Manual . . . Net Price: $1.00

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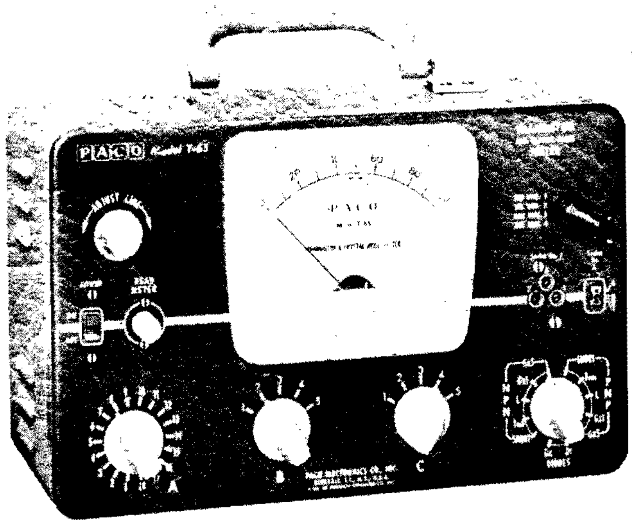


ASSEMBLY *and* OPERATING MANUAL *for*

PACO

TRANSISTOR and Crystal Diode TESTER KIT

Model T-65

PACO ELECTRONICS CO., INC.

A DIVISION OF PRECISION APPARATUS CO., INC. 70-31 84th STREET, GLENDALE 27, L. I., N. Y.

IMPORTANT NOTICE

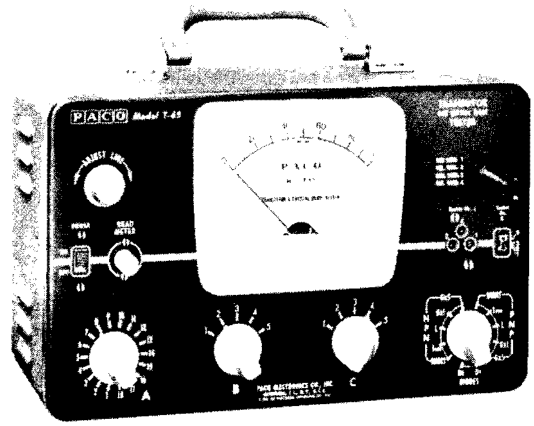
PLEASE MAKE THE FOLLOWING CORRECTIONS IN YOUR INSTRUCTION MANUAL BEFORE YOU PROCEED WITH THE ASSEMBLY OF THIS KIT.

MODEL T-65 INSTRUCTION CORRECTIONS 359

PAGE 19-STEP 85: - CHANGE "RED-BLACK (125V-PRIMARY)" TO "RED-GREEN (125V-PRIMARY)". CHANGE "RED-BLACK LEAD TO CA1" TO "RED-GREEN LEAD TO CA1".

PAGE 21-STEP 97: - CHANGE "RED-W/GREEN TRACER" TO BROWN-RED".

PAGE 21-STEP 100:- CHANGE "WHITE-BLACK" TO "BROWN-BLACK".



T-65 FEATURES AND SPECIFICATIONS

TESTS: Low power, medium power, and power type transistors, NPN and PNP types.

TESTS: Crystal diodes for forward (Df) and reverse (Dr) current in comparison with manufacturer's specifications.

ALL TRANSISTOR TESTS READ ON ONE 0-100 METER SCALE: Direct test limits for each transistor listed on the accompanying data sheets.

TWO PANEL-MOUNTED TRANSISTOR SOCKETS: Supplemented by a universal alligator-terminated cable to provide connection facilities for all transistors.

METER: Large,. easy to read clear-plastic cased meter. Accurately balanced and factory calibrated to within ± 2%. Rugged double-jeweled D'Arsonval type, produced by the PACE Division of Precision Apparatus Co., Inc.

MICRO-LINE ADJUSTMENT: Read directly on meter. Continuously variable heavy-duty line voltage control.

TEST CIRCUITS COMPLETELY TRANSFORMER-ISOLATED FROM POWER LINE: Assures utmost safety to operator and instrument.

Transistor Tests, Ranges

MODEL T-65 SEQUENTIALLY TESTS TRANSISTORS AS FOLLOWS:

(1) SHORTS: Collector-to-Emitter and/or Base shorts indicated for each transistor on the data sheets by a limit meter reading. Automatic maximum range prevents damage to meter.

(2) I_{cbo}: Collector cut-off current, from 2 microamperes on the first meter range to 50 milliamperes full scale reading in 5 separate ranges:

0-100	Microamperes, Full Scale
0-500	Microamperes, Full Scale
0-2500	Microamperes, Full Scale
0-10	Milliamperes, Full Scale
0-50	Milliamperes, Full Scale

Proper collector voltage has been predetermined for each transistor and is automatically panel-selected to one of 17 available potentials between the range of .5V DC to 100V DC.

(3) L: Leakage test (Collector-to-Emitter current, with open Base) provides an intermediate reading for maximum accuracy of subsequent Gain test.

(4) GAIN: Measures direct-reading beta in two ranges from a low reading of 2 (GX1 range) to a maximum reading of 500 (GX5 range) with predetermined selection of 5 Base current injection values as follows:

0-50-200-500 Microamperes
0-2-5 Milliamperes

Crystal Diode Tests

ALL DIODES ARE CHECKED FOR FORWARD AND REVERSE CURRENT AT PREDETERMINED APPLIED VOLTAGES.

FOR DIODE REVERSE (Dr) TESTS: Current ranges from 2 microamperes (lowest reading) up to 50 milliamperes are automatically panel-selected at any one of 17 predetermined voltages (from .5 to 100 volts).

FOR DIODE FORWARD (Df) TESTS: Current ranges from 5 milliamperes to 500 milliamperes are provided at any one of 17 predetermined voltages (from .75 to 75 volts).

GENERAL KIT CONSTRUCTION INFORMATION

INTRODUCTION

The PACO kit you have just purchased is a high quality instrument and when assembled and used according to the instructions in this manual, will provide many years of trouble-free service. Therefore, the first, and we feel, most valuable advice we can offer in this manual is to work carefully and patiently. By doing so, you will experience more satisfaction in your new instrument, and greater confidence in your ability.

THE MANUAL

We suggest that you spend a little time NOW and read this entire manual thoroughly before starting actual construction of the kit. This will familiarize you with the contents and general procedure to be followed.

The step-by-step instructions will help you assemble the instrument with a minimum possibility of error. Further assistance may be gained from using the large folded-in diagrams supplied with this manual. These are enlargements of the smaller size figures referred to in the step-by-step instructions. They should be attached to the wall above your work bench for easier reference.

We advise you to keep this manual after the kit has been constructed, for future assistance in using and maintaining your PACO instrument.

UNPACKING

We cannot stress too strongly the need for exercising care throughout these instructions. This is especially true now as you unpack the kit. Parts may become easily damaged through carelessness here. Do not throw away any packing materials until all parts are accounted for. Each part should be checked against the parts list at the back of the manual to make certain all parts are present and correct as to value and type. The color code chart at the back of this manual will assist you in identifying doubtful parts. Please notify us promptly if any shortage or erroneous part is discovered. Return the inspection slip with your letter to expedite handling. Keep in mind, however, minor differences in some parts do not indicate an error. A .05 mfd capacitor, for example, may sometimes be found in the kit where a .047 mfd is called for in the parts list. Such substitutions are checked carefully before they are made and you can be assured they will work satisfactorily. The registration card accompaning each PACO kit MUST be filled in and returned to the company immediately after purchase. Our warranty applies only to registered instruments.

TOOLS REQUIRED FOR ASSEMBLING AND WIRING PACO KITS

Only standard tools are required in constructing PACO kits — a good quality soldering iron with a small tip (50 or 60 watts), a pair of long-nose pliers, a pair of diagonal or side-cutting pliers, a small assortment of screwdrivers, and a few small end-wrenches or a small adjustable wrench. Screwdriver handled nut-drivers may be used in place of wrenches in most cases.

ASSEMBLING AND WIRING

Proper positioning of wires and parts in this instrument is quite important, and changes may affect operation. Follow the diagrams closely and you should encounter little, if any difficulty, for the layout has been thoroughly prechecked and tested for best results.

When wiring, remove only about 1/4 inch of insulation from the ends of hook-up wire. Excessive removal of insulation may result in the exposed wire shorting to nearby terminals or wiring. If the wire has a brown, baked enamel coating (transformer leads, for example) be sure to scrape the enamel off with sandpaper or a knife to expose the copper wire before making a terminal connection. Leads on parts (resistors, capacitors, etc.) should be trimmed to proper length before mounting. Do not cut leads too short! All parts should fit between designated points without strain.

SOLDERING

We wish to emphasize at this point the extreme importance of proper soldering technique. Much engineering skill and effort has gone into making your PACO instrument capable of high quality performance. To obtain this performance, good solder joints are essential. Solder, an alloy of tin and lead, is applied to an electrical connection to provide a permanent electrical bond between the wires and terminals being joined. It also seals the connection from air and moisture and prevents formation of corrosion, which produces undesirable resistance between the joined conductors. It you have had little or no previous experience with soldering, we suggest you read this section carefully and spend some time practicing with an old tube socket or terminal strip and some scrap pieces of wire, before doing any soldering on your kit.

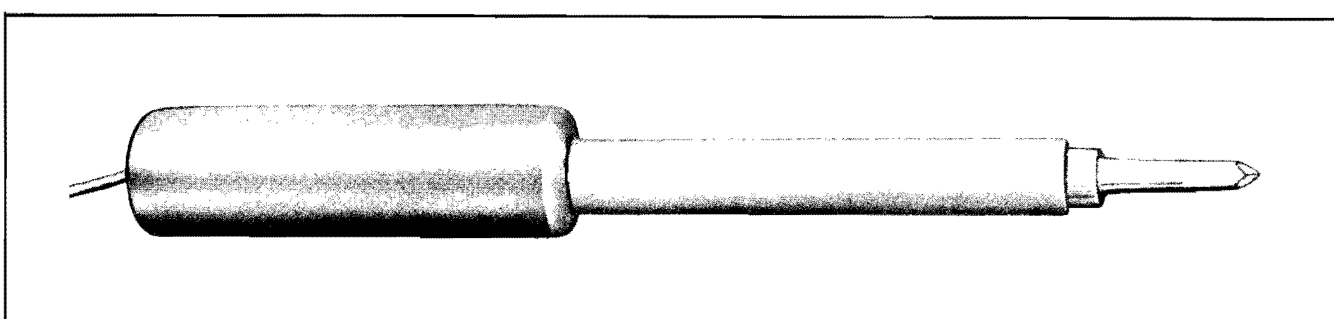
Soldering is not difficult. Just observe a few simple rules and precautions and spend a reasonable amount of time practicing to attain a workable degree of soldering skill. Following are some of the more important points to be remembered:

1. Only good quality solder with a non-corrosive (rosin) core should be used: THIS IS IMPORTANT! ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE ANY PACO INSTRUMENT WIRED WITH ACID CORE SOLDER OR PASTE FLUX.

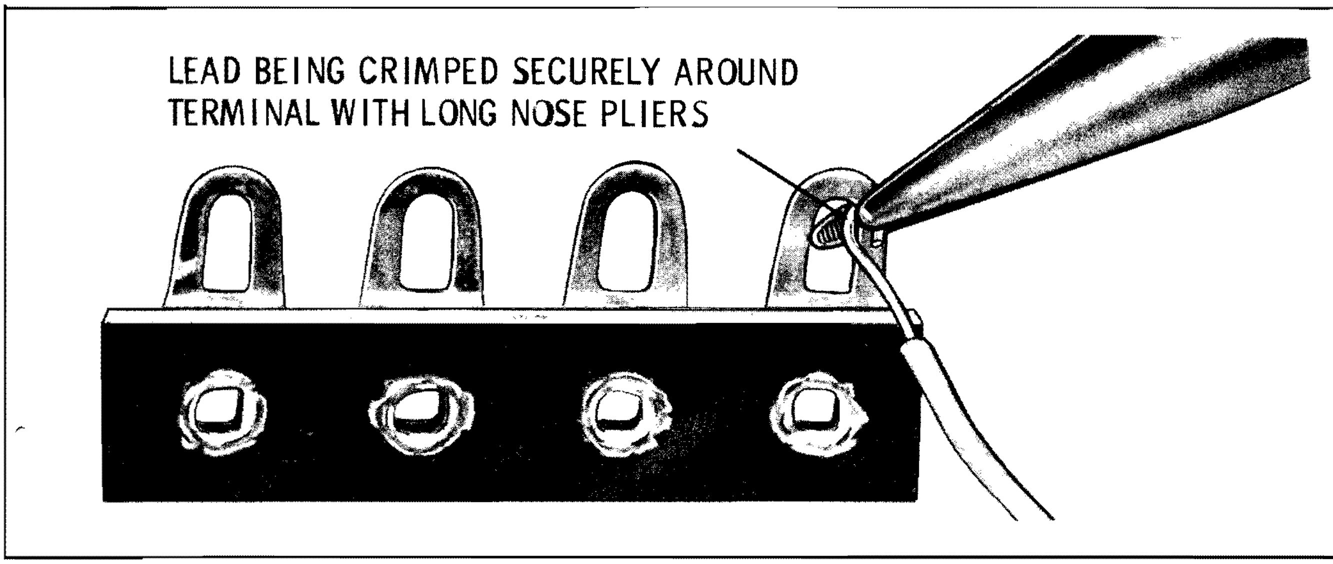
Acid core solder and paste fluxes are primarily used in sheet metal and plumbing work where a strong "cutting" agent is needed to remove heavy deposits of dirt and corrosion while soldering. The acid itself is very corrosive, however, and any remaining deposits must be quickly removed after soldering. IT SHOULD BE OBVIOUS, THEREFORE, THAT ANY ATTEMPT TO USE THIS TYPE OF SOLDER ON ELECTRICAL EQUIPMENT WOULD ONLY RESULT IN MUCH DAMAGE TO CIRCUIT COMPONENTS AND WIRING.

To remove any doubt about the solder you use, we suggest you make certain the roll you buy has been clearly labeled for television and radio use.

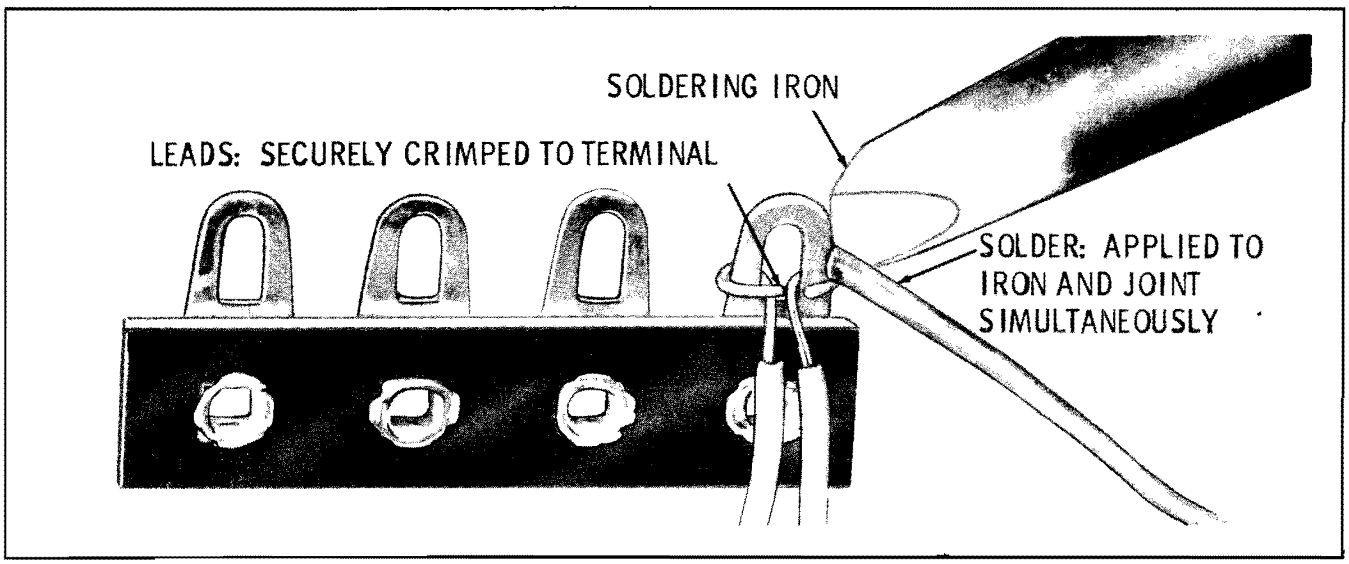
2. Use a good soldering iron, one which has the correct wattage for the work you are doing. For soldering to printed circuit boards and certain miniaturized components such as transistors, a pencil-type iron between 25 to 50 watts is recommended. Most other work may be adequately performed with an iron in the 50-80-watt range. Heavier wattages (100-250 watts) may sometimes be useful for certain jobs, such as soldering to chassis, but such occasions will not arise too often. As for the type of iron, you may use either the standard diamond or "chisel" tip, or one of the newer "solder guns". Whichever you choose, remember to keep the tip properly tinned according to manufacturer's instructions. It should have a "bright" appearance, and be free of excess solder. (See illustration.) An old rag or piece of steel wool should be used to wipe the hot tip clean.



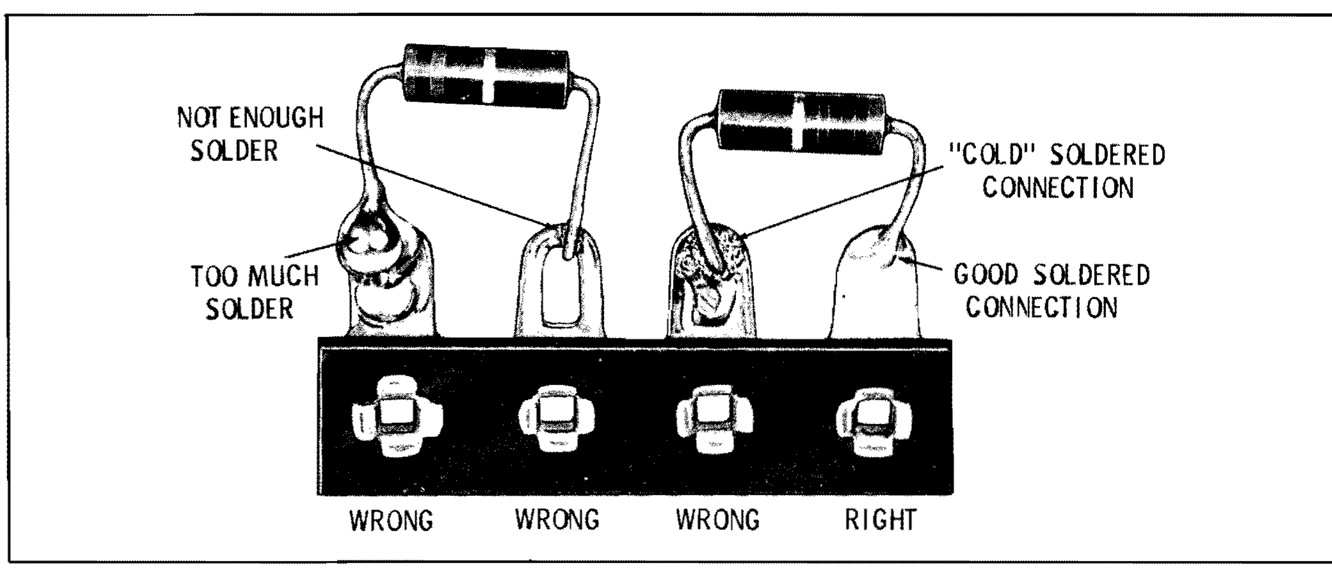
CLEAN, WELL-TINNED SOLDERING IRON.



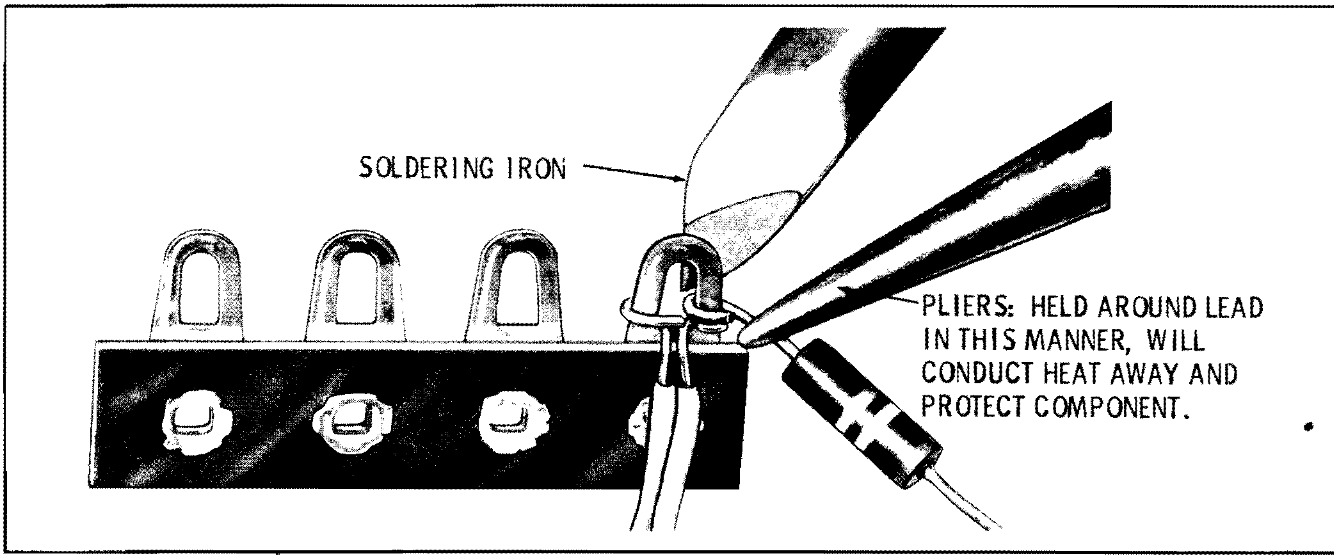
MAKING GOOD MECHANICAL CONNECTION PRIOR TO SOLDERING



SOLDERING A CONNECTION



EXAMPLES OF GOOD AND BAD SOLDERING



PROTECTING SMALL COMPONENTS FROM OVERHEATING.

3. Before soldering, be sure terminals and leads are free from wax, dirt, or corrosion. Solder will not adhere to dirty or corroded metal. Radio and television solders are supplied with a rosin flux core. Rosin flux "cuts" or removes most of the dirt or corrosion from metal surfaces being joined and allows the solder to adhere. Rosin, however, is a relatively mild "cutting" agent and will not completely remove heavy deposits of dirt, wax, or corrosion. Therefore, before applying solder, all leads and terminals which are not bright and clean, must be scraped clean using a knife or single-edged razor blade.

4. Do not rely on solder alone for mechanical strength! Make a good mechanical connection before soldering by crimping the wires and leads securely to the terminals with your pliers. (See illustration.) All stranded wire should be "tinned" with solder before connecting. ("Tinning" means lightly soldering the wire end itself before crimping it to its connecting point.) Tinning stranded wire facilitates crimping this type of wire to terminals, and also prevents small wire strands from breaking. Tinning leads on components like resistors and capacitors is not always necessary, but is still advisable because it helps the solder adhere more readily to the connection.

