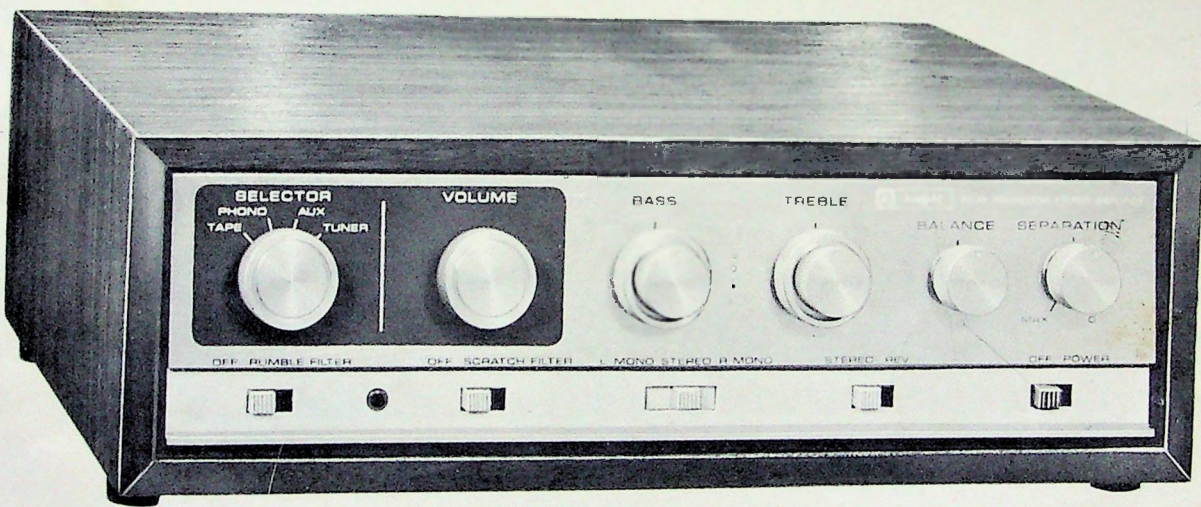


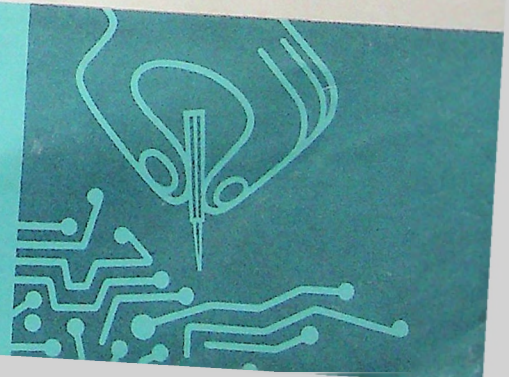
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KX-60 50-WATT TRANSISTOR STEREO AMPLIFIER 83 YU 994

ASSEMBLY MANUAL

*knight-kit*®





***knight-kit***<sup>®</sup>

**KX-60 50-WATT  
TRANSISTOR STEREO  
AMPLIFIER**

The KX-60 Transistor Stereo Amplifier is designed to provide you with years of listening pleasure. The amplifier supplies 50 watts of superb music power with all the advantages of transistors . . . compact size, cool, low cost operation, extreme durability, and instant playing without warmup. Twenty transistors and four diodes are used in this unique circuit, providing exceptional frequency response . . . even at full rated output, over the entire audio range. Because of true direct coupling to the speakers (no output transformers or DC blocking capacitors are used) the frequency response is extremely wide and flat.

The controls are grouped to provide every wanted stereo control plus convenience of operation. Designed to accommodate any equipment you may add to your home music system, the KX-60 has five pairs of inputs and a pair of outputs for use with a tape recorder. Two handsome cabinets are available, either in metal or hand-rubbed oiled walnut.



## HOW TO SOLDER

WITHOUT GOOD SOLDERING, AN ELECTRONIC UNIT WILL NOT WORK . . . just as a suit of clothing will fall apart if the stitches are loose . . . no matter how excellent the material.

### USE ENOUGH HEAT

This is the main idea of good soldering. The purpose of soldering is to join metal parts, making an UNBROKEN metal path over which electricity can travel. To do this you must apply enough heat to the metal surfaces to make the solder spread freely on them, until the contour (shape) of the connection shows under the solder. If the solder barely melts and forms a rounded ball, *you are not using enough heat*. If you do not use enough heat, there may be no electrical connection, although it appears soldered.

### HERE'S HOW TO DO IT . . .

1. Join bare metal to bare metal. Insulation must be removed.
2. Coat the tip of a hot iron with solder.
3. **FIRMLY PRESS THE FLAT SIDE OF THE TIP OF A HOT IRON FLAT** against the parts to be soldered together. Keep it there while you apply the solder **BETWEEN THE IRON TIP AND THE METAL TO BE SOLDERED**. Use only enough solder for it to flow over **ALL** the surfaces of the connection. Remove the iron.
4. **DO NOT MOVE PARTS UNTIL THE SOLDER HARDENS**. If you accidentally move the wires as the solder is hardening, apply your iron and reheat.

Compare your soldering with the pictures on this page. You have a good connection if your solder has flowed over all surfaces to be connected, following the shape of the surfaces. It should appear smooth and bright.

**YOU HAVE NOT USED ENOUGH HEAT:** If your connection is rough and flaky-looking, or if the solder has formed a round ball instead of spreading.

The difference between good soldering (enough heat) and poor soldering (not enough heat,) is just a few extra seconds with a hot iron **FIRMLY** applied. Remember, larger metal surfaces take a longer time to heat.

### THE SOLDERING IRON

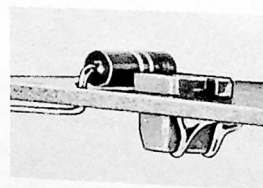
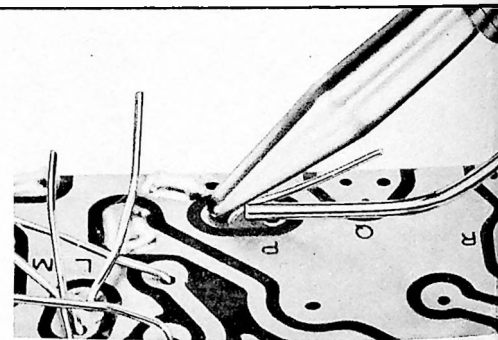
A soldering iron in the 40-100 watt range is recommended. Any iron in the above range with a clean, chisel-shaped tip will supply the correct amount of heat to make a good solder connection, you may also use a solder gun. If you use a soldering gun, be sure the tip reaches full heat before you solder. Notice how the iron is held in the picture. Heat the iron for ten minutes before you start soldering. Keep the tip brightly coated with solder. When necessary, wipe the hot tip clean with a cloth.

### USE ONLY ROSIN CORE SOLDER

We supply the right kind of solder (*rosin core solder*). Do not use any other kind of solder! **USE OF ACID CORE SOLDER, PASTE, OR IRONS CLEANED ON A SAL AMMONIAC BLOCK WILL RUIN ANY ELECTRONIC UNIT AND WILL VOID THE GUARANTEE.**

Press **FLAT** side  
of a **HOT** iron

Apply solder  
**BETWEEN**  
iron and connection



Compare your soldering with these pictures.

**THE ONE-TWO-THREE OF GOOD SOLDERING.**

## CONSTRUCTION HINTS

- Check the contents of your kit against the parts list at the back of the book. This will help you become acquainted with the parts. Parts can be identified by comparing them with the pictures in the wiring illustrations or the parts identification chart.
- Assort hardware by size when you check your parts. The thinnest screws are #4, the thickest are #8.

The only tools needed to build your 50-watt Transistor Stereo Amplifier are a soldering iron rated 40 to 125 watts, long nose pliers, diagonal cutters and a screwdriver.

Follow the step-by-step instructions exactly. Check the box for each step after you have completed it to make sure that you do not omit a step. Read the entire step through before starting because sometimes several parts are mounted with the same screw.

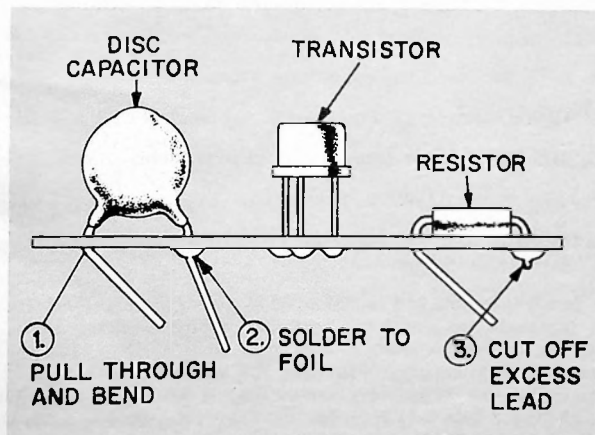


FIGURE 2. WIRING THE PC BOARD

## HOW TO CARE FOR YOUR SOLDERING IRON

Your soldering iron is the key to good soldering since it supplies the essential ingredient—HEAT. If the tip is covered by dirt (oxide) film, the iron will not be able to transfer its full heat.

A new tip can be protected from film by coating it with solder the first time it is heated. An old copper tip should be cleaned with a file until bare copper is exposed. Then solder-coat it like a new tip.

Never use the iron like a brush—soldering is not a paste-spreading operation. To get the most heat from the iron, always press the iron firmly to the connection. Hold it so the greatest tip surface is directly in contact with the connection.

## PRINTED CIRCUIT BOARDS

There are 2 printed circuit boards supplied with the kit to shorten the construction time. Notice that each board has one side with labels and outlines to show where the parts mount. This is the parts side of the board. The other side is the foil or shiny side, etched to form the desired wiring pattern. All soldering is done on the foil side.

SEE FIGURE 2.

To mount parts on a circuit board, insert the leads in the mounting holes and pull through until the part is next to the board. Bend the leads or terminals on the foil side of the board to hold the parts in place. Resistors are easier to mount if their leads are bent down close to the body. Be sure to select resistors by their number on the resistor cards. Many are precision, film-type resistors and must not be interchanged with carbon resistors of the same value.

## PARTS MOUNTING ON THE PRINTED CIRCUIT BOARDS

### SEE FIGURE 3.

The two PC boards are identical. Select either of the boards and mount the following parts.

- 100  $\mu\text{f}$ /15 volt electrolytic. The positive end (marked with a +) must be positioned as shown.
- R-16, 100K resistor (brown, black, yellow).
- R-15, 10K resistor (brown, black, orange).
- 10  $\mu\text{f}$ /15 volt electrolytic. Position the end marked with a + as shown.
- 10  $\mu\text{f}$ /15 volt electrolytic. Position the end marked with a + as shown.
- 50  $\mu\text{f}$ /10 volt electrolytic. Position the end marked with a + as shown.
- R-18, 20K resistor (red, black, orange).
- .01  $\mu\text{f}$  disc capacitor.
- R-21, 7.5K resistor (violet, green, red).
- R-20, 4.7K resistor (yellow, violet, red).
- .05  $\mu\text{f}$  disc capacitor.
- .02  $\mu\text{f}$  disc capacitor.
- R-17, 2.2K resistor (red, red, red).
- R-19, 470  $\Omega$  resistor (yellow, violet, brown).
- 50  $\mu\text{f}$ /10 volt electrolytic. Position the end marked with a + as shown.
- R-32, 330  $\Omega$  resistor (orange, orange, brown).
- R-30, 4.7K resistor (yellow, violet, red).
- R-29, 100K resistor (brown, black, yellow).

NOTE: The resistors may be color coded or have their value stamped on them.

- R-31, 6.8K film type resistor (blue, gray, red).

NOTE: The capacitors may be marked MF or  $\mu\text{f}$  for microfarad and MMF or  $\mu\mu\text{f}$  for micromicrofarad.

- .2  $\mu\text{f}$  disc capacitor.
- R-38, 330K resistor (orange, orange, yellow).
- R-37, 2.2 meg resistor (red, red, green).

- Turn the board over and solder each lead to the foil. Do not let the solder run across the board from one foil path to another.
- Cut off the excess lead lengths close to the board.
- Turn the board over and mount the following parts.
- R-39, 680K resistor (blue, gray, yellow).
- R-40, 4.7K resistor (yellow, violet, red).
- 10  $\mu\text{f}$ /15 volt electrolytic. Position the end marked with a + as shown.
- R-56, 10K resistor (brown, black, orange).
- R-90, 10K resistor (brown, black, orange).
- R-89, 680K resistor (blue, gray, yellow).
- 10  $\mu\text{f}$ /15 volt electrolytic. Position the end marked with a + as shown.
- R-57, 100K resistor (brown, black, yellow).
- 1.0  $\mu\text{f}$  disc capacitor.
- 1.0  $\mu\text{f}$  disc capacitor.
- R-54, 10K resistor (brown, black, orange).
- R-93, 100K resistor (brown, black, yellow).
- R-94, 18K, 5% resistor (brown, gray, orange, gold).
- 2  $\mu\text{f}$ /3 volt electrolytic. Position the end marked with a + as shown.
- .005  $\mu\text{f}$  disc capacitor.
- R-64, 330  $\Omega$  resistor (orange, orange, brown).
- 10  $\mu\text{f}$ /15 volt electrolytic. Position the end marked with a + as shown.
- R-62, 24K, 5% resistor (red, yellow, orange, gold).
- R-60, 4.7K resistor (yellow, violet, red).
- Turn the board over and solder each lead to the foil. Cut off the excess lead lengths close to the board.

NOTE: The transistors will be damaged if they are mounted incorrectly. Be sure the leads are positioned correctly before soldering them. When soldering the transistor leads a heat sink must be used. Simply clamp the heat sink tool, supplied with this kit, on the lead being soldered. When mounting the transistors solder lead E into hole E, lead C into hole C and lead B into hole B on the PC board. See Figure 4 for identification of the transistor leads.

- Mount the following transistors by soldering the leads where shown. Position the transistors as shown in Figure 2.

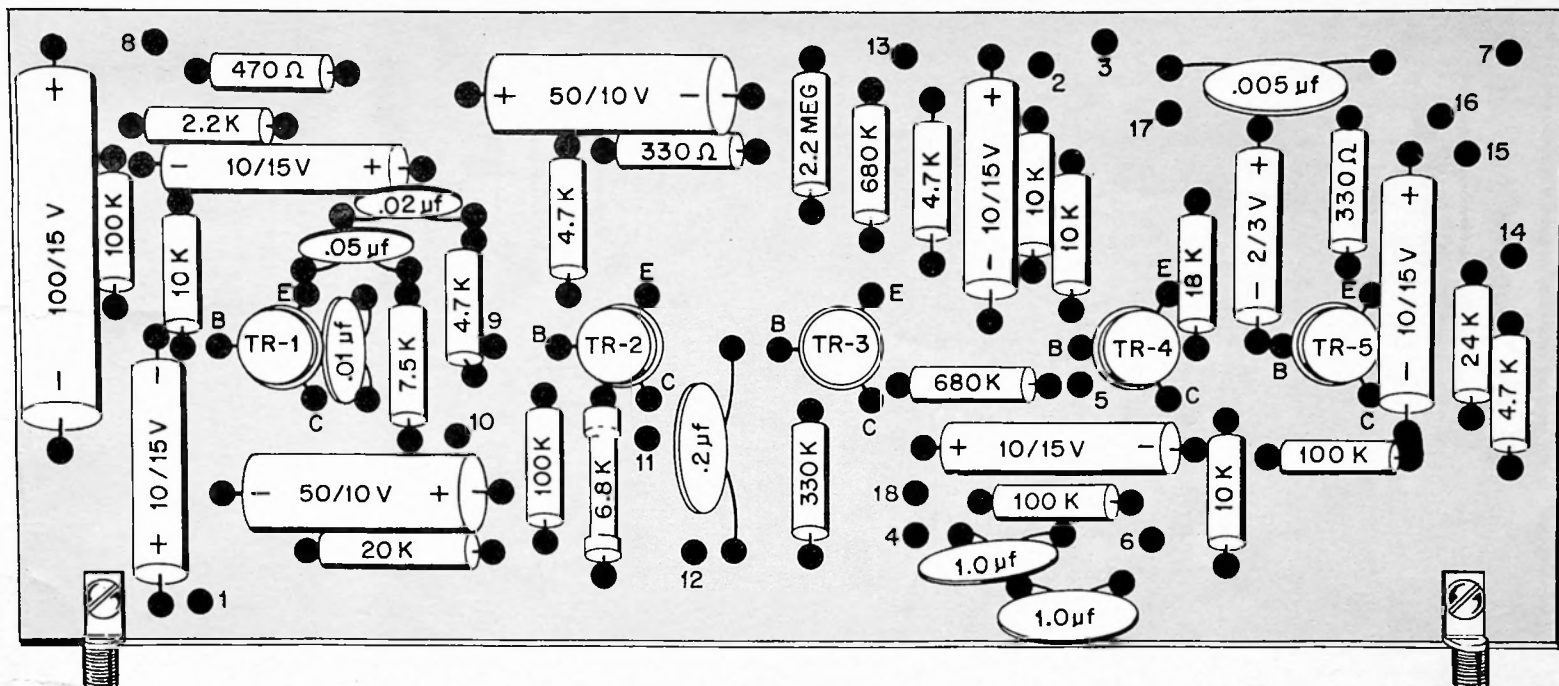
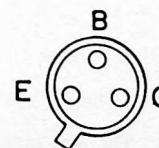


FIGURE 3. PARTS MOUNTING ON THE PC BOARD

- TR-1, part #660028.
- TR-2, part #660029.
- TR-3, part #660029.
- TR-4, part #660028.
- TR-5, part #660029.
- Two spade bolts. Mount each to the board with a 6-32 x 3/8" screw, lockwasher and nut.
- Set the board aside it will be mounted later.



LOCATING TAB

E = EMITTER  
 B = BASE  
 C = COLLECTOR

FIGURE 4. TRANSISTOR LEAD IDENTIFICATION

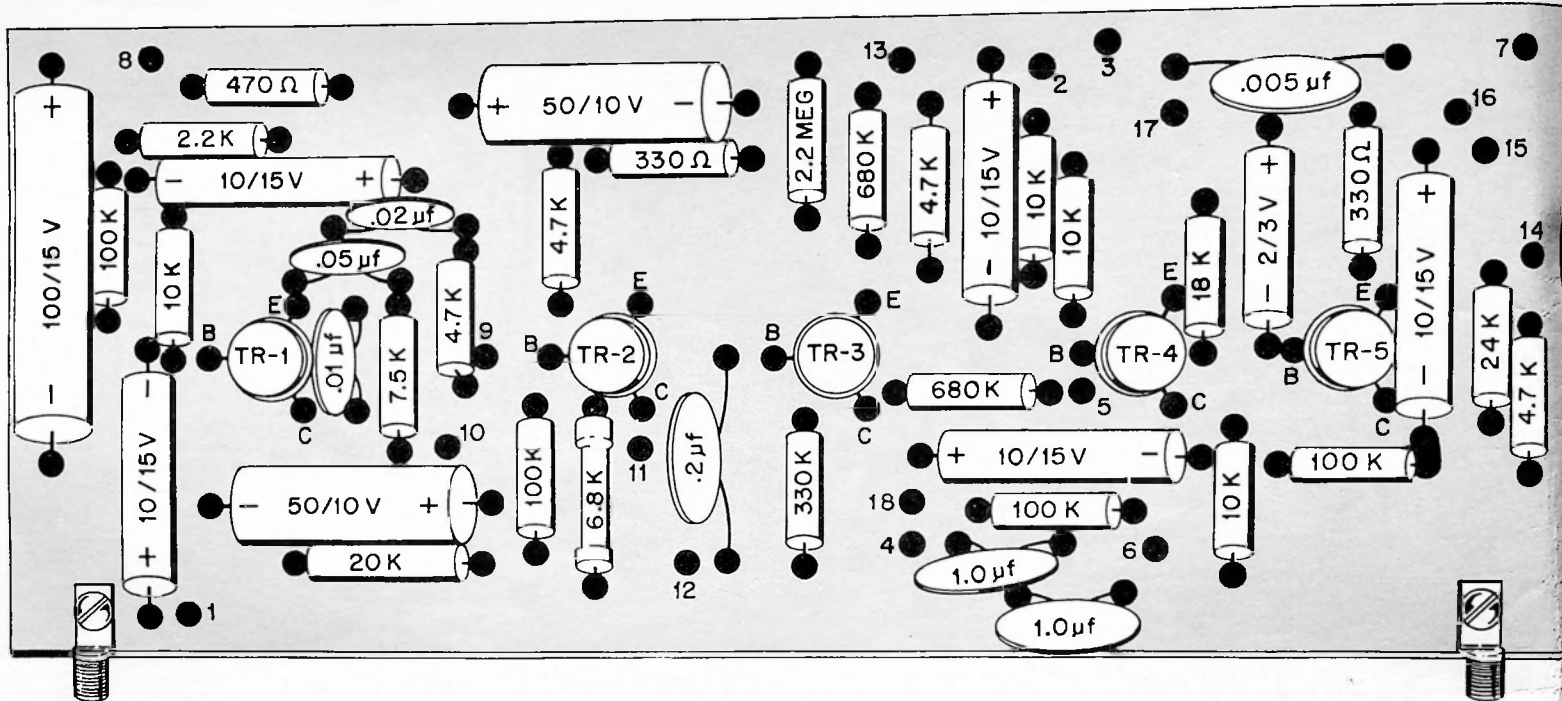


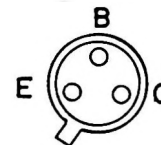
FIGURE 3. PARTS MOUNTING ON THE PC BOARD

SEE FIGURE 3.

- Mount the following parts on the other PC board.
- 100  $\mu$ f/15 volt electrolytic. The end marked with a + must be positioned as shown.
- R-22, 100K resistor (brown, black, yellow).
- R-23, 10K resistor (brown, black, orange).
- 10  $\mu$ f/15 volt electrolytic. Position the end marked with a + as shown.
- 10  $\mu$ f/15 volt electrolytic. Position the end marked with a + as shown.
- 50  $\mu$ f/10 volt electrolytic. Position the end marked with a + as shown.
- R-25, 20K resistor (red, black, orange).
- .01  $\mu$ f disc capacitor.
- R-28, 7.5K resistor (violet, green, red).
- R-27, 4.7K resistor (yellow, violet, red).

