

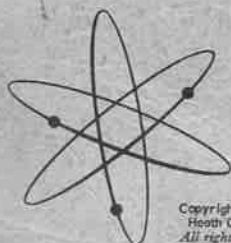
PRICE \$2.00

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATHKIT® ASSEMBLY MANUAL



**AM-FM-FM STEREO
SOLID-STATE RECEIVER**
MODEL AR-15



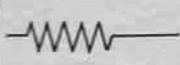
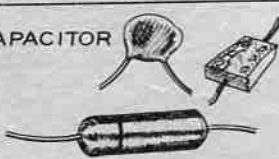
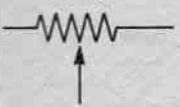
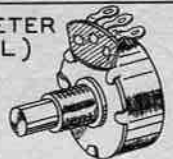
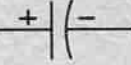
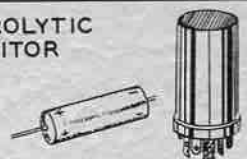
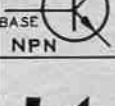
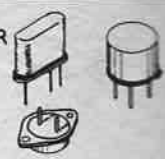
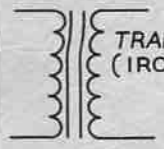
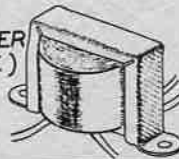
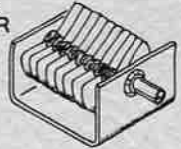
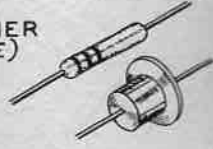
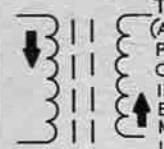
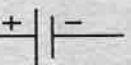
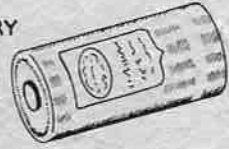
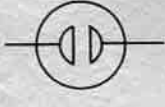
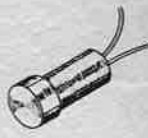
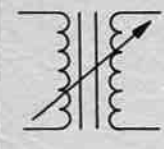
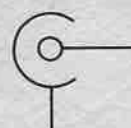
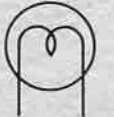
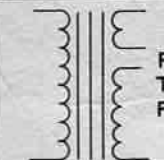
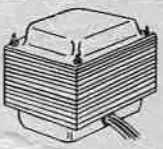
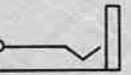
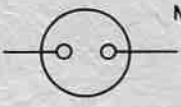
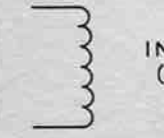
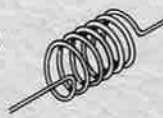
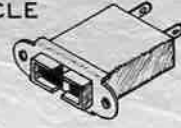
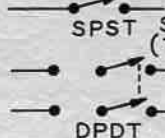
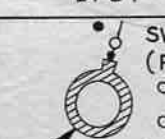
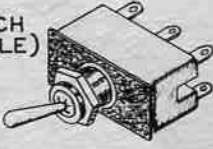
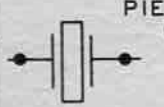
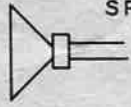
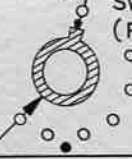
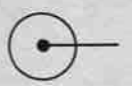
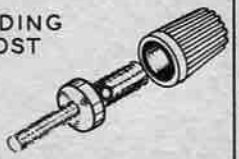
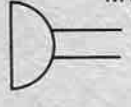
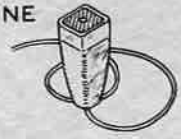
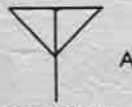
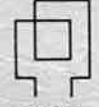
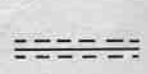
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TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations

should prove helpful in identifying most parts and reading the schematic diagrams.

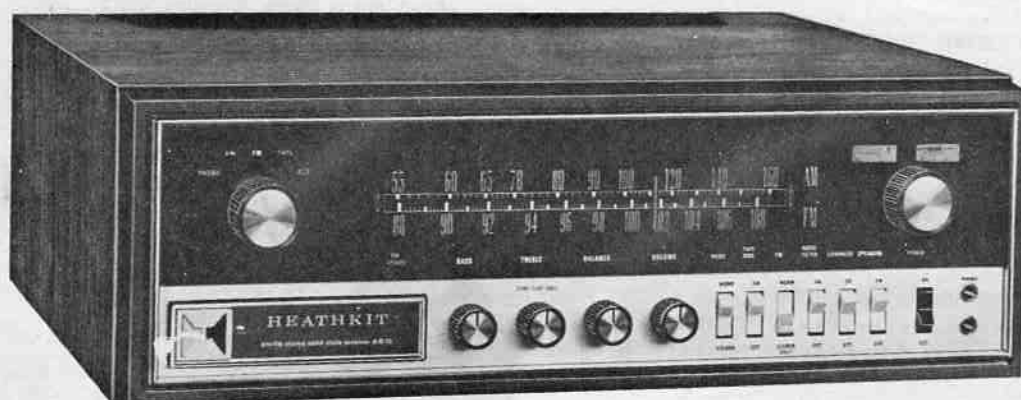
RESISTOR  	CAPACITOR  	 TUBE PLATE SUPPRESSOR SCREEN GRID CATHODE FILAMENT 
POTENTIOMETER (CONTROL)  	ELECTROLYTIC CAPACITOR  	PNP TRANSISTOR  NPN TRANSISTOR  TRANSISTOR COLLECTOR BASE EMITTER 
TRANSFORMER (IRON CORE)  	VARIABLE CAPACITOR  	RECTIFIER (DIODE)  
TRANSFORMER (ADJUSTABLE POWDERED IRON CORE) ARROW INDICATES DIRECTION OF CORE MOVEMENT TO INCREASE INDUCTANCE  	BATTERY  	 NEON BULB 
TRANSFORMER (ADJUSTABLE CORE)  	PHONO JACK  	 ILLUMINATING BULB 
POWER TRANSFORMER  	 PHONE JACK 	 METER 
INDUCTOR (COIL)  	 RECEPTACLE 	SPST SWITCH (TOGGLE)  DPDT  
PIEZOELECTRIC CRYSTAL  	 SPEAKER 	 SWITCH (ROTARY) 
 BINDING POST 	 MICROPHONE 	 FUSE 
 ANTENNA GENERAL  LOOP	 EARTH GROUND  CHASSIS GROUND	CONDUCTORS  NOT CONNECTED  CONNECTED  SHIELDED

Assembly and Operation of the



AM-FM-FM STEREO SOLID-STATE RECEIVER

Model AR-15



NOTE: THE AR-15 RECEIVER
IS SHOWN IN THE AE-16
ACCESSORY CABINET.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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NOTE: The Schematic is also on a large fold-in sheet in the back of the Manual.

INTRODUCTION

Your Heathkit Model AR-15 AM, FM, FM-Stereo Solid-State Receiver is a home entertainment center in one attractive package. The solid-state circuitry in this Receiver will provide you with the ultimate in high fidelity reproduction of AM, FM, and FM-stereo, plus inputs for phono, tape, and auxiliary sources.

Receiver operation is simplified by having only the primary controls and switches directly accessible on the front panel; secondary controls, which only need to be adjusted occasionally, are located behind a small door in the front panel. Individual input level controls are also located behind the panel door. These Phono, Tape, AM-FM, Tape Monitor, and auxiliary input level controls can be adjusted for equal sound levels when switching from one source to another.

Dual Bass and dual Treble controls are used in each channel. A Tone Flat switch bypasses the Tone controls, assuring a flat audio response. A Balance control permits the attenuation of either the right or left channel signal to compensate for speaker placement, room acoustics, or other factors that might otherwise produce unequal sound levels from the speakers.

Two front panel meters help you tune AM and FM stations accurately: The "Tune" meter indicates zero tuning at the exact center frequency of an FM station; the "Signal" meter normally indicates the relative strength of the AM or FM signal being received. This meter can also be switched to serve as a test meter during the initial checkout of the Receiver, or it can be switched into the multiplex circuit to adjust the 19 kHz pilot signal for maximum output.

Front-panel rocker-type switches are used for the selection of Mode, Noise Filter, Stereo Only, Mono, Speakers, Tape Mon, and Loudness. A back-lighted slide-rule-type dial, a die cast front panel, and a walnut wood cabinet (optional) give the receiver an impressive appearance that matches its high performance.

Any type of high fidelity speakers that have an impedance between 4 and 16 ohms can be used with this Receiver. Phone jacks are provided on the front panel so two pairs of stereo headphones can be used simultaneously. The Speaker switch on the front panel will turn off both speakers if only headphone listening is desired.

Sixty-nine transistors, forty-three diodes and two integrated circuits are used in the most advanced semi-conductor circuitry. The pre-assembled FM tuning unit uses field-effect transistors to provide high sensitivity and low cross-modulation, with no overloading on strong local stations. Two integrated circuits, each containing ten transistors and seven diodes in a space normally taken by one ordinary transistor, are used to both amplify and limit the FM IF signal. Two IF crystal filters provide excellent bandpass characteristics with minimum phase shift for sharp selectivity.

Most of the components in this Receiver are mounted on seven printed circuit boards; there are only a few chassis-mounted parts. Three cable assemblies, with color-coded wires, connect to numbered holes in the circuit boards to minimize assembly time and reduce the possibility of a wiring error.

Overload protection makes the power amplifier circuits virtually short-circuit-proof. Should the speaker leads be shorted together accidentally, the Zener diodes will limit the current in the output transistors. The thermal circuit breakers will cut off the DC supply voltage should the output transistors in either channel become too hot. These circuit breakers close automatically when the short is removed and the temperature of the output transistors returns to normal.

The power supply circuit provides regulated DC voltages to the various Receiver circuits. The heavy duty power transformer can be wired for operation from 120 volt or 240 volt AC outlets, and is protected by a slow-blow fuse. AC accessory sockets, both switched and unswitched, are mounted on the rear of the chassis.

This exceptional Receiver will give you a great deal of listening pleasure and satisfaction, plus long, dependable service.

THE MANUAL

The assembly part of this Manual is divided into several sections so all the parts will not be spread out on your work area at the same time. Each section contains a Parts List and Step-By-Step Assembly instructions for one part of the Receiver. Each Parts List matches a separate package of parts.

After you have completed the main assembly, an Initial Checkout section in the Manual describes a procedure for checking resistance and voltage in the various circuits, using the Receiver's Signal meter as a tester. This will help you locate and repair any wiring errors, short circuits, or other faults, that could damage components or cause faulty operation. A Test And Adjustment section gives a simple method of testing the signal paths in the Receiver and making all necessary adjustments.

UNPACKING

The Receiver packaging consists of the large shipping carton, which contains smaller packages and a number of loose parts. Some of the smaller packages have numbers 1 through 7 stamped on them (#1, #2, etc.). After these seven numbered packages have been removed from the large carton, the remaining parts in the carton will be part of package #7.

You will be directed to open each of these packages as they are needed. Each of the assembly sections of the Manual contains its own Parts List and Step-By-Step instructions. At the beginning of each Parts List you will be told which numbered package to open. You will also be directed to remove some of the parts from package #7 to complete each assembly section.

To avoid intermixing parts, do not open any of the parts packs until directed to do so at the beginning of one of the Parts Lists. Any part that is packaged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

Refer to the "Kit Builders Guide" for additional information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

To order replacement parts, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit.

PHONO PREAMPLIFIER CIRCUIT BOARD

PARTS LIST

Unpack the package marked 1 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Phono Preamplifier Parts Pictorial (fold-out from Page 21). Any part that is packaged in an

individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
-------------	------------------	-------------

RESISTORS

1/2 Watt

(1) 1-3	✓ 2	100 Ω (brown-black-brown)
1-13	✓ 2	2700 Ω (red-violet-red)
1-16	✓ 2	4700 Ω (yellow-violet-red)
1-109	✓ 2	12 K Ω (brown-red-orange)
1-121	✓ 1	120 K Ω (brown-red-yellow)

1/2 Watt 5% Low-Noise

(2) 4-12	✓ 2	390 Ω (orange-white-brown)
4-23	✓ 2	22 K Ω (red-red-orange)
4-24	✓ 2	24 K Ω (red-yellow-orange)
4-40	✓ 2	51 K Ω (green-brown-orange)
4-32	✓ 2	390 K Ω (orange-white-yellow)
4-33	✓ 2	470 K Ω (yellow-violet-yellow)

CAPACITORS

(3) 25-54	✓ 2	10 μ fd electrolytic, 15 V
25-56	✓ 2	100 μ fd electrolytic, 10 V
25-146	✓ 1	100 μ fd electrolytic, 30 V

PART No.	PARTS Per Kit	DESCRIPTION
-------------	------------------	-------------

NOTE: The Mylar* capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and example (fold-out from Page 21) to help identify these capacitors.

(4) 27-68	✓ 2	.0033 μ fd (3300) Mylar (wide orange band-red)
27-69	✓ 2	.0091 μ fd (9100) Mylar (white-brown-red)
27-85	✓ 2	.22 (0.22) μ fd Mylar (wide red band-yellow)

TRANSISTORS

(5) 417-91	✓ 2	2N5232A
417-135	✓ 2	2N3859A

ITEMS FROM PACK 7

85-165-2	✓ 1	Phono preamplifier circuit board
597-308	✓ 1	Kit Builders Guide
346-1	✓ 1	Small sleeving (vinyl)
	✓ 1	Manual (See front cover for part number.)
	✓	Solder

STEP-BY-STEP ASSEMBLY

Before you start the circuit board assembly, be sure to read the Circuit Board Parts Mounting and Soldering sections (Pages 11, 12, and 13) of the Kit Builders Guide.

Resistors will be called out by only the resistance value (in Ω or $K\Omega$) and color code. Use 1/2 watt resistors unless directed otherwise in a step.

Capacitors will be called out by only the capacitance value (in pf or μfd) and type (disc, silver mica, Mylar, electrolytic, or polystyrene).

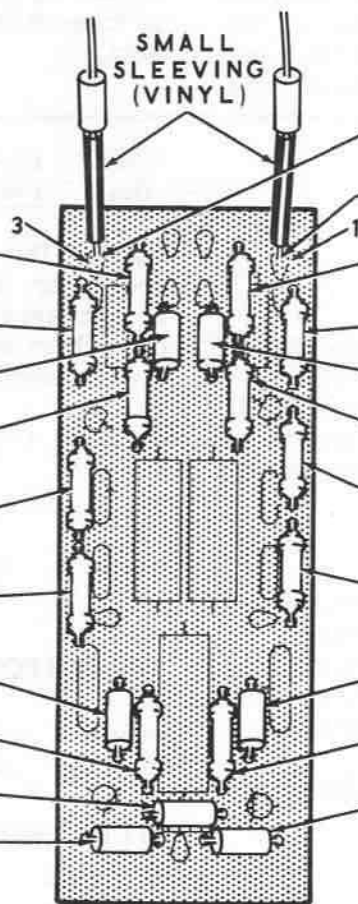
Position the phono preamplifier circuit board as shown in Pictorial 1-1. Then complete each step on the Pictorial.

START



CAUTION: When soldering parts on the circuit board, do not use too much solder. This could cause a solder bridge between two foils that should not be connected together. If a solder bridge should occur, reheat the connection and quickly brush away the solder between the foils. Also, after soldering several components, wipe the tip of the soldering iron with a cloth. Keeping the tip clean will insure better solder connections.

- (✓) 51 $K\Omega$ 5% (green-brown-orange), low-noise.
- (✓) 390 Ω 5% (orange-white-brown), low-noise.
- (✓) 2700 Ω (red-violet-red).
- (✓) 390 $K\Omega$ 5% (orange-white-yellow), low-noise.
- (✓) 24 $K\Omega$ 5% (red-yellow-orange), low-noise.
- (✓) 470 $K\Omega$ 5% (yellow-violet-yellow), low-noise.
- (✓) 100 Ω (brown-black-brown).
- (✓) 22 $K\Omega$ 5% (red-red-orange), low-noise.
- (✓) 120 $K\Omega$ (brown-red-yellow).
- (✓) 12 $K\Omega$ (brown-red-orange).
- (✓) Solder all leads to the foil side of the circuit board. Do not fill the unused holes with solder. After soldering, clip off the excess lead lengths.



CONTINUE



NOTE: When installing the resistors in the next two steps, use 3/4" lengths of small sleeving (vinyl) on the indicated leads. As each resistor is installed, solder the leads to the foil.

- (✓) 4700 Ω (yellow-violet-red) at hole 3.
- (✓) 4700 Ω (yellow-violet-red) at hole 1.
- (✓) 51 $K\Omega$ 5% (green-brown-orange), low-noise.
- (✓) 390 Ω 5% (orange-white-brown), low-noise.
- (✓) 2700 Ω (red-violet-red).
- (✓) 390 $K\Omega$ 5% (orange-white-yellow), low-noise.
- (✓) 24 $K\Omega$ 5% (red-yellow-orange), low-noise.
- (✓) 470 $K\Omega$ 5% (yellow-violet-yellow), low-noise.
- (✓) 100 Ω (brown-black-brown).
- (✓) 22 $K\Omega$ 5% (red-red-orange), low-noise.
- (✓) 12 $K\Omega$ (brown-red-orange).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

NOTE: Set aside the remaining length of sleeving; it will be used later.

PROCEED TO PICTORIAL 1-2.

PICTORIAL 1-1

START



NOTE: When mounting the electrolytic capacitors in the following steps, always match the positive (+) mark on the capacitor with the positive (+) mark lettered on the circuit board.



(✓) 10 μ fd electrolytic.

(✓) 100 μ fd electrolytic, 10 V.

NOTE: The Mylar capacitors may either be color coded or marked with a value.

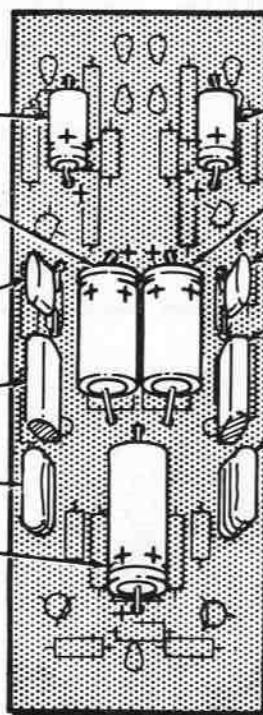
(✓) .0033 μ fd (3300) Mylar (wide orange band-red).

(✓) .0091 μ fd (9100) Mylar (white-brown-red).

(✓) .22 (0.22) μ fd Mylar (wide red band-yellow).

(✓) 100 μ fd electrolytic, 30 V.

(✓) Solder all leads to the foil and cut off the excess lead lengths.



CONTINUE



(✓) 10 μ fd electrolytic.

(✓) 100 μ fd electrolytic, 10 V.

(✓) .0033 μ fd (3300) Mylar (wide orange band-red).

(✓) .0091 μ fd (9100) Mylar (white-brown-red).

(✓) .22 (0.22) μ fd Mylar (wide red band-yellow).

(✓) Recheck the five electrolytic capacitors to make sure the positive (+) ends are positioned correctly.

(✓) Solder all leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 1-3.

PICTORIAL 1-2

Transistors, because they are small and use very little power, permit high-performance, compact designs that were not feasible with conventional electron tubes. Along with their virtues, however, many transistors do present a problem to the kit builder. Since most transistors are small, the leads must be grouped closely, making them difficult to identify correctly.

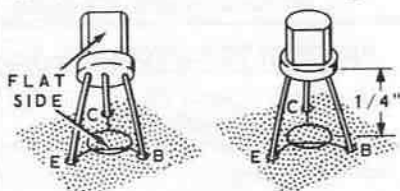
To help you avoid any problem in identifying transistor leads, we have provided the drawings below to show the lead arrangements. Refer to these drawings when you install the transistors. Make sure you correctly identify the leads of each transistor and that you connect each lead

in the correct hole of the circuit board. The C, B, and E leads of the transistor must be placed in the corresponding C, B, and E holes of the circuit board. After the transistor has been installed as directed, recheck its connections for accuracy. The kit will not work unless the transistor leads are connected properly.

NOTE: Due to a lack of standardization among transistor manufacturers, the transistors included in this kit may not appear exactly as pictured in the drawings accompanying the installation steps. Be sure to identify each transistor by the part or type number printed on the case before installation.

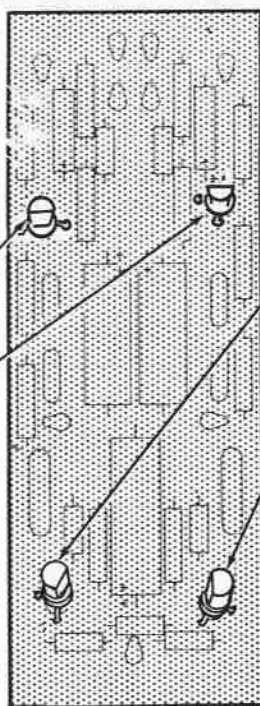
START

NOTE: Install the transistors in the following manner, as shown: First, match the flat side of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, the holes are indicated by the letters C, B, and E. Position the transistors 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



() Transistor 2N5232A (Part #417-91) at Q1R.

() Transistor 2N5232A (Part #417-91) at Q1L.



CONTINUE

() Transistor 2N3859A (Part #417-135) at Q2R.

() Transistor 2N3859A (Part #417-135) at Q2L.

() Recheck the transistors to make sure the leads were installed in the correct holes.

() Be sure all leads are soldered to the foil. Then set the circuit board aside until it is called for later.

FINISH

PICTORIAL 1-3

POWER SUPPLY CIRCUIT BOARD

PARTS LIST

Unpack the package marked 2 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Power Supply Circuit Board Parts Pictorial (fold-out from Page 21). Any part that is pack-

aged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
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RESISTORS

1/2 Watt

(1) 1-118	✓1	82 Ω (gray-red-black)
1-3	✓1	100 Ω (brown-black-brown)
1-66	✓1	150 Ω (brown-green-brown)
1-6	✓1	470 Ω (yellow-violet-brown)
1-7	✓1	680 Ω (blue-gray-brown)
1-11	✓1	1500 Ω (brown-green-red)
1-109	✓1	12 K Ω (brown-red-orange)
1-65	✓1	51 K Ω (green-brown-orange)
1-34	✓1	680 K Ω (blue-gray-yellow)

Other Resistors

(2) 1-57-1	✓1	5600 Ω 1 watt (green-blue-red)
(3) 3-26-5	✓1	390 Ω 5 watt
(4) 3-30-10	✓1	225 Ω 10 watt
3-31-10	✓1	290 Ω 10 watt

CAPACITORS

NOTE: The Mylar capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and

PART No.	PARTS Per Kit	DESCRIPTION
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example (fold-out from Page 21) to help identify these capacitors.

(5) 27-60	✓2	.22 (0.22) μ fd Mylar (wide red band-yellow)
(6) 25-146	✓3	100 μ fd electrolytic, 30 V
(7) 25-172	✓1	100 μ fd electrolytic, 70 V
25-173	✓1	500 μ fd electrolytic, 75 V

DIODES

(8) 56-25	✓1	Zener, 15 V
56-47	✓1	Zener, 27 V
(9) 57-27	✓3	Silicon (70SP), 750 milliam pere
(10) 57-42	✓4	Silicon, 3 ampere

TRANSISTORS-CONNECTOR PIN

(11) 417-116	✓1	S2091
(12) 417-203	✓1	TA-7311
(13) 417-137	✓1	40409
(14) 259-20	✓10	Connector pin

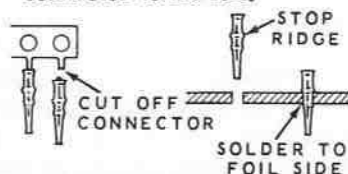
ITEMS FROM PACK 7

85-163-2	1	Power supply circuit board
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STEP-BY-STEP ASSEMBLY

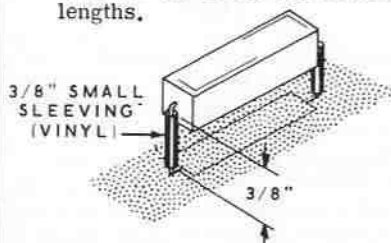
START

- () Install ten connectors in holes 5, 7, 11, 12, 13, 14, 15, 16, 17, and 18 as shown. Push the connectors into the holes until the stop ridge is firmly against the circuit board. Then solder the connector to the foil.



- (✓) 150 Ω (brown-green-brown).

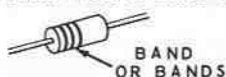
- (✓) 390 Ω 5 watt. Place a 3/8" length of small sleeving (vinyl) on each lead. Then install the resistor, solder the leads to the foil, and cut off the excess lead lengths.



- (✓) 12 K Ω (brown-red-orange).

- (✓) 51 K Ω (green-brown-orange).

- (✓) Zener diode (part #56-47) at ZD501. Be sure to position the cathode end of the diode as shown. The cathode end is marked with a band or bands.



NOTE: When installing the next two resistors, use a 7/16" length of small sleeving (vinyl) on each lead.

- (✓) 290 Ω 10 watt. Solder both leads. Disregard the 7 watt marking on the circuit board.

- (✓) 225 Ω 10 watt. Solder both leads. Disregard the 230 and 7 watt markings on the circuit board.

- (✓) Bend the 225 Ω resistor 1/4" away from the 290 Ω resistor as shown in the inset.

- (✓) Solder all leads to the foil and cut off the excess lead lengths.

Position the power supply circuit board as shown in Pictorial 2-1. Then complete each step on the Pictorial.

CONTINUE

NOTE: When installing the following silicon diodes, be sure to position the cathode end as shown. The cathode end is marked with a band.



- (✓) Silicon diode (part #57-42) at D506, D507, D508, and D509.

NOTE: When installing the following silicon diodes, be sure to position the cathode end as shown. The cathode end is marked with either a color end or band.



- (✓) Silicon diodes 70 SP (Part #57-27) at D503, D504 and D505.

- (✓) Zener diode (part #56-25) at ZD502. Position the cathode end as shown.

- (✓) 5600 Ω (green-blue-red) 1 watt.

- (✓) 470 Ω (yellow-violet-brown).

- (✓) 680 K Ω (blue-gray-yellow).

- (✓) 1500 Ω (brown-green-red).

- (✓) 680 Ω (blue-gray-brown).

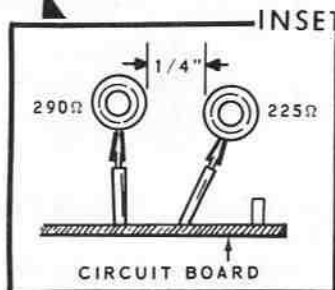
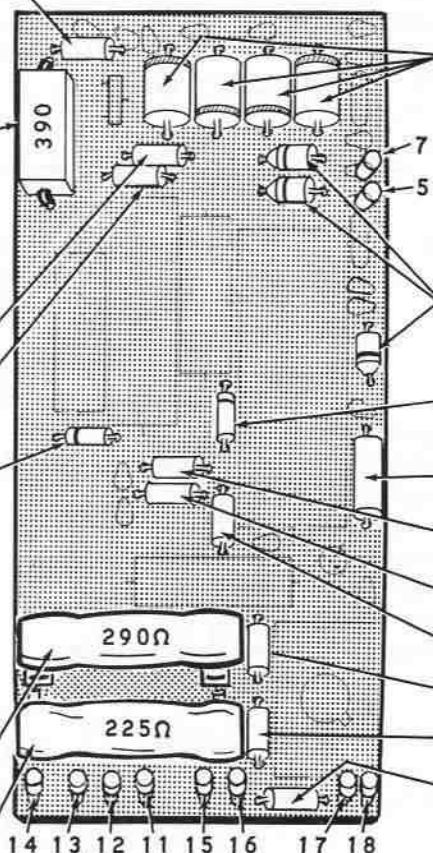
- (✓) 100 Ω (brown-black-brown).

- () 82 Ω (gray-red-black).

- (✓) Solder all leads to the foil and cut off the excess lead lengths.

- (✓) Set aside the remaining length of sleeving; it will be used later.

PROCEED TO PICTORIAL 2-2.



PICTORIAL 2-1

START

NOTE: The Mylar capacitors may be either color coded or marked with a value.

(✓) .22 (0.22) μ fd Mylar (wide red band-yellow).

(✓) .22 (0.22) μ fd Mylar (wide red band-yellow).

(✓) 100 μ fd 30 V electrolytic. NOTE: When mounting electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.



(✓) 100 μ fd 70 V electrolytic.

(✓) 100 μ fd 30 V electrolytic.

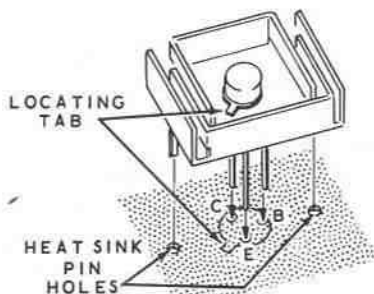
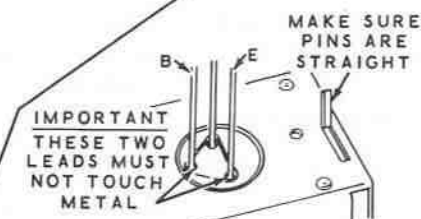
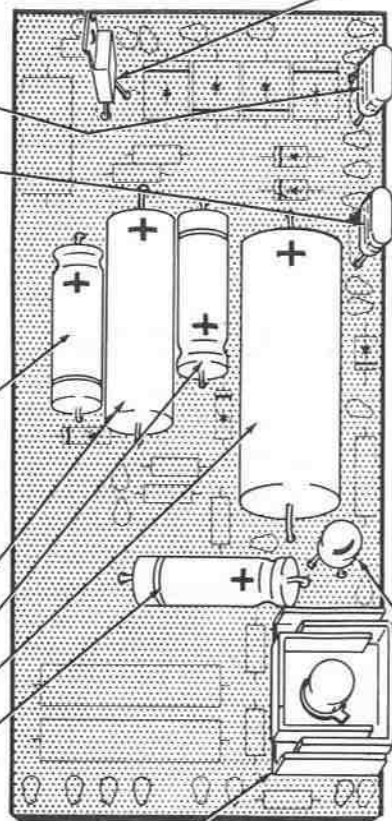
(✓) 500 μ fd 75 V electrolytic.

(✓) 100 μ fd 30 V electrolytic.

(✓) Recheck the five electrolytic capacitors to make sure the positive (+) end are positioned correctly.

(✓) Solder all leads to the foil and cut off the excess lead lengths.

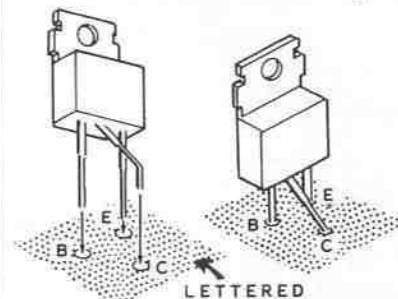
(✓) Install transistor 40409 (part #417-137) at Q504 in the following manner, as shown in Detail 2-2A: First turn the transistor over and check the B and E leads to make sure they are not touching the metal heat sink. Then line up the locating tab of the tab on the circuit board. Insert the transistor leads into their correct holes, which are indicated by C, B, and E. Push the heat sink pins into the holes in the circuit board. Then solder the pins and transistor leads to the foil. Clip off the excess transistor lead lengths.



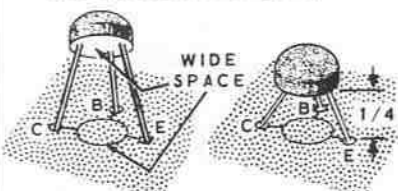
Detail 2-2A

CONTINUE

() Install transistor TA-7311 (part #417-203) at Q502 in the following manner, as shown: First line the transistor with the outline on the circuit board. Then insert the transistor leads into their correct holes which are indicated by C, B, and E. Position the transistor 1/4" above the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



() Install transistor S2091 (part #417-116) at Q503 in the following manner, as shown: First note the wide space on the circuit board between letters C and E. Then note the wide space between the transistor leads. Line up the wide space between the transistor leads with the wide space on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistor 1/4" away from the circuit board. Solder each lead to the foil and cut off the excess lead lengths.



() Recheck the last two transistors to make sure the leads were installed in the correct holes.

() Carefully inspect the foil side of the circuit board and solder any connections that might have been missed. Then set this circuit board aside temporarily.

PICTORIAL 2-2

POWER AMPLIFIER CIRCUIT BOARDS

PARTS LIST

Unpack the package marked 3 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Power Amplifier Circuit Board Parts Pictorial (fold-out from Page 21). Any part that is

packaged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
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RESISTORS

1/2 Watt

(1) 1-129	✓2	4.7 Ω (yellow-violet-gold)
1-3	✓6	100 Ω (brown-black-brown)
1-42	✓2	270 Ω (red-violet-brown)
1-4	✓2	330 Ω (orange-orange-brown)
1-9	✓4	1000 Ω (brown-black-red)
1-16	✓2	4700 Ω (yellow-violet-red)
1-20	✓2	10 KΩ (brown-black-orange)

1/2 Watt 5% Low-Noise

(2) 4-16	✓2	1800 Ω (brown-gray-red)
4-17	✓2	2200 Ω (red-red-red)
4-18	✓2	3300 Ω (orange-orange-red)
4-26	✓6	33 KΩ (orange-orange-orange)
4-30	✓2	270 KΩ (red-violet-yellow)
4-31	✓2	330 KΩ (orange-orange-yellow)

PART No.	PARTS Per Kit	DESCRIPTION
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Other Resistors

(3) 1-1-1	✓2	470 Ω 1 watt (yellow-violet-brown)
(4) 3-24-5	✓4	.67 Ω 5 watt
3-7-5	✓2	11 Ω 5 watt

CAPACITORS

(5) 21-149	✓2	2.7 pf disc
21-17	✓2	270 pf disc
21-14	✓2	.001 μfd disc
(6) 20-139	✓2	330 pf silver mica

NOTE: The Mylar capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and example (fold-out from Page 21) to help identify these capacitors.

(7) 27-47	✓2	.1 μfd Mylar (brown-black-yellow)
(8) 25-180	✓2	2.2 μfd electrolytic (may be marked 2R2)

<u>PART</u> <u>No.</u>	<u>PARTS</u> <u>Per Kit</u>	<u>DESCRIPTION</u>
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CAPACITORS (cont'd.)

(9) 25-220	✓ 2	10 μ fd, 20 V tantalum
(10) 25-126	✓ 2	50 μ fd electrolytic
25-153	✓ 2	100 μ fd electrolytic
25-175	✓ 4	250 μ fd electrolytic

TRANSISTORS-DIODES-CONNECTORS

(11) 417-118	✓ 4	2N3393 transistor
(12) 417-136	✓ 2	40408 transistor

<u>PART</u> <u>No.</u>	<u>PARTS</u> <u>Per Kit</u>	<u>DESCRIPTION</u>
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TRANSISTORS-DIODES-CONNECTORS (cont'd.)

(13) 417-137	✓ 2	40409 transistor
417-138	✓ 2	40410 transistor
(14) 56-44	✓ 4	Zener diode
(15) 259-20	✓ 4	Connector pin

ITEMS FROM PACK 7

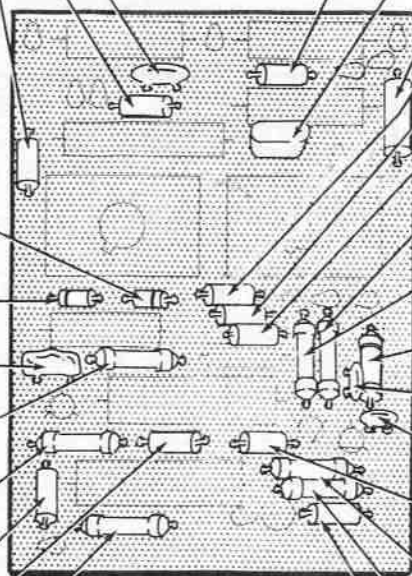
85-164-3	✓ 2	Power amplifier circuit board
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STEP-BY-STEP ASSEMBLY

Position either power amplifier circuit board as shown in Pictorial 3-1. Then complete each step on the Pictorial. NOTE: Repeat the following steps on each Pictorial for the other power amplifier board. Two checkoff spaces are provided in front of each step for this purpose.

START

(✓) (✓) .001 μ fd disc.
(✓) (✓) 100 Ω (brown-black-brown).
(✓) (✓) 4.7 Ω (yellow-violet-gold).
NOTE: When mounting the zener diodes in the next steps, position the cathode end as shown. The cathode end is marked with a band or bands.
 BAND OR BANDS
(✓) (✓) Zener diode (part # 56-44) at ZD204.
(✓) (✓) Zener diode (part #56-44) at ZD205.
(✓) (✓) 330 pf silver mica.
(✓) (✓) 33 K Ω 5% (orange-orange-orange), low-noise.
(✓) (✓) 2200 Ω 5% (red-red-red), low-noise.
(✓) (✓) 270 Ω (red-violet-brown).
(✓) (✓) 1000 Ω (brown-black-red).
(✓) (✓) 1800 Ω 5% (brown-gray-red), low-noise.
(✓) (✓) Solder all leads to the foil and cut off the excess lead lengths.



CONTINUE

(✓) (✓) 100 Ω (brown-black-brown).
NOTE: The Mylar capacitor may either be color coded or marked with a value.
(✓) (✓) .1 μ fd Mylar (brown-black-yellow).
(✓) (✓) 470 Ω (yellow-violet-brown) 1 watt.
(✓) (✓) 100 Ω (brown-black-brown).
(✓) (✓) 4700 Ω (yellow-violet-red).
(✓) (✓) 1000 Ω (brown-black-red).
(✓) (✓) 33 K Ω 5% (orange-orange-orange), low noise.
(✓) (✓) 3300 Ω 5% (orange-orange-red), low-noise.
(✓) (✓) 330 K Ω 5% (orange-orange-yellow), low noise.
(✓) (✓) 2.7 pf disc.
(✓) (✓) 270 pf disc.
(✓) (✓) 330 Ω (orange-orange-brown).
(✓) (✓) 270 K Ω (red-violet-yellow), low-noise.
(✓) (✓) 33 K Ω 5% (orange-orange-orange), low-noise.
(✓) (✓) 10 K Ω (brown-black-orange).
(✓) (✓) Solder all leads to the foil and cut off the excess lead lengths.

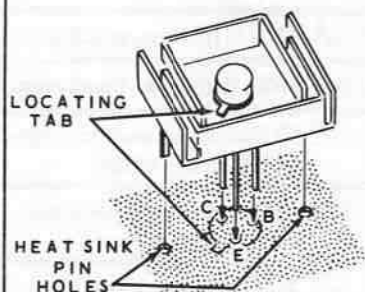
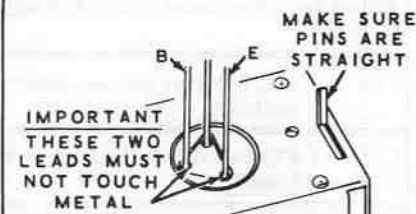
PROCEED TO PICTORIAL 3-2.

PICTORIAL 3-1

START

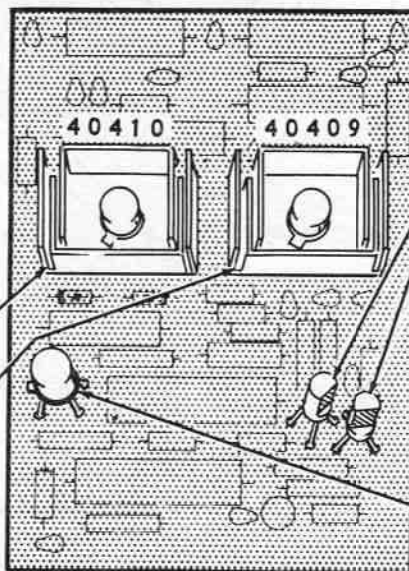


NOTE: Before installing the next two transistors, turn them over and check the B and E leads to make sure they are not touching the metal heat sink. Then install them in the following manner, as shown. First line up the locating tab of the transistor with the outline of the tab on the circuit board. Then insert the transistor leads into their correct holes which are indicated by C, B, and E. Push the heat sink pins into the circuit board. Then solder the pins and transistor leads to the foil. Clip off the excess transistor lead lengths.



(✓) (✓) 40410 transistor (part #417-138) at Q205.

(✓) (✓) 40409 transistor (part #417-137) at Q204.

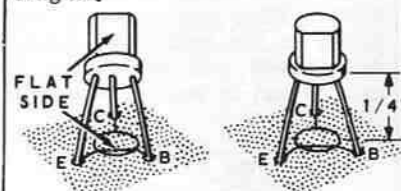


PICTORIAL 3-2

CONTINUE

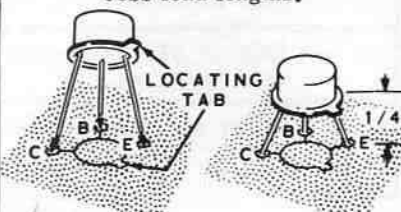


NOTE: Install the next two transistors in the following manner as shown: First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistor 1/4" away from the circuit board. Then solder each lead to the foil and clip off the excess lead lengths.



(✓) (✓) 2N3393 transistor (part #417-118) at Q201 and Q202.

(✓) (✓) Install transistor 40408 (Part #417-136) at Q203 in the following manner, as shown: First line up the locating tab of the transistor with the outline of the tab on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistor 1/4" away from the circuit board. Solder each lead to the foil and cut off the excess lead lengths.

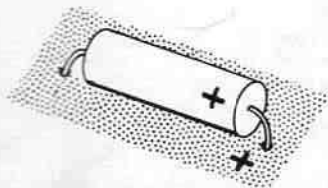


(✓) (✓) Carefully inspect the foil side of the circuit board and solder any connections that might have been missed.

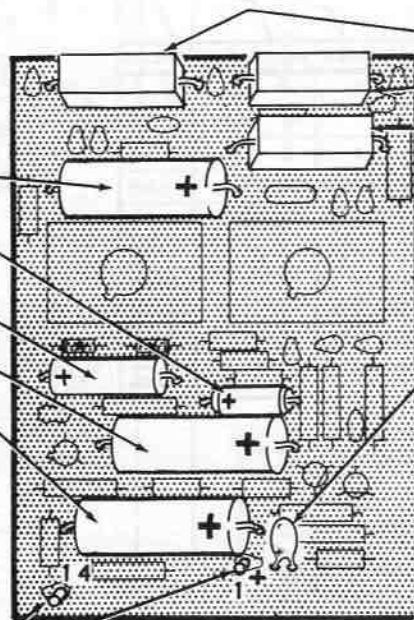
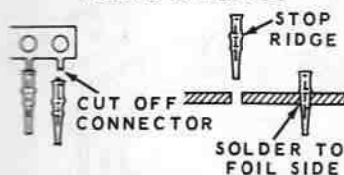
PROCEED TO PICTORIAL 3-3.

START

NOTE: When mounting the electrolytic capacitors in the following steps, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.



- (✓) (✓) 50 μ fd electrolytic.
- (✓) (✓) 2.2 μ fd electrolytic. May be marked 2R2.
- (✓) () 100 μ fd electrolytic.
- (✓) () 250 μ fd electrolytic.
- (✓) () 250 μ fd electrolytic.
- (✓) () Solder all leads to the foil and cut off the excess lead lengths.
- (✓) () Install connectors in holes 1 and 14 as shown. Push the connectors into the holes until the stop ridge is down firmly against the circuit board. Then solder the connectors to the foil.



CONTINUE

- (✓) (✓) .67 Ω 5 watt.
 - (✓) (✓) .67 Ω 5 watt.
 - (✓) (✓) 11 Ω 5 watt.
 - (✓) (✓) 10 μ fd tantalum electrolytic capacitor. Match positive (+) markings.
- POSITIVE (+) MARKING
-
- NOTE: Scrape off insulating material from the leads where they contact the foil.
- (✓) (✓) Recheck the six electrolytic capacitors to make sure the positive (+) ends are positioned correctly.
 - (✓) (✓) Solder all leads to the foil and cut off the excess lead lengths.
 - (✓) (✓) Carefully inspect the foil side of the circuit board and solder any connections that might have been missed. Then set this circuit board aside temporarily.

PICTORIAL 3-3

MYLAR CAPACITOR COLOR CODE CHART

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

EXAMPLE

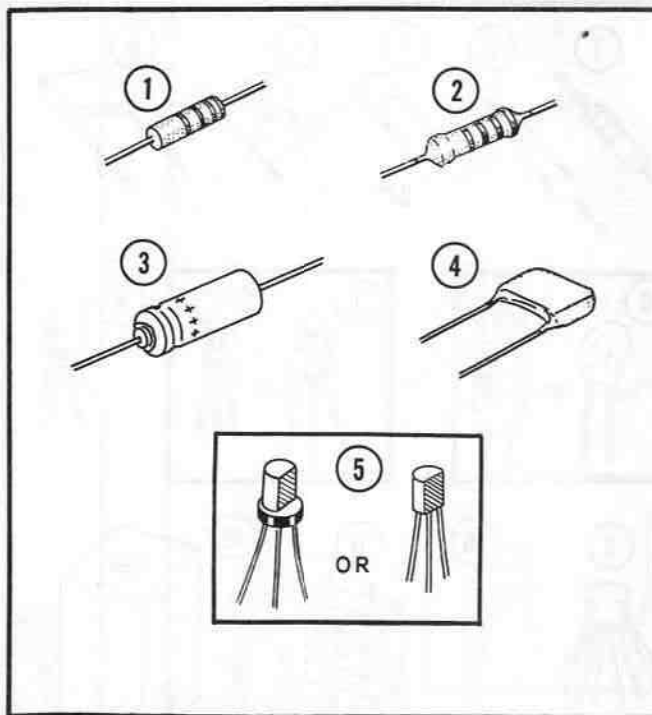
BROWN - 1

BLACK - 0

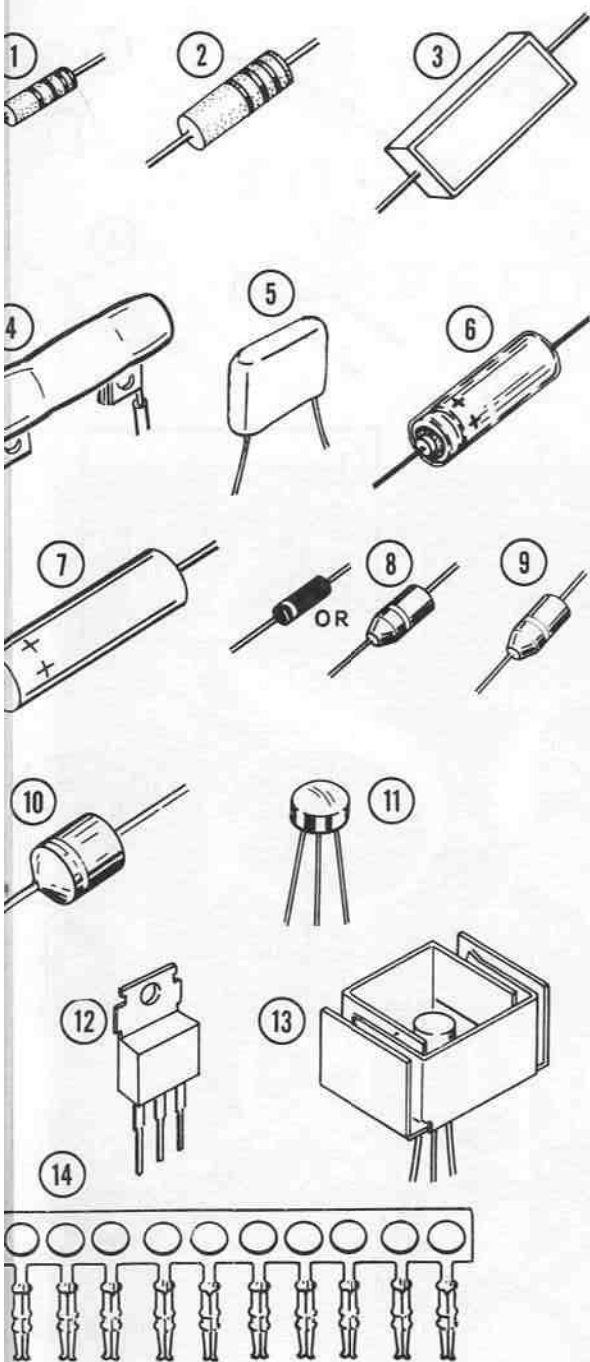
ORANGE - 1,000

$10 \times 1,000 = 10,000 \text{ pf}$
or
 $10,000 \text{ pf} = .01 \mu\text{fd}$

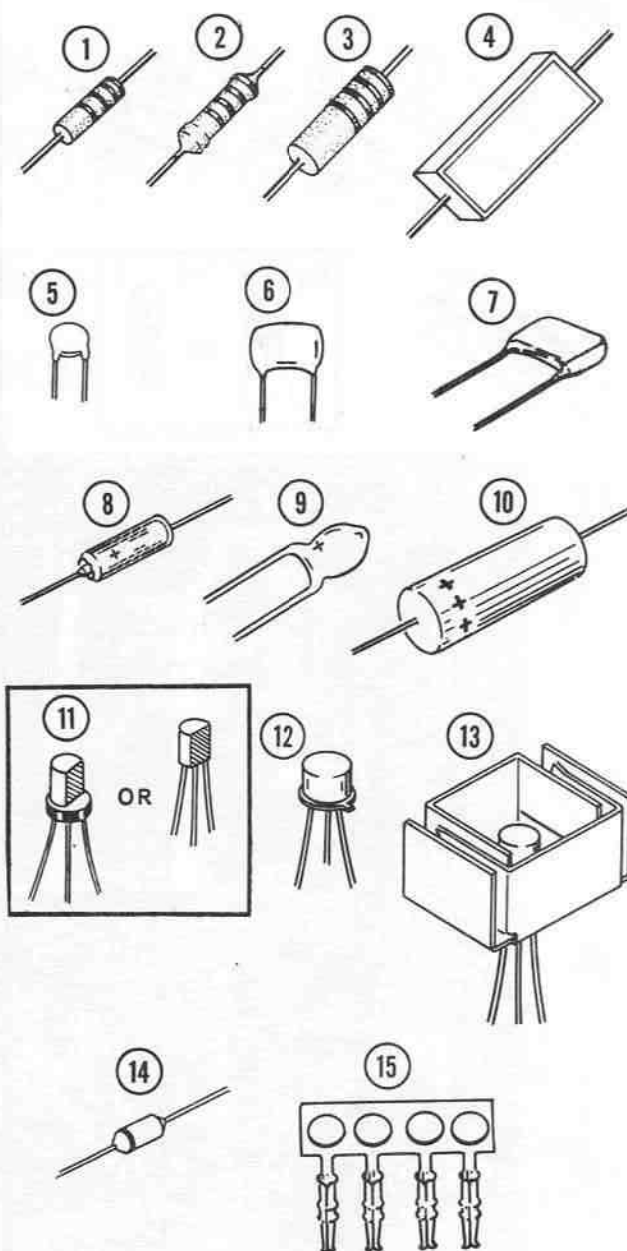
PHONO PREAMPLIFIER PARTS PICTORIAL



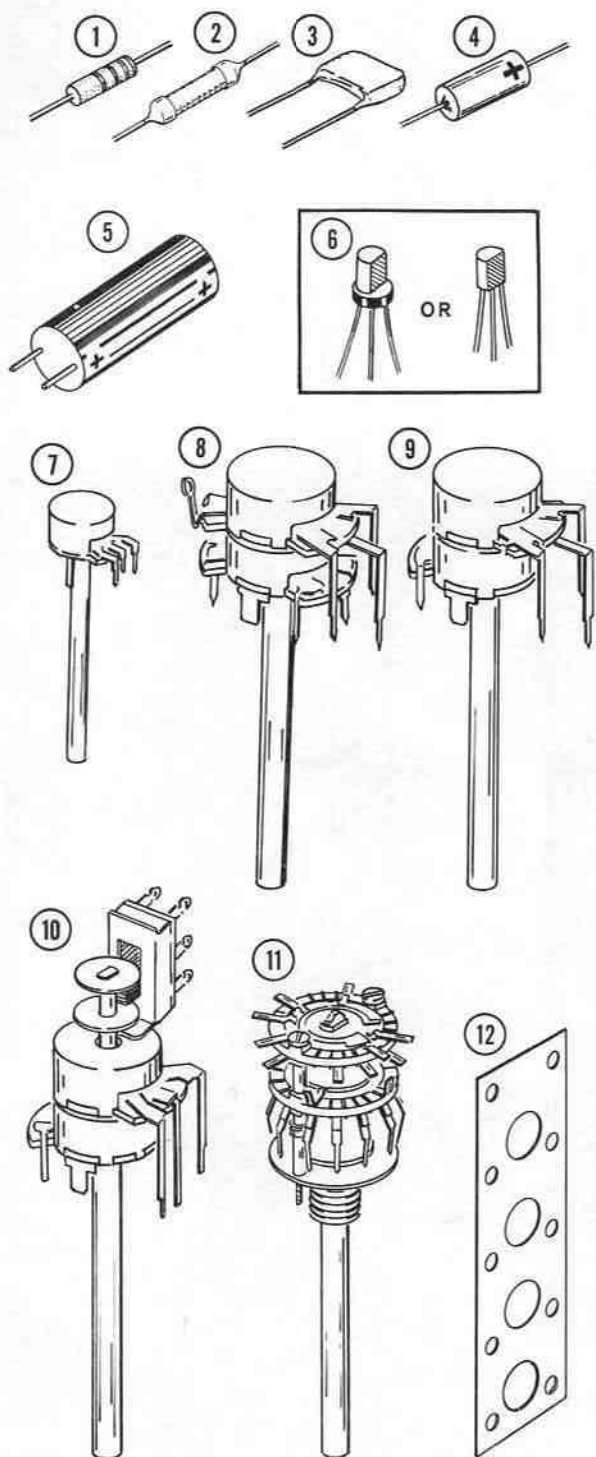
POWER SUPPLY
CIRCUIT BOARD
PARTS PICTORIAL



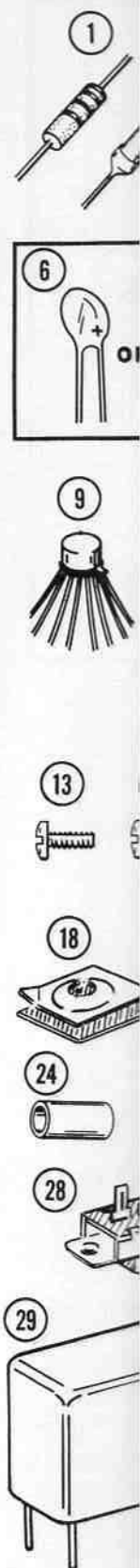
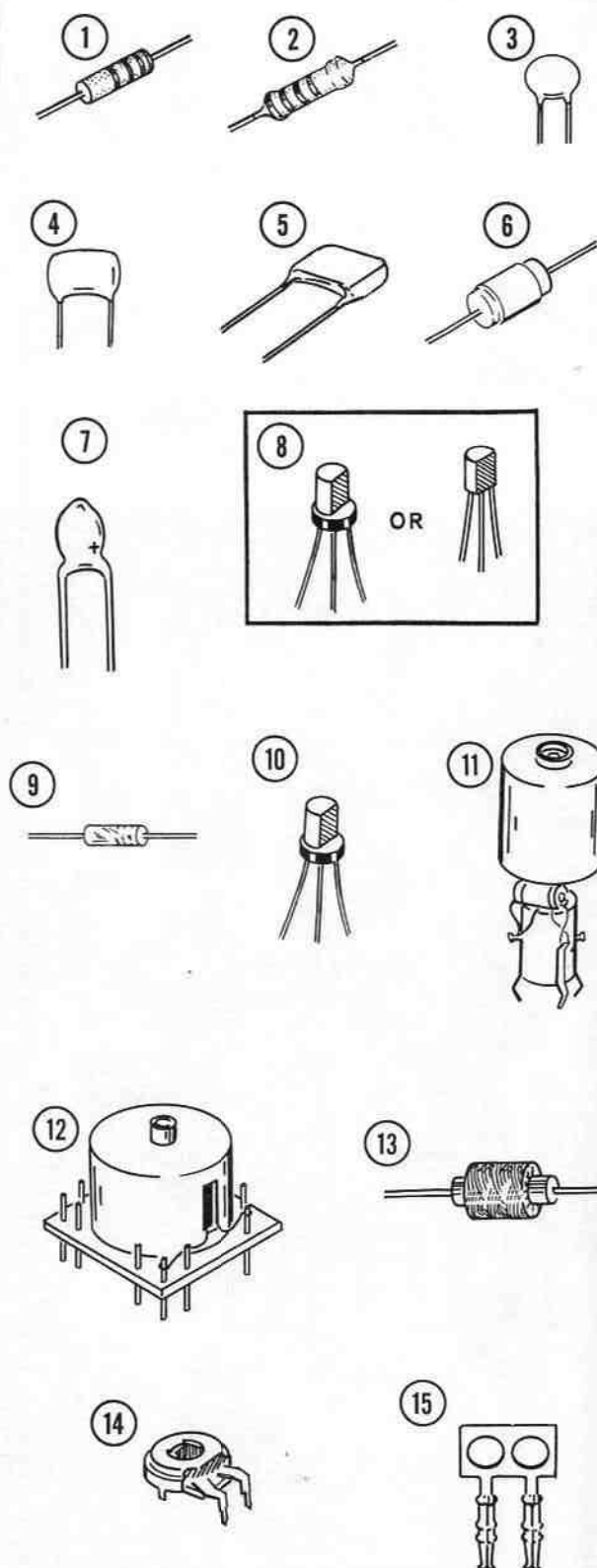
POWER AMPLIFIER
CIRCUIT BOARD
PARTS PICTORIAL



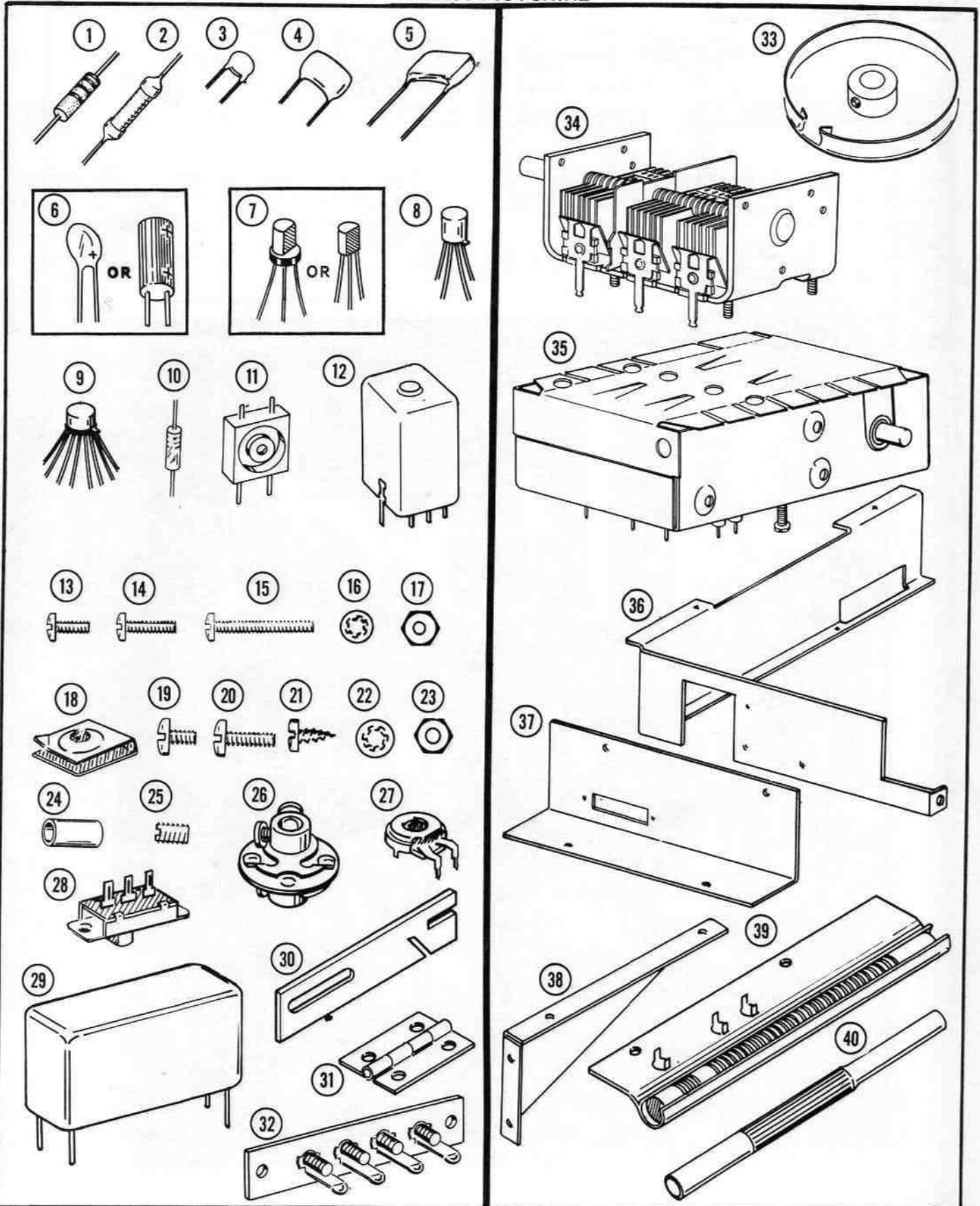
CONTROL PREAMPLIFIER CIRCUIT BOARD PARTS PICTORIAL



MULTIPLEX CIRCUIT BOARD PARTS PICTORIAL



AM-FM CIRCUIT BOARD PARTS PICTORIAL



MYLAR CAPACITOR COLOR CODE CHART

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

EXAMPLE

BROWN - 1

BLACK - 0

ORANGE - 1,000

$10 \times 1,000 = 10,000 \text{ pf}$

or

$10,000 \text{ pf} = .01 \mu\text{fd}$

CONTROL PREAMPLIFIER CIRCUIT BOARD

PARTS LIST

Unpack the package marked 4 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Control Preamplifier Circuit Board Parts Pictorial (fold-out from Page 22). Any part that is pack-

aged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
----------	---------------	-------------

RESISTORS

1/2 Watt, General

(1) 1-42	✓ 1	270 Ω (red-violet-brown)
1-9	✓ 4	1000 Ω (brown-black-red)
1-11	✓ 4	1500 Ω (brown-green-red)
1-14	✓ 4	3300 Ω (orange-orange-red)
1-16	✓ 2	4700 Ω (yellow-violet-red)
1-18	✓ 8	5600 Ω (green-blue-red)
1-20	✓ 4	10 K Ω (brown-black-orange)
1-22	✓ 2	22 K Ω (red-red-orange)
1-23	✓ 2	27 K Ω (red-violet-orange)
1-25	✓ 8	47 K Ω (yellow-violet-orange)
1-26	✓ 2	100 K Ω (brown-black-yellow)

1/2 Watt 5% Low-Noise

(2) 4-41	✓ 4	1500 Ω (brown-green-red)
4-19	✓ 2	3900 Ω (orange-white-red)
4-25	✓ 4	27 K Ω (red-violet-orange)
4-34	✓ 2	100 K Ω (brown-black-yellow)
4-29	✓ 2	220 K Ω (red-red-yellow)
4-32	✓ 2	390 K Ω (orange-white-yellow)

PART No.	PARTS Per Kit	DESCRIPTION
----------	---------------	-------------

CAPACITORS

NOTE: The Mylar capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and example to help identify these capacitors.

(3) 27-70	✓ 4	.0022 μ fd Mylar (wide red band)
27-73	✓ 2	.047 μ fd Mylar (yellow-violet-orange)
27-47	✓ 2	.1 (0.1) μ fd Mylar (brown-black-yellow)
27-61	✓ 4	.47 (0.47) μ fd Mylar (yellow-violet-yellow)
(4) 25-54	✓ 14	10 μ fd electrolytic
25-145	✓ 2	25 μ fd electrolytic
25-56	✓ 2	100 μ fd electrolytic
(5) 25-164	✓ 1	1000 μ fd electrolytic

TRANSISTORS

(6) 417-201	✓ 2	X29A829
417-118	✓ 2	2N3393
417-218	✓ 6	TZ1160

STEP-BY-STEP ASSEMBLY

Position the control preamplifier circuit board with the part number as shown in the identification drawing. Then complete each step on the Pictorial.

NOTE: Only one-half of the circuit board is shown in Pictorial 4-1. The identification drawing at the top of the Pictorial shows the area of the circuit board to be assembled.

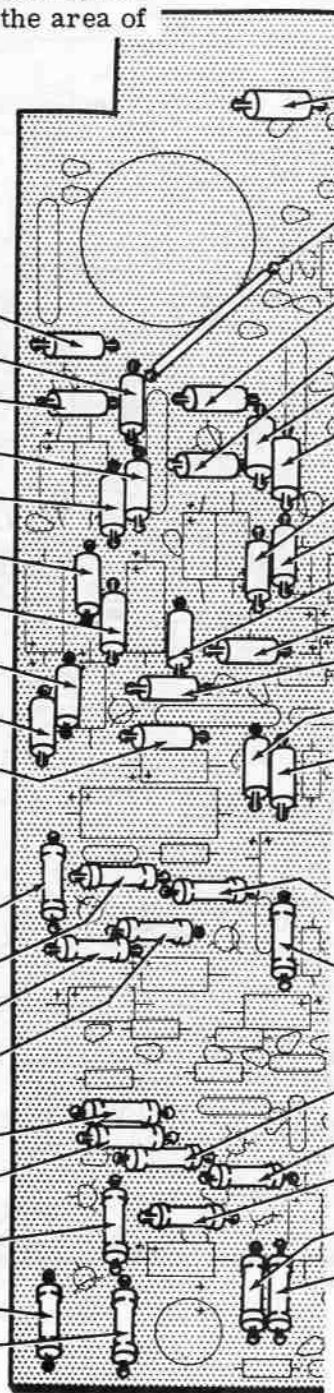
Part number

IDENTIFICATION
DRAWING

CONTINUE

START

- (✓) 1000 Ω (brown-black-red).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 4700 Ω (yellow-violet-red).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 22 K Ω (red-red-orange).
- (✓) 1500 Ω (brown-green-red).
- (✓) 1500 Ω (brown-green-red).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.
- NOTE: The following nine resistors are 5% low-noise.
- (✓) 220 K Ω (red-red-yellow).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 1500 Ω (brown-green-red).
- (✓) 1500 Ω (brown-green-red).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 1500 Ω (brown-green-red).
- (✓) 390 K Ω (orange-white-yellow).
- (✓) 3900 Ω (orange-white-red).
- (✓) 100 K Ω (brown-black-yellow).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.



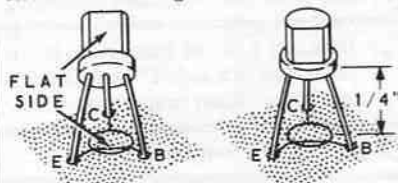
PICTORIAL 4-1

- (✓) 10 K Ω (brown-black-orange).
- (✓) Remove 1/4" of insulation from each end of a 1-3/4" black hook-up wire. Then install the wire.
- (✓) 1000 Ω (brown-black-red).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 1000 Ω (brown-black-red).
- (✓) 4700 Ω (yellow-violet-red).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 1500 Ω (brown-green-red).
- (✓) 1500 Ω (brown-green-red).
- (✓) 1000 Ω (brown-black-red).
- (✓) 3300 Ω (orange-orange-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.
- NOTE: The following resistors are 5% low-noise.
- (✓) 27 K Ω (red-violet-orange).
- (✓) 220 K Ω (red-red-yellow).
- (✓) 1500 Ω (brown-green-red).
- (✓) 390 K Ω (orange-white-yellow).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 3900 Ω (orange-white-red).
- (✓) 100 K Ω (brown-black-yellow).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 4-2.

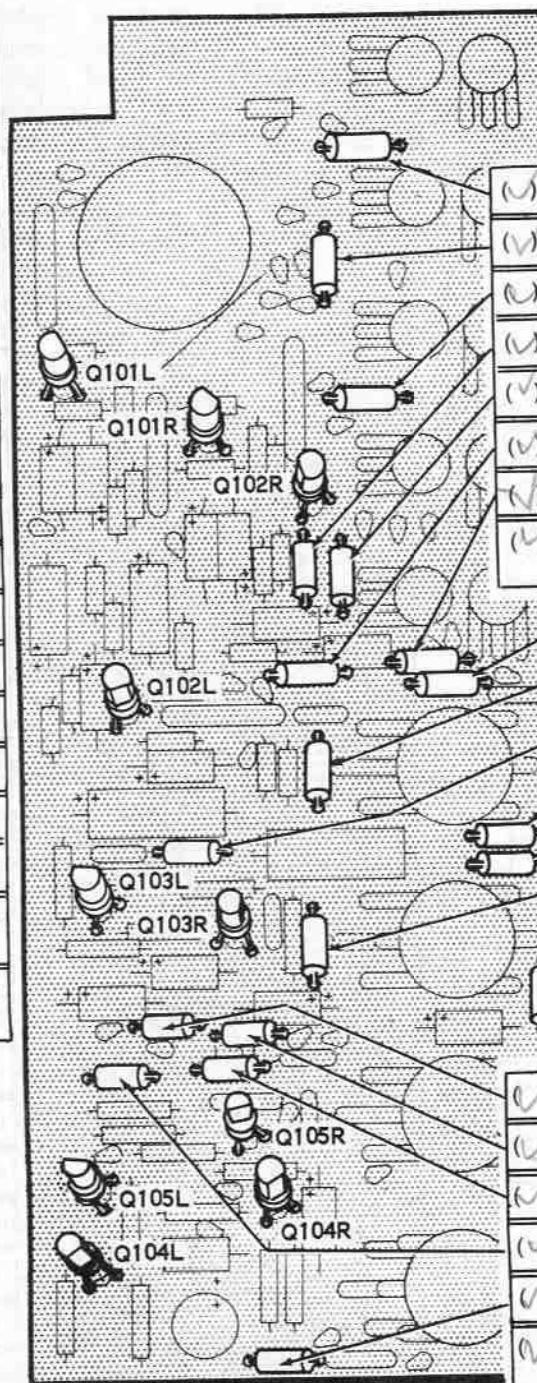
START

NOTE: Install the transistors in the following manner as shown: First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistors 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



Install TZ1160 transistors (part # 417-218) at the following locations:

- (✓) TZ1160 at Q101L.
- (✓) TZ1160 at Q101R.
- (✓) TZ1160 at Q102R.
- (✓) TZ1160 at Q102L.
- (✓) TZ1160 at Q103R.
- (✓) TZ1160 at Q103L.
- (✓) 2N3393 at Q104L (#417-118).
- (✓) 2N3393 at Q104R (#417-118).
- (✓) X29A829 transistor (Part #417-201) at Q105R.
- (✓) X29A829 transistor (Part #417-201) at Q105L.



CONTINUE

- (✓) 10 K Ω (brown-black-orange).
- (✓) 10 K Ω (brown-black-orange).
- (✓) 10 K Ω (brown-black-orange).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 22 K Ω (red-red-orange).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 3300 Ω (orange-orange-red).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

- (✓) 5600 Ω (green-blue-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) 5600 Ω (green-blue-red).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

- (✓) 100 K Ω (brown-black-yellow).
- (✓) 100 K Ω (brown-black-yellow).
- (✓) 3300 Ω (orange-orange-red).
- (✓) 270 Ω (red-violet-brown).
- (✓) 3300 Ω (orange-orange-red).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 4-3.

START

NOTE: The Mylar capacitors may either be color coded or marked with a value.

(✓) .47 (0.47) μ fd Mylar (yellow-violet-yellow).

(✓) .47 (0.47) μ fd Mylar (yellow-violet-yellow).

NOTE: When mounting electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.



(✓) 10 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) 25 μ fd electrolytic.

(✓) 25 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) Solder all leads to the foil and cut off the excess lead lengths.

(✓) .47 (0.47) μ fd Mylar (yellow-violet-yellow).

(✓) 10 μ fd electrolytic.

(✓) 100 μ fd electrolytic.

(✓) .0022 μ fd Mylar (wide red band).

(✓) .0022 μ fd Mylar (wide red band).

(✓) 10 μ fd electrolytic.

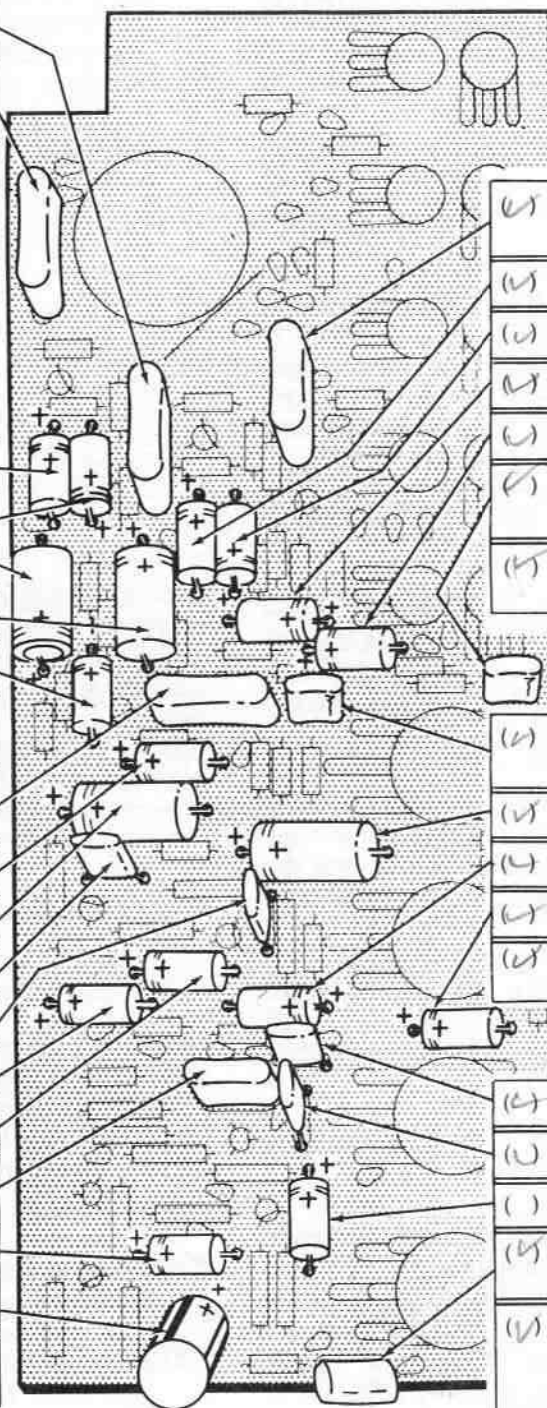
(✓) 10 μ fd electrolytic.

(✓) .1 μ fd Mylar (brown-black-yellow).

(✓) 10 μ fd electrolytic.

(✓) 1000 μ fd electrolytic.

(✓) Solder all leads to the foil and cut off the excess lead lengths.



CONTINUE

(✓) .47 (0.47) μ fd Mylar (yellow-violet-yellow).

(✓) 10 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) .047 μ fd Mylar (yellow-violet-orange).

(✓) Solder all leads to the foil and cut off the excess lead lengths.

(✓) .047 μ fd Mylar (yellow-violet-orange).

(✓) 100 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) 10 μ fd electrolytic.

(✓) Solder all leads to the foil and cut off the excess lead lengths.

(✓) .0022 μ fd Mylar (wide red band).

(✓) .0022 μ fd Mylar (wide red band).

(✓) 10 μ fd electrolytic.

(✓) .1 μ fd Mylar (brown-black-yellow).

(✓) Recheck the electrolytic capacitors to make sure the positive (+) ends are positioned correctly.

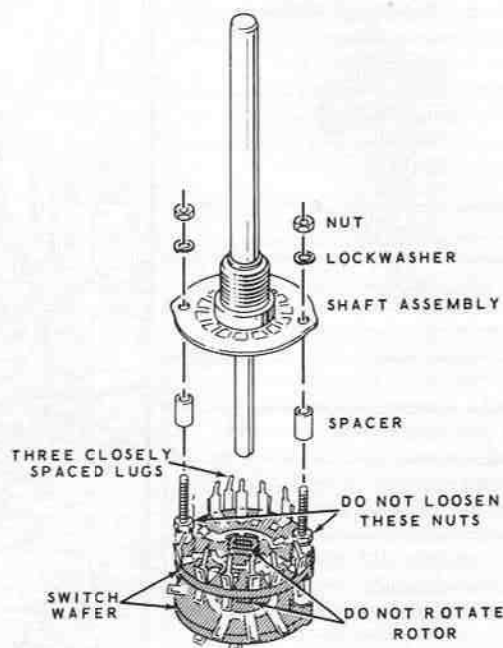
(✓) Solder all leads to the foil and cut off the excess lead lengths.

PICTORIAL 4-3

Refer to Pictorial 4-4 and Detail 4-4A, (fold-out from Page 29) for the following steps.

- (✓) Before proceeding to the following steps to install the miniature controls, cut a piece of cardboard from the flap of the packing carton. Refer to Part D of Detail 4-4A for the dimensions. You will be instructed to use the cardboard in one of the following steps.
- (✓) Locate ten miniature controls (#10-212). NOTE: Handle these controls carefully; they can be damaged if their shafts are bent too far sideways.
- (✓) Install a miniature control at DA and DE as follows and as shown in parts A and B of Detail 4-4A. Insert the shaft, three lugs, and two mounting tabs in the circuit board holes. Make sure the lugs and tabs are inserted all the way into the circuit board. The shaft should be perpendicular to the board. Solder the two mounting tabs first, and then the three lugs to the foil.
- (✓) Position the control template with the wide-spaced end as shown in Part C of Detail 4-4A. Then place the template partway onto shafts DA and DE (approximately 3/4").
- (✓) Now turn the board over as shown in Part D of Detail 4-4A and install the remaining eight controls on the circuit board with the shafts protruding through the template.
- (✓) Place the piece of cardboard, that was previously cut, between the two rows of controls as shown in Part D. This will keep the controls from falling out when the board is turned over.
- (✓) Turn the circuit board over so it rests on the cardboard as shown in Part E.
- () Make sure the template is near the ends of the controls (approximately 3/4") and parallel with the circuit board. Then solder each control to the foil. First push the control firmly against the board, solder the two mounting tabs, and then the three lugs. Leave the template on the controls.

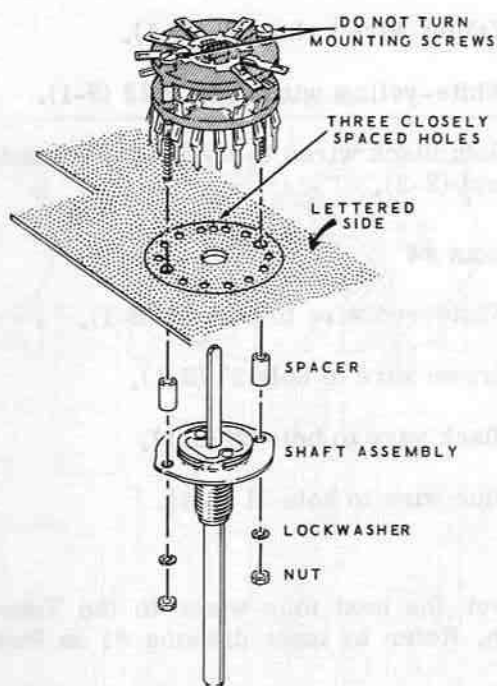
- (✓) Remove the piece of cardboard from between the controls and discard it.
- (✓) Locate the rotary switch (#63-429).
- (✓) Disassemble the front part of the switch as shown in Detail 4-4B. Remove two nuts, and lockwashers. Then pull out the shaft assembly and remove the spacers. Do not misplace these parts; they will be used in another step. IMPORTANT: Do not rotate the rotor of either switch wafer while the switch shaft is not in place.



Detail 4-4B

NOTE: Three of the lugs of the indicated switch wafer are spaced closer together than the other lugs. When mounting this switch in the following step, be sure to match up these lugs with the three closely spaced holes in the circuit board.

- (✓) Mount the switch wafers on the circuit board as shown in Detail 4-4C. Match up the switch lugs and mounting screws with the correct holes in the circuit board. NOTE: The lugs will have to be bent out slightly to get into the holes.



Detail 4-4C

(✓) While holding the switch in place, install both spacers on the mounting screws. Then insert the shaft assembly through the circuit board hole and both switch wafers. Fasten the assembly on the screws by reinstalling the lockwashers and nuts. Tighten the nuts an equal amount (not too tight). Do not turn the mounting screws with a screwdriver; this could crack the switch wafers.

(✓) Solder all thirteen switch lugs to the foil.

NOTE: To install the next four controls, insert the lugs and two mounting tabs firmly into the circuit board holes as shown in Detail 4-4D. Then turn the board over and twist the two tabs 1/8 turn to hold the control in place. Solder the lugs and tabs to the foil.

(✓) Install a 50 K Ω dual control (#12-79).

(✓) Install a 50 K Ω dual control with switch (#19-107).

(✓) Install a 25 K Ω dual control (#12-78).

(✓) Install a 25 K Ω dual control (#12-77).

NOTE: When wiring this kit, you may find it easier to prepare the lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and strip 1/4" of insulation from each end. The wires are listed in the order in which they will be used.

(✓) Prepare the following lengths of black hookup wire:

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

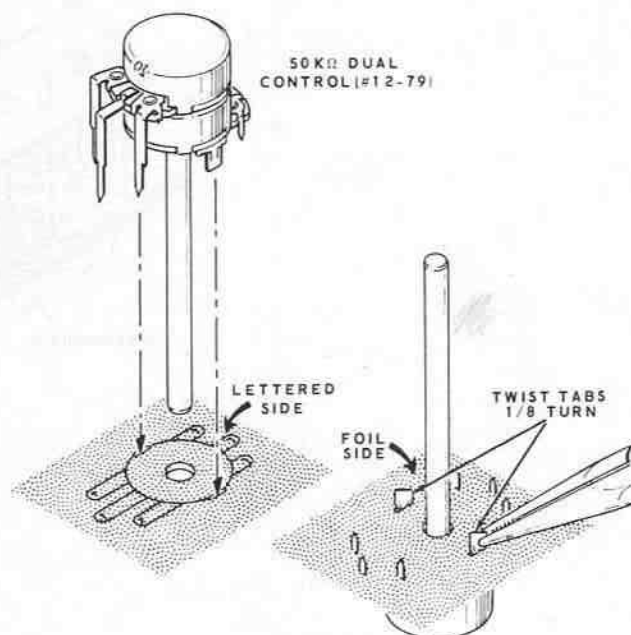
(✓) Connect a 4-1/2" wire from lug 1 of the Tone Flat switch (S-1) to hole 19 on the circuit board (S-1). Route the wire as shown.

(✓) Connect a 3" wire from lug 4 of the Tone Flat switch (S-1) to hole 22 of the circuit board (S-1). Route the wire as shown.

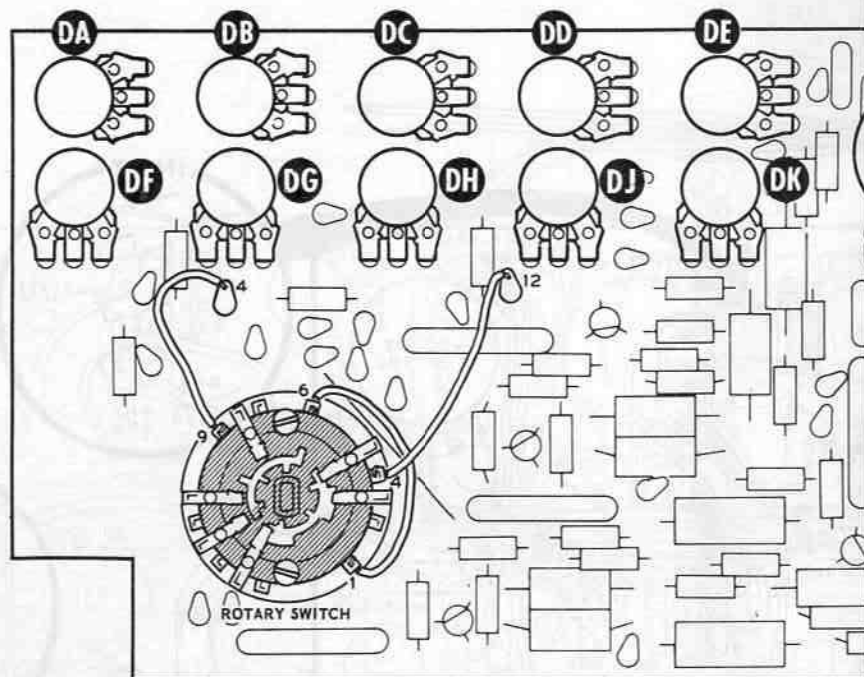
(✓) Connect a 1-3/4" wire between lugs 1 (S-1) and 6 (NS) of the rotary switch.

(✓) Connect a 2-3/4" wire from lug 4 of the rotary switch (S-1) to hole 12 of the circuit board (S-1).

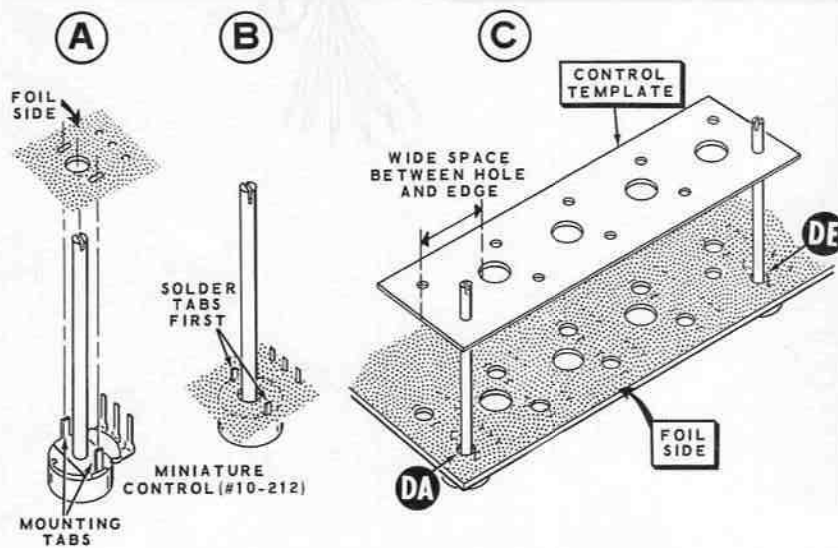
(✓) Connect a 1-3/4" wire from lug 9 of the rotary switch (S-1) to hole 4 of the circuit board (S-1).



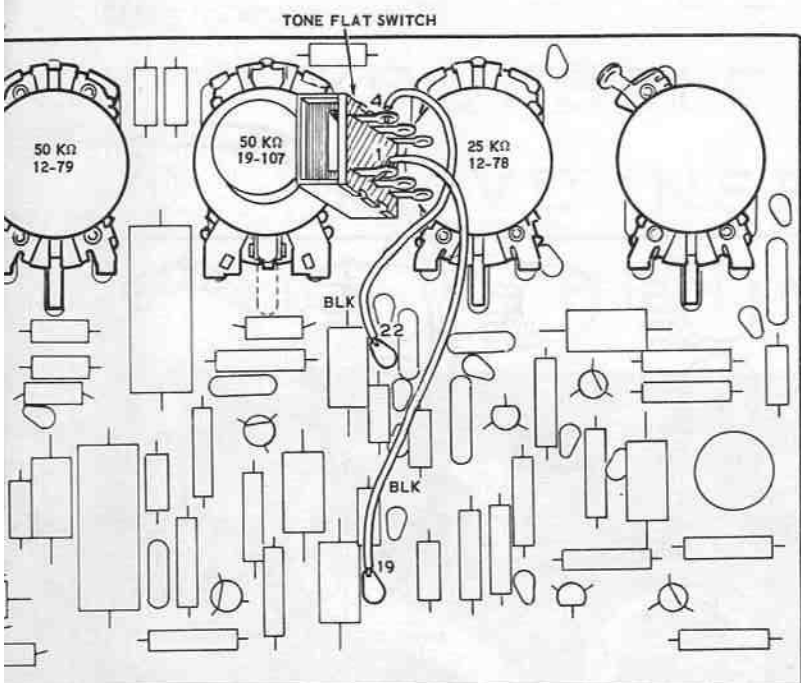
Detail 4-4D



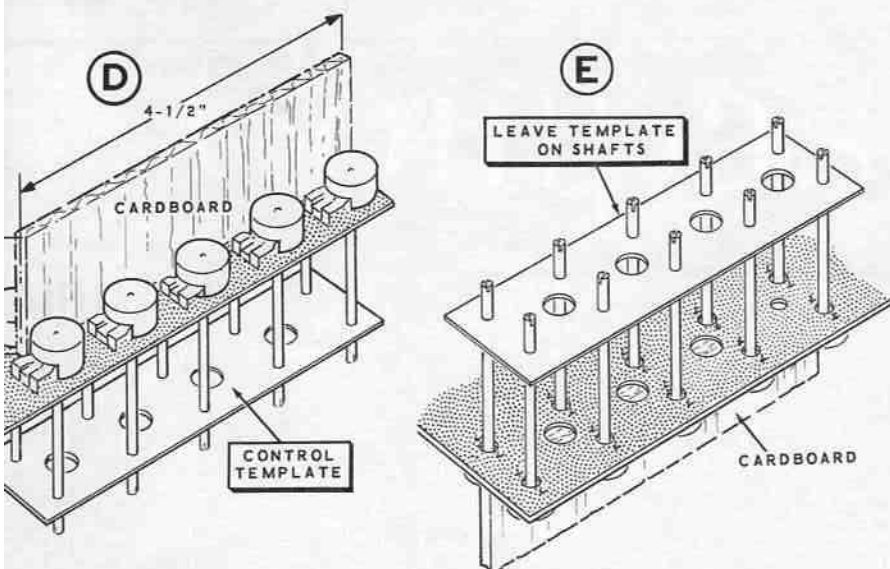
PICTOR



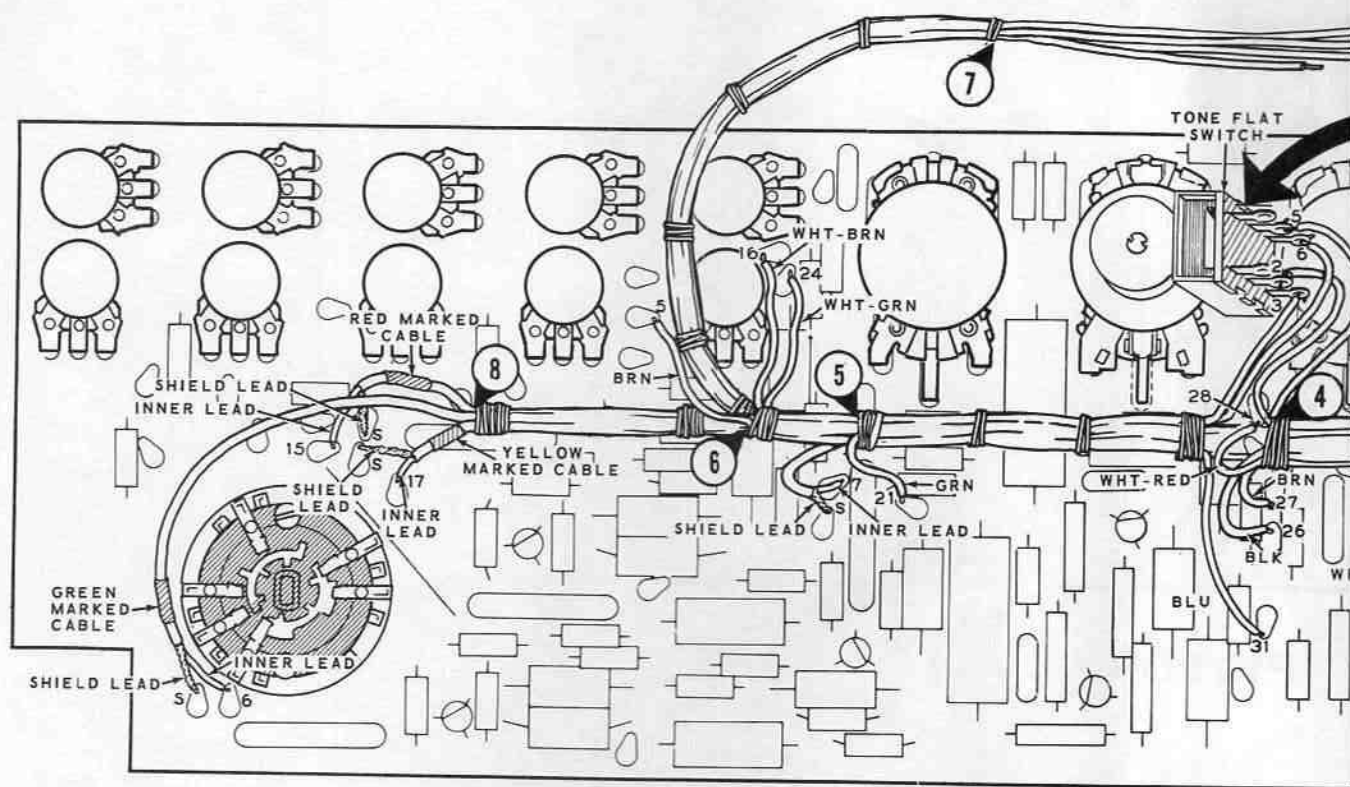
Detail



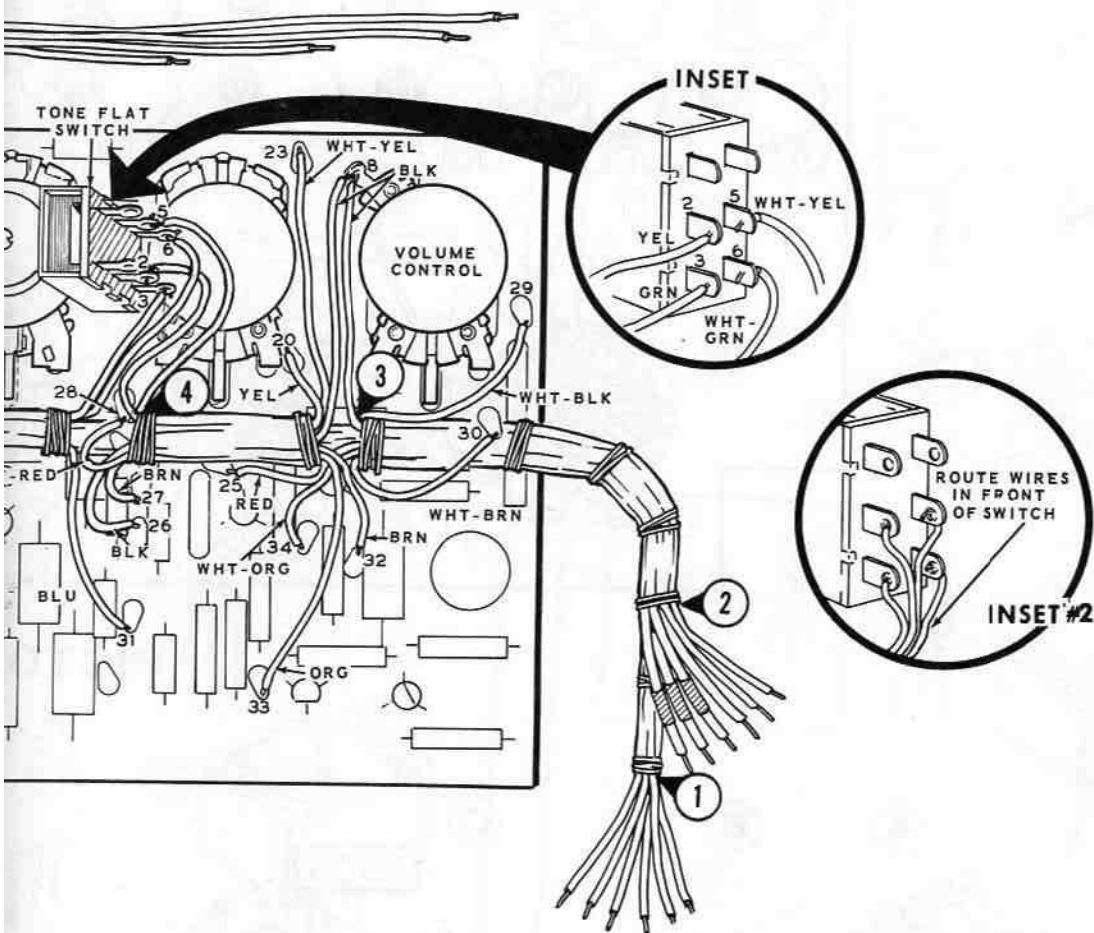
IAL 4-4



I 4-4A



PICTORIAL 4-5



CABLE WIRING

Refer to Pictorial 4-5 for the following steps.

- (✓) Locate the control preamplifier cable assembly (#134-148). Unfold the assembly and straighten the wires at each breakout. NOTE: The term "breakout" refers to a place where a group of wires come from the cable assembly.

- (✓) Place the cable assembly on the circuit board with breakouts 1 through 8 positioned as shown.

Connect the wires from breakouts 3, 4, 5, 6, and 8 to the circuit board in the following steps.

Breakout #3

- (✓) White-black wire to hole 29 (S-1).
- (✓) White-brown wire to hole 30 (S-1).
- (✓) Brown wire to hole 32 (S-1).
- (✓) White-orange wire to hole 34 (S-1).
- (✓) Orange wire to hole 33 (S-1).
- (✓) Red wire to hole 25 (S-1).

- (✓) Yellow wire to hole 20 (S-1).

- (✓) White-yellow wire to hole 23 (S-1).

- (✓) Both black wires to lug 8 of the Volume control (S-2).

Breakout #4

- (✓) White-red wire to hole 28 (S-1).

- (✓) Brown wire to hole 27 (S-1).

- (✓) Black wire to hole 26 (S-1).

- (✓) Blue wire to hole 31 (S-1).

Connect the next four wires to the Tone Flat switch. Refer to inset drawing #1 on Pictorial 4-5.

- (✓) Green wire to lug 3 (S-1).

- (✓) White-green wire to lug 6 (S-1).

- (✓) Yellow wire to lug 2 (S-1).

- (✓) White-yellow wire to lug 5 (S-1).

- (✓) Route these wires in front of the switch as shown in inset drawing #2.

Breakout #5

- () Green wire to hole 21 (S-1).

NOTE: When installing shielded cables, the leads will always be identified in the following manner: The insulated lead will be called the "inner lead," while the remaining lead will be called the "shield lead."

- (✓) Inner lead of the cable to hole 7 (S-1). Shield lead to hole S (S-1).

Breakout #6

- (✓) Brown wire to hole 5 (S-1).
- (✓) White-green wire to hole 24 (S-1).
- (✓) White-brown wire to hole 16 (S-1).

Breakout #8

- (✓) Inner lead of the yellow-marked cable to hole 17 (S-1). Shield lead to hole S. (There are two holes marked S; use either one). (S-1).
- (✓) Inner lead of the red-marked cable to hole 15 (S-1). Shield lead to hole S (S-1).
- (✓) Inner lead of the green-marked cable to hole 6 (S-1). Shield lead to hole S (S-1).

The wires from breakouts 1, 2, and 7 will be connected later.

- (✓) Carefully inspect the foil side of the circuit board for any solder bridges between foils. Solder any connections that might have been missed and cut off the excess lead lengths. Then set this circuit board aside temporarily. Set aside the remaining length of black hookup wire and sleeving; it will be used later.

MULTIPLEX CIRCUIT BOARD

PARTS LIST

Unpack the package marked 5 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Multiplex Circuit Board Parts Pictorial (fold-out

from Page 22). Any part that is packaged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
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RESISTORS

1/2 Watt

(1) 1-1	✓1	47 Ω (yellow-violet-black)
1-42	✓1	270 Ω (red-violet-brown)
1-4	✓1	330 Ω (orange-orange-brown)
1-48	✓1	390 Ω (orange-white-brown)
1-6	✓1	470 Ω (yellow-violet-brown)
1-9	✓3	1000 Ω (brown-black-red)
1-10	✓1	1200 Ω (brown-red-red)
1-11	✓2	1500 Ω (brown-green-red)
1-44	✓6	2200 Ω (red-red-red)
1-19	✓1	6800 Ω (blue-gray-red)
1-73	✓2	8200 Ω (gray-red-red)
1-20	✓4	10 KΩ (brown-black-orange)
1-21	✓4	15 KΩ (brown-green-orange)
1-22	✓1	22 KΩ (red-red-orange)
1-23	✓4	27 KΩ (red-violet-orange)
1-25	✓5	47 KΩ (yellow-violet-orange)

PART No.	PARTS Per Kit	DESCRIPTION
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RESISTORS 1/2 Watt (cont'd.)

1-60	✓1	68 KΩ (blue-gray-orange)
1-26	✓3	100 KΩ (brown-black-yellow)
1-27	✓2	150 KΩ (brown-green-yellow)
1-29	✓3	220 KΩ (red-red-yellow)
1-35	✓3	1 megohm (brown-black-green)
1-38	✓1	3.3 megohm (orange-orange-green)

1/2 Watt 5% Low-Noise

(2) 4-15	✓2	1000 Ω (brown-black-red)
4-18	✓2	3300 Ω (orange-orange-red)
4-19	✓1	3900 Ω (orange-white-red)
4-20	✓3	4700 Ω (yellow-violet-red)
4-37	✓1	6800 Ω (blue-gray-red)
4-38	✓1	9100 Ω (white-brown-red)
4-22	✓5	10 KΩ (brown-black-orange)

PART No.	PARTS Per Kit	DESCRIPTION
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1/2 Watt 5% Low-Noise (cont'd.)

4-39	✓3	12 K Ω (brown-red-orange)
4-23	✓1	22 K Ω (red-red-orange)
4-25	✓2	27 K Ω (red-violet-orange)
4-26	✓4	33 K Ω (orange-orange-orange)
4-27	✓2	47 K Ω (yellow-violet-orange)
4-29	✓3	220 K Ω (red-red-yellow)
4-32	✓1	390 K Ω (orange-white-yellow)
4-46	✓2	1.5 megohm (brown-green-green)

PART No.	PARTS Per Kit	DESCRIPTION
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Polystyrene

(6) 29-5	✓1	1000 pf
29-6	✓1	1200 pf
29-4	✓4	1800 pf
29-3	✓1	2700 pf
29-8	✓2	3300 pf
29-9	✓1	8200 pf
29-2	✓1	.01 μ fd (10,000 pf)

Electrolytic

(7) 25-220	✓4	10 μ fd, 20 V tantalum
25-223	✓1	47 μ fd, 15 V tantalum

CAPACITORS**Disc**

(3) 21-7	✓1	33 pf
21-75	✓3	100 pf
21-56	✓5	470 pf
21-14	✓1	.001 μ fd
21-27	✓2	.005 μ fd
21-82	✓1	.02 μ fd, 50 V
21-100	✓1	.47 μ fd

Silver Mica

(4) 20-108	✓1	200 pf
20-115	✓2	300 pf
20-107	✓2	680 pf

Mylar

NOTE: The Mylar capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and example on Page 22 to help identify these capacitors.

