

# INSTRUCTION MANUAL

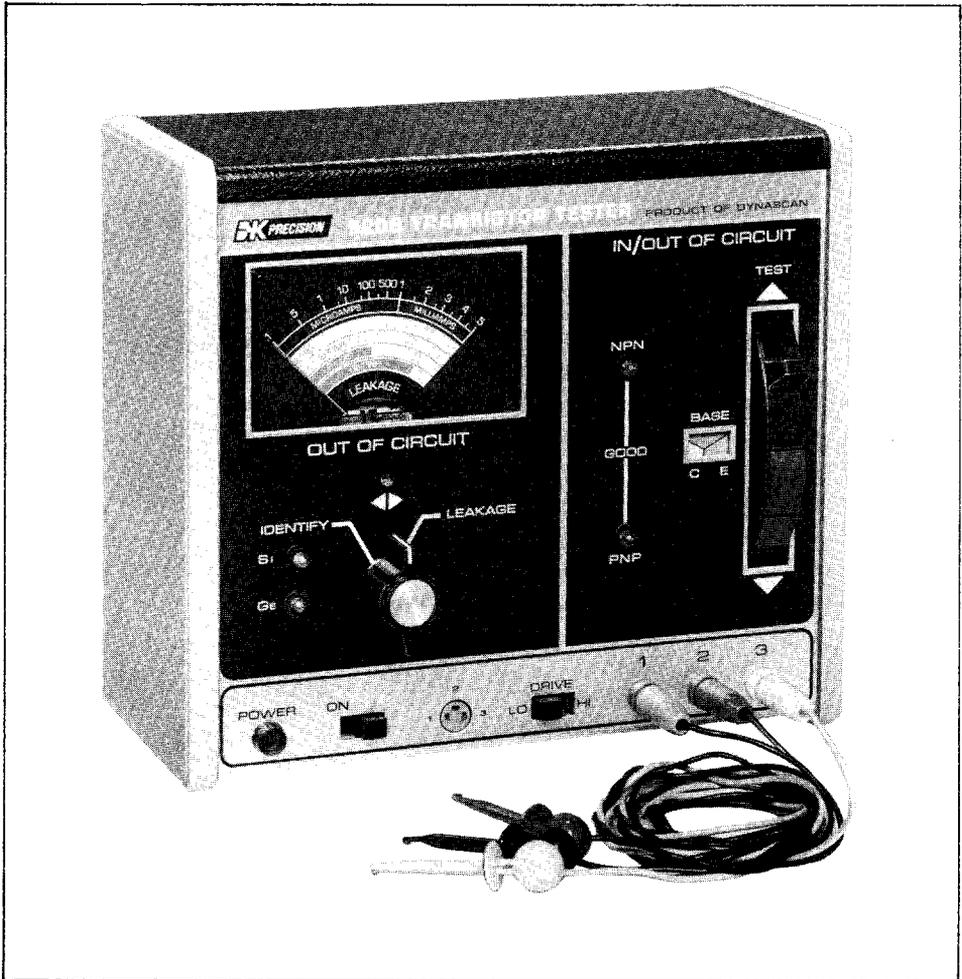
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BK PRECISION®

## MODEL 520B

# TRANSISTOR TESTER



BK PRECISION®

## TEST INSTRUMENT SAFETY

### WARNING

An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Higher voltages pose an even greater threat because such voltages can more easily produce a lethal current. However, voltage as low as 35 volts DC or AC RMS should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. Be alert to the following hazards when using the Model 520B Transistor Tester:

1. When performing in-circuit testing of semiconductors, make sure power is removed from the circuit under test. For "hot chassis" equipment, disconnect the power plug in addition to turning off the on-off switch. Most recent television sets, audio equipment, and other equipment with a 2-wire power cord are transformerless "hot chassis" powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized power plug to prevent insertion the "wrong" way, a serious shock hazard exists if the chassis is touched. Additionally, damage to the semiconductor tester or the equipment under test could result. Unplug any such equipment from its ac outlet; just turning off the on-off switch does not eliminate the hazard. To be on the safe side, treat all equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
2. Servicing of the transistor tester should be performed only by qualified electronics technicians who are trained to work safely in the presence of high voltage. Line voltage (120 or 240 VAC) may be present at points in the primary power circuit any time it is connected to an ac outlet, even if the unit is turned off. Always observe caution when the covers are removed from the tester.

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## INTRODUCTION

The B & K-Precision Model 520B Transistor Tester is designed for in-circuit and out-of-circuit transistor testing, with special features for making additional tests on devices out-of-circuit.

It uses both a high-current, low duty-cycle pulse technique to test transistors in the presence of shunting circuitry, and a low-current drive system which enables the user to identify the terminals of the device in most in-circuit tests and all out-of-circuit checks.

The instrument is designed for a minimum amount of control manipulation, making for rapid testing of most devices.