- .05  $\mu\text{f}$  disc capacitor.
- .02  $\mu\text{f}$  disc capacitor.
- R-24, 2.2K resistor (red, red, red).
- R-26, 470  $\Omega$  resistor (yellow, violet, brown).
- 50  $\mu\text{f}/10$  volt electrolytic. Position the end marked with a + as shown.
- R-36, 330  $\Omega$  resistor (orange, orange, brown).
- R-34, 4.7K resistor (yellow, violet, red).
- R-33, 100K resistor (brown, black, yellow).
- R-35, 6.8K film type resistor (blue, gray, red).
- .2  $\mu\text{f}$  disc capacitor.
- R-42, 330K resistor (orange, orange, yellow).
- R-41, 2.2 meg resistor (red, red, green).
- Turn the board over and solder each lead to the foil. Cut off the excess lead lengths close to the board.
- Turn the board over and mount the following parts.
- R-43, 680K resistor (blue, gray, yellow).
- R-44, 4.7K resistor (yellow, violet, red).
- 10  $\mu\text{f}/15$  volt electrolytic. Position the end marked with a + as shown.
- R-59, 10K resistor (brown, black, orange).
- R-92, 10K resistor (brown, black, orange).
- R-91, 680K resistor (blue, gray, yellow).
- 10  $\mu\text{f}/15$  volt electrolytic. Position the end marked with a + as shown.
- R-58, 100K resistor (brown, black, yellow).
- 1.0  $\mu\text{f}$  disc capacitor.
- 1.0  $\mu\text{f}$  disc capacitor.
- R-55, 10K resistor (brown, black, orange).
- R-95, 100K resistor (brown, black, yellow).
- R-96, 18K, 5% resistor (brown, gray, orange, gold).
- 2  $\mu\text{f}/3$  volt electrolytic. Position the end marked with a + as shown.
- .005  $\mu\text{f}$  disc capacitor.
- R-65, 330  $\Omega$  resistor (orange, orange, brown).
- 10  $\mu\text{f}/15$  volt electrolytic. Position the end marked with a + as shown.

- R-63, 24K, 5% resistor (red, yellow, orange, gold).
- R-61, 4.7K resistor (yellow, violet, red).
- Turn the board over and solder each lead to the foil. Cut off the excess lead lengths close to the board.



LOCATING TAB

E = EMITTER  
 B = BASE  
 C = COLLECTOR

FIGURE 4. TRANSISTOR LEAD IDENTIFICATION

**NOTE:** The transistors will be damaged if they are mounted incorrectly. Be sure the leads are positioned correctly before soldering them. When soldering the transistor leads a heat sink must be used. Simply clamp the heat sink tool, supplied with this kit, on the lead being soldered. When mounting the transistors solder lead E into hole E, lead C into hole C and lead B into hole B on the PC board. See Figure 4 for identification of the transistor leads.

- Mount the following transistors as done on the other board.
- TR-1, part #660028.
- TR-2, part #660029.
- TR-3, part #660029.
- TR-4, part #660028.
- TR-5, part #660029.
- Two spade bolts. Mount each to the board with a 6-32 X  $\frac{3}{8}$ " screw, lockwasher and nut.
- Set the board aside, it will be mounted later.



## PARTS MOUNTING ON THE CHASSIS

SEE FIGURE 5.

NOTE: The transistor sockets are stamped with an E and a B to designate the emitter and base terminals. When mounting the sockets position the stamped ends EXACTLY as shown. If they are positioned incorrectly the transistors will be damaged.

- Six transistor sockets for TR-10 through TR-15. Position the stamped ends exactly as shown and mount each with two 6-32 x  $\frac{3}{8}$ " filister head screws, lockwashers and nuts.
- TS-1 and TS-2, two 2-screw strips. Mount from outside the chassis using two 6-32 x  $\frac{3}{8}$ " screws, lockwashers and nuts for each.
- TS-3, TS-4, and TS-5, three jack strips. Mount each with an insulator and four 4-40 x  $\frac{3}{8}$ " screws, lockwashers and nuts as shown in Figure 6. Mount TS-14, a 4-terminal strip with one of the mounting screws of TS-4.

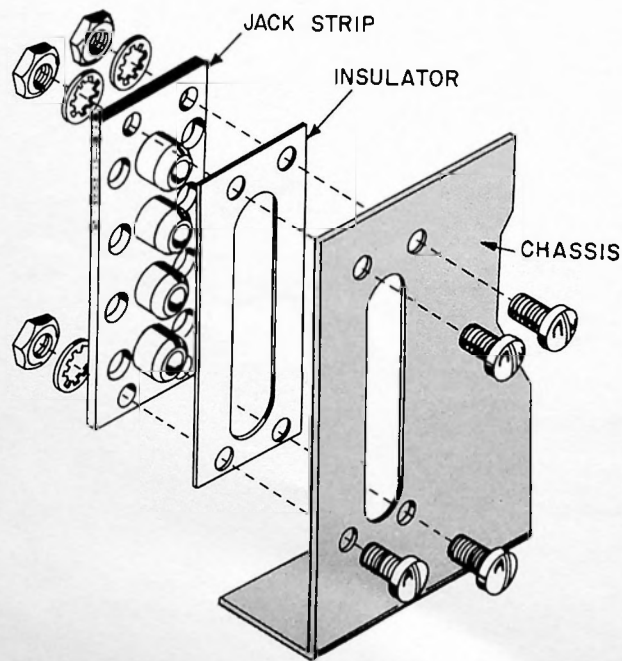


FIGURE 6. JACK STRIP MOUNTING

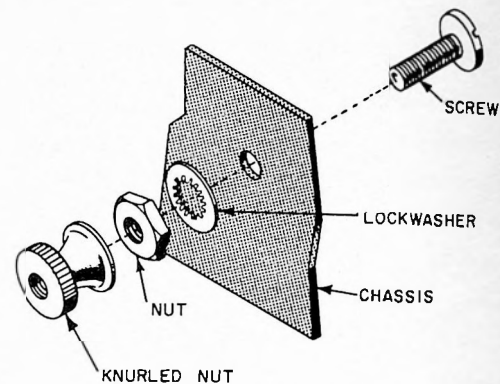


FIGURE 7. GROUND POST MOUNTING

- Ground post, an 8-32 x  $\frac{1}{2}$ " screw, lockwasher, nut and knurled nut. Assemble as shown in Figure 7.
- Fuse holder. Position with the terminals as shown. Mount as shown in Figure 8.
- J-1 and J-2, two AC receptacles. Mount each with two 6-32 x  $\frac{3}{8}$ " screws, lockwashers and nuts.
- Position the following terminal strips as shown. Mount each with a 6-32 x  $\frac{3}{8}$ " screw, lockwasher and nut.
  - TS-7, a 3-terminal strip, See Figure 38.
  - TS-8 and TS-9, two 2-terminal strips.

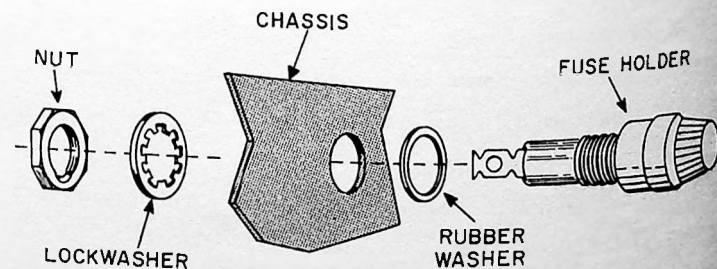


FIGURE 8. FUSE HOLDER MOUNTING

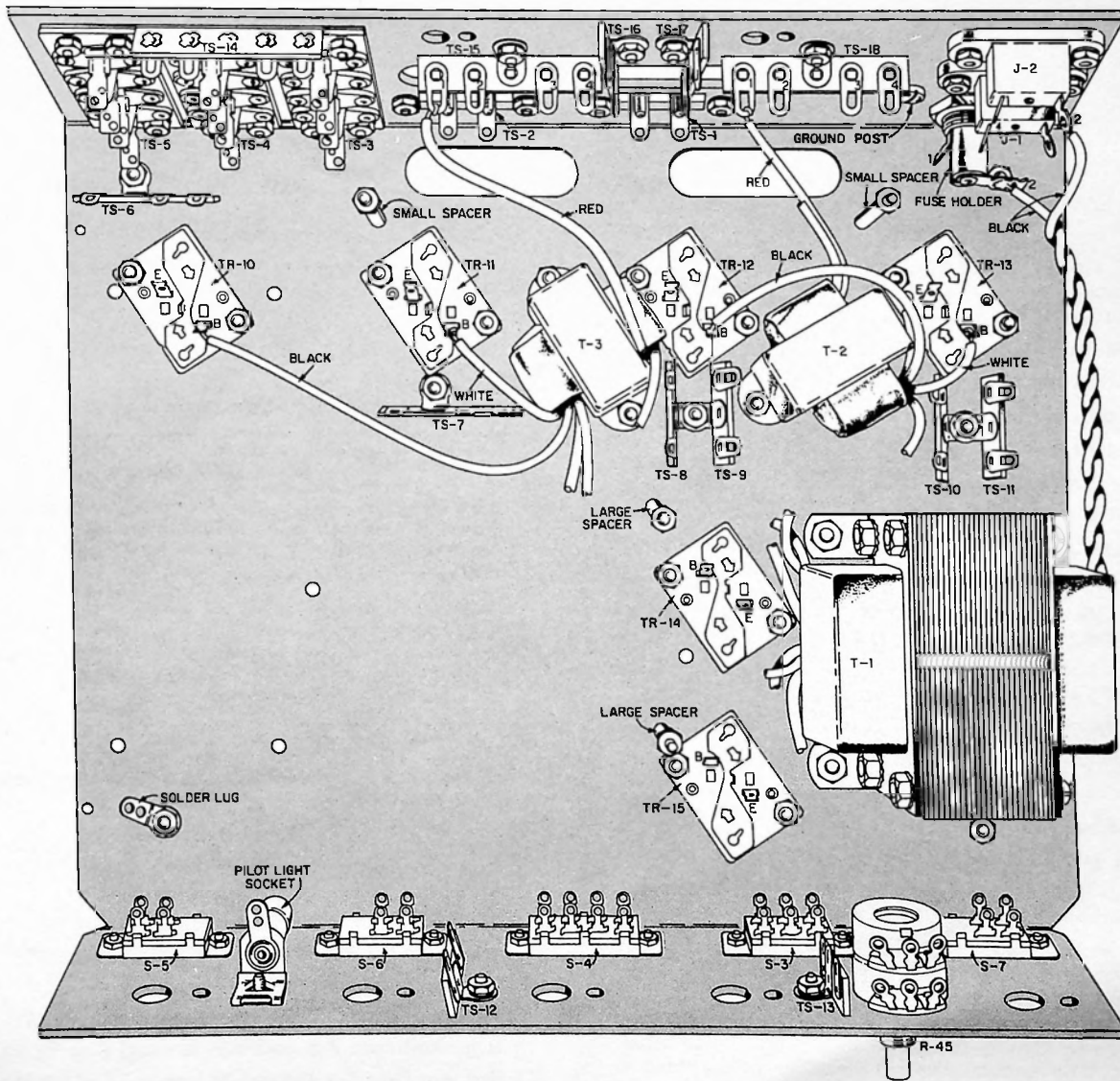


FIGURE 5. PARTS MOUNTING ON THE CHASSIS

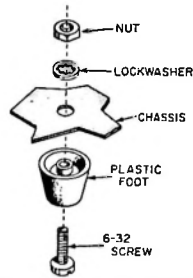


FIGURE 10. FOOT MOUNTING

- TS-10 and TS-11, two 2-terminal strips.
- TS-12, 2-terminal strip.
- TS-13, 3-terminal strip, See Figure 38.
- TS-15, 4-terminal strip.
- TS-16, 2-terminal strip.
- TS-17, 2-terminal strip.
- TS-18, 4-terminal strip.
- Two small spacers. Mount each with a 4-40 x 1 3/8" screw and nut.
- Two large spacers. Mount each with a 4-40 x 2" screw, and nut.
- S-4, 8-terminal slide switch. Mount from inside the chassis with two 4-40 x 3/8" flathead screws, and nuts.
- The following switches are mounted from inside the chassis. Mount each with two 4-40 x 3/8" screws, and nuts.
  - S-7, 4-terminal slide with red button.
  - S-3, 6-terminal slide.
  - S-6, 4-terminal slide.
  - S-5, 4-terminal slide.
- Pilot light socket, pilot light and a large clip nut. Assemble as shown in Figure 9.
- Mount the pilot light socket to the chassis with a 6-32 x 3/8" screw.
- R-45, 50K dual control (part #420041). Mount by inserting the locating tab in the locating hole in the chassis. Fasten with a 3/8" lockwasher and nut.
- Four plastic feet, TS-6, a 3-terminal strip and a solder lug. Mount each foot as shown in Figures 10 and 34 with a 6-32 x 1/2" screw, lockwasher and nut. The terminal strip and the solder lug are mounted with the same hardware used to mount two of the feet. See Figure 5 for the location of TS-6 and the solder lug.

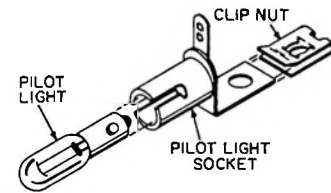


FIGURE 9. PILOT LIGHT ASSEMBLY

NOTE: The two driver transformers T-2 and T-3 are identical.

- T-3, driver transformer. Position with the leads as shown and mount with two 6-32 x 3/8" screws, lockwashers and nuts.
- T-2, driver transformer. Position with the leads as shown and mount with two 6-32 x 3/8" screws, lockwashers and nuts.
- T-1, power transformer. Position with the leads as shown and mount with four 6-32 x 3/8" screws, lockwashers and nuts.

#### IMPORTANT INSTRUCTIONS

THE INSTRUCTION CONNECT MEANS: Connect the wire or lead to the given point. Make a firm mechanical connection, BUT DO NOT SOLDER AT THIS TIME. Later another wire(s) will be connected to this point.

THE INSTRUCTION SOLDER MEANS: Connect the wire or lead to the given point and then solder the connection and all wires in it. If there is more than one wire in the connection, the number will be stated—for example (2 wires). After soldering a connection trim all wires as close as possible to the terminal.

- Two black leads from T-1. Twist the two wires together. Solder one of the leads to terminal 2 of the fuse holder. Connect the other lead to terminal 2 of J-2.
  - The other leads of T-1 will be connected later.
- NOTE: The transformer leads may be shortened for neater connections.
- White lead from T-2. Connect to terminal B of TR-13.
  - Black lead from T-2. Solder to terminal B of TR-12.
  - Red lead from T-2. Connect to terminal 1 of TS-18.
  - The other leads of T-2 will be connected later.
  - White lead from T-3. Connect to terminal B of TR-11.
  - Black lead from T-3. Solder to terminal B of TR-10.
  - Red lead from T-3. Connect to terminal 1 of TS-15.
  - The other leads from T-3 will be connected later.

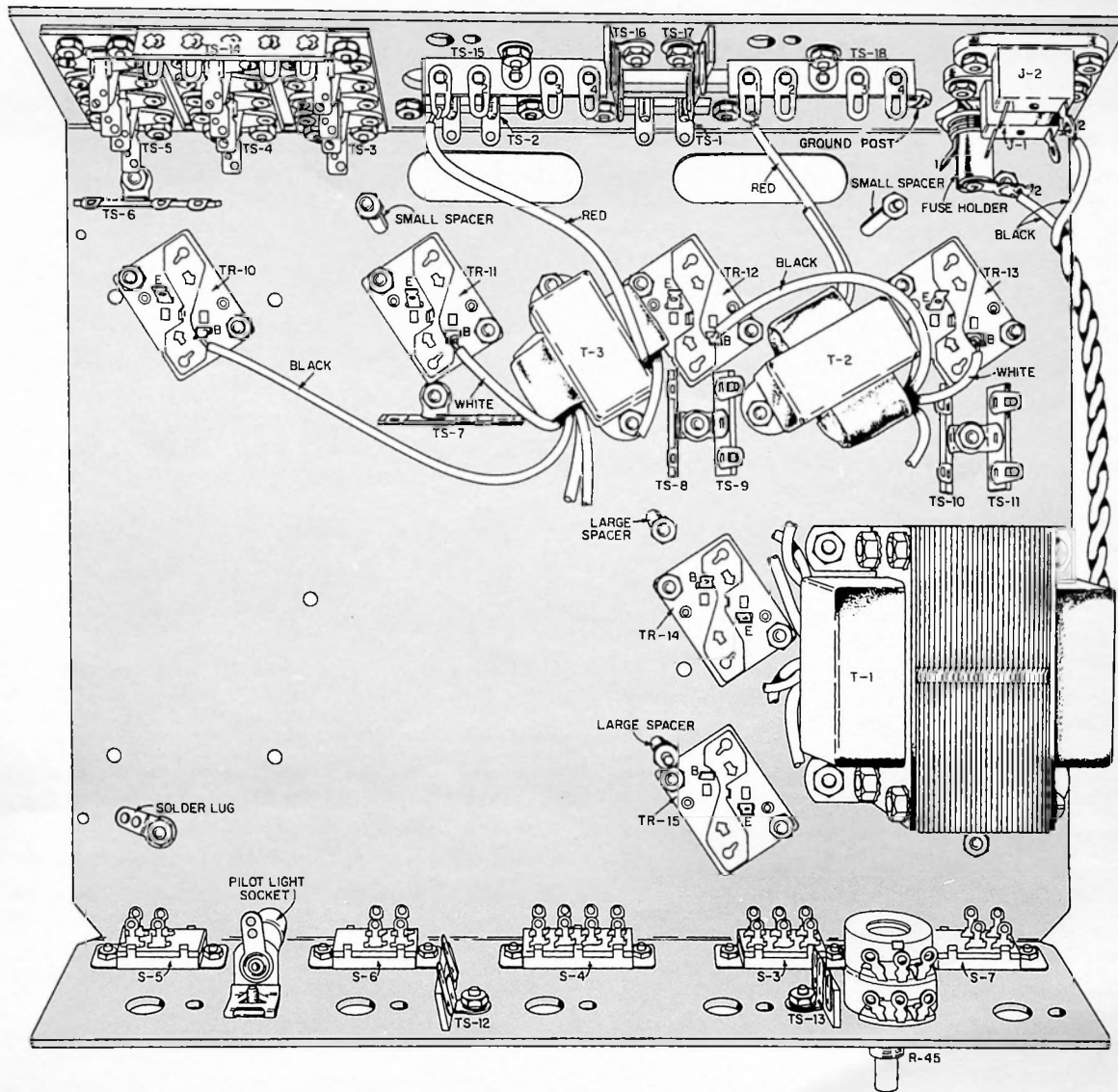


FIGURE 5. PARTS MOUNTING ON THE CHASSIS

## FIRST WIRING ON THE CHASSIS

SEE FIGURES 11 and 12.

R-45, has been omitted from this view for clarity.

NOTE: There are two sizes of bare wire and tubing used in this kit. Be sure to use the size called for in the step.

- Cut a 2½" piece of the large bare wire. Lay the wire across terminals 2 of TS-3, TS-4 and TS-5. Solder the wire to each of these terminals.
- Cut a 2½" piece of the large bare wire. Lay the wire across terminals 5 of TS-3, TS-4 and TS-5. Solder the wire to each of these terminals.
- Cut a 1½" piece of the large bare wire. Solder one end to terminal 2 of TS-5. Solder the other end to terminal 5 of TS-6.
- Red wire. Solder one end to terminal 5 of TS-5. Connect the other end to terminal 1 of TS-6.
- R-1, 100K resistor (brown, black, yellow). Connect one lead to terminal 1 of TS-5. Solder the other lead to the bare wire.
- R-8, 100K resistor (brown, black, yellow). Connect one lead to terminal 3 of TS-5. Solder the other lead to the bare wire.
- R-2, 47K resistor (yellow, violet, orange). Connect one lead to terminal 4 of TS-5. Solder the other lead to the bare wire.
- R-9, 47K resistor (yellow, violet, orange). Connect one lead to terminal 6 of TS-5. Solder the other lead to the bare wire.
- R-12, 270K resistor (red, violet, yellow). Connect one lead to terminal 1 of TS-14. Solder the other lead to the bare wire.
- R-5, 270K resistor (red, violet, yellow). Connect one lead to terminal 2 of TS-14. Solder the other lead to the bare wire.
- R-14, 270K resistor (red, violet, yellow). Connect one lead to terminal 3 of TS-14. Solder the other lead to the bare wire.
- R-7, 270K resistor (red, violet, yellow). Connect one lead to terminal 4 of TS-14. Solder the other lead to the bare wire.
- R-10, 680K resistor (blue, gray, yellow). Connect one lead to terminal 6 of TS-5. Connect the other lead to terminal 3 of TS-6.
- C-1, 82 μμf disc capacitor. Solder one lead to terminal 4 of TS-4. Connect the other lead to terminal 2 of TS-6.
- C-2, 82 μμf disc capacitor. Solder one lead to terminal 6 of TS-4. Solder the other lead to terminal 3 of TS-6 (2 wires).
- R-12, 270K resistor (red, violet, yellow). Solder one lead to terminal 3 of TS-4. Connect the other lead to terminal 1 of TS-14.