(5) 27-74	✓6	.01 μ fd (brown-black-orange)
27-73	✓4	.047 μ fd (yellow-violet-orange)
27-47	✓5	.1 μ fd (brown-black-yellow)
27-85	✓2	.22 (0.22) μ fd (wide red band-yellow)

TRANSISTORS-DIODES

(8) 417-94	1	2N3416 transistor
417-118	✓11	2N3393 transistor
417-201	✓8	X29A829 transistor
(9) 56-26	✓8	1N191 diode
(10) 56-35	✓4	Dual diode (may be marked 16U1 or 1N4951)

COILS-CHOKE-CONTROL-CONNECTOR

(11) 40-787	✓2	7 mH coil, 67 kHz trap
40-788	✓2	20 mH coil, 19 kHz trap
40-789	✓1	23 mH coil, 53 kHz low pass
40-790	✓3	70 mH coil
(12) 40-786	✓1	7 mH coil, 19 kHz amplifier
40-791	✓1	7 mH coil, 19 kHz doubler
40-792	✓1	7 mH coil, 38 kHz oscillator
(13) 45-47	✓1	2 mH RF choke
(14) 10-155	✓1	750 Ω control
(15) 259-20	✓2	Connector pin

ITEM FROM PACK 7

85-167-4	1	Multiplex circuit board
----------	---	-------------------------

STEP-BY-STEP ASSEMBLY

Position the multiplex circuit board with the Part number, as shown in the small identification drawing. Then complete each step on the Pictorial.

NOTE: Only one-half of the circuit board is shown in each of the following Pictorials. An identification drawing at the top of each Pictorial shows the area of the circuit board to be assembled.

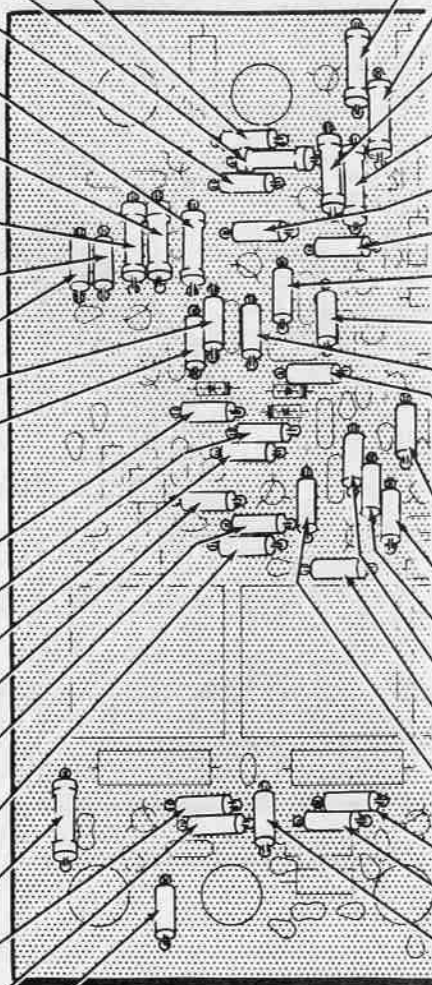
START

Part number

IDENTIFICATION
DRAWING

CONTINUE

- (✓) 1000 Ω (brown-black-red).
- (✓) 12 K Ω 5% (brown-red-orange) low-noise.
- (✓) 2200 Ω (red-red-red).
- (✓) 47 K Ω 5% (yellow-violet-orange) low-noise.
- (✓) 33 K Ω 5% (orange-orange-orange) low-noise.
- (✓) 4700 Ω 5% (yellow-violet-red) low-noise.
- (✓) 15 K Ω (brown-green-orange).
- (✓) 1 megohm (brown-black-green).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.
- (✓) 68 K Ω (blue-gray-orange).
- (✓) 1000 Ω (brown-black-red).
- (✓) 10 K Ω (brown-black-orange).
- (✓) 10 K Ω (brown-black-orange).
- (✓) 3.3 megohm (orange-orange-green).
- (✓) 1 megohm (brown-black-green).
- (✓) 3900 Ω 5% (orange-white-red) low-noise.
- (✓) 2200 Ω (red-red-red).
- (✓) 150 K Ω (brown-green-yellow).
- (✓) 2200 Ω (red-red-red).
- () Solder all leads to the foil and cut off the excess lead lengths.



- (✓) 1.5 megohm 5% (brown-green-green) low-noise.
- (✓) 220 K Ω 5% (red-red-yellow) low-noise.
- (✓) 3300 Ω 5% (orange-orange-red) low-noise.
- (✓) 1000 Ω 5% (brown-black-red) low-noise.
- (✓) 22 K Ω (red-red-orange).
- (✓) 2200 Ω (red-red-red).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 220 K Ω (red-red-yellow).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.
- (✓) 10 K Ω (brown-black-orange).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 15 K Ω (brown-green-orange).
- (✓) 270 Ω (red-violet-brown).
- (✓) 8200 Ω (gray-red-red).
- (✓) 47 Ω (yellow-violet-black).
- (✓) 330 Ω (orange-orange-brown).
- () 220 K Ω (red-red-yellow).
- (✓) 150 K Ω (brown-green-yellow).
- (✓) Solder all leads to the foil and cut off the excess lead lengths.

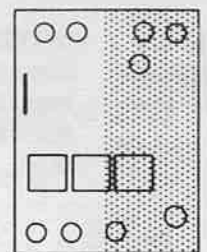
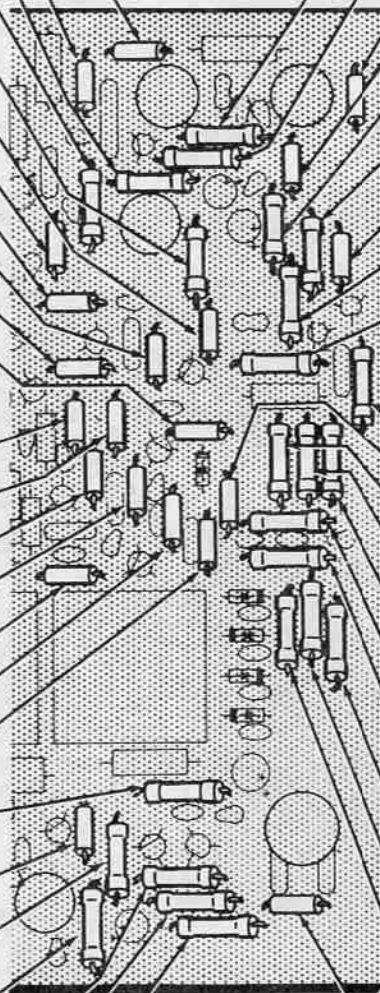
PICTORIAL 5-1

PROCEED TO PICTORIAL 5-2

START

CONTINUE

- (✓) 1 megohm (brown-black-green).
- (✓) 15 K Ω (brown-green-orange).
- (✓) 6800 Ω 5% (blue-gray-red) low-noise.
- (✓) 47 K Ω 5% (yellow-violet-orange) low-noise.
- (✓) 22 K Ω 5% (red-red-orange) low-noise.
- (✓) 1200 Ω (brown-red-red).
- (✓) 1500 Ω (brown-green-red).
- (✓) 47 K Ω (yellow-violet-orange).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 27 K Ω (red-violet-orange).
- (✓) 8200 Ω (gray-red-red).
- () Solder all leads to the foil and cut off the excess lead lengths.
- (✓) 220 K Ω (red-red-yellow).
- (✓) 15 K Ω (brown-green-orange).
- (✓) 100 K Ω (brown-black-yellow).
- (✓) 2200 Ω (red-red-red).
- (✓) 100 K Ω (brown-black-yellow).
- (✓) 6800 Ω (blue-gray-red).
- (✓) 10 K Ω (brown-black-orange).
- (✓) 4700 Ω 5% (yellow-violet-red) low-noise.
- (✓) 1500 Ω (brown-green-red).
- (✓) 9100 Ω 5% (white-brown-red) low-noise.
- (✓) 12 K Ω 5% (brown-red-orange) low-noise.
- (✓) 220 K Ω 5% (red-red-yellow) low-noise.
- (✓) 390 K Ω 5% (orange-white-yellow) low-noise.
- () 10 K Ω 5% (brown-black-orange) low-noise.
- () Solder all leads to the foil and cut off the excess lead lengths.

IDENTIFICATION
DRAWING

- (✓) 4700 Ω 5% (yellow-violet-red) low-noise.
- (✓) 33 K Ω 5% (orange-orange-orange) low-noise.
- (✓) 2200 Ω (red-red-red).
- (✓) 1000 Ω (brown-black-red).
- (✓) 1000 Ω 5% (brown-black-red) low-noise.
- (✓) 12 K Ω 5% (brown-red-orange) low-noise.
- (✓) 100 K Ω (brown-black-yellow).
- (✓) 220 K Ω 5% (red-red-yellow) low-noise.
- (✓) 1.5 megohm 5% (brown-green-green) low-noise.
- () Solder all leads to the foil and cut off the excess lead lengths.
- (✓) 3300 Ω 5% (orange-orange-red) low-noise.
- (✓) 390 Ω (orange-white-brown).
- (✓) 33 K Ω 5% (orange-orange-orange) low-noise.
- (✓) 27 K Ω 5% (red-violet-orange) low-noise.
- (✓) 33 K Ω 5% (orange-orange-orange) low-noise.
- (✓) 27 K Ω 5% (red-violet-orange) low-noise.
- (✓) 10 K Ω 5% (brown-black-orange) low-noise.
- (✓) 10 K Ω 5% (brown-black-orange) low-noise.
- (✓) 10 K Ω 5% (brown-black-orange) low-noise.
- (✓) 10 K Ω 5% (brown-black-orange) low-noise.
- () 470 Ω (yellow-violet-brown).
- () Solder all leads to the foil and cut off the excess lead lengths.

PICTORIAL 5-2

PROCEED TO PICTORIAL 5-3

START

- (✓) 1800 pf polystyrene. NOTE: Disregard the marked end on this type of capacitor; it can be installed either way.

NOTE: The Mylar capacitors may either be color coded or marked with a value.

- (✓) .22 (0.22) μ fd Mylar (wide red band-yellow).

- (✓) .047 μ fd Mylar (yellow-violet-orange).

- (✓) .1 μ fd Mylar (brown-black-yellow).

- (✓) .47 μ fd disc.

- (✓) .1 μ fd Mylar (brown-black-yellow).

- (✓) .1 μ fd Mylar (brown-black-yellow).

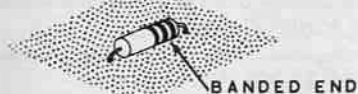
- (✓) .001 μ fd disc.

- (✓) Solder all leads to the foil and cut off the excess lead lengths.

- (✓) .005 μ fd disc.

- (✓) .01 μ fd Mylar (brown-black-orange).

NOTE: When installing the following crystal diodes, position the banded end of each diode as shown.

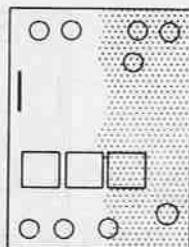


- (✓) 1N191 crystal diodes (brown-white-brown), part #56-26, at D423, D424, D425, D426, and D432.

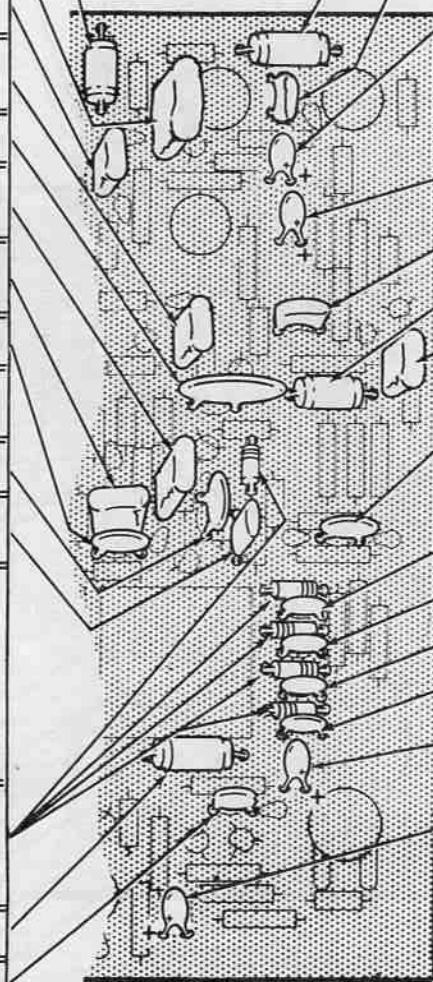
- (✓) 2700 pf polystyrene.

- (✓) 100 pf disc.

- (✓) Solder all leads to the foil and cut off the excess lead lengths.



IDENTIFICATION
DRAWING



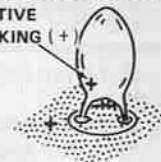
CONTINUE

- (✓) 3300 pf polystyrene.

- (✓) 300 pf silver mica.

- (✓) 10 μ fd electrolytic. NOTE: When mounting electrolytic capacitors, always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board. Solder each lead to the foil.

POSITIVE
MARKING (+)



- (✓) 10 μ fd electrolytic. Position the positive (+) end as shown.

- (✓) 680 pf silver mica.

- (✓) 1800 pf polystyrene.

- (✓) .047 μ fd Mylar (yellow-violet-orange).

- (✓) .005 μ fd disc.

- (✓) Solder all leads to the foil and cut off the excess lead lengths.

- (✓) 470 pf disc.

- (✓) 470 pf disc.

- (✓) 470 pf disc.

- (✓) 470 pf disc.

- (✓) 47 μ fd electrolytic. Position the positive (+) mark as shown.

- (✓) 10 μ fd electrolytic. Position the positive (+) mark as shown.

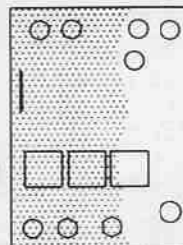
- (✓) Recheck the four electrolytic capacitors to make sure the positive (+) ends are positioned correctly.

- (✓) Solder all leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 5-4.

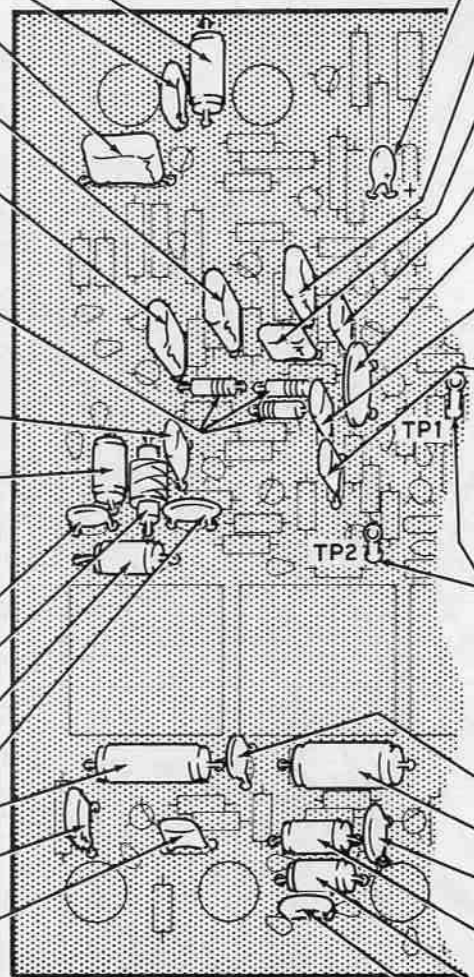
PICTORIAL 5-3

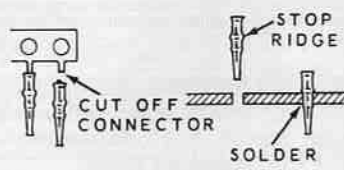
START

IDENTIFICATION
DRAWING

CONTINUE

- (✓) 3300 pf polystyrene.
- (✓) 300 pf silver mica.
- (✓) .22 (0.22) μ fd Mylar (wide red band-yellow).
- (✓) .047 μ fd Mylar (yellow-violet-orange).
- (✓) .047 μ fd Mylar (yellow-violet-orange).
- (✓) 1N191 crystal diodes (brown-white-brown), part #56-26, at D421, D430, and D431. Position the banded end of each diode as shown.
- (✓) .01 μ fd Mylar (brown-black-orange).
- (✓) 1200 pf polystyrene.
- () Solder all leads to the foil and cut off the excess lead lengths.
- (✓) 100 pf disc.
- (✓) 2 mh RF choke (part #45-47).
- (✓) 1800 pf polystyrene.
- (✓) 33 pf disc.
- (✓) 8200 pf polystyrene.
- (✓) 200 pf silver mica.
- (✓) .01 μ fd Mylar (brown-black-orange).
- () Solder all leads to the foil and cut off the excess lead lengths.



- (✓) 10 μ fd electrolytic. Position the positive (+) mark as shown.
 - (✓) .1 μ fd Mylar (brown-black-yellow).
 - (✓) .1 μ fd Mylar (brown-black-yellow).
 - (✓) .01 μ fd Mylar (brown-black-orange).
 - (✓) .02 μ fd 50 V disc.
 - (✓) .01 μ fd Mylar (brown-black-orange).
 - (✓) .01 μ fd Mylar (brown-black-orange).
 - () Solder all leads to the foil and cut off the excess lead lengths.
 - (✓) Install connectors at TP1 and TP2 as shown.
- 
- (✓) 100 pf disc.
 - (✓) 10,000 pf polystyrene.
 - (✓) 470 pf disc.
 - (✓) 1800 pf polystyrene.
 - (✓) 1000 pf polystyrene.
 - (✓) 680 pf silver mica.
 - () Solder all leads to the foil and cut off the excess lead lengths.

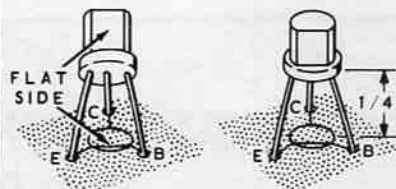
PICTORIAL 5-4

PROCEED TO PICTORIAL 5-5.

START



NOTE: Install the transistors in the following manner, as shown: First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes which are indicated by C, B, and E. Position the transistor 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



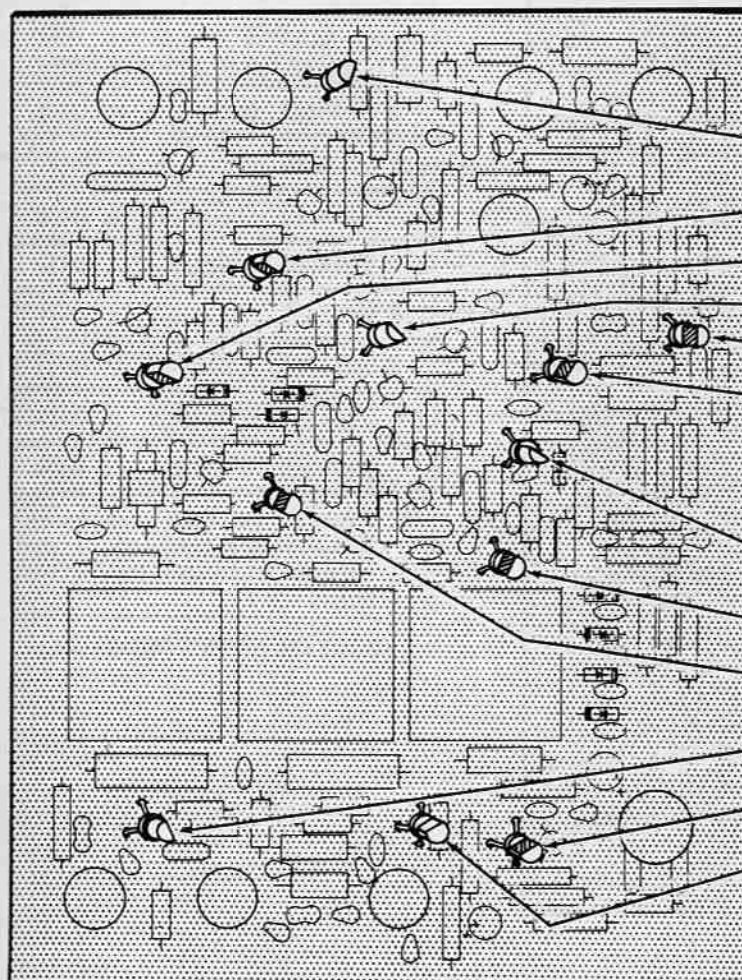
Install 2N3393 transistors (part #417-118) at the following locations:

- (✓) 2N3393 transistor at Q406.
- (✓) 2N3393 transistor at Q402.
- (✓) 2N3393 transistor at Q401.
- (✓) 2N3393 transistor at Q416.
- (✓) 2N3393 transistor at Q407.
- (✓) 2N3393 transistor at Q419.

NOTE: The next transistor only is a 2N3416 (part #417-94). However, install it as you did the preceding transistors.

- (✓) 2N3416 transistor at Q420.
- (✓) 2N3393 transistor at Q405.
- (✓) 2N3393 transistor at Q414.
- (✓) 2N3393 transistor at Q410.
- (✓) 2N3393 transistor at Q403.
- (✓) 2N3393 transistor at Q411.

- () Recheck the transistors to make sure the leads were installed in the correct holes.

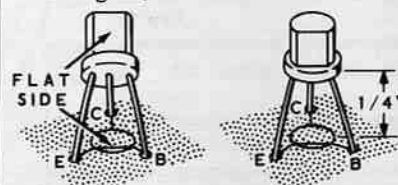


PICTORIAL 5-5

PROCEED TO PICTORIAL 5-6.

START

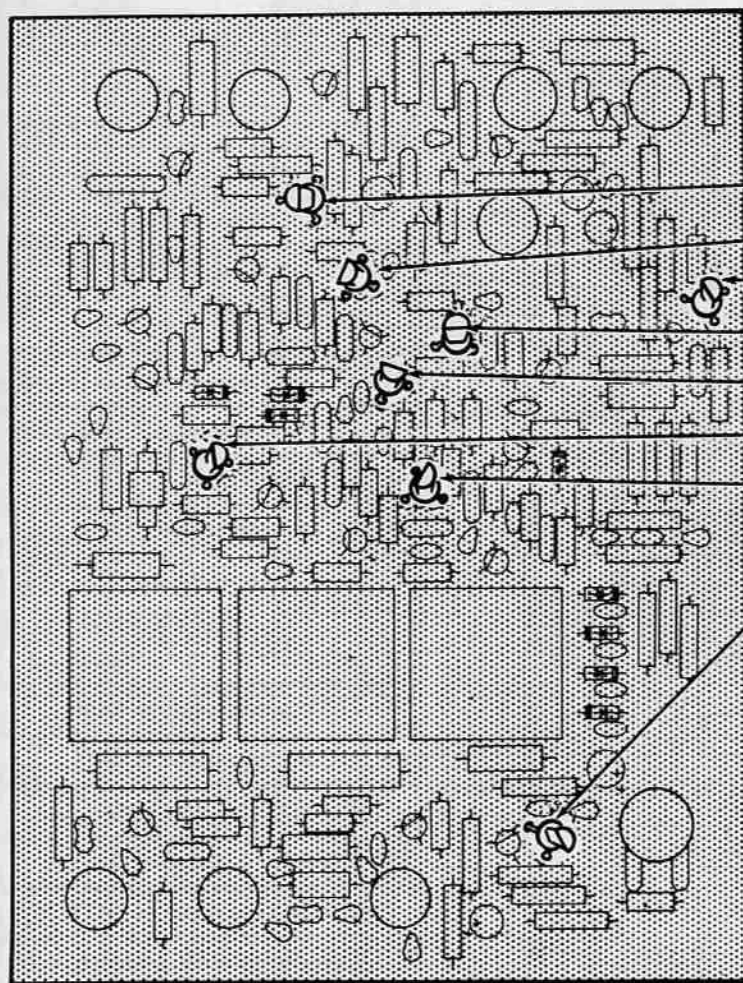
NOTE: Install the transistors in the following manner as shown: First line up the flat of the transistor with the outline on the flat on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistor 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



Install X29A829 transistors (Part #417-201) at the following locations:

- (✓) X29A829 transistor at Q408.
- (✓) X29A829 transistor at Q412.
- (✓) X29A829 transistor at Q409.
- (✓) X29A829 transistor at Q418.
- (✓) X29A829 transistor at Q415.
- (✓) X29A829 transistor at Q413.
- (✓) X29A829 transistor at Q417.
- (✓) X29A829 transistor at Q404.
- (✓) Recheck the eight transistors that were just installed to make sure the leads are in the correct holes.

PROCEED TO PICTORIAL 5-7.

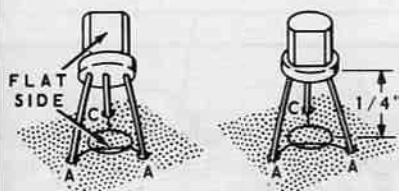


PICTORIAL 5-6

START



NOTE: Install the dual diodes in the following manner as shown: First line up the flat of the diode with the outline of the flat on the circuit board. Insert the center lead of the diode into hole C and the remaining two leads into holes A. Position the diode 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



Install dual diodes (part #56-35) at the following locations. NOTE: These diodes may be marked 16U1 or 1N4951.

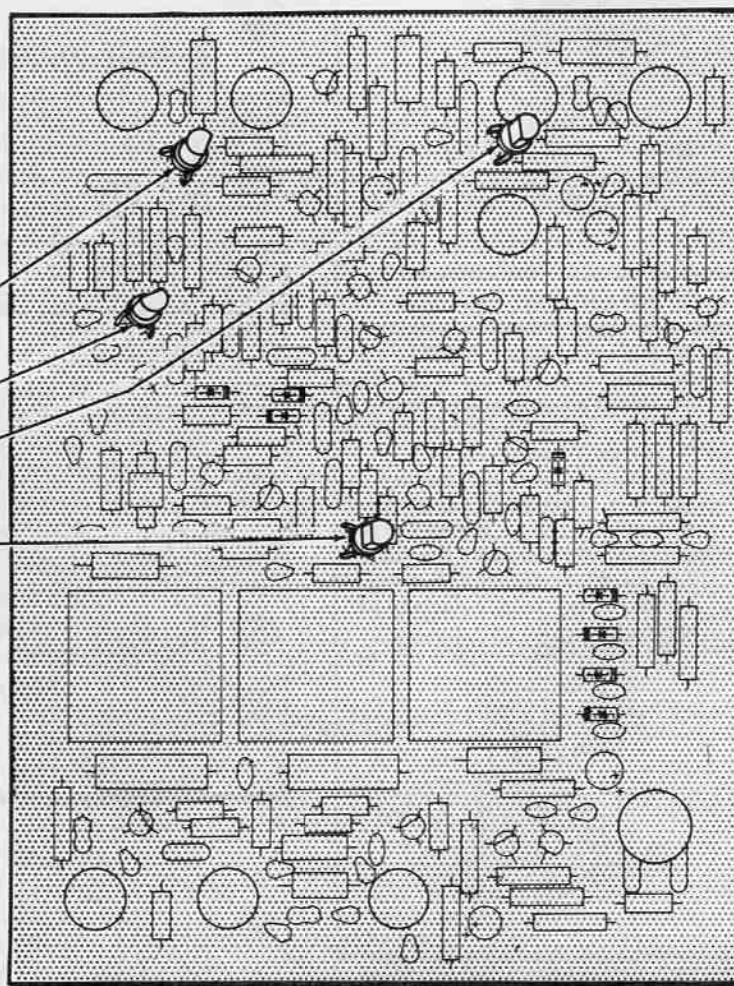
(✓) Dual diode at D427.

(✓) Dual diode at D422.

(✓) Dual diode at D428.

(✓) Dual diode at D429.

(✓) Recheck the diodes to make sure the leads were installed in the correct holes.



PROCEED TO PICTORIAL 5-8.

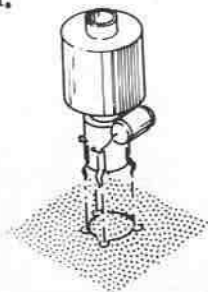
PICTORIAL 5-7

START



NOTE: After installing each of the following parts, carefully turn the circuit board over and solder the lugs to the foil.

- (✓) 19 kHz trap coil (part #40-788). Line up the coil lugs with the correct holes in the circuit board. Then push the coil in place and solder each lug to the foil.



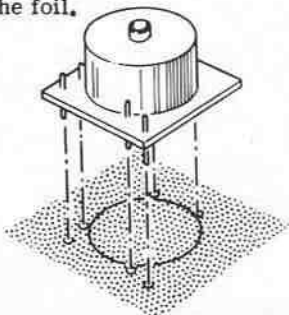
- (✓) 70 mH coil (part #40-790).

- (✓) 70 mH coil (part #40-790).

- (✓) 19 kHz trap coil (part #40-788).

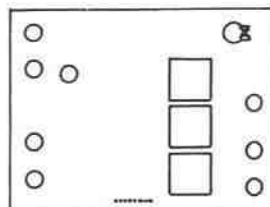
- (✓) 70 mH coil (part #40-790).

- (✓) 38 kHz oscillator coil (part #40-792). Line up the lugs of the coil with the correct holes in the circuit board. Then push the coil in place and solder each lug to the foil.



- (✓) 19 kHz doubler coil (part #40-791).

- (✓) 19 kHz amplifier coil (part #40-786).

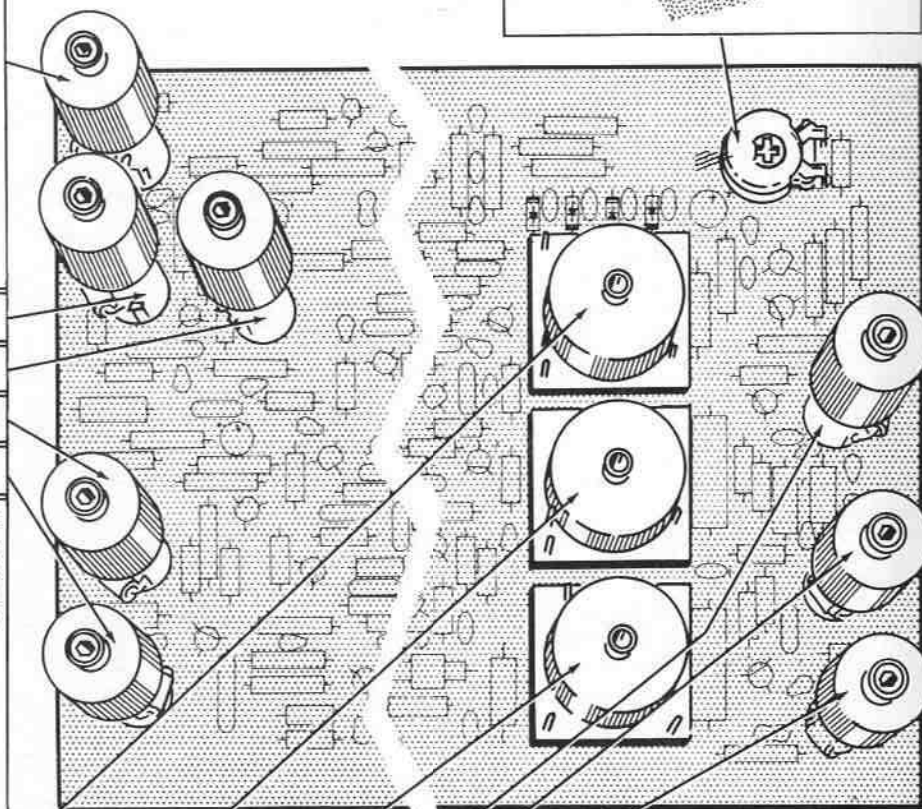


IDENTIFICATION DRAWING

CONTINUE



- (✓) 750 Ω control (part #10-155). Push the control firmly against the circuit board, and then solder the lugs to the foil.



- (✓) 67 kHz trap coil (part #40-787).

- (✓) 53 kHz low pass coil (part #40-789).

- (✓) 67 kHz trap coil (part #40-787).

- () Carefully inspect the foil side of the circuit board and solder any connections that might have been missed. Then set this circuit board aside temporarily.

FINISH

AM-FM CIRCUIT BOARD

PARTS LIST

Unpack the package marked 6 and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the AM-FM Circuit Board Parts Pictorial (fold-

out from Page 22). Any part that is packaged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
----------	---------------	-------------

RESISTORS

1/2 Watt

(1) 1-103	1	33 Ω (orange-orange-black)
1-1	2	47 Ω (yellow-violet-black)
1-3	3	100 Ω (brown-black-brown)
1-66	1	150 Ω (brown-green-brown)
1-45	1	220 Ω (red-red-brown)
1-4	1	330 Ω (orange-orange-brown)
1-6	3	470 Ω (yellow-violet-brown)
1-119	1	560 Ω (green-blue-brown)
1-8	1	820 Ω (gray-red-brown)
1-9	4	1000 Ω (brown-black-red)
1-11	2	1500 Ω (brown-green-red)
1-93	1	1800 Ω (brown-gray-red)
1-44	1	2200 Ω (red-red-red)
1-13	2	2700 Ω (red-violet-red)
1-14	1	3300 Ω (orange-orange-red)
1-16	3	4700 Ω (yellow-violet-red)
1-73	1	8200 Ω (gray-red-red)
1-20	6	10 K Ω (brown-black-orange)
1-22	1	22 K Ω (red-red-orange)
1-25	3	47 K Ω (yellow-violet-orange)

PART No.	PARTS Per Kit	DESCRIPTION
----------	---------------	-------------

RESISTORS 1/2 Watt (cont'd.)

1-60	2	68 K Ω (blue-gray-orange)
1-26	2	100 K Ω (brown-black-yellow)
1-142	1	560 K Ω (green-blue-yellow)

1/2 Watt 1% Precision

(2) 2-111	1	400 Ω
2-181	1	5490 Ω (5.49 K)
2-50	1	10 K Ω

1/2 Watt 5% Low-Noise

4-12	2	390 Ω (orange-white-brown)
4-13	1	510 Ω (green-brown-brown)
4-14	2	620 Ω (blue-red-brown)
4-41	1	1500 Ω (brown-green-red)
4-17	1	2200 Ω (red-red-red)
4-37	1	6800 Ω (blue-gray-red)
4-22	2	10 K Ω (brown-black-orange)
4-45	1	82 K Ω (gray-red-orange)
4-34	1	100 K Ω (brown-black-yellow)

PART No.	PARTS Per Kit	DESCRIPTION
----------	---------------	-------------

CAPACITORS**Disc-Silver Mica**

(3) 21-78	✓1	5 pf disc
21-13	✓1	500 pf disc
21-82	✓4	.02 μ fd disc, 50 V
(4) 20-102	✓2	100 pf silver mica
20-139	✓1	330 pf silver mica

Mylar

NOTE: The Mylar capacitors may be color coded, or the value may be printed on them. If necessary, refer to the capacitor color code chart and example (fold-out from Page 22) to help identify these capacitors.

(5) 27-74	15	.01 μ fd (brown-black-orange)
27-73	✓5	.047 μ fd (yellow-violet-orange)
27-47	✓9	.1 μ fd (brown-black-yellow)
27-85	✓2	.22 (0.22) μ fd (wide red band - yellow)
27-61	✓1	.47 (0.47) μ fd (yellow-violet-yellow)

Electrolytic

(6) 25-220	✓4	10 μ fd, 20 V tantalum
25-223	✓3	47 μ fd, 15 V tantalum
25-148	✓1	1000 μ fd

TRANSISTORS-INTEGRATED CIRCUITS-DIODES

(7) 417-83	✓3	L842 transistor
417-118	✓2	2N3393 transistor
417-201	✓4	X29A829 transistor
(8) 417-133	✓4	40245 transistor
(9) 417-123	✓2	Integrated circuit (CA3012)
(10) 56-26	✓8	1N191 crystal diode

COILS-TRANSFORMERS

(11) 40-583	✓1	10 μ H peaking coil
(12) 40-676	✓1	Oscillator coil
40-677	✓1	RF-mixer coil
52-104	✓1	455 kHz interstage IF trans-former
52-90	✓1	455 kHz output IF trans-former
53-11	✓1	Ratio detector transformer

PART No.	PARTS Per Kit	DESCRIPTION
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HARDWARE**#4 HARDWARE**

(13) 250-52	✓4	4-40 x 1/4" screw
(14) 250-273	✓5	4-40 x 3/8" screw
(15) 250-312	✓1	4-40 x 3/4" screw
(16) 254-9	✓10	#4 lockwasher
(17) 252-2	✓10	4-40 nut
(18) 252-89	✓3	4-40 speednut

#6 Hardware

(19) 250-138	✓3	6-32 x 3/16" screw
(20) 250-89	✓4	6-32 x 3/8" screw
(21) 250-170	✓5	#6 x 1/4" sheet metal screw
(22) 254-1	✓2	#6 lockwasher
(23) 252-3	✓2	6-32 nut
(24) 255-3	✓1	3/8" spacer

#8 Hardware

(25) 250-43	✓1	8-32 x 1/4" setscrew
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MISCELLANEOUS

(26) 456-1	✓1	Shaft coupler (with four 6-32 x 3/16" screws)
(27) 10-155	✓1	750 Ω control
(28) 60-4	✓1	3-lug slide switch
(29) 404-383	✓2	10.7 MHz crystal filter
(30) 205-544	✓1	Support bracket
(31) 265-12	✓2	Hinge
(32) 431-13	✓1	4-lug screw-type terminal strip
(33) 100-642	✓1	Dial cord pulley

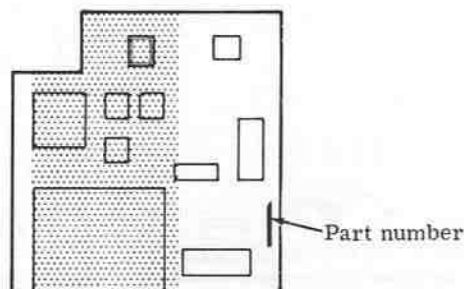
ITEMS FROM PACK 7

85-299-2	✓1	AM-FM circuit board
(34) 26-112	✓1	AM tuning capacitor
(35) 110-39	✓1	FM tuning unit
(36) 206-430	✓1	AM-FM shield
(37) 206-329-1	✓1	Phono preamplifier circuit board shield
(38) 204-755	✓1	Antenna support bracket
(39) 40-793	✓1	AM antenna coil
347-2	✓1	Twin lead
344-52	✓1	Red hookup wire
344-53	✓1	Yellow hookup wire
(40) 490-5	✓1	Nut starter

STEP-BY-STEP ASSEMBLY

Position the AM-FM circuit board with the part number as shown in the identification drawing. Then complete each step on the Pictorial.

NOTE: Only one-half of the circuit board is shown in each of the following Pictorials. An identification drawing at the top of each Pictorial shows the area of the circuit board to be assembled.



IDENTIFICATION DRAWING

(✓) 470 Ω (yellow-violet-brown).	(✓) 4700 Ω (yellow-violet-red).	(✓) 4700 Ω (yellow-violet-red).
(✓) 4700 Ω (yellow-violet-red).	(✓) 8200 Ω (gray-red-red).	(✓) 100 Ω (brown-black-brown).
(✓) 1500 Ω (brown-green-red).	(✓) 100 K Ω (brown-black-yellow).	(✓) 47 K Ω (yellow-violet-orange).
(✓) 100 K Ω (brown-black-yellow).	(✓) 68 K Ω (blue-gray-orange).	(✓) 2700 Ω (red-violet-red).
(✓) Solder all leads to the foil and cut off the excess lead lengths.	(✓) 100 Ω (brown-black-brown).	(✓) 1800 Ω (brown-gray-red).
(✓) 100 K Ω (brown-black-yellow).	(✓) 6800 Ω 5% (blue-gray-red) <u>low-noise</u> .	(✓) 1000 Ω (brown-black-red).
(✓) 390 Ω 5% (orange-white-brown) <u>low-noise</u> .	(✓) 390 Ω 5% (orange-white-brown) <u>low-noise</u> .	(✓) Solder all leads to the foil and cut off the excess lead lengths.
(✓) 10 k Ω 5% (brown-black-orange) <u>low-noise</u> .	(✓) Solder all leads to the foil and cut off the excess lead lengths.	(✓) 10 K Ω (brown-black-orange).
		(✓) 4700 Ω (yellow-violet-red).
		(✓) 560 K Ω (green-blue-yellow).
		(✓) 47 Ω (yellow-violet-black).
		(✓) 22 K Ω (red-red-orange).
		(✓) 330 Ω (orange-orange-brown).
		(✓) Solder all leads to the foil and cut off the excess lead lengths.

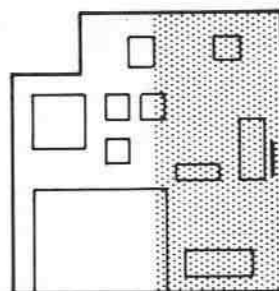
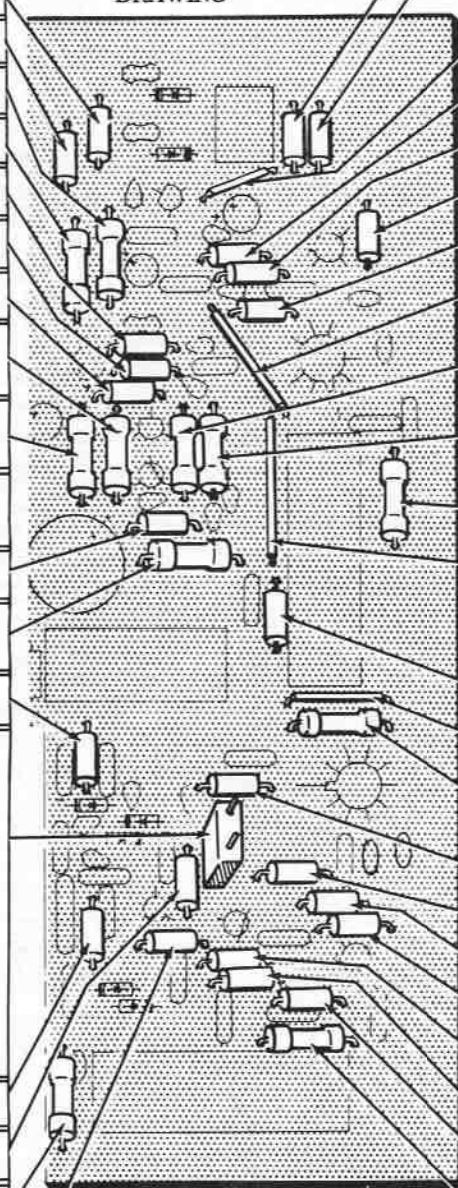
PROCEED TO PICTORIAL 6-2

PICTORIAL 6-1

START



- (✓) 1000 Ω (brown-black-red).
 - (✓) 1500 Ω (brown-green-red).
 - (✓) 5490 Ω (5.49K) 1% precision.
 - (✓) 10 K Ω 1% precision.
 - (✓) 10 K Ω (brown-black-orange).
 - (✓) 47 K Ω (yellow-violet-orange).
 - (✓) 3300 Ω (orange-orange-red).
 - (✓) 100 K Ω 5% (brown-black-yellow) low noise.
 - (✓) 10 K Ω 5% (brown-black-orange) low noise.
 - (✓) Solder all leads to the foil and cut off the excess lead lengths.
 - (✓) 100 Ω (brown-black-brown).
 - (✓) 1500 Ω 5% (brown-green-red) low noise.
 - (✓) 820 Ω (gray-red-brown).
 - (✓) 10 μ H peaking coil (#40-583).
- LONGER LEADS
- (✓) 10 K Ω (brown-black-orange).
 - (✓) 1000 Ω (brown-black-red).
 - (✓) 400 Ω 1% precision.
 - (✓) 47 Ω (yellow-violet-black).
 - (✓) Solder all leads to the foil and cut off the excess lead lengths.

IDENTIFICATION
DRAWING

PICTORIAL 6-2

CONTINUE

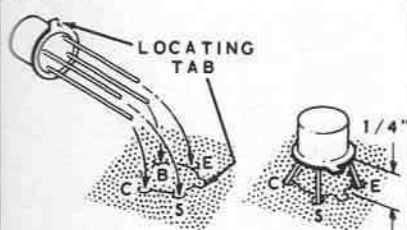


- (✓) 470 Ω (yellow-violet-brown).
 - (✓) 470 Ω (yellow-violet-brown).
- NOTE: When installing the following hookup wires, remove 1/4" of insulation from each end.
- (✓) 1" black hookup wire.
 - (✓) 220 Ω (red-red-brown).
 - (✓) 68 K Ω (blue-gray-orange).
 - (✓) 10 K Ω (brown-black-orange).
 - (✓) 2200 Ω (red-red-red).
 - (✓) 1-1/2" black hookup wire.
 - (✓) 82 K Ω 5% (gray-red-orange) low noise.
 - (✓) 2200 Ω 5% (red-red-red) low noise.
 - (✓) 620 Ω 5% (blue-red-brown) low noise.
 - (✓) 1-5/8" black hookup wire.
 - (✓) Solder all leads to the foil and cut off the excess lead lengths.
 - (✓) 33 Ω (orange-orange-black).
 - (✓) 1-1/4" black hookup wire.
 - (✓) 510 Ω 5% (green-brown-brown) low noise.
 - (✓) 150 Ω (brown-green-brown).
 - (✓) 2700 Ω (red-violet-red).
 - (✓) 47 K Ω (yellow-violet-orange).
 - (✓) 10 K Ω (brown-black-orange).
 - (✓) 10 K Ω (brown-black-orange).
 - (✓) 560 Ω (green-blue-brown).
 - (✓) 1000 Ω (brown-black-red).
 - (✓) 620 Ω 5% (blue-red-brown) low noise.
 - (✓) Solder all leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 6-3.

START

NOTE: Install the transistors in the following manner as shown: First line up the locating tab of the transistor with the outline of the tab on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by S, C, B, and E. Position the transistor 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



Install 40245 transistors (part #417-133) at the following locations:

(✓) 40245 transistor at Q316.

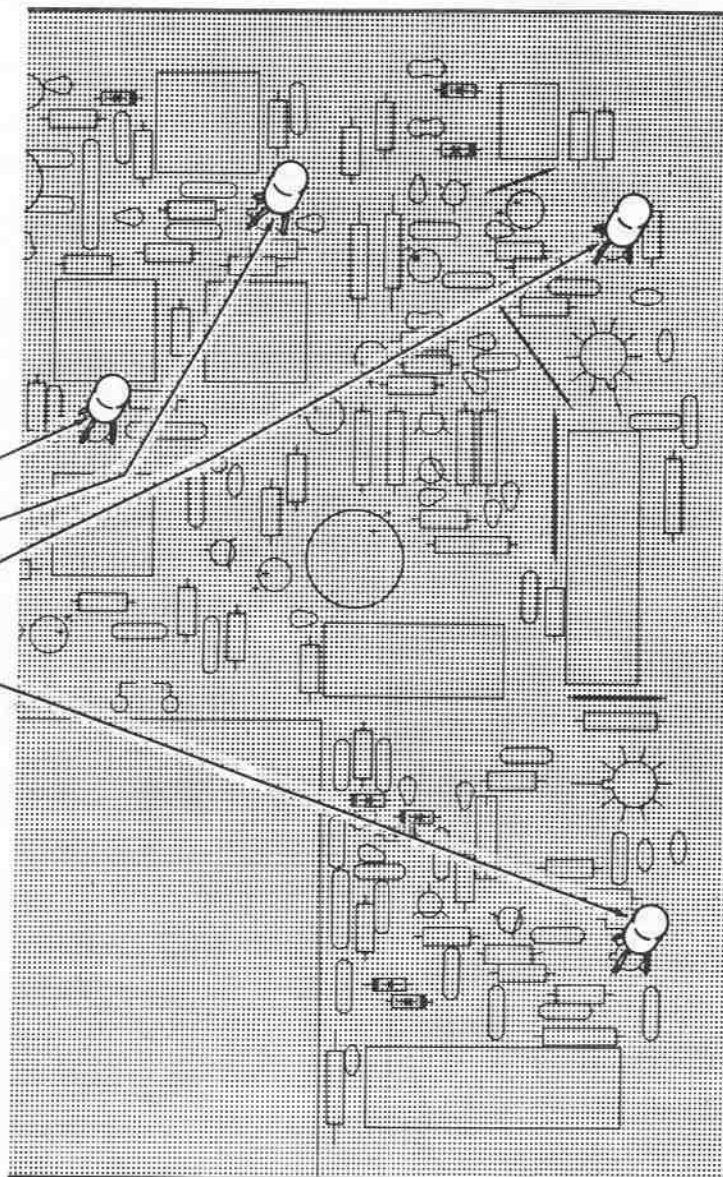
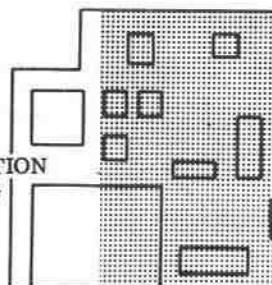
(✓) 40245 transistor at Q317.

(✓) 40245 transistor at Q306.

(✓) 40245 transistor at Q305.

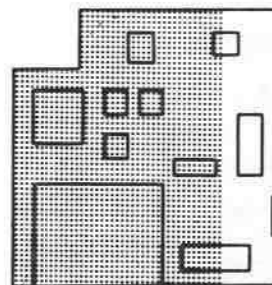
(✓) Recheck the transistors to make sure the leads were installed in the correct holes.

IDENTIFICATION
DRAWING



PROCEED TO PICTORIAL 6-4.

PICTORIAL 6-3

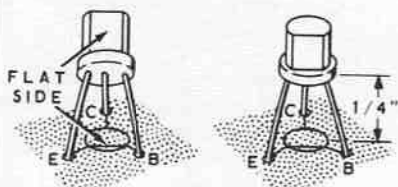


IDENTIFICATION DRAWING

START



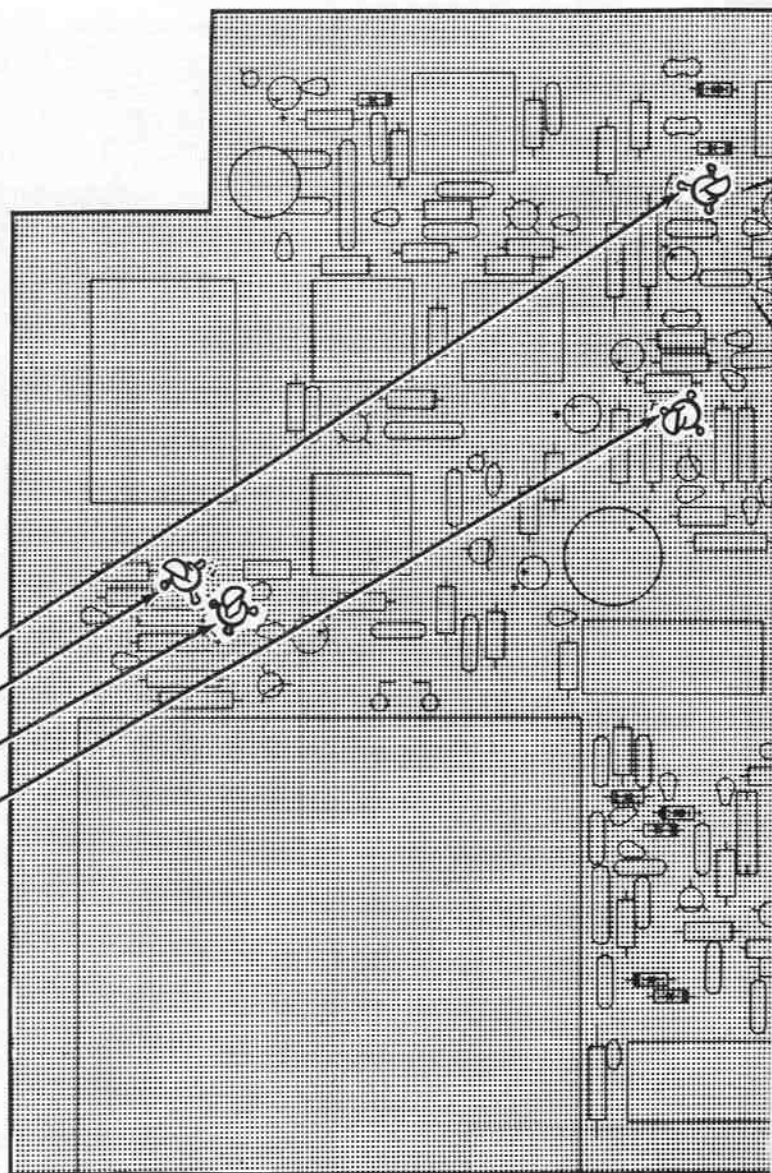
NOTE: Install the transistors in the following manner as shown: First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistor 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



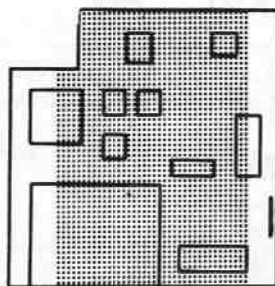
Install X29A829 transistors (Part #417-201) at the following locations:

- (✓) X29A829 transistor at Q311.
- () X29A829 transistor at Q314.
- (✓) X29A829 transistor at Q313.
- (✓) X29A829 transistor at Q307.
- (✓) Recheck the transistors to make sure the leads were installed in the correct holes.

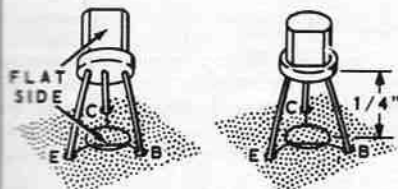
PROCEED TO PICTORIAL 6-5.



PICTORIAL 6-4

IDENTIFICATION
DRAWING**START**

NOTE: Install the transistors in the following manner as shown: First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, which are indicated by C, B, and E. Position the transistors 1/4" away from the circuit board. Then solder each lead to the foil and cut off the excess lead lengths.



Install 2N3393 transistors (part #417-118) at the following locations:

(✓) 2N3393 transistor at Q308.

(✓) 2N3393 transistor at Q312.

Install L842 transistors (part #417-83) at the following locations:

(✓) L842 transistor at Q315.

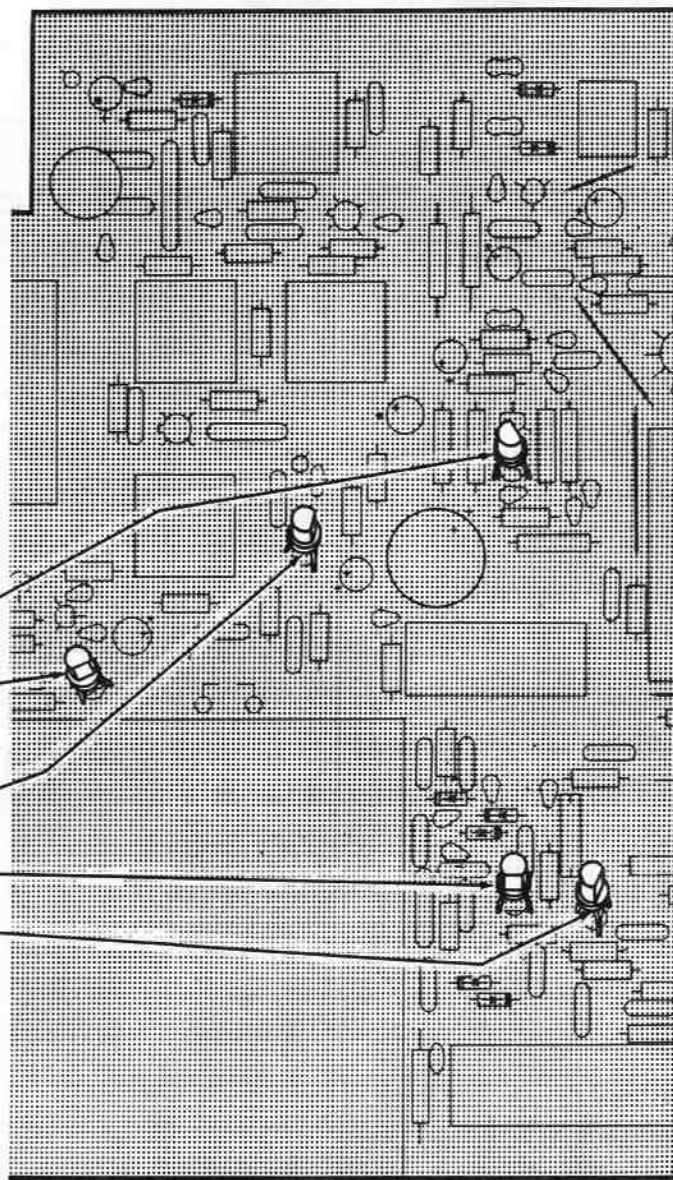
(✓) L842 transistor at Q310.

(✓) L842 transistor at Q309.

() Recheck the transistors to make sure the leads were installed in the correct holes.

PROCEED TO PICTORIAL 6-6.

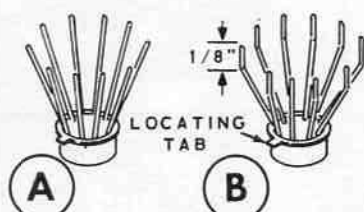
PICTORIAL 6-5



START

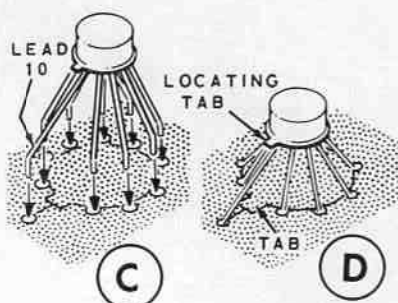
NOTE: Install the integrated circuits in the following manner, as shown:

- (A) Bend all leads out to form a $3/4$ " circle.



- (B) Bend the end of each lead so that it points straight up as shown.

- (C) Line up the locating tab of the integrated circuit with the outline of the tab on the circuit board. Insert lead 10 (the one nearest the locating tab) into the hole at the tab and then insert the remaining leads into their correct holes.

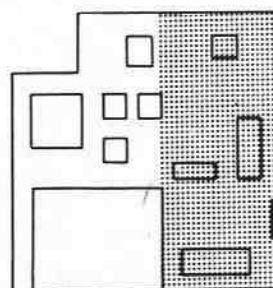


- (D) Hold the integrated circuit in place and turn the circuit board over. First solder lead 10 to the foil and then solder the remaining nine leads. NOTE: It is not necessary to bend the leads over or clip off the excess leads after soldering them.

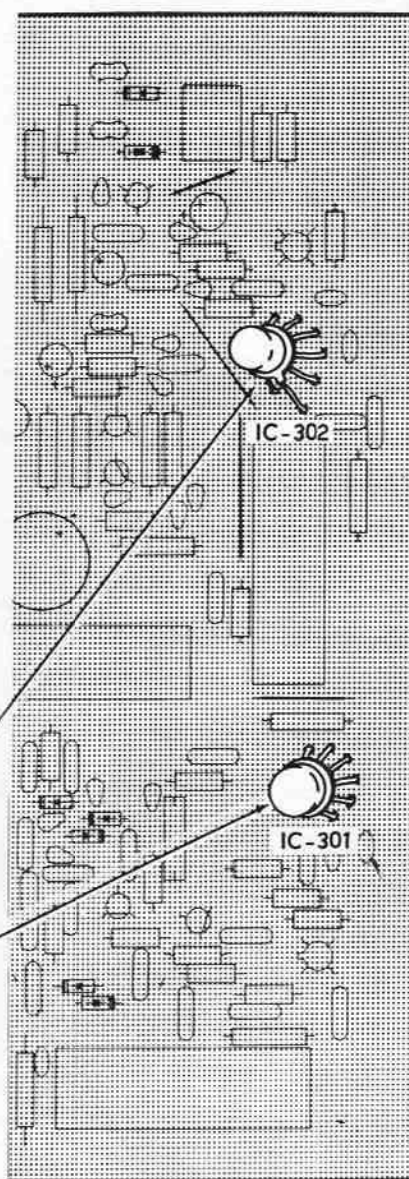
() Integrated circuit CA3012 at IC-302.

() Integrated circuit CA3012 at IC-301.

() Recheck the integrated circuits to make sure the leads were installed in the correct holes.



IDENTIFICATION DRAWING



PROCEED TO PICTORIAL 6-7.

PICTORIAL 6-6

START

NOTE: When installing crystal diodes, position the banded end as shown.

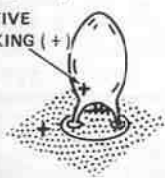


BANDED END

- 1N191 crystal diode (brown-white-brown), part #56-26, at D308.

When installing electrolytic capacitors always match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.

POSITIVE MARKING (+)



- 10 μ fd electrolytic.

NOTE: The Mylar capacitors may either be color coded or marked with a value.

- .47 (0.47) μ fd Mylar (yellow-violet-yellow).

- .047 μ fd Mylar (yellow-violet-orange).

- .01 μ fd Mylar (brown-black-orange).

- .22 (0.22) μ fd Mylar (wide red band-yellow).

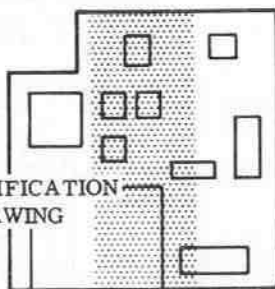
- 47 μ fd electrolytic.

- .047 μ fd Mylar (yellow-violet-orange).

- .047 μ fd Mylar (yellow-violet-orange).

- Solder all leads to the foil and cut off the excess lead lengths.

IDENTIFICATION DRAWING



CONTINUE

- .01 μ fd Mylar (brown-black-orange).

- .047 μ fd Mylar (yellow-violet-orange).

- .047 μ fd Mylar (yellow-violet-orange).

- .01 μ fd Mylar (brown-black-orange).

- 500 pf disc.

- 47 μ fd electrolytic.

- 10 μ fd electrolytic.

- 10 μ fd electrolytic.

- 1000 μ fd electrolytic.

- Solder all leads to the foil and cut off the excess lead lengths.

- .22 (0.22) μ fd Mylar (wide red band-yellow).

- .1 μ fd Mylar (brown-black-yellow).

- .01 μ fd Mylar (brown-black-orange).

- .1 μ fd Mylar (brown-black-yellow).

- .1 μ fd Mylar (brown-black-yellow).

- .01 μ fd Mylar (brown-black-orange).

- .01 μ fd Mylar (brown-black-orange).

- 5 pf disc.

- Recheck the six electrolytic capacitors to make sure the positive (+) ends are positioned correctly.

- Solder all leads to the foil and cut off the excess lead lengths.

PICTORIAL 6-7

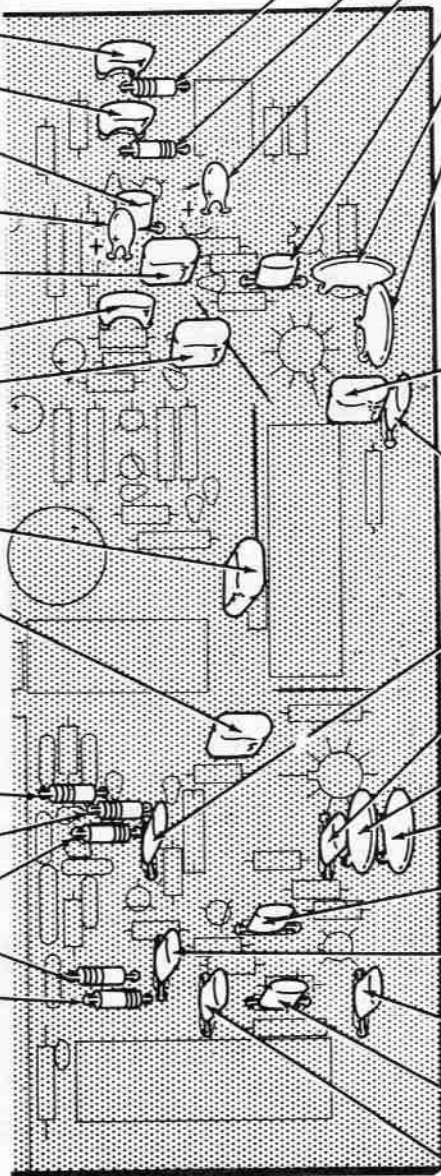
PROCEED TO PICTORIAL 6-8.

START

IDENTIFICATION
DRAWING

CONTINUE

- () 100 pf silver mica.
 - () 100 pf silver mica.
 - () .1 μ fd Mylar (brown-black-yellow).
 - () 10 μ fd electrolytic.
 - () .1 μ fd Mylar (brown-black-yellow).
 - () 330 pf silver mica.
 - () .1 μ fd Mylar.
 - () Solder all leads to the foil and cut off the excess lead lengths.
 - () .1 μ fd Mylar (brown-black-yellow).
 - () .1 μ fd Mylar (brown-black-yellow).
- NOTE: When installing the 1N191 (part #56-26) crystal diodes in the following steps, position the banded end as shown.
- () 1N191 crystal diode at D305.
 - () 1N191 crystal diode at D304.
 - () 1N191 crystal diode at D303.
 - () 1N191 crystal diode at D306.
 - () 1N191 crystal diode at D307.
 - () Solder all leads to the foil and cut off the excess lead lengths.

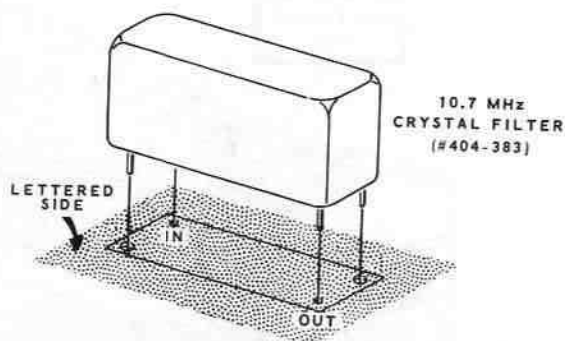


- () 1N191 crystal diode at D301.
 - () 1N191 crystal diode at D302.
 - () 47 μ fd electrolytic.
 - () .01 μ fd Mylar (brown-black-orange).
 - () .02 μ fd 50 V disc.
 - () .02 μ fd 50 V disc.
- NOTE: Be sure the capacitors installed in the next two steps are spaced about 1/4" apart. (If they are too close to each other, the squelch circuits may not operate properly.)
- () .1 μ fd Mylar (brown-black-yellow). NOTE: Position this capacitor away from the rectangular outline of the XTAL FILTER.
 - () .01 μ fd Mylar (brown-black-orange).
 - () Solder all leads to the foil and cut off the excess lead lengths.
 - () .01 μ fd Mylar (brown-black-orange).
 - () .01 μ fd Mylar (brown-black-orange).
 - () .02 μ fd 50 V disc.
 - () .02 μ fd 50 V disc.
 - () .01 μ fd Mylar (brown-black-orange).
 - () .01 μ fd Mylar (brown-black-orange).
 - () .01 μ fd Mylar (brown-black-orange).
 - () .01 μ fd Mylar (brown-black-orange).
 - () .01 μ fd Mylar (brown-black-orange).
 - () Solder all leads to the foil and cut off the excess lead lengths.

PROCEED TO THE NEXT PAGE.

Refer to Pictorial 6-9 (fold-out from Page 59) for the following steps.

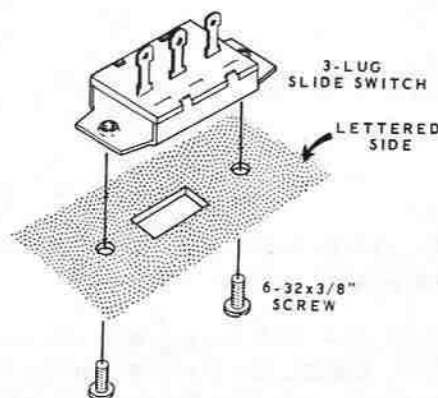
- (✓) Position the circuit board as shown.
- (✓) Locate both 10.7 MHz crystal filters (#404-383). Install one filter at F301 and another one at F302 as follows, and as shown in Detail 6-9A. First match the lugs marked IN and OUT on the filter with the same markings on the circuit board. Then push the filters in place against the circuit board.



Detail 6-9A

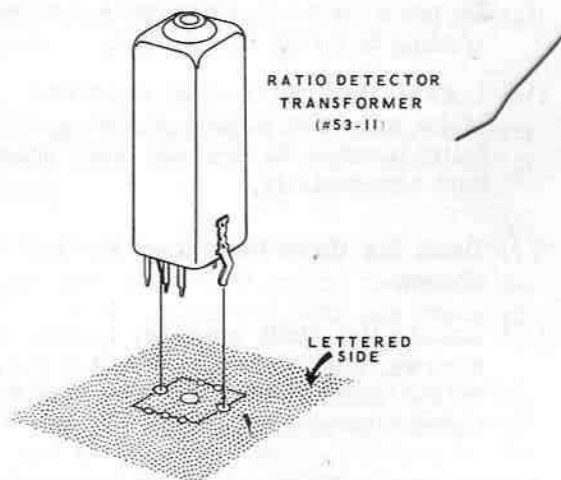
- (✓) Solder the lugs of each crystal to the circuit board foil, and then cut off the excess lugs.
- (✓) Install the 3-lug slide switch (#60-4) with two 6-32 x 3/8" screws. Refer to Detail 6-9B.

NOTE: Before installing the following transformers and coils, observe the lug spacing of each part and the hole spacing on the circuit board. Then insert the lugs into the holes and solder them to the foil. Refer to Detail 6-9C.

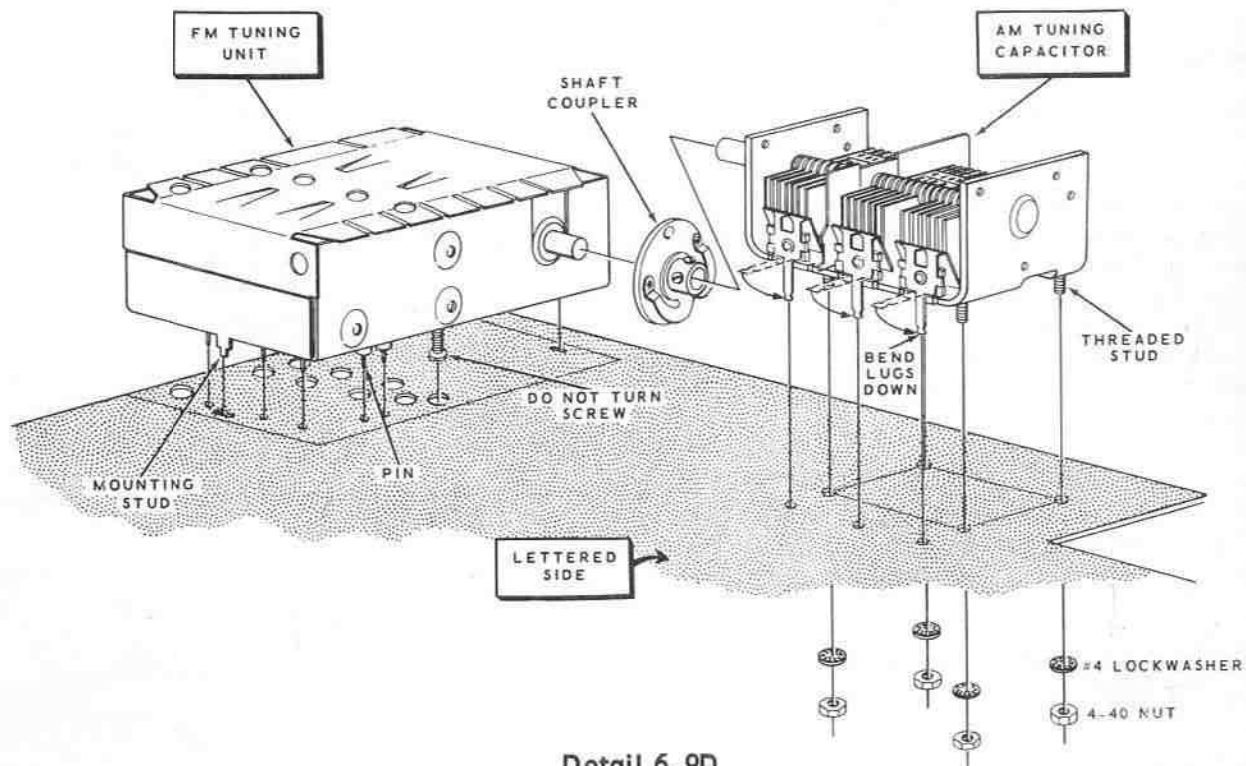


Detail 6-9B

- (✓) Install the ratio detector transformer (#53-11).
- (✓) Install IF transformer (#52-104). Solder only the lugs that have foil around them.
- (✓) Install IF transformer (#52-90). Solder only the lugs that have foil around them.
- (✓) Install oscillator coil (#40-676).
- (✓) Install RF-mixer coil (#40-677).
- (✓) Install the 750 Ω control (#10-155). Push the control firmly against the circuit board and then solder the lugs to the foil.



Detail 6-9C



Detail 6-9D

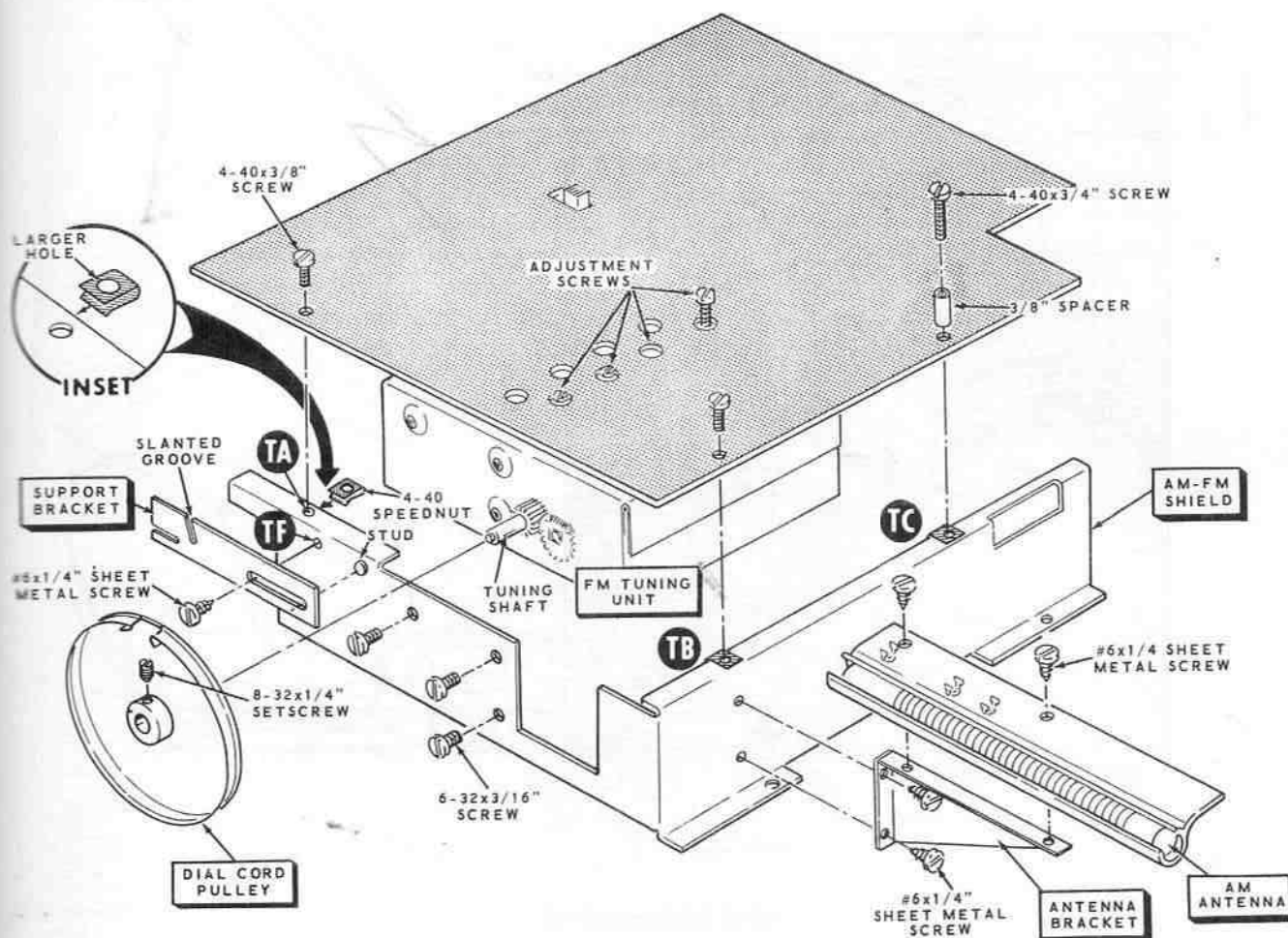
Refer to Detail 6-9D and Pictorial 6-9 for the following steps.

- () Install the FM tuning unit on the circuit board. Insert the three mounting studs and five tuner pins into the correct holes. Make sure the tuner studs are firmly against the circuit board. First solder the three studs and then the five tuner pins to the foil. NOTE: Do not turn the four adjustment screws protruding from the tuning unit.
- (✓) Locate the AM tuning capacitor. NOTE: Make sure the plates of the capacitor are fully meshed to prevent them from being bent accidentally.
- (✓) Bend the three tuner lugs straight down as shown.
- (✓) Locate the shaft coupler. Loosen the four screws; then slide either end of the coupler on the shaft of the AM tuning unit. Do not tighten the screws at this time.
- () Mount the tuning capacitor on the circuit board as follows: Insert the three lugs and four threaded studs into the circuit board holes. Then slide the coupler on the shaft of the FM tuning unit. Fasten the capacitor to the circuit board with four #4 lockwashers and four 4-40 nuts. NOTE: Before you tighten the nuts, make sure the shaft of the tuning capacitor is in line with the shaft of the FM tuning unit.
- () Solder the three tuning capacitor lugs to the circuit board foil.
- () Turn the shaft of the FM tuning unit fully clockwise and turn the shaft of the AM tuning capacitor full counterclockwise. Then center the coupler between both shafts and tighten all four screws.

Refer to Pictorial 6-10 for the following steps.

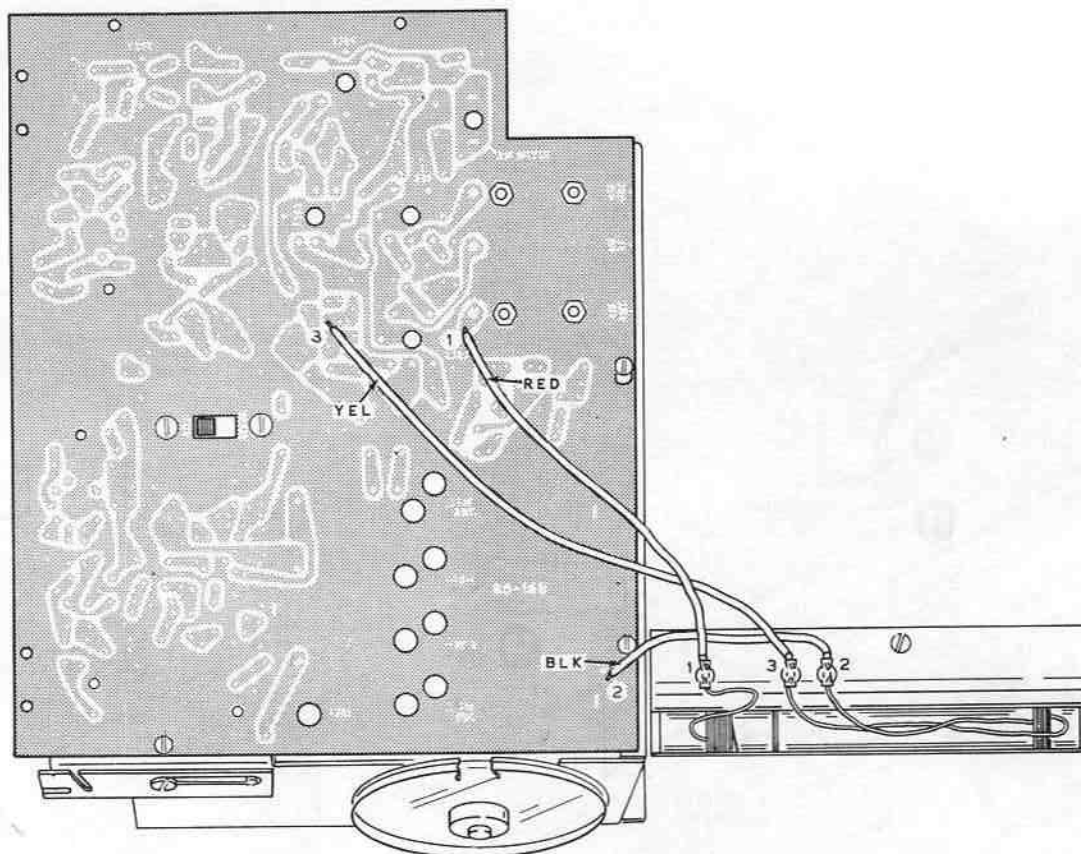
NOTE: The Heath Company has provided a plastic nut starter with this kit. Use this nut starter to hold and start 6-32, and 4-40 nuts on screws. Refer to Page 3 of the Kit Builders Guide for further information.

- () Position the AM-FM shield as shown and install 4-40 speednuts at holes TA, TB, and TC. Make sure the speednuts are positioned with the larger hole up as shown in the inset drawing and then push them over the flange of the shield.



PICTORIAL 6-10

- (1) Position the circuit board as shown and mount it on the shield. Use 4-40 x 3/8" screws at TA and TB and a 4-40 x 3/4" screw and 3/8" spacer at TC. Do not tighten the screws at this time.
- (2) Fasten the front of the shield to the FM tuning unit with three 6-32 x 3/16" screws. Start all of the screws in the holes and then tighten them.
- (3) Tighten the screws at TA, TB, and TC.
- (4) Position the support bracket with the slanted groove as shown. Then mount the bracket on the shield at TF with a #6 x 1/4" sheet metal screw. Make sure the long slot on the bracket lines up with the small stud on the shield; then tighten the screw.
- (5) Mount the antenna bracket on the AM-FM shield with two #6 x 1/4" sheet metal screws.
- (6) Mount the AM antenna coil on the antenna bracket with two #6 x 1/4" sheet metal screws.
- (7) Locate the dial cord pulley and start an 8-32 x 1/4" setscrew into the bushing.
- (8) Turn the FM tuning shaft fully clockwise. Then place the dial cord pulley on the shaft with the cutout in the pulley pointing in the 12 o'clock position as shown. Position the pulley flush with the end of the outer shaft (not the slender inner shaft) and tighten the setscrew.



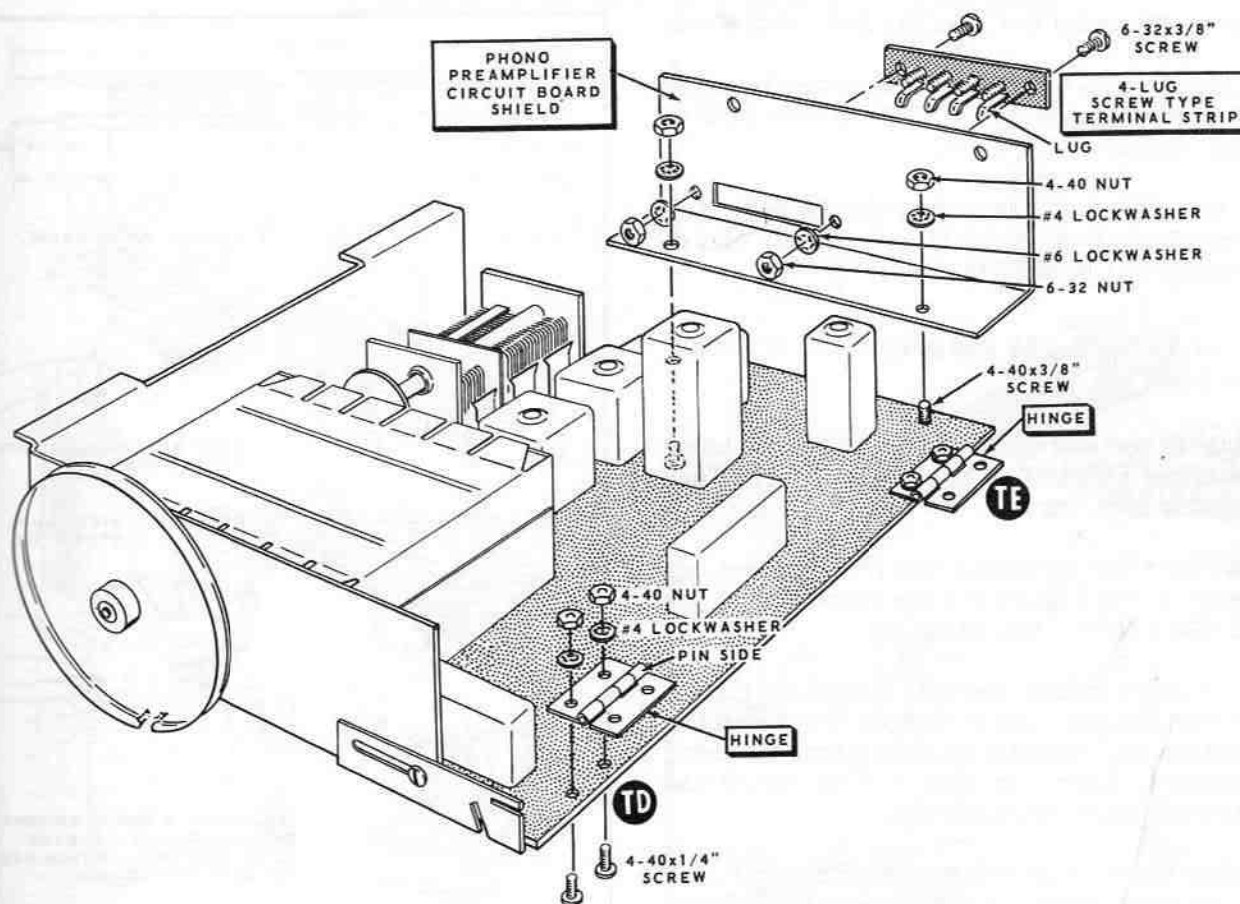
PICTORIAL 6-11

Refer to Pictorial 6-11 for the following steps.

() Position the circuit board assembly as shown.

NOTE: When soldering to the antenna lugs, use only enough heat to make a good solder connection. This will prevent the lugs from being loosened in the plastic.

- () Connect a 3-3/4" black wire from lug 2 of the antenna (S-1) to hole 2 of the circuit board (S-1).
- () Connect a 7-3/4" yellow wire from lug 3 of the antenna (S-1) to hole 3 of the circuit board (S-1).
- () Connect a 5-3/4" red wire from lug 1 of the antenna (S-1) to hole 1 of the circuit board (S-1).



PICTORIAL 6-12

Refer to Pictorial 6-12 for the following steps.

- (1) Mount hinges at TD and TE with 4-40 x 1/4" screws, #4 lockwashers, and 4-40 nuts. Be sure to position the hinges with the pin side facing up as shown.
- (2) Position the phono preamplifier circuit board shield and 4-lug screw-type terminal strip as shown. Then mount the terminal strip on the shield with 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts.
- (3) Mount the shield on the circuit board with 4-40 x 3/8" screws, #4 lockwashers, and 4-40 nuts.

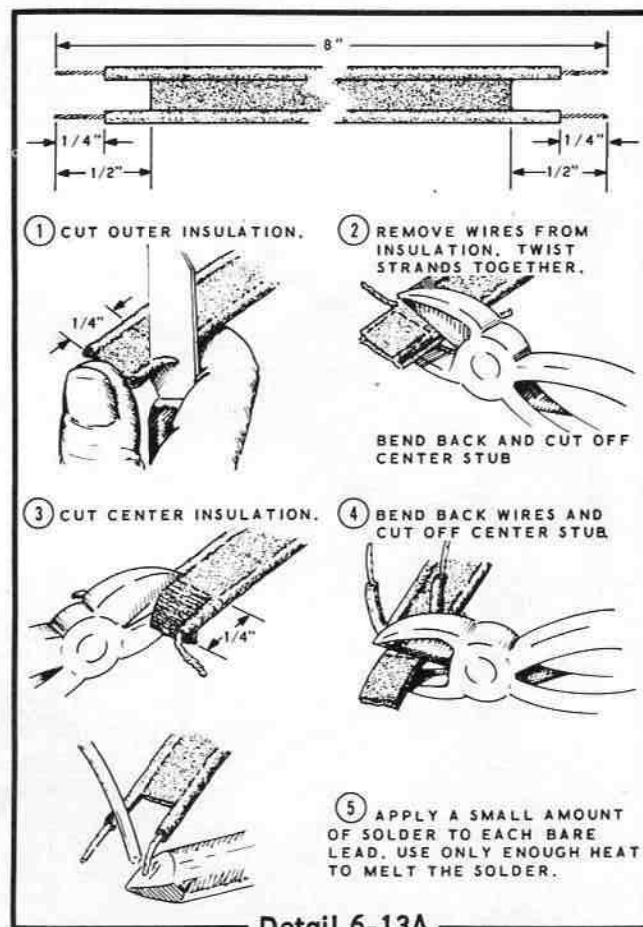
Refer to Pictorial 6-13 for the following steps.

- () Connect a 3-1/2" black hookup wire from lug 3 of terminal strip TG (S-1) to hole GND of the circuit board (S-1).
- () Connect a 5" black hookup wire from lug 4 of terminal strip TG (S-1) to hole EXT ANT of the circuit board (S-1).

Refer to Detail 6-13A and prepare an 8" length of twin lead.

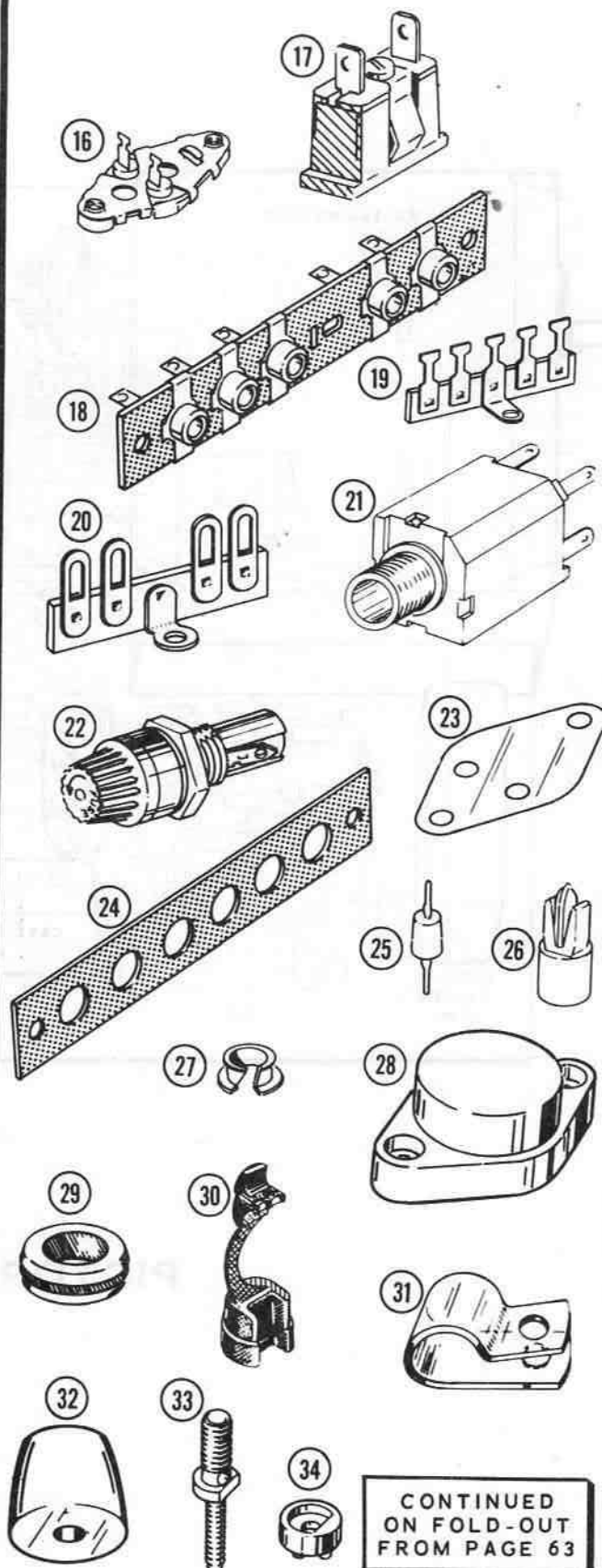
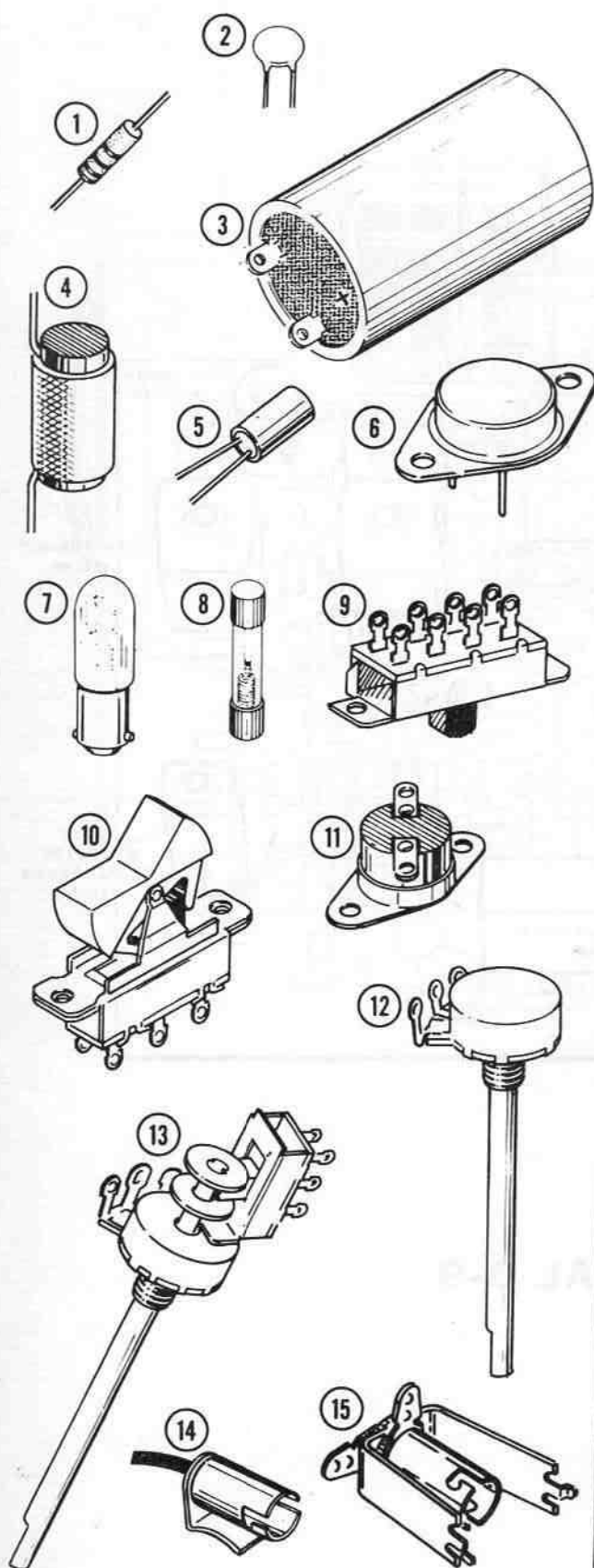
- () Insert one end of the twin lead into the holes marked FM ANT of the circuit board. Then solder both wires to the foil.
- () At the other end of the twin lead, connect one wire to lug 1 (S-1) and the other wire to lug 2 (S-1) of terminal strip TG.
- () Carefully inspect the foil side of the circuit board for any solder bridges between foils. Solder any connections that might have been missed. Then set this circuit board assembly aside temporarily.

Set aside the wire and sleeving that was left over from the preceding sections of the Manual. These parts will be used in the Chassis section.

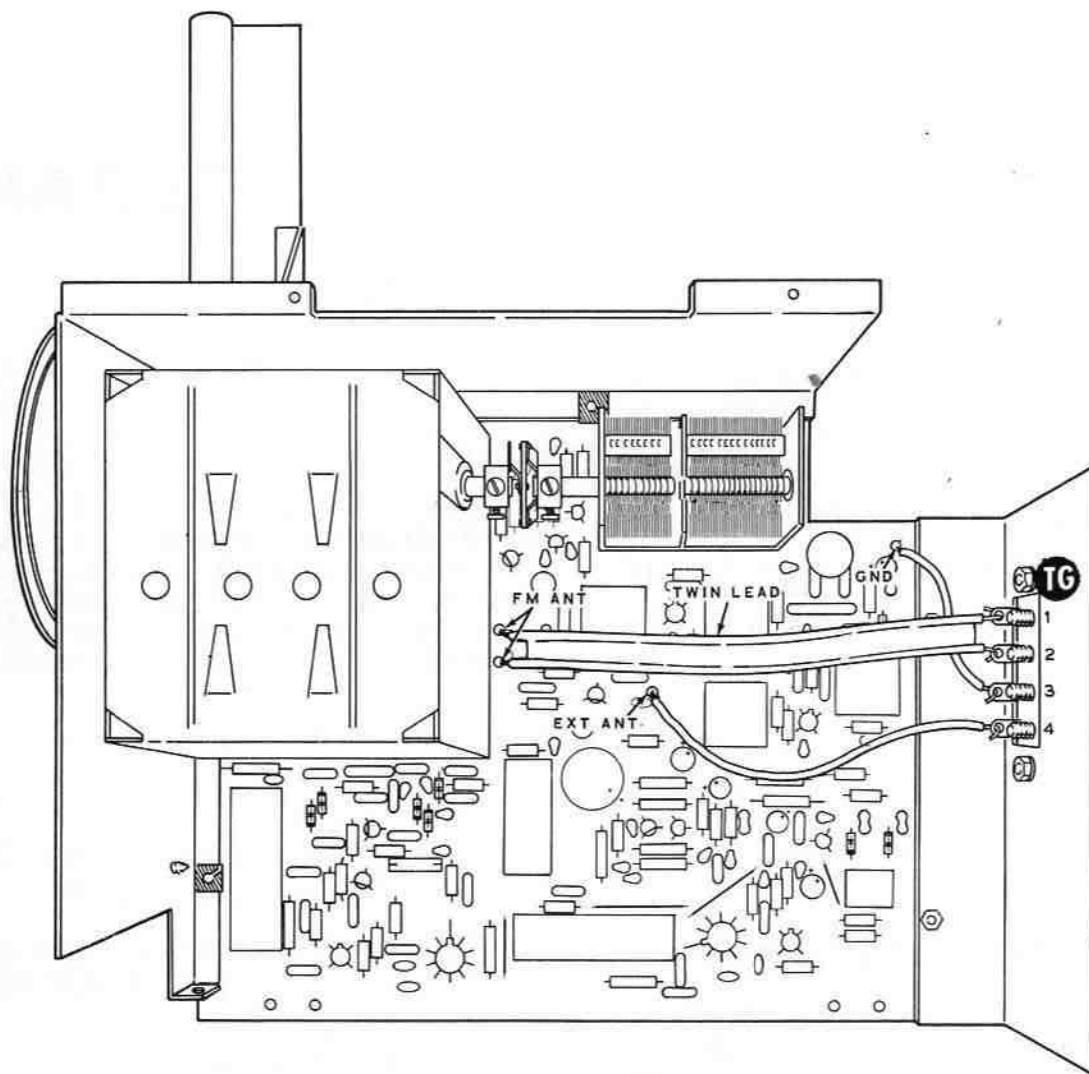


Detail 6-13A

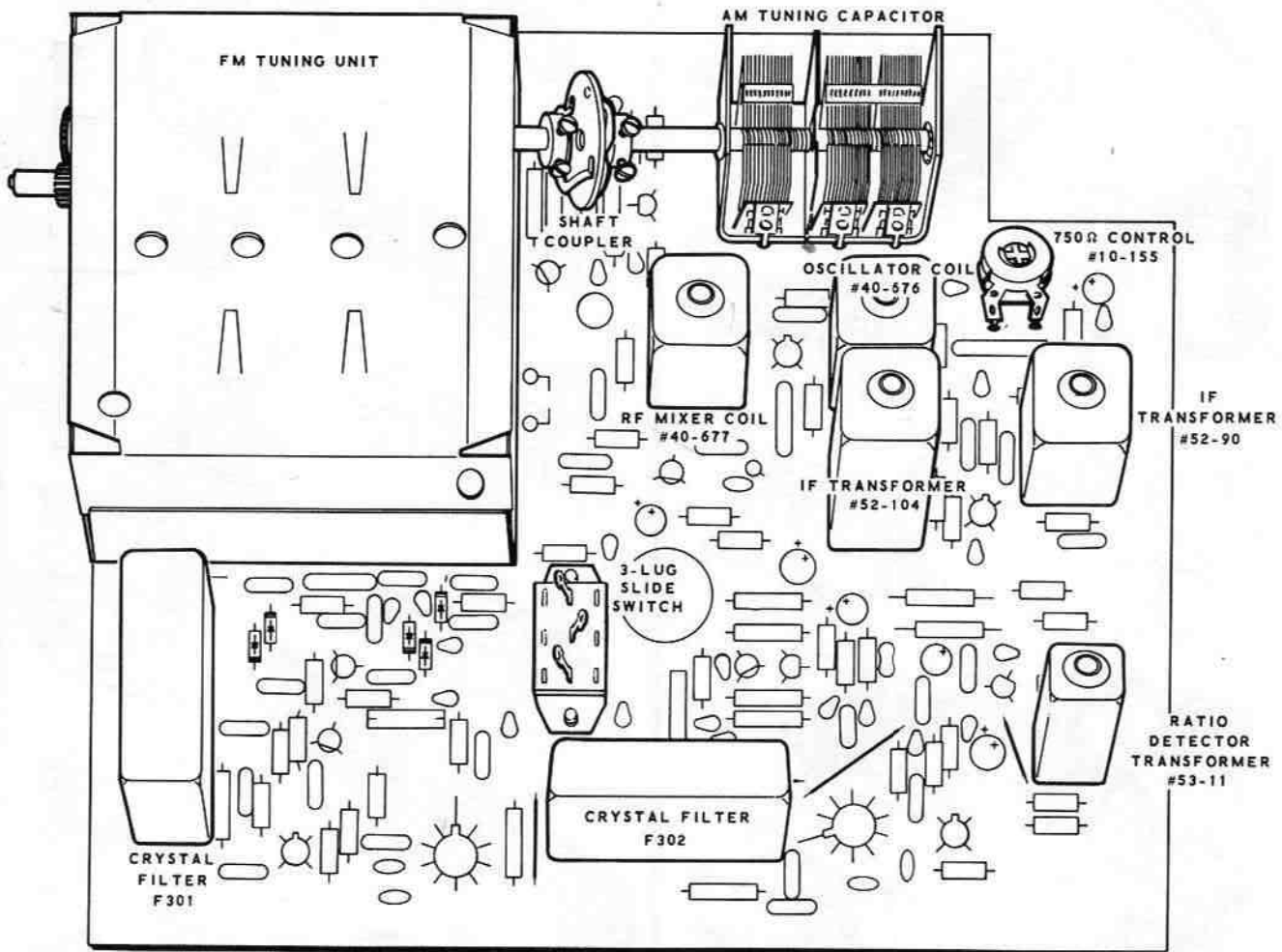
CHASSIS PARTS PICTORIAL



CONTINUED
ON FOLD-OUT
FROM PAGE 63



PICTORIAL 6-13



PICTORIAL 6-9

CHASSIS

PARTS LIST

Unpack the package marked 7, which is all of the remaining parts, and check each part against the following Parts List. The numbers in parentheses are keyed to the numbers on the Chassis Parts Pictorial (fold-out from Pages 60 and 63).

