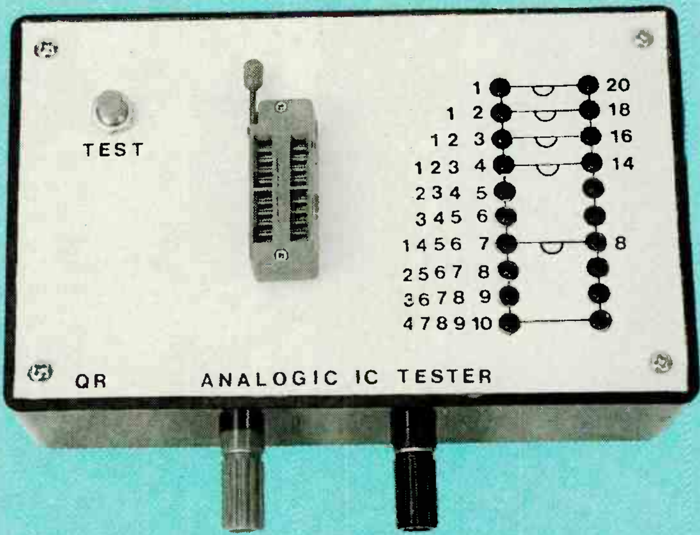
ANALOGIC IC TESTER



Check out digital and analog ICs with this inexpensive home-brew combo tester

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THE ANALOGIC IC TESTER IS A DEvice designed to test both analog and digital integrated circuits. Most IC testers will test digital ICs, but are unable to test analog or linear ICs. The few commercial IC testers that test linear devices cost thousands of dollars, which leaves the average electronics technician or hobbyist between a rock and a hard place. The Analogic IC Tester is designed to fill this void and to provide a reliable means to test all types of integrated circuits. Although the device does not boast 100 percent reliability, the Analogic IC Tester is a very good indicator of the condition of an integrated circuit.

The Analogic IC Tester checks out more than just ICs. It will test virtually all PN junction devices such as diodes and transistors, as well as passive devices such as capacitors and inductors, making it a very useful addition to any test bench.

The Analogic IC Tester is very easy to operate. There are no switches to program or time-consuming test procedures to follow. The Analogic IC Tester is a static tester, that does not actively test the function of the IC. The tester will check all ICs with as many as 20 pins. Devices with more than 20 pins can be tested as well, although the tests must be made off-board.

Theory of operation

The Analogic IC Tester tests for PN junction faults in an IC. Every IC is composed of diodes and transistors connected in many varied combinations. However, what all ICs have in common is the PN junction at each pin. In most cases when an IC fails, one or more PN junctions have failed. All it takes is one junction failure to alter or halt the normal operation of an integrated circuit.

Every IC has its very own semiconductive "fingerprint" unique to itself, in much the same way that every person has a unique fingerprint. The Analogic IC Tester provides a visual indication of that fingerprint. When the fingerprint of the device being tested matches that of a known good identical device, then the IC is considered good. If the fingerprints do not match, then the IC is considered defective. The Analogic IC Tester will give a relatively accurate analysis of the device being tested in most cases.

The IC fingerprint patterns are displayed on dual rows of ten LEDs. Each LED corresponds to an IC pin. The PN junctions of an IC are tested by first applying a positive potential to the ground pin and/or the +V pin. This positive voltage then turns on the forward biased PN junctions in the IC. This forward current then activates various LEDs on the pinout display via buffering circuitry. The brightness of the LEDs depends upon the number of PN junctions and resistances within the IC in the current path.

Circuit description

Figure 1 is a schematic diagram of the Analogic IC Tester. Each pin of the IC socket (SO1) is connected to a transistor buffer which drives a display LED. There are 20 LEDs (LED1 to LED20) for each pin connector in SO1. Transistors Q1 to Q20 provide buffering while resistors R1 to R20 and R21 to R40 provide current limiting, voltage division, and biasing for the transistors. Resistors R41 to R60 limit the current to the LEDs to a safe level.

Power is obtained from a standard 9-volt battery. Voltage regulator IC1 steps the battery voltage down to +5-volts regulated, a safe level for most ICs. Test switch S1, when it is pressed, passes the supply current. Binding posts BP1 and BP2 are standard five-way binding posts. The red post is +5-volt DC while the black post is the circuit's common ground.