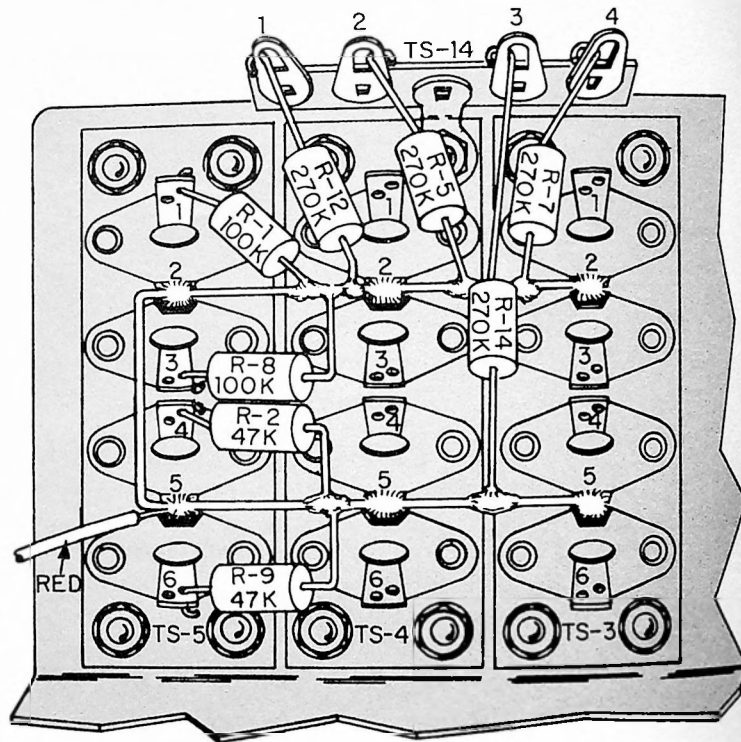


FIGURE 12. WIRING THE JACK STRIPS

- R-5, 270K resistor (red, violet, yellow). Solder one lead to terminal 1 of TS-4. Connect the other lead to terminal 2 of TS-14.
- R-14, 270K resistor (red, violet, yellow). Solder one lead to terminal 3 of TS-3. Connect the other lead to terminal 3 of TS-14.
- R-7, 270K resistor (red, violet, yellow). Solder one lead to terminal 1 of TS-3. Connect the other lead to terminal 4 of TS-14.
- Cut a 2½" piece of the large bare wire. Place a 2" piece of the large tubing over the wire. Solder one end to terminal 1 of TS-2. Connect the other end to terminal 2 of TS-16.
- Cut a 2½" piece of the large bare wire. Solder one end to terminal 2 of TS-2. Solder the other end to terminal 2 of TS-1.
- Cut a 1¾" piece of the large bare wire. Place a 1¼" piece of large tubing over the wire. Solder one end to terminal 1 of TS-1. Connect the other end to terminal 2 of TS-17.

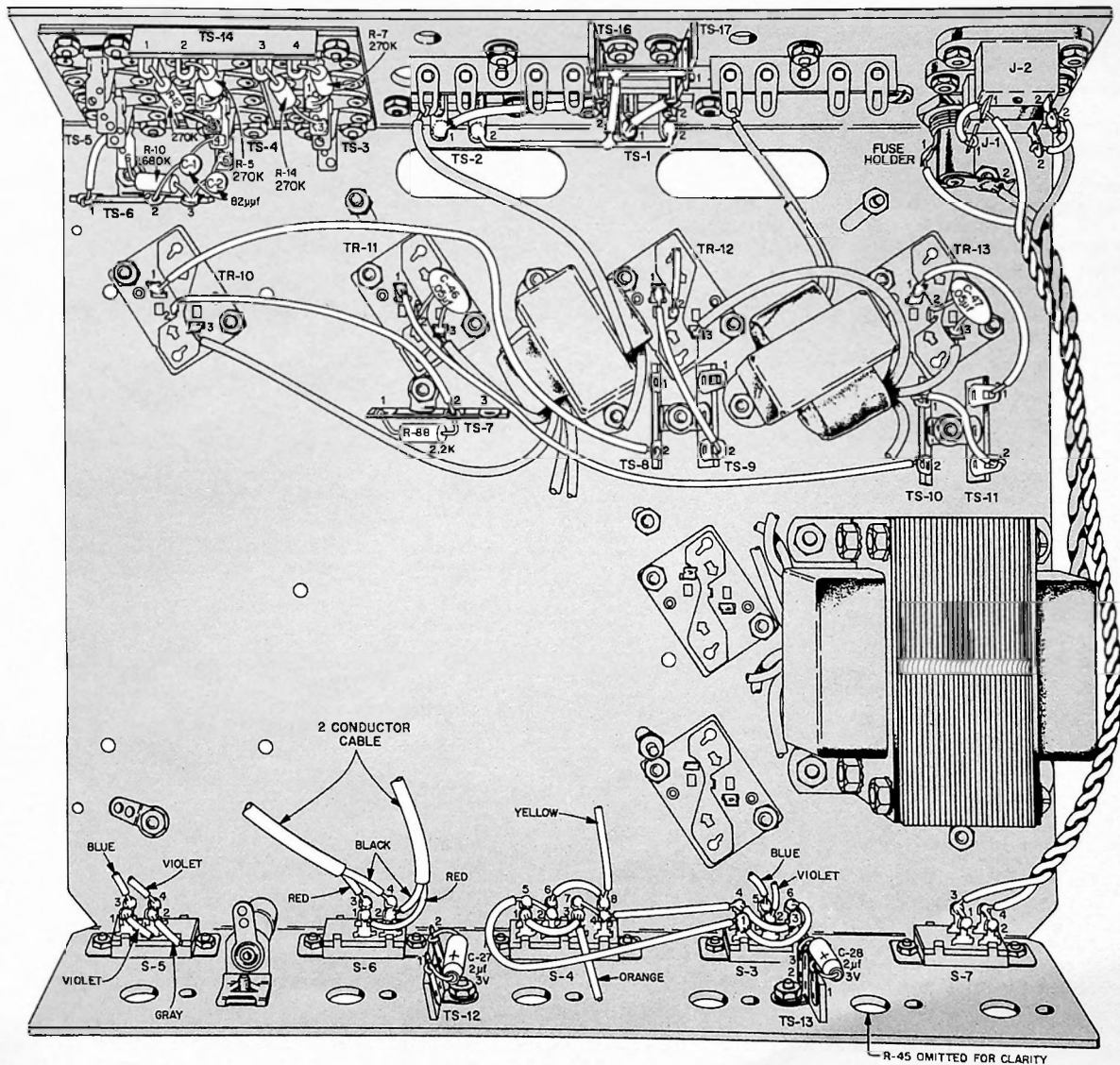


FIGURE 11. FIRST WIRING ON THE CHASSIS

- Cut a 1" piece of the large bare wire. Connect one end to terminal 1 of TS-16. Connect the other end to terminal 1 of TS-17.
- Cut a 2¼" piece of the large bare wire. Place a 1¾" piece of large tubing over the wire. Solder one end to the bare wire from TS-1 to TS-2. Solder the other end to the bare wire from TS-16 to TS-17.
- Red wire. Connect one end to terminal 1 of J-1. Connect the other end to terminal 1 of J-2.
- Red wire. Connect one end to terminal 2 of J-1. Solder the other end to terminal 2 of J-2 (2 wires).
- A white and a brown wire. Twist the two wires together. Solder one end of the brown wire to terminal 1 of the fuse holder. Solder one end of the white wire to terminal 1 of J-2 (2 wires). Insert the other end of the brown wire through terminals 1 and 3 of S-7. Solder these two terminals. Insert the other end of the white wire through terminals 2 and 4 of S-7. Solder these two terminals.
- C-28, 2 µf, 3 volt electrolytic capacitor. Connect the positive lead (the end marked with a +) to terminal 1 of TS-13. Connect the other lead to terminal 3 of TS-13.
- Red wire. Solder one end to terminal 6 of S-3. Connect the other end to terminal 1 of S-3.
- Red wire. Solder one end to terminal 3 of S-3. Connect the other end to terminal 4 of S-3.
- Blue wire. Solder one end to terminal 5 of S-3. The other end will be connected later.
- Violet wire. Solder one end to terminal 2 of S-3. The other end will be connected later.
- Red wire. Solder one end to terminal 4 of S-3 (2 wires). Connect the other end to terminal 4 of S-4.
- Orange wire. Solder one end to terminal 1 of S-3 (2 wires). Connect the other end to terminal 5 of S-4.
- Red wire. Solder one end to terminal 6 of S-4. Connect the other end to terminal 8 of S-4.
- Red wire. Solder one end to terminal 1 of S-4. Connect the other end to terminal 3 of S-4.
- Cut a ½" piece of the small bare wire. Solder one end to terminal 5 of S-4 (2 wires). Solder the other end to terminal 2 of S-4.
- Cut a ½" piece of the small bare wire. Solder one end to terminal 7 of S-4. Solder the other end to terminal 4 of S-4 (2 wires).
- Yellow wire. Solder one end to terminal 8 of S-4 (2 wires). The other end will be connected later.

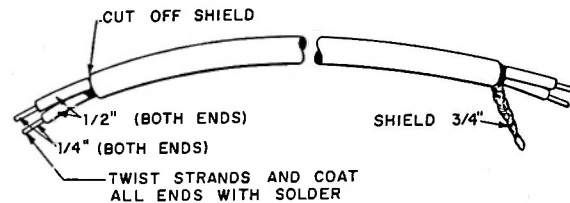


FIGURE 13. 2-CONDUCTOR CABLE

- Orange wire. Solder one end to terminal 3 of S-4 (2 wires). The other end will be connected later.
- C-27, 2 µf, 3 volt electrolytic capacitor. Connect the positive lead (the end marked with a +) to terminal 1 of TS-12. Connect the other lead to terminal 2 of TS-12.
- Prepare a 7½" and a 9" length of the 2-conductor cable as shown in Figure 13.
- 9" length of 2-conductor cable. Solder the red lead, of the end without the shield wire, to terminal 3 of S-6. Solder the black lead to terminal 4 of S-6. The other end of the cable will be connected later.
- 7½" length of 2-conductor cable. Solder the red lead, of the end without the shield wire, to terminal 1 of S-6. Solder the black lead to terminal 2 of S-6. The other end of the cable will be connected later.
- Blue wire. Solder one end to terminal 3 of S-5. The other end will be connected later.
- Violet wire. Solder one end to terminal 4 of S-5. The other end will be connected later.
- Violet wire. Solder one end to terminal 1 of S-5. The other end will be connected later.
- Gray wire. Solder one end to terminal 2 of S-5. The other end will be connected later.
- Violet wire. Solder one end to terminal 1 of TR-10. Connect the other end to terminal 2 of TS-8.
- Green wire. Solder one end to terminal 2 of TR-10. Connect the other end to terminal 2 of TS-7.
- R-88, 2.2K resistor (red, red, red). Connect one lead to terminal 1 of TS-7. Connect the other lead to terminal 2 of TS-7.
- C-46, .05 µf disc capacitor. Connect one lead to terminal 2 of TR-11. Solder the other lead to terminal 3 of TR-11 (2 wires).
- Violet wire. Solder one end to terminal 1 of TR-11. Connect the other end to terminal 2 of TS-10.

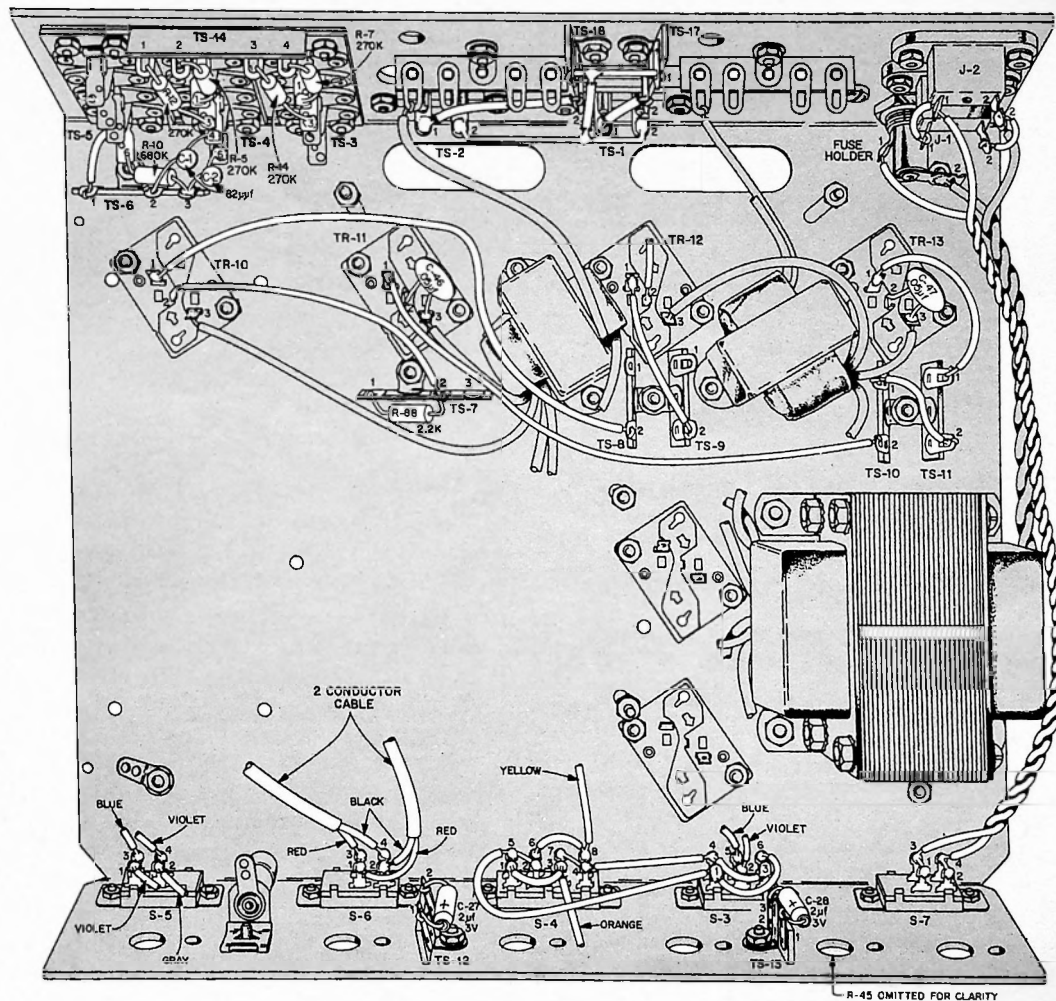


FIGURE 11. FIRST WIRING ON THE CHASSIS

- Orange wire. Solder one end to terminal 1 of TR-12. Connect the other end to terminal 2 of TS-9.
- Orange wire. Solder one end to terminal 2 of TR-12. The other end will be connected later.
- C-47, .05  $\mu$ f disc capacitor. Solder one end to terminal 3 of TR-13 (2

- wires). Connect the other end to terminal 2 of TR-13.
- Orange wire. Solder one end to terminal 1 of TR-13. Connect the other end to terminal 1 of TS-11.
- Red wire. Connect one end to terminal 1 of TS-10. Connect the other end to terminal 2 of TS-11.



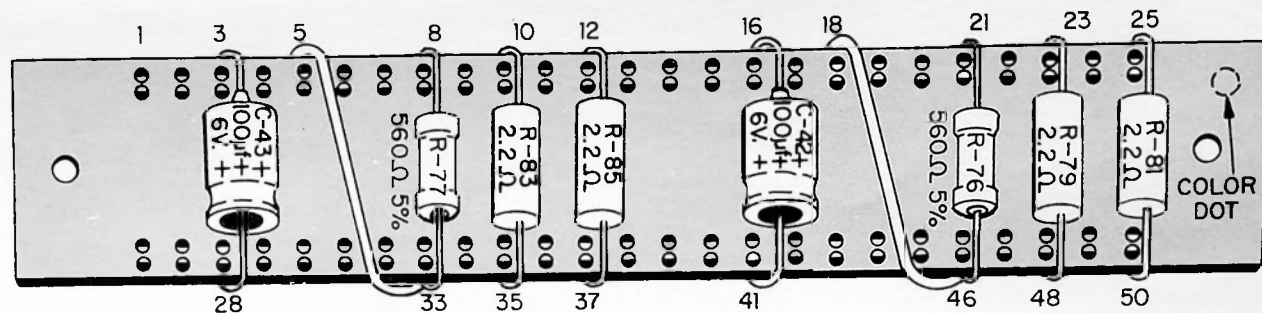


FIGURE 14. PREWIRING THE TERMINAL BOARD

## PREWIRING THE TERMINAL BOARD

### SEE FIGURE 14.

- Position TB-1, the 50-terminal board, with the color dot as shown. Mount the following parts on the back of the board.
- C-43, 100  $\mu$ f, 6 volt electrolytic. Solder the positive lead (marked with a +) to terminal 28. Solder the other lead to terminal 3.
- Red wire. Connect one end to terminal 5. Connect the other end to terminal 33.
- R-77, 560 $\Omega$ , 5% film type resistor (green, blue, brown, gold). Connect one lead to terminal 8. Connect the other lead to terminal 33.
- R-83, 2.2  $\Omega$ , 5% resistor (red, red, gold, gold). Solder one lead to terminal 35. Connect the other lead to terminal 10.
- R-85, 2.2  $\Omega$ , 5% resistor (red, red, gold, gold). Connect one lead to terminal 12. Connect the other lead to terminal 37.
- C-42, 100  $\mu$ f, 6 volt electrolytic. Connect the positive lead (marked with a +) to terminal 41. Solder the other lead to terminal 16.
- Red wire. Connect one end to terminal 18. Connect the other end to terminal 46.
- R-76, 560  $\Omega$ , 5% film type resistor (green, blue, brown, gold). Connect one lead to terminal 46. Connect the other lead to terminal 21.
- R-79, 2.2  $\Omega$ , 5% resistor (red, red, gold, gold). Solder one lead to terminal 48. Connect the other lead to terminal 23.
- R-81, 2.2  $\Omega$ , 5% resistor (red, red, gold, gold). Connect one lead to terminal 50. Connect the other lead to terminal 25.

### SEE FIGURE 15.

- Position TB-1 with the color dot as shown.
- R-66, 20K, 5% film type resistor (red, black, orange, gold). Solder one lead to terminal 1. Connect the other lead to terminal 26.
- Red wire. Solder one end to terminal 27. Connect the other end to terminal 30.
- Cut a 1 $\frac{1}{4}$ " piece of the large bare wire. Solder one end to terminal 4. Connect the other end to terminal 29.
- R-71, 20  $\Omega$ , 5% resistor (red, black, black, gold). Solder one lead to terminal 5. (2 wires). Connect the other lead to terminal 30.
- TR-7, part #660029. Connect the leads as follows. See Figure 16 for identification of the transistor leads.
  - Solder lead E to terminal 6.
  - Place a 1 $\frac{1}{4}$ " piece of small tubing over lead B. Connect to terminal 26.
  - Solder lead C to terminal 31.
- C-44, .01  $\mu$ f disc capacitor. Solder one lead to terminal 33 (3 wires). Connect the other lead to terminal 8.
- Red wire. Solder one end to terminal 8 (3 wires). Connect the other end to terminal 10.
- R-78, 470  $\Omega$ , 1 watt resistor (yellow, violet, brown). Connect one lead to terminal 34. Connect the other lead to terminal 9.
- R-80, 470  $\Omega$ , 1 watt resistor (yellow, violet, brown). Solder one lead to terminal 36. Connect the other lead to terminal 11.

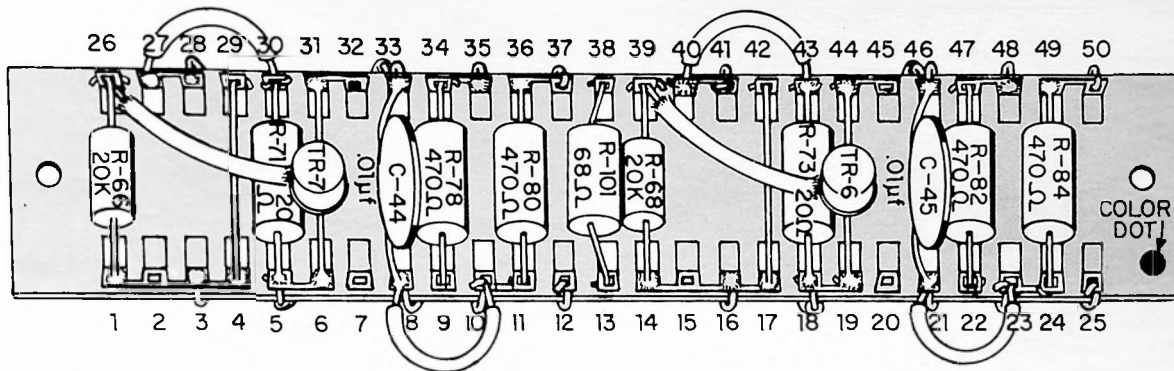
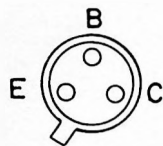


FIGURE 15. PREWIRING THE TERMINAL BOARD



LOCATING TAB

E = EMITTER  
B = BASE  
C = COLLECTOR

FIGURE 16. TRANSISTOR LEAD IDENTIFICATION

- R-101, 68  $\Omega$ , 1 watt resistor (blue, gray, black). Connect one lead to terminal 38. Connect the other lead to terminal 13.
- R-68, 20K, 5% film type resistor (red, black, orange, gold). Solder one lead to terminal 14. Connect the other lead to terminal 39.
- Red wire. Solder one end to terminal 40. Connect the other end to terminal 43.
- Cut a  $1\frac{1}{4}$ " piece of the large bare wire. Solder one end to terminal 17. Connect the other end to terminal 42.
- R-73, 20  $\Omega$ , 5% resistor (red, black, black, gold). Solder one lead to terminal 43 (2 wires). Solder the other lead to terminal 18 (2 wires).
- TR-6, part #660029. Connect the leads as follows. See Figure 16 for identification of the transistor leads.
  - Solder lead E to terminal 19.
  - Place a  $1\frac{1}{4}$ " piece of small tubing over lead B. Connect to terminal 39.
  - Solder lead C to terminal 44.
- C-45, .01  $\mu$ f disc capacitor. Solder one lead to terminal 46 (3 wires). Connect the other lead to terminal 21.
- Red wire. Solder one end to terminal 21 (3 wires). Connect the other lead to terminal 23.
- R-82, 470  $\Omega$ , 1 watt resistor (yellow, violet, brown). Connect one lead to terminal 47. Connect the other lead to terminal 22.
- R-84, 470  $\Omega$ , 1 watt resistor (yellow, violet, brown). Connect one lead to terminal 24. Solder the other lead to terminal 49.
- Set the board aside; it will be mounted later.