5. To properly make a solder connection:
   a. Apply iron to joint, and hold until joint heats sufficiently to melt solder.
   b. Apply solder to joint and iron simultaneously, allowing solder to flow smoothly and freely around and into connection. Do not just melt drops of solder on to the joint . . . solder must FLOW into the joint to be effective.

Keep in mind that solder will not flow smoothly into a connection unless the joint itself has been heated enough to melt the solder. Unless this is done, "cold" or high resistance joints often result. (See illustration.) You will notice that "cold" solder joints have a dull and "grainy" appearance. A good solder connection will present a smooth and "shiny" appearance. (See illustration.) Other causes of "cold" joints are melting drops of solder on the joint with the iron; leads and wires not sufficiently cleaned of wax, dirt, and corrosion; and moving leads before the solder has "set" or hardened. When in doubt as to the condition of a joint, it may be tested by moving the leads slightly and observing whether they are loose. Loose leads indicate a "cold" connection. When correcting a "cold" solder condition, always apply new solder. As a rule, simply reheating a joint will not properly do the job.

When using your iron, avoid applying excessive heat, as this could damage small components and insulation on wires connected to the joint. Components can be protected from overheating, by grasping the lead between the body of the component and the joint with your long-nose pliers. The pliers will then conduct most of the heat away from the component.

Avoid excessive use of solder when making a connection, especially when soldering to tube socket pins and switch terminals. This often results in shorted conditions between adjacent terminals or wiring. Also, switches will be ruined if solder flows into switch contacts. An example of unnecessary "piling on" of solder is shown in the illustration.

THE PACO WARRANTY

PACO Electronics Co., Inc., hereafter referred to as the Company, guarantees all parts supplied with any PACO kit to be free of defects in material and workmanship under normal use and service for ninety (90) days from purchase date. The Company's obligation under this warranty is limited to those parts which are returned transportation prepaid with prior permission of the Company, and in the judgment of the Company are defective under terms of this warranty. This warranty is in lieu of all other warranties, and the Company neither assumes nor authorizes any other person to assume for them any other liability in connection with the sale of PACO kits.

We urge the assembler to follow the instructions in this manual. The Company assumes no responsibility for any damages or injuries sustained in assembling or operating PACO instruments.

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

The registration card accompanying each PACO kit MUST be filled in and returned to the Company immediately after purchase. This warranty applies only to registered instruments.

INFORMATION REGARDING THE PACO WARRANTY

All material and parts supplied with PACO kits have been carefully selected to meet design requirements and should perform satisfactorily. However, on occasion, improper instrument operation may be traced to a faulty tube or component. Should replacement of a part be necessary, write directly to PACO Electronics Co., Inc., and supply the following information:

1. Identify the model and serial number of the kit in which the part is used.
2. Identify the questionable part thoroughly. Use part number and description as given in the parts list.
3. Completely describe the nature of the defect or your reason for requesting a replacement.

Please do not return the part in question until we notify you. Do not tamper with the component, as this voids our warranty.

When returning tubes, pack them carefully to avoid breakage in shipment. Broken tubes will not be replaced. Parts broken or damaged through carelessness, misuse, or improper installation by the kit builder likewise will not be replaced.

SERVICE POLICY

PACO Electronics Co., Inc., offers its full cooperation and assistance to help you obtain the specified performance from your instrument. We maintain a complete Service Department with whom you may correspond in the event you continue to experience operational difficulties with your completed instrument. We will inspect and repair this TRANSISTOR AND CRYSTAL DIODE TESTER Kit for a minimum service charge of $4.00 plus cost of parts, provided this instrument has been constructed and completed according to instructions in this manual. This special repair service is available for one year from purchase date. Repair service for PACO instruments that have been used longer will be available for PACO owners at most economical charges.

Instruments not entirely completed or that have been modified in design will not be accepted for repair. Instruments showing evidence of the use of acid core solder or paste fluxes will be returned not repaired.

Instruments for repair or service MUST be returned to us, transportation charges PREPAID, according to the following shipping instructions.

SHIPPING INSTRUCTIONS

When returning a PACO instrument, be sure all parts are securely mounted. Always pack carefully in a rugged, OVERSIZED container, preferably wood, using a generous supply of padding such as excelsior, shredded paper, or crumpled newspaper. Do not ship in the original kit carton, as this carton is not large enough or adequate for safe shipment of the completed instrument. Attach a tag to the instrument giving your name, address, and trouble experienced. Never return an instrument unless it is accompanied by a full explanation of difficulties encountered. The more explicit the details, the more rapidly your instrument can be handled and processed.

Please ship Via Railway Express PREPAID and address to:

PACO ELECTRONICS CO., INC.,
70-31 – 84th STREET
GLENDALE 27, L.I., N.Y.
ATT: SERVICE DIVISION

A FRAGILE label should appear on at least four sides of the carton.

Return shipment by PACO will be by Railway Express COLLECT, including repair service charges, unless otherwise requested.

Please note that a carrier cannot be held liable for damage in transit if, in HIS OPINION, packing is insufficient!

STEP-BY-STEP ASSEMBLY

These instructions were prepared by skilled technicians and technical writers from experience gained by actually constructing this PACO kit. Therefore, you will find them arranged in a logical sequence, with every consideration given to the practical aspects of kit assembly. We feel the instructions offer the fastest and best method of assembling your PACO kit.

We urge you to read each step thoroughly and understand the step completely before performing it. This will help you avoid errors. We also suggest you use the check space, ( ), to indicate completion of each step. This will help you avoid omissions. Many kit builders also cross out, with a colored pencil, each wire and component on the wiring diagram after installation.

The "(Solder)" and "(Don't Solder)" designations in the instructions are self-explanatory and should be complied with. When you see "(Don't Solder)" after a step, you should only crimp the lead to the terminal and proceed to the next step. A later step will indicate when all leads have been connected to this terminal and soldering must be done.

All parts, after being checked against the parts list, should be placed where they are readily available and will not be lost or damaged. You may find it advantageous to group parts and place them in suitable containers.

To aid you in placing components, a system of alphabetical and numerical coding has been devised. Certain components, such as switches and controls, have been coded with letter designations relating to the function of the component. For example, "C" indicates a control and "S" indicates a switch. In kits having more than one component of this type, distinction is made between them by letters added in alphabetical sequence. For example, "CA" indicates one control, "CB" indicates a second control, etc. All resistors (except controls) have been coded with an "R" designation (R1, R2, etc.). These designations appear on the schematic, in the parts list, and in the step-by-step instructions and wiring diagrams.

Other components, such as tube sockets and terminal strips, have been assigned single letter designations having no particular reference to function. These designations are usually assigned in the order in which the component is installed, and will not always be the same in other kits. For example, "A" may indicate a tube socket in one kit and perhaps a terminal strip or other component in another kit.

Numbers have been assigned to terminals on the various components. Thus, "SA2" indicates terminal 2 of switch "SA", "SB3" indicates terminal 3 of switch "SB", etc.

You are now ready to begin constructing your PACO TRANSISTOR TESTER.

PRE-WIRING OF FUNCTION SELECTOR SWITCH

REFER TO FIGURE 1.

NOTE: Before wiring, be sure the switch rotor segments are positioned with respect to the switch contacts as shown in Figure 1. Also note red mark adjacent to terminal 43. This will assist you in locating the switch terminals.

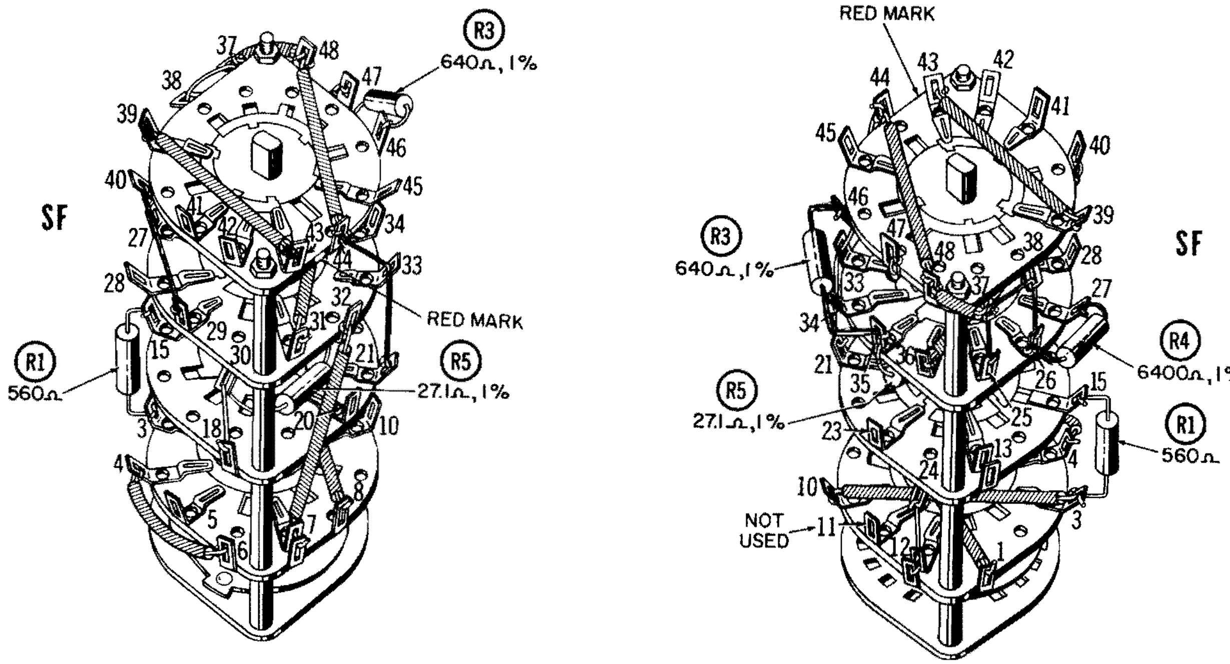


FIGURE 1 (SEE BLOW-UP NO. 2)

( ) 1. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 1 (Solder) to SF 8 (Don't Solder).

( ) 2. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 3 (Don't Solder) to SF 10 (Solder).

( ) 3. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 4 (Solder) to SF 6 (Don't Solder).

( ) 4. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 7 (Don't Solder) to SF 32 (Don't Solder). Be sure to connect this wire to both lugs at SF 7.

( ) 5. Connect a length of solid, bare hook-up wire from SF 12 (Solder) to SF 24 (Solder). Be sure to connect this wire to both lugs at SF 12.

( ) 6. Connect R5 (27.1Ω, 1% wire-wound precision resistor) from SF 35 (Don't Solder) through SF 30 (Don't Solder) to SF 18 (Don't Solder). Now solder SF 30. (Use extra care to make a good solder joint at SF 30.) Carefully position this resistor away from contacts, metallic deck spacer, and moving parts of switch.

( ) 7. Connect R3 (640Ω, 1% carbon precision resistor) from SF 35 (Solder) to SF 46 (Solder).

( ) 8. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 47 (Solder) to SF 31 (Don't Solder).

(✓) 9. Connect a length of solid, bare hook-up wire from SF 21 (Don't Solder) through SF 33 (Don't Solder) to SF 44 (Don't Solder). Now solder SF 33.

(✓) 10. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 48 (Don't Solder) to SF 44 (Solder).

(✓) 11. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 48 (Solder) to SF 37 (Don't Solder).

(✓) 12. Connect one end of a length of solid, bare hook-up wire through SF 38 (Don't Solder) to SF 26 (Don't Solder). Connect the other end through SF 37 (Don't Solder) to SF 25 (Solder). Now solder SF 37 and SF 38.

(✓) 12A. Connect R4 (6400Ω, 1% carbon precision resistor) from SF 27 (Solder) to SF 26 (Solder).

(✓) 13. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 36 (Solder) to SF 40 (Don't Solder).

(✓) 14. Connect a length of solid, bare hook-up wire from SF 40 (Solder) to SF 29 (Don't Solder).

(✓) 15. Connect a length of solid, bare hook-up wire (use spaghetti) from SF 39 (Solder) to SF 43 (Don't Solder).

(✓) 16. Connect R1 (560Ω, 10% carbon resistor) (green-blue-brown) from SF3 (Don't Solder) to SF 15 (Don't Solder).

PRE - WIRING OF "B" SWITCH (P14-286)

REFER TO FIGURE 2.

NOTE: Before wiring, be sure switch shaft is turned to extreme counterclockwise position.

(✓) 17. Connect R16 (24.7K, 1% carbon precision resistor) from SB 1 (Solder) to SB 2 (Don't Solder).

(✓) 18. Connect R15 (5K, 1% carbon precision resistor) from SB 2 (Solder) to SB 3 (Don't Solder). Position this resistor close to switch so resistor leads will clear side of chassis when mounted.

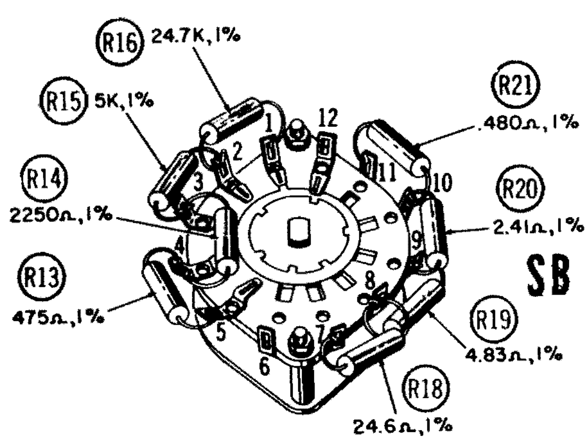


FIGURE 2

(✓) 19. Connect R14 (2250Ω, 1% carbon precision resistor) from SB 3 (Solder) to SB 4 (Don't Solder). Position this resistor to inside of switch so resistor leads will clear side of chassis when mounted. See Figure 2.

( ) 20. Connect R13 (475Ω, 1% carbon precision resistor) from SB 4 (Solder) to SB 5 (Don't Solder). Position this resistor close to switch so resistor leads will clear side of chassis when mounted.

( ) 21. Connect R18 (24.6Ω, 1% wire-wound precision resistor) from SB 7 (Solder) to SB 8 (Don't Solder).

( ) 22. Connect R19 (4.83Ω, 1% wire-wound precision resistor) from SB 8 (Solder) to SB 9 (Don't Solder).

( ) 23. Connect R20 (2.41Ω, 1% wire-wound precision resistor) from SB 9 (Solder) to SB 10 (Don't Solder).

( ) 24. Connect R21 (480Ω, 1% wire-wound precision resistor) from SB 10 (Solder) to SB 11 (Don't Solder).

PRE - WIRING OF "C" SWITCH (P14-285)

REFER TO FIGURE 3.

NOTE: Before wiring, be sure switch shaft is turned to extreme counterclockwise position.

( ) 25. Connect a length of solid, bare hook-up wire from SC 2 (Don't Solder) to SC 4 (Don't Solder).

( ) 26. Connect R8 (333.3Ω, 1% carbon precision resistor) from SC 8 (Solder) to SC 9 (Don't Solder). Position this resistor close to switch so resistor leads will clear side of chassis when mounted.

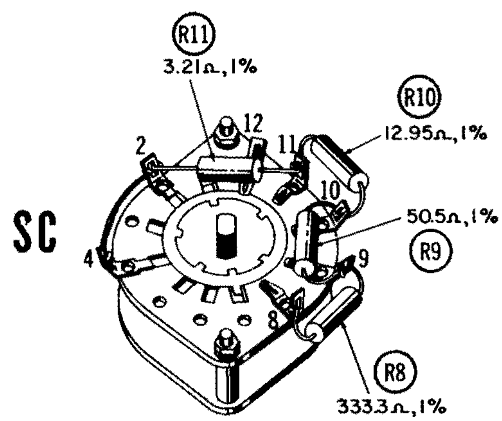


FIGURE 3

( ) 27. Connect R9 (50.5Ω, 1% carbon precision resistor) from SC 9 (Solder) to SC 10 (Don't Solder). Position this resistor to inside of switch so resistor leads will clear side of chassis when mounted. See Figure 3.

( ) 28. Connect R10 (12.95Ω, 1% wire-wound precision resistor) from SC 10 (Solder) to SC 11 (Don't Solder). Position this resistor close to switch so resistor leads will clear side of chassis when mounted.

( ) 29. Connect R11 (3.21Ω, 1% wire-wound precision resistor) from SC 11 (Solder) to SC 2 (Don't Solder).

PRE-ASSEMBLY OF TERMINAL BOARD

REFER TO FIGURES 4 AND 5.

(✓) 30. Mount CB (500Ω calibrating control) on the terminal board at location CB. Use two #4-40 x 1/4" BH screws, two #4 lockwashers (mount #4 solder lug on screw at location G) and two #4-40 hex nuts. Position terminals as shown in Figures 4 and 5. Solder the lug at location G to control flange.

(✓) 31. Mount CC (60Ω calibrating control) on the terminal board at location CC. Use a 3/8" control hex nut. Position terminals as shown in Figures 4 and 5.

(✓) 32. Connect R7 (33K, 10% carbon resistor) (orange-orange-orange) from lug H (Solder) to lug J (Solder). To mount this resistor, insert leads through rivet holes in base of lugs, bend leads back on opposite side of board to hold resistor in place while soldering, then solder and trim off excess leads.

(✓) 33. Connect R6 (22Ω, 10% carbon resistor) (red-red-black) from CB 1 (Solder) to CC1 (Don't Solder).

(✓) 34. Connect the positive (+) lead of the 100 mfd, 150-volt electrolytic capacitor to lug J (Don't Solder). Connect the negative (-) lead of this capacitor through lug H (Don't Solder) to CC 1 (Solder).

MECHANICAL ASSEMBLY

REFER TO FIGURES 4 THROUGH 9.

(✓) 35. Install the small, 4-pin in-line transistor socket in cutout at location D, Figure 5. Position terminals as shown in Figure 5. Also see Figure 6 for method of mounting. After mounting, bend terminals over as shown in Figure 5. Use a small file to enlarge the cutout if the socket does not fit without forcing.

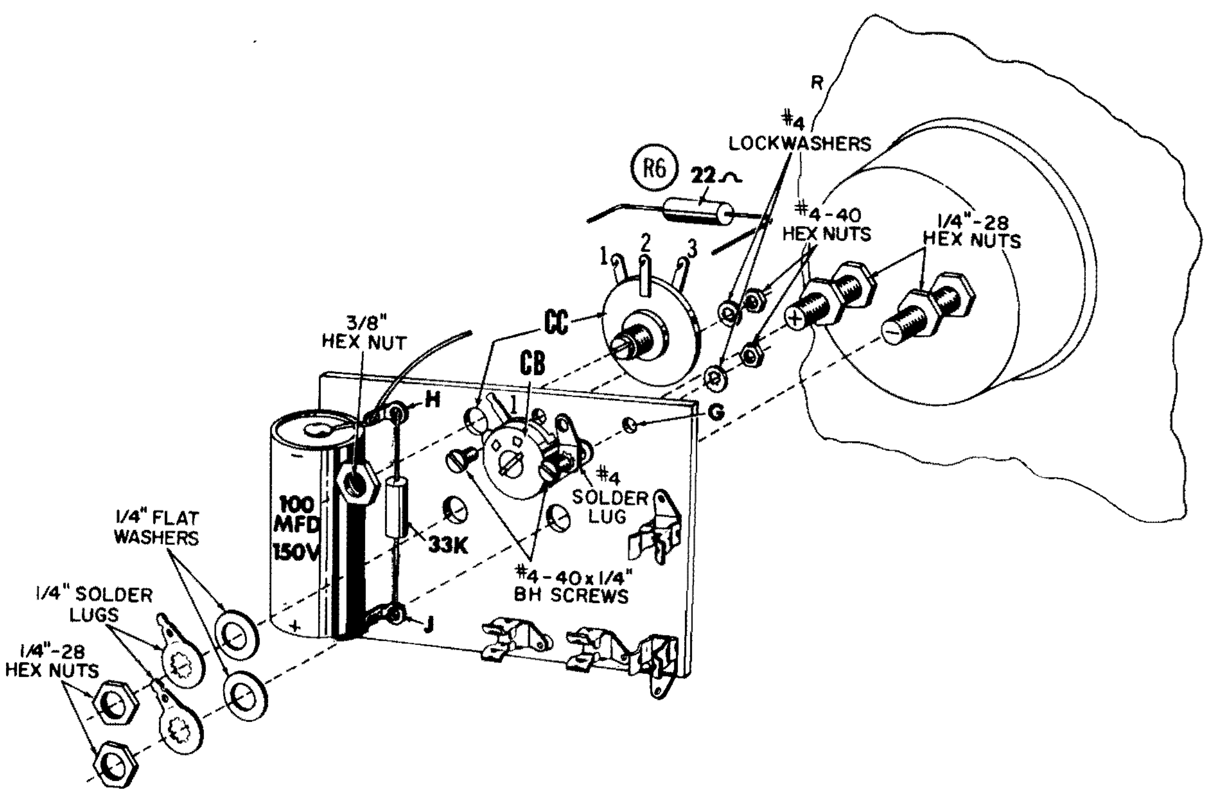


FIGURE 4

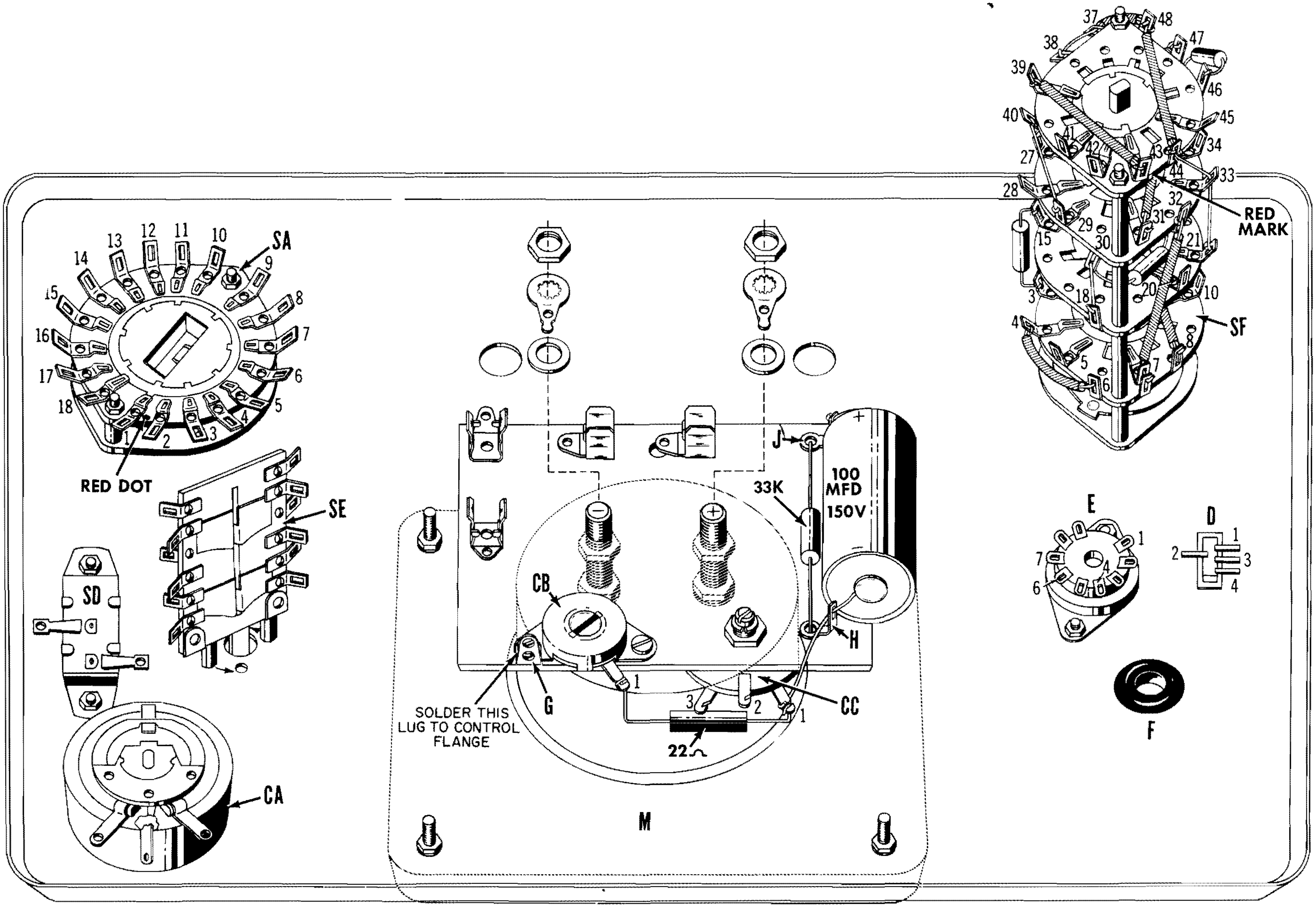


FIGURE 5 (SEE BLOW-UP NO. 1)

( ) 36. Mount the 9-pin miniature tube socket (power-transistor socket) at location E, Figure 5. Use the two #4-40 x 3/8" Rd. Hd. nylon screws, two #4 spacers, two #4-40 hex nuts, and two #4 lockwashers. See Figures 5 and 7.