Putting it together

Construction is simplified when a printed-circuit board is used. Hardwiring to a perfboard is an alternative if you have the

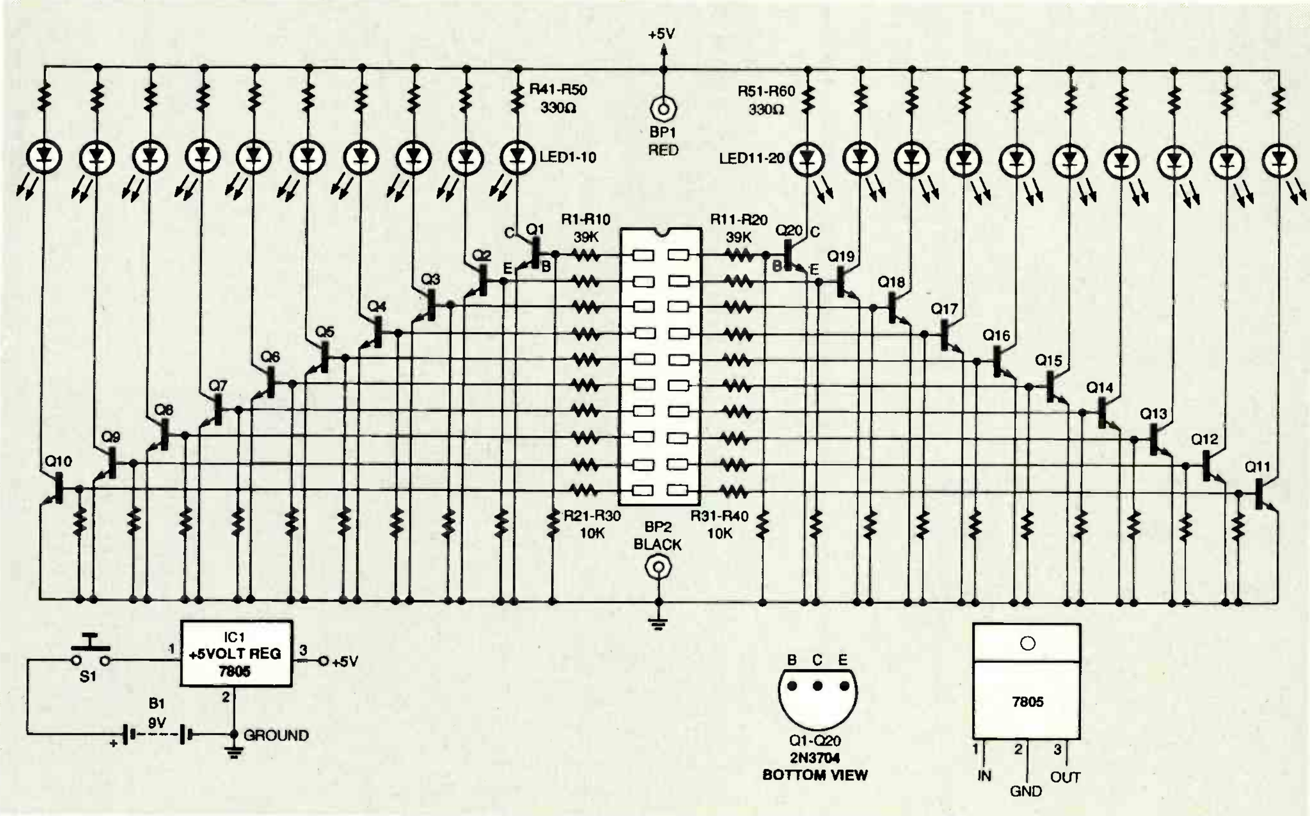

FIG. 1—SCHEMATIC DIAGRAM for the Analogic IC Tester reveals possible mirror-image layout on printed-circuit board.

PARTS LIST

All resistors are 1/4-watt, 5%.
R1-R20—39,000 ohms
R21-R40—10,000 ohms
R41-R60—330 ohms
Semiconductors
Q1-Q20—2N3704 NPN transistors
IC1—7805 5-volt DC regulator (TO-220 case)
LED1-LED20—Light-emitting diodes, standard red
Other Components
BP1—5-way binding post, red
BP2—5-way binding post, black
S1—SPST pushbutton switch, normally open
SO1—20-pin wirewrap IC socket
SO2—20-pin, Zero Insertion Force socket
Miscellaneous
Materials required to etch a single-side PC board (3 × 5-inch), 9-volt transistor-radio battery clip, plastic box (6-1/4 × 3-3/4 × 2-inch) with aluminum faceplate (6 × 3-1/2-in) (Radio Shack 270-627), spacers, screws, adhesive, wire, solder, etc. Patch cords—1 red, 1 black, banana plug to miniclip.