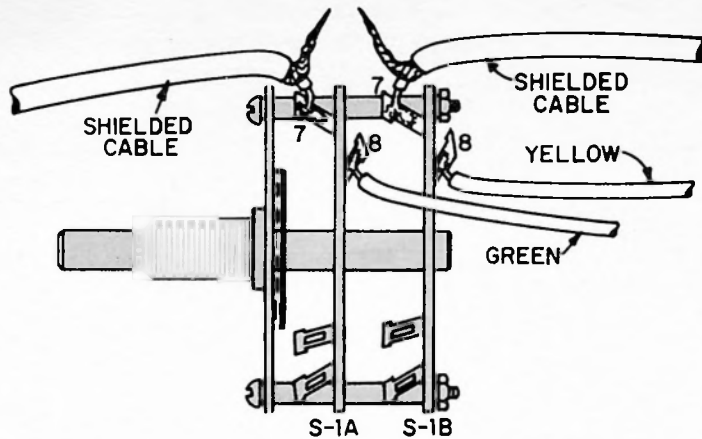


FIGURE 17. PREWIRING THE SELECTOR SWITCH

## PREWIRING THE SELECTOR SWITCH

SEE FIGURE 17.

- Position S-1, the selector switch, as shown.

**NOTE:** The other ends of the wires connected to the switch will be connected later.

- Green wire. Solder one end to terminal 8 of S-1A.
- Yellow wire. Solder one end to terminal 8 of S-1B.
- Prepare a 4" and a 6" length of shielded cable as shown in Figure 18. Connect the two wires as follows:
  - 4" length of cable. Solder the inner conductor, of the end with the shield wire to terminal 7 of S-1B. The shield wire will be connected later.
  - 6" length of cable. Solder the inner conductor of the end with shield wire to terminal 7 of S-1A. The shield wire will be connected later.

## SECOND WIRING ON THE SWITCH

SEE FIGURE 19.

- Position the switch as shown.

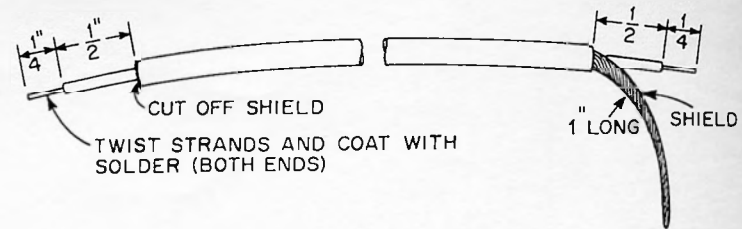


FIGURE 18. CABLE PREPARATION

- Green wire. Solder one end to terminal 3 of S-1A.
- Green wire. Solder one end to terminal 4 of S-1A.
- Brown wire. Solder one end to terminal 5 of S-1A.
- White wire. Solder one end to terminal 6 of S-1A.
- Cut a 1/2" piece of the small bare wire. Solder one end to terminal 2 of S-1A. Solder the other end to terminal 2 of S-1B.
- Yellow wire. Solder one end to terminal 3 of S-1B.
- Yellow wire. Solder one end to terminal 4 of S-1B.
- Brown wire. Solder one end to terminal 5 of S-1B.
- White wire. Solder one end to terminal 6 of S-1B.
- Set the switch aside. It will be mounted later.

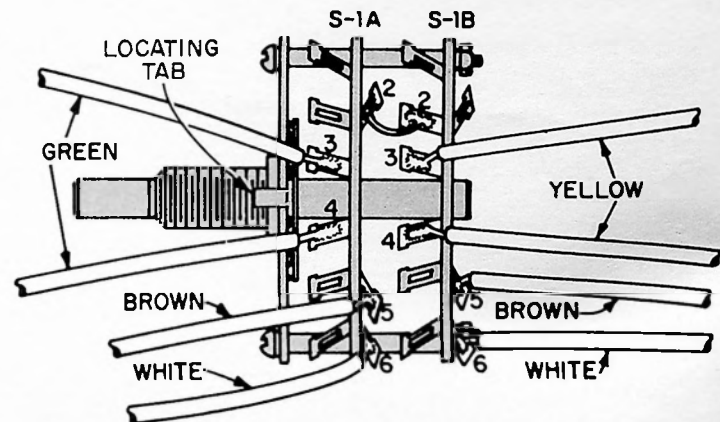


FIGURE 19. SECOND WIRING ON THE SWITCH

## SECOND WIRING ON THE CHASSIS

### SEE FIGURE 20.

- R-3, 680K resistor (blue, gray, yellow). Connect one lead to terminal 4 of TS-5. Solder the other lead to terminal 2 of TS-6 (2 wires).
- Mount TB-1, the prewired 50-terminal board on top of the spacers, with the color dot positioned as shown. Use two small flatwashers and two 4-40 nuts.
- Red wire. Solder one end to terminal 29 of TB-1 (2 wires). Connect the other end to terminal 3 of TS-15.
- Green and orange leads from T-3. Twist the two leads together. Solder the green lead to terminal 34 of TB-1 (2 wires). Solder the orange lead to terminal 37 of TB-1 (2 wires).
- Cut a 1" piece of the small bare wire. Solder one end to terminal 45 of TB-1. Connect the other end to terminal 2 of TS-18.
- Red wire. Solder one end to terminal 42 of TB-1 (2 wires). Connect the other end to terminal 3 of TS-18.
- Green and orange leads from T-2. Twist the two leads together. Solder the green lead to terminal 47 of TB-1 (2 wires). Solder the orange lead to terminal 50 of TB-1 (2 wires).
- Orange wire. Solder one end to terminal 2 of TR-11 (2 wires). Solder the other end to terminal 10 of TB-1 (3 wires).
- Cut a 1 3/4" piece of the large bare wire. Connect one end to terminal 11 of TB-1. Solder the other end to terminal 2 of TS-16 (2 wires).
- Orange wire. Solder one end to terminal 11 of TB-1 (3 wires). Connect the other end to terminal 1 of TS-8.
- Blue lead from T-2. Connect to terminal 13 of TB-1.
- Blue lead from T-3. Connect to terminal 13 of TB-1.
- Yellow wire. Solder one end to terminal 13 of TB-1 (4 wires). Connect the other end to terminal 3 of TS-7.
- Cut a 3" piece of the large bare wire. Place a 2 1/2" piece of large tubing over the wire. Solder one end to terminal 23 of TB-1 (3 wires). Solder the other end to terminal 2 of TS-17 (2 wires).
- Orange wire. Connect one end to terminal 24 of TB-1. Connect the other end to terminal 1 of TS-9.
- Red wire. Solder one end to terminal 24 of TB-1 (3 wires). Solder the other end to terminal 2 of TR-13 (2 wires).
- Orange wire. Connect one end to terminal 25 of TB-1. Connect the other end to terminal 1 of TS-10.
- Mount S-1, the prewired selector switch to the chassis by inserting the locating tab in the locating hole in the chassis. Mount with a 3/8" lockwasher and nut.
- Fasten a 6-32 nut over each spade bolt on both PC boards.
- Mount the two printed circuit boards by inserting the spade bolts into the mounting holes in the chassis. Fasten each with two 6-32 nuts.
- CAUTION: When soldering wires to the PC boards be sure the solder does not run from one foil pattern to another.
- The 2-conductor cable connected to terminals 3 and 4 of S-6. Connect the free end as follows:
  - Red lead. Solder in hole 15 on Board A.
  - Black lead. Solder in hole 17 on Board A.
  - Shield wire. Place a 3/4" piece of small tubing over the wire. Solder in hole 3 on Board A.
- The 2-conductor cable connected to terminals 1 and 2 of S-6. Connect the free end as follows:
  - Red lead. Solder in hole 15 on Board B.
  - Black lead. Solder in hole 17 on Board B.
  - Shield wire. Place a 3/4" piece of small tubing over the wire. Solder on hole 3 on Board B.
- The blue and violet wires connected to terminals 3 and 4 of S-5. Twist the two wires together. Solder the violet wire in hole 6 on Board A. Solder the blue wire in hole 4 on Board A.
- The violet and gray wires connected to terminals 1 and 2 of S-5. Twist the two wires together. Solder the gray wire in hole 6 on Board B. Solder the violet wire in hole 4 on Board B.
- Green wire connected to terminal 8 of S-1A. Solder in hole 11 on Board B.
- Yellow wire connected to terminal 8 of S-1B. Solder in hole 11 on Board A.
- Shielded cable connected to terminal 7 of S-1A. Connect the shield wire to the solder lug. Solder the inner conductor of the free end in hole 12 on Board B.
- Shielded cable connected to terminal 7 of S-1B. Solder the shield wire to the solder lug (2 wires). Solder the inner conductor of the free end in hole 12 on Board A.
- Green wire connected to terminal 4 of S-1A. Solder in hole 10 on Board B.
- Green wire connected to terminal 3 of S-1A. Solder in hole 9 on Board B.

- Yellow wire. Solder one end to terminal 9 of S-1A. Solder the other end in hole 1 on Board B.
- Orange wire. Solder one end to terminal 9 of S-1B. Solder the other end in hole 1 on Board A.
- R-46, 10K dual control. Insert the locating tab in the hole in the chassis. Fasten with a  $\frac{3}{8}$ " lockwasher and nut.
- R-50, 50K dual control (part #420037). Mount with a  $\frac{3}{8}$ " lockwasher and nut.
- Violet wire connected to S-3. Solder the free end to terminal 5 of R-46.
- Blue wire connected to S-3. Solder the free end to terminal 2 of R-46.
- Yellow wire connected to S-4. Connect the free end to terminal 1 of R-50.
- Orange wire connected to S-4. Connect the free end to terminal 4 of R-50.
- Mount the following controls by inserting the locating tab in the locating hole in the chassis. Fasten each with a  $\frac{3}{8}$ " lockwasher and nut.
  - R-51, 50K dual control (part #420037).
  - R-47, 50K single control with switch.
- Red wire. Solder one end to terminal 5 of R-47. Connect the other end to terminal 3 of R-47.
- Cut a  $\frac{1}{2}$ " piece of the small bare wire. Solder one end to terminal 2 of R-47. Solder the other end to terminal 3 of R-47 (2 wires).
- Red wire. Solder one end to terminal 1 of R-47. Connect the other end to terminal 6 of R-45.
- Orange wire. Solder one end to terminal 4 of R-47. Connect the other end to terminal 1 of R-45.
- Prepare three  $10\frac{1}{2}$ " lengths of shielded cable as shown in Figure 21. Connect as follows:
  - $10\frac{1}{2}$ " length. Solder the inner conductor of the end with shield wire to terminal 3 of TS-13 (2 wires). Connect the shield wire

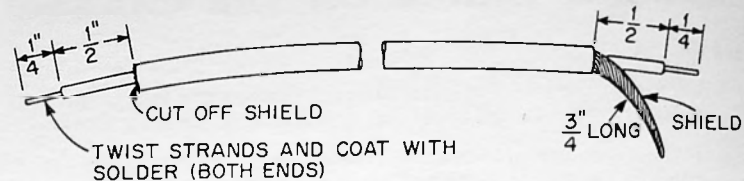


FIGURE 21. CABLE PREPARATION

- to terminal 2 of TS-13. Solder the inner conductor of the other end in hole 5 on Board B.
- $10\frac{1}{2}$ " length. Connect the inner conductor of the end with the shield wire to terminal 3 of R-50. Place a  $\frac{1}{2}$ " piece of the small tubing over the shield wire. Connect the shield wire to terminal 2 of TS-13. Solder the inner conductor of the other end in hole 18 on Board B.
- $10\frac{1}{2}$ " length. Connect the inner conductor of the end with the shield wire to terminal 6 of R-50. Place a  $\frac{1}{2}$ " piece of the small tubing over the shield wire. Solder to terminal 2 of TS-13 (3 wires). Solder the inner conductor of the other end in hole 18 on Board A.
- C-25, .005  $\mu$ f disc capacitor. Place a  $\frac{1}{2}$ " piece of the small tubing over one lead. Solder this lead to terminal 2 of R-50. Connect the other lead to terminal 1 of TS-13.
- C-23, .005  $\mu$ f disc capacitor. Place a 1" piece of the small tubing over one lead. Solder this lead to terminal 5 of R-50. Place a  $1\frac{1}{2}$ " piece of small tubing over the other lead. Connect this lead to terminal 1 of TS-12.
- C-24, .05  $\mu$ f disc capacitor. Connect one lead to terminal 4 of R-51. Connect the other lead to terminal 6 of R-51.
- R-52, 4.7K resistor (yellow, violet, red). Place a  $\frac{1}{2}$ " piece of small tubing over one lead. Solder this lead to terminal 5 of R-51. Solder the other lead to terminal 1 of TS-12 (3 wires).
- Yellow wire. Solder one end in hole 16 on Board A. Solder the other end to terminal 26 of TB-1 (3 wires).
- Green wire. Solder one end in hole 16 on Board B. Solder the other end to terminal 39 of TB-1 (3 wires).

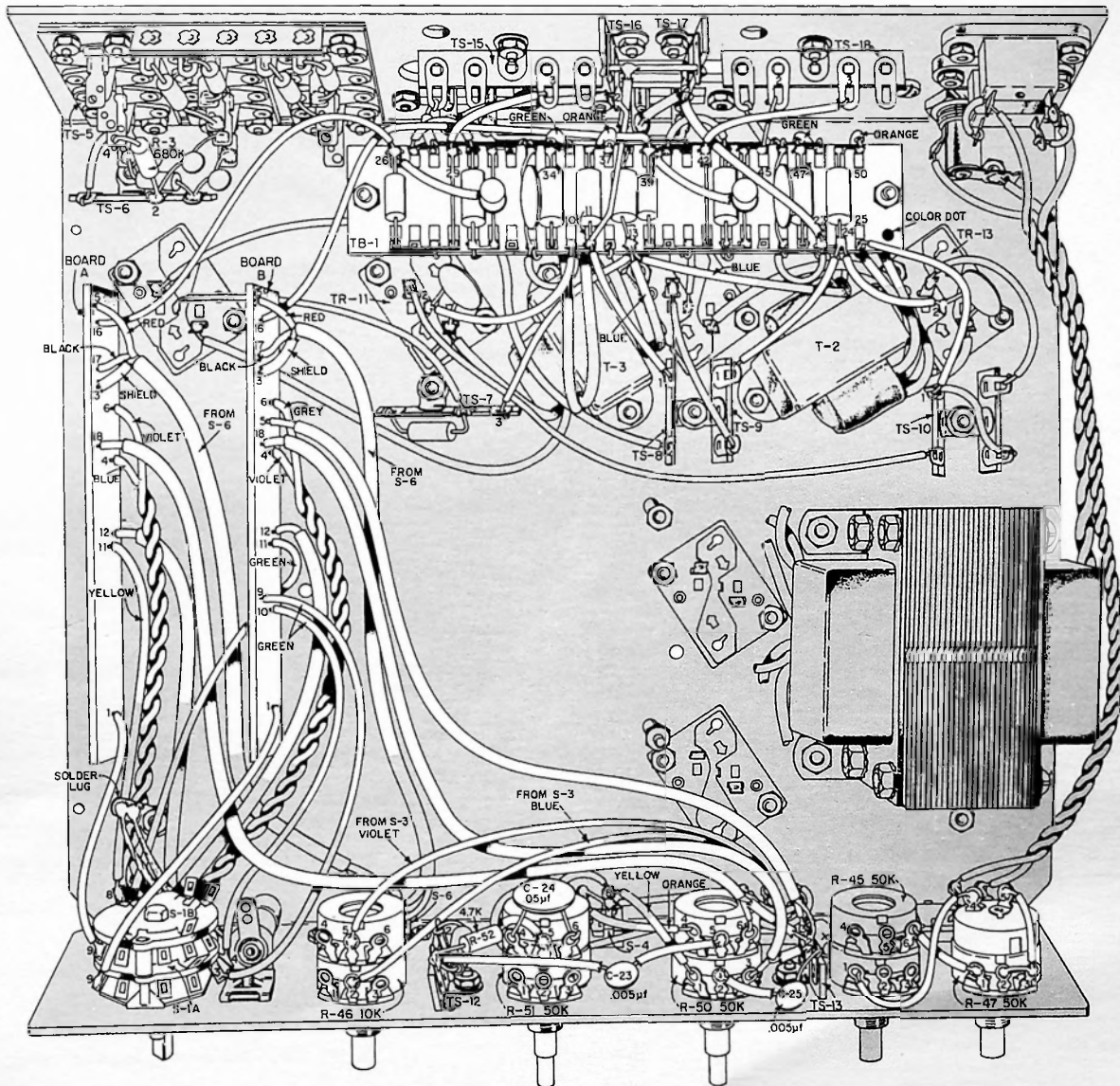


FIGURE 20. SECOND WIRING ON THE CHASSIS

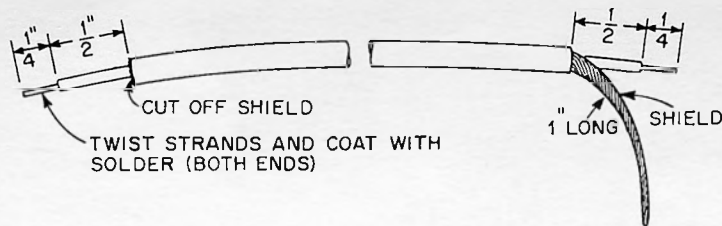


FIGURE 18. CABLE PREPARATION

## THIRD WIRING ON THE CHASSIS

SEE FIGURE 22.

- Violet wire. Solder one end to terminal 6 of R-45 (2 wires). Connect the other end to terminal 4 of R-46.
- Blue wire. Solder one end to terminal 1 of R-45 (2 wires). Connect the other end to terminal 1 of R-46.
- Prepare two 11" lengths of shielded cable as shown in Figure 18.
- 11" length of cable. Solder the inner conductor of the end without the shield wire to terminal 2 of R-45. Solder the inner conductor of the other end in hole 2 of Board B. Place a 1/2" piece of small tubing over the shield wire. Solder in hole 13 on Board B.
- 11" length of cable. Solder the inner conductor of the end without the shield wire to terminal 5 of R-45. Solder the inner conductor of the other end in hole 2 of Board A. Place a 1/2" piece of the small tubing over the shield wire. Solder the shield in hole 13 on Board A.
- R-100, 4.7K resistor (yellow, violet, red). Place a 3/4" piece of small tubing over each lead. Solder one lead to terminal 3 of R-50 (2 wires). Connect the other lead to terminal 3 of R-51.
- R-53, 4.7K resistor (yellow, violet, red). Place a 1" piece of small tubing over each lead. Solder one lead to terminal 1 of TS-13 (3 wires). Solder the other lead to terminal 2 of R-51.
- R-99, 4.7K resistor (yellow, violet, red) Place a 3/4" piece of small tubing over each lead Solder one lead to terminal 6 of R-51 (2 wires). Solder the other lead to terminal 6 of R-50 (2 wires).
- R-48, 3.9K resistor (orange, white, red). Place a 3/4" piece of small tubing over each lead. Solder one lead to terminal 4 of R-51 (2 wires). Solder the other lead to terminal 4 of R-50 (2 wires).
- Prepare a 7" and a 9 1/2" length of shielded cable as shown in Figure 21.

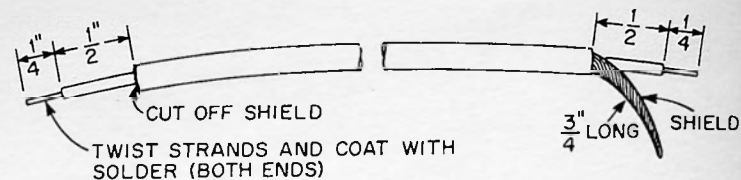


FIGURE 21. CABLE PREPARATION

- 7" length of cable. Solder the inner conductor of the end with the shield wire, to terminal 2 of TS-12 (2 wires). Place a 1/2" piece of the small tubing over the shield wire. Connect the shield to terminal 6 of R-46. Solder the inner conductor of the other end in hole 5 on Board A.
- 9 1/2" length of cable. Solder the inner conductor, of the end without the shield wire, to terminal 1 of R-46 (2 wires). Solder the inner conductor of the other end to terminal 6 of TS-3. Solder the shield wire to the large bare wire.
- White wire connected to terminal 6 of S-1A. Solder the free end to terminal 1 of TS-14 (3 wires).
- White wire connected to terminal 6 of S-1B. Solder the free end to terminal 2 of TS-14 (3 wires).
- Brown wire connected to terminal 5 of S-1A. Solder the free end to terminal 3 of TS-14 (3 wires).
- Brown wire connected to terminal 5 of S-1B. Solder the free end to terminal 4 of TS-14 (3 wires).
- Yellow wire connected to terminal 4 of S-1B. Solder the other end in hole 10 on Board A.
- Yellow wire connected to terminal 3 of S-1B. Solder the other end in hole 9 of Board A.
- Green wire and an orange wire. Twist the two wires together. Connect both wires at one end to terminal 1 of TS-7. Solder the other end of the orange wire in hole 14 on Board B. Solder the other end of the green wire in hole 14 on Board A.
- Orange wire. Solder one end to terminal 1 of TS-6 (2 wires). Solder the other end in hole 7 on Board A.
- Cut a 3/4" piece of the small bare wire. Connect one end to terminal 2 of TS-15. Solder the other end to terminal 32 of TB-1.
- Orange wire. Solder one end to terminal 30 of TB-1 (3 wires). Connect the other end to terminal 1 of TS-16.