Any part that is packaged in an individual envelope with a part number on it, should be placed back in its envelope after it is identified, until that part is called for in a step.

PART No.	PARTS Per Kit	DESCRIPTION
-------------	------------------	-------------

RESISTORS-CAPACITORS-CHOKES-TRANSFORMER

(1) 1-49	✓1	22 Ω resistor (red-red-black)
1-103	✓1	33 Ω resistor (orange-orange-black)
1-13	✓1	2700 Ω resistor (red-violet-red)
(2) 21-14	✓1	.001 μ fd disc capacitor
21-31	✓2	.02 μ fd disc capacitor, 500 V
(3) 25-156	✓2	4000 μ fd electrolytic capacitor
25-171	✓1	8000 μ fd electrolytic capacitor
(4) 45-59	✓2	8.8 μ H choke
54-181	✓1	Power transformer

PART No.	PARTS Per Kit	DESCRIPTION
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DIODES-TRANSISTORS-LAMPS-FUSE

NOTE: The diodes and transistors may be marked with either the part number or the type number.

(5) 56-33	✓6	1N3754 diode
(6) 417-215	✓1	2N3055 transistor
417-139	✓4	40411 transistor
(7) 412-38	✓1	#49 lamp (red)
412-39	✓1	#756 lamp (red)
412-14	✓1	#44 lamp
(8) 421-6	✓2	3 ampere slow-blow fuse

PART No.	PARTS Per Kit	DESCRIPTION
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SWITCHES-CONTROLS

(9) 60-22	✓1	8-lug slide switch
(10) 60-31	✓6	Rocker switch (white)
60-32	✓1	Rocker switch (black)
(11) 65-21	✓2	Thermal switch
(12) 10-213	✓2	1000 Ω control
(13) 19-108	✓1	10 K Ω control with switch

SOCKETS-TERMINAL STRIPS-PHONE JACKS-FUSEHOLDER

(14) 434-85	✓1	Lamp socket (with leads)
(15) 434-171	✓2	Lamp socket (without leads)
(16) 434-117	✓3	Transistor socket
(17) 434-147	✓3	AC socket
(18) 434-165	✓2	Phono socket strip
(19) 431-39	✓2	5-lug miniature terminal strip
(20) 431-5	✓1	4-lug terminal strip
(21) 436-27	✓2	Phone jack
(22) 423-2	✓1	Fuseholder

INSULATORS-BUSHINGS-CLAMPS-PLASTIC FEET

(23) 75-60	✓1	Mica insulator (Packed between two pieces of cardboard). There are two extra insulators.
(24) 75-86	✓2	Phono socket insulator
(25) 75-87	✓5	Feedthrough insulator
(26) 75-85	✓6	Nylon insulator
(27) 455-54	✓4	Nylon bushing 17/
(28) 75-88	✓3	Nylon transistor cover
(29) 73-3	✓1	Rubber grommet
(30) 75-24	✓1	Line cord strain relief
(31) 207-22	✓2	Plastic clamp
(32) 261-17	✓4	Plastic feet

BINDING POSTS-KNOBS

(33) 427-3	✓4	Binding post base
(34) 75-17	✓8	Binding post insulator
(35) 100-16-18	✓2	Red binding post cap
100-16-2	✓2	Black binding post cap
(36) 462-241	✓3	Plastic knob
(37) 462-269	✓4	Small metal knob
(38) 462-268	✓2	Large metal knob

PART No.	PARTS Per Kit	DESCRIPTION
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BRACKETS-DIAL PARTS

(39) 204-9	✓2	Angle bracket
(40) 100-622	✓4	Pulley bracket
(41) 463-44	✓1	Dial pointer
(42) 453-148	✓1	Tuning shaft
(43) 454-2	✓1	Flywheel
100-643	✓1	Dial cord
(44) 258-1	✓1	Dial cord spring 17/

WIRE-SLEEVING-CABLES-SHIELDING

344-15	✓4	Black stranded wire
344-16	✓4	Red stranded wire
344-51	✓1	Brown hookup wire
344-54	✓1	Orange hookup wire
344-55	✓1	Green hookup wire
346-4	✓1	Small sleeving (braided)
346-5	✓1	Large sleeving
134-147	✓1	Power amplifier cable assembly
134-149	✓1	Multiplex cable assembly
89-13	✓1	Line cord
(45) 206-345	✓1	Spiral shielding

HARDWARE

#2 Hardware		
(46) 250-310	✓2	2-32 x 1/8" self-tapping screw
#4 Hardware		
(47) 250-52	✓18	4-40 x 1/4" screw
(48) 250-273	✓18	4-40 x 3/8" screw
(49) 252-2	✓22	4-40 nut
(50) 254-9	✓26	#4 lockwasher
(51) 259-9	✓2	#4 solder lug
#6 Hardware		
(52) 250-56	✓3	6-32 x 1/4" screw
(53) 250-116	✓3	6-32 x 1/4" black screw
(54) 250-170	✓29	#6 x 1/4" sheet metal screw
(55) 250-100	✓2	6-32 x 5/16" setscrew
(56) 250-89	✓32	6-32 x 3/8" screw
(57) 250-276	✓6	6-32 x 3/8" black flat head screw
(58) 250-162	✓4	6-32 x 1/2" screw
(59) 250-298	✓10	6-32 x 3/4" self-tapping screw
(60) 250-206	✓8	6-32 x 11/16" screw
(61) 252-3	✓31	6-32 nut

PART No.	PARTS Per Kit	DESCRIPTION
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#6 Hardware (cont'd.)

(52) 252-23	1	6-32 thumbnut
(53) 254-1	33	#6 lockwasher
(54) 253-60	2	#6 x 3/8" washer
(55) 259-1	10	#6 solder lug
(56) 252-22	4	6-32 speednut

#8 Hardware

(57) 250-16	4	8-32 x 3/16" setscrew
(58) 250-43	1	8-32 x 1/4" setscrew
(59) 250-22	2	8-32 x 7/16" setscrew
(60) 252-4	4	8-32 nut
(61) 254-2	4	#8 lockwasher
(62) 250-174	4	8-32 x 1/4" screw

Other Hardware

(73) 252-7	18	Control nut
(74) 253-11	1	E washer
(75) 253-49	2	7/16" nylon washer
(76) 253-36	1	Spring washer
(77) 253-21	4	9/16" washer
(78) 254-5	3	Control lockwasher
(79) 253-85	4	Felt washer
(80) 255-1	6	1/8" spacer
(81) 255-71	1	3/4" spacer
(82) 255-11	2	1" spacer
(83) 255-75	2	1-1/8" hexagonal spacer
(84) 255-70	2	1-9/32" round spacer
(85) 432-67	1	Wire nut
(86) 258-72	2	Steel spring

FRONT PANEL ASSEMBLY

(87) 100-618	1	Front panel
(88) 446-56	1	Dial window
(89) 446-57	1	Tinted window
(90) 206-330-1	1	Large light reflector
(91) 206-332-1	1	Small light reflector
(92) 206-331-1	1	Light shield

PART No.	PARTS Per Kit	DESCRIPTION
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Front Panel Assembly (cont'd.)

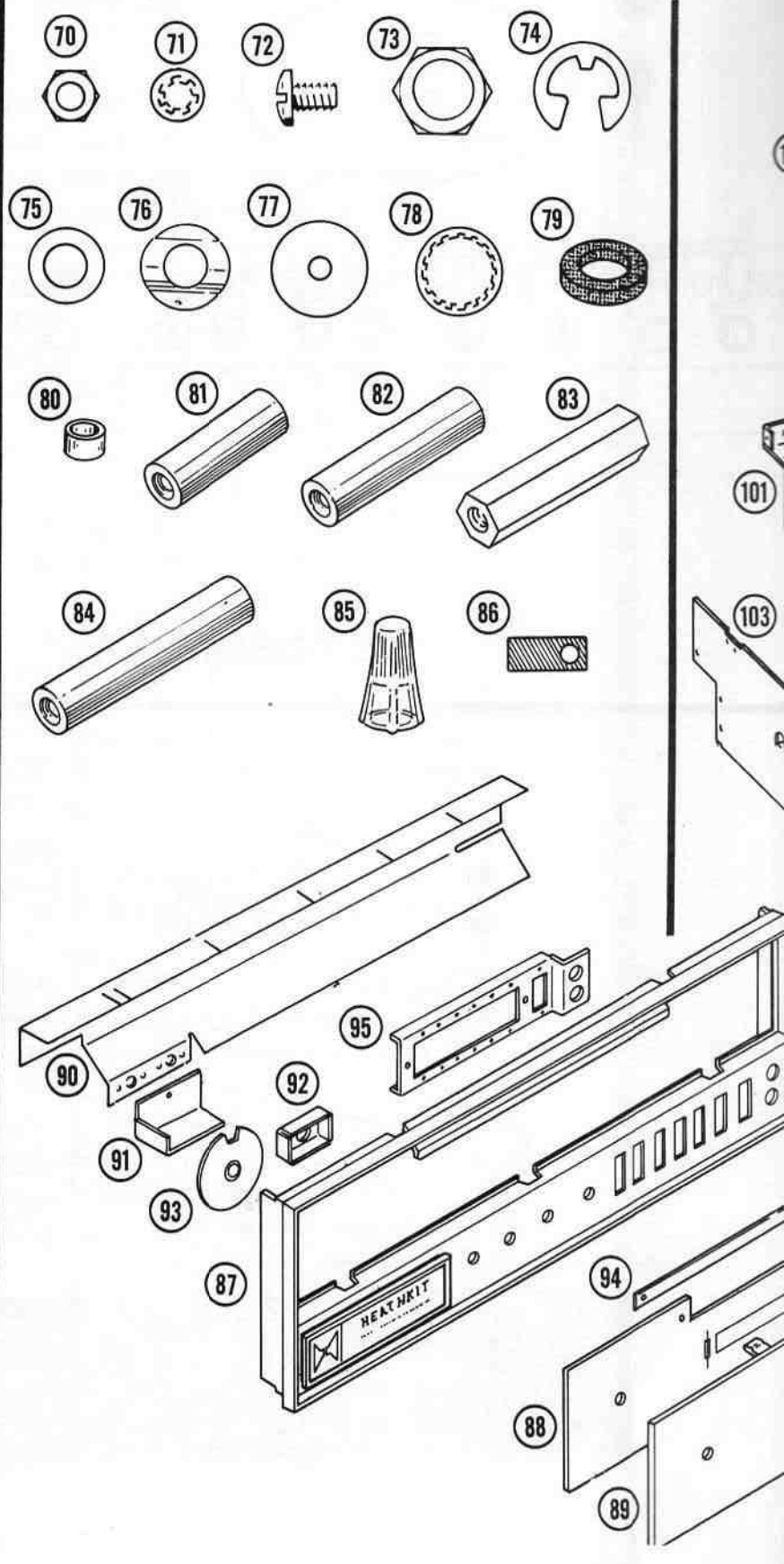
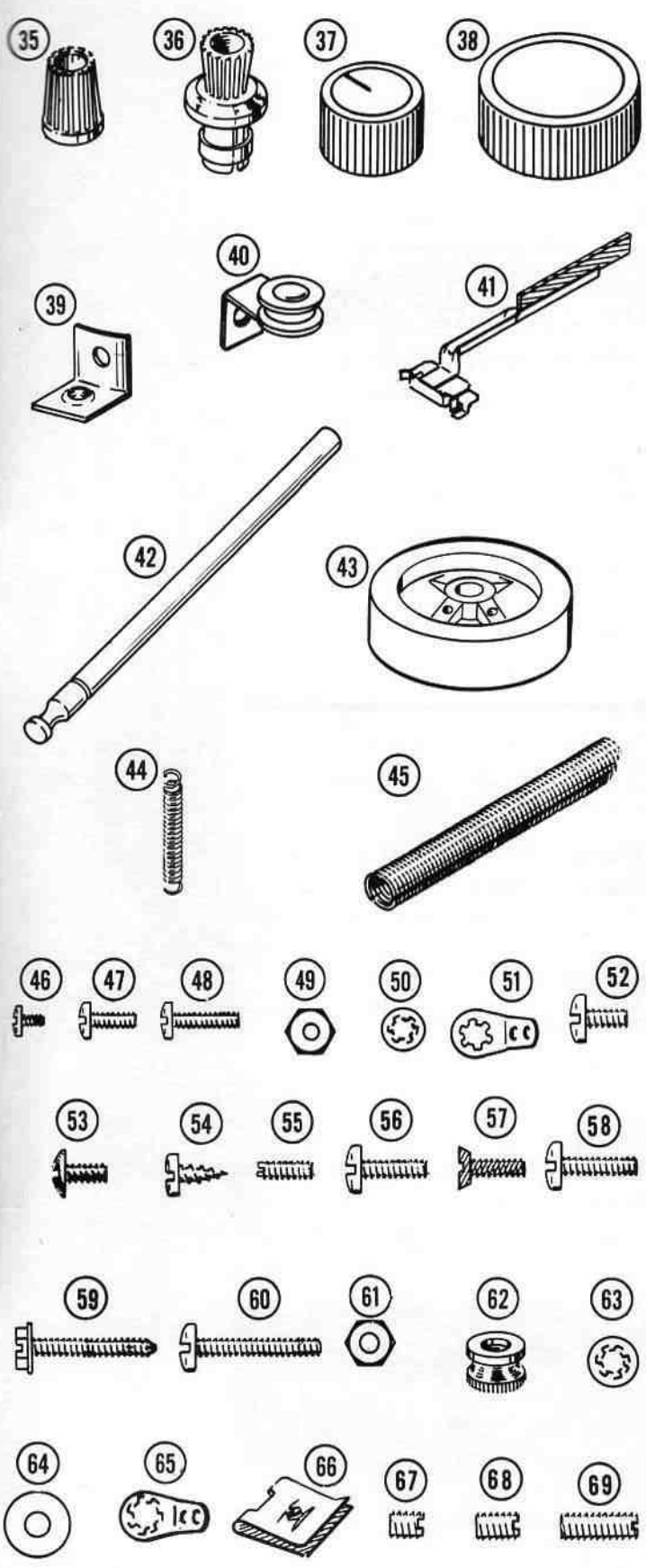
(93) 100-621	1	Indicator disc
(94) 266-93	1	Dial pointer rail
(95) 205-539	1	Rocker switch bracket
(96) 204-757	1	Meter mounting bracket
(97) 407-115	1	Tune meter
(98) 407-116	1	Signal strength meter
(99) 446-60	1	Green meter shield

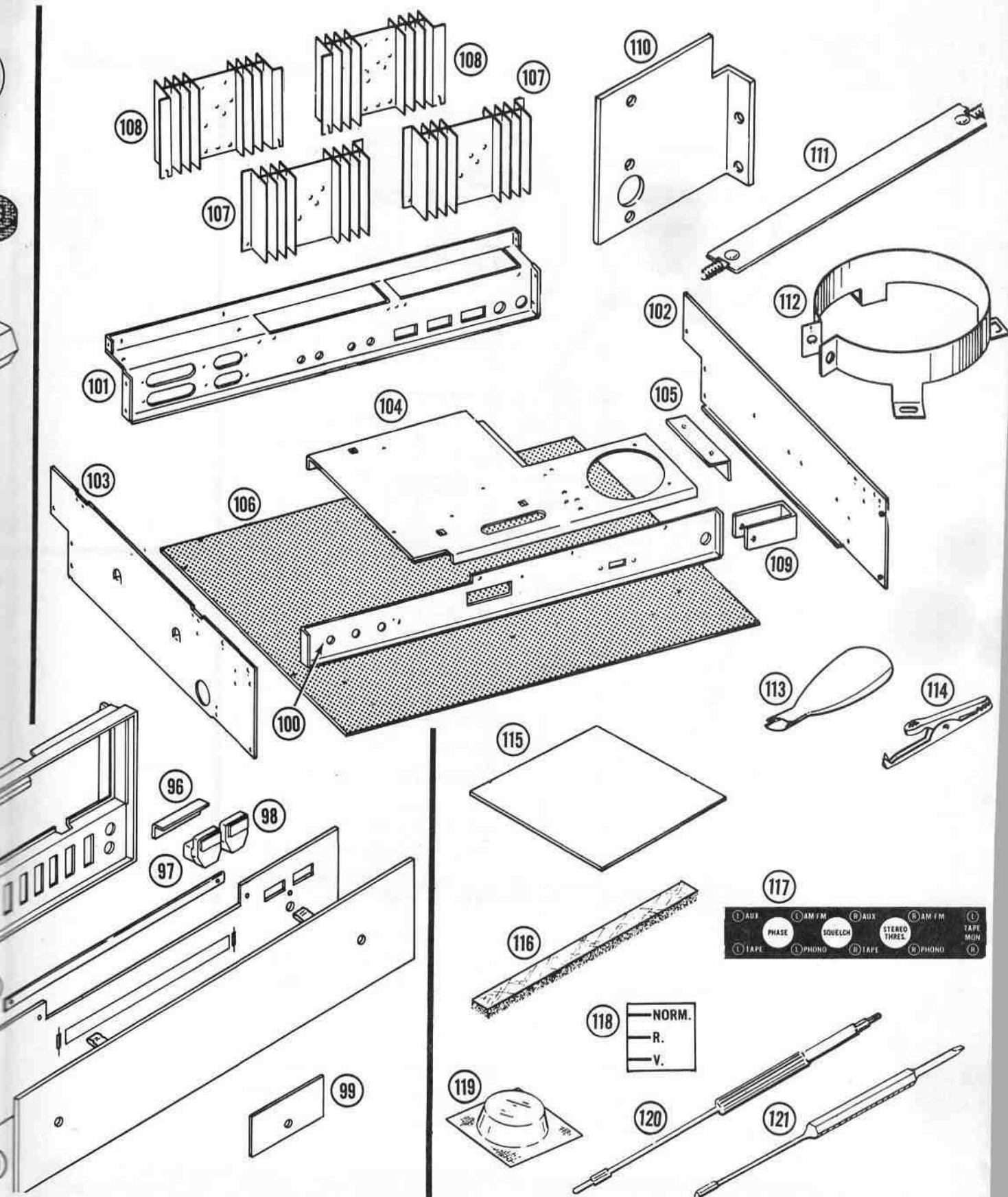
CHASSIS METAL PARTS

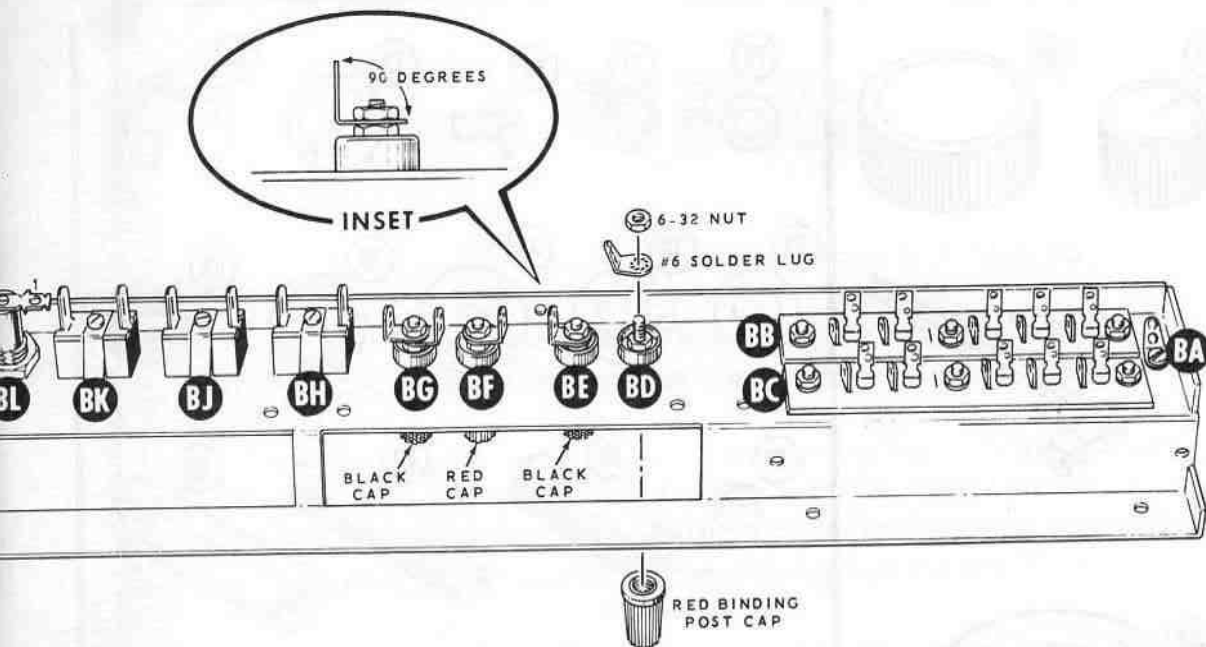
(100) 202-64	1	Front apron
(101) 202-61-1	1	Rear apron
(102) 202-62	1	Right apron
(103) 202-63	1	Left apron
(104) 201-38	1	Chassis base
(105) 204-752	1	Transformer support bracket
(106) 205-540	1	Bottom cover
(107) 215-22	2	Heat sink (with two threaded holes in flange)
(108) 215-23	2	Heat sink (with two slots in flange)
(109) 204-756	1	Tuning shaft bracket
(110) 204-753	1	Switch support bracket
(111) 100-589	2	Capacitor mounting strap
(112) 207-56	1	Capacitor mounting clamp

MISCELLANEOUS

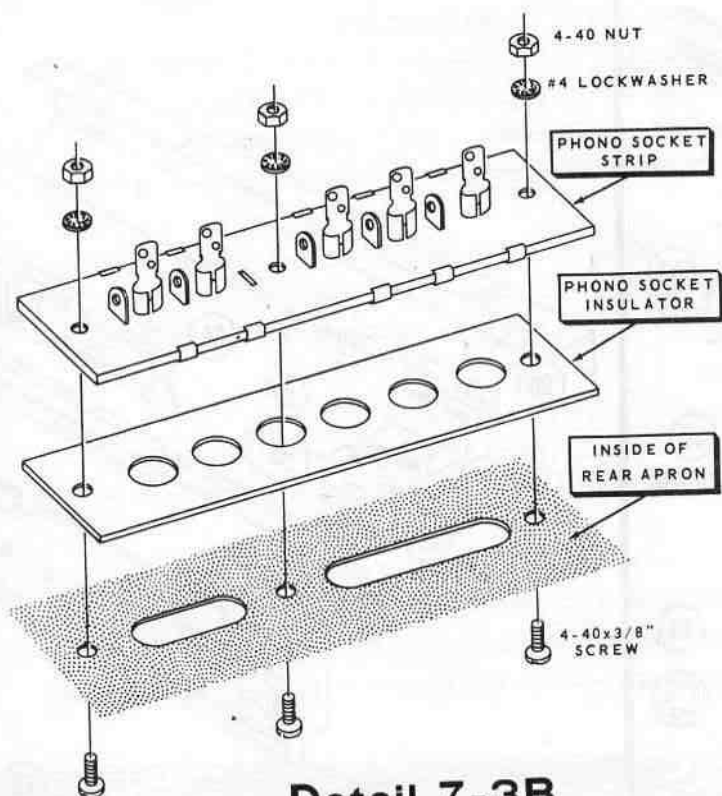
(113) 73-34	1	Red insulator
(114) 260-16	1	Alligator clip
(115) 75-90	1	Insulating paper
(116) 73-39	1	Foam tape
(117) 390-180	1	Control identification label
(118) 390-184	1	Meter switch label
(119) 352-13	3	Silicone grease
(120) 490-1	1	Large alignment tool
(121) 490-109	1	Small alignment tool
597-260	1	Parts order form
391-34	1	Blue and white label
		Solder



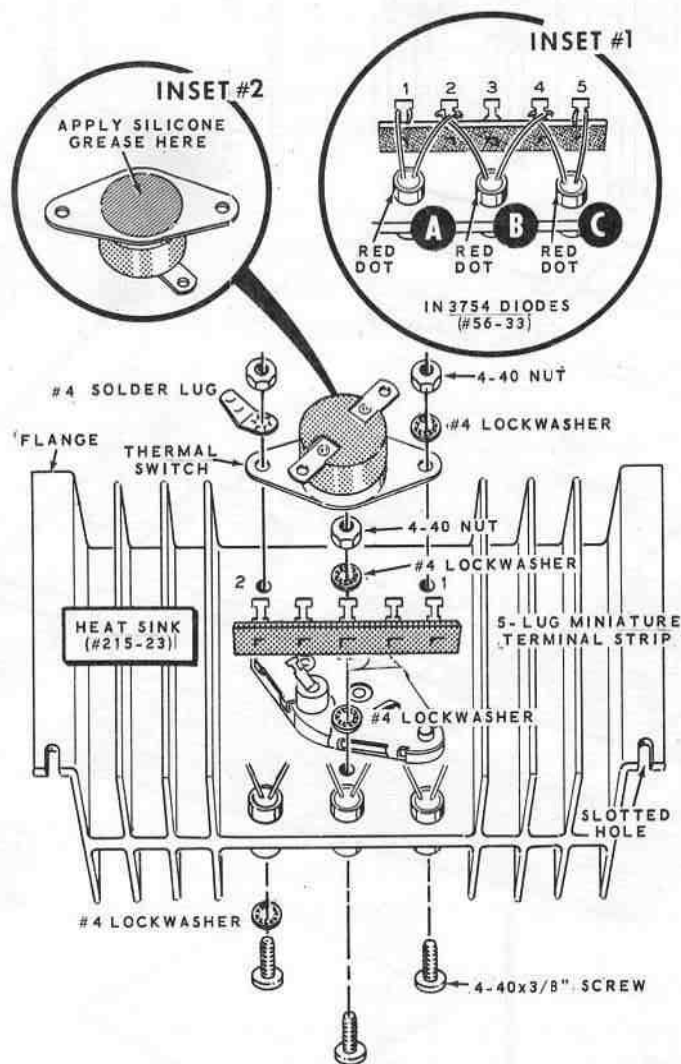




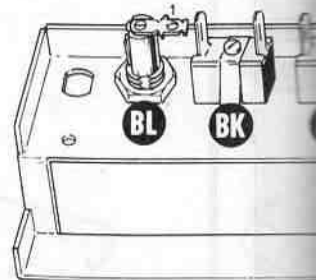
PICTORIAL 7-3



Detail 7-3B



PICTORIAL 7-2



STEP-BY-STEP ASSEMBLY

HEAT SINK PARTS MOUNTING

Refer to Pictorial 7-1 for the following steps.

- () Locate the following parts: two heat sinks with threaded holes (#215-22), two heat sinks with slotted holes (#215-23), four transistor sockets, four 40411 transistors (#417-139), four mica insulators, two nylon transistor covers, four 1/8" spacers, four 6-32 x 1/2" screws, four 6-32 x 11/16" screws, and two containers of silicone grease.

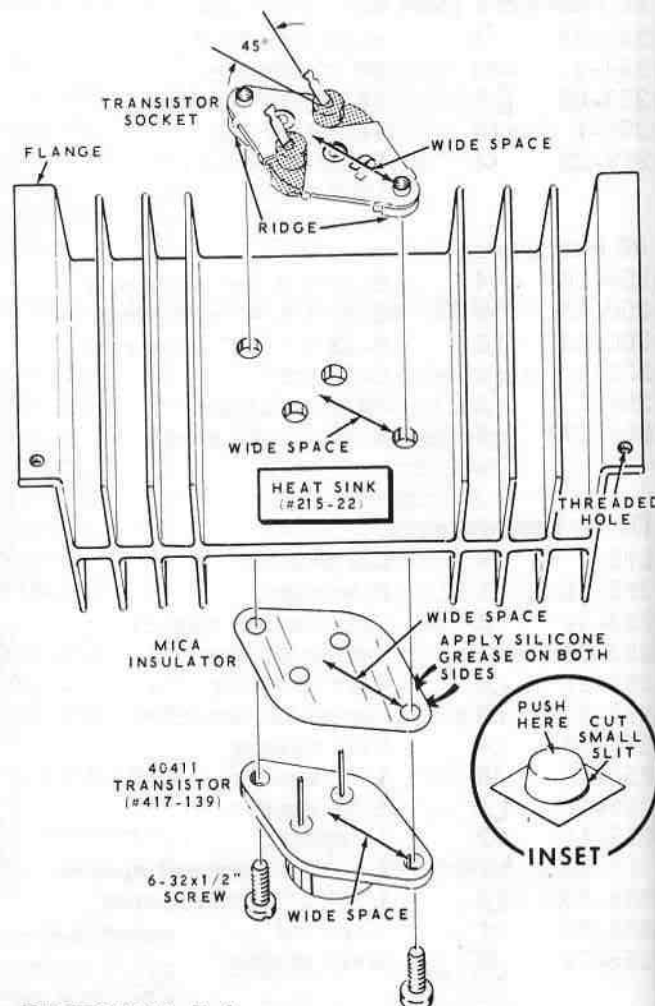
NOTE: Four transistors will be mounted on the heat sinks with insulators and sockets in the following steps. As you mount each transistor, make sure the indicated wide space on the transistor, transistor socket, and mica insulator is lined up with the wide space on the heat sink. Also, make sure the ridges on the socket seat properly in the heat sink mounting holes before tightening the screws. See Pictorial 7-1.

- () Place the four mica insulators on a piece of paper on your work surface. Then apply a layer of silicone grease on both sides of each insulator with the tip of your finger. Important: Use 1/2 of a container for each insulator. The inset drawing in Pictorial 7-1 shows a good way to remove the silicone grease from the container.

- (✓) Place both threaded-hole heat sinks (#215-22) on your work surface with the flange positioned up as shown. Then mount a 40411 transistor, a mica insulator, and a transistor socket on each heat sink. Use 6-32 x 1/2" screws.

- (-) Bend the lugs of the transistor sockets at a 45 degree angle as shown.

- (✓) Set the completed heat sinks aside temporarily.



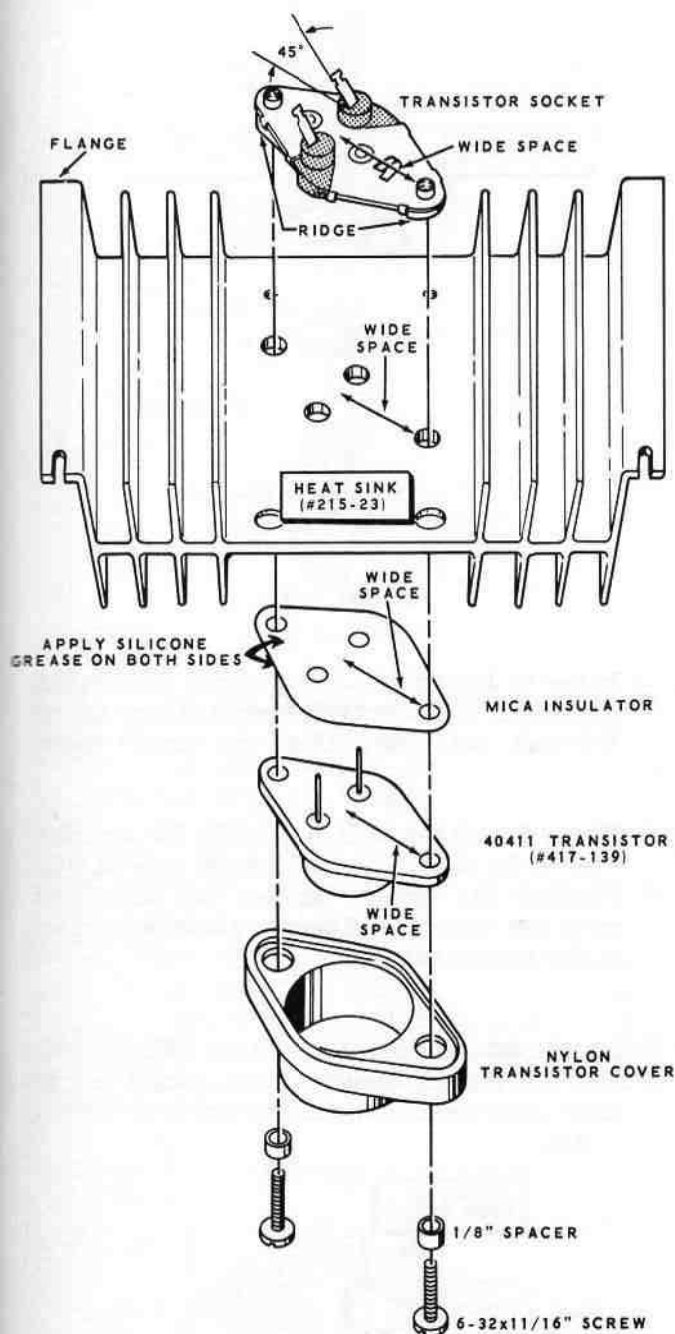
PICTORIAL 7-1

Refer to Detail 7-2A for the following steps.

- (✓) Place the remaining two heat sinks on your work surface with the flange positioned up. Then mount a nylon transistor cover, a 40411 transistor, a mica insulator, and a transistor socket on each heat sink. Use 6-32 x 11/16" screws and 1/8" spacers.

NOTE: Be sure to tighten the 6-32 x 11/16" screws sufficiently to force the 1/8" spacers into the nylon transistor covers, and seat them against the transistor case. Good electrical contact between these parts is essential for proper circuit operation.

- (✓) Bend the lugs of the transistor sockets at a 45 degree angle as shown.



Detail 7-2A

Refer to Pictorial 7-2 (fold-out from Page 64) for the following steps.

- () Locate the following parts: two thermal switches, two 5-lug miniature terminal strips, six 1N3754 diodes (#56-33), six 4-40 x 3/8" screws, eight #4 lockwashers, six 4-40 nuts, and two #4 solder lugs.

NOTE: Repeat the following steps twice, once for each heat sink. Two checkoff spaces are provided in front of each step for this purpose.

- () () Apply a layer of silicone grease on the thermal switch as shown in the inset drawing #2 on Pictorial 7-2. Important: Use 1/4 of a container for each thermal switch.
- () () Mount a thermal switch on the heat sink. Use a 4-40 x 3/8" screw, #4 lockwasher, and a 4-40 nut at 1. At position 2 use a 4-40 x 3/8" screw, #4 lockwasher, 4-40 nut and a #4 solder lug.
- () () Mount a 5-lug miniature terminal strip on the heat sink with a 4-40 x 3/8" screw, two #4 lockwashers, and a 4-40 nut. Position the terminal strip so the mounting foot is pointed toward the transistor.

NOTE: Each diode is marked with a color dot near one lead. When installing the diodes, position them so the dots are as shown in inset drawing #1 on Pictorial 7-2. Then push the diodes firmly into the holes.

IMPORTANT: When you connect the diode leads in the following steps, make sure they are connected to the proper lugs.

- () () Install a 1N3754 diode (#56-33) at A. Connect the lead next to the red dot to lug 1 of the terminal strip (NS). Connect the other lead to lug 2 (NS).
- () () Install a 1N3754 diode at B. Connect the lead next to the red dot to lug 2 of the terminal strip (S-2). Connect the other lead to lug 4 (NS).
- () () Install a 1N3754 diode at C. Connect the lead next to the red dot to lug 4 of the terminal strip (S-2). Connect the other lead to lug 5 (NS).

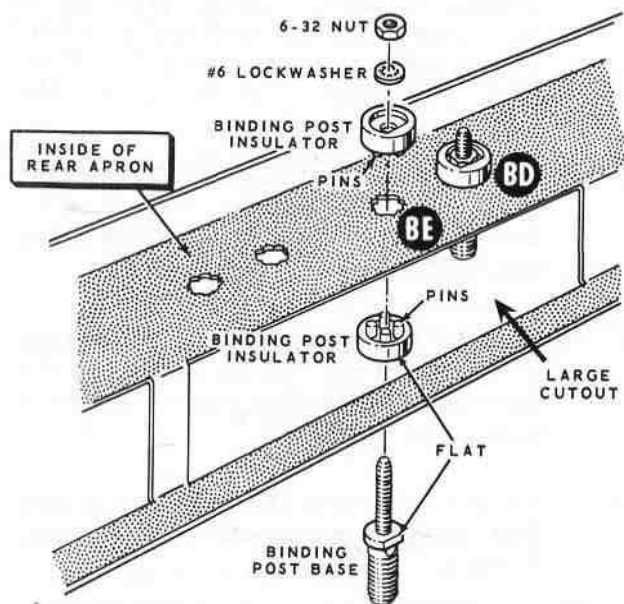
- () () Remove any metal filings or bits of wire that may have collected around the transistors.

- () Set the completed heat sinks aside temporarily.

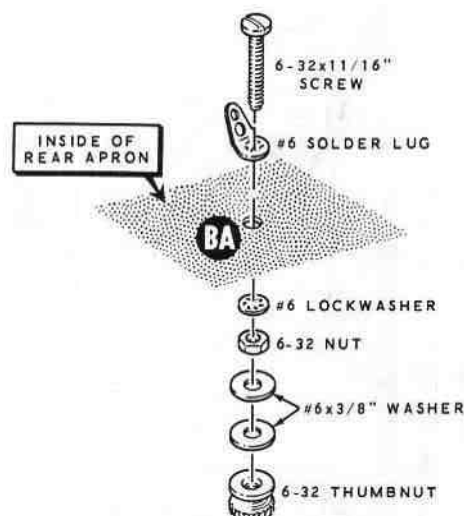
REAR APRON PARTS MOUNTING

Refer to Pictorial 7-3 (fold-out from Page 64) for the following steps.

- (✓) Locate the rear apron and position it on your work surface as shown.
- (✓) Install a 6-32 x 11/16" screw and #6 solder lug at BA with a #6 lockwasher and a 6-32 nut; then tighten the nut. Now install two #6 x 3/8" washers and a 6-32 thumbnut. Tighten the thumbnut finger tight. Refer to Detail 7-3A.
- (✓) Place a phono socket insulator on each phono socket strip. Mount these assemblies at BB and BC with 4-40 x 3/8" screws, #4 lockwashers, and 4-40 nuts. Refer to Detail 7-3B (fold-out from Page 64). Before you tighten the screws, center the sockets in the rear apron cutouts so they do not touch any metal.
- (✓) Mount binding post bases at BD, BE, BF, and BG. Use two binding post insulators, a #6 lockwasher, and a 6-32 nut at each location as shown in Detail 7-3C. Before you tighten the nut, position the flats on the base and insulator toward the large cutout in the rear apron. Also make sure the pins on both insulators seat properly in the rear apron holes.

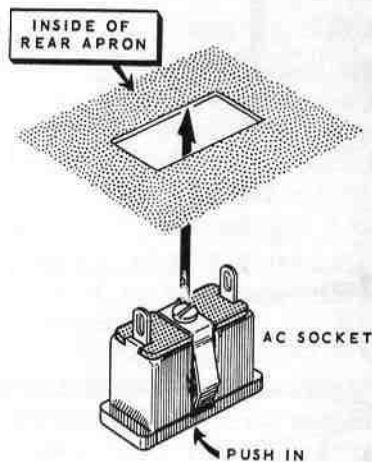


Detail 7-3C

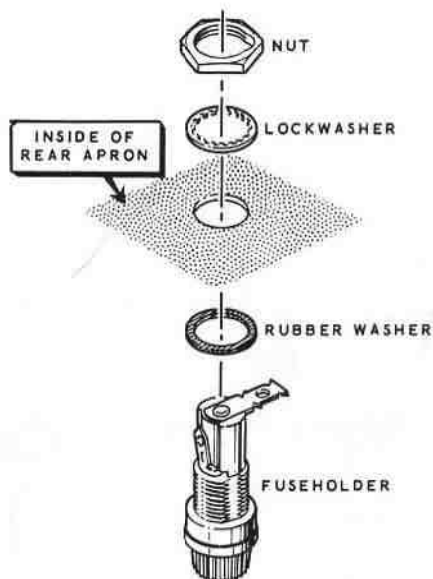


Detail 7-3A

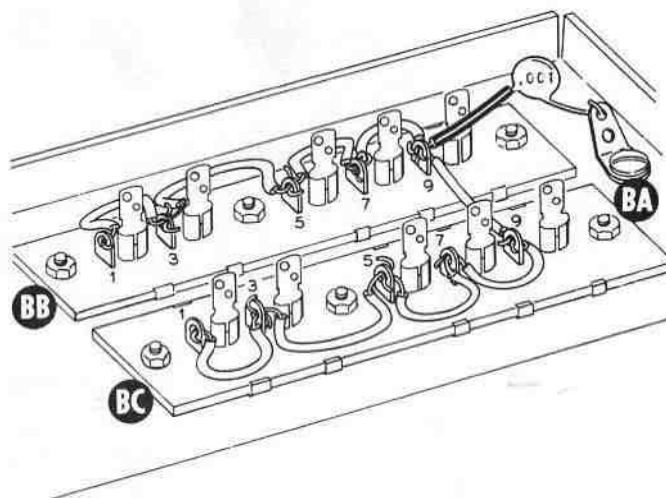
- (✓) Refer to Pictorial 7-3 and install red binding post caps at BD and BF. Install black caps at BE and BG. Turn them on finger tight.
- (✓) Mount #6 solder lugs at BD, BE, BF, and BG with 6-32 nuts. Use two solder lugs at BG. Position all lugs as shown, and then bend each one to form a 90 degree angle, as shown in the inset drawing.
- (✓) Install AC sockets at locations BH, BJ, and BK. To install these sockets, push them in until they snap into place. Refer to Detail 7-3D.



Detail 7-3D



Detail 7-3E



Detail 7-3F

- () Mount the fuseholder at BL. Use the rubber washer, lockwasher, and nut supplied with the fuseholder. Position lug 1 as shown in the Pictorial. Refer to Detail 7-3E.

Refer to Detail 7-3F for the following steps.

NOTE: When wiring this kit, you may find it easier to prepare the lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length and strip 1/4" of insulation from each end. The wires are listed in the order in which they will be used.

- () Prepare the following lengths of black hookup wire:

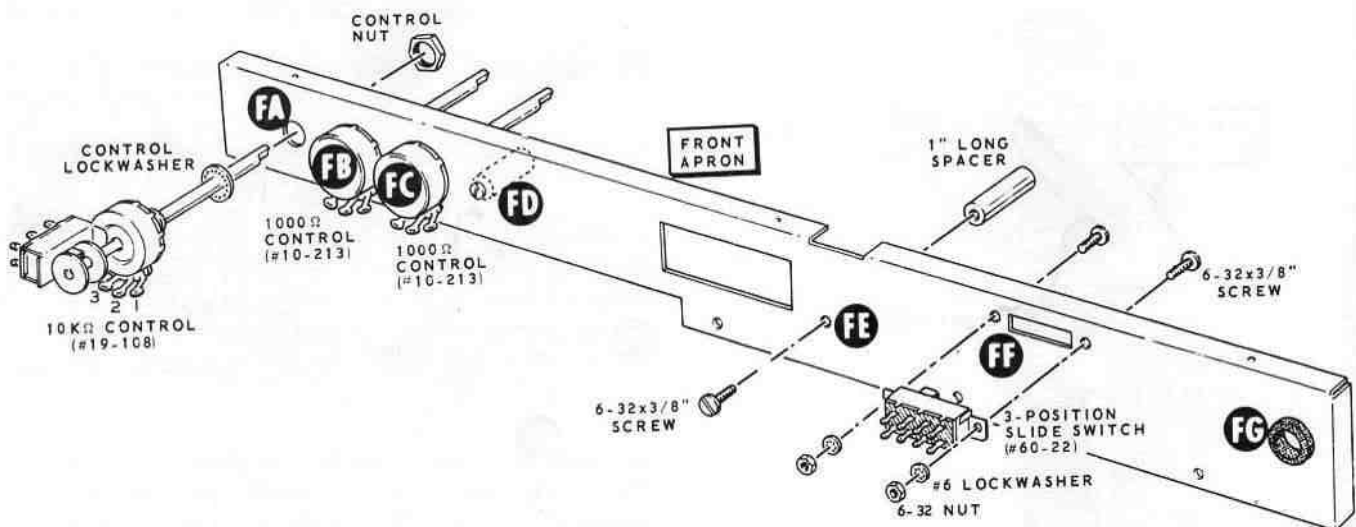
1-3/8"	1-3/8"	2"
2"	1-1/8"	1-3/8"
1-3/8"	1-3/8"	1-3/8"

Connect these wires to phono socket strips BB and BC in the following steps.

- () 1-3/8" wire between lugs 1 (S-1) and 3 (NS) of BB.
- () 2" wire between lugs 3 (S-2) and 5 (NS) of BB.

- () 1-3/8" wire between lugs 5 (S-2) and 7 (NS) of BB.
- () 1-3/8" wire between lugs 7 (S-2) and 9 (NS) of BB.
- () 1-1/8" wire from lug 9 of BB (NS) to lug 9 of BC (NS).
- () 1-3/8" wire between lugs 1 (S-1) and 3 (NS) of BC.
- () 2" wire between lugs 3 (S-2) and 5 (NS) of BC.
- () 1-3/8" wire between lugs 5 (S-2) and 7 (NS) of BC.
- () 1-3/8" wire between lugs 7 (NS) and 9 (S-2) of BC.
- () Place a 3/4" length of small sleeving (vinyl) on one lead of a .001 μ fd disc capacitor. Connect this lead to lug 9 of BB (S-3). Connect the other lead to solder lug BA (S-1).

Set the rear apron assembly aside temporarily.



PICTORIAL 7-4

FRONT APRON PARTS MOUNTING

Refer to Pictorial 7-4 for the following steps.

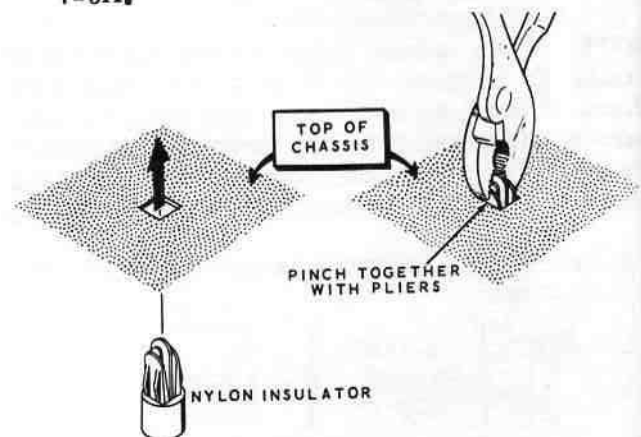
- (✓) Locate the front apron and position it on your work surface as shown.
- (✓) Mount a 10 KΩ control (#19-108) at FA with a control lockwasher and control nut. Position the control with lugs 1, 2, and 3 as shown.
- (✓) Similarly, mount 1000 Ω controls (#10-213) at FB and FC with control lockwashers and control nuts. Position the controls with the lugs as shown.
- (✓) Mount 1" long spacers at FD and FE with 6-32 x 3/8" screws.
- (✓) Mount an 8-lug slide switch (#60-22) at FF with 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts.
- (✓) Install a rubber grommet at FG.

Set the front apron assembly aside temporarily.

CHASSIS BASE PARTS MOUNTING

Refer to Pictorial 7-5 for the following steps.

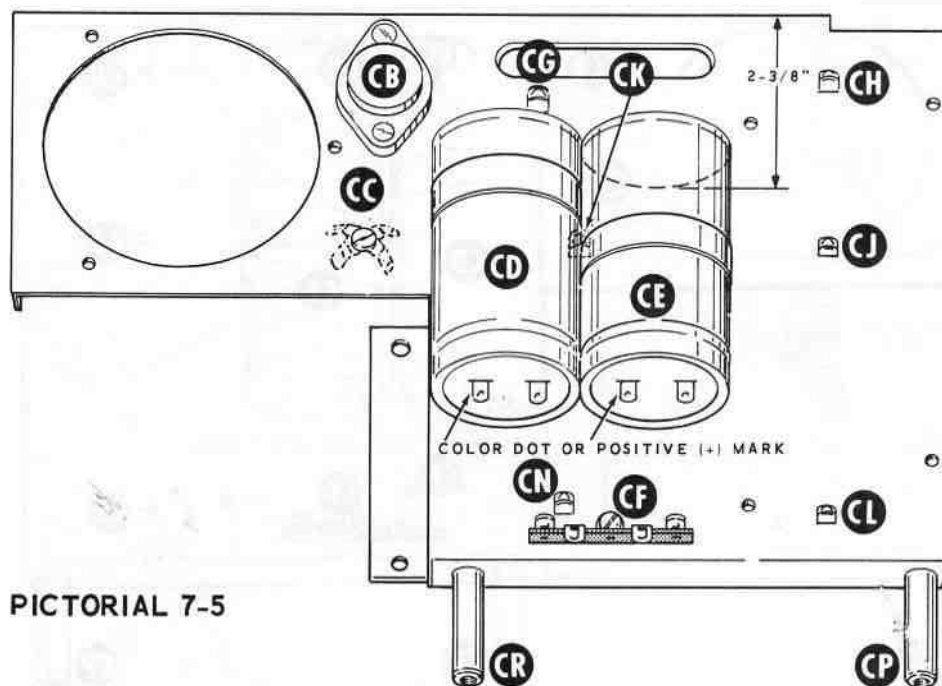
- (✓) Locate the chassis base and position it on your work surface as shown.
- (✓) Install nylon insulators at holes CG, CH, CJ, CK, CL, and CN from the bottom of the chassis. Use a pair of pliers as shown in Detail 7-5A.



Detail 7-5A

Refer to Detail 7-5B for the following steps.

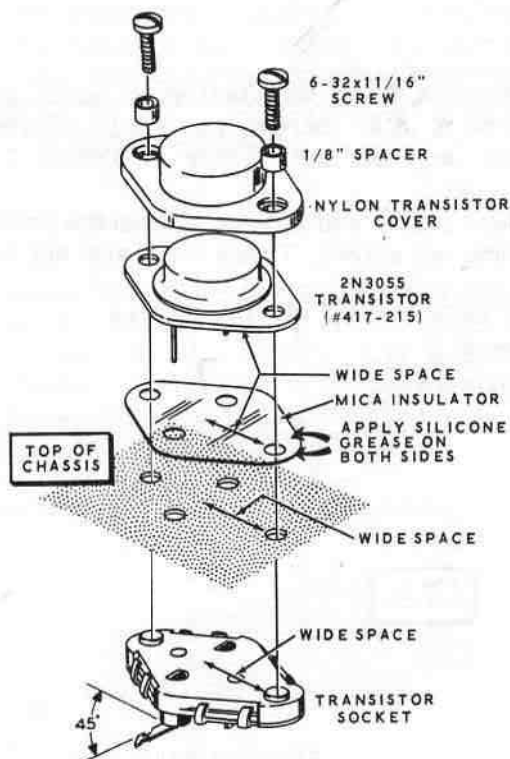
- () Locate the following parts: 2N3055 transistor (#417-215), mica insulator, transistor socket, nylon transistor cover, silicone grease, two 6-32 x 11/16" screws, and two 1/8" spacers.



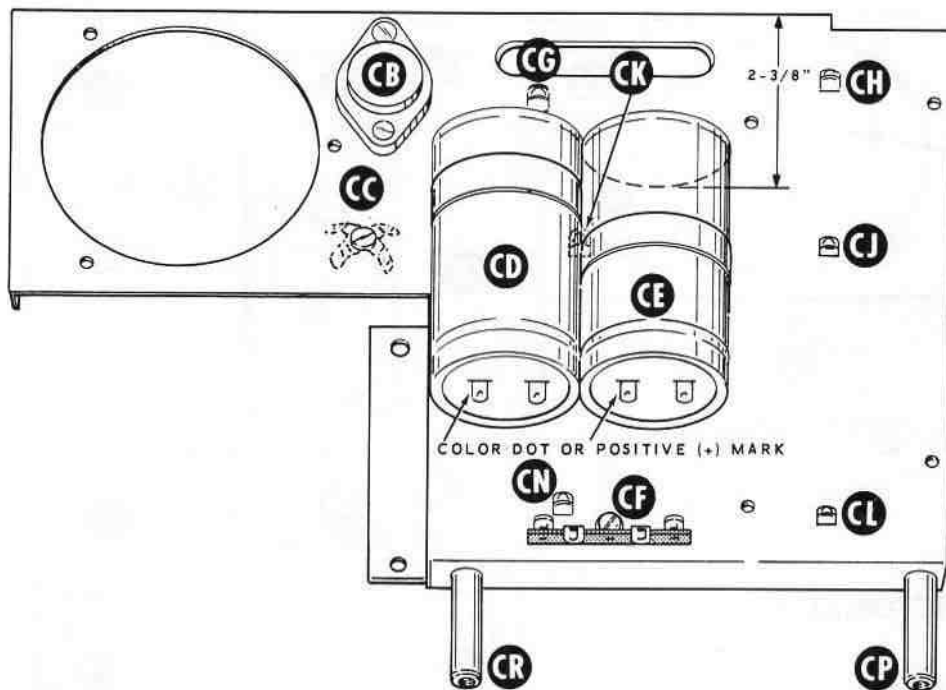
PICTORIAL 7-5

NOTE: As you mount the following transistor, make sure the indicated wide space on the transistor, transistor socket, and mica insulator is lined up with the wide space on the chassis. Also make sure the ridges on the socket seat properly in the chassis mounting holes before tightening the screws.

- (1) Apply a layer of silicone grease on both sides of the mica insulator with the tip of your finger. Important: Use 1/2 of a container on the insulator.
- (2) Mount a nylon transistor cover, a 2N3055 transistor (part #417-215), a mica insulator, and a transistor socket at CB. Use two 6-32 x 11/16" screws and two 1/8" spacers.
- (3) Bend the lugs of the transistor socket at a 45 degree angle as shown.

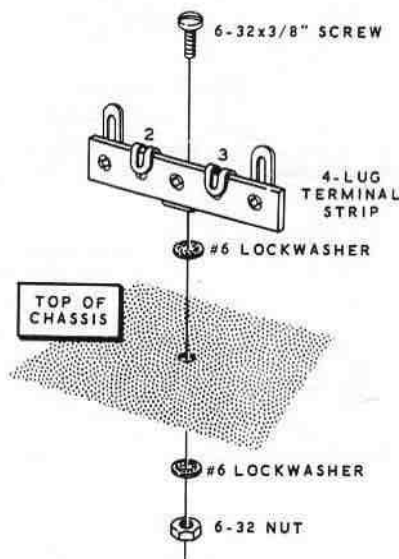


Detail 7-5B



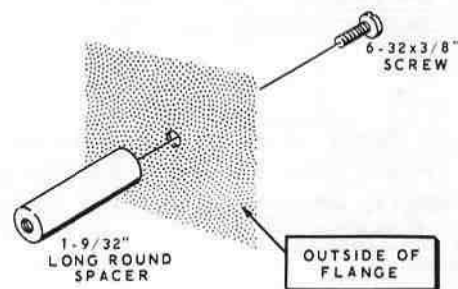
PICTORIAL 7-5
(REPEAT)

- (✓) Mount a 4-lug terminal strip at CF. Use a 6-32 x 3/8" screw, two #6 lockwashers, and a 6-32 nut. Refer to Detail 7-5C.
- (✓) Bend lugs 2 and 3 down against the terminal strip as shown. These lugs are not used.



Detail 7-5C

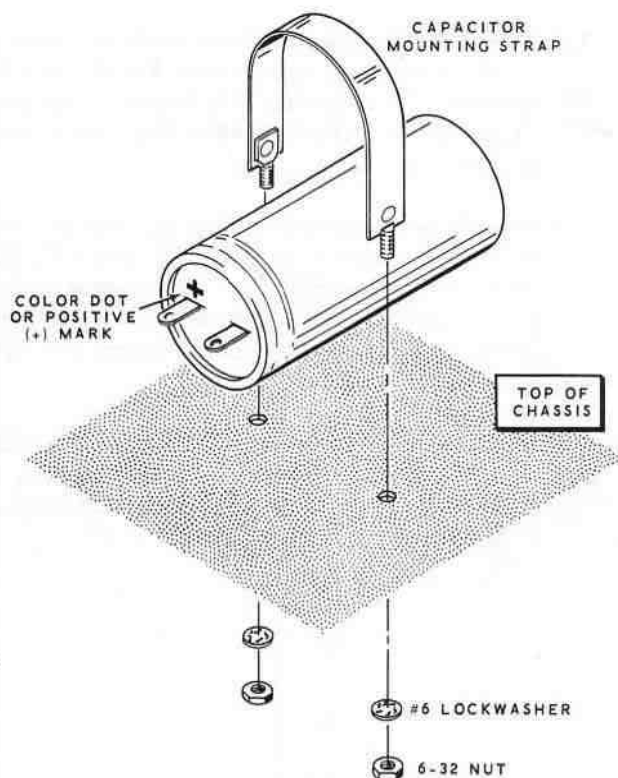
- (✓) Mount 1-9/32" long round spacers at CP and CR with 6-32 x 3/8" screws. Refer to Detail 7-5D.



Detail 7-5D

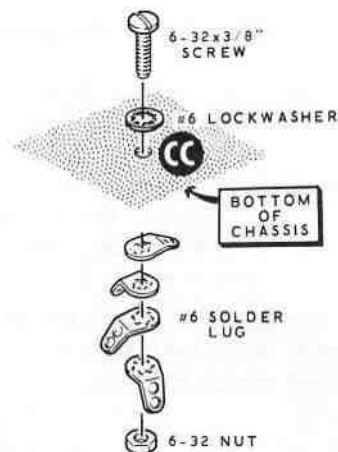
Refer to Detail 7-5E for the following steps.

- (✓) Locate two capacitor mounting straps and two 4000 μ fd electrolytic capacitors.
- (✓) Bend the capacitor strap in the shape of a U (use the capacitor as a form). Mount the strap at CE with #6 lockwashers and 6-32 nuts. Do not tighten the nuts at this time.



Detail 7-5E

- () Slide the 4000 μ fd electrolytic capacitor under the strap. Position the capacitor 2-3/8" from the edge of the chassis as shown. Then turn the capacitor so the color dot or positive-marked lug is positioned as shown. Now tighten the nuts on the capacitor strap. NOTE: These nuts have to be tight, but it is possible to overtighten them and warp the chassis.



Detail 7-5F

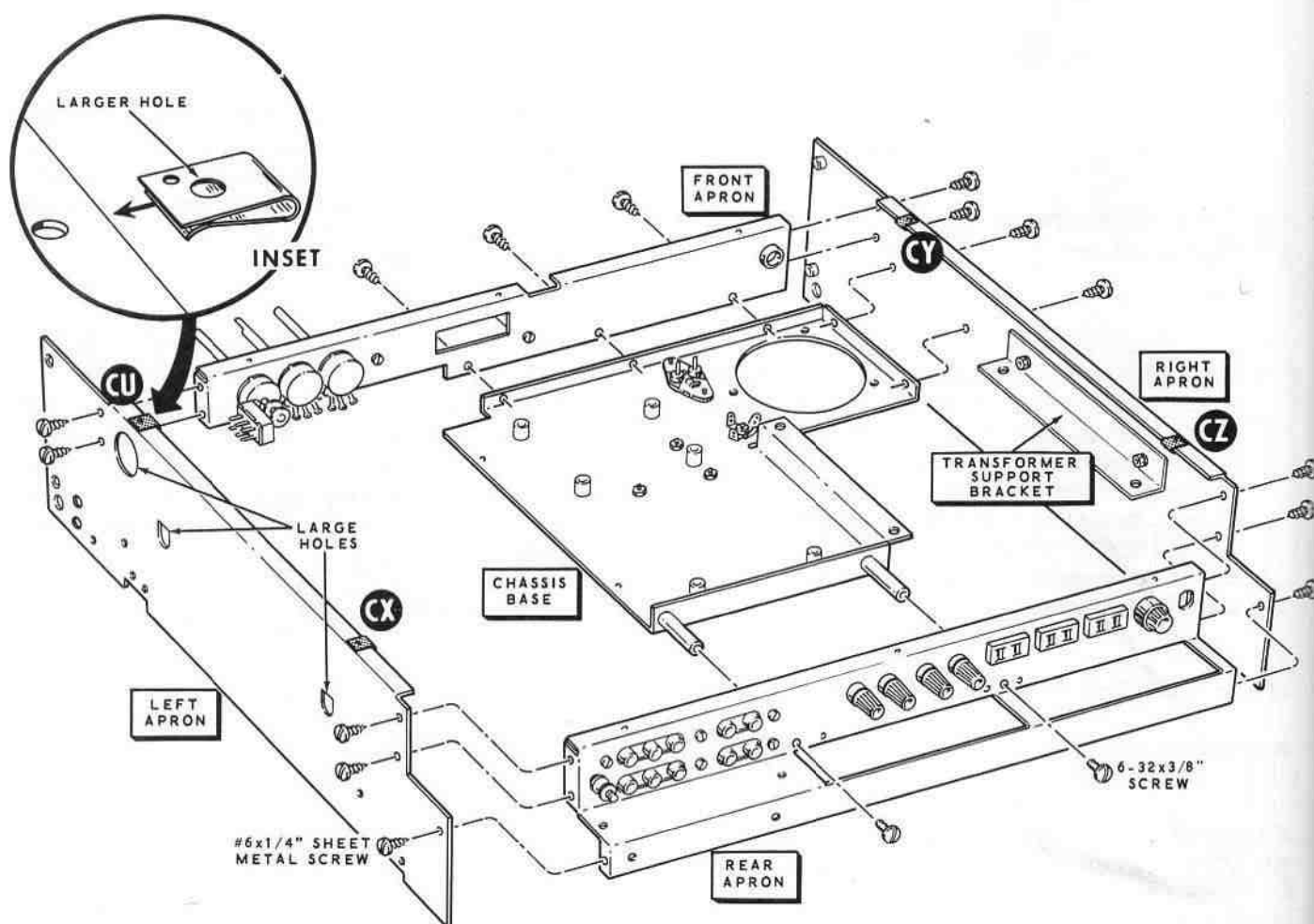
- (✓) Similarly, mount the other strap and 4000 μ fd electrolytic capacitor at CD. Position the capacitor so the marked lug is as shown. Also, this end of the capacitor should be even with the end of the other capacitor. Do not overtighten the nuts.
- (✓) Mount four #6 solder lugs on the bottom side of the chassis at CC with a 6-32 x 3/8" screw, #6 lockwasher, and a 6-32 nut. Position the solder lugs approximately as shown and tighten the screw securely. Refer to Detail 7-5F.

Set the chassis base aside temporarily.

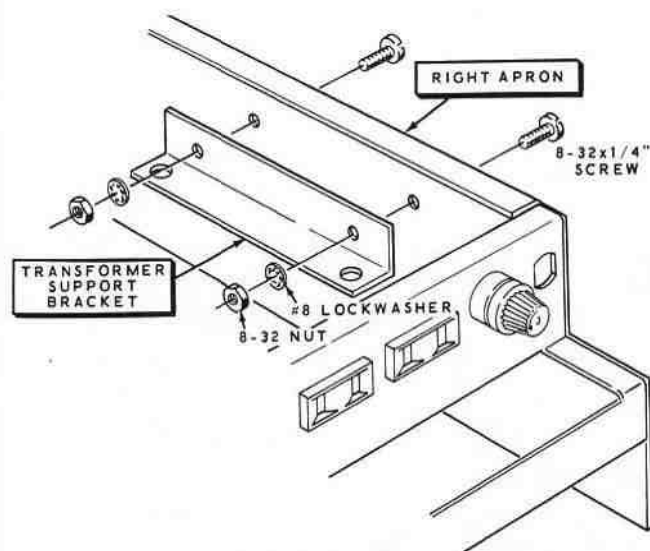
Refer to Pictorial 7-6 for the following steps.

- (✓) Locate the left apron (the one with the three indicated holes) and the rear apron.
- (✓) Position the left apron and rear apron as shown. Then fasten them together with three #6 x 1/4" sheet metal screws.
- (✓) Locate and position the front apron as shown and fasten it to the left apron with two #6 x 1/4" sheet metal screws.
- (✓) Locate and position the right apron as shown and fasten it to the rear apron and front apron with five #6 x 1/4" sheet metal screws.

- (✓) Position the chassis base as shown and fasten it to the rear apron with two 6-32 x 3/8" screws. Then fasten it to the front apron and right apron with five #6 x 1/4" sheet metal screws.
- (✓) Install 6-32 speednuts on the left and right aprons at holes CU, CX, CY, and CZ. Make sure the speednuts are positioned with the larger hole up as shown in the inset drawing. Then push the speednuts over the apron flanges.
- (✓) Position the transformer support bracket as shown and mount it on the right apron. Use 8-32 x 1/4" screws, #8 lockwashers, and 8-32 nuts as shown in Detail 7-6A.



PICTORIAL 7-6



Detail 7-6A

CHASSIS WIRING

Refer to Pictorial 7-7 (fold-out from Page 73) for the following steps.

- (✓) Place the chassis assembly on your work surface as shown.
- (✓) Locate the power amplifier cable assembly (#134-147). Unfold the assembly and straighten the wires at each breakout.

Place the cable assembly on the chassis in the following manner:

- (✓) Position the wires at breakouts 1, 4, and 9 at the approximate locations shown on the Pictorial. The wire colors are called out at these breakouts.
- (✓) Insert the wires at breakout 10 through grommet FG.
- (✓) At breakout #8, route the yellow, orange, white-black-blue, and white-black-violet wires near AC sockets BJ and BK. Route the remaining wires down through the large opening as shown.
- (✓) At breakout #7, route the white, white-gray, white-brown, white-black-violet, and white-black-blue wires as shown. Route the remaining wires down through the large opening near spacer CT.
- (✓) At breakout #6, route the wires as shown.

- (✓) At breakout #5, route all of these wires down through the large opening as shown.
- (✓) At breakout #3, route the wires as shown.
- (✓) At breakout #2, route the white-gray-green wire down through the large opening. Leave the remaining wires as shown.

Connect the cable assembly wires in the following steps. NOTE: Before connecting a stranded wire, twist the strands together tightly.

Breakout #3

- (✓) Blue stranded wire to the solder lug at binding post BD (S-1).
- (✓) Two black stranded wires and the black solid wire to the solder lug at binding post BE (S-3).

Breakout #6

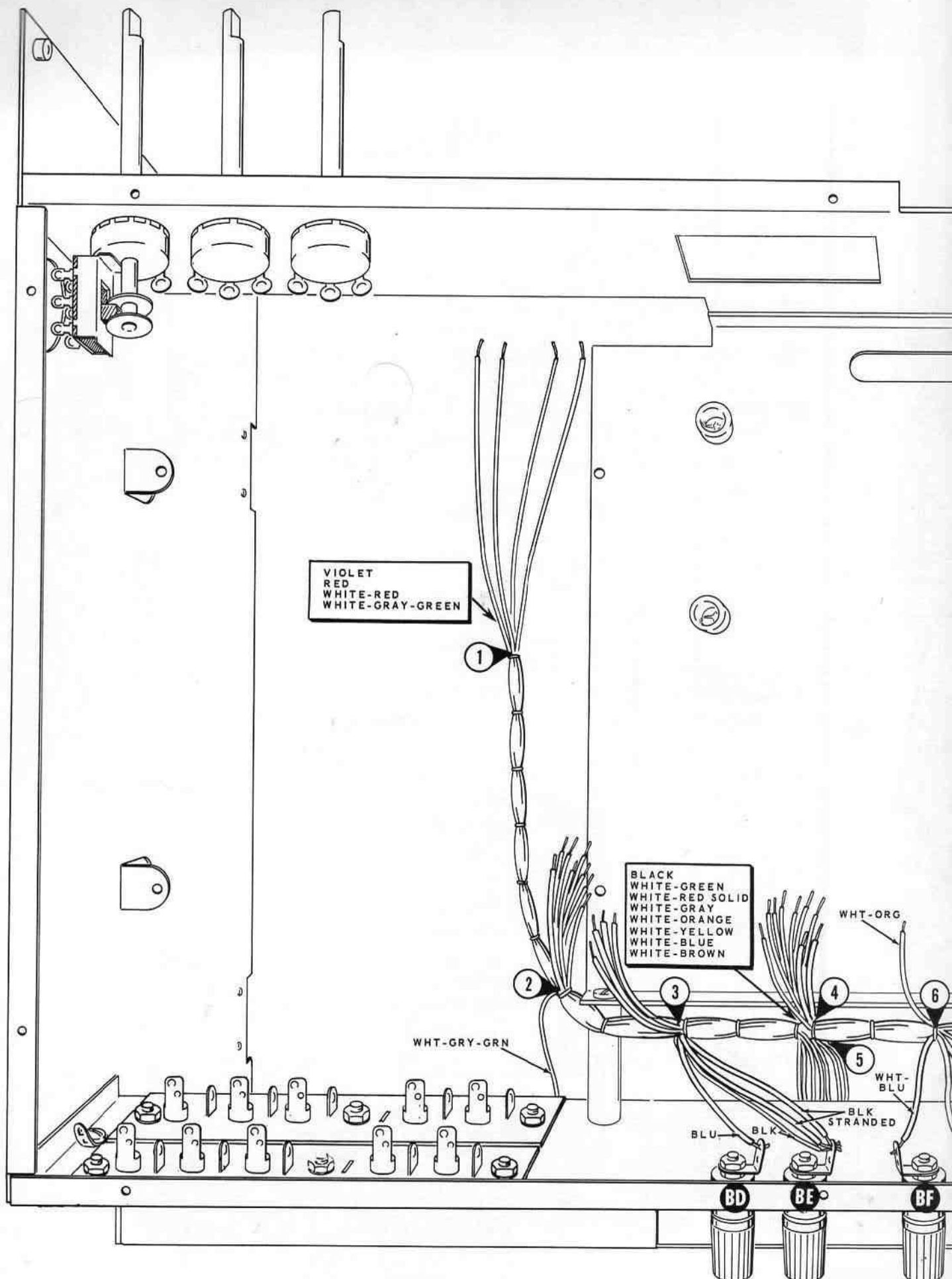
- (✓) White-blue stranded wire to the solder lug at binding post BF (S-1).
- (✓) Any two black stranded wires to solder lug 1 of binding post BG (S-2).
- (✓) One black stranded wire and the black solid wire to lug 2 of binding post BG (S-2).

Breakout #7

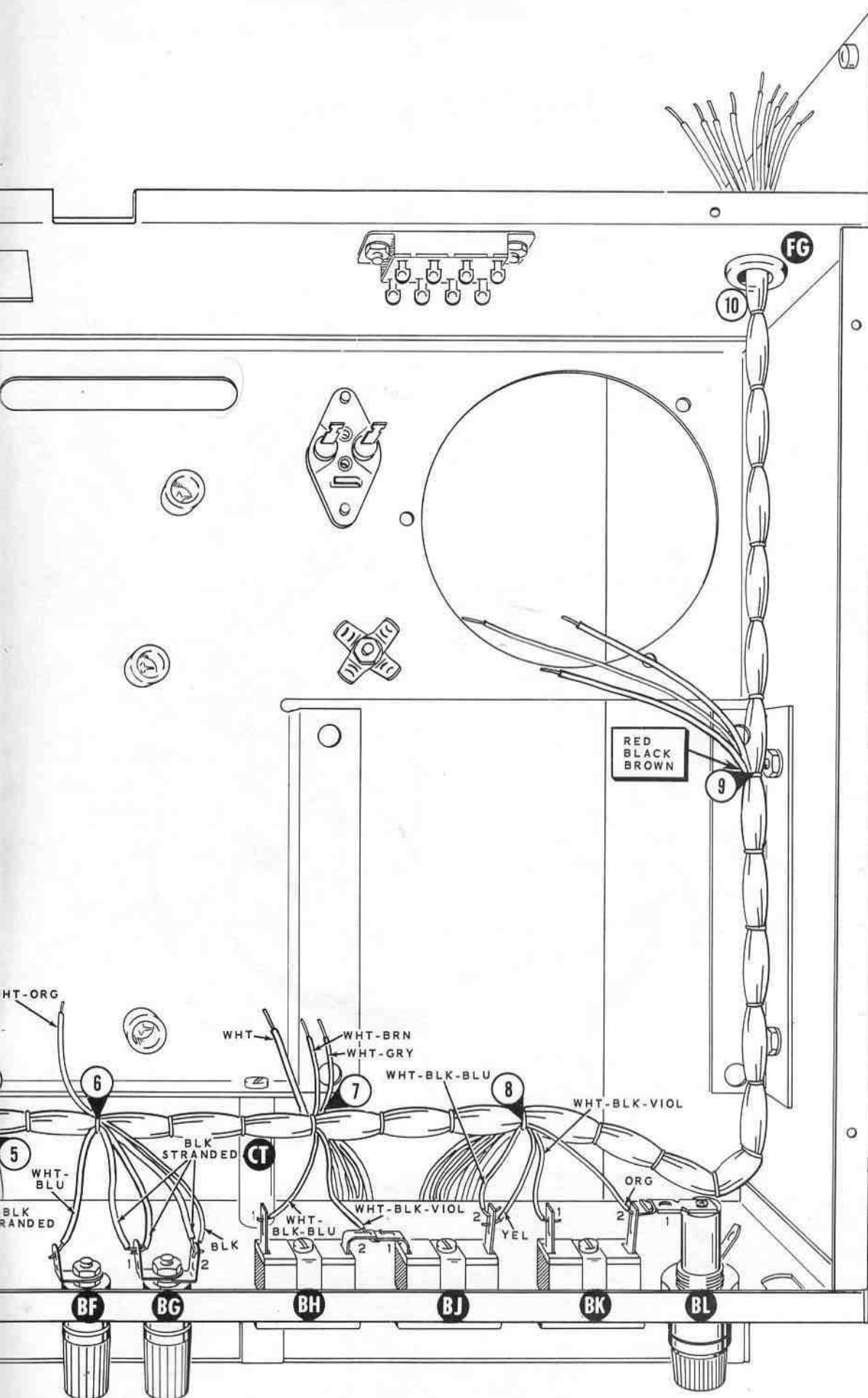
- (✓) White-black-blue wire to lug 1 of socket BH (S-1).
- (✓) Bend lug 2 of socket BH and lug 1 of socket BJ as shown. Then connect the white-black-violet wire through lug 2 to lug 1 (you may have to remove an additional 1/4" of insulation from the wire). Solder both connections.

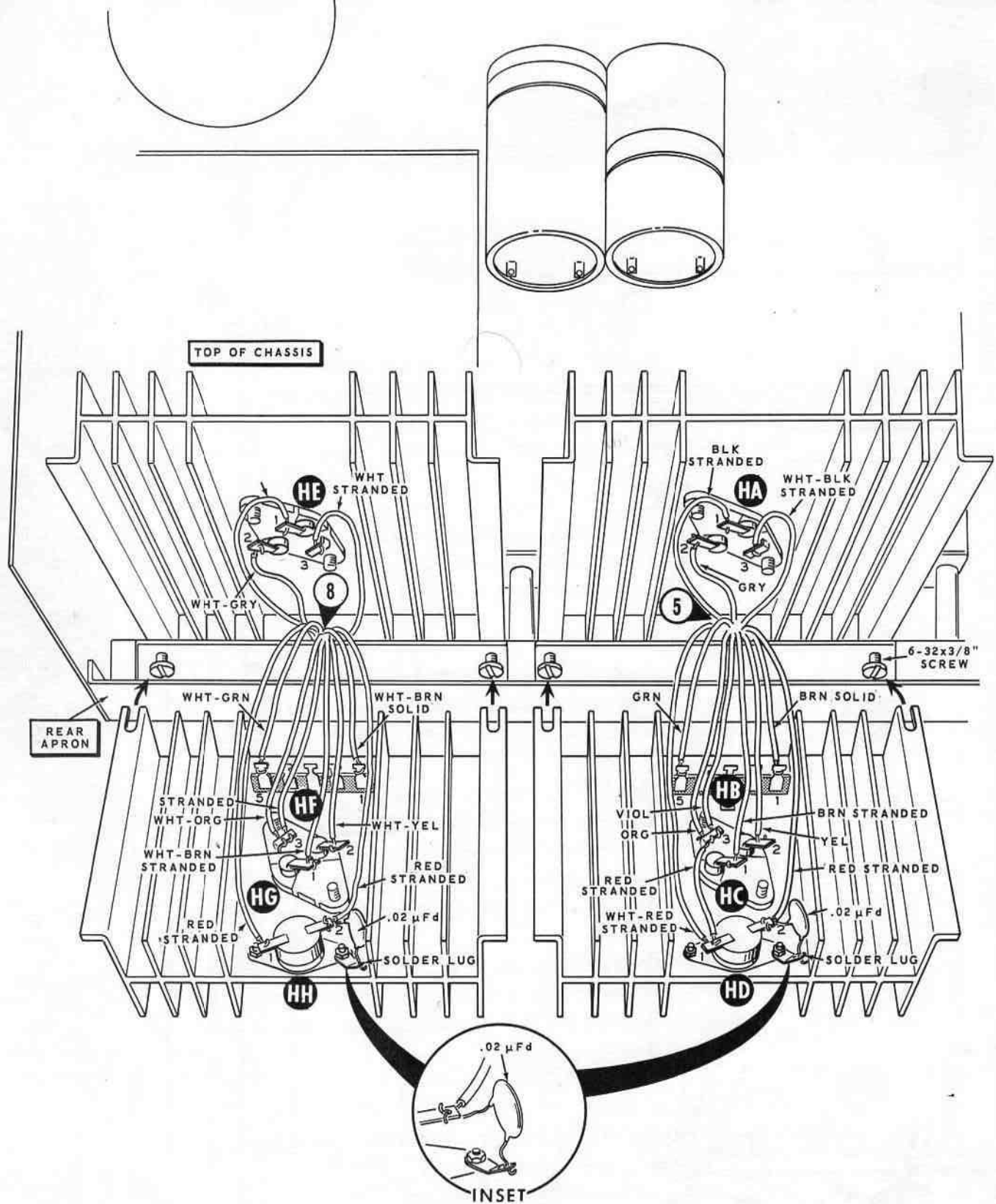
Breakout #8

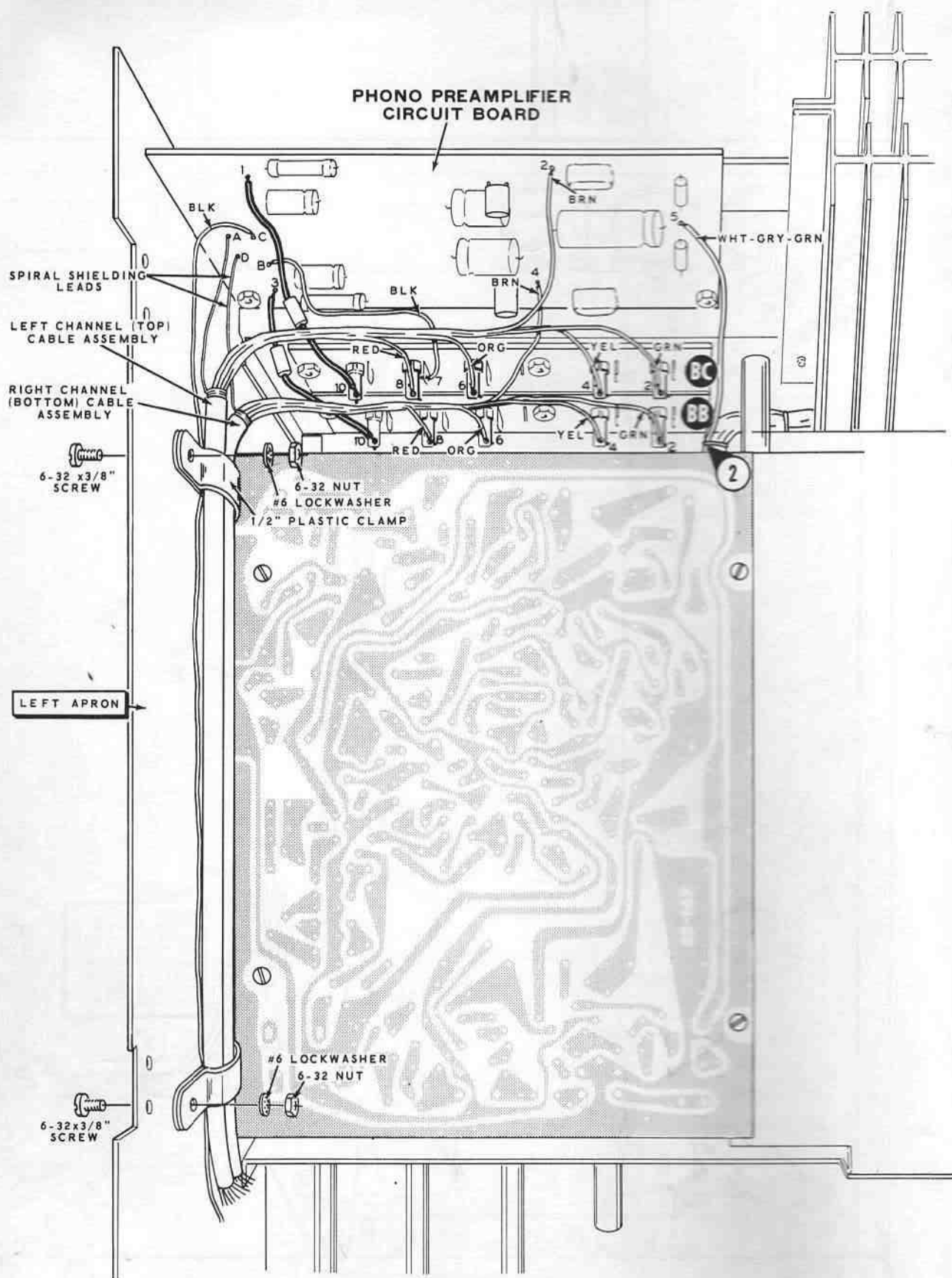
- (✓) Yellow wire and white-black-blue wire to lug 2 of socket BJ (NS).
- (✓) White-black-violet wire to lug 1 of socket BK (NS).
- (✓) Orange wire through lug 2 of socket BK to lug 1 of fuseholder BL (you may have to remove an additional 1/4" of insulation from the wire). Solder both lugs.



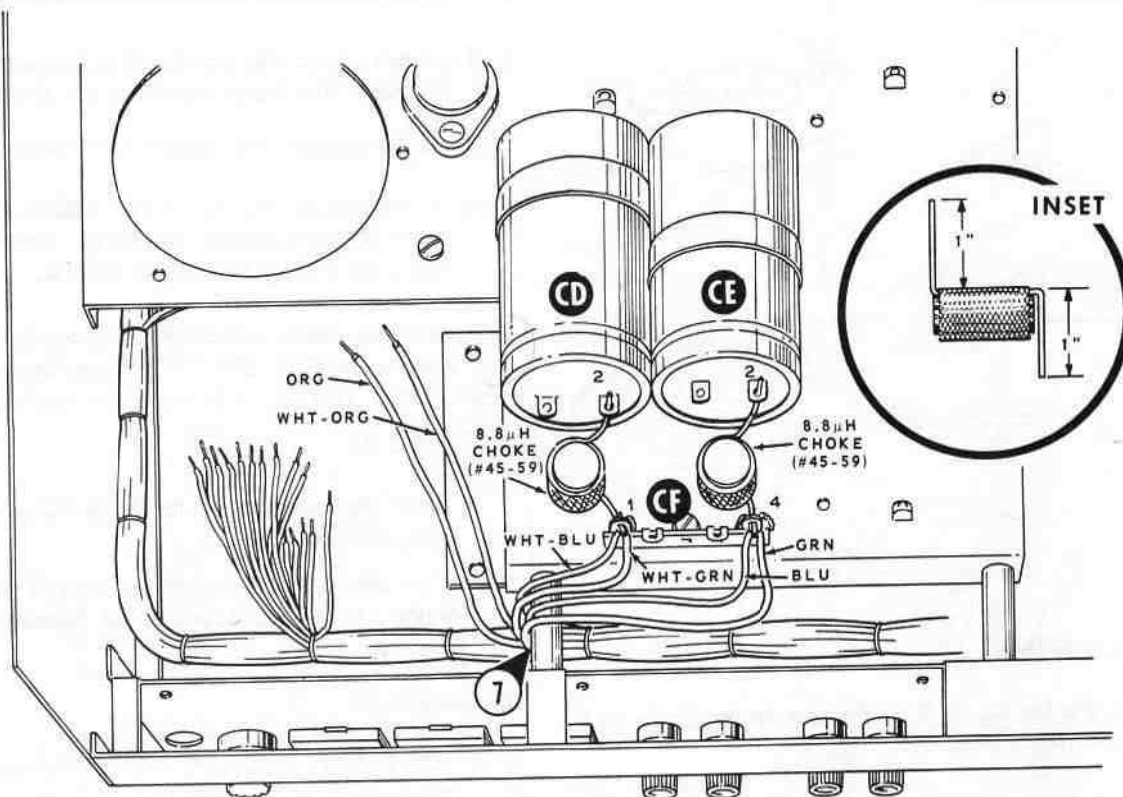
PICTORIAL 7







PICTORIAL 7-12



PICTORIAL 7-8

Refer to Pictorial 7-8 for the following steps.

- (✓) Turn the chassis assembly over and position it on your work surface as shown.
- (✓) Locate both 8.8 μ H chokes (#45-59). Prepare the leads as shown in the inset drawing on Pictorial 7-8.

NOTE: When installing the chokes, it is not necessary to bend the leads around the lugs. Merely push them into the lugs and follow the soldering instructions. When soldering the choke leads, solder near the ends. The leads are covered with an enamel near the body of the choke that can cause a poor solder connection. Also, make sure the choke leads do not touch the chassis.

- (✓) Connect an 8.8 μ H choke from lug 1 of terminal strip CF (NS) to lug 2 of capacitor CD (S-1). Position the choke as shown.
- (✓) Connect an 8.8 μ H choke from lug 4 of terminal strip CF (NS) to lug 2 of capacitor CE (S-1). Position the choke as shown.

Connect the wires from breakout #7 of the cable assembly in the following steps.

- (✓) White-blue wire and white-green stranded wire to lug 1 of terminal strip CF (S-3).
- (✓) Blue wire and green stranded wire to lug 4 of terminal strip CF (S-3).

The white-orange and orange wires will be connected later. Route them away from the rear apron as shown.

Refer to Pictorial 7-9 for the following steps.

- (✓) Locate the two heat sinks which have only the transistors mounted on them.
- (✓) Mount one of these heat sinks as follows on the rear apron at breakout #8. Place all of the wires as shown. Then fasten the heat sink with two 6-32 x 3/8" screws. Turn the screws only part way into the heat sink.
- (✓) Mount the other heat sink at breakout #5 in the same way. Again, position all the wires as shown.

Connect the wires from breakout #5 to socket HA in the following steps. Route the wires as shown.

- (✓) White-black stranded wire to lug 3 of HA (S-1).

(✓) Gray wire to lug 2 of HA (S-1).

(✓) Black stranded wire to lug 1 of HA (S-1).

Connect the wires from breakout #8 to socket HE in the following steps. Route the wires as shown.

(✓) White stranded wire to lug 3 of HE (S-1).

(✓) White-gray wire to lug 2 of HE (S-1).

(✓) Black stranded wire to lug 1 of HE (S-1).

(✓) Position one of the two remaining heat sinks in front of the rear apron at breakout #5.

(✓) Prepare both ends of a 2-1/2" red stranded wire. Remove 1/4" of insulation from both ends and twist the strands of wire together. Then connect the wire from lug 3 of socket HC (NS) to lug 1 of thermal switch HD (NS).

Connect the wires from breakout #5 in the following steps.

(✓) Brown solid wire to lug 1 of terminal strip HB (S-2).

(✓) Green wire to lug 5 of terminal strip HB (S-2).

(✓) Violet wire and orange wire to lug 3 of socket HC (S-3).

(✓) Yellow wire to lug 2 of socket HC (S-1).

(✓) Brown stranded wire to lug 1 of socket HC (S-1).

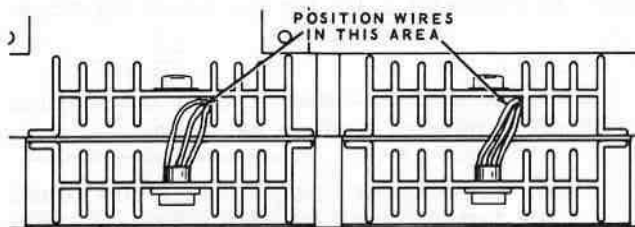
(✓) Red stranded wire to lug 2 of thermal switch HD (NS).

(✓) Connect a .02 μ fd 500 V disc capacitor as shown between lug 2 of thermal switch HD (S-2) and the solder lug (S-1).

(✓) White-red stranded wire to lug 1 of thermal switch HD (S-2).

(✓) Carefully inspect all connections for loose wires or unsoldered lugs. Remove any wire clippings or solder splashes that may be lodged in the wiring.

(✓) Install this heat sink over the two screws. Make sure the wires are positioned between the heat sinks as shown in Detail 7-9A. Also make sure the lugs of transistor HC do not touch the lugs of transistor HA. Then tighten the screws.



Detail 7-9A

(✓) Check to see that none of the wires connected to terminal strip HB are shorting to the chassis.

(✓) Position the remaining heat sink in front of the rear apron at breakout #8.

Connect the wires from breakout #8 to the heat sink in the following steps.

(✓) White-brown solid wire to lug 1 of terminal strip HF (S-2).

(✓) White-green wire to lug 5 of terminal strip HF (S-2).

(✓) White-red stranded wire and white-orange wire to lug 3 of socket HG (S-2).

(✓) White-yellow wire to lug 2 of socket HG (S-1).

(✓) White-brown stranded wire to lug 1 of socket HG (S-1).

(✓) Either red stranded wire to lug 2 of thermal switch HH (NS).

(✓) Connect a .02 μ fd 500 V disc capacitor as shown between lug 2 of thermal switch HH (S-2) and the solder lug (S-1).

(✓) Remaining red stranded wire to lug 1 of thermal switch HH (S-1).

(✓) Carefully inspect all connections for loose wire or unsoldered lugs. Remove any wire clippings or solder splashes that may be lodged in the wiring.

(✓) Install the heat sink over the two screws. Make sure the wires are positioned between the heat sinks as shown in Detail 7-9A. Also make sure the lugs of transistor HG do not touch the lugs of transistor HE. Then tighten the screws.

(✓) Check to see that none of the wires connected to terminal strip HF are shorting to the chassis.

Refer to Pictorial 7-10 for the following steps.

- () Turn the chassis assembly over and position it on your work surface as shown.
- () Place either power amplifier circuit board on the left side of the chassis as shown. This will now be the left channel power amplifier circuit board. NOTE: This circuit board and the remaining power amplifier circuit board will be mounted to the chassis after they both have been wired.

Connect the wires from the cable assembly to the left channel power amplifier circuit board in the following steps. After installing each wire, turn the circuit board over and solder it to the foil. Then cut off the excess lead lengths.

Breakout #2

- (✓) Brown stranded wire to hole 7 (S-1).
- (✓) Gray wire to hole 13 (S-1).
- (✓) Black wire to hole 12 (S-1).
- (✓) Blue wire to hole 11 (S-1).
- (✓) Yellow wire to hole 6 (S-1).
- (✓) Orange wire to hole 5 (S-1).
- (✓) Red wire to hole 2 (S-1).
- (✓) Green wire to hole 3 (S-1).

The white-gray-green wire will be connected later.

Breakout #3

- (✓) Orange stranded wire to hole 10 (S-1).
- (✓) Gray wire to hole 9 (S-1).
- (✓) Brown wire to hole 4 (S-1).

- (✓) White-black stranded wire to hole 8 (S-1).

- (✓) Place the remaining power amplifier circuit board on the chassis beside the left channel power amplifier board. This board will now be the right channel power amplifier circuit board.

Connect the wires from the cable assembly to the right channel power amplifier circuit board in the following steps.

Breakout #4

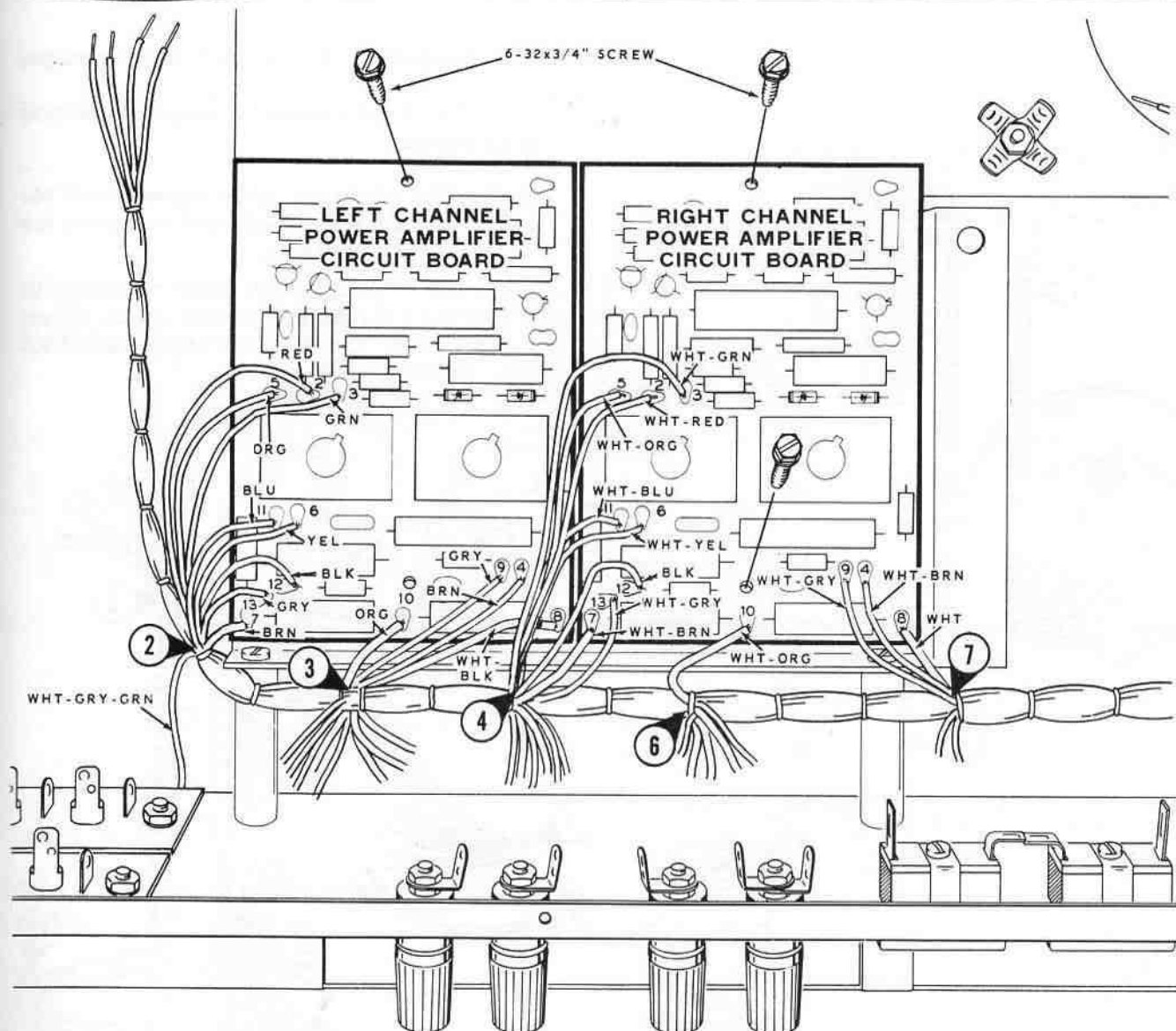
- (✓) White-brown stranded wire to hole 7 (S-1).
- (✓) White-gray wire to hole 13 (S-1).
- (✓) Black wire to hole 12 (S-1).
- (✓) White-blue wire to hole 11 (S-1).
- (✓) White-yellow wire to hole 6 (S-1).
- (✓) White-orange wire to hole 5 (S-1).
- (✓) White-red solid wire to hole 2 (S-1).
- (✓) White-green wire to hole 3 (S-1).

Breakout #6

- (✓) White-orange stranded wire to hole 10 (S-1).

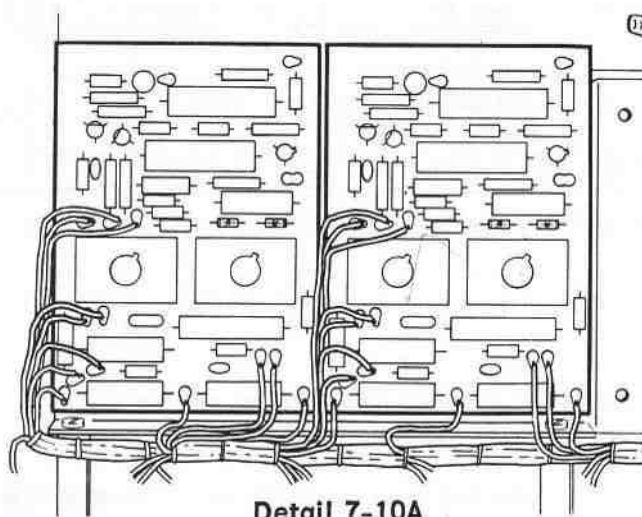
Breakout #7

- (✓) White stranded wire to hole 8 (S-1).
- (✓) White-gray wire to hole 9 (S-1).
- (✓) White-brown wire to hole 4 (S-1).



PICTORIAL 7-10

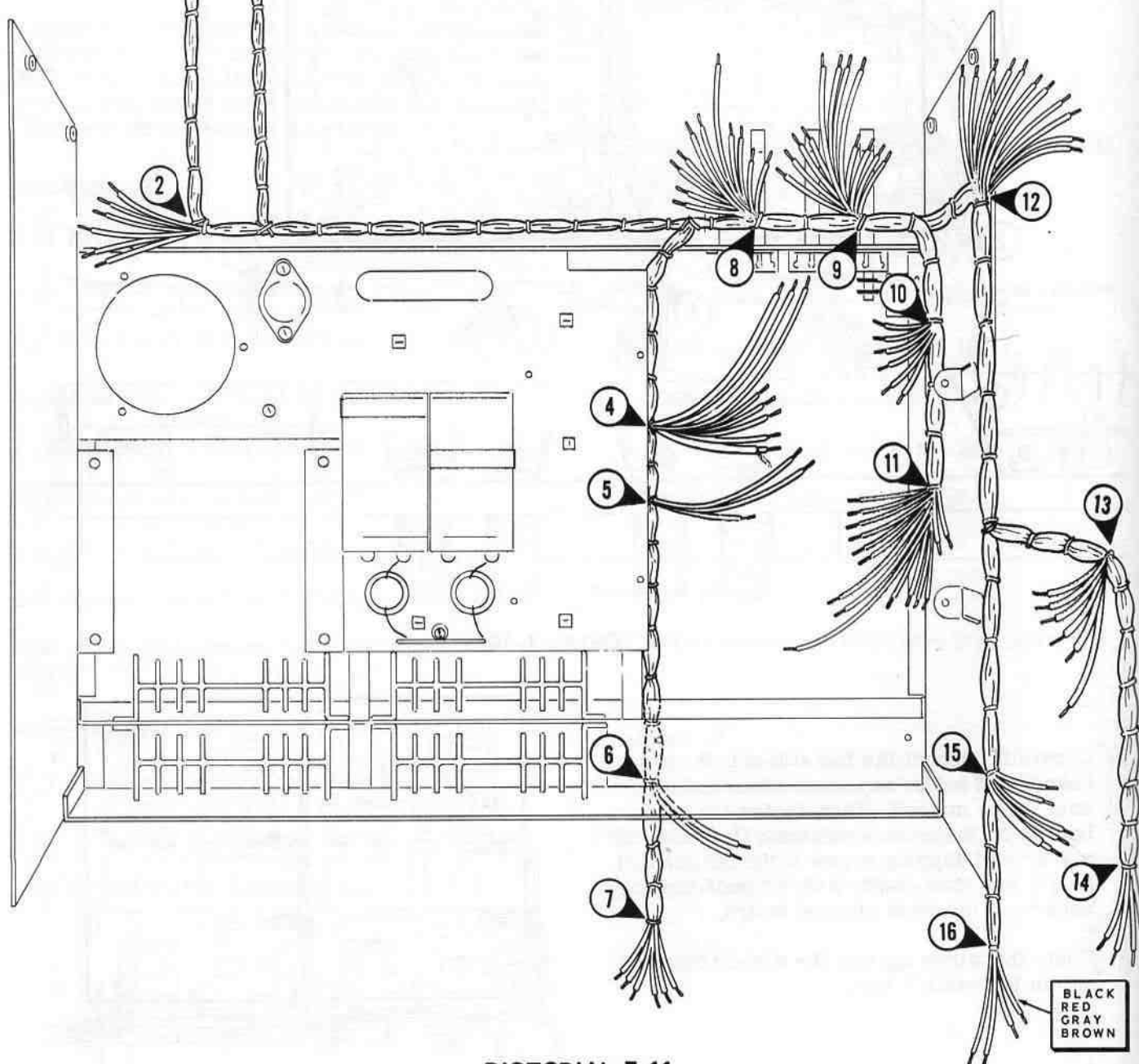
- (A) Carefully inspect the foil side of both circuit boards and solder any connections that might have been missed. Then fasten the circuit boards on the nylon insulators. Use one 6-32 x 3/4" self-tapping screw in the left channel board and two 6-32 x 3/4" self-tapping screws in the right channel board.
- (B) Route the wires against the circuit board as shown in Detail 7-10A.



