



HEATHKIT[®] MANUAL

for the

SSB TRANSCEIVER

Model HW-101

595-1277-18



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

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YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

SSB TRANSCEIVER

Model HW-101

595-1277-18

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model HW-101 SSB Transceiver transmits and receives SSB (single sideband) and CW (continuous wave) signals on the 80 through 10 meter amateur bands. It may also be used as an exciter for a linear amplifier, and it has an ALC (automatic level control) input for use in this service. The Heathkit ac power supply is available for fixed station use, and the Heathkit dc power supply and mobile mounting bracket may be used for mobile operation.

The Transceiver is furnished with a crystal filter for SSB use. A narrow CW crystal filter, available as an optional accessory, may be mounted in the Transceiver and switched from the front panel for convenient change of operating mode.

Provisions are made for both VOX (voice-operated transmit) and PTT (push-to-talk) operation. An anti-trip circuit prevents a signal received over the speaker from feeding back to the microphone and switching the transmitter on during VOX operation. The crystal-controlled heterodyne oscillator assures accurate, stable operation.

The dial mechanism has a large tuning knob which operates smoothly and provides convenient, backlash-free tuning. A built-in crystal calibrator allows the dial to be accurately calibrated at 100 kHz intervals. Other features include TALC (triple action level control) to prevent overdriving the final amplifiers, and tone-actuated CW operation. The panel meter operates as an S meter on receive, and reads ALC voltage on transmit. The same meter can be switched manually to read either relative power output or final amplifier cathode current.

A total of twenty tubes and nineteen semiconductors is used. The VFO uses a field-effect transistor as the oscillator. The use of circuit boards and a wiring harness provides a clean, compact chassis layout and greatly simplifies kit assembly. The use of Switch-Boards* (circuit boards which have band switch wafers mounted on them) eliminates much of the intricate wiring to the band switch.

Refer to the "Kit Builders Guide" for information on tools, wiring, soldering, resistors, and capacitors.

PARTS PACKAGING

The Transceiver parts are packed in the large shipping carton, which contains smaller packages and other parts. Some of these smaller packages have numbers on them. The number on each of these packages corresponds to the number on one of the following seven parts lists.

After the seven numbered packages have been removed from the large carton, the remaining parts are pack #8. Pack #8 consists mainly of items too large to fit into the small packages, and those items used in the chassis assembly sections.

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 the parts from pack #8 that are required to complete that assembly section.

NOTE: 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 packed 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.

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

CIRCUIT BOARD ASSEMBLY

This section of the Manual contains separate parts lists and step-by-step assembly instructions for circuit boards.

Before starting to assemble this kit, read the "Kit Builders Guide" for information on wiring, soldering, resistors, and capacitors.

Use 1/2-watt resistors unless directed otherwise in a step. Resistors will be called out by the color code and the resistance value in Ω (ohms), $k\Omega$ (kilohms), or $M\Omega$ (megohms). Capacitors will be called out by the capacitance value and type.

Before you install a disc capacitor, remove from its leads any excess body coating material which protrudes through the circuit board and would prevent soldering the leads to the foil.

Be especially careful not to cover unused holes with solder or bridge solder between foils during the assembly of the circuit boards.

In some instances, resistors will be mounted vertically. Position each circuit board and all parts as shown in the Pictorials. Follow the instructions carefully, and read the entire step before performing the operation.

A number of coils will be installed on Switch-Boards. It is **IMPORTANT** that each coil base lies flat against the board.

Identify each circuit board by its part number. This number is listed in the upper left-hand corner of the page at the beginning of the assembly steps, and is printed on the component side of each circuit board. Position the boards foil side down as shown in the Pictorials. When a circuit board is finished, set it aside until it is called for later in the assembly instructions.

SWITCH-BOARDS

In this section you will assemble the following circuit boards: crystal, heterodyne oscillator, driver grid, and driver plate.

PARTS LIST #1

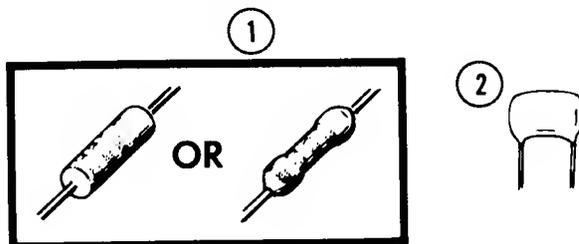
Open parts pack #1 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART	PARTS	DESCRIPTION
No.	No.	Per Kit

PARTS PICTORIAL

RESISTORS (1/2-Watt)

1	6-101	1	100 Ω (brown-black-brown)
	6-102	1	1000 Ω (brown-black-red)
	6-223	1	22 kΩ (red-red-orange)



CAPACITORS

Mica

2	20-130	1	12 pF
	20-77	1	24 pF
	20-96	4	36 pF
	20-97	1	50 pF
	20-102	1	100 pF
	20-105	2	180 pF
	20-107	2	680 pF

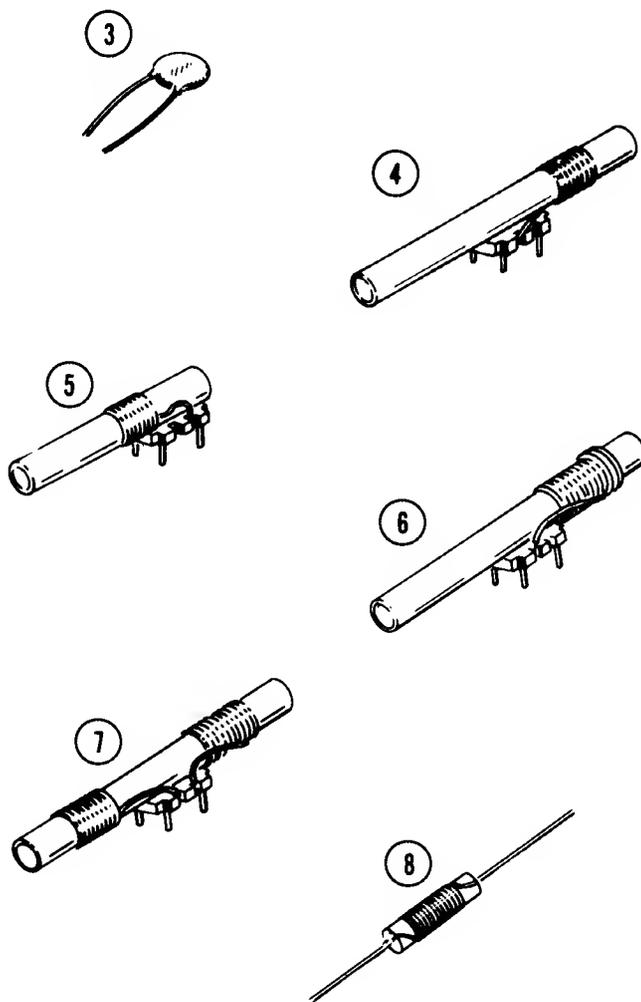
Disc

3	21-140	1	.001 μF
	21-16	2	.01 μF

COILS AND CHOKES

NOTE: The appearance of the mounting base and terminals on several of the following coils may vary from those shown on the Parts Pictorial.

4	40-686	2	7 MHz (yellow dot), L702, 802
5	40-687	4	14/21 MHz (green dot), L703, 704, 803, 804
	40-693	1	28 MHz (brown dot), L605
	40-688	2	29 MHz (black dot), L705, 805
	40-692	1	29.5 MHz (blue dot), L608
6	40-685	2	3.5 MHz (gray dot), L701, 801
7	40-689	1	3.5/7 MHz (red dot), L601/602
	40-690	1	14/21 MHz (orange dot), L603/604
	40-691	1	28.5/29 MHz (violet dot), L606/607
8	45-51	1	15 μH RF choke

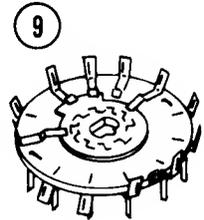


KEY PART		PARTS Per Kit	DESCRIPTION
No.	No.		

PARTS PICTORIAL

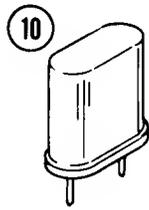
SWITCHES

9	63-396	2	Rotary wafer (red dot)
	63-397	2	Rotary wafer (yellow dot)



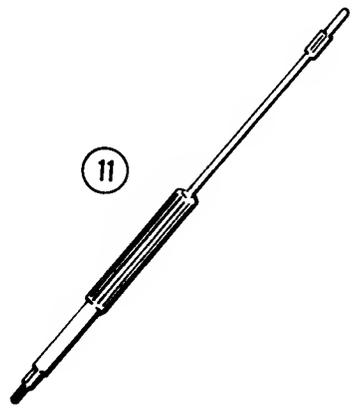
WIRE-SLEEVING

340-2	1	Small bare wire
340-3	1	Large bare wire
343-15	1	Coaxial cable
344-21	1	Large red hookup wire
344-50	1	Black hookup wire
344-51	1	Brown hookup wire
344-52	1	Red hookup wire
344-53	1	Orange hookup wire
344-59	1	White hookup wire
346-1	1	Small black sleeving
346-2	2	Clear sleeving
346-5	1	Large black sleeving



CRYSTALS

10	404-207	1	12.395 MHz
	404-208	1	15.895 MHz
	404-209	1	22.895 MHz
	404-210	1	29.895 MHz
	404-211	1	36.895 MHz
	404-212	1	37.395 MHz
	404-213	1	37.895 MHz
	404-214	1	38.395 MHz

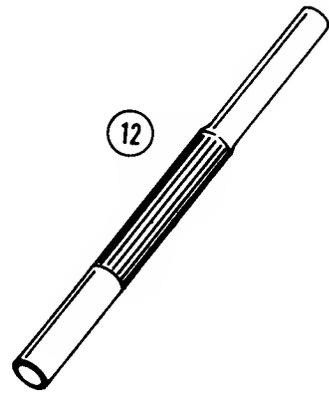


SWITCH-BOARDS

85-132-1	1	Crystal
85-133-1	1	Heterodyne oscillator
85-133-2	1	Driver grid
85-133-3	1	Driver plate

MISCELLANEOUS

	390-147	1	"Danger High Voltage" label
	390-186	1	Number sheet
		1	Blue and white identification label
11	490-1	1	Alignment tool
12	490-5	1	Nut starter
	597-260	1	Parts Order Form
	597-308	1	Kit Builders Guide
		1	Manual (See Page 1 for part number.)
			Solder



STEP-BY-STEP ASSEMBLY

CRYSTAL SWITCH-BOARD

START

Position the crystal Switch-Board (#85-132-1) as shown.

NOTE: Solder the pins of each part to the foil as it is installed. DO NOT CUT OFF THE CRYSTAL OR SWITCH PINS AFTER SOLDERING.

() 12,395 MHz crystal (#404-207).



() 22,895 MHz crystal (#404-209).

() 15,895 MHz crystal (#404-208).

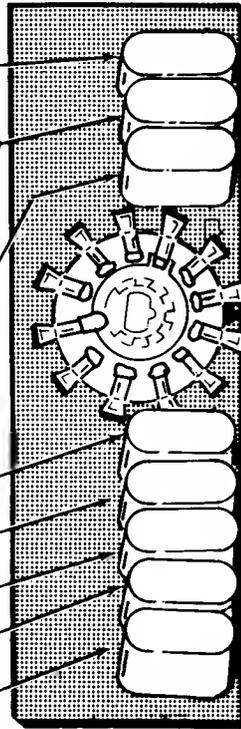
() 36,895 MHz crystal (#404-211).

() 29,895 MHz crystal (#404-210).

() 37,395 MHz crystal (#404-212).

() 37,895 MHz crystal (#404-213).

() 38,395 MHz crystal (#404-214).

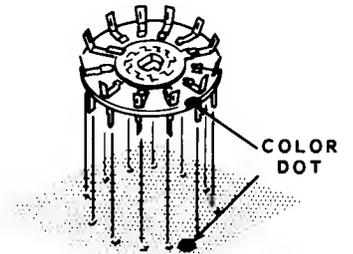


PICTORIAL 1-1

CONTINUE



() Rotary switch wafer, #63-397 (yellow color dot). Position the color dot of the switch wafer over the color dot on the Switch-Board.



() Check to see that all connections are soldered.

() Bend all switch lugs forward out of the way. Do not damage or bend the ring contacts at the inside of the switch.



NOTE: For clarity and identification purposes, other drawings in this Manual may show the switches with the lugs extended.

FINISH

HETERODYNE OSCILLATOR SWITCH-BOARD

START



CONTINUE



Position the heterodyne oscillator Switch-Board (#85-133-1) as shown.

() 100 Ω (brown-black-brown).

() .001 μF disc.

() Solder the resistor and capacitor leads to the foil and cut off the excess lead lengths.

NOTE: When installing the coils in the following steps, align the coil form with the coil outline on the board, and position the color dot on the coil over the color dot on the Switch-Board. Then hold the coil base flat against the board and solder the coil pins. DO NOT cut off the pins after soldering.

() Coil #40-693 (brown color dot).

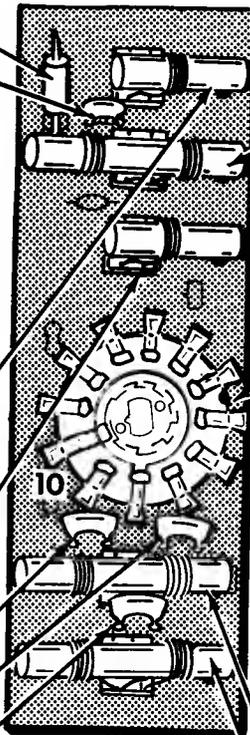
() Coil #40-692 (blue color dot).

() 100 pF mica.

() 50 pF mica.

() 24 pF mica.

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



PICTORIAL 1-2

() Coil #40-691 (violet color dot). Hold the coil base firmly against the Switch-Board when soldering.

() Rotary switch wafer, #63-397 (yellow color dot). Position the color dot on the switch wafer over the color dot on the Switch-Board. Solder the pins to the foil.

() Bend all switch lugs, except lug 10, forward out of the way. Do not damage or bend the ring contacts at the inside of the switch.

