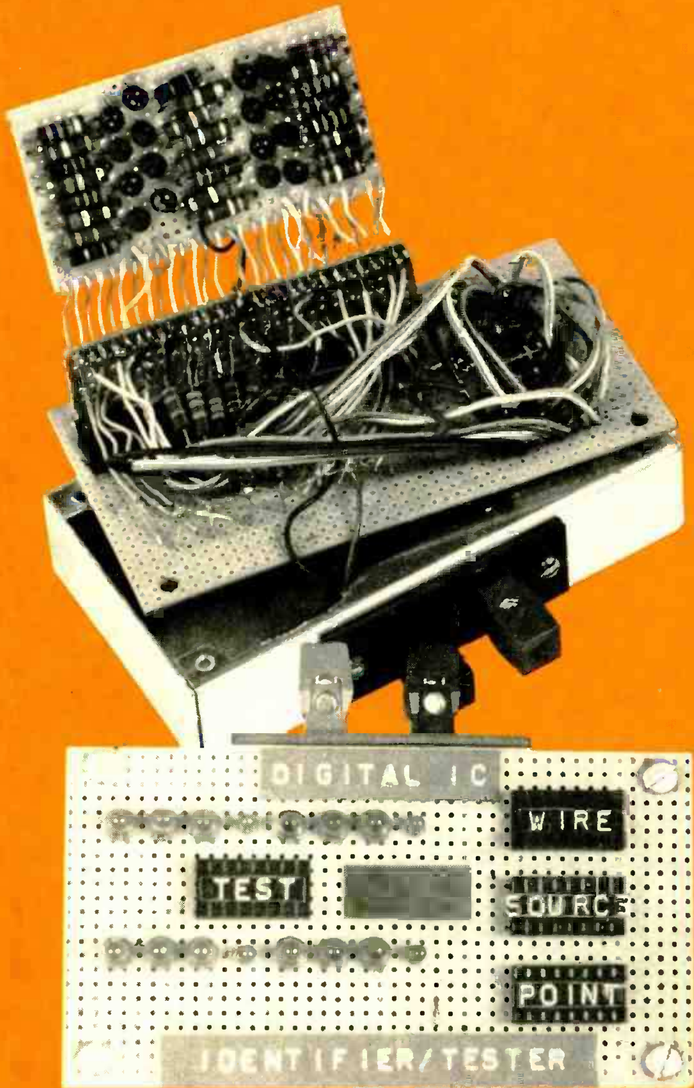

Build A Digital IC Identifier/Tester

Simple device tests digital IC's and identifies many of the unknown ones

EARL R. SAVAGE

YOU HAVE JUST FINISHED A PROJECT using digital IC's and after applying power, the darned thing just sits there or goes up in smoke! Several hours of troubleshooting leads to the discovery that one (or more) of the IC's is defective. Out comes the old soldering iron and a lot more time is wasted.

Sound familiar? Well, it happens all the time unless you pay premium prices for your IC's. This kind of trouble surely takes much of the pleasure out of building projects. But take heart—help is here. A small investment of time and money to build this Identifier/Tester will pay handsome dividends. With this instrument on your workbench, you can save your blood pressure and your money.

This easily built device will enable you to quickly and easily test any 8- 14- or 16-pin digital IC whether it is RTL, DTL, TTL, CMOS or several other types if you exercise some care. Of course, it works like a charm with the old standby TTL's. Now, instead of paying for first-quality IC's, you can buy the "cheapies" knowing that you can assort out the rejects and never again wire in a bad IC. If that is not enough for you, there is a hidden bonus in this little device.

You don't even have to buy the "cheapies"—you can buy the "super cheapies." These are the bulk packs of mixed, untested IC's of which some are marked, some are unmarked, and some are marked with factory numbers that may as well be Greek. Best of all, these IC's cost only about two cents each!

The Identifier/Tester (if you haven't already guessed) will *identify* IC's as well as test them. Actually, it will enable you to identify *many* IC's—some are simply too complex to decipher. So, you pay a couple of cents per IC and, even if you throw out two-thirds as bad or unidentifiable, that is still just six cents per IC. While that is not bad at all, the "throw-outs" run only one-third to one-half of the big economy packs.

How it works

The Identifier/Tester is really quite simple. It is nothing more than three IC sockets (labeled WIRE, TEST and POINT) connected in parallel and 16 LED indicators (Fig. 1), one indicator per socket pin. The LED indicators are transistor-driven to reduce loading on the IC being tested. This is necessary to prevent false indications and erratic operation of some IC's, which would occur if the LED's were connected directly to the pins.

