Simple tester for digital ICs

A small unit which combines a power supply, an IC socket with LED indicators to indicate logic levels at the device pins, and a simple test signal generator. Low in cost and easily built, it makes an ideal test jig for the experimenter working with digital ICs.

by R. K. LAIRD*

The simple digital IC tester shown has been of great assistance to the author in designing and debugging digital projects using TTL devices. It can be used to familiarise yourself with the functions of a new device, to test a used device suspected of being faulty, to check the operation of circuits built up around single ICs (such as different types of clock oscillator), and to connect a "forgotten" IC temporarily into a larger circuit. It will also serve as a small logic trainer, to help in teaching yourself the concepts of digital circuit operation.

Although the tester itself has only one IC socket, its power supply is capable of supplying current to quite a number of devices, so that it can be used to check more elaborate setups if required. The power supply output is made available via a small jack socket for this purpose.

Interconnections between the IC under test, the power supply and the test signal generator section are made by means of standard banana plugs and sockets. I have made up a set of ten leads, which seem to be quite sufficient for most purposes. Eight of the leads are single wires with a plug at each end, from 6 to 9 inches long; the other two leads are of the double type, with a common banana plug in the centre joined to two others via leads again 6-9in long.

The power supply uses a three-terminal 5V regulator IC made by National Semiconductor, the LM309K, which is capable of providing output currents in excess of 1A. It is short-circuit proof, and if adequately heatsunk can operate from input voltages anywhere from 7V to 37V. I have used a transformer with a 25V centre-tapped secondary, and two 1A silicon diodes in a standard full-wave rectifier feeding into a 2200uF / 18VW reservoir electro. This has proved to be quite adequate.

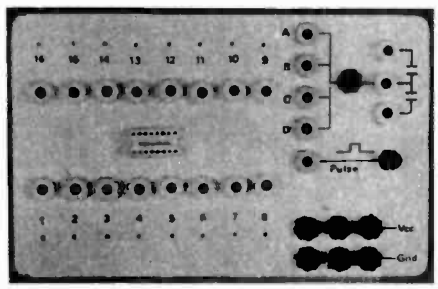
The IC holder is a standard 16-pin dual in line socket, many of which are available. It should be of the type capable of being bolted to the front panel of the box used, and preferably one which allows an IC to be inserted and removed easily without damage to the pins.

Each of the pins of the socket is connected to a banana socket and also to an LED for monitoring the logic level. The LEDs have the usual current limiting resistors fitted in series, and in order to reduce loading of the IC terminals, all of the LEDs are switched on and off rapidly with a short duty cycle, rather than operated continuously. Visually this actually improves the subjective brightness, while the current consumption and loading are very much reduced.

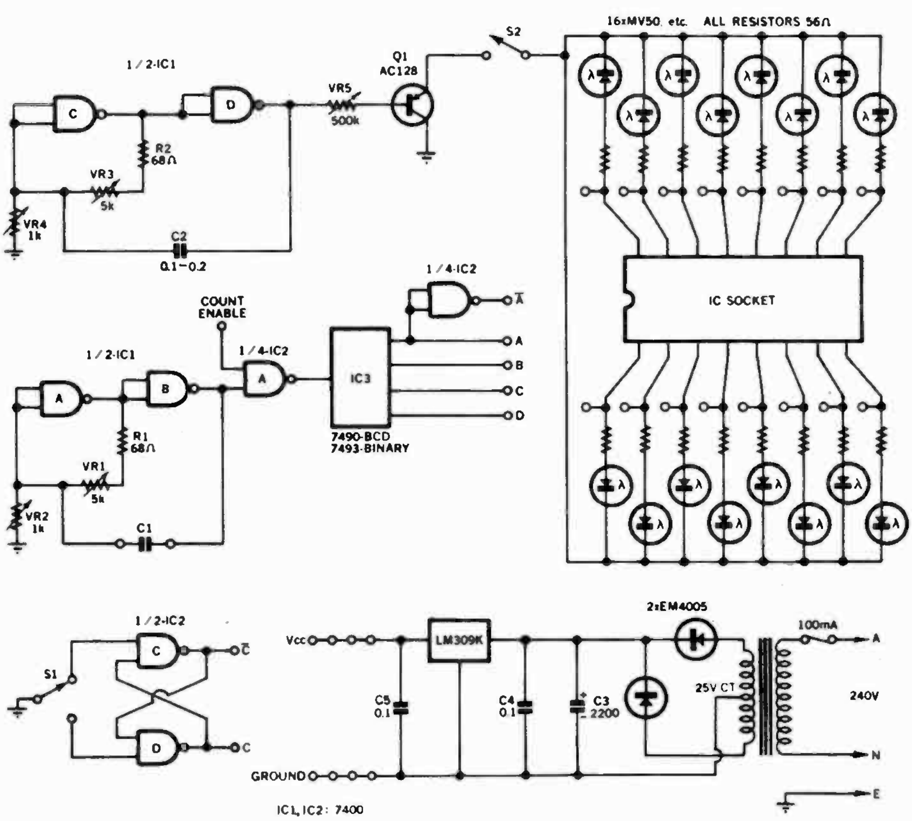
In the prototype unit pictured I used Monsanto MV50 LEDs, which are one of the cheapest devices available. However they are very small, which makes mounting something of a problem, and they are also rather fragile. Since making the first unit I have used the NSL5023 and the NSL100 devices from NS Electronics, which are easier to handle; they also have mounting clips which are free on request.

