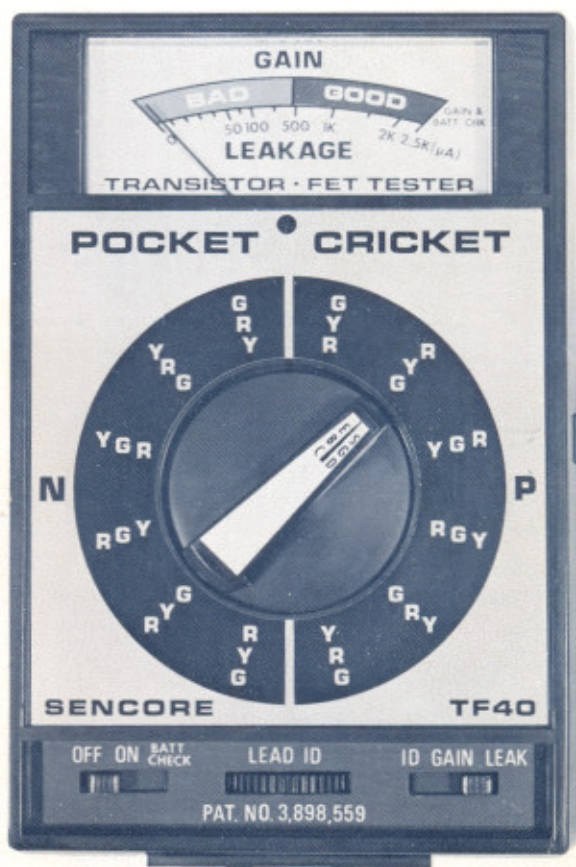


TF40

POCKET CRICKET

TRANSISTOR AND FET TESTER

OPERATION, APPLICATION AND MAINTENANCE MANUAL



SENCORE

THE ALL AMERICAN LINE OF HIGH QUALITY TEST EQUIPMENT

SENCORE SAFETY REMINDERS

Every precaution has been taken in the design of your instrument to insure that it is as safe as possible. However, safe operation depends on you, the operator.

There is always a danger present when testing electronic equipment. Unexpected high voltages can be present at unusual locations in defective equipment. Become familiar with the equipment you're working with, and observe the following safety precautions.

1. This unit is designed to be used with the power removed from the unit you are testing. Always be sure the power is off and the filter capacitors discharged before making test lead connections.
2. A severe shock hazard can result if the chassis of the equipment being serviced is tied to the "hot" side of the AC line. An isolation transformer should always be used with this equipment. Also, be sure that the top of the workbench and the floor underneath it is dry and made of non-conductive material.
3. Be sure your equipment is in good order. Broken or frayed test leads can cause improper testing results.
4. Remove the test leads immediately after the test has been completed to reduce the possibility of shock.
5. Do not work alone when working on hazardous circuits. Always have another person close by in case of an accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltage.

TF40

POCKET CRICKET

TRANSISTOR AND FET TESTER

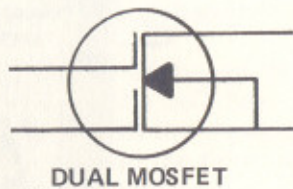
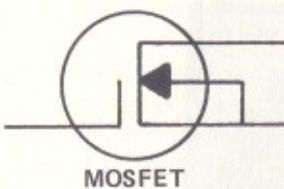
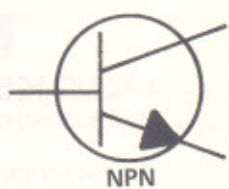
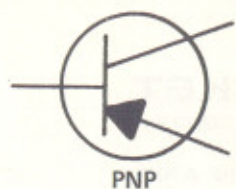
OPERATION, APPLICATION AND
MAINTENANCE MANUAL



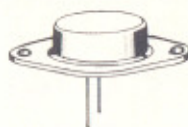
SENCORE

3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

FAMILIARIZATION



20,000 TRANSISTOR TYPES

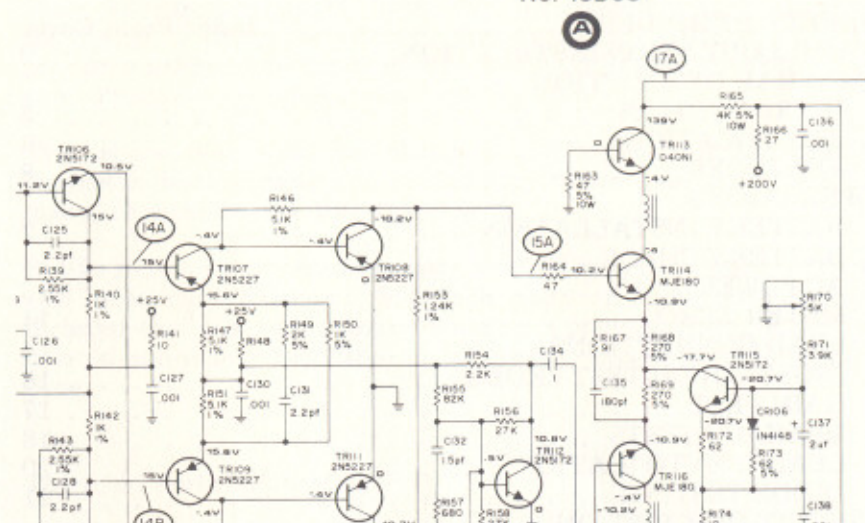


MANY DIFFERENT POWER RATINGS

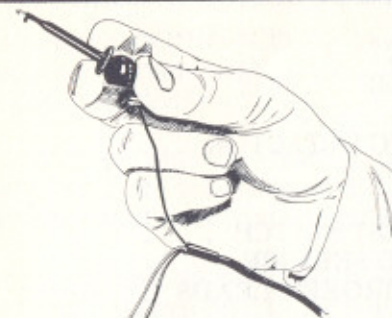


OVER 500 DIFFERENT BASING DIAGRAMS

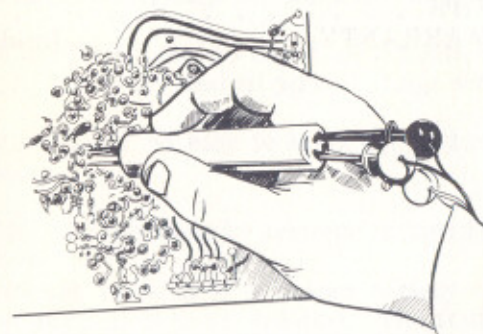
VERTICAL PREAMP P.C. BOARD
NO. 43B68



HIGH FREQUENCY, DIRECT COUPLED STAGES



OPERATING E-Z HOOK CLIP



USING TOUCH-TEST PROBE

TABLE OF CONTENTS

SAFETY REMINDERS	Inside Front Cover
FAMILIARIZATION INSTRUCTION	2
GENERAL DESCRIPTION	
INTRODUCTION	5
SPECIFICATIONS	6
FEATURES	8
OPERATIONS	
BATTERY INSTALLATION	12
BATTERY CHECK	13
AC POWER	13
METER ZERO	14
LEAD CONNECTIONS	14
39G85 TOUCH-TEST PROBE	16
GAIN TEST	17
LEAKAGE TESTS	18
LEAD IDENTIFICATION	20
DIODE TESTING	21
CIRCUIT DESCRIPTION	
THEORY OF OPERATION	23
BLOCK DIAGRAM & FUNCTION DESCRIPTION	23
POWER SUPPLY	24
BATTERY CHECK	24
TEST OSCILLATOR	25
TEST AMPLIFIER	25
INVERSION LOGIC DETECTOR	26
LEAD ID TEST	27
LEAKAGE	27
PERMUTATOR TEST SWITCH	28
MAINTENANCE AND SERVICE	
CHECKING FOR BROKEN LEADS	28
DISASSEMBLY	29
CALIBRATION	31
APPLICATION TIPS	33
SERVICE AND WARRANTY	Inside Back Cover

INTRODUCTION

Since its introduction, the transistor has created many changes in the design of electronic devices. There are many types of transistor products available today that were not even imagined several years ago. Products are smaller and more portable.

The service technician has always found a need for an accurate transistor testing method. Transistor testers have gone through many changes to fill this basic need.

But in recent years, the technician's needs have been centered more and more on efficiency. The high costs of doing business have dictated that the technician — whether a one-man-shop, or part of a multi-national corporation — not waste valuable troubleshooting time.

The main needs are these:

1. The test should give a complete test of whether the transistor is operating properly and not require any additional testers.
2. The test should be GO/NO—GO for basic troubleshooting, so that the technician is not wasting time setting up the tester or interpreting the results of the test.
3. The test should be able to check a transistor in circuit to eliminate removing the transistor from the circuit, and to minimize the possibility of heat damaging the transistor.
4. The test must be easy to perform to save servicing time and enable non-technical personnel to do routine tests.
5. The test must not damage the transistor under test.
6. The test should be able to check all transistor types — Bipolar or FET, N or P types, and all power ratings with the same test.
7. The tester should be easy to hook up, and not require basing information.
8. Most of all, the test must be accurate, in nearly every circuit.

With the increased popularity of more battery operated portable devices — one more need has developed. The transistor tester must be able to be used anywhere. This requires battery operation and

compact size to fit in a tool case. Finally, the tester must be rugged enough to take rough daily use.

All of these needs are satisfied with the TF40 Pocket Cricket transistor and FET tester.

The TF40 is small, rugged, and battery operated, yet it is a complete, easy to use, high accuracy tester.