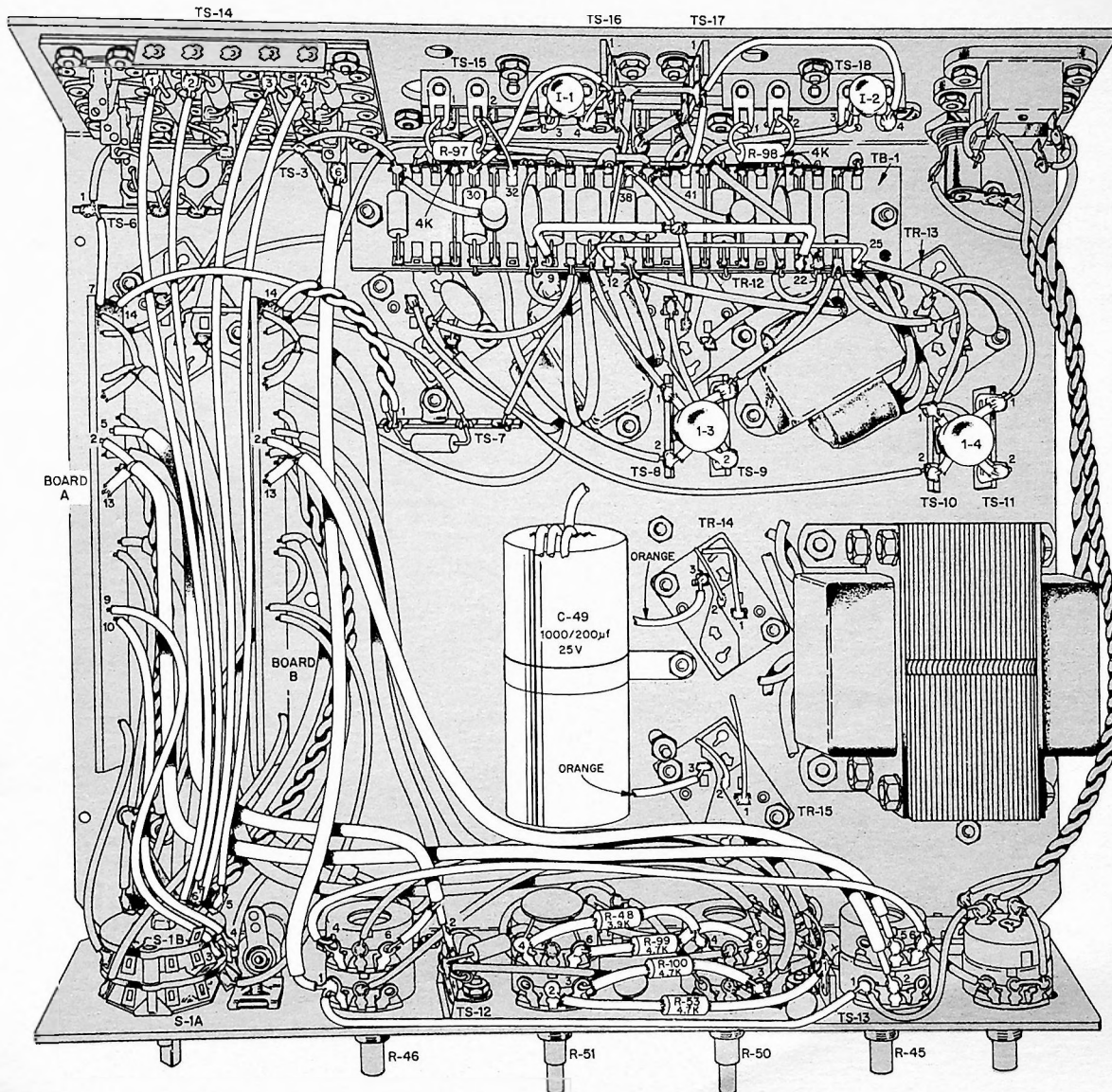


FIGURE 22. THIRD WIRING ON THE CHASSIS



- R-97, 4K, 5% resistor (yellow, black, red, gold). Connect one lead to terminal 1 of TS-15. Connect the other lead to terminal 2 of TS-15.
- Cut a  $1\frac{1}{4}$ " piece of the small bare wire. Connect one end to terminal 4 of TS-15. Connect the other end to terminal 1 of TS-16.
- Red wire. Connect one end to terminal 1 of TS-17. Solder the other end to terminal 41 of TB-1 (2 wires).
- Orange wire. Solder one end to terminal 1 of TS-17 (3 wires). Connect the other end to terminal 4 of TS-18.
- R-98, 4K, 5% resistor (yellow, black, red, gold). Connect one lead to terminal 1 of TS-18. Connect the other lead to terminal 2 of TS-18.
- Cut a  $4\frac{3}{4}$ " piece of the large bare wire. Place a 2" piece of large tubing over each end of the wire. Bend the wire 90°, one inch from each end of the wire. Solder one end of the wire to terminal 22 of TB-1 (2 wires). Connect the other end to terminal 9 of TB-1.
- Cut a 4" piece of the large bare wire. Bend the wire 90° one half inch from each end of the wire. Solder one end to terminal 12 of TB-1 (2 wires). Solder the other end to terminal 25 of TB-1 (3 wires).
- Orange wire connected to terminal 2 of TR-12. Solder the free end to the bare wire, between the two pieces of tubing.
- Red wire. Solder one end to terminal 38 of TB-1 (2 wires). Solder the other end to the bare wire, between the two pieces of tubing.
- Orange wire. Solder one end to terminal 3 of TR-14. The other end will be connected later.
- Cut a  $2\frac{1}{4}$ " piece of the large bare wire. Solder one end to terminal 2 of TR-14. The other end will be connected later.
- Cut a  $2\frac{1}{2}$ " piece of the large bare wire. Solder one end to terminal 1 of TR-14. The other end will be connected later.

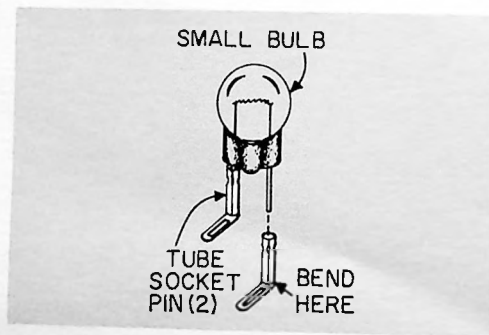


FIGURE 23. SMALL BULB

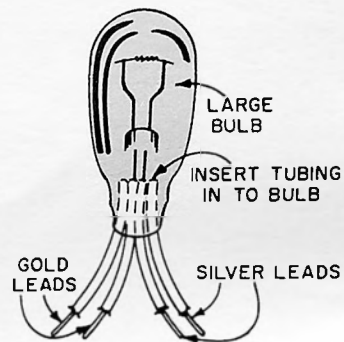


FIGURE 24. LARGE BULB

- Orange wire. Solder one end to terminal 3 of TR-15. The other end will be connected later.
- Cut a 2" piece of the large bare wire. Solder one end to terminal 2 of TR-15. The other end will be connected later.
- Cut a  $2\frac{1}{2}$ " piece of the large bare wire. Solder one end to terminal 1 of TR-15. The other end will be connected later.
- C-49, 1000/200  $\mu\text{f}$ , 25 volt electrolytic capacitor. Position with the leads as shown. Mount with a 6-32 x  $\frac{3}{8}$ " screw, lockwasher and nut.
- I-1, one of the small bulbs and two tube socket pins. Place a socket pin over each lead of the bulb as shown in Figure 23.
- Position the bulb so the pins set on terminals 3 and 4 of TS-15. Solder terminal 4 of TS-15 (2 wires).
- I-2, the other small bulb and two tube socket pins. Assemble as shown in Figure 23.
- Position the bulb so the pins set on terminals 3 and 4 of TS-18. Solder terminal 4 of TS-18 (2 wires).
- I-3, one of the large bulbs. Carefully separate the four leads as shown in Figure 24. Place a  $1\frac{1}{4}$ " piece of small tubing over each of the leads. Slide the tubing into the bulb. Place the two gold leads on one side of the bulb and the two silver leads on the other. Connect the leads as follows:
  - One of the gold leads. Solder to terminal 1 of TS-8 (2 wires).
  - The other gold lead. Solder to terminal 2 of TS-8 (2 wires).
  - One of the silver leads. Solder to terminal 1 of TS-9 (2 wires).
  - The other silver lead. Solder to terminal 2 of TS-9 (2 wires).

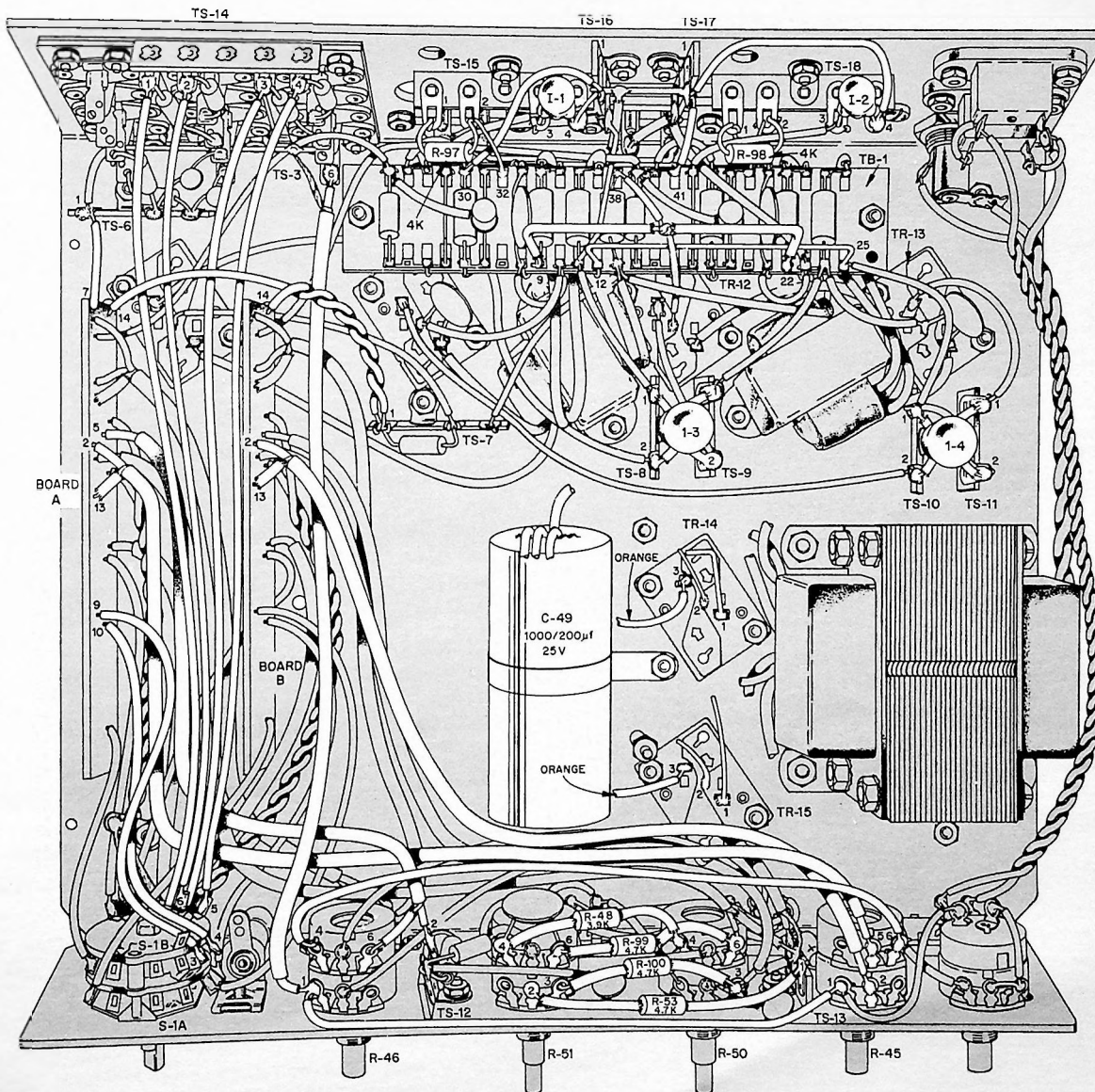


FIGURE 22. THIRD WIRING ON THE CHASSIS

- I-4, the other large bulb. Prepare the bulb in the same manner as I-3. Connect the leads as follows:
  - One of the gold leads. Solder to terminal 1 of TS-10 (3 wires).
  - The other gold lead. Solder to terminal 2 of TS-10 (2 wires).
  - One of the silver leads. Solder to terminal 1 of TS-11 (2 wires).
  - The other silver lead. Solder to terminal 2 of TS-11 (2 wires).

## FOURTH WIRING ON THE CHASSIS

SEE FIGURE 25.

- R-49, 3.9K resistor (orange, white, red). Place a  $\frac{3}{4}$ " piece of small tubing over each lead. Solder one lead to terminal 1 of R-50 (2 wires). Connect the other lead to terminal 1 of R-51.
- C-26, .05  $\mu$ f disc capacitor. Place a  $\frac{3}{4}$ " piece of small tubing over each lead. Solder one lead to terminal 1 of R-51 (2 wires). Solder the other lead to terminal 3 of R-51 (2 wires).
- Cut a  $\frac{3}{4}$ " piece of the small bare wire. Solder one end to terminal 6 of R-46 (2 wires). Connect the other end to terminal 3 of R-46.
- Orange wire. Solder one end to terminal 3 of R-46 (2 wires). Connect the other end to terminal 2 of S-1B.
- Red wire. Solder one end in hole 8 on Board A. Connect the other end to terminal 2 of S-1B.
- Red wire. Solder one end to terminal 2 of S-1B (3 wires). Solder the other end in hole 8 of Board B.
- Prepare three 10" lengths of shielded cable as shown in Figure 26.
- Solder the inner conductor of the end without the shield wire, of one of the 10" lengths, to terminal 4 of R-46 (2 wires). Solder the inner conductor of the other end to terminal 4 of TS-3. Solder the shield wire to the large bare wire.

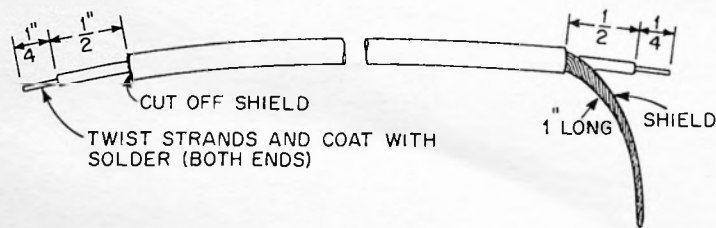


FIGURE 26. CABLE PREPARATION

- Solder the inner conductor of the end without the shield wire, of one of the 10" lengths, to terminal 1 of S-1A. Solder the inner conductor of the other end to terminal 6 of TS-5 (3 wires). Solder the shield wire to the large bare wire.
- Solder the inner conductor of the end without the shield wire, of the remaining 10" length, to terminal 1 of S-1B. Solder the inner conductor of the other end to terminal 4 of TS-5 (3 wires). Solder the shield wire to the large bare wire.
- Cut a  $2\frac{1}{4}$ " piece of the large bare wire. Place a  $1\frac{3}{4}$ " piece of large tubing over the wire. Solder one end to terminal 2 of TS-7 (3 wires). Solder the other end to terminal 9 of TB-1 (3 wires).
- TB-2, 20-terminal board and a solder lug. Place on the spacers with the color dot and solder lug positioned as shown. Mount with two small flatwashers and 4-40 nuts.
- Cut a  $1\frac{1}{8}$ " piece of the large bare wire. Connect one end to terminal 1 of TB-2. Connect the other end to terminal 11 of TB-2.
- CR-1, silicon rectifier. Connect the marked end (marked with a band) to terminal 2 of TB-2. Connect the other end to terminal 12 of TB-2.
- CR-2, silicon rectifier. Connect the marked end (marked with a band) to terminal 4 of TB-2. Solder the other end to terminal 14 of TB-2.
- R-86, 100  $\Omega$  resistor (brown, black, brown). Solder one lead to terminal 15 of TB-2. Connect the other lead to terminal 5 of TB-2.
- Cut a  $1\frac{1}{8}$ " piece of the large bare wire. Connect one end to terminal 6 of TB-2. Connect the other end to terminal 16 of TB-2.
- CR-3, silicon rectifier. Solder the marked end (marked with a band) to terminal 17 of TB-2. Connect the other end to terminal 7 of TB-2.
- Cut a  $1\frac{1}{8}$ " piece of the large bare wire. Connect one end to terminal 8 of TB-2. Connect the other end to terminal 18 of TB-2.
- CR-4, silicon rectifier. Solder the marked end (marked with a band) to terminal 19 of TB-2. Connect the other end to terminal 9 of TB-2.
- R-87, 100  $\Omega$  resistor (brown, black, brown). Connect one lead to terminal 10 of TB-2. Connect the other lead to terminal 20 of TB-2.
- Orange wire connected to terminal 3 of TR-15. Connect the free end to terminal 10 of TB-2.
- Bare wire connected to terminal 2 of TR-15. Place a  $1\frac{1}{4}$ " piece of the large tubing over this wire. Connect the free end to terminal 20 of TB-2.
- Orange wire connected to terminal 3 of TR-14. Connect the free end to terminal 5 of TB-2.
- Two blue leads from T-1. Twist the two leads together. Solder either of the leads to terminal 2 of TB-2 (2 wires). Solder the other lead to terminal 4 of TB-2 (2 wires).

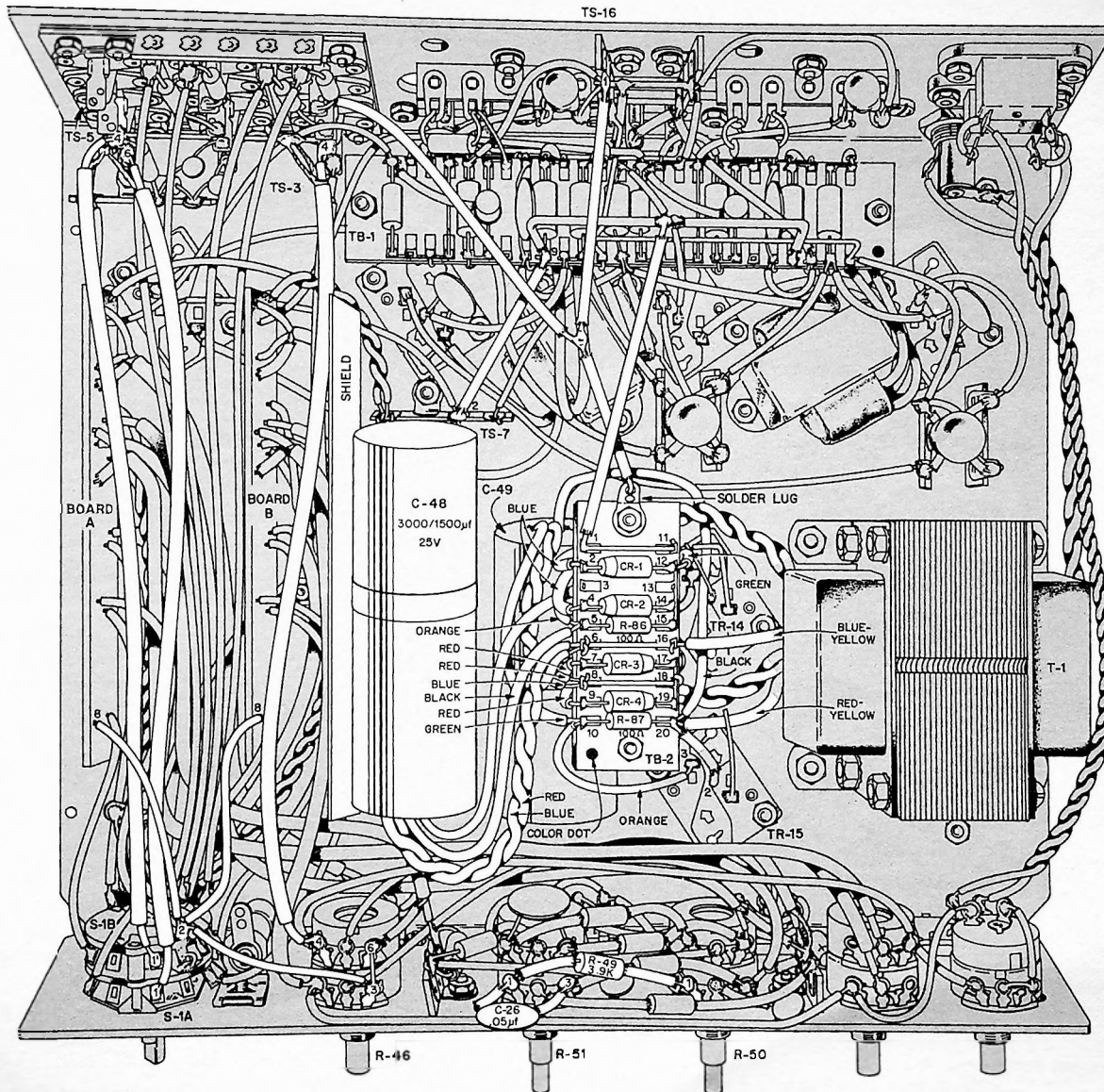


FIGURE 25. FOURTH WIRING ON THE CHASSIS

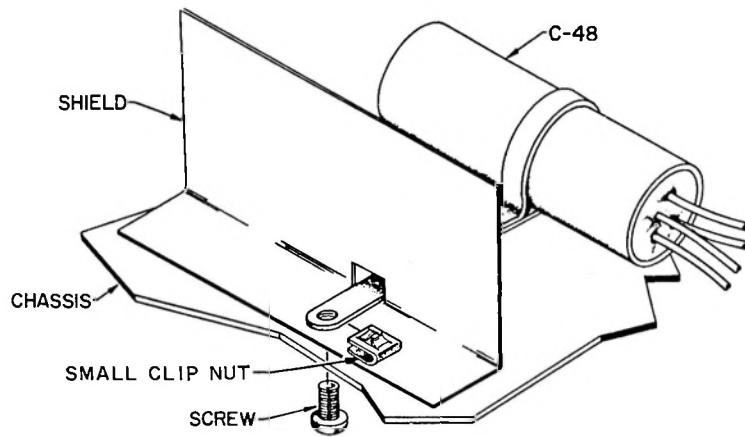


FIGURE 27. MOUNTING C-48

- Blue-yellow lead from T-1. Connect to terminal 16 of TB-2.
- Two red leads from T-1. Twist the two leads together. Solder either of the leads to terminal 7 of TB-2 (2 wires). Solder the other lead to terminal 9 of TB-2 (2 wires).
- Red-yellow lead from T-1. Connect to terminal 20 of TB-2.
- Black lead of C-49. Solder to terminal 20 of TB-2 (4 wires).
- Green lead of C-49. Solder to terminal 10 of TB-2 (3 wires).
- Red and blue leads of C-49. Twist the two leads together. Connect both leads to terminal 8 of TB-2.
- C-48, 3000/1500  $\mu$ f, 25 volt electrolytic and the shield. Mount to the chassis with a 4-40 x  $\frac{3}{4}$ " screw and small clip nut as shown in Figure 27.
- Connect the leads of C-48 as follows:
  - Green lead. Solder to terminal 12 of TB-2 (2 wires).
  - Black lead. Solder to terminal 5 of TB-2 (3 wires).
  - Red and blue leads. Twist the two leads together. Connect both leads to terminal 6 of TB-2.
- Cut a  $3\frac{1}{2}$ " piece of the large bare wire. Place a  $2\frac{3}{4}$ " piece of large tubing over the wire. Solder one end to terminal 1 of TB-2 (2 wires). Solder the other end to the large bare wire connected between terminals 9 and 22 of TB-1.