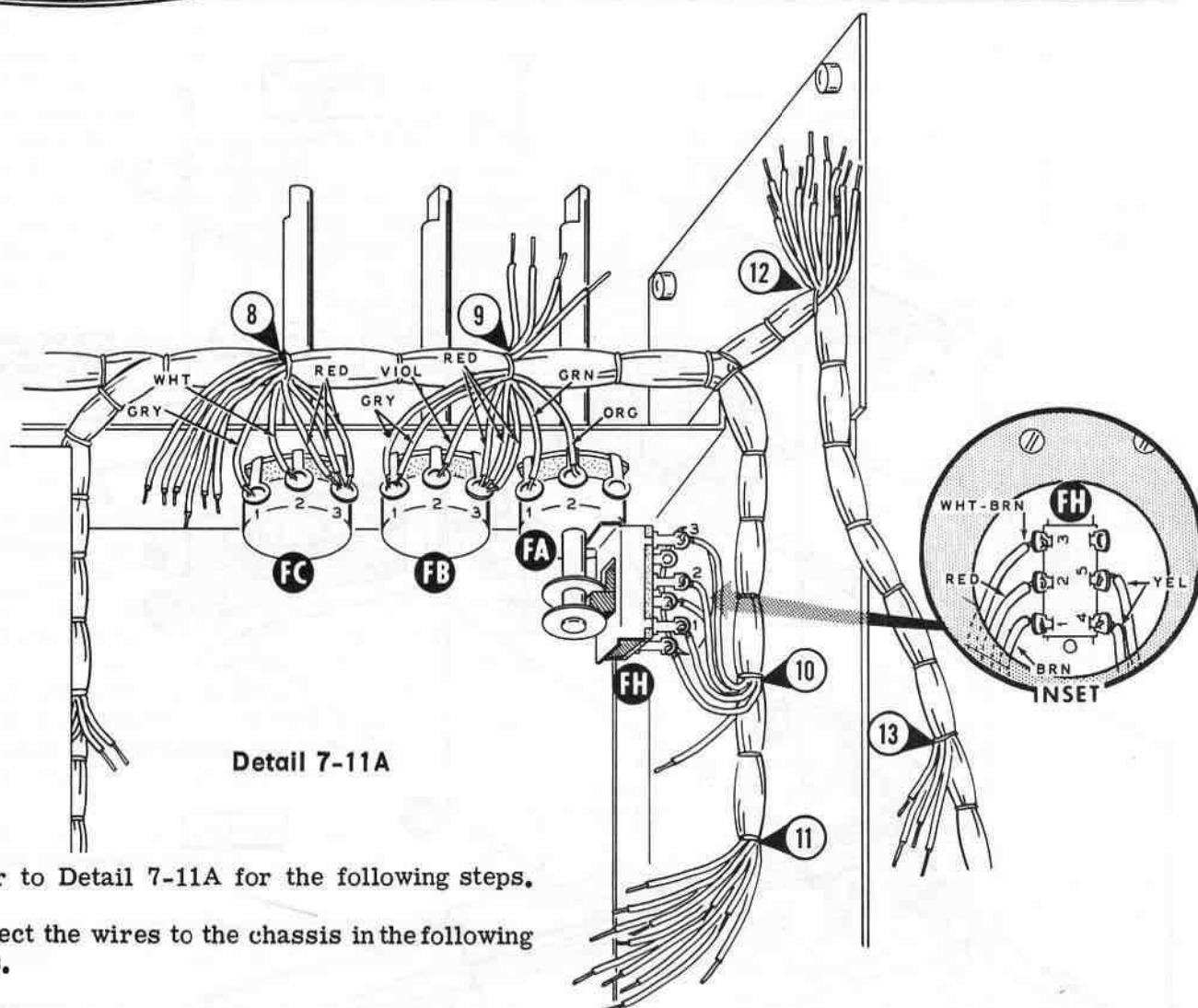
Detail 7-10A

Refer to Pictorial 7-11 for the following steps.

- (✓) Turn the chassis assembly over and position it as shown.
- (✓) Locate the multiplex cable assembly (#134-149). Unfold the assembly and straighten the wires at each breakout.
- (✓) Place the cable assembly on the chassis with breakouts 1 through 16 positioned as shown in the Detail. The wire colors are called out at these breakouts.



PICTORIAL 7-11



Detail 7-11A

Refer to Detail 7-11A for the following steps.

Connect the wires to the chassis in the following steps.

Breakout #8

- (✓) Gray wire to lug 1 of control FC (S-1).
- (✓) White wire to lug 2 of control FC (S-1).
- () Three red wires to lug 3 of control FC (S-3).
- (✓) Route the remaining wires along the side of the control as shown.

Breakout #9

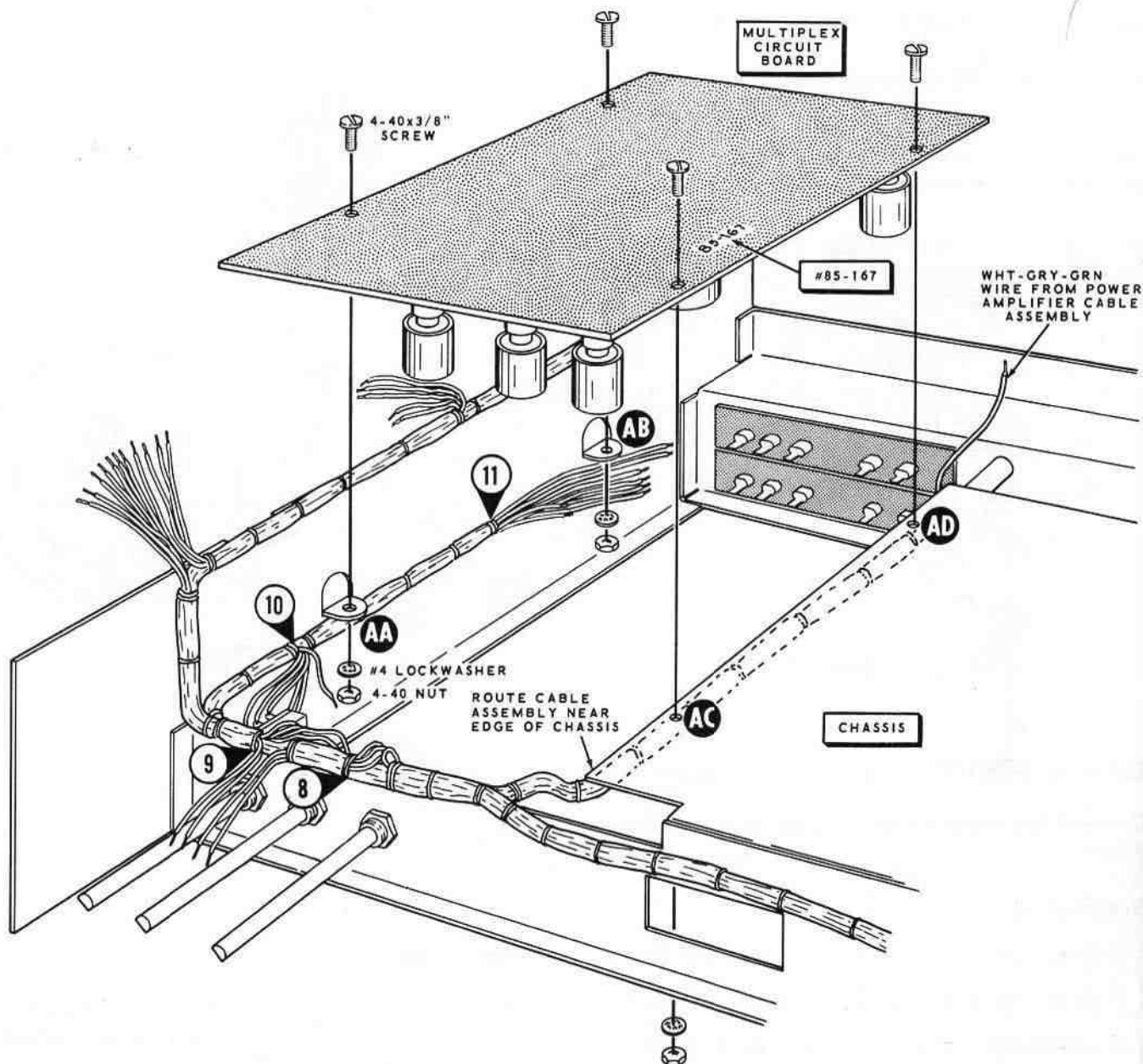
- (✓) Two gray wires to lug 1 of control FB (S-2).
- (✓) Violet wire to lug 2 of control FB (S-1).
- (✓) Three red wires to lug 3 of control FB (S-3).
- (✓) Green wire to lug 1 of control FA (S-1).
- (✓) Orange wire to lug 2 of control FA (S-1).

Breakout #10

Refer to the inset drawing on Detail 7-11A for the following steps. These wires can be reached through the hole in the left apron.

- (✓) Brown wire to lug 1 of switch FH (S-1).
- (✓) Red wire to lug 2 of switch FH (S-1).
- () White-brown wire to lug 3 of switch FH (S-1).
- (✓) Either yellow wire to lug 4 of switch FH (S-1).
- (✓) Remaining yellow wire to lug 5 of switch FH (S-1). NOTE: Lug 6 is not used.

The black wire will be connected later.



Detail 7-12A

Refer to Detail 7-12A for the following steps.

- (✓) Turn the chassis around and position it on your work surface as shown.
- (✓) Position the wires at breakout #9 straight out from the front apron.
- (✓) Route the cable assembly under mounting tab AA and AB.
- (✓) Form a bend in the group of wires coming out of the cable assembly near breakout #8. Then route these wires under the chassis near AC and AD.
- (✓) Route the white-gray-green wire coming from the power amplifier cable assembly near the rear apron.

- (✓) Position the multiplex circuit board with the foil side facing up and the number (#85-167) as shown. Then carefully mount the circuit board to the chassis and right apron. Use 4-40 x 3/8" screws, #4 lockwashers, and 4-40 nuts at AA, AB, AC, and AD. In order to install the screw at AD, the left power amplifier circuit board that is mounted on the other side of the chassis will have to be moved aside.

- (✓) Refasten the left power amplifier circuit board to the nylon spacers with two 6-32 x 3/4" self-tapping screws.

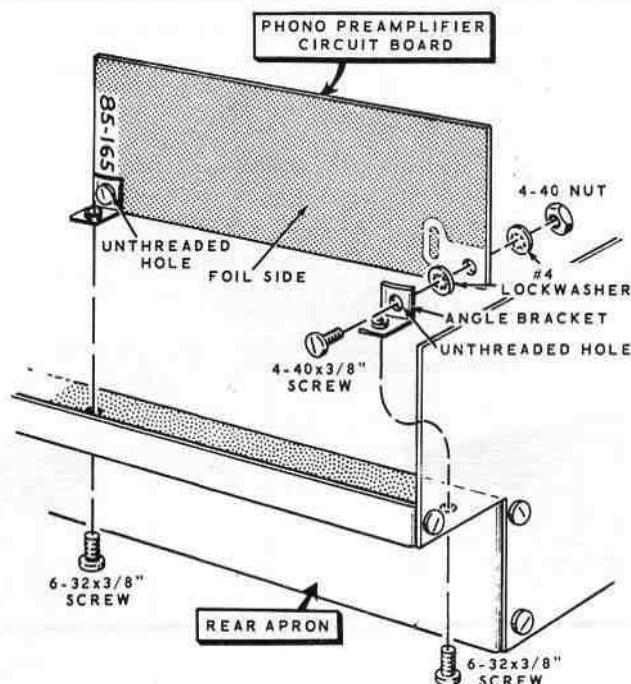
Refer to Detail 7-12B for the following steps.

- (✓) Position the phono preamplifier circuit board with the number (#85-165) as shown.
- (✓) Position the angle brackets with the unthreaded holes as shown in the Detail. Then mount them to the foil side of the circuit board with two 4-40 x 3/8" screws, four #4 lockwashers, and two 4-40 nuts. Make sure the brackets do not turn when the screws are being tightened.

Refer to Pictorial 7-12 (fold-out from Page 74) for the following steps.

Connect the wires and resistors to the phono preamplifier circuit board in the following steps.

- (✓) Mount the circuit board on the rear apron with two 6-32 x 3/8" screws. Refer to Detail 7-12B and Pictorial 7-12. Route the resistors toward the phono socket strips as shown in the Pictorial.
- (✓) Place a 1" length of small (vinyl) sleeving on the free end of the resistor which is connected to hole 3 of the phono preamplifier circuit board. Then connect this lead to lug 10 of phono socket strip BB (S-1).
- (✓) Place a 1" length of small (vinyl) sleeving on the free end of the resistor which is connected to hole 1 of the phono preamplifier circuit board. Then connect this lead to lug 10 of phono socket strip BC (S-1).

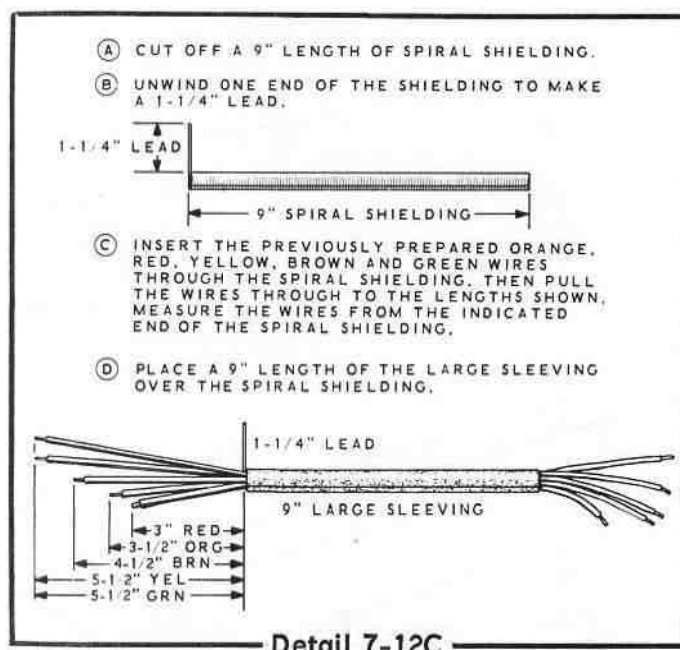


Detail 7-12B

NOTE: When soldering the following wires to the foil side of the circuit board, position the chassis so that the solder does not flow between the foil patterns of the board.

- (✓) Connect a 3" black hookup wire from lug 7 of phono socket strip BC (S-3) to hole B (S-1).
- (✓) Connect the white-gray-green wire coming from breakout 2 of the cable assembly to hole 5 (S-1).
- (✓) Cut the following lengths of hookup wire. Do not remove any insulation from the wires at this time.

Two 15-1/4" orange
 Two 15-1/4" red
 Two 20" yellow
 Two 18-1/4" brown
 Two 19" green



(✓) Locate the spiral shielding and large sleeving. Then prepare two cable assemblies as shown in Detail 7-12C. Be sure to perform all steps; A, B, C, and D.

(✓) Now remove 1/4" of insulation from the ends of all wires in the two cable assemblies.

() Place both cable assemblies with the spiral shielding leads toward the phono preamplifier circuit board as shown in Pictorial 7-12. Then place two plastic clamps on the left apron with 6-32 x 3/8" screws, #6 lock-washers, and 6-32 nuts. NOTE: Position the cables one above the other and centered between the clamps.

Connect the wires from the right channel (bottom) cable assembly to the preamplifier circuit board and to phono socket strip BB in the following steps. Route the wires as shown.

(✓) Spiral shielding wire to hole D of the circuit board (S-1).

(✓) Brown wire to hole 4 of the circuit board (S-1).

(✓) Red wire to lug 8 of BB (S-1).

(✓) Orange wire to lug 6 of BB (S-1).

(✓) Yellow wire to lug 4 of BB (S-1).

(✓) Green wire to lug 2 of BB (S-1).

(✓) Route these wires next to the lugs of phono socket strip BB as shown.

Connect the wires from the left channel (top) cable assembly to the preamplifier circuit board and to phono socket strip BC in the following steps. Route the wires as shown.

(✓) Spiral shielding wire to hole A of the circuit board (S-1).

(✓) Brown wire to hole 2 of the circuit board (S-1).

(✓) Red wire to lug 8 of BC (S-1).

(✓) Orange wire to lug 6 of BC (S-1).

(✓) Yellow wire to lug 4 of BC (S-1).

(✓) Green wire to lug 2 of BC (S-1).

(✓) Insert a 15" black hookup wire through both plastic clamps. Connect one end of the wire to hole C of the phono preamplifier circuit board (S-1). The other end of this wire and the two cable assemblies will be connected later.

(✓) Route these wires next to the lugs of phono socket strip BC as shown.

(✓) Cut off the excess wire ends from the foil side of the circuit board.

Refer to Pictorial 7-13 for the following steps.

- (✓) Position the chassis so that it rests on the right apron.

Connect the wires from the multiplex cable assembly to the multiplex circuit board in the following steps. After soldering each wire, cut off the excess lead lengths on the foil side of the board.

Breakout #4

- (✓) Inner lead of the shielded cable to hole 10 (S-1). Shield lead to hole S (S-1).
- (✓) Blue wire to hole 17 (S-1).
- (✓) Brown wire to hole G (S-1).
- (✓) White-black wire to hole F (S-1).

Breakout #8

- (✓) White-red wire to hole 19 (S-1).
- (✓) Green wire to hole 1 (S-1).
- (✓) Either yellow wire to hole 11 (S-1).
- (✓) Remaining yellow wire to hole 12 (S-1).
- (✓) Brown wire to hole 13 (S-1).
- (✓) Orange wire to hole 2 (S-1).

Breakout #10

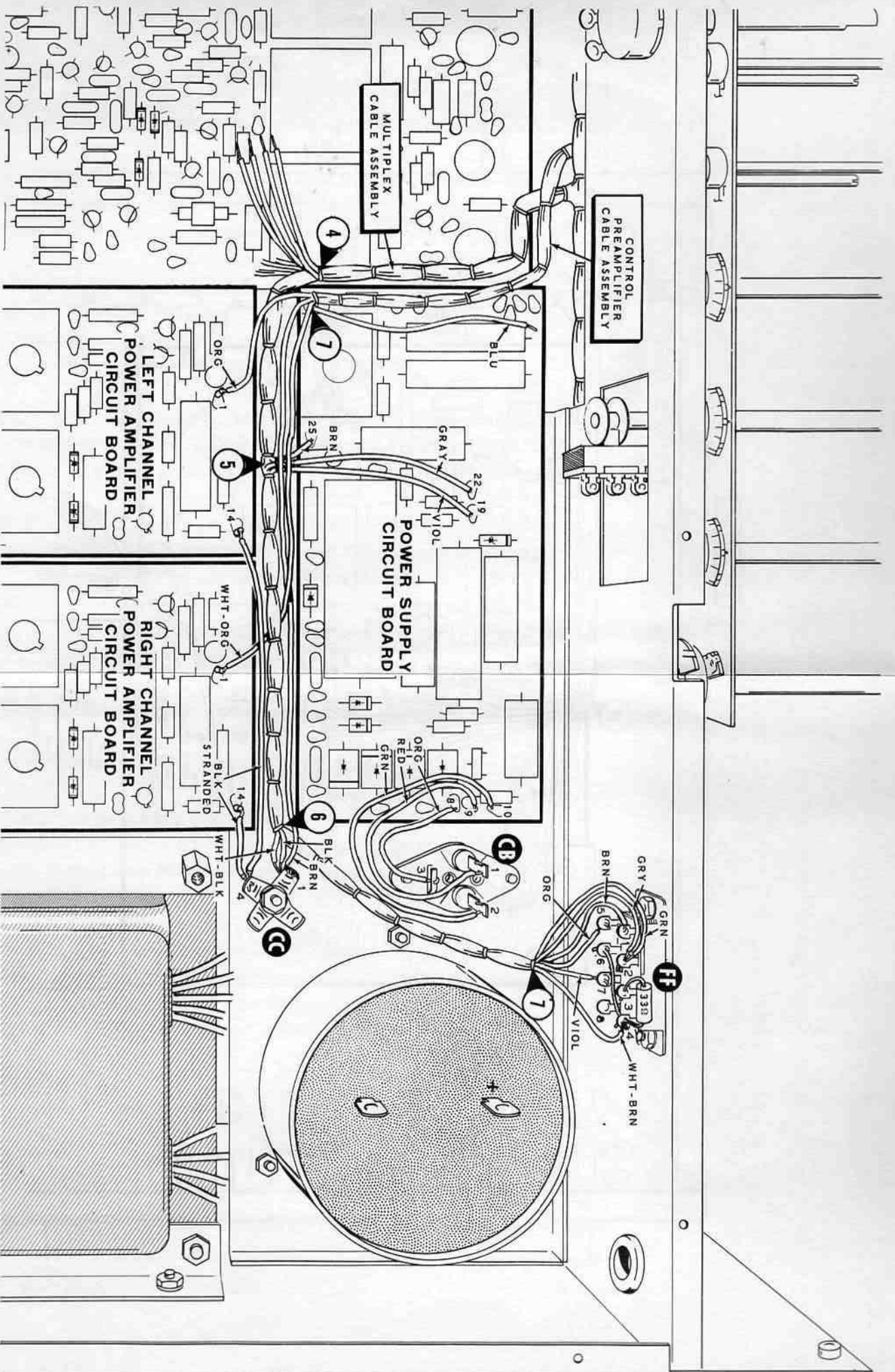
- (✓) Black wire to hole 21 (S-1).

Breakout #11

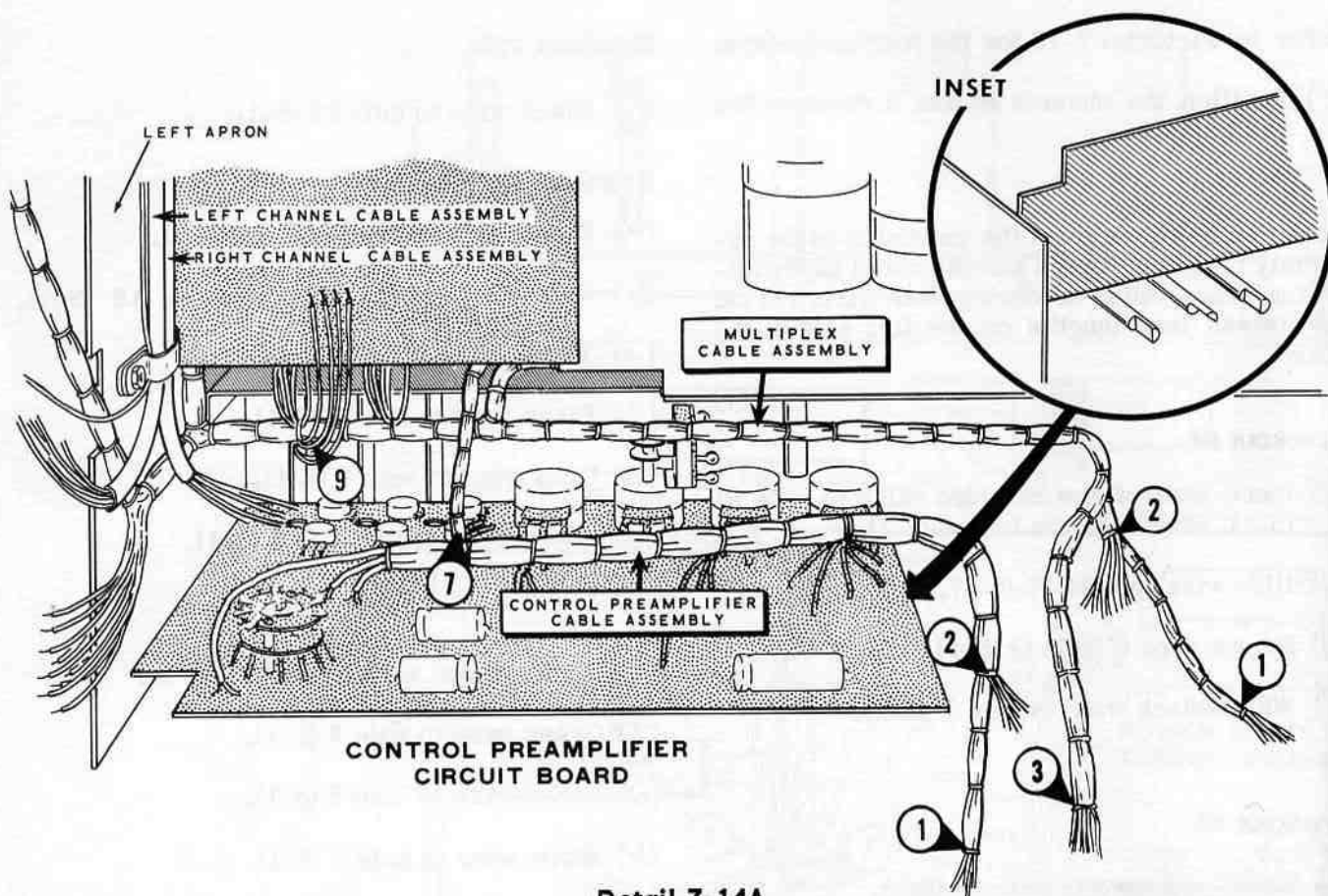
- (✓) Either blue wire to hole 15 (S-1).
- (✓) Remaining blue wire to hole 16 (S-1).
- (✓) Yellow wire to hole 20 (S-1).
- (✓) Black wire to hole 9 (S-1).
- (✓) Gray wire to hole 6 (S-1).
- (✓) White-red wire to hole 4 (S-1).
- (✓) Red wire to hole 3 (S-1).
- (✓) White-brown wire to hole 14 (S-1).
- (✓) Green wire to hole 8 (S-1).
- (✓) Violet wire to hole 5 (S-1).
- (✓) White wire to hole 7 (S-1).
- (✓) White-blue wire to hole 18 (S-1).
- (✓) White-black wire to hole F (S-1).
- (✓) Brown wire to hole G (S-1).
- (✓) White-yellow wire to hole 22 (S-1).
- (✓) Route the wires against the circuit board as shown.



PICTORIAL 7-13



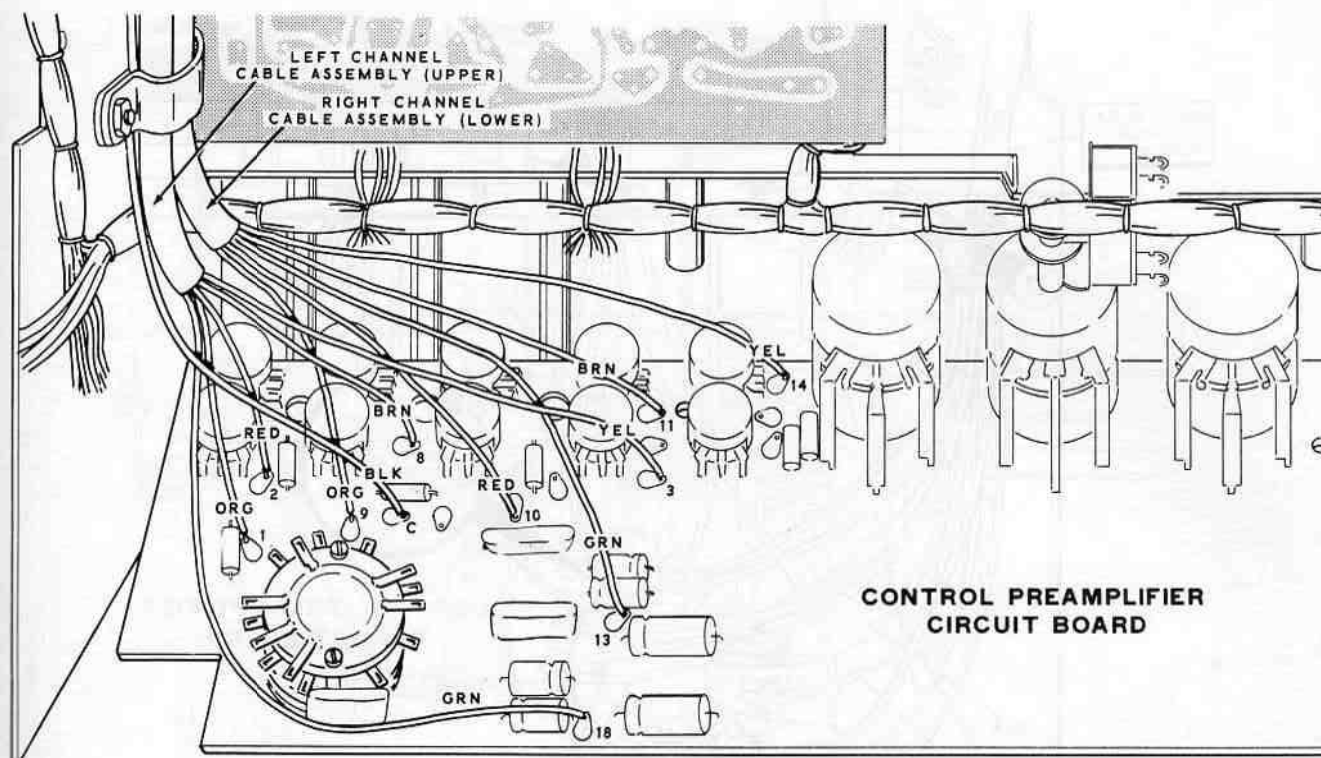
PICTORIAL 7-20



Detail 7-14A

Refer to Detail 7-14A for the following steps.

- (✓) Position the chassis on your work surface with the left apron as shown and the controls toward you.
- (✓) Bend the wires coming from the left channel cable assembly back out of the way as shown. These are the wires which are connected to the top row of lugs of the phono socket strip.
- (✓) Locate the control preamplifier circuit board (the one with the cable assembly connected to it).
- (✓) Place the edge of the circuit board on top of the control shafts as shown in the inset drawing on Detail 7-14A. Leave the circuit board in this position for the following wiring.
- (✓) Insert the wires coming from breakout #7 of the control preamplifier cable assembly through the cutout in the chassis base. Position the wires from breakouts 1 and 2 as shown.
- (✓) Position the wires from breakouts 1, 2, 3, and 9 of the multiplex cable assembly as shown.



PICTORIAL 7-14

Refer to Pictorial 7-14 for the following steps.

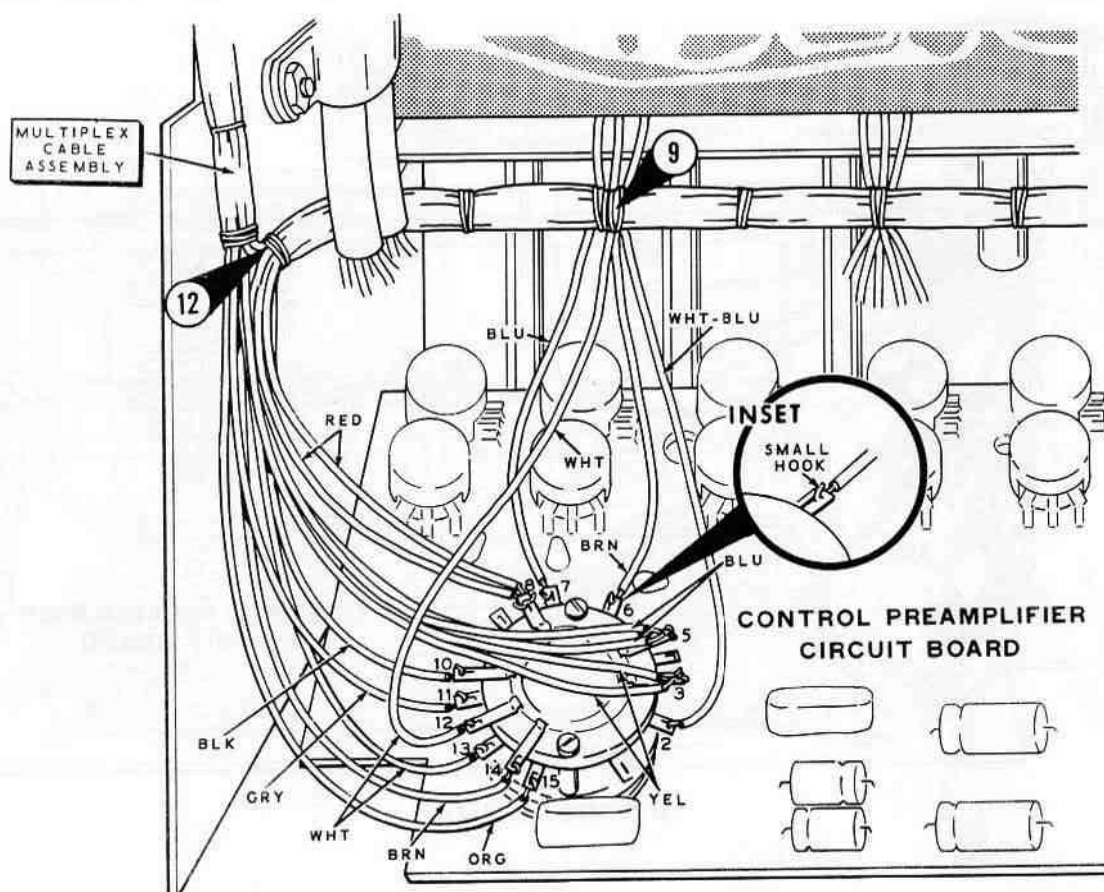
NOTE: When you solder the following wires to the circuit board foil, be careful that the solder does not flow between the foil patterns.

Connect the wires from the right channel (lower) cable assembly to the control preamplifier circuit board in the following steps.

- (✓) Orange wire to hole 9 (S-1).
- (✓) Red wire to hole 10 (S-1).
- (✓) Brown wire to hole 11 (S-1).
- (✓) Yellow wire to hole 14 (S-1).
- (✓) Green wire to hole 13 (S-1).

Connect the wires from the left channel (upper) cable assembly to the control preamplifier circuit board in the following steps.

- (✓) Red wire to hole 2 (S-1).
- (✓) Orange wire to hole 1 (S-1).
- (✓) Brown wire to hole 8 (S-1).
- (✓) Yellow wire to hole 3 (S-1).
- (✓) Green wire to hole 18 (S-1).
- (✓) Connect the black hookup wire coming through the plastic clamp to hole C of the circuit board (S-1).



PICTORIAL 7-15

Refer to Pictorial 7-15 for the following steps.

NOTE: The rotary switch that will be wired next has two wafers, front (mounted to the circuit board) and rear. The wires will be connected to the lugs of the rear wafer only. There are lugs on both sides of this rear wafer, so count the lugs carefully when you connect the wires.

Connect the wires from breakouts 9 and 12 of the multiplex cable assembly to the rotary switch in the following steps. Before connecting each of these wires, cut the stripped end to 1/8" and bend it to form a small hook as shown in the inset drawing. Be careful when soldering the wires to the switch lugs; do not allow the solder to flow onto the switch contacts.

Breakout #9

- (✓) Brown wire to lug 6 (S-2).
- (✓) Blue wire to lug 7 (S-1).

The remaining two wires from breakout #9 will be connected later.

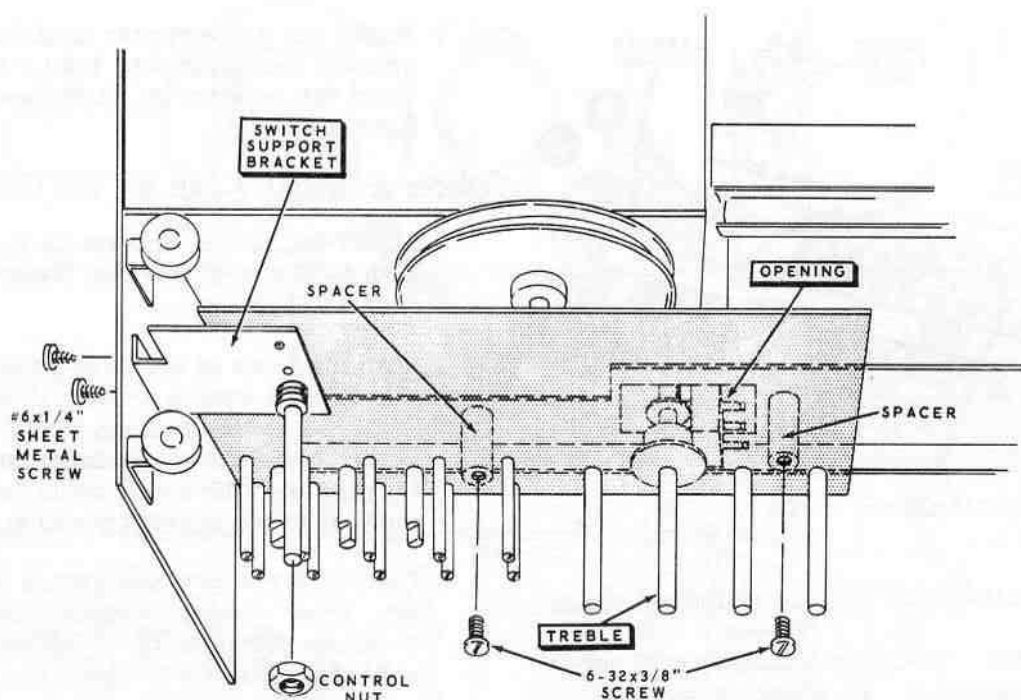
Breakout #12

- (✓) Both red wires to lug 8 (S-2).
- (✓) Black wire to lug 10 (S-1).
- (✓) Gray wire to lug 11 (S-1).

NOTE: Do not connect a wire, at this time, to lug 12.

- (✓) White wire to lug 13 (S-1).
- (✓) Brown wire to lug 14 (S-1).
- (✓) Orange wire to lug 15 (S-1).
- (✓) Both blue wires to lug 5 (S-2).
- (✓) Both yellow wires to lug 3 (S-2).

NOTE: Do not connect a wire, at this time, to lug 2.



Detail 7-15A

- (✓) Carefully inspect the foil side of the circuit board for any solder bridges between foils. Also, check the rotary switch lugs for any unsoldered connections or broken wires. Solder any connections that might have been missed.

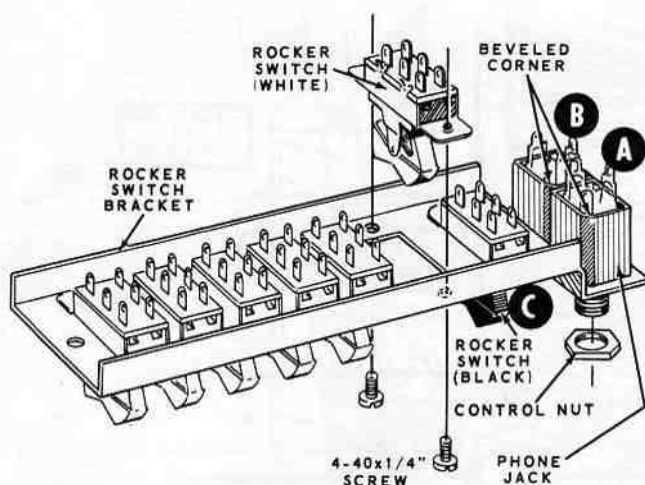
- (✓) Mount the circuit board as follows and as shown in Detail 7-15A. Line up the three holes in the board with the shafts of the three chassis controls. Then carefully push the circuit board against the front apron spacers while guiding the switch on the treble control through the cutout in the front apron. Make sure no wires are pinched between the spacers and the circuit board.

- (✓) Fasten the circuit board to the spacers with 6-32 x 3/8" screws.

- () Place the switch support bracket over the shaft of the rotary switch. Then fasten it to the left apron with #6 x 1/4" sheet metal screws and to the switch with a control nut.

Refer to Pictorial 7-15 and connect the remaining two wires from breakout #9 of the multiplex cable assembly to the rotary switch in the following steps.

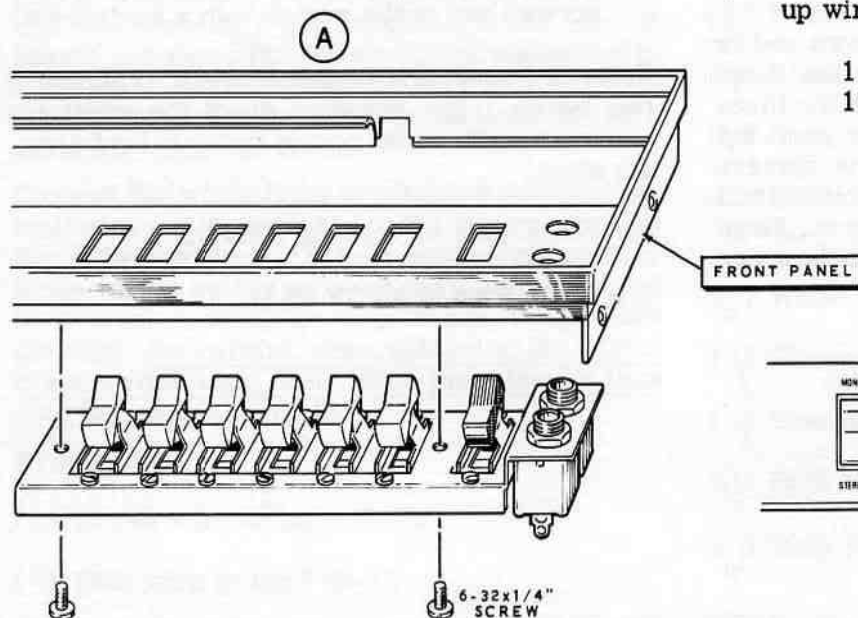
- (✓) White-blue wire to lug 2 (S-1).
- (✓) White wire to lug 12 (S-1).



Detail 7-16A

Refer to Detail 7-16A for the following steps.

- (✓) Locate the rocker switch bracket, seven rocker switches, two phone jacks, and the front panel.
- (✓) Position the switch bracket as shown. Mount the phone jacks at A and B with control nuts. Be sure to position the phone jacks with the beveled corners as shown.
- (✓) Mount the black rocker switch at C with 4-40 x 1/4" screws. Turn the screws in all the way, but do not tighten them.



Detail 7-16B

- (✓) Mount six white rocker switches at the remaining locations with 4-40 x 1/4" screws. Turn the screws in all the way, but do not tighten them.

Refer to Detail 7-16B for the following steps.

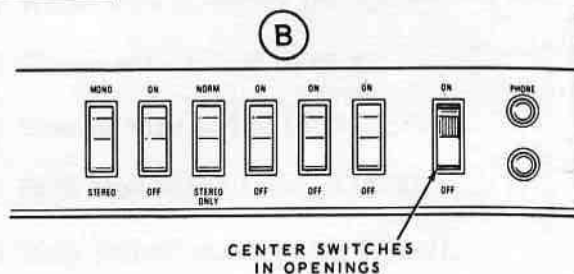
- () Mount the switch bracket on the front panel with 6-32 x 1/4" screws. Refer to Part A of Detail 7-16B.
- () With the front of the front panel toward you, check each switch to see if it is properly centered in the opening. Refer to Part B of Detail 7-16B. If any of them need to be centered, grasp the switch from the lug side and move it to the correct position.

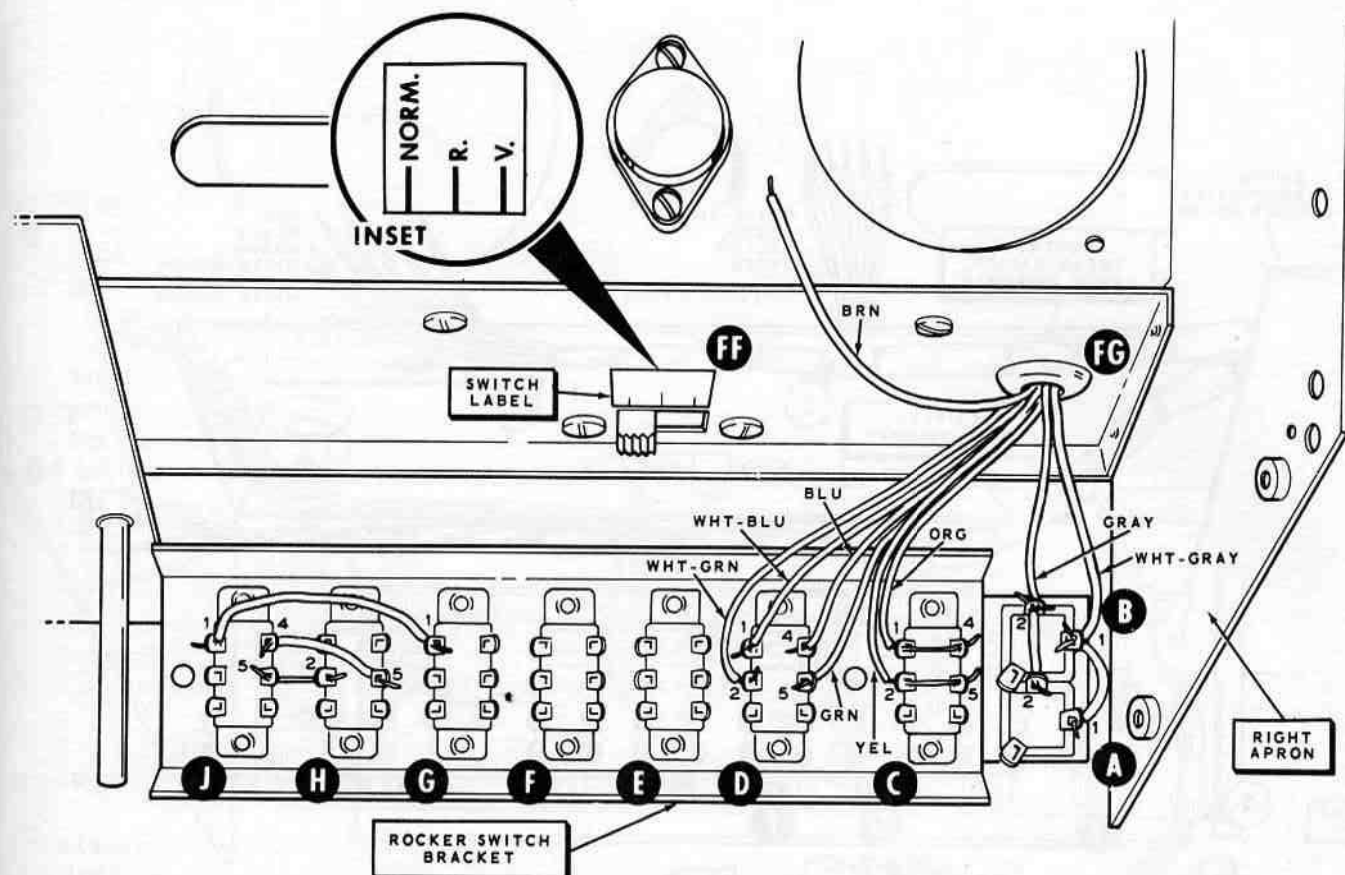
- () Carefully remove the switch bracket from the front panel without disturbing the switches position. Then tighten both screws of each switch. Set the front panel and screws aside; they will be used later.

Refer to Pictorial 7-16 for the following steps.

- (✓) Locate the meter switch label and peel away the paper backing. Position the label with the letter V to the right as shown in the inset drawing on Pictorial 7-16. Center the label above and between the mounting screws of switch FF and press it in place.
- () Prepare the following lengths of black hook-up wire.

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





PICTORIAL 7-16

Connect black hookup wires to the rocker switches and phone jacks in the following steps.

(✓) Position the rocker switch bracket as shown.

(✓) 1-1/4" wire from lug 1 of A (S-1) to lug 1 of B (NS).

(✓) 1" wire from lug 2 of A (S-1) to lug 2 of B (NS).

(✓) 1-1/4" wire from lug 4 of J (S-1) to lug 5 of H (NS).

(✓) 2" wire from lug 1 of J (S-1) to lug 1 of G (S-1).

(✓) Remove all the insulation from a 3/4" black hookup wire. Connect the wire from lug 5 of J (S-1) to lug 2 of H (NS).

(✓) Position the chassis as shown in the Pictorial and place the switch bracket in front of it near the right apron.

Connect the wires coming through grommet FG to the switch bracket in the following steps.

(✓) Gray wire to lug 2 of phone jack B (S-2).

(✓) White-gray wire to lug 1 of phone jack B (S-2).

NOTE: Where a wire passes through a connection and then goes to another point, as in the next step, it will count as two wires in the solder instructions (S-2), one entering and one leaving the connection.

(✓) Remove an additional 1/4" of insulation from the orange wire. Connect the wire through lug 1 (S-2) to lug 4 (S-1) of C.

(✓) Remove an additional 1/4" of insulation from the yellow wire. Connect the wire through lug 2 (S-2) to lug 5 (S-1) of C.

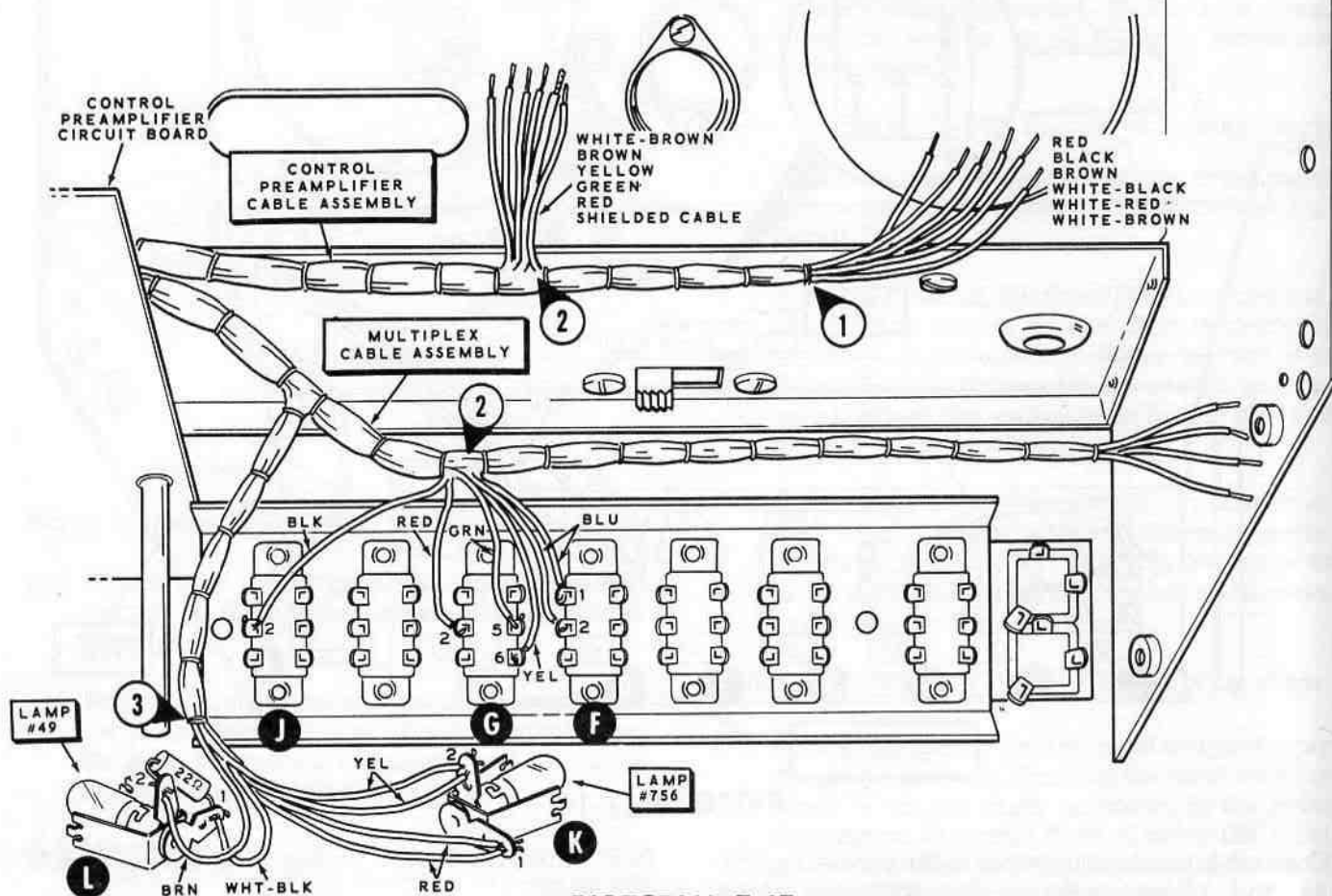
(✓) Blue stranded wire to lug 4 of D (S-1).

(✓) White-blue stranded wire to lug 1 of D (S-1).

(✓) White-green stranded wire to lug 2 of D (S-1).

(✓) Green stranded wire to lug 5 of D (S-1).

The brown wire will be connected later.



PICTORIAL 7-17

Refer to Pictorial 7-17 for the following steps.

Connect the wires from the multiplex cable assembly to the switch bracket in the following steps.

NOTE: Keep these wires below the control preamplifier cable assembly as shown.

Breakout #2

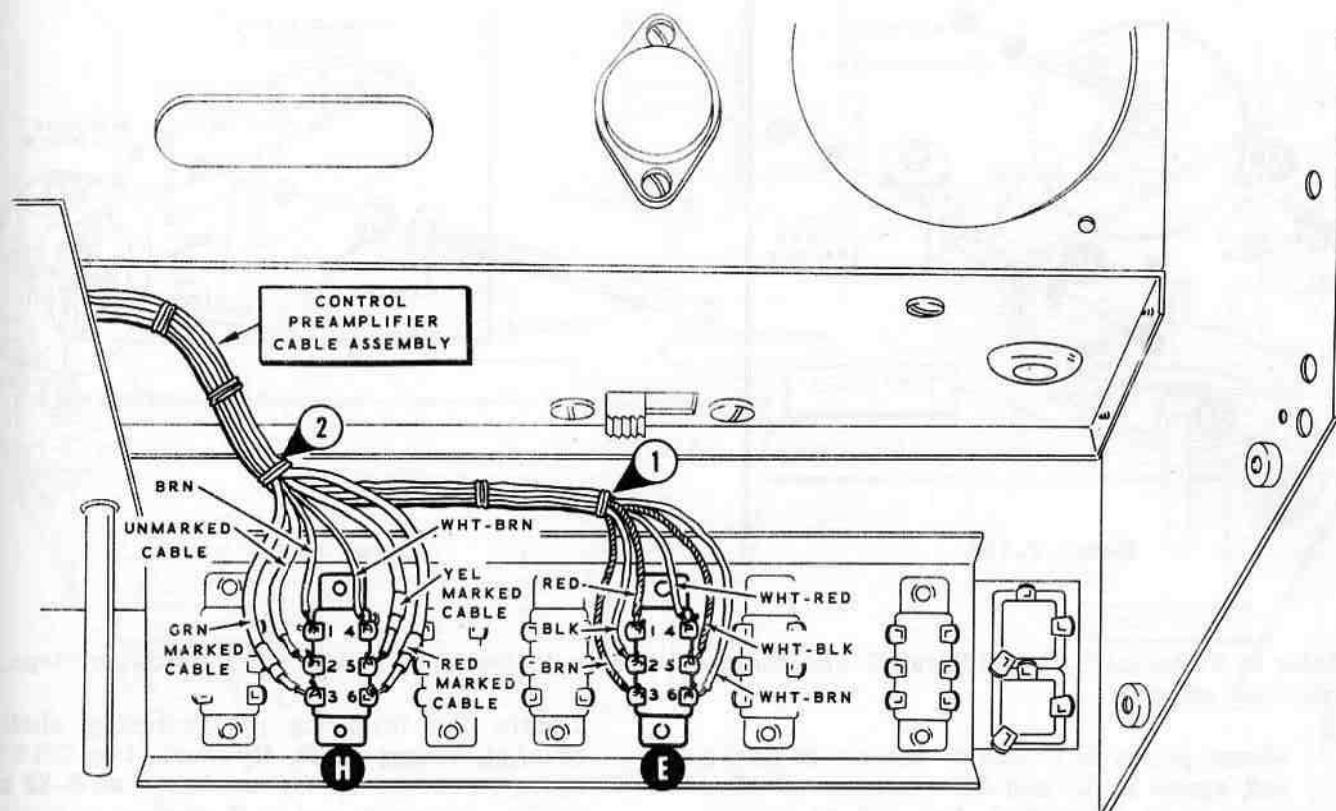
- (✓) Black wire to lug 2 of J (S-1).
- (✓) Red wire to lug 2 of G (S-1).
- () Green wire to lug 5 of G (S-1).
- (✓) Yellow wire to lug 6 of G (S-1).
- () Either blue wire to lug 1 (S-1) and other blue wire to lug 2 (S-1) of F.

- (✓) Locate both lamp sockets (without leads) and both red lamps.

- (✓) Position the lamp sockets with lugs 1 as shown at K and L.

Connect the wires from breakout #3 of the multiplex cable assembly to the lamp sockets in the following steps.

- (✓) Both red wires to lug 1 of K (S-2).
- (✓) Both yellow wires to lug 2 of K (S-2).
- (✓) Connect a 22 Ω (red-red-black) resistor between lugs 1 (NS) and 2 (NS) of socket L. Position the resistor in front of the socket as shown.
- (✓) White-black wire to lug 1 of L (S-2).
- (✓) Brown wire to lug 2 of L (S-2).



PICTORIAL 7-18

(✓) Install the #756 lamp in socket K. Push the lamp in, and then turn it clockwise slightly.

(✓) Similarly, install the #49 lamp in socket L.

Refer to Pictorial 7-18 for the following steps.

Connect the wires from the control preamplifier harness to the switch bracket in the following steps.

Breakout #1

(✓) Red wire to lug 1 of E (S-1).

(✓) White-red wire to lug 4 of E (S-1).

(✓) Black wire to lug 2 of E (S-1).

(✓) Brown wire to lug 3 of E (S-1).

(✓) White-black wire to lug 5 of E (S-1).

(✓) White-brown wire to lug 6 of E (S-1).

Breakout #2

(✓) Brown wire to lug 1 of H (S-1).

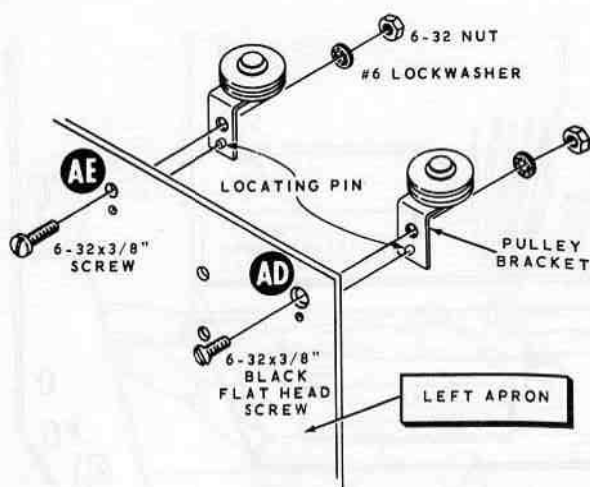
(✓) White-brown wire to lug 4 of H (S-1).

(✓) Unmarked cable to lug 2 of H (S-2).

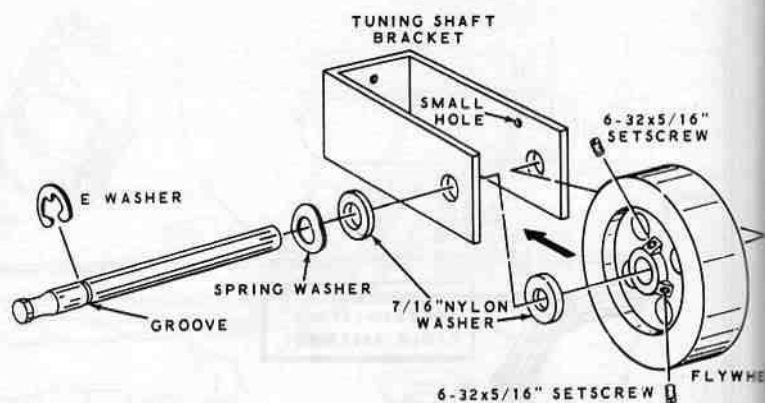
(✓) Yellow marked cable to lug 5 of H (S-2).

(✓) Green marked cable to lug 3 of H (S-1).

(✓) Red marked cable to lug 6 of H (S-1).



Detail 7-19A



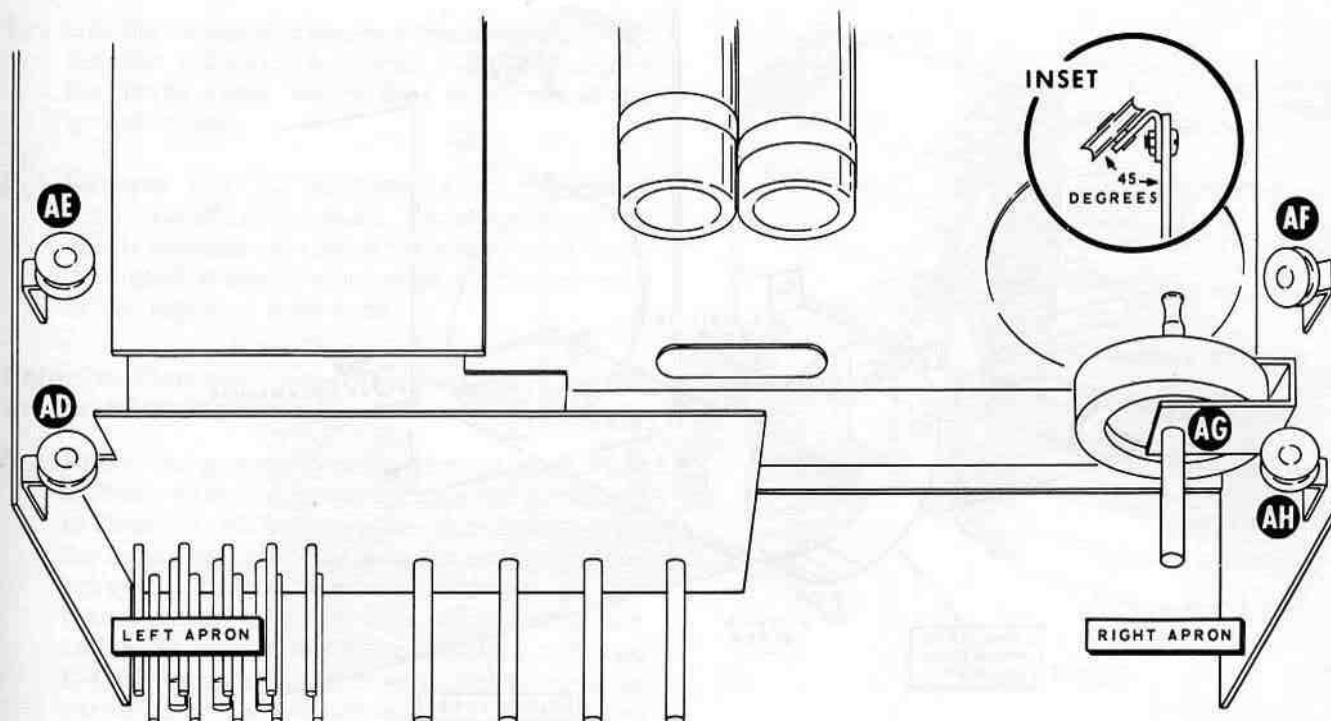
Detail 7-19B

Refer to Pictorial 7-19 and Detail 7-19A for the following steps.

- () Mount pulley brackets to the inside of the left apron at AD and AE (note the locating pins on the bracket). Use a 6-32 x 3/8" black flat head screw, a #6 lockwasher and a 6-32 nut at AD. Use a 6-32 x 3/8" screw, a #6 lockwasher, and a 6-32 nut at AE.
- () Similarly, mount pulley brackets to the inside of the right apron at AH and AF. Use a 6-32 x 3/8" black flat head screw, a #6 lockwasher, and a 6-32 nut at AH. Use a 6-32 x 3/8" screw, a #6 lockwasher, and a 6-32 nut at AF.
- () Refer to the inset drawing on Pictorial 7-19 and bend pulley bracket AF to a 45 degree angle as shown.

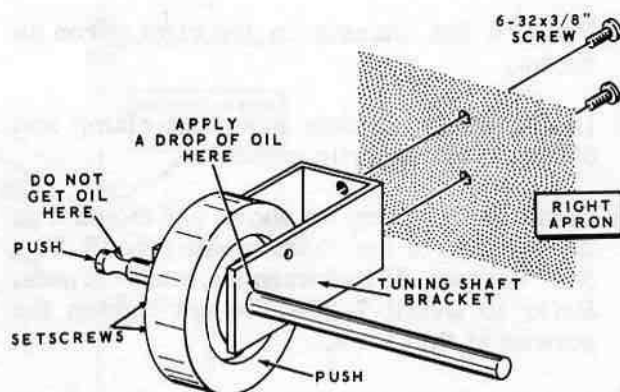
Refer to Detail 7-19B for the following steps.

- () Locate the following parts: ~~tuning shaft bracket, tuning shaft, flywheel, two 7/16" nylon washers, spring washer, two 6-32 x 5/16" setscrews, and an E washer.~~
- () Start both setscrews into the flywheel holes.
- () Install the E washer on the shaft. Make sure it snaps in place around the groove of the shaft.
- () Position the tuning shaft bracket with the small hole as shown, and the flywheel with the setscrew side as shown. Then assemble these parts with the nylon washers, a spring washer, and the tuning shaft as shown.

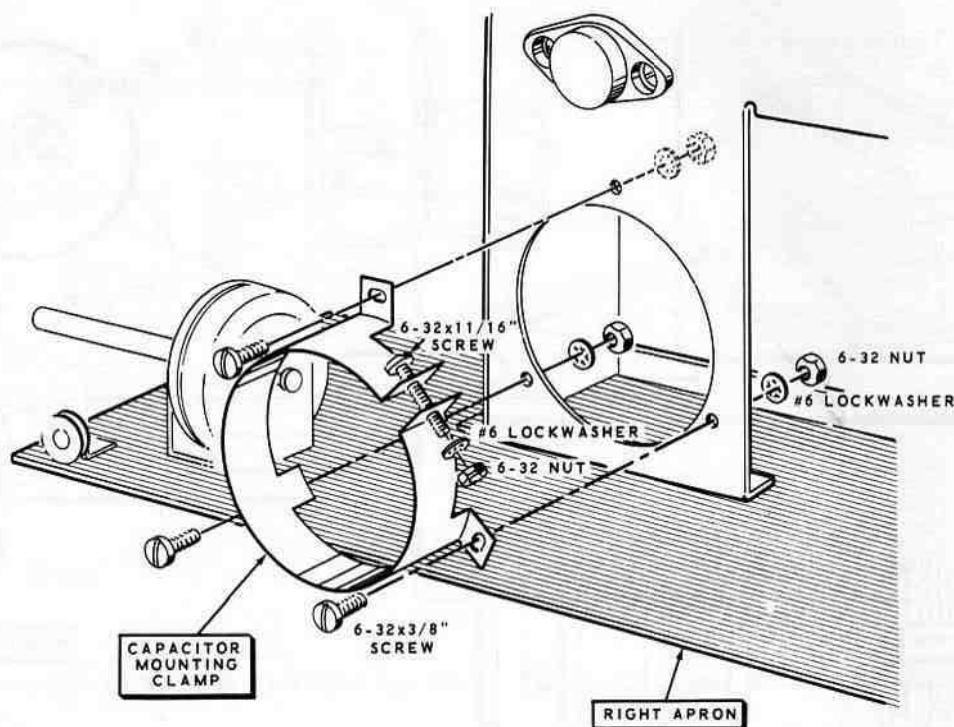


PICTORIAL 7-19

- (✓) Refer to Detail 7-19C and place the flywheel against the nylon washer. Then push on the end of the shaft until the spring washer is against the other nylon washer. Now tighten the flywheel setscrews. Make sure the tuning shaft turns freely. If it does not, loosen the setscrews and slide the shaft back slightly to relieve some of the pressure on the spring washer.
- (✓) Mount the tuning shaft bracket on the inside of the right apron with 6-32 x 3/8" screws.
- (✓) Apply a drop of oil on the sides of the bracket where the tuning shaft goes through. Be careful not to get any oil in the large groove around the shaft.



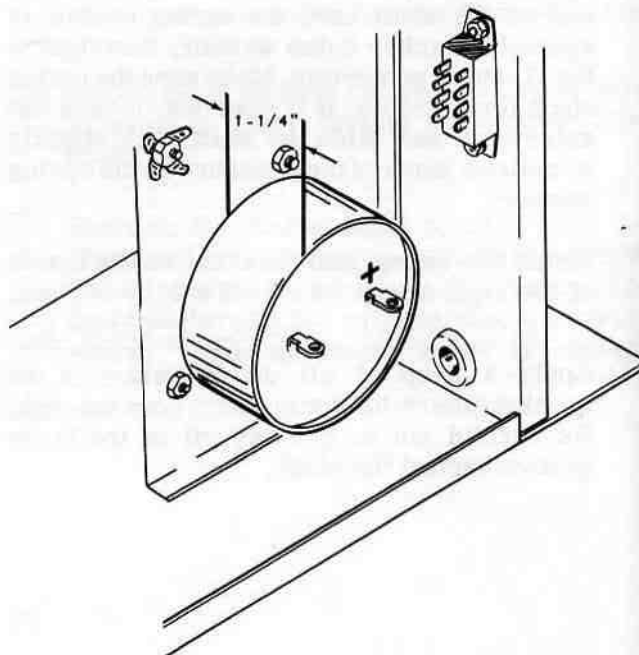
Detail 7-19C



Detail 7-20A

Refer to Detail 7-20A for the following steps.

- (V) Position the chassis on the right apron as shown.
- (V) Locate the capacitor mounting clamp and 8000 μ fd electrolytic capacitor.
- (V) Position the clamp as shown and mount it on the top side of the chassis with three 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts. Refer to Detail 7-20A. Do not tighten the screws at this time.
- (V) Install a 6-32 x 11/16" screw on the clamp with a #6 lockwasher and 6-32 nut. Do not tighten the screw at this time.
- (V) Position the 8000 μ fd electrolytic capacitor with the positive (+) marked lug as shown in Detail 7-20B. Then place the capacitor inside the clamp. Position the capacitor 1-1/4" below the chassis as shown and tighten the screw.
- (V) Tighten the three capacitor clamp screws.

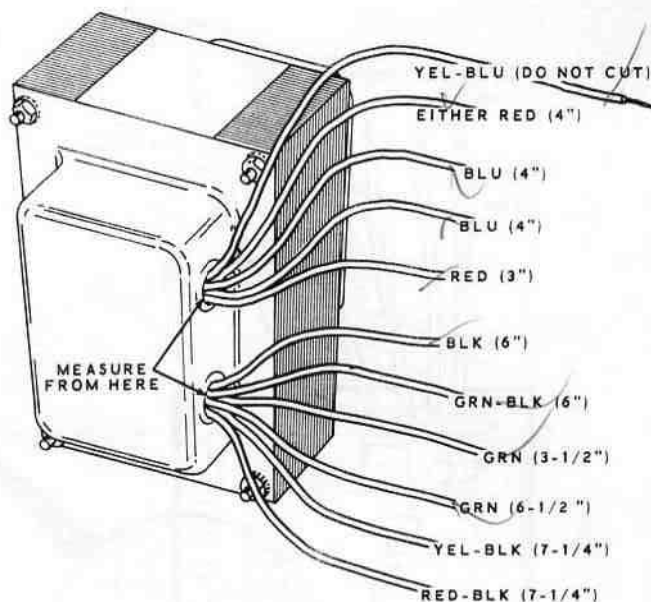


Detail 7-20B

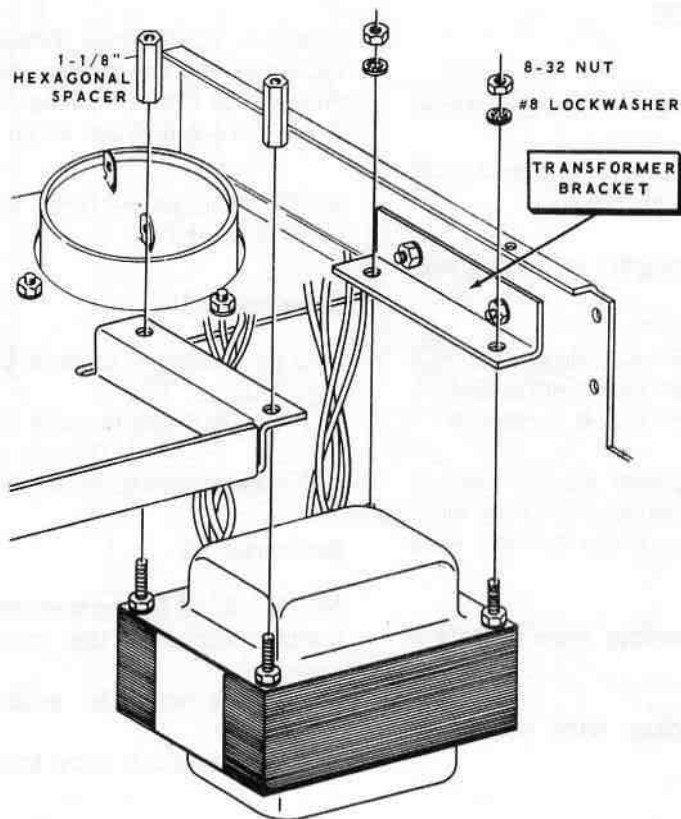
- ✓) Cut the leads of the power transformer to the lengths indicated in Detail 7-20C. Measure the leads from where they come out of the transformer.
- () Remove 1/4" of insulation from the end of each transformer lead. Twist together the small strands of wire at the end of each lead; then melt a small amount of solder on each of the exposed lead ends.

Refer to Pictorial 7-20 (fold-out from Page 84) for the following steps.

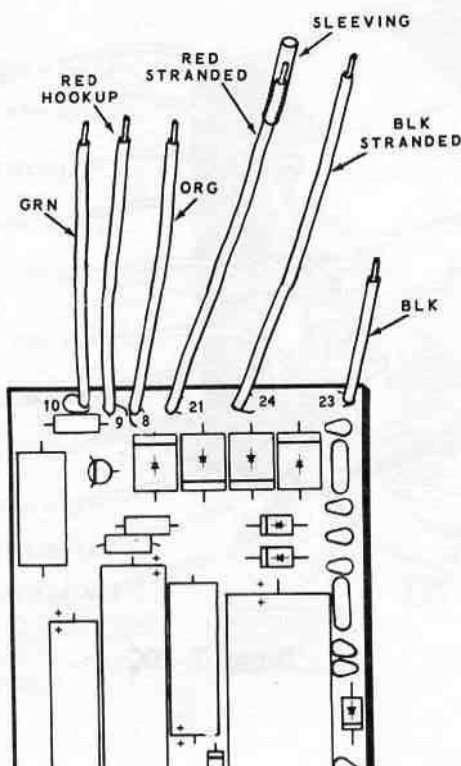
- ✓) Place the power transformer on your work surface with the leads coming out as shown in Detail 7-20D. Then place the chassis over the leads and onto the transformer mounting screws. Fasten the transformer on the transformer bracket with #8 lockwashers and 8-32 nuts and to the chassis with two 1-1/8" hexagonal spacers. Make sure no wires are pinched between the chassis and transformer.



Detail 7-20C



Detail 7-20D



Detail 7-20E

Refer to Detail 7-20E for the following steps.

- (✓) Locate the completed power supply circuit board and position it as shown.
- () Prepare the following lengths of hookup and stranded wire:

4" orange hookup	5" red stranded
4" red hookup	2" black stranded
4" green hookup	5" black stranded

Connect these wires to the power supply circuit board in the following steps. After soldering each wire, clip off the excess wire from the foil side of the board.

- (✓) Connect a 4" orange hookup wire to hole 8 (S-1).
- (✓) Connect a 4" red hookup wire to hole 9 (S-1).

- (✓) Connect a 4" green hookup wire to hole 10 (S-1).

NOTE: Twist the ends of the stranded wires before inserting them into the circuit boardholes.

- (✓) Connect a 5" red stranded wire to hole 21 (S-1).
- (✓) Slip a 1" length of small sleeving (braided) over the free end of the wire connected to hole 21 to cover the bare wire end.

- (✓) Connect a 2" black stranded wire to hole 23 (S-1).

- (✓) Connect a 5" black stranded wire to hole 24 (S-1).

- (✓) Place the completed power supply circuit board on the chassis base. The board will not be fastened to the chassis until the remaining wiring has been completed.

Connect the wires from the multiplex cable assembly to the power supply circuit board and chassis in the following steps. Refer to Pictorial 7-20 (fold-out from Page 84).

NOTE: The wires from breakout #4 will be connected later.

Breakout #5

- (✓) Brown wire to hole 25 (S-1).
- (✓) Violet wire to hole 19 (S-1).
- () Gray wire to hole 22 (S-1).

Breakout #6

NOTE: It is important that you connect the following wires to the proper solder lug at CC.

- (✓) Black wire to solder lug 1 at CC (NS).
- (✓) White-black wire to solder lug 1 at CC (NS).

NOTE: When connecting a wire to the circuit board connectors, as in the next step, twist the strands together tightly, insert the wire into the connector, and then solder it. It may be necessary to reheat the connector before inserting the wire.

- (✓) Connect a 2-1/4" black stranded wire from connector 14 of the right channel power amplifier circuit board (S-1) to solder lug 4 at CC (NS).
- (✓) Connect a 5-1/4" black stranded wire from connector 14 of the left channel power amplifier circuit board (S-1) to solder lug 4 at CC (NS).

Connect the wires from breakout #7 of the control preamplifier cable assembly in the following steps.

- (✓) Orange wire to connector 1 of the left channel power amplifier circuit board (S-1).
- (✓) White-orange wire to connector 1 of the right channel power amplifier circuit board (S-1).
- (✓) Brown wire to solder lug 1 at CC (S-3).

NOTE: The blue wire will be connected later.

Connect the free end of the wires coming from the power supply circuit board in the following steps. Position the wires as shown.

- (✓) Orange wire from hole 8 to lug 3 of socket CB (S-1).
- (✓) Red wire from hole 9 to lug 1 of socket CB (S-1).
- (✓) Green wire from hole 10 to lug 2 of socket CB (S-1).

Connect the wires from breakout #7 of the multiplex cable assembly in the following steps.

- (✓) Orange wire to lug 5 of switch FF (S-1).
- (✓) Connect a 1" black hookup wire between lugs 6 (S-1) and 4 (NS) of switch FF.
- (✓) Violet wire to lug 7 of switch FF (S-1).
- (✓) Brown wire to lug 1 of switch FF (S-1).
- (✓) Gray wire and green wire to lug 2 of switch FF (S-2).
- (✓) White-brown wire to lug 4 of switch FF (NS).
- (✓) Connect a 33 Ω (orange-orange-black) resistor between lugs 3 (NS) and 4 (S-3) of switch FF. Position the resistor as shown.

Refer to Pictorial 7-21 (fold-out from Page 99) for the following steps.

Connect the wires from the power amplifier cable assembly to the power supply circuit board in the following steps.

Breakout #1

- (✓) Violet wire to hole 20 (S-1).

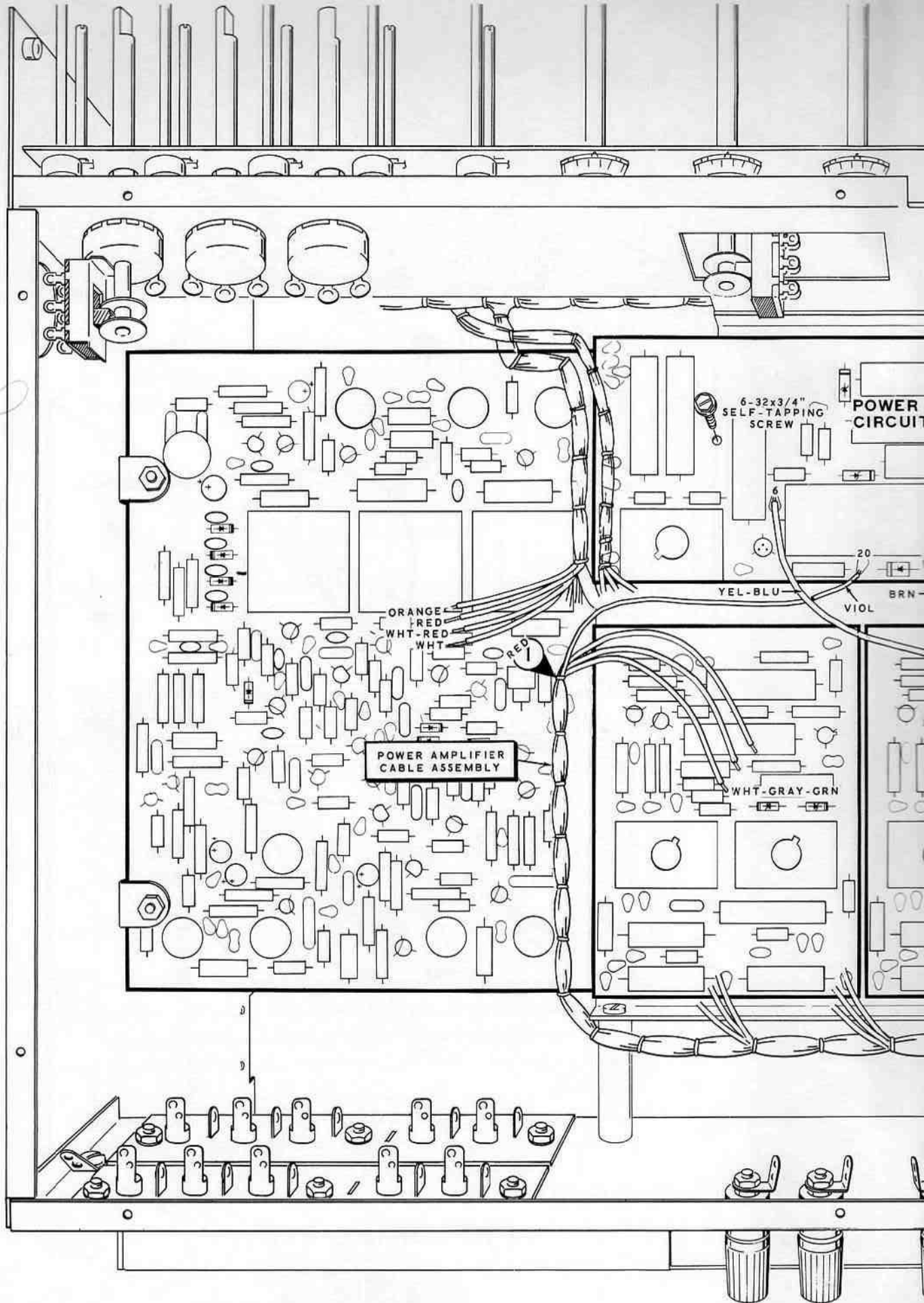
NOTE: The red, white-red, and white-gray-green wires will be connected later.

- () Push all the wires that have been connected into the space between the power supply and power amplifier circuit boards.

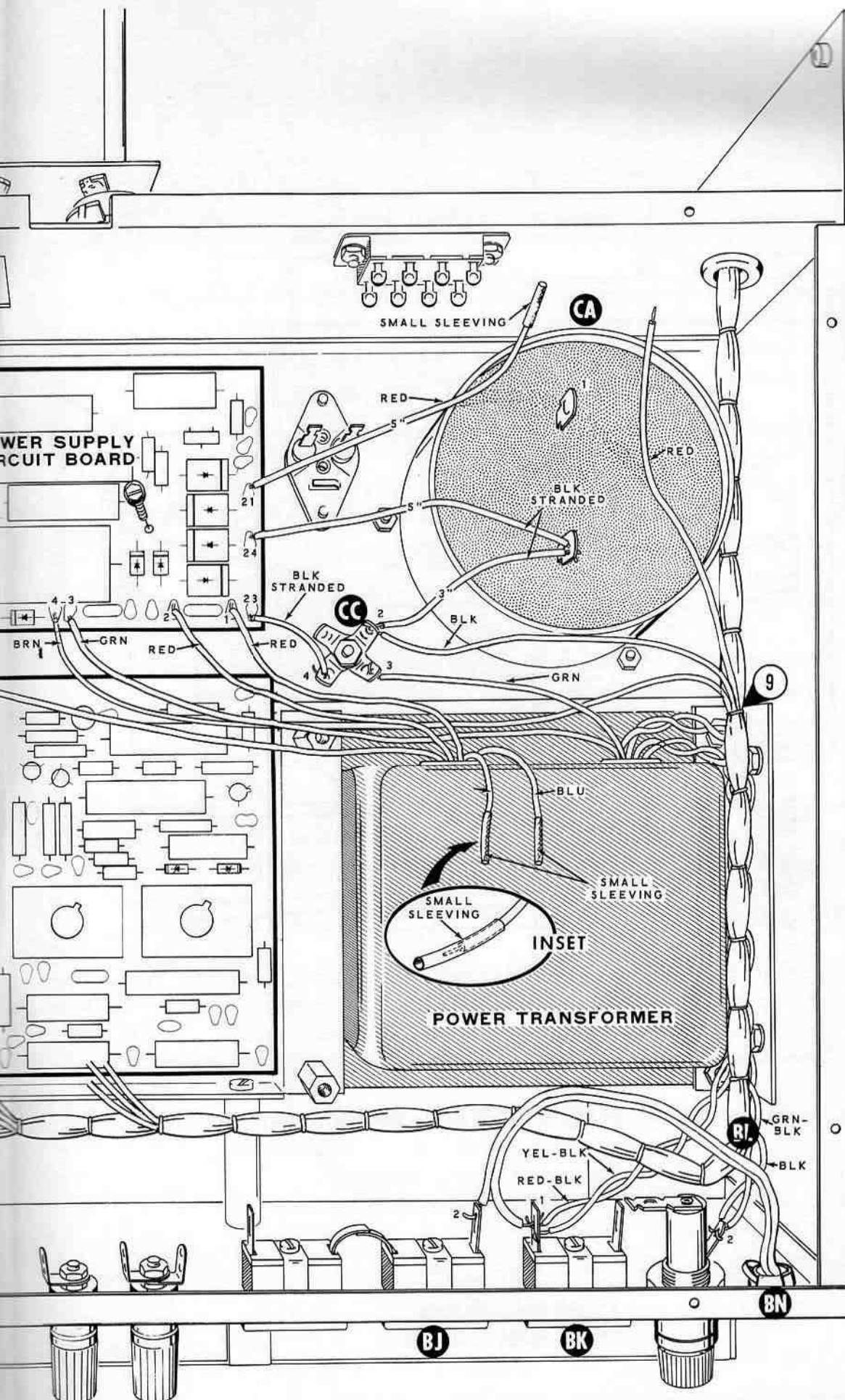
Breakout #9

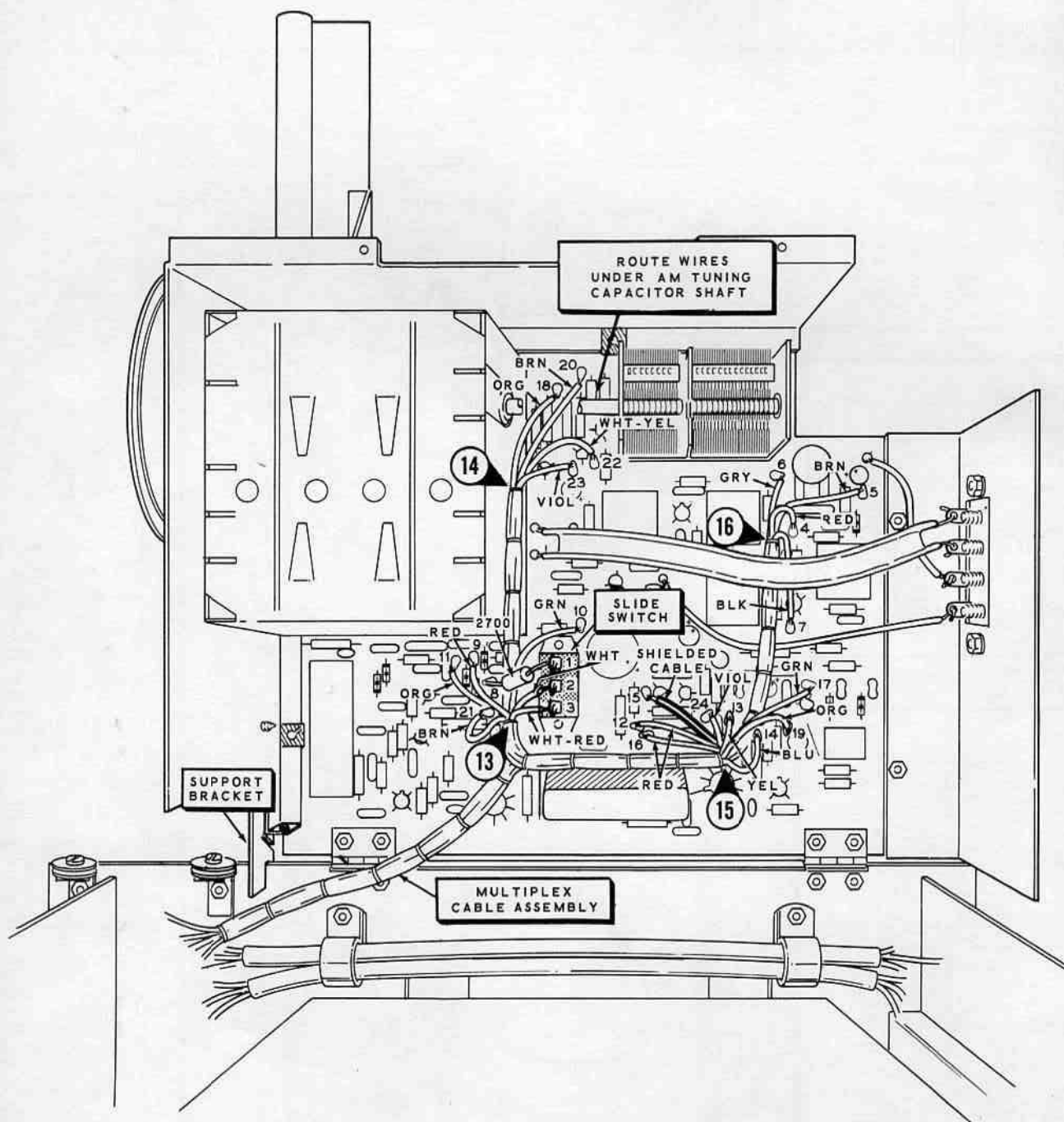
- (✓) Brown wire to hole 4 (S-1).
- (✓) Black wire to solder lug 2 at CC (NS).

NOTE: The red wire from breakout #9 will be connected later.

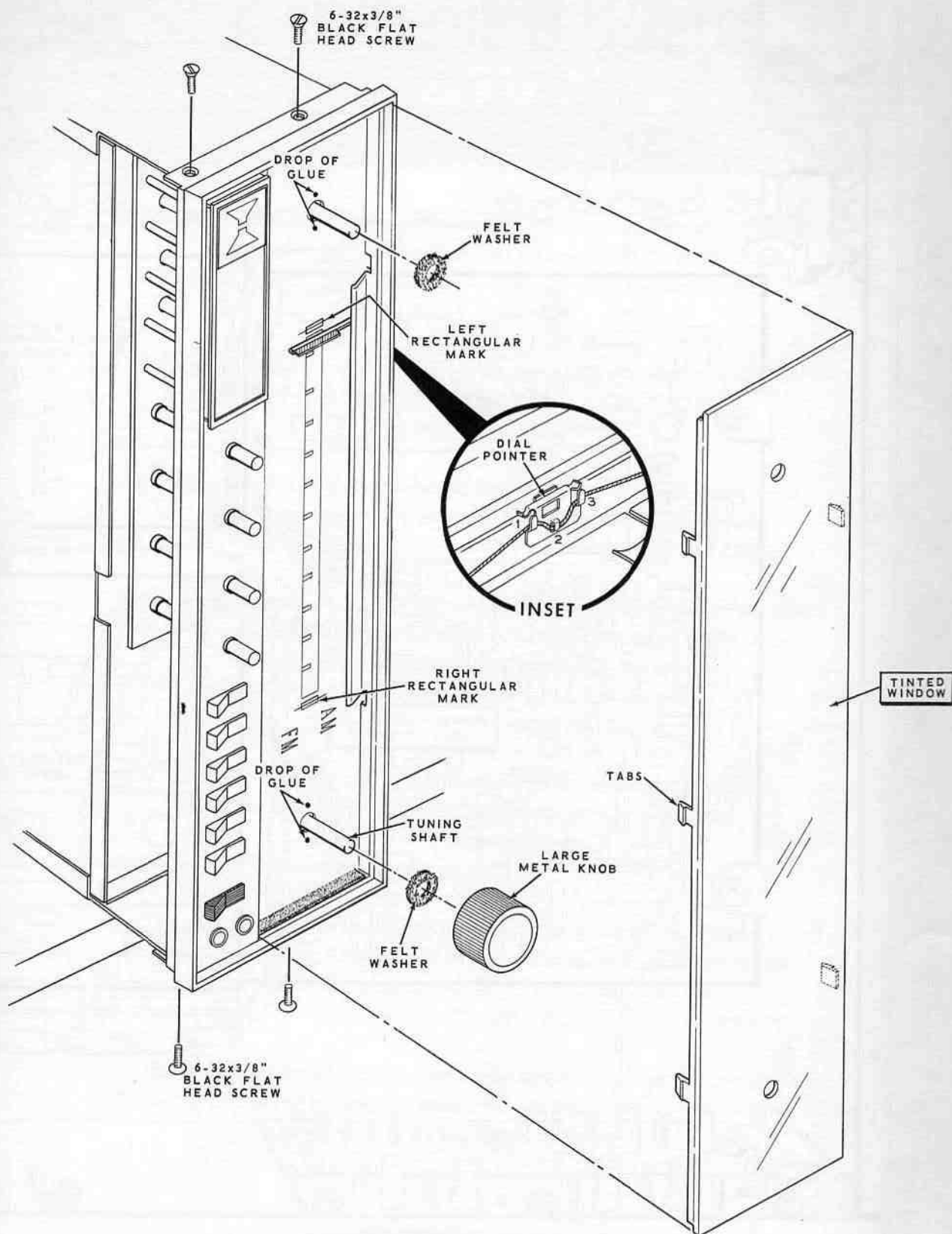


PICTORIA





PICTORIAL 7-22

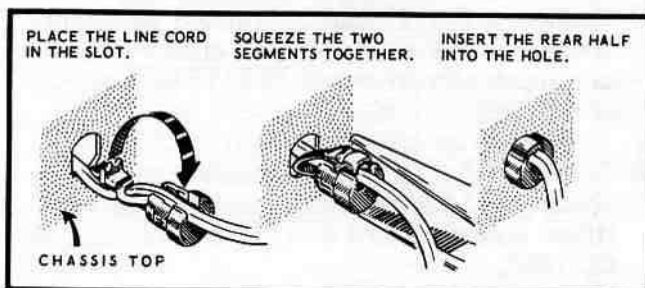


PICTORIAL 7-31

Connect the leads from the power transformer to the power supply circuit board in the following steps.

- (✓) Yellow-blue lead to hole 6 (S-1).
- (✓) Long green lead to hole 3 (S-1).
- (✓) Short green lead to solder lug 3 at CC (S-1).
- (✓) Long red lead to hole 2 (S-1).
- (✓) Short red lead to hole 1 (S-1).
- (✓) Cut two 1" lengths of small (braided) sleeving. Slip the sleeving over the ends of the blue transformer leads to cover the stripped ends. Leave the sleeving on these leads until you are instructed to remove it. Refer to the inset drawing on Pictorial 7-21.
- (✓) Connect the black stranded wire coming from hole 24 of the power supply circuit board to lug 2 of capacitor CA (NS).
- (✓) Connect a 3" black stranded wire from lug 2 of capacitor CA (S-2) to solder lug 2 at CC (S-2).
- (✓) Connect the black stranded wire coming from hole 23 of the power supply circuit board to solder lug 4 at CC (S-3).
- (✓) Carefully inspect the power supply circuit board for any unsoldered connections, solder bridges between foils, or broken leads. Clip off any bare wire ends from the foil side of the board.
- (✓) Fasten the circuit board to the nylon insulator with two 6-32 x 3/4" self-tapping screws. Do not overtighten the screws.
- (✓) Locate the line cord and line cord strain relief.
- (✓) Apply a small amount of solder to the end of each lead to hold the small wire strands together.

- (✓) Insert the line cord through hole BN. Connect one lead to lug 1 of socket BK (NS). Connect the other lead to lug 2 of socket BJ (S-3).
- (✓) Place the line cord in the strain relief as shown in Detail 7-21A. Then install the strain relief in hole BN. Position the line cord as shown.



Detail 7-21A

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A., 120 VAC is most often used, while in foreign countries 240 VAC is more common. **USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.**

120 V AC Wiring

Refer to Pictorial 7-21 for the following steps.

NOTE: Before connecting the following wires, place them under the cable assembly along the power transformer for a neat looking appearance.

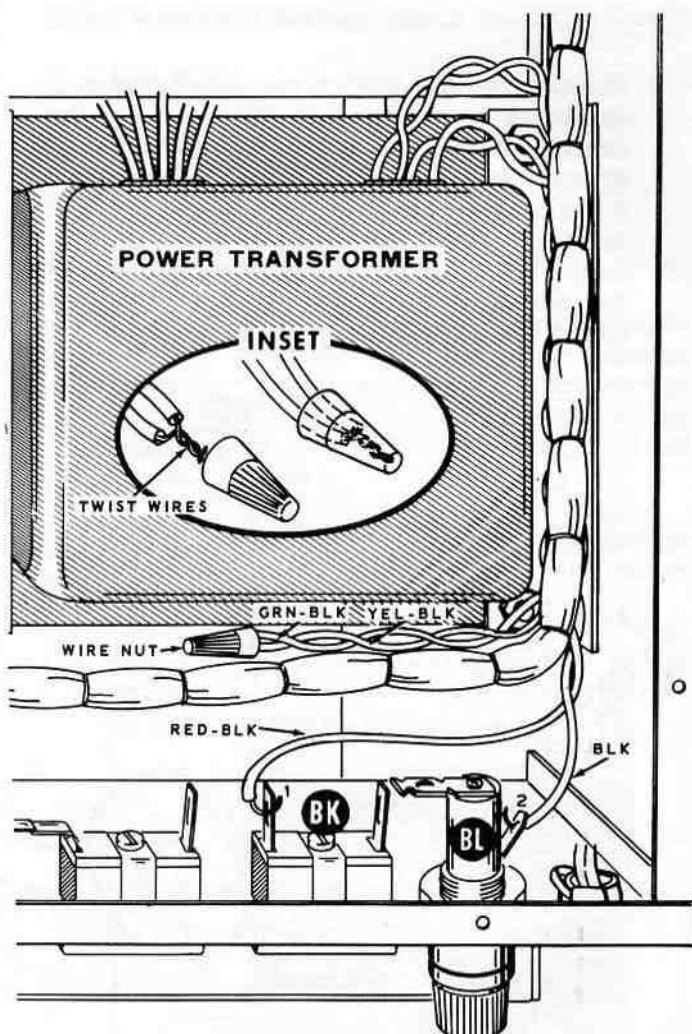
- (✓) Twist together the entire lengths of the red-black and yellow-black transformer leads. Connect both leads to lug 1 of socket BK (S-4).
- (✓) Twist together the entire lengths of the black and green-black transformer leads. Connect both leads to lug 2 of fuseholder BL (S-2).
- (✓) Install one of the 3-ampere fuses in the fuseholder. The remaining fuse is a spare that can be set aside.

240 V AC Wiring

Refer to Detail 7-21B for the following steps.

NOTE: Before connecting the following wires, place them under the cable assembly along the power transformer for a neat looking appearance.

- () Twist together the red-black and black transformer leads.
- () Connect the red-black transformer lead to lug 1 of socket BK (S-3).
- () Connect the black transformer lead to lug 2 of fuseholder BL (S-1).
- () Twist together (clockwise) the entire length and the ends of the green-black and yellow-black transformer leads. Then install the wire nut over the ends of the leads; turn the nut in a clockwise direction. Refer to the inset drawing on Detail 7-21B.
- () Install a 1-1/2-ampere fuse in the fuseholder. NOTE: This fuse is not furnished with the Receiver.



Detail 7-21B

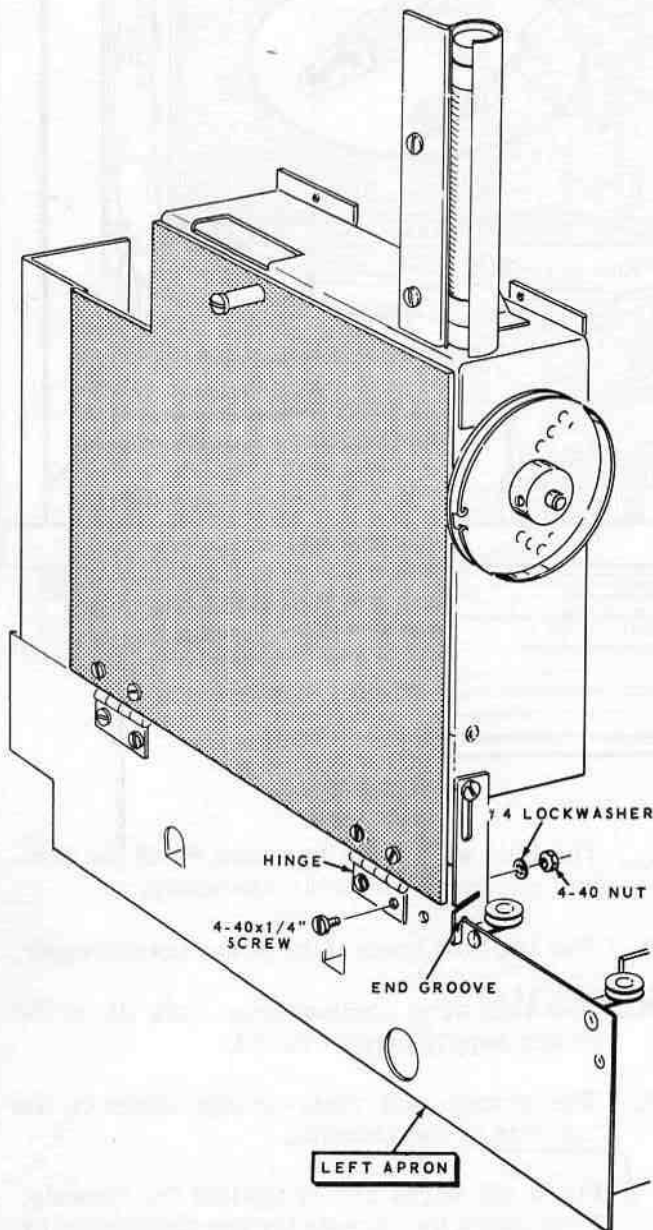
This completes the wiring on this side of the chassis. The following wires still remain to be connected on the bottom side of the chassis. They will be connected after the Initial Checkout.