SPECIFICATIONS

DEVICES TESTED: Bipolar transistors, single gate FET's, dual-gate FET's, diodes, rectifiers

NOTE: Following tests are with Permutator switch set to the single basing position, which gives a "GOOD" reading on LEAD ID test, when testing a good transistor.

GAIN TEST METHOD: Phase inversion detector for indication of gain. (Patent 3898559).

APPLIED VOLTAGES: $V_{be} = 7V$ P-P, centered on zero reference
 $V_{ce} = \pm 4.5V$ max.

APPLIED CURRENTS: $I_{be} = 10mA$ max.
5mA continuous

TEST FREQUENCY: 1.2KHz (nominal)

LEAKAGE TEST METHOD: Measures reverse collector - base leakage (I_{cbo}). All other leakage paths tested with rotation of Permutator switch. (I_{ebo} , I_{beo} , I_{ceo} , I_{eco} , I_{bco}).

APPLIED VOLTAGE: $V_{cb} = \pm 4.5V$, depending on polarity used.

GENERAL METER: 2½", 200uA moving magnet, 5%
GAIN: "GOOD-BAD" scale
LEAKAGE: 0 to 2500uA scale

ELECTRICAL: All Solid State and IC circuitry

MECHANICAL: Completely insulated Cyclac® case construction with three E-Z Mini-Hook® cables attached.

SIZE: 6"x4"x1¼" (15.2x10.2x3.2cm) HWD

WEIGHT: 14 Oz. (.392Kg) (with battery)

POWER CONSUMPTION: 1½mA idle
20mA during Gain test

POWER REQUIREMENTS: One 9V radio battery (Eveready No. 22 or equivalent) or AC Line Operation using Sencore PA202 Power Adapter only, with 9V battery for filtering.

ACCESSORIES: E-Z Mini-Hook® test leads (attached).
39G85 Touch-Test Probe (optional)
PA202 Power Adapter (optional)
Manual, Schematic and Parts List
TF40 Familiarization Instruction Tape

FEATURES

(FOLD OUT)



13. 39G85 TOUCH TEST PROBE: (Optional) for testing P.C. mounted transistors from foil side of board.
14. PA202 POWER ADAPTER (Optional) Provides AC operation (used with battery for filtering) and doubles as battery charger for rechargeable battery.

FEATURES

METER: Gives visual "GOOD-BAD" indication of transistor gain, leakage current in microAmps, and indication of battery condition for "BATT CHECK."

METER ZERO: Gets mechanical zero of meter movement for accurate test readings.

POWER ADAPTER JACK: For use with PA202 power adapter. Allows use as bench tester without draining batteries.

LEAD COLOR AND BASING CODE: Indicator used for determining complete basing information of unknown transistor.

PERMUTATOR TEST SWITCH: Eliminates need for basing or set-up information for testing any bipolar transistor or FET. Also allows complete testing of all leakage parameters.

FUNCTION SWITCH: Gives choice of Cricket Gain test, full lead identification or leakage tests.

LEAD IDENTIFICATION CONTROL: Adjusts gain sensitivity for determining exact basing diagram and identifying bipolar transistors from FET's.

E-Z HOOK® CONNECTORS: Allows fast, sure connections to transistor under test.

POWER/BATTERY CHECK SWITCH: Applies power to unit in "ON" positions. Checks battery condition using "GOOD/BAD" scale of meter.

BREAK - PROOF INSULATED CASE: Made of Cyclocac® plastic. Protects TF40 from mechanical damage when used in portable applications.

POLARITY INDICATOR: Indicates polarity of transistor under test. "N" indicates NPN (Bipolar) or N-Channel (FET) and "P" indicates PNP or P-Channel.

BATTERY COMPARTMENT AND TILT STAND: (Rear of unit) houses single 9 volt "transistor radio" battery. Tilt stand sets tester at 30° angle for easy meter reading when used on bench.

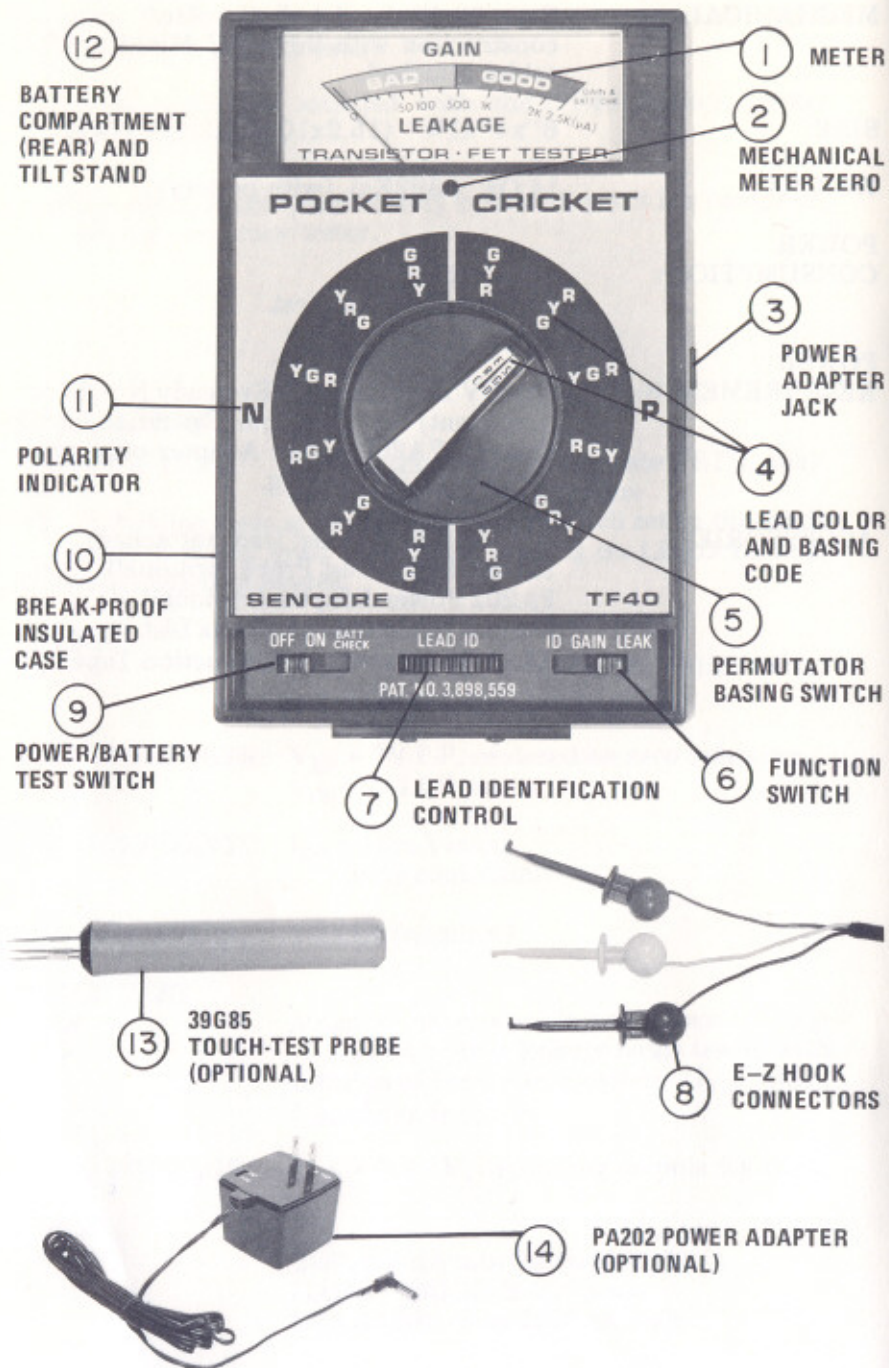


Fig. 1 TF40 Pocket Cricket - Transistor & FET Tester

OPERATIONS

INTRODUCTION

Review the general features of the TF40 Pocket Cricket by playing the familiarization tape packed with the unit while following the illustrations on pages 2 and 3. Then review the instructions listed below.

Following the Operations Instructions are the Circuit Description and Maintenance Instructions. The final pages of this manual contain several "Applications Tips." These Tips should be referred to for special tests and applications beyond the scope of the basic operations instructions.

BATTERY INSTALLATION:

The TF40 operates on a single standard 9 volt alkaline battery, or rechargeable battery. To install or change this battery, use the following procedure:

1. Remove the single screw at the top-rear of the case, and remove the battery compartment door.
2. Clip the battery into place, and slide it into the space provided. The door is then replaced by re-tightening the screw.

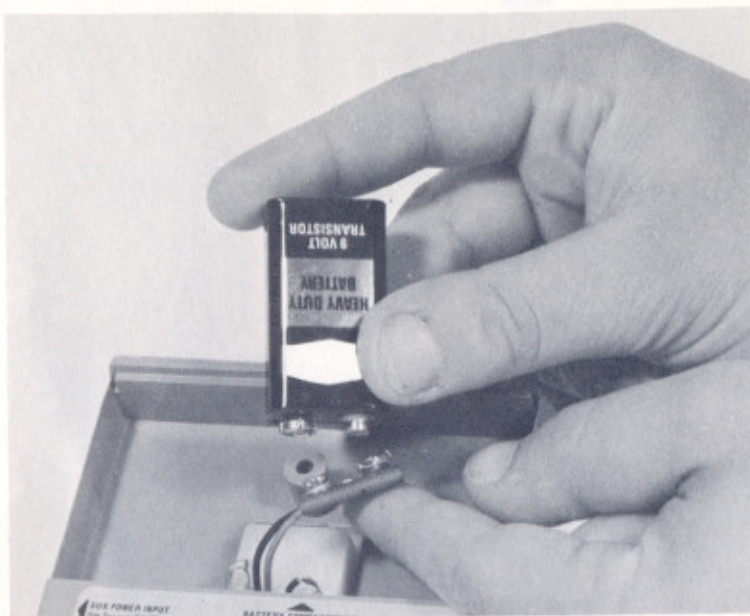


Fig. 2 Installing Battery

BATTERY CHECK

The battery must supply sufficient voltage for the TF40 to give reliable test results. Slide the ON-OFF/BATTERY CHECK switch to the "BATT CHECK" position to test the battery. The battery is supplying sufficient voltage if the meter reads in the green "GOOD" section of the scale. If the meter reads in the "BAD" section, the battery should be recharged or replaced.