The oscillator which pulses the LEDs via the AC128 current gating transistor is a simple circuit using half of a low-cost quad two-input gate such as the 7400. It is frequency adjustable, which allows the duty cycle to be adjusted for optimum subjective brightness from the LEDs. Although I have not actually fitted it to the prototype unit, the circuit shows a switch (S2) fitted in series with the AC128 to allow the LEDs to be turned off altogether. This is worthwhile, as the LEDs can tend to degrade the performance of some ICs at high speeds.

The circuitry which produces the test signals is very simple, yet it seems to be quite adequate. There is a simple pushbutton pulser, using a miniature pushbutton switch with an RS flip-flop made from two 2-



At right is the author's prototype IC tester, while below is its full circuit schematic.



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input gates for bounce suppression. The gates are provided by half of another 7400 or similar. The other test signals are provided by an oscillator like that used for the LED pulsing, together with a divider to produce submultiples of the oscillator frequency. The divider may be either a 7490 for BCD division, or a 7493 or similar for straight binary; the idea is to produce signals which may be used to test decoders and similar devices.

A choice of oscillator capacitors is provided, to allow the rate to be adjusted from less than one hertz to about 15MHz. I used banana sockets for the range selection, but a switch would be somewhat neater and perhaps more convenient. A gate is connected between the oscillator and the divider IC, to allow gating the outputs if required; if the second input of the gate is connected to ground, the oscillator output will be prevented from reaching the divider. Conversely leaving it open or connecting it to the positive rail will allow the divider to operate.

Note that for added flexibility I have made both outputs of the pushbutton flip-flop available via banana sockets, so that both "normally high" and "normally low" outputs may be used. Similarly the divider IC has a complementary output available from the first divider stage, and this too is made available.

The prototype unit was built in a small diecast aluminium box, which was then painted. The LM309K should be mounted on a reasonably good heat-sink, and this may well be the case if this is of metal. Note that the 0.1uF parasitic stopper capacitors should be wired directly between the input and output pins of the device and earth, respectively.

The layout of the unit is probably not very critical, and may be varied to suit your requirements and taste. I designed a small printed board to take most of the wiring and the ICs, but you could easily wire them up on a length of miniature resistor panel or a piece of Veroboard.

When the wiring is completed, turn VR1, VR3 and VR5 to maximum resistance and make sure S2 is in the off position. Turn the power on, and check that the regulator output is 5V. If it is not, you may have the rectifier output connected to the LM309K with the wrong polarity, so switch off immediately and check. If any of the other ICs gets hot, switch off and make sure that you haven't connected it into circuit the wrong way around.

Adjust VR4 until the LED pulsing oscillator is working, as monitored using a CRO or a high impedance earphone. Now switch on S2 and connect a lead between one of the test IC banana sockets and a Vcc supply socket (+5V). Then reduce the value of VR5 until the LED connected to the test socket pin glows, checking that the pulsing oscillator is still working. Now switch off S2, and connect a milliammeter across it, adjusting VR3 and VR5 for minimum current. This should be around 20mA or less. Finally remove the meter, switch S2 back on and try each of the LEDs in turn to check that they glow equally.

The test signal oscillator is adjusted in much the same way. VR1 is the main frequency range control, while VR2 is used to adjust the oscillator's operation so that

(Continued on Page 125)

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ANSWERS from P 123

work on the circuit, we could not commit ourselves to nominating the type of LED and the associated modifications.

BOARDS IN NZ: Could you please tell me if there is a New Zealand supplier of printed boards — specifically the 72 sa10 used in the Playmaster 136. (W.K. Marton, NZ).