## SPECIAL FEATURES

1. Patented limited-energy pulse circuit permits highly successful use of in-circuit testing in the presence of low shunt impedances with complete safety for the device under test.
2. A human-engineered panel design which eliminates the need for reference to the operating manual – only three switches, no panel adjustments.
3. Six-position TEST switch sequentially connects the device being tested in all possible configurations, making it unnecessary to know the device terminal identification. Can be left in GOOD position so that additional tests can be made without memorizing test position.
4. Base or gate lead identified by color as TEST switch is operated when testing with HI drive. All leads of transistor are identified when testing with LO drive.
5. Audible tone tells when the device under test is good – no need to take eyes off circuit board while testing hard-to-get-at devices.
6. A logarithmic leakage meter which displays a wide leakage current range on a single meter scale.
7. Automatic polarity indication to identify NPN or PNP type devices.
8. Identification of SILICON and GERMANIUM device types for proper evaluation of leakage current with color-keyed LED indicators for positive test interpretation.
9. Clip-on test leads that make positive connections to devices in difficult locations. Free operator's hands to make further tests.
10. Choice of test leads or front panel socket for out-of-circuit tests.

**SPECIFICATIONS****IN-CIRCUIT:**

GOOD/BAD test for transistors, FET's, or SCR's.  
Identifies transistor as NPN or PNP and FET as N or P channel.  
Identifies SILICON or GERMANIUM transistors.  
Identifies gate lead of FET or base lead of transistor (HI drive).  
Identifies all leads of transistor when using LO drive.  
Identifies all leads of SCR's.

**OUT-OF-CIRCUIT:**

GOOD/BAD test for transistors, FET's or SCR's.  
Identifies transistor as NPN or PNP and FET as N or P channel.  
Identifies SILICON or GERMANIUM transistors.  
Identifies gate lead of FET by test lead color.  
Identifies all leads of transistor or SCR by test lead color.  
Measures reverse LEAKAGE from 0.1  $\mu$ A to 5 mA.  
Measures  $I_{DSS}$  and gate leakage of FET's.

**APPLIED TEST CURRENTS:**

Base Drive: 250 mA (HI drive) or 1 mA (LO drive) at 4% duty cycle.  
Collector Drive: 125 mA at 4% duty cycle.  
Test Repetition Rate: 10 per second.  
Reverse Voltage for leakage test: 2.OV.

**LIMITING IN-CIRCUIT SHUNT****VALUES FOR VALID GOOD/BAD TEST:**

Resistance: Down to 10 ohms with HI drive.  
Down to 1.5K ohms with LO drive  
Capacitance: Up to 15 mfd with HI drive.  
Up to .3 mfd with LO drive.

**ACCESSORIES:**

Three test leads with mini-lock clips supplied.  
FP-5 Dynaflex Probe (optional).

**SIZE:** 8" x 7" x 3½"

**WEIGHT:** 5 lbs.

**POWER REQUIREMENTS:** 105-125 VAC, 60 Hz, 5 watts.  
105-125/210-250 VAC, 50/60 Hz version  
available.  
CSA approved version available.

## BRIEF SUMMARY OF WHAT THE 520B WILL DO

1. Determines good or bad transistors, FET's or SCR's, in or out-of-circuit.
2. Determines good or bad diodes in or out-of-circuit.
3. Identifies Emitter-Base-Collector leads of transistors.
4. Identifies gate lead of FET's.
5. Indicates polarity of good devices (NPN or PNP; N or P Channel).
6. Identifies Cathode-Gate-Anode leads of SCR's.
7. Indicates whether SILICON or GERMANIUM.
8. Measures  $I_{CES}$  or  $I_{BES}$  of transistors.
9. Measures  $I_{DSS}$  and gate leakage of FET's.
10. Measures reverse leakage current of diodes.
11. Determines whether device is transistor, FET or SCR.

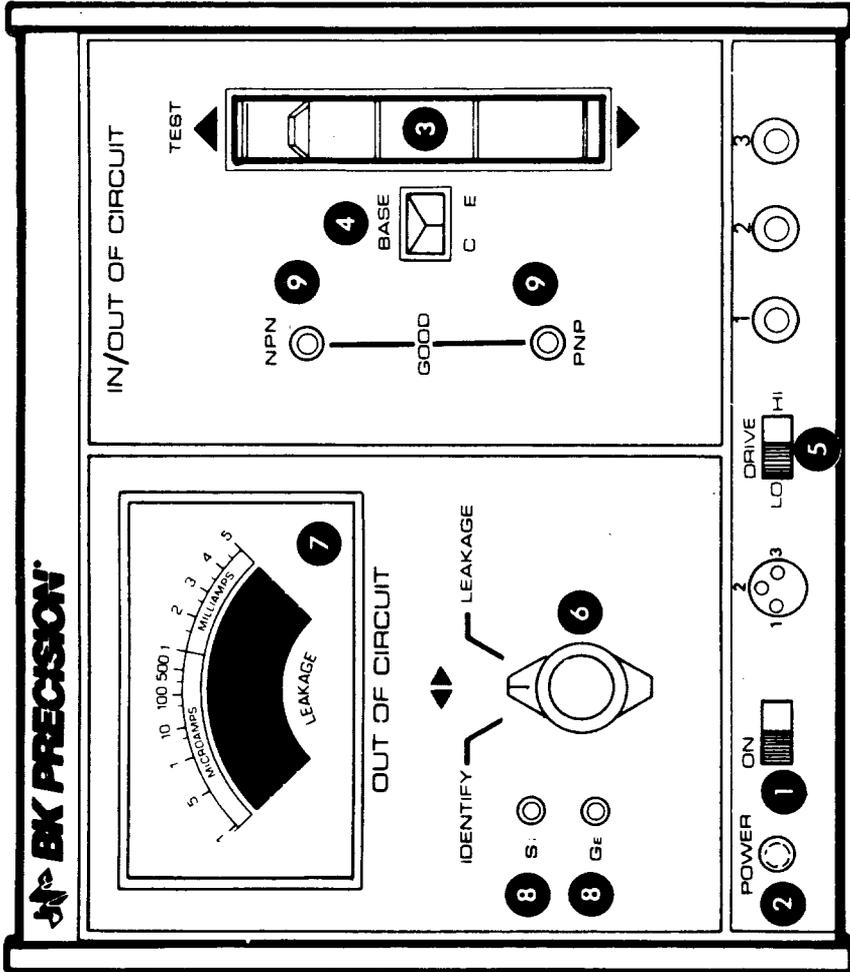


Fig. 1. Front panel showing controls and indicators.