The following is available from Quantum Research, 17919 77th Avenue, Edmonton, Alberta, Canada T5T-2S1:

Etched and drilled PC board, $20.00
Partial kit—includes PC board and all board mounted components. Does not include ZIF socket, 5-way binding posts, box and hardware. Order #AIT1PK, $49.95
All prices in U. S. funds. Please include 10% for shipping and handling.

time and tenacity. A suitable PC foil pattern is illustrated. After you have etched the PC board, here's how you go about it.

Layout and identify all parts and become familiar with the construction steps.

Following the parts placement diagram, insert all the resistors onto the PC board in groups as illustrated in Fig. 2. Solder them in place. Be sure to use only rosin-core solder and do not overheat the pads or traces on the PC board. Insert all the transistors and solder in place. Check that they are inserted correctly. Heatsink the transistor body when soldering to prevent possible heat damage.

Insert the LEDs onto the PC board and solder them in position. Be sure they are installed correctly. It is important that they are mounted the correct distance from the board. The prototype was mounted to the faceplate with 1/2-inch spacers, so the LED height should also be 1/2 inch or slightly more, measured from the surface of the PC board to the top of the LED.

Insert the +5-volt DC regulator IC1 and solder in place. Gently force IC1 backward so that its leads bend and the device is horizontal to the PC board. Solder pushbutton switch S1 onto the PC board. The threaded portion of S1's shaft should be above the 1/2-inch plane so that the unit's faceplate and a flat washer can be secured with a nut. Solder

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the battery clip to the board noting that the red lead goes to the battery's positive terminal and the black lead to the negative terminal.

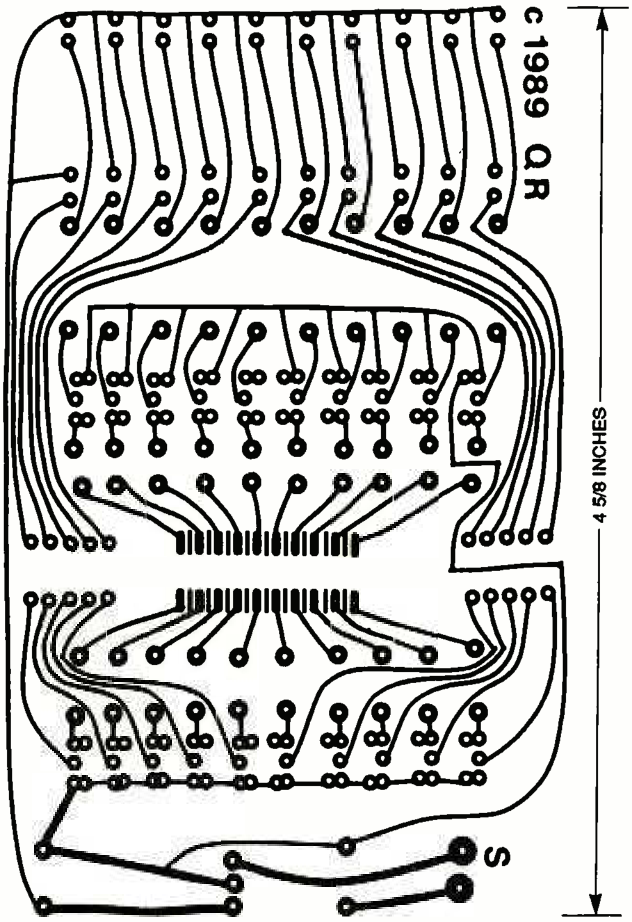
Mount a 20-terminal, wire-wrap socket (SO1) to the PC board. It too should be mounted slightly more than 1/2 inch off the PC board so that it is approximately flush with the unit's faceplate on assembly. When SO1 is in position, solder it in place. Solder to the board two lengths of wire about four inches long. Use a red wire for connection to BP1; black for BP2. This completes the required soldering on the PC board. Inspect your work carefully and re-work any bad connections or cold solder joints. Remove accidental solder bridges. Check that all the traces are continuous without breaks.