- A. The orange, red, white-red, and white wires from breakout #4 of the multiplex cable assembly.
- B. The red, white-red, and white-gray-green wires from breakout #1 and the red wire from breakout #9 of the power amplifier cable assembly.

- C. The blue wire from breakout #7 of the control preamplifier cable assembly.
- D. The two blue leads of the power transformer.
- E. The red wire coming from hole 21 of the power supply circuit board.
- F. The orange and white-orange wires on the top side of the chassis.
- () Place all wires neatly against the chassis. Then check the chassis for any unsoldered or broken leads. Turn the chassis over and shake out any bits of wire or solder splashes that may have lodged in the wiring.

Refer to Detail 7-22A for the following steps.

- () Position the AM-FM circuit board assembly as shown and mount it by the hinges on the outside of the left apron. Use 4-40 x 1/4" screws, #4 lockwasher, and 4-40 nuts. Note: A good way to help balance this assembly, while installing the screws, is to slide the support bracket end groove over the edge of the left apron as shown. Leave the circuit board in this position for the following steps.



Detail 7-22A

Refer to Pictorial 7-22 for the following steps.

- (✓) Cut each lead of a 2700 Ω (red-violet-red) resistor to 5/8". Connect this resistor from lug 1 of the slide switch (S-1) to hole 8 of the circuit board (S-1).
- (✓) Route the wires coming from breakouts 13, 14, 15, and 16 of the multiplex cable assembly to the approximate locations shown on the AM-FM circuit board.
- (✓) Connect the white wire from breakout #13 to lug 2 of the slide switch (S-1).
- (✓) Connect the white-red wire from breakout #13 to lug 3 of the slide switch (S-1).

Connect the multiplex harness to the AM-FM circuit board in the following steps.

Breakout #13

- (✓) Red wire to hole 9 (S-1).
- (✓) Orange wire to hole 11 (S-1).
- (✓) Brown wire to hole 21 (S-1).
- (✓) Green wire to hole 10 (S-1).

Breakout #14

NOTE: Route the wires from this breakout under the AM tuning capacitor shaft before connecting them.

- (✓) White-yellow wire to hole 22 (S-1).
- (✓) Violet wire to hole 23 (S-1).
- (✓) Orange wire to hole 18 (S-1).
- (✓) Brown wire to hole 20 (S-1).
- () Push the wires, from this breakout, against the circuit board and away from the shaft coupler.

Breakout #15

- (✓) Blue wire to hole 14 (S-1).
- (✓) Yellow wire to hole 13 (S-1).
- (✓) Violet wire to hole 24 (S-1).
- (✓) Either red wire to hole 12 (S-1).
- (✓) Remaining red wire to hole 16 (S-1).
- () Shielded cable to hole 15 (S-1).
- (✓) Orange wire to hole 19 (S-1).
- (✓) Green wire to hole 17 (S-1).

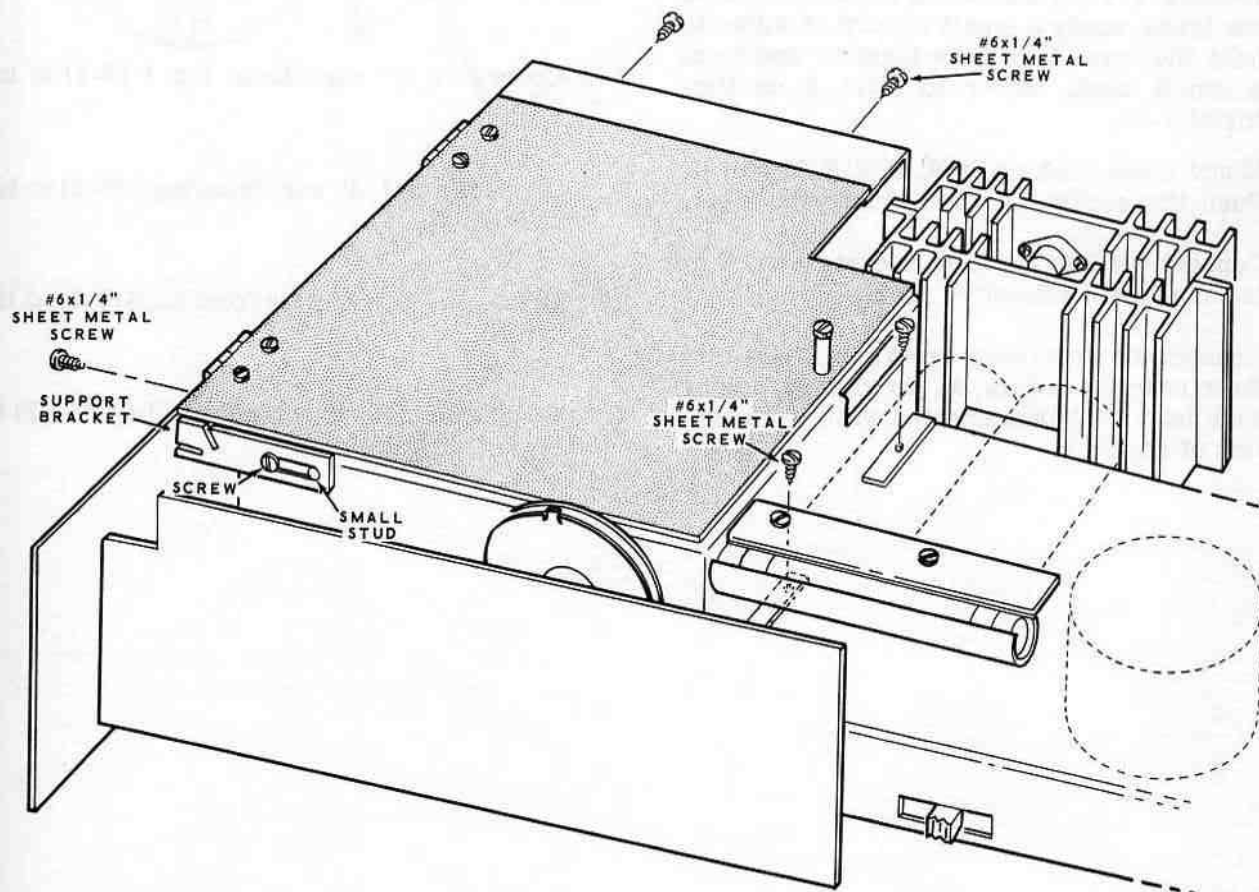
Breakout #16

NOTE: Position the wires from this breakout under the twin lead before connecting them.

- (✓) Black wire to hole 7 (S-1).
- (✓) Red wire to hole 4 (S-1).
- (✓) Gray wire to hole 6 (S-1).
- (✓) Brown wire to hole 5 (S-1).

Refer to Detail 7-22B for the following steps.

- () Loosen the support bracket screw and carefully fold the AM-FM shield on the chassis. Make sure no wires are pinched between the shield and chassis. Line up the slot in the bracket with the small stud on the shield and tighten the screw.
- () Check the cable assemblies located near the dial cord pulley. Make sure none of the wires touch the pulley.
- () Fasten the circuit board assembly to the preamplifier shield and chassis with five #6 x 1/4" sheet metal screws.



Detail 7-22B

Refer to Pictorial 7-23 for the following steps.

- () Locate the following parts: seven lamp sockets (with leads), seven #44 lamps, five nylon feedthrough insulators, and the large light reflector.

NOTE: Be careful when handling the light reflector in the following steps to avoid scratching the white surface.

- () Position the reflector as shown in Part A of Pictorial 7-23. Then push the tapered ends of the nylon insulators in holes #1 through #5 as shown in the inset drawing. Use the small end of the nut starter to push the insulators firmly into the holes. Then squeeze the tapered end slightly with pliers.

- (✓) Install #44 lamps in the seven sockets. Push each lamp in, and then turn it clockwise slightly.

- (✓) Prepare six of the lamp sockets (there are seven) by cutting the leads to 1-1/4". Then remove 1/4" of insulation from the ends of the leads, apply a small amount of solder to hold the strands of wire together and form a small hook. Refer to Part A on Pictorial 7-23.

- (✓) Mount these sockets at N, P, R, S, T, and U. Push the socket all the way into the slots.

- () Connect the leads of lamp sockets N and P to feedthrough insulator #1 (S-2).

- () Connect the remaining lamp socket leads to their respective lugs, #2 through #5. Solder each lead as it is connected with the exception of socket U.

- (✓) Cut the lead of the remaining lamp socket to 4-1/4" and prepare the end of the lead as before.

- (✓) Install this socket at X midway between the large slot and the edge of the reflector.

- (✓) Connect the lead of this socket to lug 5 (S-2).

- (✓) Turn the reflector over as shown in Part B of Pictorial 7-23.

- (✓) Prepare the following lengths of black hook-up wire:

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

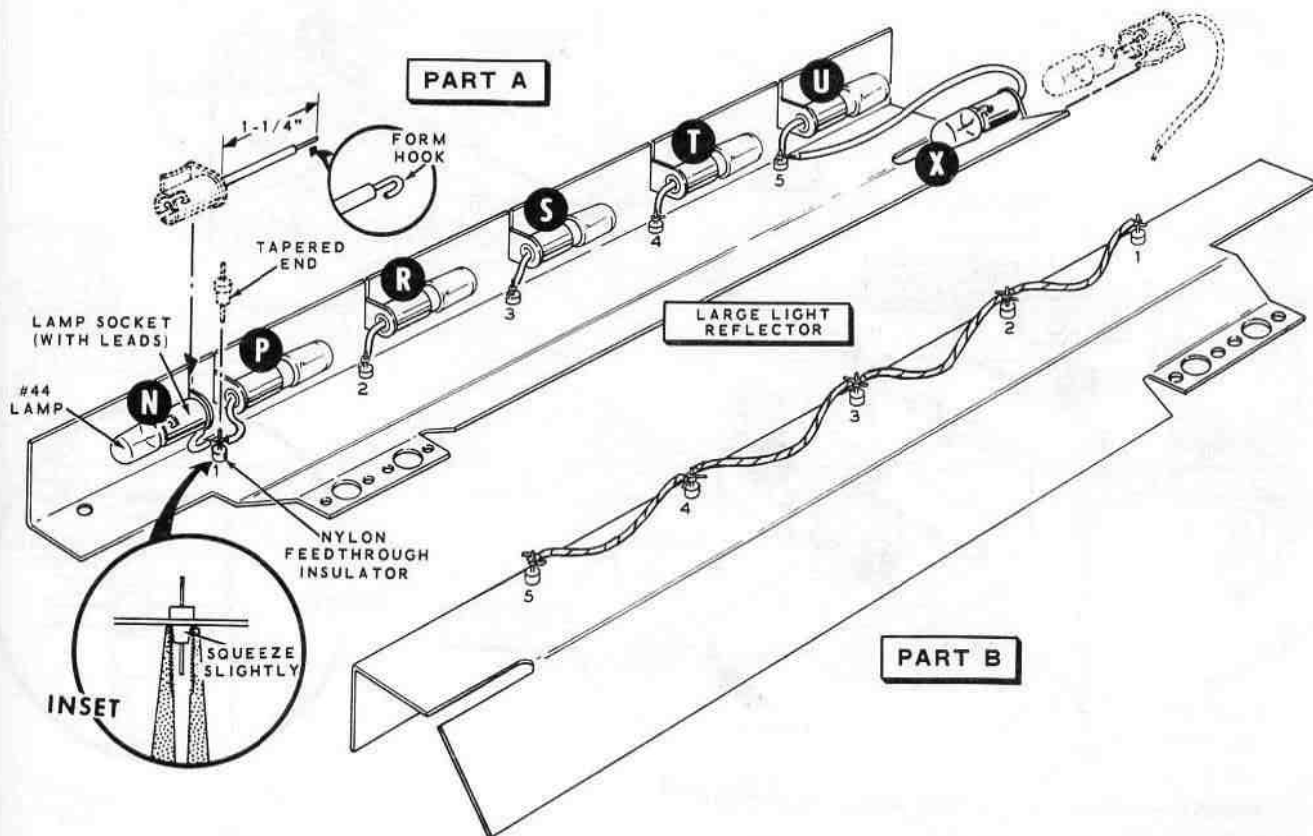
Connect the following wires to the feedthrough insulators on the large light reflector in the following steps.

- (✓) Connect a 3" wire from lug 1 (S-1) to lug 2 (NS).

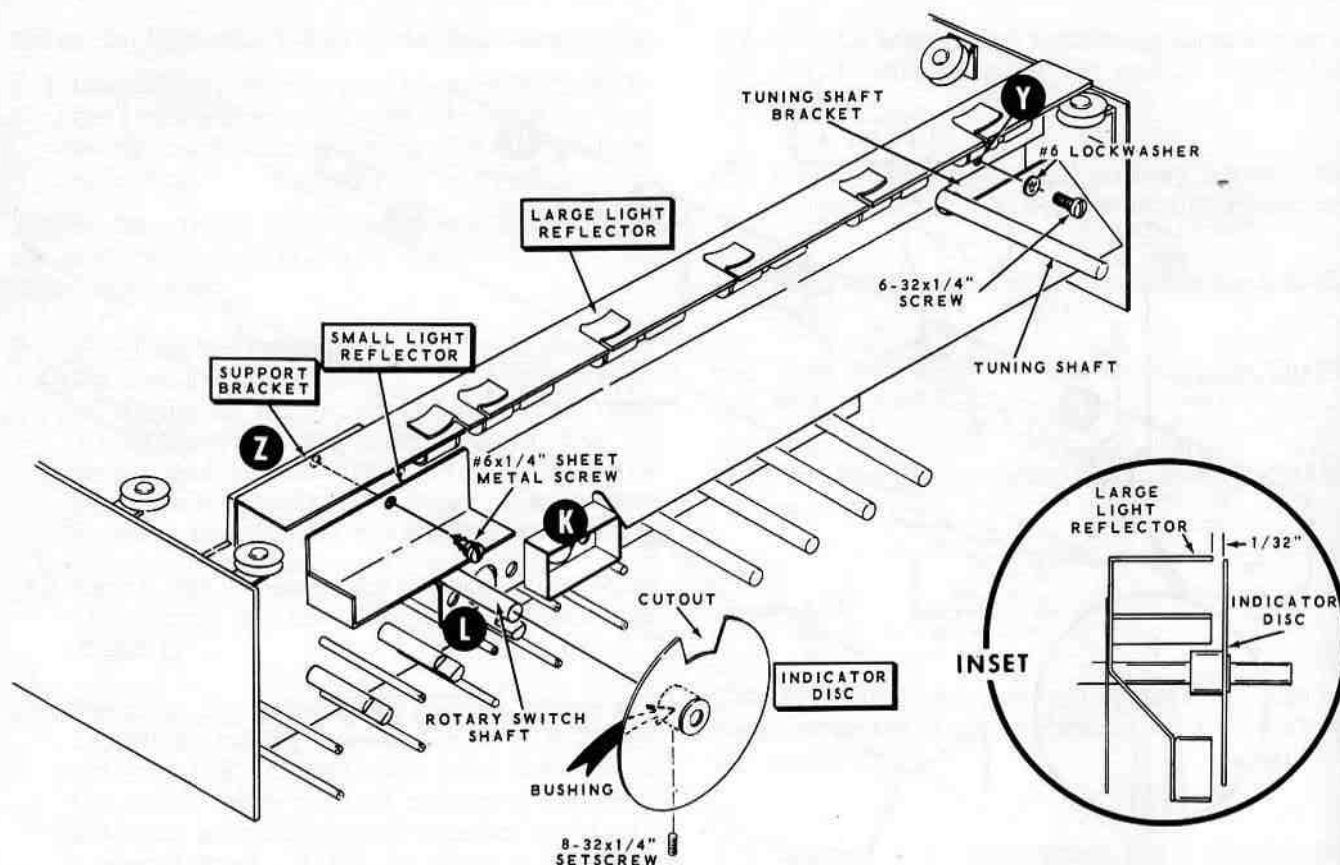
- (✓) Connect a 3-1/4" wire from lug 2 (S-2) to lug 3 (NS).

- (✓) Connect a 3-1/4" wire from lug 3 (S-2) to lug 4 (NS).

- (✓) Connect a 2-3/4" wire from lug 4 (S-2) to lug 5 (NS).



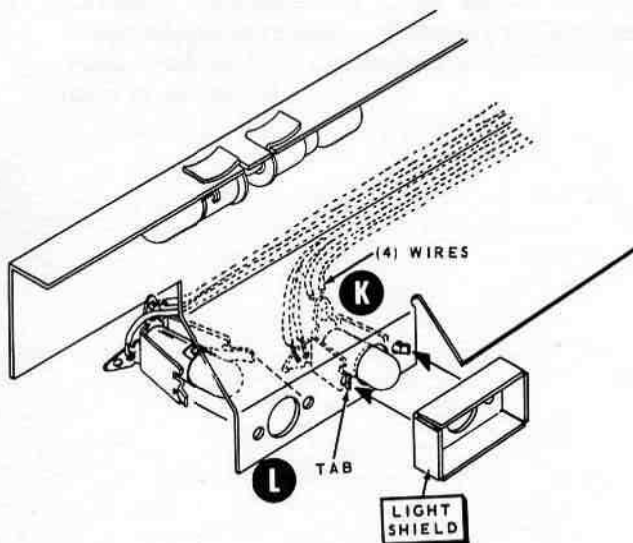
PICTORIAL 7-23



PICTORIAL 7-24

Refer to Pictorial 7-24 for the following steps.

- (N) Position the light shield as shown in Detail 7-24A.

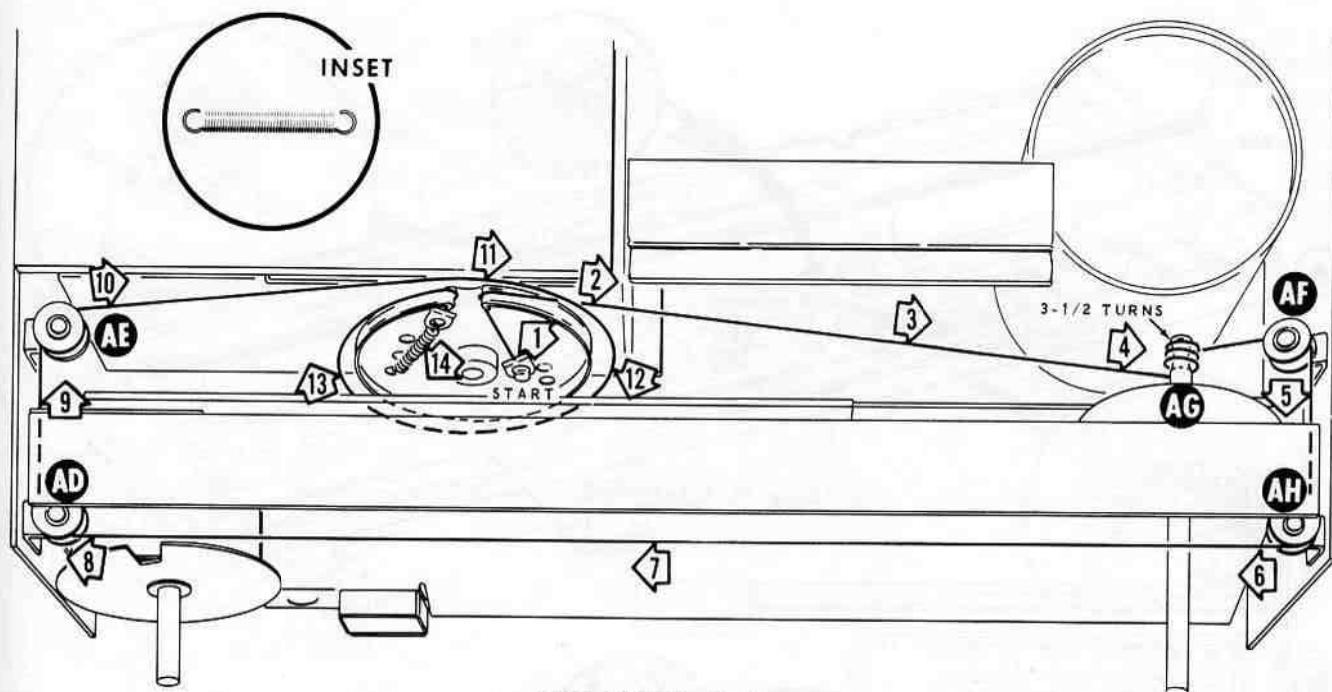


Detail 7-24A

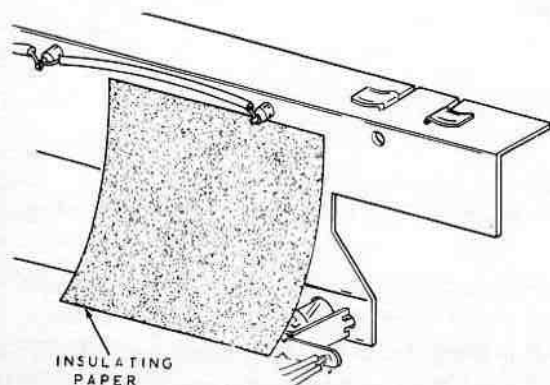
- (N) Install the lamp socket (the one with the four wires connected to it) and the light shield on the light reflector at hole K. To install this type of socket, squeeze the sides together and insert the tabs in the small holes.

NOTE: Make sure the wires which are connected to the lamp sockets are above the control shafts.

- () Install the remaining lamp socket on the reflector at L.
- (N) Locate the square piece of insulating paper and peel away the backing material. Press the paper in place on the back of the light reflector directly behind the two lamp sockets. Refer to Detail 7-24B. This will insulate the lamp sockets from the circuit board.
- (N) Mount the large light reflector between the left and right aprons. Insert the slotted end over the tuning shaft and place the other end on top of the rotary switch shaft. Fasten the light reflector to the tuning shaft bracket at Y. Use a 6-32 x 1/4" screw and #6 lockwasher.



PICTORIAL 7-25



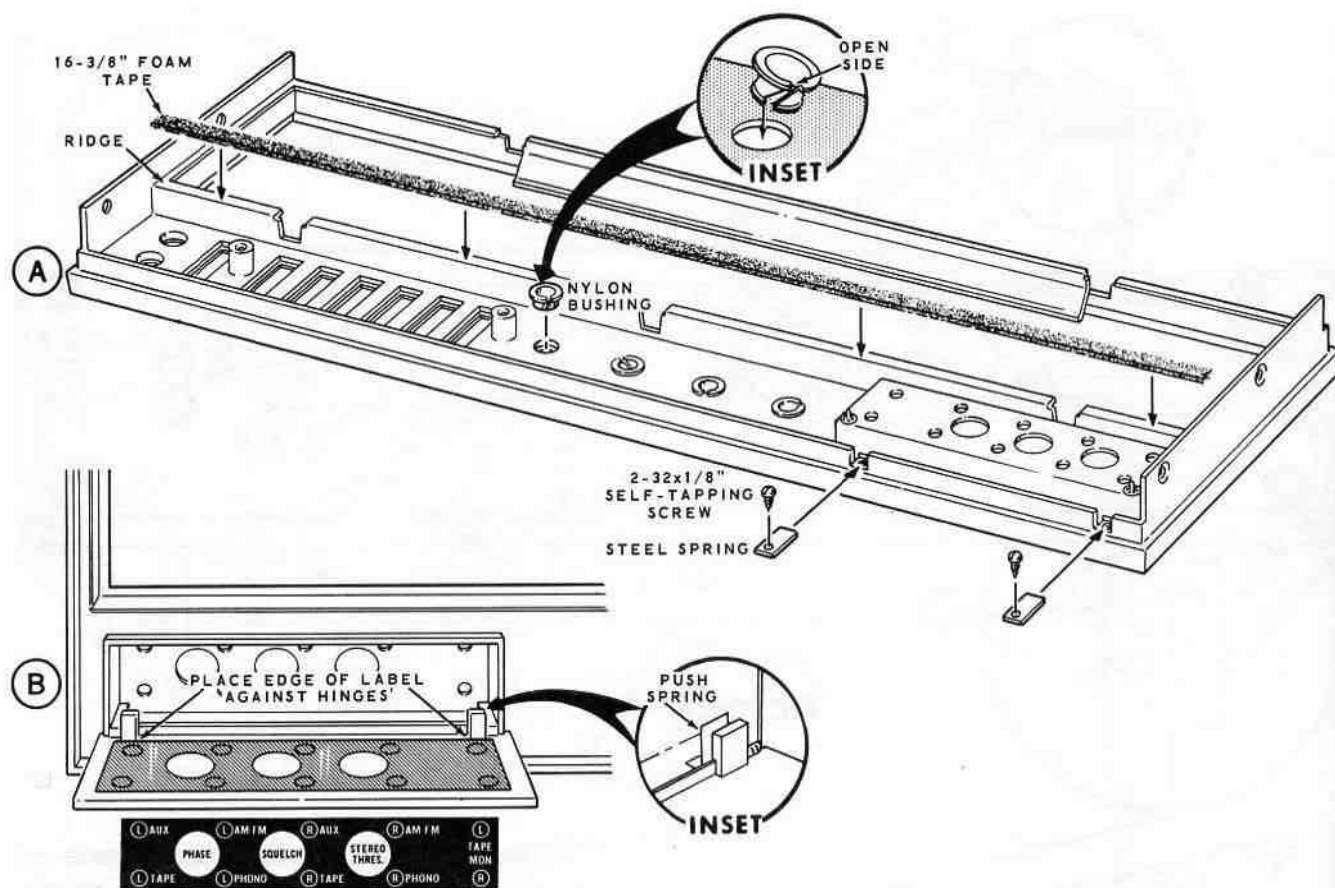
Detail 7-24B

- ✓ Mount the small light reflector and large light reflector to the support bracket at Z. Use a #6 x 1/4" sheet metal screw. NOTE: Remove the lamp before installing this screw. Then reinstall the lamp.
- ✓ Refer to Pictorial 7-24 and temporarily install one of the large metal knobs on the rotary switch shaft. Then turn the shaft fully counterclockwise. Now turn the shaft clockwise two clicks (to the FM position) and remove the knob.
- ✓ Start an 8-32 x 1/4" setscrew in the indicator disc bushing.

- () Position the bushing toward the chassis and the cutout in the disc straight up as shown. Then install the disc on the rotary switch shaft. Place the disc 1/32" from the edge of the large light reflector as shown in the inset drawing on Pictorial 7-24. Then tighten the setscrew.

Refer to Pictorial 7-25 for the following steps.

- (✓) Position all wires away from the tuning shaft at AG and the pulleys at AF and AH.
- (✓) Locate the dial cord and dial cord spring.
- (✓) Bend out each end of the spring to form a small hook as shown in the inset drawing on Pictorial 7-25. Then set the spring aside temporarily.
- (✓) Rotate the dial cord pulley fully clockwise as viewed from the front of the pulley.
- (✓) Follow the numbered arrows on Pictorial 7-25, starting with number 1, and complete the dial stringing. At arrow number 14, connect the dial cord spring between the end of the dial cord and the indicated hole in the pulley.



PICTORIAL 7-26

Refer to Pictorial 7-26 for the following steps.

- () Locate the following parts: front panel, control identification label, two steel springs, a length of foam tape, two 2-32 x 1/8" self-tapping screws, and four nylon bushings.

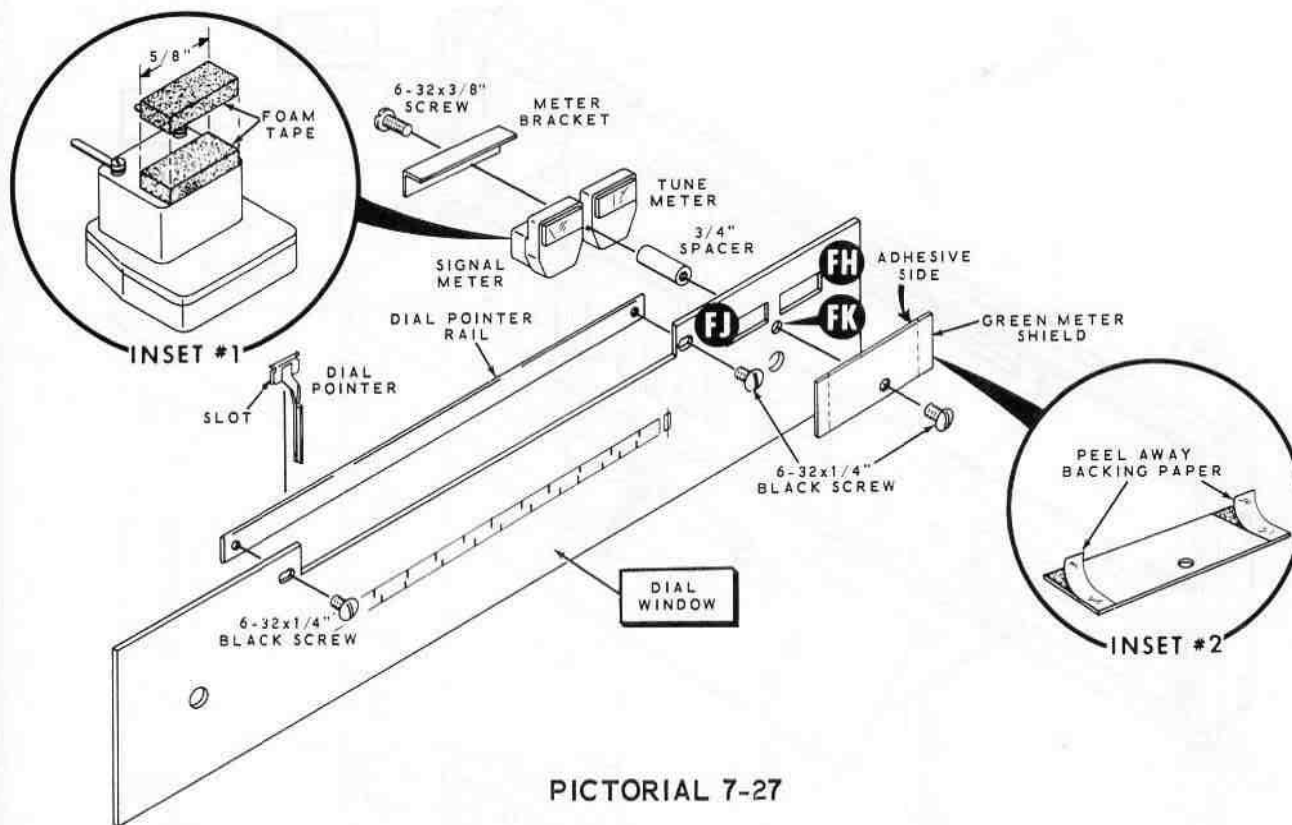
Make sure the auxiliary control door is closed; then place the front panel on a soft cloth, while performing the following steps, so the chrome surface does not get scratched.

- () Insert the steel spring into the small slots in the front panel and fasten them with 2-32 x 1/8" self-tapping screws.
- () Install four nylon bushings in the front panel holes. Insert the open side of each bushing into the hole first, as shown in the inset drawing; then push it in place.

- () Cut a 16-3/8" length of foam tape. Peel away the backing paper and press the tape in place on the ridge of the front panel. NOTE: Do not stretch the tape when you install it; merely put it in place and press it down.

- () Turn the front panel around and check the auxiliary control door to see if it closes all the way. If it does not, open the door and bend both steel springs forward slightly. Refer to the inset drawing in Part B of Pictorial 7-26.

- () Open the auxiliary control door. Then peel away the backing paper from the control identification label. Center the label on the door with the back edge of the label against the door hinges. Then press it in place. Refer to Part B of the Pictorial.



PICTORIAL 7-27

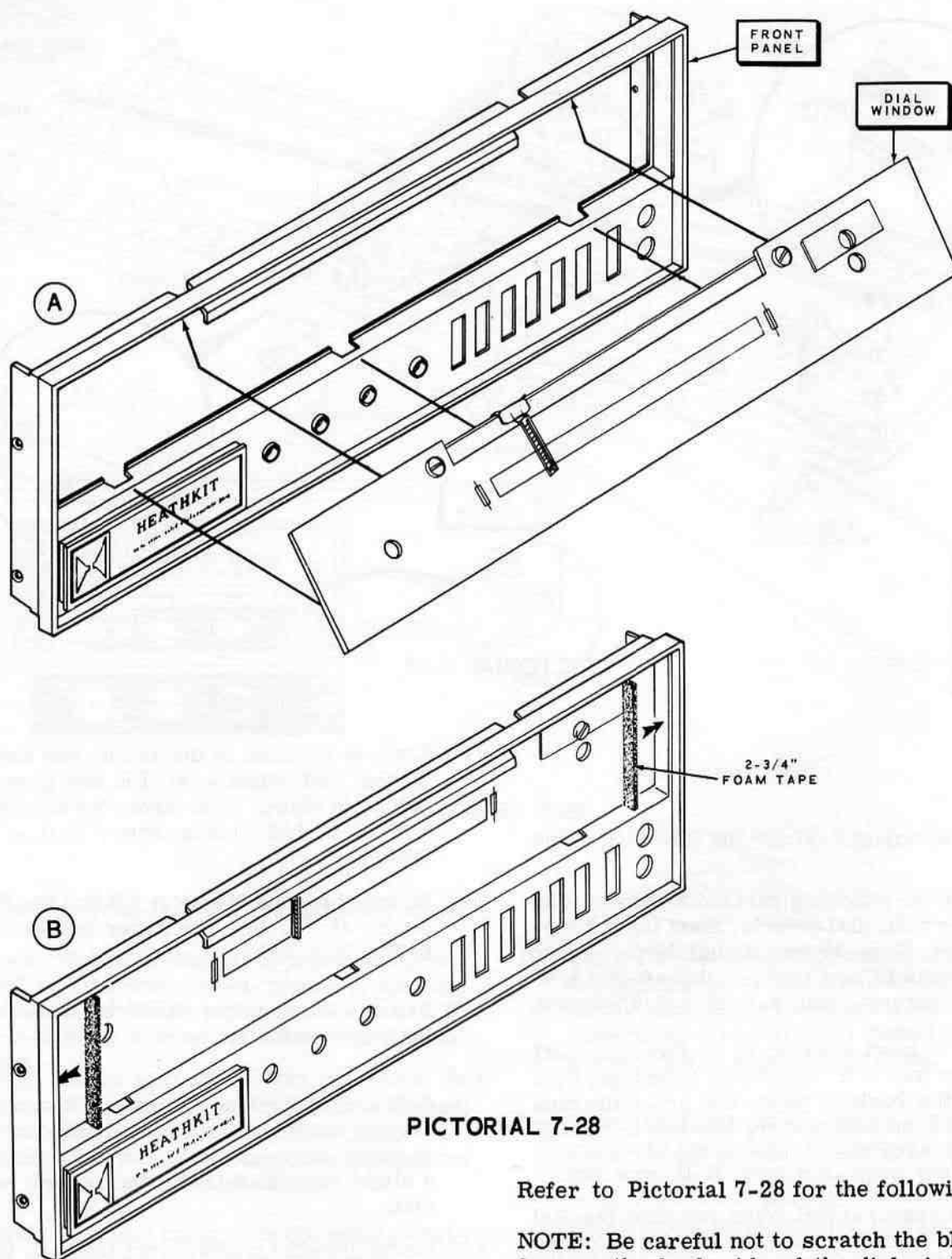
Refer to Pictorial 7-27 for the following steps.

- () Locate the following parts: dial window, dial pointer rail, dial pointer, foam tape, meter bracket, Tune Meter, Signal Meter, green meter shield, 3/4" spacer, three 6-32 x 1/4" black screws, and a 6-32 x 3/8" screw.
- (✓) Refer to inset drawing #1 on Pictorial 7-27 and cut four 5/8" lengths of foam tape. Peel away the backing paper and press the tape in place on each meter. Use two lengths of tape on each meter, one on top of the other.

NOTE: Be very careful when handling the dial window to avoid scratching the black surface on the back side of the plastic.

- () Refer to inset drawing #2 on Pictorial 7-27 and peel away the backing paper from the adhesive strips on each end of the green meter shield.

- (✓) Line up the hole in the shield with the hole in the dial window at FK and press the shield in place. Then fasten the shield with a 6-32 x 1/4" black screw and a 3/4" spacer.
- (✓) Mount the Tune Meter at FH and the Signal Meter at FJ. Use the meter bracket and a 6-32 x 3/8" screw.
- (✓) Remove the shorting wire from between the lugs of each meter.
- (✓) Mount the rail on the dial window with two 6-32 x 1/4" black screws. Center the screws in the window and tighten only one of these screws. This is to allow room for a slight expansion of the dial window material.
- (✓) Insert the dial pointer over the rail. Check the pointer to make sure it is not bent to the right or left and that it is parallel with the front of the dial window.
- (✓) Check to make sure the pointer slides easily along the rail. If it does not, open the slot slightly.

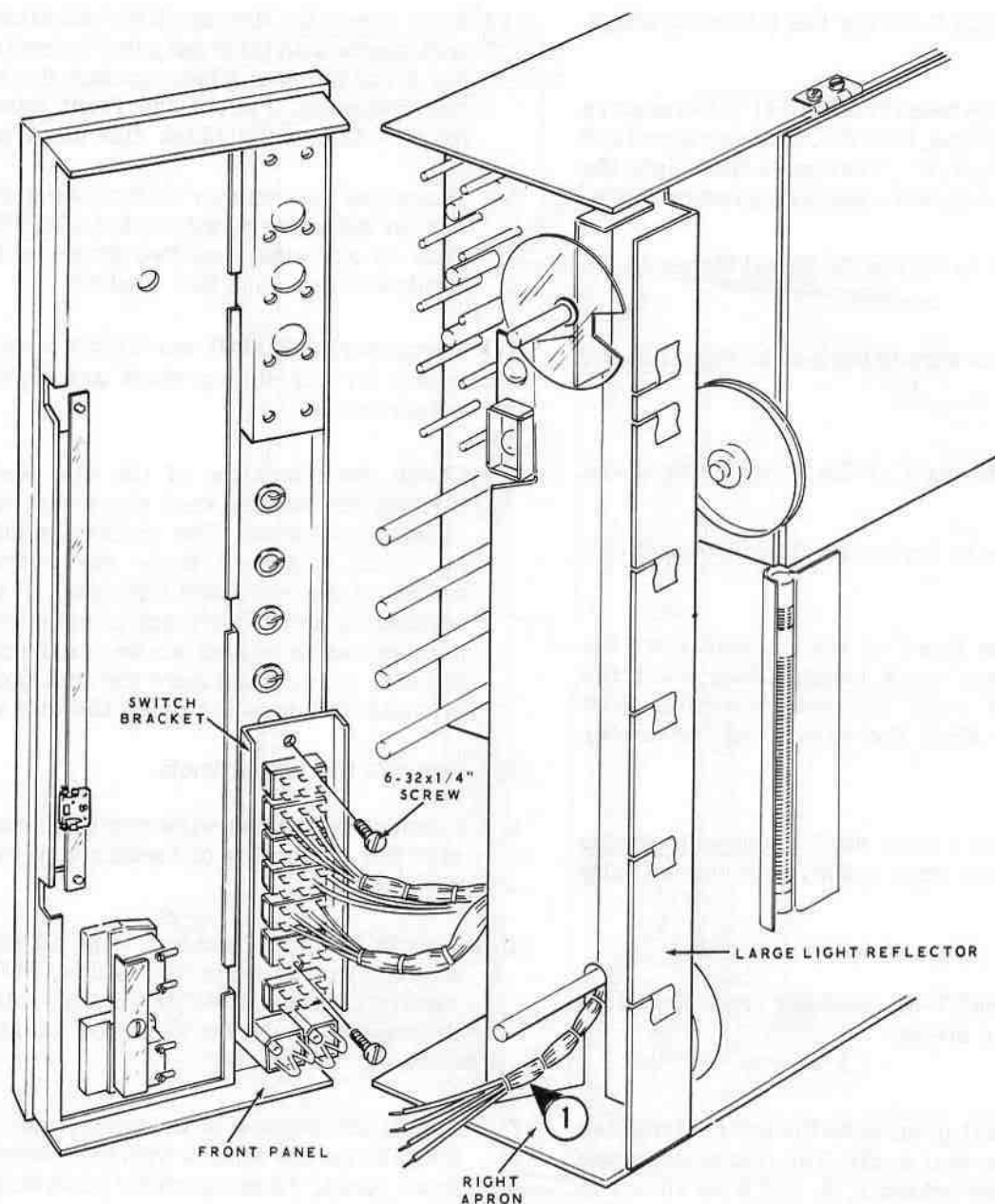


PICTORIAL 7-28

Refer to Pictorial 7-28 for the following steps.

NOTE: Be careful not to scratch the black surface on the back side of the dial window while performing the following steps.

- () Place the dial window inside the front panel opening. Refer to Part A of the Pictorial. Push the top edge in first, and then the bottom edge.



PICTORIAL 7-29

- (✓) Cut two 2-3/4" lengths of foam tape and peel off the backing paper. Make sure the dial window is all the way in place on the front panel. Then press the tape in place against the sides of the front panel next to the dial window. Refer to Part B of the Pictorial.
- Refer to Pictorial 7-29 for the following steps.
- () Position the chassis on the right apron and the front panel on its right side as shown.
- (✓) Position the four wires from breakout #1 of the multiplex harness through the groove in the large light reflector. They will be connected to the meters later.
- () Mount the switch bracket on the front panel with two 6-32 x 1/4" screws.

Refer to Pictorial 7-30 for the following steps.

Connect the wires from breakout #1 to the meters in the following steps. NOTE: Cut the stripped end of these wires to 1/8". Then push them into the meter lugs and follow the soldering instructions.

(✓) Green wire to lug 1 of the Signal Meter (S-1).

(✓) White-brown wire to lug 2 of the Signal Meter (S-1).

(✓) Blue wire to lug 1 of the Tune Meter (S-1).

(✓) Yellow wire to lug 2 of the Tune Meter (S-1).

(✓) Position the front of the chassis over the edge of your work bench. Then start the front panel over the rotary switch shaft and tuning shaft (be careful of the meter wires).

(✓) Now turn the tuning shaft counterclockwise until the dial cord pulley has turned fully clockwise.

Refer to Pictorial 7-31 (fold-out from Page 100) for the following steps.

(✓) Move the dial pointer to the left rectangular mark on the dial scale. Then carefully place the dial cord behind 1, 2, and 3 as shown in the inset drawing on Pictorial 7-31.

(✓) Very carefully line up all the miniature control shafts with the front panel holes and push the front panel in place against the left and right aprons. Fasten the front panel with four 6-32 x 3/8" black flat head screws.

(✓) Place one felt washer on the tuning shaft and one on the rotary switch shaft. NOTE: If any glue is available, put two drops on the dial window under each felt washer.

(✓) Temporarily install one of the large metal knobs on the tuning shaft and tighten the setscrew.

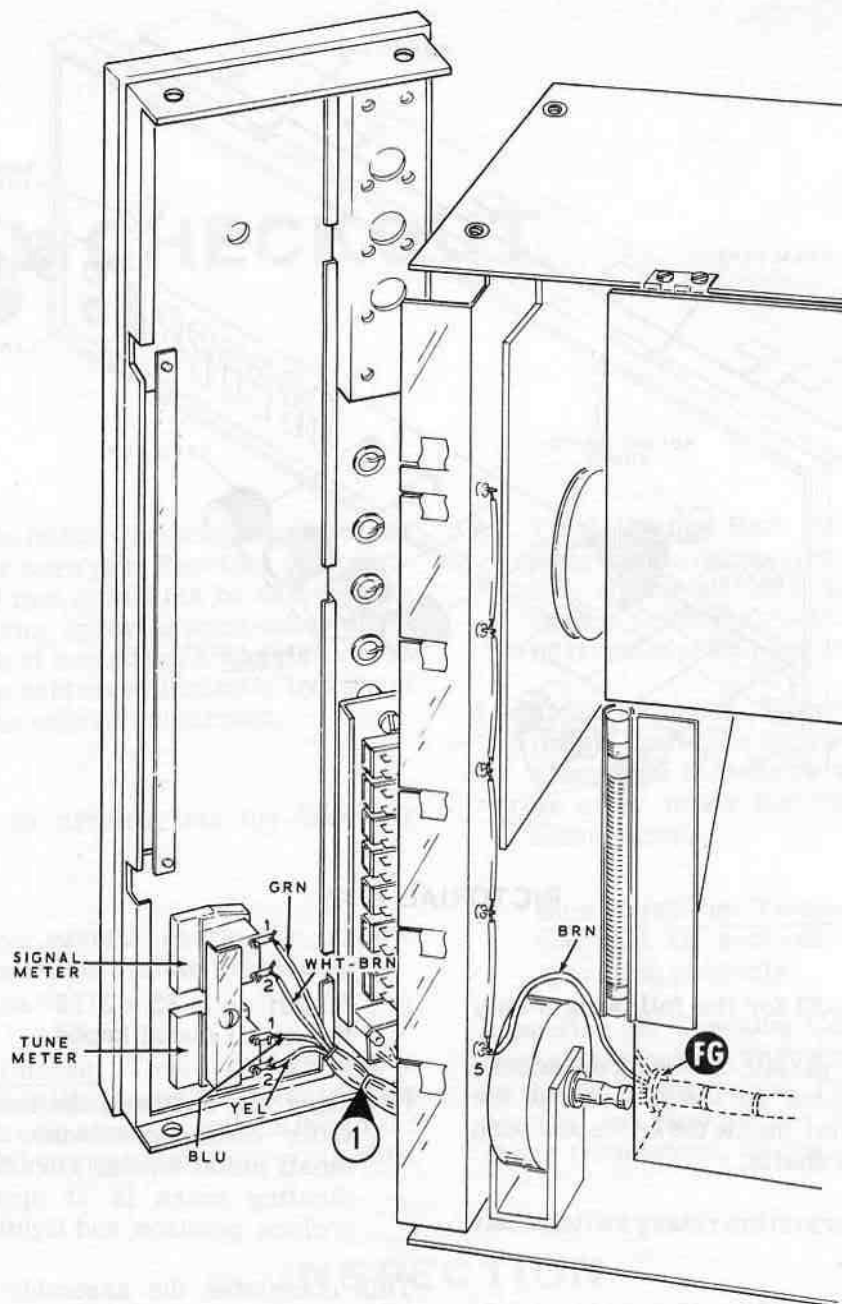
(✓) Check the operation of the dial pointer by turning the tuning knob clockwise and then counterclockwise. The pointer should stop an equal distance from the rectangular marks at the right and left sides of the dial window. If any adjustment is necessary, the pointer can be moved one way or the other on the dial cord. Make sure the dial pointer is straight and does not touch the dial window.

(✓) Remove the tuning knob.

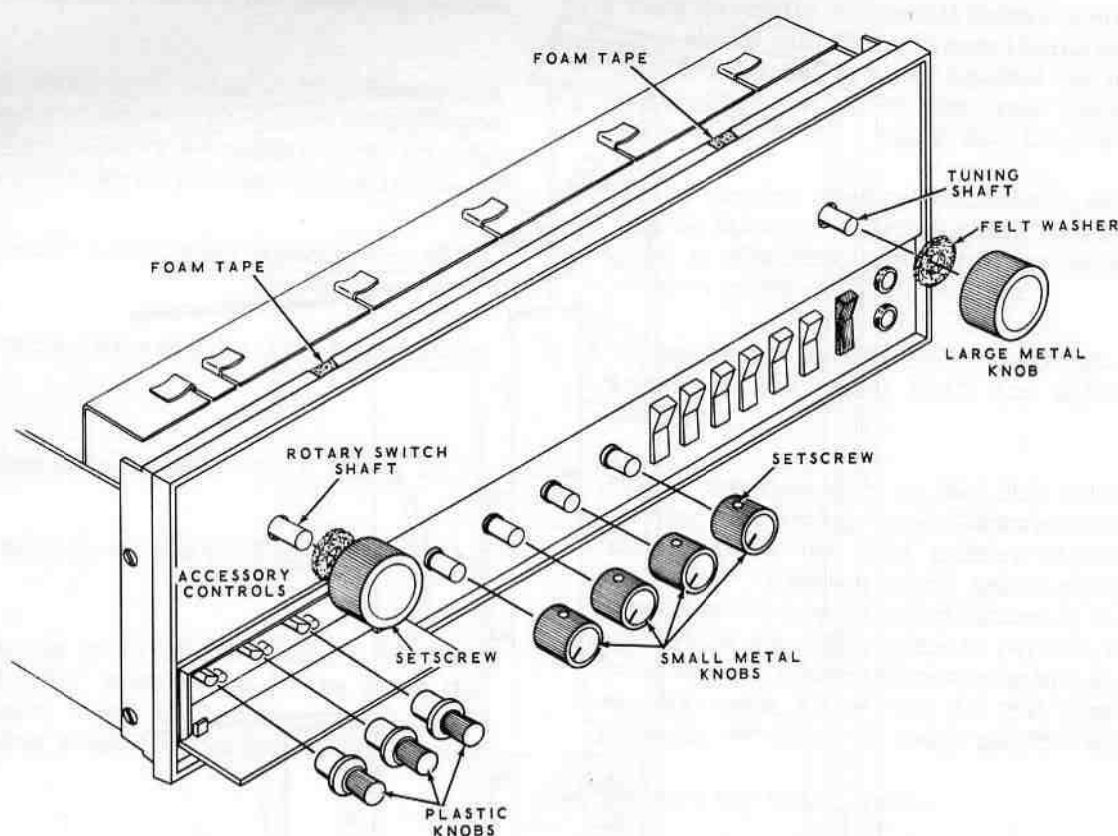
(✓) Connect the brown wire coming from grommet FG to the lug of feedthrough insulator #5 (S-2).

(✓) Locate the tinted window. Wipe off any lint or smudge marks from both sides. NOTE: Any record cleaning fluid or diluted, mild liquid detergent would be ideal for cleaning the window.

(✓) Install the window on the front panel. Line up the tabs on the window with the cutouts in the front panel. Then carefully push the panel in place by applying pressure at each tab.



PICTORIAL 7-30



PICTORIAL 7-32

Refer to Pictorial 7-32 for the following steps.

- (✓) Install the three plastic knobs on the accessory controls. Line up the flat side of the shafts with the flat inside the knobs and push the knobs on the shafts.
- (✓) Place felt washers on the rotary switch shaft and tuning shaft.
- (✓) Install an 8-32 x 7/16" setscrew in each of the two large knobs.
- (✓) Install a large knob on the tuning shaft. Push the knob on all the way and tighten the setscrew.
- (✓) Install the other large knob on the rotary switch shaft. Position this knob so the setscrew is pointing straight down. Then tighten the setscrew.

- (✓) Install an 8-32 x 3/16" setscrew in each of the small metal knobs.

- (✓) Turn the shafts of the remaining four controls counterclockwise. Then install the small metal knobs. Turn the knobs so the indicating mark is at approximately the 7 o'clock position and tighten the setscrews.

This completes the assembly of the Receiver. Proceed to the Initial Checkout section.

NOTE: Set aside the four 6-32 x 3/4" self-tapping screws and four 9/16" flat washers; they will be used to fasten the Receiver in the AE-16 Cabinet if one was purchased.

- (✓) Cut two 7/16" lengths of foam tape and peel off the backing paper. Then press the tape in the two slots on the top edge of the front panel.

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INITIAL CHECKOUT

The purpose of the Initial Checkout section of the Manual is to make sure your Receiver will operate properly, and that it will not be damaged as the result of a wiring error or some other difficulty when it is first turned on. A transistor, for example, could be destroyed instantly by a short circuit that causes excessive current.

Initial Checkout is divided into the following parts:

1. Inspection. A careful check for obvious assembly errors or visible problems.
2. Resistance Checks. These checks use a meter that is built into the Receiver to make sure there are no short circuits in the power supply and DC voltage distribution circuits.

3. Final Wiring. Here the last fourteen power distribution wires are connected. They are not connected until after the resistance checks are completed to avoid the possibility of transistor damage due to a short circuit.
4. Voltage Checks. These checks use the meter that is built into the Receiver for additional assurance that there are no short circuits or other faults that could cause damage to some parts.
5. Hum Injection Tests. These tests assure you that all sections of the Receiver are operating properly.

A section on Checking Components (Page 165) may also be helpful when you are using the Charts in the following pages. The instructions in this section tell how to use the SIGNAL meter to check transistors, diodes, and capacitors.

INSPECTION

Refer to Figure 1-1 (fold-out from Page 115) for the following steps.

Set all of the Receiver switches and controls as directed in the following groups of steps. Then, do not change the position of any control or switch unless a step or check instructs you to do so.

PRIMARY CONTROLS AND SWITCHES

- (N) Source: AUX (Full clockwise).
- (U) BASS: Center of rotation.

- (U) TREBLE (pushed in): Center of rotation.
- (U) BALANCE: Center of rotation.
- (N) VOLUME: Full counterclockwise.
- (U) MODE: MONO (Monophonic).
- (N) TAPE MON (Monitor): OFF.
- (U) FM: NORM (Normal).
- (N) NOISE FILTER: OFF.

- (✓) LOUDNESS: OFF.
- (✓) SPEAKERS: OFF.
- (✓) POWER: OFF.

SECONDARY CONTROLS

- (✓) PHASE (pushed in): Center of rotation.
- (✓) SQUELCH: Full counterclockwise.
- (✓) STEREO THRES (Threshold): Full counterclockwise.
- (✓) All ten Level controls: Full clockwise.

OTHER SWITCHES

Refer to Figure 1-2 (fold-out from Page 115) for the next three steps.

- (✓) Signal Meter Function: R (resistance).
- (✓) 19 kHz switch: NORM (Normal).
- (✓) AM METER: Full counterclockwise.

Refer to Figure 1-3 (fold-out from Page 115) for the following steps.

Position the Receiver on the right apron for the following steps.

- (✓) Carefully examine both sides of all exposed circuit boards. Be sure all connections are properly soldered and that no solder bridges exist between any of the foils.

- (✓) Check all wires that are connected to the circuit boards. Be sure each wire color and point number is correct.

- (✓) Examine all chassis mounted parts to make sure they are properly mounted and connected.

- (✓) Bend back the fourteen unconnected wires so their ends do not touch any metal parts or the circuit boards. Two of these wires are called out by their colors in Figure 1-2 and twelve of them in Figure 1-3.

CAUTION: When the line cord plug is connected to an AC outlet, AC line voltage will be present at several places under the chassis. Be careful that you do not contact this voltage, or personal shock or Receiver damage could result.

- (✓) Connect the line cord plug to an AC outlet; then press the POWER switch to the ON position. The dial lamps and the HI-TEMP (temperature) indicator located on the front panel should light, and the SIGNAL meter pointer should remain at zero. If any of these conditions are different, refer to the following chart for possible causes of your trouble. Be sure to correct any troubles and obtain the proper indications before proceeding to the Resistance Checks.

- (✓) Press the POWER switch to OFF.

CONDITION	POSSIBLE CAUSE
No lamps light.	1. Fuse blown. 2. Line cord open. 3. POWER switch faulty. 4. Improper connection at point 3 on power supply circuit board. 5. Power transformer faulty.
Pilot lamps light but HI-TEMP indicator does not light.	1. HI-TEMP indicator lamp faulty. 2. Transistor Q503 faulty or improperly installed. See Figures 6-13 and 6-14. 3. Diode D505 faulty or improperly installed. See Figures 6-13 and 6-14.

RESISTANCE CHECKS

GENERAL INSPECTION

Before you proceed to the Resistance and Voltage checks, read the following ten steps. You would use this procedure to trace down a problem in the Receiver if your readings do not match the ones in the charts.

1. Bad solder joints. See the soldering instructions and illustrations in the Kit Builders Guide.
2. Solder bridge across adjacent foils of a circuit board. Melt a solder bridge with your soldering iron and wipe away the excess solder.
3. A wire connected to the wrong place. Check the wire connections against the Pictorials for that area.
4. Wrong value of resistor installed. It would be very easy, for example, to install a 10 K Ω resistor (brown-black-orange) instead of a 100 K Ω resistor (brown-black-yellow).
5. Electrolytic capacitor installed backwards. Be sure the positive (+) lead goes to the correct place. An electrolytic capacitor that is installed wrong will probably be ruined after the Receiver is turned on, and it could easily develop a short circuit that would burn out other parts connected in the same circuit.
6. Diode installed backwards. Be sure the marked end of each diode is positioned as shown in the Pictorials.
7. Transistor improperly installed. Check the mounting instructions for each transistor.
8. Bare wires touching each other or the chassis. Broken leads.
9. On rare occasions, it is also possible for a new part, such as an electrolytic capacitor, to be open or shorted.

10. If you should find a faulty component, be sure to determine the cause of its failure. A burned out resistor, for example, would indicate a short circuit somewhere else that caused too much current to flow through it. In this case, the short circuit would have to be repaired also, or a new resistor would also burn out.

Refer to Figure 1-3 for the following steps.

- (✓) Disconnect the line cord plug from the AC outlet.
- (✓) Remove 1/4" of insulation from each end of the remaining length of red stranded wire (approximately 46"). Melt a small amount of solder on these wire ends to hold the wire strands together.
- (✓) Connect one end of the red stranded wire to lug 3 of the Signal Meter Function switch (S-2).
- (✓) Install the test clip and insulator on the other end of this red stranded wire. Refer to the inset drawing on Figure 1-3.

In the following checks, you will test the resistance at the ends of the wires shown in Figure 1-3. These wires come from the three cable assemblies and from the chassis mounted parts.

Perform these checks by placing the test clip in contact with the bare end of each colored wire, as directed in the chart on Page 116. Allow time for the meter pointer to stabilize; then if the SIGNAL meter does not show approximately the same indication shown on the chart, disconnect the line cord. Then refer to the two right hand columns to locate the area of the trouble and its possible cause. Make any necessary repairs before you continue with another test.

CAUTION: Do not touch the two blue wires that come from the power transformer. Leave the sleeving on each of these wires and the red stranded wire coming from hole 21 of the power supply circuit board until you are directed to remove it.

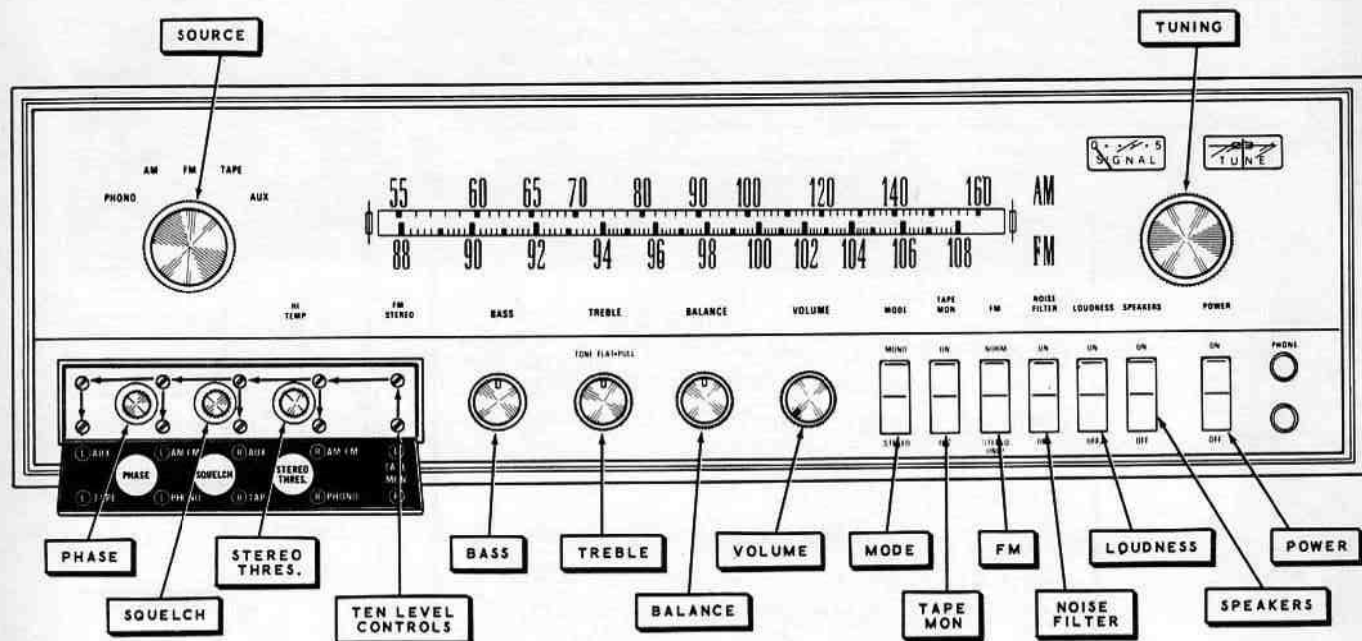


FIGURE 1-1

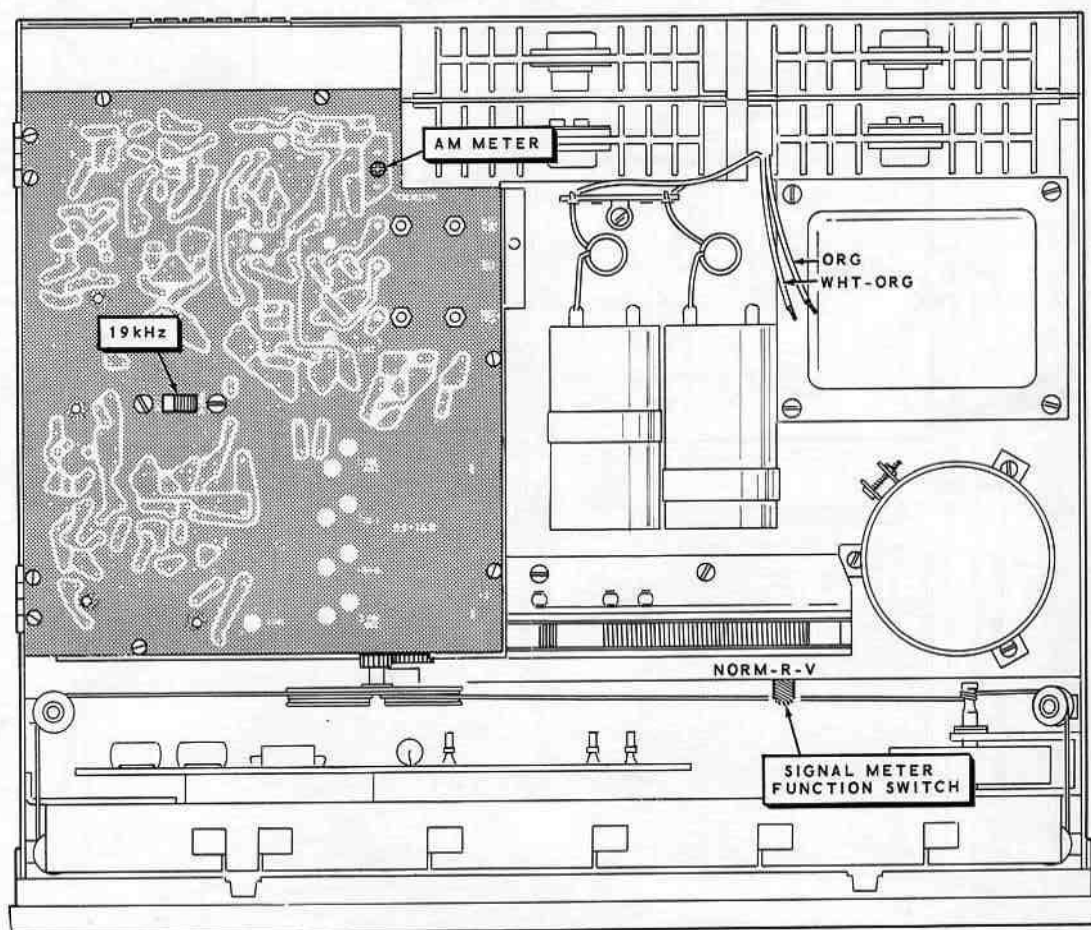


FIGURE 1-2

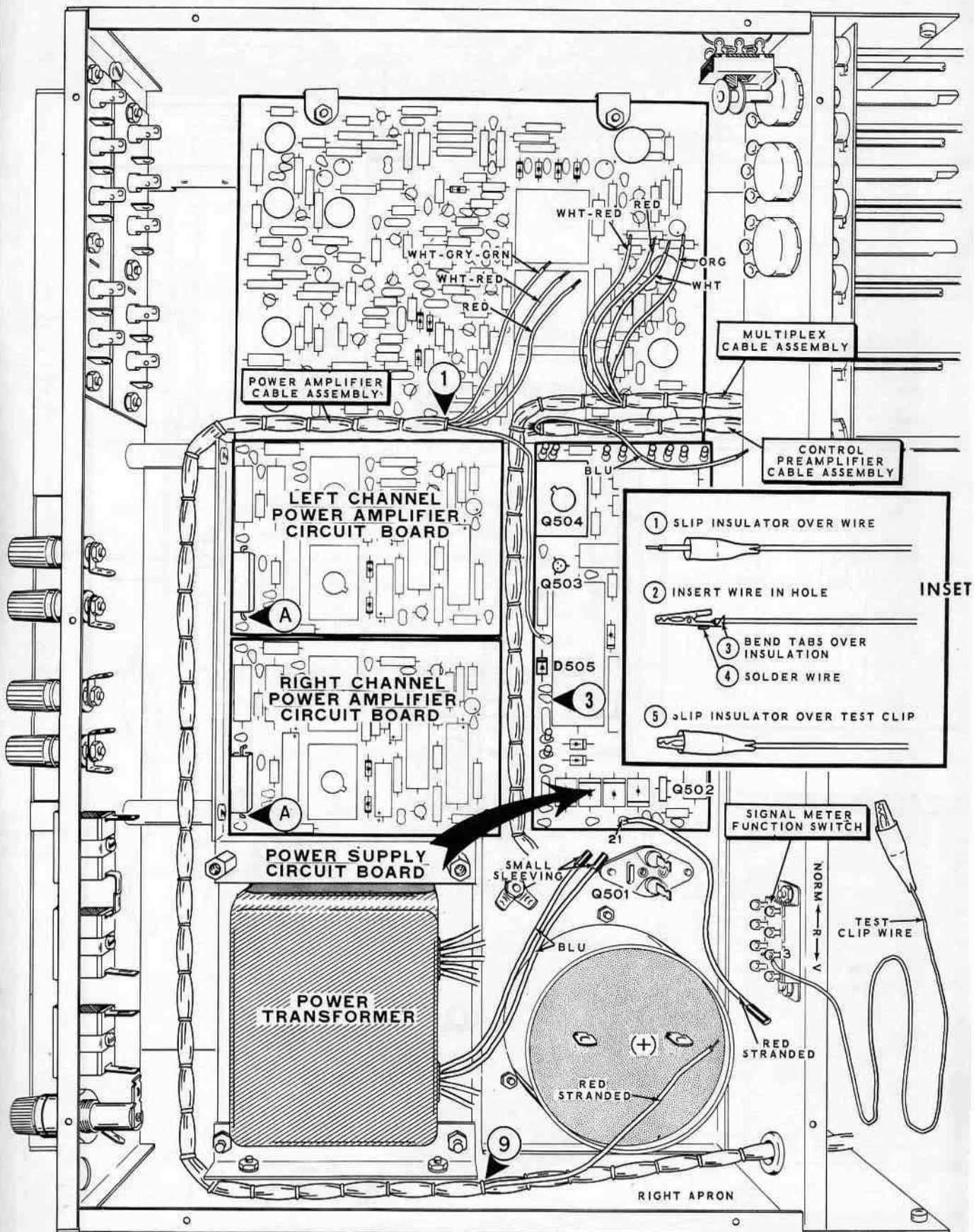


FIGURE 1-3

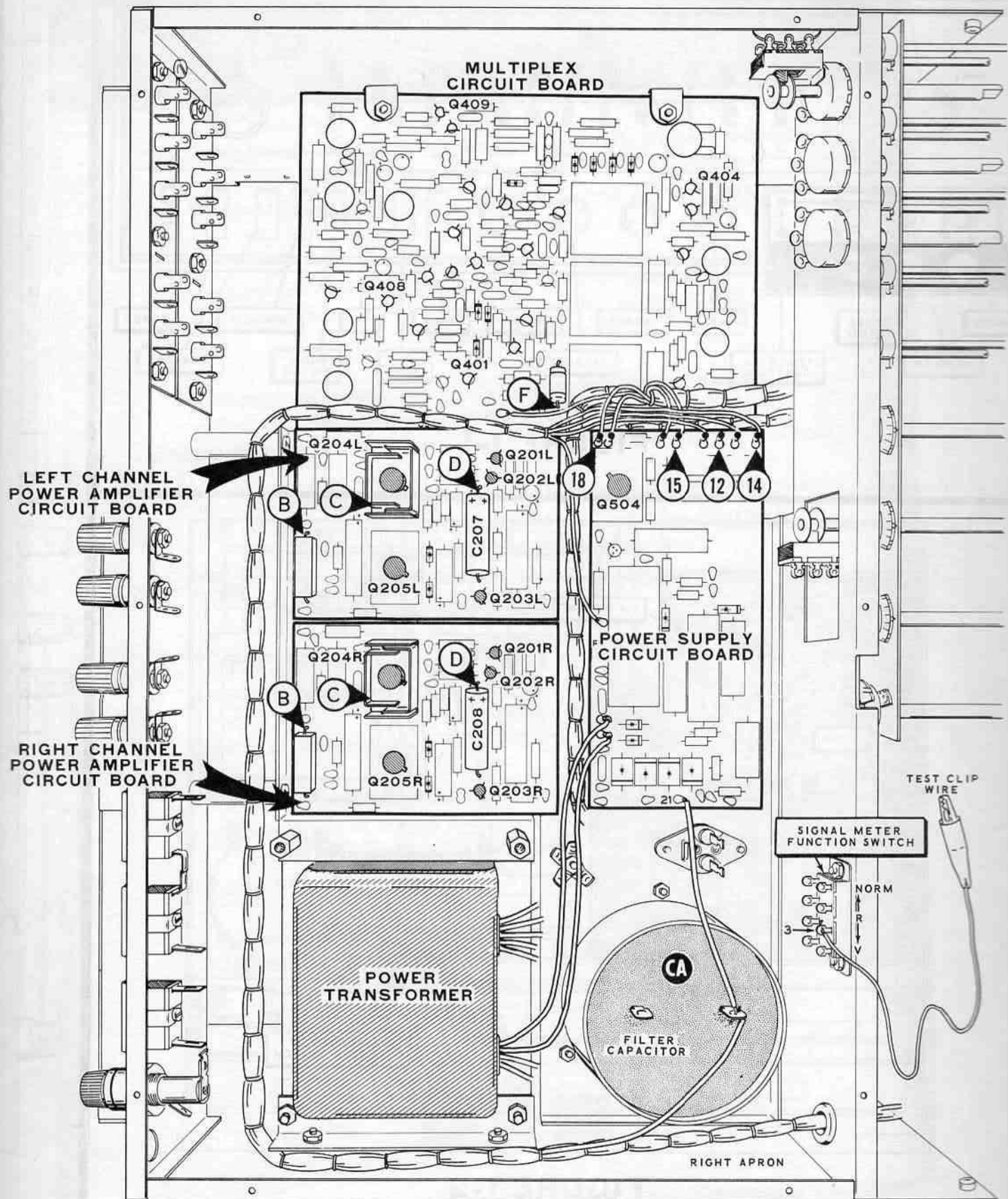


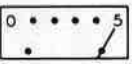
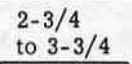
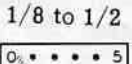
FIGURE 1-6

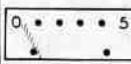
() Connect the line cord to an AC outlet.

() Press the POWER switch to ON.

NOTE: The HI-TEMP indicator will light during these resistance checks. It will not light after the Final Wiring is completed unless the output transistors become overheated.

Perform the checks listed in the following chart.

Wire Color or Test Point	Location	Approximate Meter Reading	Area of Trouble If Meter Reading Differs From Normal	Possible Cause Of Trouble
(✓) Test clip	Clip on metal chassis	5 	SIGNAL meter of Signal Meter Function switch.	Meter or switch wired incorrectly.
(✓) Blue wire	Control Preamplifier Cable Assembly	1/2 to 2 	Control preamplifier circuit board. See Figures 6-3 and 6-4.	1. A high meter reading indicates the presence of a short circuit. This condition could be caused by a solder bridge across adjacent circuit board foils, bare wires touching each other or the chassis, improper component installation, a wiring error or a faulty component. 2. A low meter reading indicates the presence of an open circuit. This condition could be caused by a bad solder joint, improper component installation, a broken lead, an open or cracked foil on a circuit board, or a faulty component.
(✓) Red wire	Power Amplifier Cable Assembly (breakout #1)	1/4 to 1-1/4 	Left power amplifier circuit board. See Figures 6-5 and 6-6.	
(✓) Wht-red wire	Power Amplifier Cable Assembly	1/4 to 1-1/4 	Right power amplifier circuit board. See Figures 6-7 and 6-8.	
(✓) Wht-gry-grn wire	Power Amplifier Cable Assembly	1/8 to 1/2 	Phono preamplifier circuit board. See Figures 6-1 and 6-2.	
(✓) Orange wire	Multiplex Cable Assembly	3-3/4 to 4-1/2 	AM-FM circuit board. See Figures 6-9 and 6-10.	
(✓) Red wire	Multiplex Cable Assembly	2-3/4 to 4-3/4 	STEREO THRES or SQUELCH controls, FM or PHASE switches. AM-FM circuit board. See Figures 6-9 and 6-10.	
(✓) Wht-red wire	Multiplex Cable Assembly	2-3/4 to 3-3/4 	Multiplex circuit board. See Figure 6-15.	
(✓) Red stranded wire	Power Amplifier Cable Assembly (breakout #9)	1/8 to 1/2 	Output stages of power amplifier transistors Q206L or Q206R, or their mica insulators. See Figure 6-15.	1. Check the Area of Trouble for a wiring error. 2. Be sure the mica insulators are properly installed on the transistors. 3. Check transistors Q204 and Q205. 4. Check the thermal circuit breaker for wiring errors.

Wire Color Or Test Point	Location	Approximate Meter Reading	Area Of Trouble If Meter Reading Differs From Normal	Possible Cause Of Trouble (See Figures 6-5, 6-6, 6-7, and 6-8.)
(✓) Point A	Left Power Amplifier circuit board	1/8 to 1/2 	Q207L, or its mica insulator. See Figure 6-15.	1. Check the Area of Trouble for a wiring error. 2. Be sure the mica insulators are properly installed on the transistors. 3. Check transistors Q204 and Q205. 4. Check the thermal circuit breaker for wiring errors.
() Point A 	Right Power Amplifier circuit board	1/8 to 1/2 	Q207R, or its mica insulator. See Figure 6-15.	
 Press the POWER switch to OFF and unplug the line cord.				

FINAL WIRING

Refer to Figure 1-4 for the following steps.

() With the Receiver still resting on the right apron, turn the Receiver around as shown in the Figure.

(✓) Connect the orange wire coming from breakout #7 to lug 1 of capacitor CE (S-1).

(✓) Connect the white-orange wire coming from breakout #7 to lug 1 of capacitor CD (S-1).

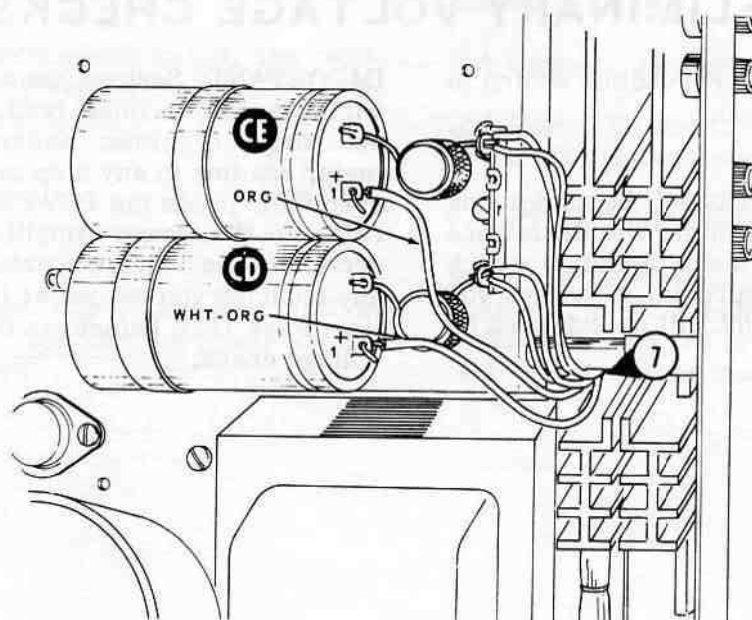


Figure 1-4

Refer to Figure 1-5 (fold-out from Page 116) for the following steps.

- (✓) With the Receiver still resting on the right apron, turn it around so the bottom of the unit is toward you.

Connect the following wires to the power supply circuit board. Insert the ends of the wires into the connectors and solder them.

Connect the four wires from breakout #4 of the multiplex cable assembly as follows:

- (✓) White-red to connector 18 (S-1).
- (✓) Red to connector 17 (S-1).
- (✓) White to connector 16 (S-1).
- (✓) Orange to connector 15 (S-1).

Connect the three wires from breakout #1 of the power amplifier cable assembly as follows:

- (✓) Red to connector 11 (S-1).
- (✓) White-red solid to connector 12 (S-1).
- (✓) Connect the blue wire from breakout #7 of the control preamplifier cable assembly to connector 13 (S-1).

- (✓) White-gray-green to connector 14 (S-1).
- (✓) Route the wires neatly along the power supply circuit board.
- (✓) Remove the sleeving from the ends of the two blue leads of the power transformer. Then connect either blue lead to connector 5 (S-1), and the other blue lead to connector 7 (S-1).
- (✓) Remove the sleeving from the end of the red stranded wire coming from hole 21 of the power supply circuit board. Connect the wire to lug 1 of capacitor CA (NS).
- (✓) Connect the red stranded wire coming from breakout #9 of the power amplifier cable assembly to lug 1 of capacitor CA (S-2).

All wiring is now complete. Do not use the Signal Meter for any further resistance checks. If resistance test must be made at any later time, be sure the POWER switch is turned OFF, and use an external ohmmeter. (To use the internal ohmmeter, the fourteen wires that were just connected would have to be disconnected to prevent meter damage.)

PRELIMINARY VOLTAGE CHECKS

- (✓) Place the Signal Meter Function switch in the V (voltage) position.

The following voltage checks will be made using the same test clip you used for the Resistance checks. With the Signal Meter Function switch in the V position, the approximate voltage you measure at each test point will be indicated on the SIGNAL meter.

IMPORTANT: Serious damage could result if a wiring error, or other fault, existed in the output stage of either power amplifier. If the meter reading in any step is not within the range specified, press the POWER switch to OFF and refer to the Power Amplifier Voltage Checks section of the Voltage charts. Locate and repair any troubles you encounter (see General Inspection, Page 115), before you continue with another voltage check.

Refer to Figure 1-6 (fold-out from Page 116) for the following steps.

- () Connect the line cord plug to an AC outlet.
- () Connect the test clip to the resistor lead at point B on the left channel power amplifier circuit board.

NOTE: In the following steps, the meter needle will begin to rise and then stop. Wait until the needle stops before you take the reading.

- (✓) Press the POWER switch to ON. The reading should be between 2 and 3. Press the POWER switch to OFF.



- (✓) Connect the test clip to the resistor lead at point B on the right channel power amplifier circuit board.

- (✓) Press the POWER switch to ON. The reading should be between 2 and 3. Press the POWER switch to OFF.



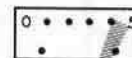
- (✓) Connect the test clip to the heat sink at point C on the left channel power amplifier circuit board.

- (✓) Press the POWER switch to ON. The reading should be between 4 and 5. Press the POWER switch to OFF.



- (✓) Connect the test clip to the heat sink at point C on the right channel power amplifier circuit board.

- (✓) Press the POWER switch to ON. The reading should be between 4 and 5. Press the POWER switch to OFF.



POWER SUPPLY VOLTAGE CHECKS

The following voltage checks are arranged in chart form. Refer to Figure 1-6 for location of the test points. You may want to write your meter reading on the chart as you make each check.

Make the Power Supply Voltage Checks in the first chart as directed. Then, if no trouble is encountered, disregard the remaining charts and proceed directly to the Hum Injection Test on Page 126.

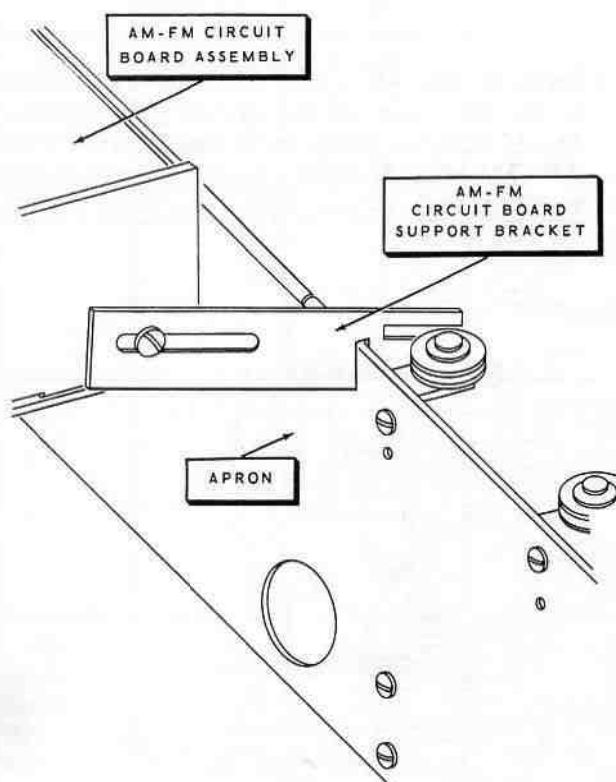
If any meter reading differs from the normal range listed in the chart, disconnect the line cord plug from the AC outlet. Then locate and repair the trouble using the Area Of Trouble column. Apply the General Inspection to the areas listed, and perform additional checks as directed.

Once you have repaired the trouble, return to the power supply test point in this first chart that gave you the incorrect meter reading. Recheck the reading at that point to be sure the trouble has been repaired; then continue with voltage checks.

- (✓) Connect the line cord plug to an AC outlet.
- (✓) Place the Signal Meter Function switch in the V (voltage) position.
- () Press the POWER switch to ON.

Make the following voltage checks by connecting the test clip to the test points listed in the chart. Refer to Figure 1-6 to find these locations. After each check, press the POWER switch to OFF.

- (✓) Loosen the setscrew in the hub of the dial string pulley. Then slide the pulley off of the FM tuning unit shaft. The tension of the dial string will hold the dial string pulley suspended next to the chassis.
- (✓) Position the hinged AM-FM circuit board assembly as shown in Detail 7-32B. Then latch the assembly in place with the circuit board support bracket and tighten the screw in the support bracket.



Detail 7-32B

Leave the AM-FM circuit board assembly in the access position until you have completed the Initial Checkout and the Adjustment sections.

You will then be instructed to remount the assembly. CAUTION: Be very careful, while the AM-FM circuit board assembly is in this position, that you do not bump or damage the circuit board. Also, be sure the dial string pulley remains suspended away from the foils of the multiplex circuit board.

POWER AMPLIFIER VOLTAGE CHECKS

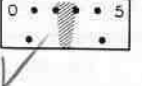
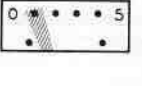
- (✓) Connect the free end of the test clip lead to lug 3 of the Signal Meter Function switch (S-1). Refer to Figure 1-5.
- (✓) Connect a pair of speakers to the LEFT and RIGHT SPEAKER terminals on the rear of the chassis. See Figure 2-1 on Page 137.
- (✓) Connect the line cord plug to an AC outlet.
- (✓) Press the SPEAKER switch to ON.
- (✓) Place the Signal Meter Function switch in the V (voltage) position.
- (✓) Place the POWER switch in the ON position.

The left and right channel power amplifier circuits are identical. However, resistor and capacitor numbers are arranged so that odd numbers are on the left channel circuit board, and the even numbers are on the right channel circuit board.

Make the following voltage checks on the component side of the left (and/or right) channel power amplifier circuit board.

Connect the test clip to the test points listed in the chart. Refer to Figure 1-6 to find these locations. After each check, press the POWER switch to OFF.

NOTE: Disconnect the test clip lead from lug 3 of the Signal Meter Function switch after completing the checks and correcting any problem that was found.

VOLTAGE CHECKS			TROUBLESHOOTING CHART
Test Point	Wire Color	Approximate Meter Reading	Area of Trouble (See Figures 6-5 through 6-8 and Chassis Photographs.)
C (heat sink)	Org (left channel) Wht-org (right channel)	4 to 5 	A. No meter reading: power supply: either thermal circuit breaker (if HI-TEMP indicator is lit). See Power Supply Voltage Checks if HI-TEMP indicator is not lit. B. High or low meter reading: transistor Q203-Q207.
B (resistor lead)	Org (left channel) Wht-org (right channel)	2 to 3 	A. Transistors Q203-Q207 (check only the affected channel); diodes D201, D202, D203. B. Capacitors C223 and C224 reversed or defective.
D (positive (+) lead of capacitor C207 or C208).		1/2 to 1-1/2 	Transistor Q201, Q202.

MULTIPLEX VOLTAGE CHECKS

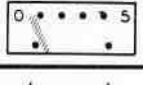
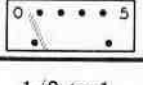
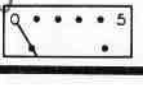
- (✓) Connect the free end of the test clip lead to lug 3 of the Signal Meter Function switch (S-2). Refer to Figure 1-5.
- (✓) Connect the line cord plug to an AC outlet.
- (✓) Place the Signal Meter Function switch in the V (voltage) position.
- () Press the POWER switch to ON.

() Turn the Source switch to the FM position.

() Press the SPEAKER switch to OFF.

Make the following voltage checks by connecting the test clip to the test points listed in the chart. Refer to Figure 1-6 to find these locations. After each check, press the POWER switch to OFF.

NOTE: Disconnect the test clip lead from lug 3 of the Signal Meter Function switch after completing the checks.

VOLTAGE CHECKS		TROUBLESHOOTING CHART
Test Point	Approximate Meter Reading	Area Of Trouble
F ✓	1/4 to 3/4 	FM output section of AM-FM Tuner circuit board: transistor Q306 or Q307. See Figures 6-9 and 6-10.
E (emitter) of Q408 or Q409 ✓	1/4 to 3/4 	A. Transistor Q406, Q407, Q408, or Q409; coil L405 (L407), L406 (L408). See Figures 6-11 and 6-12.
E (emitter) of Q404 ✓	1/2 to 1 	Transistor Q403 or Q404. See Figures 6-11 and 6-12.
C (collector) of Q401 ✓	0 	Transistor Q401, Q402, Q412. See Figures 6-11 and 6-12.

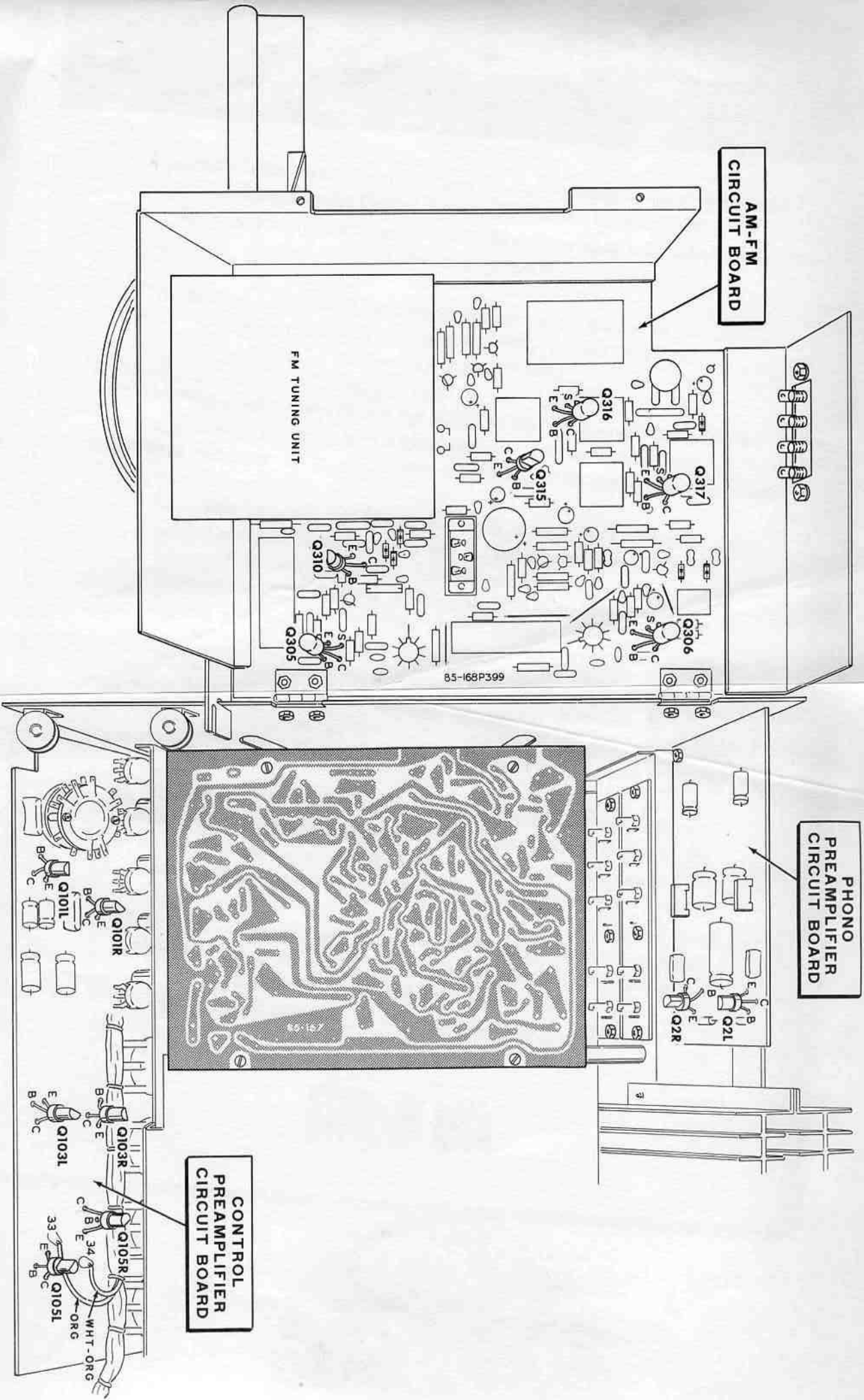


FIGURE 1-7

CONTROL PREAMPLIFIER VOLTAGE CHECKS

- (✓) Connect the free end of the test clip lead to lug 3 of the Signal Meter Function switch (S-1).
- (✓) Connect the line cord plug to an AC outlet.
- (✓) Place the Signal Meter Function switch in the V (voltage) position.
- (✓) Press the POWER switch to ON.

- (✓) Place the SPEAKER switch in the OFF position.

Make the following voltage checks by connecting the test clip to the test points listed in the chart. Refer to Figure 1-7 (fold-out from this page) to find these locations. After each check, press the POWER switch to OFF.

NOTE: Disconnect the test clip lead from lug 3 of the Signal Meter Function switch after completing the checks.

VOLTAGE CHECKS		TROUBLESHOOTING CHART
Test Point	Normal Meter Reading	Area Of Trouble (See Figures 6-3 and 6-4)
E (emitter) of Q105L ✓	1/2 to 1-1/2 	Transistor Q105L, Q105R, Q104L, or Q104R.
C (collector) of Q103L or Q103R ✓	1/2 to 1-1/2 	Transistor Q103L or Q103R.
C (collector) of Q101L or Q101R ✓	1/2 to 1 	Transistor Q101L, Q101R, Q102L, Q102R. Capacitor C105 (C106), C107 (C108), C111 (C112) reversed or faulty.

PHONO PREAMPLIFIER VOLTAGE CHECKS

- () Connect the free end of the test clip lead to lug 3 of the Signal Meter Function switch (S-1).
- () Connect the line cord plug to an AC outlet.
- () Place the Signal Meter Function switch in the V (voltage) position.
- () Press the POWER switch to ON.
- () Turn the Source switch to PHONO.

() Place the SPEAKER switch in the OFF position.

Make the following voltage checks by connecting the test clip to the test points listed in the chart. Refer to Figure 1-7 to find these locations. After each check, press the POWER switch to OFF.

NOTE: Disconnect the test clip lead from lug 3 of the Signal Meter Function switch after completing the checks.

VOLTAGE CHECK		TROUBLESHOOTING CHART
Test Point	Meter Reading	Area Of Trouble (See Figures 6-1 and 6-2)
C (collector) of Q2L or Q2R ✓	1-1/2 to 2-1/2 	Transistor Q1L, Q1R, Q2L, Q2R.

FM VOLTAGE CHECKS

- () Connect the free end of the test clip lead to lug 3 of the Signal Meter Function switch (S-1).
- () Connect the line cord plug to an AC outlet.
- () Place the Signal Meter Function switch in the V (voltage) position.
- () Press the POWER switch to ON.
- () Turn the Source switch to FM.

() Place the SPEAKER switch in the OFF position.

Make the following voltage checks by connecting the test clip to the test points listed in the chart. Refer to Figure 1-7 to find these locations. After each check, press the POWER switch to OFF.

NOTE: Disconnect the test clip lead from lug 3 of the Signal Meter Function switch after completing the checks.

VOLTAGE CHECKS		TROUBLESHOOTING CHART
Test Point	Approximate Meter Reading	Area Of Trouble (See Figures 6-9 and 6-10)
C (collector) of Q306 ✓	1/4 to 3/4 	IF Amplifier Q306, Coil T302 open.
C (collector) of Q305 ✓	1/4 to 3/4 	IF Amplifier Q305. NOTE: If the meter reading is incorrect at both Q305 and Q306, transistor Q306 or IC301 or IC302 is shorted.
C (collector) of Q310 ✓	1/2 to 1-1/2 	AGC and Meter Amplifier: transistor Q309 or Q310.

AM VOLTAGE CHECKS

- () Connect the free end of the test clip lead to lug 3 of the Signal Meter Function switch (S-1).
- (✓) Connect the line cord plug to an AC outlet.
- (✓) Place the Signal Meter Function switch in the V (voltage) position.
- (✓) Press the POWER switch to ON.

- (✓) Turn the Source switch to AM.
- () Press the SPEAKER switch to OFF.

Make the following voltage checks by connecting the test clip to the test points listed in the chart. Refer to Figure 1-7 to find these locations. After each check, press the POWER switch to OFF.

NOTE: Disconnect the test clip lead from lug 3 of the Signal Meter Function switch after completing the checks.

VOLTAGE CHECKS		TROUBLESHOOTING CHART
Test Point	Approximate Meter Reading	Area Of Trouble (See Figures 6-9 and 6-10)
C (collector) of Q315 ✓	1/2 to 1-1/2 	RF Amplifier Q315: coil L307; capacitor C376.
C (collector) of Q316 ✓	1/2 to 1-1/2 	Oscillator-Mixer Q316: coil L307; transformer T303 open.
C (collector) of Q317 ✓	1/2 to 1-1/2 	IF Amplifier Q317: transformer T303; transformer T304 open.

HUM INJECTION TESTS

To make hum injection tests, you will touch the tip of a narrow-bladed screwdriver to the signal input points of the various circuits. By noticing the sound reproduced by the speakers as you touch these points, you can determine whether the circuits are operating.

Before you begin the tests, make sure the switches and controls are in the following positions. Then, do not change any control or switch from these positions unless a test directs you to do so.

- () Source: AUX.
- () PHASE (push in): Center of rotation.
- () SQUELCH: Full counterclockwise.
- () STEREO THRES: Full counterclockwise.
- () BASS: Center of rotation.
- () TREBLE (push in): Center of rotation.
- () BALANCE: Center of rotation.
- () VOLUME: Full counterclockwise.
- () MODE: Stereo.
- () TAPE MONITOR: Off.
- () FM: Normal.
- () NOISE FILTER: Off.
- () LOUDNESS: Off.
- () SPEAKERS: Off.
- () POWER: Off.

- () All ten Input Level controls full clockwise.
- () Signal Meter Function: Normal.
- () 19 kHz switch (on AM-FM circuit board): Normal.
- () AM METER adjust (on AM-FM circuit board): Full counterclockwise.

You may want to follow the circuit on the Block Diagram (fold-out from Page 133) and on the Schematic (fold-out from Page 213) as you perform the following steps.

CAUTION: Full AC line voltage will be present at several places in the Receiver when the line cord plug is connected to an AC outlet. Use a screwdriver with an insulated handle, and do not let your fingers touch the screwdriver blade while any part of your body is in contact with any conductor, metal object, or the chassis. Be especially careful that you do not touch the AC accessory sockets, POWER switch, or fuseholder.

As you make these tests, touch the tip of the screwdriver blade only to the point specified. Be careful that the screwdriver does not slip, or short across two points at once. If you do not get the proper response in any of these tests, refer to Stage-By-Stage Signal Injection (Page 160 in the In Case Of Difficulty section of this Manual). Then locate and repair the cause of trouble before you continue with the next test in this section.

POWER AMPLIFIER TEST (See Figure 1-8 fold-out from this page)

- (✓) Connect a speaker to the LEFT SPEAKER terminals on the rear of the Receiver. Then connect another speaker to the RIGHT SPEAKER terminals. See Figure 2-1 on Page 137.
- (✓) Press the SPEAKER switch to ON.
- (✓) Connect the line cord plug to an AC outlet and press the POWER switch to the ON position.

Perform the following test twice; once on the left channel power amplifier circuit board, and once on the right channel power amplifier circuit board.

- (✓) (✓) Hold your finger on the metal part of the screwdriver and touch the screwdriver tip to point 1 on the power amplifier circuit boards. A very faint click should be heard as you touch the test point.

If the click was not heard from one or both speakers, refer to the In Case Of Difficulty section of this Manual on Page 149.

CONTROL PREAMPLIFIER TEST

The following tests will be made at the lugs of the input sockets on the rear of the chassis. See Figure 1-8. Hold your finger on the metal part of the screwdriver as you touch the screwdriver tip to the point specified in each of the tests that follow.

- (✓) Turn the VOLUME control to the 3 o'clock position.
- (✓) Touch the tip of the screwdriver to the LEFT AUX input socket, and then to the RIGHT AUX input socket. A fairly loud hum should be heard from each channel's speaker as you touch each of these lugs. If the hum was not heard from one of the speakers, refer to the In Case Of Difficulty section of this Manual.
- (✓) Change the Source switch to the TAPE position. Then touch the screwdriver tip to the LEFT TAPE input socket, and to the RIGHT TAPE input socket. A fairly loud hum should be heard from each speaker. If the hum was not heard from either speaker, refer to the In Case Of Difficulty section of this Manual.

PHONO PREAMPLIFIER TEST

- (✓) Turn the VOLUME control to the 9 o'clock position.
- (✓) Turn the Source switch to the PHONO position. Then touch the screwdriver tip to the LEFT PHONO input jack, and then to the RIGHT PHONO input jack. A loud hum should be heard from the left speaker, and then from the right speaker as you touch each phono input jack.

If the hum is heard, proceed to the Adjustments section on Page 129. If the hum is not heard, refer to the In Case Of Difficulty section of this Manual. Then, after correcting the problem, proceed to the Adjustments section.