NOTE: For clarity and identification purposes, other drawings in this Manual may show the switches with the lugs extended.

() Coil #40-689 (red color dot).

() Coil #40-690 (orange color dot).

() Cut off the projecting switch mounting pins on the foil side of this Switch-Board only.

() Check to see that all connections are soldered. Disregard any unused holes in the Switch-Board.

FINISH

PROCEED TO PICTORIAL 1-3

CONTINUE

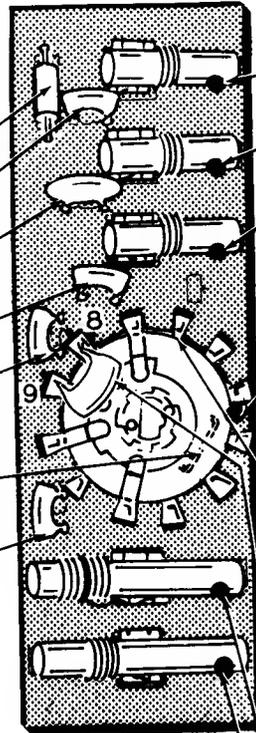


DRIVER GRID SWITCH-BOARD

START



- | |
|---|
| Position the driver grid Switch-Board (#85-133-2) as shown. |
| () 1000 Ω (brown-black-red). |
| () 680 pF mica. |
| () .01 μ F disc. |
| () 12 pF mica. |
| () 180 pF mica. |
| () 1" bare wire. Use black hookup wire with the insulation removed. |
| () 36 pF mica. |
| () Solder all leads to the foil and cut off the excess lead lengths. |



NOTE: Solder the pins of the coils and switch wafer as they are installed, but do not cut off their pins after soldering.

- | |
|--|
| () Coil #40-687 (green color dot). |
| () Coil #40-687 (green color dot). |
| () Coil #40-688 (black color dot). |
| () Rotary switch wafer, #63-396 (red color dot). Position the color dot on the switch wafer over the color dot on the Switch-Board. |

- | |
|--|
| () Bend the unused switch lugs forward out of the way. Do not damage or bend the ring contacts at the inside of the switch. |
|--|



NOTE: For clarity and identification purposes, other drawings in this Manual may show the switches with the lugs extended.

- | |
|--|
| () Cut each lead of a 36 pF mica capacitor to a length of 1/2". Connect this capacitor between lug 8 (S-1) and lug 9 (S-1) of the switch wafer. |
| () Coil #40-685 (gray color dot). |
| () Coil #40-686 (yellow color dot). |
| () Check to see that all connections are soldered. Disregard any unused holes in the Switch-Board. |

FINISH

PROCEED TO PICTORIAL 1-4



CONTINUE



DRIVER PLATE SWITCH-BOARD

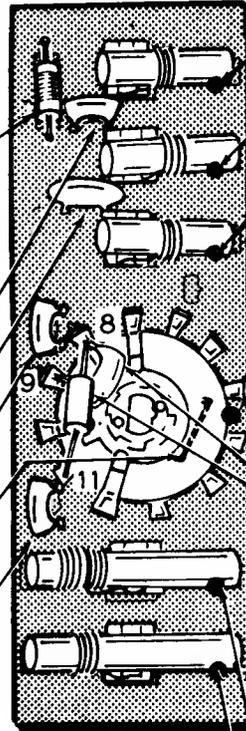
START



Position the driver plate Switch-Board (#85-133-3) as shown.

- () 15 μ H RF choke (#45-51). Bend each lead toward the slot.

- () 680 pF mica.
- () .01 μ F disc.
- () 10 pF mica.
- () 1" bare wire. Use black hookup wire with the insulation removed.
- () 36 pF mica.
- () Solder all connections and cut off the excess lead lengths.



NOTE: Solder the pins of the coils and switch wafer as they are installed, but do not cut off their pins after soldering.

- () Coil #40-687 (green color dot).
- () Coil #40-687 (green color dot).
- () Coil #40-688 (black color dot).
- () Rotary switch wafer #63-396 (red color dot). Position the color dot of the switch wafer over the color dot on the Switch-Board.
- () Bend the unused switch lugs forward out of the way. Do not damage or bend the ring contacts at the inside of the switch.

NOTE: For clarity and identification purposes, other drawings in this Manual may show the switches with the lugs extended.

- () Cut each lead of a 36 pF mica capacitor to a length of 1/2". Connect this capacitor from lug 8 (NS) to lug 9 (S-1) of the switch wafer.
- () 22 k Ω (red-red-orange) between lugs 8 (S-2) and 11 (S-1) of the switch wafer. Be sure the resistor and capacitor clear the switch rotor. Cut off the excess leads.
- () Coil #40-685 (gray color dot).
- () Coil #40-686 (yellow color dot).
- () Check to see that all connections are soldered. Disregard any unused holes in the Switch-Board.

PICTORIAL 1-4

FINISH

PROCEED TO "MODULATOR CIRCUIT BOARD."

MODULATOR CIRCUIT BOARD

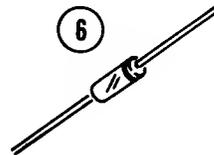
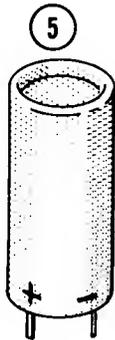
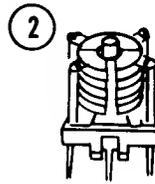
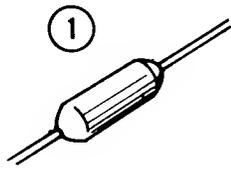
PARTS LIST #2

Open parts pack #2 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from this Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART No.	No.	PARTS Per Kit	DESCRIPTION	KEY PART No.	No.	PARTS Per Kit	DESCRIPTION
RESISTORS (1/2-Watt)				Other Capacitors			
6-221	2	220 Ω	(red-red-brown)	1	21-29	1	4.7 pF (MMF) ceramic tubular
6-471	1	470 Ω	(yellow-violet-brown)	2	26-94	1	13 pF differential
6-102	2	1000 Ω	(brown-black-red)	3	27-34	3	.2 μ F Mylar*
6-202	2	2000 Ω	(red-black-red)	4	25-115	1	10 μ F electrolytic
6-472	3	4700 Ω	(yellow-violet-red)	5	25-135	1	20 μ F electrolytic
6-333	2	33 k Ω	(orange-orange-orange)	CRYSTALS			
6-473	2	47 k Ω	(yellow-violet-orange)	404-205	1	3393.6 kHz	
6-104	4	100 k Ω	(brown-black-yellow)	404-206	1	3396.4 kHz	
6-154	1	150 k Ω	(brown-green-yellow)	404-215	1	3395.4 kHz	
6-105	4	1 M Ω	(brown-black-green)	DIODES			
CAPACITORS				6	56-87	4	FH-1100
Mica				7	57-27	2	1N2071
20-130	1	12 pF		MISCELLANEOUS			
20-77	1	24 pF		8	10-147	1	200 Ω control
20-96	1	36 pF		9	52-79	1	IF transformer
20-97	1	50 pF		10	253-34	1	Fiber washer
20-102	1	100 pF		11	434-112	1	7-pin socket
Disc				12	434-130	1	9-pin socket (with ground clip)
21-13	1	500 pF		13	434-79	1	9-pin socket (without ground clip)
21-140	1	.001 μ F		85-127-2	1	Circuit board	
21-27	2	.005 μ F					
21-16	3	.01 μ F					
21-31	6	.02 μ F					

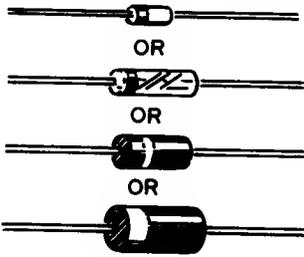
*DuPont Registered Trademark

PARTS PICTORIAL



7

NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.

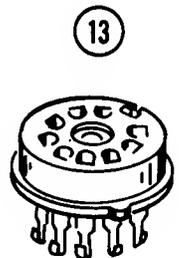
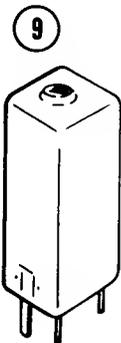
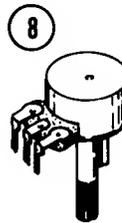


OR

OR

OR

OR



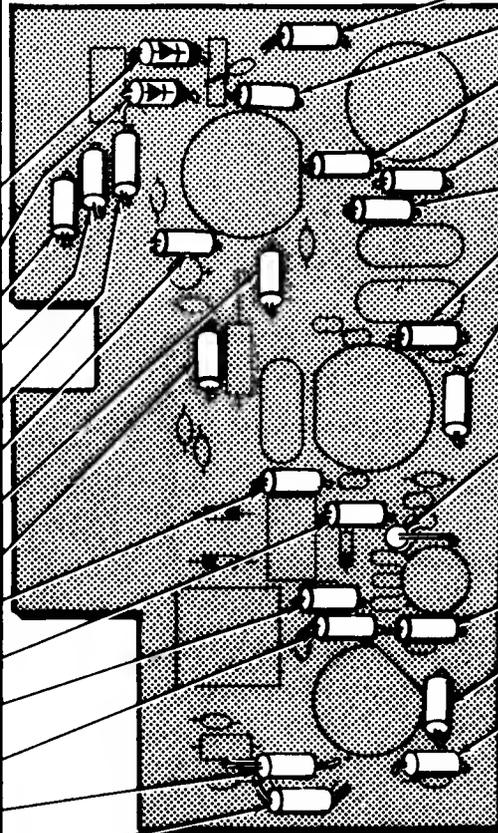
STEP-BY-STEP ASSEMBLY

START



- Position the modulator circuit board (#85-127-2) as shown.
- On the foil side of some circuit boards you will find lines in the foil which are parallel to an edge of the circuit board. Note that there are solder points (holes) close to each line. The lines are "solder stops" to prevent solder from running out to the edge of the board. DO NOT allow any solder to get on the dashes or on the mounting edges of the circuit boards.
- NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. THE CATHODE END OF THE DIODE IS MARKED WITH A BAND OR BANDS. ALWAYS POSITION THIS END AS SHOWN IN THE PICTORIAL.
-
- BAND OR BANDS**
- () 1N2071 diode (#57-27).
 - () 1N2071 diode (#57-27).
 - () 47 kΩ (yellow-violet-orange).
 - () 1 MΩ (brown-black-green).
 - () 100 kΩ (brown-black-yellow).
 - () 1000 Ω (brown-black-red).
 - () 2000 Ω (red-black-red).
 - () 33 kΩ (orange-orange-orange).
 - () 100 kΩ (brown-black-yellow).
 - () 20 Ω (red-red-brown).
 - () 220 Ω (red-red-brown).
 - () 4700 Ω (yellow-violet-red).
 - () 2000 Ω (red-black-red).
 - () 4700 Ω (yellow-violet-red).
 - () Solder all leads to the foil and cut off the excess lead lengths.

CONTINUE



- () 1 MΩ (brown-black-green).
 - () 150 kΩ (brown-green-yellow).
 - () 100 kΩ (brown-black-yellow).
 - () 4700 Ω (yellow-violet-red).
 - () 1 MΩ (brown-black-green).
 - () 100 kΩ (brown-black-yellow).
 - () 33 kΩ (orange-orange-orange).
 - () 1000 Ω (brown-black-red).
Mount vertically.
-
- () 1 MΩ (brown-black-green).
 - () 470 Ω (yellow-violet-brown).
 - () 47 kΩ (yellow-violet-orange).
 - () Solder all leads to the foil and cut off the excess lead lengths. Before soldering the vertically mounted resistor, make sure it is properly positioned.

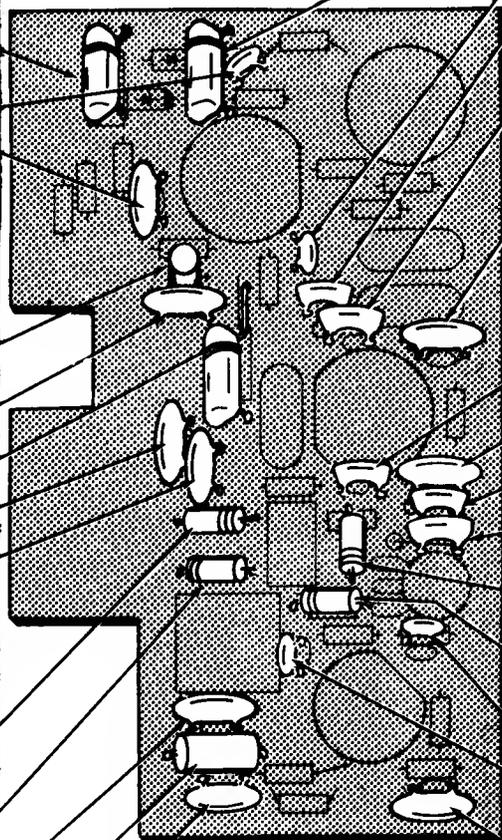
PROCEED TO PICTORIAL 2-2

PICTORIAL 2-1

START



- NOTE: When you install Mylar capacitors, position the banded end as shown.
- () .2 μ F Mylar. Note banded end.
 - () 500 pF disc.
 - () .01 μ F disc.
- NOTE: When you install electrolytic capacitors, position the positive (+) lead at the plus (+) mark on the circuit board.
- () 10 μ F electrolytic. Note (+) marking.
 - () .02 μ F disc.
 - () .2 μ F Mylar. Note banded end.
 - () .02 μ F disc.
 - () .01 μ F disc.
- NOTE: When you install an FH-1100 diode (#56-87), position the banded end as shown.
- () FH-1100 diode. Note banded end.
 - () FH-1100 diode. Note banded end.
 - () .02 μ F disc.
 - () 4.7 pF (MMF) tubular.
 - () .01 μ F disc. NOTE: There are three holes at this location. Use the outer holes for the capacitor leads.
 - () Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE



- () .2 μ F Mylar. Position body to clear outline of tube socket V1. Note banded end.
- () .001 μ F disc.
- () 12 pF mica.
- () 24 pF mica. Position the body so it will clear the outline of tube socket V16 which will be installed later.
- () .02 μ F disc. Position the body so it will clear the outline of tube socket V16 which will be installed later.
- () Solder the leads to the foil and cut off the excess lead lengths.
- () 36 pF mica.
- () .02 μ F disc.
- () 50 pF mica.
- () 100 pF mica.
- () FH-1100 diode. Note banded end.
- () FH-1100 diode. Note banded end.
- () .005 μ F disc.
- () .005 μ F disc.
- () .02 μ F disc. NOTE: There are three holes at this location. Use the outer holes for the capacitor leads.
- () Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 2-3

PICTORIAL 2-2

START

NOTE: Solder the pins of each part to the foil as it is installed. Do not cut off the lugs of any of these parts after soldering.

