PRICE $2.00

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT® by Daystrom

TRANSISTOR TESTER

MODEL IM-30

RESISTOR AND CAPACI

RESISTORS

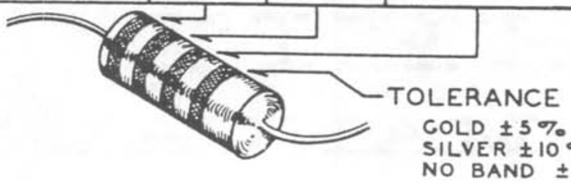
The colored bands around the body of a color coded resistor represent its value in ohms. These colored bands are grouped toward one end of the resistor body. Starting with this end of the resistor, the first band represents the first digit of the resistance value; the second band represents the second digit; the third band represents the number by which the first two digits are multiplied. A fourth band of gold or silver represents a tolerance of ±5% or ±10% respectively. The absence of a fourth band indicates a tolerance of ±20%.

The physica… …stor is related to its wattage rating. … …sively as the wattage rating is increased. … of 1/2 watt, 1 watt and 2 watt resistors are approximately 1/8", 1/4" and 5/16", respectively.

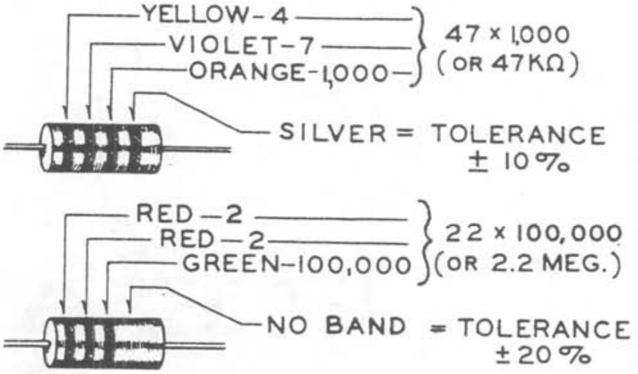
The color code chart and examples which follow provide the information required to identify color coded resistors.

CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD	-	-	.1
SILVER	-	-	.01



EXAMPLES



CAPACITORS

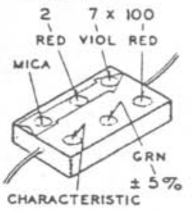
Generally, only mica and tubular ceramic capacitors, used in modern equipment, are color coded. The color codes differ somewhat among capacitor manufacturers, however the codes shown below apply to practically all of the mica and tubular ceramic capacitors that are in common use. These codes comply with EIA (Electronics Industries Association) Standards.

MICA

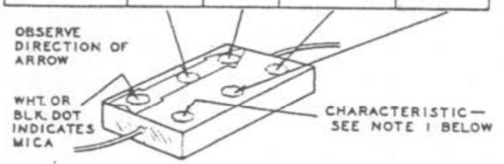
CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLER. %
BLACK	0	0	1	±20
BROWN	1	1	10	—
RED	2	2	100	± 2
ORANGE	3	3	1,000	± 3
YELLOW	4	4	10,000	—
GREEN	5	5	—	± 5
BLUE	6	6	—	—
VIOLET	7	7	—	—
GRAY	8	8	—	—
WHITE	9	9	—	—
GOLD	-	-	.1	—
SILVER	-	-	.01	± 10

EXAMPLE



2,700 μμf ± 5 %
OR .0027 μfd



(VALUE IN μμf—SEE NOTE 3 BELOW)

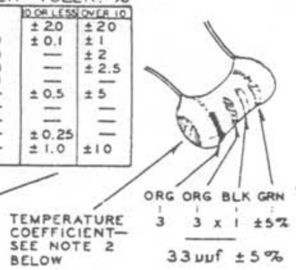
TUBULAR CERAMIC

Place the group of rings or dots to the left and read from left to right.

CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLER. % 10 OR LESS	TOLER. % OVER 10
BLACK	0	0	1	± 20	± 20
BROWN	1	1	10	± 0.1	± 1
RED	2	2	100	—	± 2
ORANGE	3	3	1,000	—	± 2.5
YELLOW	4	4	10,000	—	—
GREEN	5	5	—	± 0.5	± 5
BLUE	6	6	—	—	—
VIOLET	7	7	—	—	—
GRAY	8	8	—	± 0.25	—
WHITE	9	9	—	± 1.0	± 10

EXAMPLE



33 μμf ± 5 %

(VALUE IN μμf—SEE NOTE 3 BELOW)

NOTES:

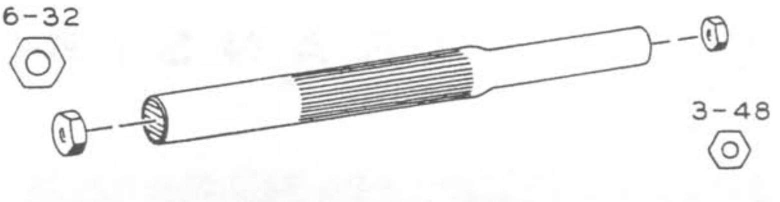
1. The characteristic of a mica capacitor is the temperature coefficient, drift capacitance and insulation resistance. This information is not usually needed to identify a capacitor but, if desired, it can be obtained by referring to EIA Standard, RS-153 (a Standard of Electronic Industries Association.)

2. The temperature coefficient of a capacitor is the predictable change in capacitance with temperature change and is expressed in parts per million per degree centigrade. Refer to EIA Standard, RS-198 (a Standard of Electronic Industries Association.)

3. The farad is the basic unit of capacitance, however capacitor values are generally expressed in terms of μfd (microfarad, .000001 farad) and μμf (micro-micro-farad, .000001 μfd); therefore, 1,000 μμf = .001 μfd, 1,000,000 μμf = 1 μfd.

USING A PLASTIC NUT STARTER

A plastic nut starter offers a convenient method of starting the most used sizes: 3/16" and 1/4" (3-48 and 6-32). When the correct end is pushed down over a nut, the pliable tool conforms to the shape of the nut and the nut is gently held while it is being picked up and started on the screw. The tool should only be used to start the nut.



Assembly

and

Operation

of the

HEATHKIT by Daystrom

TRANSISTOR TESTER

MODEL IM-30

HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

a subsidiary of DAYSTROM, INCORPORATED

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*Fold-out from page.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

2/22/63

SPECIFICATIONS

TESTS

Gain.	DC beta (h_{FE}): 0-300 on two scales. DC alpha (α): 0-0.9966 on two scales.
Short.	Collector to emitter.
Leak Current.	Collector to emitter, I_{ceo}. Collector to base, I_{cbo}.
Diodes.	Forward and reverse current.
By Calculation.	AC current gain $\frac{\Delta I_c}{\Delta I_b}$. DC transconductance $\frac{I_c}{E_b}$. AC transconductance $\frac{\Delta I_c}{\Delta E_b}$. DC resistance, base $\frac{E_b}{I_b}$, collector $\frac{E_c}{I_c}$. AC resistance, base $\frac{\Delta E_b}{\Delta I_b}$, collector $\frac{\Delta E_c}{\Delta I_c}$.

METER

Scales.	15-0-15 and 50-0-50.
Sensitivity.	10-0-10 μa, 100 K ohm/volt.
Resistance.	5000 ohms.

POWER SUPPLY

Internal.	Seven size D 1.5 volt batteries.

EXTERNAL CONNECTORS

Binding Posts.	Transistors and diodes. EXTernal BIAS supply. EXTernal COLLECTOR VOLTAGE supply. EXTernal LEAK VOLTAGE supply.

SWITCHES

Lever.	Selects any one of eight tests: BASE CURRENT GAIN COLLECTOR VOLTAGE COLLECTOR CURRENT LEAK VOLTAGE SHORT TEST I_{ceo} or DIODE TEST I_{cbo}

BIAS	Selects INT. 1.5 V battery or EXT. source.
POLARITY	Selects NPN or DIODE FWD, OFF, and PNP or DIODE REV.
COLLECTOR VOLTAGE	Selects internal batteries in 1.5 volt increments up to 9 volts; selects external voltages up to 50 volts.
LEAK VOLTAGE	Selects internal batteries in 1.5 volt increments up to 9 volts; selects external voltages up to 150 volts.
LEAK CURRENT	Selects meter ranges from 15 μa to 1.5a in steps of times 10.
COLLECTOR CURRENT	Selects meter ranges from 150 μa to 15a in steps of times 10.
GAIN, HIGH-LOW	Selects Gain Test control scales of 0-150 Beta and 0-0.993 Alpha, or 150-300 Beta and 0.993-0.9966 Alpha.

CONTROLS

BIAS	Adjusts collector current to any value from 0 to 15a.
Gain Test	Calibrated scale shows actual gain (Beta and Alpha) of transistor when control is adjusted to null the meter.

GENERAL

Universal transistor socket.

Dimensions	5-1/2" high x 10-1/4" deep x 10-3/4" wide.
Net Weight	8 lbs.
Shipping Weight	10 lbs.

See Operational Picture on fold-out from Page 24.

INTRODUCTION

The Model IM-30 Transistor Tester is a portable tester designed for production testing, incoming inspection, servicing, and design work.

By using the switches any DC operating point of a transistor or diode can be quickly set up. The gain of a transistor is found by comparing the BASE and COLLECTOR currents, which are indicated by nulling the meter with the Gain Test control.

CIRCUIT DESCRIPTION

The IM-30 Transistor Tester tests transistors and diodes under conditions that correspond to actual DC operating conditions.

AC operating conditions can be readily found by testing the transistor at two different bias points and calculating the desired AC operating condition.

The 4-lever, 3-position switch selects the various tests by moving the proper lever to the desired test position. Tests selected by the Lever switch are BASE CURRENT, GAIN, COLLECTOR VOLTAGE, COLLECTOR CURRENT, LEAK VOLTAGE, SHORT TEST, I_{ceo} or DIODE, and I_{cbo}.

The following paragraphs describe each test separately. Refer to the individual schematic for a better understanding of each test.

BASE CURRENT TEST (I_b)

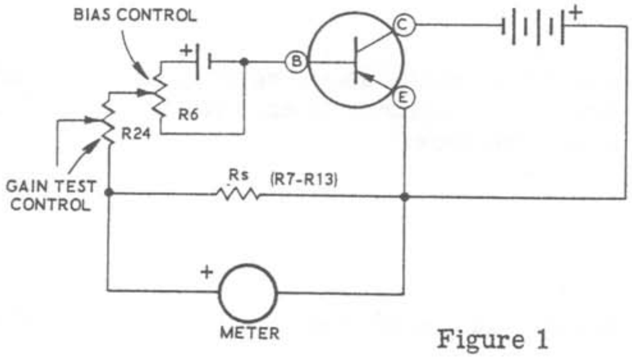


Figure 1

The meter is connected in series with the base circuit, therefore it shows base current directly. R_s (resistors R7 through R13) is the meter shunt which varies in value with the position of the LEAK-DIODE-BASE CURRENT switch. Collector voltage is selected with the COLLECTOR VOLTAGE switch. BIAS control R6 is set for the specified base current.

GAIN TEST (DC BETA - DC ALPHA)

For this test, the meter shows the difference between the voltage drop across R_s and that across Gain Test control R24. By adjusting R24 for meter null, the voltage drop across R_s equals the voltage drop across R24. That is, I_c (collector current) times R_s (meter shunt value) equals I_b (base current) times R24 (Gain Test control). The gain, beta, is directly proportional to the setting of R24.

R24 has a calibrated dial (0-150) which indicates beta or alpha directly. Alpha equals beta divided by beta plus one.

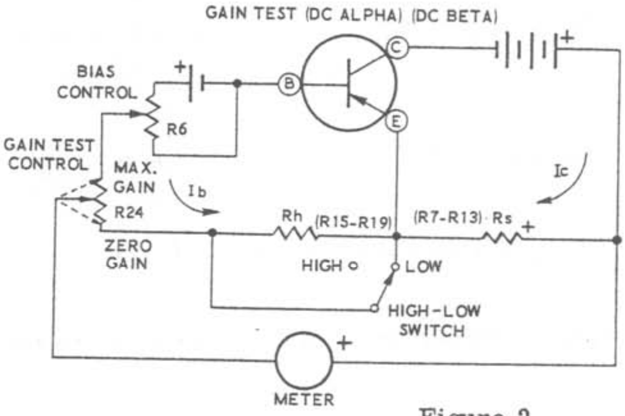


Figure 2

If at any time the gain of a transistor is higher than 150, the GAIN HIGH-LOW switch should be placed in its HIGH position. This puts resistance R_h (which consists of resistors R15 through R19) in series with the Gain Test control and extends the beta scale from 150 to 300. Resistance R_h varies with the position of the COLLECTOR CURRENT switch.

The true gain of the transistor is shown regardless of the BIAS control setting.

COLLECTOR VOLTAGE TEST (E_c)

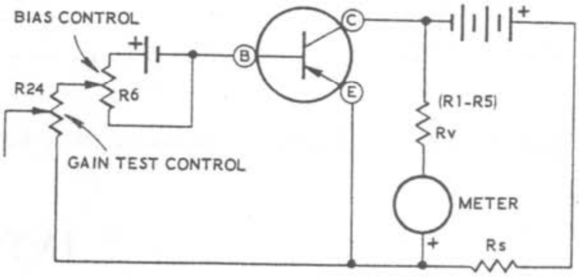


Figure 3

The meter shows the voltage between the collector and the emitter. This voltage is selected with the COLLECTOR VOLTAGE switch. R_v is the meter shunt which is made up of resistors R1 through R5. This voltage is checked under DC operating conditions of the transistor.

COLLECTOR CURRENT TEST (I_c)

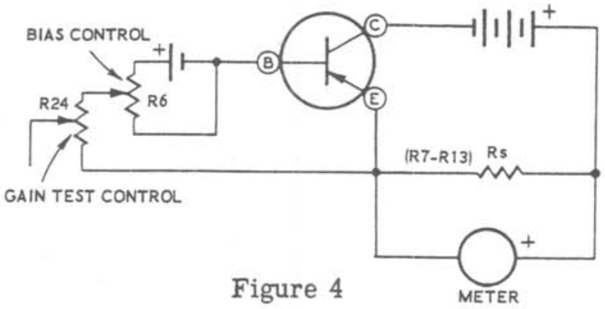


Figure 4

This current is checked between collector and emitter as shown in Figure 4. The BIAS control is adjusted for the desired collector current.

LEAK VOLTAGE TEST (E_L)

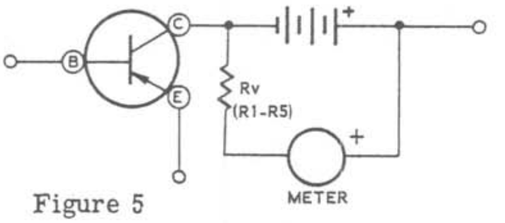


Figure 5

In this test, the meter measures the supply voltage selected by the LEAK voltage switch. The base and emitter of the transistor are open in this test.

SHORT TEST

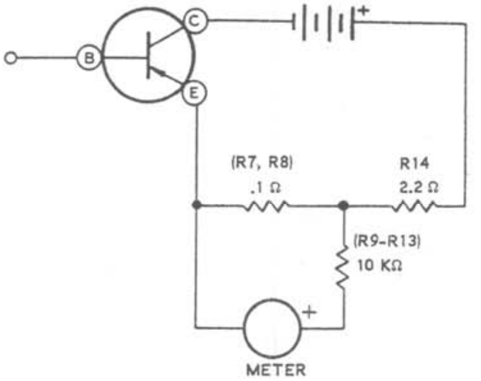


Figure 6

Here the meter is in series with the collector and emitter. Collector voltage is selected with the COLLECTOR VOLTAGE switch. .1Ω, 2.2Ω, and 10 KΩ resistors act as the meter shunt and dropping resistors to protect the meter when a shorted transistor is checked and to give the proper meter deflection.

COLLECTOR TO EMITTER LEAKAGE (I_{ceo}) OR DIODE TEST

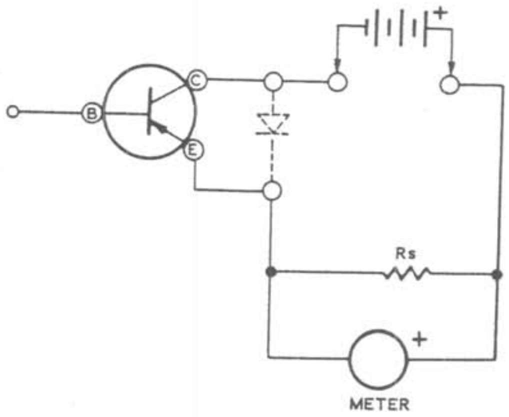


Figure 7

The meter shows leakage current between collector and emitter, with the base open. Again, resistance R_s is the meter shunt, as selected by the LEAK-DIODE-BASE switch.

When checking diodes, the diode replaces the transistor as indicated in Figure 7. To check the forward current of a diode, the power supply voltage is reversed with the POLARITY switch.