The next procedure is to fabricate the faceplate of the enclosing plastic box with the aluminum faceplate purchased with the plastic box. Use the template shown in Fig. 3 to mark the holes to be drilled on the faceplate. (Make a copy or two and use them.) Use a center punch to locate hole centers for the LEDs and switch S1, then drill the holes. Check that the switch shaft passes through its hole. The LEDs' rounded lenses should fit in the holes without passing through. Cut out the rectangular opening for the socket SO1. Use a nibbling tool or small saw and file to cut out the opening for SO1.

Deburr all the drill openings and file the edges smooth. Glue the template (copied from Fig. 3) onto the faceplate with common paper glue. Apply a sheet of clear, self-adhesive vinyl over the template to protect the paper's surface.

Drill two holes in the side of the plastic box (refer to photos) and mount BP1 and BP2.

Drill four holes in the circuit board and attach the standoffs



FOIL PATTERN for non-parts side of the printed-circuit board.

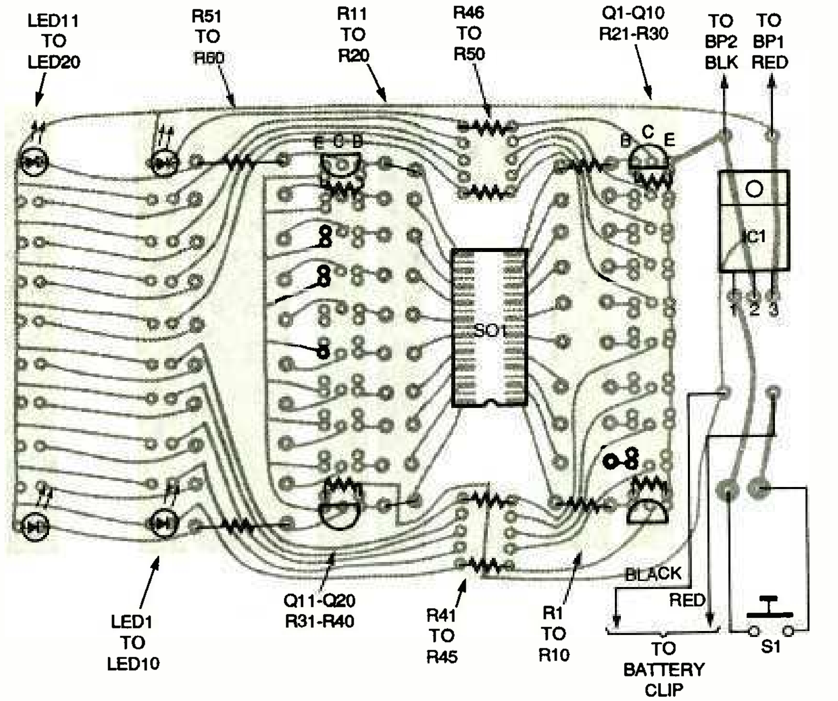


FIG. 2—PARTS LOCATION for the Analogic IC Tester. Limited numbers of parts are illustrated because similar-function parts (transistors, LEDs and resistors) mount in apparent columns in the diagram.

using the screws that came with the standoffs. Apply a small amount of silicone adhesive on the unmounted ends of the standoffs. Align the board with the prepared metal faceplate and then press the standoffs to the backside of the plate. Allow the adhesive to set overnight.

Solder the binding-post leads to BP1 and BP2 and attach a 9-volt battery to the bottom of the enclosure with double-sided tape. Do not use silicone adhesive or epoxy cement—the battery has to be replaced from time to time. Insert the ZIF IC socket SO2 into SO1. Snap the battery clip onto the 9-volt battery and position the faceplate on the box opening. Fasten the faceplate in place with four small self-tapping screws. Construction is now complete.

Testing and operation

In order to use the Analogic IC Tester it is necessary to build or purchase a 12-inch long test cable with a standard banana plug at one end and a microclip at the opposite end. A pair of one red and one black test cables is good to have, although for standard testing, only one red cable is required.

Plug the banana plug of the red cable into BP1, the red binding post. That puts +5- volts DC on the micro-clip every time TEST pushbutton S1 is pressed. With S1 pressed, touch the end of the microclip (metal hook) to each contact of the ZIF socket in succession. If the unit is functioning correctly, each LED will light when its corresponding socket contact is touched. This simple test confirms that the Analogic IC Tester is functioning and ready to test ICs.