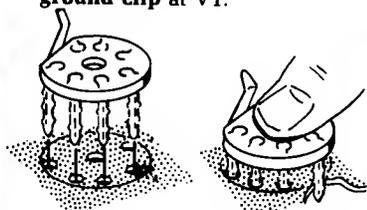
() 3396.4 kHz crystal (#404-206).

() Solder the center pin to the ground clip on the 9-pin tube socket before you mount it in the following step. Heat the center pin and allow the solder to flow onto the ground clip.

IMPORTANT: When you install tube sockets on any circuit board, DO NOT use the sockets with ground clips unless they are specifically called for, as in the following step.



() Install a 9-pin tube socket with ground clip at V1.

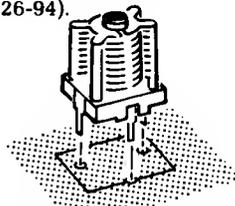


ALIGN ALL PINS TO THEIR RESPECTIVE HOLES.

PRESS THE SOCKET DOWN UNTIL IT SNAPS IN PLACE.

() Install a 9-pin tube socket at V16.

() 13 pF differential capacitor (#26-94).



() Install a 7-pin tube socket at V2.

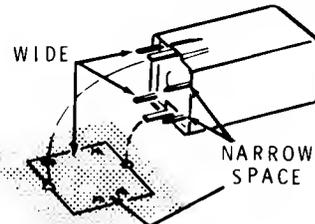
CONTINUE

() 20 μ F electrolytic. Note (+) marking.

() 3393.6 kHz crystal (#404-205).

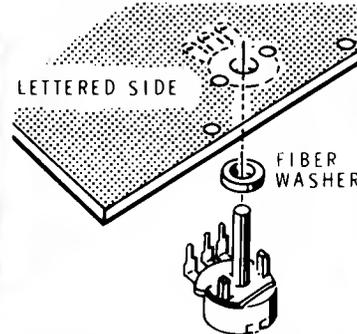
() 3395.4 kHz crystal (#404-215).

() 3.395 MHz transformer (#52-79).

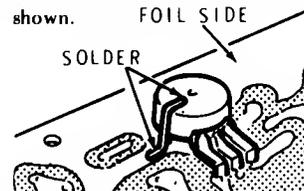


NOTE: Use a minimum of solder in the following steps to prevent rosin from getting into the control.

() Place a fiber washer on the shaft of a 200 Ω control (#10-147). Then install the control from the foil side of the board. Solder the five tabs to the foil.



() Solder a clipped-off resistor lead to the case of 200 Ω control and to the foil shown.



() Check to see that all connections are soldered before putting the board aside. Disregard any unused holes.

PICTORIAL 2-3

FINISH

PROCEED TO "IF CIRCUIT BOARD."

IF CIRCUIT BOARD

PARTS LIST #3

Open parts pack #3 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from this Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART No.	PARTS No.	DESCRIPTION	KEY PART No.	PARTS No.	DESCRIPTION
1/2-Watt					
6-470	2	47 Ω (yellow-violet-black)			
6-151	1	150 Ω (brown-green-brown)			
6-221	1	220 Ω (red-red-brown)			
6-471	1	470 Ω (yellow-violet-brown)			
6-102	3	1000 Ω (brown-black red)			
6-332	1	3300 Ω (orange-orange-red)			
6-472	1	4700 Ω (yellow-violet-red)			
6-473	1	47 k Ω (yellow-violet-orange)			
6-104	3	100 k Ω (brown-black-yellow)			
1-40	1	10 M Ω (brown-black-blue)			
COILS-TRANSFORMERS					
			3	40-487	1 300 μ H coil
			4	40-587	1 6.8 MHz trap coil
				52-73	1 3.395 MHz IF transformer
				52-79	1 3.395 MHz IF transformer
MISCELLANEOUS					
				57-27	1 1N2071 diode
				85-128-4	1 IF circuit board
				434-112	2 7-pin socket
				434-79	1 9-pin socket

1-Watt

1	1-5-1	1	22 k Ω (red-red-orange)
1	1-28-1	1	100 k Ω (brown-black-yellow)

CAPACITORS

Mica

20-97	1	50 pF
20-102	1	100 pF

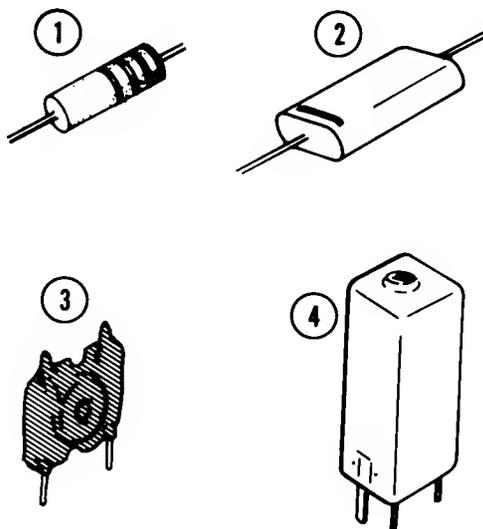
Disc

21-13	2	500 pF
21-140	1	.001 μ F
21-27	2	.005 μ F
21-31	10	.02 μ F

Other Capacitors

27-34	1	.2 μ F Mylar
2 27-19	1	1 μ F tubular (shape may vary)

PARTS PICTORIAL



STEP-BY-STEP ASSEMBLY

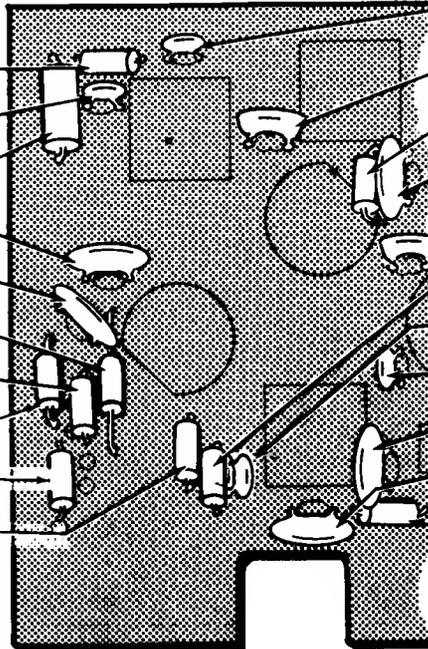
START



CONTINUE



- | |
|---|
| Position the IF circuit board (#85-128-4) as shown. |
| () 1000 Ω (brown-black-red). |
| () .005 μF disc. |
| () 22 k Ω 1-watt (red-red-orange). |
| () .02 μF disc. |
| () .02 μF disc. |
| () 100 k Ω 1-watt (brown-black-yellow). |
| () 47 Ω (yellow-violet-black). |
| () 47 Ω (yellow-violet-black). |
| () 150 Ω (brown-green-brown). |
| () 100 k Ω (brown-black-yellow). |
| () Solder the leads to the foil and cut off the excess lead lengths. |



- | |
|---|
| () .001 μF disc. |
| () 50 pF mica. |
| () 220 Ω (red-red-brown). |
| () .02 μF disc. |
| () 100 pF mica. |
| () 100 k Ω (brown-black-yellow). |
| () .005 μF disc. |
| () 500 pF disc. |
| () .02 μF disc. |
| () .02 μF disc. |
| () 1000 Ω (brown-black-red). |
| () Solder the leads to the foil and cut off excess lead lengths. |

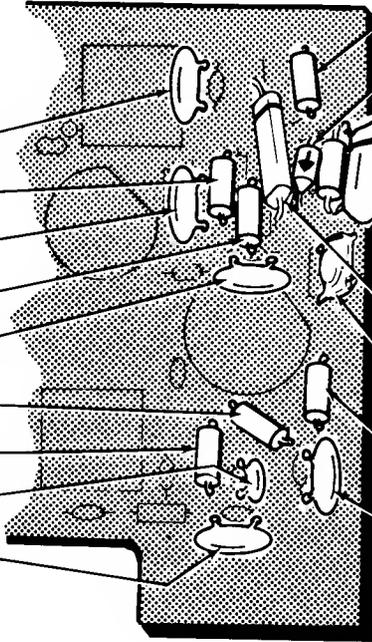
PROCEED TO PICTORIAL 3-2

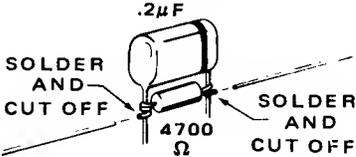
PICTORIAL 3-1

CONTINUE 

START 

- () .02 μ F disc.
- () 1000 Ω (brown-black-red).
- () .02 μ F disc.
- () 10 M Ω (brown-black-blue).
- () .02 μ F disc.
- () 47 k Ω (yellow-violet-orange).
- () 100 k Ω (brown-black-yellow).
- () 500 pF disc.
- () .02 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.



- () 3300 Ω (orange-orange-red).
 - () 1N2071 diode (#57-27). Note cathode or banded end.
 - () 4700 Ω (yellow-violet-red) and .2 μ F Mylar combination. Note banded end of capacitor.
- 
- () 1 μ F tubular. Note banded end.
 - () 300 μ H coil (orange-black-brown) #40-487.
 - () 470 Ω (yellow-violet-brown).
 - () .02 μ F disc.
 - () Solder the leads to the foil and cut off the excess lead lengths.

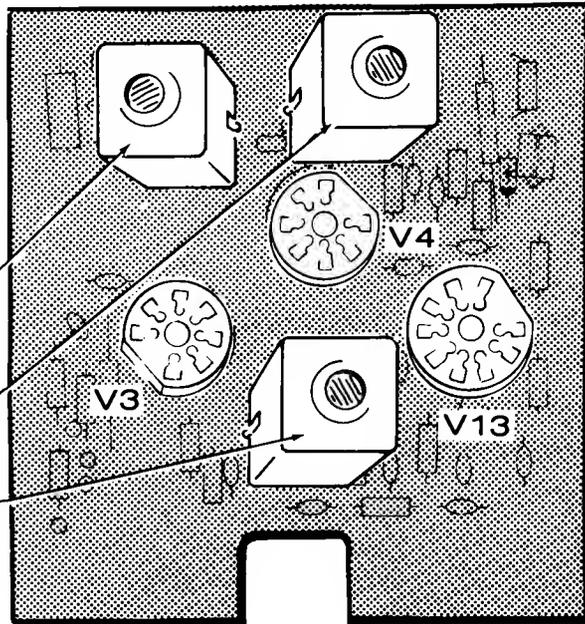
PROCEED TO PICTORIAL 3-3

PICTORIAL 3-2

START 

NOTE: Solder the connections of each part as it is installed. Do not cut off the lugs of these parts after soldering.

- () Install 7-pin tube sockets at V3 and V4.
- () Install a 9-pin tube socket at V13.
- () 3,395 MHz IF transformer (#52-73). Note lug spacing.
- () 6.8 MHz trap coil (#40-587). Note lug spacing.
- () 3,395 MHz transformer (#52-79). Note lug spacing.
- () Check to see that all connections are soldered before putting the board aside.



FINISH

PROCEED TO "BANDPASS CIRCUIT BOARD."

PICTORIAL 3-3

BANDPASS CIRCUIT BOARD

PARTS LIST #4

Open parts pack #4 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from the Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART No.	KEY PART No.	PARTS Per Kit	DESCRIPTION	KEY PART No.	KEY PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS (1/2-Watt)				DIODES			
6-470		1	47 Ω (yellow-violet-black)	3	56-25	1	1N4166A (Appearance may vary)
6-331		4	330 Ω (orange-orange-brown)		56-26	1	1N191 (brown-white-brown)
6-102		2	1000 Ω (brown-black-red)		57-27	1	1N2071
6-472		1	4700 Ω (yellow-violet-red)	MISCELLANEOUS			
6-103		1	10 k Ω (brown-black-orange)	404-43		1	100 kHz crystal
6-473		1	47 k Ω (yellow-violet-orange)	434-79		4	9-pin socket
6-104		7	100 k Ω (brown-black-yellow)	85-129-6		1	Bandpass circuit board
6-154		1	150 k Ω (brown-green-yellow)				
6-474		2	470 k Ω (yellow-violet-yellow)				
6-155		1	1.5 M Ω (brown-green-green)				

CAPACITORS

Mica

20-97	3	50 pF
20-102	2	100 pF

Disc

21-140	1	.001 μ F
21-27	3	.005 μ F
21-31	7	.02 μ F

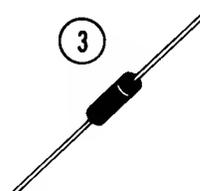
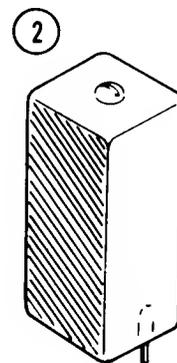
Other Capacitors

25-115	1	10 μ F electrolytic
27-34	1	.2 μ F Mylar
1 31-36	1	8-50 pF trimmer

COILS-TRANSFORMERS

45-51	1	15 μ H RF choke
40-1023	1	Plate tank mixer coil
2 52-65	1	Bandpass transformer

PARTS PICTORIAL

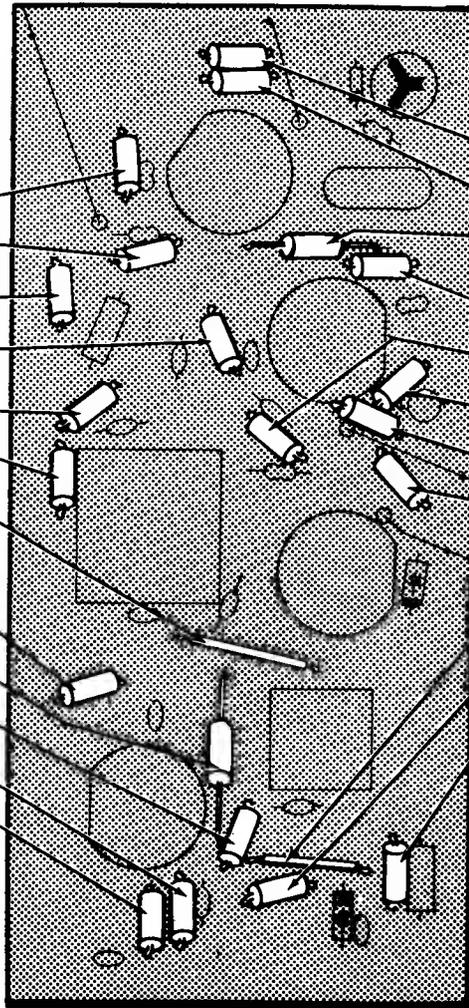


STEP-BY-STEP ASSEMBLY

START



- Position the bandpass circuit board (#85-129-6) as shown.
- () 10 kΩ (brown-black-orange).
- () 330 Ω (orange-orange-brown).
- () 47 kΩ (yellow-violet-orange).
- () 100 kΩ (brown-black-yellow).
- () 330 Ω (orange-orange-brown).
- () 330 Ω (orange-orange-brown).
- () 1-3/4" wire. Use black hookup wire from pack #1 with 1/4" insulation removed from each end.
- () 47 Ω (yellow-violet-black).
- () 100 kΩ (brown-black-yellow).
- () 1000 Ω (brown-black-red).
- () 100 kΩ (brown-black-yellow).
- () 100 kΩ (brown-black-yellow).
- () Solder the leads to the foil and cut off the excess lead lengths.