NOTE: Be careful not to use excessive force when tightening the nylon screws.

( ) 37. Insert a 3/8" rubber grommet in hole at location F, Figure 5.

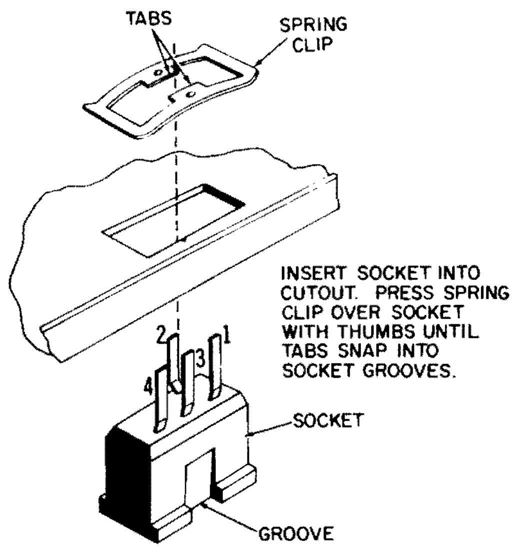


FIGURE 6

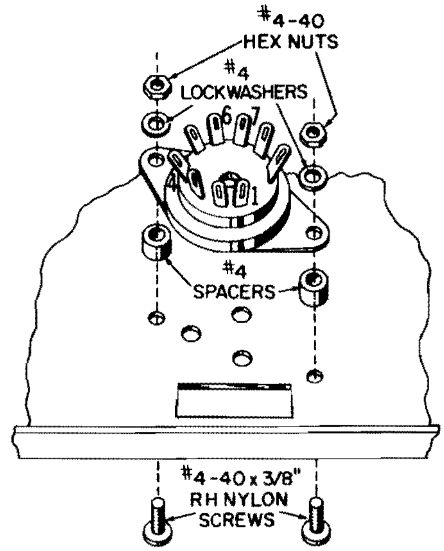


FIGURE 7

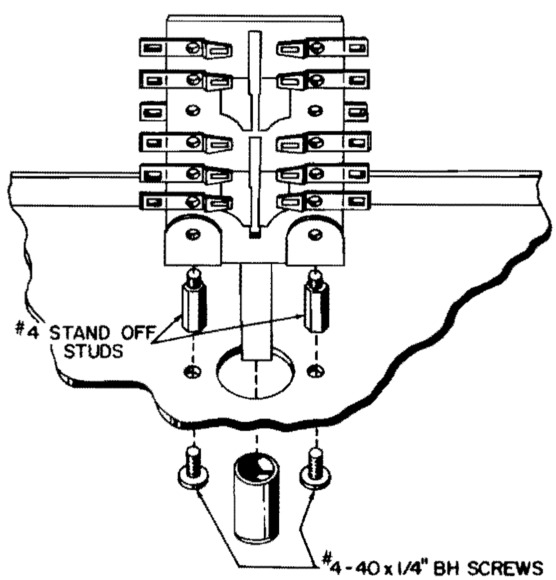


FIGURE 8

( ) 38. Install SD (ON-OFF slide switch) in cutout at location SD. Position terminals as shown in Figure 5. Use two #4-40 x 1/4" BH screws, two #4 hex nuts, and two #4 lockwashers. (NOTE: Do NOT bend switch terminals flat; the illustrations show them flat only for purposes of clarity.)

( ) 39. Install SE (READ METER switch) at location SE. Position terminals as shown in Figure 5. Use the two #4 stand-off studs and two #4-40 x 1/4" BH screws. See Figure 8 for method of mounting. Place the push-button knob on the switch shaft from front of panel and push it down as far as it will go. Make sure the button does not bind against the sides of the hole. If necessary, loosen the screws and move the switch until button clears hole. Then re-tighten screws.

( ) 40. Mount CA (300Ω, 25-watt ADJUST LINE control) at location CA and position terminals as shown in Figure 5. Use two 3/8" control hex nuts, one 3/8" control lockwasher, and one "Bakelite" panel washer. Also see Figure 9 for method of control and switch mounting.

( ) 41. Mount SA (18-position rotary switch) (switch "A") at location SA. Use two 3/8" control hex nuts, one 3/8" control lockwasher, and one "Bakelite" panel washer. See Figure 9. Before tightening panel nut, be sure extension tip of switch rotor is contacting terminal #1 (identified by red dot) as shown in Figure 5. Then position switch so flat side of shaft is directly opposite the "1" marking on the panel. Check by placing one of the large pointer knobs on the shaft and tightening the set screw. Make sure the set screw is tightened against the flat side of the shaft. Reposition switch if pointer does not line up with the "1" marking. Retighten pointer knob on shaft.

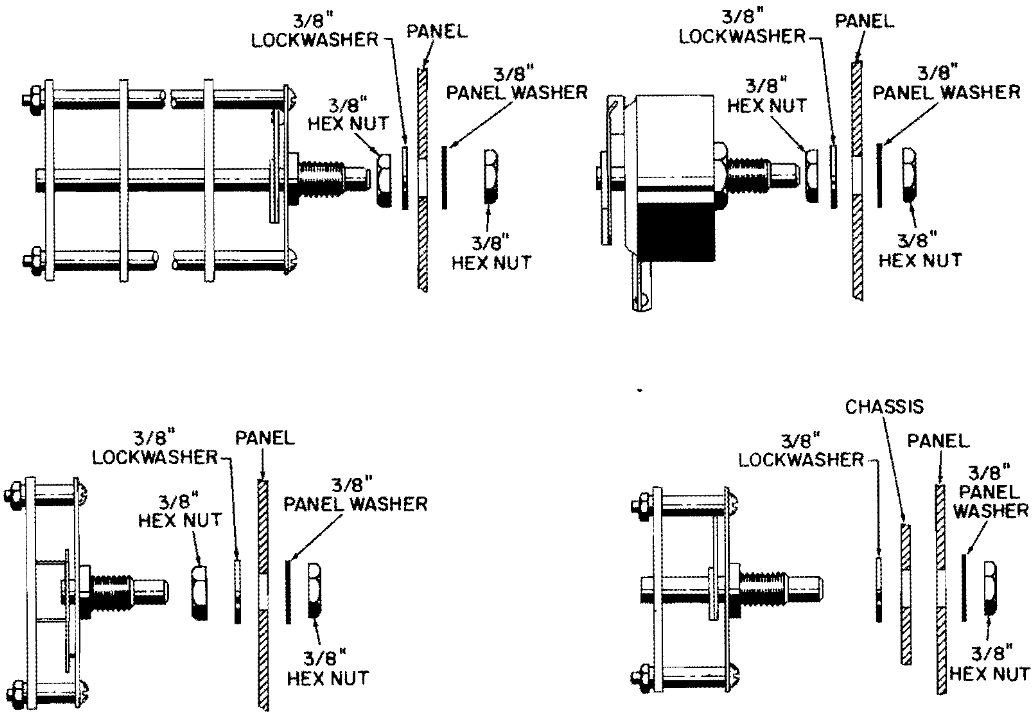


FIGURE 9

( ) 42. Carefully remove meter from its wrapping. Also remove the small plastic bag containing hardware. Install meter in large hole at location M, using four #6 split lockwashers and four #6-32 hex nuts.

( ) 43. Place a 1/4"-28 hex nut on each of the two 1/4"-28 meter terminal studs. Screw each nut approximately halfway onto each stud. See Figure 4. Now place the assembled terminal board over the two meter studs, as shown in Figures 4 and 5. With the board pressed firmly against the two nuts, there should be at least 1/8" clearance between control CC and back of meter; if not, adjust the two nuts accordingly.

( ) 44. When clearance between control CC and meter has been correctly adjusted, secure terminal board to meter, using the two 1/4" flat washers, two 1/4" solder lugs, and two 1/4"-28 hex nuts. Position solder lugs as shown in Figures 4 and 5.

( ) 45. Mount the pre-wired Function Selector switch at location SF. Use two 3/8" control hex nuts, one 3/8" control lockwasher, and one "Bakelite" panel washer. See

Figure 9. Before tightening panel nut, rotate switch so that red dot is located as shown in Figure 5. Then orient switch so that flat side of shaft is directly opposite the NPN "SHORT" marking on the panel. Check by placing one of the large pointer knobs on the panel and tightening the set screw. Make sure the set screw is tightened against the flat side of the shaft. Reposition switch if pointer does not line up with the NPN "SHORT" marking. Retighten pointer knob on shaft.

WIRING

REFER TO FIGURE 10.

NOTE: Position all wires close to panel in an orderly fashion.

(✓) 46. Connect an 8 1/2" length of green, solid hook-up wire from SF 7 (Solder) to lug H on the meter terminal board (Don't Solder). Be sure to solder both lugs at SF 7.

( ) 47. Connect a 3-1/4" length of yellow, solid hook-up wire from SF 8 (Solder) to E 1 (Don't Solder).

(✓) 48. Connect an 11-1/2" length of orange, solid hook-up wire from SF 5 (Solder) to SE 7 (Solder).

(✓) 49. Connect a 3-1/4" length of red, solid hook-up wire from SF 6 (Solder) to E 7 (Don't Solder).

(✓) 50. Connect a 7-1/2" length of red, solid hook-up wire from SF 20 (Solder) to lug J on the meter terminal board (Solder).

(✓) 51. Connect a 14-1/2" length of green, solid hook-up wire from SF 23 (Solder) to lug G on the meter terminal board (Solder).

(✓) 52. Connect a 10-1/4" length of yellow, solid hook-up wire from SF 13 (Solder) to clip K on the meter terminal board. Pass this wire from bottom of terminal board, through hole in board, and into the clip (Solder). Be sure to connect this wire to both lugs at SF 13.

( ) 53. Connect a 5-1/2" length of orange, solid hook-up wire from SF 31 (Solder) to E 4 (Don't Solder).

( ) 54. Connect a 14-1/2" length of yellow, solid hook-up wire from SF 34 (Solder) to SE 10 (Solder).

( ) 55. Connect a 13" length of orange, solid hook-up wire from SF 28 (Solder) to SE 4 (Solder).

( ) 56. Connect a 14-3/4" length of green, solid hook-up wire from SF 43 (Solder) to SE 1 (Solder).

(✓) 57. Connect a 13" length of yellow, solid hook-up wire from SF 45 (Solder) to SA 6 (Don't Solder).

(✓) 58. Connect a 12-1/4" length of orange, solid hook-up wire from SF 41 (Solder) to SE 9 (Don't Solder).

(✓) 59. Connect a 12" length of red, solid hook-up wire from SF 42 (Solder) to SE 8 (Don't Solder).

(✓) 60. Connect a 4-1/2" length of red, solid hook-up wire from SE 8 (Solder) to SA 18 (Solder).

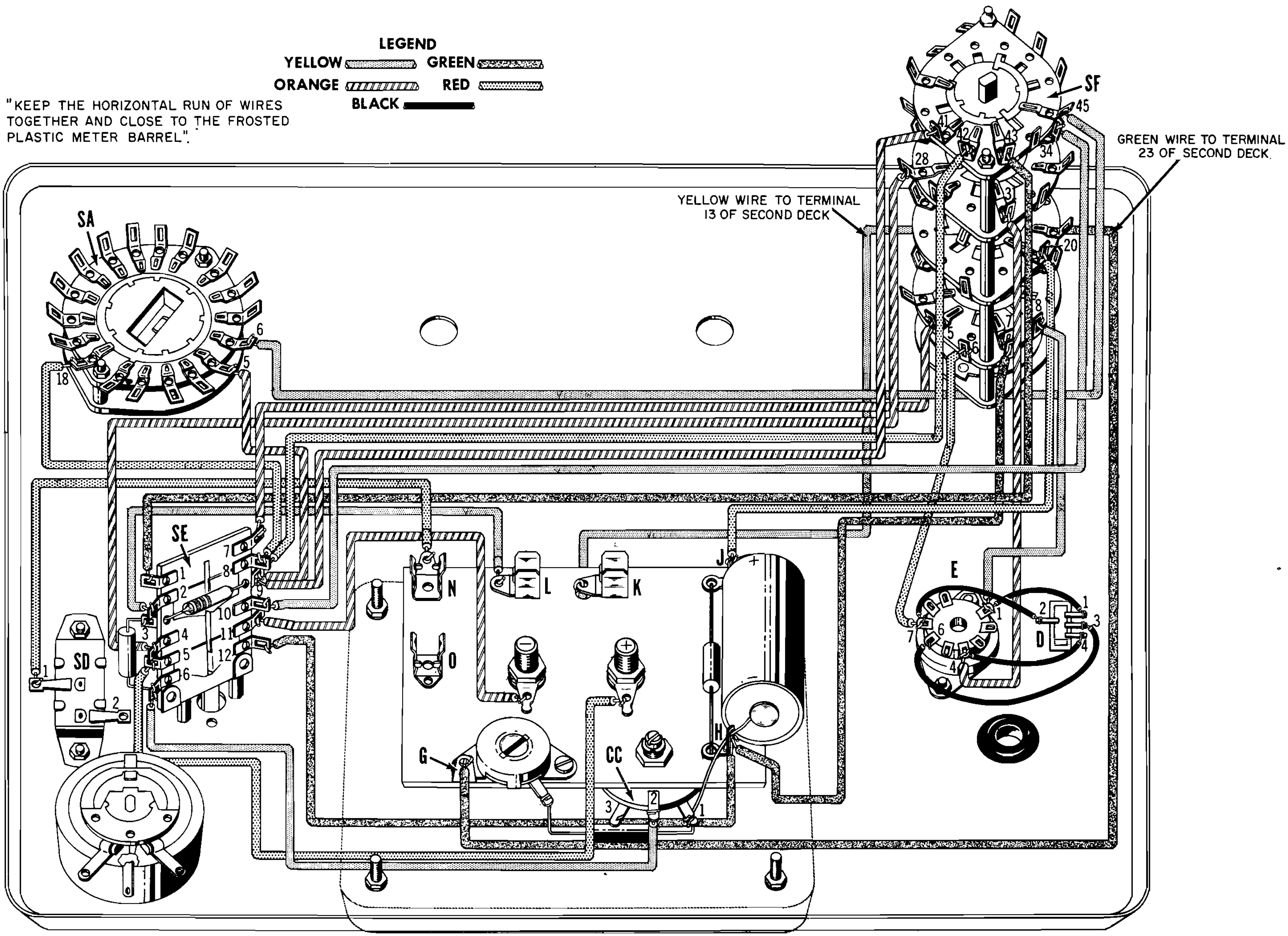


FIGURE 10 (SEE BLOW-UP NO. 1)

( ) 61. Connect a 4" length of orange, solid hook-up wire from SE 9 (Don't Solder) to SA 5 (Don't Solder).

( ) 62. Connect the anode lead (—, blank end) of the crystal diode to SE 9 (Solder). Connect the cathode lead (+, color coded end) to SE 3 (Don't Solder). Mount diode through rivet holes on front of switch as shown in Figure 10. Before soldering at SE 9 protect the diode against excessive heat by grasping the lead close to body of diode with long nose pliers.

CAUTION: DO NOT OVERHEAT DIODE AS EXCESSIVE HEAT MAY DAMAGE IT.

( ) 63. Connect R2 (470Ω, 10% resistor) (yellow-violet-brown) from SE 3 (Solder) to SE 6 (Don't Solder). Before soldering at SE 3, protect diode from excessive heat as in Step 62.

( ) 64. Connect an 8-3/4" length of yellow, solid hook-up wire from SE 6 (Solder) to CC 2 (Solder).

( ) 65. Connect an 11" length of red, solid hook-up wire from SE 5 (Solder) to solder lug on meter positive (+) terminal (Solder).

( ) 66. Connect an 8-3/4" length of yellow, solid hook-up wire from SE 2 (Solder) to clip L on meter terminal board (Solder).

( ) 67. Connect an 11-1/2" length of green, solid hook-up wire from SE 12 (Solder) to lug H on meter terminal board (Solder).

( ) 68. Connect an 8-1/2" length of orange, solid hook-up wire from SE 11 (Solder) to solder lug on meter negative (—) terminal (Solder).

( ) 69. Connect a 6-1/2" length of red solid hook-up wire from clip N on meter terminal board (Solder) to SD 1 (Solder).

( ) 70. Connect a 2" length of black, thin-wall stranded hook-up wire from D 1 (Solder) to E 1 (Don't Solder). After soldering D 1, examine solder joint to make sure no excess solder is touching D 2 or chassis.

( ) 71. Connect a 2-1/4" length of black, thin-wall, stranded hook-up wire from D 2 (Solder) to E 7 (Don't Solder).

( ) 72. Connect a 3" length of black, thin-wall, stranded hook-up wire from D 3 (Solder) to E 6 (Don't Solder).

( ) 73. Connect a 2" length of black, thin-wall, stranded hook-up wire from D 4 (Solder) to E 4 (Don't Solder).

REFER TO FIGURES 9 AND 11.

( ) 74. Place chassis against panel as shown in Figure 11, lining up chassis holes for switches SB and SC with those in panel. Be sure that transformer mounting holes on sides of chassis are positioned as in Figure 11.

( ) 75. Install switch "B" (P14-286) at location SB. Use a 3/8" control hex nut, 3/8" control lockwasher, and a "Bakelite" panel washer. See Figure 9. Before tightening panel nut, be sure switch is in extreme counterclockwise position. Orient switch so flat side of shaft is directly opposite the "1" marking on the panel. Check by placing one of the large pointer knobs on the shaft and tightening the set screw. Make sure the set screw is tightened against the flat side of the shaft. Reposition switch if pointer does not line up with the "1" marking. Retighten pointer knob on shaft. Check to make sure sufficient clearance has been allowed between switch resistors and side of chassis.

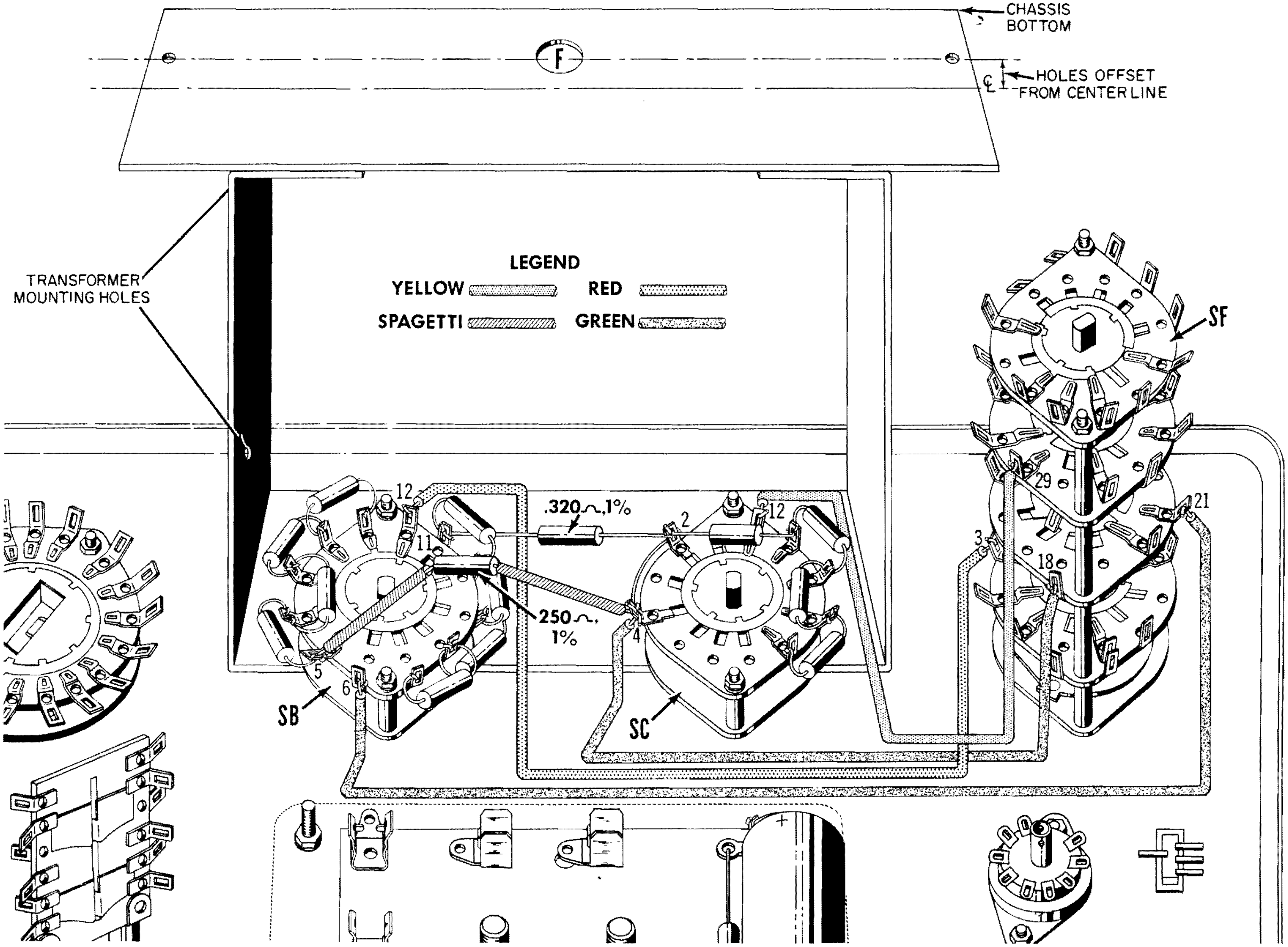

CHASSIS BOTTOM
HOLES OFFSET FROM CENTER LINE
F
TRANSFORMER MOUNTING HOLES
LEGEND
YELLOW
RED
SPAGETTI
GREEN
.320 Ω, 1%
250 Ω, 1%
SB
SC
SF
12
11
5
6
2
12
4
3
29
18
21

FIGURE 11

( ) 76. Install switch "C" (P14-285) at location SC. Use a 3/8" control hex nut, 3/8" control lockwasher, and a "Bakelite" panel washer. See Figure 9. Before tightening panel nut, be sure switch is in extreme counterclockwise position. Orient switch so flat side of shaft is directly opposite the "1" marking on the panel. Check by placing one of the large pointer knobs on the shaft and tightening the set screw. Make sure the set screw is tightened against the flat side of the shaft. Reposition switch if pointer does not line up with the "1" marking. Retighten pointer knob on shaft. Check to make sure sufficient clearance has been allowed between switch resistors and side of chassis.