- Cut a  $4\frac{1}{4}$ " piece of the large bare wire. Place a  $1\frac{3}{4}$ " piece of the large tubing over both ends of the wire. Solder one end to terminal 1 of TS-16 (4 wires). Connect the other end to the solder lug on TB-2.
- Cut a  $4\frac{1}{4}$ " piece of the large bare wire. Place a  $3\frac{3}{4}$ " piece of large tubing over the wire. Solder one end to the bare wire from TS-16 to the solder lug. Solder the other end to the large bare wire connected to terminal 2 of TS-3.

## FINAL WIRING ON THE CHASSIS

### SEE FIGURE 28.

- Prepare two 10" lengths of the shielded cable as shown in Figure 26.
- Solder the inner conductor of the end without the shield wire, of one of the lengths of cable, to terminal 10 of S-1A. Solder the inner conductor of the other end terminal 3 of TS-5 (2 wires). Solder the shield wire to the large bare wire.
- Solder the inner conductor of the end without the shield wire, of the other length of cable, to terminal 10 of S-1B. Solder the inner conductor of the other end to terminal 1 of TS-5 (2 wires). Solder the shield wire to the large bare wire.
- Green wire. Solder one end to the terminal of the pilot light socket. Solder the other end to terminal 8 of TB-2 (4 wires).
- Bare wire connected to terminal 1 of TR-15. Place a  $1\frac{3}{4}$ " piece of the large tubing over the wire. Solder the free end to terminal 16 of TB-2 (3 wires).
- Bare wire connected to terminal 2 of TR-14. Place a  $1\frac{1}{4}$ " piece of large tubing over the wire. Solder the free end to terminal 13 of TB-2.
- Bare wire connected to terminal 1 of TR-14. Solder the free end to terminal 11 of TB-2 (2 wires).
- Cut a  $2\frac{1}{4}$ " piece of the large bare wire. Place a  $1\frac{3}{4}$ " piece of large tubing over the wire. Solder one end to the solder lug (2 wires). Solder the other end to the large bare wire as shown.
- Cut a  $5\frac{1}{4}$ " piece of the large bare wire. Place a  $4\frac{3}{4}$ " piece of large tubing over the wire. Solder one end to terminal 18 of TB-2 (2 wires). Solder the other end to the large bare wire as shown.
- Line cord and bushing. The split ends of the line cord must extend 2" beyond the bushing. Fasten the line cord and bushing to the chassis as shown in Figure 29.
- Solder one of the line cord leads to terminal 1 of J-1 (2 wires). Solder the other lead to terminal 2 of J-1 (2 wires).
- C-50, 500  $\mu$ f, 25 volt electrolytic. Place a  $1\frac{1}{4}$ " piece of small tubing over each lead. Connect the positive lead (marked with a +) to terminal 6 of TB-2. Solder the other lead to terminal 3 of TS-7 (2 wires).

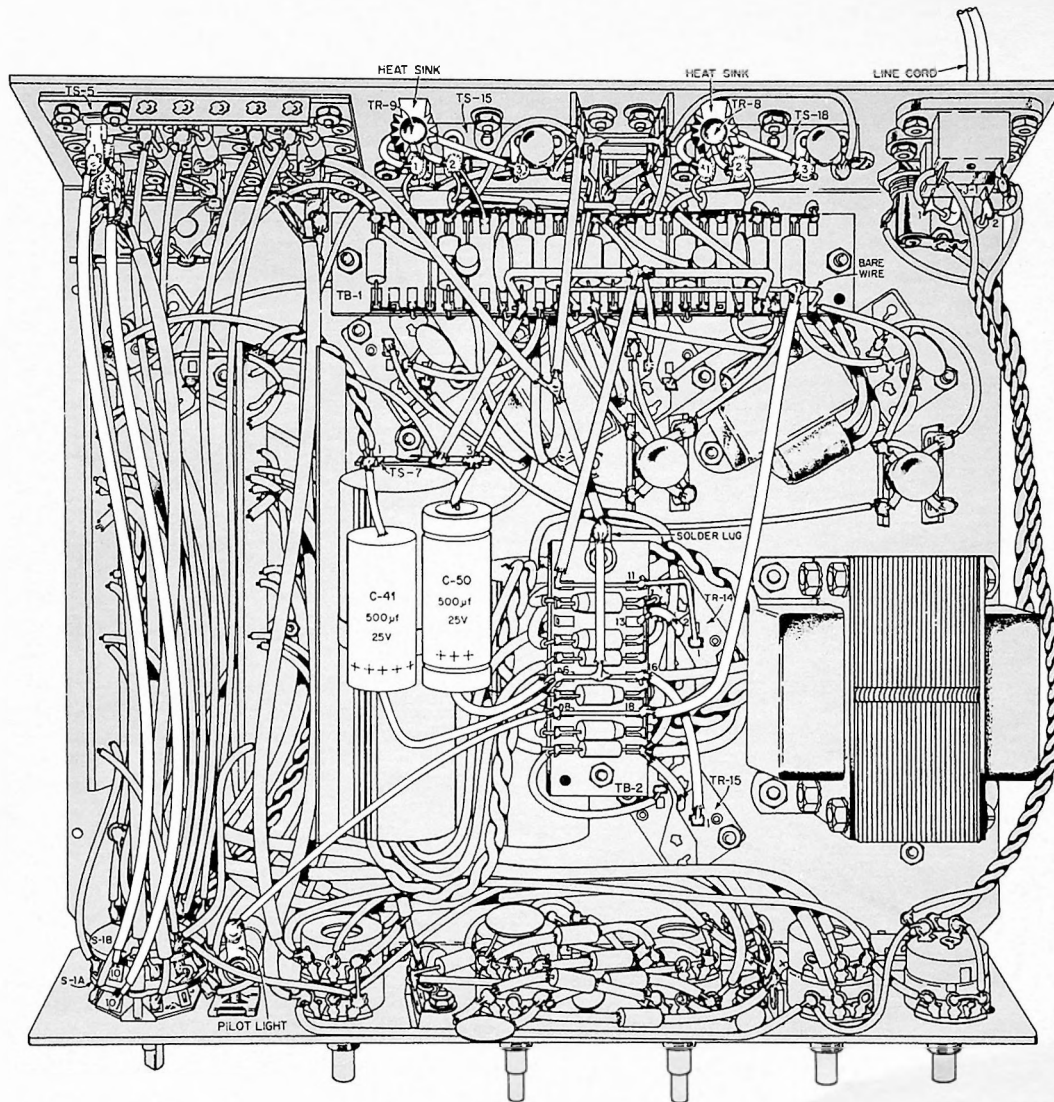


FIGURE 28. FINAL WIRING ON THE CHASSIS

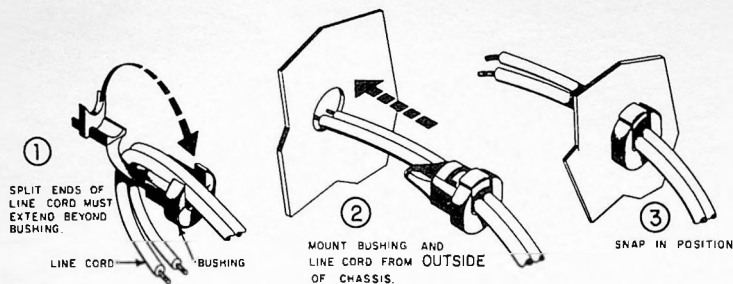


FIGURE 29. LINE CORD

- C-41, 500  $\mu$ f. 25 volt electrolytic. Place a 2" piece of small tubing over each lead. Solder the positive lead (marked with a +) to terminal 6 of TB-2 (6 wires). Solder the other lead to terminal 1 of TS-7 (4 wires).

NOTE: TR-8, and TR-9, the driver transistors may be one of two types. If the heat sink is not attached to the transistor assemble the two as shown in Figure 30. Mount the assembly to the chassis with a 4-40 x 3/16" screw.

If the heat sink is already attached to the transistor mount the transistor to the chassis with a mica insulator, shoulder washer and nut as shown in Figure 31.

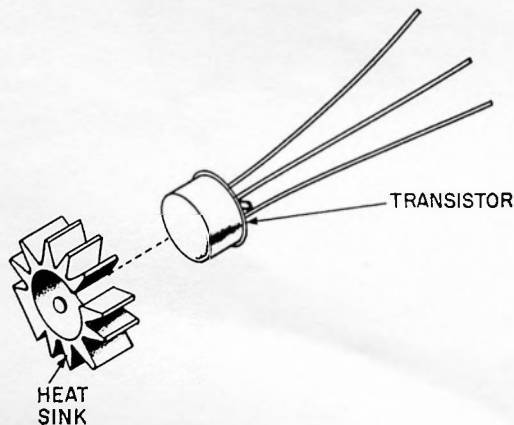


FIGURE 30. MOUNTING THE HEAT SINK

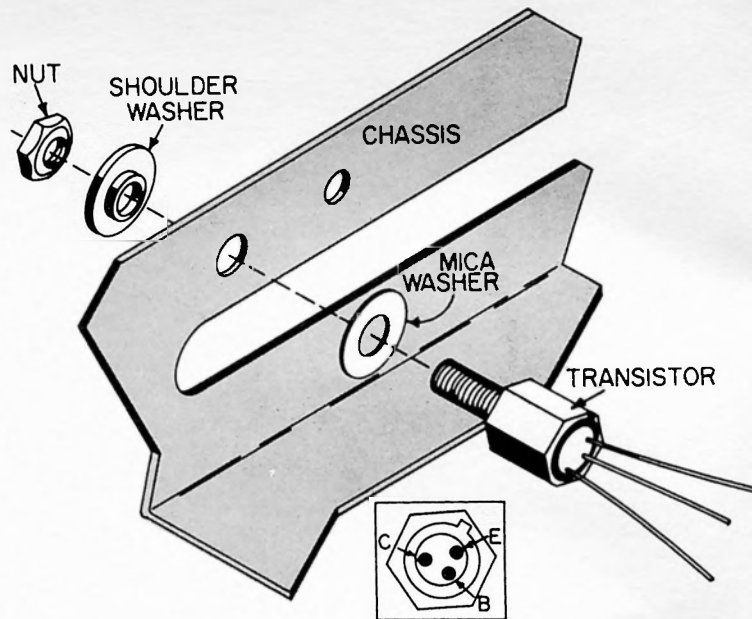


FIGURE 31. HEAT SINK MOUNTING

When mounting either type of transistor, lead E should be to the right. See Figure 32 for transistor lead identification.

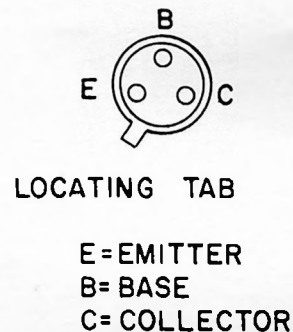


FIGURE 32. TRANSISTOR LEAD IDENTIFICATION

- TR-9, driver transistor (part #660030). Mount as instructed in the above NOTE. Connect the lead as follows:
  - Place a 1" piece of small tubing over lead E. Solder to terminal 3 of TS-15 (3 wires).
  - Place a 3/4" piece of small tubing over lead B. Solder to terminal 2 of TS-15 (3 wires).
  - Place a 1/2" piece of small tubing over lead C. Solder to terminal 1 of TS-15 (3 wires).
- TR-8, driver transistor (part #660030). Mount as instructed above. Connect the leads as follows:
  - Place a 1" piece of small tubing over lead E. Solder to terminal 3 of TS-18 (3 wires).
  - Place a 3/4" piece of small tubing over lead B. Solder to terminal 2 of TS-18 (3 wires).
  - Place a 1/2" piece of small tubing over lead C. Solder to terminal 1 of TS-18 (3 wires).
- The wiring is now completed. Carefully recheck your work to make sure that all connections are correct. CAREFULLY CHECK EVERY CONNECTION FOR—NO SOLDER, TOO LITTLE SOLDER, OR TOO MUCH SOLDER. IF A CONNECTION APPEARS DOUBTFUL, REHEAT THE CONNECTION. Trim any excess wire in all connections made.

## FINAL ASSEMBLY

### SEE FIGURE 33.

- If you have a cabinet refer to the CABINET INSTALLATION before doing the following steps.
- Place the fiber switch cover over the 3-position slide switch.
- Place the dress panel over the control shafts. Fasten to the amplifier with six 3/8" flatwashers and nuts.
- Turn the shafts of all controls fully counterclockwise (all the way to the left).
- Place one of the large knobs over the shaft of the selector switch with the marked portion of the knob in the TAPE position. Fasten with a 7/16" long setscrew.
- Place the other large knob over the volume control, with the marked portion of the knob to the left. Fasten with a 7/16" long setscrew.
- Two of the small knobs have a larger hole for the shaft. Place these two knobs over the shafts of the balance and separation controls. Fasten each with a 1/4" long setscrew.

- Two large knobs with center holes. Place on the shafts of the bass and treble controls, with the marked portion of the knob on the left. Firmly push knob until it is well seated.
- Two small knobs. Place on the shafts of the bass and treble controls. Fasten each with a 1/4" long setscrew.
- Insert the pilot light button into the hole in the panel.
- Insert the fuse in the fuse holder.

## MOUNTING THE TRANSISTORS

### SEE FIGURE 34.

- Mount each of the following transistors with an insulator and two self-tapping screws as shown in Figure 35.
  - TR-10, part #660031.
  - TR-11, part #660031.
  - TR-12, part #660031.
  - TR-13, part #660031.
  - TR-14, part #660032.
  - TR-15, part #660032.

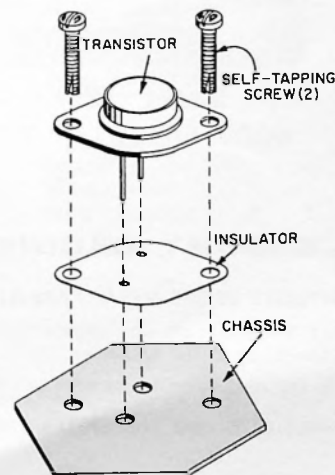


FIGURE 35. MOUNTING TRANSISTORS



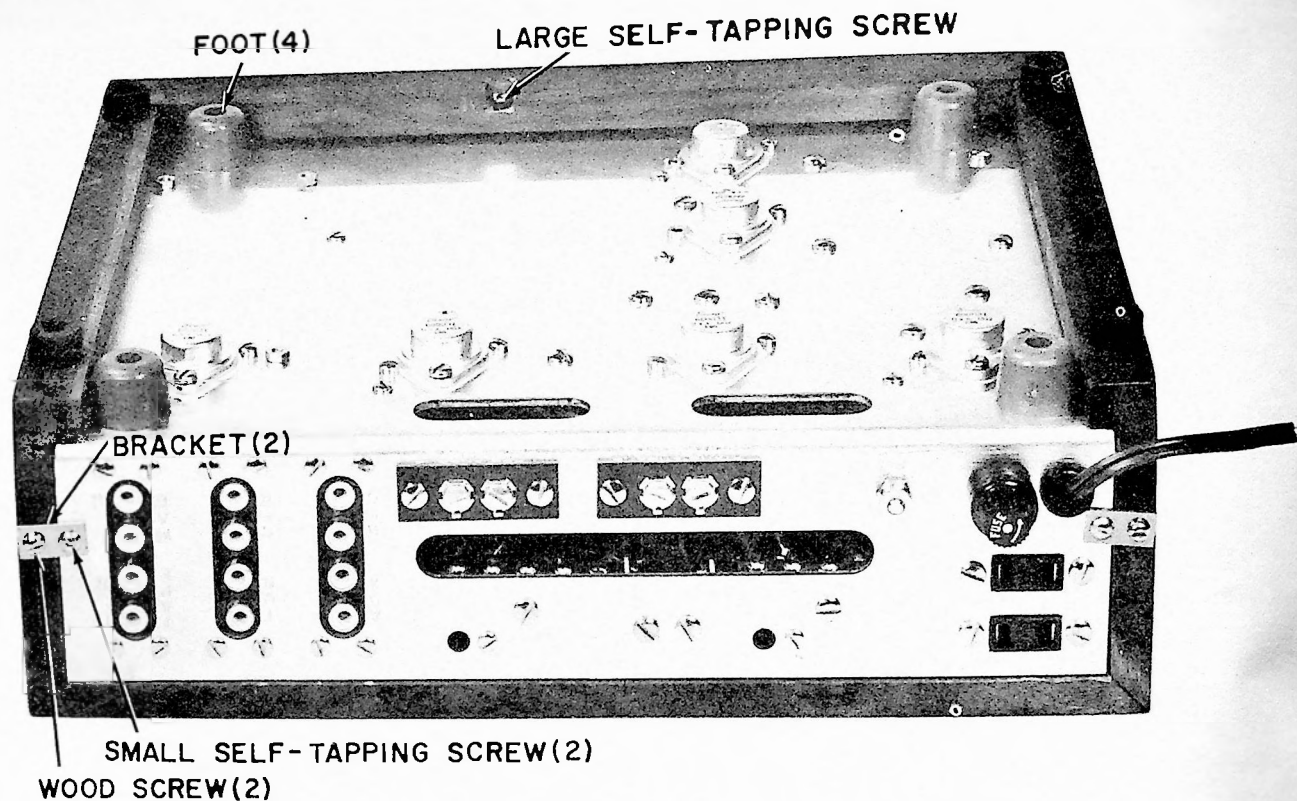


FIGURE 36. CABINET INSTALLATION

## ACCESSORY CABINETS

### INSTALLING THE AMPLIFIER IN THE METAL CABINET

- Slide the case over the amplifier. The angular edge of the flange on the case goes to the front of the amplifier.
- Fasten the case to the chassis with the four self-tapping screws.

### INSTALLING THE AMPLIFIER IN THE WOOD CABINET

SEE FIGURE 36.

- Remove the front panel if it is already mounted.

- Slide the front of the amplifier into the rear of the cabinet.
- Fasten the amplifier to the front support with a large self-tapping screw.
- Fasten the two brackets to the back of the amplifier. Mount each bracket with a small self-tapping screw and a wood screw.
- Four rubber feet. Mount each to the cabinet with a wood screw.
- Mount the panel to the amplifier.



For the finest in stereo listening, use your 50-watt transistor amplifier with components of equal quality . . . especially, your stereo speakers and enclosures.

Read the following pages carefully . . . The time you spend will be well rewarded by many useful hints on how to get the most out of your stereo equipment.

	PAGE
CONNECTING EQUIPMENT .....	34
PHASING YOUR SPEAKERS .....	36
OPERATING THE AMPLIFIER .....	36
USING THE CONTROLS .....	36
STEREO HINTS .....	37
HOW IT WORKS .....	39
SPECIFICATIONS .....	39
SERVICE HINTS .....	39
PARTS LIST .....	41
SCHEMATIC DIAGRAM .....	43
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## CONNECTING EQUIPMENT

Always use shielded cable to connect equipment to the amplifier inputs.

LOCATE EQUIPMENT PROPERLY to allow:

1. Adequate ventilation.
2. At least two feet separation between turntable and amplifier.
3. Correct speaker location. Never turn speakers toward each other.

### RECORD PLAYER

**Stereo.** A record player with a stereo cartridge has two output cables. For stereo ceramic cartridges, connect each of the two output cables to a CER input. For stereo magnetic cartridges connect each of the output cables to a MAG input.

**Monophonic.** A monophonic cartridge has only one output cable. For a monophonic ceramic cartridge, connect the output cable to either of the CER inputs. For monophonic magnetic cartridges, connect the cable to either of the MAG inputs.

### TUNERS (FM OR AM)

**FM tuner** (with built-in multiplex). Connect the FM output to one of the TUN inputs. Connect the multiplex output to the other TUN input.

**FM tuner** (with external multiplex adapter). Connect the two outputs from the multiplex adapter to the TUN inputs. If you desire, connect the regular FM output on the tuner to an AUX input. Monophonic FM broadcasts can be played through the AUX position on the amplifier without going through the multiplex adapter.

**AM tuner.** When using FM and multiplex, connect the AM tuner to an AUX input. If you do not have multiplex equipment, connect the AM tuner to one of the TUN inputs.

## TAPE PLAYBACK EQUIPMENT

**Tape Deck** (Basic Unit with no preamplifier). For a stereo tape deck, connect each of the two output cables to a TAPE input. For a monophonic tape deck, connect the single output cable to either of the TAPE inputs.

**Tape unit with a preamplifier.** If the tape unit preamplifier output is less than .5 volts or unknown connect it to the TUN inputs. If it is greater than .5 volts, connect it to the AUX inputs.

For a stereo tape unit connect both of the output cables to the same pair of inputs—either TUN or AUX. For a monophonic, connect the single cable to either of the TUN or AUX inputs.

### USING THE AUX INPUTS

The AUX inputs are intended for use with signals greater than .5 volts. However, any high-level signal from tuners, multiplex units, tape equipment, or crystal phono cartridges can be connected to the AUX input. For monophonic equipment, connect the cable to either of the AUX inputs.

### USING THE AC POWER RECEPTACLES

On the rear of the amplifier are two 110-125 volt AC power receptacles. They supply power whenever the amplifier is plugged in.

### THE GROUND POST

To minimize hum which may originate elsewhere in your stereo system, connect a #18 or larger wire from the chassis of your tuner and motor frame of your record player and tape transport to the GROUND POST on your amplifier input panel.

It is also recommended that the GROUND POST be connected to an earth ground by connecting it to the nearest water pipe, steam radiator or ground rod.

### CONNECTING RECORDING EQUIPMENT TO THE AMPLIFIER

Always use shielded cable to connect recording equipment to the amplifier. Output from the amplifier to a recorder can be taken from the REC jacks. For stereo operation, connect both REC jacks on the amplifier to the stereo inputs on the recorder. For monophonic operation connect the REC jack of the channel being used to the input on the recorder.