AC POWER (OPTIONAL)

The TF40 may be operated from any 110-130VAC, 50/60Hz outlet with the PA202 Power Adapter. This adapter will double as a battery charger if rechargeable batteries are used in the unit. Whenever the PA202 is used, be sure to have batteries installed in the unit. This will make sure that the unit is always ready to be used for field service without the power supply adapter. THE BATTERIES ALSO SERVE AS FILTERS, AND MUST BE IN THE UNIT WHENEVER THE PA202 ADAPTER IS USED.

To use the PA202:

1. Install the 9V battery into the unit.
2. Connect the PA202 to 110-130VAC, 50/60Hz power.
3. Insert the adapter plug of the PA202 into the socket on the right side of the TF40 case.
4. The PA202 may be left connected to the TF40 when the tester is turned off. This will allow a rechargeable battery to recharge when the tester is turned off.

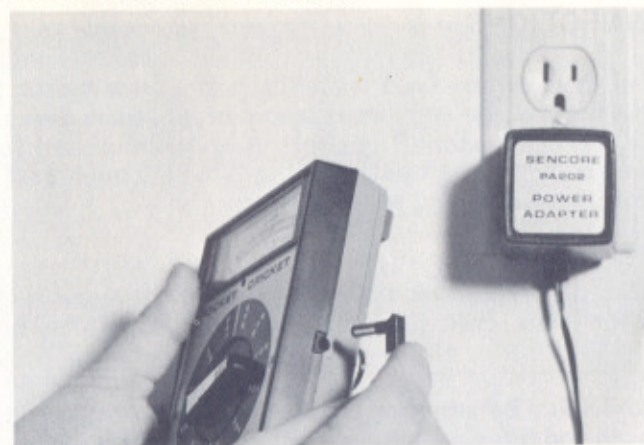


Fig. 3 Use of PA202 Power Adapter

NOTE: The PA202 will provide enough current to operate the TF40 unless the batteries are totally discharged. If a rechargeable battery is allowed to discharge, the PA202 should be connected to the TF40 with the TF40 turned off for several hours to bring the battery voltage back to the operating range.

METER ZERO

Proper calibration of your TF40 requires that the meter movement be properly zeroed. An adjustment screw is provided at the bottom of the Meter movement. This screw should be adjusted only with the TF40 in the "OFF" position. Use a non-magnetized screwdriver with the TF40 laying flat.

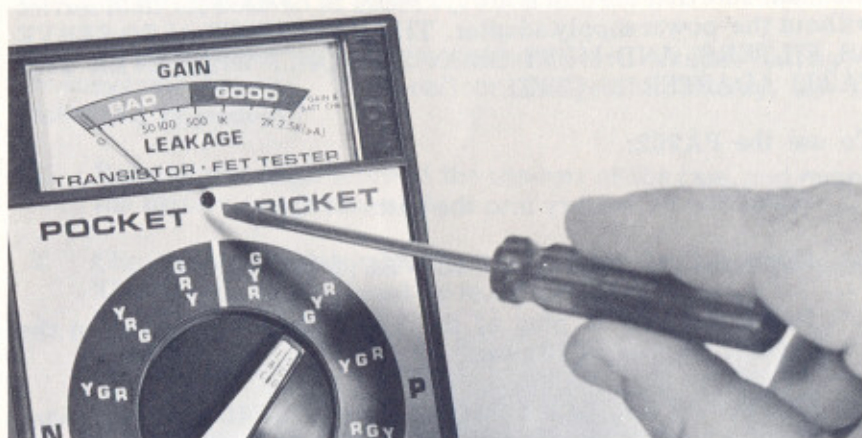


Fig. 4 Adjusting Meter Zero

LEAD CONNECTIONS

The patented Cricket test used with the permutator switch allows the three test leads to be connected in any order to the device to be tested. The three E-Z Hook® connectors are color coded for lead identification, and may be used with the 39G85 Touch-Test Probe (optional) for in-circuit board testing.

The small size of the E-Z Hooks® allows them to be connected to most transistor leads, even if only a small amount of the leads are exposed.

WARNING: Be sure power to the transistor has been removed and filter capacitors discharged before connecting test leads

1. To open the hook, grasp the hook with the first and second fingers, resting on the plastic collar. Place the thumb of the same hand at the rear of the ball. Now, by pulling back with the two fingers on the collar, the gold contact can be extended to allow it to be connected to the transistor leads.
2. Connect each of the E-Z Hooks® to each leg of the transistor to be tested. In the case of a small transistor with close spacing between the legs, make sure that the test connectors do not short to each other. (See Figure 6).
3. Perform the required test as indicated in the "TEST" section of the manual.

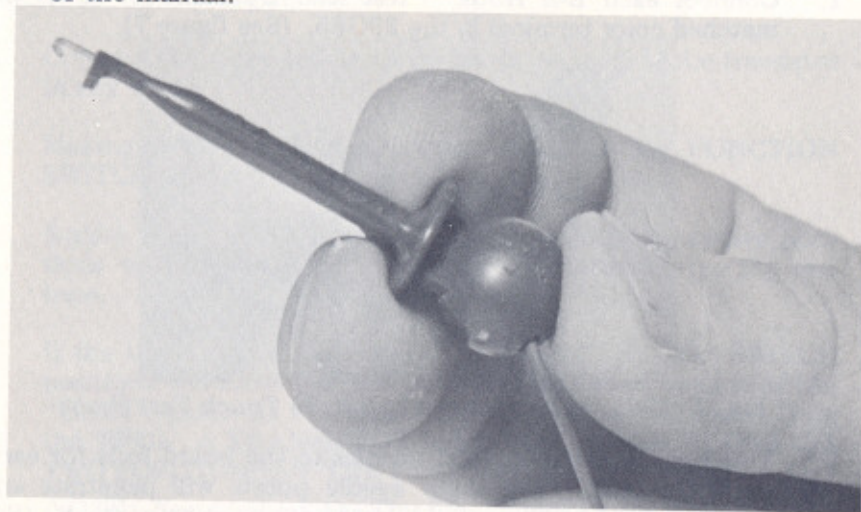


Fig. 5 Opening E-Z Hook® Connector

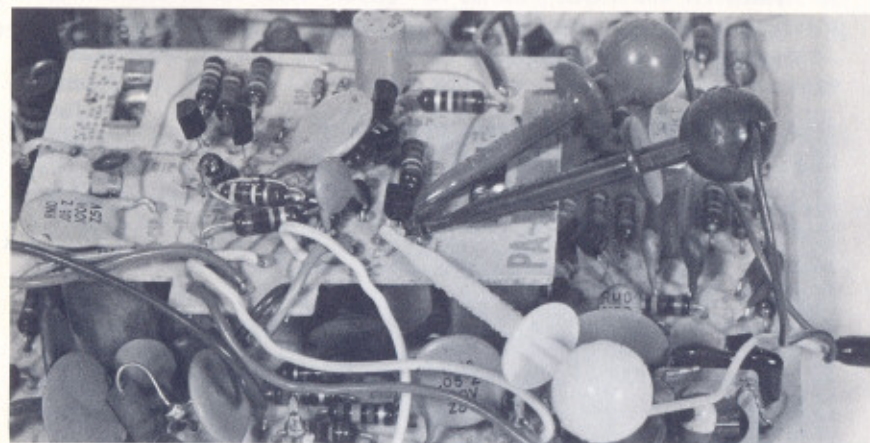


Fig. 6 Connections for Testing Transistor In-Circuit

39G85 TOUCH TEST PROBE (OPTIONAL)

The optional Sencore 39G85 Touch Test Probe may be used with the TF40 for fast in-circuit testing from the foil side of a circuit board.

At the rear of the probe are three recessed terminals which are identically color coded to the sleeves over the contact needles (R = Red, G = Green, Y = Yellow).

To use the 39G85:

1. Connect each E-Z Hook® test lead from the TF40 to the matched color terminal in the 39G85. (See figure 7)

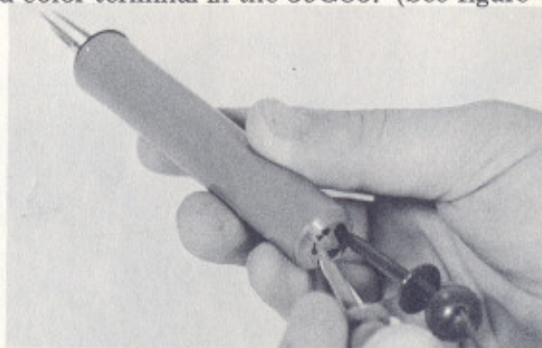


Fig. 7 Making Connections to 39G85 Touch Test Probe

2. Touch each of the contact needles to the board foils for each transistor lead. The sharp needle points will penetrate any solder flux or coating on the board for positive contact. (See figure 8).
3. Make the in-circuit Cricket gain test on the tester as explained under "Test Procedures."