To operate the tester, insert a known good IC into the ZIF socket. You can use the pin-orientation guide on the top panel although it doesn't really matter to the tester what position the IC is inserted. Once the IC is in place, push the lever on the ZIF socket to lock the IC in place. Now clip the microclip onto the ground or −V pin of the IC. If you do not know which pin that is, you will have to consult a data book to find out. With the microclip in place, push the TEST button and observe the device's fingerprint on the LED display. If the IC is a digital device then all the LEDs should be lit to some degree of brightness. As a general rule, TTL and CMOS digital ICs should light all the pin LEDs. We have not yet discovered an exception, although you may. Of course, pins designated as *not connected* (NC) will never affect the operation of the LEDs. If a connected pin of a digital IC does *not* light, there is a fault at that pin and the IC should be discarded or marked accordingly.

If the IC under test is a linear IC then the rules change somewhat. LEDs of a good device may or may not be lit. There may even be differences in the fingerprints of the same device from different manufacturers. For example, if you compare schematic diagrams of the 555 timer IC from various manufacturers you will notice that they are not all identical. These differences can change the device's fingerprint.

With analog or linear ICs, two tests are necessary. Attach the microclip to the −V pin and then push the TEST button. Note which LEDs are lit, dim or unlit. Then remove the test-lead microclip and attach it to the +V pin. Push the TEST button

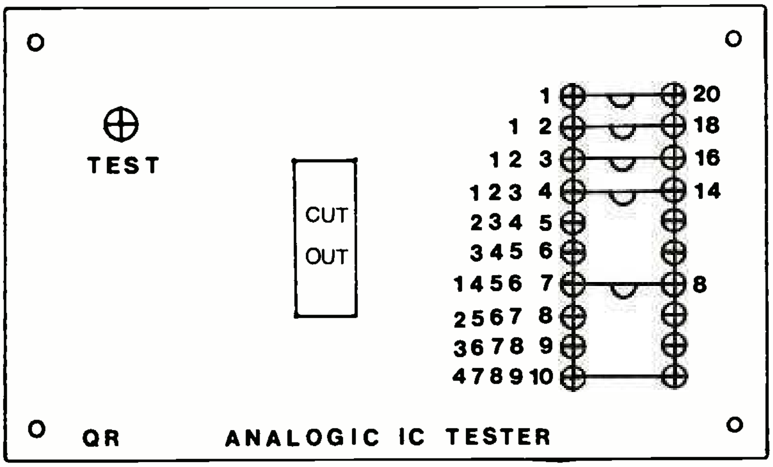
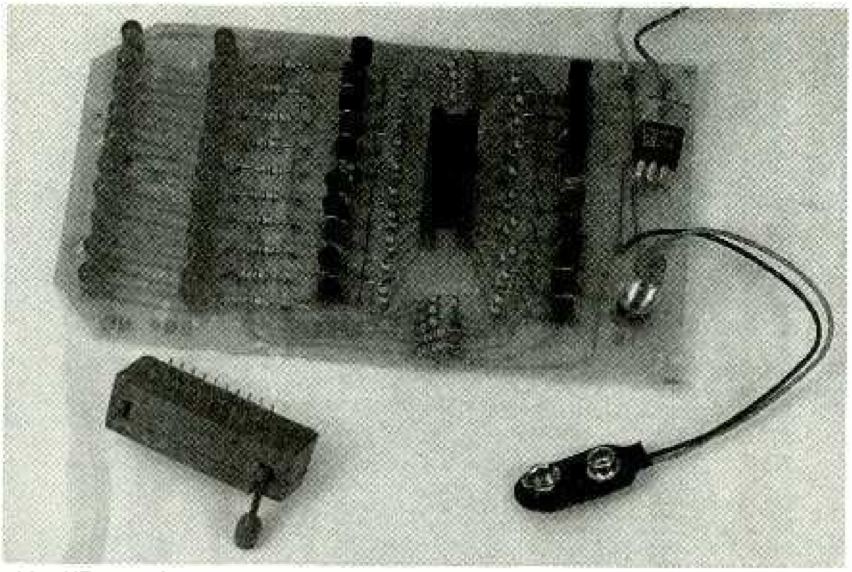


FIG. 3—FACEPLATE TEMPLATE is illustrated two-thirds original size. Zero-insertion-force socket SO2 connects to 20-pin IC wire-wrap socket that is positioned under the "CUT OUT" rectangle in diagram.