( ) 77. Connect a 9-3/4" length of green, solid hook-up wire from SB 6 (Solder) to SF 21 (Solder).

( ) 78. Connect a 9-3/4" length of red, solid hook-up wire from SB 12 (Solder) to SF 3 (Solder).

( ) 79. Connect a 6-1/2" length of green, solid hook-up wire from SC 4 (Don't Solder) to SF 18 (Solder). Use extra care to make a good solder joint at SF 18.

( ) 80. Connect a 6-1/2" length of yellow, solid hook-up wire from SC 12 (Solder) to SF 29 (Solder).

( ) 81. Connect R12 (250Ω, 1% carbon precision resistor) from SB 5 (Solder) to SC 4 (Solder). Use spaghetti on both leads. Use extra care to make a good solder joint at SC 4.

( ) 82. Connect R17 (320Ω, 1% wire-wound precision resistor) from SB 11 (Solder) to SC 2 (Solder). Use extra care to make good solder joints at SB 11 and SC 2.

FINAL WIRING

REFER TO FIGURES 12 AND 13.

NOTE: All power transformer leads have been trimmed to proper length and tinned for easy connection into the circuit.

( ) 83. Mount power transformer on side of chassis at location T. Position leads as shown in Figure 12. Use two #8-32 x 3/8" BH screws, two #8-32 hex nuts, and two #8 lockwashers.

( ) 84. Twist together the red (0V-secondary) and two green (1V) transformer leads as shown in Figure 12. Connect the red lead to SF 32 (Solder). Connect one green lead to SF 15 (Solder). Connect the other green lead to E 6 (Don't Solder). Use extra care to make a good solder joint at SF 32.

( ) 85. Twist together the red-GREEN [redacted] (125V-primary) and yellow-black (100V-primary) transformer leads as shown in Figure 12. Connect the red-GREEN [redacted] lead to CA 1 (Solder). Connect the yellow-black lead to CA 3 (Solder).

( ) 86. Connect the black (0V-primary) transformer lead to SD 2 (Solder).

( ) 87. Connect the gray-yellow (4.75V) transformer lead to SA 6 (Solder).

( ) 88. Connect the gray (3.7V) transformer lead to SA 5 (Solder).

( ) 89. Connect the orange (2.6V) transformer lead to SA 4 (Solder).

( ) 90. Connect the red-white (2.15V) transformer lead to SA 3 (Solder).

( ) 91. Connect the red-yellow (1.50V) transformer lead to SA 2 (Solder).

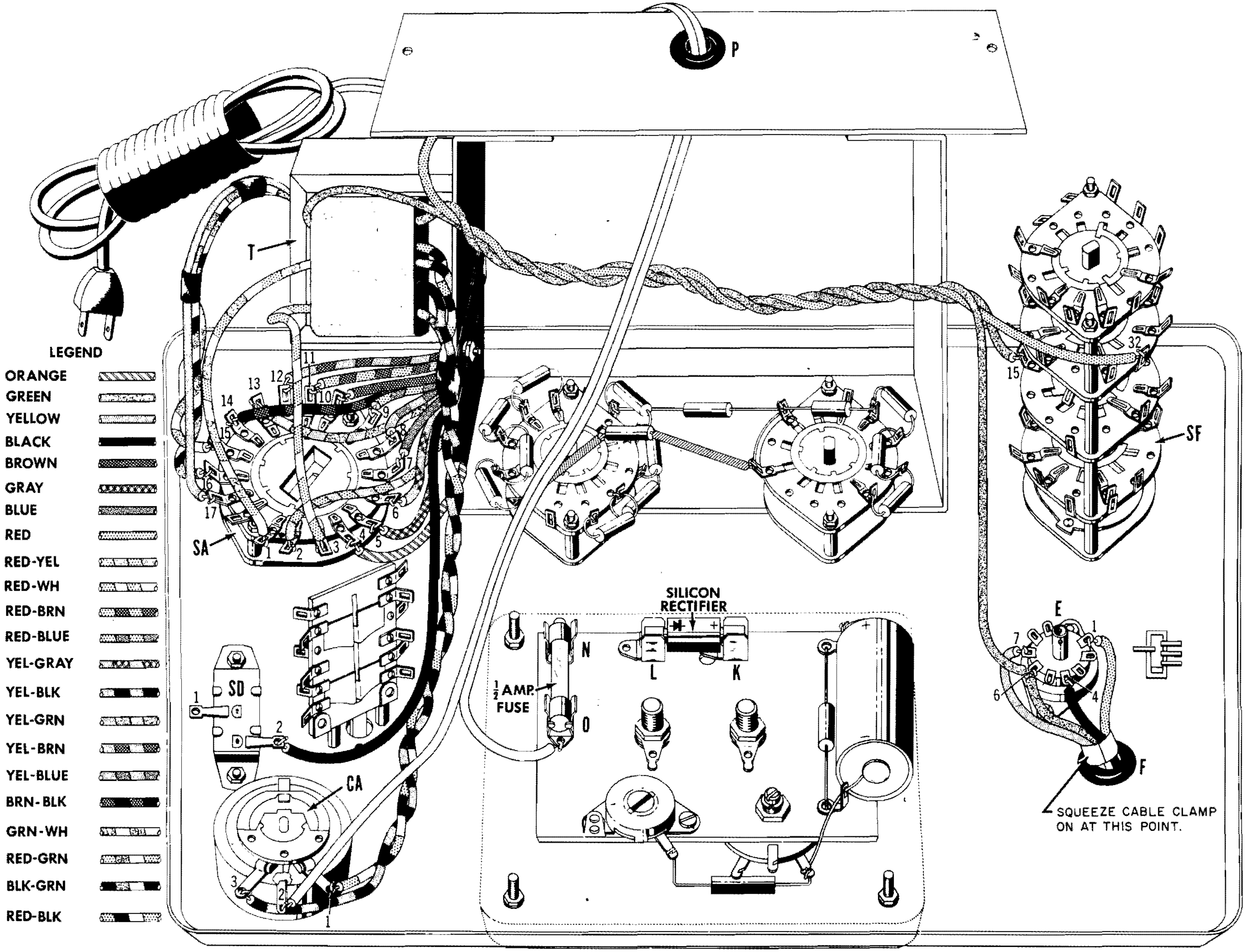


FIGURE 12 (SEE BLOW-UP NO. 2)

( ) 92. Connect the red-green (.75V) transformer lead to SA 1 (Solder).

( ) 93. Connect the blue (6.8V) transformer lead to SA 7 (Solder).

( ) 94. Connect the blue-yellow (8.9V) transformer lead to SA 8 (Solder).

( ) 95. Connect the blue-red (11V) transformer lead to SA 9 (Solder).

( ) 96. Connect the brown (14.7V) transformer lead to SA 10 (Solder).

( ) 97. Connect the ~~red-W/green tracer~~ BROWN-RED (18V) transformer lead to SA 11 (Solder).

( ) 98. Connect the brown-yellow (21.5V) transformer lead to SA 12 (Solder).

( ) 99. Connect the green-yellow (29V) transformer lead to SA 13 (Solder).

( ) 100. Connect the ~~white~~ BROWN-black (36V) transformer lead to SA 14 (Solder).

( ) 101. Connect the white-green (43V) transformer lead to SA 15 (Solder).

( ) 102. Connect the green-black (58V) transformer lead to SA 16 (Solder).

( ) 103. Connect the yellow (72V) transformer lead to SA 17 (Solder).

( ) 104. Dress and tape leads as shown in Figure 12.

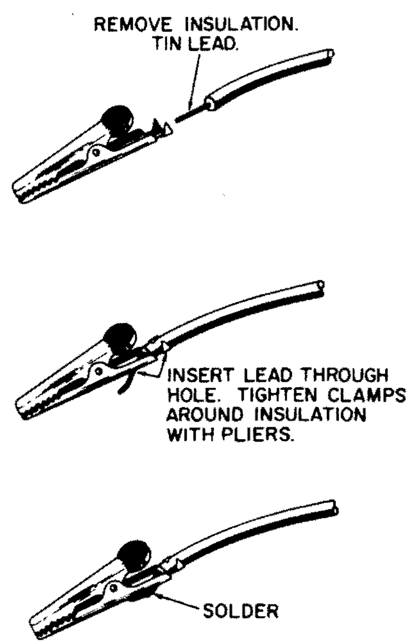


FIGURE 13

( ) 105. Connect one end of the short length of yellow, heavy-wall, stranded hook-up wire to E 7 (Solder). Pass other end of this wire through grommet F.

( ) 106. Connect one end of the short length of green, heavy-wall, stranded hook-up wire to E 6 (Solder). Pass other end of this wire through grommet F.

( ) 107. Connect one end of the short length of black, heavy-wall, stranded hook-up wire to E 4 (Solder). Pass other end of this wire through grommet F.

( ) 108. Connect one end of the short length of red, heavy-wall, stranded hook-up wire to E 1 (Solder). Pass other end of this wire through grommet F.

( ) 109. Leave a slight amount of slack in the four wires just installed. Then, secure wires together with the small "U" shaped cable clamp by gently squeezing open ends of clamp together with your pliers. Be very careful not to crush wires.

( ) 110. Pull wires through grommet F from front of panel until clamp comes to rest against grommet. Then, trim the red, green, and yellow wires to equal length, using the shortest of the three as a guide. Do not trim the black lead.

( ) 111. Solder the four small alligator clips to the ends of the four wires as shown in Figure 13. Allow clips to cool, then slip an insulating sleeve over each clip.

( ) 112. Insert a 3/8" rubber grommet in hole at location P.

( ) 113. Insert line cord from rear of chassis through grommet P. Tie an overhand knot approximately 9" from end of cord inside chassis for strain relief. Separate cord ends for a distance of 2-1/2".

( ) 114. Connect one lead of line cord to CA 2 (Solder). Connect other lead to clip O (Solder).

( ) 115. Install the 1/2-amp fuse clips O and N on meter terminal board. Squeeze clips together slightly for good contact grip.

( ) 116. Install the silicon rectifier in clips K and L on meter terminal board so that positive (+) end of rectifier is in clip K. Squeeze clips together slightly for good contact grip.

( ) 117. Install the small pointer knob on "ADJUST LINE" control shaft. Rotate control to approximate center of its range. Position white index mark on knob to "T" in "ADJUST". Tighten knob set screw.

( ) 118. Carefully inspect instrument construction. Be sure all wires and components have been properly connected and soldered. Check positioning of wires and components for possible short circuits. Turn the instrument over and shake out any loose solder or wire cuttings.

PRELIMINARY TEST

Plug the T-65 line cord into a 117-volt, 60-cycle AC source. Set power switch to "ON". Meter pointer should deflect to approximately mid-scale. "ADJUST LINE" control should move pointer to left and right. Depressing "READ METER" button should cause meter pointer to fall back to "0" on scale. If the instrument fails to respond as indicated or if signs of trouble such as smoke or overheating appear, disconnect the line cord from the power source and check for wiring errors and short circuits. Further assistance in locating trouble may be found in the section "COMPLETE CHECK-OUT PROCEDURE".

If the instrument responds in the manner indicated, proceed to "CALIBRATION PROCEDURE."

CALIBRATION PROCEDURE

1. With power "OFF", zero adjust the meter in the position it will be used (usually horizontal).

2. Use an accurate, high-impedance VOM, like PRECISION Model 120 or 110 or PACO Model M-40. Set VOM to 6VAC or higher. Clip positive (+) VOM test prod tip to lug 6 (gray-yellow lead) on "A" switch. Clip minus (-) VOM test prod tip to minus (-) end of the 100-mfd capacitor. Control and switch settings do not matter.

3. Turn power "ON" and turn the "ADJUST LINE" control until VOM reads 4.7 VAC.

4. Adjust 60-ohm calibrating control (CC) until meter pointer coincides with "ADJUST LINE" calibration.

5. Remove VOM test prod tip from terminal 6 of "A" switch and connect to positive (+) terminal of the silicon rectifier. Leave minus (-) VOM prod as is. Set VOM to 3 VDC or higher range.

6. Set Model T-65 Function Selector to NPN "L" position.

7. Check to see that meter pointer lines up with "ADJUST LINE" calibration and then depress "READ METER" button.

8. Adjust 500-ohm calibrating control (CB) until VOM reads 1.75 VDC.

9. Repeat Steps 2, 3 and 4 to determine whether the adjustment in Step 8 necessitates a slight readjustment of the 60-ohm calibrating control (CC) in Step 4. If necessary, repeat Steps 4 and 8 until both readings are correct.

COMPLETE CHECK-OUT PROCEDURE

(Equipment required: 20,000 ohms per volt VOM, PACO Model M-40, PRECISION Model 110 or 120 or equivalent).

1. With power "OFF", meter pointer should line up with "0" calibration on meter scale. If not, adjust the meter pointer by rotating the screw head on the meter case.

2. Turn power "ON" and rotate "ADJUST LINE" control till pointer coincides with "ADJUST LINE" calibration on meter scale. Meter pointer should be set to "ADJUST LINE" calibration for each step unless otherwise noted.

3. Set Function Selector to NPN "SHORT". Clip lead 4 to 2 and depress "READ METER" button. Meter pointer should read 100 on 0-100 scale within ±3 divisions. (NOTE: Should meter read above 100, reset "ADJUST LINE" control until meter reads 100 and release "READ METER" button. Meter pointer should now be within 2 divisions of "ADJUST LINE" calibration on meter scale.)

4. Repeat Step 3 with Function Selector set to PNP "SHORT". Disconnect lead 2, clip lead 4 to lead 1, and repeat Step 3.

5. Set Function Selector to NPN "SHORT" (with leads 1 and 4 only, clipped together) and repeat Step 3.

6. Remove short between leads 1 and 4. Reset meter pointer to "ADJUST LINE", if necessary. Use an accurate, high-impedance VOM like the PRECISION Model 110 or 120 or PACO Model M-40. Set VOM to lowest DC voltage range. Clip the (+) VOM test prod to lead 2 of Model T-65. Clip the (-) VOM test prod to lead 4. Set Model T-65 "A" switch to "1" and Function Selector to PNP "I_{cbo}" position. Depress "READ METER" button. VOM should read approximately .5 VDC. Release "READ METER" button and set T-65 "A" switch to position 2. Depress "READ METER" button and read VOM. Repeat this procedure for all "A" switch positions. DC voltages should be within ±10% of DC voltages indicated on schematic, except possibly for position "1" of "A" switch where larger percentage variations may occur. Position "18" of "A" switch, will read 0 volts, but time must be allowed for capacitor to discharge.

7. Reverse VOM test leads. Set Function Selector to "Dr" and take a voltage reading as in Step 6. Only one voltage reading is needed.

8. Keep test leads as in Step 7. Set Function Selector to NPN "I_{cbo}" and take one voltage reading.

9. Leave T-65 Function Selector on NPN "I_{cbo}". Remove VOM test prods. Connect 4700-ohm checking resistor across leads 2 and 4. Set "A" and "C" switches as shown in the following table and depress "READ METER" button. Meter should read as indicated in corresponding column, ±20%.

"C" Switch	"A" Switch	Meter Reads
1	1	74
2	2	58
3	6	50
4	12	60
5	13	16

10. Set Function Selector to PNP "I_{cbo}" and take a reading as in Step 9 (only one reading needed).

11. Set Function Selector to "Dr" and take one reading as in Step 9.

12. Remove resistor and set Function Selector to PNP "L". Set VOM to 3 VDC or higher range. Connect (+) VOM test prod to lead 1 and (-) VOM test prod to lead 4. Set T-65 "B" switch to "5". Depress "READ METER" button. VOM should read 1.75 VDC. (Same as you obtained in Step 8 of "CALIBRATION PROCEDURE").

13. Set Function Selector to PNP "GX1" and repeat reading as in Step 12.

14. Set Function Selector to PNP "GX5" and repeat reading as in Step 12.

15. Set Function Selector to NPN "L" and repeat reading as in Step 12, except reverse VOM test leads.

16. Set Function Selector to NPN "GX1" and repeat reading as in Step 12, except reverse VOM test leads.

17. Set Function Selector to NPN "GX5" and repeat reading as in Step 12, except reverse VOM test leads.

18. Set Function Switch to NPN "GX1". Remove VOM test prods. Connect 390-ohm and 33-ohm check resistors in turn, as indicated in the following table, between Model T-65 leads 1 and 4. Set "B" switch as shown. Depress "READ METER" button. Meter should read within ±20% of value listed in the following table.

Resistor connected between 1 and 4	"B" Switch Position	Meter Reading
390 ohms	1	80
390 ohms	2	22
390 ohms	3	9
33 ohms	4	25
33 ohms	5	11

19. Repeat Step 18 for NPN "L", PNP "L" and PNP "GX1" positions. (Only one reading required for each Function Selector position.)

20. Set Function Selector to PNP "GX5" position. Connect 390-ohm resistor between leads 1 and 4. Set "B" switch to position "1". Depress "READ METER" button. Meter should read approximately 16.

21. Repeat Step 20, except with Function Selector in NPN "GX5" position.

22. Keep Function Selector in NPN "GX5" position. Remove 390-ohm resistor. Set VOM to DC current. Connect (+) VOM test prod to lead 2 and (-) VOM test prod to lead 1. Set "B" switch as indicated in the following table. Depress "READ METER" button. Meter should read approximately as shown in the table. (Meter readings vary mainly because of impedance of VOM used.)

"B" Switch	1	2	3	4	5
VOM Reading	40 to 60μa	150 to 250μa	400 to 600μa	1.5 to 2.5ma	4 to 7ma

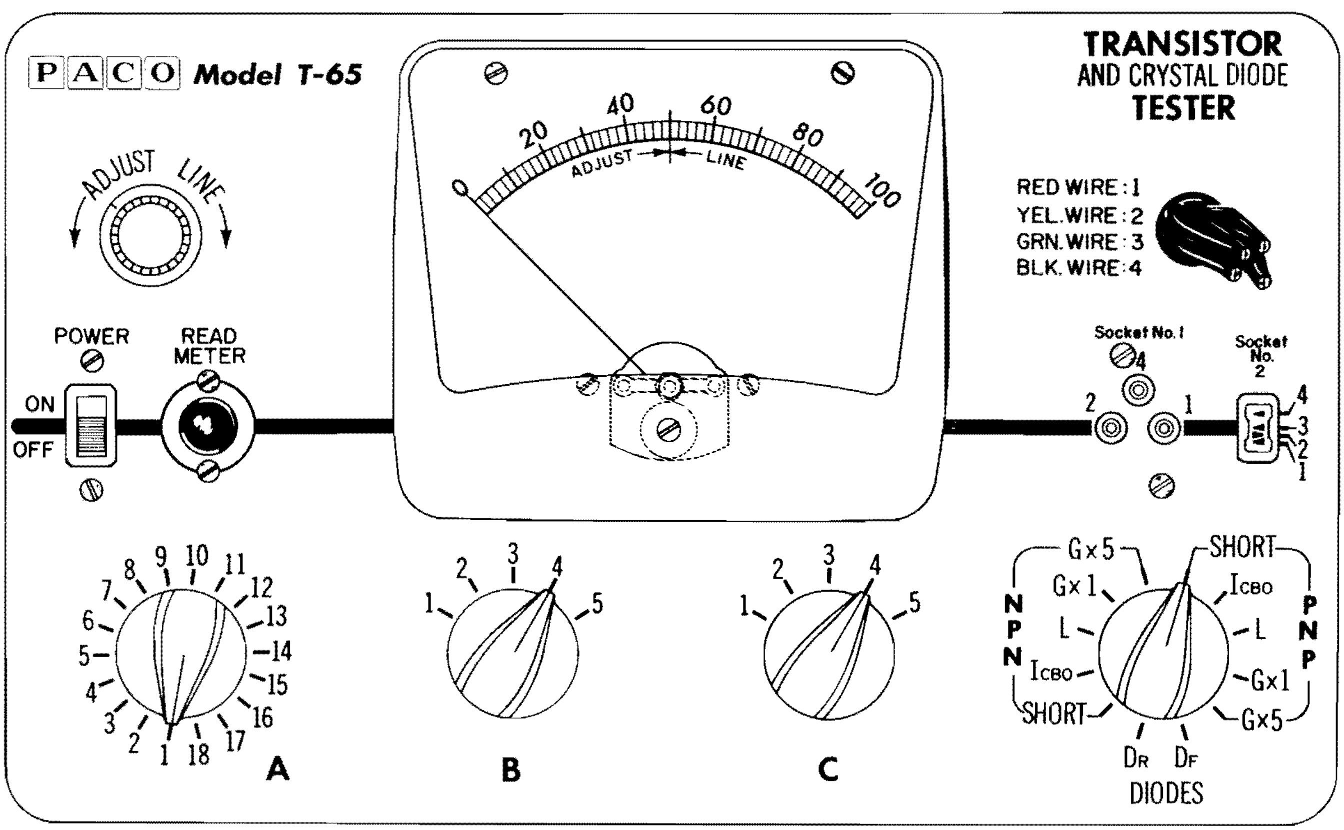
23. Repeat Step 22 for NPN "GX1" position. (Only one reading required.)

24. Reverse VOM test prods and repeat Step 22 for PNP "GX1" and PNP "GX5" positions. (Only one reading required for each Function Selector position.)

25. Keep Function Selector in PNP "GX5" position. Set VOM to 3 VAC. Connect VOM test prods between leads 2 and 3. VOM should read 1 VAC ±20% with "READ METER" button in both normal and depressed positions.

26. Repeat Step 25 for PNP "GX1", NPN "GX1" and NPN "GX5".

27. Remove VOM test prods. Set "A" switch to "1", "B" switch to "5" and Function Selector to "Df". Take a crystal diode known to be good (silicon rectifier may be removed from Model T-65 for this check). Connect diode cathode (+) to lead 4 and diode anode (-) to lead 2. Depress "READ METER" button and note meter reading, if any. Release button and set "B" switch to "4". Depress "READ METER" button. Meter reading, if any, should be higher than the previous reading. If meter readings were obtained, check is then completed. If not, proceed as above, setting "B" switch to successively lower numbers. Note that it is not necessary or desirable to go through the remaining lower numbered "B" switch positions



FRONT PANEL

after obtaining a sizable meter reading, since the meter may slam and possibly be damaged. (Turn power off and replace silicon rectifier if removed for test.)

