Build a Low-Cost Transistor Tester

BY CYRIL C. MILLER

Tests small-signal, high-power, or phototransistors, SCR's, FET's and conventional diodes.

THE SIMPLE, low-cost transistor tester described here can check small- and large-signal as well as medium- and high-power npn and pnp transistors, n-channel FET's, conventional and light-activated SCR's, phototransistors, and diodes. The tester is easy to build and use.

In operation, all you do is insert the device to be tested into a socket, press a TEST button, and observe a meter. A three-conductor cable is used for testing devices that are too large for the tester's sockets. There is no power switch because the circuit consumes very little power, which also means that a device under test cannot be damaged by test conditions.

The circuit for the transistor tester is shown in the schematic diagram.

Construction. The tester can be assembled in a 5" × 2.5" × 1.5" (12.7 × 6.4 × 3.8 cm) plastic case with an aluminum cover. Neither parts location nor wiring is critical.

The meter movement, four sockets, and three switches can be mounted on the cover. Wire sockets *SO1* and *SO2* to accommodate the two different basings commonly used for small transistors and wire *SO3* to accommodate a three-conductor cable to test devices that do not fit the sockets. Socket *SO4* is used for high-power transistors. Point-to-point wiring, using terminal strips, can be used to assemble the project.

A satisfactory substitute for the meter movement specified in the Parts List is Radio Shack's No. 22-051, a 50-μA movement with the same characteristics. However, this meter is slightly larger and may require a larger case for the project. A 100-μA meter movement can be used if the value of *R3* is changed to 10,000 ohms. Alternatively, a 1-mA movement can be used if the value of *R3* is changed to 1000 ohms and the value of *R5* is changed to 220 ohms. (Bear in mind that some loss in sensitivity may occur with these changes.)

Use insulated material between *SO4* and the metal cover of the case. (The metal cases of power transistors are the collector terminals.) Also, use low-profile fillister-head screws for mounting the socket so that, when a power transistor is plugged into *SO4*, its base and emitter pins will fit the socket and its case will make the collector's electrical connection. Before mounting *SO4*, be sure the base and emitter pin openings in the cover plate are large enough to prevent the transistor's pins from shorting to the metal plate.

Any type of lettering can be used to label the switches and sockets. The single AA cell that supplies power for the circuit should be mounted in a battery holder affixed to the bottom of the plastic case.

External test leads can be fabricated from lengths (about 7") of color-coded stranded hookup wire. Solder a miniature insulated alligator clip to one end of each wire and a plug that mates with *SO3* to the other ends of the wires. (In the prototype, a conventional transistor socket was used for the plug. The socket pins were removed and the ends of the three test leads were tinned with solder to serve as pins. The stiff wires were inserted into the socket from the top until they protruded to conventional transistor pin length. A short length of heat-shrinkable tubing was then used to secure the three leads to the socket.)

Calibration. Install the AA cell, but do not secure the cover to the case until *R4* has been adjusted. Insert the test cable into *SO3* and connect a 1000-ohm resistor between the collector and emitter clips of the test cable. With *S1* set to LOW (*S2* can be in either position), the meter's pointer should swing to approximately half-scale. With *S1* in the HI position, very little deflection should occur. Return *S1* to its LOW position and remove the resistor.

Short together the emitter and collector alligator clips while adjusting potentiometer *R4* until the meter's pointer swings to full scale. Setting *S1* to HI should keep the pointer at full scale.

Switch *S2* can be checked for proper operation by inserting an npn or pnp transistor known to be good into the proper socket, noting which leads are for the base, collector, and emitter. With *S2* set to the appropriate position, press *S3* (TEST); you should observe a significant increase in meter pointer deflection. If the pointer does not swing up-scale, *S2* is probably reversed; in which case, either relabel the switch or rotate the switch by 180°.

This completes calibration. Fasten the cover in place.

Operation. Semiconductors can be checked as detailed in the Table. If you are uncertain whether a transistor under test is npn or pnp, set *S2* to its alternate

TESTING PROCEDURES

Device to be tested	Socket	S1	S2	Initial meter indication	Test indication	Remarks
Small-signal pnp transistor	1	LOW	PNP	Low	Increase	Socket 1 for EBC, 2 for BCE
Small-signal npn transistor	1	LOW	NPN	Low	Increase	Socket 1 for EBC, 2 for BCE
Medium-power transistor	1	LOW	As required	Low	Increase	
High-power transistor	4	HI	As required	Low	Increase	
N-channel FET	1	LOW	PNP	Low	Increase	
SCR	1	LOW	As required	Low	High	SCR will lock on. S1 or S2 to opposite position to unlock.
Light-activated SCR	2	LOW	As required	Low	Not required	Expose to strong light to test.
Photo transistor	1	LOW	As required	Low	Not required	Expose to moderate light to test.
Diodes*	Test leads	LOW				

*Use external test cables. Observe meter indication. Flip S2 to opposite side. Note second meter indication. One indication should be high, the other low.