COLLECTOR TO BASE LEAKAGE TEST (I_{cbo})

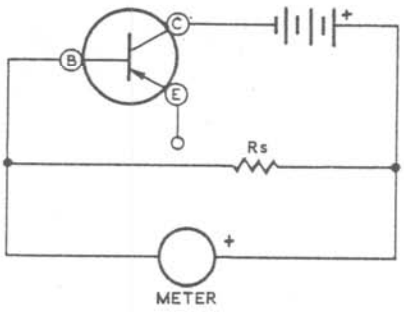
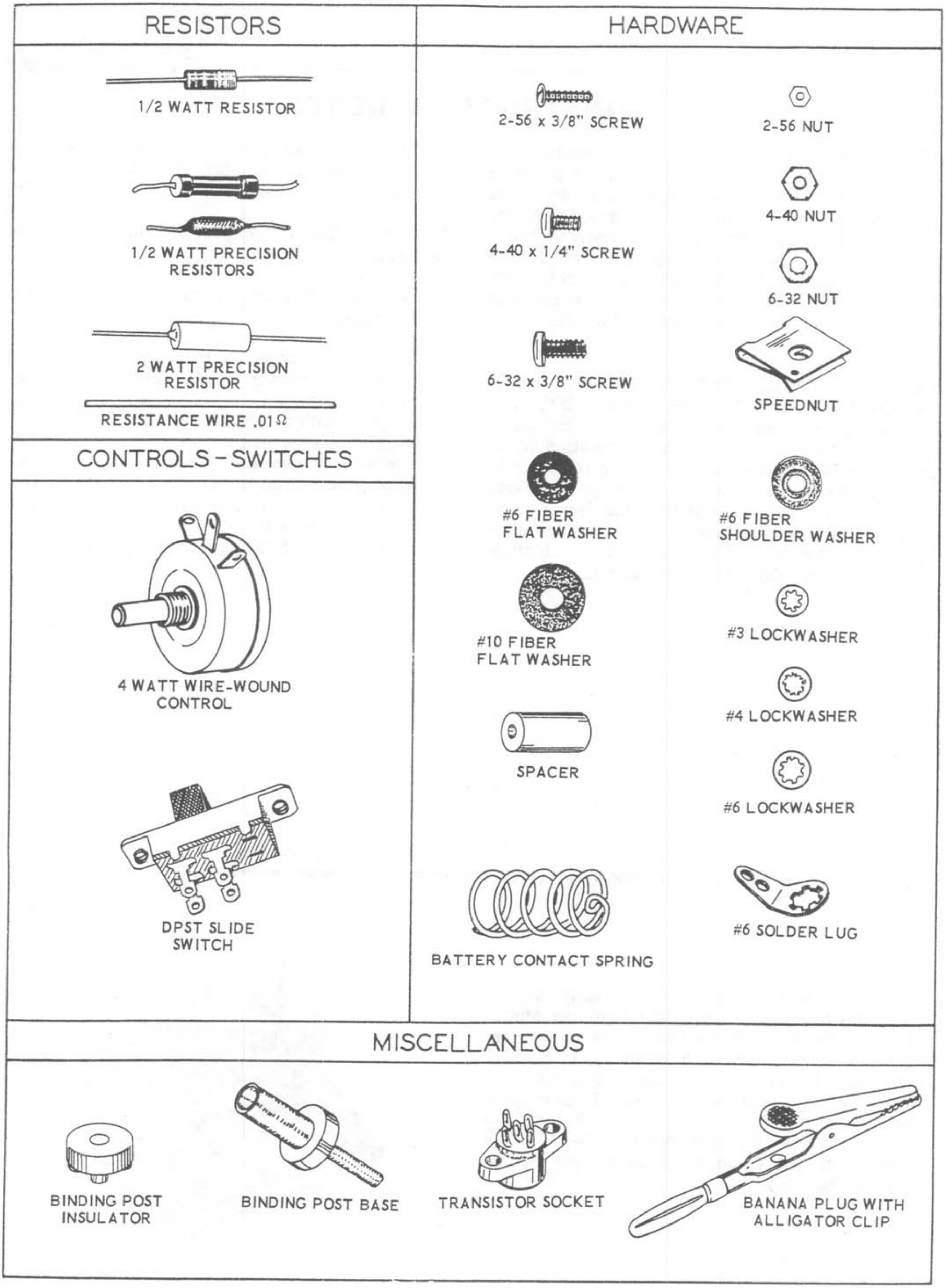


Figure 8

In this test, the meter shows the leakage current between the collector and base with the emitter open. R_s is the meter shunt.


RESISTORS
1/2 WATT RESISTOR
1/2 WATT PRECISION RESISTORS
2 WATT PRECISION RESISTOR
RESISTANCE WIRE .01Ω
CONTROLS - SWITCHES
4 WATT WIRE-WOUND CONTROL
DPST SLIDE SWITCH
HARDWARE
2-56 x 3/8" SCREW
2-56 NUT
4-40 NUT
4-40 x 1/4" SCREW
6-32 NUT
6-32 x 3/8" SCREW
SPEEDNUT
#6 FIBER FLAT WASHER
#6 FIBER SHOULDER WASHER
#10 FIBER FLAT WASHER
#3 LOCKWASHER
#4 LOCKWASHER
SPACER
#6 LOCKWASHER
BATTERY CONTACT SPRING
#6 SOLDER LUG
MISCELLANEOUS
BINDING POST INSULATOR
BINDING POST BASE
TRANSISTOR SOCKET
BANANA PLUG WITH ALLIGATOR CLIP

CONSTRUCTION NOTES

This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be a stable instrument, operating at a high degree of dependability. We suggest that you retain the manual in your files for future reference, both in the use of the instrument and for its maintenance.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the charts and other information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacement section and supply the information called for therein. Include all inspection slips in your letter to us.

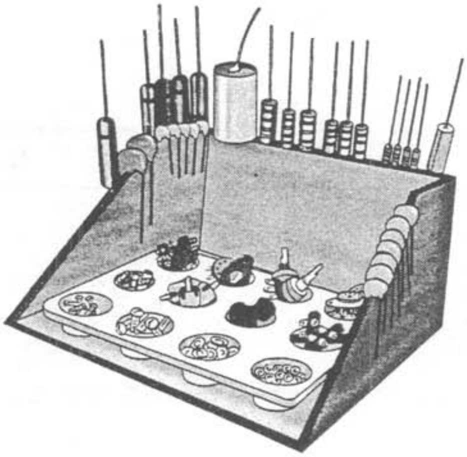
Resistors in this kit have the tolerance ratings stated in the Parts List. In reading resistor values, K = 1000, meg = 1,000,000.

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.

2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a pen knife or a tool for stripping insulation from wires; a soldering iron (or gun) and rosin core solder. A set of nut drivers and a nut starter, while not necessary, will aid extensively in construction of the kit.

Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.



PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
2-148	1	.09 Ω 1% precision
2-149	1	.9 Ω 1% precision
2-150	1	1.5 Ω 1% precision
2-19	1	9 Ω 1% precision
2-151	2	13.5 Ω 1% precision
2-24	1	90 Ω 1% precision
2-152	2	135.7 Ω 1% precision
2-29	1	900 Ω 1% precision
2-153	1	1350 Ω 1% precision
2-154	1	1515 Ω 1% precision
2-35	1	9000 Ω 1% precision
2-155	1	13.5 KΩ 1% precision
2-156	1	145 KΩ 1% precision
2-157	1	350 KΩ 1% precision
2-14	1	1 megohm 1% precision
2-158	1	3.5 megohm 1% precision
2-17	1	10 megohm 1% precision
2B-11	1	1.5 Ω 2 watt 1% precision
3B-5	1	2.2 Ω 2 watt (red-red-gold) 10%
340-M12	1	Resistance wire .01 Ω 1%
Controls		
11-41	1	100 Ω 4 watt wire-wound
11-42	1	15 KΩ 2 watt wire-wound
Switches		
60-4	1	SPDT slide
60-5	1	DPST slide
62-14	1	4-lever, 3-position, spring return
63-272	1	3-position, 2-section, rotary
63-273	1	10-position, 4-section, rotary
63-274	1	6-position, 3-section, rotary
63-275	1	10-position, 3-section, rotary
63-276	1	6-position, 1-section, rotary
Sheet Metal Parts		
90-M174F	1	Cabinet shell
100-M321F506-507-508-616	1	Top panel
204-M413	2	Battery spacing bracket
205-M307F	1	Rear cover
214-M14	1	Battery housing

PART No.	PARTS Per Kit	DESCRIPTION
Knobs-Pointers		
462-97	4	Lever knob
462-139	6	Small knob
462-140	1	Large knob
463-27	6	Small pointer
463-28	1	Large pointer
Hardware		
250-175	2	2-56 x 3/8" screw
250-52	4	4-40 x 1/4" screw
250-56	10	6-32 x 1/4" screw
250-89	30	6-32 x 3/8" screw
250-8	3	#6 x 3/8" sheet metal screw
252-51	2	2-56 nut
252-2	4	4-40 nut
252-3	31	6-32 nut
252-7	7	Control nut
252-22	14	Speednut
253-10	7	Control flat washer
253-1	7	#6 fiber flat washer
253-2	14	#6 fiber shoulder washer
253-6	7	#10 fiber flat washer
254-7	2	#3 lockwasher
254-9	4	#4 lockwasher
254-1	10	#6 lockwasher
254-4	7	Control lockwasher
255-23	2	Spacer
259-1	23	#6 solder lug
258-43	7	Spring, battery contact
Miscellaneous		
344-1	1	Length #22 hookup wire
344-6	1	Length #18 hookup wire
75-17	18	Binding post insulator
427-2	9	Binding post base
100-M16B	6	Binding post cap, black
100-M16R	3	Binding post cap, red
434-116	1	Transistor socket
407-83	1	Meter
390-114	1	Adhesive label
261-4	4	Rubber feet
438-14	2	Banana plug with alligator clip
260-16	1	Alligator clip, small
331-6		Solder
595-444	1	Manual

Seven standard size "D" flashlight batteries should be purchased at this time for use in the completed kit.

PROPER SOLDERING TECHNIQUES

Only a small percentage of HEATHKIT equipment purchasers find it necessary to return an instrument for factory service. Of these instruments, by far the largest portion of malfunctions are due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

For most wiring, a 30 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly over the joint. Keep the iron tip clean and bright by wiping it from time to time with a cloth.

CHASSIS WIRING AND SOLDERING

1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire). In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the construction step.

2. Leads on resistors are generally much longer than they need to be to make the required connections. In these cases, the leads should be cut to proper length before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points.

3. Crimp or bend the lead (or leads) around the terminal to form a good joint without relying on solder for physical strength. If the wire is too large to allow bending or if the step states that the wire is not to be crimped, position the wire so that a good solder connection can still be made.

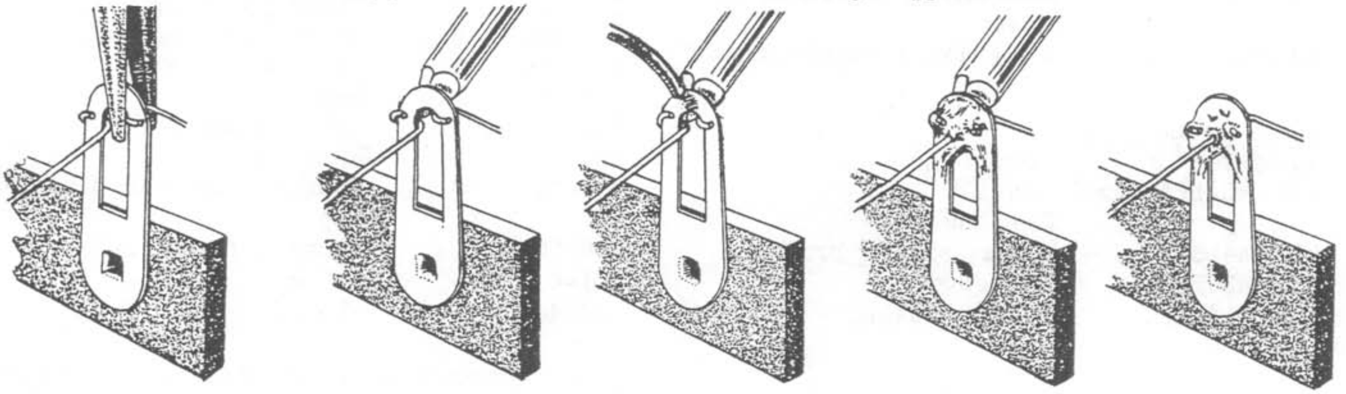
4. Position the work, if possible, so that gravity will help to keep the solder where you want it.

5. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.

6. Then place the solder against the heated terminal and it will immediately flow over the joint; use only enough solder to thoroughly wet the junction. It is usually not necessary to fill the entire hole in the terminal with solder.

7. Remove the solder and then the iron from the completed junction. Use care not to move the leads until the solder is solidified.

A poor or cold solder joint will usually look crystalline and have a grainy texture, or the solder will stand up in a blob and will not have adhered to the joint. Such joints should be reheated until the solder flows smoothly over the entire junction. In some cases, it may be necessary to add a little more solder to achieve a smooth bright appearance.



CRIMP WIRES — HEAT CONNECTION — APPLY SOLDER — ALLOW SOLDER TO FLOW — PROPER SOLDER CONNECTION

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

STEP-BY-STEP PROCEDURE

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted. Some kit builders have also found it helpful to mark each lead in colored pencil on the Pictorial as it is added.

The fold-out diagrams in this manual may be removed and attached to the wall above your working area; but, because they are an integral part of the instructions, they should be returned to the manual after the kit is completed.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a lead to lug 1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. (In cases where a lead passes through a terminal or lug and then connects to another point, it will count as two leads, one entering and one leaving the terminal.)

The steps directing the installation of resistors include color codes to help identify the parts. Also, the schematic letter-number designation of each resistor will appear at the beginning of the construction step which directs its installation.

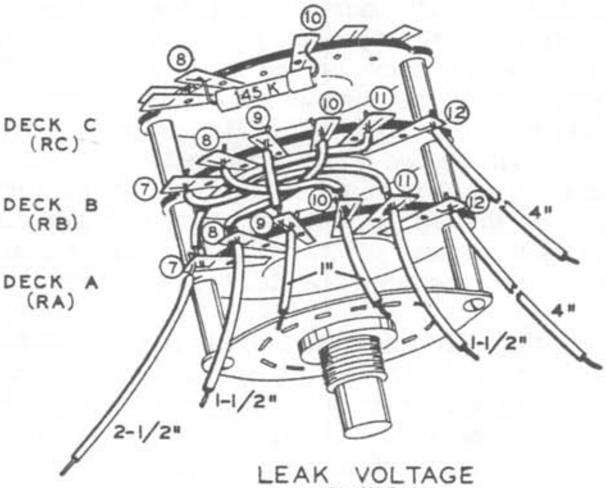
STEP-BY-STEP ASSEMBLY

When wiring this instrument you may wish to prepare the lengths of wire ahead of time. The lengths of hookup wire needed for the wiring steps are listed at the beginning of each section. Prepare each length by stripping 1/4" of insulation from each end. Arrange the wires in the sequence listed. This will save time in performing the wiring steps.

NOTE: Use the small diameter hookup wire in all wiring steps unless large-diameter (heavy) wire is specifically called for. Do not use the bare resistance wire until it is specifically called for.

PREWIRING LEAK VOLTAGE SWITCH R

Refer to Pictorial 1 for the following steps.



LEAK VOLTAGE
SWITCH
R

Pictorial 1

( ) Select the 3-section rotary switch (#63-275. Since there are two 3-deck switches in the kit, make sure you have the correct switch by comparing the lug arrangement with Pictorial 1). This switch is designated as switch R. In referring to switch connections such as RA5, the first letter, R, refers to the LEAK VOLTAGE switch. The second letter, A, means deck A of the switch; the deck closest to the front of the switch. The number 5 means lug number 5.

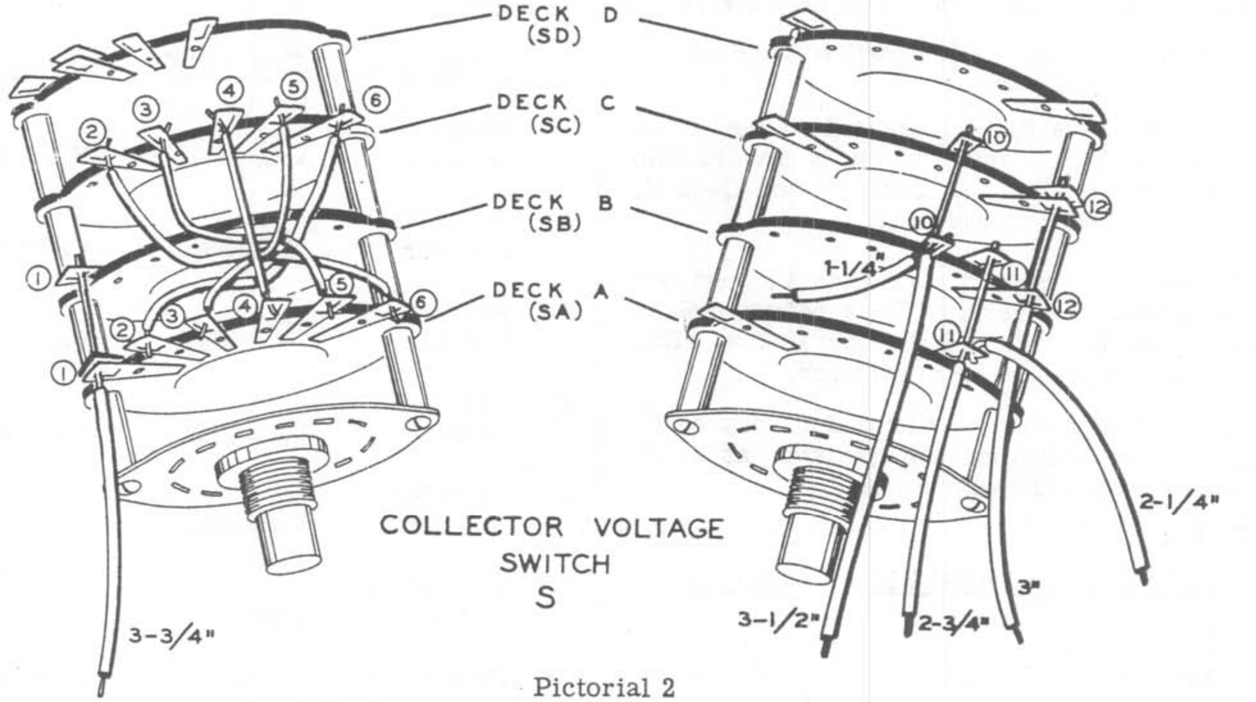
( ) Prepare the following lengths of hookup wire:

2"	2"	1"
1-3/4"	4"	1"
1"	4"	1-1/2"
1-3/4"	1-1/2"	2-1/2"

Prewire switch R as follows:

CONNECT A	FROM LUG	TO LUG
( ) 2" wire	RA7 (NS)	RB11 (S-1).
( ) 1-3/4" wire	RA8 (NS)	RB10 (S-1).
( ) 1" wire	RA9 (NS)	RB9 (S-1).
( ) 1-3/4" wire	RA10 (NS)	RB8 (S-1).
( ) 2" wire	RA11 (NS)	RB7 (S-1).
( ) 4" wire	RB12 (S-1)	not connected
( ) 4" wire	RA12 (S-1)	not connected
( ) 1-1/2" wire	RA11 (S-2)	not connected
( ) 1" wire	RA10 (S-2)	not connected
( ) 1" wire	RA9 (S-2)	not connected
( ) 1-1/2" wire	RA8 (S-2)	not connected
( ) 2-1/2" wire	RA7 (S-2)	not connected
( ) R1, 145 KΩ resistor	RC8 (NS)	RC10 (NS).

Set the switch aside to be installed later.