Fig. 8 Using 39G85 Touch Test Probe

TEST PROCEDURES

GAIN TEST

No technical information is needed for testing for transistor gain. The same procedure is used for testing a transistor in or out-of-circuit.

WARNING: Be sure power to the transistor has been removed and filter capacitors discharged before connecting the test leads.

To test for transistor gain:

1. Connect the three test leads to the three leads of the transistor in any order.
2. Making sure the TF40 is turned on, move the FUNCTION SWITCH to the "GAIN" position.
3. Rotate the PERMUTATOR SWITCH through its twelve positions while watching the meter and/or listening for the test tone.
4. If the transistor has gain, one or two PERMUTATOR SWITCH positions will cause the meter to read in the good portion of the "GAIN" scale. At the same time, a test tone will sound from the TF40. A TRANSISTOR MAY TEST GOOD IN ONE OR TWO POSITIONS OF THE PERMUTATOR SWITCH.

NOTE: See Applications Tips No. 11 and 12 for more details.

5. If the transistor tests "BAD" in circuit, check the schematic of the transistor being tested to see if there is a low-impedance shunt path around the transistor (between any two elements). Generally, the TF40 will be able to check in-circuit leakage paths as low as 50 ohms (or lower depending on the transistors gain) or capacitive leakage up to 15uF.

Remove the transistor and check it out of circuit. If the transistor now checks "GOOD", perform the out-of-circuit leakage check.

In the case where a transistor checks "BAD" in circuit, and "GOOD" out-of-circuit, with no leakage, there is probably something wrong in the circuit. Check for:

1. Shorted P.C. foils,
2. Shorted components in the associated circuit.

NOTE: See Applications Tip No. 10 for more information on testing in low-impedance circuits.

LEAKAGE TESTS

Leakage in a transistor or FET can shunt signals or change bias voltages and upset circuit operation. This is especially true in high frequency (such as IF stages) or direct coupled stages. Transistor leakage should be checked whenever circuit operation indicates leakage is the cause of the circuit malfunction.

There are six possible leakage paths in a transistor (see figure 9). Collector/base (I_{CBO}) and emitter/base leakage (I_{EBO}) are the two "Key Leakage" paths that most-often upset circuit operation. In a FET, gate leakage (I_{GSO}) is the key leakage path. Using the PERMUTATOR SWITCH, the TF40 will read all six paths.

The leakage test should be done out-of-circuit since the external components of the circuit may cause false readings.

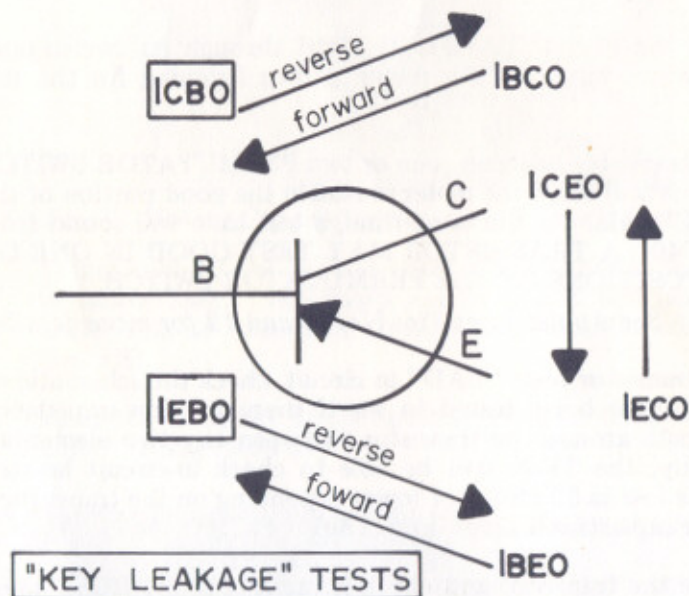


Fig. 9 Leakage Paths of PNP Transistor

To test for Key Leakage:

1. Perform the "GAIN" test as described in "GAIN TEST". Note which two positions indicate "GOOD" on this test.

2. Move the FUNCTION SWITCH to "LEAK" and switch the PERMUTATOR SWITCH to the same two positions that gave the "GOOD" test. These two positions are reading the I_{CBO} and I_{EBO} leakage of the transistor. In an FET they are reading I_{GSO} and I_{GDO} . The amount of leakage is read on the calibrated LEAKAGE scale of the meter.
3. To determine which is I_{CBO} , perform "LEAD IDENTIFICATION" test. I_{CBO} is read in the same PERMUTATOR SWITCH position used to determine basing.

NOTE: See Applications Tip No. 1 for details on when to perform this test.

To perform the Extended Leakage Test:

1. Perform the "KEY LEAKAGE" test described above. You will note that there are still four positions left on the PERMUTATOR SWITCH for the same polarity transistor.
2. Rotate the PERMUTATOR SWITCH through the remaining four positions on the same side of the polarity marking. If you are testing a bipolar transistor, you should see two of the positions give high (usually full-scale) leakage. These are the forward leakage current, I_{BCO} and I_{BEO} . The other two positions should read lower leakage. The two leakages in these last two positions being read are I_{CEO} and I_{ECO} . Figure 10 shows how the PERMUTATOR SWITCH selects leakage for the lead connections shown.
3. A junction FET will give high leakage in all four remaining switch positions since the channel of the FET is for all practical purposes a low-value resistor. The following leakage chart gives general guidelines for the amount of typical maximum leakage for different types of transistors and FETs.

NOTE: See Applications Tip No. 2 for details on when to perform this test.

MAXIMUM LEAKAGE FOR "GOOD" TRANSISTOR

DEVICE	"KEY LEAKAGE" I_{CBO} , I_{CEO}
Small Si. Transistor	0.1uA
Large Si. & Small Ge. Transistor	1-50uA
Large Ge. Transistor	10-2500uA
JFET	0uA
MOSFET	0uA

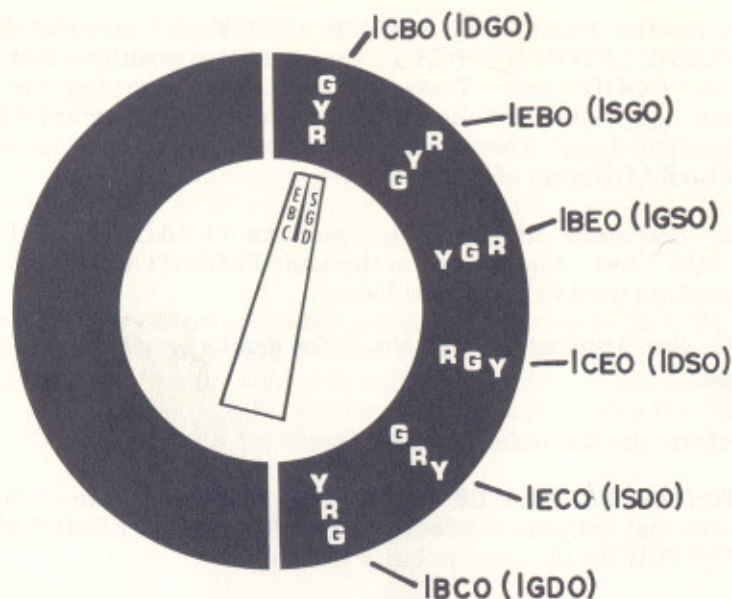


Fig. 10 Leakage Paths Checked At Different Settings of Permutator Switch if Green Lead is Connected to Emitter, Yellow to Base, Red to Collector of PNP Transistor. FET Leakages Shown in Parentheses.

LEAD IDENTIFICATION

The TF40 will identify all three leads of most bipolar transistors and the gate of an FET. The TF40 may be used to check the basing of a transistor to make sure it is installed in the circuit correctly. It can also help find a cross reference transistor if a direct substitute is not available. This test shows the polarity and basing of the transistor. It should be performed out of circuit for best results.

NOTE: See Applications Tip No. 13 for details on when to use this test.

To Determine Transistor Basing (Out-of-Circuit):

1. Perform the GAIN test. The POLARITY of the device will be indicated by the permutator pointer.
2. Switch the FUNCTION SWITCH to the "ID" position.
3. Switch between the two "GOOD" permutator positions while adjusting the "LEAD ID" control.

- a. If only one of the positions gives a "GOOD" test, this position indicates the lead arrangement of a bipolar transistor. The three elements of the transistor are listed on the switch pointer, and the corresponding colors of the test leads are shown on the outside ring.
- b. If one "GOOD" setting cannot be obtained with the "LEAD ID" control in any position, the device is a FET. The gate lead of the FET is indicated by the center letter on the outside ring. The remaining leads are connected to the source and drain leads and are interchangeable.

DIODE TESTING

The TF40 checks the front-to-back leakage ratio of a diode. This test is easier to perform than using an ohmmeter, (since the permutator switch reverses the leads for you). It is also more accurate. This increased accuracy is because the leakage scale of the TF40 is calibrated in microAmps. The readings can be compared directly to spec sheets to determine if the diode meets its reverse leakage specs. The test will also determine the diode lead connections. This test should be done out-of-circuit since the external components of the circuit may cause false readings.

To Check A Diode:

1. Connect the red lead to either end of the diode and the yellow lead to the other end.
2. Move the FUNCTION SWITCH to the "LEAK" position.
3. Move the PERMUTATOR SWITCH to either of the two top-most positions and note the meter reading. (See figure 11).
4. Rotate the PERMUTATOR SWITCH to either of the two bottom-most positions and note the meter reading. (See figure 11).