## CONTROLS AND INDICATORS

1. **POWER ON Switch:** Applies power to 520B
2. **POWER ON Lamp:** Indicates power is ON.
3. **TEST Switch:** Selects proper device connection for testing and lead identification.
4. **Lead Identification Window:** Identifies leads by color.
5. **DRIVE Switch:** Selects LO or HI base drive.
6. **FUNCTION Switch:** Spring-return switch selects either of two additional tests:
  - a.  $I_{CES}$  or  $I_{BES}$  for transistors;  $I_{DDS}$  and gate leakage for FET's.
  - b. Identifies device material (silicon or germanium).
7. **LEAKAGE Meter:** Indicates device leakage current.
  - a. Indicates safe leakage limits for typical silicon and germanium transistors.
  - b. Indicates  $I_{DSS}$  and gate leakage for FET's.
8. **IDENTIFY Lamps:** Indicate silicon or germanium device.
9. **NPN and PNP Lamps:** Indicate polarity of good devices.
10. **AUDIBLE TONE:** Indicates good device.

## HINTS AND KINKS

### IDENTIFYING TRANSISTORS AND DIODES

1. Nearly all germanium transistors come in metal cases, either the tubular type with flexible leads, or in the standard TO-5 package.
2. Power transistors in stud packages or in the TO-5 or TO-3 can be either germanium or silicon, depending on age. Two and three digit 2N-numbers are mostly germanium.
3. The TO-66 power transistors and the plastic power tab packages are nearly always silicon. The collector is usually, but not always, connected to the mounting tab and the center lead.
4. The base lead of most modern plastic type transistors is either the center lead or the right hand lead when facing the flat side with the leads down. In the latter case the collector lead is in the middle.
5. Most plastic FET's have the gate lead on the right side when facing the flat side with the leads down, and the source in the middle, but there are exceptions. With nearly all junction FET's, the source and drain can be interchanged with no adverse effects.
6. All transistors will have some gain with the collector and emitter leads interchanged, with the exception of Darlington's.
7. Germanium signal diodes can usually be recognized by their transparent hollow glass cases with either three or four color bands, or type numbers printed on them. Silicon diodes are usually painted because silicon is light-sensitive and must be protected from ambient light. The "moose" types, such as the stud package, can be either germanium or silicon.

## THINGS TO KNOW ABOUT THE 520B

1. There are certain semiconductor devices that look like transistors which the 520B cannot test. These include: Triacs, diacs and diode arrays.
2. In HI drive, most transistors that test good will do so in *two* adjacent TEST switch positions. This is because transistors have some gain when the collector and emitter are interchanged. If the circuit is heavily shunted, or the “reverse beta” of the transistor is very low, the transistor will test good in only *one* TEST switch position. In either case, the transistor can be considered good.
3. In LO drive, most transistors that test good will do so in only *one* TEST switch position. In some rare cases, high-frequency transistors or transistors with higher than usual “reverse beta” may test good in *two* adjacent TEST switch positions having the same BASE color in the Lead Identification Window. This is still a valid good test, but only the base lead of the transistor can be identified.
4. FET’s can be tested in either LO or HI drive, but only FET’s with a high  $G_m$  will test good in LO drive. Therefore, to insure a valid good/bad test for all junction FET’s, the DRIVE switch should be set to HI when the device being tested is known to be an FET. The 520B detection circuit is more sensitive in the HI drive position.

## USING THE MODEL 520B

## IN-CIRCUIT TESTING

**WARNING**

Make sure all power is turned off in the circuit being tested, and that all capacitors are discharged.

**A. Transistors/FET's**

1. Set the DRIVE switch to the LO position.
2. Connect the three test leads in any manner to the three leads of the device you wish to test.
3. Move the TEST switch slowly through its six positions or until the tone is heard. One of the two red lamps will glow indicating whether the device is NPN or PNP, or N or P channel (the NPN lamp will glow if the FET is N Channel and the PNP lamp will glow if the FET is P Channel). In LO drive, most transistors that test good will do so in only *one* TEST switch position (see THINGS TO KNOW ABOUT THE 520B). In this TEST switch position, all the leads of the transistor can be identified as shown in the Lead Identification Window. Most FET's will test good (LO or HI drive) in *two* adjacent TEST switch positions having the same BASE color shown in the Lead Identification Window, since practically all junction FET's are symmetrical. The BASE color indicated is the *gate* lead of the FET.
4. If no tone is heard as the TEST switch is slowly moved through its six positions, in LO drive, then the device under test is one of the following:
  - a. Transistor with high leakage or very low gain (may not function properly in circuit).
  - b. Device with open/shorted elements.
  - c. Device with excessive circuit shunting (see SPECIFICATIONS).
  - d. FET that will not test with LO drive.
5. Retest the device using HI drive. In HI drive, most transistors that test good will do so in *two* adjacent TEST switch positions having the same BASE color shown in the Lead Identification Window. Only the base lead of the transistor can be identified.