### SPEAKERS

Always use heavy, insulated wire (line cord for example) to connect speakers to the amplifier. On the back of the chassis are two speaker strips; RIGHT OUTPUT and LEFT OUTPUT.

**TWO SPEAKER SYSTEM** (stereo or monophonic). For 4, 8 or 16 ohm speaker. Connect the leads from the left speaker to the L-CHANNEL Strip. Connect the right speaker in the same manner to the R-CHANNEL strip.

**CENTER SPEAKER.** In some installations, a center speaker can be used to improve stereo listening. To connect a center speaker, connect one lead from the speaker to the right channel strip and the other lead of the speaker to the left channel strip. Refer to illustration of how equipment is connected for proper terminals.

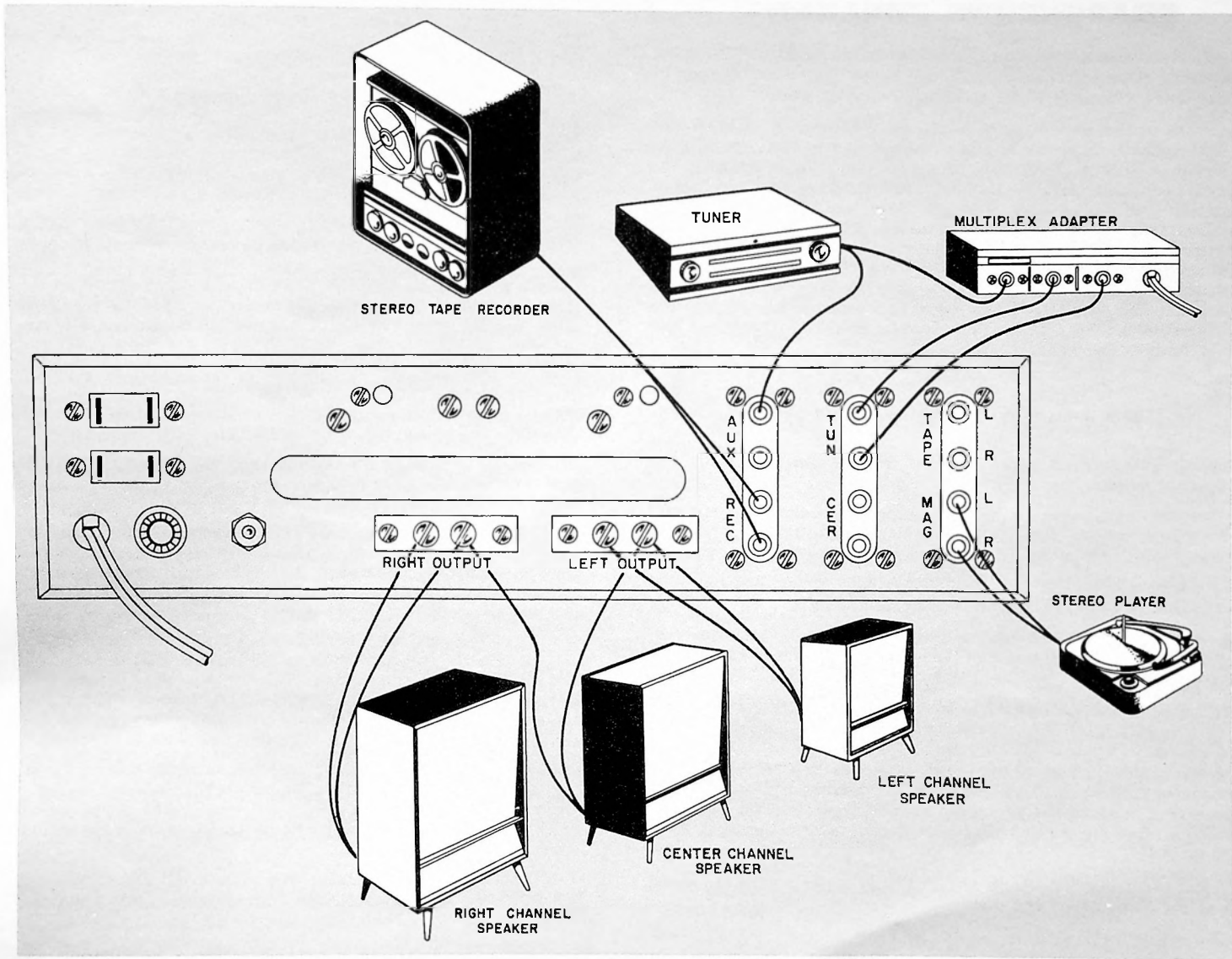


FIGURE 37. CONNECTING EQUIPMENT

## PHASING THE SPEAKERS

For best stereo reproduction the speakers must be in phase so the sound waves produced by each speaker add together. A partial cancellation of the bass tones will result if the speakers are out of phase.

Connect one of the speaker leads to the positive terminal of a 1.5 volt flashlight battery. Connect the other speaker lead to the negative battery terminal. Note whether the speaker cone moves in or out when the battery is connected. Mark the lead connected to the positive terminal of the battery with a plus (+). Mark the other lead with a minus (-). Now connect the second speaker to the battery. If the cone does not move in the same direction, reverse the speaker leads. When the cone of the second speaker moves in the same direction as the first speaker mark the speaker leads plus or minus depending on their connection. The speakers are now in phase. When connecting your speaker connect the minus leads to the two terminals on the right of the speaker strips and the plus leads to the terminals on the left.

## OPERATING THE AMPLIFIER

- Connect all equipment to the amplifier. Connect a speaker to the left and right output strips.
- Set the POWER switch to the OFF position. Turn the VOLUME control all the way to the left. Plug the line cord of the amplifier into a 110-125 volt, 60 cycle AC source.

**CAUTION: NEVER TOUCH ANY OF THE WIRING WHILE THE AMPLIFIER IS PLUGGED INTO A POWER CIRCUIT.**

- Plug the line cords of the system components into suitable power outlets. The two AC receptacles on the rear of the amplifier can be used for this purpose.
- Turn on the equipment that you wish to hear. Turn the amplifier on.
- Set the SELECTOR switch for the equipment that you wish to hear.
- Set the L MONO/STEREO/R MONO switch to the STEREO position when using stereo equipment; the L MONO position when the selected equipment is connected to the left channel input, and the R MONO position when the selected equipment is connected to the right channel input.
- Adjust the VOLUME, BASS and TREBLE controls until the sound is at the desired level and tone.
- Adjust the BALANCE and SEPARATION controls for the most pleasing stereophonic effect.
- If the sound appears to be reversed, set the STEREO REV switch to the REV position.

To fully enjoy the many control features of your amplifier, we suggest that you spend a few minutes reading this description of the function of each control. After you read the operating instructions, it is a good idea to experiment a bit with various control settings.

## FRONT PANEL CONTROLS

**SELECTOR** should be placed in the position for the equipment you wish to hear. Its function is to select the inputs to be connected to the amplifier circuits. Use TAPEHEAD to play back tapes on a tape transport, PHONO for records, TUNER for radio and AUX for any equipment connected to the AUX inputs.

**SEPARATION** controls the amount of channel separation, or how far apart the left and right sound sources seem to be. In the OFF position there is maximum channel separation; in extreme clockwise (to the right) there is minimum separation. This control is especially useful where no center speaker is used or where speakers are relatively far apart. It has the effect of filling the "hole in the middle". The "hole in the middle" is the awareness of two separate sound sources and can be caused by poor acoustics or wide separation of the speakers.

**BASS** and **TREBLE** are clutch-type controls which can be adjusted to obtain the exact tonal balance you prefer for each channel.

The vertical lines above the controls show the flat position (no boost or cut). For less bass or treble, turn the controls to the left. For bass or treble boost, turn the controls to the right.

To adjust one channel separately, for example the right channel, hold the outer knob firmly in place as you turn only the small, center knob. Once the control is adjusted for both channels, the relative settings will remain the same. Then, as you turn one knob, the other knob on the control will also turn to the same degree.

**BALANCE** controls the relative volume of your left and right speakers. As you turn the balance control to the left, the relative volume of your left speaker will increase as the volume of your right decreases. Turning to the right will increase the relative volume of your right speaker. The center position provides approximately equal volume on left and right channels. In normal operation, the control is set close to center.

Correct volume balance between your left and right speakers is essential for full enjoyment of stereo. As you adjust for balance, turn the control freely to learn how it affects the sound. With a little experience, you will quickly find the most pleasing position for the greatest realism and full-dimensional sound.

**VOLUME** controls the listening level of both left and right speakers to the same degree. Turning to the right increases the sound at BOTH speakers.

**RUMBLE FILTER** removes any annoying, low-frequency, rumbling sounds which may be heard with some record players. For full reproduction of the low frequencies, leave this switch in the OFF position when the filter is not needed.

**SCRATCH FILTER** removes the high-frequency, scratchy and hissing sounds heard on old or worn records. For full reproduction of the high frequencies, leave this switch in the OFF position when the filter is not needed.

The **L MONO/STEREO/R MONO** switch determines the mode of operation. The **STEREO** position is used for stereo equipment. The **L MONO** and **R MONO** positions are used for monophonic equipment. The position is determined by which channel input the equipment is connected to.

The **STEREO REV** switch is used to switch the left channel, input material to the right channel speaker and the right channel input material to the left channel speaker.

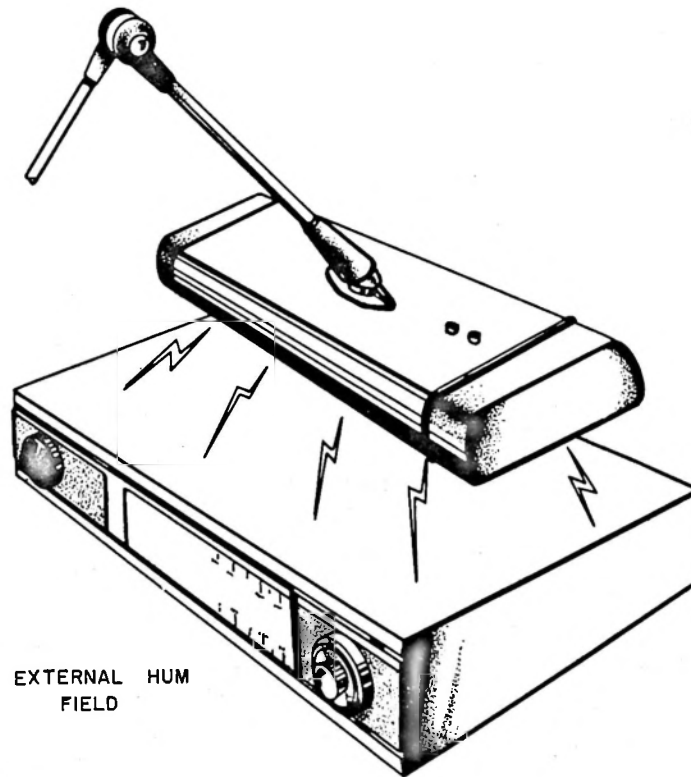
### STEREO HINTS

These hints can help you get the most out of your stereo system. Each piece of equipment may be in perfect operating condition yet annoying symptoms can be developed if components are incorrectly placed or ground connections are not sufficient.

#### LOSS OF STEREO EFFECT

First check one channel at a time, to be sure both channels are operating. Loss of stereo, when both channels are operating, can usually be traced to one of the following, easily-corrected faults.

1. **Reversed channels.** Directions appear to be reversed so that instruments normally located at the left side of the orchestra appear to be located at the right. To correct, just change the position of the **STEREO-REV** switch of your receiver from **STEREO** to **REV**. The **REV** position has the effect of reversing the speaker channels.
2. **Speaker location not correct.** The full stereo effect will be limited in area if speaker location is not correct. Speakers may be just 3 feet apart if they are turned away from each other at a slight angle. Never turn speakers toward each other. If more room is available, speakers may be placed flat against the wall, about 6 to 8 feet apart. If a center speaker is used, the left and right speakers may be spaced further apart. Experiment a bit to find the best location.
3. **Stereo cartridge not mounted correctly.** Distortion and loss of channel separation result if the cartridge and turntable are not perfectly level. Check by placing a single, unwarped record on the player. Then set a small mirror on the record and place the stylus needle on the mirror. If the stylus is not vertical to the mirror, check the angle of the tone arm and the mounting screws of the cartridge to find out why the cartridge is tilted.



EXTERNAL HUM  
FIELD

#### HUM SOURCE

4. **Stylus pressure too heavy.** Stylus pressure above the recommended value forces the stylus to ride too deeply in the record groove. Loss of channel separation and damage to the record result. Check with a stylus pressure gauge and, if the pressure is too high, reduce it to the minimum needed for good tracking.

#### HUM

Sometimes hum is picked up by a stereo system although each unit in the system is relatively hum-free. Hum can often be eliminated by taking the following steps . . .

1. **Remove external hum sources.** Electric clocks, fluorescent lamps and power equipment are sources of hum which can be picked up by a stereo system. Such electrical appliances should not be placed too close to your music system. Remove any suspected appliances and note if the hum level of the system decreases.

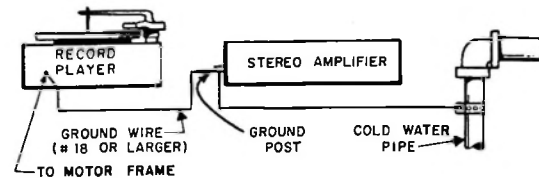
- Reverse the position of each line cord plug in the socket, one at a time, to find the position which results in least hum.

DISCONNECT ALL UNITS FROM THE POWER LINE BEFORE TRYING THE FOLLOWING STEPS:

- Check component placement. To minimize hum, the record player cartridge should be at least 2 feet away from amplifier or tuner power transformers. Power line cords should never be close to the interconnecting audio cables. The tuner and amplifier should not be stacked because the amplifier may pick up radiation from the tuner.
- Check interconnecting shielded cables. Be sure the shield braid or spiral shield is properly soldered to the outside of the plug and that each is firmly seated all the way in the jack.
- Twist together the two audio cables from your record player before you connect them to your amplifier.
- Connect a ground cable (#18 wire or heavier) between the motor frame of your record player and the GROUND POST of your amplifier. Many record players have ground or "earth" terminals provided for this purpose. In the same way, connect the chassis of your other equipment to the amplifier GROUND POST. If two separate tuners are used, connect the two chassis with a single ground wire; then connect just one of the tuner chassis to the amplifier GROUND POST.
- Use a true earth ground, if hum persists. Connect a ground cable from the GROUND POST of your amplifier to a true earth ground such as a cold water or radiator pipe or a copper rod driven into the earth.

### ACOUSTIC FEEDBACK

Rumble and squeal are often caused by acoustic feedback or the return of sound vibration from the speakers back into the record player or amplifier. The simplest cure is to house each speaker in a separate cabinet, away from other components. Sometimes it is necessary to place a foam rubber pad under each speaker enclosure and move the speaker enclosures away from the wall to be sure that vibrations from the speakers do not travel along wall or floor to other components. If speakers must be mounted in the same cabinet as other components, the cabinet should be solidly built of heavy wood and the speaker compartments should be completely padded with a cushion of 1" foam rubber.



GROUND WIRE CONNECTION

### RECORD AND STYLUS CARE

To keep stereo records in good condition, they should be treated with the care they deserve.

- Stylus (needle) pressure should be kept to the minimum needed for good tracking. Follow the cartridge manufacturer's recommendations for stylus pressure. An inexpensive stylus pressure gauge will allow you to check the needle pressure from time to time and will prove to be a good investment.
- Keep your records clean. Dust is a destructive abrasive and causes wear of both stylus and record grooves. Clean records often with a soft sponge moistened with clear, cold water.
- Brush the stylus often with a soft, camel's hair brush. Considerable distortion will result if the stylus is allowed to accumulate fuzz. NEVER RUB YOUR FINGER AGAINST THE STYLUS—Stylus alignment may be disturbed.
- Change stylus as needed. Although diamonds last much longer than sapphire tips, no stylus stays in good condition forever.

### STEREO TAPES

Stereo tapes are an increasingly popular program source. The tapes require no special care other than avoiding extremes of temperature and humidity. However, routine care of the heads will assure continued high quality of reproduction, play after play. Routine care includes cleaning the tape heads with tape-head cleaner and demagnetizing the heads. Some enthusiasts recommend cleaning heads after 4 hours of use, demagnetizing after 8 hours.

## CIRCUIT DESCRIPTION

The Knight Transistor Amplifier consists of two identical amplifiers combined on the same chassis. Since the channels are identical only the left channel circuitry will be explained. A complete schematic diagram is in the rear of the book.

S-1, the selector switch connects the low-level phono and tape head inputs to the preamplifier. The preamplifier section of the amplifier consists of a printed circuit board which contains all the equalization, tone control and high and low pass filter components. There are five low-signal transistors on the circuit board. TR-1A and TR-2A make up the low level preamplifier section. R-1 and R-9 are 47 K resistors to match a magnetic pickup. These values can be changed to match any stereo cartridge. Feedback is used between the collector of TR-2A and TR-1 to get a high input impedance at TR-1A. The output from TR-2A is then fed to TR-3A, the high-level driver. The high-level tuner and auxiliary inputs are connected directly to the input of TR-3A by the selector switch.

The output of TR-3A is applied to the tone control driver. TR-4A, the tone control driver provides enough gain to make up for any losses in the tone control circuit. TR-5A and TR-7, the voltage amplifier and pre-driver amplify the signal and apply it to the input of TR-9, the driver.

TR-10 and TR-11 are operated as single-ended push-pull common emitter amplifiers operating class B. I-3A and I-4A provide DC stabilization and set the transistor's operating points. TR-10 and TR-11 are biased so there is very little current flow when no signal is applied to the amplifier. When a signal is applied to the amplifier, equal but out-of-phase signals are fed from the secondaries of the driver transformer (T-3) to the bases of TR-10 and TR-11. Each transistor will conduct on alternate half-cycles of the applied signal so current will flow alternately through the speaker.

I-3A and I-4A, the two bulbs in the emitter circuits of TR-10 and TR-11, are identical. They have several functions in the circuit the main one being thermal feedback. They prevent the transistors from being damaged by drawing too much current as they heat up. The cold resistance of the bulb is very small, however, as the transistor draws more current the extra current through the bulb causes its temperature to rise, thereby increasing its resistance. The increased resistance of the bulb limits the current flow in the emitter circuit thereby preventing the transistor from damaging itself by thermal run-away. The bulb also serves as a fuse to protect the speakers. If the transistor breaks down, instead of the supply voltage being applied to the voice coil of the speakers and damaging them, it is applied first across the bulb. The bulb is a 6-volt bulb and will burn out instantly.

I-1, the bulb in the emitter circuit of TR-9, also operates as a thermal feedback device. It has a small resistance, which is bypassed by C-42 and is used as the DC feedback loop for TR-9.

The power supply consists of a positive and a negative 23 volts. Each secondary winding is terminated in a full wave silicon rectifier with

capacitive input filter. TR-14 and TR-15 are used to provide electronic filtering and some regulation. The effective output capacity of the negative supply is greater than 120,000 microfrads and that of the positive supply is in excess of 25,000 microfarads.

## SPECIFICATIONS

POWER OUTPUT	50 watts IHFM
	36 watts continuous sine wave
FREQUENCY RESPONSE	$\pm 1$ db from 20 to 20,000 cps at full output
HARMONIC DISTORTION	Less than 1.0% at full output
HUM	
TUNER INPUT	90 db below full output
PHONO INPUT	60 db below full output
SENSITIVITY	(Input signal required for all output)
TAPE HEAD	2.0 millivolts
MAGNETIC PHONO	2.5 millivolts
CERAMIC PHONO	300 millivolts
TUNER	500 millivolts
AUXILIARY	500 millivolts
CROSSTALK	Better than -40 db on all inputs
POWER REQUIREMENTS	110-125 volts, 60 cycle AC
TRANSISTOR COMPLEMENT	14 audio and 6 power transistors.

## SERVICE HINTS

If the amplifier does not work, recheck all the wiring. Correcting any wiring errors and resoldering poor connections will usually bring the amplifier up to full performance. Check the position of each transistor and the wiring of the leads.

If you have a meter, voltage and resistance measurements can be made. Check the voltages indicated on the schematic diagram. If the amplifier blows fuses check for shorts or wiring errors in the power supply. If hum is heard, reverse the line cord in the AC outlet, check for open shield wires or badly soldered ground connections.