28. Check sockets and leads from front panel with an ohmmeter. All terminals marked "1" must show short when connected to any other terminal marked "1". Repeat for terminals marked "2", then for terminals marked "3", and finally for terminals marked "4". This completes check-out procedure.

CARRYING CASE ASSEMBLY

REFER TO FIGURE 14.

(✓) 119. Install handle hinges and handle on top of carrying case. The handle hinges mount over holes on top of case with two #6-32 x 3/8" oval head screws, two #6-32 hex nuts, and two #6 lockwashers for each hinge. See Figure 14. To assemble, first mount one of the hinges, then place one end of handle on mounted hinge. Next, insert other hinge into hole at other end of handle and mount this hinge to carrying case.

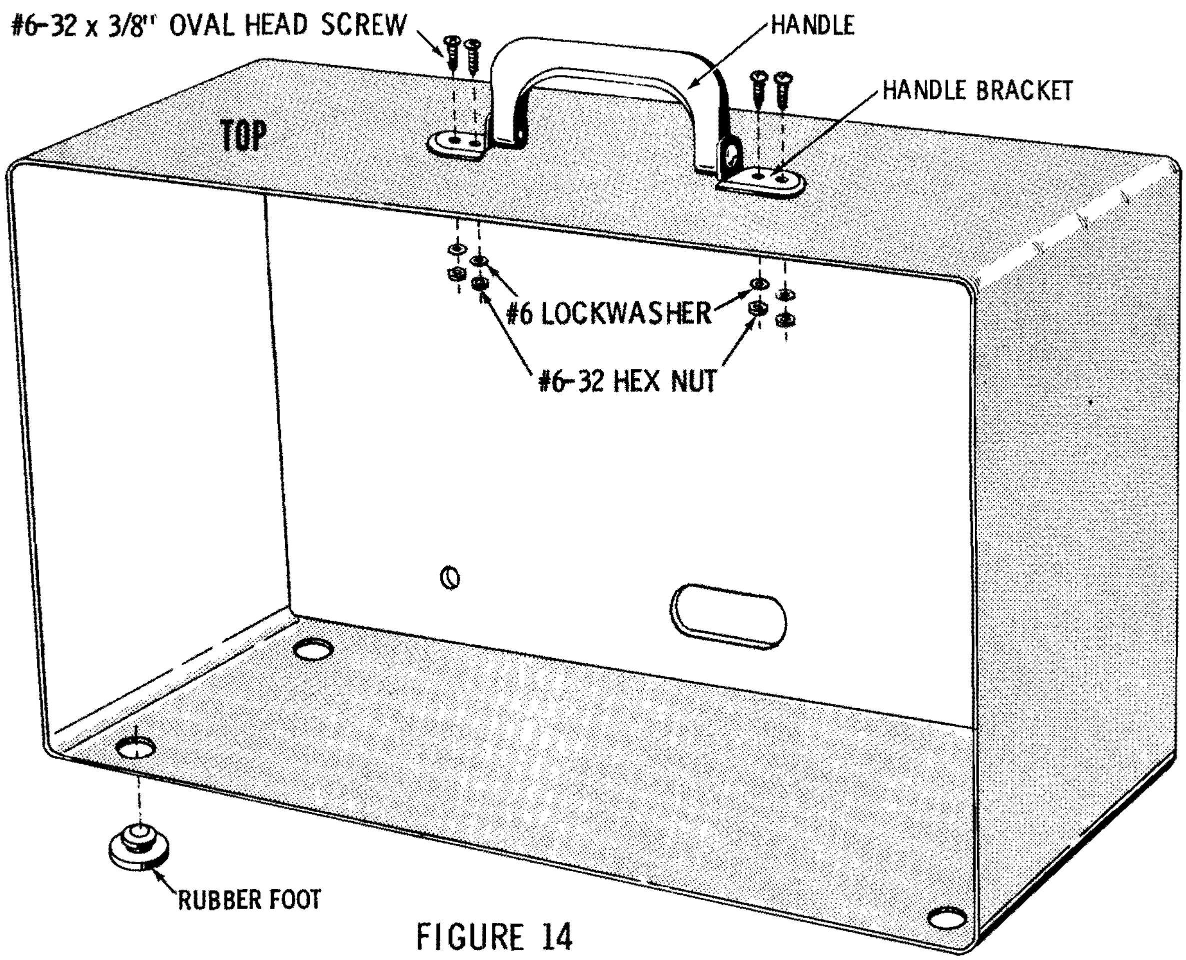


FIGURE 14

(✓) 120. Insert the four rubber feet into holes in bottom of carrying case. Install each foot so flat portion is outside case. See Figure 14.

FINAL ASSEMBLY

(✓) 121. Pass line cord through large hole in rear of carrying case. Slide instrument in until flanged edges of panel fit snugly around front edges of carrying case.

(✓) 122. Secure rear of chassis to rear of carrying case with the two #6 x 3/8" BH, self-tapping screws.

BASIC CIRCUIT FUNCTIONS

Circuits for testing PNP transistors are identical to NPN transistor circuits, except that meter and DC voltage polarities are reversed. Therefore, to avoid repetition, simplified schematics are shown only for NPN tests.

"Shorts" Test Circuit (Figure 15)

Emitter and base of the transistor are tied together and a small DC voltage (approximately 4.5 volts) is applied between them and collector. Meter readings for good transistors should not be greater than the maximum indicated in the test data under "Short Max. Settings of "A" , "B", and "C" switches have no effect during the shorts test.

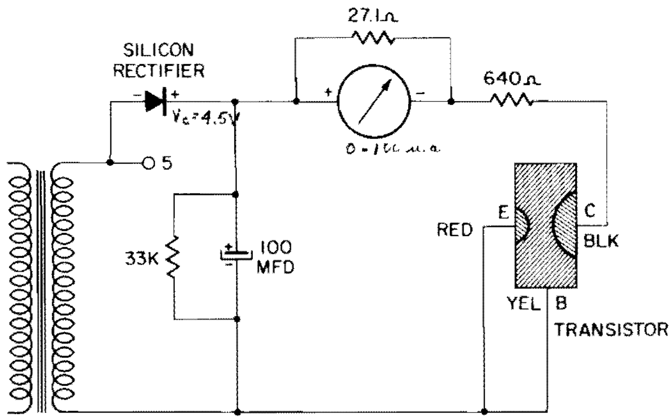


FIGURE 15

"I_{cbo}" Test Circuit (Figure 16)

The emitter circuit is left open for this test. Proper voltage is selected by the setting of the "A" switch. Collector polarity is positive with respect to base. Meter reading should not be greater than a certain maximum quoted in test data for that transistor. "C" switch setting governs the meter shunt value.

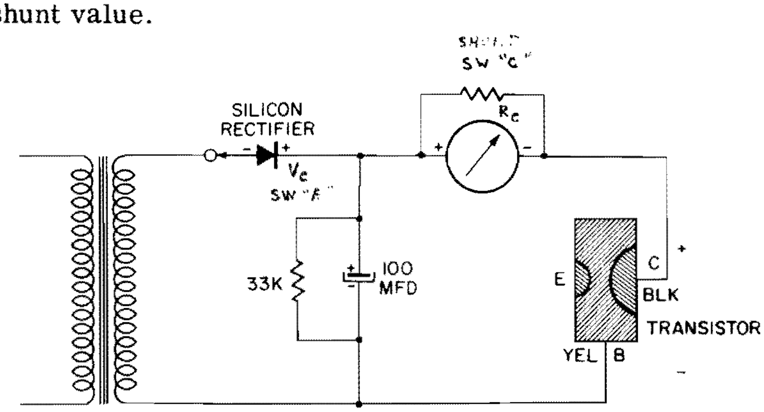


FIGURE 16

"L" Test Circuit (Figure 17)

Voltage for this test is not affected by the "A" switch setting. Meter shunt value is governed by "B" switch setting. "C" switch setting has no effect on the test.

"G" Test Circuit (Figure 18)

The basic circuit for the "GX1" and "GX5" tests is shown in Figure 18. The only difference between the two tests is that a 6400Ω resistor is added in series with the meter lead for the

"GX5" test. The green lead is connected to the transistor only when a tetrode is being tested, and then only after completing all other tests. Resistors R_B are selected by positions of the "B" switch.

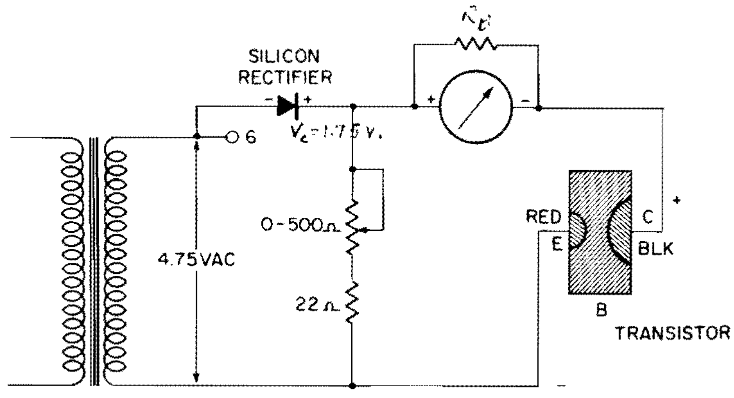


FIGURE 17

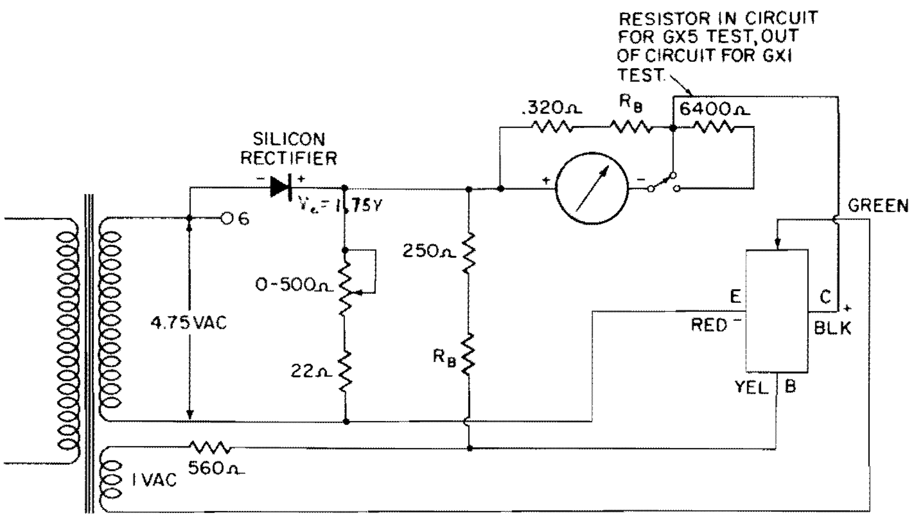


FIGURE 18

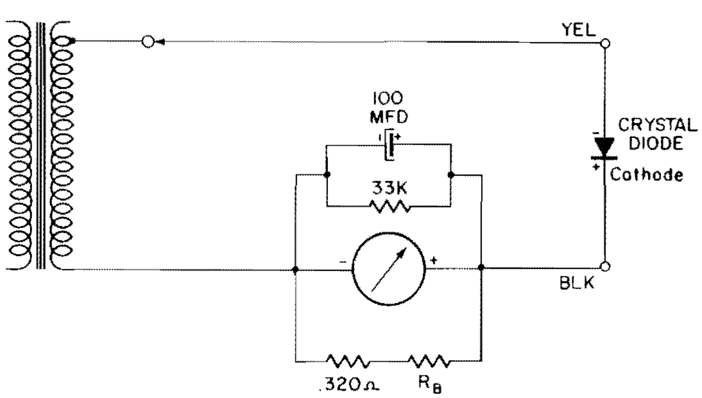


FIGURE 19

"Df" (Diode Forward) Test Circuit (Figure 19)

The circuit for testing forward current of crystal diodes is shown in Figure 19. Setting of the "A" switch determines the AC voltage applied to the circuit and depends upon the diode being tested. The diode itself serves as a rectifier for the meter circuit. The meter shunt will be .320 ohms, plus the value selected by the "B" switch position.

"Dr" (Diode Reverse) Test Circuit (Figure 20)

In this test, a reverse DC voltage is applied to the diode. Meter polarity is opposite to that of the "Df" test. Value of applied voltage is governed by the "A" switch setting. Value of meter shunt depends on the "C" switch setting.

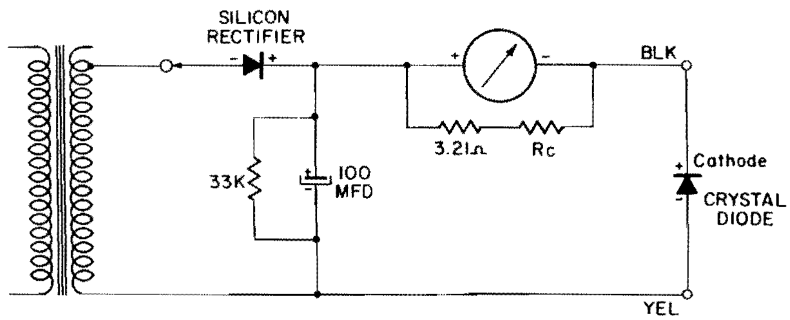


FIGURE 20

FUNCTIONS OF FRONT PANEL CONTROLS AND SWITCHES

1. "ADJUST LINE" control compensates for varying line voltage conditions.

2. Switch "A" is the collector voltage selector for I_{cbo} readings. It provides 17 predetermined values of collector voltage from .5 volts DC to 100 volts DC. (See schematic for the complete list of collector voltages available through Switch "A".) Switch "A" also selects AC voltages in the "Df" (Diode Forward Current) test.

3. Switch "B" is the base current injection selector (for gain tests) for all classes of transistors.

Position	Injection	Type
1	50 Microamperes	Low Power
2	200 Microamperes	Medium Power and Misc.
3	500 Microamperes	Medium Power and Misc.
4	2 Milliamperes	Medium Power and Misc.
5	5 Milliamperes	Power

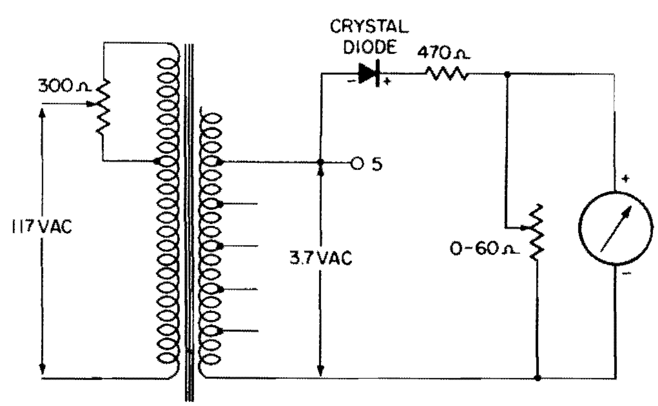


FIGURE 21

Switch "B" also varies the meter sensitivity for transistor leakage and gain tests ("L", "GX1", and "GX5") and diode forward current test ("Df").

4. Switch "C" is the meter "I_{cbo}" and "Dr" sensitivity selector. This selector sets up the indicating circuit for all "I_{cbo}" readings. The switch is discussed in greater detail under "Operating Instructions — I_{cbo} test."

When the instrument is first turned on, the meter acts as a Line-Adjust indicator until the "READ METER" button is pressed for testing. Meter circuit for a Line-Adjust operation is shown in Figure 21. This circuit is in effect at all times when the "READ METER" button is not pressed. Adjustment to compensate for line voltage variations is made with "ADJUST LINE" control.

WHAT TRANSISTORS ARE

Semiconductors are devices made of materials (germanium or silicon) which cannot be classified as good conductors or insulators. However, under proper conditions, they may exhibit either quality.

Semiconductors are classified in two types, P-type and N-type. Semiconducting materials, whose atomic structure contains a surplus of free electrons, are referred to as N-type (Negative) conductors. Materials having a deficiency of electrons are called P-type (Positive) conductors. These deficiencies are referred to as "holes". Current will flow in either direction in an N- or P-type material. If these two materials are joined and a voltage of proper polarity applied, the materials act as a very low resistance and current will flow. If the polarity is reversed, the materials act as a very high resistance and very little current will flow. Thus, we have a good diode or rectifier. Diodes are rated for their maximum average rectified current and inverse voltage (applied in opposite polarity to that causing maximum forward current).

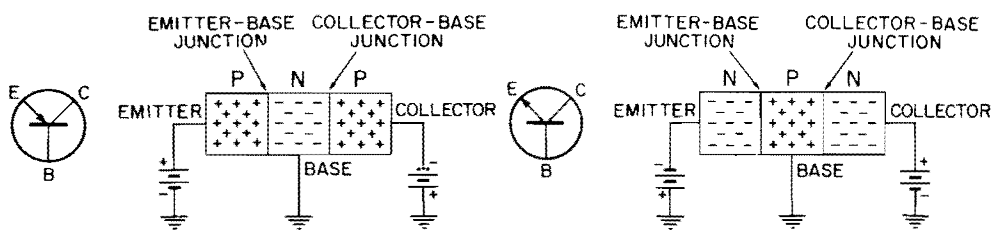


FIGURE 22

By adding another piece of P- or N-type material, we produce a transistor, shown in Figure 22 with proper voltage polarities applied. Both a PNP and an NPN transistor are shown with their appropiate symbols.

When an N- and a P-type of material are joined and a voltage of the proper polarity is applied, electrons will flow from N to P and holes will move from P to N. Considering the PNP transistor in the diagram, and with batteries connected as shown, electrons will flow through the junction of the emitter and the base to the emitter and holes will move into the base. A few of the holes will be neutralized in the N material, but most of them will get through the base and collector junction to the collector. With the collector biased negative, current normally would not flow through it. However, under these conditions, current will flow from the emitter through the collector because of surplus holes at the junction. In this way, the collector current is controlled by the emitter. Very little current flows through the common base connection; most of it flows through the emitter to the collector.

Since very little voltage is required to cause current to flow into the emitter, input power is very low. Almost all of the emitter current flows in the collector circuit, where voltages can be high. Therefore, a relatively large amount of power can be controlled in the output circuit, with a high power gain for the transistor.

TRANSISTOR TESTING

A number of tests have been advanced for checking the relative quality of transistors. One parameter, however, has been found to be superior to most others in determining transistor quality. This parameter is called I_{cbo} and can be used successfully as a yardstick for determining quality or condition of a transistor after it has been installed and used in commerical equipment.

The reading during an I_{cbo} test is usually in microamperes and therefore requires a sensitive indicator for a usable reading. The Model T-65 is designed around a meter movement having the required sensitivity; full scale deflection is obtained at 100 microamperes with the maximum-sensitivity instrument setting.

Transistor manufacturers have standardized a number of nomenclature symbols for various transistor characteristics. Three most commonly encountered terms are:

1. I_{cbo} — This symbol indicates current flowing between collector and base with the emitter open. See Figure 16. The letter I of course, is the symbol for current; the next two symbols represent collector and base, the two parts of the transistor in which current is measured; o indicates the remaining element of the transistor, the emitter, is open for this test. In similar manner, a test requiring the current measurement between emitter and base, with the collector open, is represented by the symbol I_{ebo}. In fact, this test is sometimes used by transistor manufacturers.

2. I_{cbs} — In this symbol, I, c, and b mean the same as before; s indicates the missing element (the emitter in this case) is shorted to the base.

3. Beta — Beta describes current gain and is analogous to amplification factor in receiving tube nomenclature. Specifically, it is current gain from collector to base with output shorted and a constant collector voltage. Beta refers to either AC or DC current gain. In the Model T-65, Beta or gain is indicated by first observing a reading of emitter to collector current with base open, then obtaining a second reading with a predetermined value of current injected into the base to produce an increased collector current reading. The increase in current indicates the gain or Beta of the transistor. Extensive tests show close correlation between AC and DC Beta readings under these conditions.

Other symbols may be encountered by the technician. They will, however, follow the same pattern as those just described.

A diffused junction PNP transistor can be seen in Figure 23. Both physical and schematic representations are shown. The physical sketch is much larger than the actual size of the transistor elements and shows that emitter and collector can be spaced close to each other and hence become shorted. Therefore, the "SHORT" test is the first important test which should be performed with the Model T-65 tester. A shorted or low resistance transistor should be rejected without further testing. A simplified schematic of the circuit for the "SHORT" test is shown in Figure 15.

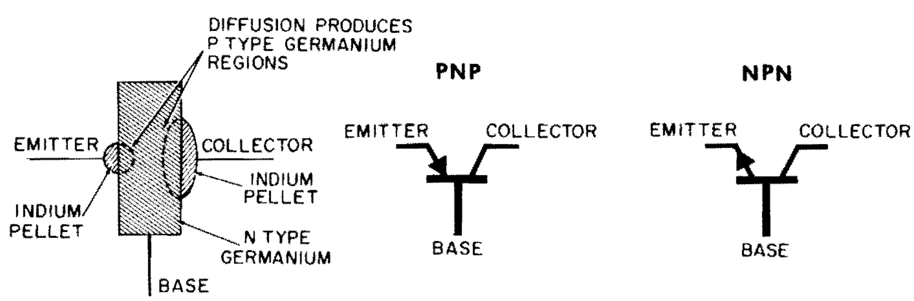


FIGURE 23

As noted previously, I_{cbo} is the basic transistor test parameter. It should be the second test performed on all transistors with the Model T-65 tester. A simplified circuit for this test is pictured in Figure 16.

The third transistor test is "L" or leakage. The circuit for this test appears in Figure 17. The leakage test in itself has no special significance insofar as the condition of the transistor is concerned but is used to arrive at a final figure for transistor gain or Beta.

The circuit for the Beta test is shown in Figure 18. The reading obtained during the leakage test is subtracted from the reading obtained by the gain test to yield an actual gain number.

Tetrode transistors are similar in construction to the usual three terminal transistor except that an additional base connection which functions as a tetrode connection is made externally. Before testing for tetrode action, the usual tests for I_{cbo}, leakage, and gain are performed. Finally, a selected potential is applied to the tetrode connection to produce a potential difference between tetrode connection and base. Proper tetrode action is indicated if the applied potential decreases the gain reading.

Transistors Are Temperature-Sensitive

MOST I_{cbo} LIMITS LISTED ON THE DATA SHEETS SUPPLIED WITH YOUR T-65 ARE BASED ON AN AMBIENT TEMPERATURE OF 77° F. (25° C.). I_{cbo} CAN DOUBLE FOR EACH 18° F. INCREASE IN TEMPERATURE OR MAY READ APPROXIMATELY HALF ITS VALUE FOR EACH 18° F. REDUCTION IN TEMPERATURE. IF THE FIRST I_{cbo} READING IS QUITE LOW, THE OPERATOR NEED NOT BE PARTICULARLY CONCERNED ABOUT ROOM TEMPERATURE. HOWEVER, WHEN READINGS CLOSE TO THE REJECT POINT ARE OBTAINED, THE OPERATOR SHOULD CHECK ROOM TEMPERATURE BEFORE MAKING A FINAL JUDGEMENT OF I_{cbo}. DO NOT HOLD THE TRANSISTOR IN THE FINGER TIPS WHILE TESTING I_{cbo}, SINCE HEAT FROM THE FINGERS MAY AFFECT THE I_{cbo} READING.