Pictorial 2

PREWIRING COLLECTOR VOLTAGE SWITCH S

Refer to Pictorial 2 for the following steps.

(✓) Select the 4-section rotary switch (#63-273).

( ) Prepare the following lengths of hookup wire:

2-1/4"	2-1/4"	2-1/4" heavy
1-3/4"	3-3/4" heavy	3-1/2" heavy
1-1/4"	3" heavy	1-1/4" heavy
1-3/4"	2-3/4" heavy	

Prewire switch S as follows:

CONNECT A	FROM LUG	TO LUG
(✓) 2-1/4" wire	SA2 (NS)	SC6 (NS)
(✓) 1-3/4" wire	SA3 (NS)	SC5 (NS).
(✓) 1-1/4" wire	SA4 (NS)	SC4 (NS).
(✓) 1-3/4" wire	SA5 (NS)	SC3 (NS).
(✓) 2-1/4" wire	SA6 (NS)	SC2 (NS).

NOTE: When making connections to double lugs, the wire should be passed through both lugs.

(✓) Strip an additional 1/2" of insulation from one end of a 3-3/4" heavy wire. Insert this end through SA1 (NS) to SB1 (S-1). Now solder SA1 (S-2).

(✓) Strip an additional 1/2" of insulation from one end of a 3" heavy wire. Insert this end through SB12 (NS) to SC12 (S-1). Now solder SB12 (S-2).

(✓) Strip an additional 1/2" of insulation from one end of a 2-3/4" heavy wire. Insert this end through SA11 (NS) to SB11 (S-1).

(✓) Connect a 2-1/4" heavy wire to SA11 (S-3). Leave the other end free.

(✓) Strip an additional 1/2" of insulation from one end of a 3-1/2" heavy wire. Insert this end through SB10 (NS) to SC10 (S-1).

(✓) Connect a 1-1/4" heavy wire to SB10 (S-3).

The free ends of the heavy hookup wires, just installed, will be connected later.

Set the switch aside for use later.

PREWIRING COLLECTOR CURRENT SWITCH V

Refer to Pictorial 3 (fold-out from Page 13) for the following steps.

Select the 3-section rotary switch (#63-274). The prewiring of this switch is divided into three sections: Deck A, Deck B, and Deck C. Deck C will be prewired first.

To install a resistor on switch V, bend one lead against the resistor body before making the connection. Cut off the excess lead after the connection has been soldered.

NOTE: Read each resistor value very carefully before installing the resistor as some resistor values are very similar.

DECK C

CONNECT A	FROM LUG	TO LUG
(✓) R20. 1515 Ω resistor	VC1 (S-1)	VC2 (NS).
(✓) R21. 135.7 Ω resistor	VC2 (S-2)	VC3 (NS).
(✓) R22. 13.5 Ω resistor	VC3 (S-2)	VC4 (NS).
(✓) R23. 1.5 Ω 2 watt	VC4 (S-2)	VB6 (NS).

DECK B

CONNECT A	FROM LUG	TO LUG
(✓) R15. 13.5 KΩ resistor	VB1 (NS)	VB6 (NS).
(✓) R16. 1350 Ω resistor	VB1 (S-2)	VB2 (NS).
(✓) R17. 135.7 Ω resistor	VB2 (S-2)	VB3 (NS).
(✓) R18. 13.5 Ω resistor	VB3 (S-2)	VB4 (NS).
(✓) R19. 1.5 Ω resistor	VB4 (S-2)	VB5 (NS).

DECK A

CONNECT A	FROM LUG	TO LUG
(✓) R13. 9000 Ω resistor	VA1 (NS)	VA2 (NS).
(✓) R12. 900 Ω resistor	VA2 (NS)	VA3 (NS).
(✓) R11. 90 Ω resistor	VA3 (NS)	VA4 (NS).
(✓) R10. 9 Ω resistor	VA4 (NS)	VA5 (NS).
(✓) R9. 0.9 Ω resistor	VA5 (NS)	VA6 (NS).
(✓) R8. 0.09 Ω resistor	VA6 (NS)	VA7 (NS).

(✓) Prepare five 2-3/4" lengths of wire and connect one end of each wire to:

(✓) VA1 (NS).

(✓) VA2 (S-3).

(✓) VA3 (S-3).

(✓) VA4 (S-3).

(✓) VA5 (S-3).

(✓) Connect a 2-3/4" length of heavy wire to VA6 (NS).

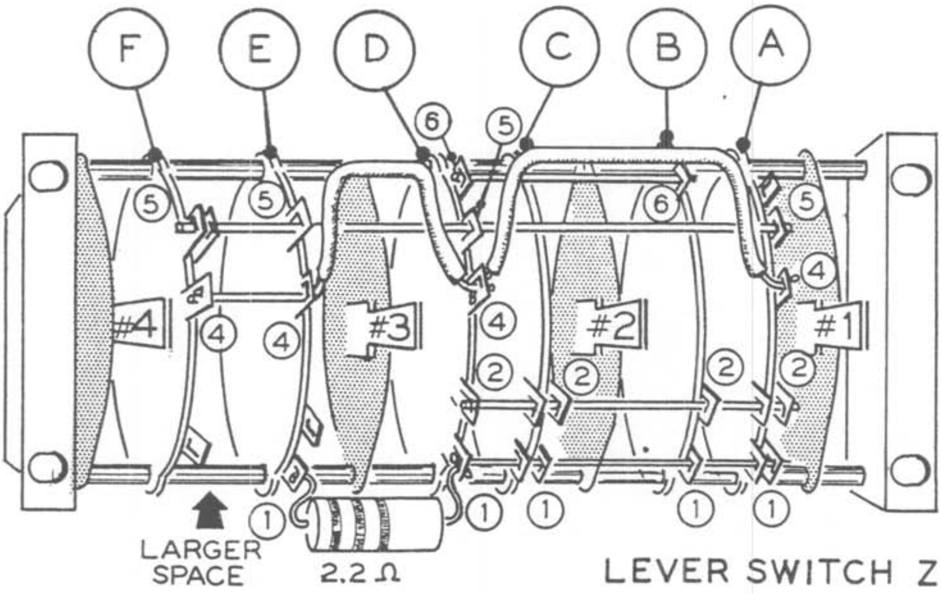
(✓) Connect a 3/4" bare wire (stripped heavy hookup wire) from VB7 (S-1) to VA7 (S-2).

(✓) Connect a 10" length of wire to VA1 (S-3).

The other ends of the wires just installed will be connected later.

Now check the switch carefully. The resistor bodies should not touch each other, switch contacts, or other resistor leads.

Set the switch aside for use later.



Pictorial 4

PREWIRING LEVER SWITCH Z

Refer to Pictorial 4 for the following steps.

NOTE: Only heavy hookup wire is used in the prewiring of the Lever switch.

( ) Prepare the following lengths of heavy hookup wire:

1-5/8" heavy	2-1/2" heavy
1-5/8" heavy	3" heavy
3" heavy	1-1/8" heavy

( ) Position the Lever switch as shown in Pictorial 4. Study the lug configuration to be sure of the proper position.

( ) Remove the insulation from a 1-5/8" heavy wire. Insert this wire through ZA1 (NS), ZB1 (NS), and ZC1 (NS), to ZD1 (NS). CAUTION: Make sure this wire does not touch the metal plate between decks B and C. Now solder ZA1 (S-1), ZB1 (S-2), and ZC1 (S-2).

( ) R14. Connect the 2.2 Ω (red-red-gold) resistor from ZD1 (S-2) to ZE1 (S-1).

( ) Remove the insulation from a 1-5/8" heavy wire. Insert this wire through ZA2 (NS), ZB2 (NS), and ZC2 (NS) to ZD2 (S-1). Now solder ZA2 (S-1), ZB2 (S-2), and ZC2 (S-2).

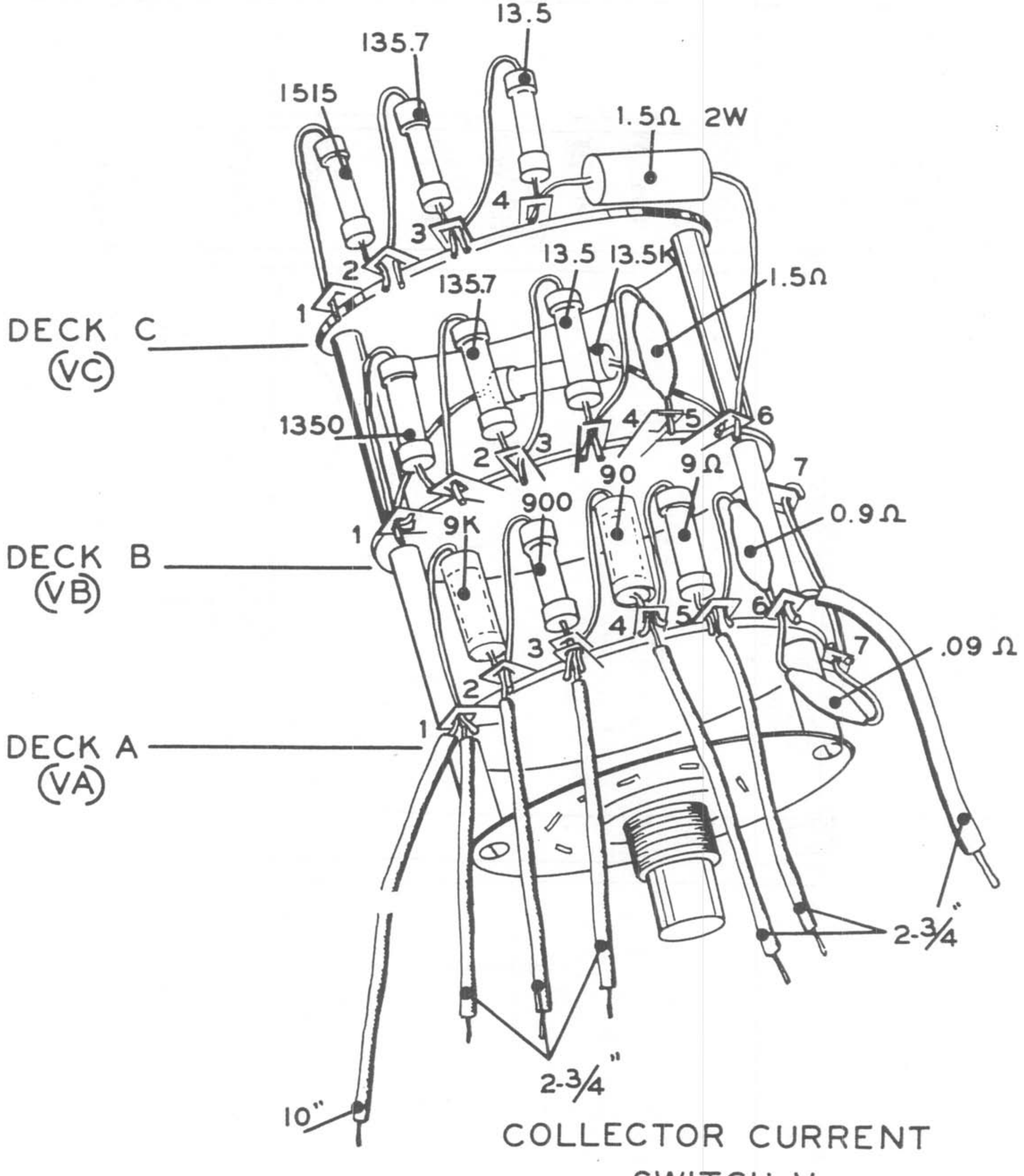
( ) Connect a 3" heavy wire from ZA4 (S-1) to ZD4 (NS). Position this wire as shown in Pictorial 4 to prevent lever #2 from contacting it when the lever is depressed.

( ) Strip an additional 1/2" insulation from one end of a 2-1/2" heavy wire. Insert this end through ZE4 (NS) to ZF4 (S-1). Now solder ZE4 (S-2). Connect the other end of this wire to ZD4 (S-2). Position this wire as shown to prevent lever #3 from hitting it when the lever is depressed.

( ) Remove the insulation from a 3" heavy wire. Insert this wire through ZA5 (NS), ZD5 (NS), and ZE5 (NS) to ZF5 (S-1). Now solder ZA5 (S-1), ZD5 (S-2), and ZE5 (S-2).

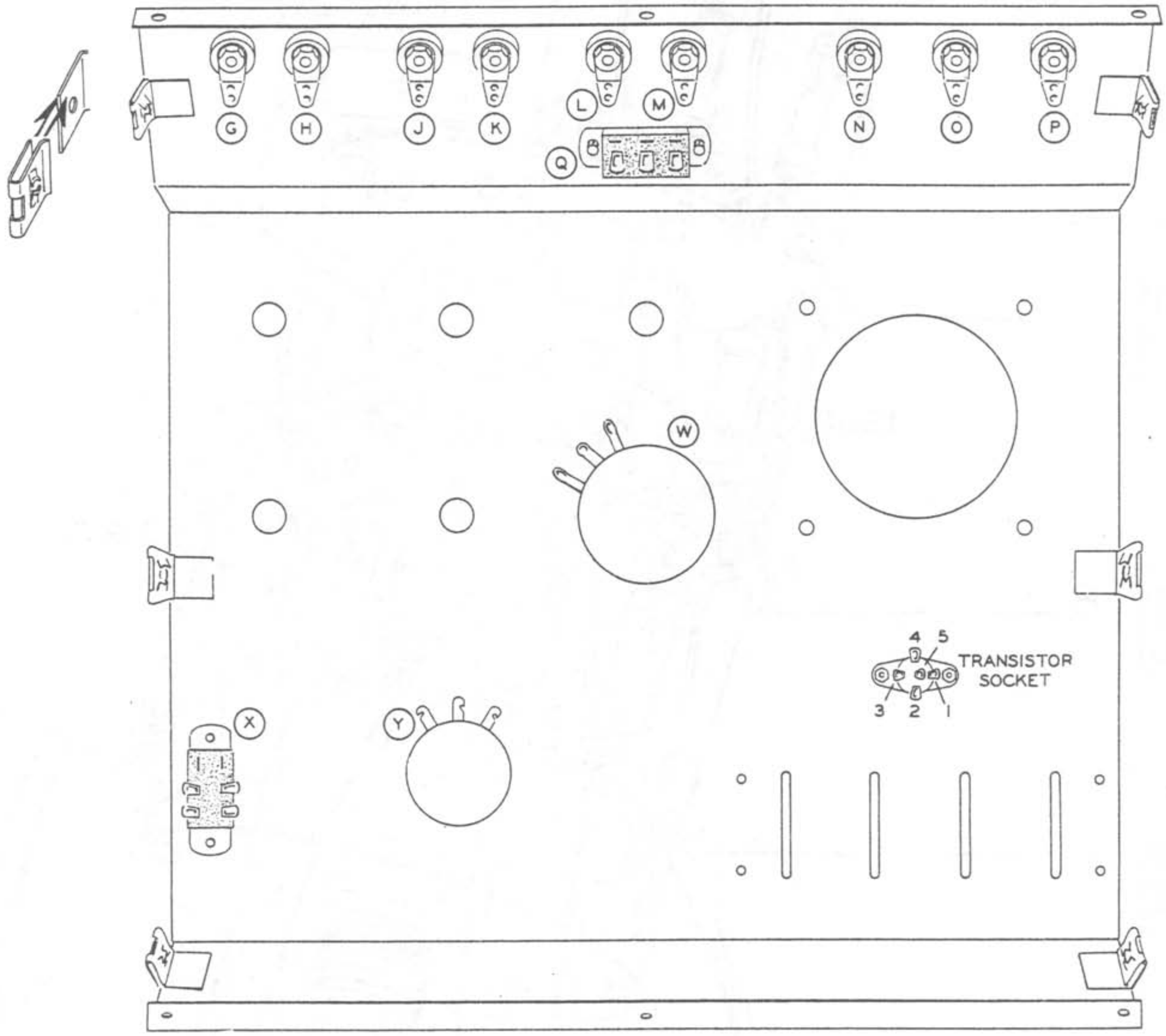
( ) Remove the insulation from a 1-1/8" heavy wire. Insert this wire through ZB6 (NS) to ZD6 (S-1). CAUTION: Make sure this bare wire does not touch the metal plate between decks B and C. Now solder ZB6 (S-1).

Set the switch aside for use later.



COLLECTOR CURRENT
SWITCH V

Pictorial 3



Pictorial 5

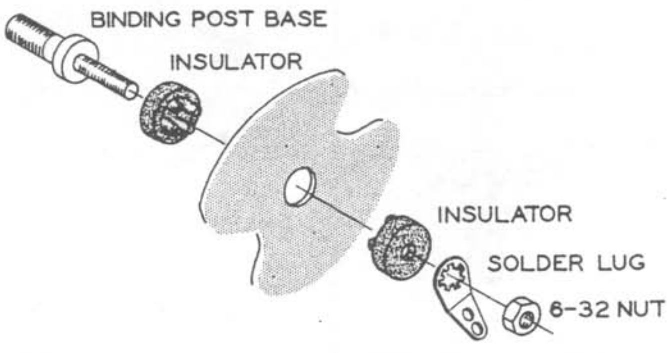
TOP PANEL PARTS MOUNTING

( ) Position the top panel as shown in Pictorial 5.

( ) Mount six speednuts, one on each L bracket, as shown in Pictorial 5. The flat side of each speednut should be toward the edge of the panel. Place a cloth on your working area to prevent scratching the panel.

( ) Install the nine binding post bases at the top of the panel as shown in Detail 5A. Position each solder lug as shown in Pictorial 5. Orient the small hole in each binding post base perpendicular to the flange of the panel.

( ) Fasten BIAS switch Q (#60-4) in place, using 6-32 x 1/4" screws.

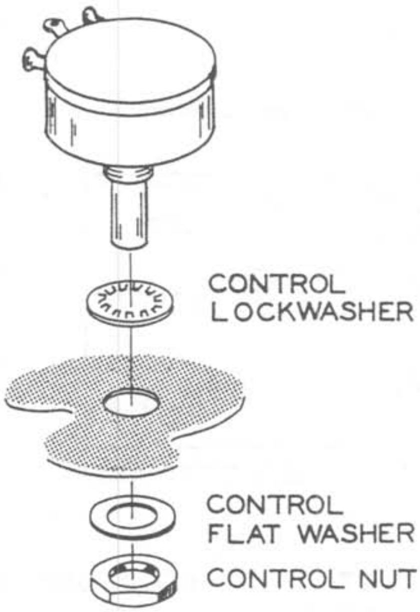


Detail 5A

( ) R6. Mount BIAS control W (#11-41), using a control lockwasher, flat washer, and control nut as shown in Detail 5B. Position the control as shown in Pictorial 5.