Four of the LED's are smaller than the others. They correspond to pins 4, 8, 9, and 13. The purpose of having these LED's smaller (or a different color) is to make it easier to count the pin numbers.

A fourth socket is labeled SOURCE. It

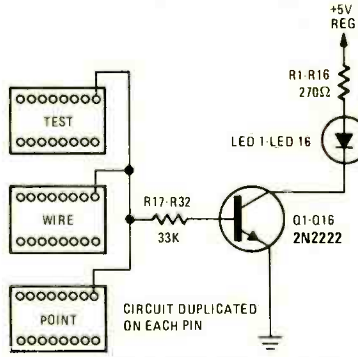

FIG. 1—IDENTIFIER/TESTER circuit. The corresponding pins on each socket are connected in parallel and connected to an LED indicator circuit.

PARTS LIST

R1-R16—270-470 ohm, 1/4 watt, 10% (see text)
R17-R32—33,000 ohm, 1/4 watt, 10%
R33—1000 ohm, 1/2 watt, 10%
R34—330 ohm, 1/2 watt, 10%
Q1-Q16—2N2222 or similar switching transistor
LED1-LED16—LED's of size and color to suit (MV5054 or equal.)
Misc.—perforated board, binding posts, four 16-pin IC sockets, 4 1/2 × 2 1/2 × 1-inch chassis.

serves as a source of four different voltages. When working with TTL's, these voltages are: HI (+5 VDC), LO (0 VDC), LO5 (+5 VDC through a 1K resistor), and HI0 (0 VDC through a 330-ohm resistor). The HI0 voltage is not used in testing but is necessary in the IC identification procedure. These voltages are wired to the pins as shown in the detail drawing of the SOURCE socket (Fig. 2).

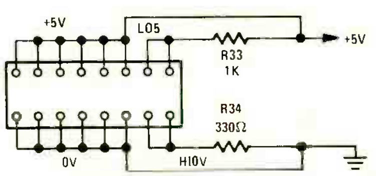

FIG. 2—LOGIC LEVELS are obtained from the front-panel source socket.

The three sockets on the right side of the panel (WIRE, SOURCE, and POINT) are not used as sockets at all. They are used as compact connectors for temporary application of voltages to the pins of the IC in the TEST socket. Though the POINT socket may be omitted, it is very convenient for making touch-and-go voltage-applications without getting mixed up with the connections already made to the WIRE socket.

Construction

Parts used in the construction of the Identifier/Tester are *not* critical. Your junk box will probably provide most of them. If not, the parts are readily available.

The LED dropping resistors should be adjusted for the general IC families that are most often encountered. The 270-ohm value shown on the schematic is best for TTL's and their 5-volt power-supply. Resistors of 390 ohms were used in the prototype in anticipation of testing higher voltage IC's. They also work fine with 5V TTL's; the LED's are just a little dimmer.

As to transistors, almost any small-signal NPN transistor will be suitable. Low cost switching transistors are ideal. The type certainly is not critical—apparently anything that will wiggle the needle on a simple transistor checker will work fine.

Point-to-point wiring was used in the prototype. It looks like a rat's nest but operates fine since there is no interaction between various parts of the circuit. A printed-circuit board could be used but that seems such a waste of effort when building only one or two.

Perforated board is used for the front panel and for mounting the resistors and transistors internally. The internal board is attached to the panel by a "wire hinge" so that it can be folded parallel to the panel. The boards were cut to fit a small chassis. A plastic box could be used as well.

The prototype was built on a chasis measuring 11.5 × 6.5 × 2.5 cm (4 1/2 × 2 1/2 × 1 inch). That is about as small as one can use with point-to-point wiring. Even with a printed-circuit board, the box should not be smaller or the instrument will be too difficult to handle conveniently.

Note that a power supply is *not* included in the prototype. For TTL's, a *regulated* positive 5 volts DC is brought in through the binding posts at the top. This arrangement permits easy use with other voltages when testing other IC families. The supply may be built-in if a larger box is used. A suitable internal or external 5-volt supply is shown in Fig. 3. It is strongly recommended that the power be regulated with one of the IC regulators that provides for both thermal and over-current shutdown. This will offer protection in cases involving shorted IC's and mistakes in wiring between the SOURCE and WIRE sockets.