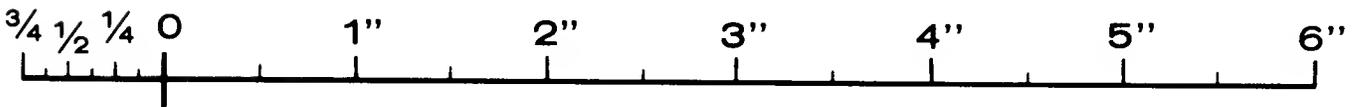
CONTINUE



- () 4700 Ω (yellow-violet-red).
- () 100 kΩ (brown-black-yellow).
- () 150 kΩ (brown-green-yellow).
- () 1.5 MΩ (brown-green-green).
- () 470 kΩ (yellow-violet-yellow).
- () 330 Ω (orange-orange-brown).
- () 100 kΩ (brown-black-yellow).
- () 100 kΩ (brown-black-yellow).
- () 1-1/2" wire. Use black hookup wire with 1/4" of insulation removed from each end.
- () 1000 Ω (brown-black-red).
- () 470 kΩ (yellow-violet-yellow).
- () Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 4-2

PICTORIAL 4-1



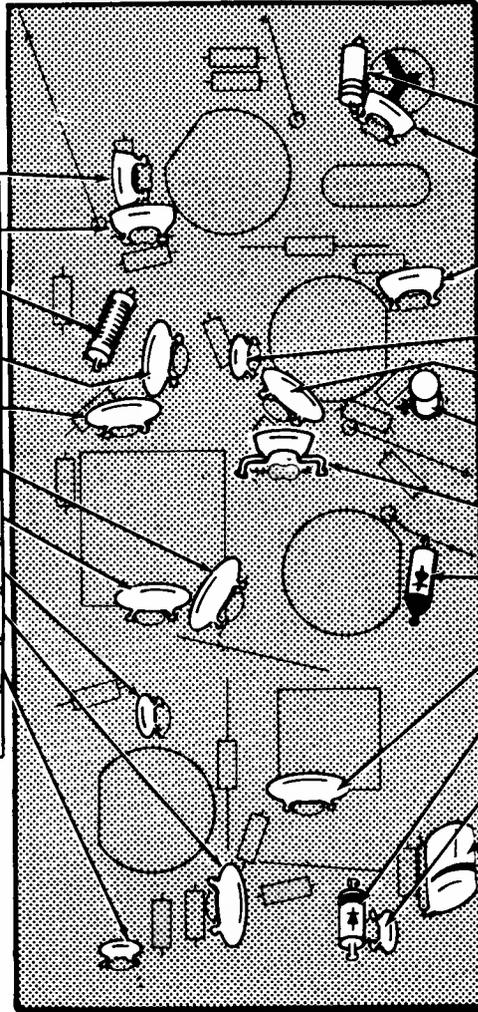
CONTINUE



START



- 50 pF mica.
- 100 pF mica.
- 15 μ H RF choke (#45-51). Bend each lead toward the slot.
- .02 μ F disc.
- .005 μ F disc.
- .02 μ F disc.
- .005 μ F disc.
- Solder the leads to the foil and cut off excess lead lengths.



- 1N191 diode (#56-26, brown-white-brown). Note banded end.
- 50 pF mica.
- 100 pF mica. Position to clear the tube socket to be installed later.
- .001 μ F disc.
- .02 μ F disc.
- 10 μ F electrolytic. Note (+) marking.
- 50 pF mica.
- 1N2071 diode (#57-27). Note cathode end.
- .02 μ F disc.
- 1N4166A diode (#56-25). Note banded end.
- .005 μ F disc.
- .2 μ F Mylar. Note banded end.
- Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 4-3

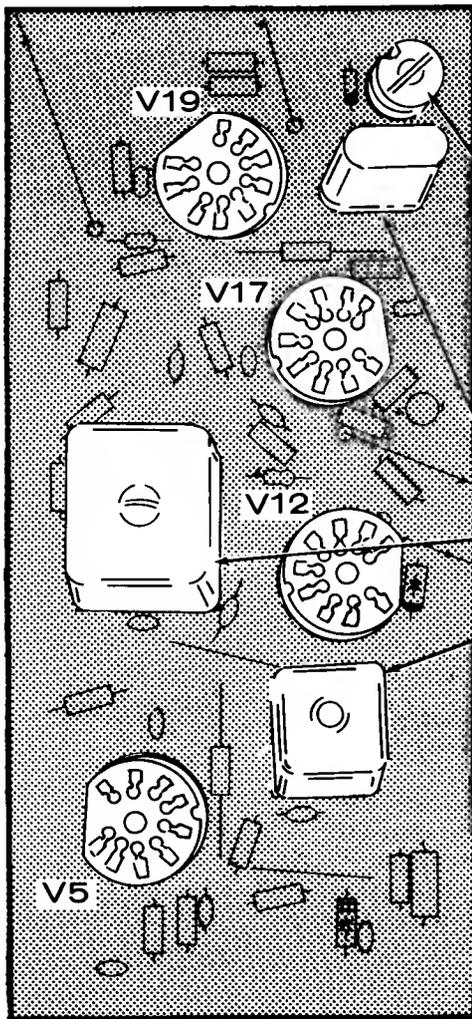
PICTORIAL 4-2

START



NOTE: Solder the pins of each part as it is installed. Do not cut off the lugs of these parts after soldering.

- () Install 9-pin tube sockets at V5, V12, V17, and V19.



CONTINUE



- () 8-50 pF trimmer capacitor (#31-36). Note position of "Y" on trimmer and circuit board. DO NOT BEND THE LEADS.



- () 100 kHz crystal (#404-43).

- () 8.4-8.9 MHz bandpass transformer (#52-65). NOTE: This transformer will not fit down tightly against the board.

- () Plate tank mixer coil (#10-1023).

CAUTION: Do not solder the two pins that do not have foil around them. Be extremely careful not to let the pins touch any foil.

- () Check to see that all connections are soldered before putting the board aside.

FINISH

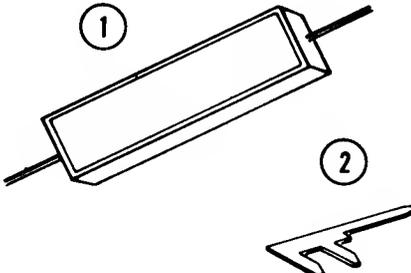
PROCEED TO AUDIO CIRCUIT BOARD

PICTORIAL 4-3

AUDIO CIRCUIT BOARD

PARTS LIST #5

Open parts pack #5 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from this Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

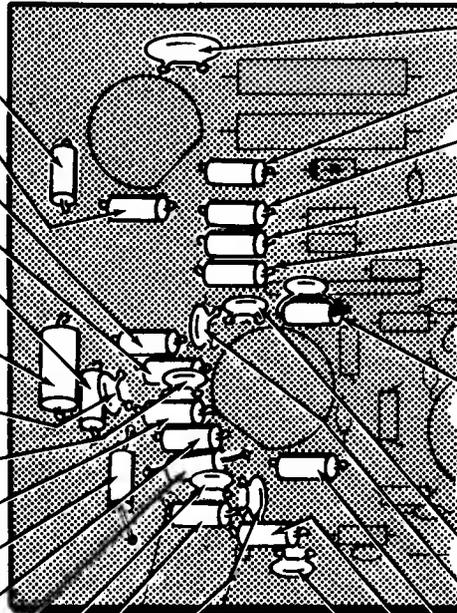
KEY PART No.	KEY PART No.	PARTS Per Kit	DESCRIPTION	KEY PART No.	KEY PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS				Disc			
1/4-Watt				21-13		1	500 pF
6-474-12		6	470 k Ω (yellow-violet yellow)	21-140		2	.001 μ F
1/2-Watt				21-27		8	.005 μ F
6-101		2	100 Ω (brown-black-brown)	21-16		2	.01 μ F
6-331		1	330 Ω (orange-orange brown)	21-31		7	.02 μ F
6-102		1	1000 Ω (brown-black-red)	Electrolytic			
6-472		1	4700 Ω (yellow-violet-red)	25-135		1	20 μ F
6-223		3	22 k Ω (red-red-orange)	DIODES			
6-473		7	47 k Ω (yellow-violet-orange)	57-27		1	1N2071
6-104		1	100 k Ω (brown-black-yellow)	SOCKETS			
6-224		1	220 k Ω (red-red-yellow)	434-112		1	7-pin
6-334		2	330 k Ω (orange-orange yellow)	434-79		2	9-pin
6-474		4	470 k Ω (yellow-violet-yellow)	MISCELLANEOUS			
6-684		2	680 k Ω (blue-gray-yellow)	2	432-734	3	F connector
6-105		3	1 M Ω (brown-black-green)		85-130-4	1	Audio circuit board
6-225		1	2.2 M Ω (red-red-green)		85-2138-1	1	Phase shift circuit board
6-335		1	3.3 M Ω (orange-orange-green)	PARTS PICTORIAL			
1-Watt							
1-3-1		1	3300 Ω (orange-orange-red)				
7-Watt							
1	3-15-7	1	1000 Ω (1 k Ω)				
	3-16-7	1	2500 Ω (2.5 k Ω)				
CAPACITORS							
Mlca							
	20-128	5	470 pF				

STEP-BY-STEP ASSEMBLY

START



- Position the audio circuit board (#85-130-2) as shown.
- () 47 kΩ (yellow-violet-orange).
 - () 22 kΩ (red-red-orange).
 - () 1000 Ω (brown-black-red).
 - () 4700 Ω (yellow-violet-red).
 - () 330 kΩ (orange-orange-yellow).
 - () 3300 Ω 1 watt (orange-orange-red).
 - () .005 μF disc.
 - () .005 μF disc.
 - () 47 kΩ (yellow-violet-orange).
 - () 330 kΩ (orange-orange-yellow).
 - () 1 MΩ (brown-black-green).
 - () 1 MΩ (brown-black-green).
 - () .001 μF disc.
 - () 470 kΩ (yellow-violet-yellow).
 - () .005 μF disc.
 - () Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE



- () .02 μF disc.
 - () 47 kΩ (yellow-violet-orange).
 - () 47 kΩ (yellow-violet-orange) and a 500 pF disc combination.
-
- () .005 μF disc.
 - () .01 μF disc.
 - () 22 kΩ (red-red-orange).
 - () 470 kΩ (yellow-violet-yellow).
 - () .005 μF disc.
 - () Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 5-2

PICTORIAL 5-1

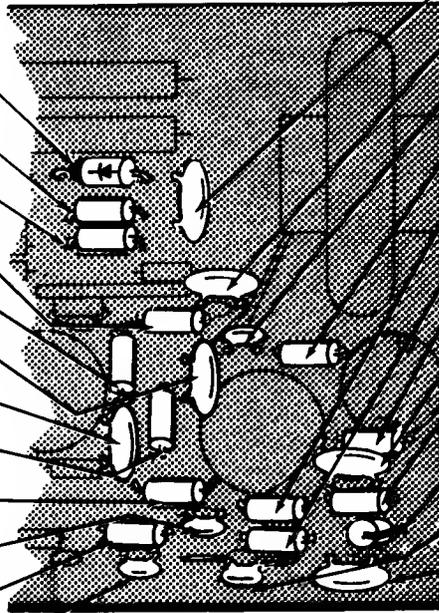
CONTINUE



START



- () 1N2071 diode. (#57-27). Note cathode end.
- () 680 kΩ (blue-gray-yellow).
- () 680 kΩ (blue-gray-yellow).
- () 100 Ω (brown-black-brown).
- () 1 MΩ (brown-black-green).
- () .02 μF disc.
- () .02 μF disc.
- () 100 Ω (brown-black-brown).
- () 100 kΩ (brown-black-yellow).
- () .005 μF disc.
- () 470 kΩ (yellow-violet-yellow).
- () .005 μF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 5-2

- () .02 μF disc.
- () .02 μF disc.
- () .001 μF disc.
- () 22 kΩ (red-red-orange).
- () 220 kΩ (red-red-yellow).
- () 3.3 MΩ (orange-orange-green).
- () 330 Ω (orange-orange-brown).
- () .02 μF disc.
- () 470 kΩ (yellow-violet-yellow).
- () 2.2 MΩ (red-red-green). Install in a vertical position.
- () .005 μF disc.
- () .02 μF disc.
- () Solder the leads to the foil and cut off the excess lead lengths.