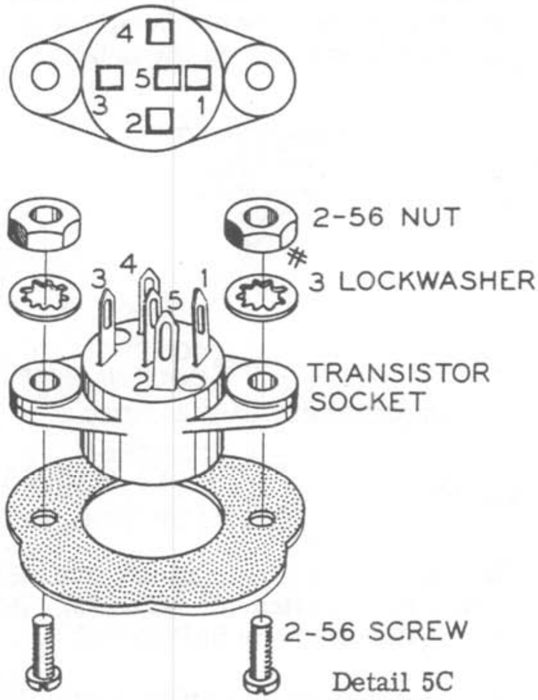
( ) R24. Mount GAIN control Y (#11-42) in the same manner.

( ) Fasten GAIN switch X (#60-5), using 6-32 x 1/4" screws. Position as shown in Pictorial 5.

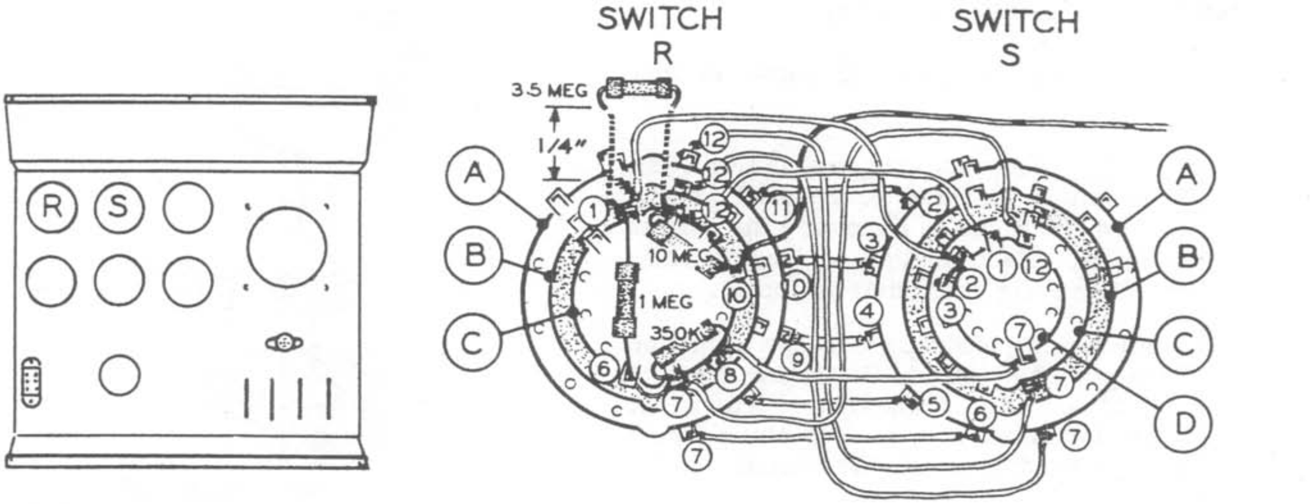


Detail 5B

( ) Mount the transistor socket as shown in Detail 5C. Use 2-56 screws, #3 lockwashers, and 2-56 nuts. Make sure lug 1 is toward the edge of the panel as shown.



Detail 5C

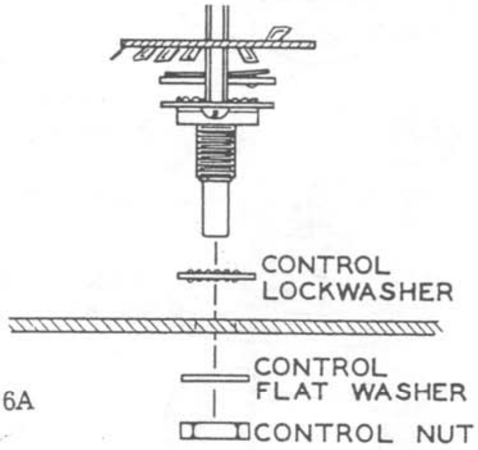


Pictorial 6

LEAK VOLTAGE AND COLLECTOR VOLTAGE SWITCH WIRING

Refer to Pictorial 6 and Detail 6B for the following steps.

( ) Mount LEAK VOLTAGE switch R (#63-275), using control lockwasher, flat washer, and control nut as shown in Detail 6A. Position the switch as shown in Pictorial 6.



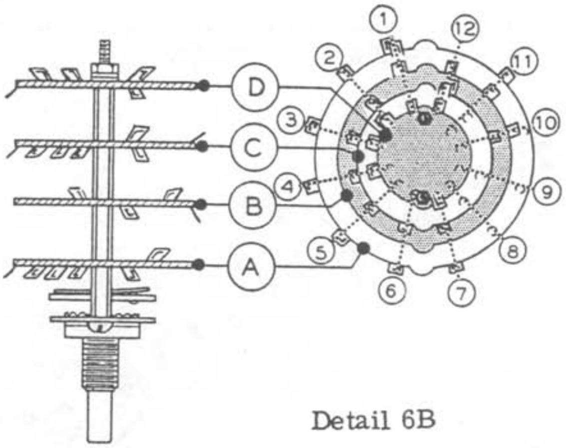
Detail 6A

( ) In the same manner, mount COLLECTOR VOLTAGE switch S (#63-273). Position the switch as shown in Pictorial 6.

( ) Connect the wire coming from RA11 to SA2 (S-2).

( ) Connect the wire coming from RA10 to SA3 (S-2).

( ) Connect the wire coming from RA9 to SA4 (S-2).



Detail 6B

( ) Connect the wire coming from RA8 to SA5 (S-2).

( ) Connect the wire coming from RA7 to SA6 (S-2).

( ) Connect the wire coming from RA12 to SC7 (NS).

( ) Connect the wire coming from RB12 to SA7 (NS).

( ) Prepare the following lengths of hookup wire.

3-1/2"	3"
2-1/2"	2"
5"	

( ) Connect a 3-1/2" wire from RC7 (NS) to SD12 (S-1). Position as shown in Pictorial 6.

( ) Connect a 2-1/2" wire from RC8 (NS) to SD7 (S-1).

( ) Connect a 5" wire to RC10 (S-2). Position the other end of this wire as shown in Pictorial 6 to be connected later.

( ) Strip an additional 1/2" of insulation from one end of a 3" wire. Insert this end through SD2 (NS) to SD3 (S-1). Now solder SD2 (S-2). Connect the other end of this wire to RC1 (NS).

( ) Connect a 2" wire from RC12 (NS) to SD1 (S-1).

( ) R4. Connect a 3.5 megohm resistor from RC1 (NS) to RC12 (NS). Position as shown.

( ) R5. Connect a 10 megohm resistor from RC11 (S-1) to RC12 (S-3).

( ) R2. Connect a 350 KΩ resistor from RC7 (NS) to RC8 (S-3).

( ) R3. Insert one lead of a 1 megohm resistor through RC6 (NS) to RC7 (S-3). Now solder RC6 (S-2). Connect the other lead of this resistor to RC1 (S-3).

POLARITY SWITCH WIRING

Refer to Pictorial 7 for the following steps.

( ) Prepare the following lengths of hookup wire:

6"	6"	6"	2"
10-1/2"	10-1/2" heavy	3-1/2"	7-1/2"

( ) Mount POLARITY switch T (#63-272), using control lockwasher, flat washer, and control nut as shown in Detail 6A. Position as shown in Pictorial 7.

( ) Connect a 6" wire from RA1 (S-1) to TA6 (S-1).

( ) Connect a 10-1/2" wire to TA5 (S-1). Position the other end of this wire toward lever switch Z to be connected later. See Pictorial 9, fold-out from Page 14.

( ) Connect a 6" wire from RB1 (S-1) to TA4 (S-1).

( ) Connect the heavy wire coming from SB12 to TA3 (S-1).

( ) Connect a 10-1/2" heavy wire to TA2 (S-1). Position the other end of this wire toward lever switch Z to be connected later. See Pictorial 9.

( ) Connect the heavy wire coming from SA1 to TA1 (S-1).

( ) Connect a 6" wire from TB1 (S-1) to RB2 (NS).

( ) Connect the wire coming from RC10 to TB3 (NS).

( ) Connect one of the heavy wires coming SA11 to TB4 (S-1).

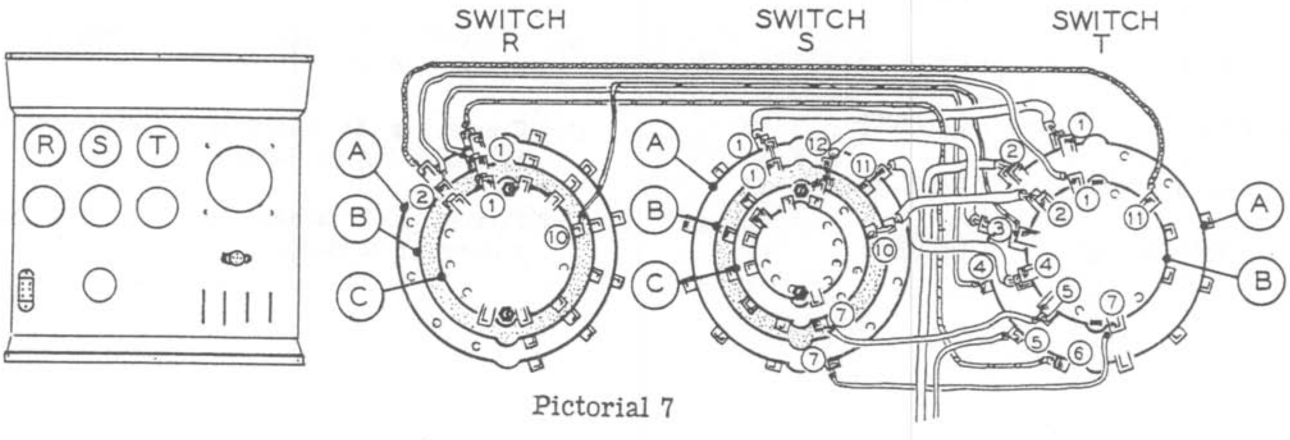
( ) Connect the shortest heavy wire coming from SB10 to TB2 (S-1).

( ) Connect a 3-1/2" wire from SA7 (S-2) to TB7 (NS).

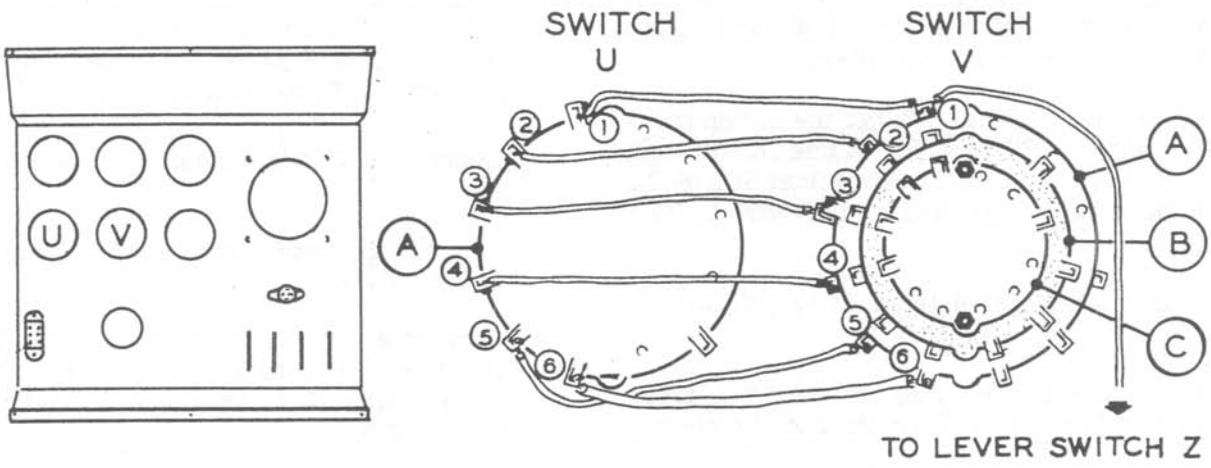
( ) Connect a 2" wire from SC7 (S-2) to TB5 (NS).

( ) Connect a 7-1/2" wire from RA2 (NS) to TB11 (S-1).

NOTE: The remaining heavy wires coming from SB10 and SA11 will be connected later.



Pictorial 7



Pictorial 8

LEAK-DIODE-BASE AND COLLECTOR CURRENT SWITCH WIRING

Refer to Pictorial 8 for the following steps.

( ) Mount LEAK-DIODE-BASE switch U (#63-276), using a control lockwasher, flat washer, and control nut as shown in Detail 6A. Position as shown in Pictorial 8.

( ) Mount COLLECTOR CURRENT switch V (#63-274) in the same manner. Position as shown in Pictorial 8. Route the long wire from VA1 as shown.

NOTE: Position the wires in the following steps as shown in Pictorial 8.

Connect wires coming from switch V to switch U as follows:

FROM	TO
( ) VA1 (short)	U1 (S-1)
( ) VA2	U2 (S-1)
( ) VA3	U3 (S-1)
( ) VA4	U4 (S-1)
( ) VA5	U5 (S-1)
( ) VA6 heavy	U6 (S-1)

TOP PANEL WIRING

Refer to Pictorial 9 (fold-out from Page 14) for the following steps.

( ) Prepare the following lengths of hookup wire:

2-1/4"	5" heavy
2-1/4"	4" heavy
1-1/4" heavy	10" heavy
2" heavy	7" heavy

( ) Connect a 2-1/4" wire from RA2 (S-2) to solder lug G (S-1).

( ) Connect a 2-1/4" wire from RB2 (S-2) to solder lug H (S-1).

( ) Connect the heavy wire coming from SB10 to solder lug J (S-1).

( ) Connect the heavy wire coming from SA11 to solder lug K (S-1).

( ) Connect a 1-1/4" heavy wire from Q1 (S-1) to solder lug L (S-1).

( ) Connect a 2" heavy wire from Q2 (S-1) to TA10 (S-1).

( ) Connect a 5" heavy wire from TA7 (NS) to solder lug M (S-1).

( ) Connect a 4" heavy wire from TA9 (NS) to solder lug N (S-1).

(✓) Connect a 10" heavy wire to solder lug O (S-1). Position the other end of this wire as shown to be connected later.

(✓) Connect a 7" heavy wire from TB3 (NS) to solder lug P (S-1). Push this wire up through both lugs of TB3. Do not crimp as another wire will be connected later.

LEVER SWITCH WIRING

Refer to Pictorial 9 (fold-out from Page 14) for the following steps.

(✓) Prepare the following lengths of hookup wire:

7-1/2" heavy	11"
7"	10-1/2" heavy
2-1/2"	9"
6"	4-1/4"

(✓) Set lever switch Z in its normal mounted position on the top panel. See Pictorial 9. Make sure the side of the switch on which the 2.2 Ω resistor is mounted is toward the transistor socket. Do not use mounting hardware yet.

NOTE: A screwdriver handle may be used to prop the top panel so the lever switch will rest flush on the panel surface. Lugs 1 through 6 are toward the panel.

(✓) Remove an additional 1/2" of insulation from a 7-1/2" heavy wire. Insert this end through VA8 (NS) to VB8 (S-1). Now solder VA8 (S-2). Connect the other end of this wire to the bare wire connected to ZD2 (S-1).

(✓) Connect a 7" wire from VA6 (S-4) to ZE2 (S-1).

(✓) Insert one end of a 2-1/2" wire through lug 2 (NS) to lug 5 (S-1) of the transistor socket. Now solder lug 2 (S-2). Connect the other end of this wire to ZF2 (NS).

(✓) Connect a 6" wire from TA9 (NS) to ZF2 (S-2).

(✓) Connect an 11" wire from VA9 (S-1) to ZA6 (S-1).

(✓) Connect a 10-1/2" heavy wire from W3 (S-1) to the bare wire connected to ZD6 (S-1).

(✓) Connect the wire coming from VA1 to the bare wire connected to ZF4 (S-1).

(✓) Connect a 9" wire to the bare wire connected to ZF5 (S-1). Route the other end of this wire toward the meter mounting hole. It will be connected later.

(✓) Connect the heavy wire coming from TA2 to the bare wire connected to ZD1 (S-1).

(✓) Connect a 4-1/4" wire from VB11 (S-1) to TA9 (S-3).

Refer to Pictorial 10 (fold-out from Page 23) for the following steps.

(✓) Mount the Lever switch to the top panel, using four 4-40 screws, four #4 lockwashers, and four 4-40 nuts. See Pictorial 10. CAUTION: Make sure none of the soldered connections on the lever side of the switch touch the top panel and center the levers in the slots.

(✓) Prepare the following lengths of hookup wire:

1" heavy	1-1/4" heavy
3/4" heavy	3" heavy
3" heavy	2-1/2" heavy

(✓) Remove the insulation from a 1" heavy wire. Insert one end through ZB7 (NS) to ZD7 (S-1). Make sure this wire does not touch the metal plate between decks B and C. Now solder ZB7 (S-1).

(✓) Remove the insulation from a 3/4" heavy wire. Insert one end through ZE7 (NS) to ZF7 (S-1). Now solder ZE7 (S-1).

(✓) Connect a 3" heavy wire from ZA8 (S-1) to ZF8 (NS).

(✓) Remove the insulation from a 1-1/4" heavy wire. Insert one end through ZA9 (NS) to ZC9 (S-1). Now solder ZA9 (S-1).

(✓) Remove the insulation from a 3" heavy wire. Insert one end through ZA10 (NS), ZB10 (NS), ZC10 (NS), ZD10 (NS), ZE10 (NS), and ZF10 (S-1). Now solder ZA10 (S-1), ZB10 (S-2), ZC10 (S-2), ZD10 (S-2), and ZE10 (S-2).