Transistors are classified as PNP or NPN. The only difference between these two classes, so far as testing the transistor is concerned, is the polarity of the applied test voltage and metering circuit. In other words, all tests performed on a PNP transistor are the same as on an NPN transistor, except the Function Selector switch of Model T-65 applies test voltages of the correct polarity to the transistor.

A negative potential is applied to the collector of a PNP transistor, whereas a positive potential is applied to the collector of an NPN transistor.

OPERATING INSTRUCTIONS

Transistors

AGAIN, ONE OF THE MORE IMPORTANT FACTORS TO REMEMBER WHEN TESTING TRANSISTORS IS THEIR SENSITIVITY TO TEMPERATURE CHANGES. TRANSISTORS SHOULD NOT BE HELD IN THE HAND DURING TESTS, SINCE THIS CONTACT IS ENOUGH TO CHANGE THE TRANSISTOR OPERATION.

Check the zero setting of the meter needle before turning on the instrument. If necessary, zero the needle by means of the adjustment screw on the front of the meter.

1. Set Switches "A", "B", and "C" to the settings indicated in the Test Data sheets.

2. Determine whether the transistor is "NPN" or "PNP" from the data sheets and set the lower right hand (Function Selector) switch to the corresponding "SHORT" position. Move power switch to "ON" and set "ADJUST LINE" control so meter pointer lines up with "ADJUST LINE" calibration mark.

3. Identify the transistor leads by referring to the illustrations of different transistor types and insert the leads into the panel socket. Make sure the proper numbered lead terminals insert into the correspondingly numbered parts of the socket, and the uninsulated transistor leads are not shorting to each other.

NOTE: If the transistor cannot be accomodated by either of the two sockets, use the alligator leads to connect to the transistor, carefully observing the numbering identification on both the transistor and alligator leads. See illustrations accompanying data. If the transistor is a power type with the collector terminating in the metal transistor case, use the black alligator lead to clip to the transistor shell.

4. Press the "READ METER" button and read the 0-100 meter scale. Compare this reading with the reading on the data sheet. If the reading is higher on the scale than on the data sheet, reject the transistor as shorted. No further test should be performed if the transistor does not pass this test, since a shorted transistor can cause excessive meter current to flow in subsequent tests.

5. Rotate the Function Selector to the "I_{cbo}" position, depress the "READ METER" button, read the 0-100 scale and refer to the data for the maximum permissible value of "I_{cbo}". If the transistor reads higher than the maximum value, the transistor is probably defective.

NOTE 1: The data will list either a "Max" or a "Typ" value. If a "Typ" (typical) value is listed, this means actual maximum limit data from the manufacturer of the particular transistor are not yet available. In such a case, the "Typical" value merely indicates a mean value for the transistor; therefore, the operator must allow a reasonable tolerance when using a "Typ" value.

NOTE 2: In some cases, the "I_{cbo}" reading <u>increases</u> as the button is held down. If the "I_{cbo}" reading doubles within 10 seconds, reject the transistor. If the "I_{cbo}" reading is within limits and goes <u>down</u>, the transistor is good.

NOTE 3: All "I_{cbo}" test data are based upon readings taken at a room temperature of 77^{o} F. "I_{cbo}" can double for every 18^{o} F. increase above this temperature.

All "I_{cbo}" test data relate to the 0-100 meter scale. In some cases, the "I_{cbo}" will be direct reading in terms of 0-100 microamperes. However, in other cases (depending upon the position of Switch "C"), the meter reading will simply be an arbitrary reading based on the 0-100 meter scale. If the operator wishes to convert these arbitrary readings to direct microamperes or milliamperes of current, he may do so by using the following table:

Switch "C"	Full Scale Current
1	100 microamperes
2	500 microamperes
3	2500 microamperes
4	10 milliamperes
5	50 milliamperes

For example, if Switch "C" had been set to Position "1", the meter will now be reading between 0-100 microamperes. However, if the switch had been set to Position "2", the meter is between 0-500 microamperes. In this case, all scale readings must be multiplied by 5 to obtain the true "I_{cbo}" reading.

If the switch had been set to Position "3", the meter will indicate a full scale range of 2500 microamperes; the operator must multiply all readings by 25 to obtain true "I_{cbo}."

If the switch had been set to Position "4", the meter will read 10 milliamperes full scale. The operator reads the scale directly and divides all readings by 10. Bear in mind that this scale is now reading in terms of milliamperes for true "I_{cbo}."

If the switch had been set to Position "5", the meter will read 50 milliamperes full scale. The operator divides all readings by 2. Again, bear in mind that the readings are in terms of milliamperes for true "I_{cbo}" readings.

The same discussion relates to "Dr" (Diode Reverse Current) readings.

6. The Function Selector should next be rotated to the "L" position and a reading taken. The "L" reading must be remembered for use in Step 7. (The "L" reading is subtracted from the gain reading to obtain maximum accuracy of Gain.)

7. The last step involves the actual gain reading of the transistor. You will note that two positions are available, "GX1" and "GX5". If the transistor gain is expected to be well below 100, then you will use the "GX1" position inasmuch as the meter scale reads directly from 0-100. On the other hand, if the gain reading is expected to go close to or above 100, the transistor data will tell you to use the "GX5" position and multiply all scale readings by 5 to obtain the actual gain figure.

NOTE 1: Do not forget to subtract the "L" reading from your final gain reading.

NOTE 2: Do not keep the "READ METER" button depressed longer than necessary to take a reading in either the "GX1" or "GX5" positions. Most transistors increase in reading if the button is held down, due to heating of the collector junction. The initial reading is the correct one to use.

8. If the transistor is a tetrode type, proceed as follows: Use the alligator clip leads; leave terminal 3 disconnected; go through the transistor tests as described previously. After completing the gain test ("GX1" or "GX5") connect alligator clip lead 3 (green) to terminal 3 of the transistor, press the "READ METER" button and watch for a reading LOWER than the previous "GX1" or "GX5" reading. If the reading does not differ from the "GX1" or "GX5" reading, then the condition of the tetrode connection of the transistor should be questioned.

Crystal Diodes

Connect the cathode (+) of the crystal diode to terminal 4 (black) of Model T-65. Connect (-) of diode to terminal 2 (yellow) of Model T-65.

NOTE: It is extremely important that the diode be connected properly, as described above; otherwise, the diode and instrument can be damaged. See Figure 24 for polarity identification of various types of crystal diodes.

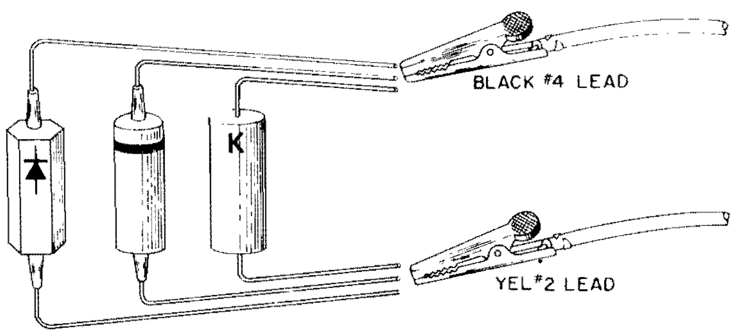


FIGURE 24

DIODE FORWARD TEST

1. Set Function Selector switch to "Df" position.

2. Set "A" and "B" switches as indicated on test data sheet for forward current test of diode being tested.

3. Depress "READ METER" button. If meter reading is within specified range, proceed to diode reverse test. Otherwise, reject the diode without further test. A diode which reads well below the minimum forward reading can damage the instrument if the diode reverse test is attempted.

DIODE REVERSE TEST

Leave diode connections as above and proceed as follows:

1. Set Function Selector switch to "Dr" position.

2. Set "A" and "C" switches as indicated on test data sheet for diode reverse current test.

3. Depress "READ METER" button. Reading should be below that specified under diode reverse current.

MAINTENANCE SUGGESTIONS

Your PACO TRANSISTOR TESTER can fulfill continuous daily service requirements for many years. However, to fully realize these capabilities, the same degree of care in operation and maintenance should be accorded your instrument that would be given any fine piece of equipment.

It is always possible that repairs will be necessary. Should your TRANSISTOR TESTER need servicing, you will encounter little or no difficulty if you simply apply the same process of elimination you use in troubleshooting any electronic circuit. The checks outlined under "COMPLETE CHECK-OUT PROCEDURE," as well as the information presented under "BASIC CIRCUIT FUNCTIONS," will aid you considerably. Proper operating voltages are shown on the schematic. These may very up to ±10% and still be acceptable.

Should you suspect failure of the meter movement coil, the continuity may be checked with an ohmmeter if a limiting resistor of approximately 10K ohms is first connected in series with the ohmmeter test leads. NEVER directly test meter coil continuity with an ohmmeter. This could "burn-out" the coil from excessive ohmmeter battery current. Should this occur, the meter must be replaced.

Do not attempt to repair the meter coil, as this automatically voids our warranty.

Should the plastic meter cover become damaged, you can obtain a separate replacement cover from PACO Electronics Co.

To remove the cover, insert a small screwdriver or knife blade under one of the upper corners and gently pry upwards. Being a friction fit, the cover should pop right off.

When installing a new cover, be careful to properly engage the small plastic stud on the cover with the slotted zero adjust lever on the meter movement.

Do not leave the meter movement exposed to air for any length of time. Accumulations of dust and other foreign matter can seriously harm this delicate instrument. If you must remove the plastic cover for any length of time, protect the movement in some way, such as by enclosing in a box.

The plastic cover may occasionally, through repeated polishing or cleaning, accumulate charges of static electricity. This will cause the pointer to deflect erratically with the instrument turned on or off. Static charges may be removed with one of the commercially available anti-static solutions or a solution of any good liquid detergent (the kind used for washing dishes) and water. Simply dip a clean, soft cloth in the solution and wipe the surface of the meter cover. The cover need not be removed for this.

Faulty operation of your TRANSISTOR TESTER may often be traced to the test leads, especially after long use. Their maintenance, therefore, should not be ignored. Check the leads frequently and carefully for breakage, soldered connections developing resistance, etc.

NOTE: See page 37 for SPECIAL SUBSCRIPTION SERVICE on Test Data Sheets.

PARTS LIST

RESISTORS

Ref. No.	Part No.	Quantity	Description
R1	P15-738	1	560Ω, 10% Carbon
R2	P15-277	1	470Ω, 10% Wirewound
R3	P15-276	1	640Ω, 1% Carbon Precision
R4	P15-274	1	6400Ω, 1% Carbon Precision
R5	P15-947	1	27.1Ω, 1% Wirewound Precision
R6	P15-872	1	22Ω, 10% Wirewound
R7	P15-581	1	33KΩ, 10% Carbon
R8	P15-271	1	333.3Ω, 1% Carbon Precision
R9	P15-270	1	50.5Ω, 1% Carbon Precision
R10	P15-940	1	12.95Ω, 1% Wirewound Precision
R11	P15-941	1	3.21Ω, 1% Wirewound Precision
R12	P15-269	1	250Ω, 1% Carbon Precision
R13	P15-272	1	475Ω, 1% Carbon Precision
R14	P15-273	1	2250Ω, 1% Carbon Precision
R15	P15-268	1	5KΩ, 1% Carbon Precision
R16	P15-275	1	24.7KΩ, 1% Carbon Precision
R17	P15-946	1	.320Ω, 1% Wirewound Precision
R18	P15-942	1	24.6Ω, 1% Wirewound Precision
R19	P15-943	1	4.83Ω, 1% Wirewound Precision
R20	P15-944	1	2.41Ω, 1% Wirewound Precision
R21	P15-945	1	.480Ω, 1% Wirewound Precision
	P15-949	1	33Ω, 10% (Special External Test Resistor)
	P15-234	1	390Ω, 10% (Special External Test Resistor)
	P15-948	1	4700Ω, 10% (Special External Test Resistor)

CAPACITOR

Ref. No.	Part No.	Quantity	Description
	P16-213	1	100 mfd, 150V, Electrolytic

CONTROLS - SWITCHES

Ref. No.	Part No.	Quantity	Description
CA	P17-107B	1	300Ω, 25-Watt Wirewound Control (ADJUST LINE)
CB	P17-260	1	500Ω Calibrating Control
CC	P17-264	1	60Ω Calibrating Control
SA	P14-282B	1	18-Position Rotary Switch (Switch "A")
SB	P14-286	1	5-Position Rotary Switch (Switch "B")
SC	P14-285	1	5-Position Rotary Switch (Switch "C")

CONTROLS - SWITCHES (Cont.)

Ref. No.	Part No.	Quantity	Description
SD	P14-171-1	1	SPST Slide Switch (ON-OFF)
SE	P14-287	1	Spring-Loaded, Push-Type Switch (READ METER)
SF	P14-284	1	4-Section, 12-Position Rotary Switch (Function Selector)

TRANSFORMER

Ref. No.	Part No.	Quantity	Description
T	P18-184	1	Power Transformer

SOCKETS-CONNECTORS-TERMINAL STRIPS

Part No.	Quantity	Description
P20-182	1	4-Pin, In-Line Transistor Socket
P23-272	1	Rectangular Clip For 4-Pin Socket.
P20-150	1	9-Pin Miniature Tube Socket (Power Transistor Socket)
P20-172	4	Alligator Clip
P23-267	1	#4 Solder Lug
P10-567-1	1	"Bakelite" Terminal Board

KNOBS-GROMMETS-FEET

Part No.	Quantity	Description
P10-460	4	Large Pointer Knob
P10-475-1	1	Small Round Knob
P10-135-2	1	Push-Button Knob
P29-132	2	3/8" Rubber Grommet
P29-149	4	Rubber Feet

HARDWARE

Part No.	Quantity	Description
P24-255	6	#4-40 x 1/4" Binding Head Machine Screw
P24-276	2	#4-40 x 3/8" Round Head Nylon Screw
P24-243	4	#6-32 x 3/8" Oval Head Machine Screw
P24-215	2	#6 x 3/8" Binding Head, Self-Tapping Screw
P24-267	2	#8-32 x 3/8" Binding Head Machine Screw
P24-158	6	#4-40 Hex Nut
P24-125	4	#6-32 Hex Nut
P24-134	2	#8-32 Hex Nut
P24-180	9	3/8" Control Hex Nut
P24-253	7	#4 Lockwasher
P24-246	4	#6 Lockwasher
P24-247	2	#8 Lockwasher
P24-175	6	3/8" Control Lockwasher
P23-224	5	3/8" "Bakelite" Control Washer
P33-117	2	#4 Stand-off Studs (For READ METER Switch)
P33-232	2	#4 Spacers (For Power Transistor Socket)
P11-304	1	Special Cable Clamp

WIRE-SPAGHETTI-SLEEVING-TAPE

Part No.	Quantity	Description
P21-148	1	Roll, Thin-Wall, Solid Hook-up Wire (Red, Green, Yellow, Orange)
P21-159	1	Roll, Heavy-Wall, Stranded Hook-up Wire (Red, Green, Yellow, Black)
P21-124	1	Length, Thin-Wall, Stranded Hook-up Wire (Black)
P21-104	1	Length, Solid, Bare Hook-up Wire
P21-147-1	1	Line Cord
P21-170	1	Length, Spaghetti
P29-148	4	Insulating Sleeves (For Alligator Clips)
P35-110	1	Length, Tape

MISCELLANEOUS

Part No.	Quantity	Description
P32-141	1	Silicon Power Rectifier
P32-121	1	Crystal Diode
P12-166	1	100 Microampere Meter with Hardware
P19-127	1	1/2 Amp. Fuse
P13-393	1	Front Panel
P11-302	1	Chassis
P22-170	1	Carrying Case
P23-243	1	Carrying Case Handle
P23-244	2	Carrying Case Handle Hinge
P26-179	1	Instruction Book
P26-180	1 Set	Data Sheets and Illustration
P29-154	1 Set	Sponge Rubber Feet

SPECIAL SUBSCRIPTION SERVICE

New Transistor And Diode Test Data

In line with PACO's desire to extend utmost service to builders and users of PACO test equipment kits, new test data is available to you on a special, low-cost, subscription basis.

This plan automatically provides up-to-date sets of data during a one-year subscription period for the nominal fee of only $2.00 per year, or four sets of data during a two year subscription period for only $3.50.

The first year's subscription may be started at once upon our receipt of your registration-subscription card, accompanied by check or money order. If is important that this registration-subscription card be completely filled-in and returned to us immediately, in order that you may receive the full benefits of this special service.

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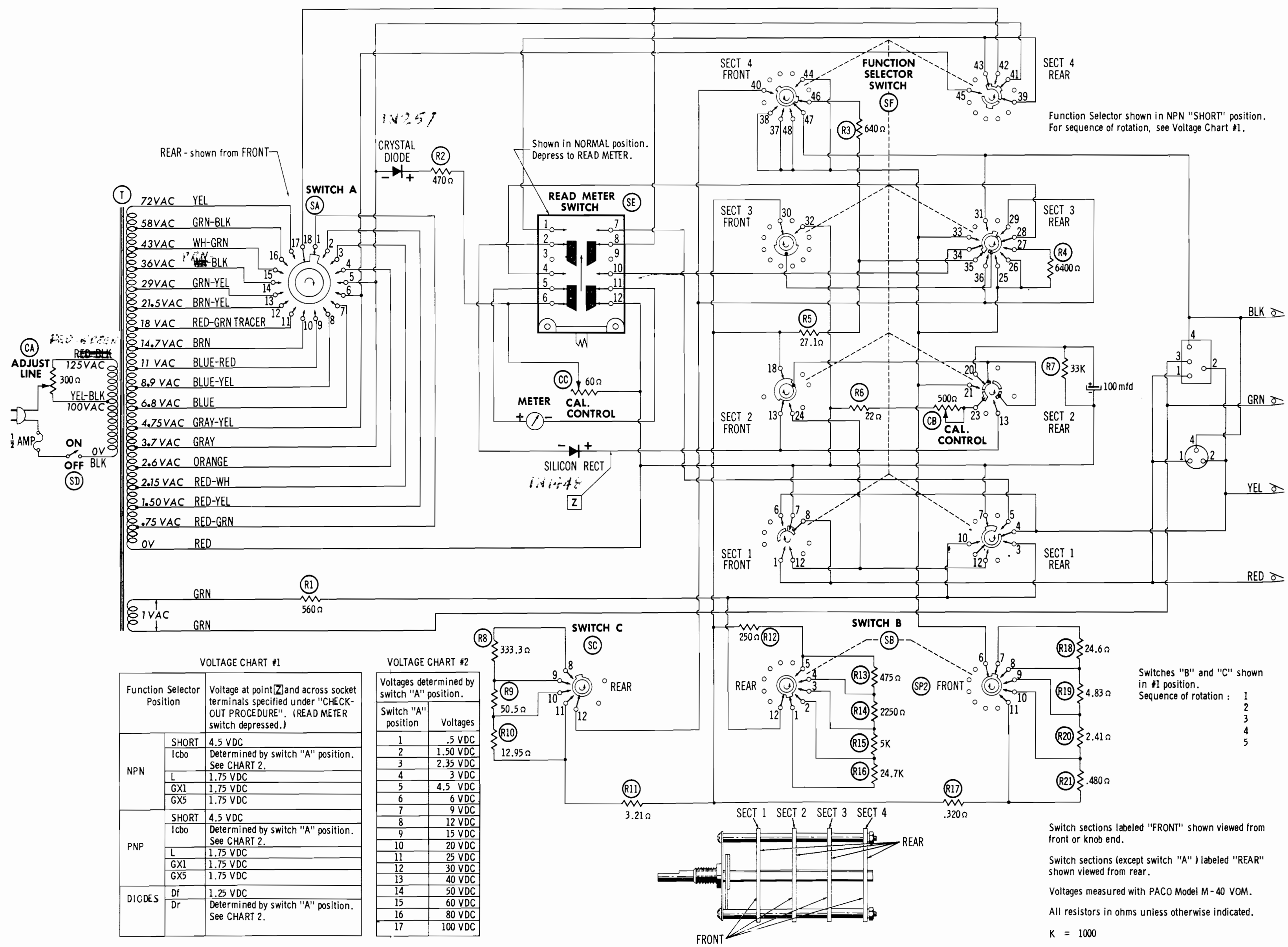
For those who may not wish to subscribe or renew their subscription, new up-to-date data sheets are available upon request at the nominal cost of $1.25 each. It is very important that individual data sheet requests list the following information:

A. Model No. of Tester.
B. Serial No. of Tester.
C. Form No. of your present data sheets.
(Printed at upper left hand corner of the top sheet.)

This information permits our Test Data Department to respond with the correct data for your particular tester.

SPECIAL NOTE:
Paid subscription service applies only to Continental U.S.A., Canada and U.S. possessions.



Function Selector shown in NPN "SHORT" position. For sequence of rotation, see Voltage Chart #1.

VOLTAGE CHART #1

Function Selector Position		Voltage at point Z and across socket terminals specified under "CHECK-OUT PROCEDURE". (READ METER switch depressed.)
NPN	SHORT	4.5 VDC
	Icbo	Determined by switch "A" position. See CHART 2.
	L	1.75 VDC
	GX1	1.75 VDC
	GX5	1.75 VDC
PNP	SHORT	4.5 VDC
	Icbo	Determined by switch "A" position. See CHART 2.
	L	1.75 VDC
	GX1	1.75 VDC
	GX5	1.75 VDC
DIODES	Df	1.25 VDC
	Dr	Determined by switch "A" position. See CHART 2.

VOLTAGE CHART #2

Voltages determined by switch "A" position.

Switch "A" position	Voltages
1	.5 VDC
2	1.50 VDC
3	2.35 VDC
4	3 VDC
5	4.5 VDC
6	6 VDC
7	9 VDC
8	12 VDC
9	15 VDC
10	20 VDC
11	25 VDC
12	30 VDC
13	40 VDC
14	50 VDC
15	60 VDC
16	80 VDC
17	100 VDC

Switches "B" and "C" shown in #1 position.
Sequence of rotation : 1 2 3 4 5

Switch sections labeled "FRONT" shown viewed from front or knob end.

Switch sections (except switch "A") labeled "REAR" shown viewed from rear.

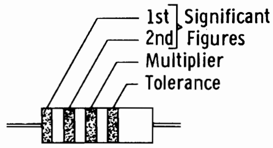
Voltages measured with PACO Model M-40 VOM.

All resistors in ohms unless otherwise indicated.

K = 1000

SCHEMATIC DIAGRAM – MODEL T-65 – TRANSISTOR TESTER

COLOR BAND SYSTEM



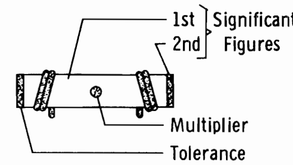
Resistors With Black Body Color Are Composition, Non-Insulated.
Resistors With Colored Bodies Are Composition, Insulated.
Wire-Wound Resistors Have The 1st Digit Color Band Double Width.