6. If the device tests good using HI drive, then 4 (a) above could be true.
7. If the device does not test good in any TEST switch position, in HI drive, remove the device from the circuit and retest using OUT-OF-CIRCUIT procedures.

## B. SCR's

1. Set the DRIVE switch to the HI position.
2. Connect the three test leads in any manner to the three leads of the SCR you wish to test.
3. Move the TEST switch slowly through its six positions. For most SCR's, the NPN lamp glows in one test position and the PNP lamp glows in another test position having a different BASE color shown in the Lead Identification Window. Some medium and high voltage SCR's may give only an NPN indication.
4. The SCR is good if an NPN indication is obtained. The additional PNP indication, if obtained, merely confirms that the device is an SCR rather than a transistor.
5. With the TEST switch in the position that gives the NPN indication, lead identification is thus: base color is gate lead, emitter color is cathode lead, and collector color is anode lead.
6. If the SCR tests bad, then it should be removed from the circuit and tested again (may be subject to excessive shunting in-circuit).

## C. Diodes

Connect the blue and yellow test leads across the diode. Test for LEAKAGE in uppermost and second positions (GREEN BASE) of TEST switch. One position will read full scale, while the other will give a lower reading depending on the shunting effect of the circuitry. If both positions produce full scale readings, the diode is either shorted or heavily shunted by low resistance circuitry; for example, a transient suppressor diode across a relay or solenoid coil. In this case the diode should be disconnected from the circuit and retested.

#### D. "Hands Off" Testing

When the base lead of devices being tested can be identified, leave the test switch in the uppermost position. The transistors can then be probed one by one by connecting the green lead to the base, and the blue and yellow leads to the collector and emitter respectively. The audible tone will tell you when the transistor is good. Occasionally, the collector and emitter leads may have to be interchanged to produce a tone.

The "Hands Off" method is useful when it is necessary to test a number of transistors in a circuit, or when it is impossible to connect all three leads to the device being tested: If one lead can be clipped on the device, both hands are free to probe the remaining two leads. With this feature, you can also use the B & K-Precision DYNAFLEX MODEL FP-5 PROBE (optional) to test devices from either side of the P.C. board.

#### E. Intermittent Testing

Often the Model 520B can be used to identify intermittent transistors in a circuit. Connect the test leads to the suspected transistors and move the TEST switch until the tone is heard. Then, leaving the 520B in this position, the transistor can be subjected to various physical tests such as tapping, heating, or cooling. An intermittent transistor will show up as an intermittent tone.

**HINT:** A can of "Instant Cold Spray" is quite useful for providing rapid cooling of discrete components.

### OUT-OF-CIRCUIT TESTING

#### A. Transistors

1. Set the DRIVE switch to the LO position.
2. Connect the three test leads to the device or plug it into the convenient test socket on the Model 520B panel (no need to worry about lead identification).
3. Slowly move the TEST switch until the 520B indicates a good transistor and produces an audible tone. Leave the TEST switch in this position and identify all the leads of the transistor by the colors shown in the Lead Identification Window. In LO drive, the transistor should test good in only *one* TEST switch position (see "THINGS TO KNOW ABOUT THE 520B").

4. If no tone is heard as the TEST switch is slowly moved through its six positions, in LO drive, then the device under test is one of the following:
  - a. Transistor with high leakage or very low gain (may not function properly in-circuit).
  - b. Transistor with open/shorted elements.
  - c. Device is an FET. If this can be verified from available service information, retest as outlined below.
  - d. Device is a power Darlington which requires high base voltage. If this can be verified from service information available, retest using HI drive.
5. A transistor which tests *good* can be further evaluated for leakage and material identification.
6. LEAKAGE TESTS. Set DRIVE switch to HI. Move the TEST switch to a position which produces a good indication and turn the function switch to LEAKAGE and note the meter indication. Hold the function switch in LEAKAGE position and move the TEST switch to the other position which displays the same BASE color in the Lead Identification Window. The leakage should be about equal in both TEST positions, and within the limits shown on the meter scale, In one of the positions the meter indicates ICES; in the other IBES.
7. IDENTIFICATION OF TRANSISTOR TYPES: If the type of transistor is not known, turn the function switch to IDENTIFY position and the Model 520B will indicate whether the device is SILICON (yellow LED glows) or GERMANIUM (green LED glows). The leakage indicated can then be compared to the proper limits marked on the meter face. The meter leakage scales are color-keyed to the LED IDENTIFY indicators.

## B. FET's

1. Set the DRIVE switch to the HI position.
2. Slowly move the TEST switch until the 520B indicates a good FET.
3. J-FET's will indicate good in *two* adjacent TEST switch positions which have the same BASE color. (Most J-FET's are symmetrical.)
4. The BASE color shown in the Lead Identification Window is the *gate*.
5. If no audible tone is heard then the FET under test is defective.

