dil led probe

The use of digital ICs has increased over the years to such an extent that by now on average four to five ICs are used in a relatively small circuit. This does not make trouble shooting any easier; for this reason a universal tester was designed which can be used for testing ICs under operating conditions. The probe discussed in this article is suitable for testing 14- and 16-pin dual-in-line ICs.

Although in principle the probe is suitable for TTL- DTL- and cos/mos ICs, it is not recommended for use with the latter. In the first place the supply voltage for cos/mos ICs covers too wide a range (between 3 V and 15 V). In the second place many cos/mos ICs can only deliver (or sink) a very small load current, so that the digital IC-probe may give erratic indications.

If the probe is to be used universally for DTL- and TTL-ICs, several requirements will have to be met. For ease of use, the probe must be able to function without an extra power supply. TTL- and DTL-ICs have a supply voltage between about 4.75 V and 5.25 V – apart from a few exceptions. This supply voltage for the IC under test must also provide the supply for the probe itself. The complete probe should draw as little power as possible from the IC under test, in order not to disturb the functioning of the circuit. In the design this has been achieved by using buffer ICs which ensure that the IC under test is hardly loaded, apart from the supply.

The best way to obtain a simple test procedure is to have two rows of LEDs on the probe, each one corresponding to one pin of the IC under test. Each LED will light up if the corresponding pin is at the '1' level. Consequently, a dark LED indicates that the pin is at '0' level.

The supply

Certain problems arise from the requirement that the probe must be fed from the IC under test. The supply is not always at the same pin; for 14-pin ICs and 16-pin versions there is a certain amount of standardisation, but with so many exceptions that the probe must be able to locate the supply connections on any of the 14 or 16 pins. In its simplest form a 'supply finder' can be made as shown in figure 1. If in this figure point X has a positive voltage, this voltage will also be available on point A. A zero potential at point X will be passed on to point B.

Because there can be up to 16 IC pins from which the supply must be found, the circuit of figure 1 must be repeated 16 times.

Figure 1. A single 'supply finder'.

Figure 2. A supply locator with three inputs.

Figure 3. A single supply locator with corresponding LED indicator.

Figure 4. A complete supply locator with inverter and LED, of which 16 are needed.

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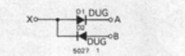

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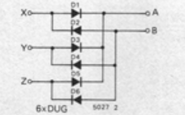

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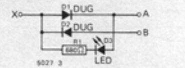

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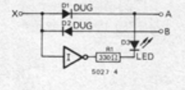

To clarify matters, figure 2 shows a 'supply locator' with three connections (X, Y and Z). If on one of these connections, say X, there is a positive voltage, whereas point Y is at zero potential, the given supply voltage between X and Y is also available at points A and B. Because of the diodes, the voltage between the points A and B is twice the diode threshold lower than the voltage between X and Y. To keep this voltage drop at a minimum, it is better to use germanium diodes (DUG) than silicon types (DUS). Since a '1' is always somewhat lower than the supply voltage (and a '0' higher than the 'actual zero'), a logic level will hardly contribute to the supply current for the probe. This implies (figure 2) that a logic level at point Z is scarcely loaded by the supply.

Read out

The logic levels are read out with LEDs. Figure 3 shows how this could be done. TTL- and DTL-ICs can handle the highest currents at an output '0'. It is therefore recommended to have the LED light up at a '0'. To keep the overall power consumption of the probe within reasonable limits, the LED (D_3) of figure 3 draws no more than about 4 mA. This is sufficient to obtain a good optical indication. However, 4 mA is too high a load for some IC outputs. Furthermore, the abovementioned '0' indication is less atrractive. Both problems can be solved by adding an inverter to the circuit of figure 3. Figure 4 shows a complete indicator stage, 16 of which are used. In this figure, I is the inverter mentioned. The result of the circuit according to figure 4 is a lower IC loading (about 1.5 mA per connecting pin) and a LED indication at '1'.

Owing to the TTL/DTL properties, inverter I (figure 4) also ensures that the LED regards an unconnected pin as a '1'. This is the case, for instance, if a 14-pin IC is tested: the two remaining vacant pins cause their LEDs to light up.