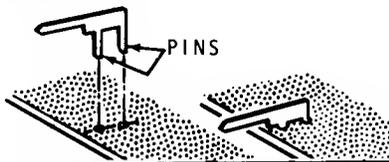
PROCEED TO PICTORIAL 5-3

START

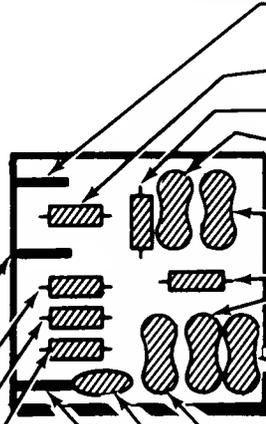


Position the phase shift circuit board (#85-2138-1) as shown.

In some of the following steps you will install F connectors. First, from the component side, insert the pins into the circuit board holes and press them in until the connector body rests against the circuit board. Then solder the pins to the foil. Be sure each connector is down against the circuit board.



- () F connector.
- () 470 kΩ (yellow-violet-yellow).
- () 470 kΩ (yellow-violet-yellow).
- () 470 kΩ (yellow-violet-yellow).
- () Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 5-3

- () F connector.
- () 470 kΩ (yellow-violet-yellow).
- () 470 kΩ (yellow-violet-yellow).
- () 470 pF mica.
- () 470 pF mica.
- () 470 kΩ (yellow-violet-yellow).
- () 470 pF mica.
- () .01 μF disc.
- () F connector.
- () Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 5-4.

CONTINUE



START

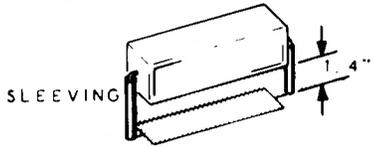


NOTE: Solder the connection of each part as it is installed. Cut off only the leads of the 7-watt resistors and the phase shift network after soldering.

() Install a 7-pin tube socket at V18.

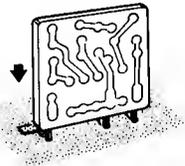
() Install 9-pin tube sockets at V14 and V15.

() 1000 Ω , 7-watt (1 k Ω). Use 1/2" of small black sleeving on each lead. Mount 1/4" above the board.



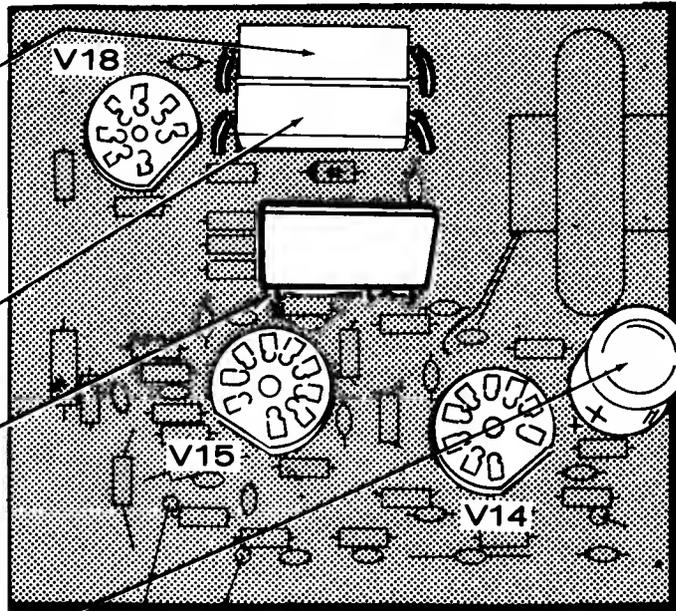
() 2500 Ω , 7-watt (2.5 k Ω). Use 1/2" of small black sleeving on each lead as above.

() Phase shift circuit board.



() 20 μ F electrolytic. Note (+) marking.

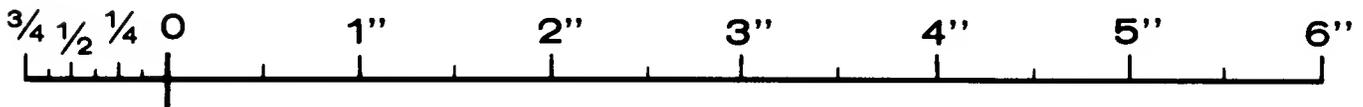
() Check to see that all connections are soldered before putting the board aside.



PICTORIAL 5-4

FINISH

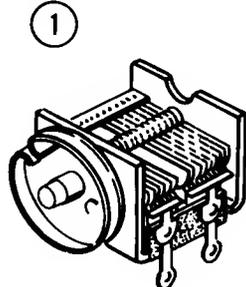
PROCEED TO "RF DRIVER CIRCUIT BOARD."



RF DRIVER CIRCUIT BOARD

PARTS LIST #6

Open parts pack #6 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from the Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART		PARTS	DESCRIPTION	KEY PART		PARTS	DESCRIPTION
No.	No.			No.	No.		
RESISTORS							
1/2-Watt							
6-151		1	150 Ω (brown-green-brown)				
6-221		1	220 Ω (red-red-brown)				
6-331		1	330 Ω (orange-orange-brown)				
6-472		1	4700 Ω (yellow-violet-red)				
6-103		1	10 k Ω (brown-black-orange)				
6-223		1	22 k Ω (red-red-orange)				
6-104		5	100 k Ω (brown-black-yellow)				
6-154		1	150 k Ω (brown-green-yellow)				
6-474		1	470 k Ω (yellow-violet-yellow)				
6-105		2	1 M Ω (brown-black-green)				
6-335		1	3.3 M Ω (orange-orange-green)				
CAPACITORS							
20-77		2	24 pF mica				
20-105		1	180 pF mica				
21-140		1	.001 μ F disc				
21-27		6	.005 μ F disc				
21-31		11	.02 μ F disc				
1 26-122		1	2-section variable				
SOCKETS							
				434-112		2	7-pin socket
				434-129		1	7-pin socket (with ground clip)
				434-130		1	9-pin socket (with ground clip)
MISCELLANEOUS							
				85-131-6		1	RF driver circuit board
PARTS PICTORIAL							
							

STEP-BY-STEP ASSEMBLY

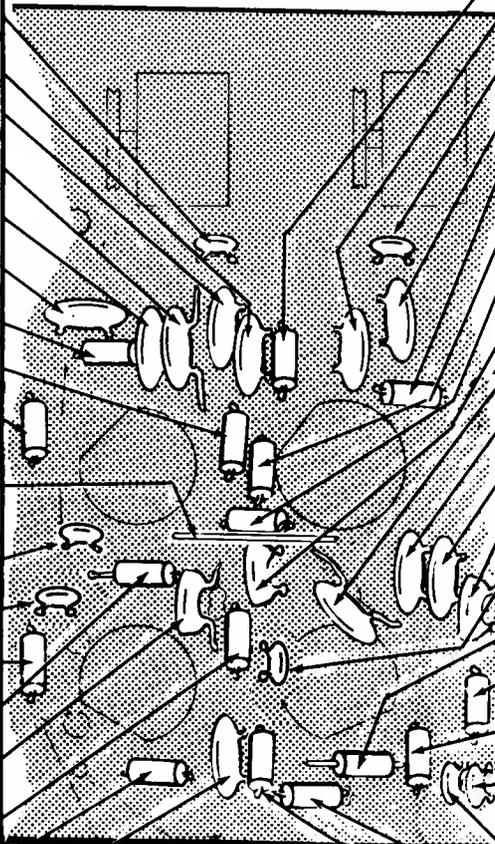
START



CONTINUE



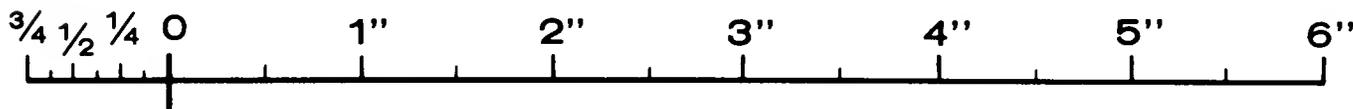
- Position the driver circuit board (#85-131-6) as shown.
- () .005 μ F disc.
- () .02 μ F disc.
- () 22 k Ω (red-red-orange).
- () 1 M Ω (brown-black-green).
- () 100 k Ω (brown-black-yellow).
- () 1-3/4" wire. Use black hookup wire with 1/4" of insulation removed from each end.
- () .001 μ F disc.
- () .005 μ F disc.
- () 330 Ω (orange-orange-brown).
- () 100 k Ω (brown-black-yellow).
- () 24 pF mica.
- () 10 k Ω (brown-black-orange).
- () 470 k Ω (yellow-violet-yellow).
- () .02 μ F disc.
- () Solder the leads to the foil and cut off the excess lead lengths.



- () 150 Ω (brown-green-brown).
- () .02 μ F disc.
- () .005 μ F disc.
- () .02 μ F disc.
- () 4700 Ω (yellow-violet-red).
- () 100 k Ω (brown-black-yellow).
- () 150 k Ω (brown-green-yellow).
- () 180 pF mica.
- () .02 μ F disc.
- () .02 μ F disc.
- () .02 μ F disc.
- () 24 pF mica.
- () .005 μ F disc.
- () 1 M Ω (brown-black-green).
- () 100 k Ω (brown-black-yellow).
- () 100 k Ω (brown-black-yellow).
- () .005 μ F disc.
- () .005 μ F disc.
- () 3.3 M Ω (orange-orange-green).
- () 220 Ω (red-red-brown).
- () Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 6-2

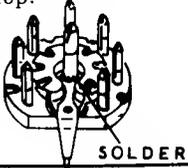
PICTORIAL 6-1



START



() Solder the center pin to the ground clip on the 7 and 9-pin tube sockets before mounting them on the circuit boards. Heat the center pin and allow the solder to flow onto the ground clip. NOTE: Use the sockets with ground clips only where they are specifically called for in a step.



NOTE: Solder the connections of each part as it is installed. Do not cut off the lugs of any of these parts after soldering.

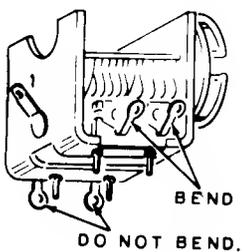
() Install a 7-pin tube socket with ground clip at V6.

() Install 7-pin tube sockets at V10 and V11.

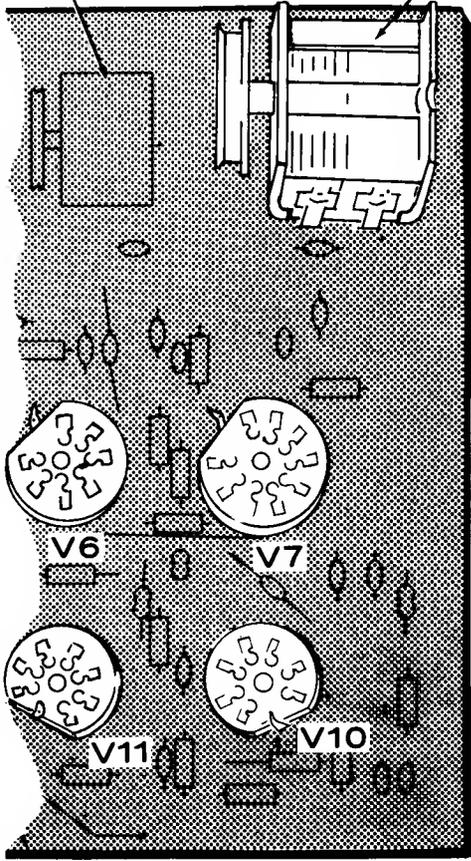
() Install a 9-pin tube socket with ground clip at V7.

CAUTION: Keep the plates of variable capacitors fully meshed at all times to prevent them from being damaged during the assembly of the kit.

() Locate a 2-section variable capacitor (#26-122). Bend both lugs, as shown, on the indicated side of the capacitor.



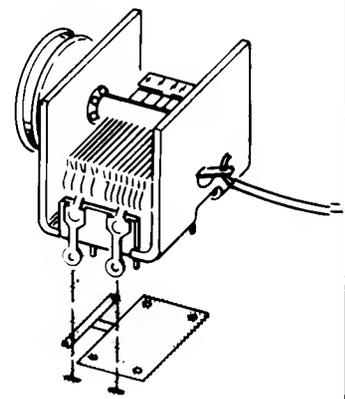
NOTE: This capacitor will be mounted later.



CONTINUE



() 2-section variable capacitor.



() Bend out the tip of the solder lug on the rear of the capacitor as shown above.

() Prepare a 2-3/4" large red wire by removing 1/4" of insulation from each end. Connect one end of this wire to the solder lug on the rear of the variable capacitor (S-1). The other end of this wire will be connected later.

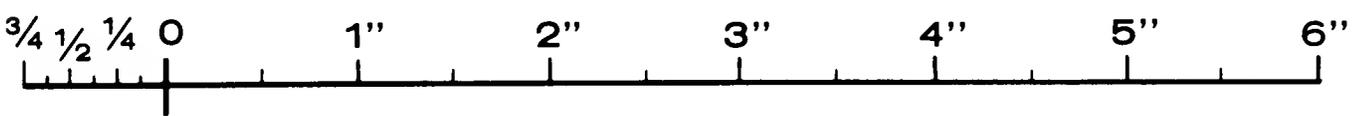
() Check to see that all connections are soldered before putting the board aside.

FINISH

The remaining items from the "Wire-Sleeving" and the "Miscellaneous groups" of "Parts List #1" should be retained for use later. All other parts in the preceding parts lists should have been used in the assembly of circuit boards.

PROCEED TO "VFO."