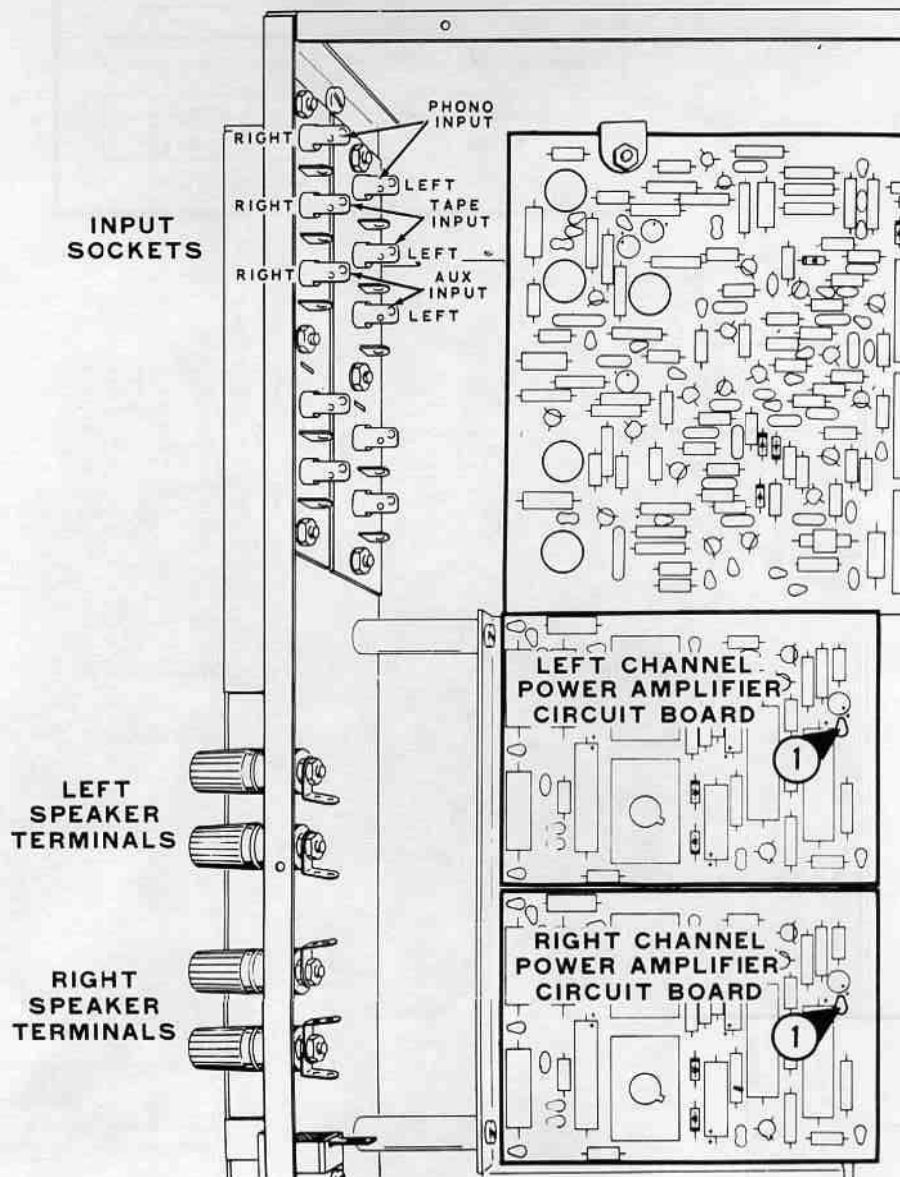


FIGURE 1-8

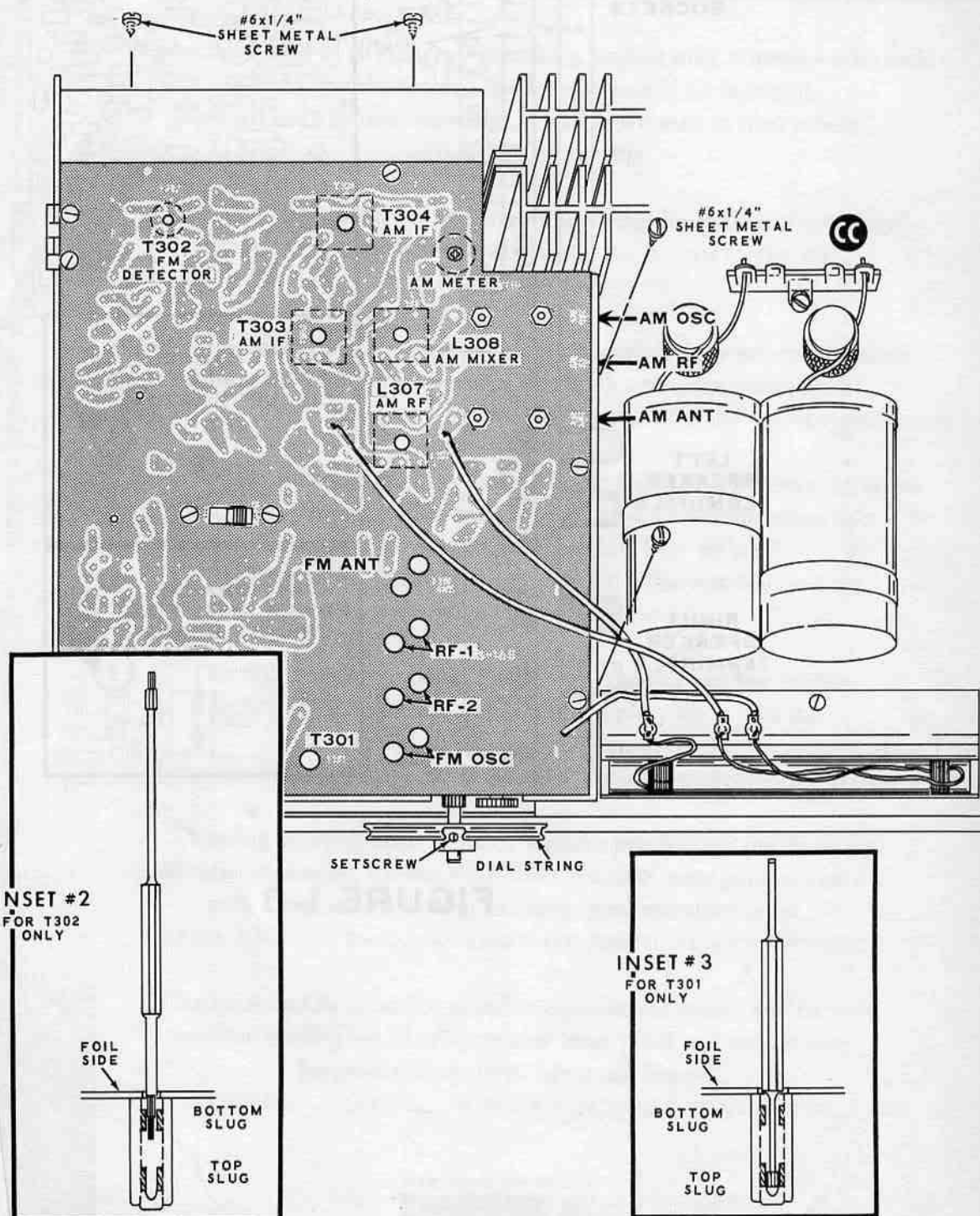
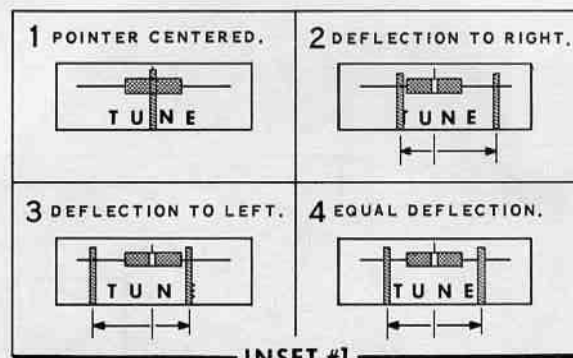
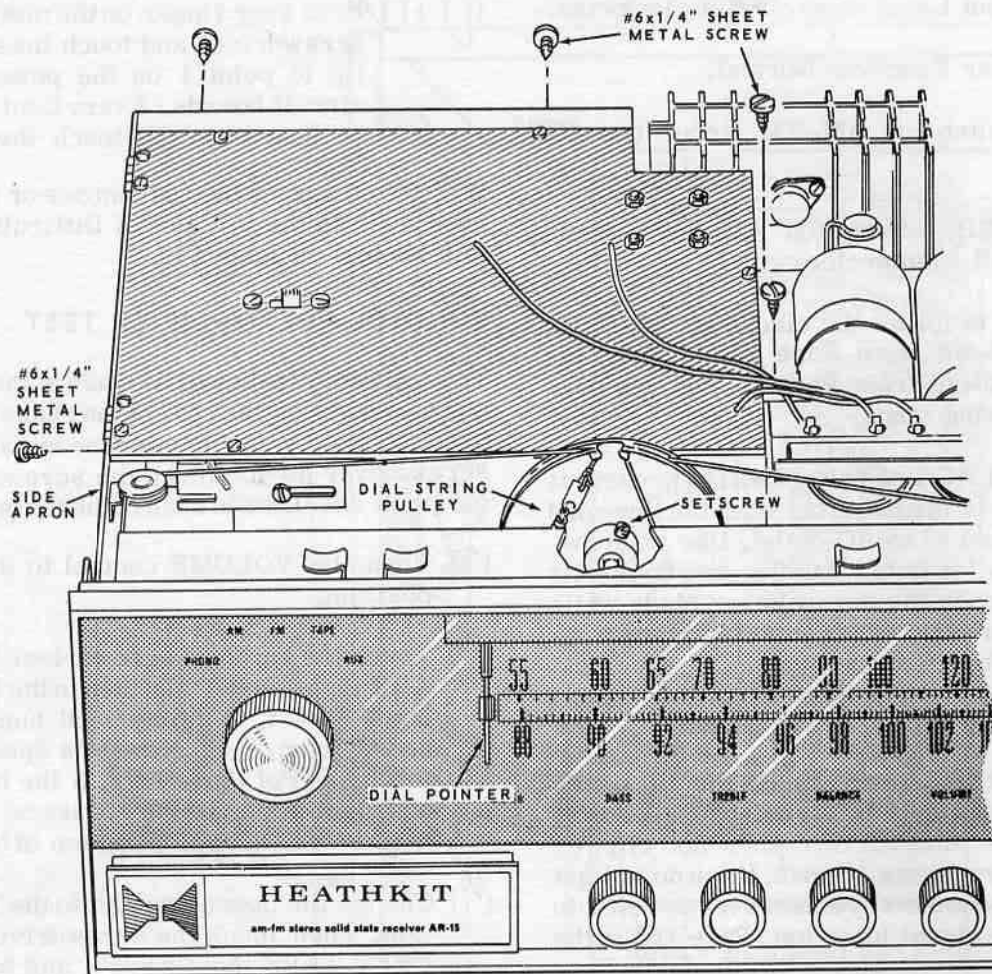


FIGURE 1-9



Detail 7-32C

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ADJUSTMENTS

If the AM-FM circuit board assembly was opened, it must be remounted and the dial string pulley attached before you make final adjustments in your Receiver.

Refer to Detail 7-32C, then perform the following steps.

- () Turn the shaft of the AM-FM tuner to the fully clockwise position. The plates of the AM tuning capacitor should be fully closed.
- () Unlatch the AM-FM circuit board support bracket from the apron. Then position the bracket parallel to the edge of the circuit board as shown, and tighten the sheet metal screw to hold the bracket in place.

() Carefully close the AM-FM circuit board against the chassis. Be sure you do not pinch any wires between the shields and the chassis.

() Replace the #6 x 1/4" sheet metal screws in the flanges of the AM-FM shield and in the rear of the phono preamplifier shield.

() Slide the dial string pulley onto the FM tuning unit shaft. Then rotate the Tuning knob until the setscrew is at the 12 o'clock position. Now tighten the setscrew in the dial string pulley.

FM ADJUSTMENTS

Refer to Figure 1-9 (fold-out from Page 128) for the following steps.

Very little adjustment, if any, will be required in the FM section of the AM-FM circuit board. The following steps will help you check the FM section and make any adjustments that are necessary.

NOTE: The FM OSC, FM ANT, RF1 and RF2 adjustments in the FM tuning unit were prealigned at the factory. These locations are shown on the foil side of the circuit board. Do not turn these adjustments.

- () Turn the Source switch to the FM position.

() Press the SPEAKER switch to ON.

() Connect an antenna to the FM antenna terminals. Refer to Page 139.

() Slowly turn the tuning knob until only one station signal is heard. Find a station that causes a steady SIGNAL meter deflection between 1 and 4.

() Observe the TUNE meter as you slowly turn the tuning knob to either side of the station signal. The TUNE meter should deflect an equal distance from the zero center mark as you tune from one side of the signal to the other. See inset drawing #1 on Figure 1-9.

Perform the next step only if the TUNE meter does not deflect an equal distance both sides of zero as you tune through a station signal.

NOTE: Transformer T302, which will be adjusted next, has two internal adjustments, top slug and bottom slug, as shown in inset drawing #2. Do not adjust the top slug of T302.

Use the short hexagonal end of the large plastic alignment tool in the following adjustment.

- () Insert the end of the alignment tool through the foil side of the AM-FM circuit board in the hole at T302. Then adjust the bottom slug of FM detector coil T302 very carefully as you slowly turn the Tuning knob back and forth through the station signal. When the TUNE meter deflection is equal on both sides of zero, the bottom slug of T302 is properly adjusted.

- () Tune in the station so the TUNE meter is centered at zero.

Use the hexagonal end of the small plastic alignment tool in the following adjustments.

NOTE: Transformer T301, which will be adjusted next, has two internal adjustments, top slug and bottom slug. To reach the top slug, push the alignment tool through the hole in the bottom slug, as shown in inset drawing #3.

- () Insert the alignment tool through the foil side of the AM-FM circuit board in the hole at T301. Then adjust the top slug of FM IF transformer T301 for maximum SIGNAL meter deflection.
- () Adjust the bottom slug of T301, through the hole from the foil side of the circuit board, for maximum SIGNAL meter deflection.

MULTIPLEX ADJUSTMENTS

Adjustments in the multiplex circuits will be made on the component side of the multiplex circuit board.

Before you begin these adjustments, set the following controls and switches as indicated. Then perform the steps that follow.

- () Source: FM.
- () PHASE (push in): Center of rotation.
- () SQUELCH: Fully counterclockwise.
- () STEREO THRES: Full counterclockwise.
- () MODE: STEREO.
- () FM: NORMAL.
- () NOISE FILTER: Off.
- () Separation control: Full clockwise; then counterclockwise 1/4 turn. See Figure 1-10.
- () Tune in an FM station, which is known to be broadcasting stereo program, so the TUNE meter pointer is centered at zero.
- () Set the 19 kHz switch (on the AM-FM circuit board) to the ADJUST position.

Refer to Figure 1-10 for the following steps.

NOTE: Use the screwdriver end of the small alignment tool to adjust coil L409 and transformers T401 and T402 in the next steps.

- () Adjust the slug in coil L409 (no more than 1-1/2 turns in either direction) for a maximum reading on the SIGNAL meter. The FM STEREO indicator should light.
- () Adjust the slug in coil L409 counterclockwise for a reading of 1-1/2 on the SIGNAL meter.



- () Adjust the slug in transformer T402 for maximum deflection on the SIGNAL meter.
- () If the FM STEREO indicator is still lit, turn the slug of L409 counterclockwise until the light just goes off.
- () Press the POWER switch to OFF.
- () Connect a 6" length of hookup wire from pin GND of coil L409 to TP1 on the circuit board.
- () Press the POWER switch to ON. The FM STEREO indicator should light.

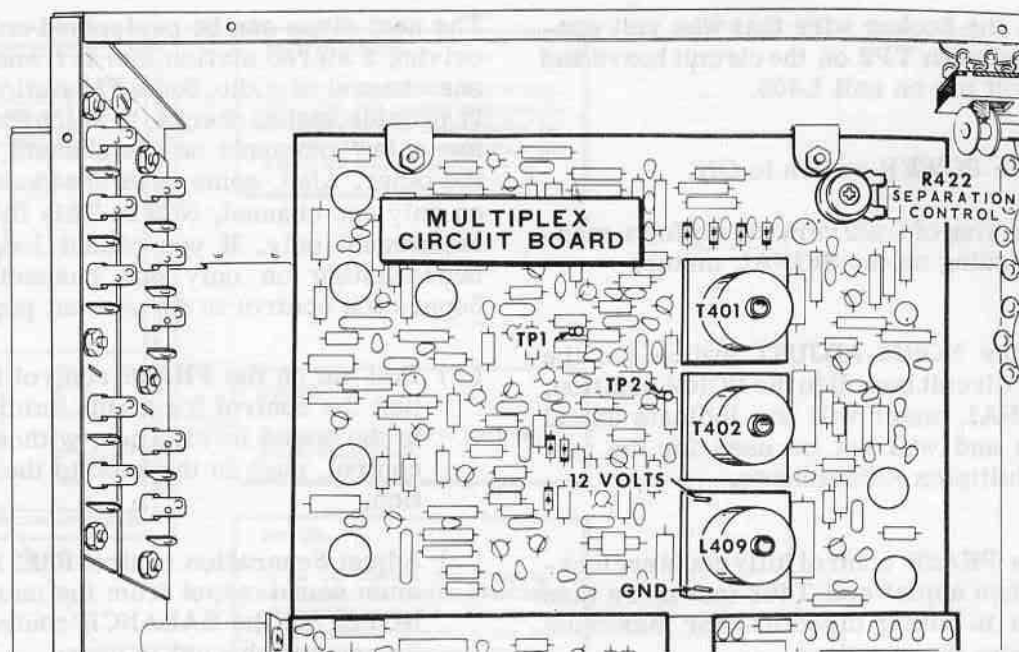


Figure 1-10

In the following steps, the 38 kHz oscillator will be adjusted to the same frequency as the stereo subcarrier. If the oscillator and subcarrier are not at the same frequency, the audio will sound garbled on stereo stations. This adjustment is made by turning to a station broadcasting stereo. A beat note will be heard in the background (due to the connections that were made earlier. NOTE: The beat note can be identified by a steady whistle.) The 38 kHz oscillator will then be adjusted until the beat note disappears and the audio becomes clear.

- () Pull the PHASE control knob out to the ADJUST position.
- () Tune in an FM stereo station. If it is difficult to detect a beat note, try another stereo station.
- () Turn the slug of transformer T401 (no more than 1 turn) slowly in the direction which lowers the pitch of the beat note until the note disappears and the audio becomes clear.
- () Note the position of the slot in the slug of T401. Then slowly turn the slug in the same direction it was last turned until the audio again becomes garbled.

- () Again note the position of the slot in the slug. Now turn the slug so the slot is midway between this last position and the first position.
- () Press the POWER switch to OFF.
- () Remove the hookup wire previously installed between TP1 on the circuit board and pin GND of coil L409.
- () Connect the hookup wire from TP2 on the circuit board to the 12 volt pin on coil L409.
- () Press the POWER switch to ON.

If the audio is not garbled, the 38 kHz oscillator (T401) is adjusted properly and step 1 (only) below can be omitted. If it is still garbled, proceed with the following adjustment.

NOTE: This is a fine adjustment and should be done very carefully. The point you will be instructed to find in the next step can be passed by very easily.

1. () Turn the slug of T401 very slowly (no more than 1/4 turn) until the audio becomes clear.
- () Press the POWER switch to OFF.

- () Remove the hookup wire that was just connected between TP2 on the circuit board and the 12 volt pin on coil L409.
- () Press the POWER switch to ON.
- () Turn the slug of L409 very slowly for a maximum reading on the SIGNAL meter.
- () Return the NORM-ADJUST switch (on the AM-FM circuit board) to the NORM position. The SIGNAL meter will now indicate signal strength and will not be used for the rest of the Multiplex Adjustments.
- () Turn the PHASE control fully counterclockwise. Then adjust coil T402 (not more than one turn in either direction) for maximum sound from the speakers.
- () Turn the PHASE control clockwise until a null (minimum sound) is reached in the sound from the speakers. Then, without turning the control, push the knob in to the NORM position.

The next steps can be performed only while receiving a stereo station that is transmitting only one channel of audio. Some FM stations frequently provide stereo checks, in which they broadcast for a few moments on one channel, and then on the other. Also, some news broadcasts are made on only one channel. NOTE: This is an optimum adjustment only. If you cannot locate a station broadcasting on only one channel, leave the Separation control in its present position.

- () Pull out on the PHASE control knob and adjust the control for a null (minimum sound) in the sound level. Then, without turning the control, push in the knob to the NORM position.
- () Adjust Separation control R422 for the minimum sound output from the unused channel. NOTE: Set the BALANCE control until only the unused channel is heard.

This completes the Multiplex Adjustments. Do not try to adjust any other coils on the multiplex circuit board at this time. Special equipment is required for these adjustments, as described in the Alignment With Instrument section of the Manual.

AM ADJUSTMENTS

These adjustments will be made on the foil side of the AM-FM circuit board, as shown in Figure 1-9 (fold-out from Page 128).

- (✓) Turn the Receiver upright with the front panel toward you.
- (✓) Turn the tuning knob fully counterclockwise.
- (✓) Turn the AM OSC, AM RF, and AM ANT trimmer screws clockwise until they are just snug. Then loosen each of these screws approximately 1/8 turn. These screws are on the side of the AM tuning capacitor and can be reached with a small screwdriver through the slot in the side of the AM-FM shield. Be careful not to touch the output coils or the lugs of terminal strip CC with the screwdriver shaft.
- (✓) Connect the line cord plug to an AC outlet; then press the POWER switch to the ON position.
- (✓) Turn the Source switch to the AM position. A slight background noise, or hissing sound, should be heard from the speakers.
- () Without a station tuned in, adjust the AM METER control until the SIGNAL meter indicates zero.
- () Slowly turn the tuning knob clockwise until an AM station signal is heard from the speakers. The SIGNAL meter should deflect slightly.

NOTE: The best signal to use for the following adjustments is a weak signal received at approximately 60 on the AM dial. However, you may use the first weak signal you receive as you turn the knob clockwise. Use the large plastic alignment tool that is provided to adjust the coil slugs in the following steps.

✓) Adjust the slug in IF transformer T304 a turn or two in either direction until the sound is loudest and the SIGNAL meter deflects farthest. Turn the VOLUME control counterclockwise if the sound becomes too loud.

() Alternately adjust the bottom slug and the top slug in IF transformer T303 for maximum SIGNAL meter deflection and loudest sound. See inset drawing #2 on Figure 1-9 (fold-out from Page 128).

() If the previous two steps have increased the receiver sensitivity, turn the tuning knob to try to find a weaker station signal near 60 on the AM dial. It may be necessary to turn the chassis slightly on your work surface to receive the weak station. Then repeat the last two steps. NOTE: The TUNE meter will not indicate when the SOURCE switch is in the AM position.

() Turn the Source switch to FM.

() Tune in an FM station near 98 MHz on the dial. Check the frequency of the station as listed in a newspaper, or announced during station break. Then hold the dial string pulley so it can not turn and slide the dial pointer to the station number.

() Turn the Source switch to AM.

1. () Tune in a station of known frequency near 1400 kHz (140 on the dial scale).

If the dial pointer does not indicate the station frequency correctly, the AM OSC trimmer screw must be adjusted as directed in the following step.

2. () Slowly turn the AM OSC trimmer screw as you move the Tuning knob in the direction of the proper station frequency. Stop when the dial pointer indicates the frequency of the station that is tuned in.

3. () Adjust the AM RF trimmer screw (on the side of the AM tuning capacitor) for maximum SIGNAL meter deflection and loudest sound.

4. () Similarly, adjust the AM ANT trimmer screw.

5. () Tune in a station of known frequency near 600 kHz (60 on the dial scale).

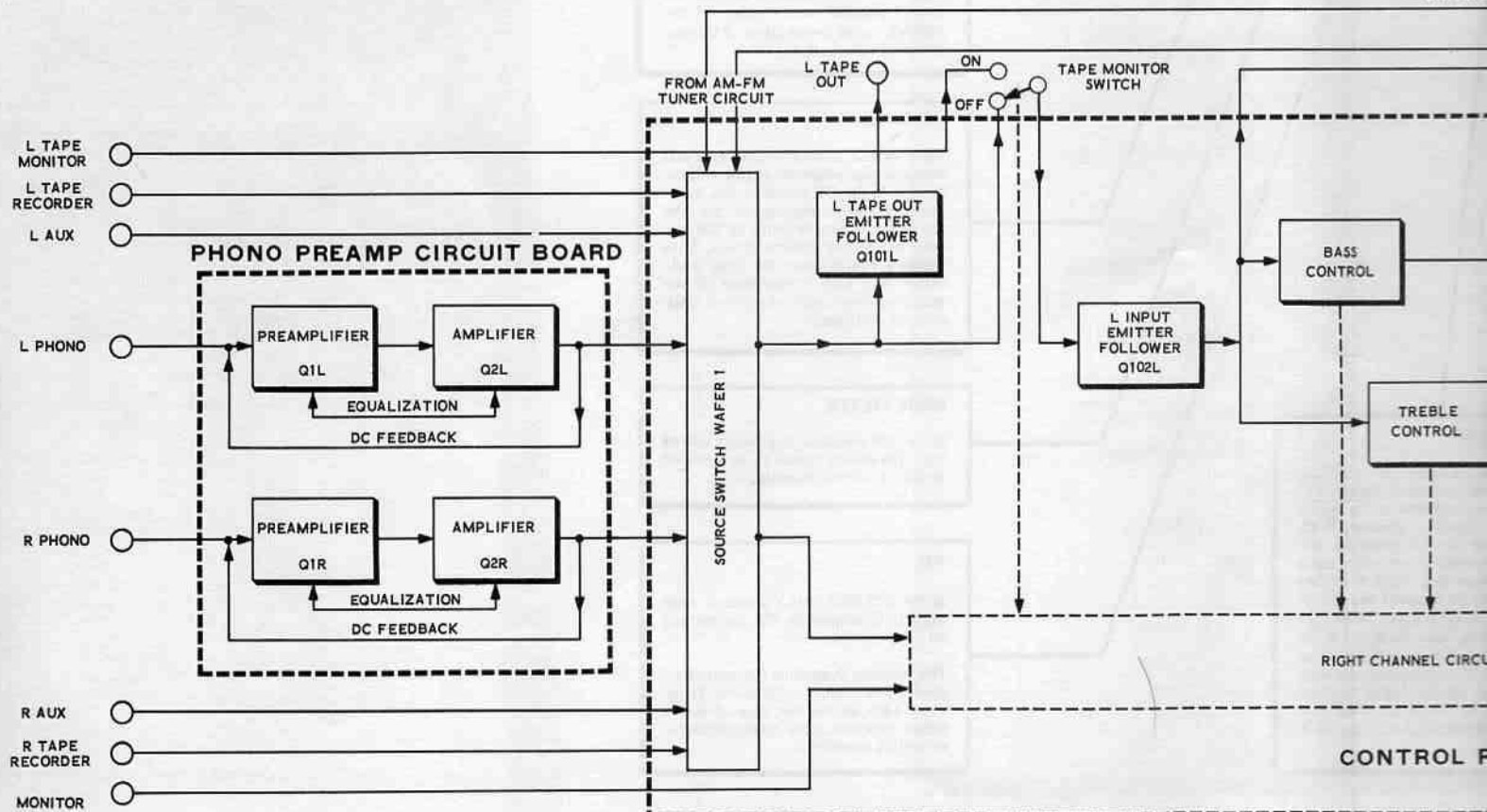
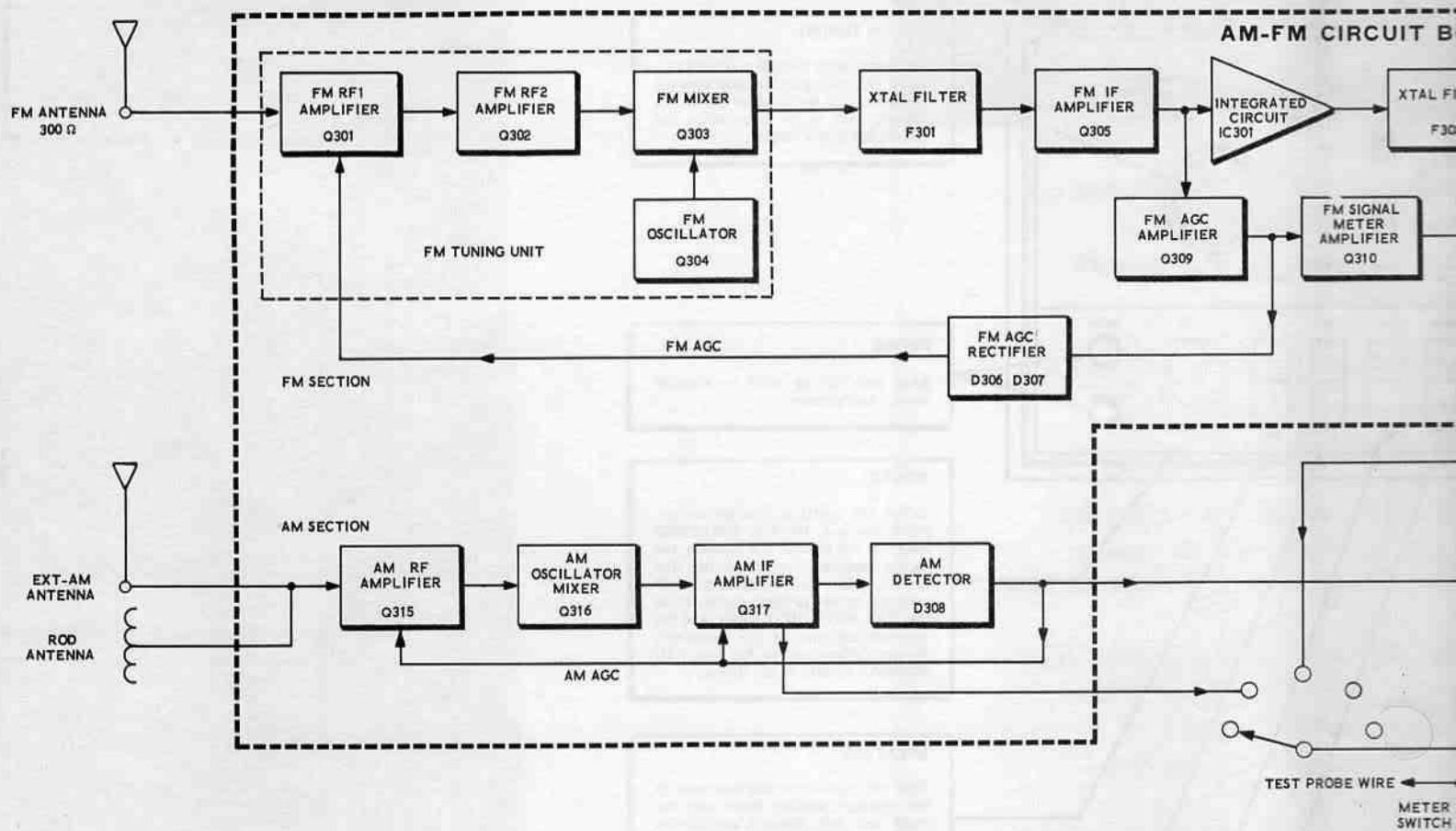
6. () Slowly turn the dial pointer back and forth (on each side of the station frequency) while adjusting the slug in coil L308 for a maximum SIGNAL meter deflection.

7. () Adjust the slug in RF coil L307 for maximum SIGNAL meter deflection and loudest sound.

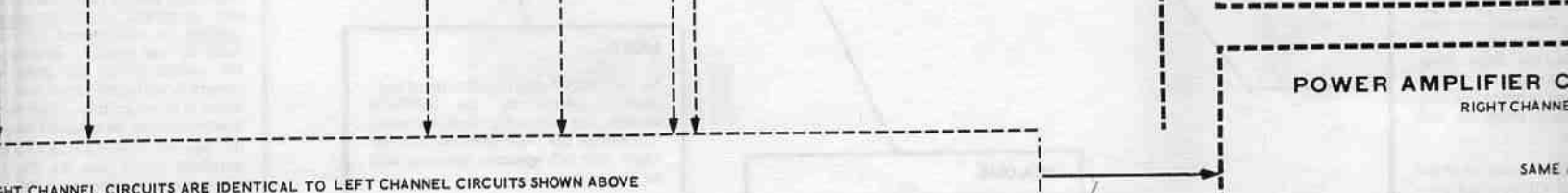
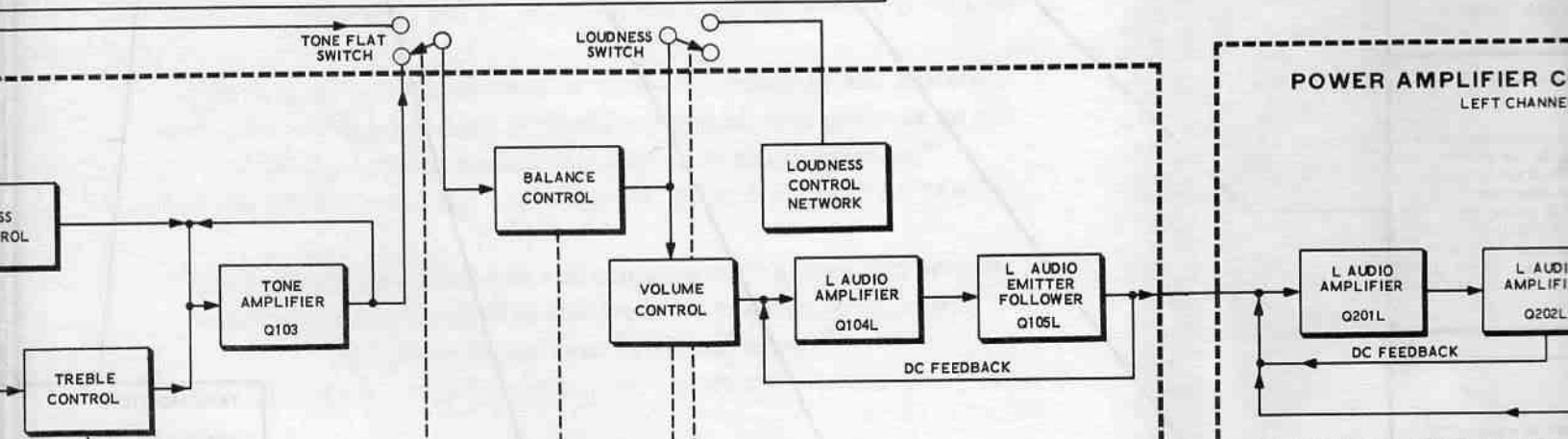
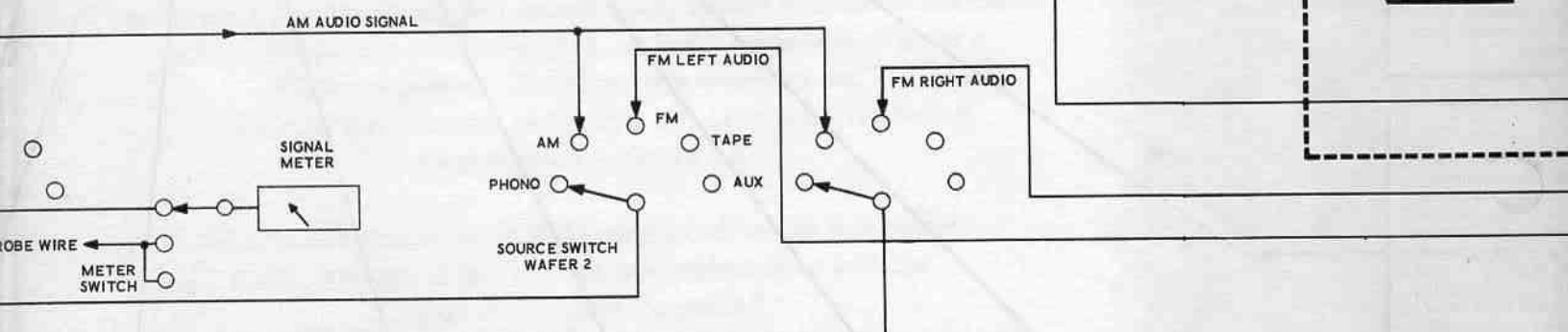
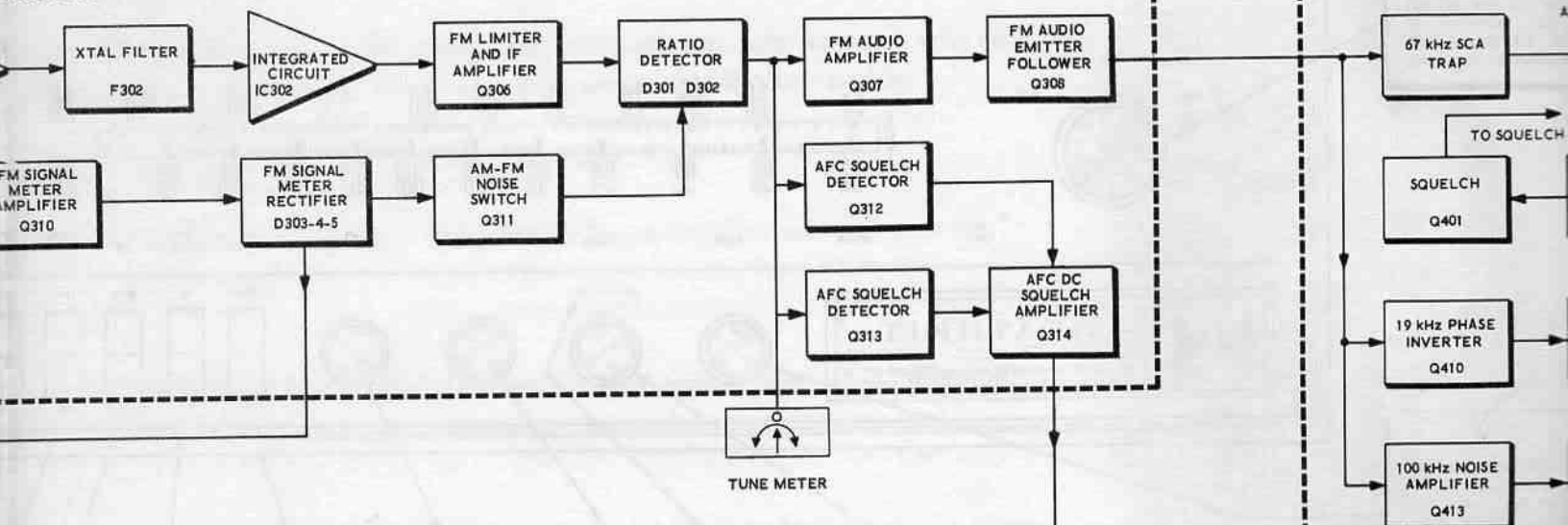
8. () Recheck the tuning of the station near 140 on the dial. If the pointer is no longer at the correct point, repeat steps 1 through 8.

The Receiver is now completely tested and adjusted. Proceed to the Final Assembly section.

NOTE: At the low end of the dial, you may receive a station better when the pointer is to one side or the other of the station number. EXAMPLE: A station at 60 on the dial (600 kHz) may read 58 to 62. This is normal and no readjustments are necessary.

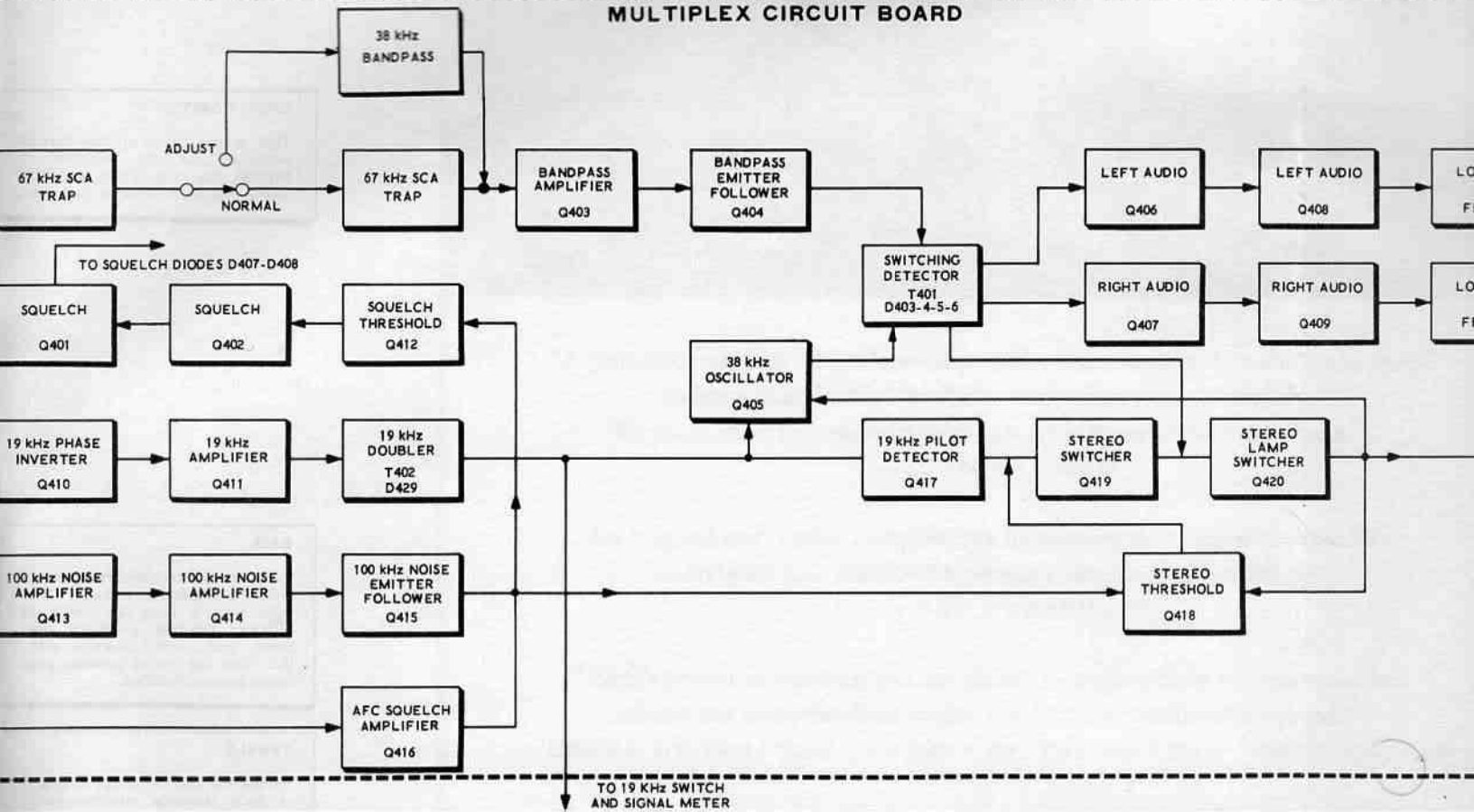


CIRCUIT BOARD

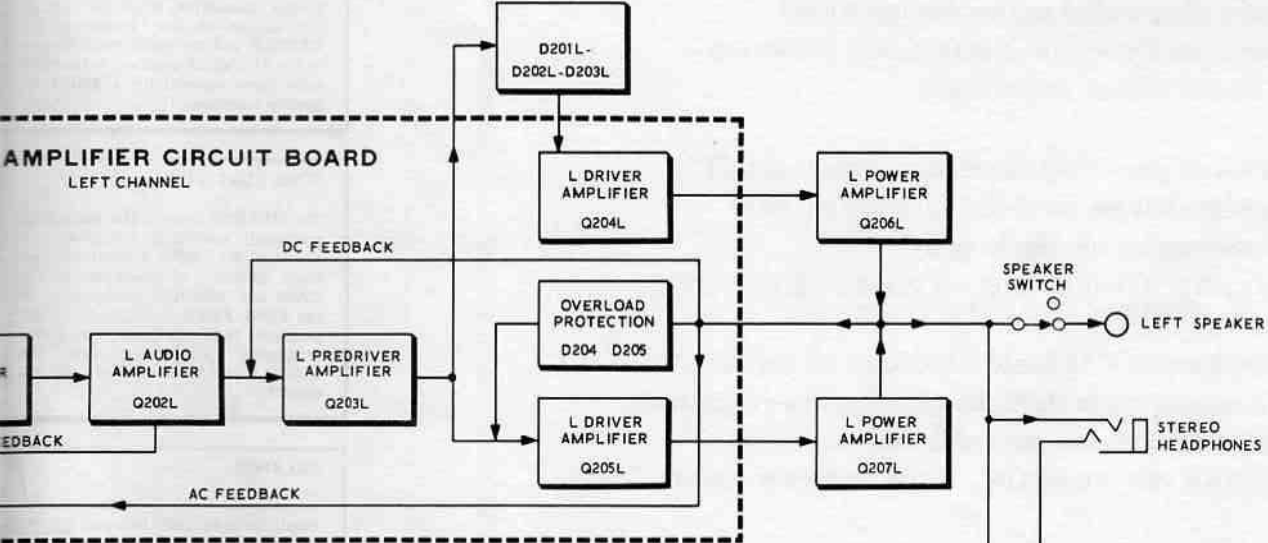


CONTROL PREAMP CIRCUIT BOARD

MULTIPLEX CIRCUIT BOARD

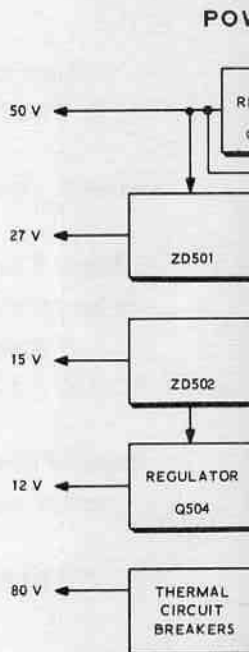


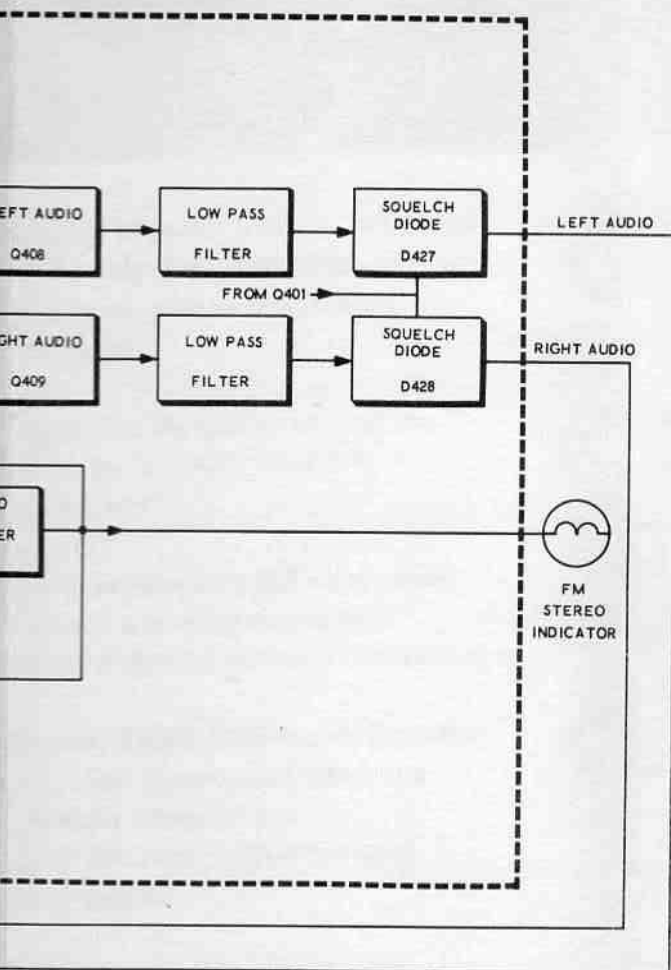
AMPLIFIER CIRCUIT BOARD LEFT CHANNEL



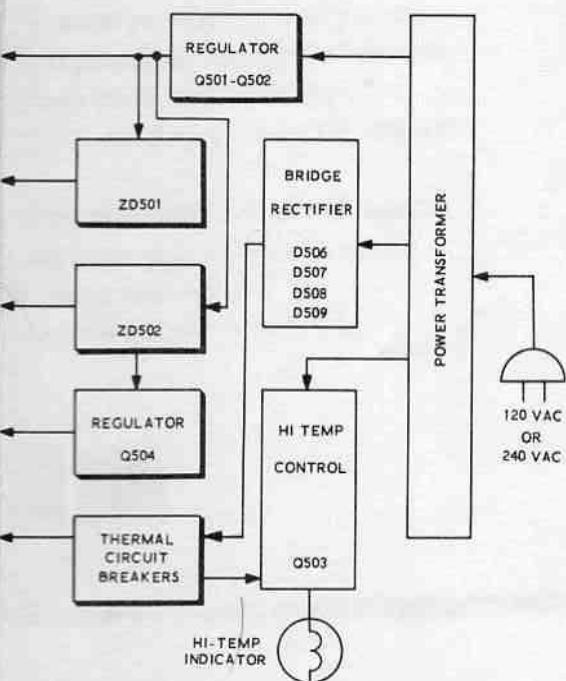
AMPLIFIER CIRCUIT BOARD RIGHT CHANNEL

SAME AS LEFT CHANNEL SHOWN ABOVE





POWER SUPPLY



SOURCE SWITCH

This switch does all the circuit switching for the selection of PHONO, AM, FM, TAPE, and AUX (auxiliary) input program material.

BASS

Varies the low frequency response of both channels simultaneously. Clockwise rotation from the center (12 o'clock) position produces bass boost, and counterclockwise rotation from the center position produces bass attenuation.

TREBLE

Varies the high frequency response of both channels simultaneously. Clockwise rotation from the center (12 o'clock) position produces treble boost, and counterclockwise rotation from the center position produces treble attenuation. When the indicator marks on the knobs of the TREBLE and the BASS controls are in the 12 o'clock position, both channels have essentially a flat frequency response.

TONE FLAT-PULL

The TREBLE control also includes a push-pull switch. In the pushed-in position, the TREBLE and BASS controls function as described in the BASS and TREBLE paragraphs. In the TONE FLAT-PULL (pulled-out) position, both channels have a flat frequency response, and the TREBLE and BASS controls are inoperative.

BALANCE

Adjusts the left or right channel amplifiers so there is equal effective sound from the left and right channel speakers. Counterclockwise rotation, from the center (12 o'clock) position, decreases the output from the right channel amplifier; clockwise rotation from the same position decreases the output from the left channel amplifier.

Full counterclockwise rotation of the BALANCE control will produce zero output from the right channel amplifier. Full clockwise rotation will produce zero output from the left channel amplifier.

VOLUME

Adjusts the sound level of both channels simultaneously. Maximum output is obtained in the full clockwise position.

MODE

In the MONO position the input signals, selected by the SOURCE switch, are applied to both channels. Therefore the reproduction from the right and left speaker systems will be the same.

In the STEREO position, left and right channel signals are applied to the corresponding left and right channel amplifiers.

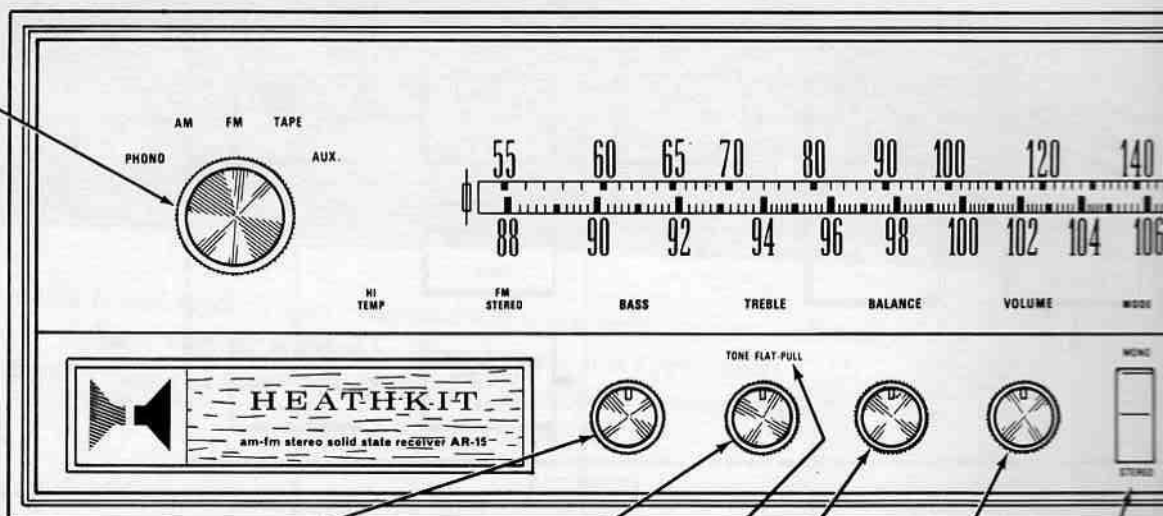
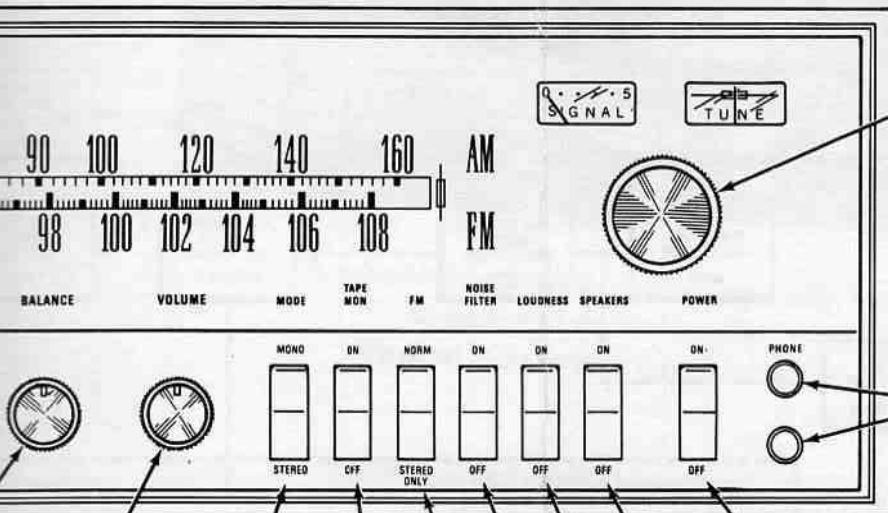


FIGURE 3-1



AM-FM TUNING

Performs both the AM and FM TUNING. The dial pointer indicates the frequency of the station being received, (AM on the upper scale and FM on the lower scale).

PHONE

Each jack can be used for a set of stereo headphones.

POWER

In the ON position, this switch applies power to the VAC SWITCHED outlet at the rear of the chassis and to the internal circuits of the Receiver. With the switch in the OFF position, power is disconnected from the VAC SWITCHED outlet and the internal circuits of the Receiver. Power is applied to the two VAC NORMAL outlets at all times.

SPEAKERS

This switch electrically disconnects the speaker system from both the right and left channel amplifiers. Output signals are present at the PHONE jacks regardless of the position of this switch.

LOUDNESS

This switch allows you to hear full musical reproduction at low volume levels. In the ON position, the loudness circuit compensates for the nonlinear characteristic of the human ear at low volume levels. This enables you to hear the low, mid-range and high frequencies at the same apparent level at low VOLUME control settings.

NOISE FILTER

In the ON position this switch allows high frequency noise to be reduced from FM stereo signals.

FM

In the STEREO ONLY position, only signals broadcast in FM Stereo will be reproduced.

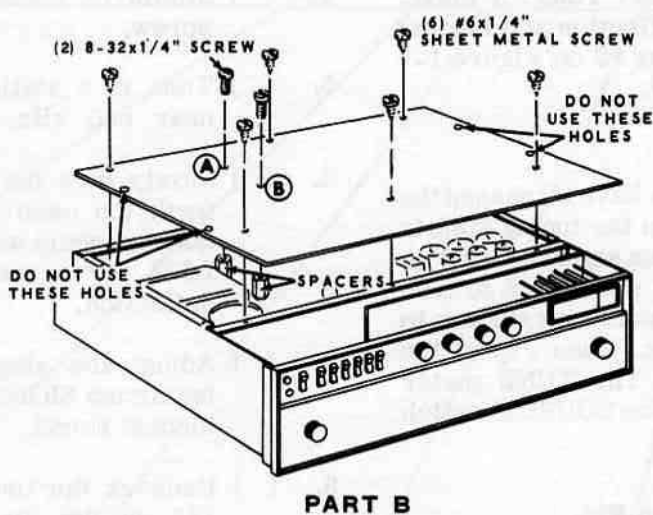
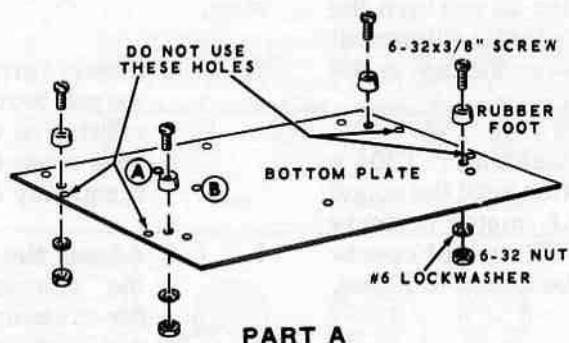
The Normal Operation Program Reproduction Chart, (fold-out from Page 148) shows the type of audio output obtained from different rocker switch positions.

TAPE MONITOR

With this switch in the OFF position, any program material being recorded, is reproduced at the same time by the speaker system. With the switch in the ON position, the program material is not heard until after it is recorded. This recorded material may be coupled back from the tape recorder (if it has a separate playback head) into the Tape MON (tape monitor) jacks on the rear of the chassis. This provides you with instantaneous monitoring of the tape recording. The connections for this feature are illustrated in Figure 2-1 on Page 137.

position the input signal by the SOURCE led to both channels. reproduction from the speaker systems will

position, left and right are applied to the left and right channel

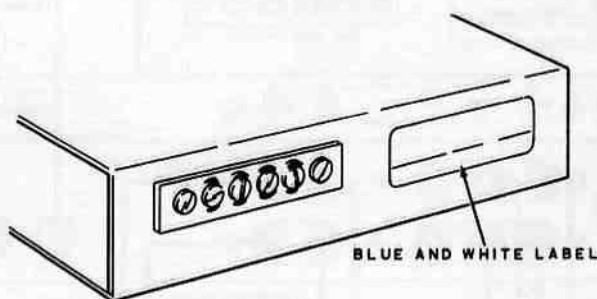


PICTORIAL 7-33

FINAL ASSEMBLY

NOTE: If the Receiver is to be custom mounted or installed in the Heath Accessory Cabinet, complete steps 3, 4, and 5 only and refer to Part B of Pictorial 7-33. If the Receiver is to be placed on a shelf or a similar location, complete steps 1 through 5 and refer to Parts A and B of the Pictorial.

1. () Position the bottom plate with holes A and B as shown. NOTE: The bottom plate is perforated with ventilation holes. However, the mounting holes can be identified by their larger diameter.
 2. () Mount the four plastic feet on the bottom plate with 6-32 x 3/8" screws, #6 lockwashers, and 6-32 nuts. NOTE: Do not use the mounting holes called out in the Pictorial.
 3. () Place the Receiver on your work surface as shown.
 4. () Position the bottom plate with holes A and B as shown. Then mount the plate on the chassis with two 8-32 x 1/4" screws in holes A and B. Do not use the holes called out in the Pictorial.
 5. () Install six #6 x 1/4" sheet metal screws in the indicated holes.
- () Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the phono preamplifier shield along side the antenna terminal strip. Refer to Detail 7-33A. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.



Detail 7-33A

INSTALLATION

Refer to Figure 2-1 before you connect the speaker systems, antennas, and accessory equipment to your Receiver.

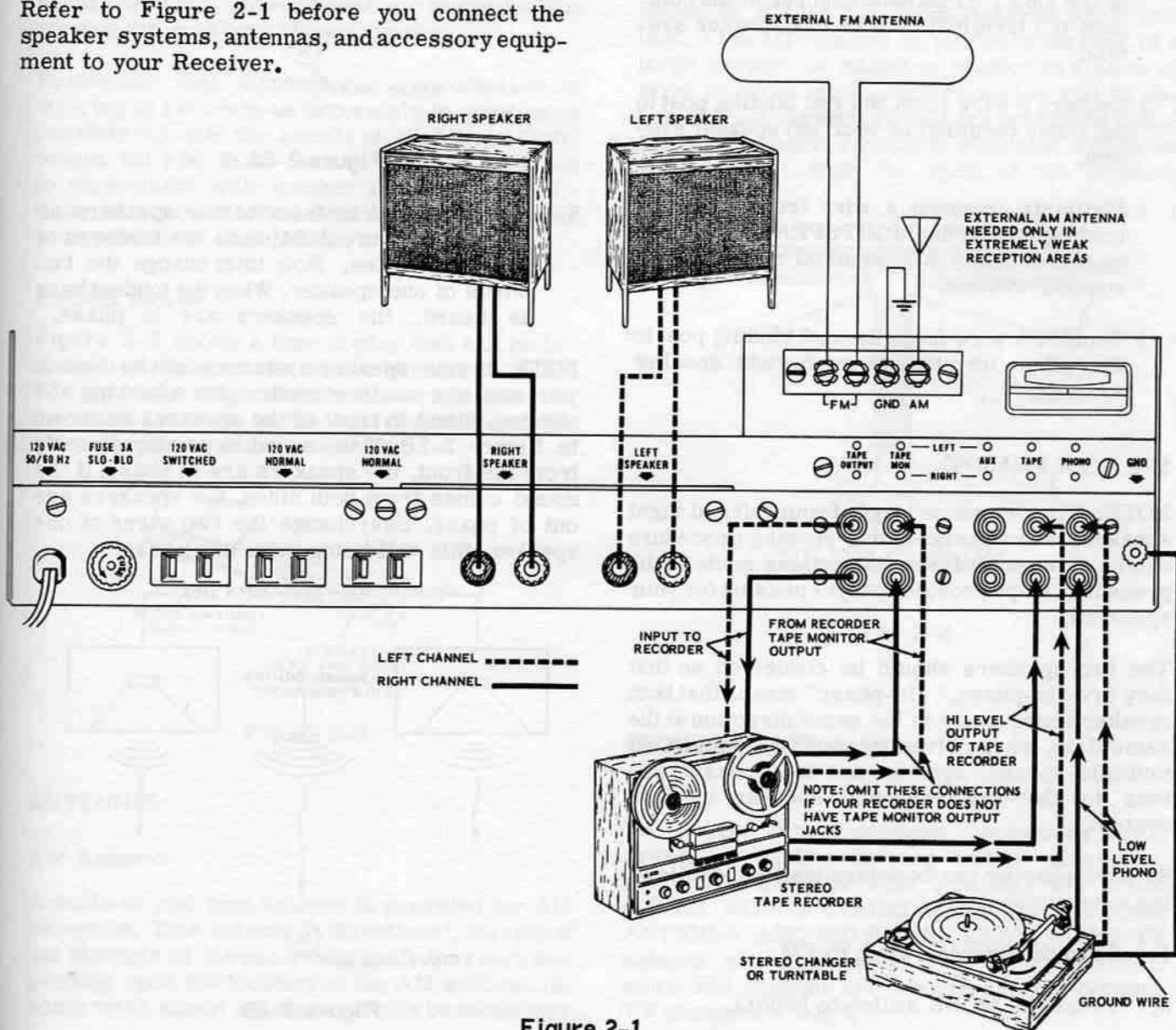


Figure 2-1

SPEAKER CONNECTIONS

Any speaker system that has an impedance rating of 4 ohms to 16 ohms may be connected to the LEFT SPEAKER or RIGHT SPEAKER binding posts.

For best results, both the left and right speaker systems should have the same impedance rating. **CAUTION:** Make sure the wires connected to the Receiver binding posts, or those connected to the terminals of your speaker systems, do not short together.

- () Connect a wire from the black binding post of the LEFT SPEAKER channel to the common (C) terminal of your left speaker system.
- () Connect a wire from the red binding post to the other terminal of your left speaker system.
- () Similarly, connect a wire from the black binding post of the RIGHT SPEAKER channel to the common (C) terminal of your right speaker system.
- () Connect a wire from the red binding post to the other terminal of your right speaker system.

SPEAKER PHASING

NOTE: If the "common" lugs of your left and right speakers were marked, this phasing procedure can be disregarded; the connections made in the preceding steps provided proper phasing for your speakers.

The two speakers should be connected so that they are "in-phase." "In-phase" means that both speaker cones move in the same direction at the same time, when driven by identical signals. (If multiple-speaker systems are used, phasing refers to the low-frequency speaker in each system.)

Speaker phasing can be determined in the following manner:

1. Turn the Source switch to FM.
2. Press the MODE switch to MONO.

3. Tune in an FM station and turn up the VOLUME controls to a comfortable listening level.
4. Turn the speakers so they face each other and are approximately three feet apart. See Figure 2-2A.

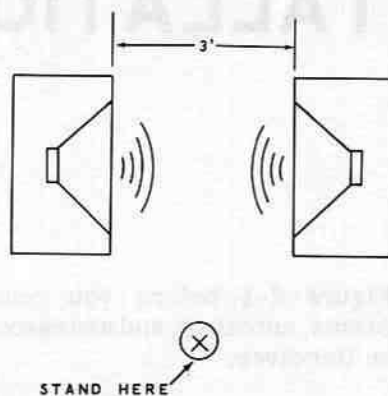


Figure 2-2A

5. As you stand in front of the speakers as shown in Figure 2-2A, note the loudness of the bass notes. Now interchange the two wires of one speaker. When the loudest bass is heard, the speakers are in phase.

NOTE: If your speaker system cannot be moved, you can use another method for checking the phasing. Stand in front of the speakers as shown in Figure 2-2B. If the sound is coming directly from the front, the speakers are in phase. If the sound comes from both sides, the speakers are out of phase. Interchange the two wires of one speaker; this will bring them into phase.

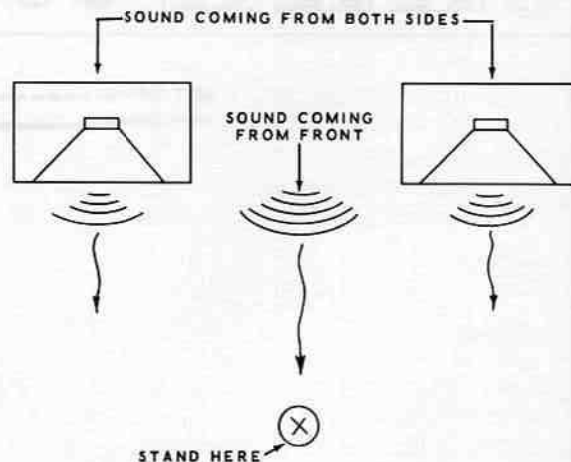


Figure 2-2B

SPEAKER PLACEMENT

Generally, for stereo listening, the two speakers should be spaced four to eight feet apart. They should be placed along a wall facing the listening area. The optimum positions can best be determined by experiment. A great deal depends upon the size and acoustic properties of the room, and upon the high frequency dispersion characteristics of the speakers. Identical speakers or speaker systems are recommended.

Correct spacing between speakers depends to some extent upon the listener's position and distance from the speakers. If the listening position is restricted to one that is relatively close to the speakers, some improvement may be obtained by moving the speakers closer together.

Remember that stereophonic reproduction is striving to recreate as accurately in position as possible not only the sounds of "right" and "left" origin, but also those near the center. Feel free to experiment with speaker and listening positions to arrive at the best set of conditions for your particular installation.

PHONE JACKS

Figure 2-3 shows a type of plug that can be installed on the end of a stereo headphone cable. The tip of the plug connects to the right channel, the ring connects to the left channel, and the sleeve is the common connection.

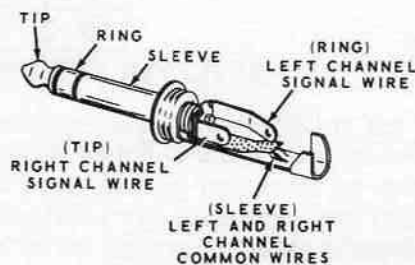


Figure 2-3

ANTENNAS

AM Antenna

A built-in rod type antenna is provided for AM reception. This antenna is directional, therefore the strength of the received signals may vary depending upon the location of the AM stations. In some weak signal locations, it may be necessary

to connect a ten foot length of hookup wire to the external AM antenna connection to improve reception. This wire may be draped behind the equipment cabinet or spread along the baseboard of the room.

INDOOR ANTENNAS

Several types of indoor TV and FM antennas are available that will provide satisfactory mono FM operation of the Receiver in strong signal areas, or from strong local stations. For stereo FM however, an outdoor antenna should be used.

A simple folded dipole antenna can be made as shown in Figure 2-4, from standard 300 Ω twin lead. This antenna can be placed on the rear of a large cabinet or nailed or stapled to a piece of wood to reinforce it. Best reception will be obtained from the stations that are broadside to this antenna. Weakest reception will occur with those stations that face the ends of the antenna.

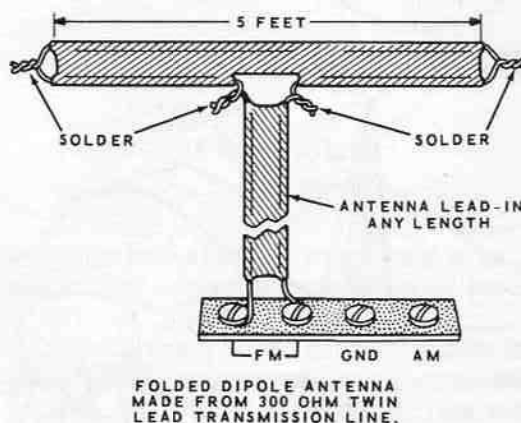


Figure 2-4

OUTDOOR ANTENNAS

To receive weaker stations, or in weak signal areas, an outdoor antenna will be necessary. BEST RECEPTION FOR STEREO FM WILL OCCUR WITH A COMMERCIAL FM OUTDOOR ANTENNA AND 300 Ω TWIN LEAD. A VHF TV antenna can also be used as an FM antenna, since FM stations are actually located between TV channels 6 and 7.

Do not connect a TV antenna to both the TV set and the Receiver at the same time, unless a TV antenna coupler is used, or a weak and distorted signal may occur in both units. Pad type couplers are not recommended because large amounts of signal are lost in them. Use a preamplifier type of coupler instead, where there is no loss of signal.

MULTI-PATH SIGNALS

FM or FM stereo signals sometimes become noisy or distorted because they are reaching your antenna from several directions at the same time. See Figure 2-5. These multi-path signals are usually reflected from objects such as large buildings or large metal structures. This type of distortion can usually be eliminated or minimized by turning your antenna until it is receiving only one of these signals.

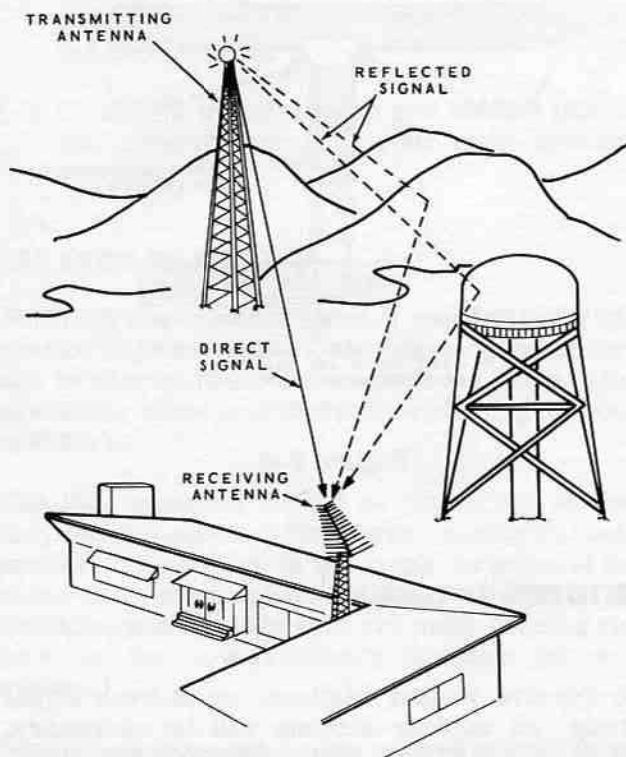


Figure 2-5

FOR A 300 Ω TO 75 Ω UNBALANCED ANTENNA HOOKUP, USE A MATCHING TRANSFORMER AND 75 Ω SHIELDED CABLE.

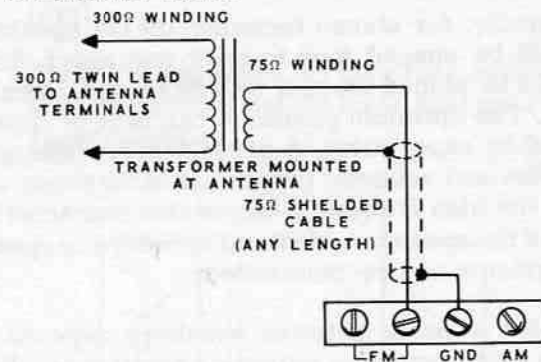


Figure 2-6

Unwanted reflected signals may also be picked up on your antenna lead-in wire in strong signal areas. To eliminate this condition, connect your antenna lead-in to the antenna terminal strip as shown in Figure 2-6 or 2-7.

300 Ω BALANCED ANTENNA HOOKUP USING TWO 75 Ω SHIELDED CABLES

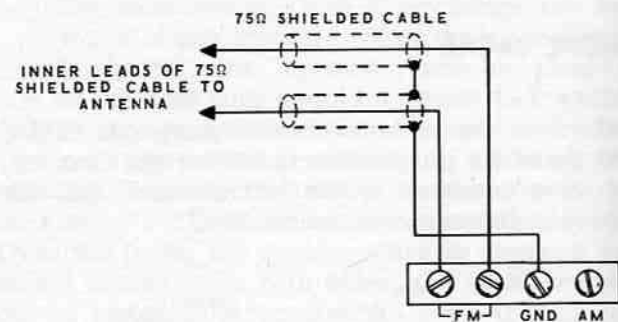


Figure 2-7

INPUT CONNECTIONS

Shielded cables, terminated in standard phono plugs, should be used to connect all signal sources to the input sockets of your Receiver. The following information gives the correct input connections for the various types of signal sources.

Phono Input

For magnetic or variable reluctance phono cartridges.

Auxiliary Input

For use with most high level signal sources such as a television receiver or tape recorders with preamplifier output. A record changer or a turntable equipped with a crystal or ceramic stereo cartridge may also be connected to the AUX inputs. However, the BASS control should be turned up in order to compensate for the low frequency losses when using these cartridges.

Ground Terminal

In some cases the mechanism of a turntable or a changer is not connected to the audio cable shield. To reduce hum in these cases, a separate ground wire should be connected from the turntable to this ground terminal.

AC OUTLETS

120 V AC Switched Outlet

For supplying power to other equipment used with the Receiver. The other equipment can then be controlled by the POWER switch on the Receiver (350 watts maximum).

120 V AC Normal Outlets

For supplying power to devices such as record changers or tape decks that may be damaged if you turn off the power at the Receiver before you shut off the mechanism (350 watts maximum).

MOUNTING THE RECEIVER

This Receiver may be installed in the Heathkit Model AE-16 Cabinet, or it may be custom installed in your present cabinetry or wall paneling. Instructions are given for both types of installation in the following pages. Use only the instructions that apply to your situation.

AE-16 Cabinet Installation

Refer to Figure 2-8 for the following steps.

Locate the four plastic feet supplied with the AE-16 Cabinet and the four 6-32 x 3/4" self-tapping screws, and four 9/16" flat washers that were supplied with the Receiver. Then install the cabinet on the Receiver as follows.

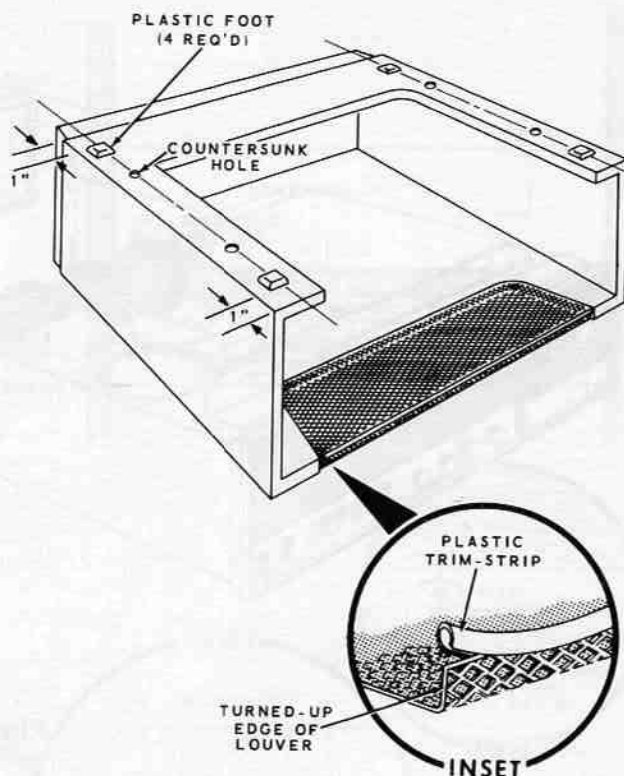


Figure 2-8

- () Place a soft cloth on your work area. Then place the cabinet upside down on the cloth.
- () Carefully remove the backing paper from a plastic foot, then install the foot on the bottom of the AE-16 Cabinet in line with the countersunk hole and 1" from the edge of the cabinet as shown. Press the foot firmly into position.
- () In a similar manner, install plastic feet at the other three corners.

Refer to the inset drawing on Figure 2-8 for the next two steps.

- () Install the plastic trim-strip, supplied with the cabinet, on the turned-up edge of the ventilating louver at the rear of the cabinet top (See Inset Drawing).
- () Start at one end and press the trim-strip into position along the entire length of the louver.

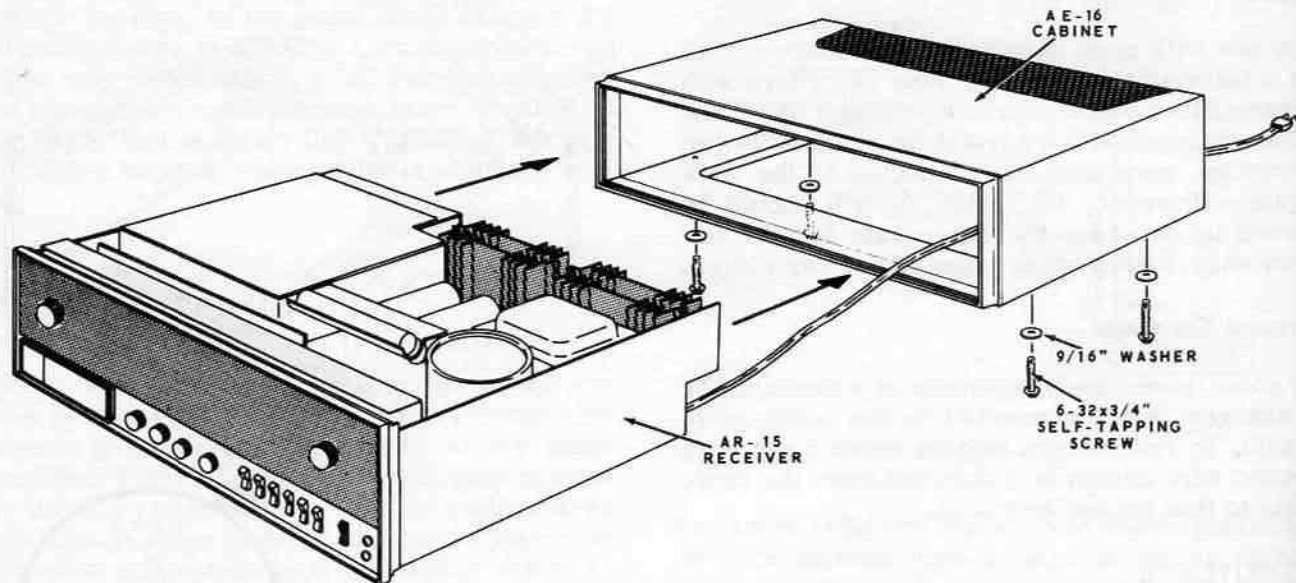


Figure 2-9

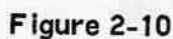
Refer to Figure 2-9 for the following steps.

- () Place the cabinet on your work surface. Pass the line cord through the cabinet and insert the rear of the Receiver through the opening in the front of the cabinet. Slide the Receiver into the cabinet as far as it will go.
- () Position one side of the Receiver over the edge of the work bench. Then fasten the cabinet to the chassis with two 6-32 x 3/4" self-tapping screws and two 9/16" washers. Repeat this procedure with the other side.

This completes the AE-16 Cabinet installation.

CUSTOM INSTALLATION

When planning your custom installation, keep in mind that the Receiver requires adequate ventilation and that the input sockets, speaker connections, and AC outlets on the rear of the chassis must be accessible. The connecting cables should be long enough so they can be connected or disconnected when the Receiver is removed from its installed position.



the Receiver bottom plate. The method you use to secure the mounting board to the panel or wall area will depend upon the specific conditions you encounter in your installation.

OPERATION

INTRODUCTION

The AR-15 Receiver operates from any 105-125, or 210-250 volt 50/60 Hz AC power source. All controls are clearly marked and are accessible from the front. Connections to Speaker Systems, Antennas, and Auxiliary equipment are clearly marked and are made at the rear of the chassis.

The controls are divided into three parts: Primary Controls and Switches, Figure 3-1 (fold-out from Page 134); Secondary Controls and Switches, Figure 3-2, and Meters and Indicator Lamps, Figure 3-3 (fold-out from Page 147).

The Normal Operation Program Reproduction Chart (fold-out from Page 148) shows the type of audio output obtained from different rocker switch positions.

Refer to Figure 3-1 and preset the switches and controls as follows:

- () POWER: OFF.
- () SPEAKERS: ON.
- () LOUDNESS: OFF.
- () NOISE FILTER: OFF.
- () FM: NORM (Normal).
- () TAPE MON (Monitor): OFF.
- () MODE: STEREO.
- () SOURCE: AM.
- () BALANCE: Center of rotation.
- () BASS: Center of Rotation.
- () TREBLE: Center of rotation.

- () VOLUME: Center of rotation.

NOTE: Do not change the setting of the VOLUME control again until after the PHONO and AUX (auxiliary) Level controls have been adjusted. Perform all of the adjustments in the sequence listed on the following pages and do not change the settings of any controls or switches unless you are directed to in a step.

Refer to Figure 3-2 for the following steps.

- () Turn the ten slotted-shaft L and R Level controls, and the PHASE, SQUELCH, and STEREO THRES (threshold) controls, behind the hinged door on the front panel, to their full counterclockwise positions.

AM OPERATION

The following procedure will help you adjust the operating controls of your new Receiver so you will realize the utmost enjoyment from its operation.

- () Place the POWER switch in the ON position. Then tune in a local AM broadcasting station. Tune for maximum deflection of the pointer of the SIGNAL meter.
- () Turn the L-AM/FM Level control clockwise to obtain the desired sound output from the left channel speaker.
- () Now turn the R-AM/FM Level control clockwise until the same sound output is obtained from the right channel speaker.

NOTE: The preceding adjustments set the input level of both the AM and FM signals.

FM OPERATION

The following instructions tell you how to tune in monophonic and stereophonic FM stations to obtain the best reception.

MONOPHONIC FM

Refer to Figures 3-1 and 3-2 for the following steps.

Change the settings of the following switches only:

- () SOURCE: FM.
- () Tune in an FM station. Adjust the Tuning knob until the pointer of the TUNE meter is at the center line between the dark areas of the meter scale. NOTE: Because of the high sensitivity of the AR-15 Receiver and the quantity of FM stations available for listening, it is possible to locate two stations that are quite close together (200 kHz). When this happens, it may be better to tune away from the adjacent station slightly for better listening. The pointer of the TUNE meter will then not be at the center line as described earlier.
- () Now tune off-station until noise is heard from your speaker systems. Then turn the SQUELCH control clockwise just enough to eliminate the between-station noise.
- () Tune across the FM dial to check the effectiveness of the squelch action. The SQUELCH control may have to be turned off (fully counterclockwise) to receive very weak stations. As this control is turned clockwise, only the strongest stations are heard. NOTE: It is not necessary to adjust the SQUELCH control each time you tune in a station.

If high frequency noise is present when the FM station is tuned in correctly, place the NOISE switch in the ON position. This will reduce the high frequency noise.

STEREOPHONIC FM

NOTE: The FM STEREO lamp will light only when an FM stereo station is tuned in. This lamp will not light when monophonic FM stations are tuned in.

- () Place the MODE switch in the STEREO position.
- () Tune across the FM dial until the FM STEREO lamp lights, indicating an FM stereo signal. Adjust the Tuning knob until the station is tuned in correctly with the pointer of the TUNE meter at the scale centerline.
- () Pull out on the PHASE control. Adjust this control for minimum sound from the speaker systems; then push the control back in. This adjustment assures you of maximum separation between the two channels.

NOTE: When an FM stereo transmission is received, the FM STEREO lamp will light. However, if the station should play a monophonic recording, while broadcasting in stereo, there will be no stereo reproduction from your speaker systems and the PHASE control cannot be set.

The setting of the STEREO THRES (threshold) control determines the noise level that will automatically switch your Receiver from stereophonic to monophonic operation when the FM switch is in the NORM position.

You may also want to place the FM switch in the STEREO ONLY position. In this position, only signals from stations broadcasting FM stereo will be reproduced.

- () Adjust the STEREO THRES control full counterclockwise.
- () Tune in a weak noisy FM stereo signal. The FM STEREO lamp should come on.
- () Adjust the STEREO THRES control clockwise until the FM STEREO lamp goes out. Now only FM stereo stations with a noise level below this threshold level setting will be reproduced in stereo and all others will be reproduced monophonically.

TAPE RECORDER OPERATION

Proper connections to the tape recorder are illustrated in Figure 2-1 (Page 137). DO NOT CONNECT A TAPE RECORDER TO THE RECEIVER SPEAKER TERMINALS OR TO THE LUGS OF YOUR SPEAKERS, as some recorder manufacturers recommend, or the Receiver output could become short circuited through the common ground of the tape recorder. Also, many tape recorders place a short circuit across their input terminals while the recorder inputs are not being used.

The signals of any program selected by the SOURCE switch appear at the TAPE OUTPUT jacks, therefore, any source program can be recorded by a suitable tape recorder.

The tape recording procedure is basically the same for all Source switch positions, therefore, operation in only one position of the switch will be presented. Refer to Figures 3-1, 3-2, and 3-3 to identify switch and control positions. Refer to Figure 2-1 for the Tape Recorder connections.

- () Turn the SOURCE switch to the FM position; then tune in an FM stereo station. Make sure the Receiver MODE switch is in the STEREO position.
- () Follow the Tape Recording procedure outlined in the Instruction Manual for your recorder and proceed to record the material.

TAPE RECORDER PLAYBACK

- () Set up your Tape Recorder for stereoplayback operation.

Turn the Receiver SOURCE switch to the TAPE position.

- () Make sure the Receiver VOLUME control is at its center-of-rotation position; then adjust the L-TAPE level control for the desired sound output from your left channel speaker.
- () Now adjust the R-TAPE level control to obtain the same sound output from your right channel speaker.

TAPE MONITOR OPERATION

NOTE: If your Tape Recorder does not have a Tape Monitor output circuit, disregard this information and proceed to the Phono and Auxiliary Level Controls section. If your Recorder has a Tape Monitor output circuit, you can monitor program material while it is being recorded.

Set the switches and controls as follows:

- () Turn the SOURCE switch to the position that is necessary to record the desired program material. Set up your recorder for Tape Monitor operation as stated in your recorder Instruction Manual.
- () Place the Receiver TAPE MON switch in the ON position.
- () Adjust the L TAPE MON level control for the desired sound output from your left channel speaker.
- () Now adjust the R TAPE MON level control to obtain the same sound output from your right channel speaker.
- () Quickly flip the Receiver TAPE MON switch on and off and note any difference in sound output from your speaker systems. (There will be a short time delay between the source and tape information.) If necessary, readjust the L and R TAPE MON level controls to obtain the same sound output from your speaker systems when the TAPE MON switch is in either the ON or OFF position.

PHASE

Adjust this control as follows to obtain maximum separation between the right and left FM stereo channels. Tune in an FM stereo station; then pull out on the control. Adjust the control for minimum output from the speaker systems; then push the control back in. Make this adjustment each time a different FM stereo station is tuned in if you desire maximum channel separation at all times.

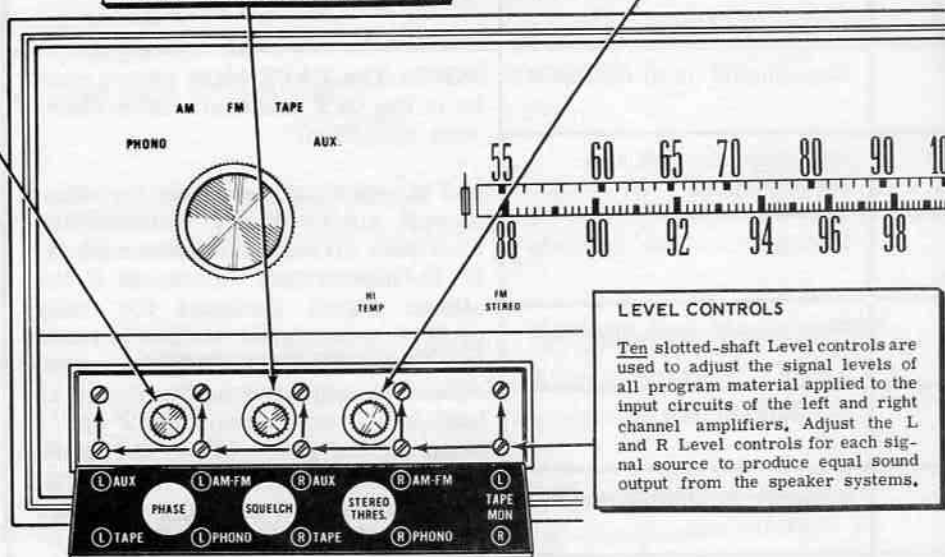
SQUELCH

Adjust this control to eliminate the noise that is heard when tuning between stations. No squelch action is produced when this control is turned fully counterclockwise. Squelch action increases with clockwise rotation and reaches maximum at the full clockwise position.

If this control is turned to maximum (fully clockwise), only the strong stations will be heard. It may be necessary to turn the SQUELCH control off to receive very weak stations.

STEREO THRES

The setting of the STEREO THRES (threshold) control determines the noise level that will switch the Receiver from stereo to monophonic operation when a signal becomes too weak and noisy for good stereo reproduction.



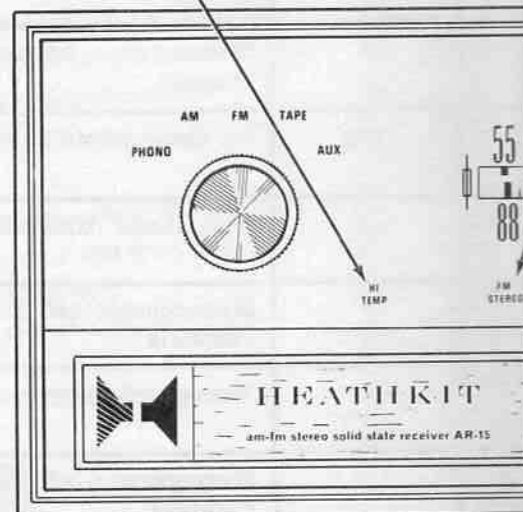
LEVEL CONTROLS

Ten slotted-shaft Level controls are used to adjust the signal levels of all program material applied to the input circuits of the left and right channel amplifiers. Adjust the L and R Level controls for each signal source to produce equal sound output from the speaker systems.

FIGURE 3-2

HI TEMP

This lamp will light and the power amplifiers will be shut off if the temperature of the output transistors becomes too high due to an overload, short circuit, insufficient ventilation, etc. The lamp will go out and the power amplifiers will come on after the condition is corrected and the output transistors have cooled off.



FM STEREO

This indicator lamp will glow steadily when an FM stereo signal is received.

SIGNAL

The SIGNAL meter operates when you receive AM, FM and FM stereo programs, and shows the strength of the received signal. Tune for maximum pointer deflection when receiving AM stations. NOTE: There is very little pointer deflection on weak stations, but they may still be heard satisfactorily.

TUNE

The TUNE meter only operates when FM or FM stereo signals are received. For precise tuning, adjust the Tuning knob so the pointer of the TUNE meter is at the center line between the dark areas of the meter scale.

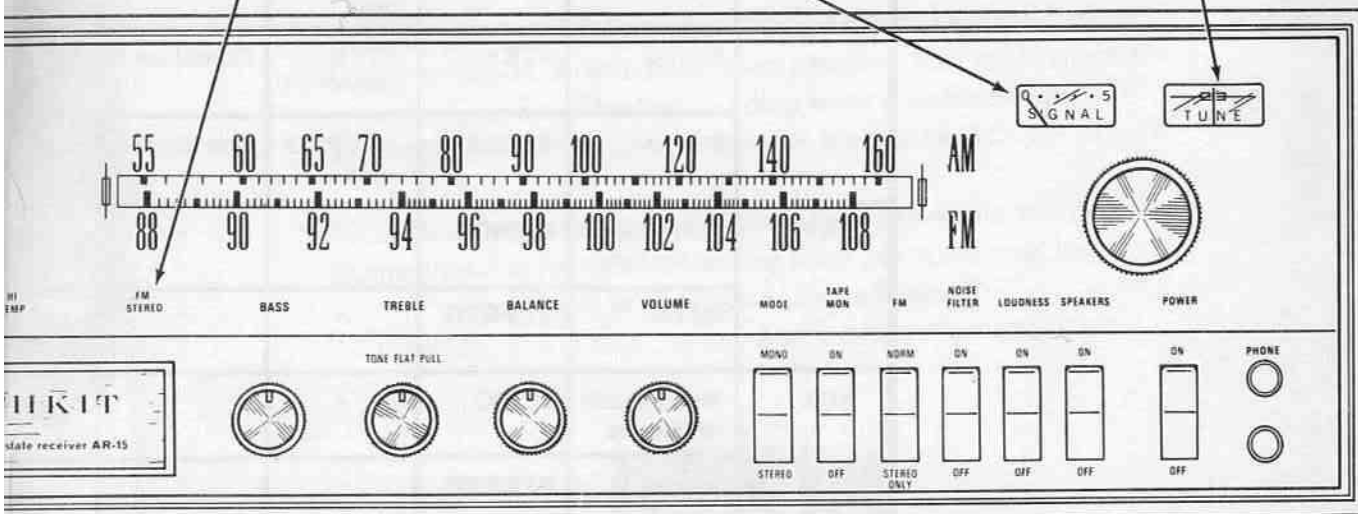


FIGURE 3-3

NORMAL OPERATION PROGRAM RE

This chart shows the type of audio output you can obtain with diff

SOURCE SWITCH POSITION	PROGRAM MATERIAL	MODE SWITCH POSITION	FM SWITCH POSITION	STEREO THRES effect on output (See Notes)	FM STEREO LAMP IS:
PHONO	Monophonic or Stereo	MONO	-	-	-
	Stereo	STEREO	-	-	-
AM	Monophonic	MONO or STEREO	-	-	-
FM	Monophonic or Stereo	MONO	NORM	No effect	OFF
	Monophonic	MONO	STEREO only	No effect	OFF
	Stereo	MONO	STEREO only	Condition 1	ON
	Stereo	MONO	STEREO only	Condition 2	OFF
	Monophonic	STEREO	NORM	No effect	OFF
	Stereo	STEREO	NORM	Condition 1	ON
	Stereo	STEREO	NORM	Condition 2	OFF
	Monophonic	STEREO	STEREO only	No effect	OFF
	Stereo	STEREO	STEREO only	Condition 1	ON
	Stereo	STEREO	STEREO only	Condition 2	OFF
TAPE	Monophonic or Stereo	MONO	-	-	-
	Stereo	STEREO	-	-	-
AUX	Monophonic or Stereo	MONO	-	-	-
	Stereo	STEREO	-	-	-

GRAM REPRODUCTION CHART

an obtain with different combinations of switch settings.

	FM STEREO LAMP IS:	AUDIO OUTPUT WILL BE:	NOTES:
	-	Monophonic both channels	NOTE: The TAPE MON switch must be in the OFF position unless otherwise specified. In FM operation, the stereo threshold circuit automatically switches the multiplex circuits from stereophonic to monophonic operation if the stereo signal becomes too noisy or if a monophonic station is tuned in. The STEREO THRES control should be adjusted so the Receiver switches over to monophonic operation at the point where the noise level is objectionable to you. NOTE: Read the section on Multi-path Signals on Page 140 for additional information on noise and distortion. Condition 1 = Low noise level = Multiplex circuits will pass a stereophonic signal. Condition 2 = High noise level = Multiplex circuits switched over to monophonic operation.
	-	Stereophonic-left and right channel	
	-	Monophonic-both channels	
	OFF	Monophonic-both channels	
	OFF	No audio output	
1	ON	Monophonic-both channels	
2	OFF	No audio output	
	OFF	Monophonic-both channels	
1	ON	Stereophonic-left and right channel	
2	OFF	Monophonic-both channels	
	OFF	No audio output	
1	ON	Stereophonic-left and right channel	
2	OFF	No audio output	
	-	Monophonic-both channels	
	-	Stereophonic-left and right channels	
	-	Monophonic-both channels	
	-	Stereophonic-left and right channels	

PHONO AND AUXILIARY LEVEL CONTROLS

PHONO

- () Turn the SOURCE switch to the PHONO position and play a stereo record. Make sure the Receiver VOLUME and BALANCE controls are in the center-of-rotation position.
- () Adjust the R-PHONO level control for the desired sound output level from your right channel speaker.
- () Adjust the L PHONO level control to obtain the same sound output level from your left channel speaker.

AUXILIARY

- () Turn the SOURCE switch to the AUX position. Make sure the Receiver VOLUME and BALANCE controls are in their center-of-rotation position.
- () Adjust the L AUX level control for the desired sound output level from your left channel speaker.
- () Adjust the R AUX level control to obtain the same sound output level from your right channel speaker.

IN CASE OF DIFFICULTY

NOTE: Refer to the Kit Builders Guide for Service and Warranty information.

INTRODUCTION

This part of the Manual is intended to provide you with information that will help you locate and correct any difficulty which might occur in your Receiver. This information is divided into four sections. The first section contains suggestions of a general nature in the following areas:

- A. Visual checkover and inspection (Visual Tests).
- B. Precautions to observe when bench testing.
- C. How to determine the area of the Receiver in which the trouble is located (How to Troubleshoot Your Receiver.)
- D. Locating and correcting both the cause and the effect of a trouble (Repairing The Receiver).

The second section consists of Troubleshooting Charts. These charts call out specific problems that may occur and list one or more conditions

or components that could cause each difficulty. The resistor R numbers, capacitor C numbers, coil and transformer L and T numbers, and the test point numbers, are identified in these charts by the same numbers that are used on the Schematic Diagram. X-Ray Views (Page 203) are also provided to help you locate the components and test points.

The third section consists of Stage-By-Stage Signal Injection (hum) tests in chart form. These tests are arranged in numerical order. They start with the power amplifier output circuits and progress back toward the input circuits, one stage at a time.

The fourth section is titled "Checking Components." This section tells you how to use the SIGNAL meter to check transistors, diodes, and capacitors. Use this section in conjunction with the Troubleshooting Charts and Stage-By-Stage Injection charts.

GENERAL SECTION

VISUAL TESTS

1. About 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by a careful inspection of connections to make sure they are soldered as described in the Proper Soldering section of the Kit Builders Guide. Reheat any doubtful connections and be sure all the wires are soldered at places where several wires are connected.
2. Check to be sure that all transistors are in their proper locations, and are installed correctly.
3. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the Pictorial diagrams and as called out in the wiring instructions. It would be easy, for example, to install a 2200 Ω (red-red-red) resistor in a step that calls for a 220 Ω (red-red-brown) resistor.
4. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.
5. Check all wires connected to the circuit boards. Make sure the wires do not extend through the circuit board and make contact with other connections or parts, such as coil shields or component leads.
6. If the difficulty still is not cured, read the Precautions For Bench Testing section, and section entitled How To Troubleshoot Your Receiver. Refer to the Service section of the Manual if you are unable to resolve the difficulty and need assistance from the Technical Consultation Department of the Heath Company.

PRECAUTIONS FOR BENCH TESTING

1. Be cautious when testing transistor circuits. Although transistors have almost unlimited life when used properly, they are much more vulnerable to damage from excessive volt-

age or current than tubes. A vacuum tube can often be operated under shorted, zero-bias, excessive-voltage, or high-current conditions for short periods of time without materially damaging the tube. Any one of these same conditions can completely destroy a transistor instantly.

2. Be sure you do not short any terminals to ground when making voltage measurements. If the probe should slip, for example, and short out a bias or voltage supply point, it is almost certain to cause damage to one or more transistors or diodes.
3. Do not remove transistors while the Receiver is turned on, since this could damage the transistor.

CAUTION: The full AC line voltage is present at several points (fuseholder, AC outlets, On/Off switch etc.) in the power supply circuit of the Receiver. Be careful to avoid personal shock when performing the checks described.

HOW TO TROUBLESHOOT YOUR RECEIVER

If you know which area your trouble is in, apply the Visual Tests listed, to that area. It may also be helpful to apply the General Inspection listed on Page 115.

You may also go directly to the Troubleshooting Charts to see if the difficulty you are having is listed in one of the "Condition" columns. If your difficulty is listed here, check the Possible Causes listed for that item and apply the Visual Tests listed, to the Area of Difficulty.

If you cannot resolve your problem with the Troubleshooting Charts, refer to the Stage-By-Stage Signal Injection tests, beginning on Page 160. Perform these tests as directed. First, they will lead you to the area your trouble is in. When you have localized your trouble down to one area, check the Possible Causes listed for that area. It may also be helpful to apply the Visual Tests listed on Page 150 to that area.

The Checking Components section can be used in conjunction with the Troubleshooting Charts and Stage-By-Stage Signal Injection Charts to determine a faulty transistor, diode, or capacitor.

REPAIRING THE RECEIVER

When you make repairs to your Receiver, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you should find a burned resistor, be sure you find out what it was (wiring error, etc.) that caused the resistor to burn. If the cause is not eliminated, the replaced resistor will burn up when the Receiver is put back into operation.

FACTORY REPAIR SERVICE

You can return your completed kit to the Heath Company Service Department to have it repaired for a minimum service fee. (Kits that have been modified will not be accepted for repair.) If you wish, you can deliver your kit to a nearby Heath Authorized Service Center. These centers are listed in your Heathkit catalog.

To be eligible for replacement parts under the terms of the warranty, equipment returned for factory repair service, or delivered to a Heath Authorized Service Center, must be accompanied by the invoice or the sales slip, or a copy of either. If you send the original invoice or sales slip, it will be returned to you.

If it is not convenient to deliver your kit to a Heath Authorized Service Center, please ship it to the factory at Benton Harbor, Michigan and follow the following shipping instructions:

Prepare a letter in duplicate, containing the following information:

- Your name and return address.
- Date of purchase.
- A brief description of the difficulty.
- The invoice or sales slip, or a copy of either.
- Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the warranty.

Attach the envelope containing one copy of this letter directly to the unit before packing, so that we do not overlook this important information. Send the second copy of the letter by separate mail to Heath Company, Attention: Service Department, Benton Harbor, Michigan.

Check the equipment to see that all parts and screws are in place. (Do not include wooden cabinets when shipping receivers, tuners, amplifiers, or TV sets, as these are easily damaged in shipment.) Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least **THREE INCHES** of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton. Seal the carton with gummed paper tape, and tie it with a strong cord. Ship it by prepaid express, United Parcel Service, or insured parcel post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

TROUBLESHOOTING CHARTS

The Troubleshooting Charts on the following pages list specific difficulties that could occur in your Receiver. Several possible causes are listed for each difficulty.

Refer to the X-Ray Views of the circuit boards (Page 203) and to the Chassis Photographs on Pages 208 and 209, and to the Schematic (fold-out from Page 213), to locate and identify the parts listed in these charts.