POWER SUPPLY

R1—50 ohm, 10 watt, 10%
R2—270 ohm, 1/4 watt, 10%
C1—1000 μF, 35 volt DC
D1—1N4002
IC1—7805 5-volt regulator
S1—SPST switch
LED1—red LED (MV5054 or equal.)
T1—117-volt primary; 12.6-volt, 1.2-amp secondary
F1—1/2-amp fuse

When construction is completed, test the instrument as follows:

Check for continuity (ohmmeter) between corresponding pins of the TEST, WIRE, and POINT sockets.

Check for shorts between any pins on one of these three sockets.

Apply power to the device through the binding posts—*NO* LED's should turn on.

Check for proper voltage on each pin of the SOURCE socket.

Apply +5 volts from the SOURCE socket to each pin in turn on the POINT socket. The corresponding LED (only) should turn on as each pin is touched.

If any of these checks fail, remove power and correct the wiring error(s) in the instrument.

Testing digital IC's

When first using the tester, the listed steps should be followed exactly. It will be possible to take some shortcuts without too much risk after you have gained some experience.

Step 1. Remove all power from the tester.

Step 2. Insert IC into the TEST socket. IC's with less than 16 pins should always be mounted on the left end of the socket to avoid confusion in pin numbering while testing. (This is where the smaller LED's are very helpful.)

Step 3. Wire +5 volts and 0 volts to the appropriate power pins of the IC by placing jumper wires (No. 22 or 24 wire) between the SOURCE and WIRE sockets.

Step 4. Apply power to the tester.

Step 5. Quickly observe the LED's; if *all* are on, remove power and check Step 3. If Step 3 is correct, IC is shorted; discard it. If wiring change is made, return to Step 4. If V+ and some LED's (but not all) are on, proceed.

Step 6. Apply "finger test" to IC. If it is hot or warm to the touch, remove power. Check wiring and return to Step

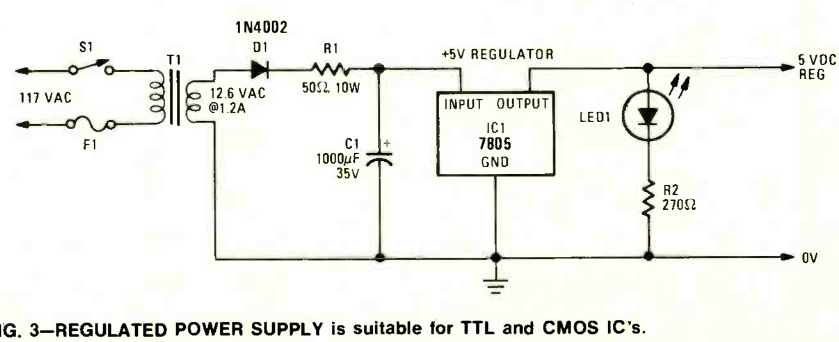

FIG. 3—REGULATED POWER SUPPLY is suitable for TTL and CMOS IC's.

4. If IC again comes up hot, there is an internal short–discard it.

Step 7. Observe the LED's. If only the LED connected to the V_{cc} pin is on, suspect an open circuit in the internal power wiring of the IC. Normally, unconnected input pins will float high and some output pins will be high, thus lighting some of the LED's. Proceed to the next several steps to confirm the open circuit before discarding the IC.

Step 8. Remove power from the tester.

Step 9. Wire 1's (+5) and 0's to the input pins (jumpers between SOURCE and WIRE) as required by the function and pinout of the IC under test.

Step 10. Wire LO5 from the SOURCE to any pins that are open collector outputs. This is a pull-up voltage which makes it possible for the LED to accurately indicate the outputs.

Step 11. Apply power.

Step 12. Observe the output pin LED's to determine whether or not they are behaving as expected.

Step 13. When testing such IC's as flip-flops, counters, registers, multivibrators and the like, it will be necessary to make and break a connection several times while observing the LED's. This is most conveniently done by just touching the wire to the proper pin on the POINT socket rather than inserting it into the WIRE socket.

Step 14. If the outputs do what the pinout (or data book) indicates they are supposed to do as you manipulate the inputs, the IC is good and can be wired into your project without fear that it will cause a problem.

That is about all there is to testing an IC. The simple ones such as gates, flip-flops and counters, can be checked out very quickly. The more complex IC's require more time, but even they are easy and a little experience will make checking them quick, too.

Identifying Unknown IC'S

Identifying an unknown IC can be a tricky business, especially if it is one of the more complex ones. The less complex are rather straightforward. The following procedure has been found to produce the best results:

Step 1. Insert IC into the TEST socket.

Step 2. Briefly touch each pin of the POINT socket with +5 volts (from the SOURCE socket) observing the LED's as you do so.

Step 3. If all or many LED's turn on as +5 volts is applied to *every* pin, discard the IC.