(✓) Remove the insulation from a 2-1/2" heavy wire. Insert one end through ZB11 (NS), ZD11 (NS), ZE11 (NS), and ZF11 (S-1). Now solder ZB11 (S-1), ZD11 (S-2), and ZE11 (S-2).

(✓) Prepare the following lengths of hookup wire:

9-1/2" heavy	9" heavy
12" heavy	13"
11" heavy	11-1/2"
3" heavy	7-1/2"

(✓) Connect a 9-1/2" heavy wire from TA8 (S-1) to the bare wire connected to ZD7 (S-1).

(✓) Connect the wire coming from TA5 to the bare wire connected to ZF7 (S-1).

(✓) Remove an additional 1/4" insulation from one end of a 12" heavy wire. Insert this end through X2 (NS) to X1 (S-1). Now solder X2 (S-2). Route this wire as shown in Pictorial 10 and connect the other end to the bare wire connected to ZC9 (S-1).

(✓) Connect an 11" heavy wire from U8 (S-1) to ZF8 (S-2).

NOTE: All lugs on switch U should now be soldered.

(✓) Connect the heavy wire coming from solder lug O to ZF12 (NS).

(✓) Connect a 3" heavy wire from lug 1 of the transistor socket (S-1) to ZF12 (S-2).

(✓) Wrap one end of a 9" heavy wire around the wire protruding from TB3 as shown in Pictorial 10 (S-3). Connect the other end of this wire to lug 3 of the transistor socket (S-1).

(✓) Connect a 13" wire from RC2 (S-1) to ZE12 (S-1). Position this wire as shown in Pictorial 10.

NOTE: All lugs on switch R should now be soldered.

(✓) Connect an 11-1/2" wire from SD4 (S-1) to ZD12 (S-1). Position this wire as shown in Pictorial 10.

(✓) Connect a 7-1/2" wire from Y2 (S-1) to ZB12 (S-1).

(✓) Bend down lug 4 of the transistor socket as this lug is not used.

FINAL COLLECTOR CURRENT AND LEVER SWITCH WIRING

Refer to Pictorial 10 for the following steps.

(✓) Prepare the following lengths of hookup wire:

4-1/2" heavy	3-1/2" heavy
2-1/2" heavy	4-1/2"
3-1/2" heavy	5"
1-1/2"	4"
2" heavy	

( ) Connect a 4-1/2" heavy wire from VB5 (S-2) to the bare wire connected to X2 (S-1).

( ) Connect a 2-1/2" heavy wire from VB6 (S-3) to Y1 (NS).

( ) Strip an additional 1/8" of insulation from one end of a 3-1/2" heavy wire. Insert this end through X4 (NS) to X3 (S-1). Now solder X4 (S-2). Connect the other end of this wire to Y1 (S-2).

( ) Connect a 1-1/2" wire from W1 (S-1) to VB9 (S-1).

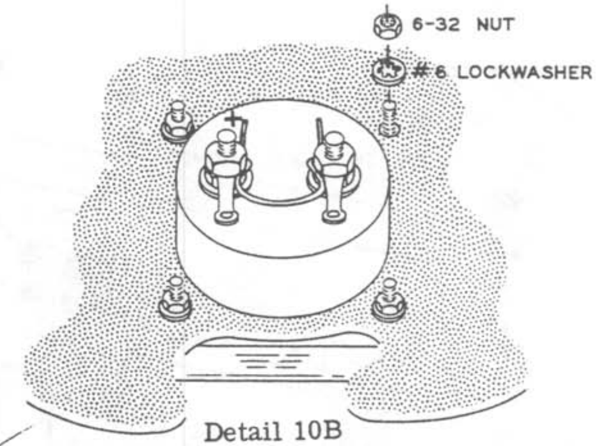
( ) Connect a 2" heavy wire from W2 (S-1) to VC10 (NS).

( ) Connect a 3-1/2" heavy wire from VC10 (S-2) to Y3 (S-1).

( ) Locate the .01 Ω length of resistance wire. Place this wire over Detail 10A and carefully bend it exactly as shown. Do not cut this wire.

( ) Connect the formed resistance wire from the bare wire at VA7 (S-1) to the bare wire at ZF10 (S-1). Fill the formed ends of the wire with solder, but do not allow solder to flow along the wire beyond the connections.

NOTE: All lugs on switch V should now be soldered.



Detail 10B

( ) Mount the meter as shown in Detail 10B, using four #6 lockwashers and four 6-32 nuts. Do not remove the shorting wire between the meter terminals.

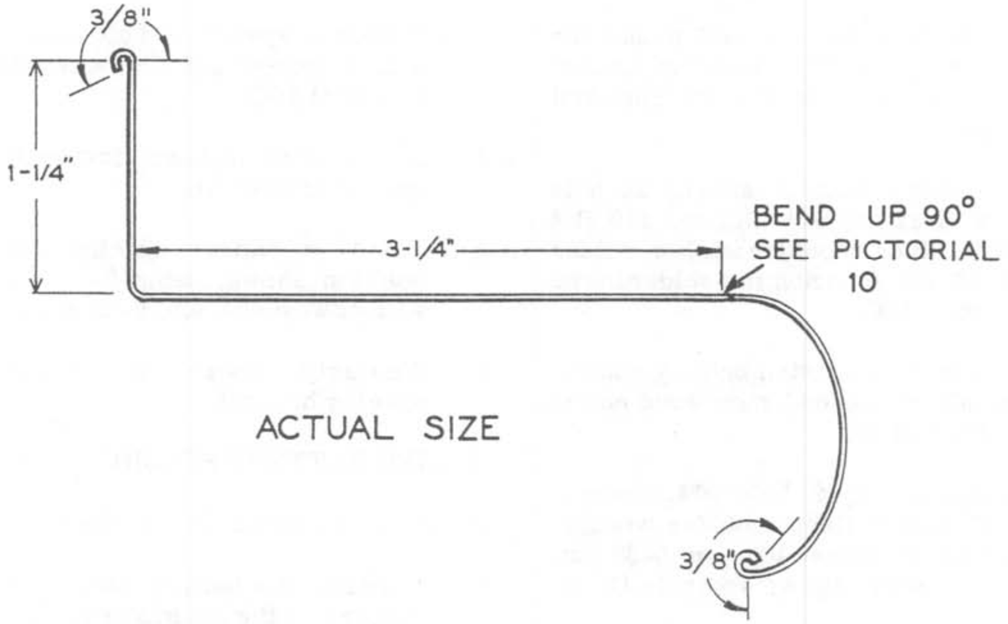
( ) Connect the wire coming from ZF5 to the positive (+) lug of the meter (NS).

( ) Connect a 4-1/2" wire from the bare wire connected to ZB11 (S-1) to the negative (-) lug of the meter (NS). See Pictorial 10.

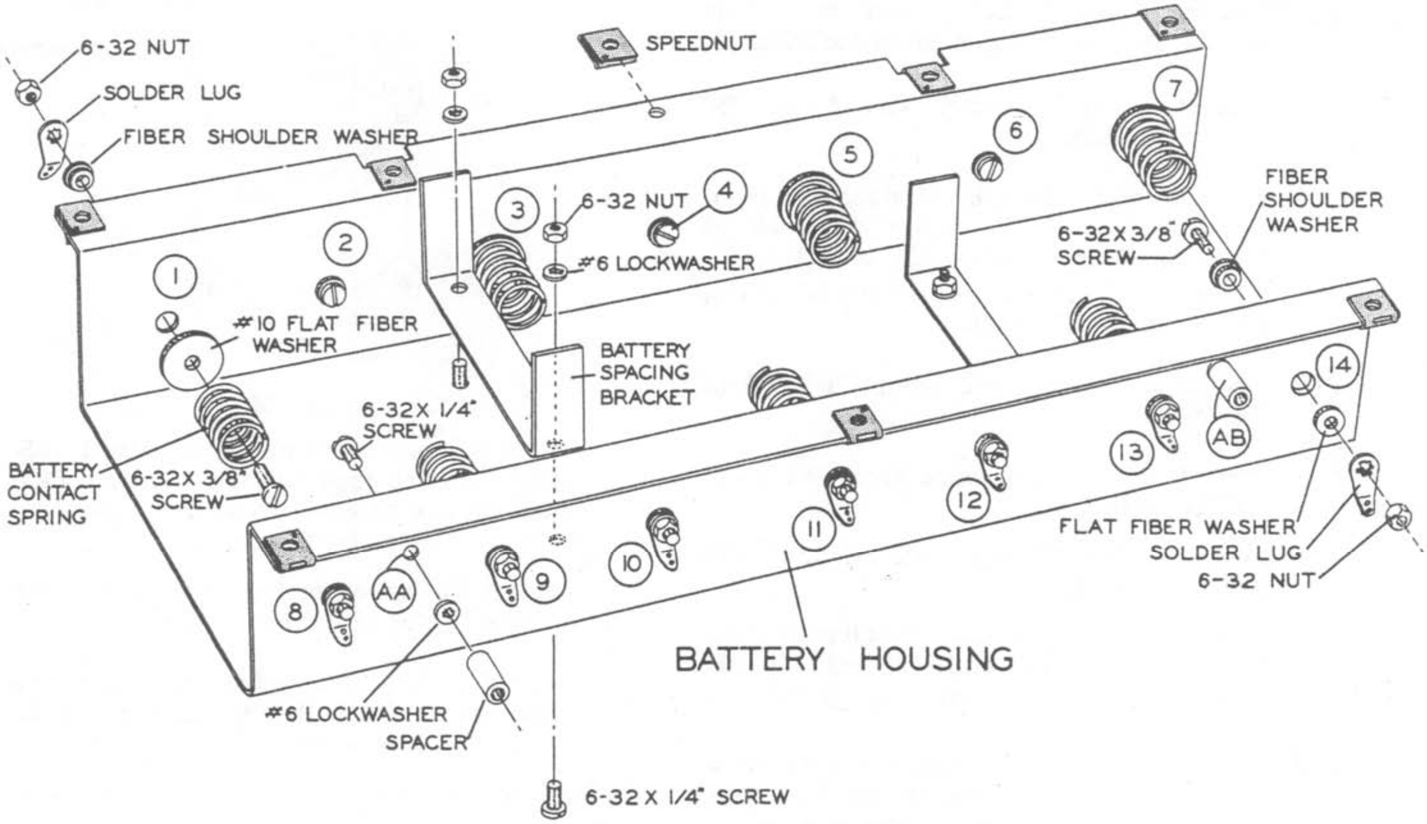
NOTE: The lever switch wiring is now complete.

( ) Connect a 5" wire from TB9 (S-1) to the negative (-) lug of the meter (S-2).

( ) Connect a 4" wire from TB10 (S-1) to the positive (+) lug of the meter (S-2).



Detail 10A



Detail 10C

BATTERY HOUSING PARTS MOUNTING

Refer to Detail 10C for the following steps.

(✓) Locate the battery housing and mount the eight speednuts at the locations shown. Make sure the flat side of each speednut faces outward.

(✓) Fasten a battery contact spring at hole #1 using a 6-32 x 3/8" screw, #10 flat fiber washer, fiber shoulder washer, solder lug, and 6-32 nut. Position the solder lug as shown in Detail 10C.

(✓) In the same manner, fasten battery contact springs at all of the odd-numbered holes; 3, 5, 7, 9, 11, and 13.

(✓) Fasten a solder lug at hole #14, using a 6-32 x 3/8" screw, fiber shoulder washer, fiber flat washer, solder lug, and 6-32 nut. Position the solder lug as shown in Detail 10C.

(✓) In the same manner, fasten solder lugs at all of the even-numbered holes; 2, 4, 6, 8, 10, and 12.

(✓) Fasten a spacer at hole AA, using a 6-32 x 1/4" screw and #6 lockwasher as shown in Detail 10C.

(✓) In the same manner, fasten the remaining spacer at hole AB.

(✓) Fasten a battery spacing bracket in the position shown, using 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

(✓) Similarly, fasten the remaining battery spacing bracket.

WIRING BATTERY HOUSING

Refer to Pictorial 10 for the following steps.

(✓) Position the battery housing with the two spacers in the position shown.

NOTE: Only heavy hookup wire is used in the following steps.

( ) Prepare the following lengths of heavy hookup wire.

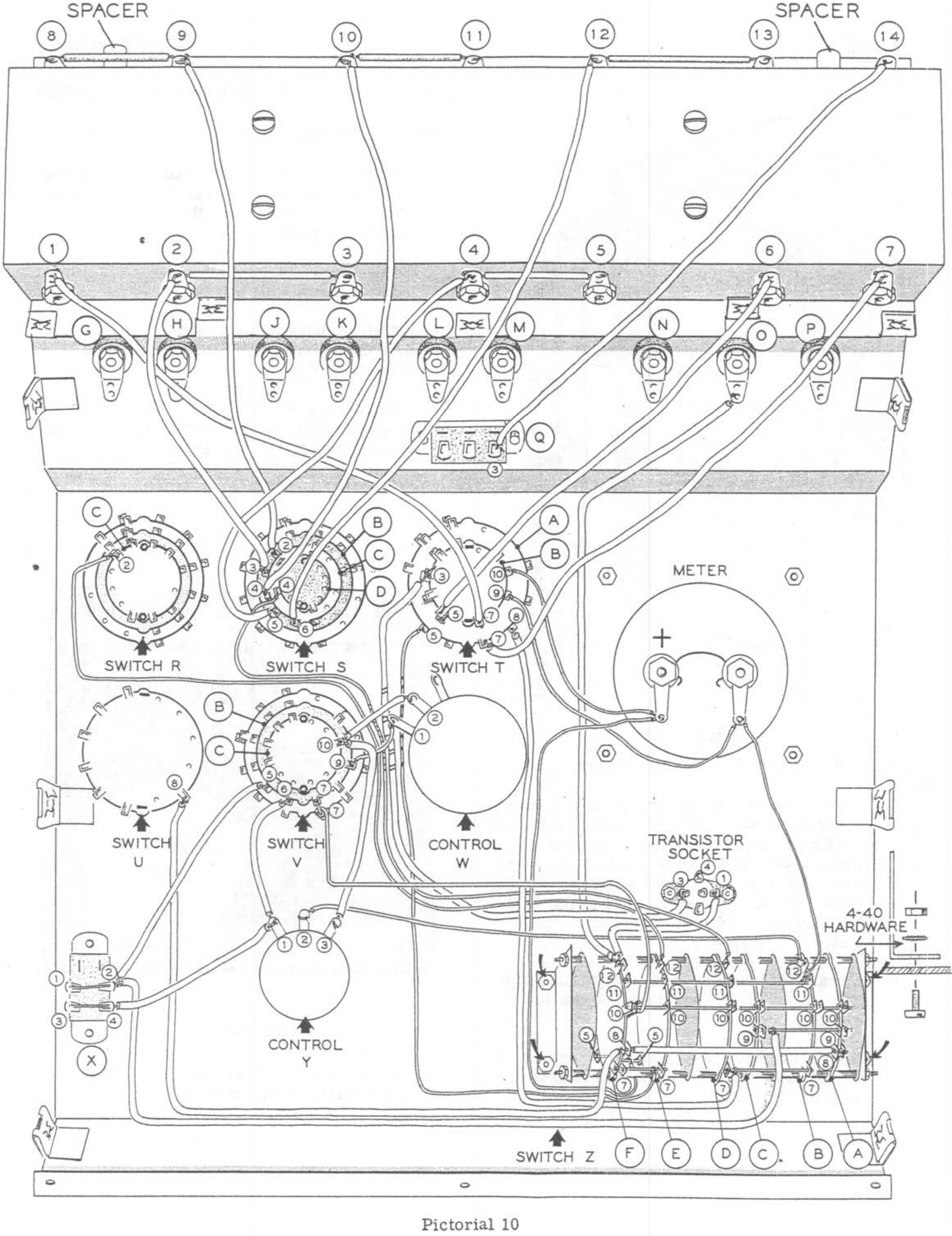
1-3/4"	2-1/4"	6"	6-1/2"	8-1/2"
1-3/4"	1-3/4"	7"	6-1/2"	8"
2-1/4"	3"	5-1/2"	7-1/2"	4"

Connect the lengths of heavy hookup wire as follows:

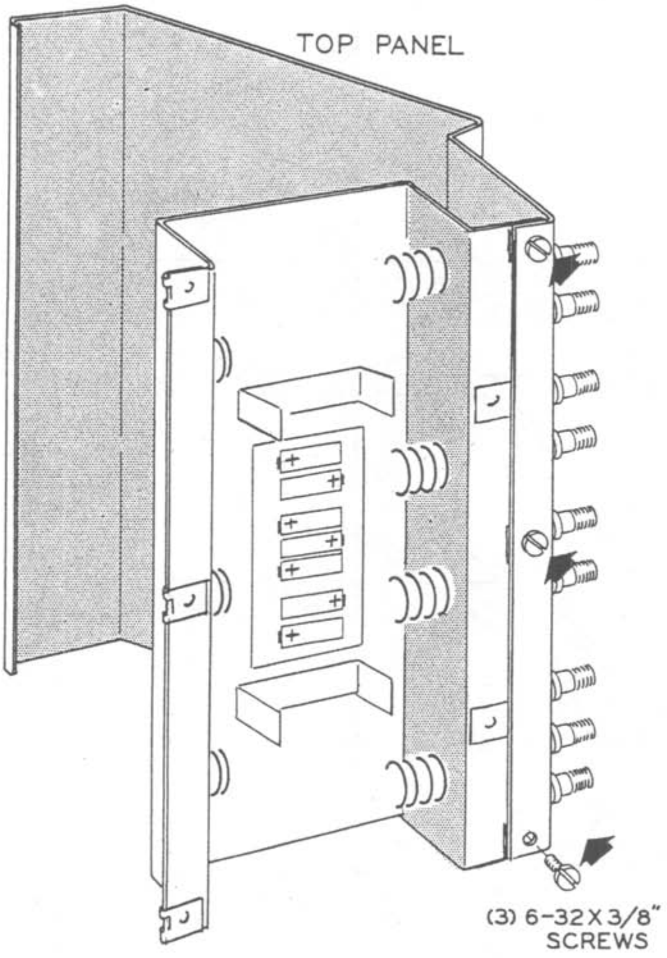
CONNECT A	FROM	TO
(✓) 1-3/4"	solder lug 8 (S-1)	solder lug 9 (NS).
(✓) 1-3/4"	solder lug 10 (NS)	solder lug 11 (S-1).
(✓) 2-1/4"	solder lug 12 (NS)	solder lug 13 (S-1).
(✓) 2-1/4"	solder lug 2 (NS)	solder lug 3 (S-1).
(✓) 1-3/4"	solder lug 4 (NS)	solder lug 5 (S-1).
(✓) 3"	SC3 (S-2)	solder lug 2 (S-2).
(✓) 6"	SC5 (S-2)	solder lug 4 (S-2).
(✓) 7"	TB7 (S-2)	solder lug 1 (S-1).
(✓) 5-1/2"	TB5 (S-2)	solder lug 6 (S-1).
(✓) 6-1/2"	TA7 (S-2)	solder lug 7 (S-1).
(✓) 6-1/2"	SC2 (S-2)	solder lug 9 (S-2).
(✓) 7-1/2"	SC4 (S-2)	solder lug 10 (S-2).
(✓) 8-1/2"	SC6 (S-2)	solder lug 12 (S-2).
(✓) 8"	Q3 (S-1)	solder lug 14 (S-1).