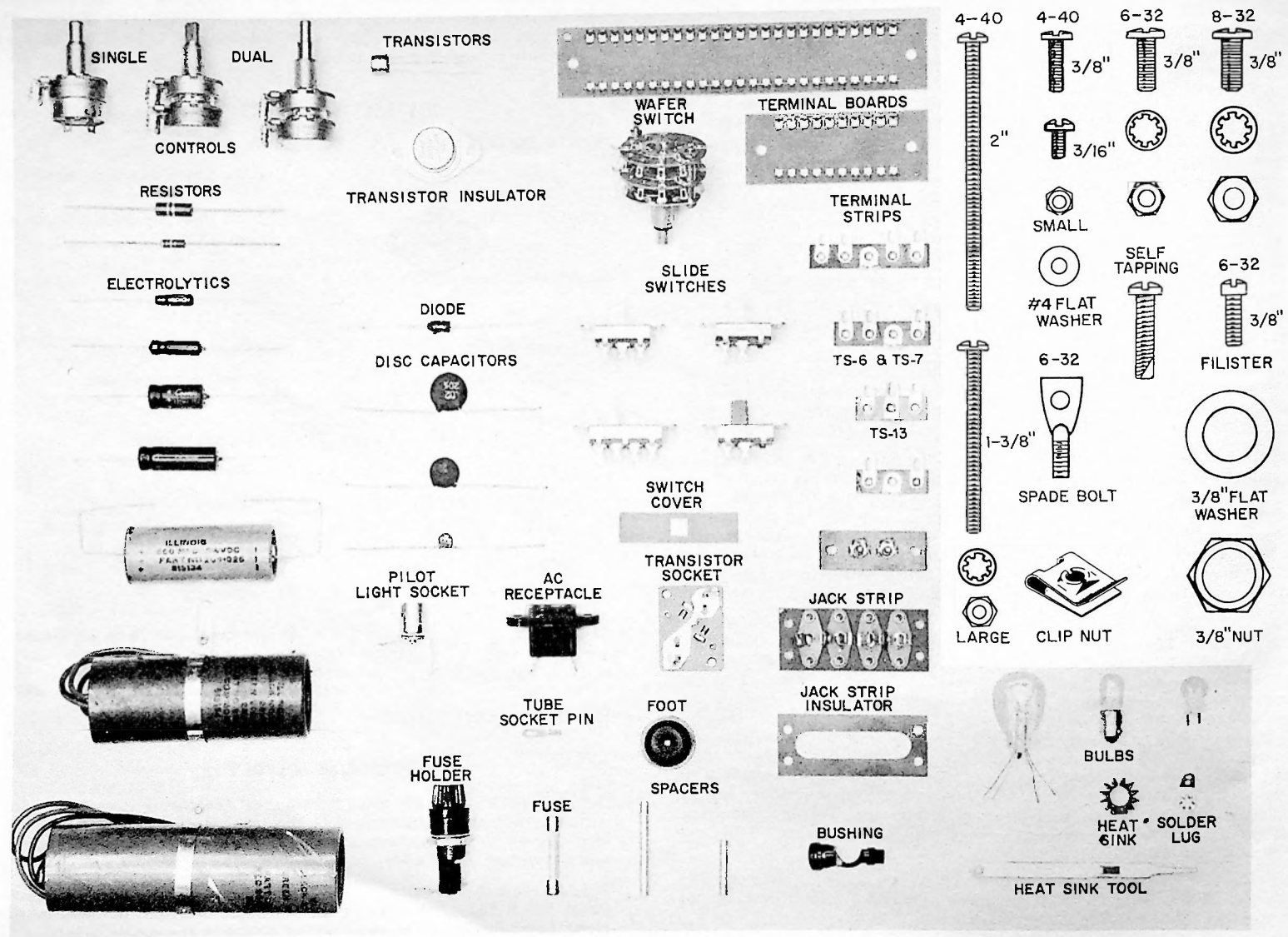


FIGURE 38. PARTS IDENTIFICATION

# PARTS LIST

## CAPACITORS

All capacitors ceramic disc, 20% tolerance,  
unless otherwise specified.

Symbol Number	Description	Part Number
C-1	82 $\mu\text{f}$ , 10% .....	296016
C-2	82 $\mu\text{f}$ , 10% .....	296016
C-3	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-4	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-5	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-6	.02 $\mu\text{f}$ , 500 volts .....	276025
C-7	.05 $\mu\text{f}$ , 50 volts .....	278051
C-8	.01 $\mu\text{f}$ , 600 volts .....	276015
C-9	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-10	.02 $\mu\text{f}$ , 500 volts .....	276025
C-11	.05 $\mu\text{f}$ , 50 volts .....	278051
C-12	.01 $\mu\text{f}$ , 600 volts .....	276015
C-13	50 $\mu\text{f}$ , 10 volt electrolytic .....	221500
C-14	50 $\mu\text{f}$ , 10 volt electrolytic .....	221500
C-15	50 $\mu\text{f}$ , 10 volt electrolytic .....	221500
C-16	50 $\mu\text{f}$ , 10 volt electrolytic .....	221500
C-17	100 $\mu\text{f}$ , 15 volt electrolytic .....	221107
C-18	100 $\mu\text{f}$ , 15 volt electrolytic .....	221107
C-19	.2 $\mu\text{f}$ , 10 volt, +80%, -10% .....	271024
C-20	.2 $\mu\text{f}$ , 10 volt, +80%, -10% .....	271024
C-21	10 $\mu\text{f}$ , 15 volt, electrolytic .....	221106
C-22	10 $\mu\text{f}$ , 15 volt, electrolytic .....	221106
C-23	.005 $\mu\text{f}$ , 500 volts .....	276054
C-24	.05 $\mu\text{f}$ , 50 volts .....	278051
C-25	.005 $\mu\text{f}$ , 500 volts .....	276054
C-26	.05 $\mu\text{f}$ , 50 volts .....	278051
C-27	2 $\mu\text{f}$ , 3 volts electrolytic .....	221205
C-28	2 $\mu\text{f}$ , 3 volts electrolytic .....	221205
C-29	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-30	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-31	1 $\mu\text{f}$ , 3 volt .....	271010
C-32	1 $\mu\text{f}$ , 3 volt .....	271010
C-33	1 $\mu\text{f}$ , 3 volt .....	271010
C-34	1 $\mu\text{f}$ , 3 volt .....	271010
C-35	2 $\mu\text{f}$ , 3 volt electrolytic .....	221205
C-36	2 $\mu\text{f}$ , 3 volt electrolytic .....	221205
C-37	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-38	10 $\mu\text{f}$ , 15 volt electrolytic .....	221106
C-39	.005 $\mu\text{f}$ , 500 volts .....	276054
C-40	.005 $\mu\text{f}$ , 500 volts .....	276054
C-41	500 $\mu\text{f}$ , 25 volt electrolytic .....	209052
C-42	100 $\mu\text{f}$ , 6 volt electrolytic .....	220107
C-43	100 $\mu\text{f}$ , 6 volt electrolytic .....	220107
C-44	.01 $\mu\text{f}$ , 600 volts .....	276015
C-45	.01 $\mu\text{f}$ , 600 volts .....	276015
C-46	.05 $\mu\text{f}$ , 50 volts .....	278051
C-47	.05 $\mu\text{f}$ , 50 volts .....	278051
C-48	3000/1500 $\mu\text{f}$ , 25 volt electrolytic .....	211202
C-49	1000/200 $\mu\text{f}$ , 25 volt electrolytic .....	211203
C-50	500 $\mu\text{f}$ , 25 volt electrolytic .....	209052

## LAMPS

Symbol Number	Description	Part Number
I-1	#19 Lamp .....	640016
I-2	#19 Lamp .....	640016
I-3	2 Filament Lamp .....	640015
I-4	2 Filament Lamp .....	640015
I-5	#1829 Pilot Light .....	640014

## RECTIFIERS

Symbol	Description	Part Number
CR-1	Silicon .....	622202
CR-2	Silicon .....	622202
CR-3	Silicon .....	622202
CR-4	Silicon .....	622202

## RESISTORS

All resistors  $\frac{1}{2}$  watt, 10% carbon unless  
otherwise specified.

Symbol	Description	Part Number
R-1	100K .....	301104
R-2	47K .....	301473
R-3	680K .....	301684
R-4	270K .....	301274
R-5	270K .....	301274
R-6	270K .....	301274
R-7	270K .....	301274
R-8	100K .....	301104
R-9	47K .....	301473
R-10	680K .....	301684
R-11	270K .....	301274
R-12	270K .....	301274
R-13	270K .....	301274
R-14	270K .....	301274
R-15	10K .....	301103
R-16	100K .....	301104
R-17	2.2K .....	301222
R-18	20K, 5% Film .....	330021
R-19	470 $\Omega$ .....	301471
R-20	4.7K .....	301472
R-21	7.5K, 5% .....	302752
R-22	100K .....	301104
R-23	10K .....	301103
R-24	2.2K .....	301222
R-25	20K, 5%, Film .....	330021
R-26	470 $\Omega$ .....	301471
R-27	4.7K .....	301472
R-28	7.5K, 5% .....	302752
R-29	100K .....	301104
R-30	4.7K .....	301472
R-31	6.8K, 5% Film .....	330051
R-32	330 $\Omega$ .....	301331
R-33	100K .....	301104
R-34	4.7K .....	301472
R-35	6.8K, 5% Film .....	330051

## RESISTORS (Cont'd)

Symbol Number	Description	Part Number
R-36	330 $\Omega$ .....	301331
R-37	2.2 Meg .....	301225
R-38	330K .....	301334
R-39	680K .....	301684
R-40	4.7K, 5% Film .....	330011
R-41	2.2 Meg .....	301225
R-42	330K .....	301334
R-43	680K .....	301684
R-44	4.7K, 5% Film .....	330011
R-45	50K, dual control .....	420041
R-46	10K, dual control .....	420042
R-47	50K, control, with S-2 .....	390169
R-48	3.9K .....	301392
R-49	3.9K .....	301392
R-50	50K, dual concentric .....	420037
R-51	50K, dual concentric .....	420037
R-52	4.7K .....	301472
R-53	4.7K .....	301472
R-54	10K .....	301103
R-55	10K .....	301103
R-56	10K .....	301103
R-57	100K .....	301104
R-58	100K .....	301104
R-59	10K .....	301103
R-60	4.7K .....	301472
R-61	4.7K .....	301472
R-62	24K, 5% .....	302243
R-63	24K, 5% .....	302243
R-64	330 $\Omega$ .....	301331
R-65	330 $\Omega$ .....	301331
R-66	20K, 5% Film .....	330021
R-67	Omitted .....	
R-68	20K, 5% Film .....	330021
R-69	Omitted .....	
R-70	Omitted .....	
R-71	20 $\Omega$ , 5% Wirewound .....	302200
R-72	Omitted .....	
R-73	20 $\Omega$ , 5% Wirewound .....	302200
R-74	Omitted .....	
R-75	Omitted .....	
R-76	560 $\Omega$ , 1 watt .....	330052
R-77	560 $\Omega$ , 1 watt .....	330052
R-78	470 $\Omega$ , 1 watt .....	304471
R-79	2.2 $\Omega$ , 5% Wirewound .....	312020
R-80	470 $\Omega$ , 1 watt .....	304471
R-81	2.2 $\Omega$ , 5% Wirewound .....	312020
R-82	470 $\Omega$ , 1 watt .....	304471
R-83	2.2 $\Omega$ , 5% Wirewound .....	312020
R-84	470 $\Omega$ , 1 watt .....	304471
R-85	2.2 $\Omega$ , 5% Wirewound .....	312020
R-86	100 $\Omega$ .....	301101
R-87	100 $\Omega$ .....	301101
R-88	2.2K .....	301222
R-89	680K .....	301684

# PARTS LIST

## RESISTORS (Cont'd)

Symbol Number	Description	Part Number
R-90	10K	301103
R-91	680K	301684
R-92	10K	301103
R-93	100K	301104
R-94	18K, 5%	302183
R-95	100K	301104
R-96	18K, 5%	302183
R-97	4K, 5%	302402
R-98	4K, 5%	302402
R-99	4.7K	301472
R-100	4.7K	301472
R-101	68 Ω, 1 watt	304680

## SWITCHES

S-1	2-wafer switch	432218
S-2	ON R-47	
S-3	6-terminal slide	431307
S-4	8-terminal slide	431504
S-5	4-terminal slide	431200
S-6	4-terminal slide	431200
S-7	4-terminal slide, red button	431201

## TERMINAL BOARDS

TB-1	50-terminal	442500
TB-2	20-terminal	442203

## TERMINAL STRIPS

TS-1	2-screw	441201
TS-2	2-screw	441201
TS-3	4-jack	502240
TS-4	4-jack	502240
TS-5	4-jack	502240
TS-6	3-terminal	440303
TS-7	3-terminal	440303
TS-8	2-terminal	440201
TS-9	2-terminal	440201
TS-10	2-terminal	440201
TS-11	2-terminal	440201
TS-12	2-terminal	440201
TS-13	3-terminal	440301
TS-14	4-terminal	440402
TS-15	4-terminal	440402
TS-16	2-terminal	440201
TS-17	2-terminal	440201
TS-18	4-terminal	440402

## TRANSFORMERS

Symbol Number	Description	Part Number
T-1	Power	101207
T-2	Driver	103300
T-3	Driver	103300

## TRANSISTORS

Description	Quantity	Part Number
Low Noise	4	660028
Small Signal	8	660029
Driver	2	660030
Power, Output	4	660031
Power	2	660032

## MISCELLANEOUS

Board, PC	2	820113
Bushing, line cord	1	880031
Button, Pilot light	1	641002
Chassis	1	461608
Cover, fiber switch	1	850058
Foot	4	880016
Fuse, 1½ amp	1	491012
Fuse holder	1	492200
Heat, sink, transistor	2	480022
Heat sink, tool	1	957009
Insulator, jack strip	3	850060
Insulator, transistor	6	811013
Knob, large	2	761006
Knob, small shaft hole	2	763511
Knob, large shaft hole	2	763512
Manual, assembly	1	750315
Panel, dress	1	480025
Pin, tube socket	4	502244
Receptacle, AC	2	502226
Shield	1	470431
Socket, pilot light	1	501730
Socket, transistor	6	501020
Spacer, large	2	480027
Spacer, small	2	480026

## HARDWARE

Description	Quantity	Part Number
Flatwasher, 4-40	4	580200
Flatwasher, ½"	6	580702
Lockwasher, #4	12	582200
Lockwasher, #6	52	582300
Lockwasher, #8	1	582400

## HARDWARE (Cont'd)

Description	Quantity	Part Number
Lockwasher, ¾"	6	582700
Nut, small clip	1	572220
Nut, large clip	1	531009
Nut, knurled	1	572441
Nut, 3-48	10	570110
Nut, 4-40	20	570221
Nut, 6-32	55	570340
Nut, 8-32	1	570440
Nut, ¾"	12	570840
Screw, 3-48 x ¾"	8	560111
Screw, 3-48 x ¾", flathead	2	563114
Screw, 4-40 x 3/16"	2	560221
Screw, 4-40 x ¾"	14	560224
Screw, 4-40 x ¾"	1	560227
Screw, 4-40 x 1 ½"	2	564221
Screw, 4-40 x 2"	2	564225
Screw, 6-32 x ¾"	31	560344
Screw, 6-32 x ½"	4	560346
Screw, 6-32 x ¾", filister head	12	563344
Screw, 8-32 x ½"	1	560446
Screw, self-tapping	12	563390
Setscrew, 7/16" long	2	563445
Setscrew, ¼" long	4	569001
Solder lug	2	553005
Spade bolt	4	568344

## WIRE, SOLDER AND TUBING

Bare wire, #16, 74" long	1	806400
Bare wire, #20, 10" long	1	806010
Cable, 140"	1	803090
Cable, 2-conductor, 22"	1	803065
Line cord	1	802012
Solder, 10'	2	930005
Tubing, #16, 38" long	1	812014
Tubing, #20, 46" long	1	812001
Wire, 2", red	24	801002
Wire, 3", orange	20	801003
Wire, 4", yellow	10	801004
Wire, 5", green	7	801005
Wire, 6", blue	4	801006
Wire, 7", violet	7	801007
Wire, 8", gray	1	801008
Wire, 9", white	3	801009
Wire, 10", brown	3	801010

## SUGGESTED ACCESSORIES

Stock Number	Description	Price
83 YX 644	Metal Case	\$ 4.95
83 YX 645	Wood cabinet	12.45

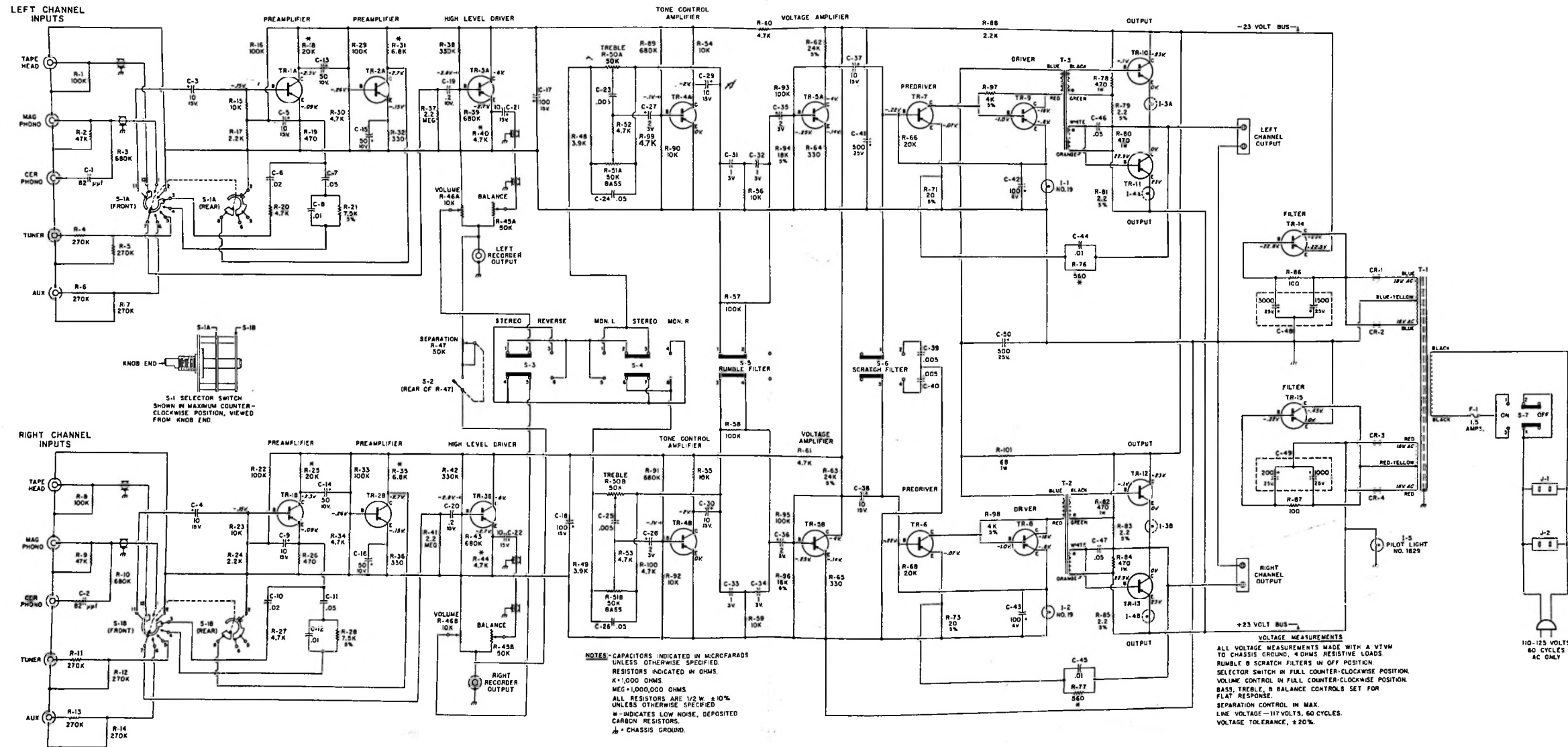


FIGURE 39. SCHEMATIC DIAGRAM

# ALLIED SERVICE FACILITIES

## FREE INFORMATION SERVICE

First, write a letter to us if your wired kit does not operate properly. Address KNIGHT-KIT Dept. at Allied Radio. Give the stock number of the kit, date of purchase and describe the problem. In a great many cases our technicians can determine corrective steps from the information in your letter. This free information service may save you the expense and inconvenience of returning the kit for repairs.

Should it appear that work in our shop is necessary, we will send you a pre-addressed label and specific packing instructions for your kit.

## SPECIAL INSPECTION SERVICE

You may return this wired KNIGHT-KIT for inspection and repair within one year after purchase for a special service charge of \$12.50. An additional charge will be made for any parts damaged in construction or for parts beyond the ELA 90-day warranty period. Service charges for kits returned after the one year period will be based on the length of time needed to repair the unit plus the cost of any parts required.

**PLEASE NOTE:** Kits soldered with acid core solder, paste flux, or with irons cleaned on a sal ammoniac block are not eligible for repair or service because they have been permanently damaged by the acid flux.

## PACKING INSTRUCTIONS

If you return this kit, pack it well. Do NOT use the original carton—it is too small for the assembled kit. To prevent damage in shipment, use a carton large enough so that cushioning material can be placed around the instrument. Cushion it well and tightly. Mark it: **FRA-GILE—DELICATE ELECTRONIC EQUIPMENT.**

We recommend that this equipment be shipped **ONLY** by Railway Express, if at all possible, to forestall damage in shipment. Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed for standard repair charges plus transportation costs. Any excess remittance will be refunded.

## IF YOUR KIT ARRIVED DAMAGED

If your kit was damaged in a parcel post shipment, please write us at once, describing the condition in which the shipment was received. If your kit was part of a Railway Express shipment that was damaged in transit, please notify the local Railway Express agent at once and then write us.

## KNIGHT-KIT GUARANTEE

Allied fully protects your Knight-Kit purchase with this exclusive money-back guarantee. Your Knight-Kit must meet with your complete satisfaction or your purchase price is refunded.

In addition, we guarantee that only premium-quality components are selected for use in KNIGHT-KITS. Every KNIGHT-KIT component is fully warranted against defects in material and workmanship for a period of 90 days from date of original purchase. Should replacement parts be required under this warranty, notify us promptly, including sufficient details to identify the required parts. Parts will be shipped without charge. We reserve the right to request the return of defective parts.



**KNIGHT-KITS ARE YOUR BEST BUY** THE FINEST ELECTRONIC EQUIPMENT IN KIT FORM. CREATIVE ENGINEERING AND USE OF PREMIUM QUALITY PARTS ASSURE SUPERIOR PERFORMANCE. THAT'S WHY KNIGHT-KITS ARE SOLD WITH THIS EXCLUSIVE GUARANTEE: *EVERY KNIGHT-KIT MUST MEET PUBLISHED SPECIFICATIONS OR WE REFUND YOUR MONEY.*

**KNIGHT-KITS ARE "CONVENIENCE ENGINEERED"** RESISTORS ARE CARD MOUNTED AND IDENTIFIED. WIRE IS PRECUT. SMALL PARTS ARE PACKAGED IN SEE-THROUGH PLASTIC BAGS. DETAILS SUCH AS THESE AND STEP-BY-STEP INSTRUCTION MANUALS MAKE KNIGHT-KITS EASIEST TO BUILD.

**KNIGHT-KITS ARE THE FIRST CHOICE** OF EXACTING BUILDERS OF ELECTRONIC KITS EVERYWHERE AND HAVE BEEN SINCE THE EARLY 20's. THERE IS AN OUTSTANDING KNIGHT-KIT AVAILABLE FOR EVERY REQUIREMENT. EACH IS A REWARDING ADVENTURE IN KIT CONSTRUCTION. YOU WILL BE PROUD TO BUILD AND OWN A KNIGHT-KIT.