6. A FET which tests *good* can be further evaluated as indicated in the following steps.
7.  **$I_{DSS}$  LEAKAGE.** Move the TEST switch to a position which produces a good indication, then turn the function switch to LEAKAGE. The meter will read  $I_{DSS}$ . Note that the  $I_{DSS}$  of FET's can range from a few microamperes to several milliamperes, and in some cases will read off scale on the 502B.
8. **FET GATE LEAKAGE.** Drain-to-gate or source-to-gate leakage of either N-Channel or P-Channel FET's can be tested by treating the gate junction as a diode. First, locate the gate lead by moving the TEST switch through each of its six positions until the tone is heard. The *gate* lead is the **BASE** color which appears in the Lead Identification Window. Then connect the FET gate to the blue test clip and one or both of the remaining FET leads to the yellow test clip. Move the TEST switch through the uppermost and second positions (**GREEN BASE**) and check for leakage. The leakage should be zero in one of the positions if the device is a J-FET, or both positions if it is a MOS-FET.
9. N-Channel FET drain or source-to-gate leakage can be measured in another way. Leave the FET connected to the three test leads. Put the TEST switch in any position which does not indicate good. Then, holding the FUNCTION switch in the LEAKAGE position, move the TEST switch through all six positions and watch the meter. If the device is good, the meter will indicate zero current in two of the six positions. P-Channel FET's must be measured as diodes, as described above.
10. **DEPLETION MODE FET'S.** Drain-to-source leakage of depletion mode FET's cannot be measured reliably by the Model 520B, as this requires that the gate be reverse-biased while testing. Merely disconnecting the gate lead leaves the device subject to stray pickup and/or leakage currents, and with the extremely high gate impedance there is no way of assuring that the gate will pinch off.
11. **ENHANCEMENT MODE FET's.** Enhancement mode FET's can be tested in the same way as transistors.

### C. Diodes

1. **LEAKAGE.** Connect the blue and yellow test leads to the two ends of the diode. Hold the function switch in the LEAKAGE position while moving the TEST switch through the two green **BASE** positions. If the diode is good the meter will indicate full scale in one position and will indicate zero or some low value in the other. The low reading is the **LEAKAGE** current of the diode.

2. **LEAD IDENTIFICATION.** The anode and cathode leads of the diode can be identified. Connect the blue and yellow test leads to the diode leads. While holding the function switch in the **LEAKAGE** position, move the **TEST** switch to whichever of the two green **BASE** positions produces a full scale reading. The diode *cathode* is connected to the test lead color indicated as the **COLLECTOR** in the Lead Identification Window.

#### **D. SCR's**

1. Set the **DRIVE** switch to the **HI** position.
2. Connect the three test leads to the **SCR** or plug it into the test socket on the front panel (no need to worry about lead identification).
3. Move the **TEST** switch slowly through its six positions. For most **SCR's**, the **NPN** lamp glows in one test position and the **PNP** lamp glows in another test position having a different **BASE** color shown in the Lead Identification Window. Some medium and high voltage **SCR's** may give only an **NPN** indication.
4. The **SCR** is good if an **NPN** indication is obtained. The additional **PNP** indication, if obtained, merely confirms that the device is an **SCR** rather than a transistor.
5. With the **TEST** switch in the position that gives the **NPN** indication, lead identification is thus: base color is gate lead, emitter color is cathode lead, and collector color is anode lead.
6. If the **NPN** lamp does not light in any test position, the **SCR** is defective. A "good" indication verifies that the **SCR** can be triggered into conduction, and in most cases this is sufficient testing. However, it is sometimes desirable to additionally test whether or not the **SCR's** forward blocking voltage is normal. A procedure is given at the end of this manual.

## TEST SWITCH

1. The 520B transistor tester uses a six-position lever switch located at the right side of the panel to connect the device being tested in the correct manner for testing. As this switch is moved from top to bottom, the device connected to the three test leads, or plugged into the socket, is connected in all possible configurations to the testing circuit. The uppermost position is the "normal" connection, in that the socket is connected in standard triangle configuration to the testing circuits and the blue, green and yellow leads are connected to the collector, base and emitter circuits respectively.
2. In two of the six positions, using HI drive, the device is connected properly for testing. This is true since almost all transistors have gain, although usually very little, when the collector and emitter are interchanged, and most junction FET's are symmetrical. These two positions are always adjacent, and always display the same base color in the Lead Identification Window whenever the 520B is indicating a good device.
3. In LO drive, a transistor should indicate good in only one switch position since limited base drive allows the detector to test the transistor as a good device in only its high gain connection.

## GAIN TEST CIRCUIT

4. The 520B circuitry generates a continuous series of pulses specially designed to periodically test a transistor about ten times per second. These short, high-current pulses apply a voltage pulse to the collector, first positive for testing NPN devices, followed by negative for testing PNP (see Fig. 2a). During this pulse, a shorter pulse of the same polarity is applied to the base of the device which drives the collector voltage toward saturation. Taking a closer look at the basic pulse circuitry, refer to Fig. 2. T1 is the period clock, which runs at approximately 10 Hz. It initiates each test period while simultaneously resetting FF1 and FF2. T2 runs at 1000 Hz and controls the pulse-forming circuits.
5. The pulse-forming circuit uses a combination of toggles and RS flip-flops to produce the proper sequence of pulses for the collector drive circuit A and the base drive circuit B. A and B are level-shifting complementary drivers which can deliver several hundred milliamperes at +5V and -5V or return to zero volts.
6. A properly connected NPN transistor, as shown above, will see the waveform at Fig. 2A, and its base will see the waveform at Fig. 2B. Note that during the