PICTORIAL 6-2



VFO

PARTS LIST #7

Open parts pack #7 and check each part against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from this Parts Pictorial. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART No.	PARTS No.	DESCRIPTION
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RESISTORS

1/2-Watt

6-470	2	47 Ω (yellow-violet-black)
6-101	1	100 Ω (brown-black-brown)
6-471	2	470 Ω (yellow-violet-brown)
6-102	1	1000 Ω (brown-black-red)
6-472	2	4700 Ω (yellow-violet-red)
6-103	1	10 k Ω (brown-black-orange)
6-474	1	470 k Ω (yellow-violet-yellow)

CAPACITORS

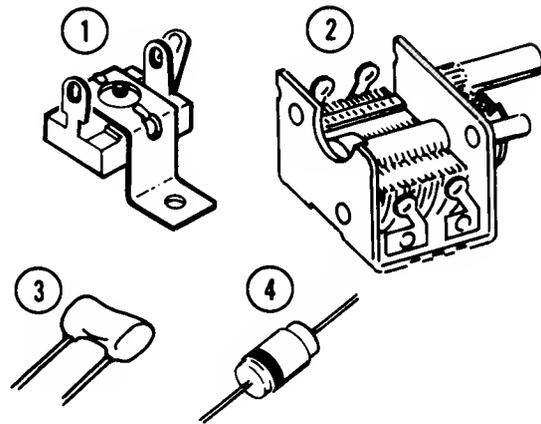
Disc

21-3	1	10 pF
21-147	1	47 pF
21-85	1	56 pF
21-144	1	4700 pF (.0047)
21-27	3	.005 μ F
21-31	2	.02 μ F

Other Capacitors

1	100-1759	1	1.7 to 24 pF mica trimmer (May be marked 31-92)
2	26-132	1	9-63 pF variable
	21-29	1	4.7 pF ceramic tubular (MMF)
3	21-41	1	14 pF ceramic tubular (brown-yellow-black-green)
4	29-4	1	1800 plastic tubular

PARTS PICTORIAL



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

HARDWARE**#3 Hardware**

5	250-49	5	3-48 x 1/4" screw
6	254-7	8	#3 lockwasher
7	252-1	5	3-48 nut

#4 Hardware

8	250-285	3	4-40 x 1/4" screw
9	250-273	2	4-40 x 3/8" screw
10	250-248	7	4-40 x 1/2" self-tapping screw
11	252-15	4	4-40 nut
12	253-59	3	Spring washer
13	253-80	2	#4 flat washer
14	254-9	4	#4 lockwasher

#6 Hardware

15	250-56	10	6-32 x 1/4" screw
16	250-89	3	6-32 x 3/8" screw
17	250-170	8	#6 x 1/4" sheet metal screw
19	251-1	4	#6 spade bolt
20	252-3	8	6-32 nut
21	254-1	16	#6 lockwasher
22	259-6	1	#6 small solder lug

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

MISCELLANEOUS

23	40-1076	1	VFO coil
24	52-103	1	Transformer
25	56-26	1	1N191 diode (brown white-brown)
26	75-87	3	Nylon feedthrough
27	100-1041	1	Jackson drive
28	200-590-1	1	VFO chassis
29	201-49	1	VFO chassis base
30	205-761	1	Drive mounting plate
31	205-762	1	VFO front plate
32	255-45	1	9/16" phenolic spacer
33	266-200	1	Plastic clutch
	350-12	1	Cement
34	352-13	1	Silicone grease
35	417-118	1	2N3393 transistor
36	417-169	1	MPF-105 field-effect transistor
37	431-62	3	3-lug terminal strip
38	434-34	1	7-pin socket
39	434-44	1	Pilot lamp socket
40	434-42	1	Phono socket
	489-1	1	Sandpaper

STEP-BY-STEP ASSEMBLY

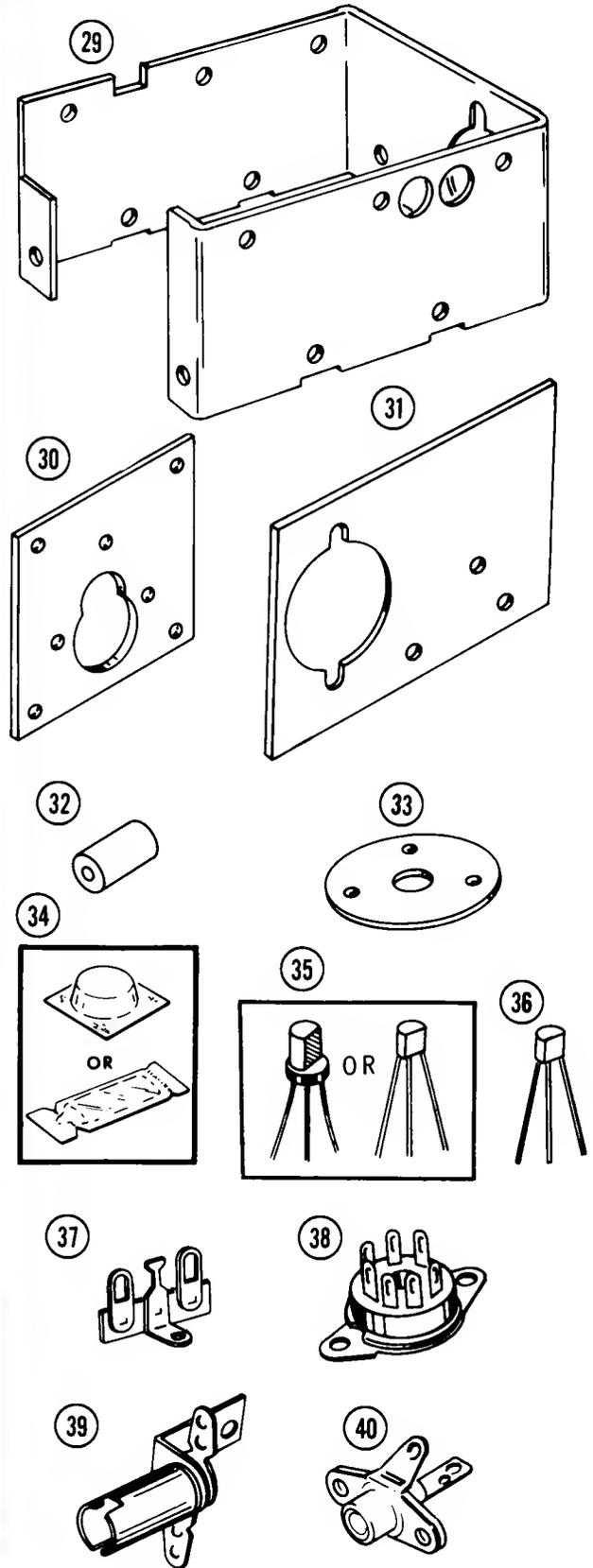
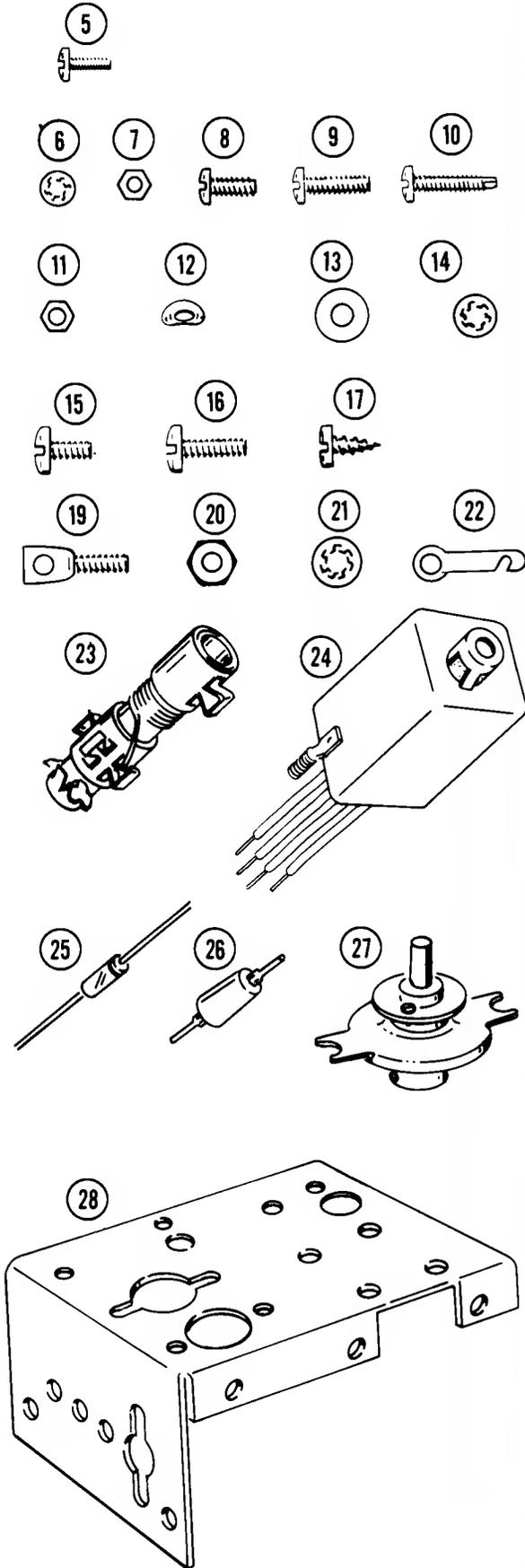
The illustrations in the "Step-by-Step Assembly" section of the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details are used in addition to the Pictorials to illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

As you mount a part, use the hardware specified in the step. Only the size and type of hardware to be used will usually

be called out in a step. For example, "Use 3-48 x 1/4" hardware" means to use a 3-48 x 1/4" screw, one or more #3 lockwashers, and a 3-48 nut. Refer to the Details associated with the step for the proper installation of the hardware and the correct number of lockwashers.

The plastic nut starter (#490-5) will help you pick up a nut and start it on the screw threads. Be sure to tighten the hardware after you mount a part.

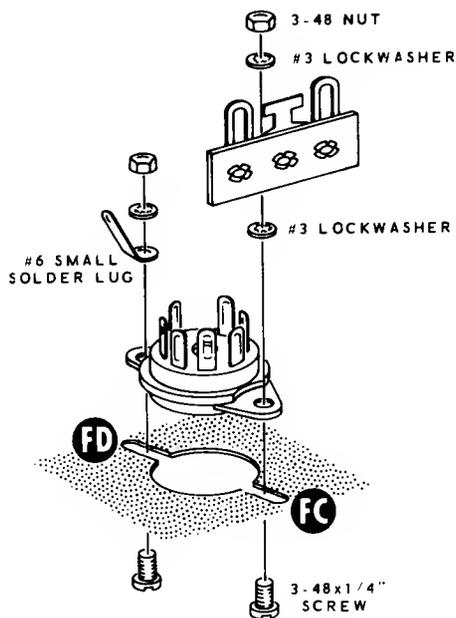
PARTS PICTORIAL



For VFO stability it is **IMPORTANT** that each part be positioned exactly as shown in the photograph on the fold-out from this page. Refer to this photograph when you install resistors and capacitors in the VFO.

Refer to Pictorial 7-1 for the following steps.

- () Refer to Detail 7-1A and mount a 7-pin socket at V20. Position the wide space between the lugs as shown by the arrow in the Pictorial. At FD, use a 3-48 x 1/4" screw, a #6 small solder lug shaped as shown, a #3 lockwasher and a 3-48 nut. At FC, use a 3-48 x 1/4" screw, two #3 lockwashers, a 3-lug terminal strip, and a 3-48 nut.

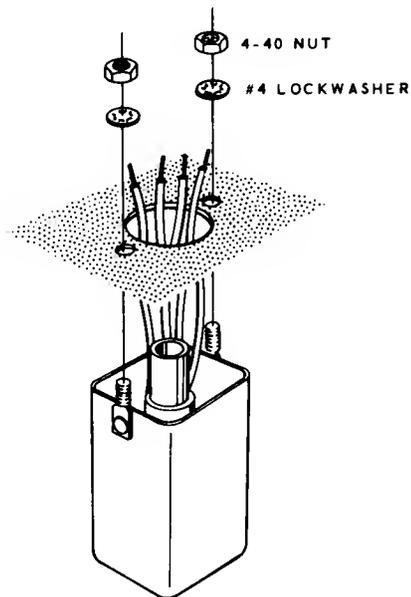


Detail 7-1A

- () Refer to Detail 7-1B and mount a 3-lug terminal strip at FF. Use a 3-48 x 1/4" screw, two #3 lockwashers, and a 3-48 nut.