(✓) Solder the small alligator clip to one end of a 4" heavy wire. Then strip an additional 1/4" of insulation from the other end of the wire. Set this wire aside for use later.

(✓) This completes wiring of the Transistor Tester. Carefully inspect the wiring for loose solder or pieces of wire. Make sure all connections have been properly soldered.



Pictorial 10



Pictorial 11

Refer to Pictorial 11 for the following steps.

( ) Fasten the battery housing to the top panel, using three 6-32 x 3/8" screws as shown in Pictorial 11. Do not fully tighten these screws yet. Make sure none of the wires are pinched and see that the battery housing does not touch the resistors on LEAK VOLTAGE switch R. Reposition the resistors if necessary.

( ) Remove the backing from the gummed label and install it on the inside of the battery housing.

( ) Install the batteries as per instructions on the gummed label. Also see Pictorial 13, on Page 28.

BINDING POST CAP AND KNOB INSTALLATION

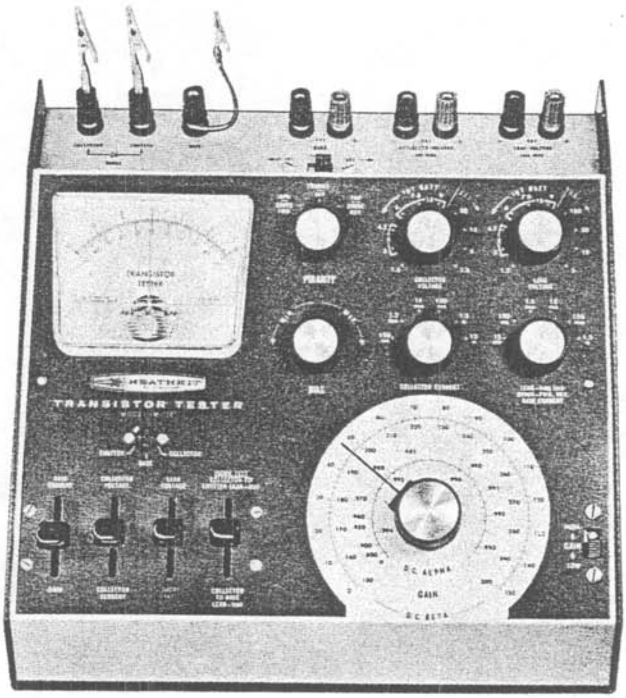
Refer to Pictorial 12 for the following steps.

( ) Install a black binding post cap on the following binding posts: COLLECTOR, EMITTER, BASE, and the three negative (-) binding posts.

( ) Install a red binding post cap on the three positive (+) binding posts.

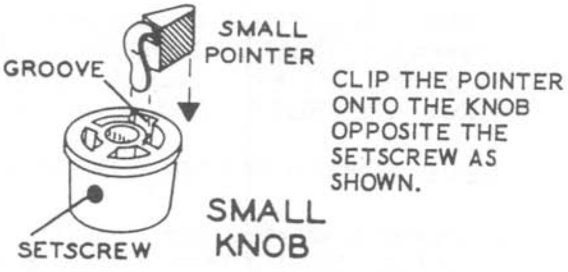
( ) Install a banana plug with alligator clip into the external COLLECTOR and EMITTER binding posts.

( ) Connect the heavy wire with the small alligator clip on one end to the external BASE binding post. See Pictorial 12.



Pictorial 12

( ) Clip a small pointer on each of the six small knobs as shown in Detail 12A.

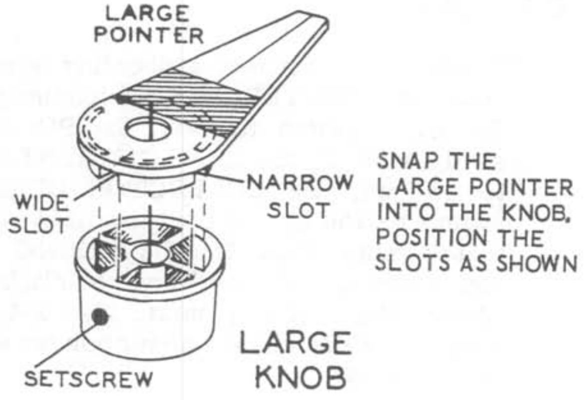


Detail 12A

( ) Install a small knob on each of the six switch shafts as shown in Pictorial 12. Make sure the setscrew is tightened against the flat of each switch shaft. It may be necessary to loosen the mounting nuts and rotate the switches slightly so the knob pointers will line up with the front panel markings.

( ) Snap the large pointer into the large knob as shown in Detail 12B.

( ) Install the large knob on the Gain Test control shaft. Center the knob so the pointer travels the same distance past the markings on each side of the scale.



Detail 12B

( ) If the knob pointers tend to spring away from the panel after the knobs are installed, the pointers may be removed and bent gently to correct this condition.

( ) Install the four lever switch knobs. If the knobs do not line up, use a pair of long-nose pliers and twist the levers slightly.

( ) Now remove the shorting wire from between the meter terminals.

INSTRUMENT CHECKOUT

No current flows in the tester until one of the levers on the Lever switch is actuated.

If the proper results are not obtained in any of the following steps, refer to the In Case Of Difficulty section.

POLARITY SWITCH

( ) Set the POLARITY switch to PNP. Pick up the tester and shake it slightly, noting the action of the meter pointer. Turn the POLARITY to the OFF position and again shake the tester slightly, noting the action of the meter. This time the meter movement should be more damped, that is, very little movement should be noted. With the POLARITY switch in the OFF position the meter terminals are shorted together.

Now repeat the preceding test with the POLARITY switch in NPN position. The results should be the same as before.

COLLECTOR VOLTAGE AND LEAK VOLTAGE SWITCHES

( ) Return the POLARITY switch to PNP position. Set the COLLECTOR VOLTAGE switch to 1.5. Push the COLLECTOR VOLTAGE lever; the meter should deflect to the right and indicate 1.5 volts or slightly higher with fresh batteries. Now check the remaining collector voltage steps for corresponding meter indications by rotating the COLLECTOR VOLTAGE switch.

NOTE: The meter will not deflect when the COLLECTOR VOLTAGE switch is in the EXT. position.

( ) Repeat the above test with the POLARITY switch set to NPN. The meter should now deflect to the left.

( ) Repeat the above two tests with the LEAK VOLTAGE switch while pushing the LEAK VOLTAGE lever.

BIAS CONTROL

( ) Temporarily connect a shorting wire between the EMITTER and BASE binding posts. Set BIAS switch to INT., the POLARITY switch to PNP, the LEAK CURRENT switch to 15 ma, the COLLECTOR CURRENT switch to 150 ma, and set the BIAS control to minimum. Push BASE CURRENT lever and advance the BIAS control slightly to deflect the meter pointer. Now set BIAS switch to EXT. and the meter pointer should return to zero.

COLLECTOR CURRENT LEVER

( ) Remove the shorting wire from between the EMITTER and BASE binding posts. Now connect a shorting wire between the COLLECTOR and EMITTER binding posts. Set the COLLECTOR VOLTAGE switch to INT. 1.5, the POLARITY switch to PNP, and set the COLLECTOR CURRENT switch to 15 a. Pull the COLLECTOR CURRENT lever and the meter pointer should deflect. Now set COLLECTOR CURRENT switch to 1.5 a. With the COLLECTOR CURRENT lever still pulled down, deflection of the meter pointer should be greater.

SHORT TEST LEVER

( ) Make sure the shorting wire is still connected between the COLLECTOR and EMITTER binding posts and the COLLECTOR VOLTAGE switch at INT. 1.5, and the POLARITY switch at PNP. Pull the SHORT TEST lever and the meter pointer should deflect. Remove the shorting wire from between the COLLECTOR and EMITTER binding posts. The meter should remain at zero when the SHORT TEST lever is pulled.

I_{cbo} LEVER AND LEAK CURRENT SWITCH

( ) Connect a shorting wire between the BASE and COLLECTOR binding posts. Set LEAK VOLTAGE switch to INT. 1.5, and set the LEAK CURRENT switch to 1.5 a. Pull the I_{cbo} lever and the meter should deflect off-scale slightly.

GAIN HIGH-LOW SWITCH

( ) Remove the BASE to COLLECTOR shorting wire and connect it between the BASE and EMITTER binding posts.

( ) Set the switches and controls as follows:

BIAS switch - INT.
POLARITY switch - PNP
COLLECTOR CURRENT switch - 15 ma
GAIN HIGH-LOW switch - LOW
BIAS control - minimum
Gain Test control - midway (75)

Pull GAIN lever and adjust the BIAS control to deflect the meter pointer to the left slightly. Now set the GAIN HIGH-LOW switch to HIGH. The meter pointer deflection should be greater.

If the Transistor Tester operated satisfactorily in the previous steps, proceed with the Adjustment section, which follows.

ADJUSTMENT

METER ZERO

(✓) Turn the POLARITY switch to PNP.

(✓) To mechanically adjust the meter pointer to zero, slowly turn the screw on the meter face while gently tapping the meter with your finger.

GAIN TEST CONTROL CALIBRATION

(✓) Connect a shorting wire between the EMITTER and BASE binding posts.

(✓) Set the POLARITY switch to PNP.

(✓) Set the COLLECTOR VOLTAGE switch to INT. 1.5.

(✓) Turn the BIAS control to minimum.

(✓) Set the COLLECTOR CURRENT switch to 15 ma.

(✓) Set the HIGH-LOW GAIN switch to LOW.

(✓) Turn the Gain Test control to 10.

(✓) Pull the GAIN lever and turn the BIAS control clockwise until the meter indicates approximately 5 on the 15 scale. Deflection should be to the left.

( ) Turn the Gain Test control fully counterclockwise. With the GAIN lever still down, slowly advance the Gain Test control until the meter starts to deflect. Note the position of the pointer on the Gain Test control with respect to zero. Now loosen the setscrew, turn the pointer to zero, and retighten the setscrew. After retightening the setscrew, repeat the above test to make sure it indicates directly over zero.

(✓) Remove the shorting wire from between the EMITTER and BASE binding posts.

This completes adjustment of the Transistor Tester.

OPERATIONAL CHECK

The Figures 5 and 15 on the COLLECTOR VOLTAGE and LEAK VOLTAGE switches INT. scale, are the meter scales to be used when the knob pointer is in one of those ranges. The 1.5 volt position is read 1.5 on the 15 meter scale.

(✓) Place a low power transistor in the transistor socket. (Use the External transistor terminals if the transistor does not fit in the socket.)

( ) Set the control and switches as follows:

BIAS control - Minimum
BIAS switch - INT.
POLARITY switch - to type for transistor; most likely PNP.
COLLECTOR VOLTAGE switch - 1.5 volts, INT.
LEAK VOLTAGE switch - 9 volts, INT.
COLLECTOR CURRENT switch - 15 ma.
LEAK CURRENT switch - 1.5 ma
GAIN HIGH-LOW switch - LOW

(✓) Pull the SHORT TEST lever. If there is no meter deflection, proceed with the test. If the meter deflects, the transistor is shorted. In this case, try a different transistor and start the Operational Check from the beginning.

(✓) Pull the COLLECTOR CURRENT lever and slowly advance the BIAS control. Notice that collector current increases as bias is increased. This indicates a good transistor. Adjust collector current to 5 ma.

(✓) Check collector voltage by pushing the COLLECTOR VOLTAGE lever. It should be approximately 1.5 volts. During this test, the 5 ma of collector current is still flowing.

(✓) Pull the GAIN lever and rotate the Gain Test control for a meter null*; this probably will be between 30 and 120, depending on the particular transistor.

*Zero indication on the meter.

( ) Push the BASE CURRENT lever to check base current. The current range is set with the LEAK CURRENT switch. This setting must not be less than 1/10 of the COLLECTOR CURRENT switch setting because this would reduce the base current.

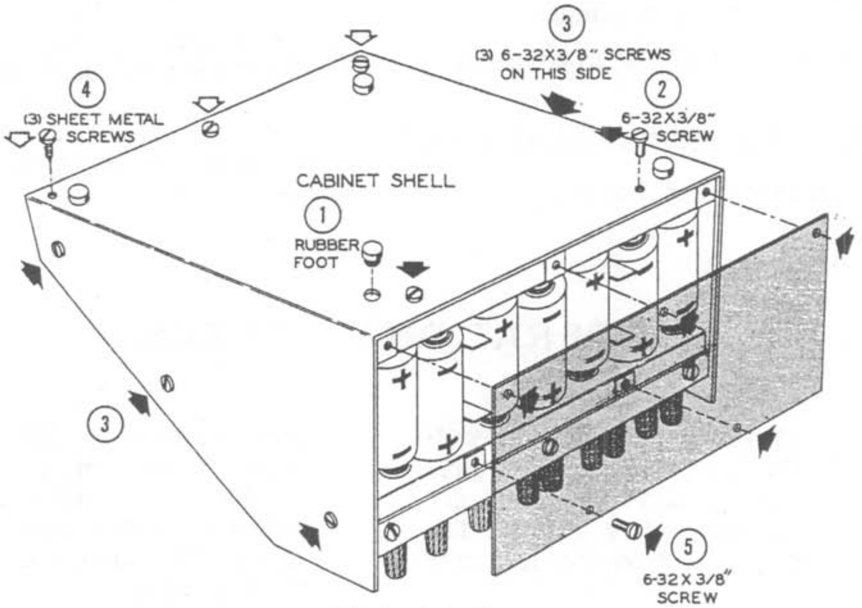
( ) Now push the LEAK VOLTAGE lever and note the meter reading of 9 volts.

( ) Push the I_{ceo} lever and note the collector to emitter leakage. Increase the setting of the LEAK CURRENT range switch if necessary; that is, if the pointer is deflected beyond the end of the scale.

( ) Pull the I_{cbo} lever and read collector to base leakage on the meter. Change the setting of the LEAK CURRENT range switch if necessary. Note that I_{cbo} is much smaller than I_{ceo}.

The results obtained in the preceding steps should be typical for a good transistor of the type tested. If the Transistor Tester seems to operate normally, proceed with installation of the cabinet. Be sure the POLARITY switch is in the OFF position.

CABINET INSTALLATION



Pictorial 13

Refer to Pictorial 13 for the following steps.

( ) Press the small end of one of the rubber feet through each of the four mounting holes in the bottom of the chassis.

( ) Install the back plate, using five 6-32 x 3/8" screws. Do not tighten.

( ) Install the unit in the cabinet shell, using three #6 sheet metal screws and two 6-32 x 3/8" screws on the bottom of the cabinet. Tighten securely.

( ) Insert six 6-32 x 3/8" screws in the sides of the cabinet. Do not tighten.

( ) Make sure the back plate is flush with the top panel and tighten the eight screws on the back of the unit.

( ) Now tighten the three screws on each side of the cabinet.

Your Transistor Tester can now be put into service. Note that, in the future, the batteries may be replaced without taking the unit out of the cabinet shell.

BATTERY REPLACEMENT

Replace only those batteries that check weak, since some of the batteries are used more than others.

NOTE: When carrying or moving the Tester the POLARITY switch should be in the OFF position to damp movement of the meter pointer.

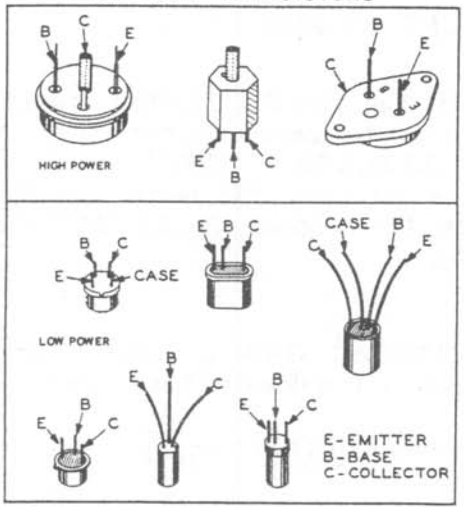
OPERATION

CAUTION: To prevent damage to the meter movement, use the meter only as described.

The importance of thoroughly understanding the operation of your Transistor Tester cannot be overemphasized. Testing is performed on a qualitive, rather than quantitive, basis. Interpretation of the meter reading, instead of the reading itself, will be the determining factor in deciding "whether or not to replace." Proper interpretation of the meter indications can come only from using the instrument, and being familiar with its operation.

NOTE: A chart illustrating the lead connections of various type of Typical Transistors is provided. If you are in doubt as to the type of transistor to be tested (high power or low power), we suggest that the transistor in question be compared with the chart. An up-to-date transistor manual will provide any detailed information needed.

TYPICAL TRANSISTORS



Refer to Figure 9 (fold-out from Page 24) for a description of each control, switch, and external connection.

GENERAL TRANSISTOR TESTING

This procedure requires that the operator know the approximate ratings of the transistor to be tested. Sufficient information on most transistors can be found in standard transistor manuals. If you do not have ratings for the transistor, refer forward to the procedure titled: Testing Transistors With Unknown Ratings.

Set up conditions for the transistor being tested by setting the following switches: COLLECTOR VOLTAGE, LEAK VOLTAGE, COLLECTOR CURRENT, LEAK CURRENT, and POLARITY (NPN or PNP). Set the BIAS control to minimum. Place the transistor into the transistor socket.

NOTE: The following tests are momentary and the levers should be held down only long enough to get the reading. Actuate one lever at a time.

Check for a shorted transistor by pulling the SHORT TEST lever. A shorted transistor will deflect to 4 or more on the 15 scale of the meter.