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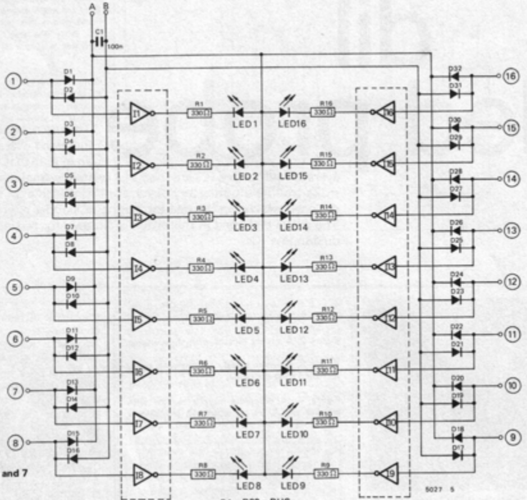

Parts list for figures 5 and 7

R_1 ..... R_{16} = 330Ω
C_1 = 100n, low inductance type
D_1 .... D_{32} = DUG (or DUS)
LED_1 .... LED_{16} = any type
IC_1,IC_2,IC_3 = 7405

D1 ... D32 = DUG
I1,2,3,6,7,8 = IC1
I4,5,12,13 = 2/3 IC2
I9,10,11,14,15,16 = IC3
IC1,IC2,IC3 = 7405

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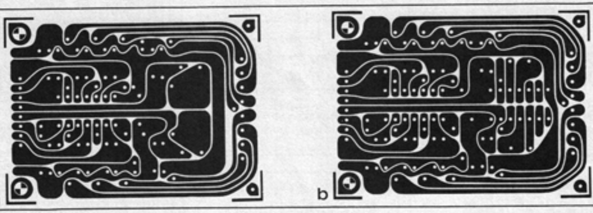

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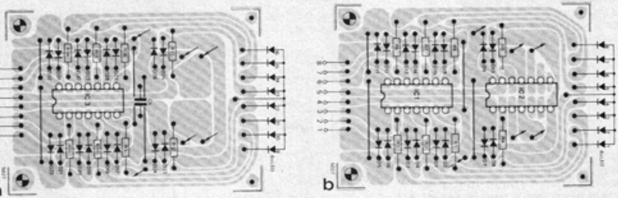

a b

Figure 5. The complete circuit diagram of a digital IC probe.

Figure 6. The lay-outs of the printed circuit boards A and B for the probe.

Figure 7. The boards A and B with the component arrangement for the circuit of figure 5.

Figure 8. Photograph of a complete digiprobe.

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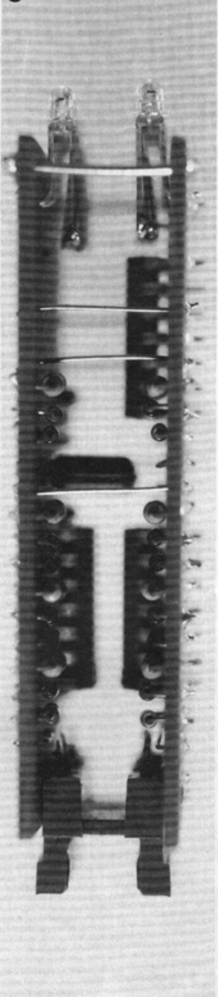

The complete tester

Figure 5 shows the circuit diagram of the complete digital probe. Some 32 diodes (D_1 ... D_{32}) are needed for the voltage probe. For the 16 inverters use is made of three TTL-ICs, type 7405. Each 7405 contains six inverters, so that two inverters remain unused. The encircled codings in figure 5 represent the connecting pins of the IC probe. Points A and B are the supply and common for the three 7405 ICs.

The printed circuit boards

Figure 6 gives the lay-out of the two p.c. boards for the circuit of figure 5. The component arrangements for this circuit are shown in figure 7. Board A carries only one IC. This board accommodates the circuit section for pins 1 ... 8. After assembly the boards are connected back-to-back. This is illustrated in figure 8, showing a photograph of the complete probe. As the figure shows, the p.c. boards are placed with the component sides facing each other. A 16-pin connector is provided between them. The so-called pick-a-back connector shown is made by Electrosil.

As shown in the figure, the anodes of the LEDs are coupled together and connected to points G and G′ respectively. The points A ... F on board A are electrically connected with the corresponding points on board B (so: A with A′, B with B′ ...). If this is done with stiff copper wire, the sandwiched assembly will be fairly sturdy.

The opposing corner holes of the p.c. boards are also joined by means of rigid copper wire.