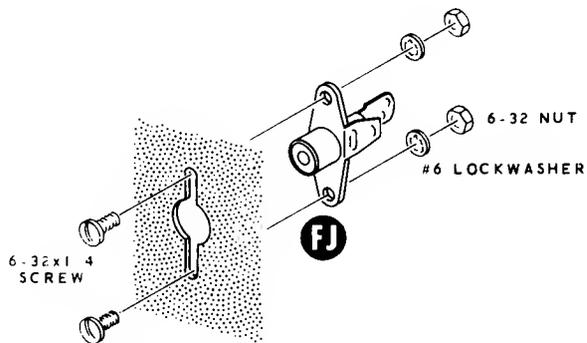


Detail 7-1B

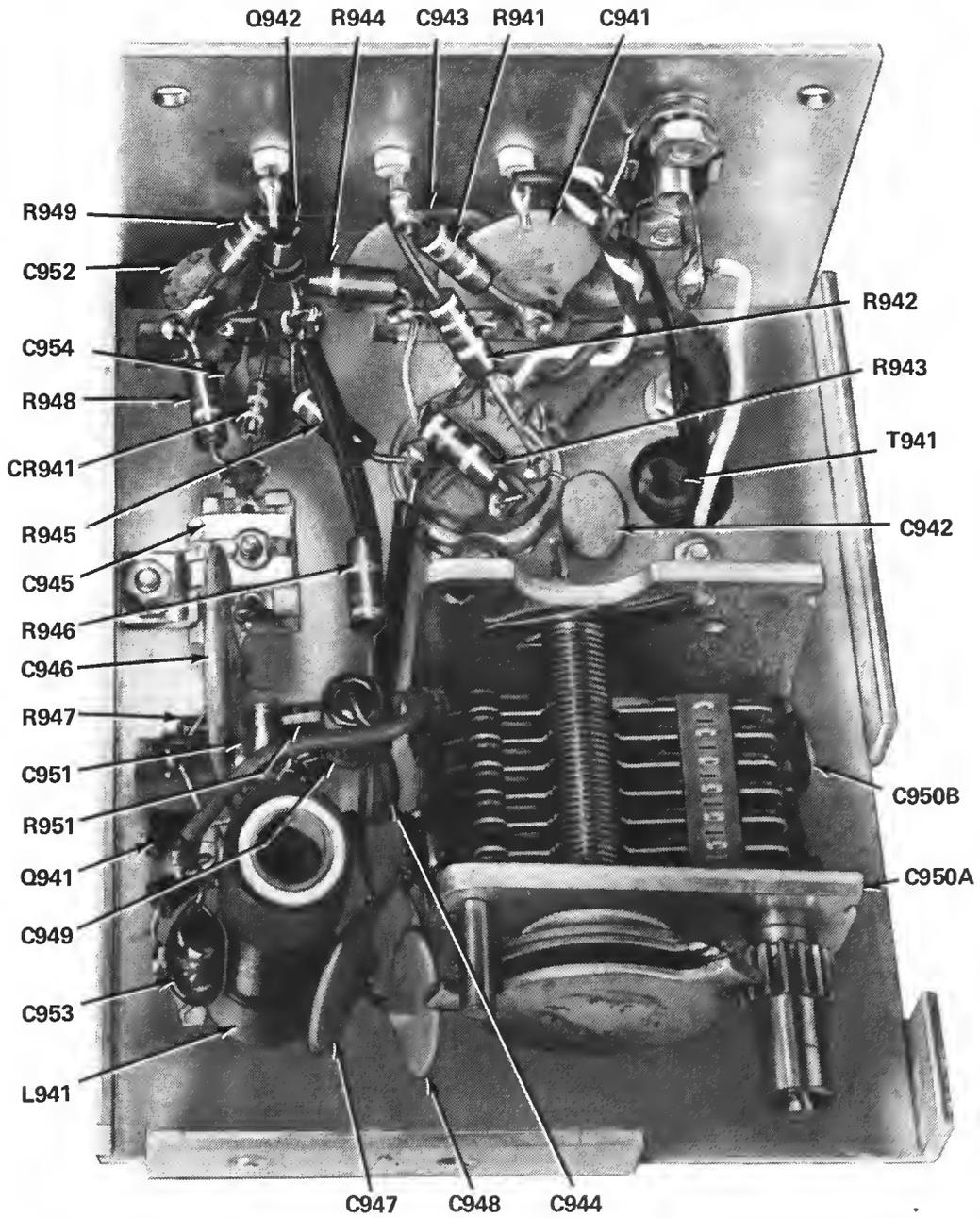


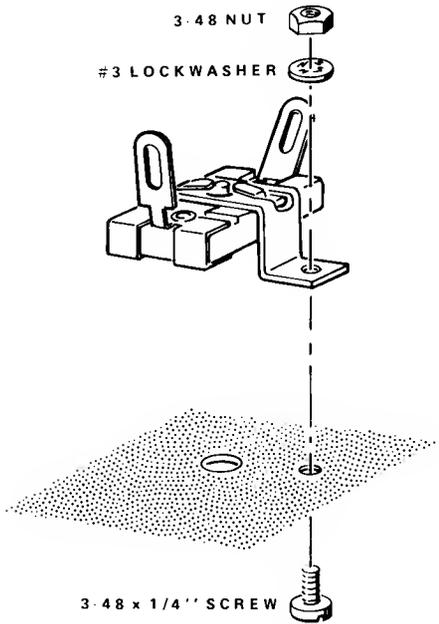
Detail 7-1C

- () Mount a 3-lug terminal strip at FH. Use a 3-48 x 1/4" screw, two #3 lockwashers, and a 3-48 nut.
- () Refer to Detail 7-1C and mount the transformer (#52-103) at FZ. Use a #4 lockwasher and a 4-40 nut at each mounting hole.
- () Refer to Detail 7-1D and mount a phono socket at FJ. Use a 6-32 x 1/4" screw, a #6 lockwasher, and a 6-32 nut at each mounting hole. Position the lugs of the socket as shown in the Pictorial.

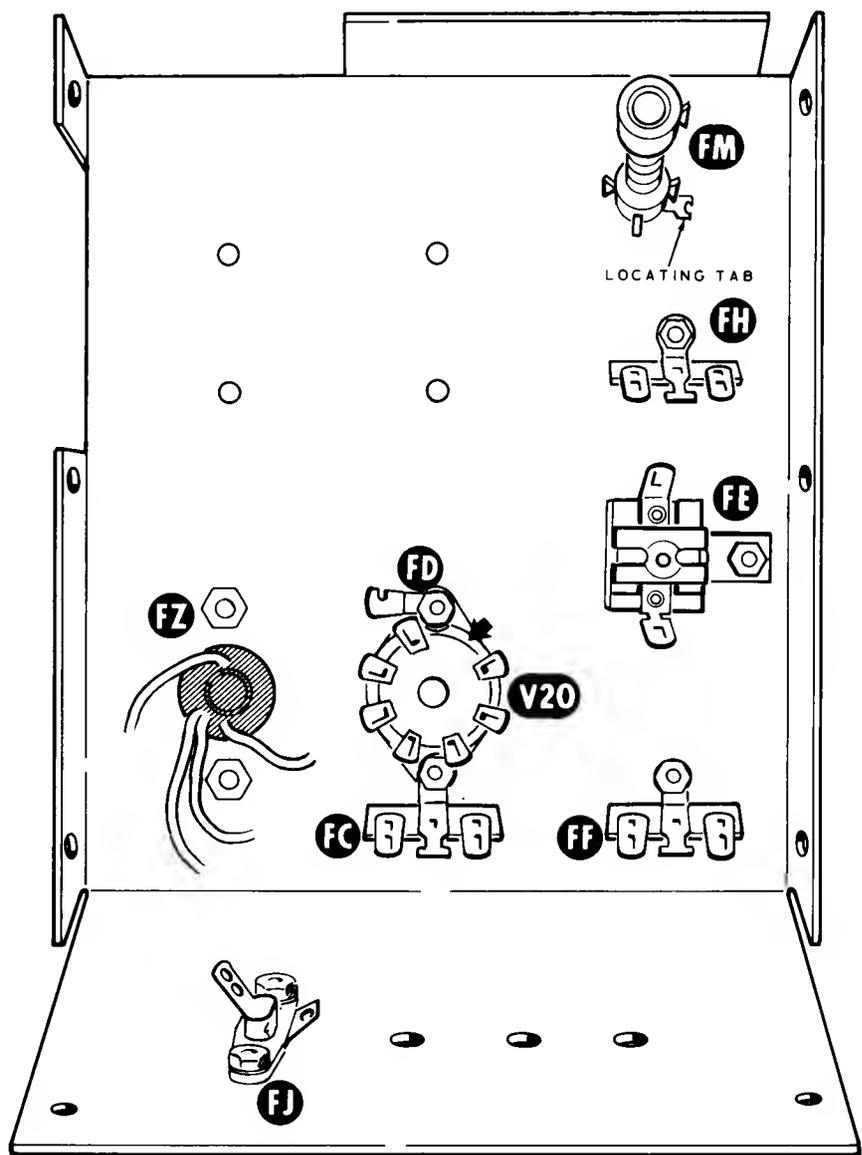


Detail 7-1D



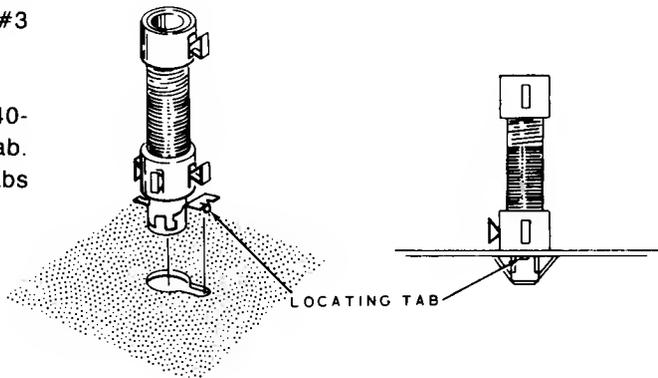


Detail 7-1E



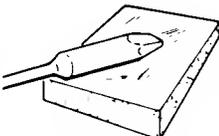
PICTORIAL 7-1

- () Refer to Detail 7-1E and mount a 1.7 to 24 mica trimmer at FE. Use a 3-48 x 1/4" screw, a #3 lockwasher, and a 3-48 nut.
- () Refer to Detail 7-1F and mount the VFO coil (#40-1076) at FM. Note the position of the locating tab. Push the coil into its hole until the mounting tabs snap into place.



Detail 7-1F

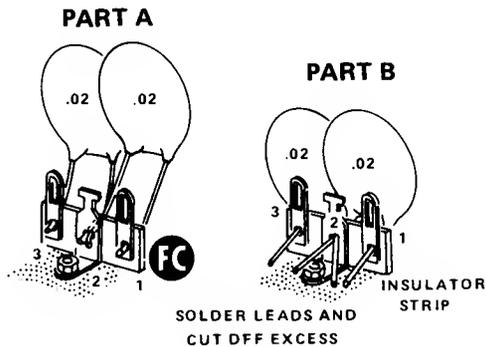
FOR GOOD SOLDER CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN... WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



Refer to Pictorial 7-2 (fold-out from Page 43) for the following steps.

Connect the wires from transformer FZ as follows:

- () Red to lug 1 of terminal strip FC (NS).
- () Blue to lug 5 of tube socket V20 (S-1).
- () Black to lug 2 of phono socket FJ (NS).
- () White to lug 1 of phono socket FJ (S-1).
- () Refer to Detail 7-2A and start the leads of two .02 μ F disc capacitors into the lower holes of a 3-lug terminal strip as shown in Part A. Before soldering, push the capacitors down, as shown in Part B, so the lower edges of the capacitors are even with the top edge of the insulator strip. Then solder the leads at lugs 1, 2, and 3 and cut off the excess leads.



Detail 7-2A

NOTE: When you connect capacitors into the VFO, shorten the leads as much as possible.

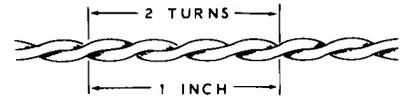
In the following steps, a disc capacitor and a resistor will be connected to lug 3 of terminal strip FF. Position these parts so they do not extend beyond the end of the terminal strip.

- () Connect a .005 μ F disc capacitor between lugs 2 (NS) and 3 (NS) of terminal strip FF.

- () Connect a .005 disc capacitor between lugs 1 (NS) and 2 (NS) of terminal strip FF.
- () Connect a .005 μ F disc capacitor from lug 6 of tube socket V20 (NS) to solder lug FD (S-1).
- () Connect one end of a 100 Ω (brown-black-brown) resistor to lug 3 of terminal strip FC (NS). Connect the other end of this resistor to lug 1 of terminal strip FF (NS).

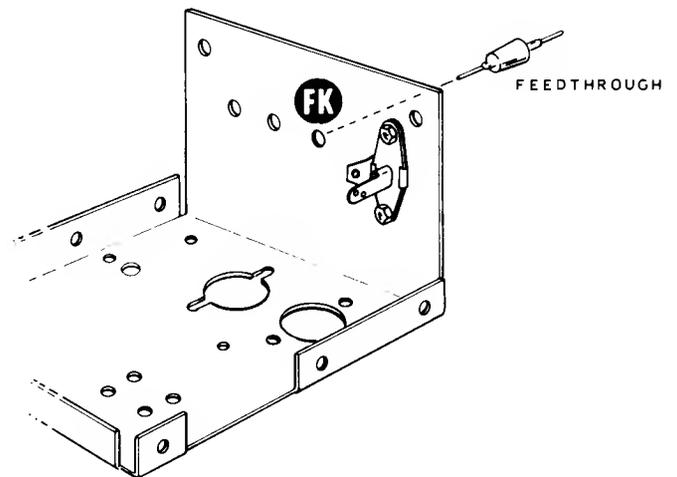
NOTE: To prepare a piece of hookup wire, cut it to the length specified and remove 1/4" of insulation from each end.

- () Prepare a 3" white hookup wire and a 3" brown hookup wire. Refer to Detail 7-2B and form a twisted pair from these two wires.

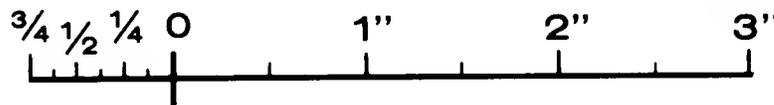


Detail 7-2B

- () At one end of this twisted pair, connect the white wire to lug 4 (S-1) and the brown wire to lug 3 (S-1) of tube socket V20.
- () Refer to Detail 7-2C and insert the smaller end of a nylon feedthrough in hole FK from the outside of the VFO chassis. Press it firmly into place.



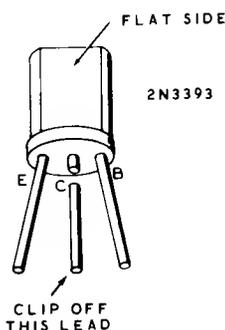
Detail 7-2C



- () At the free end of the twisted pair, connect the white wire to lug 2 of phono socket FJ (S-2) and connect the brown wire to feedthrough FK (S-1).
- () Insert a nylon feedthrough in hole FL.
- () Connect one lead of a 470 Ω (yellow-violet-brown) resistor to lug 1 of terminal strip FC (S-2). Connect the other lead to feedthrough FL (NS).

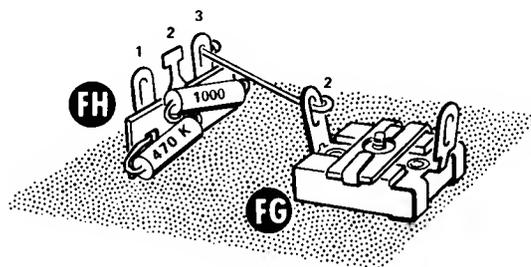
NOTE: Where a wire passes through a connection and then goes to another point, as in the next step, it will count as two wires in the solder instructions, one entering and one leaving the connection.