Check I_{cbo} and I_{ceo} leakage with the proper lever position.

Pull the COLLECTOR CURRENT lever and adjust the BIAS control for proper collector current.

Push the COLLECTOR VOLTAGE lever to check collector voltage.

Now pull the GAIN lever and adjust Gain Test control for meter null. Read the gain directly.

If the GAIN HIGH-LOW switch is moved to the HIGH position, readjust the BIAS control for the desired collector current.

TESTING TRANSISTORS WITH UNKNOWN RATINGS

SHORT TEST

Place the transistor to be tested in the transistor socket.

Set the POLARITY switch to PNP. Set the COLLECTOR VOLTAGE switch to 1.5 V. Pull SHORT TEST lever and watch the meter. The meter will deflect to 4 or more on the 15 scale, if the transistor is shorted. A good transistor will cause no deflection of the meter.

TESTING FOR NPN OR PNP

Insert the transistor into the socket or, if necessary, use the external transistor terminals. Assume that it is a PNP type (most are) and set the POLARITY switch to the PNP position. Set the BIAS control at minimum, the COLLECTOR VOLTAGE switch to 1.5 and set the COLLECTOR CURRENT switch to 15 ma. Pull the COLLECTOR CURRENT lever. If there is no meter deflection, advance the BIAS control to see if a collector current reading can be obtained. If there is a collector current indication, the transistor is a PNP type.

If the meter does deflect at zero bias, the transistor is an NPN type. As a final check, advance the BIAS control to deflect the meter pointer toward zero. This confirms that the transistor is an NPN type. With the POLARITY switch in the NPN position, collector current will increase normally as the BIAS control is advanced.

TESTING SMALL TRANSISTORS

Set the POLARITY switch to NPN or PNP as just determined. Then set the COLLECTOR CURRENT switch to 15 ma, the COLLECTOR VOLTAGE switch to 1.5 volts, and set the LEAK VOLTAGE switch to 9 volts. Pull the COLLECTOR CURRENT lever and advance the BIAS control. If collector current increases with advance of the BIAS setting, it can be assumed that the transistor is good. As a final check, pull the I_{cbo} lever. Leakage current should not be over 25 μa. NOTE: I_{ceo} is much larger than I_{cbo}.

TESTING POWER TRANSISTORS

Set the Polarity switch to NPN or PNP as determined above. Then set the COLLECTOR CURRENT switch to 1.5a, the COLLECTOR VOLTAGE switch to 1.5 volts, and set the LEAK VOLTAGE switch to 9 volts. Pull the COLLECTOR CURRENT lever and advance the BIAS control. If collector current increases as the bias setting is advanced, it can be assumed that the transistor is good. As a final check, pull the I_{cbo} lever. Leakage current should not be over 5 ma.

MATCHING TRANSISTORS FOR GAIN AND LEAKAGE

Set up test as for Transistor Testing. Using identical BIAS control and LEAK VOLTAGE switch settings, insert each transistor to be checked into the transistor socket and determine gain and leakage. Then separate them into common groups.

PRODUCTION GO NO-GO TESTS

PNP TRANSISTORS

Set up the specified test conditions, check for short, then check for leakage. Each transistor must show less than the maximum allowable leakage for the particular production application.

For checking gain, set up the proper bias condition and set the Gain Test control for minimum allowable gain. With the GAIN lever pulled, each transistor having a gain higher than the minimum allowable (preset) will deflect the meter to the right. Any transistor having less gain will deflect the meter to the left.

NPN TRANSISTORS

Use the same procedure as described above, except NPN transistors having a gain higher than the minimum allowable will deflect the meter to the left. NPN transistors having less gain will deflect the meter to the right.

DC CURRENT GAIN (h_{FE})

NOTE: The BASE CURRENT switch setting should not be more than one range lower than the COLLECTOR CURRENT switch setting. If this is not done, the meter resistance will reduce the original COLLECTOR CURRENT setting.

DC CURRENT GAIN is defined as collector current (I_c) divided by base current (I_b); that is, $\frac{I_c}{I_b} = h_{FE} = B_{dc}$; alpha $= \frac{B_{dc}}{B_{dc}+1}$

DC current gain, beta and alpha, is read directly from the calibrated dial under the Gain Test control pointer. This gain may be found using the instructions under General Transistor Testing.

AC CURRENT GAIN

AC current gain equals $\frac{\Delta I_c}{\Delta I_b} \Big| E_c$ constant

or $\frac{I_{c1} - I_{c2}}{I_{b1} - I_{b2}}$ at same E_c

AC current gain is defined as: The change in collector current divided by the change in base current that produced the change in collector current with collector voltage held constant.

Set the POLARITY, COLLECTOR VOLTAGE, COLLECTOR CURRENT, and LEAK CURRENT switches to the desired positions, depending on the type of transistor to be checked.

Pull the COLLECTOR CURRENT lever and adjust the BIAS control to the desired collector current (I_{c1}). Push the BASE CURRENT lever and read base current (I_{b1}) on the meter.

Now push the COLLECTOR CURRENT lever and adjust the bias to a lower collector current, say 25%. This is I_{c2}. Push the BASE CURRENT lever and read I_{b2} on the meter.

Using the values determined above, calculate the AC current gain.

DC TRANSCONDUCTANCE (g_{FE})

DC transconductance is defined as collector current (I_c) divided by base voltage (E_b); that is $\frac{I_c}{E_b} = g_{FE}$

To find g_{FE}, set up a given bias condition and, with an external voltmeter, measure base to emitter voltage at the external transistor terminals. Then use above formula.

AC TRANSCONDUCTANCE (g_{fe})

AC transconductance is defined as a change in base voltage (ΔE_b) that will produce a change in collector current (I_c), with collector voltage (E_c) held constant; that is,

$$g_{fe} = \frac{\Delta I_c}{\Delta E_b}\Big| E_c \text{ constant or } \frac{I_{c1} - I_{c2}}{E_{b1} - E_{b2}}$$

To find g_{fe}, set up a given bias condition, push COLLECTOR CURRENT lever and adjust the BIAS control. Read collector current I_{c1} on the meter. With an external voltmeter measure base to emitter voltage E_{b1} at the external transistor terminals. Now push the COLLECTOR CURRENT lever, reduce the bias, and read I_{c2} on the meter. Read E_{b2} on an external voltmeter.

Calculate g_{fe} by $\frac{I_{c1} - I_{c2}}{E_{b1} - E_{b2}}$

DC BASE RESISTANCE

DC base resistance is defined as base voltage (E_b) divided by base current (I_b); that is $\frac{E_b}{I_b}$

Set up a given bias condition, push COLLECTOR CURRENT lever, and adjust the BIAS control. Push the BASE CURRENT lever and read I_b on the meter. With a voltmeter connected between the BASE and EMITTER transistor terminals, read base voltage E_b.

AC BASE RESISTANCE

AC base resistance is defined as the change in base voltage (E_b) divided by the change in base current (I_b) with collector voltage (E_c) held constant; that is,

$$\frac{\Delta E_b}{\Delta I_b} / E_c \text{ constant}$$

To find AC base resistance, set up a given bias condition, push the COLLECTOR CURRENT lever and adjust the bias control. Push the BASE CURRENT lever and read I_{b1}. With a voltmeter connected between BASE and EMITTER external transistor terminals read base voltage E_{b1}. Now push COLLECTOR CURRENT lever and reduce bias. Push the BASE CURRENT lever and read I_{b2}. Read E_{b2} on external voltmeter.

Using the values just found, calculate AC base resistance as follows:

$$\frac{E_{b1} - E_{b2}}{I_{b1} - I_{b2}}$$

DC COLLECTOR RESISTANCE

DC collector resistance is defined as collector voltage E_c divided by collector current I_c; that is $\frac{E_c}{I_c}$

To find DC collector resistance, set up a given bias condition, push the COLLECTOR CURRENT lever and adjust the BIAS control. Read collector current I_c. Push the COLLECTOR VOLTAGE lever and read collector voltage E_c.

AC COLLECTOR RESISTANCE

AC collector resistance is defined as a change in collector voltage (E_c) divided by the change in collector current (I_c) with base current (I_b) held constant, that is;

$$\frac{\Delta E_c}{\Delta I_c} \Big| I_b \quad \text{constant}$$

To find AC collector resistance, set up a low collector voltage condition. Push the COLLECTOR CURRENT lever and adjust the Bias Control. Read collector current I_{c2}. Now push COLLECTOR VOLTAGE lever to read collector voltage E_{c2}.

Increase the COLLECTOR VOLTAGE switch setting, use the same bias setting as above, and read E_{c1}. Now push the COLLECTOR CURRENT lever and read I_{c1}.

Using the values just found, calculate AC collector resistance as follows:

$$\frac{E_{c1} - E_{c2}}{I_{c1} - I_{c2}}$$

TRANSISTOR LEAKAGE TESTS

I_{cbo} = collector to base leakage with the emitter open.

Adjust the LEAK VOLTAGE switch to the specified voltage, and set the LEAK CURRENT switch to proper meter range. Push the I_{cbo} lever and read leakage current directly.

I_{ceo} = collector to emitter leakage with the base open.

Adjust the LEAK VOLTAGE switch to the specified voltage, and set the LEAK CURRENT switch to the proper meter range. Pull the I_{ceo} lever and read leakage current directly.

I_{ces} = collector to emitter leakage with base shorted to the emitter.

Connect a shorting wire between the BASE and EMITTER binding posts. Then read I_{ces} on the meter, using the same procedure as outlined above for I_{ceo}.

I_{cer} = collector to emitter leakage with a specified resistance connected between the base and emitter.

Connect the specified resistance between BASE and EMITTER binding posts. Then read I_{cer} on the meter, using the procedure outlined above for I_{ceo}.

I_{cerv}, I_{cex} = collector to emitter leakage with specified reverse bias battery and resistance in series between the base and emitter.

Connect the specified reverse battery and resistance between the BASE and EMITTER binding posts. Now read I_{cerv} or I_{cex} on the meter, using the procedure outlined above for I_{ceo}.

DIODE TESTING

REVERSE CURRENT

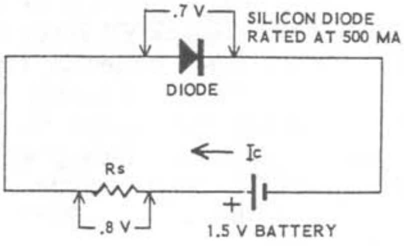
Set the LEAK VOLTAGE switch to the proper value and set the LEAK CURRENT switch to the proper meter range. Place the POLARITY switch in the DIODE REV. position. Pull the SHORT lever to see if the diode is shorted. If the diode is not shorted, push the DIODE lever and read the reverse (leakage) current on the meter.

FORWARD CURRENT

WARNING: Always connect a resistor in series with the diode before checking forward current. Without a series resistor, too much current will flow, possibly damaging the diode.

EXAMPLE: A silicon diode normally drops approximately .7 volt. If the 1.5 volt supply is used, a series resistor must be used to drop the other .8 volt.

I equals 500 ma
E equals .8 V
$$R_s = \frac{E}{I} = \frac{.8}{.5} = 1.8\ \Omega$$



Rs = SERIES RESISTANCE

Here a 2 Ω resistor will prevent excessive current from damaging the diode under test.

The series resistor may be left connected when checking REVERSE CURRENT. The series resistance is normally a very small resistance compared to the high reverse-current resistance of the diode.

Connect the diode to be tested and the predetermined series resistor to the external transistor terminals; cathode to EMITTER and anode to COLLECTOR. Set the LEAK VOLTAGE switch to the proper value and the LEAK CURRENT switch to the proper meter range. Place the POLARITY switch in the DIODE FWD. position. Push the DIODE lever and read forward current on the meter.

Other types of diodes may also be tested as just described.

EXTERNAL BIAS VOLTAGE TERMINALS

Connect the external DC power supply leads to the external bias terminals; the positive lead to positive (+) terminal and the negative lead to negative (-) terminal.

Set the BIAS switch to the EXT. position. The internal BIAS control is used to set the desired amount of bias. NOTE: A maximum of 5 volts may be applied to these terminals.

The external bias supply may be a battery or any high-current, low-voltage unit, such as a battery eliminator.

The external BIAS terminals should be used when continuous power transistor testing is required.

EXTERNAL COLLECTOR VOLTAGE TERMINALS

Connect the external DC power supply to external COLLECTOR VOLTAGE terminals; the positive lead from the power supply connects to the positive (+) terminal and the negative lead to the negative (-) terminal.

Adjust the COLLECTOR VOLTAGE switch to the desired EXT. voltage range. Now set the power supply for the desired collector voltage. NOTE: A maximum of 50 volts may be applied to these terminals.

The external collector voltage power supply may be any high-current unit, such as a battery eliminator.

The external collector voltage terminals should be used when continuous power transistor testing is required.

EXTERNAL LEAK VOLTAGE TERMINALS

Connect the external DC power supply leads to the external LEAK VOLTAGE terminals; the positive lead to positive (+) and the negative lead to negative (-) terminal.

Adjust the LEAK VOLTAGE switch to the proper EXT. voltage range. Now set the power supply for the desired leak voltage. NOTE: A maximum of 150 volts may be applied to these terminals.

The external leak voltage power supply may be any high-voltage supply such as a laboratory DC power supply.

The external LEAK VOLTAGE terminals must be used when higher leak voltages are required than are available from the internal battery supply.

CHECKING CURRENT RANGES

EXT. TRANSISTOR TERMINALS

Connect an external DC ammeter between the COLLECTOR and EMITTER external terminals. The positive (+) side goes to the EMITTER with POLARITY switch in PNP position. Connect resistance Rx in series with the ammeter as shown in Figure 11.

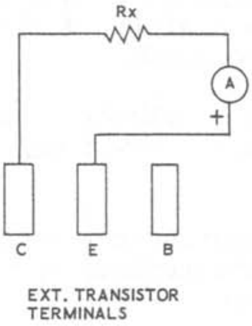


Figure 11

Before calculating the size of resistor Rx, decide on the current range to be checked, and what voltage it will be checked at.

For example:

Current range to be checked - 150 milliamperes.
Collector voltage used - 1.5 volts.

$$Rx = \frac{E}{I} = \frac{1.5}{.150} = 10\ \Omega.$$

In this case a 10 Ω resistor is used as Rx to limit the current to 150 milliamperes.

Set the POLARITY switch to PNP and set the COLLECTOR VOLTAGE switch to 1.5 volts. Now pull the COLLECTOR CURRENT lever and compare the current indicated on the ammeter with the current indicated by the meter on the Transistor Checker. If an appreciable difference is found between the two readings, and if you are certain of the accuracy of the external ammeter, the meter and shunt resistors of your Checker should be checked.

This same procedure may be used to check the other current ranges.

CHECKING VOLTAGE RANGES

Connect an external DC voltmeter between the external COLLECTOR and EMITTER terminals. The positive (+) side of the meter goes to the EMITTER terminal.

Set the POLARITY switch to PNP and set the COLLECTOR VOLTAGE switch to the internal voltage range to be checked. Push the COLLECTOR VOLTAGE lever and compare the LEAK voltage readings on the two meters. If an appreciable difference is found between the two readings, check the meter and multipler resistors of your Transistor Checker.

To check the higher external ranges, connect an external power supply to the EXTERNAL LEAK VOLTAGE terminals along with an external voltmeter as shown in Figure 12.

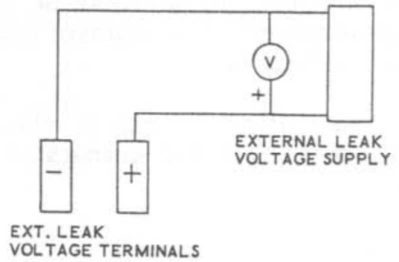


Figure 12

Set the LEAK VOLTAGE switch to the desired external range and push the LEAK VOLTAGE lever to read the LEAK voltage and compare the two meter readings.

SUGGESTED MANUALS

TRANSISTOR MANUAL - General Electric Co. (Gives specifications of most transistor types.)

POWER TRANSISTOR HANDBOOK - Motorola, Inc.

SILICON ZENER DIODE AND RECTIFIER HANDBOOK - Motorola, Inc.

Manufacturers Specification Sheets of particular Transistor and Diode types. - Write directly to manufacturer involved.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of this manual.

3. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring beneath the panel.

5. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

6. Make sure the batteries are not run down. If necessary, install a fresh set of batteries.

7. Repeating the Instrument Checkout procedure may be helpful in pinpointing the problem.

TROUBLESHOOTING CHART

If one of the switches or controls does not respond properly during the Instrument Checkout procedure, the chart below will show where the difficulty might be found. Refer to the correct switch or control and check the wiring of the components listed under "Possible Source Of Difficulty." Refer to the Pictorials listed.

CONTROL OR SWITCH	POSSIBLE SOURCE OF DIFFICULTY
A. POLARITY switch	POLARITY switch and meter. See Pictorial 10.
B. COLLECTOR and LEAK VOLTAGE switches.	Batteries, battery housing, meter, POLARITY, COLLECTOR, and LEAK VOLTAGE switches. Lever switch wafers C and E. See Pictorials 1, 2, 4, 6, 7, 9, and 10.
C. BIAS control.	Batteries, battery housing, meter, BIAS, POLARITY, COLLECTOR and LEAK CURRENT switches; Lever switch wafers A and B. BIAS and Gain Test controls. External transistor terminals. See Pictorials 3, 4, 8, 9, and 10.
D. COLLECTOR CURRENT lever.	Batteries, battery housing, meter, POLARITY, COLLECTOR VOLTAGE, and COLLECTOR CURRENT switches; Lever switch wafers C and D. External transistor terminals. See Pictorials 2, 3, 4, 6, 7, 8, 9, and 10.
E. SHORT TEST lever.	Batteries, battery housing, meter, POLARITY, COLLECTOR VOLTAGE and COLLECTOR CURRENT switches; Lever switch wafers D and E. External transistor terminals. See Pictorials 2, 3, 4, 6, 7, 8, 9, and 10.
F. I_{ceo}, I_{cbo} Lever and LEAK CURRENT switches.	Batteries, battery housing, meter, POLARITY, LEAK VOLTAGE, and LEAK CURRENT switches; Lever switch wafer F. External transistor terminals. See Pictorials 1, 4, 6, 7, 8, 9, and 10.
G. GAIN HIGH-LOW switch.	Batteries, battery housing, meter, BIAS, POLARITY, COLLECTOR CURRENT, and GAIN HIGH-LOW switch; Lever switch wafers A and B. BIAS and Gain Test controls. External transistor terminals. See Pictorials 2, 3, 4, 6, 7, 8, 9, and 10.