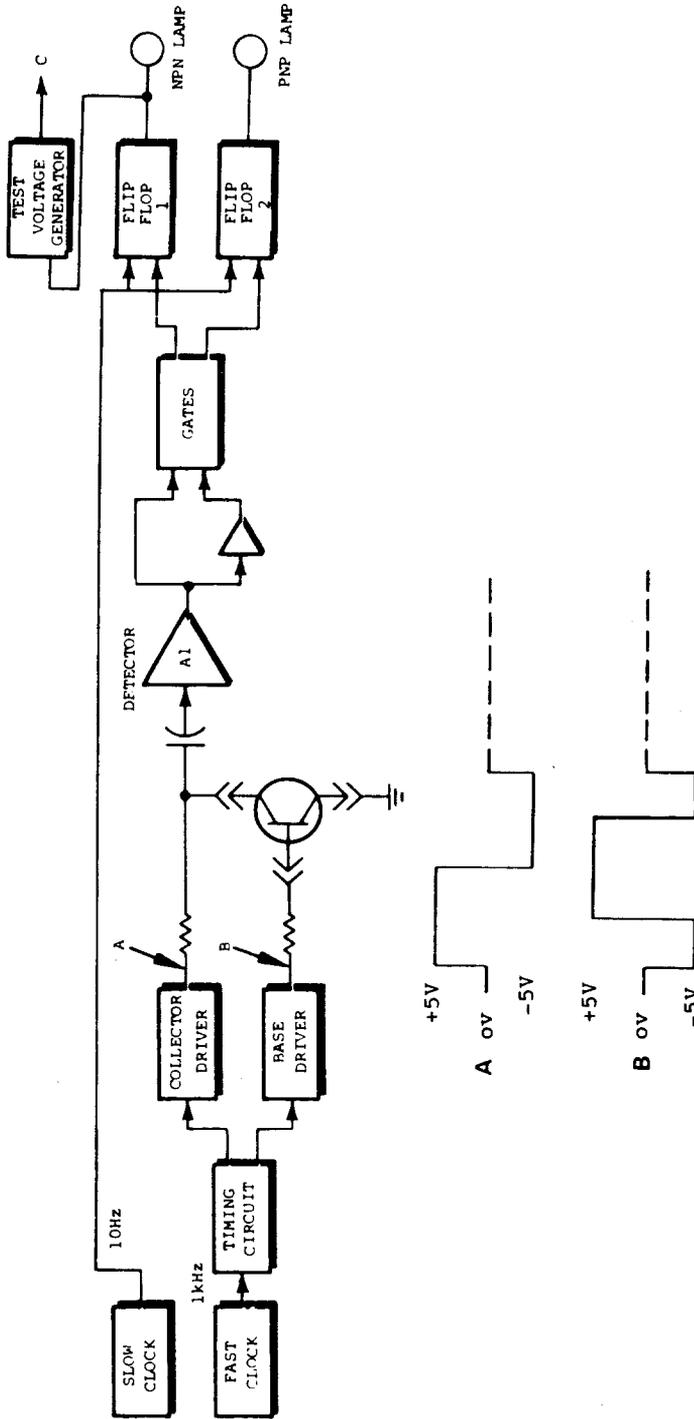


Fig. 2. Block diagram.

positive excursion of the collector voltage, the base is driven first negative and then positive. If the transistor being tested is NPN, the collector voltage will drop abruptly when its base is driven positive. This negative-going transition, which can only occur if transistor action is present, is differentiated and the differentiated signal is used to latch flip-flop 1.

If a PNP transistor is tested, the turn-on transition occurs in the second half of the waveform 2A, and in the opposite direction.

The PNP output pulse is inverted in order to have the proper polarity to operate flip-flop 2. Of course, other pulses appear at the differentiator output, since all voltage transitions are similarly differentiated, but the synchronized gating circuits prevent the unwanted pulses from reaching the lamp driving flip-flops and thus eliminating wrong indications.

The input to FF1 is only enabled during the time period in which an NPN device can be detected and similarly, FF2 is only enabled when a PNP device can be detected. Only the flip-flop which corresponds to the type of device being tested can be latched, lighting the lamp corresponding to that device.

In addition to being connected to the LED's on the panel, both outputs are connected through an OR gate to activate the audible tone if either of the latches operate. Thus, if the basing and polarity of a device is unknown, the TEST switch can be moved from position to position until the tone is heard.

It is then left in that position and the polarity of the device is indicated by one of the PNP-NPN lamps on the 520B panel. If the switch is left in this position, the circuitry is then set up to make several additional out-of-circuit tests on the transistor.

The output of FF1 is either +5V or 0, depending on whether the device tested was PNP or NPN. This output in turn drives another level-shifting complementary circuit which produces either +5V or -5V, but always at the correct polarity to further test the same device. When not testing, this voltage is always left at -5, to be available for diode testing.

## CURRENT METER

7. The 520 is equipped with a special non-linear meter circuit to measure  $I_{CES}$  and  $I_{BES}$ . When the FUNCTION switch is turned to LEAKAGE, two things happen. First, the reset pulse is inhibited from FF1 and FF2. This leaves FF1 in the state in which it was while "Gain Testing" the transistor. FF1 in turn, through the test generator, produces the correct output voltage for testing at point (C), + for NPN or - for PNP.