Step 4. If only the LED for the pin with +5 volts applied turns on *every* time, discard the IC.

Step 5. [14-pin DIP's] If pin 7 and pin 14 turn on many LED's and most other pins do not, pin 7 is GND (0V) and pin 14 is V_{cc} (+5V).

Step 6. [16-pin DIP's] If pins 8 and 16 turn on many LED's and most other pins do not, pin 8 is GND (0V) and pin 16 is V_{cc} (+5V).

Step 7. Most non-military IC's (TTL) will display the pin 7 and pin 14 or the pin 8 and pin 16 combination.

Step 8. If one of those combinations does not appear, note which pins turn on many LED's–one is GND and one is V_{cc}.

Step 8.1 Check your catalogs of IC pinouts; the odd combination itself may identify the IC.

Step 8.2 If not, make a guess–apply +5 to one and 0 to the other.

Step 8.21 If the IC gets warm to the touch, reverse the leads and try again (the IC may not be damaged).

Step 9. Apply power to the IC (V_{cc} and GND).

Step 9.1 Since floating inputs go high, the input LED's will be on.

Step 9.2 Some output pin LED's will be on.

Step 10. Briefly, apply HI0 (GND through 330 ohms) to each pin with a high logic-level.

Step 10.1 Each pin pulled low (LED turned off) by the applied HI0 may be labeled an input pin since few high outputs will be pulled low by this procedure.

Step 10.2 Those that are not pulled low *and* those that are low may be labeled output pins.

Step 11. Knowing V_{cc}, GND, INPUT and OUTPUT pins, match this information with the pinout diagrams in your catalogs and/or data books.

Step 11.1 If positive identification is made, test the IC and mark it with its proper number using a carbide scriber.

Step 11.2 If several possible identifications are made, test the IC for each possibility.

Step 11.3 If no identification can be made, further experimentation may reveal additional facts to make identification possible.

Step 11.31 Generally, flip-flops will change output states (toggle) when the T output is grounded and ungrounded.

Step 12. If an IC cannot be identified, put it aside to try again after you have gained some experience.

Step 13. Do not expect to identify them all; some are very complex little monsters–even some of the 14-pin DIP's!

Note that you will sometimes find an IC that is part good and part bad. For example, there may be only two or three good gates in a 7400 or a 7473 may have one good flip-flop and one bad one. Of course, you can throw them out but, if they don't get mixed up with your good ones, they can come in quite handy.

The solution is to mark a partly-bad IC so that you won't wire it into a circuit requiring a fully operational IC. Then, you can keep it until you run into a project that requires fewer functions than are to be found in one IC.

TTL and CMOS are the most popular IC families. Probably most of your work will be with these types. If so, consider wiring up for and building in a 5-volt supply. The TTL's use 5 volts and most CMOS devices will operate with the same voltage.

Now you have an instrument for testing and/or identifying many types of IC's. You will find it good practice to test *every* IC before wiring it into a circuit. Even premium quality IC's are sometimes bad and the testing can be done quickly. The Identifier/Tester will prevent a lot of grief on the workbench. **R-E**

CB training workshops start in Indianapolis

More than 50 technicians attended the first of a series of Forest Belt Training Workshops, held in the Airport Holiday Inn, Indianapolis, during the last week of January.

The first three days of the five-day program were spent in exploring the basics of CB servicing–studying phase-locked loops, single sideband, modulators and demodulators, AGC, ANL and other CB fundamentals. The third day treated specific troubleshooting.

The fourth and fifth days were devoted to studies in preparation for the FCC Second Class Radiotelephone license.

A number of awards were given out at the banquet that concluded the program. NESDA (*N*ational *E*lectronic *S*ervice *D*ealers *A*ssociation) awarded three gift memberships. High point of the banquet was the Hickok Prize, which consisted of the right to choose between a Hickok

AUTHOR-INSTRUCTOR FOREST BELT, former editor of Radio-Electronics, explains a point in his trademarked *Easi-Way Servicing*.

model 388 In-Line frequency counter and power/VSWR/modulation meter, or to put the ticket into a grand-prize drawing at the last of the series of fifteen 1977 workshops. The winner of that 15-person drawing will receive an entire Hickok COMM-Line six-instrument service center.

Further workshops are planned at Atlanta, Baltimore, St. Paul, Boston, Chicago, again at Indianapolis and probably one at Toronto. Enrollment fee for a five-day workshop is $280. For further information, write for Brochure 24 to: Forest Belt's Training Workshops, Box 68120, Indianapolis, IN 46268. **R-E**