5. One position will read higher than the other for a good diode. The highest reading indicates forward leakage, and the lowest reads reverse leakage.
6. If the highest reading was obtained in the top switch position, the red lead is connected to the cathode of the diode, and if it was obtained in the bottom switch position, the yellow lead is connected to the cathode.
7. A shorted diode is indicated by two full scale indications, while no reading on either position will be produced by an open diode.

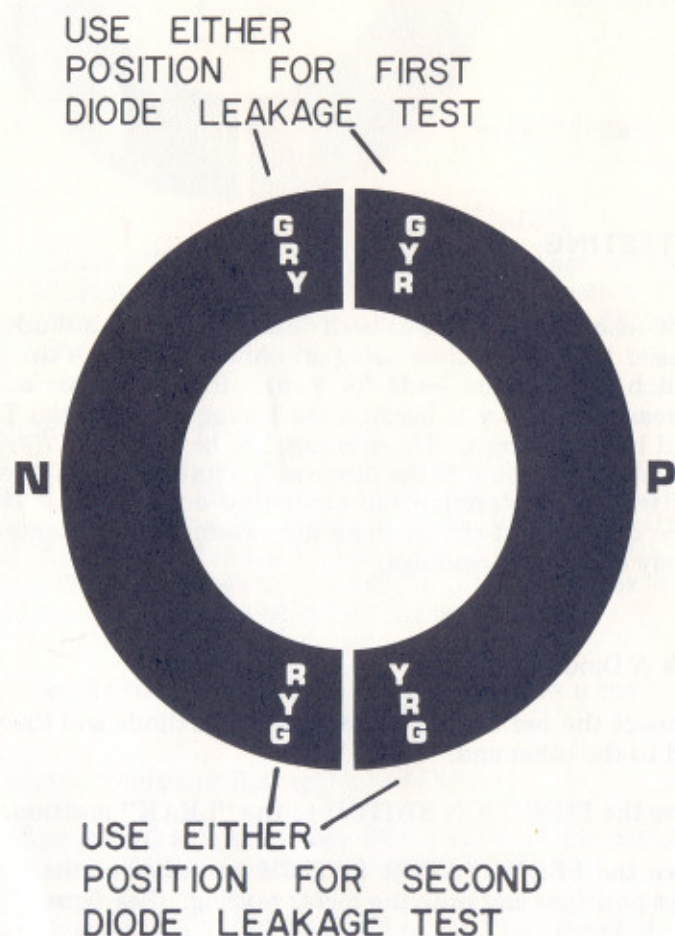


Fig. 11 Permutator Positions for Diode Test

CIRCUIT DESCRIPTION

THEORY OF OPERATION

Before designing the patented Cricket test, Sencore engineers found two important facts about transistors.

1. Over 90% of all transistor failures result in a no-gain condition.
2. All transistors with good gain will invert the output signal compared to the input signal. Since an active device is needed for this inversion, virtually no combination of passive components would duplicate this transistor action.

BLOCK DIAGRAM AND FUNCTION DESCRIPTION

There are four main sections to the TF40. Each section uses an Operational Amplifier (OP-AMP) as the main component. These sections are: 1) the power supply, 2) the test-signal generator, 3) the test amplifier, and 4) the inversion logic detector. The PERMUTATOR TEST SWITCH, meter and speaker circuits complete the TF40.

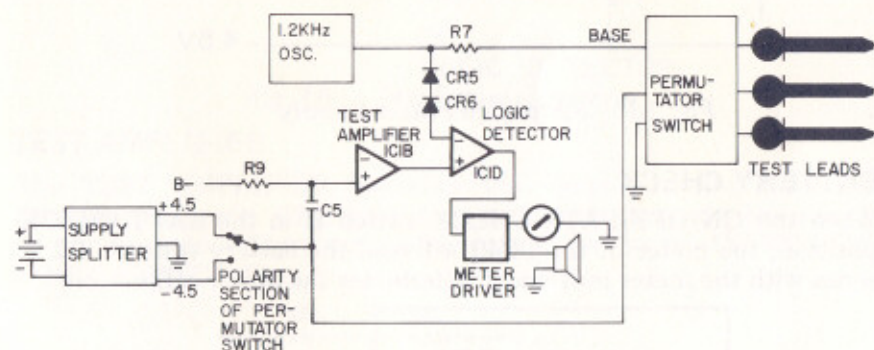


Fig. 12 Gain Test Block Diagram

The function of the PERMUTATOR TEST SWITCH is to allow connecting the transistor in any combination. This switch connects the three leads of the transistor under test in all possible combinations. The switch also selects either a positive or negative bias for different polarity devices.

POWER SUPPLY

A single 9 volt battery powers the TF40. This supply must provide a positive and negative output to power the OP-AMP I.C. and to test all polarities of transistors. To provide this pair of supplies, the 9 volts are divided with an OP-AMP SUPPLY SPLITTER — IC1A. This circuit will equally divide the 9 volt input while providing a zero reference voltage. As the voltage of the battery drops, the SUPPLY SPLITTER will continue to place the zero reference voltage at one-half the battery voltage.

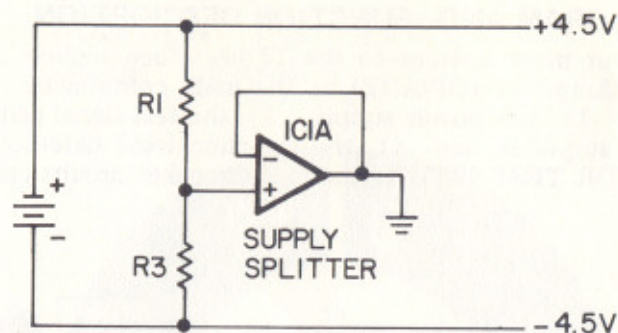


Fig. 13 Simplified Power Supply

BATTERY CHECK

When the ON/OFF/BATT CHECK switch is in the BATT CHECK position, the meter of the TF40 will read the battery voltage. R2 in series with the meter movement determines the meter calibration.

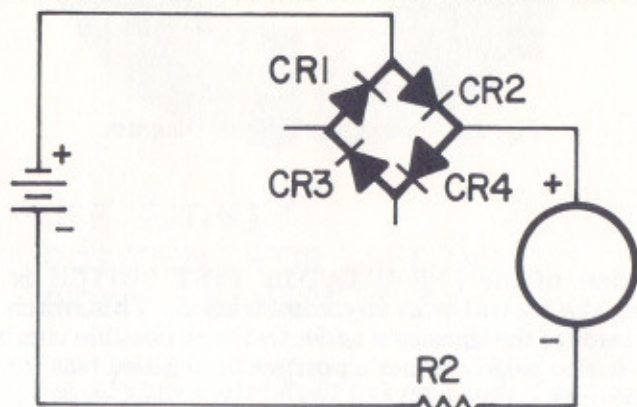


Fig. 14 Simplified Battery Test

TEST OSCILLATOR

The Test Oscillator IC1C provides two functions. First, a positive DC bias is fed to the INVERSION LOGIC DETECTOR through CR5 and CR6.

Second, IC1C is used to generate a square wave signal at approximately 1.2KHz. This output is fed through R7 to the BASE lead of the PERMUTATOR TEST SWITCH.

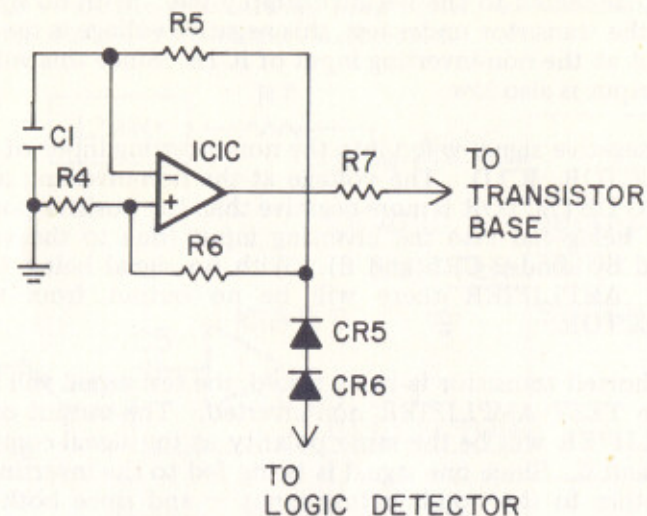


Fig. 15 Test Signal Generator

TEST AMPLIFIER

The TEST AMPLIFIER amplifies the signal returning from the transistor collector. This signal may be inverted from the test signal, or non-inverted. The amplified output is fed to the INVERSION LOGIC DETECTOR.

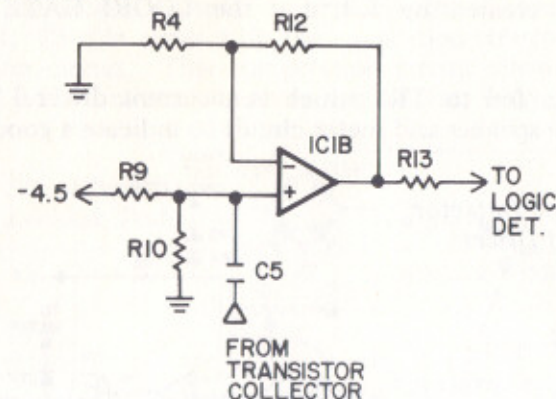


Fig. 16 Test Amplifier

INVERSION LOGIC DETECTOR

IC1D is really the heart of the TF40. It determines whether or not the transistor under test was able to invert the test signal.

A portion of the TEST OSCILLATOR signal is fed through CR5 and 6 to IC1D, the detector. These diodes shift the test signal approximately 1.2 volts positive and feed into the inverting input of the OP-AMP.

