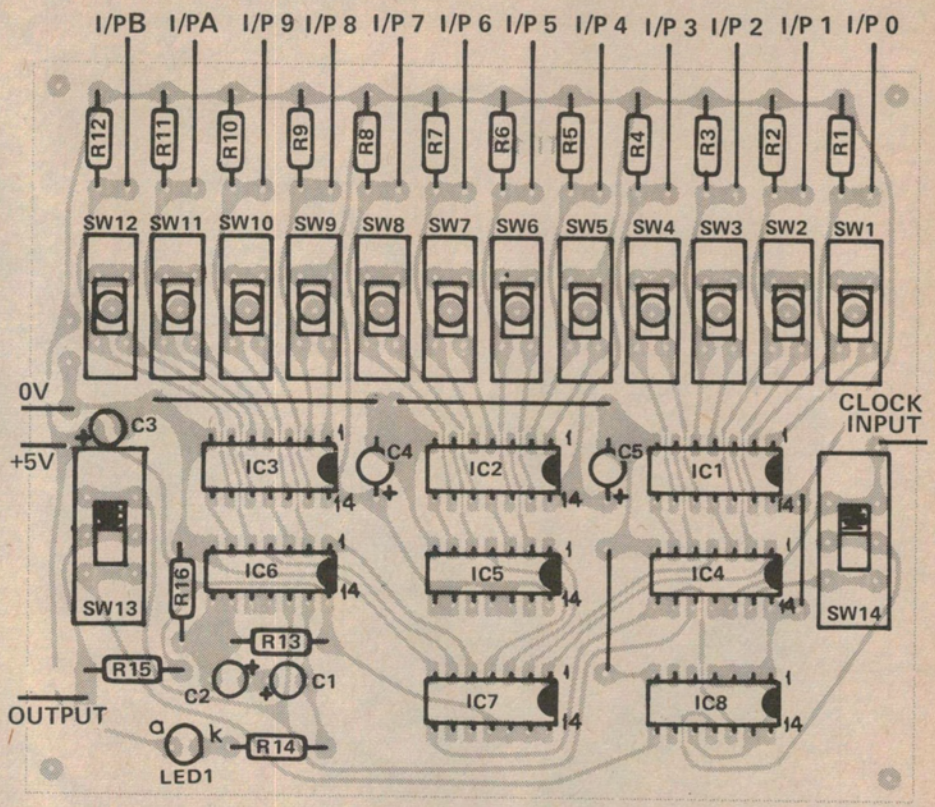


Fig. 2 Overlay of the PCB

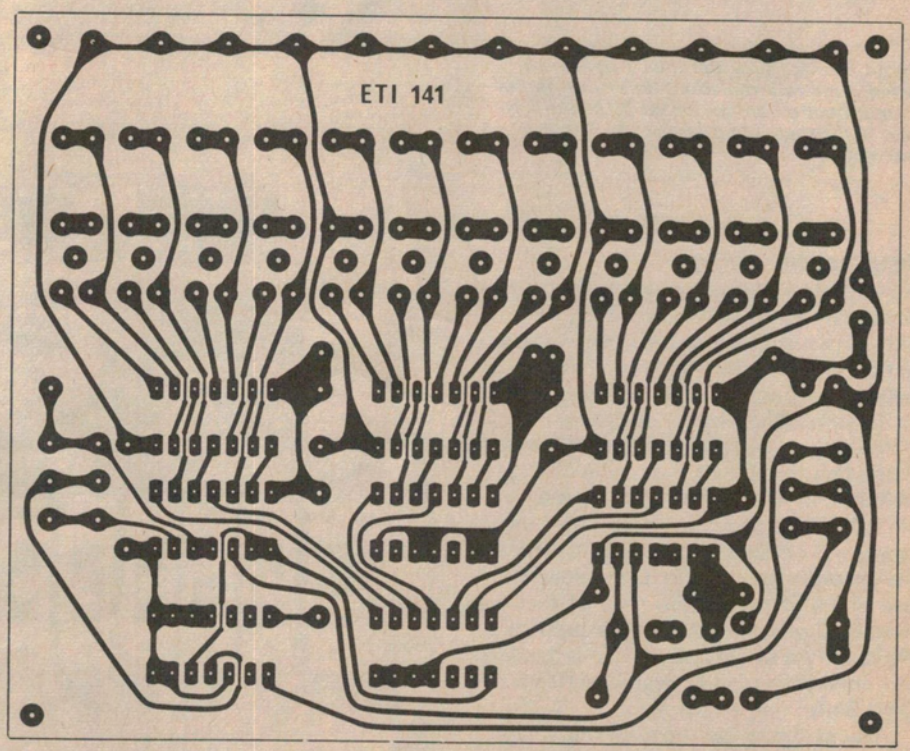


Fig. 3 PCB pattern shown full size.