SERVICE INFORMATION

SERVICE

If, after applying the information contained in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipemnt. Specifically report operating procedures, switch positions, connections to other units and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit model number and date of purchase if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)

5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed instrument to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although you may find charges for local service somewhat higher than for factory service, the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

ATTACH A TAG TO THE EQUIPMENT BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan

Include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

WARRANTY

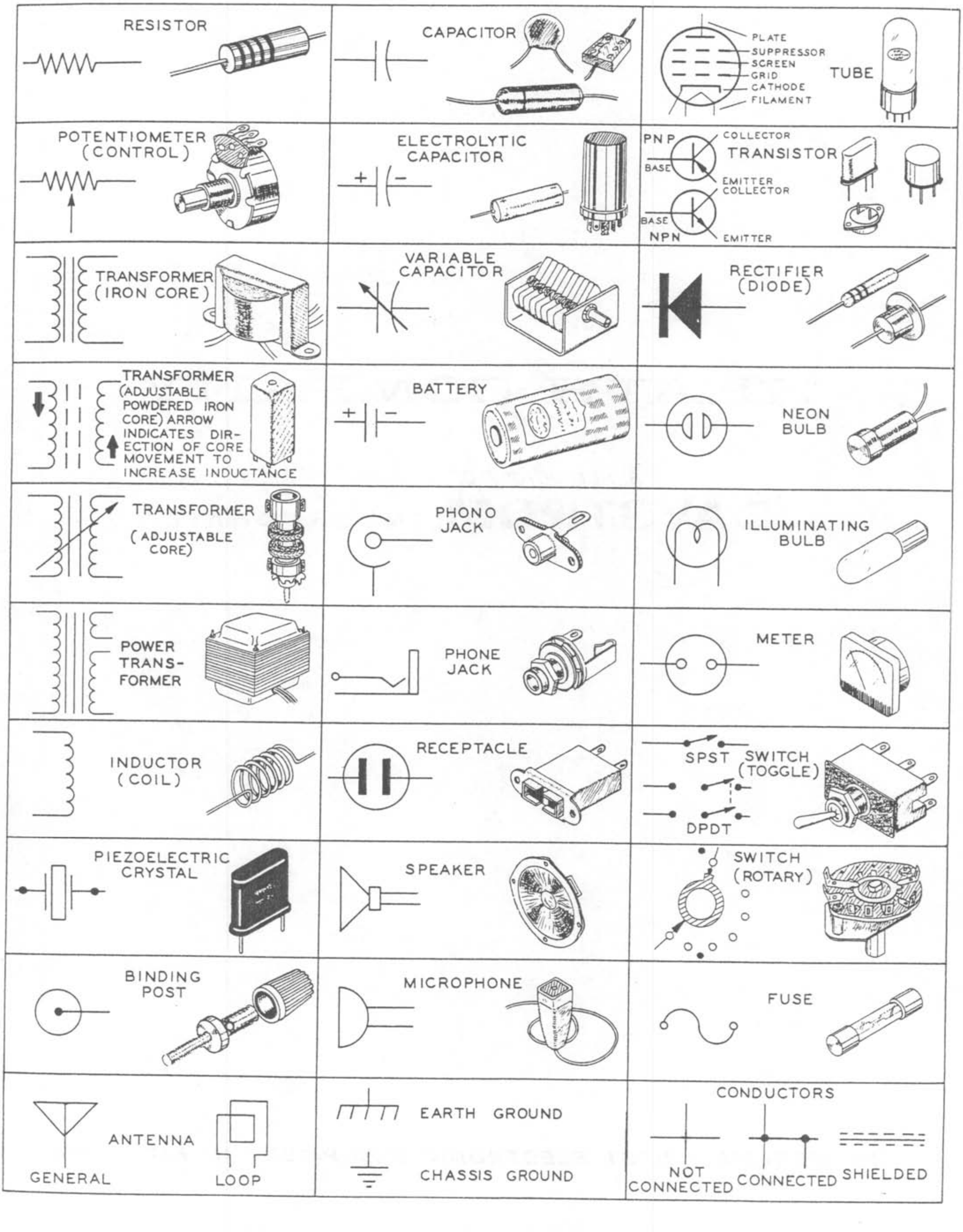
Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

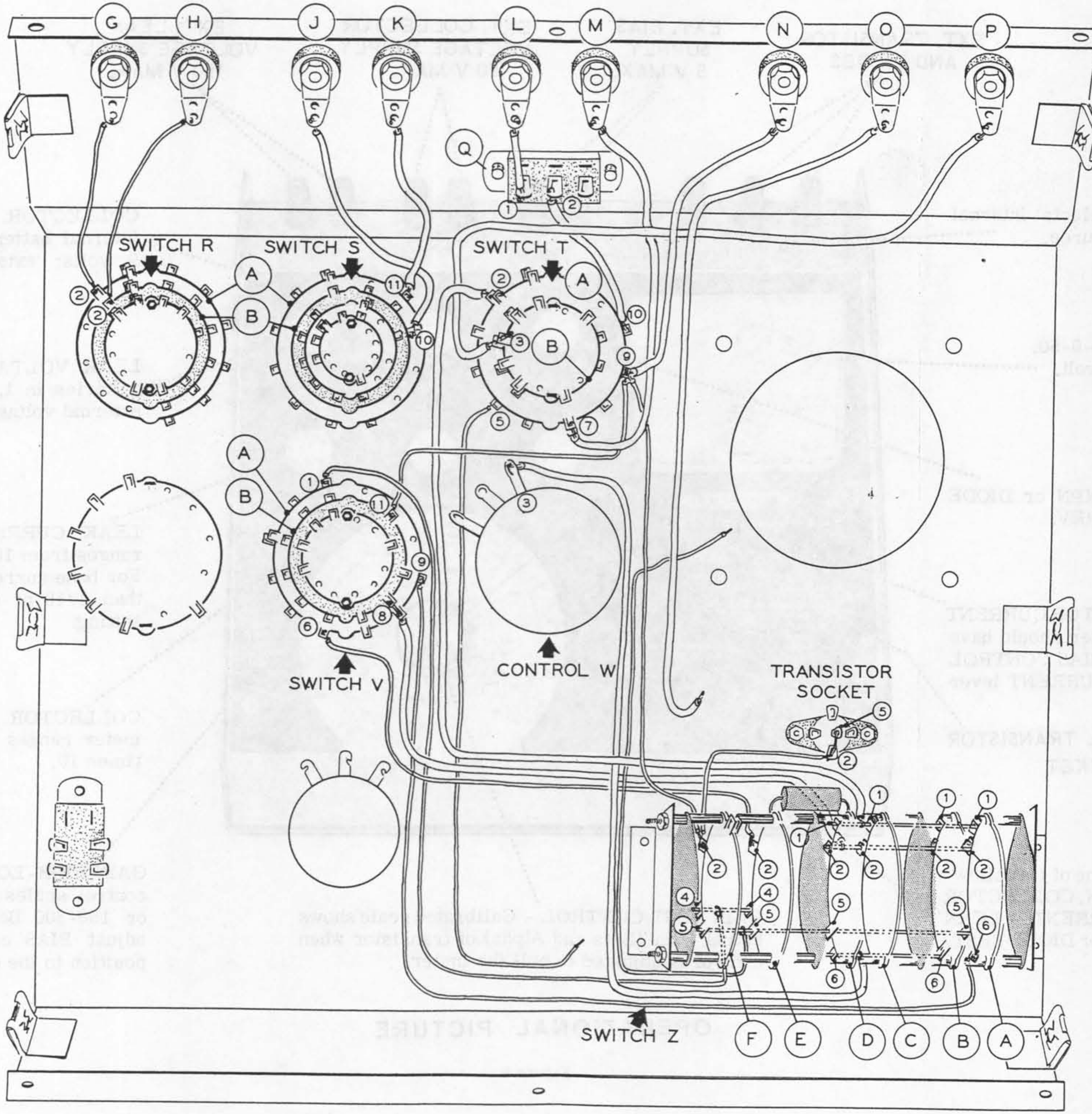
NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.




G
H
J
K
L
M
N
O
P
Q
SWITCH R
SWITCH S
SWITCH T
A
B
SWITCH V
CONTROL W
TRANSISTOR
SOCKET
SWITCH Z
F
E
D
C
B
A

Pictorial 9

EXT. TRANSISTOR AND DIODES

EXT. BIAS SUPPLY 5 V MAX.

EXT. COLLECTOR VOLTAGE SUPPLY 50 V MAX.

EXT. LEAK VOLTAGE SUPPLY 150 V MAX.

BIAS INT.-EXT. SWITCH - Selects internal 1.5 volt battery or an external source.

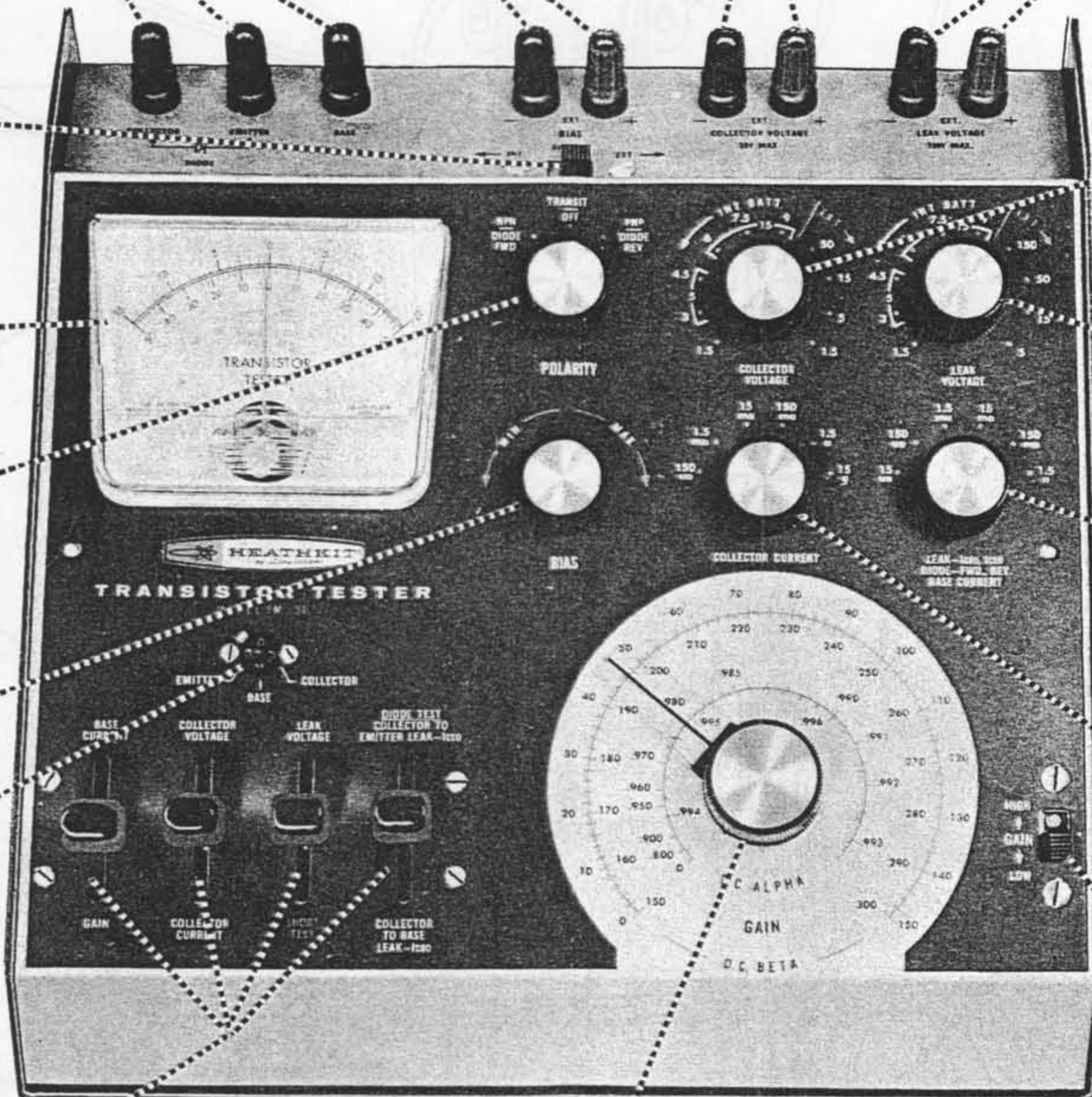
METER - Scales: 15-0-15 and 50-0-50. Sensitivity: 10-0-10 μa, 100 KΩ/volt. Resistance: 5000 Ω.

POLARITY SWITCH - Selects NPN or DIODE FWD, OFF, and PNP or DIODE REV.

BIAS CONTROL adjusts COLLECTOR CURRENT to any value from 0 to 15 a. Meter should have no appreciable deflection with BIAS CONTROL at minimum and COLLECTOR CURRENT lever pulled.

UNIVERSAL TRANSISTOR SOCKET

LEVER SWITCH - Selects any one of the following tests: BASE CURRENT, GAIN, COLLECTOR VOLTAGE, COLLECTOR CURRENT, LEAK VOLTAGE, SHORT TEST, Iceo or DIODE TEST, and Icbo.



GAIN TEST CONTROL - Calibrated scale shows actual gain (Beta and Alpha) of transistor when control is adjusted to null the meter.

COLLECTOR VOLTAGE SWITCH - Selects internal batteries in 1.5 volt increments up to 9 volts; external voltages up to 50 volts.

LEAK VOLTAGE SWITCH - Selects internal batteries in 1.5 volt increments up to 9 volts; external voltages up to 150 volts.

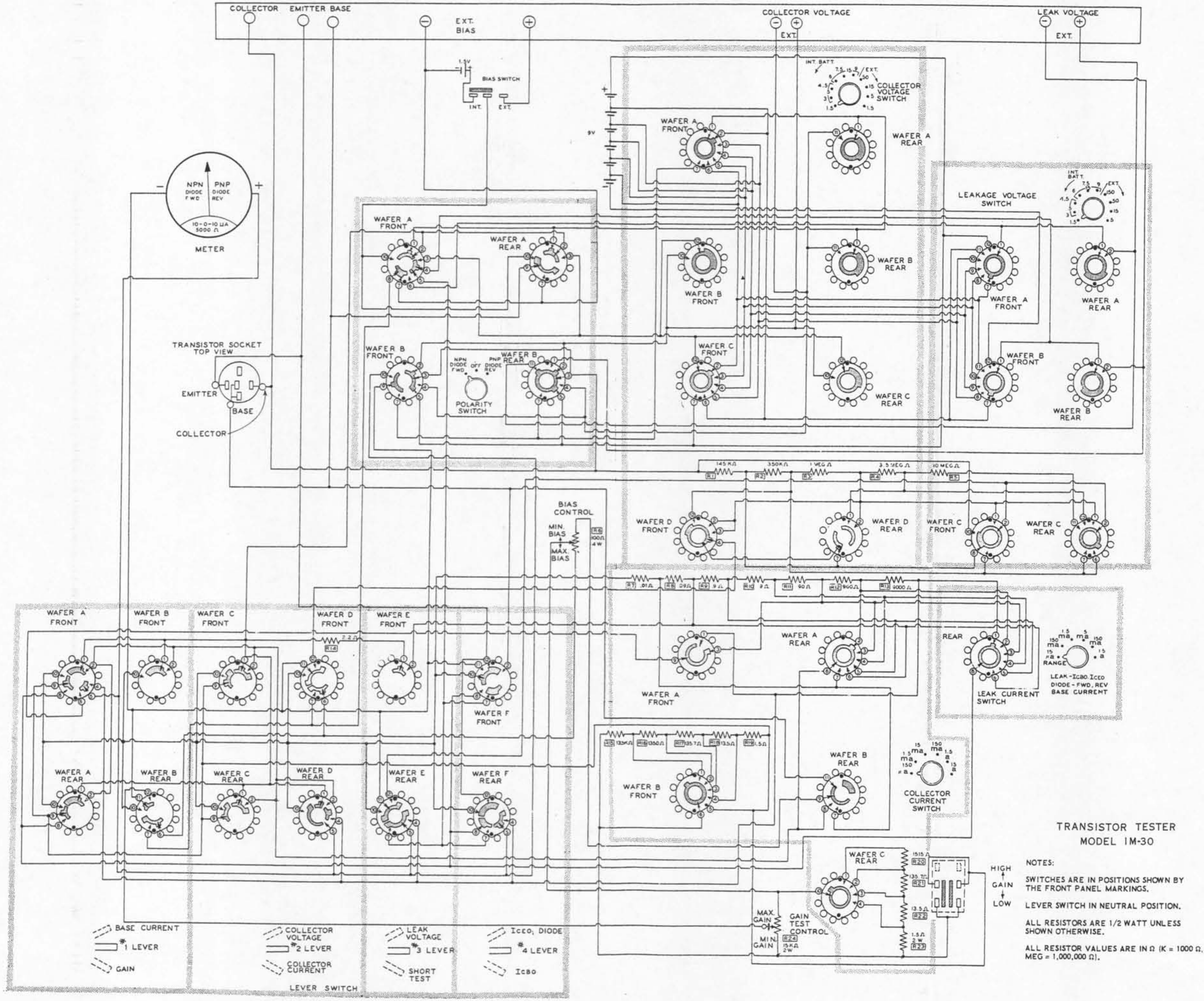
LEAK CURRENT SWITCH - Selects meter ranges from 15 μa to 1.5 a in steps of times 10. For base current measurement, do not set less than 1/10 of COLLECTOR CURRENT switch setting.

COLLECTOR CURRENT SWITCH - Selects meter ranges from 150 μa to 15 a in steps of times 10.

GAIN HIGH-LOW SWITCH - Selects GAIN TEST control scales of 0-150 Beta and 0-0.993 Alpha or 150-300 Beta and 0.993-0.9966 Alpha. Readjust BIAS control when changing from one position to the other.

OPERATIONAL PICTURE

Figure 9



TRANSISTOR TESTER
MODEL IM-30

NOTES:

SWITCHES ARE IN POSITIONS SHOWN BY THE FRONT PANEL MARKINGS.

LEVER SWITCH IN NEUTRAL POSITION.

ALL RESISTORS ARE 1/2 WATT UNLESS SHOWN OTHERWISE.

ALL RESISTOR VALUES ARE IN Ω (K = 1000 Ω, MEG = 1,000,000 Ω).

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