R9 is connected to the negative supply line. With no signal coming from the transistor under test, this negative voltage is the only signal present at the non-inverting input of IC1B. Since this voltage is low, the output is also low.

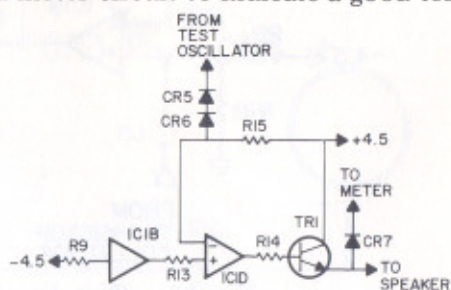
This negative signal is fed into the non-inverting input of the LOGIC DETECTOR, IC1D. The voltage at the non-inverting input of the LOGIC DETECTOR is more negative than the positive portion of the signal being fed into the inverting input (due to the voltage shift caused by diodes CR5 and 6). With no signal being fed into the TEST AMPLIFIER there will be no output from the LOGIC DETECTOR.

If a shorted transistor is being tested, the test signal will be returned to the TEST AMPLIFIER non-inverted. The output of the TEST AMPLIFIER will be the same polarity as the signal coming through CR5 and 6. Since one signal is being fed to the inverting input and the other to the non-inverting input — and since both are of the same polarity — they cancel each other resulting in no output from the LOGIC DETECTOR.

When a good transistor is being tested, the output of the TEST AMPLIFIER is inverted compared to the signal being fed through the diodes (CR5 and 6). The two signals are now aiding each other. The sum of the two signals is great enough to overcome the negative bias created by R9, and the LOGIC GATE produces an output.

This output is fed to TR1 which is a current driver. This stage drives both the speaker and meter circuit to indicate a good test.

Fig. 17 Logic Detector And Driver



LEAD ID TEST

The "LEAD ID" test operates the same as the GAIN test except the signal fed to the base of the transistor under test is fed through a 1 megohm variable resistor.

This resistor limits the amount of current being fed to the base of the transistor. The resistor is set until the emitter output of the transistor no longer gives a "readable inversion." Since the gain of the collector is usually greater than the emitter, the control can be set until only the collector output is detected.

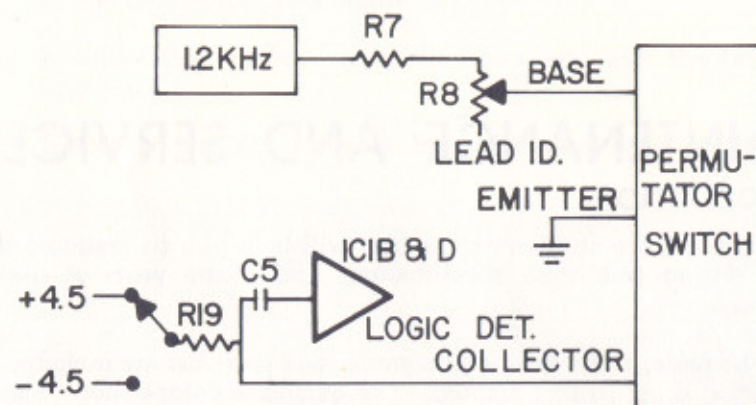
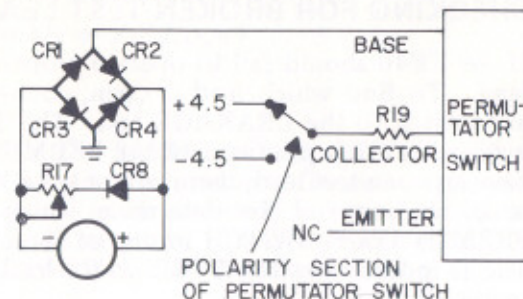


Fig. 18 Simplified Lead ID

LEAKAGE

The leakage test is made of a diode matrix consisting of CR1-4, and 8 and the meter movement. The positive or negative terminal of the battery is connected to the Collector lead through switch SW3A. The emitter lead is not connected. The base lead is connected to the meter through the diode matrix. CR1-4 are steering diodes to direct the proper polarity calibration current through the meter movement. CR8 in series with the calibration control R17, forms a compression circuit. This compression circuit allows the meter to read from 0-2500 microAmps on a single meter scale.

Fig. 19 Simplified Leakage Test



PERMUTATOR TEST SWITCH

This twelve position switch allows all lead combinations to be connected to the tester. There are six possible lead combinations (permutations) for the three leads of a transistor. In addition, there are two possible polarities. This results in a total permutation of 12 different transistor basings.

MAINTENANCE AND SERVICE

INTRODUCTION

This Maintenance and Service section will help you to maintain the TF40 within published specifications and assure years of useful application.

The schematic, parts location diagrams, and parts list are included as a separate sheet to this manual. The exclusive color-coded "Signal Tracer" schematic has the key signal paths marked for fast identification and recognition of supply voltages, function paths, and circuit waveforms. The color coding simplifies and speeds understanding of the circuit functions and pinpoints signal locations that otherwise would be "lost in the woods."

Warranty information is printed on the back of the Quality Assurance tag attached to the instrument. Factory Service information is located inside the back cover of this manual.

CHECKING FOR BROKEN TEST LEADS

If the TF40 should fail to operate properly, check for a broken test lead. To find which lead is open, connect all three leads together and switch to the LEAKAGE test. The TF40 should read full-scale leakage in ALL positions of the PERMUTATOR SWITCH. If you have an open test lead, there will only be two positions that give full-scale readings. To determine which lead is open, leave the PERMUTATOR SWITCH in one of these two positions. The open lead is indicated as EMITTER on the lead identification code on the switch.

The break usually occurs within $\frac{1}{2}$ " of the E-Z Hook® connector. To repair a broken lead:

1. Give a sharp tug to the lead that has been determined to be open. If the break is near the connector, the wire will slide out of the insulation.
2. Re-strip the wire leaving about $\frac{1}{2}$ " of exposed conductor.
3. Open the E-Z Hook® by pulling the ball straight off the back of the connector. (See figure 20).
4. Resolder the test lead onto the hook, and slide the ball back into place.
5. Retest the lead to make sure the problem has been corrected.

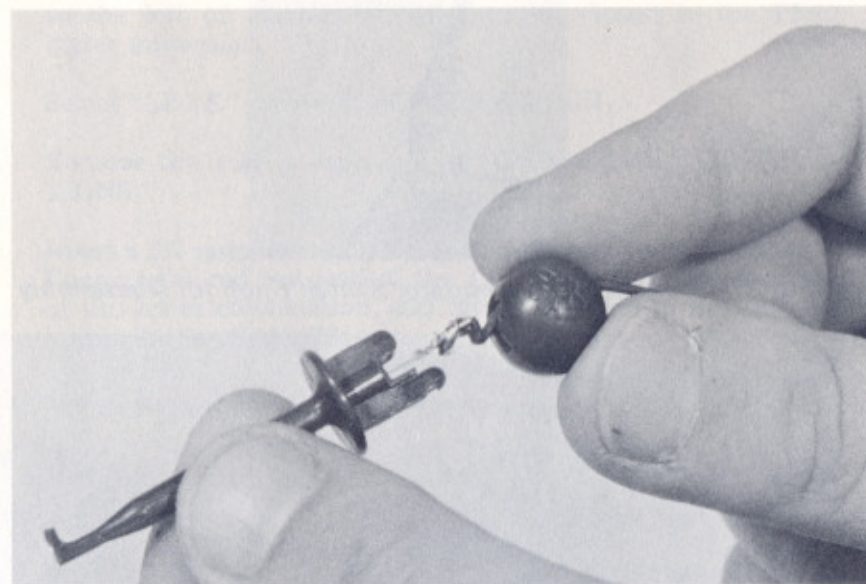


Fig. 20 Disassembly of E-Z Hook® for Service

DISASSEMBLY

1. Remove the knob from the PERMUTATOR SWITCH. This knob is held in place by a friction mount. To remove it, use two pieces of soft material (such as several layers of cloth) to cushion the jaws of a pair of pliers. Grasp the pointer of the knob and pull it straight off the shaft. (See figure 21).

2. Remove the two screws on either side of the bottom support bracket. Pull the bracket away from the TF40 body. (See Figure 22).
3. Remove the battery compartment cover and battery. Remove the two screws located inside the battery compartment. The front of the case may now be lifted free from the rear of the case. If it is necessary to remove the printed circuit assembly, the battery clip is pulled through the hole in the case that the meter passes through. The battery may be reconnected to the terminals to operate the TF40 for service or calibration.



Fig. 21 Removal of Permutator Switch Knob for Disassembly

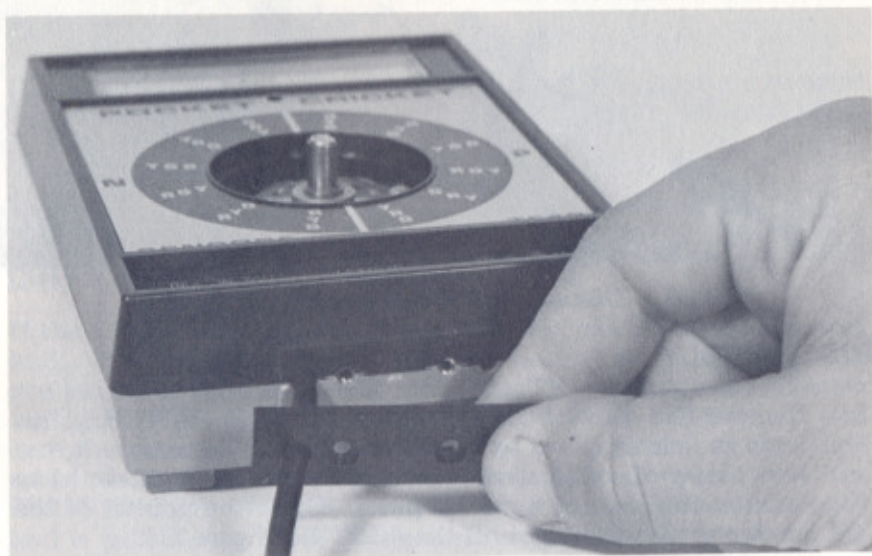


Fig. 22 Removing Bottom Support Bracket for Disassembly

CALIBRATION

The only internal calibration control is the leakage calibration adjustment.