AMPLIFIER AND POWER SUPPLY CIRCUITS

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
1.	Receiver completely dead,	Power supply circuit.	1. Blown fuse. 2. Open line cord or On-Off switch. 3. Faulty power transformer.
2.	Pilot lamps on, but no sound. Output transistors overheated but HI-TEMP lamp not on.	Power supply circuit.	1. Open HI TEMP lamp. 2. Transistor Q503 open. 3. Diode D505 open.
3.	Pilot lamps on but no sound.	Speaker switch.	1. SPEAKER switch turned OFF. 2. Refer to the Stage-By-Stage Signal Injection tests on Page 160.
4.	HI-TEMP lamp on and amplifier operating normally.	Power supply circuit.	1. Transistor Q503 shorted.
5.	HI-TEMP lamp on. No heating of output transistors, no sound.	Power amplifier.	1. Thermal circuit breaker faulty.
6.	Amplifier not operating and output transistors overheated, HI-TEMP lamp <u>not</u> on.	Power amplifier.	1. Thermal circuit breaker loose on heat sinks. 2. Faulty thermal circuit breaker (will not open).
7.	High frequency oscillations from left channel output.	Power amplifier left channel circuit.	1. Check connections of L201, C217, C219, and R239. 2. Check capacitors C207 and C209.
8.	High frequency oscillations from right channel output.	Power amplifier right channel circuit.	1. Check connection of L202, C218, C220, and R240. 2. Check capacitors C208 and C210.

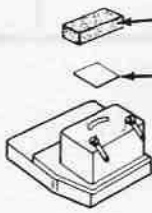
TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
9.	Right channel dead. Left channel OK.	1. Power amplifier right channel circuit. 2. Control preamplifier right channel circuit.	1. Refer to Stage-By-Stage tests on Page 160.
10.	Left channel dead. Right channel OK.	1. Power amplifier left channel circuit. 2. Control preamplifier left channel circuit.	1. Refer to Stage-By-Stage tests on Page 160.
11.	Distorted output from left channel at high volume level in all Source switch positions.	Power amplifier left channel circuit.	1. Zener diodes ZD204L and/or ZD205L shorted. 2. Transistors Q203L, Q204L, Q205L, Q206L, or Q207L faulty.
12.	Distorted output from right channel at high volume level in all Source switch positions.	Power amplifier right channel circuit.	1. Zener diodes ZD204R and/or ZD205R shorted. 2. Transistors Q203R, Q204R, Q205R, Q206R, or Q207R faulty.
13.	Distorted output from both channels in all Source switch positions.	1. Power supply circuit. 2. Power amplifier circuit. 3. Control preamplifier circuit.	1. Low positive (+) voltages. Check voltages at test points in power supply, power amplifier, and control preamplifier circuits. (Refer to Initial Checkout section of Manual for detailed procedure.)
14.	Hum with no signal input on all positions of Source switch.	Spiral shield assemblies.	1. Spiral shield not grounded.
		Power supply.	1. Capacitor C501, C503, C505 or C508 open. 2. Transistor Q501 or Q502 shorted.
		Control preamplifier.	1. Capacitor C111, C112, or C131 open.
15.	Hum with Source switch in PHONO position (No signal input).	Phono preamplifier.	1. Shielded cable from L or R phono input sockets not grounded. 2. Capacitor C11 open.
16.	Tone controls do not operate.	Control preamplifier secondary controls on front panel.	1. TREBLE control not pushed in. 2. Check wiring to switch on rear of TREBLE control.

RECEIVER AM CIRCUITS

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
1.	No sound or weak sound on AM operation.	AM circuits on AM-FM circuit board.	1. Open or broken rod antenna assembly. 2. Incorrect AM alignment (refer to Alignment section of Manual on Page 171). 3. Transistor Q315, Q316, or Q317 defective. 4. Check wiring to Source switch. 5. Capacitor C376 faulty. 6. Faulty diode D308.
2.	Distorted output of AM reception only.	AM adjustments on AM-FM circuit board.	1. Improper AM alignment (refer to Alignment section of Manual).
3.	Noise but no stations heard on AM only. Alignment is correct.	AM circuit on AM-FM circuit board.	1. Check capacitor C397 2. AM antenna L306 open.
4.	SIGNAL meter does not operate on AM only.	AM circuit of AM-FM circuit board.	1. AM METER adjust control (R378) setting incorrect. 2. Check connections on R377, R378, and R372.
5.	SIGNAL meter does not operate on AM and FM.	AM-FM circuits.	1. 19 kHz switch position incorrect. Move to NORM position. 2. 19 kHz switch faulty. 3. Check Source switch wiring.
		Signal Meter Function switch on front apron behind panel.	1. Switch position incorrect. Move to NORM position.

RECEIVER FM CIRCUITS (Monophonic)

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
1.	FM reception weak and noisy.	External, Not in Receiver.	1. Poor or shorted FM antenna connections. 2. FM antenna lead-in open between Receiver and antenna. 3. Antenna terminals shorted.
		Receiver PHASE control.	1. PHASE control pulled out to Phase Adjust position.
		Multiplex circuits.	1. Coils L401, L402, and/or L404 open.
2.	Hum with Source switch in the FM position only. No signal input.	Power supply.	1. Capacitor C502 or C506 open.
3.	Distortion on strong signal stations, AGC (automatic gain control) circuit not operating properly.	FM tuner or FM circuits of AM-FM circuit board.	1. Faulty FM tuner. 2. Check FM tuner connections to circuit board. 3. Diodes D306 and/or D307 faulty. 4. Capacitor C366 open.
4.	TUNE meter not operating properly.	FM circuits on AM-FM circuit board.	1. Transformer T302 slug improperly adjusted (refer to Alignment section of Manual). 2. Faulty meter or meter connections. 3. Check wiring to Source switch.
5.	No operation from <u>left</u> FM channel.	Multiplex circuits.	1. Coil L405 or L406 open. 2. Check wiring to Source switch. 3. Dual diode D427 faulty. 4. Transistor Q406 or Q408 faulty.
6.	No operation from <u>right</u> FM channel.	Multiplex circuits.	1. Coil L407 or L408 open. 2. Check wiring to Source switch. 3. Dual diode D428 faulty. 4. Transistor Q407 or Q409 faulty.

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
7.	FM completely dead. SIGNAL and TUNE meters inoperative.	FM circuits on AM-FM circuit board.	1. Transistor Q305, Q309, or Q310 faulty. 2. FM tuning unit faulty. 3. Check jumper wires on circuit board.
8.	No FM reception. SIGNAL meter <u>operates</u> but TUNE meter <u>does not</u> operate.	FM circuits on AM-FM circuit board.	1. Diode D301 and/or D302 faulty. 2. Transformer T302 faulty. 3. Crystal filter F302 faulty. 4. Transistor Q306 faulty. 5. Integrated circuit IC301 or IC302 faulty.
9.	SIGNAL and TUNE meters operative, but no FM reception.	Receiver SQUELCH control.	1. SQUELCH control misadjusted. 2. Check connections on SQUELCH control.
		Multiplex circuits.	1. Coil L401, L402 or L404 open. 2. Diode D421 open. 3. Capacitor C412 or C416 open. 4. Transistor Q403 or Q404 faulty.
10.	Distorted output on FM only.	FM circuits.	1. Diode D301 or D302 faulty. 2. Transformer T302 <u>top slug</u> improperly adjusted. 3. Transistors Q307 or Q308 faulty.
11.	SIGNAL meter inoperative on FM only.	AM-FM circuits.	1. Diode D303, D304 or D305 faulty. 2. 19 kHz switch in wrong position. Move to NORM.
12.	SIGNAL Meter does not read zero when Receiver is in these positions: OFF, AUX, TAPE, or PHONO.	SIGNAL METER	1. Mechanical adjustment of meter. Adjust the meter as shown below.
13.	TUNE Meter does not read zero (center) when Receiver is in these positions: OFF, AUX, TAPE, or PHONO.	TUNE METER	 1. Remove foam tape. 2. Remove tape over small hole. 3. Adjust lever one way or the other to read 0. Use a small screwdriver or similar tool. Be careful not to damage the inside of the meter.

RECEIVER FM CIRCUITS (Stereophonic)

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
1.	FM reception normal, FM STEREO indicator does not light, and no stereo reproduction. Lamp is good.	Receiver control switch.	1. MODE switch in MONO position. 2. STEREO THRES set too high.
		Multiplex circuits.	1. Check adjustment of coil L409. 2. Transistor Q405, Q410, Q411, Q417, Q418, Q419, or Q420 faulty.
2.	FM reception normal. FM STEREO indicator lights but no stereo reproduction.	Multiplex circuits.	1. Transistor Q405 faulty. 2. Dual diode D429 faulty. 3. Check adjustment of slug in transformer T402. NOTE: Perform steps as shown in Multiplex Adjustments on Pages 130 through 132.
3.	FM STEREO indicator lights on all FM stations.	Multiplex circuits.	1. Transistor Q419 or Q420 faulty.
4.	SQUELCH control and STEREO THRES control both inoperative. FM reception normal.	Multiplex circuits. FM circuits.	1. Diode D430 or D431 faulty. 2. Transistor Q413, Q414 or Q415 faulty. 3. Capacitors C347 and C354 touching or too close to each other. See the NOTE in the right-hand column of Page 52.
5.	SQUELCH control inoperative. STEREO THRES control action correct. FM reception normal.	Multiplex circuits.	1. Diode D421 open. 2. Transistor Q401, Q402, or Q412 faulty.

RECEIVER FM CIRCUITS (Stereophonic) (cont'd.)

TEST No.	CONDITION	AREA OF DIFFICULTY	POSSIBLE CAUSE
6.	STEREO THRES control inoperative. Squelch action correct. FM reception normal.	Multiplex circuits.	1. Transistor Q418, Q419, or Q420 faulty.
7.	Stereo reproduction garbled or distorted.	Multiplex circuits.	1. Transformer T401 incorrectly adjusted. NOTE: Refer to Multiplex Adjustment procedure on Page 130. 2. Capacitor C413 open.
8.	Little or no separation of stereo signals.	Receiver secondary controls.	1. PHASE control misadjusted (refer to FM Operation section of the Manual on Page 146). 2. Separation control (R442) misadjusted.
		Multiplex Circuits.	1. Diode D423, D424, D425, D426 or D432 faulty. 2. Transistor Q405 faulty. 3. Capacitor C416 faulty. 4. Open winding on transformer T401.
9.	Left and Right channels interchanged (FM stereo only).	Multiplex Circuits.	1. Station error. 2. Misadjustment of coil L409, transformer T402, or PHASE control.

STAGE-BY-STAGE SIGNAL INJECTION

This section of the Manual consists of a systematic series of hum tests that help you locate the area a trouble is in. The hum signals are introduced into the circuits at various test points, through the blade of a small screwdriver, from the normal hum pickup from your body. The loudness of the hum should gradually increase as you progress through the test points on the charts (from the output toward the input circuits).

The area of trouble will be located between the point where normal hum response is not obtained, and the immediately preceding point where normal response was obtained.

After the area of trouble is located, it is necessary to locate the exact trouble in this area. The Possible Cause column in each chart lists several possible causes of trouble for each area. It may also be helpful to apply the General Inspection on Page 115 to the area of trouble.

CAUTION: Full AC line voltage will be present at several places in the Receiver when the line cord plug is connected to an AC outlet. Be especially careful that you do not touch the AC accessory sockets, POWER switch, or fuseholder.

Use a thin-bladed screwdriver or other thin metal object for these tests. Hold the screwdriver with one finger touching the shaft; then touch the end of the blade to the numbered test point or component terminal listed in the chart. Touch only the point listed. An example of this procedure is given later.

There are three areas in which two identical circuits are used: the phono preamplifier, the control preamplifier, and the Power Amplifier circuits. The circuit part numbers for resistors, capacitors, and coils in the left channel circuits in each of these areas are identified by odd numbers on the Schematic. The corresponding numbers for resistors, capacitors, and coils in the right channel circuits are identified by even numbers on the Schematic. Transistors are numbered both odd and even in both channels. All right-channel numbers are listed in parentheses after the left-channel numbers in the following steps.

Circuit part numbers have been assigned to all circuit board components as follows:

NUMBER SERIES	CIRCUIT BOARD
0- 99	Phono Preamplifier
100-199	Control Preamplifier
200-299	Power Amplifier
300-399	AM-FM
400-499	Multiplex
500-599	Power Supply

The Power Amplifier, Control Preamplifier, and Phono Preamplifier Charts apply to both the right and left channel circuits. The left channel test point and/or part number is given first. This is followed by the corresponding right channel test point and/or part number in parentheses. For example: R107 (R108), collector (C) of Q203L (Q203R), or point 21 (22). First determine the channel that does not respond properly; then apply the hum tests, as directed in the charts, to the appropriate left or right channel component or test points.

If a vacuum tube voltmeter is available, it may be helpful to compare the voltage readings in the area of trouble with the correct readings indicated on the Schematic. Be sure to remove the line cord plug from the AC outlet before you make any repairs to the Receiver.

NOTE: Refer to the X-Ray Views of the circuit boards (Page 203) and to the Chassis Photographs on Pages 208 and 209, and to the Schematic (fold-out from Page 213), to locate and identify the parts listed in these charts.

SIGNAL INJECTION EXAMPLE

Suppose that the sound from your right channel speaker is normal but there is no output from your left channel speaker. You have tried another speaker but there is still no output from the left channel.

Touching the screwdriver to the base (B) of transistor Q203L produces normal response. The screwdriver is then moved to the base of transistor Q201L. At this point, a reduced response or possibly no response at all is produced.

The normal response produced by touching the base of Q201L should be greater than that produced by touching the base of Q203L. The fact that it is not greater in this example indicates one of the following conditions (as shown on the following Power Amplifier Chart):

1. Transistor Q201L or Q202L open, shorted, or incorrectly installed.
2. Resistor R215 open or changed in value.

3. Capacitor C203 or C205 open or changed in capacitance.
4. Capacitor C211 shorted.
5. Resistors in transistor circuits faulty or incorrectly installed.

POWER AMPLIFIER SIGNAL INJECTION CHART

- () Disconnect the orange (or white-orange) wire from Point 1 on the circuit board.

TEST No.	TEST INJECTION POINT	NORMAL HUM RESPONSE	POSSIBLE CAUSE IF HUM RESPONSE IS NOT NORMAL
1.	Point 1 on either circuit board.	Medium-loud hum.	1. If normal hum response is obtained, omit tests number 2 and 3. 2. If normal response is not obtained, proceed with the remaining tests in this chart.
2.	Base (B) of Q203L (Q203R).	Low hum or click.	1. Transistor Q203L (Q203R), Q204L (Q204R), Q205L (Q205R), Q206L (Q206R) or Q207L (Q207R). 2. Resistors in above transistor circuits faulty. 3. Capacitor C221 (C222). 4. No voltage at Point 5 on either circuit board.
3.	Base (B) of Q201L (Q201R).	Medium-loud hum.	1. Transistor Q201L (Q201R) or Q202L (Q202R). 2. Resistor R215 (R216) open or changed in value. 3. Capacitor C203 (C204) or C205 (C206). 4. Capacitor C211 (C212) shorted.
4. Reconnect the orange (or white-orange) wire to Point 1 on the circuit board. If the trouble has been corrected, and no further troubleshooting is necessary, put the Receiver back into operation. If the trouble is still not corrected, proceed to the tests in the Control Preamplifier Chart.			

- () Set the controls to the following positions:

VOLUME - Fully counterclockwise.
 SOURCE - AUX.
 BALANCE - 12 o'clock position.

CONTROL PREAMPLIFIER SIGNAL INJECTION CHART

NOTE: It may be necessary to reposition the AM-FM circuit board to reach some of the test points on the control preamplifier circuit board. Refer to Details 7-32A and 7-32B and to the steps on Pages 121 and 122 that go with these Details to unfasten and position the circuit board. To remount this circuit board

again, refer to Detail 7-32C and the steps on Page 128 that go with this Detail.

Refer to Figures 6-3 and 6-4 (fold-out from Page 203) to locate the test injection points that are called out in the chart.

NOTE: In each of the following tests, turn up the VOLUME control enough to hear the hum.

TEST No.	TEST INJECTION POINT	NORMAL HUM RESPONSE	POSSIBLE CAUSE IF HUM RESPONSE IS NOT NORMAL
1.	Point 21 (24) on the Preamplifier circuit board.	Low hum.	1. If normal response is not obtained, the circuits containing Q105L (Q105R), Q104L (Q104R), Q103L (Q103R) are operating incorrectly. Perform tests numbers 2 through 6. 2. If normal response <u>is</u> obtained at point 21 (or 24), disregard test 2 and 4 and start with test 5. 3. Resistor R139 (R140), R145 (R146), R147 (R148) or R153 (R154) open. 4. BASS or TREBLE controls faulty.
2.	Base (B) of Q104L (Q104R).	Medium hum.	1. Transistor Q105L (Q105R) shorted or improperly installed. 2. VOLUME control turned counterclockwise. 3. Transistor Q104L (Q104R) faulty.
3.	Collector (C) of Q103L (Q103R).	Low hum or click.	1. VOLUME or BALANCE control misadjusted. 2. TREBLE control pulled out, or TONE-FLAT switch on TREBLE control improperly wired. 3. Transistor Q103L (Q103R) shorted.

TEST No.	TEST INJECTION POINT	NORMAL HUM RESPONSE	POSSIBLE CAUSE IF HUM RESPONSE IS NOT NORMAL
4.	Base (B) of Q103L (Q103R).	Medium hum.	1. Transistor Q103L (Q103R) faulty. 2. Resistor R155 (R156) open.
5.	Base (B) of Q102L (Q102R).	Medium-to-loud hum.	1. Transistor Q102L (Q102R) faulty. 2. Capacitor C107 (C108), C111 (C112), or C113 (C114) faulty or reversed polarity.
6.	L AUX (R AUX) input jack.	Medium-to-loud hum.	1. L AUX (R AUX) Level control counterclockwise. 2. TAPE MON switch in ON position or improperly wired. 3. SOURCE switch improperly wired. 4. Capacitor C103 (C104) faulty. 5. Resistor R103 (R104) or R117 (R118) open. 6. Level control R105 (R106) faulty.

PHONO PREAMPLIFIER SIGNAL INJECTION CHART

NOTE: It is necessary to reposition the AM-FM circuit board to reach the test points on the control preamplifier circuit board. Refer to

Details 7-32A and 7-32B and the steps on Pages 121 and 122 that go with these Details to unfasten and position the circuit board. To remount the circuit board again, refer to Detail 7-32C and the steps on Page 128 that go with this Detail.

TEST No.	TEST INJECTION POINT	NORMAL HUM RESPONSE	POSSIBLE CAUSE IF HUM RESPONSE IS NOT NORMAL
NOTE: Set the L PHONO and R PHONO level controls to the center of their rotation before making any of the following tests. Set the SOURCE switch to the PHONO position.			
1.	Point 8 (11) on the control preamplifier circuit board.	Low hum. NOTE: Turn up VOLUME control enough to hear hum.	1. TAPE MON switch is in ON position. 2. Poor connection or wiring error on SOURCE switch. 3. Level control R111 (R112) faulty.
2.	Base (B) of Q2L (Q2R).	Medium-to-loud hum.	1. Capacitor C7 (C8) faulty. 2. Poor connection at Point 2 (or Point 4). 3. Transistor Q2L (Q2R) faulty.
3.	Base (B) of Q1L (Q1R).	Loud hum.	1. Transistor Q1L (Q1R) faulty. 2. Shielded cable to Point 1 (Point 3) shorted.
4.	LEFT PHONO (RIGHT PHONO) input jack.	Loud hum.	1. Capacitor C1 (C2) open or poor connection. 2. Shorted input cable to LEFT PHONO (RIGHT PHONO) jacks. (Cable from record player or changer.) Disconnect Phono input cables, then recheck at the LEFT PHONO jack or the RIGHT PHONO jack.

This completes the In Case Of Difficulty section of the Manual.

CHECKING COMPONENTS

INTRODUCTION

The Signal Meter can be used to check transistors, diodes, and capacitors. Complete the following steps before you proceed to the instructions which concern the particular component you have to check.

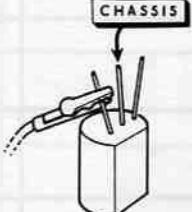
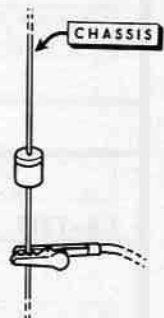
Refer to Figure 1-5 (fold-out from Page 116) for the following steps.

- () Connect the test clip lead to lug 3 of the Signal Meter Function switch (S-2).
- () Place this switch in the R position.
- () Disconnect both red stranded wires from lug 1 of capacitor CA.
- () Disconnect both blue transformer leads from connectors 5 and 7 of the power supply circuit board.

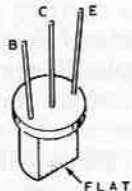
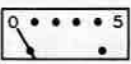
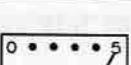
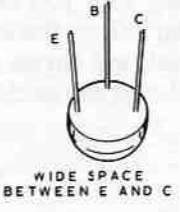
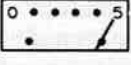
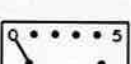
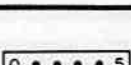
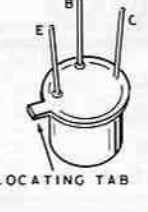
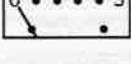
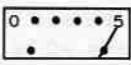
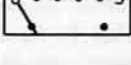
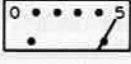
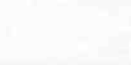
- () Place 1" lengths of small sleeving (braided) over the bare ends of the four wires to cover the stripped ends.

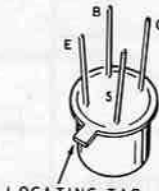
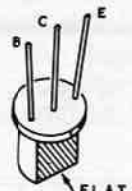
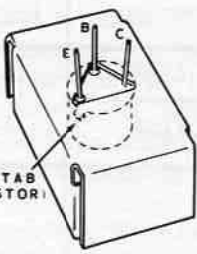
HOW TO CHECK TRANSISTORS, DUAL DIODES AND OTHER DIODES

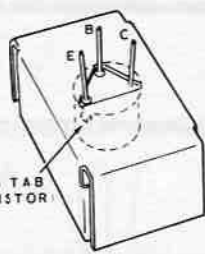
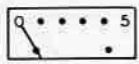
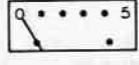
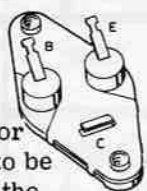
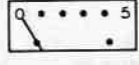
- A. Unsolder and remove the component.
- B. Connect the leads of the component as shown in the two example illustrations: for transistors and dual diodes, or for diodes.
- C. After studying these illustrations, proceed to the Checkout Chart on Page 166, and locate the component in column #1 that corresponds to the one you removed from the Receiver. Then follow the instructions at the top of the remaining three columns. A separate test is listed on each line of the chart.

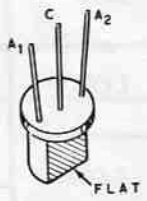
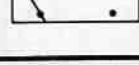
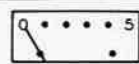
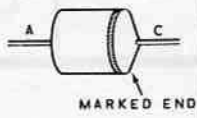
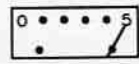
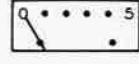
TRANSISTORS AND DUAL DIODES	DIODES
① Touch one lead to the chassis, as directed in column #2 of the chart. ② Connect the test clip to another lead, as directed in column #3 of the chart. 	① Touch one lead to the chassis, as directed in column #2 of the chart. ② Connect the test clip to the other lead, as directed in column #3 of the chart. 

NOTE: Recheck each reading to verify that the part is defective.

1	2	3	4
TRANSISTORS	Connect the following TRANSISTOR LEAD TO THE CHASSIS	Connect the TEST CLIP TO TRANSISTOR LEAD	SIGNAL METER READING
2N5232A 2N3393 2N3416 2N3859A L842 T Z 1160 	B	C	LOW 
	E	C	LOW 
	C	B	HIGH 
52091 	B	C	HIGH 
	E	C	LOW 
	C	B	LOW 
40408 	B	C	LOW 
	E	C	LOW 
	C	B	HIGH 
TA-7311 	B	C	LOW 
	E	C	LOW 
	C	B	HIGH 

1	2	3	4
TRANSISTORS	Connect the following TRANSISTOR LEAD TO THE CHASSIS	Connect the TEST CLIP TO TRANSISTOR LEAD	SIGNAL METER READING
40245 	B	C	LOW
	E	C	LOW
	C	B	HIGH
X29A829 	B	C	HIGH
	C	E	LOW
	C	B	LOW
40409 	B	C	LOW
	E	C	LOW
	C	B	HIGH

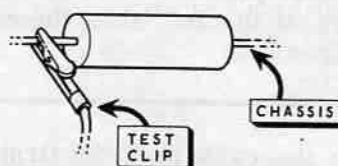
1	2	3	4
TRANSISTORS	Connect the following TRANSISTOR LEAD TO THE CHASSIS	Connect the TEST CLIP TO TRANSISTOR LEAD	SIGNAL METER READING
40410  LOCATING TAB ON TRANSISTOR	B	C	HIGH 
	E	C	LOW 
	C	B	LOW 
40411 2N3055 NOTE: This type of transistor does not have to be removed from the Receiver. Disconnect the leads from each lug. 	B	C	LOW 
	E	C	LOW 
	C	B	HIGH 

1	2	3	4
DUAL DIODES	Connect the following DIODE LEAD TO THE CHASSIS	Connect the TEST CLIP TO DIODE LEAD	SIGNAL METER READING
MARKED IN4951 OR 16U1 	C	A1	HIGH 
	C	A2	HIGH 
	A1	C	LOW 
	A2	C	LOW 
OTHER DIODES			
56-47 57-27 	C	A	HIGH 
56-25 56-26 56-33 			
57-42 56-44 	A	C	LOW 

HOW TO CHECK CAPACITORS

These instructions are divided into two groups. The first group is for capacitors of 50 μfd and above. The second group is for capacitors below the value of 50 μfd . After reading steps A, B, and C, proceed to the group of instructions for the part you intend to check.

- A. Unsolder and remove the capacitor.
- B. Discharge the capacitor by touching the leads together. (Note the special discharging instructions below for the 8000 μfd and the two 4000 μfd capacitors.)
- C. Connect the test clip to one lead. Then, while watching the Signal meter, touch the other lead to the Receiver chassis. (Note the special instructions for the electrolytic capacitors.)



How to Discharge The 4000 And 8000 μfd Capacitors

The 4000 μfd and 8000 μfd capacitors retain a very high charge and should be handled carefully. Never touch the lugs of the capacitor until you are sure it is discharged. Use either of the following two methods to discharge these capacitors.

METHOD A: Leave the Receiver turned off for approximately five minutes. This will allow the capacitor to discharge through the Receiver circuitry. Then short the two lugs of the capacitor together momentarily with the blade of a screwdriver. Now it is safe to disconnect the wires and check the capacitor.

METHOD B: Turn the Receiver off and short the two lugs of the capacitor together with a

1000 Ω 1 watt resistor. Leave the resistor between the lugs for one minute; then remove it. Now short the two lugs together momentarily with the blade of a screwdriver. It is now safe to disconnect the wires and check the capacitor.

How To Connect Electrolytic Capacitors To The Meter And Chassis

Each electrolytic capacitor has a positive (+) mark at one end. When checking one of these capacitors, always connect the positive (+) lead to the test clip and the other lead to the chassis.

Checking Capacitors

Use the procedure in steps 1, 2, 3, and 4 for checking capacitors of 50 μfd and above. Use the procedure in steps 5, 6, and 7 for capacitors below the value of 50 μfd . Read through the steps before proceeding with a check.

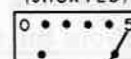
1. If the meter pointer deflects to the right side quickly, and then gradually returns to the left side the capacitor is not faulty. NOTE: The time it takes for the pointer to return to the left side depends upon the value of the capacitor. A 50 μ fd capacitor for example, will cause the pointer to return more rapidly than a 4000 μ fd capacitor.

CAPACITOR OK



2. If the meter pointer deflects to the right side and stays there, the capacitor is faulty (shorted).

CAPACITOR FAULTY (SHORTED)

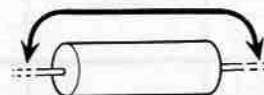


3. If the meter pointer does not deflect at all, but stays at the left side, the capacitor is faulty (open).

CAPACITOR FAULTY (OPEN)



4. Recheck the capacitor, but first discharge it by touching the leads together.



The next three steps are for checking capacitors below the value of 50 μ fd.

Because of the small capacitance of these capacitors it takes only a split second to charge them. Therefore, it is difficult to determine if the capacitor is not faulty or is faulty (open). Recheck the capacitor several times while watching the meter closely. Be sure to discharge the capacitor each time before repeating the check.

5. If the meter pointer deflects slightly and then remains at the left side, the capacitor is not faulty.

CAPACITOR OK



6. If the meter pointer does not deflect at all, but remains at the left side, the capacitor is faulty (open).

CAPACITOR FAULTY (OPEN)



7. If the meter pointer deflects to the right side and stays there, the capacitor is faulty (shorted).

CAPACITOR FAULTY (SHORTED)



NOTE: Before turning the Receiver ON again, reconnect all of the wires that you disconnected to make these checks (refer to Page 165 and Figure 1-5 fold-out from Page 116). In addition

to connecting the wires, be sure to place the SIGNAL Meter Function switch in the NORM position.

ALIGNMENT WITH INSTRUMENTS

AM ALIGNMENT

It is recommended that only persons familiar with instrument alignment perform the following adjustments, and then only if unsatisfactory operation occurs after the Adjustments are completed.

NOTE: Before starting to align your Receiver, make sure the pointer stays at the correct location on the dial when the AM-FM Tuning knob is rotated fully counterclockwise.

Equipment Needed: AM Signal Generator with modulated RF output at 400 Hz.

Refer to Figure 4-1 (fold-out from this Page) for the location of the transformers, coils, and capacitors to be adjusted in the following steps.

() Set the SOURCE switch to the AM position.

AM ALIGNMENT CHART

Adjust the generator output at-tenuator so the SIGNAL Meter pointer deflects approx-imately two divisions.		Connect AM signal generator to:	Set frequency of AM generator modulated 30% at 400 Hz to:	Set AM dial pointer to:	Adjust for maximum deflection of the SIGNAL Meter pointer.
	1	AM antenna terminal and ground.	455 kHz	Extreme low frequency end of dial.	1. Slug in T304. 2. Top and bottom slugs in T303.
	2	Loosely coupled to rod antenna (lay hot lead of AM generator close to rod).	600 kHz	60 on AM dial.	1.* Slowly turn the dial pointer back and forth (on each side of the station frequency) while adjusting the slug in coil L307. 2. Slug in L308.
	3	Loosely coupled to rod antenna.	1400 kHz	140 on AM dial.	1. C384-AM OSC. 2. C378-AM RF. 3. C375-AM ANT.
	4	Repeat steps 2 and 3 until no improvement is obtained.			

*NOTE: Maximum meter deflection may be ± 20 kHz from the station frequency.

This completes the AM Alignment procedure. Continue with the FM Alignment procedure.

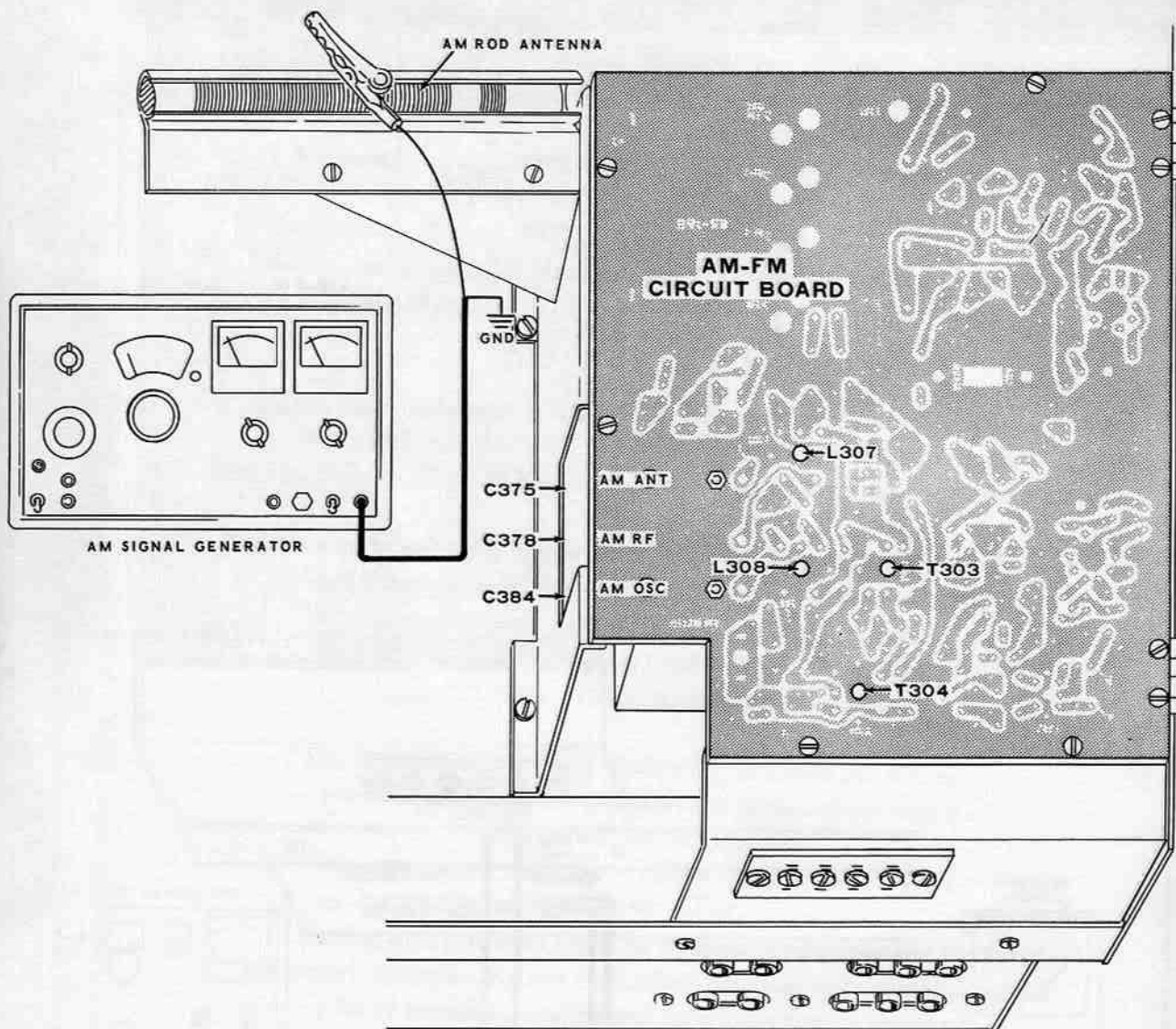


FIGURE 4-1

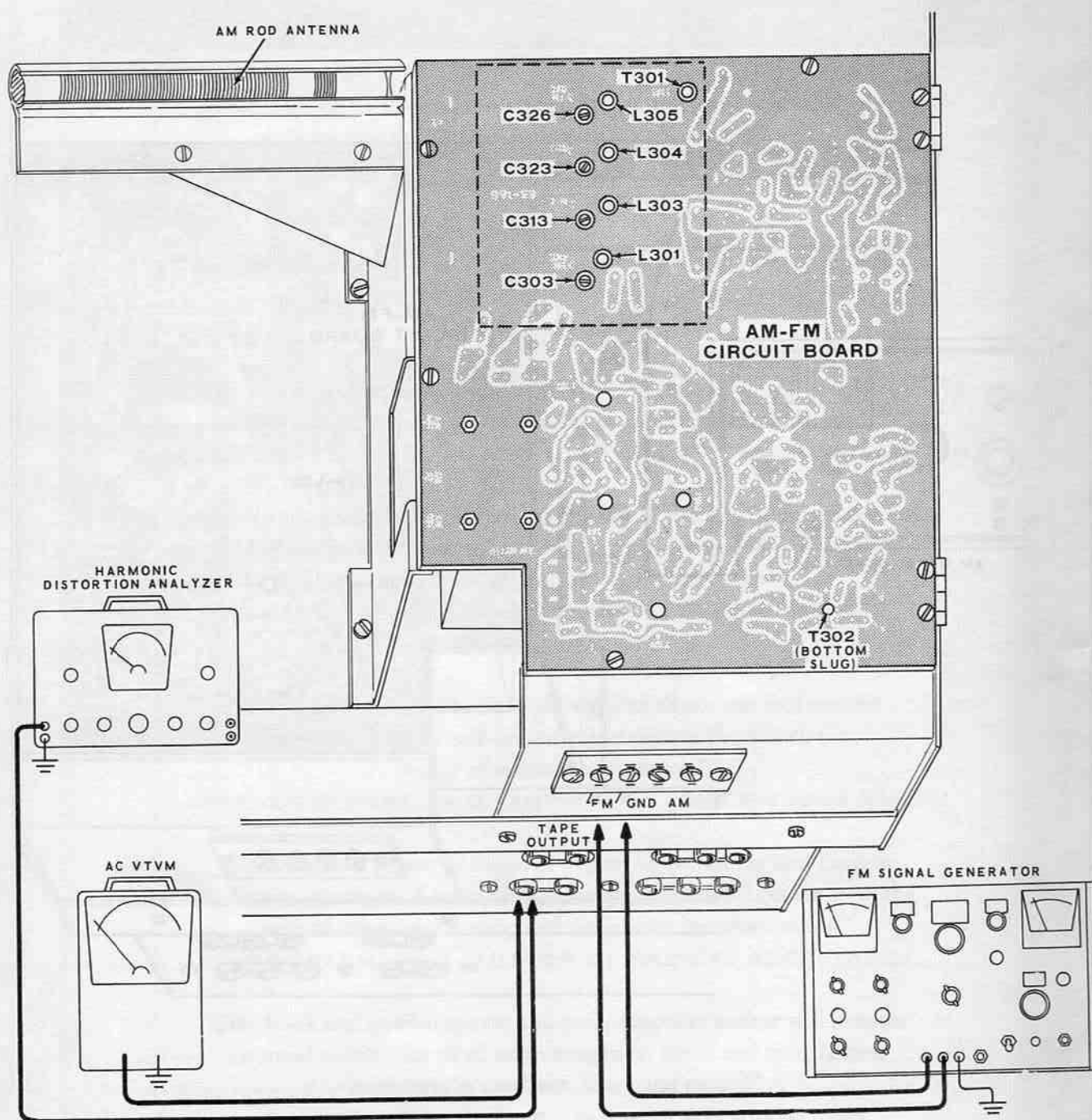


FIGURE 4-2

FM ALIGNMENT

Equipment Needed:

FM Signal Generator
Harmonic Distortion Analyzer
AC VTVM (Vacuum Tube Voltmeter)

Refer to Figure 4-2 (fold-out from this Page) for the instrument connecting points, and the location of the transformers, coils, and capacitors to be adjusted in the following steps.

Set the Receiver controls as follows:

- () SOURCE switch: FM position.
- () SQUELCH control: Fully counterclockwise.
- () STEREO THRES control: Fully clockwise.
- () L-AM/FM Level control: Fully clockwise.
- () R-AM/FM Level control: Fully clockwise.

RATIO DETECTOR (T302)

- () Connect the FM Signal Generator to the Receiver FM antenna terminals with a 300 Ω lead. Set the Generator frequency to 98 MHz (with no modulation), as shown in part 1 of Figure 4-3, with an unmodulated RF output signal of 100 μ v.
- () Tune the Receiver to this 98 MHz signal. Carefully adjust the Tuning knob until the pointer of the TUNE Meter is at the center mark on the TUNE Meter scale. (See part 1 of Figure 4-4).

The objective of the next two steps is to adjust the secondary of ratio detector transformer T302 so that an equal increase or decrease in frequency, will produce an equal left or right deflection of the pointer of the TUNE Meter. NOTE: The Signal Generator dial readings shown in part 2 and 3 of Figure 4-3, and the TUNE Meter scale readings shown in part 2 and 3 of Figure 4-4 are representative only. The actual Signal Generator dial setting and the actual TUNE Meter readings will probably be different than those shown in these Figures.

- () Increase the frequency of the Signal Generator until the TUNE Meter pointer moves away from the scale center line and then just starts back toward the center line. Note the reading of the Signal Generator frequency dial (see part 2 of Figure 4-3) at this point. Also note the amount that the TUNE Meter pointer deflects away from the center line (see part 2 or 3 of Figure 4-4).
- () Adjust the FM Signal Generator frequency an equal amount on the other side of the 98 MHz center frequency, and note how far the TUNE Meter pointer deflects on the other side of the center line (see part 4 of Figure 4-4).

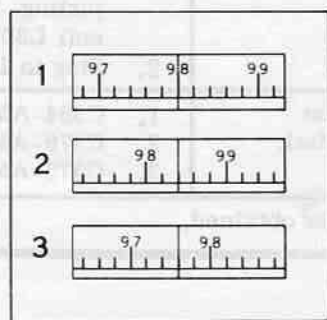


Figure 4-3

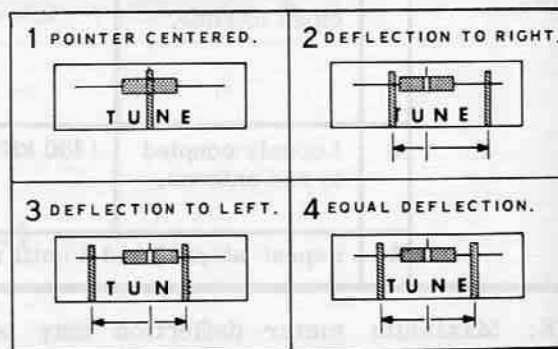


Figure 4-4

- () Now adjust the bottom slug (the one nearest the circuit board) in ratio detector transformer T302 for an equal left and right deflection of the TUNE Meter pointer when the Signal Generator frequency is alternately changed equal amounts above or below the center frequency of 98 MHz (see parts 2 and 3 of Figure 4-3).
- () Set the center frequency of the FM Signal Generator to 98 MHz and set the modulation selector switch to 400 Hz. Set the Generator modulation control for a deviation of 75 kHz and set the RF attenuator to produce an output of 1000 μV .
- () Connect the Harmonic Distortion Analyzer and the AC VTVM between the Receiver left or right TAPE OUTPUT jack and ground.
- () Tune the Receiver to this 98 MHz signal.
- () Turn the SEP ADJ (separation adjust) control fully clockwise as viewed from the component side of the multiplex circuit board. Then turn the control counterclockwise $1/4$ turn. Refer to Figure 4-5.

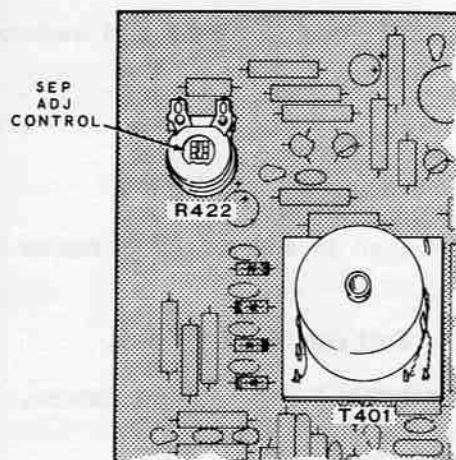


Figure 4-5

- () If the percent of harmonic distortion exceeds .5 percent, adjust the top slug (this is the one farthest from the circuit board ratio detector transformer T302 for minimum distortion).

This completes the alignment of the ratio detector circuit.

MIXER OUTPUT TRANSFORMER

Refer to Figure 4-2 (fold-out from Page 172) for the following steps.

- () Connect the Harmonic Distortion Analyzer and the AC VTVM between the Receiver left or right TAPE OUTPUT jack and ground.
- () Set the FM Signal Generator center frequency to 98 MHz and the modulation selector switch to 400 Hz. Set the modulation control for a deviation of 75 kHz.
- () Connect the FM Signal Generator to the Receiver FM antenna terminals through a 300 Ω resistive matching network as shown in Figure 4-6.

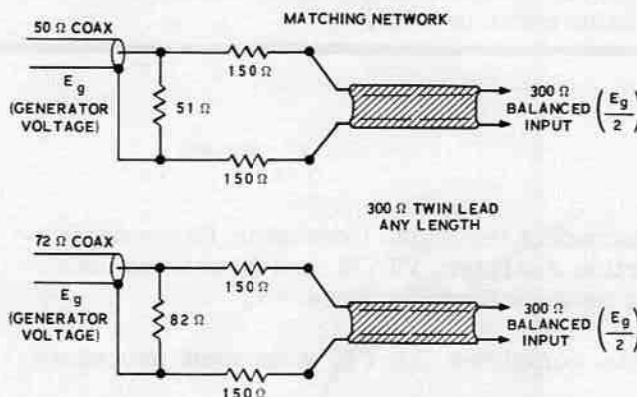


Figure 4-6

- () Adjust the output of the Signal Generator to 4 μV (2 μV if a balun match is used).
- () Carefully tune the Receiver to this 98 MHz signal.
- () Adjust the top and bottom slugs in transformer T301 for minimum distortion.

NOTE: The Harmonic Distortion Analyzer should indicate 3 percent or less total harmonic distortion. This is equivalent to a 30 db signal-plus-noise to noise ratio.

FM ALIGNMENT CHART

Step	FM SIGNAL GENERATOR		Set Receiver Dial Pointer To:	Connect Harmonic Distortion Analyzer And AC VTVM To:	Adjust For: Maximum AC VTVM Reading <u>with Minimum</u> Harmonic Distortion.
	Connect To:	Center Frequency and Output			
1.	FM Antenna terminals through 300 Ω matching network.	90 MHz at 4 μv (see NOTE).	90 MHz	Left or right TAPE OUTPUT jack.	1. L305. 2. L304. 3. L303. 4. L301.
2.	Same as Step 1.	106 MHz at 4 μv (see NOTE).	106 MHz	Same as above for Step 1.	1. C326. 2. C323. 3. C313. 4. C303.
3.	Repeat Steps 1 and 2 until no further improvement can be obtained.				
NOTE: Increase output as necessary for initial readings; then reduce output to 4 μv (2 μv if balun match is used).					

Disconnect the Signal Generator, Harmonic Distortion Analyzer, VTVM, and the antenna matching network from the Receiver.

This completes the FM Alignment procedure.

MULTIPLEX CIRCUITS

An Audio Generator and an Audio VTVM are required to align the multiplex circuits. An FM Stereo Generator may also be used if one is available.

NOTE: An oscilloscope may be used as a monitoring device if desired. No waveforms are shown in the Manual, however, as the oscilloscope will only show if the waveform being observed should distort due to excessive input signal voltage from the alignment generators.

Preset the Receiver controls and switches as follows:

SOURCE: FM.

VOLUME: Full counterclockwise.

PHASE: Pushed in and turned to center of rotation.

SQUELCH: Full counterclockwise.

STEREO THRES: Full counterclockwise.

MODE: MONO.

FM: NORM.

NOISE FILTER: OFF.

Refer to Figure 4-7 for the next two steps.

NOTE: Make sure the following connections are made only to the point specified in the step, and that the leads do not short circuit to other connections on the circuit board.

- () Use insulated hookup wire and connect a short jumper between Point A (S-1) and Point B (S-1) on the foil side of the AM-FM circuit board.
- () Place a short length of sleeving over the positive (+) lead of a 10 μ fd 25 V electrolytic capacitor. Then connect this lead to point C on the foil side of the AM-FM circuit board.
- () Connect the Audio Generator between the free lead of the 10 μ fd capacitor and ground. Set the Generator frequency to 67 kHz ($\pm$ 500 Hz) with an output of .1 volt rms.

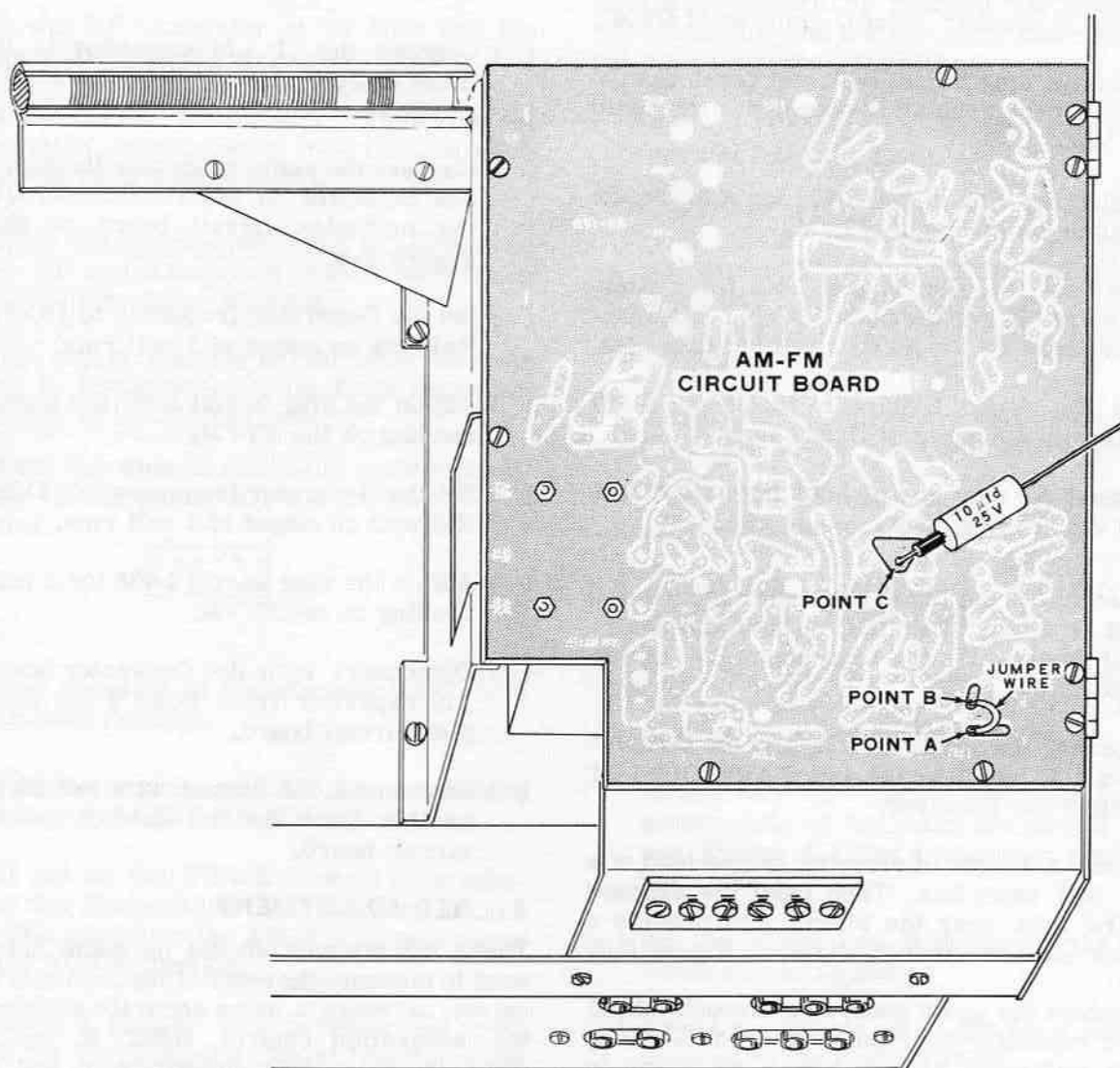


Figure 4-7

NOTE: Special connector clips are available from any radio-TV parts supply house for making connections to parts mounted on circuit boards. However, simple hook-type connectors may be constructed using a short length of solid (approximately #18) hookup wire covered with insulating sleeving as shown in Figure 4-8. Connect the test instrument leads between the free end of the connector and chassis ground.

Refer to Figures 4-8 and 4-9 (fold-out from Page 177) for the following steps.

- () Connect the Audio VTVM (and the Oscilloscope if used) to Point D (emitter of Q404).
- () Turn the slug in coil L401 counterclockwise until a peak reading is obtained on the Audio VTVM.
- () Adjust the slug in coil L404 for a minimum reading on the Audio VTVM.
- () Readjust the slug in coil L401 for a minimum reading on the Audio VTVM. This minimum reading should be 3 millivolts or less.
- () Set the Audio Generator frequency to 57 kHz with an output of .1 volt rms.
- () Adjust the slug in coil L402 for a maximum VTVM reading.
- () Disconnect the Audio Generator from the 10 μ fd capacitor at Point C on the AM-FM circuit board. Do not disconnect the 10 μ fd capacitor.
- () Connect the Audio VTVM (and the Oscilloscope if used) to the left TAPE OUTPUT jack of the Receiver.
- () Place a length of sleeving on one lead of a .1 μ fd capacitor. Then bend the exposed wire back over the sleeving to provide a hook similar to that shown in Figure 4-8.
- () Connect the audio generator through this .1 μ fd capacitor to Point E (base of Q406) on the multiplex circuit board, as shown in Figure 4-9.
- () Set the Generator frequency to 19 kHz (± 100 Hz) with an output of 1 volt.
- () Adjust the slug in coil L405 for a minimum reading on the VTVM.
- () Set the Generator to 36 kHz with 1 volt rms output.
- () Adjust the slug in coil L406 for a minimum reading on the VTVM.
- () Disconnect both the Audio Generator and the .1 μ fd capacitor from Point E.
- () Connect the Audio VTVM (and oscilloscope if used) to the right TAPE OUTPUT jack of the Receiver.
- () Connect the .1 μ fd capacitor to Point F (base of Q407) on the multiplex circuit board, as shown in Figure 4-9.
- () Connect the audio generator through this .1 μ fd capacitor to Point F (base of Q407) on the multiplex circuit board, as shown in Figure 4-9.
- () Set the Generator frequency to 19 kHz (± 100 Hz) with an output of 1 volt rms.
- () Adjust the slug in coil L407 for a minimum reading on the VTVM.
- () Set the Generator frequency to 36 kHz (± 200 Hz) with an output of 1 volt rms.
- () Adjust the slug in coil L408 for a minimum reading on the VTVM.
- () Disconnect both the Generator and the .1 μ fd capacitor from Point F on the multiplex circuit board.
- () Disconnect the jumper wire and 10 μ fd capacitor from the foil side of the AM-FM circuit board.

STEREO ADJUSTMENT

These adjustments should be made only if you want to measure the channel separation of the Receiver or make a more accurate adjustment of the separation control, R422. If you do not desire to make this measurement and adjustment, disregard the following steps and disconnect the Alignment Equipment. Then turn to Page 130 and complete the steps under Multiplex Adjustments.

Refer to Figures 4-8 and 4-9 for the following steps.

- () Place the NORM-ADJUST switch, located on the AM-FM circuit board, in the ADJUST position.
- () Place the Receiver MODE switch in the STEREO position.
- () Connect the RF output of the FM Stereo Generator to the FM antenna terminals with a 300 Ω lead.
- () Set the RF Generator at 98 MHz and the output level at 1000 μ v.
- () Set the Stereo Modulator for right channel operation, modulated at 1000 Hz with a ten percent 19 kHz pilot signal.
- () Adjust the stereo modulation to 100% total. See the manufacturer's Stereo Modulation and FM Generator Manuals.
- () First adjust the slug in coil L409; then the slug in transformer T402, for a maximum reading of the SIGNAL Meter.
- () Adjust the slug in coil L409 counterclockwise for a reading of 1-1/2 on the SIGNAL Meter.



- () Adjust the slug in transformer T402 for a maximum reading.
- () Adjust the slug in coil L409, for a maximum reading of the SIGNAL Meter.
- () Pull out on the PHASE control (this actuates the Phase-Adjust switch); then set the 19 kHz switch on the AM-FM circuit board to the NORM position.
- () Connect a jumper wire between test point TP2 on the multiplex circuit board and the +12 volt terminal on coil L409, as shown in Figure 4-9 (fold-out from this Page). Make sure that the jumper wire does not touch any other connection on the circuit board.

NOTE: The objective in the next step is to zero-beat the adjustable 38 kHz oscillator signal in the Receiver multiplex circuit with the incoming 38 kHz subcarrier signal from the Stereo Generator. If the Receiver 38 kHz oscillator frequency is not the same as the incoming subcarrier frequency, a third (difference) frequency will be produced. As the frequency of the Receiver 38 kHz oscillator approaches the frequency of the incoming subcarrier, the volume from the speaker or headphones will appear to increase and decrease slightly. When the zero-beat point (minimum rate of increase and decrease in volume) is reached, the Receiver 38 kHz oscillator and the incoming subcarrier signal are at the same frequency.

- () Set the Receiver VOLUME control for a normal listening level.
- () Carefully adjust the slug in transformer T401 until a zero-beat is obtained. This adjustment is very critical and the zero-beat point can be passed very easily. No more than one turn of the slug is normally required.
- () Remove the jumper wire between test point TP2 and the +12 volt terminal on coil L409.
- () Turn the PHASE control fully counterclockwise (do not push in).
- () Adjust the slug in coil L409 for maximum reading on the Audio VTVM.
- () Turn the PHASE control clockwise until a null point is obtained; then push the PHASE control in to its normal position.
- () Adjust SEP ADJ control R422 (on the component side of the multiplex circuit board, see Figure 4-5) for a minimum reading on the Audio VTVM.
- () Set the modulating frequency of the Stereo Generator to 15 kHz.
- () Adjust the slug in coil L403 for a minimum reading on the Audio VTVM.
- () Disconnect all alignment equipment from the Receiver. This completes the alignment procedure.

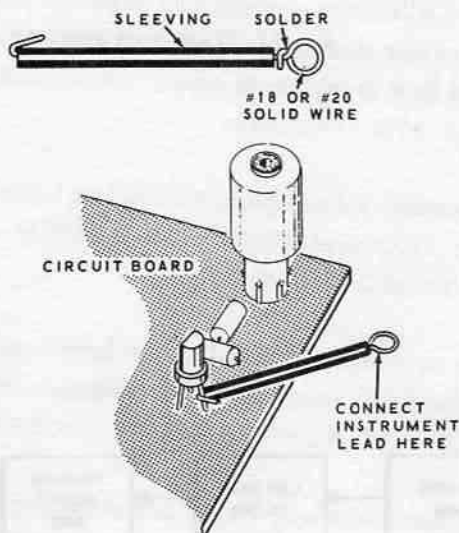


FIGURE 4-8

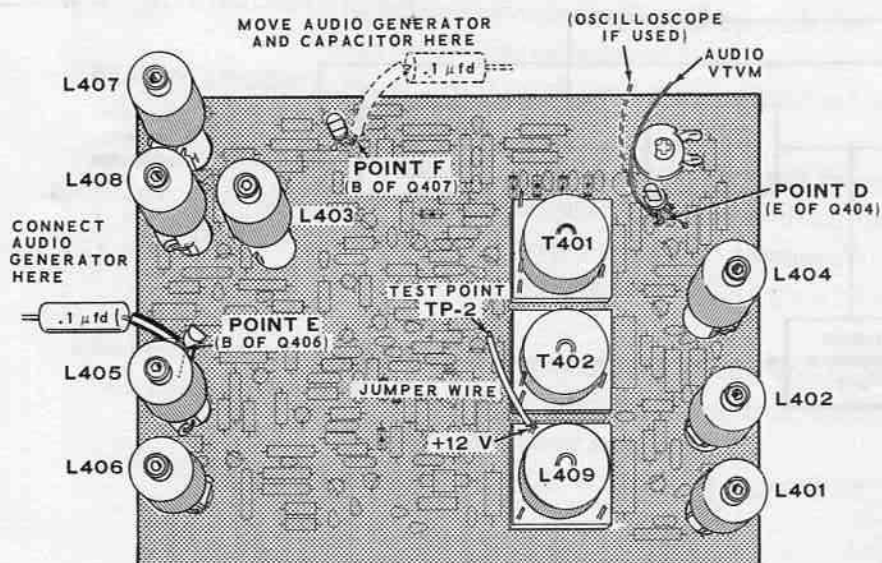


FIGURE 4-9

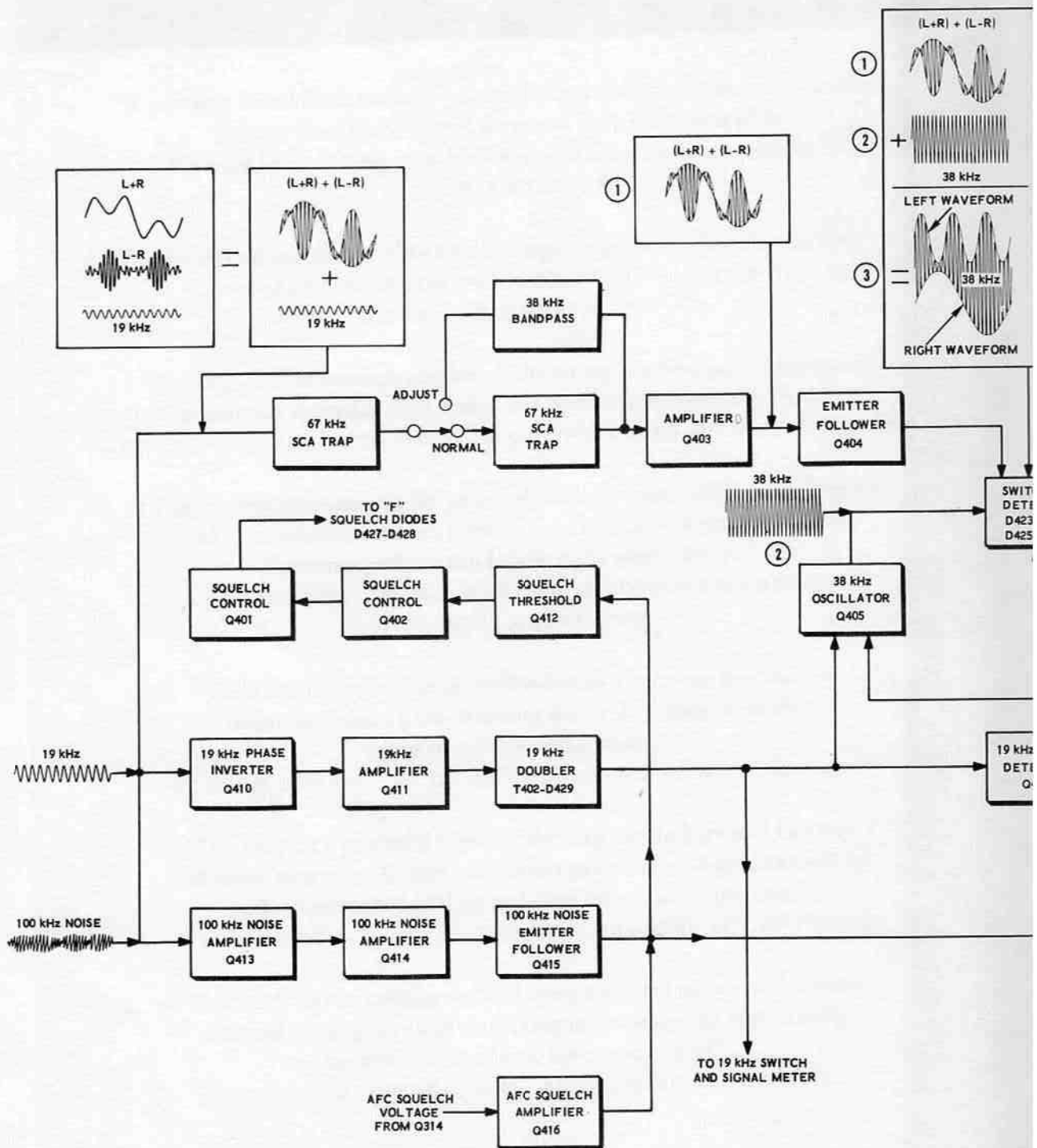


FIGURE 5-

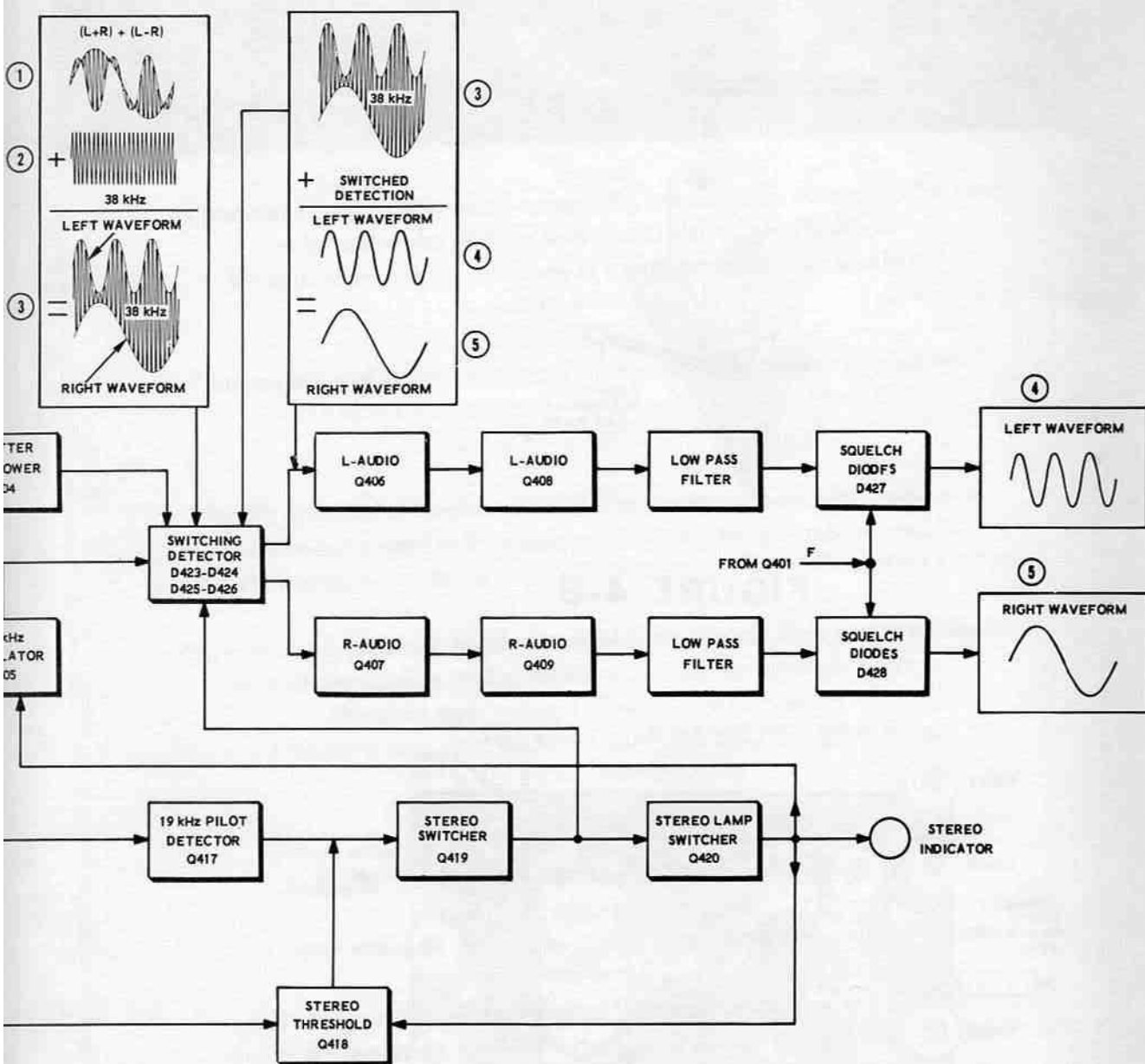


FIGURE 5-7

SPECIFICATIONS

TUNER

FM SECTION (Monophonic)

Tuning Range.	88 to 108 MHz.
Intermediate Frequency (IF).	10.7 MHz.
Frequency Response.	± 1 db, 20 to 15,000 Hz.
Antenna.	Balanced input for external 300 Ω antenna, 75 Ω antenna input may be used between either FM antenna terminal and ground.
Sensitivity.	1.8 μ v.*
Volume Sensitivity.	Below measureable level.
Selectivity.	70 db.*
Image Rejection.	90 db.*
IF Rejection.	90 db.*
Capture Ratio.	1.5 db.*
AM Suppression.	50 db.*
Harmonic Distortion.	.5% or less.*
Intermodulation Distortion.	.5% or less.*
Hum And Noise.	65 db.*
Spurious Rejection.	100 db.*

*Rated IHF (Institute of High Fidelity) Standards.

FM SECTION (Stereophonic)

Channel Separation.	40 db or greater at mid-frequencies. 30 db at 50 Hz. 25 db at 10 kHz. 20 db at 15 kHz.
Frequency Response.	±1 db from 20 to 15,000 Hz.
Harmonic Distortion.	1% at 1000 Hz with 100% modulation.
19 kHz And 38 kHz Suppression.	55 db or greater.
SCA Suppression.	50 db.

AM SECTION

Tuning Range.	535 to 1620 kHz.
Intermediate Frequency (IF).	455 kHz.
Sensitivity.	12 microvolts at 1000 kHz. Sensitivity is measured at 10 db signal-plus-noise to noise; measured at antenna terminals through a 200 pf dummy antenna.
Selectivity.	20 db at 10 kHz.
AM Antenna.	Built-in rod type. Connections for external antenna and ground on rear chassis apron.
Image Rejection.	60 db at 600 kHz. 40 db at 1400 kHz.
IF Rejection.	70 db at 1000 kHz.
Harmonic Distortion.	Less than 1.5% with a 1 millivolt input signal, 400 Hz, 90% modulation.
Hum And Noise.	45 db.*

*Rated IHF (Institute Of High Fidelity) Standards.

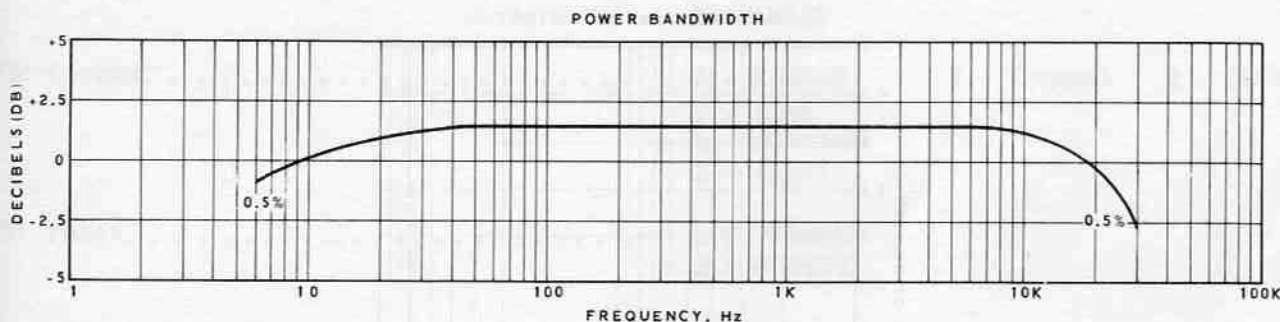
AMPLIFIER

NOTE: The following specifications are typical for both Amplifier channels, with identical signals fed to both channels simultaneously. Left channel and right channel amplifiers both operating at equal power output into individual $8\ \Omega$ resistive loads; line voltage constant at 120 volts AC.

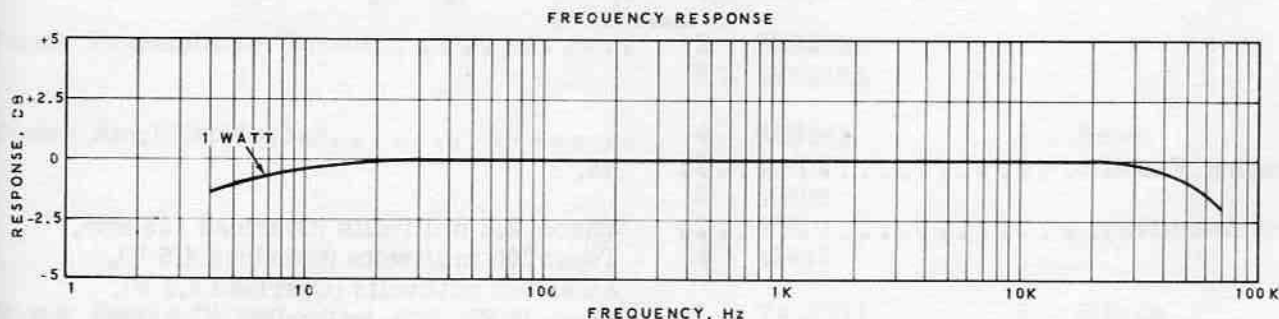
Dynamic Power Output Per Channel (Music Power Rating), 75 watts.*
(4 Ω load: 50 watts.)
(16 Ω load: 45 watts.)

Continuous Power Output Per Channel, 50 watts.*
(4 Ω load: 45 watts.)
(16 Ω load: 35 watts.)

Power Bandwidth For Constant .5% Total Harmonic Distortion*, Less than 6 Hz to 30 kHz.

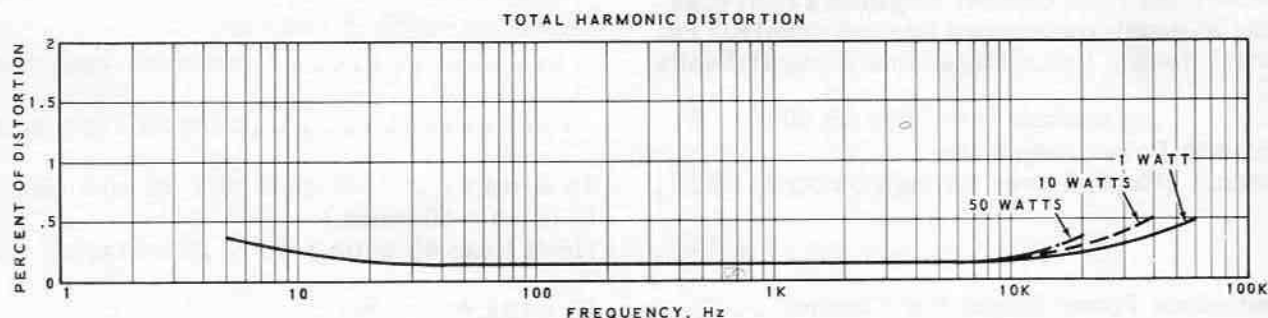


Frequency Response (1 watt level), ± 1 db, 8 to 40 kHz.
 ± 3 db, 4 to 80 kHz.

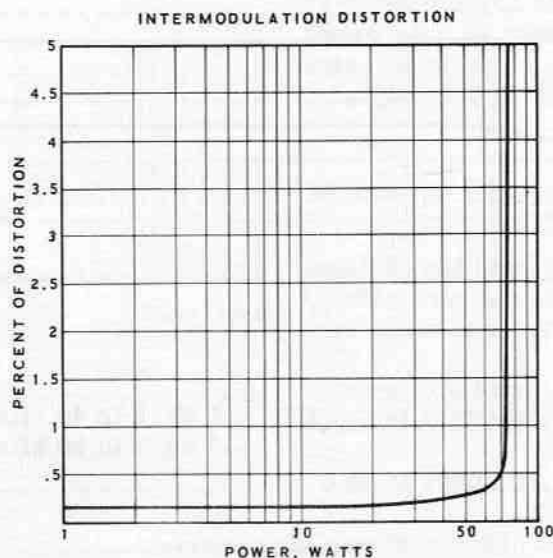


*Rated IHF (Institute of High Fidelity) Standards.

Harmonic Distortion, Less than .5% from 20 Hz to 20 kHz at 50 watts output.
 Less than .2% at 1000 Hz with 10 watts output.
 Less than .2% at 1000 Hz with 1 watt output.



Intermodulation Distortion, Less than .5% with 50 watts output, using 60 and 6,000 Hz mixed 4:1.
 Less than .2% with 1 watt output.



Damping Factor, 45.

Input Sensitivity,
 Phono: 2.2 millivolts (Overload 155 mv).
 Tape: 200 millivolts (Overload 4.5 V).
 AUX: 200 millivolts (Overload 4.5 V).
 Tape MON: 200 millivolts (Overload 4.5 V).

NOTE: Input sensitivity is the rms input voltage needed to obtain 50 watts of output power per channel into 8 Ω loads.

Hum And Noise.	Phono (10 millivolt reference): -60 db. Tape and AUX (200 millivolt reference): -65 db. Volume control in minimum position: -80 db below rated output.
Channel Separation.	Phono: 45 db or better. Tape and AUX: 55 db or better.
Output Impedance (each channel).	4 Ω through 16 Ω .
Tape Output Impedance.	120 Ω .
Input Impedance.	Phono: 51 K Ω (*RIAA Equalized). AUX, Tape, and Tape MON: 100 K Ω .
Tape Output.	.17 volt output with .2 volt input.

TRANSISTOR-DIODE COMPLEMENT

	TRANSISTORS	DIODES	INTEGRATED CIRCUITS
AM Tuning Circuit.	1 - L842 2 - 40245	1 - Crystal	
FM Circuit.	2 - 2N3393 2 - L842 4 - X29A829 2 - 40245	7 - Crystal	2 - CA3012
FM Tuner.	1 - 2N5025 3 - 2N3823		
Multiplex Circuit.	11- 2N3393 1 - 2N3416 8 - X29A829	8 - Crystal 4 - Dual Silicon	
Control Preamplifier Circuit.	2 - 2N3393 2 - X29A829 6 - TZ1160		
Phono Preamplifier Circuit.	2 - 2N3859A 2 - 2N5232A		
Power Amplifier Circuit.	4 - 2N3393 2 - 40408 2 - 40409 2 - 40410 4 - 40411	4 - Zener 6 - Silicon	
Power Supply Circuit.	1 - TA-7311 1 - S2091 1 - 2N3055 1 - 40409	7 - Silicon 2 - Zener	

*RIAA (Record Industry Association of America).

CONTROLS AND SWITCHES

FRONT PANEL

AM-FM Tuning.....	535 to 1620 kHz and 88 to 108 MHz.
Source Switch.....	Phono, AM, FM, Tape, and AUX positions.
Volume Controls.....	Dual tandem for simultaneous adjustment of both channels.
Bass Control.....	Dual tandem for simultaneous adjustment of both channels. Clockwise rotation from center provides 15 db boost at 20 Hz. Counterclockwise rotation from center provides 17 db cut at 20 Hz.
Treble Control.....	Dual tandem for simultaneous adjustment of both channels. Clockwise rotation from center provides 15 db boost at 20 kHz. Counterclockwise rotation from center provides 15 db cut at 20 kHz.
Tone Flat Switch.....	An outward pull on the TREBLE control activates a switch that makes the Bass and Treble controls inoperative and provides completely flat frequency response regardless of control setting. LOUDNESS in OFF position.
Balance Control.....	Balances the right and left channel amplifiers for equal effective sound output from both speaker systems.
Speaker Switch.....	For headphone listening. This switch disconnects the speaker systems from the amplifier outputs without damage to the amplifiers.
Power Switch.....	Applies or removes all power to the internal circuitry of the Receiver.
Mode Switch.....	Determines the Receiver mode-of-operation; MONOphonic or STEREOphonic.
Tape Monitor Switch.....	Makes it possible to monitor the source signal or the recorded signal while recording on tape.
FM Switch.....	NORMAL position: signals broadcast in FM or FM stereo are reproduced. Stereo Only position: only the signals broadcast in FM Stereo are reproduced.

Noise Filter Switch.

In the ON position, high frequency noise is reduced without reducing the frequency response (high frequency stereo separation will be affected).

Loudness Switch.

The ON position, the loudness circuit compensates for the nonlinear frequency-versus-volume characteristic of the human ear at low sound levels.

NOTE: The following controls and switches are located behind the hinged door on the front panel.

Phase Control.

Pull out to activate the Phase Adjust switch. Adjustment of the control then provides maximum FM stereo channel separation.

Squelch Control.

Eliminates between-station noise and weak noisy signals so that only clear FM stations can be heard.

Stereo Threshold Control.

Sets the threshold noise level that will cause automatic switchover from stereophonic to monophonic reproduction when the FM switch is in the Normal position.

Level Controls.

L and R (Left and Right channel) controls for Phono, AM-FM, Tape, Auxiliary, and Tape Monitor. These ten L and R controls set the level of the signals that are applied to the preamplifiers from the input selected by the Source switch.

OTHER CONTROLS AND SWITCHES

Separation Adjust Control

Set during FM alignment for correct channel separation. Control located on Multiplex circuit board.

19 kHz Switch.

Normal-Test positions. Normal position used for normal FM reception. Test position used when adjusting 19 kHz circuits. Switch located on AM-FM circuit board.

Signal Meter Function Switch.

V (volts) and R (resistance) positions used during the Initial Checkout procedure. Normal position used at all other times.

GENERAL

AC Outlet Sockets.....	Three, located on rear chassis apron for powering accessory equipment. One Switched (350 watts maximum), and two Unswitched (350 watts maximum).
Power Requirements.....	105-125 or 210-250 volts 50/60 Hz AC. 55 watts idling (zero output) and 240 watts at full output, with no load on accessory outlets.
Dimensions.....	Overall - 16-7/8" wide x 4-3/4" high x 14-1/2" deep.
Mounting.....	AE-16 Cabinet or custom mounting.
Net Weight.....	27 lbs.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to

incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 213), and to the Block Diagram (fold-out from Page 133), while you read this Circuit Description.

To help you locate specific parts in the Receiver, or on the Schematic, the circuit part numbers (R1, C101, L301, etc.) for resistors, capacitors, coils, and transistors, are in the following groups:

- 1 - 99 Parts in the Phono Preamplifier circuit.
- 100 - 199 Parts in the Control Preamplifier circuit.
- 200 - 299 Parts in the Power Amplifier circuit.
- 300 - 399 Parts in the AM-FM Tuner circuit.
- 400 - 499 Parts in the Multiplex circuit.
- 500 - 599 Parts in the Power Supply circuit.

Each of the circuits listed above will be described separately. The audio section of the Receiver is used to reproduce signals from all sources, such as Phono, Tape, and AM-FM Tuner. Therefore, the audio circuits will be described first.

AUDIO CIRCUITS

Resistor and capacitor numbers (1-299) in the audio circuits are further divided so that the odd numbers are in the left channel circuits, and the even numbers are in the right channel circuits. An exception is made for resistor R19 and capacitors C11 and C12 in the phono preamplifier, and resistor R175 and capacitor C131 in the control preamplifier. These parts are common to both channels. R19 and C11 filters the supply voltage.

Transistors in the audio circuits are designated L (left) and R (right). For example, Q201L in the left channel circuit is identical to Q201R in the right channel circuit.

The left and right channel audio circuits are identical in operation, so only the left channel circuits will be described. To match the description

to a circuit in the right channel, find the same transistor number with an R suffix, and the resistor or capacitor with the next higher even number. For example; transistor Q1L, resistor R5, and capacitor C3 in the left channel would have counterparts as Q1R, R6, and C4 in the right channel.

PHONO PREAMPLIFIER

The signal from a magnetic phono cartridge is coupled through the Phono input jack, resistor R21, and capacitor C1 to transistor Q1L, which is a high gain, low-noise amplifier. The amplified signal at the collector of Q1L is direct coupled to the base of Q2L. After further amplification in Q2L, capacitor C7 couples the signal to the output terminal of the phono preamplifier. A portion of this signal is fed back through a

frequency-sensitive network to the emitter of Q1L. This network consists of resistors R5 and R7, and capacitors C3 and C5. DC feedback from the emitter of Q2L is applied through resistors R13 and R11 to the base of transistor Q1L. RIAA (Record Industry Association of America) equalization is thus provided. The equalized signal from the output terminal is coupled to the L-Phono Level control in the Control Preamplifier circuit.

CONTROL PREAMPLIFIER

Source and Tape Monitor Switching (See Figure 5-1)

The Source switch, which is shown in the Phono position (full counterclockwise) on the Schematic, has five positions: Phono, AM, FM, Tape, and Auxiliary. Wafer 1 of this switch (1F and 1R) is in the Control Preamplifier circuit. The front of this wafer (1F) selects the input signal to be amplified. The rear of this wafer (1R) shorts out the input signals not being used. An input Level control is connected to the Source switch for each input so the amplifier circuits can receive the same level of input signal from each of the sources.

Transistors Q101L and Q102L are emitter-followers that provide high input impedance and low output impedance. Q101L provides a low output impedance to feed a tape recorder, while Q102L provides a low drive impedance to the tone control circuits.

The input signal selected by wafer 1 of the Source switch is coupled to the Tape Output jack for recording through capacitor C101, resistor R115, transistor Q101L, and capacitor C109. The signal is also coupled from the Source switch to the Tape Monitor switch.

When the Tape Monitor switch is in the Off position, the signal is coupled through C103, R117, Q102L, and C113 to the Bass and Treble tone control circuit.

When the Tape Monitor switch is in the On position, and a tape recorder is properly connected to the Tape Output and Tape Monitor jacks, the signal from Q101L is recorded on tape and immediately played back through C103, R117, Q102L, and the rest of the audio circuits. The Tape Monitor switch allows you to

hear either the source signal, or the recorded signal while recording.

The resistor-capacitor networks around transistors Q101L and Q102L provide the biasing needed for proper functioning of these stages.

Tone, Balance, and Volume Controls

The signal from capacitor C113 is coupled to separate Bass and Treble tone controls, which permit independent adjustment of the high frequency and low frequency response. The Bass circuit consists of resistors R139, R141, R143, and R145, and capacitors C115 and C117. The Treble circuit consists of resistors R147 and R149, and capacitor C119. The signal from these two circuits is coupled to the base of transistor Q103L.

The signal is amplified and inverted in Q103L, therefore, the signal at the collector is out of phase with the signal that was applied to the base. This out-of-phase signal is applied back to the Treble control through capacitor C121, and back to the Bass control through C121 and R143.

With the input signal at one end of the Bass control and an out-of-phase signal at the other end, there will be a point near the center of the control where bass response will be essentially the same as that of the input signal. As the arm of the control is moved counterclockwise, more of the out-of-phase signal is applied to the base of Q103L and a cut in bass response results; as the arm of the control is moved clockwise, more of the input signal is applied to the base of Q103L and a boost in bass response results.

Capacitor C115, across the Bass control, bypasses higher frequencies, limiting the effect of the control to the lower frequencies. Capacitor C117, between the arm of the control and the base of Q103L, has a high value to pass the low frequencies with very little attenuation.

The Treble control works the same way as the Bass control. The main difference between the bass and treble circuits is that the treble coupling capacitor, C119, has a low value to block low frequencies while passing high frequencies with very little attenuation.

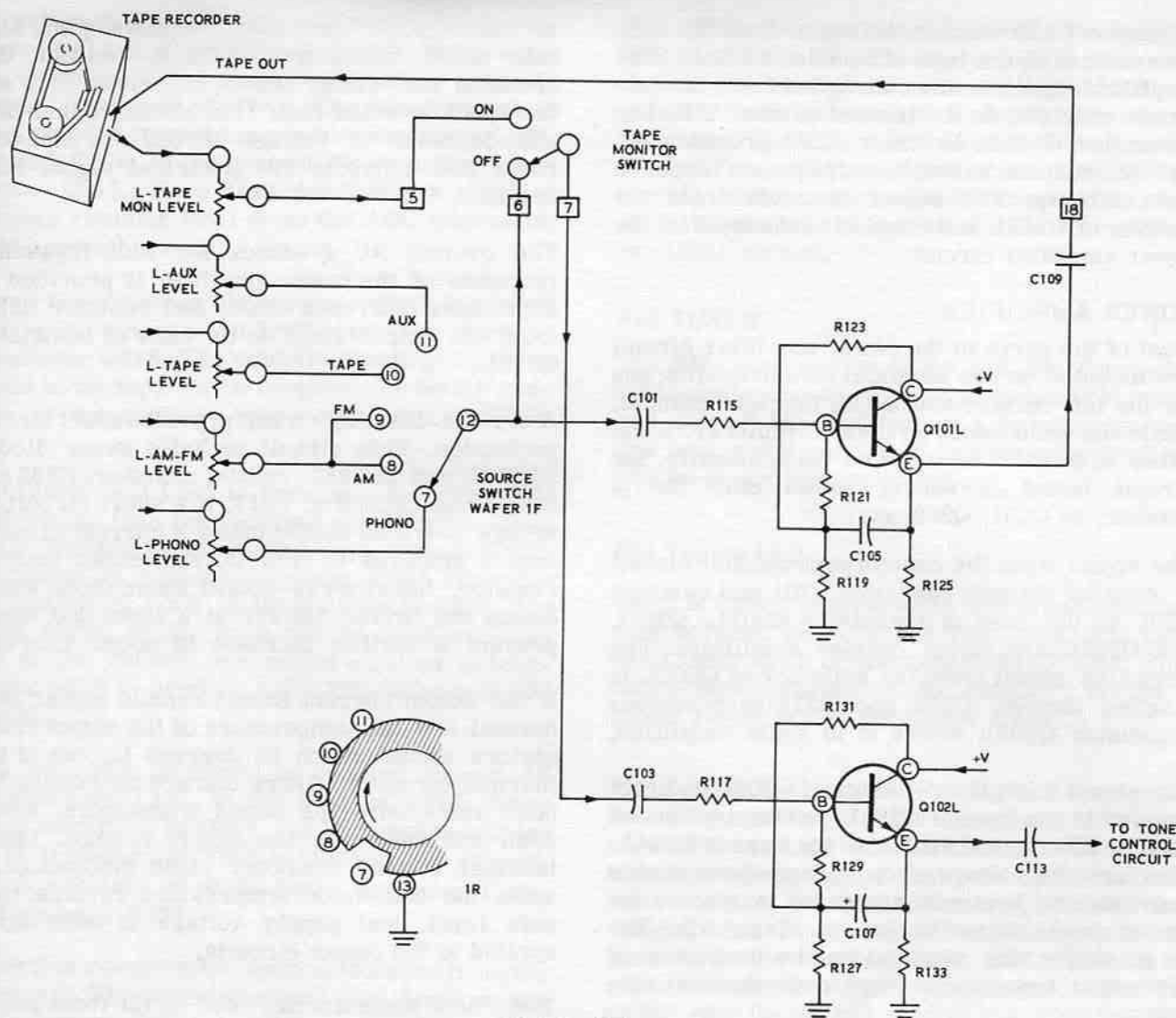


Figure 5-1

The tone compensated signals present at the collector of Q103L are coupled through capacitor C123 and the Tone Flat switch (in the Off position) to the Balance control.

The entire tone control circuit and transistor Q103L is by-passed when the Tone Flat switch (on the Treble control) is in the On position (pulled out). In this position, the Tone Flat switch couples the signal from C113 and R137 to the Balance control, and the tone controls have no effect on the signal.

The left channel and right channel Balance controls are turned by a single knob. A special control is used so that in the center of rotation, each channel's Balance control passes

its full signal to its Volume control. As the knob is turned in a clockwise direction from center, the left channel signal is reduced without affecting the right channel signal. When turned counterclockwise from center, the right channel signal is reduced without affecting the left.

The Volume control is a dual control, connected so as to raise or lower the left and right channel signals simultaneously. The Volume control functions as a "loudness" control when the Loudness switch is in the On position. Loudness operation compensates for the nonlinear response of the human ear to audio frequency signals at lower listening levels. Capacitors C125 and C127, and resistor R161, make up the loudness circuit when the Loudness switch is in the On position.

Capacitor C129 couples the signal from the Volume control to the base of transistor Q104L. The amplified signal is direct-coupled from the collector of Q104L to the base of emitter-follower transistor Q105L. Resistor R167 provides AC and DC feedback to improve frequency response and stability. The signal is taken from the emitter of Q105L and coupled to the input of the power amplifier circuit.

POWER AMPLIFIER

Most of the parts in the power amplifier circuit are mounted on two identical circuit boards; one for the left channel and one for the right channel. While the transistors in these circuits are identified with an L or an R on the Schematic, the circuit board screening shows only the Q number, as Q201, Q202, etc.

The signal from the control preamplifier circuit is coupled through capacitor C201 and resistor R201 to the base of transistor Q201L. Q201L and Q202L are direct coupled amplifiers. The amplified signal from the collector of Q202L is coupled through C207 and R215 to predriver transistor Q203L where it is again amplified.

The signal from the collector of Q203L is direct coupled to the base of Q205L, and through diodes D201L, D202L, and D203L to the base of Q204L. The forward voltage drop across these diodes provides the bias voltage needed to operate the driver and output stages in class AB. The three diodes are mounted on the heat sinks of the output transistors to provide thermal stability.

Driver transistors Q204L and Q205L, and output transistors Q206L and Q207L, form a quasi-complementary output circuit. In this circuit, a positive-going signal applied to the base of Q204L causes this transistor to conduct. This in turn causes Q206L to conduct, which causes the voltage across capacitor C223 and the speak-

er voice coil to increase. Negative-going signals cause Q205L and Q207L to conduct, decreasing the voltage across capacitor C223 and the speaker voice coil. This alternate increase and decrease of voltage across the speaker voice coil converts the electrical signal back to sound.

The overall AC feedback for wide frequency response of the power amplifier is provided by capacitors C211 and C209, and resistor R223, from the output stage to the base of transistor Q201L.

A current-limiting circuit provides short circuit protection. This circuit includes zener diodes ZD204L and ZD205L, emitter resistors R235 and R237, and capacitor C217. If a short circuit or severe overload should cause a current of more than 5 amperes to flow through either emitter resistor, the reverse-biased zener diode would clamp the driver voltage at a level that would prevent a further increase in output current.

If the output current should remain higher than normal and the temperature of the output transistors should reach 60 degrees C, one of the thermal circuit breakers that are mounted on the heat sinks with the output transistors, would open and interrupt the supply voltage. These thermal circuit breakers close automatically when the transistor temperature returns to a safe level, and supply voltage is once again applied to the output circuits.

Two Phone jacks are provided on the front panel of the Receiver so two pairs of stereo phones can be used at once. The left channel signal is coupled from coil L201, through resistor R241, to the sleeve of each Phone jack. The right channel connects to the tip of each Phone jack. Private listening, with headphones only, is permitted by placing the Speaker switch in the Off position.

AM-FM TUNER CIRCUITS

The AM-FM Tuner circuit board contains a complete AM tuner and a complete FM tuner. The AM and the FM tuner circuits will be described separately.

AM TUNER

The three-transistor AM tuner circuit consists of an RF amplifier, and oscillator-mixer,

an IF (intermediate frequency) amplifier, and a diode detector. The AM tuner section allows you to receive standard broadcast signals from 540 kHz to 1600 kHz.

RF signals are picked up by rod antenna L306, or may be coupled through capacitor C375 from

an external antenna. The desired signal is selected by a tuned circuit that consists of one winding of L306 and the antenna section of the variable tuning capacitor (C377A). The tuned signal is then coupled from the secondary winding of L306, through C376, to the base of RF amplifier transistor Q315. Base bias for Q315 is supplied through resistor R361 from the AGC (automatic gain control) circuit.

From the collector of transistor Q315, the signal is coupled through coil L307 to the base of mixer transistor Q316. The primary winding of L307 is tuned to the input signal frequency by the RF section of the variable tuning capacitor (C377B).

Oscillator coil L308 is tuned to a frequency 455 kHz higher than the received signal by the oscillator section of the tuning capacitor (C377C). Feedback is obtained through C385 from the secondary of L308 to the emitter of Q316. The input signal at the base and the oscillator signal at the emitter are mixed together in transistor Q316 to produce a 455 kHz difference (IF) signal.

The 455 kHz IF signal is coupled through IF transformer T303, to the base of Q317. After being amplified by Q317, the IF signal is coupled by IF transformer T304 to the detector circuit, which consists of diode D308, capacitor C398, and resistor R376.

Detection removes the audio modulation from the IF signal. The detected signal also develops the AGC voltage that is used to control the gain of transistors Q315 and Q317. The AGC voltage is developed across resistor R375 and is filtered by resistors R367 and R374, and capacitors C393, and C396. Automatic gain control helps to maintain a constant audio output with fading or varying RF signals.

The Signal Meter is connected to the emitter of Q317 through resistor R372 when the Source switch is in the AM position and the Test switch is in the Normal position. Thus, the Signal Meter deflects according to the amount of AGC voltage that is applied to Q317. The stronger the received signal, the more AGC voltage, and the greater the Signal Meter deflection. Contacts 10 and 14 of Source switch section 2R, and contacts 11 and 15 of section 2F, connect the Signal Meter and the AM Meter Adjust control into the emitter circuit of transistor Q317.

The AM audio signal is coupled through capacitor C397 to section 2F of the Source switch. Since AM signals are monophonic, the same signal is coupled to both the left and right audio circuits simultaneously. Contacts 1 and 4 connect the signal to the right channel input of the control preamplifier circuit, while contacts 6 and 9 connect the same signal to the left channel input of the control preamplifier circuit.

FM TUNER

The FM tuner section of the AM-FM Tuner circuit board consists of a preassembled FM tuning unit and an IF amplifier and detector section. The tuning unit and the IF and detector sections will be described separately.

FM Tuning Unit

The FM tuning unit receives FM broadcast signals between 88 MHz and 108 MHz, and converts them to an IF frequency of 10.7 MHz. This tuning unit contains two RF amplifier stages, a mixer stage, and an oscillator stage.

Field effect transistors (F.E.T.) are used in the RF and mixer stages of the tuning unit. The operation of these field effect transistors is similar to other types, except that the F.E.T. contains elements that are called "source," "gate," and "drain." See Figure 5-2. These elements compare with the emitter, base, and collector in other transistors. Either the source (emitter) or the gate (base) will control the drain (collector) current to amplify a signal.

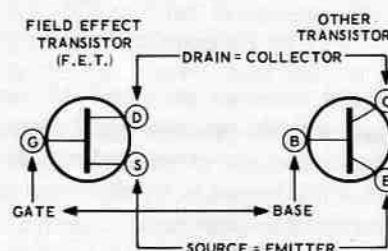


Figure 5-2

Field effect transistors offer the advantages of greater linearity, low cross-modulation, and the ability to amplify larger signals without distortion. These features provide superior operation of the RF and Mixer stages of the FM tuner.

FM station signals are coupled from an external 300 ohm FM antenna to the primary winding of antenna coil L301. The secondary winding of L301 is in a tuned circuit that consists of capacitors C301 and C303, and the antenna section of the variable tuning capacitor (C302A). C302A tunes the circuit to the frequency of the desired station. Capacitor C304 couples the tuned signal to the gate (G) of first RF amplifier F.E.T. Q301. Resistor R301 couples AGC (automatic gain control) voltage to gate of Q301. The AGC circuit will be described later.

F.E.T. Q301 and Q302 form a cascode RF amplifier. Coil L302 and capacitor C309 couple the signal from the drain (D) of Q301 to the source (S) of Q302. A third winding on L302 couples a portion of the signal back to the gate of Q301 through C306. This improves the stability and frequency response of the stage.

The amplified signal at the drain of Q302 is tuned by the circuit made up of L303, C313, C312, and the RF section of the variable tuning capacitor (C302B). This signal is coupled through C316 to another tuned RF circuit, and to the gate of mixer F.E.T. Q303. Section C of variable tuning capacitor C302, along with C317, C318, and coil L305, make up this tuned RF circuit.

Transistor Q304 operates as a grounded-base oscillator. The frequency of oscillation is determined by the primary winding of L306, capacitors C322, C323, and the oscillator section of the variable tuning capacitor (C302D). The secondary winding of L306 couples the oscillator signal to the source of mixer F.E.T. Q303. The oscillator operates 10.7 MHz higher than the received signal.

Mixer F.E.T. Q303 combines the tuned RF signal that is applied to its gate with the oscillator signal that is applied to its source. The mixing of these two signals in Q303 produces an IF signal (10.7 MHz) equal to the difference between the RF and oscillator signal frequencies.

The IF signal is taken from the drain of the mixer F.E.T. by transformer T301. Both the primary and the secondary of T301 are tuned to the IF frequency. The IF signal is then coupled through capacitor C329 and resistor R312 to the IF amplifier stages.

FM IF

The amplification, bandpass, and limiting characteristics, that are required in the FM IF section, are provided by two crystal filters, two integrated circuits, and two conventional transistor amplifier stages.

The specially-designed quartz crystal filters (F301 and F302) replace conventional IF tuned circuits, and eliminate the need for IF alignment, except for the detector coil. These crystal filters provide a steep-skirted, flat-topped bandpass with very linear phase characteristics at all signal levels.

The integrated circuits, IC301 and IC302, are compact miniature amplifiers, each containing ten transistors, seven diodes, and eleven resistors. See the integrated circuit Schematic that is printed as an inset on the main Schematic Diagram. The signal path through the transistors in the integrated circuit is shown by heavy lines. The signal input at pin 1 couples to the base of transistor A. Transistors B, E, and H are amplifiers, while A, C, D, F, and G are emitter followers used for signal coupling. Transistors J and K, and diodes D1 and D2, form a voltage regulating circuit. The amplified signal from the collector of grounded-base transistor H is taken from pin 5 of the integrated circuit.

From the FM tuner, the IF signal is coupled through resistor R312, crystal filter F301, and capacitor C337 to the base of transistor Q305. Part of the amplified signal from the collector of Q305 is coupled through C342 to AGC and meter amplifier transistors Q309 and Q310.

The IF signal from the collector of transistor Q305 is also coupled through capacitor C343 to the input of integrated circuit IC301. Both amplification and limiting (clipping) takes place in the integrated circuit. Limiting removes any noise pulses or amplitude modulation (AM) that may be superimposed on the FM signal. From IC301, the signal is coupled directly to crystal filter F302 where greater selectivity is obtained. The signal is then coupled through C347 to IC302 for further amplification and limiting. The signal output of IC302 is coupled through C352 to the base of transistor Q306, the final IF amplifier and limiter.