TABLE 1 - TYPICAL LIBRARY LISTING FOR TESTED IC's

Part No.	Make	Test No	Pin No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1741	MOT	1		U	U					U												
1741	MOT	2	D	U	U	D	D															
1458	MOT	1		U	U		U	U														
1458	MOT	2		U	U		U	U														
555	SGS	1						U														
555	SGS	2	V	D	D		U	D														
324	NAT	1																				
324	NAT	2	U	U			U	U			U	U		U	U							

LED status: *U* indicates unlit. *D* indicates dimly lit. *V* indicates very dimly lit. *No marking* indicates LED is at maximum brightness where pin exists.



ALL THE PARTS are shown correctly soldered onto the Printed-circuit board. The Zero-insertion-force socket (SO2) is inserted into SO1 after the faceplate is secured to the printed-circuit board.

and note again which LEDs are lit, dim, or unlit. Both these tests should be done on a known, good device. Record the manufacturer, part number and LED states as noted above. When testing any questionable device, compare the above record with the test results of this device. If the LEDs show a different pattern for the same IC then it should be considered defective and discarded. If the LED pattern matches, then in most cases the device is good.

When testing linear ICs, the second test is usually the most informative. Often a bad device will pass the first test, but fail the second test.

Some general guidelines are helpful when testing linear or analog ICs. They are:

1. Output pins of good devices typically have lit LEDs.
2. Output pins of defective devices may be very dim or unlit.
3. Input pins may be lit or unlit depending on the device.
4. Corresponding input and output pins of dual, triple, quad, etc., function ICs should be identical. (e.g.: If one input pin of a dual op-amp has a lit LED, the other input pin should have a lit LED.)

It is an excellent idea to record all your findings in a reference library. As your library grows you will have to rely less on having a known good IC for comparison testing. Rather you can simply look up the device in your library and note what the output display should look like if the IC is good. Table 1 is an example of a typical library listing. The above serves only as a possible type of setup. You can record your results anyway you wish as long as you are consistent in how you do it!

There's more

The Analogic IC Tester will test more than integrated circuits. You will also find it useful for testing diodes, transistors, inductors and capacitors.

Testing Diodes:

1. Insert diode leads into any two contacts of SO2.
2. Connect the positive microclip to the anode lead. Push the TEST button. Both LEDs should light if the diode is good.
3. Connect the microclip to the cathode lead. Push the TEST button. If the diode is good only the cathode LED should light.

Testing NPN Transistors:

1. Insert the transistor leads into any three contacts of SO2.
2. Attach the microclip to the base lead. The base, emitter, and collector LEDs should light if the device is good.
3. Attach the microclip to the emitter lead. the collector and base leads should *not* light when the TEST button is pushed.
4. Attach the microclip to the collector lead. Push the TEST button. The base and emitter LEDs should *not* light if the device is good.

Testing PNP Transistors:

1. Insert the transistor leads into any three contacts of SO2.
2. Attach the microclip to the base lead. Push the TEST button. The emitter and collector LEDs should *not* light.
3. Attach the microclip to the collector lead. The emitter LED should *not* light when the TEST button is pushed.
4. Attach the microclip to the emitter lead. Push the TEST button. The collector LED should *not* light.

Testing Inductors:

1. Insert inductor leads into any two contacts of SO2.
2. Attach microclip to any lead. Push the TEST button. Both LEDs should light, one possibly brighter than the other. If one of the LEDs is unlit, the inductor is open, or has an extremely high resistance.

Testing Capacitors:

This test will only determine a capacitors approximate condition and works best with values greater than 1 µF.

1. Discharge capacitor completely. Insert capacitor leads into any two contacts of SO2.
2. Attach microclip to positive lead of the capacitor if it is polarized. Watch the LED of the negative lead very closely and push the TEST button. For small value capacitors, the LED will blink once. For larger values, the LED will light, then slowly fade out as the capacitor charges up.
3. If the capacitor is open, the LED will not flash or light at all.
4. If the capacitor is shorted the LED will remain lit as long as the TEST button is pressed.

Conclusion

The Analogic IC Tester can be an extremely useful piece of equipment for the technician or hobbyist. Although its indications are sometimes not perfectly accurate, it will successfully determine the condition of many parts. The Analogic IC Tester is very easy to use and requires only minimum training time. Ω