Equipment needed:

1. 2K variable resistor
2. DC milliammeter capable of reading 2.5mA.

To set internal leakage calibration:

1. Make sure the meter is zeroed properly when the unit is off. See "METER ZERO" instructions on page 14 for Mechanical Meter Zero instructions.
2. Turn the PERMUTATOR TEST SWITCH to the first position to the left of the polarity dividing line closest to the TF40 meter movement.
3. Select "LEAK" on the FUNCTION SWITCH.
4. Remove the case as explained in "DISASSEMBLY INSTRUCTIONS."
5. Insert a 2K variable resistor in series with a DC milliammeter. Connect the red test lead of the TF40 to the positive terminal of this series combination, and the yellow lead to the negative terminal. (See figure 23).
6. Adjust the series resistor until the milliammeter reads 2.5mA.
7. Adjust R17 until the TF40 meter reads full scale. (Fig. 24)

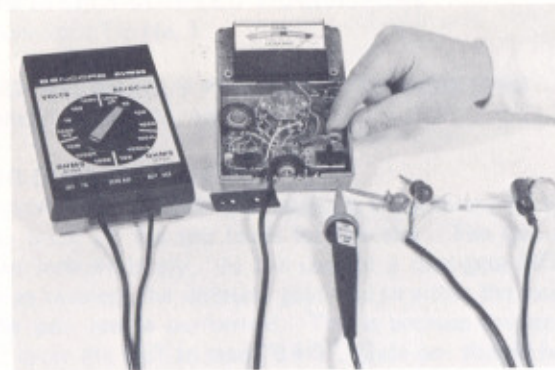


Fig. 23 Adjusting Leakage Calibration Control

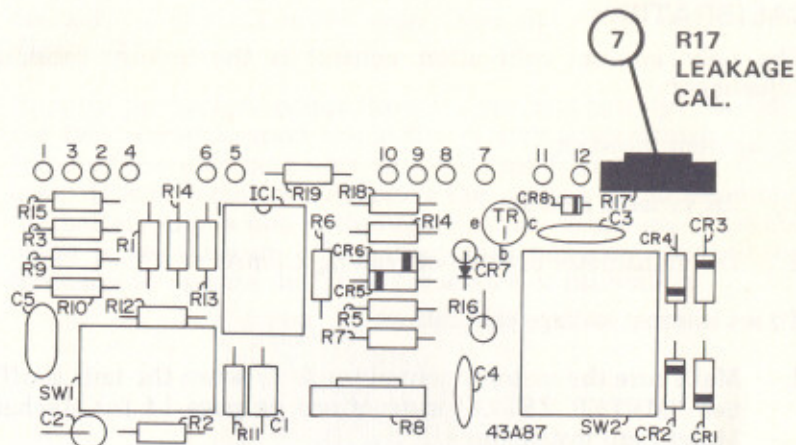


Fig. 24 Leakage Calibration

APPLICATION TIPS

Due to the wide variety of transistor types and circuits, there are a few transistors you may have questions about testing. Listed below are most of these special cases.

1. CIRCUITS REQUIRING "KEY LEAKAGE" TESTS

Most transistors that fail do so completely. These transistors will all be found by using the Cricket Gain test. Two exceptions are transistors that are just starting to go bad, and those in "critical-bias" circuits.

Critical-bias circuits fall into two main categories: 1) High frequency circuits, and 2) Direct-coupled circuits. In either type of circuit, any amount of transistor leakage can change the bias of the transistor enough to disrupt circuit operation. These transistors should be tested in-circuit using the Gain test. The circuit should then be tested for proper biases at the transistor leads as indicated in the schematic for the unit on which you are working. If these voltages are not as specified, the possibility of leakage is very high. If your troubleshooting points to the transistor — even though it has gain — it should be checked for leakage as explained in the Operation section. (SEE ALSO: Applications Tip No. 2).

2. CIRCUITS REQUIRING "EXTENDED LEAKAGE" TESTS

Emitter/collector leakage can cause improper circuit operation. While this type of leakage is rarely found in small signal transistors, it may appear in audio power output transistors, RF transmitter output transistors, and hi-current voltage regulator transistors. In these circuits, the voltages should be checked after the in-circuit gain test is performed. If the bias voltages are not correct, both the KEY and EXTENDED LEAKAGE TESTS should be performed. (SEE ALSO: Applications Tip No. 1).

3. TESTING HIGH FREQUENCY TRANSISTORS

See Applications Tip No. 1.

4. TESTING DIRECT-COUPLED TRANSISTORS

See Applications Tip No. 1.

5. TESTING INTERNALLY PROTECTED TRANSISTORS

See Applications Tip No. 12.

6. TESTING DUAL-GATE FETS

Since a dual-gate FET has four test leads, it is necessary to know basing information to hook up the test leads for the test. The two gates of the FET are tested independently. In the case of a dual-gate MOSFET, it is also necessary to connect the untested gate lead to either the source or drain lead before the gain test is performed. This is because the second gate, if left open, will cause the FET to read "BAD". Gate one should be connected to the source while testing gate 2, and gate 2 connected to the drain while testing gate one.

7. TESTING MOSFETS (IG - FETS)

When testing a metal-oxide device in circuit, no special precautions are necessary. If you test the device out-of-circuit, however, be sure to prevent possible damage to the gate due to static electricity. Keep all leads of the device shorted together by twisting them or connecting a jumper between them before removing the MOSFET from the circuit. Connect the test leads and remove the short, and test the transistor. Then, reshort the leads again before removing the test leads.

8. TESTING "NOISY" TRANSISTORS

At times, an audio transistor may check "GOOD" but cause distortion to the signal being amplified. The TF40 will help locate most of these transistors. The "Noise" may be caused by an intermittent junction (See Applications Tip No. 9). At other times, high leakage is the cause. If the circuit parameters (voltage and signal) indicate the distortion is being caused in a particular transistor, it should be tested for leakage (See Applications Tips No. 1 and 2).

9. INTERMITTENT TRANSISTORS

The combined gain and leakage test result in a 99.9% accuracy for all transistors tested. Many of the remaining .1% (1 in 1000) transistors are intermittent. The intermittent may be thermal (unit operates for a short time then cuts out) or mechanical (unit fails when bumped). Many of these intermittents may be found by taking advantage of the test tone. Perform the GAIN test, and leave the TF40 in one of the test positions that reads "GOOD". Now the transistor may be heated, cooled with freeze spray, or tapped. If there is any change in the tone, the transistor is intermittent and probably the cause of the circuit malfunction.

10. TESTING LOW IMPEDANCE CIRCUITS

The few transistors that have very low-value AC shunt paths (fewer than 1 out of every 100 transistors) will not test in-circuit. In many of these circuits, it is easy to disconnect the shunting path. In the case of a direct-coupled audio-output transistor, the speaker is the load. By disconnecting the speaker, the transistor may be tested in-circuit. In the case of an RF transmitter output, a low-resistance RF coil is usually the loading component and can be isolated from the transistor. Or, in the case of a high-power voltage regulator, the power supply filters are usually the cause of the loading, and can be eliminated by disconnecting one of the leads going to the capacitor.

11. ONE POSITION TESTS (IN-CIRCUIT)

Since most transistors give a "GOOD" indication on two permutator switch positions, many technicians assume all good transistors do. This is not the case, however. If the transistor being tested has a diode connected between two elements, or is direct-coupled to another transistor or I.C., it may only check in one position. The reason is that the diode action of the second solid-state device may "short" out one of the two transistor outputs.

When you encounter a one-position in-circuit test, refer to the schematic to see if the transistor under test is direct-coupled to any other solid-state device. If so, the one position test indicates that the transistor has gain. If there is any doubt, check the bias voltages. A final confirmation may be made out-of-circuit. (SEE ALSO: Application Tips No. 1 and 12).

12. ONE POSITION TESTS (OUT-OF-CIRCUIT)

Since most transistors give a "GOOD" indication on two permutator switch positions, many technicians assume all good transistors do. This is not the case, however. Some transistors have an extra diode junction built in for protection (as in a horizontal output transistor of a TV set) or to change its input characteristics (as in some IF transistors). This may cause only one switch position to give a "GOOD" test. If you have any doubt as to whether a transistor should read in one position or two, simply check a replacement transistor. If it reads on two positions and the suspected transistor on one, reject the transistor. The EXTENDED LEAKAGE test will also show an extra leakage path. Again if there is any question, compare the readings on a replacement transistor.

13. WHEN TO USE "LEAD ID"

Most technicians find times when they would like to know the basing diagram of a transistor, but reference material is not readily available. The most common times are: 1) A transistor has been replaced, and there is a possibility that it was not installed properly, 2) A cross-reference transistor is available, but the basing diagram is different from the original transistor, 3) An imported unit has transistors that are not shown in any cross-reference material. If any of these conditions arise, refer to the LEAD IDENTIFICATION section of the manual to determine transistor basing. If a cross-reference transistor is needed, the basing information plus the signal level and power supply ratings will usually give sufficient information to determine a cross-reference from the specifications included in most cross-reference books.