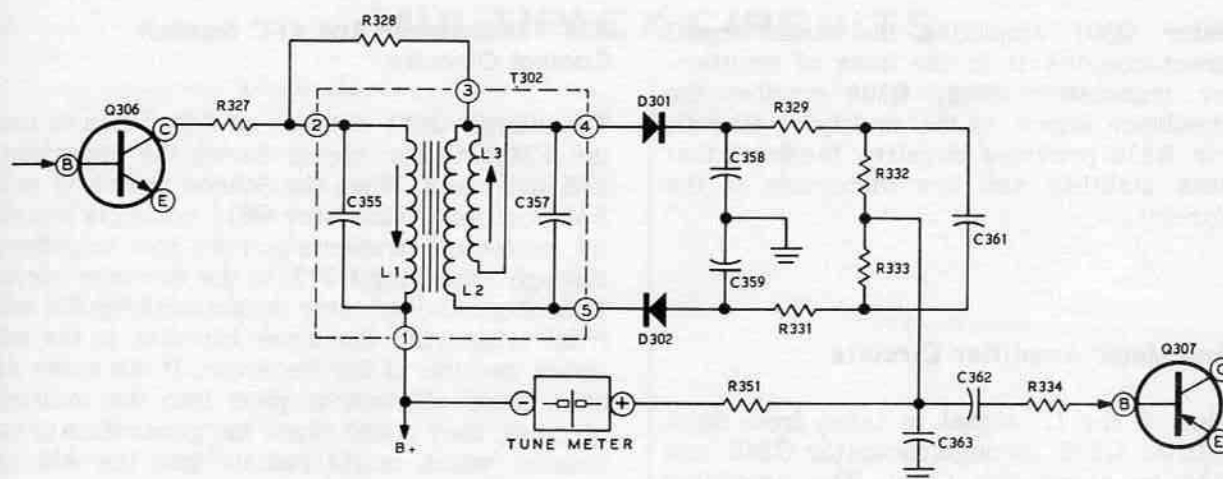


Figure 5-3

Ratio Detector

From the collector of transistor Q306, the IF signal is coupled through resistor R327 to transformer T302 in the ratio detector circuit. See Figure 5-3. Transformer T302 has a primary winding, L1, that is tuned to 10.7 MHz, and two bifilar-wound secondary windings, L2 and L3. Resistor R328 provides a DC path between the primary of T302 and the start of the two secondary windings.

A separate voltage is induced by the primary into each of the two secondary windings. The amplitude of these voltages stays relatively constant due to the limiting action of transistor Q306 (and the previous integrated circuits).

The two induced voltages, at L2 and L3, cause two separate current loops to operate in the ratio detector circuit. The current in one loop flows through L3; diode D301; resistors R329, R332, and R351; the Tune Meter; L1; and through resistor R328 to the other side of winding L3. The current in the other loop flows through L2; diode D302; resistors R331, R333, and R351; the Tune Meter; L1; and through resistor R328 to the other side of winding L2. The two currents that flow in this circuit are DC, since they are rectified by diodes D301 and D302. Note that both of these DC currents flow through resistor R351, the Tune Meter, the primary of T302, and resistor R328. At the FM IF center frequency of 10.7 MHz, the two currents are of equal amplitude; therefore, they cancel each other and no current flows.

When the IF frequency deviates from 10.7 MHz due to FM modulation (audio signal), the current in one loop increases while the current in the other loop decreases; these current changes are due to the change in phase relationship in the signal currents across coils L1, L2, and L3.

Now, a current that is controlled by the FM modulation flows through resistor R351 and the Tune Meter; this current causes the audio output signal to be developed across resistor R351 and the Tune Meter. The audio output signal is taken from the ratio detector circuit at the junction of resistors R332 and R333. It is then coupled through capacitor C362 and resistor R334 to audio amplifier transistor Q307.

The amplitude of the output signal is determined by how far the IF frequency deviates above and below 10.7 MHz. The frequency of this audio output signal is determined by how often the frequency deviates above and below 10.7 MHz.

When the Receiver is correctly tuned to the FM station, an IF center frequency of 10.7 MHz is produced, no steady current flows in the ratio detector circuit, and the pointer of the Tune Meter remains at rest. When the Receiver is tuned away from the center frequency of the FM station, an IF center frequency is produced that is either higher or lower than 10.7 MHz. This frequency causes one of the diode loops to conduct more than the other. The resulting unbalance in currents through the Tune Meter causes its pointer to indicate the direction (high or low) in which the Receiver is being detuned.

Transistor Q307 amplifies the audio signal and direct-couples it to the base of emitter-follower transistor Q308. Q308 couples the low impedance signal to the multiplex circuit. Resistor R338 provides negative feedback that maintains stability and low distortion in the audio circuit.

AGC And Meter Amplifier Circuits

A portion of the IF signal is taken from input IF amplifier Q305, through capacitor C342; and amplified by transistor Q309. The amplified signal is then coupled from the collector of Q309, through C367, to voltage-doubler rectifier diodes D306 and D307. After being rectified and doubled this voltage is filtered by C366, R342, and C365, and becomes the AGC voltage for controlling F.E.T. Q301.

The AGC voltage is proportional to the strength of the received FM station signal, and is applied to the gate of RF amplifier Q301 through resistor R301. As stronger FM station signals (200 μ v or more) are received, the increased AGC voltage applied to the gate of Q301 reduces its amplification. This prevents overloading and distortion when strong signals are received.

The signal from the collector of Q309 also is direct-coupled to the base of meter amplifier transistor Q310. The amplified signal from the collector of Q310 is coupled through capacitor C368 to voltage-doubler rectifier diodes D303 and D304. Sections 2R and 2F of the Source switch connect the Signal Meter across diode D305 with resistor R348 in series. The voltage across this diode is proportional to the signal strength, and the Signal Meter deflects accordingly. Diode D305 acts as a voltage compressor and meter protector.

AM-FM Switcher And AFC Squelch Control Circuits

Transistor Q311 acts as an AC switch to block the FM detector signal during the reception of AM programs. When the Source switch is in the AM position, transistor Q311 conducts heavily. Its collector presents a very low impedance, through capacitor C373, to the detector circuit. This stops the detector action and keeps FM noise from triggering the noise circuits in the multiplex section of the Receiver. If the noise signals were allowed to pass into the multiplex circuits, they could cause the generation of harmonics which might radiate into the AM circuitry.

When the Source switch is in the FM position, transistor Q311 is cut off. Therefore, its collector exhibits a very high impedance to the detector circuit, through C373, and permits normal FM detector operation.

A special circuit is used in this Receiver to eliminate the harsh distortion that occurs when you tune to the edge of an FM station. This deviation detector circuit, which is comprised of transistors Q312, Q313, and Q314, controls the squelch circuits in the multiplex section.

The positive or negative voltage that appears at the junction of resistors R332 and R333 is coupled through R352 to the bases of transistors Q312 and Q313. These transistors are biased by resistors R354 and R355 so a small voltage change at the ratio detector output will cause one or the other transistor to conduct. The collector of Q312 is direct coupled to the base of Q314, while the collector of Q313 is direct coupled to the collector of Q314. Thus, either a positive or a negative voltage from the ratio detector (caused by tuning either side of the center frequency) will cause a positive voltage to appear at the collector of transistor Q314. This positive voltage is applied to transistor Q416 on the multiplex circuit board where it actuates the squelch and stereo threshold circuits, as will be described later.

MULTIPLEX CIRCUITS

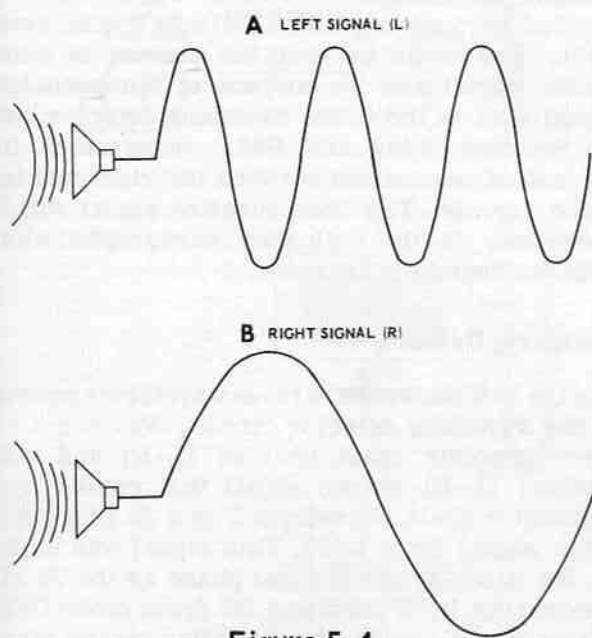


Figure 5-4

Figures 5-4A and 5-4B show two sample signals that might appear at the left (L) and right (R) channel microphones at a radio station that is broadcasting FM stereo. The transmitting circuits then combine these signals to produce the L+R (main channel) signal shown in Figure 5-5A and the L-R (subchannel) signal shown in Figure 5-5B. Note that the L-R signal is superimposed on a 38 kHz signal as shown in Figure 5-5C. This amplitude modulated L-R signal is transmitted as the subcarrier channel.

The L+R (main channel) signal and the L-R (subcarrier) signal, are combined with the 19 kHz pilot signal shown in Figure 5-5D, and the whole complex signal frequency modulates the transmitted RF carrier.

A second subcarrier signal is transmitted by some stations at a frequency of 67 kHz. This channel, which is modulated by a commercial music signal, is called the SCA (Subsidiary Communications Authorization) channel.

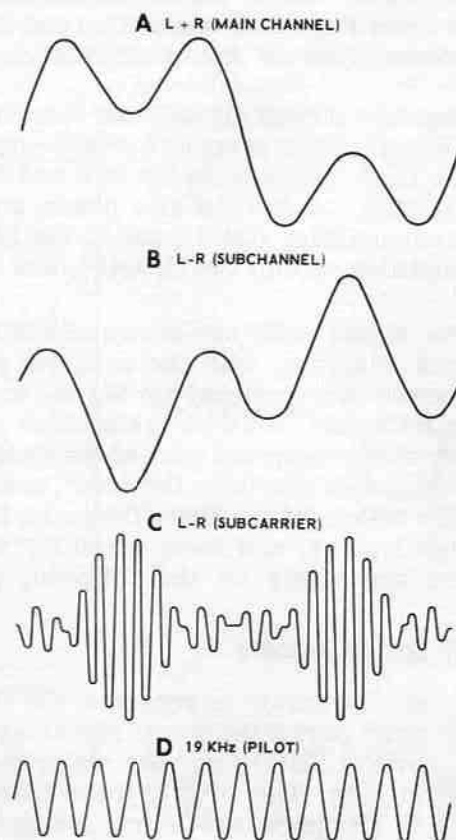


Figure 5-5

Figure 5-6 shows where the different components are to be found in a stereo FM signal. The L+R signal, which is in the audio spectrum (50 Hz to 15 kHz), is called the "main channel." Monophonic FM receivers use only this part of the signal, and the remaining signal components are attenuated by the de-emphasis network.

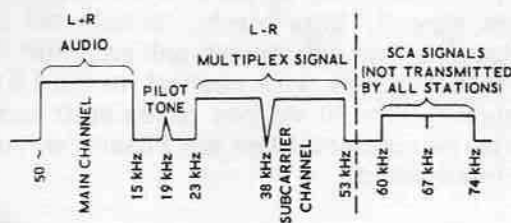


Figure 5-6

Refer to the Block Diagram (Figure 5-7, fold-out from Page 178) and to the Schematic Diagram (fold-out from Page 213) while you read the following description of the multiplex circuits.

The composite stereo signal from the output of the FM Tuner circuit is applied to three separate multiplex input circuits; to the SCA and 38 kHz filter circuits, to the 19 kHz phase inverter (Q410) and amplifier (Q411), and to the 100 kHz noise amplifier circuit (Q413, Q414, and Q415).

The three signal paths are shown on the Multiplex Block Diagram, with the program part of the composite stereo signal across the top. The 19 kHz pilot signal, and the 100 kHz noise signal, that control the program part of the composite stereo signal and eliminate the noise, are shown across the bottom of the Block Diagram. Each of these signal paths, and their circuits, will be described separately on the following pages.

Stereo Program Signals

When a stereo program is received, the (L+R) + (L-R) program part of the stereo signal is passed through several filter circuits which remove unwanted signals. The first of these filter circuits is a 67 kHz parallel SCA trap, composed of coil L401 and capacitor C403. L402 filters out noise components above 53 kHz to prevent them from beating with harmonics of the 38 kHz oscillator and subcarrier.

Another 67 kHz parallel trap is composed of L404 and C408. This trap eliminates any remaining 67 kHz SCA subcarrier, and also acts as a 38 kHz bandpass filter when the Phase switch is in the Adjust position (Phase control shaft pulled out). In the Adjust position, the Phase switch removes C409 from the circuit and inserts C405 in series with L402 to form a 38 kHz series resonant circuit. This circuit is adjusted so it will pass only the subcarrier and shift the subcarrier 90 degrees with respect to the 19 kHz pilot signal. The 90 degree phase shift causes a null to be obtained when the Phase control is properly adjusted.

The output of the filter networks is coupled through capacitor C412 to transistor Q403. The amplified signal is then direct coupled to the base of emitter-follower transistor Q404. Bias and stability for Q403 is provided by feedback resistor R417.

Separation control R422 is used to adjust the amount of composite stereo signal that is coupled through capacitor C416 to transformer T401. The ratio between the amount of composite signal and the amount of compensating signal that is fed to the switching detector output through R429 and R431, determines the amount of separation between the right and left audio signals. The compensating signal will be described in the following paragraphs along with the Switching Detector.

Switching Detector

Figure 5-8 shows the various waveforms present in the switching detector circuit. Waveform 1 is the composite main channel (L+R) and sub-channel (L-R) stereo signal that comes from transistor Q404. Waveform 2 is a 38 kHz oscillator signal from Q405. This signal was locked to the same frequency and phase as the 38 kHz subcarrier by a pulsating DC from diode D429. Waveform 3 results from adding stereo signal 1 to the 38 kHz oscillator signal 2. Waveform 3 is then applied to the switching diodes from the secondary winding of transformer T401.

Detection occurs in the switching diodes in the following manner. Waveform 3 from transformer T401 passes through two circuits. One circuit consists of the secondary winding of transformer T401 and diodes D423 and D426. Since these diodes pass only the positive peaks of waveform 3, only the left signal (waveform 4) is passed to transistor Q406. The other circuit consists of the secondary winding of T401 and diodes D424 and D425. These diodes pass only the negative peaks of waveform 3 and couple the right signal waveform to transistor Q407. Capacitors C421, C422, C423, and C424 charge to the positive and negative peaks of waveform 3 to produce smooth output waveforms 4 and 5.

Since the detection process is not 100 percent efficient, some right channel signal may be present at the left channel output and vice versa. To compensate for this, a portion of the composite stereo signal is taken from the multiplex input and fed to the left and right channel circuits. The composite stereo signal passes through a frequency selective network composed of resistor R408, coil L403, and capacitors C407 and C411, and through resistors R429 and R431 to the outputs of the left and right detector diodes. This compensating signal is 180

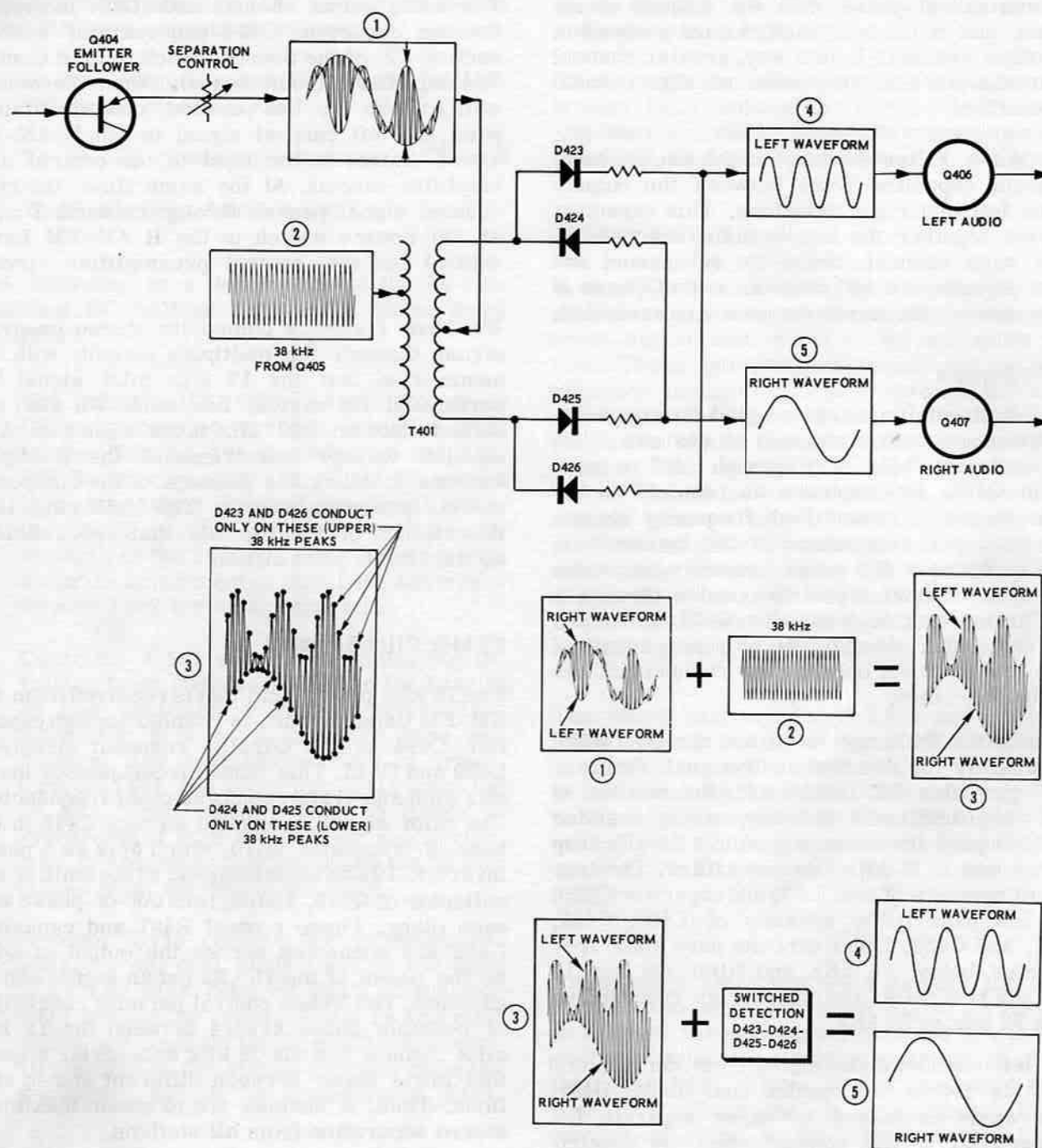


Figure 5-8

degrees out-of-phase with the outputs of the diodes, and it cancels each channel's signal in the other channel. In this way, greater channel separation is obtained, even at higher audio frequencies.

The Noise Filter switch, in the On position, connects capacitor C425 between the outputs of the left and right detectors. This capacitor couples together the higher audio frequencies from each channel. Since the subchannel and noise signals are 180 degrees out-of-phase at these points, the noise frequency is cancelled.

Audio Signals

The left channel signal is coupled through a de-emphasis network composed of resistor R432 and capacitor C426, and through C427 to transistor Q406. De-emphasis is required in the audio stages to reduce high frequency signals that were pre-emphasized at the transmitter. This provides a flat audio frequency response. The right channel signal is coupled through a similar network to transistor Q407. Since the left and right channel circuits are identical from this point on, only the left channel circuits will be described.

Transistors Q406 and Q408 are direct coupled and amplify the detected audio signal. Resistor R436 provides DC feedback to the emitter of Q406 for additional stability, while resistor R438 couples the audio signal to a 19 kHz trap circuit and a 15 kHz low-pass filter. The trap circuit consists of coil L405 and capacitor C429. The low-pass filter consists of L406, C431, C432, and C433. These circuits pass audio frequencies below 15 kHz and filter out any 19 kHz pilot signals and subcarrier frequencies from 23 kHz to 53 kHz.

The left channel audio signal from the trap and filter is fed to the squelch dual diode, D427. This diode is biased by three separate DC voltages so it will conduct when the Squelch control setting and signal and noise conditions are proper. One diode bias source is from the collector of Q408, through R438, L405, and L406. Another bias voltage is obtained through R444 from the 12 volt source. The third bias voltage is obtained through R443 from the collector of squelch control transistor Q401. The actual purpose and function of these diode biasing voltages will be described later. For now we must assume that proper conditions are met and the dual diode is properly biased to conduct the audio signal.

The audio output of dual diode D427 is coupled through capacitor C434 and resistor R445 to section 2F of the Source switch (on the Control Preamplifier circuit board). When the Source switch is in the FM position, contacts 7 and 9 pass the left channel signal to the L AM-FM Level control at the input of the control pre-amplifier circuit. At the same time, the right channel signal passes through contacts 2 and 4 of the Source switch to the R AM-FM Level control in the control preamplifier circuit.

We have traced a composite stereo program signal through the multiplex circuit, with the assumption that the 19 kHz pilot signal had performed its various functions. We also assumed that no 100 kHz noise signal or AFC squelch voltage has triggered the multiplex circuits to block the passage of the composite stereo program signal. The following is a description of the circuits that are activated by the 19 kHz pilot signal.

19 kHz Pilot Signal

The 19 kHz pilot signal that is received from the AM-FM tuner circuit, is coupled through capacitor C444 to the parallel resonant circuit of L409 and C445. This tuned circuit passes the 19 kHz pilot signal and rejects all other frequencies. The pilot signal is coupled through C446 to the base of transistor Q410, which acts as a phase inverter. 19 kHz signals appear at the emitter and collector of Q410, 180 degrees out-of-phase with each other. Phase control R497 and capacitor C448 are connected across the output of Q410 so the phase of the 19 kHz output signal can be adjusted. The Phase control permits correction of possible phase errors between the 19 kHz pilot signals and the 38 kHz subcarrier signals that might occur between different stereo stations. Thus, it enables you to obtain maximum stereo separation from all stations.

Transistor Q411 amplifies the 19 kHz pilot signal. The primary of transformer T402 is tuned to 19 kHz by capacitor C451 and is connected to the collector of Q411. The pilot signal passes to the secondary of T402 and is rectified by dual diode D429. This dual diode acts as a full-wave rectifier which doubles the 19 kHz frequency and produces a 38 kHz pulsating DC

voltage. This pulsating DC voltage is fed to three different circuits as follows:

- A. To the Normal-Adjust switch on the AM-FM Tuner circuit board;
- B. To 38 kHz oscillator transistor Q405; and
- C. To 19 kHz pilot detector Q417.

The following is a description of the 38 kHz pulsating DC voltage function in these three circuits.

- A. The pulsating DC voltage from dual diode D429 is coupled through resistor R469 to the Normal-Adjust switch on the AM-FM Tuner circuit board. When the switch is in the Adjust position, the Signal Meter is placed in the circuit to indicate the strength of the 19 kHz signal. This permits accurate adjustment of coil L409 and transformer T402 for maximum gain.
- B. Capacitor C413 couples the pulsating DC voltage from dual diode D429 to the base of 38 kHz oscillator transistor Q405. This transistor acts as a grounded base oscillator. The primary winding of transformer T401 and capacitor C419 form the 38 kHz tuned circuit. This oscillator is synchronized with the 38 kHz subcarrier, both in frequency and phase, by the 38 kHz pulses from the dual diode D429.
- C. Resistor R489 couples the pulsating DC voltage from dual diode D429 to the base of 19 kHz pilot detector Q417. Transistor Q417 detects the presence of a 19 kHz pilot signal and controls Q419, which automatically switches the stereo circuits on in the secondary circuit of transformer T401.

This switching voltage is coupled through diode D432 and resistor R424.

The 19 kHz pilot signal applied through R494 from Q419 to Q420 also turns on the 38 kHz oscillator by reducing the amount of bias voltage applied to Q405 through R418 and R421. At the same time, while the pilot signal causes Q420 to conduct during the reception of a stereo signal, collector current

flows through the FM Stereo indicator lamp and causes it to light.

Stereo switcher transistor Q419 is also controlled by a voltage from the 100 kHz noise amplifier and stereo threshold transistors Q415 and Q418, as described below.

100 kHz Noise Signal

If an FM signal is weak, or not properly tuned in, noise signals accompany the composite program signal that is fed to the multiplex circuit. These noises could impair the listening pleasure if allowed to pass through the audio circuits to the loudspeakers. In this Receiver, the noise signal itself is used to operate the squelch and stereo threshold circuits. The Stereo Threshold control can be adjusted so a certain noise level will switch off the stereo circuits and allow only monophonic reproduction, eliminating stereo noise. The Squelch control can be set to cut off the audio signal completely if the noise reaches a certain level. These circuits operate in the following manner.

The tuned circuit of coil L410 and capacitor C456 selects the noise signal at 100 kHz and couples it through capacitor C455 to the base of transistor Q413. (NOTE: Only noise is present in the region around 100 kHz; the highest frequency part of the transmitted signal only extends to 74 kHz, which is the SCA upper sideband.)

Transistors Q413 and Q414 amplify the noise signal. The amplified noise signal from Q414 is coupled through capacitor C458 to a voltage doubling detector circuit consisting of diodes D430 and D431. These diodes produce a negative DC voltage that is proportional to the amount of noise in the received signal. Capacitors C461, and C459, and resistor R483, filter out any remaining noise signal from the negative DC voltage coupled to the base of Q415.

Transistor Q415 is an emitter follower. Its output is coupled through R475 to the base of squelch threshold transistor Q412, and through R487 to the base of stereo threshold transistor Q418.

Transistor Q416 is direct coupled to the output of Q415 in such a way that a positive voltage applied to the base of Q416 has the same effect on Q412 as a negative voltage applied to the base of Q415. Thus, either a noise signal through Q415, or a deviation squelch voltage through Q416, will cause Q412 to conduct.

The amount of noise signal, or deviation squelch voltage, required to trigger transistor Q412 is determined by the setting of Squelch control R498. When the noise signal or deviation squelch voltage becomes strong enough to cancel the bias voltage on Q412, this transistor begins to conduct. This, in turn, removes the bias from Q401 and causes both Q401 and Q402 to cut off.

Transistors Q401 and Q402 control the bias voltages on dual diodes D427 and D428 which, in turn, control the passage of FM program signals from the audio amplifier stages and the filter networks. When a noise signal or deviation squelch voltage causes Q412 to conduct, and Q402 and Q401 are cut off, the bias on the cathodes of dual diodes D427 and D428 is changed to prevent these diodes from passing the audio signal. Dual diode D422 prevents the passage of audio signals from one channel to the other through R404 and R405, which would reduce the channel separation.

Stereo threshold transistor Q418 operates in a manner similar to squelch threshold transistor Q412. Bias for Q418 is adjusted by Stereo Threshold control R499, through resistor R488, to a point where a certain strength of noise signal or deviation squelch voltage will cause Q418 to conduct. The collector current of Q418 is then passed through R492 to the base of stereo switcher transistor Q419. Transistor Q419 switches the operation of the amplifier circuits to monophonic when the noise level is too high or the received signal is too weak for good stereo reproduction.

Notice that there are four ways transistor Q419 can be made to conduct and stop stereo operation:

1. In the absence of a 19 kHz pilot signal where collector current from Q417, through R491, causes Q419 to conduct. The 19 kHz pilot signal is absent when a station is transmitting in the monophonic mode.

2. When excessive noise through Q415 causes the collector current from stereo threshold transistor Q418 to flow through R492. This is the noise between stations or on weak stereo signals.
3. When a deviation squelch voltage controls Q416 and Q418. This deviation squelch voltage is produced in the FM tuner ratio detector when the Receiver is not tuned to the center frequency of an FM station.
4. When the Mode switch is in the Mono position. This causes a current to flow through R491 and causes Q419 to conduct and block stereo operation.

The Receiver can be made to pass only stereo signals by placing the FM switch in the Stereo Only position. This switch position connects the collector of transistor Q420 through resistor R474 to squelch threshold transistor Q412. As transistor Q420 does not conduct on monophonic signals, its collector voltage is high. This voltage, which is returned to the collector of Q412, has the same effect as a strong noise signal. It causes transistors Q402 and Q401 to remove the bias voltage from dual diodes D427 and D428 and stop audio signals from passing through. When stereo signals are received, the voltage returned to the collector of Q412 is reduced, and transistors Q402 and Q401 bias the squelch diodes and permit audio signals to pass.

MONOPHONIC OPERATION

Monophonic FM signals received from the FM ratio detector circuit contain only audio frequencies from 50 Hz to 15 kHz. Without the 19 kHz pilot signal, the 38 kHz oscillator is not turned on and the Stereo Indicator lamp does not light. The audio signal is passed through the circuits of transistors Q403 and Q404 to the switching detector circuit.

Since no 19 kHz pilot signal is detected by transistor Q417, stereo switcher transistor Q419 is allowed to conduct. The circuit through diode D432 and resistor R424, from the collector of Q419, biases diodes D424 and D426 ON. This biasing allows these diodes to pass the audio signal to both the left and right audio circuits simultaneously.

POWER SUPPLY CIRCUITS

The transformer operated Power Supply contains three rectifier circuits which furnish the various voltages used in the Receiver. Most of these voltages are regulated within a close tolerance to insure stable operation.

Three AC receptacles are provided on the rear of the chassis to furnish switched or unswitched power for other equipment. The two unswitched receptacles are live whenever the line cord plug is connected to an AC source. The third (switched) receptacle is live only when the Power switch is in the On position.

The line voltage is passed through a 3 ampere slow-blow fuse to the primary windings of the power transformer. When connected for 120 volt operation, the two primary windings are in parallel. For 240 volt operation, the windings are in series with a 1-1/2 ampere fuse. Three secondary windings on the transformer step down the line voltage to the amounts required.

One secondary winding supplies 57 VAC to a full-wave bridge rectifier circuit that consists of diodes D506, D507, D508, and D509. The output of the bridge rectifier circuit is filtered by capacitor C508. 83 volts DC is coupled from this point through two thermal circuit breakers to the power amplifier circuits.

Another secondary winding on the power transformer supplied 6 VAC for the pilot lamps that illuminate the dial. This voltage is also rectified by diode D505 and coupled to the emitter of transistor Q503. The 83 volts that passes through the thermal circuit breakers is coupled through resistor R512 to the base of Q503. Thus, transistor Q503 is biased off and no collector current flows through the Hi-Temp indicator lamp. One of the thermal circuit breakers is mounted on a heat sink with audio output transistor Q206L. The other circuit breaker is mounted on another heat sink with audio output transistor Q206R.

Should the temperature of either heat sink rise to 60 degrees C, due to a short circuit or overload at the output, the circuit breaker mounted on that heat sink will open and remove the supply voltage from the circuit. If that happens, the

bias is removed from the base of Q503 and this transistor will conduct. Collector current will then flow through the Hi-Temp indicator lamp, and the lamp will light. As soon as the heat sink temperature returns to a safe level, the circuit breaker automatically closes to apply voltage to the power amplifier circuits. At the same time, the bias voltage is returned to the base of Q503 which cuts off the current through the Hi-Temp indicator lamp.

A third secondary winding on the power transformer supplies 100 VAC to a full-wave rectifier circuit. Diodes D503 and D504 rectify the AC voltage and capacitor C505 filters the DC voltage. This DC voltage is applied to the collectors of Q501 and Q502, which form a series regulator-filter in the following manner.

A voltage divider that consists of R505 and R504 provides base bias for transistor Q502. When the voltage changes on the collector of transistor Q501 and begins to change the output voltage, it also passes through resistor R502 and changes the emitter-to-base voltage of Q502. This causes the collector current of Q502 to change. Since the emitter of Q502 is direct coupled to the base of Q501, the base current change in Q501 changes the collector current and compensates for the original change that appeared across the load. The result is that all voltage changes are smoothed out and a constant output of 50 volts DC is taken from the emitter of transistor Q501.

The 50 volt source is applied to the phono pre-amplifier circuit, and to additional regulator-filter circuits in the Power Supply to provide the 27 volt, 15 volt, and 12 volt sources for other Receiver circuits. For the 27 volt source, the 50 volt output of Q501 is coupled through R501 to zener diode ZD501. This zener diode maintains a constant 27 volts between its anode and cathode. This regulated 27 volts is then further filtered by capacitor C501 and supplied to the control preamplifier circuit and to the left and right channel power amplifier circuits.

The 15 volt source is taken through resistor R503 from the 50 volt output of transistor Q501. Zener diode ZD502 tends to maintain a constant 15 volts across it, and provides a regulated output that is filtered by capacitor C502. This 15 volt source is supplied to the AM-FM tuner circuit.

The reference voltage for transistor Q504 is obtained from voltage divider resistors R507 and R508. The 50 volt output of Q501 is reduced through resistor R509 and transistor Q504 to give 12 volts on the emitter of Q504. This 12 volts is held constant by the regulated 15 volts reference bias applied to the base of Q504 from zener diode ZD502. The 12 volt source supplies the multiplex circuits.

SIGNAL METER FUNCTION SWITCH

A special 3-position switch is provided to adapt the Signal Meter to indicate relative resistance or relative voltage. This permits the builder to test the various circuits and parts in the Receiver, both initially when first assembled, or in case of trouble at a later time.

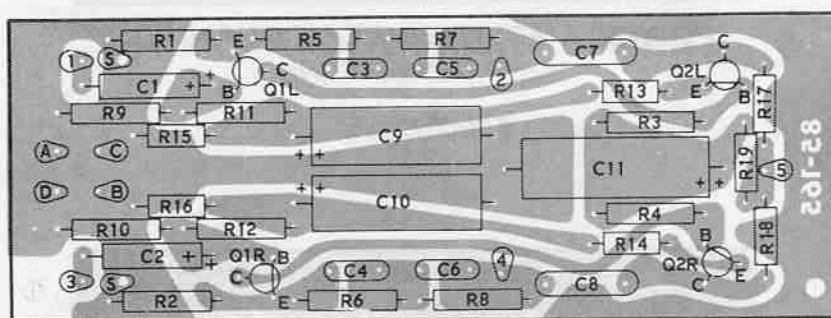
When the Signal Meter Function switch is in the Normal position, the Signal Meter is connected through Source switch wafer 2 to the AM or FM circuit. The meter will then indicate relative signal strength.

The Signal Meter can also be used during the adjustment of the 19 kHz pilot detector circuit. The 19 kHz Adjust switch, located on the AM-FM circuit board, couples the meter, through the Source switch, to the 19 kHz detector circuit of the multiplex circuit board.

When the Signal Meter Function switch is in the R (resistance) position, a current from power supply terminal 19 passes through the meter and returns to ground through resistor R514, which is mounted on the power supply circuit board. Since the resistance of R514, is very high, its voltage drop is also high, and the meter does not deflect. When the test probe wire is touched to a separate resistance, this resistance is paralleled with R514. The parallel resistance is less than R514 alone, so more current passes through the meter, which causes its pointer to deflect. The smaller the resistance, the greater the meter deflection. This enables the builder to make relative resistance measurements.

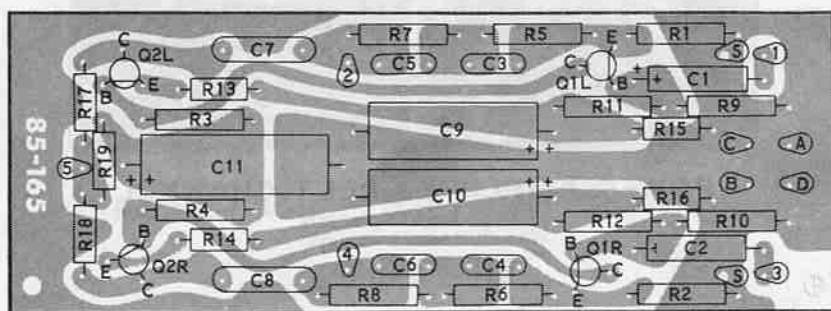
With the Signal Meter Function switch in the V (voltage) position, R514 is connected between ground and the negative (-) side of the meter, and the test probe wire is connected to the positive (+) side of the meter. When the test probe wire is touched to a voltage point in the receiver, the meter pointer will deflect in proportion to the voltage. This enables the builder to make relative voltage measurements. Resistor R514 limits the meter current so the maximum voltage to be tested in the Receiver will not damage the meter movement.

CIRCUIT BOARD X-RAY VIEWS



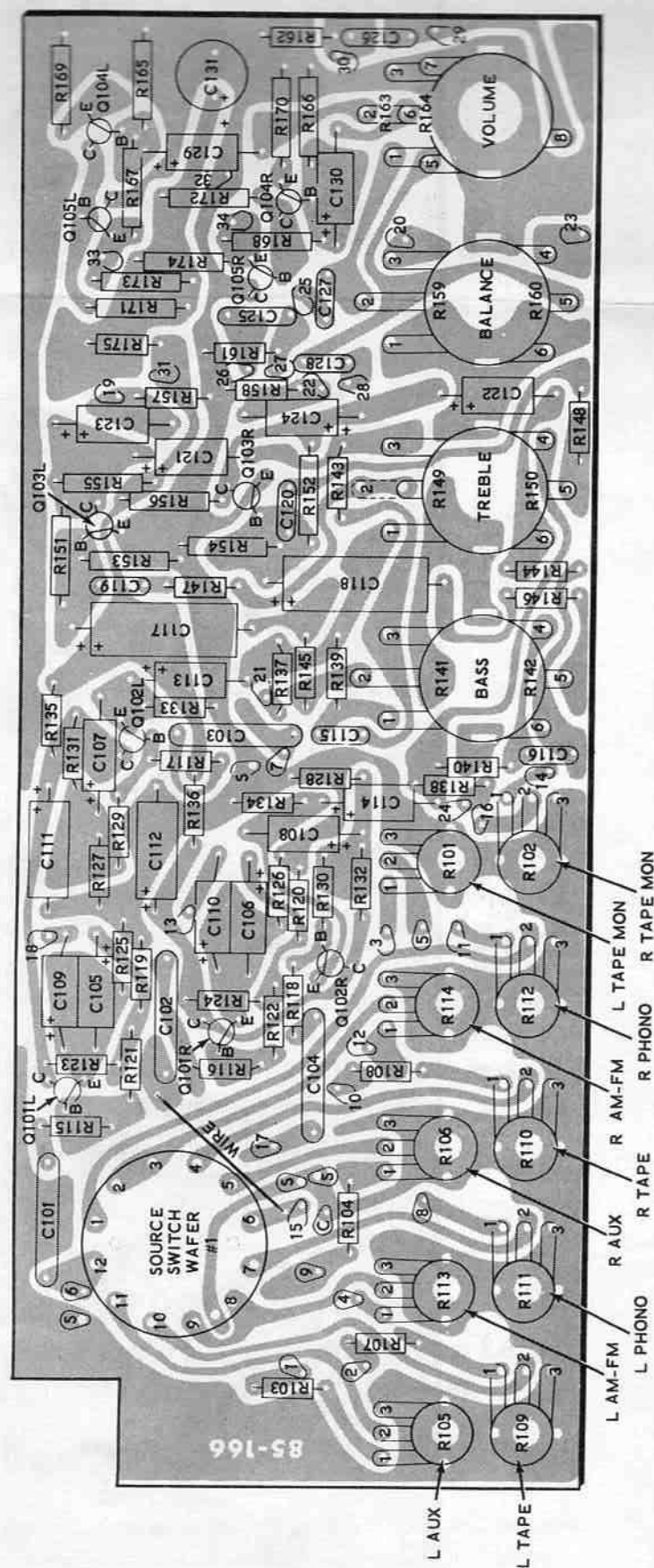
PHONO PREAMP
(VIEWED FROM SCREEN SIDE)

FIGURE 6-1



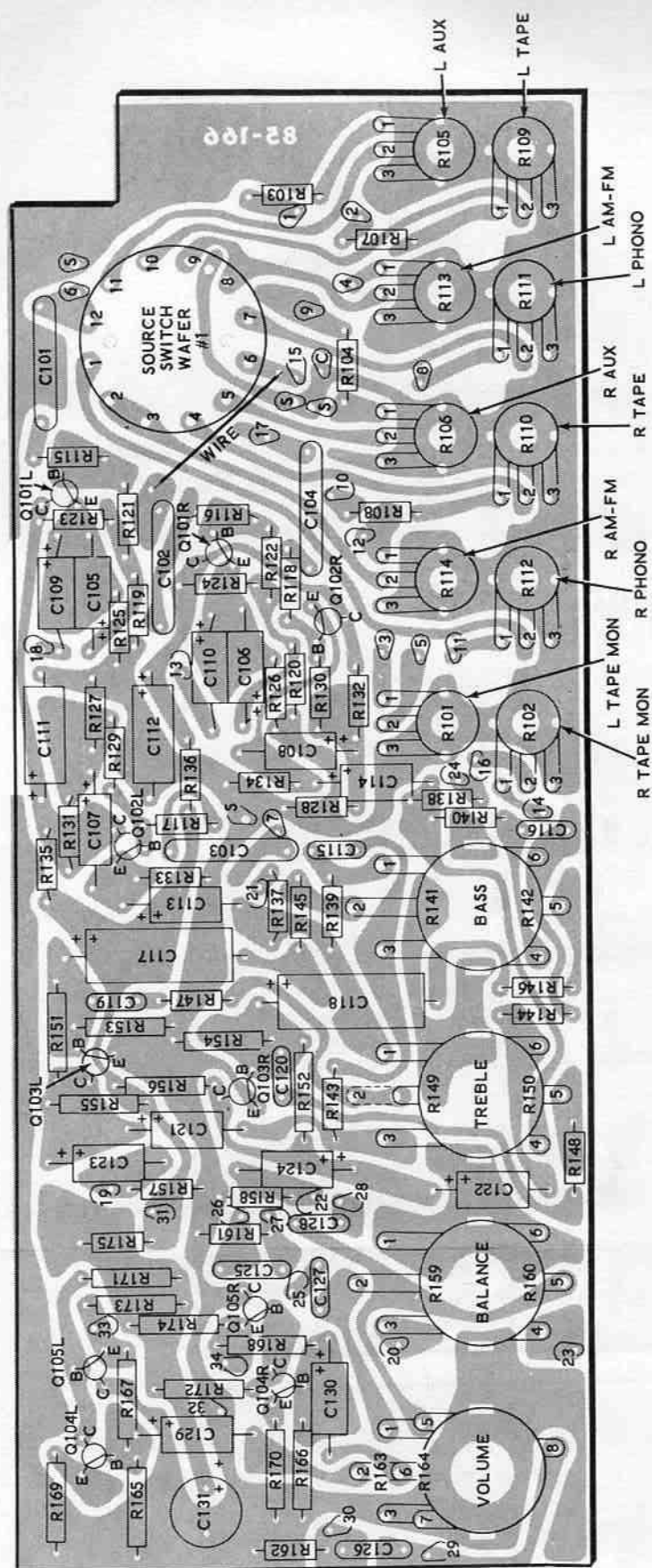
PHONO PREAMP
(VIEWED FROM FOIL SIDE)

FIGURE 6-2

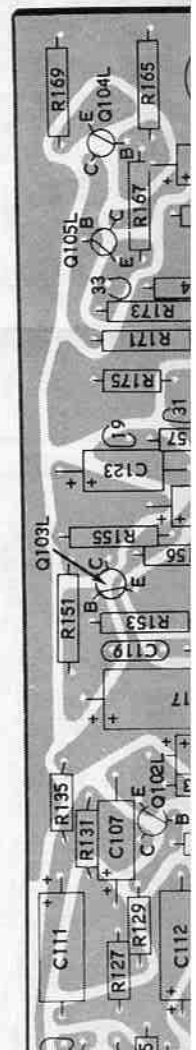


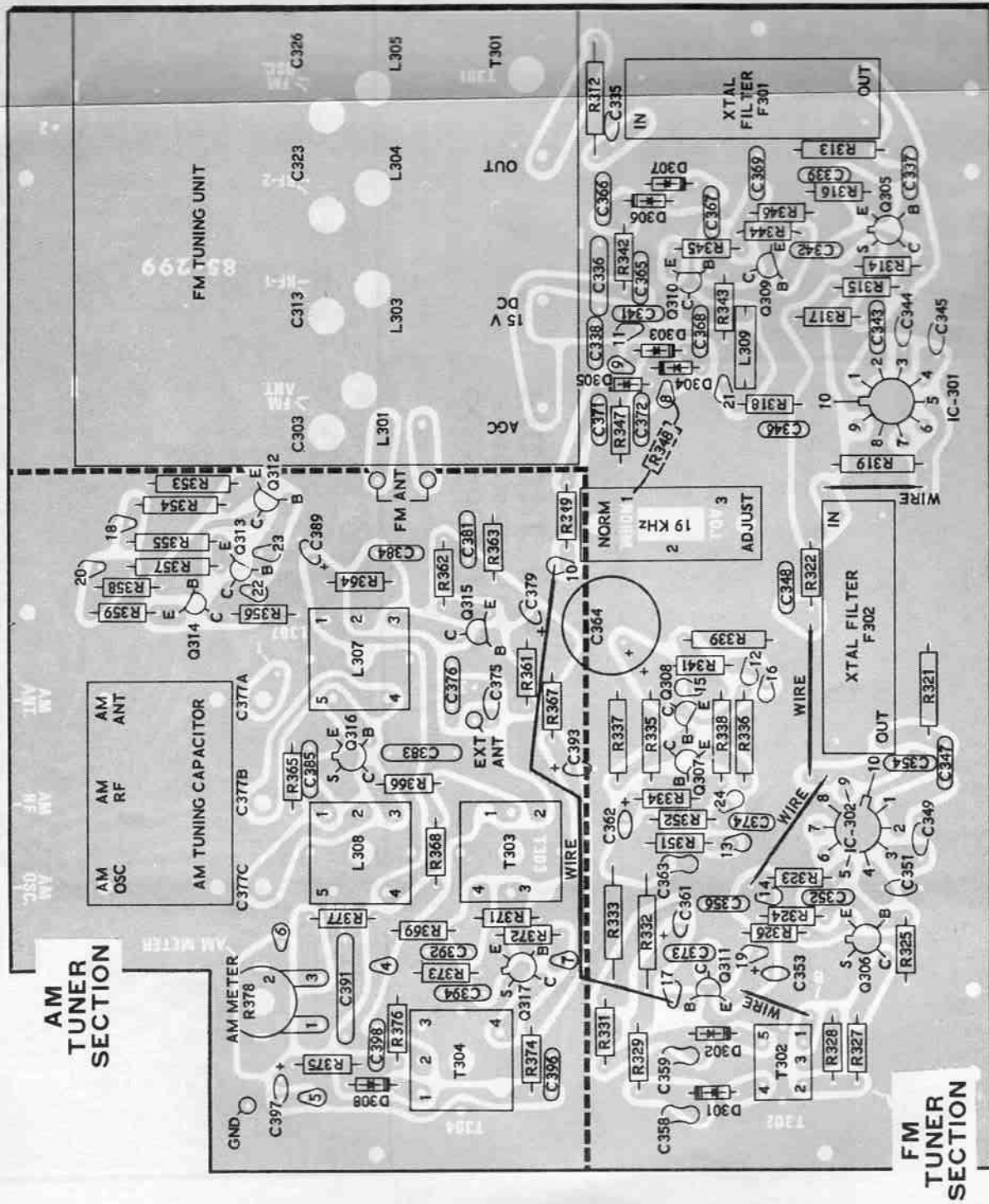
CONTROL PREAMP
(VIEWED FROM FOIL SIDE)

FIGURE 6-4



CONTROL PREAMP
(VIEWED FROM SCREEN SIDE)
FIGURE 6-3



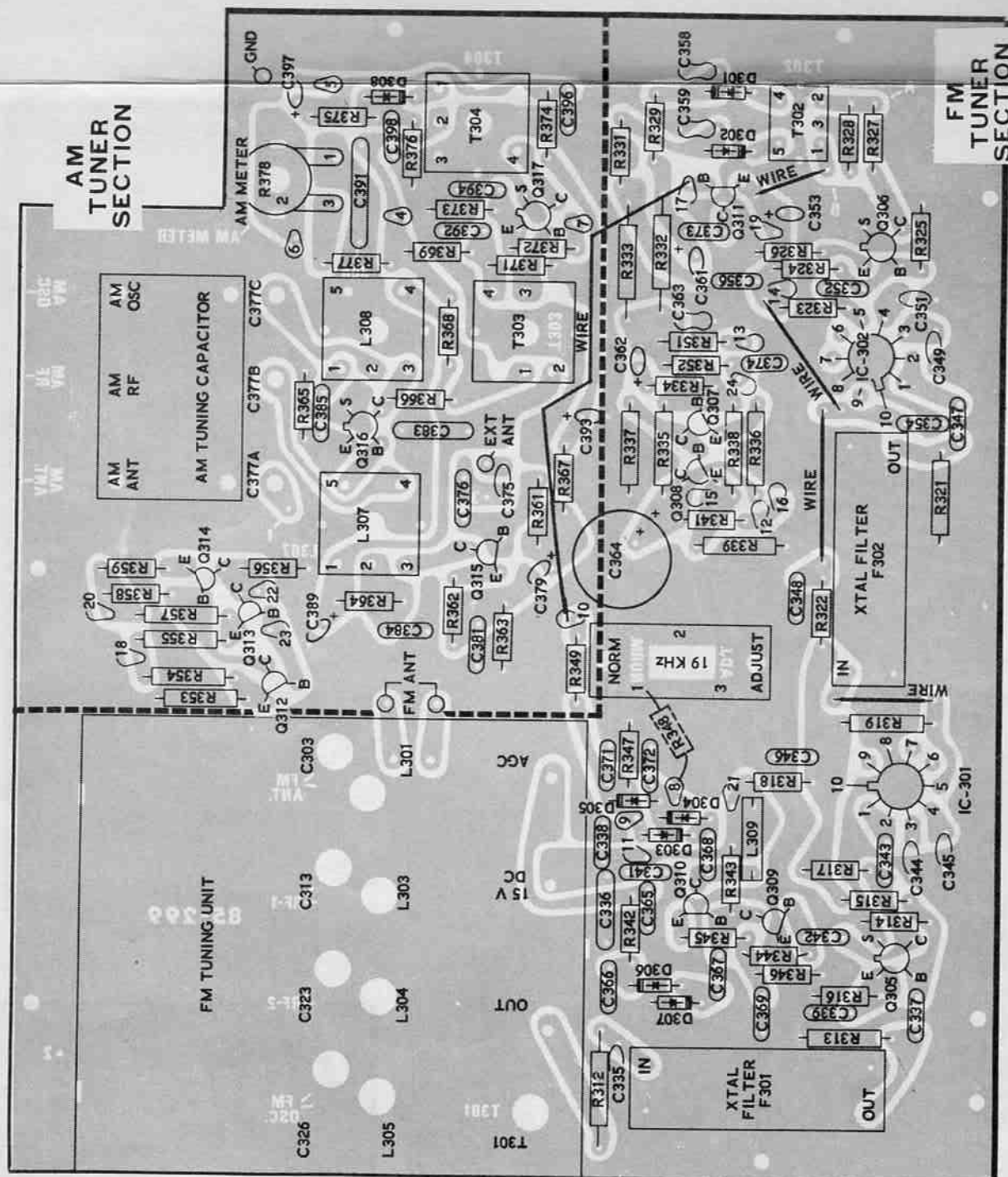


AM-FM CIRCUIT BOARD

(VIEWED FROM FOIL SIDE)

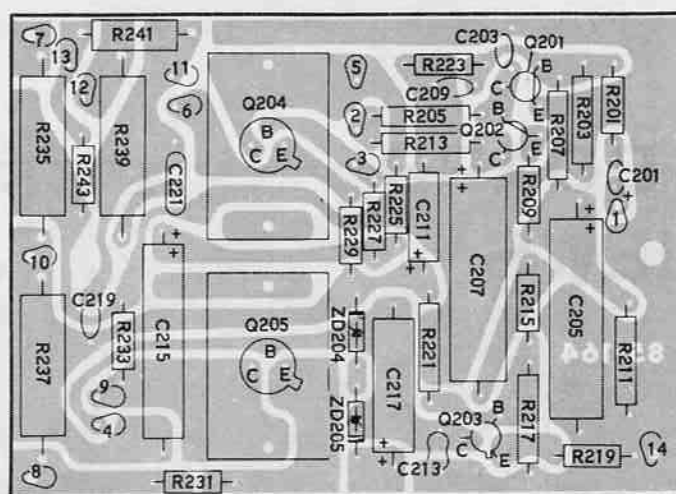
FIGURE 6-9





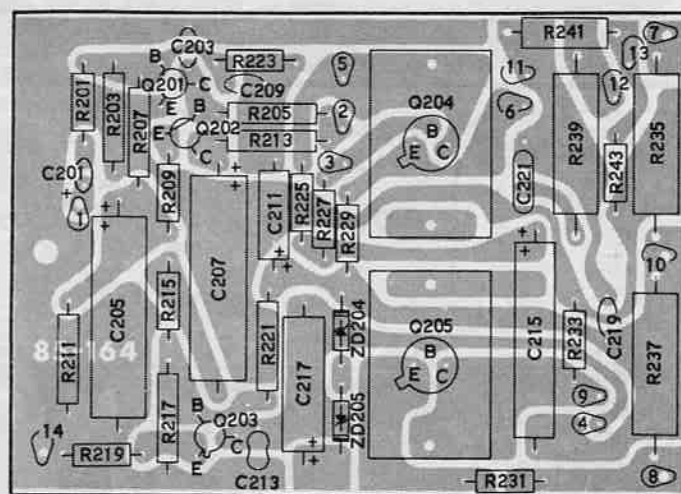
AM-FM CIRCUIT BOARD
 (VIEWED FROM SCREEN SIDE)

FIGURE 6-10



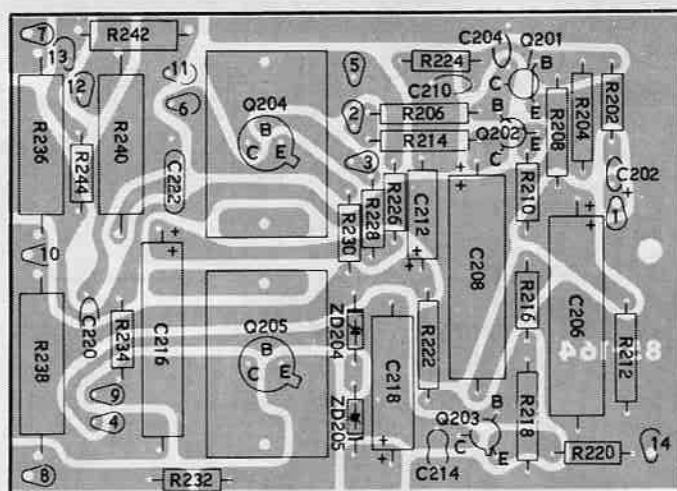
POWER AMPLIFIER LEFT CHANNEL
(VIEWED FROM SCREEN SIDE)

FIGURE 6-5



POWER AMPLIFIER LEFT CHANNEL
(VIEWED FROM FOIL SIDE)

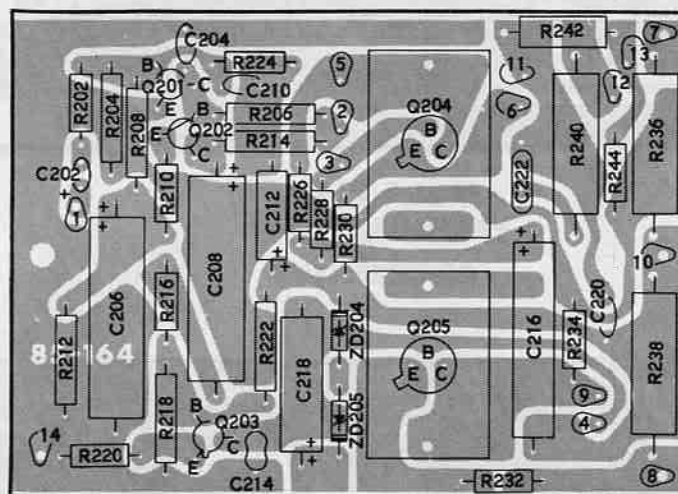
FIGURE 6-6



POWER AMPLIFIER RIGHT CHANNEL

(VIEWED FROM SCREEN SIDE)

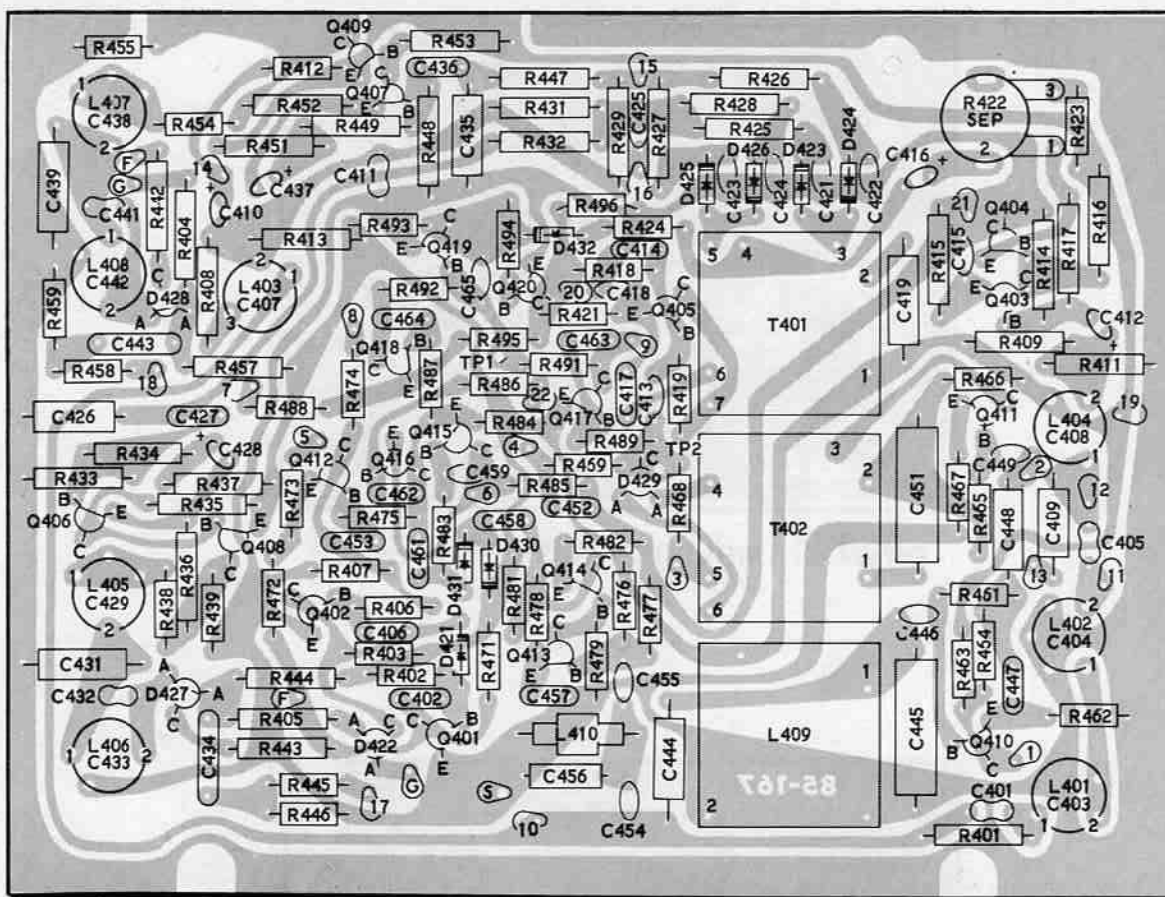
FIGURE 6-7



POWER AMPLIFIER RIGHT CHANNEL

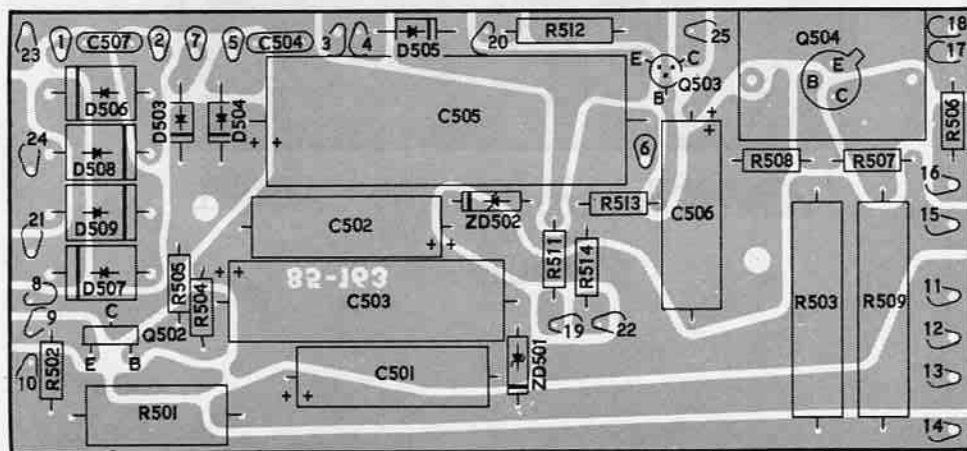
(VIEWED FROM FOIL SIDE)

FIGURE 6-8

**MULTIPLEX**

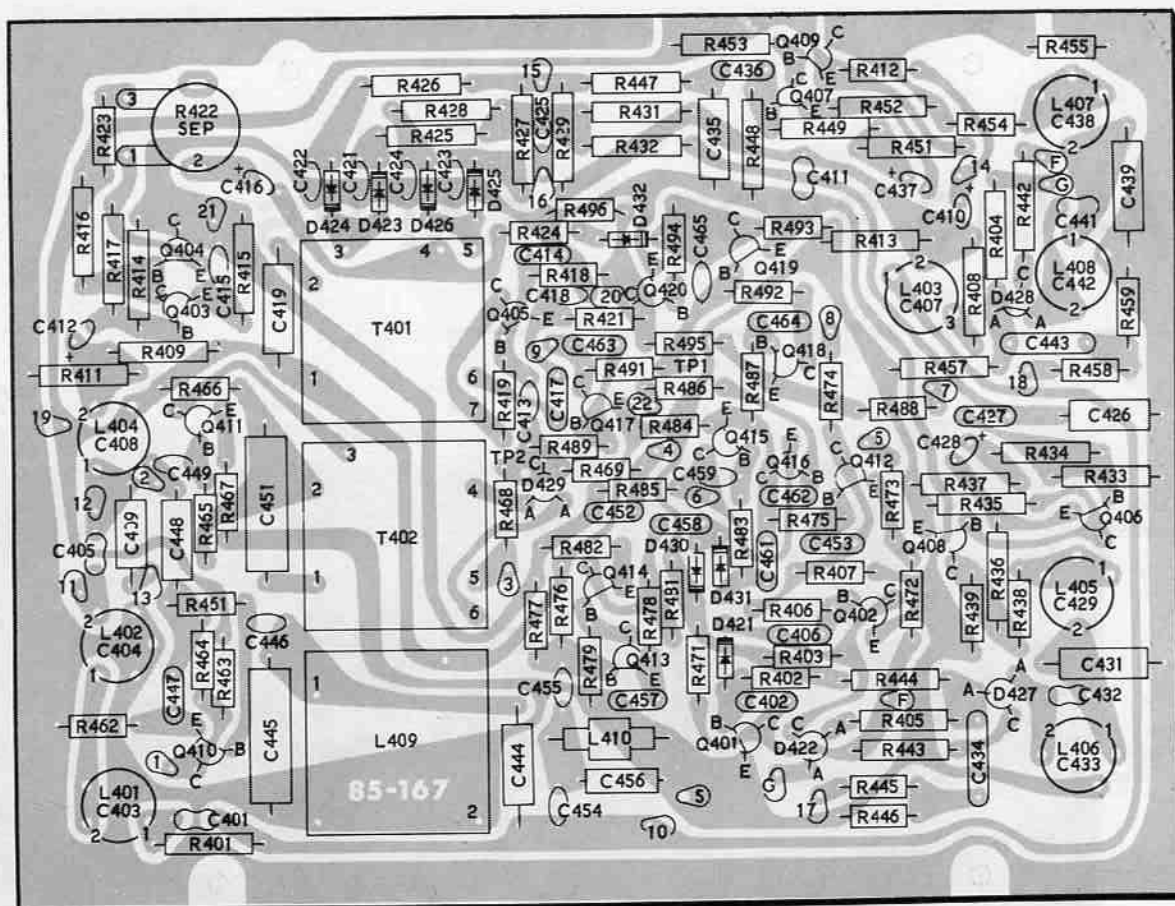
(VIEW FROM SCREEN SIDE)

FIGURE 6-11

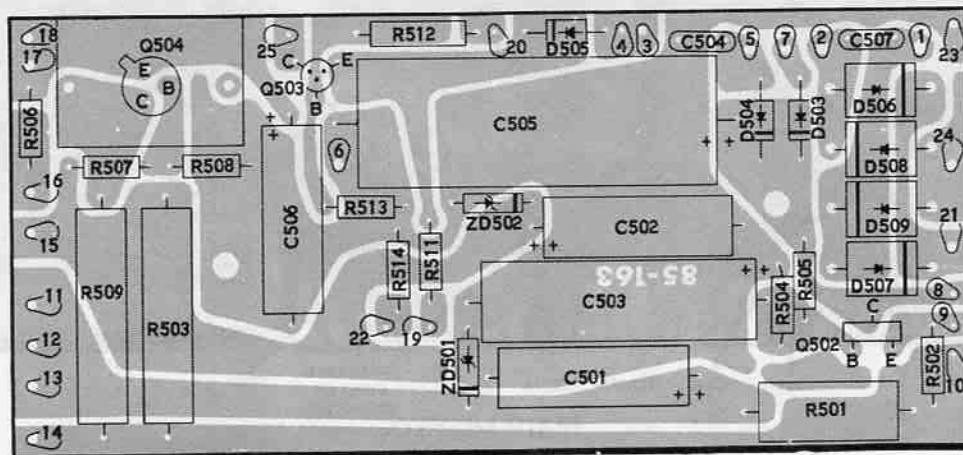
**POWER SUPPLY**

(VIEWED FROM SCREEN SIDE)

FIGURE 6-13



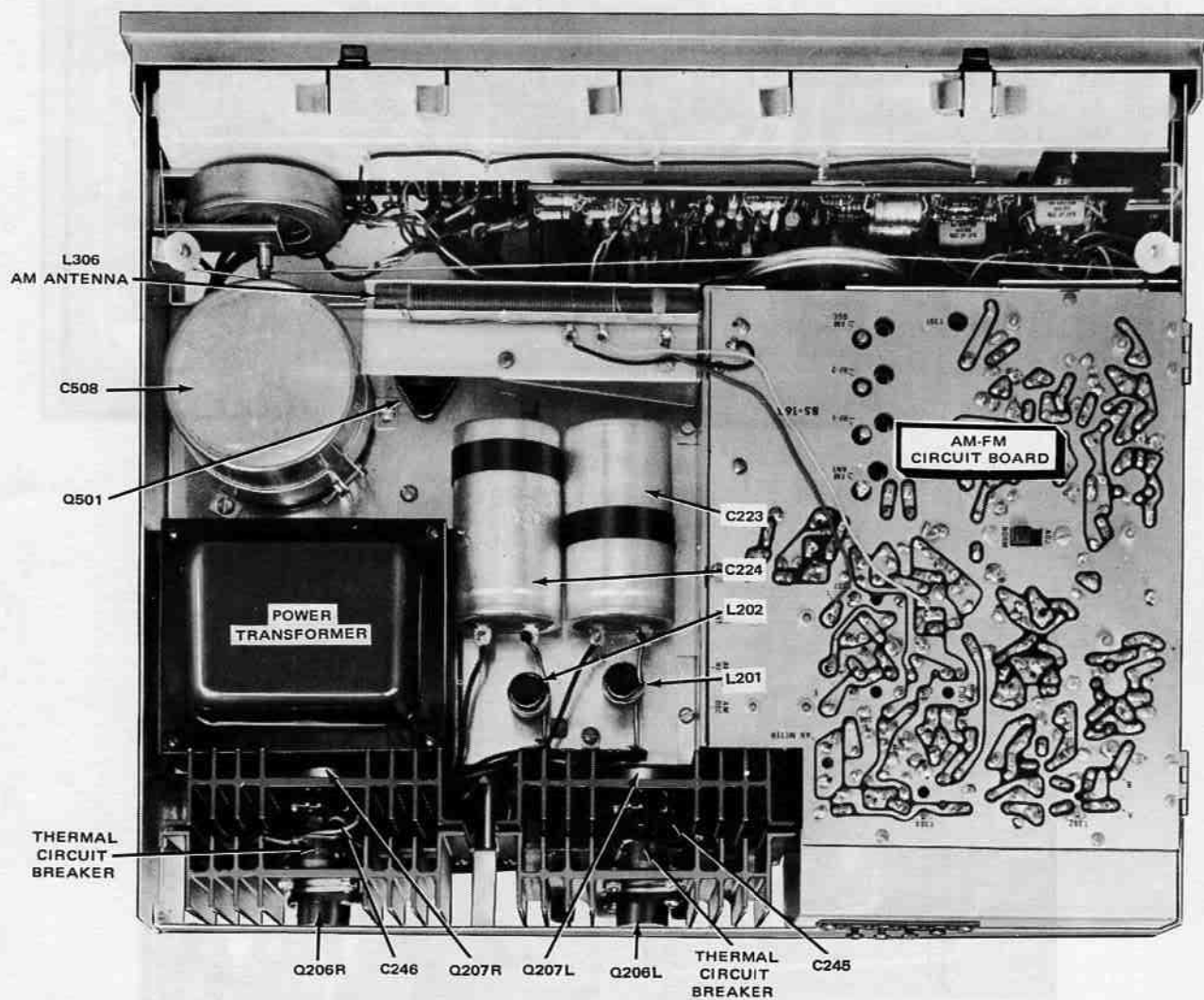
MULTIPLEX
(VIEWED FROM FOIL SIDE)
FIGURE 6-12



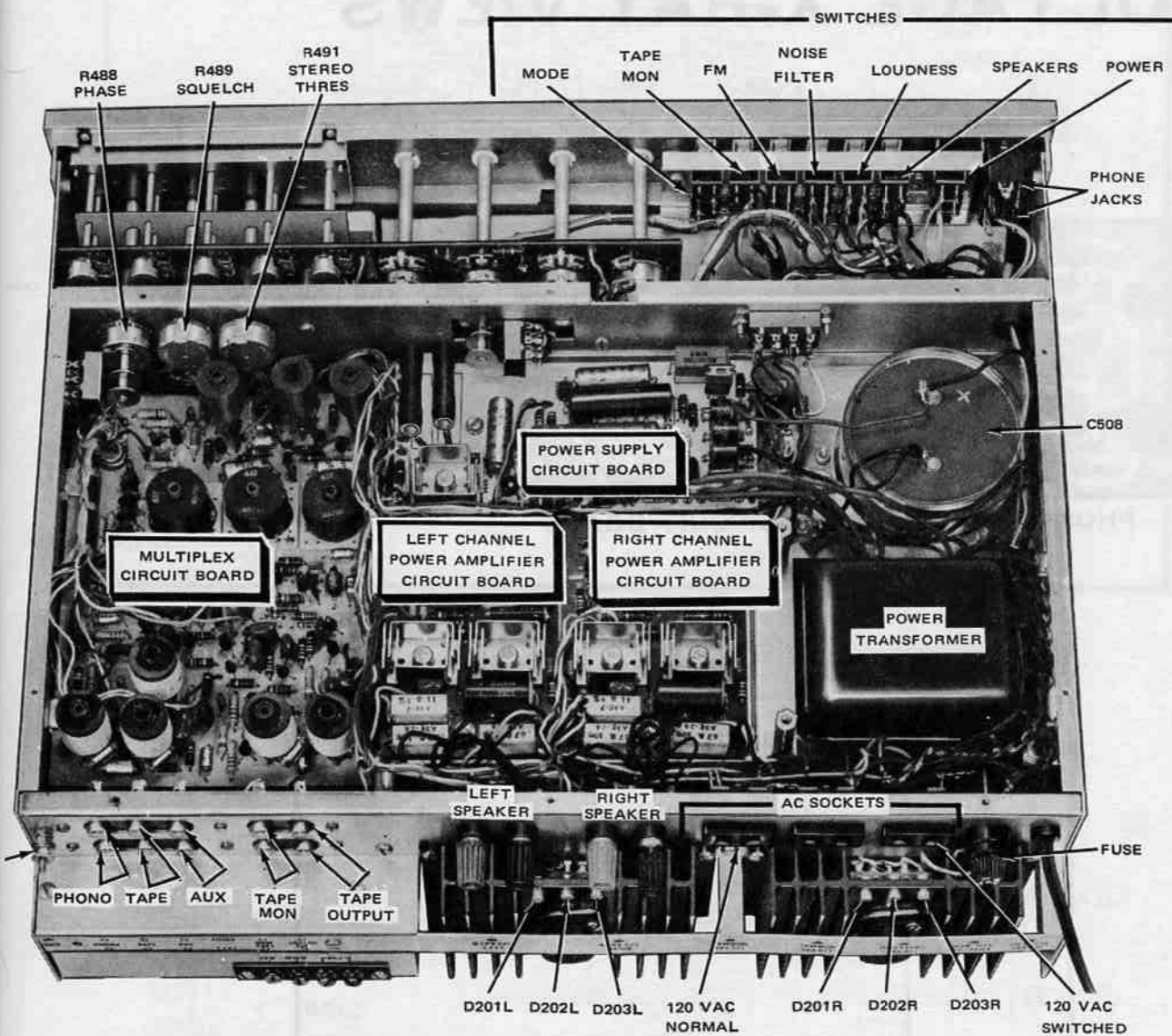
POWER SUPPLY
(VIEWED FROM FOIL SIDE)

FIGURE 6-14

CHASSIS PHOTOGRAPHS



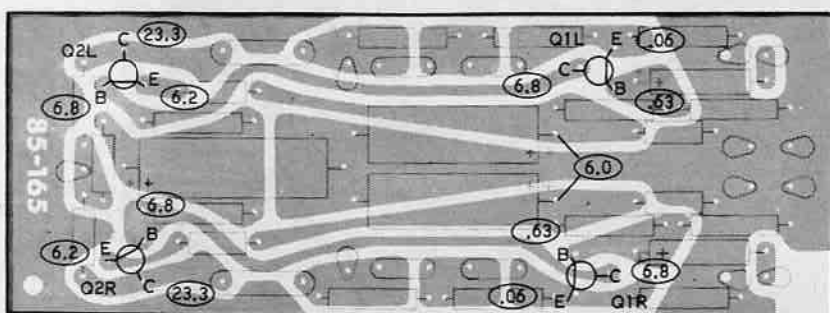
TOP VIEW
Figure 6-15



BOTTOM VIEW

Figure 6-16

CIRCUIT BOARD VOLTAGE X-RAY VIEWS



PHONO PREAMPLIFIER CIRCUIT BOARD
(VIEWED FROM FOIL SIDE)

*TRANSISTOR VOLTAGES
MEASURED UNDER CONDITIONS OTHER THAN
SHOWN ON SCHEMATIC

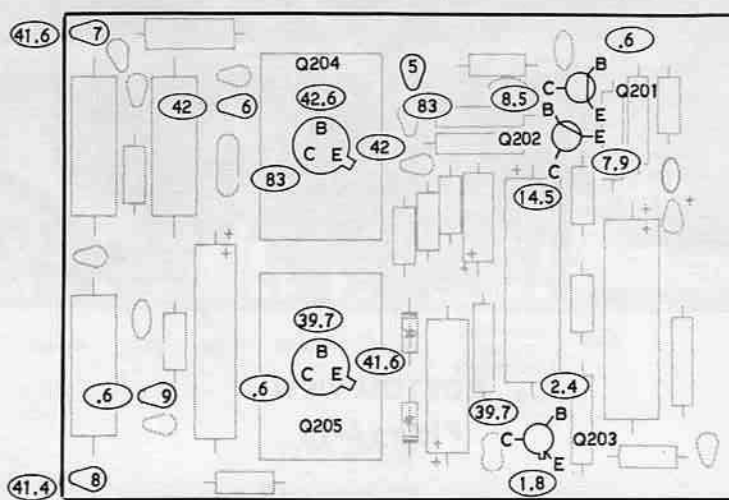
○ SOURCE: PHONO
MODE: MONO
SQUELCH: FULL CCW
STEREO THRES: FULL CCW

□ SOURCE: FM
MODE: MONO
SQUELCH: FULL CW
STEREO THRES: FULL CW
ANT: NOT CONNECTED

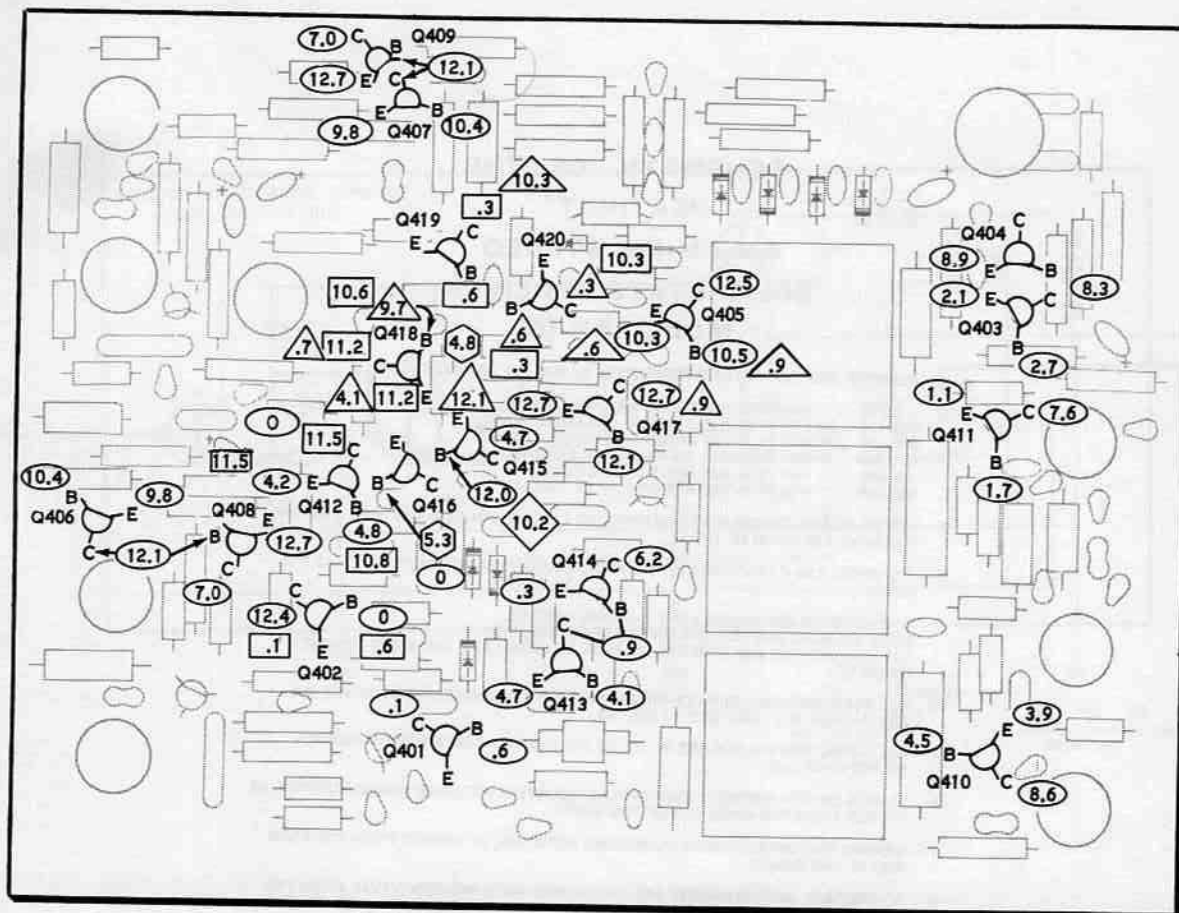
△ SOURCE: FM (STEREO STATION TUNED IN)
MODE: STEREO
SQUELCH: FULL CCW
STEREO THRES: FULL CCW
ANT: CONNECTED
TUNE METER, CENTER SCALE

◻ SAME AS △ EXCEPT
TUNE METER: LEFT END OF SCALE

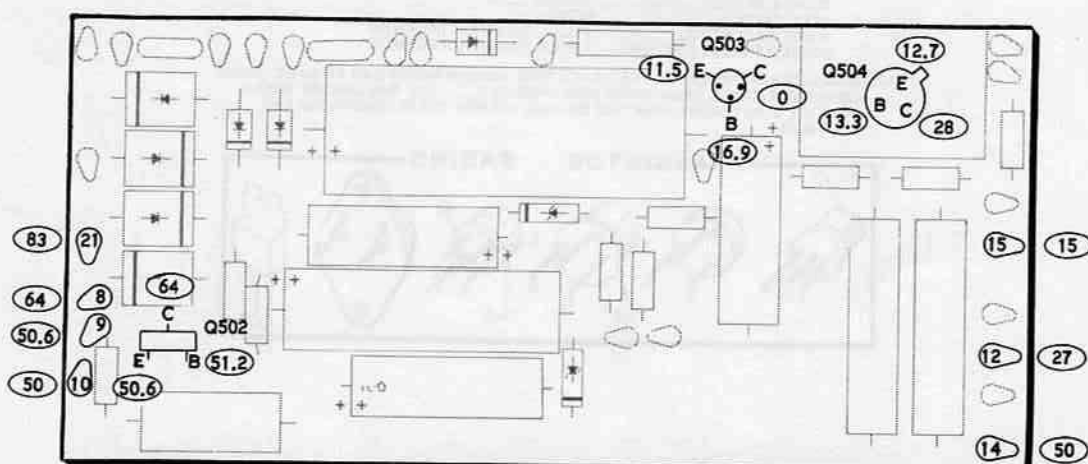
◊ SAME AS △ EXCEPT
TUNE METER: RIGHT END OF SCALE



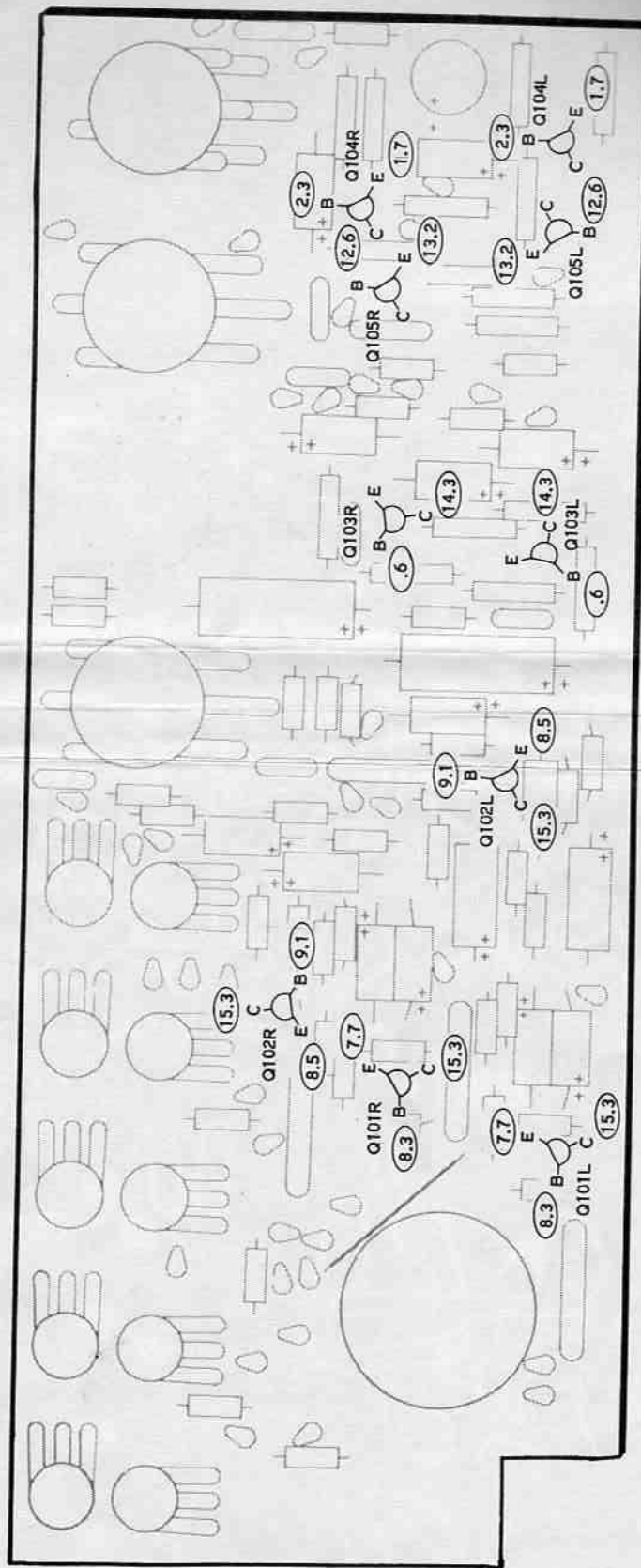
POWER AMPLIFIER CIRCUIT BOARD
(VIEWED FROM COMPONENT SIDE)



MULTIPLEX CIRCUIT BOARD
(VIEWED FROM COMPONENT SIDE)



POWER SUPPLY CIRCUIT BOARD
(VIEWED FROM COMPONENT SIDE)



CONTROL PREAMP CIRCUIT BOARD

VIEWED FROM COMPONENT SIDE



SAME AS Δ EXCEPT
TUNE METER: RIGHT END OF SCALE



SCHEMATIC OF THE HEATHKIT® AM-FM-FM STEREO SOLID-STATE RECEIVER MODEL AR-15

1. RESISTOR AND CAPACITOR NUMBERS ARE IN THE FOLLOWING GROUPS:

0- 99	PARTS IN THE PHONO PREAMP CIRCUIT.
100-199	PARTS IN THE CONTROL PREAMP CIRCUIT.
200-299	PARTS IN THE POWER AMPLIFIER CIRCUIT.
300-399	PARTS IN THE AM-FM TUNER CIRCUIT.
400-499	PARTS IN THE MULTIPLEX CIRCUIT.
500-599	PARTS IN THE POWER SUPPLY CIRCUIT.

2. REFER TO THE CHASSIS PHOTOGRAPHS AND CIRCUIT BOARD X-RAY VIEW FOR THE PHYSICAL LOCATION OF PARTS.

3. RESISTORS AND CAPACITORS IN THE AUDIO CIRCUITS (0-299) ARE DIVIDED AS FOLLOWS:

ODD NUMBERS ARE IN THE LEFT CHANNEL CIRCUIT.
EVEN NUMBERS ARE IN THE RIGHT CHANNEL CIRCUIT.
C11, C12, C13, R19 AND R175 ARE COMMON TO BOTH LEFT AND RIGHT CHANNEL CIRCUITS.

4. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K = 1,000, MEG = 1,000,000).

5. ALL CAPACITOR VALUES ARE IN μfd UNLESS MARKED OTHERWISE (pf = MICRO-MICROFARAD μf).

6. SOURCE SWITCH WAFERS SHOWN IN FULL COUNTERCLOCKWISE PHONO POSITION, AS VIEWED FROM THE KNOB END OF THE SHAFT.

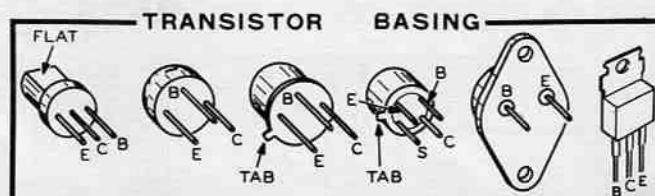
7. ARROWS ON CONTROLS SHOW CLOCKWISE ROTATION, AS VIEWED FROM THE KNOB END OF THE SHAFT.

8. DC VOLTAGE MEASUREMENTS ARE TAKEN WITH AN 11 MEGOHM VTVM, FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY $\pm 20\%$. LINE VOLTAGE 120 V AC.

9. ○ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT, TAKEN UNDER THE FOLLOWING CONDITIONS:

SOURCE SWITCH. PHONO
MODE SWITCH. MONO
SQUELCH CONTROL. FULLY COUNTERCLOCKWISE
STEREO THRESH CONTROL. FULLY COUNTERCLOCKWISE

10. *AN ASTERISK INDICATES THAT A VOLTAGE MEASUREMENT CAN BE MADE UNDER CONDITIONS OTHER THAN THOSE INDICATED BY ○. SEE THE CIRCUIT BOARD VOLTAGE X-RAY VIEWS STARTING ON PAGE 210 FOR THESE CONDITIONS AND VOLTAGES.



REPLACEMENT PARTS PRICE LIST

The following prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from an authorized Service Center or Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect

additional transportation, taxes, duties and rates of exchange.

To order parts, use the Parts Order Form furnished with this kit. If Parts Order Form is not available, refer to Replacement Parts in the Kit Builders Guide.

PART No.	PRICE Each	DESCRIPTION
-------------	---------------	-------------

RESISTORS

1/2 Watt

1-1	.10	47 Ω
1-3	.10	100 Ω
1-4	.10	330 Ω
1-6	.10	470 Ω
1-7	.10	680 Ω
1-8	.10	820 Ω
1-9	.10	1000 Ω
1-10	.10	1200 Ω
1-11	.10	1500 Ω
1-13	.10	2700 Ω
1-14	.10	3300 Ω
1-16	.10	4700 Ω
1-18	.10	5600 Ω
1-19	.10	6800 Ω
1-20	.10	10 K Ω
1-21	.10	15 K Ω
1-22	.10	22 K Ω
1-23	.10	27 K Ω
1-25	.10	47 K Ω
1-26	.10	100 K Ω
1-27	.10	150 K Ω
1-29	.10	220 K Ω
1-34	.10	680 K Ω
1-35	.10	1 megohm
1-38	.10	3.3 megohm
1-42	.10	270 Ω
1-44	.10	2200 Ω
1-45	.10	220 Ω

PART No.	PRICE Each	DESCRIPTION
-------------	---------------	-------------

RESISTORS-1/2 Watt (cont'd.)

1-48	.10	390 Ω
1-49	.10	22 Ω
1-60	.10	68 K Ω
1-65	.15	51 K Ω
1-66	.10	150 Ω
1-73	.10	8200 Ω
1-93	.10	1800 Ω
1-103	.10	33 Ω
1-109	.10	12 K Ω
1-118	.10	82 Ω
1-119	.10	560 Ω
1-121	.10	120 K Ω
1-129	.10	4.7 Ω
1-142	.10	560 K Ω

1 Watt

1-1-1	.10	470 Ω
1-57-1	.10	5600 Ω

1/2 Watt Precision

2-50	.20	10 K Ω
2-111	.20	400 Ω
2-181	.20	5490 Ω

Other Resistors

3-7-5	.15	11 Ω 5 watt
3-24-5	.15	.67 Ω 5 watt
3-26-5	.20	390 Ω 5 watt
3-31-10	.65	290 Ω 10 watt
3-30-10	.65	225 Ω 10 watt

PART No.	PRICE Each	DESCRIPTION
-------------	---------------	-------------

1/2 Watt 5% Low-Noise

4-12	.10	390 Ω
4-13	.10	510 Ω
4-14	.10	620 Ω
4-15	.10	1000 Ω
4-16	.10	1800 Ω
4-17	.10	2200 Ω
4-18	.10	3300 Ω
4-19	.10	3900 Ω
4-20	.10	4700 Ω
4-22	.10	10 k Ω
4-23	.10	22 K Ω
4-24	.10	24 K Ω
4-25	.10	27 K Ω
4-26	.10	33 K Ω
4-27	.10	47 K Ω
4-29	.10	220 K Ω
4-30	.10	270 K Ω
4-31	.10	330 K Ω
4-32	.10	390 K Ω
4-33	.10	470 K Ω
4-34	.10	100 K Ω
4-37	.10	6800 Ω
4-38	.10	9100 Ω
4-39	.10	12 K Ω
4-40	.10	51 K Ω
4-41	.10	1500 Ω
4-45	.10	82 K Ω
4-46	.10	1.5 megohm

CONTROLS

10-155	.30	750 Ω
10-212	.60	100 K Ω
10-213	.70	1000 Ω
12-77	2.65	25 K Ω dual control, Volume
12-78	1.70	25 K Ω dual control, Balance
12-79	1.50	50 K Ω dual control, Bass
19-107	2.15	50 K Ω dual control Treble-Tone Flat switch
19-108	1.40	10 K Ω control with switch

PART No.	PRICE Each	DESCRIPTION
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CAPACITORS**Disc-Silver Mica**

20-102	.15	100 pf silver mica
20-107	.40	680 pf silver mica
20-108	.20	200 pf silver mica
20-115	.25	300 pf silver mica
20-139	.25	330 pf silver mica
21-7	.10	33 pf disc
21-75	.10	100 pf disc
21-13	.10	500 pf disc
21-14	.10	.001 μ fd disc
21-27	.10	.005 μ fd disc
21-56	.10	470 pf disc
21-17	.10	200 pf disc
21-78	.10	5 pf disc
21-82	.15	.02 μ fd disc, 50 V
21-31	.10	.02 μ fd disc, 500 V
21-100	.40	.47 μ fd disc
21-149	.10	2.7 pf disc

Electrolytic

25-54	.40	10 μ fd
25-56	.45	100 μ fd
25-220	.45	10 μ fd tantalum
25-223	1.50	47 μ fd tantalum
25-126	.75	50 μ fd
25-145	.50	25 μ fd
25-146	.50	100 μ fd
25-148	.95	1000 μ fd
25-164	1.20	1000 μ fd
25-153	.40	100 μ fd
25-156	4.15	4000 μ fd
25-171	8.00	8000 μ fd
25-172	.80	100 μ fd
25-173	1.70	500 μ fd
25-175	.55	250 μ fd
25-180	1.05	2.2 μ fd
26-112	2.95	AM tuning capacitor

PART No.	PRICE Each	DESCRIPTION
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Mylar

27-74	.10	.01 μ fd
27-46	.15	.047 μ fd
27-47	.20	.1 μ fd
27-48	.25	.22 μ fd
27-60	.25	.22 μ fd
27-61	.45	.47 μ fd
27-68	.40	3300 pf
27-69	.40	9100 pf
27-70	.40	.0022 μ fd
29-2	.20	.01 μ fd
29-3	.15	2700 pf
29-4	.15	1800 pf
29-5	.10	1000 pf
29-6	.15	1200 pf
29-8	.15	3300 pf
29-9	.15	8200 pf

COILS-CHOKES-TRANSFORMERS

40-583	.20	10 μ H peaking coil
40-676	.70	Oscillator coil
40-677	.60	RF mixer coil
40-786	3.95	7 mH (19 kHz amplifier) coil
40-787	1.50	7 mH (67 kHz trap) coil
40-788	1.55	20 mH (19 kHz trap) coil
40-789	1.60	23 mH (53 kHz low-pass) coil
40-790	1.55	70 mH coil
40-791	4.20	7 mH (19 kHz doubler) coil
40-792	4.35	7 mH (38 kHz oscillator) coil
40-793	2.05	AM antenna coil
45-47	.30	2 mH RF choke
45-59	.60	8.8 μ H 10 ampere choke
52-104	1.30	IF transformer, 455 kHz interstage
52-90	1.05	IF transformer, 455 kHz output
53-11	2.55	Ratio detector
54-181	12.25	Power transformer

PART No.	PRICE Each	DESCRIPTION
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DIODES

56-25	3.00	Zener
56-26	.30	1N191 crystal
56-33	.55	1N3754
56-35	.55	Dual
56-44	1.15	Zener
56-47	1.10	Zener
57-27	.60	Silicon
57-42	1.15	Silicon

SWITCHES

60-4	.20	Slide
60-22	.35	Slide 8-lug
60-31	.55	Rocker (white)
60-32	.60	Rocker (black)
63-429	5.00	5-position rotary
65-21	1.45	Thermal

GROMMETS-INSULATORS-BINDING POSTS-CABLES-MISCELLANEOUS

73-3	.10	Grommet
73-34	.10	Insulator, test clip
73-39	.10	Foam tape
73-51	.10	Level control locator
75-17	.10	Binding post base
75-24	.10	Line cord strain relief
75-60	.10	Mica insulator
75-85	.10	Nylon insulator
75-86	.10	Phono socket insulator
75-87	.10	Feedthrough insulator
75-88	.15	Nylon cover
75-90	.10	Insulating paper
89-13	.40	Line cord
110-39	24.60	FM tuning unit*
134-147	5.00	Power amplifier cable assembly
134-148	3.65	Preamplifier cable assembly
134-149	6.50	Multiplex and tuner cable assembly

*Tuners are available at half-price plus postage on an exchange basis; the defective unit returnable after replacement is received. Tuner returned must be in repairable condition.

PART PRICE DESCRIPTION
No. Each

Grommets-Insulators-Binding Posts-Cables-Miscellaneous (cont'd.)

204-9	.10	Angle bracket
204-756	1.80	Tuning shaft bracket
206-345	.25	Spiral shield
207-22	.10	Plastic clamp
207-56	.55	Capacitor mounting clamp
215-22	1.60	Heat sink
215-23	1.90	Heat sink

HARDWARE

250-16	.05	8-32 x 3/16" setscrew
250-22	.05	8-32 x 7/16" setscrew
250-43	.05	8-32 x 1/4" setscrew
250-52	.05	4-40 x 1/4" screw
250-56	.05	6-32 x 1/4" screw
250-89	.05	6-32 x 3/8" screw
250-100	.05	6-32 x 5/16" setscrew
250-116	.05	6-32 x 1/4" screw
250-138	.05	6-32 x 3/16" screw
250-162	.05	6-32 x 1/2" screw
250-170	.05	#6 x 1/4" sheet metal screw
250-174	.05	8-32 x 1/4" screw
250-206	.05	6-32 x 11/16" screw
250-273	.05	4-40 x 3/8" screw
250-276	.05	6-32 x 3/8" screw
250-298	.05	6-32 x 3/4" screw
250-310	.05	2-32 x 1/8" self-tapping screw
250-312	.05	4-40 x 3/4" screw
252-2	.05	4-40 x 1/4" nut
252-3	.05	6-32 x 1/4" nut
252-4	.05	8-32 x 3/8" nut
252-7	.05	3/8-32 x 3/32" nut
252-22	.05	8-32 speednut
252-23	.05	6-32 thumbnut
252-89	.05	4-40 speednut
253-11	.05	E washer
253-21	.05	9/16" washer
253-36	.05	Spring washer
253-49	.10	Nylon washer 7/16" OD
253-60	.05	3/8" washer
253-85	.25	Felt washer

PART PRICE DESCRIPTION
No. Each

Hardware (cont'd.)

254-1	.05	#6 lockwasher
254-2	.05	#8 lockwasher
254-5	.05	Control lockwasher
254-9	.05	#4 lockwasher
255-1	.05	1/8" spacer
255-3	.05	3/8" spacer
255-11	.15	1" spacer
255-70	.25	1-9/32" spacer
255-71	.25	3/4" spacer
255-75	.20	1-1/8" spacer
258-1	.05	Dial cord spring
258-72	.05	Flat steel spring
259-1	.05	#6 solder lug
259-9	.05	#4 solder lug
259-20	.05	Solder lug
260-16	.10	Small alligator clip
261-17	.05	Plastic foot
265-12	.10	Hinge
331-6	.15	Solder

WIRE-SLEEVING-MISCELLANEOUS

344-15	.05/ft	Black stranded wire
344-16	.05/ft	Red stranded wire
344-50	.05/ft	Black hookup wire
344-51	.05/ft	Brown hookup wire
344-52	.05/ft	Red hookup wire
344-53	.05/ft	Yellow hookup wire
344-54	.05/ft	Orange hookup wire
344-55	.05/ft	Green hookup wire
346-1	.05/ft	Fiberglass sleeving
346-4	.05/ft	Black sleeving
346-5	.05/ft	1/4" sleeving
347-2	.05/ft	300 Ω twin lead
352-13	.15	Silicone grease
390-180	.25	Control identification label
390-184	.15	Meter switch label

PART No.	PRICE Each	DESCRIPTION
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FILTER-METERS-LAMPS

404-383	13.50	Crystal filter, 10.7 MHz
407-115	3.00	Tune meter
407-116	3.00	Signal strength meter
412-14	.15	#44 lamp
412-38	.25	#49 lamp
412-39	.35	#756 lamp

TRANSISTORS-INTEGRATED CIRCUITS

417-83	.75	L842
417-94	1.00	2N3416
417-215	2.85	2N3055
417-116	.60	S-2091
417-118	.55	2N3393
417-123	4.20	CA-3012
417-201	.50	X29A829
417-218	.50	TZ1160
417-133	1.30	40245
417-91	.65	2N5232A
417-135	.90	2N3859A
417-136	1.95	40408
417-137	2.10	40409
417-138	3.00	40410
417-139	5.80	40411
417-203	2.25	TA-7311

FUSE-TERMINAL STRIPS-SOCKETS-BUSHINGS-KNOBS-MISCELLANEOUS

421-6	.35	3 ampere slow-blow fuse
423-2	.60	Fuseholder
427-3	.15	Binding post base
431-5	.10	Terminal strip
431-13	.15	4-lug terminal strip
431-39	.15	5-pin miniature terminal strip
432-67	.10	Solderless wire connector
434-85	.20	Lamp socket with leads
434-117	.20	Transistor socket
434-147	.20	AC socket
434-165	.30	Phono socket strip
434-171	.20	Lamp socket without leads
436-27	.45	Phone jack
446-56	2.85	Dial window
446-57	1.50	Tinted window
453-148	.40	Tuning shaft
454-2	.70	Flywheel
455-54	.40	Nylon bushing
456-1	.70	Flexible shaft coupler

PART No.	PRICE Each	DESCRIPTION
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Fuse-Terminal Strips-Sockets-Bushings-Knobs-Miscellaneous (cont'd.)

462-241	.30	Knob, plastic skirt
462-268	1.80	Large metal knob
462-269	1.60	Small metal knob
463-44	.30	Dial pointer
490-1	.10	Large alignment tool
490-5	.10	Nut starter
490-109	.10	Small alignment tool
595-1096	2.00	Manual

MANUFACTURED PARTS

85-163-2	1.10	Power supply circuit board
85-164-3	.90	Power amplifier circuit board
85-165-2	.70	Phono preamplifier circuit board
85-166-2	3.05	Control preamplifier circuit board
85-167-4	2.90	Multiplex circuit board
85-299-1	3.80	AM-FM circuit board
100-16-18	.10	Red binding post cap
100-16-2	.10	Black binding post cap
100-589	.10	Mounting strap
100-618	5.35	Front panel
100-621	.35	Indicator disc
100-622	.15	Pulley bracket
100-642	.25	Dial pulley
100-643	.10	Dial cord
201-38	1.90	Chassis base
202-61-1	2.10	Rear apron
202-62	.85	Right apron
202-63	.95	Left apron
202-64	1.15	Front apron
204-752	.25	Transformer bracket
204-753	.30	Switch bracket
204-755	.35	Antenna bracket
204-757	.10	Meter bracket
205-539	.40	Switch mounting plate
205-540	1.95	Bottom cover
205-544	.10	Support bracket
206-430	.80	AM-FM shield
206-329-1	.70	Preamplifier circuit board shield
206-330-1	1.20	Large light reflector
206-331-1	.25	Light shield
206-332-1	.20	Small light reflector
266-93	.25	Pointer rail
446-60	.10	Green meter shield

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