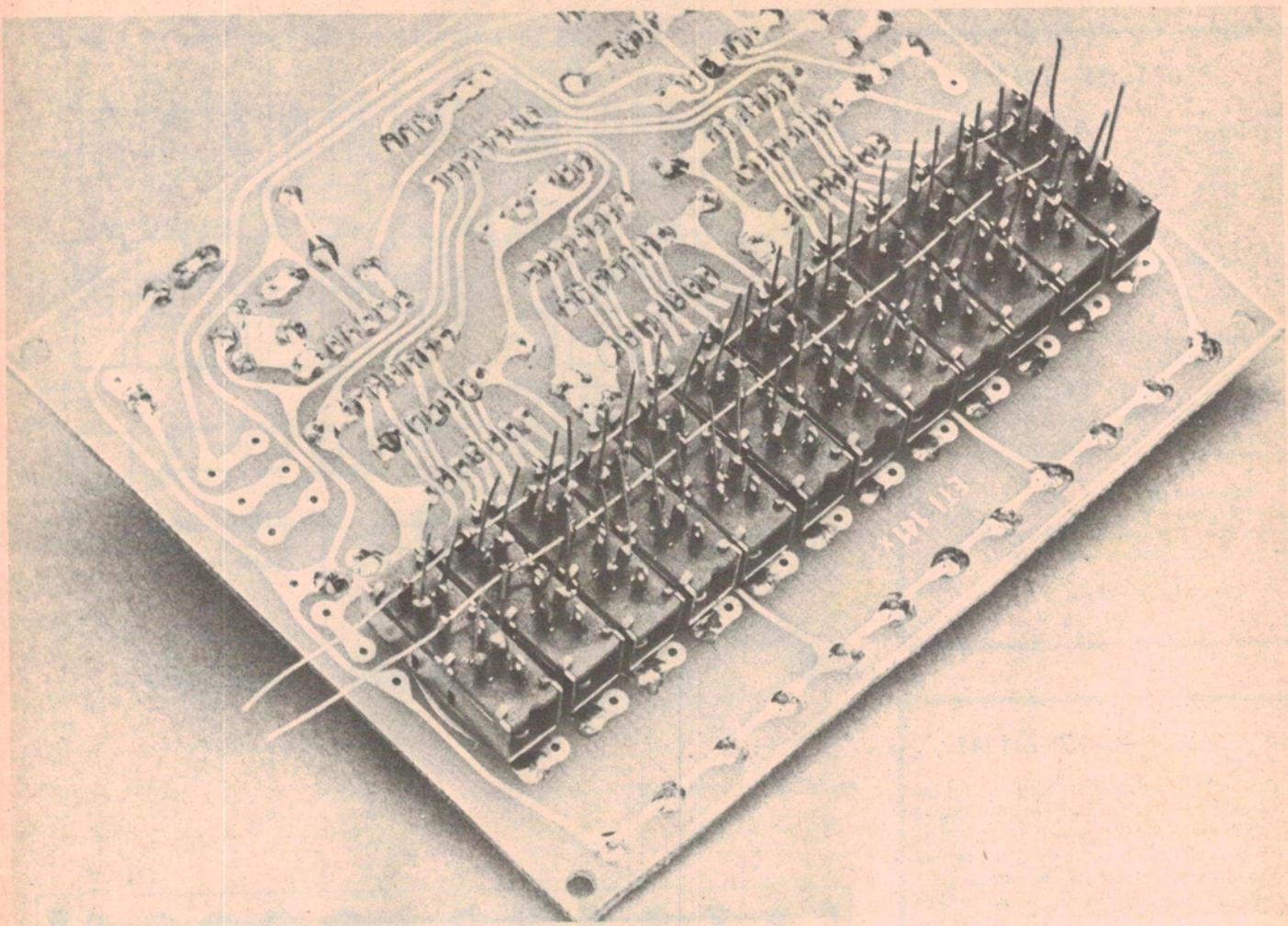
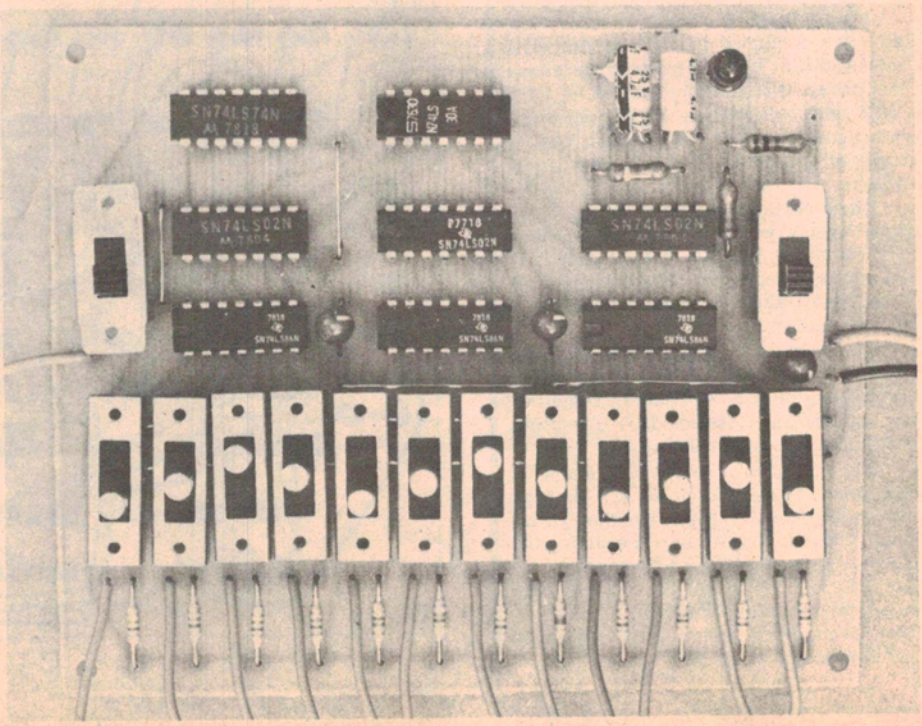


Photo showing how the slide switches are wired prior to installation. While our photo shows them on an assembled pc board it is best if they are wired before the board is assembled.



Construction

We mounted all the components on the pc board including the switches. The only difficult (fiddly) bit is the wiring of the three position slide switches which have to be preassembled before fitting to the pcb. The wiring is shown in fig.3.

To aid this we have provided 12 holes in the pcb the size of the toggle of the switches; if the switches are initially placed upside down in these holes the board will act as a template to provide the correct spacing. We have also used two wires of the second pole of the switch to provide mechanical support. While only a single pole switch is needed the only ones readily available (from Dick Smith) are two pole.

The swtiches can now be mated to the pc board with the two longitudinal wires being terminated in the holes provided at the end of the switch bank.