We know of at least two manufacturers in NZ, one in each island. In Auckland, there is the Mini Tech Manufacturing Co, PO Box 9194, Newmarket; and in the south try Printed Circuits Ltd, PO Box 2193, Christchurch.

VOX ALARM: Has your magazine ever described a voice or sound operated alarm using microphone input and loudspeaker output? Compliments on your magazine, especially the Elementary Electronics section. Whatever happened to the Reader Built It section? (P.S., Doonside, NSW).

A transistorised VOX (voice operated switch) intended for tape recorders was described in August 1966 (File No 1 RA 27). This could, with a little

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IC TESTER From P 55

its range of reliable oscillation is spread over the full rotation of VR1.

Use of the tester is fairly self-evident. As you use it, you will no doubt think of ways in which its usefulness may be extended by modifications and additions. You could increase its speed capability by using 74H or 74S series devices (and a suitable layout), or even perhaps ECL devices if these are your interest. You could even experiment with automating the testing of large numbers of similar ICs, using gates controlled by a program of binary numbers stored in a 64-bit semiconductor memory such as the National Semiconductor 7489.

In short, the basic tester unit shown is really only the starting point. The rest is up to the ingenuity and imagination of the reader.

Editor's Note: There are a variety of other devices available which could also be used in our contributor's circuit. Equivalents for the 7400 are the 9002, FJH131 and FLH101, while suitable LEDs would be the FLV101, FLV110, SL103, 5082-4403, OLD415 or OLD419. The Fairchild 7805 three-terminal regulator could also be used in place of the LM309K if desired.

FORUM from p 59

always to be entirely objective.

Indeed, the story of electronic ignition has not been a consistently happy one and troubles can arise both from electronic component failure and, in the vehicle, from higher amplitude ignition energy. According to experts in the automotive field such troubles are not unique to do-it-yourself or kit equipment. They occur in factory fitted vehicles.

Some of the troubles have been listed by staff writer Leo Simpson, in a separate article scheduled for the next issue.

Are these remarks aimed at killing electronic systems for good? Not particularly.

We have no vested interest either way, except to dampen down the kind of report to which our correspondent has obviously been exposed.

If readers want to go on building electronic ignition systems, that's okay by us— provided they elect to do so on objective grounds.

ELECTRICAL SAFETY From P43

for the job is also noted. For example tough rubber sheathed (T.R.S.) or thermo-plastic sheathed (T.R.S.) or thermo-plastic connections to appliances in damp places, or over conductive floors. (See SAA Wiring Rules, Part 1.)

Except where the mains plug is moulded to the power flex, this item is checked internally to see that the connections have been made correctly, and in a workmanlike manner. Older plug tops, which are no longer approved, are replaced before the equipment is returned to the owner or user.

When the outer case of the equipment is removed for repairs, a check is made to see that the mains flexible cord is correctly connected within the apparatus, and that it is securely anchored. SAA A.T.S. C 100 does not permit the expedient of knotting the flexible cord for this purpose.

(To be continued)

SERVICEMAN from p 63

delay use or installation.

Delivery department: Main complaint is failure to deliver on the day promised, or failure to notify installation department.

Installation department: Failure to arrive on the day promised, failure to check that all accessories have been supplied, failure to check that all sections of the appliance are working, or failure to properly instruct the customer on its operation.

Service department: Failure to respond rapidly in cases of faulty new equipment. Failure to arrive as promised. Failure to recognise, or acknowledge, a serious basic fault which requires factory attention, resorting instead to a "patch" or "gimmick" cure. The risk of this increases as the service responsibility is moved away from the dealer organisation.

Looking at each area separately — as those concerned with each area tend to do — it may well appear that the failures are a relatively small percentage. But when we add them all together, the chances that something will go wrong with any individual purchase starts to assume significant proportions.

What is the solution? On the industry side there is, first, a need to appreciate the magnitude of the problem, as seen by the customer. This is half the battle. From then on it is a matter of tightening up in all areas, even where the problem seems trivial. Remember, it seldom appears trivial to the customer.

On the customer's side there is plenty that can be done. First deal with what appears to be a reputable firm, even if the price is a little higher. And if things do go wrong, or you feel that you are getting the run-around, don't hesitate to complain. Go to the top and complain bitterly. Believe me, there are few general managers who can take even a small number of complaints from irate housewives, without starting a chain reaction which will go right down the line.

CORRECTION

The MS Components advertisement on p.124 of our April issue was incorrectly shown as "MS Sound" in the advertising index. There is no connection between the two companies.

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