RESISTOR CODES (RESISTANCE GIVEN IN OHMS)

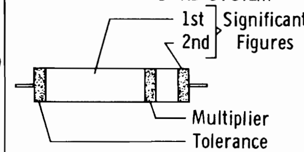
COLOR	DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	1	±20%
BROWN	1	10	±1%
RED	2	100	±2%
ORANGE	3	1000	±3% *
YELLOW	4	10000	GMV*
GREEN	5	100000	±5% (RETMA Alternate)
BLUE	6	1000000	±6%*
VIOLET	7	10000000	±12 1/2%*
GRAY	8	.01 (RETMA Alternate)	±30%*
WHITE	9	.1 (RETMA Alternate)	±10% (RETMA Alternate)
GOLD		.1 (JAN and RETMA Preferred)	±5% (JAN and RETMA Pref.)
SILVER		.01 (JAN and RETMA Preferred)	±10% (JAN and RETMA Pref.)
NO COLOR			±20%

*GMV = guaranteed minimum value, or -0 + 100% tolerance.
±3, 6, 12 1/2, and 30% are ASA 40, 20, 10, and 5 step tolerances.

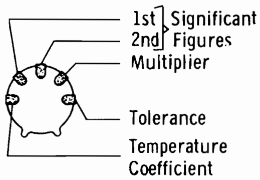
BODY-END-DOT SYSTEM



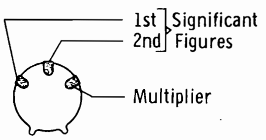
BODY- END BAND SYSTEM



DISC CERAMICS (5-DOT SYSTEM)



DISC CERAMICS (3-DOT SYSTEM)

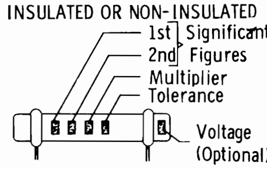


CERAMIC CAPACITOR CODES (CAPACITY GIVEN IN MMF)

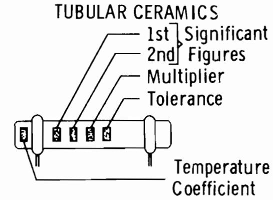
COLOR	DIGIT	MULTIPLIER	TOLERANCE 10MMF or LESS	TOLERANCE OVER 10MMF	TEMPERATURE COEFFICIENT PPM/°C	EXTENDED RANGE TEMP. COEFF. SIGNIFICANT FIGURE	EXTENDED RANGE TEMP. COEFF. MULTIPLIER
BLACK	0	1	±2.0MMF	±20%	0(NPO)	0.0	-1
BROWN	1	10	±0.1MMF	±1%	-33(N033)		-10
RED	2	100		±2%	-75(N075)	1.0	-100
ORANGE	3	1000		±2.5%	-150(N150)	1.5	-1000
YELLOW	4	10000			-220(N220)	2.2	-10000
GREEN	5		±0.5MMF	±5%	-330(N330)	3.3	+1
BLUE	6				-470(N470)	4.7	+10
VIOLET	7				-750(N750)	7.5	+100
GRAY	8	.01	±0.25MMF		+30(P030)		+1000
WHITE	9	.1	±1.0MMF	±10%	General Purpose		+10000
SILVER					Bypass & Coupling		
GOLD					+100(P100) (Jan)		

Ceramic capacitor voltage ratings are standard 500 volts, for some manufacturers, 1000 volts for other manufacturers, unless otherwise specified.

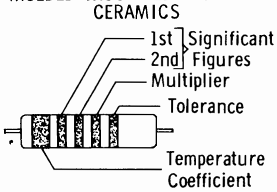
HIGH CAPACITY TUBULAR CERMICS INSULATED OR NON-INSULATED



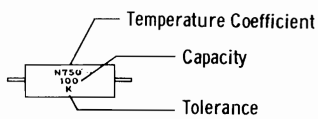
TEMPERATURE COMPENSATING TUBULAR CERAMICS



MOLDED-INSULATED AXIAL LEAD CERAMICS

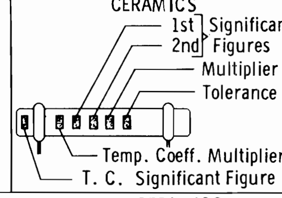


TYPOGRAPHICALLY MARKED CERAMICS



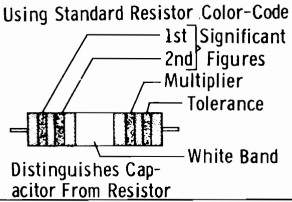
JAN LETTER	TOLERANCE 10MMF or LESS	TOLERANCE OVER 10MMF
C	±0.25MMF	
D	±0.5MMF	
F	±1.0MMF	±1%
G	±2.0MMF	±2%
J		±5%
K		±10%
M		±20%

EXTENDED RANGE T.C. TUBULAR CERAMICS

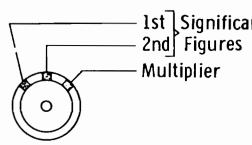


MOLDED CERAMICS

Using Standard Resistor Color-Code

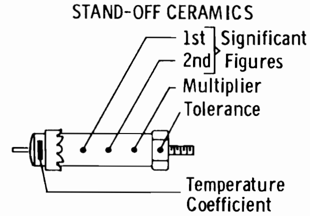


BUTTON CERAMICS

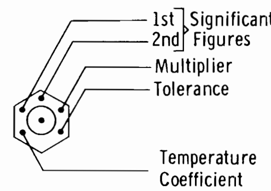


Viewed From Soldered Surface

STAND-OFF CERAMICS



FEED-THRU CERAMICS



MOLDED MICA CAPACITOR CODES

(Capacity Given In MMF)

COLOR	DIGIT	MULTIPLIER	* TOLERANCE	CLASS OR CHARACTERISTIC
BLACK	0	1	20%	A
BROWN	1	10	1%	B
RED	2	100	2%	C
ORANGE	3	1000	3%	D
YELLOW	4	10000		E
GREEN	5		5%(RETMA)	F(JAN)
BLUE	6			G(JAN)
VIOLET	7			
GRAY	8			I(RETMA)
WHITE	9			J(RETMA)
GOLD		.1	5%(JAN)	
SILVER		.01	10%	

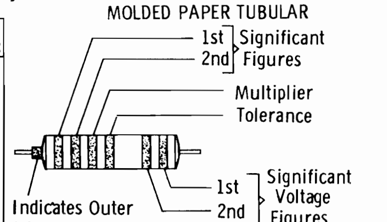
Class or characteristic denotes specifications of design involving Q factors, temperature coefficients, and production test requirements.
All axial lead mica capacitors have a voltage rating of 300, 500, or 1000 volts.
*or ±1.0 MMF whichever is greater.

MOLDED PAPER CAPACITOR CODES

(Capacity Given In MMF)

COLOR	DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	1	20%
BROWN	1	10	
RED	2	100	
ORANGE	3	1000	
YELLOW	4	10000	
GREEN	5	100000	5%
BLUE	6	1000000	
VIOLET	7		
GRAY	8		
WHITE	9		10%
GOLD			5%
SILVER			10%
NO COLOR			20%

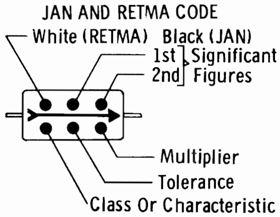
MOLDED PAPER TUBULAR



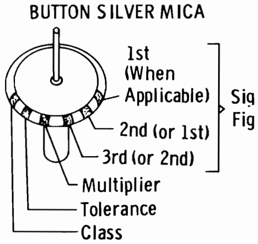
Indicates Outer Foil. May Be On Either End. May Also Be Indicated By Other Methods Such As Typographical Marking, Or Black Stripe.

Add Two Zeros To Significant Voltage Figures. One Band Indicates Voltage Ratings Under 1000 Volts.

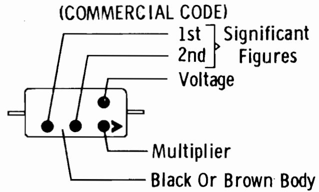
CURRENT STANDARD JAN AND RETMA CODE



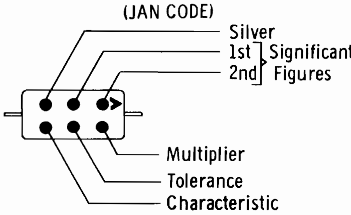
BUTTON SILVER MICA

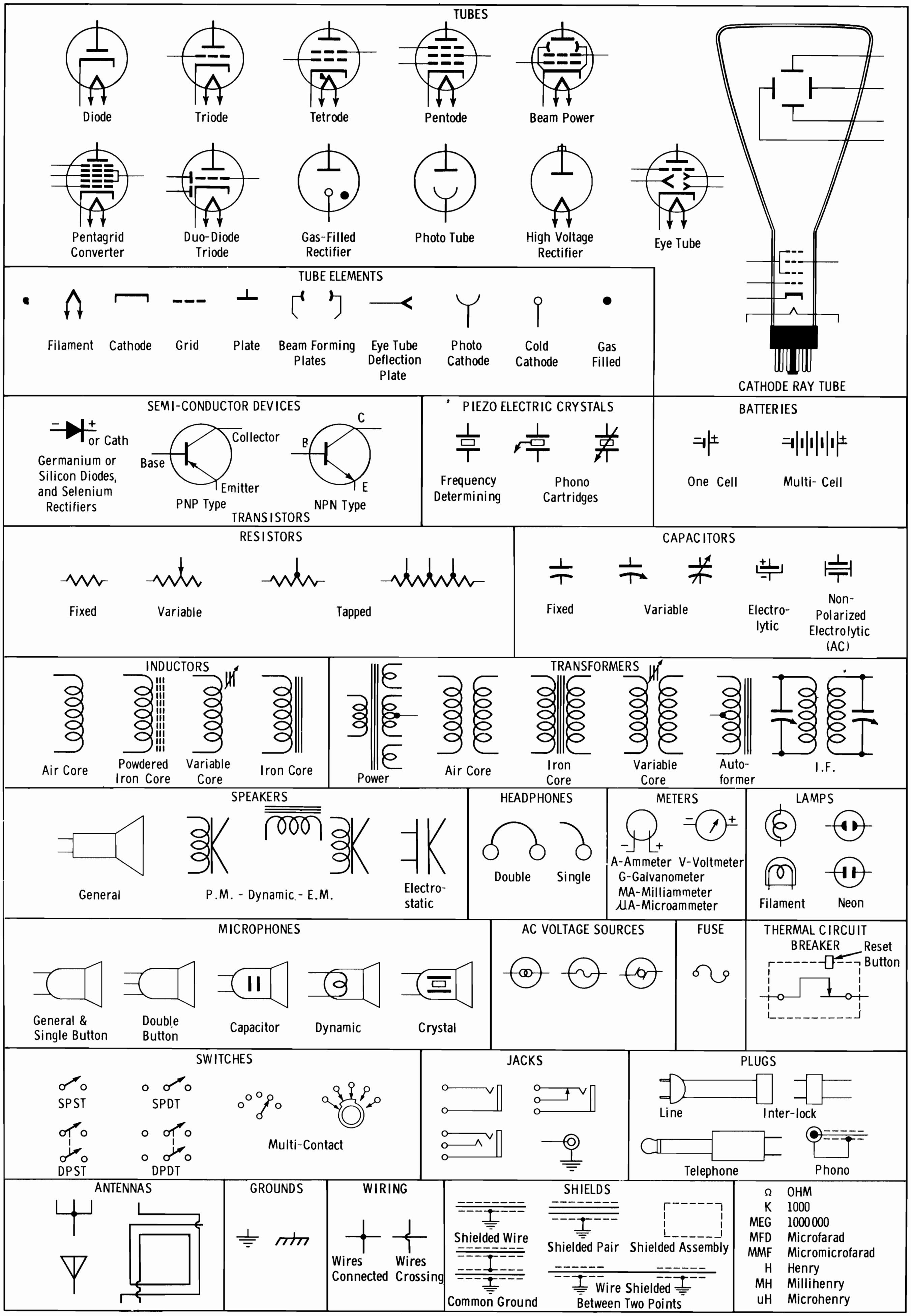


MOLDED FLAT PAPER CAPACITORS (COMMERCIAL CODE)



MOLDED FLAT PAPER CAPACITORS (JAN CODE)




TUBES
Diode
Triode
Tetrode
Pentode
Beam Power
Pentagrid Converter
Duo-Diode Triode
Gas-Filled Rectifier
Photo Tube
High Voltage Rectifier
Eye Tube
CATHODE RAY TUBE
TUBE ELEMENTS
Filament
Cathode
Grid
Plate
Beam Forming Plates
Eye Tube Deflection Plate
Photo Cathode
Cold Cathode
Gas Filled
SEMI-CONDUCTOR DEVICES
or Cath
Germanium or Silicon Diodes, and Selenium Rectifiers
Collector
Base
Emitter
PNP Type
C
B
E
NPN Type
TRANSISTORS
PIEZO ELECTRIC CRYSTALS
Frequency Determining
Phono Cartridges
BATTERIES
One Cell
Multi- Cell
RESISTORS
Fixed
Variable
Tapped
CAPACITORS
Fixed
Variable
Electro-lytic
Non-Polarized Electrolytic (AC)
INDUCTORS
Air Core
Powdered Iron Core
Variable Core
Iron Core
TRANSFORMERS
Power
Air Core
Iron Core
Variable Core
Auto-former
I.F.
SPEAKERS
General
P.M. - Dynamic - E.M.
Electro-static
HEADPHONES
Double
Single
METERS
A-Ammeter V-Voltmeter
G-Galvanometer
MA-Milliammeter
μA-Microammeter
LAMPS
Filament
Neon
MICROPHONES
General & Single Button
Double Button
Capacitor
Dynamic
Crystal
AC VOLTAGE SOURCES
FUSE
THERMAL CIRCUIT BREAKER
Reset Button
SWITCHES
SPST
SPDT
DPST
DPDT
Multi-Contact
JACKS
PLUGS
Line
Inter-lock
Telephone
Phono
ANTENNAS
GROUNDS
WIRING
Wires Connected
Wires Crossing
SHIELDS
Shielded Wire
Shielded Pair
Shielded Assembly
Common Ground
Wire Shielded Between Two Points
Ω OHM
K 1000
MEG 1000 000
MFD Microfarad
MMF Micromicrofarad
H Henry
MH Millihenry
uH Microhenry

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A DIVISION OF PRECISION APPARATUS CO., INC. 70-31 84th STREET, GLENDALE 27, L. I., N. Y.

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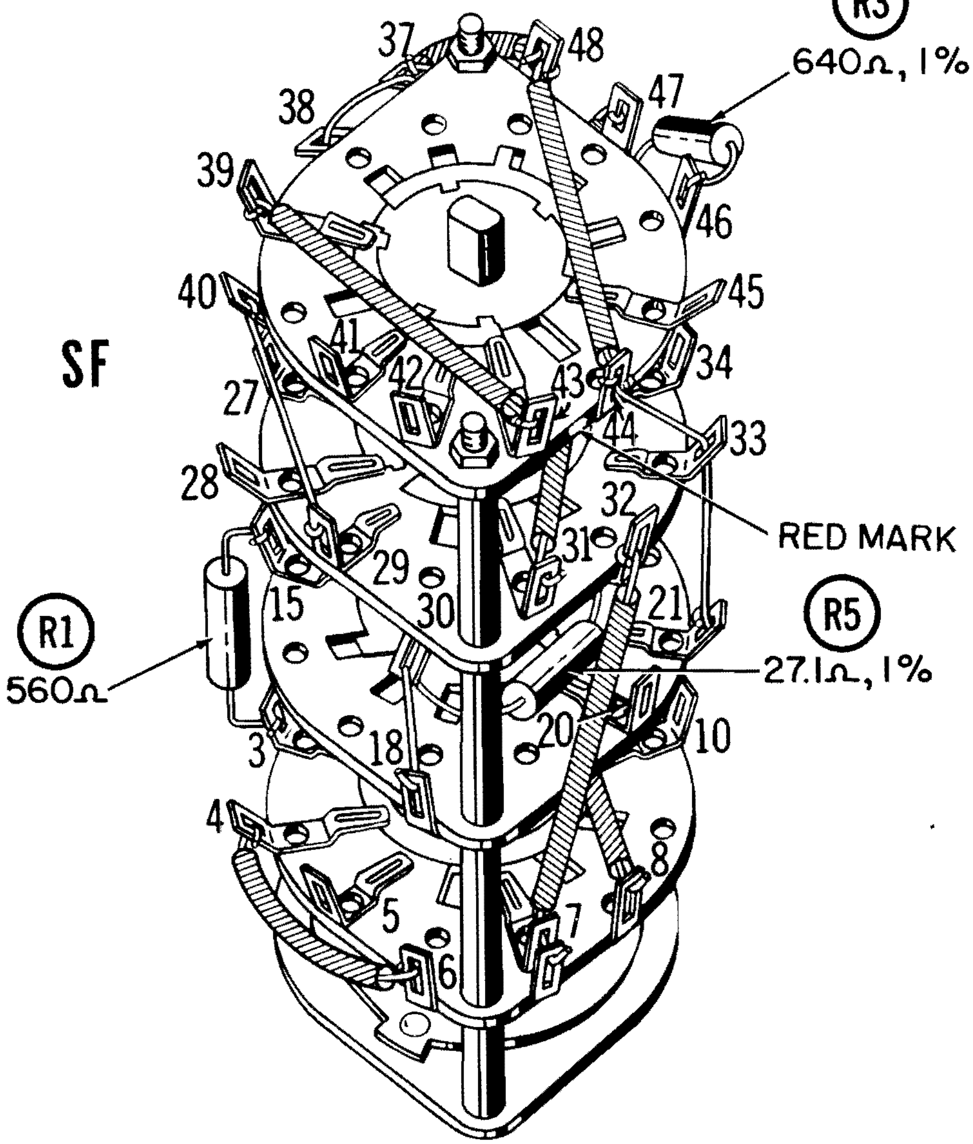
FIGUR

SF



FIGU

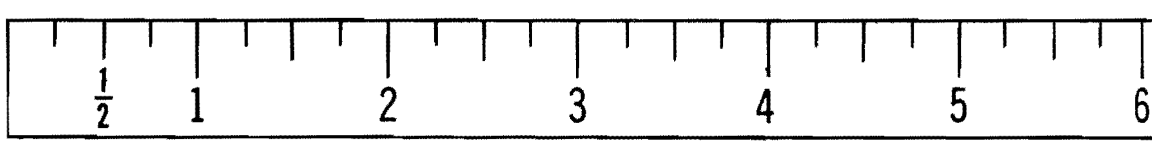
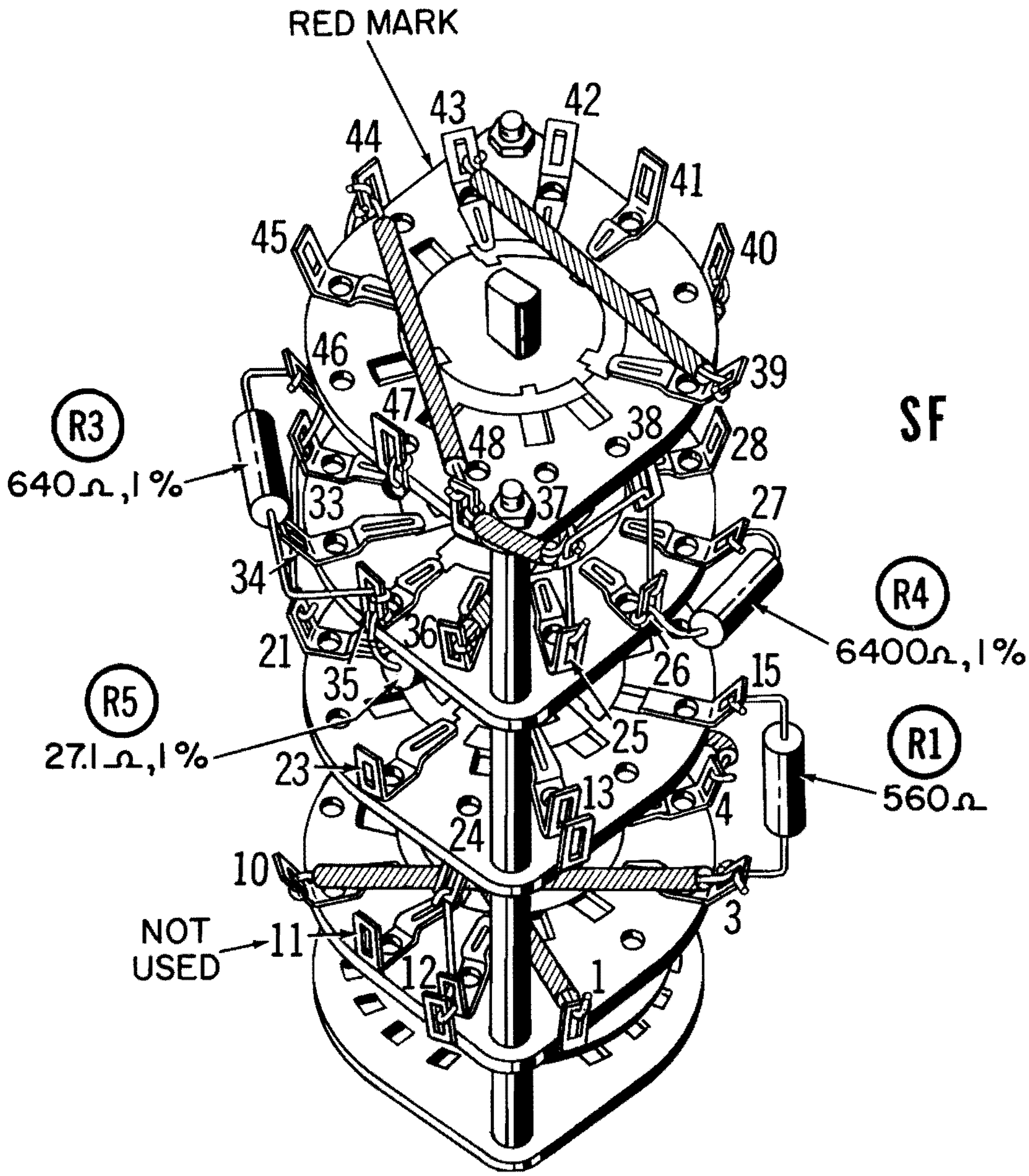
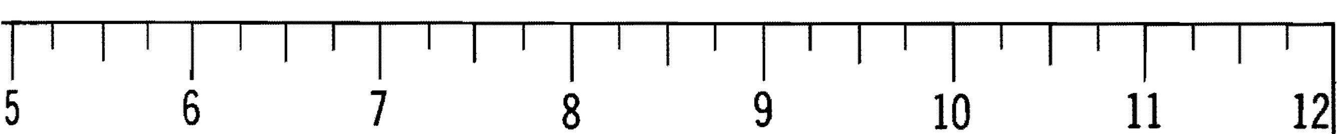