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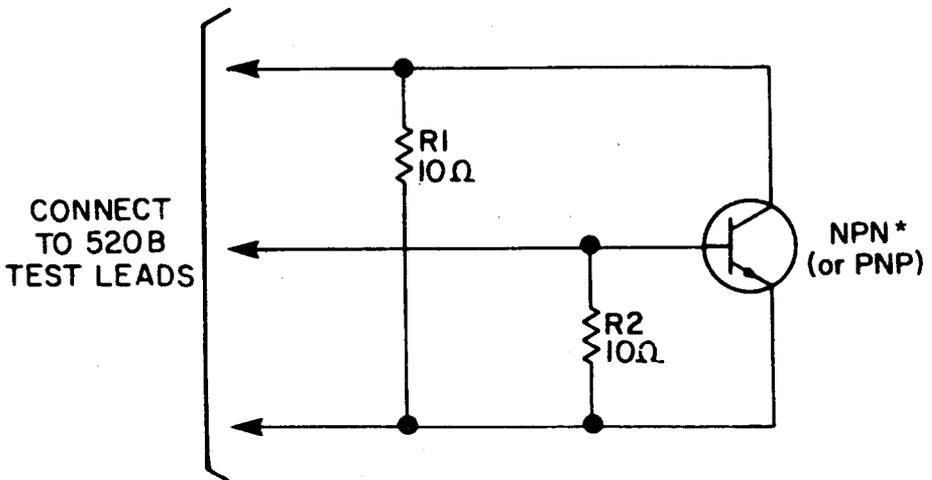
Second, the switch connects the collector to this supply, and the base and emitter to the current meter circuit. The meter circuit is designed for essentially zero voltage drop at its terminals so that the device is always tested at the proper voltage, and is made non-linear to measure a very wide range of currents on a single scale.

### **IDENTIFICATION CIRCUIT**

8. When switching to IDENTIFY, the flip-flop reset circuit is inhibited as before to lock the test voltage in the proper polarity. The base-emitter junction is then current-fed, and connected to a special voltage comparator which produces a +5 output for a Base-to-Emitter voltage above approximately  $\pm.5V$ , or zero output for B-E voltage less than  $\pm.5V$ . The output drives one of two LED's, depending on its state, indicating either silicon, which always produces more than .5V drop, or germanium, which seldom produces more than .4V drop. The LED's are enabled only when a good test is performed, and only when the switch is in the IDENTIFY position.

## OPERATIONAL TESTS

1. To ensure that the 520B is operating according to specifications, test for proper output drive power. This can be done easily by building the simple circuit in Fig. 3. The 520B must be switched to the HI drive position. Transistor should check good in only *one* TEST switch position.
2. To test the LO drive function of the 520B, eliminate R1 and replace R2 with a 1.5k $\Omega$  resistor in Fig. 3. The transistor should check good in only *one* TEST switch position.



\*GENERAL PURPOSE TRANSISTOR WITH  
A BETA OF 100 OR GREATER.

Fig. 3.

**WARNING**

The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform servicing other than contained in the operating instructions unless you are qualified to do so.

1. **Meter Calibration.** The only part of the 520B which may require calibration is the leakage current meter. The following procedure should be followed:
  - a. Turn off the 520B. If the meter does not indicate zero, insert a screwdriver in the hole on the front panel just below the meter and adjust it to indicate zero.
  - b. Remove the back of the instrument by removing the five screws at the bottom and rear of the case. Locate TP1 near the top center of the P.C. board. Connect TP1 to the metal chassis with a jumper. Turn on the 520B. If the meter is not indicating zero, adjust the ZERO control with a screwdriver through the left side hole in the top of the chassis until the meter balances. The zero control is identified on the P.C. board just below the adjustment hole (see Fig. 4). Remove the jumper.
  - c. To calibrate the meter, put the TEST switch in the uppermost (green) position. Connect a 2000 $\Omega$  potentiometer and a 0-5mA meter in series from the yellow jack to the blue jack as in Fig. 4. Then while holding the FUNCTION switch in the LEAKAGE position, adjust the potentiometer for 5 milliamperes in the external meter. If the meter on the 520B panel does not read full scale, adjust the "CAL" control through the right side hole in the top of the chassis. The CAL pot is identified on the P.C. board just below the adjustment hole. See Fig. 4.
  
2. **520B Power Supply Voltages.** Can be measured at the points marked +5 and -5 and GND on the lower right hand corner of the P.C. board. they must be between 4.7 and 5.3V for proper operation.
  
3. **Observation of Waveforms.** The waveform applied to the collector and base of the device under test can be observed with an oscilloscope connected to the jacks on the 520B panel. Leave the TEST switch in the uppermost position as above, and place a 1k $\Omega$  to 10k $\Omega$  resistor between the yellow jack and the green jack. Connect the scope ground to the yellow jack (emitter) and the vertical input to the green jack (base). The base waveform should be as shown in Fig. 2b. Connect the resistor between yellow and blue jacks. Connecting the vertical input to the collector jack (blue) should produce the waveform shown in Fig. 2a. A dual trace oscilloscope is especially convenient for observing both waveforms simultaneously.

If the line fuse blows, it must be replaced with a 1/16A, 3AG Slow-Blow fuse. Remove the back cover, as in "CALIBRATION". Remove the right end panel of the case (the side nearest the "TEST" switch). The fuse is found on the P.C. board near the power transformer. It is unlikely that the fuse will blow without some accompanying circuit failure. Look for shorted rectifier diodes (D1-D4) or input filter capacitors (C1 and C2).