14. TESTING SCR'S

The TF40 will check some SCR's in use. However, this check will only verify if the SCR is good. It is not possible to determine if a device that produces a BAD reading is actually bad, or if it is a type that cannot be tested. (No transistor tester will completely verify the condition of all SCR's, since the actual operating performance tests for transistors/FETs are different from SCR tests.)

Follow this procedure to determine if an SCR is good:

1. Perform the Gain Test by connecting the leads in any order and rotating the Permutator switch through all positions.
2. The SCR is good only if all of the following occur:

- a. Two "Good" indications are obtained.
 - b. The basing of the two test positions with "Good" readings have the "E" and "B" leads interchanged.
 - c. No leakage is indicated on either position.
3. SCR types that require a gate trigger current of more than 10mA will not be "fired" by the test circuit. Therefore, no indication during the Gain Test may be due to either a bad SCR, or may be one of these types that cannot be checked by the TF40. Verify suspected defective SCR's by substitution of a known good SCR of the same type.

NOTES

NOTES

SERVICE AND WARRANTY

You have just purchased one of the finest portable transistor testers on the market today. The Sencore TF40 has been inspected and tested twice at the factory and has passed a rugged use test by our Quality Assurance Department to insure the best quality instrument to you. If something should happen, the TF40 is covered by the exclusive 100% Made Right Lifetime Guarantee as explained on the warranty policy enclosed with your instrument.

Sencore has six factory-owned Regional Sales and Service Centers to serve you. Instruments to be serviced should be returned to the nearest Regional Center by UPS if possible. Parcel Post should be used only as a last resort. Instruments should be packed with the original packing materials or equivalent, and double boxed to insure safe arrival. The display carton is not an acceptable shipping container. When returning an instrument for service, be sure to state the nature of the problem to insure faster service.

If you wish to repair your own TF40, we have included a schematic and parts list. Any of these parts may be ordered directly from the Regional Center nearest you.

We reserve the right to examine defective components before an in-warranty replacement is issued.

SENCORE REGIONAL SALES AND SERVICE CENTER

Sencore West
3200 Sencore Drive
Sioux Falls, SD 57107
(605) 339-0100
TWX 910-660-0300

TF40

POCKET CRICKET

TRANSISTOR AND FET TESTER

SCHEMATIC AND PARTS LIST
WITH "SIGNAL-TRACER" CODING



SENCORE

3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

PRINTED IN U.S.A.

SENCORE
THE ALL AMERICAN LINE OF HIGH QUALITY TEST EQUIPMENT

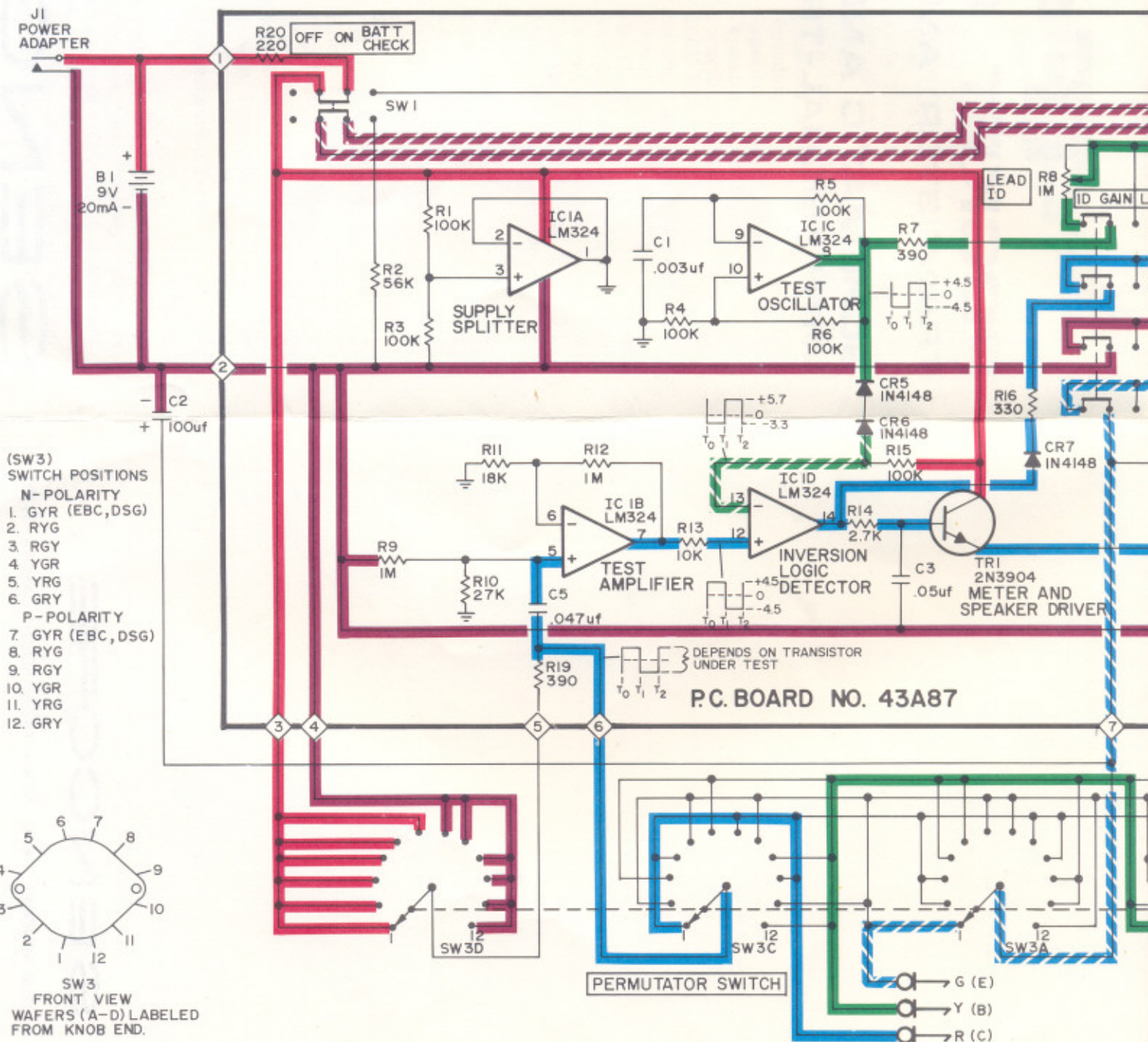
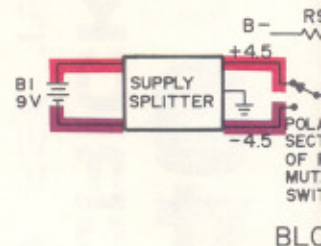
TF40 PARTS LIST

SCHEMATIC REF. NO.	PART NO.	DESCRIPTION	PRICE
IC1	69G13	IC, LM324 Quad Op Amp	3.25
TR1	19A33-1	Transistor, NPN, 2N3904	.50
CR1-4	50C3-2	Diode, 1N695	.25
CR5-8	50C5-2	Diode, 1N4148	.25
R8	15C7-26	Control, 1 Meg. LEAD ID	.75
R17	15C7-17	Control, 1K, Leakage Cal.	.75
C1	24G182	Capacitor, .0033uF, 33V Poly	.25
C2	24G347	Capacitor, 100uF, 10V Tantalum	.75
C3	24G50	Capacitor, .05uF, $\pm$ 30% Disc.	.25
C4	24G207	Capacitor, .01uF, Disc.	.25
C5	24G212	Capacitor, .047uF, 10%, 250V Mylar	.25
SW1	25A239	Switch, Slide, 2P3T, OFF-ON	1.00
SW2A	25A239	Switch, Slide, 2P3T (long) ID - GAIN	1.00
SW2B	25A233	Switch, Slide, 2P3T (short)	1.00
SW3	25A228	Switch, Rotary 12-pos.	5.25
LS1	48A3	Speaker, 1" dia. 8 ohm	5.25
M1	23B61A	Meter, 300uA, 7200 Ohm	10.25
ASSEMBLIES			
	39G99	Test Lead Assy.	9.25
	110C336-40	Case Front Assy.	2.50
	110C339	Case Back Assy.	1.75
	110C338	Battery Door Assy.	3.25
MISCELLANEOUS			
J1	26G203	Jack, AC Adaptor	.75
	8K153	Escutcheon, Knob Insert	.25
	21A70	Knob, Molded	.25
	64A53	Clip, Molded Case Retainer	.25
	21A50	Thumbwheel	.25
	55A37	Stand	.75
	26A152	Battery Terminals	.50
	37G37	Feet	.45
	1217T	Familiarization Tape	2.75

Components not listed are standard replacement parts and may be purchased locally. When ordering parts, please specify instrument model number, schematic reference, part number, and description. Please include remittance (check or money order) with your order, otherwise invoices will be shipped C.O.D. Minimum billing is \$3.00. Prices and specifications in effect at date of printing and subject to change without notice.

NOTES:

1. SIGNALS SHOWN ARE WITH A GOOD TRANSISTOR CONNECTED AND PERMUTATOR SWITCH IN GYR (EBC), N-POLARITY POSITION.
2. ALL RESISTANCES SHOWN IN OHMS; ALL CAPACITANCES AS SHOWN.
3. FRONT PANEL CONTROL NAMES ARE ENCLOSED IN A BOX



SCHEMATIC DIAGRAM TF40