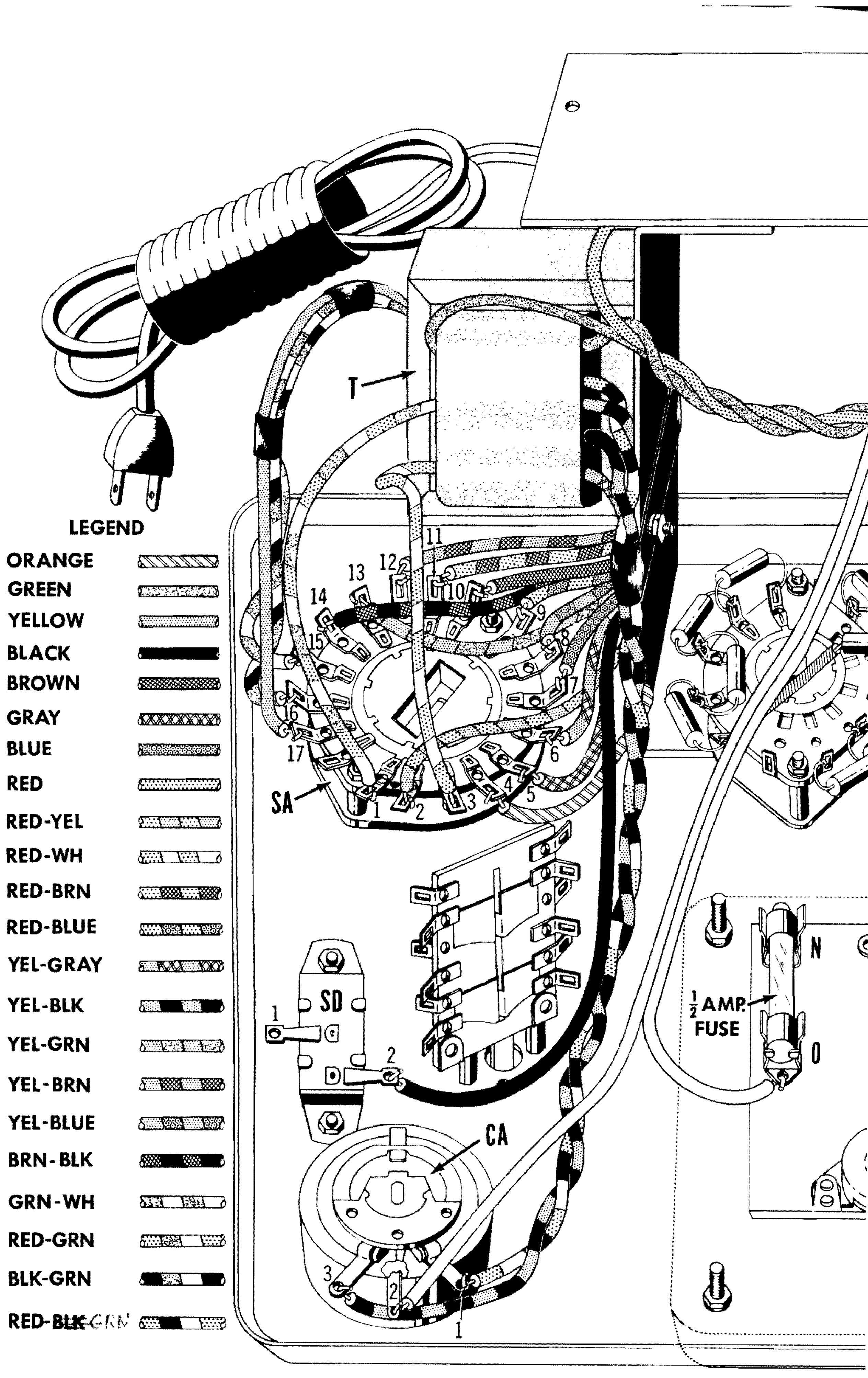
FIGURE 12



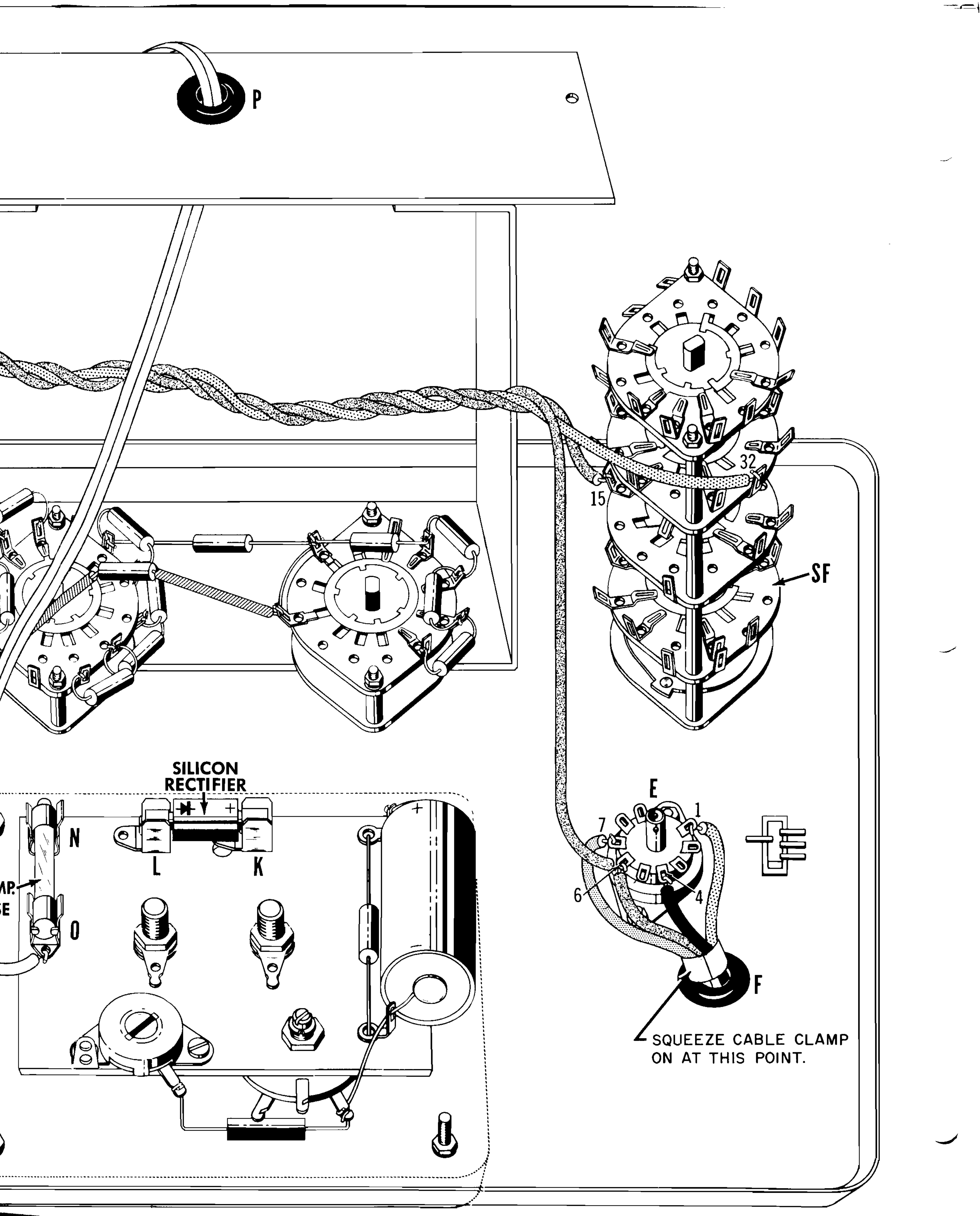
SF

FIGURE 1

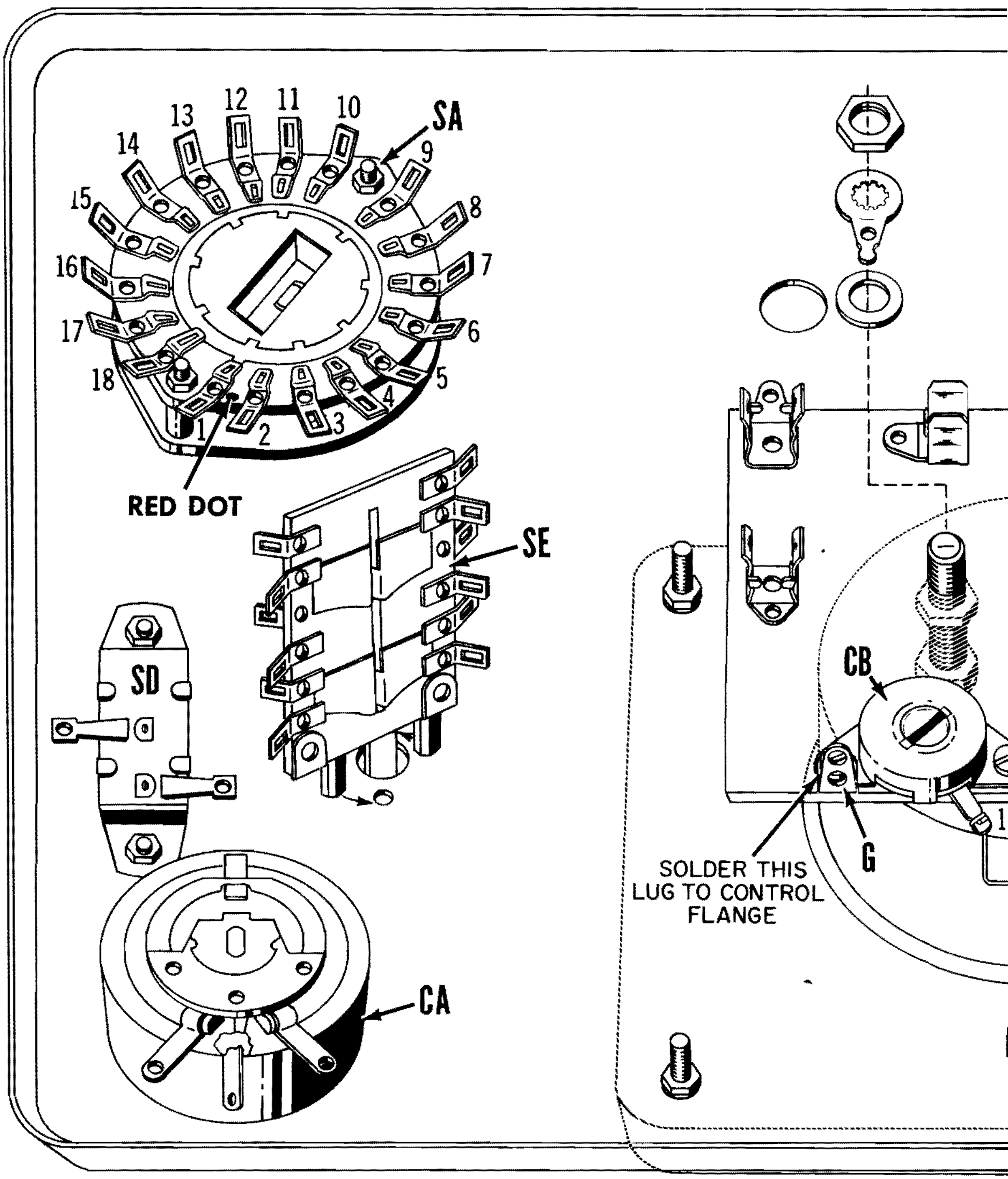




sistor Tester Model T-65
low-up No. 2



P
15
32
SF
SILICON
RECTIFIER
N
L
K
O
E
7
1
6
4
F
SQUEEZE CABLE CLAMP
ON AT THIS POINT.


SA
14
13
12
11
10
9
15
8
16
7
17
6
18
5
1
2
3
4
RED DOT
SE
SD
CA
CB
G
SOLDER THIS
LUG TO CONTROL
FLANGE

FI

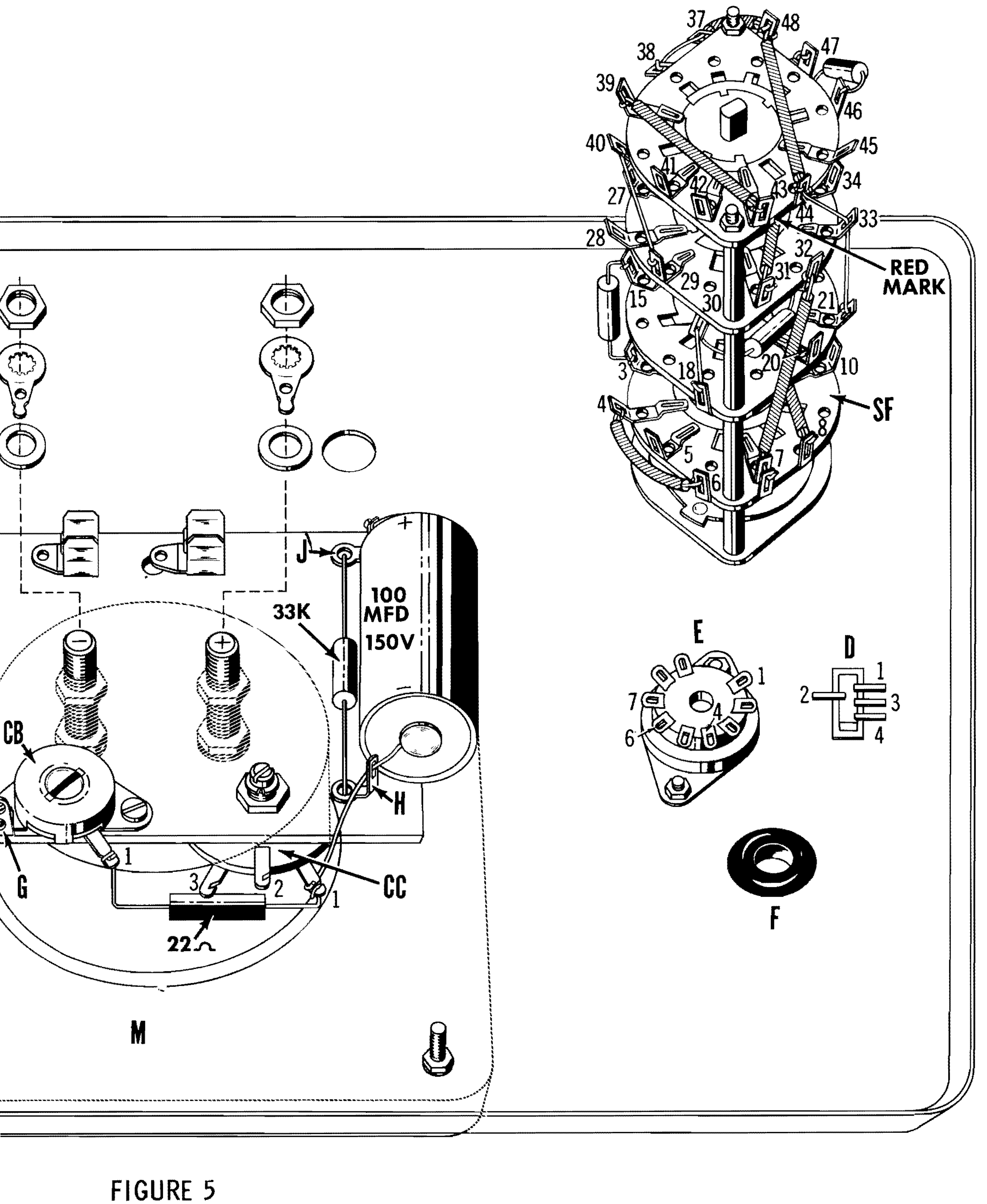

37
48
38
47
39
46
40
45
41
42
43
34
27
44
33
28
32
RED MARK
31
29
15
30
21
20
3
18
10
SF
4
8
5
7
6
J
100 MFD 150V
33K
E
D
1
2
3
7
4
6
4
CB
H
G
1
3
2
CC
1
22
F
M

FIGURE 5

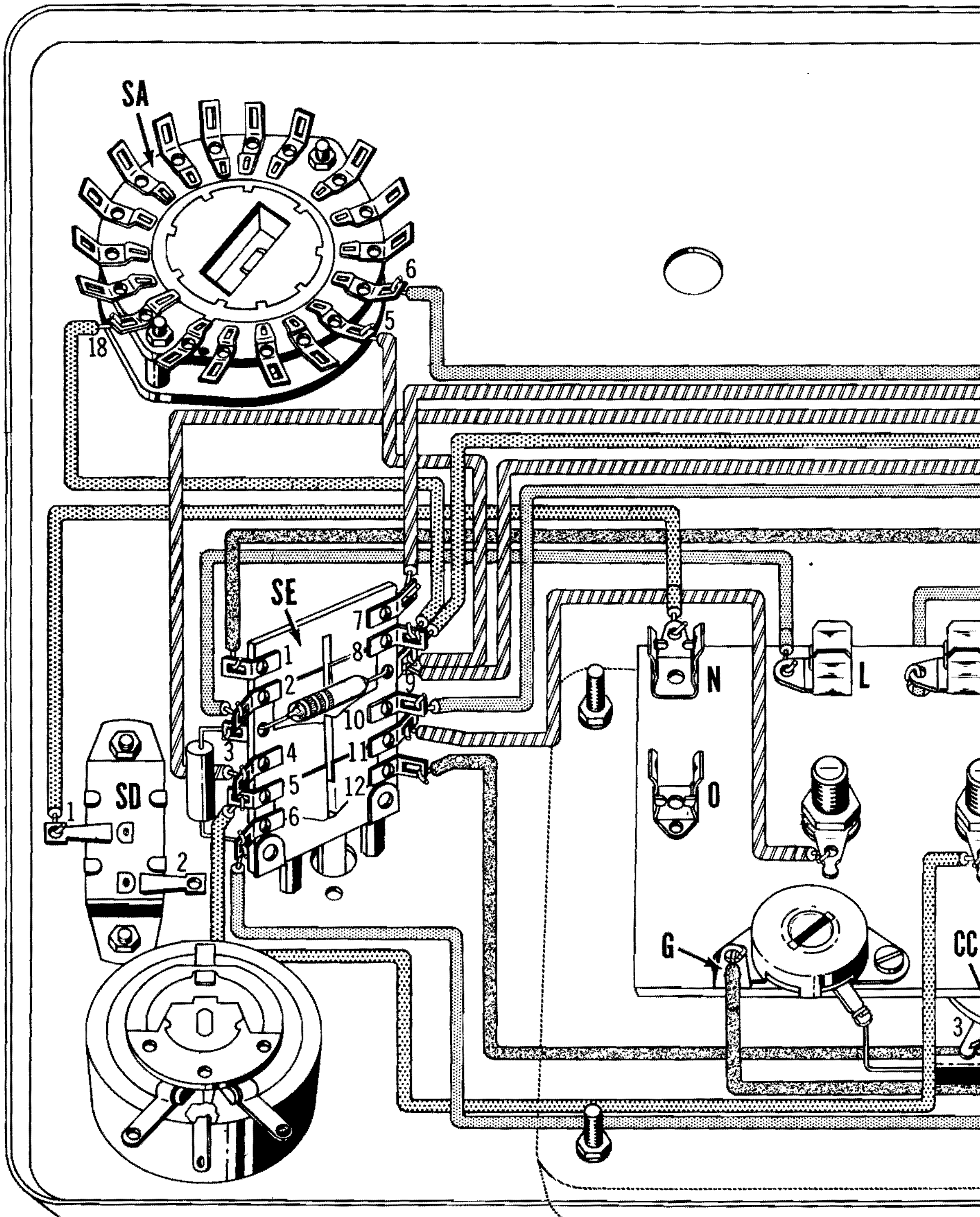
LEGEND

YELLOW — GREEN —

ORANGE — RED —

BLACK —

"KEEP THE HORIZONTAL RUN OF WIRES TOGETHER AND CLOSE TO THE FROSTED PLASTIC METER BARREL".



F

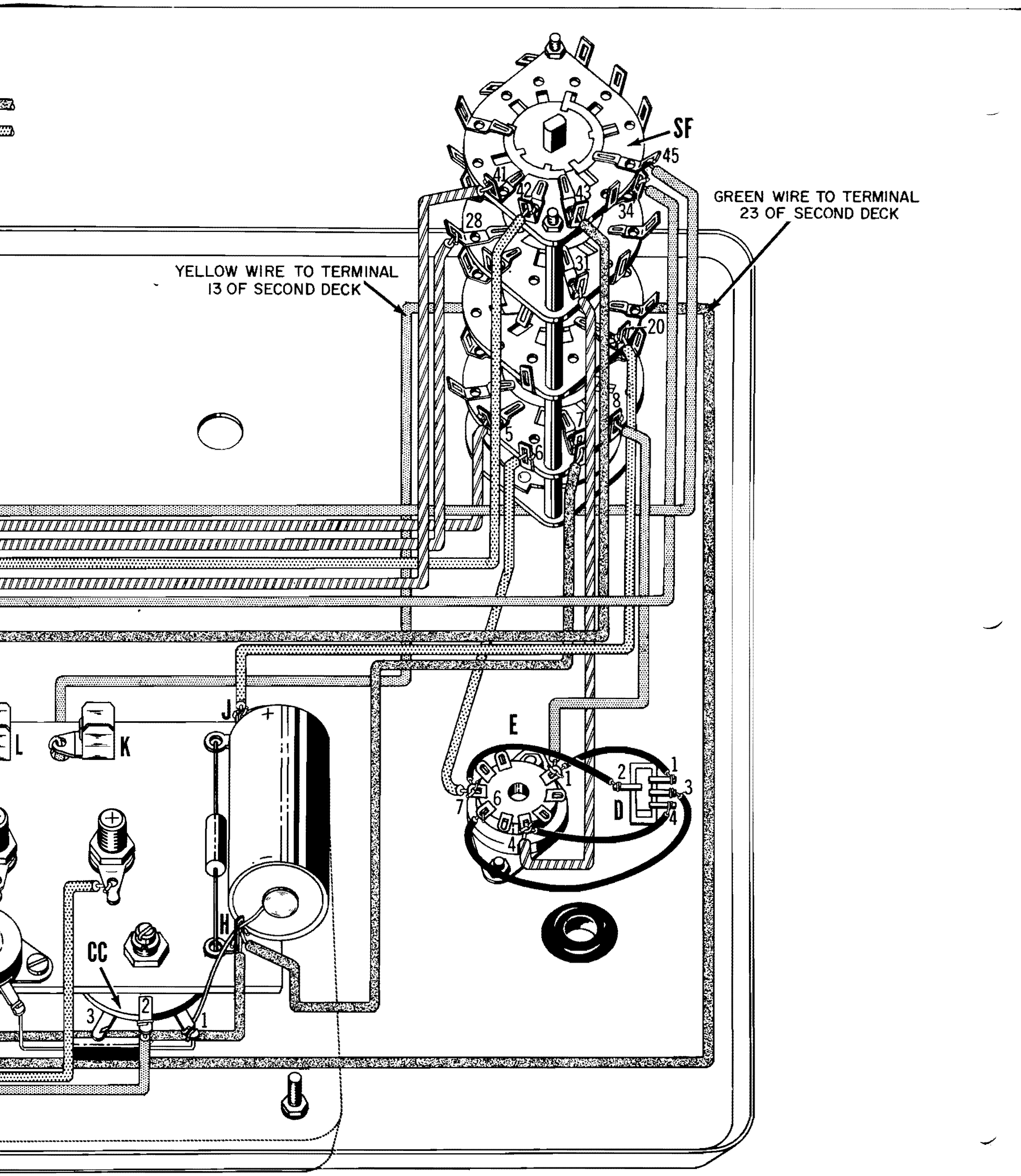

SF
45
41
42
43
28
34
3
GREEN WIRE TO TERMINAL
23 OF SECOND DECK
YELLOW WIRE TO TERMINAL
13 OF SECOND DECK
20
8
7
5
6
J
L
K
E
1
2
3
4
6
7
D
H
CC

FIGURE 10