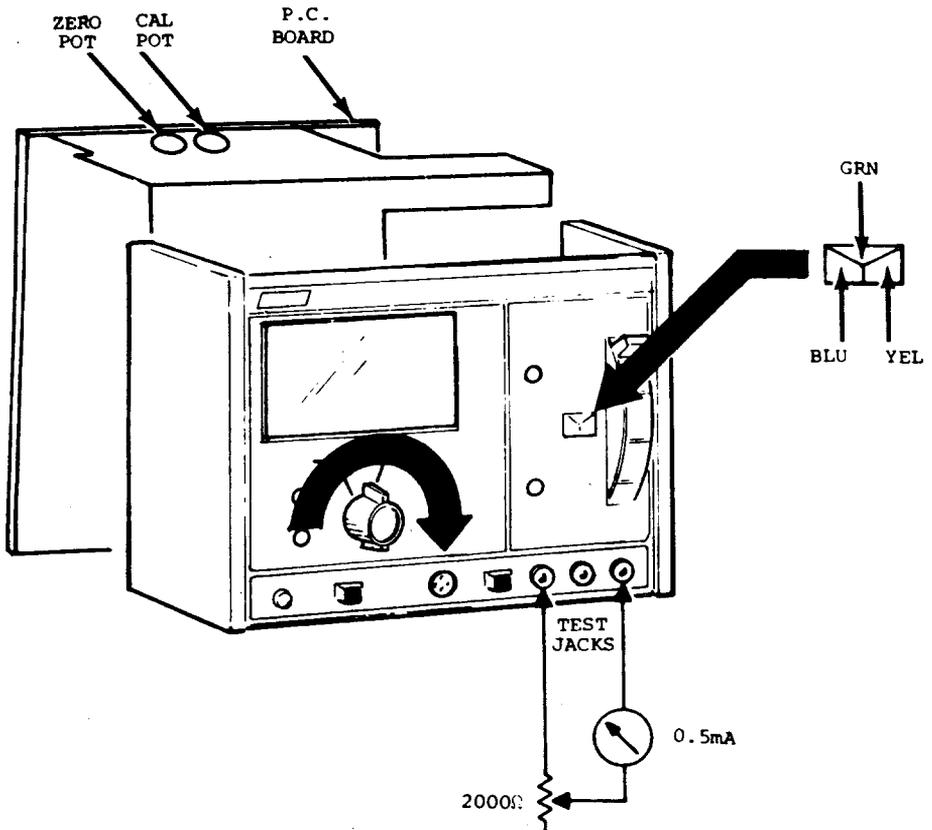


Fig. 4. Location of calibrating controls.

## FORWARD BLOCKING VOLTAGE TEST FOR SCR's

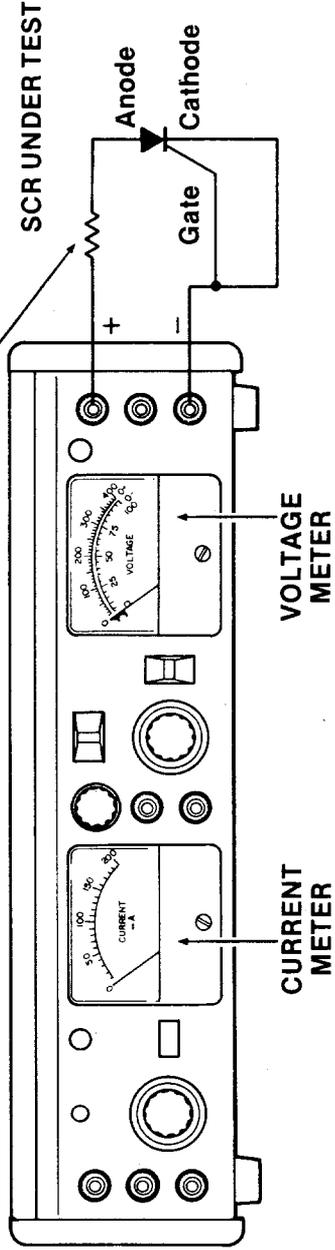
A GOOD indication verifies that the SCR can be triggered into conduction, and in most cases this is sufficient testing. However, it is sometimes desirable to additionally test whether or not the SCR's forward blocking voltage is normal. Transistor testers of this type do not test forward blocking voltage, but such a test can be performed with a High Voltage Power Supply. The power supply must have a current limiting feature to protect the SCR under test. It must also provide the adequate voltage to test the SCR. The procedures for conducting a forward blocking voltage test are as follows:

1. Set the power supply current limiter to approximately 25 mA.
2. Connect the SCR to the power supply as shown in Fig. 5.
3. Monitor power supply voltage and current.
4. Slowly increase the power supply voltage to the forward blocking voltage rating of the SCR test.
5. Power supply current should remain low throughout step 4; up to a few mA leakage current is normal for some high current SCR's. If the SCR fires as the voltage is being increased in step 4, the SCR is defective. Firing is denoted by a sudden jump to the current limiting value.

**WARNING: EXPOSED HIGH VOLTAGE. TAKE PRECAUTION TO PREVENT ELECTRIC SHOCK.**

**HIGH VOLTAGE POWER SUPPLY**

**1k $\Omega$ , 5W, Wirewound**



1. Set current limit to 25 mA.
2. Increase voltage to rating for SCR under test.
3. If OVERLOAD trips, SCR is defective.

**Fig. 5.** Forward blocking voltage test of an SCR.