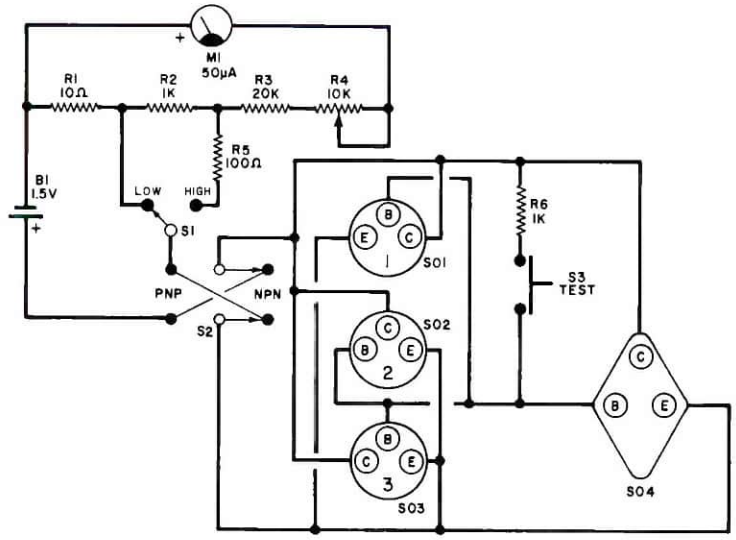
positions and press TEST in both cases. The position of *S2* in which an up-scale meter pointer deflection is obtained identifies the transistor type.

Note that the initial meter indication in the Table is always low. If it is high, set *S2* to its alternate position. If a high indication persists, the device under test is defective. If a low indication is obtained, press TEST and note the up-scale deflection of the meter's pointer. Since the meter is not calibrated in absolute values, it will be necessary to test several devices of known characteristics to gain familiarity with meter indications.

In addition to checking semiconductors, the tester can be used to determine the condition of electrolytic capacitors ranging in value from several microfarads to several thousands of microfarads. To do this, connect the capacitor to the collector and emitter alligator clips of the test cable and observe the meter. If the capacitor is shorted, the meter's pointer will swing fully up-scale and remain there. With a good capacitor, the pointer will initially swing far up-scale and then slowly return to a low value at a rate proportional to the capacitor's value.

To test SCR's, connect them to the correct socket or test leads and note the meter's indication. When the TEST switch is pressed, the meter's pointer should swing to full-scale. This high indication should remain until either *S1* or *S2* is switched to its alternate position. When testing a light-activated SCR, a low indication should be obtained when the SCR is in the dark, and a full-scale indication should be obtained when the LASCR is exposed to bright light. The TEST switch is not required here. The same approach is used for testing phototransistors. (The tester can also be used as a crude lightmeter when testing phototransistors.)

To test a diode, connect it between the collector and emitter alligator clips on the test cable. There is no need to observe polarity. Note the meter indication; the pointer will swing up-scale when the diode is forward biased and down-scale when it is reverse biased. Set *S2* to the alternate position; the meter's pointer should swing in the opposite direction. The ratio between the two indications is determined by the diode's resistance ratio.



Test circuit is simple to build and use with Table above as guide.

PARTS LIST

B1—1.5-volt AA cell
M1—50-μA meter movement (see text)
R1—10-ohm, ½-watt resistor
R2, R6—1000-ohm, ½-watt resistor
R3—20,000-ohm, ½-watt resistor
R4—10,000-ohm linear-taper potentiometer
R5—100-ohm, ½-watt resistor
S1—Spdt switch
S2—Dpdt switch
S3—Miniature normally open pushbutton switch
S01, S02, S03, S04—Transistor socket (see text)
Misc.—Plastic case with aluminum cover (see text); penlight-cell holder; power-transistor mounting kit; insulated miniature alligator clips (3); terminal strips; 1000-ohm resistor (for calibration); machine hardware; color-coded stranded hookup wire; solder; etc.

In Conclusion. The simple transistor tester described here can help you to quickly test bipolar transistors and separate them according to type. As a bonus, you can test n-channel FET's, SCR's, diodes, and even the condition of electrolytic capacitors can be checked. ◇