- () Pass one lead of a 47 Ω (yellow-violet-black) resistor through lug 2 of tube socket V20 (S-2) to lug 3 of terminal strip FC (S-2). Connect the other end of this resistor to lug 7 of tube socket V20 (S-1).
- () Connect one end of a 470 Ω (yellow-violet-brown) resistor to lug 6 of tube socket V20 (S-2). Connect the other end of this resistor to feedthrough FL (S-2).
- () Connect one end of a 4700 Ω (yellow-violet-red) resistor to lug 1 of tube socket V20 (NS). Connect the other end of this resistor to lug 1 of terminal strip FF (S-3). CAUTION: DO NOT fill the opening in the lug with solder, as two additional wires will be connected later.
- () Refer to Detail 7-2D and identify the leads of a 2N3393 transistor (#417-118). Clip off the C lead close to the body of the transistor.



Detail 7-2D

- () Connect the E lead of the transistor to lug 1 (NS) and the B lead to lug 2 (NS) of terminal strip FF.
- () Insert a nylon feedthrough in hole FN.
- () Connect one end of a 4700 Ω (yellow-violet-red) resistor to lug 3 of terminal strip FF (NS). Connect the other end of this resistor to feedthrough FN (S-1).
- () Connect one end of a 10 kΩ (brown-black-orange) resistor to lug 3 of terminal strip FF (S-3). Connect the other end of this resistor to lug 1 of trimmer capacitor FG (NS).
- () Connect the banded end of a 1N191 diode (#56-26) to lug 2 of terminal strip FF (NS). Connect the other end of this diode to lug 1 of trimmer capacitor FG (S-2). Be sure to position the banded end as shown.

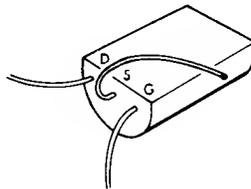


Detail 7-2E

Refer to Detail 7-2E for the next three steps. Save one of the cut-off resistor leads for use later.

- () Connect a 1000 Ω (brown-black-red) resistor from the lower hole of lug 2 (NS) to the lower hole of lug 3 (S-1) of terminal strip FH. Be careful that the lead at lug 3 does not extend beyond the end of the terminal strip.
- () Connect a 470 kΩ (yellow-violet-yellow) resistor from the lower hole of lug 1 (S-1) to the lower hole of lug 2 (S-2) of terminal strip FH.
- () Connect the cut-off resistor lead from lug 2 of trimmer FG (S-1) to lug 3 of terminal strip FH (NS).

- () Pass one lead of the 14 pF (brown-yellow-black-green) ceramic tubular capacitor through lug 2 (NS) to lug TP (NS) of coil FM. Connect the other lead to lug 3 of coil FM (NS). Position the body of the capacitor against the winding on the coil form.
- () Prepare a 1-3/4" length of black hookup wire.
- () Connect one end of this hookup wire to lug 3 of coil FM (S-2). The free end of this wire will be connected later.



Detail 7-2F

- () Refer to Detail 7-2F and identify the position of the D, S, and G leads of the MPF-105 transistor (#417-169). Form the leads as shown in the Detail.

CAUTION: When you solder the leads of the transistor to be installed in the following steps, prevent heat damage to the transistor by gripping each lead with a pair of long-nosed pliers between the transistor and the soldering point. This serves as a heat sink to dissipate excess heat which might cause damage. Keep the pliers on the lead for about 10 seconds after you remove the soldering iron. A rubber band can be placed around the handles of the pliers to hold them closed, thus leaving both hands free for soldering.

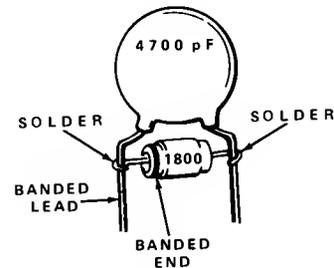
Position the #417-169 transistor as shown in the Pictorial. Be sure the body of the transistor does not touch anything else. Then connect the leads as follows:

- () G lead to lug 1 of terminal strip FH (NS).
- () D lead to lug 1 of coil FM (NS).
- () S lead to lug 3 of terminal strip FH (S-2).
- () Cut one lead of a 4.7 pF ceramic tubular capacitor to a length of 3/8". Connect this lead to lug 1 of terminal strip FH (S-2). The other lead will be connected later.

- () Place a 1" length of small black sleeving on each lead of a 10 pF disc capacitor. Connect one lead to lug 1 of coil FM (S-2). Connect the other lead to lug 1 of tube socket V20 (S-2).
- () Place a 1" length of small black sleeving on one lead of a 47 Ω (yellow-violet-black) resistor, and connect this lead to lug 1 of terminal strip FF (S-2). Three wires were previously soldered to this connection. Connect the other lead to lug TP of coil FM (NS).

Refer to Pictorial 7-3 for the following steps.

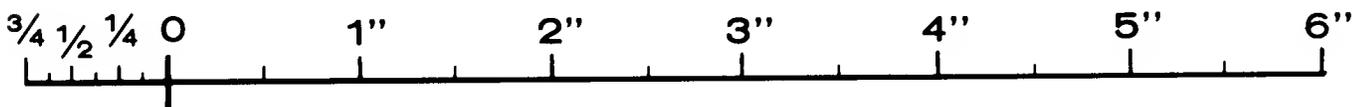
- () Refer to Detail 7-3A and assemble a 4700 pF (.0047) disc capacitor and an 1800 pF plastic tubular capacitor combination as shown (S-2). Cut off the excess leads of the tubular capacitor only. **NOTE:** Pictorial 7-3 shows the leads of this capacitor combination longer than they should be (for clarity). Observe that one end of the tubular capacitor is colored and the other end is unmarked.

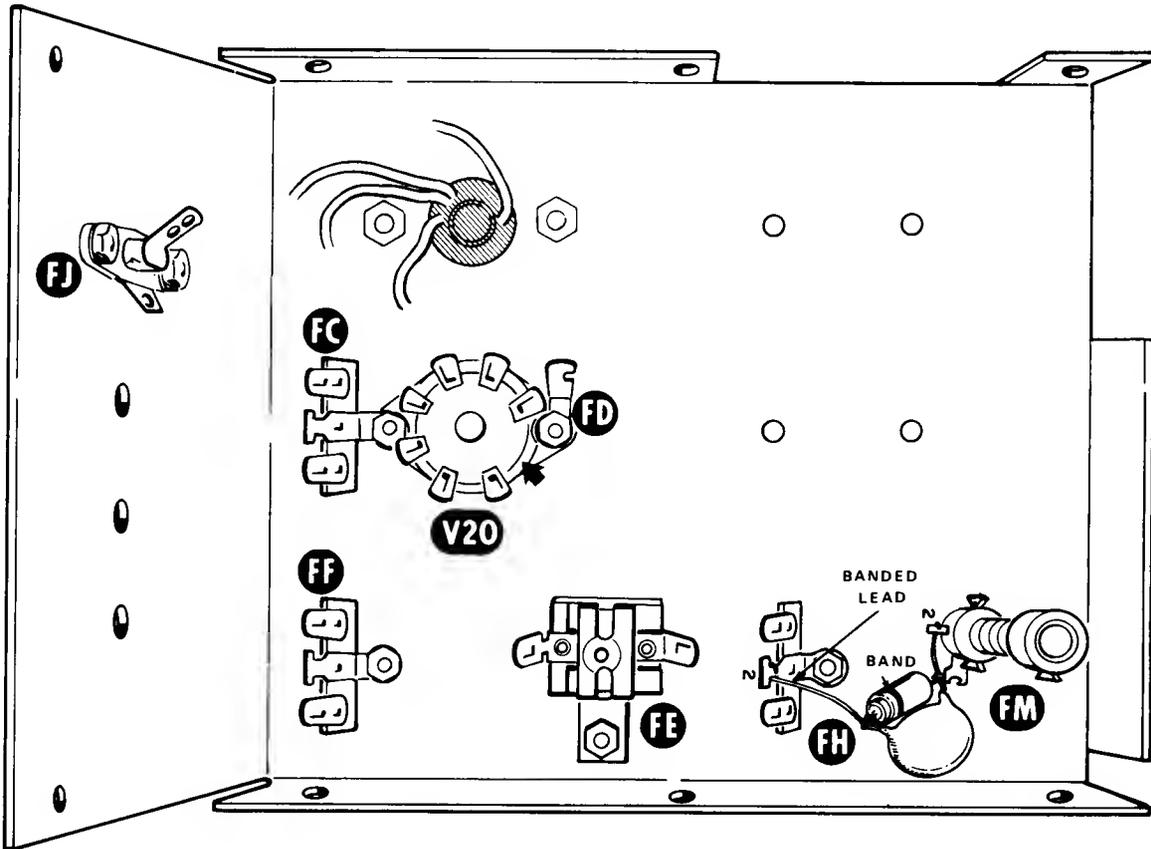


Detail 7-3A

NOTE: The capacitor combination will be installed in the following step. The Pictorial shows this combination positioned so you can see the connections. When the capacitors are installed, however, they must be placed in a vertical position with the tubular capacitor toward the chassis. Fit the capacitors into place before you solder or cut any leads.

- () Connect the banded lead of the capacitor assembly to lug 2 of terminal strip FH (S-1). Connect the other lead to lug 2 of coil FM (S-3). Make sure these capacitors do not touch the coil form.

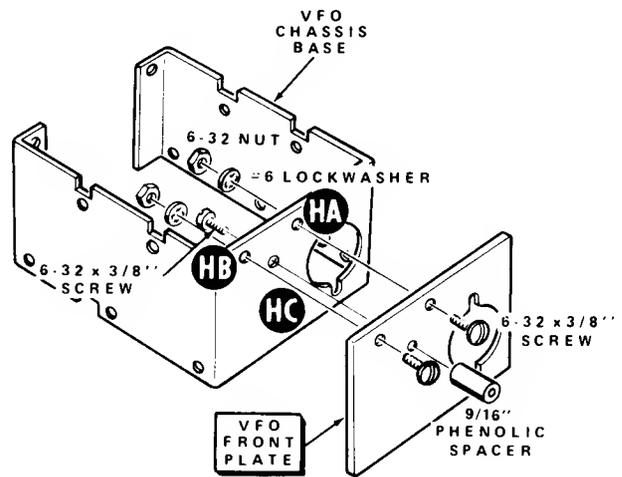




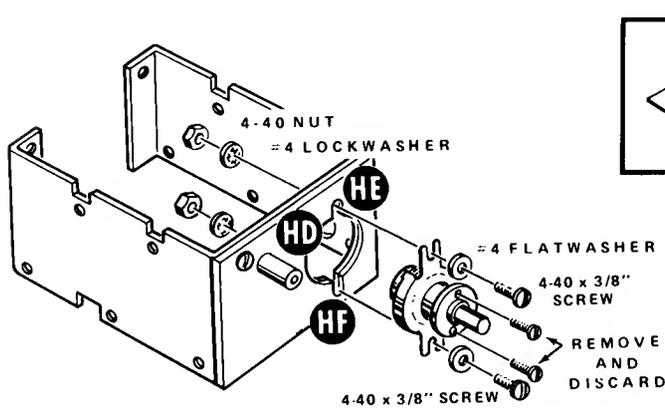
PICTORIAL 7-3

Refer to Pictorial 7-4 (fold-out from Page 43) for the following steps.

- () Cut the leads of a 56 pF and a 47 pF disc capacitor to a length of 1/2". Connect one lead of each capacitor to the TP lug of coil FM (S-4). The other leads will be connected later.
- () Refer to Detail 7-4A and mount the VFO front plate (#205-762) on the VFO chassis base. Use 6-32 x 3/8" hardware at HA and HB. Turn the screws only finger-tight at this time.
- () Refer to Detail 7-4A and mount a 9/16" phenolic spacer at HC on the VFO chassis base. Use a 6-32 x 3/8" screw. Turn the screw finger-tight only. This screw will fit only one end of the spacer.



Detail 7-4A



Detail 7-4B

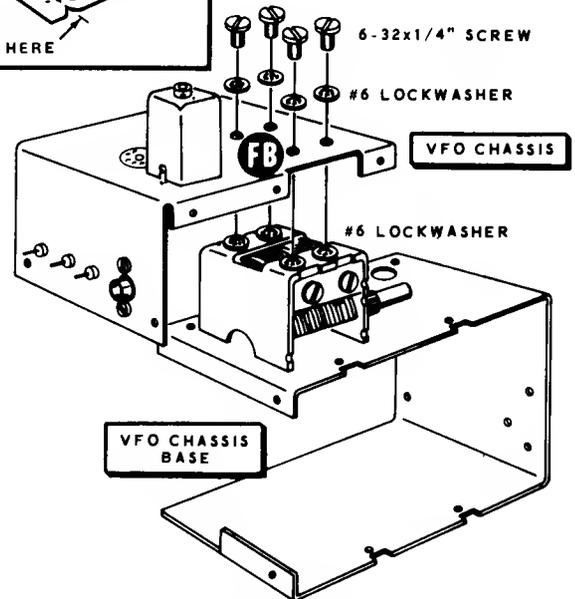
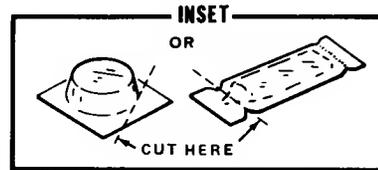
- () Refer to Detail 7-4B and install a Jackson drive (#100-1041) on the VFO chassis base at HD. Use 4-40 x 3/8" hardware in slots HE and HF. Turn the screws finger-tight only.
- () Refer to Detail 7-4B and remove and discard the two brass screws from the round collar of the Jackson drive. Use the sandpaper furnished to remove any burrs around the two holes.

NOTE: Observe the following precautions when mounting the VFO capacitor in the following steps.

1. Be sure to keep the plates of the variable capacitor fully meshed to avoid damage while handling it.
2. **DO NOT tighten the capacitor mounting screws until you are certain that all eight lockwashers are in place.**
3. Be very careful to use 6-32 x 1/4" screws only. A longer screw might contact the capacitor stator plates, damaging them, and possibly causing a short circuit.

Refer to inset drawing of Pictorial 7-4 for the following three steps:

- () Bend lugs 3 and 4 out away from the capacitor as shown in Part 1 of the Detail.
- () Bend lugs 1 and 2 outward to provide clearance for connections as shown in Part 2 of the Detail.
- () Cut off lugs 3 and 4 as close as possible to the insulating material.

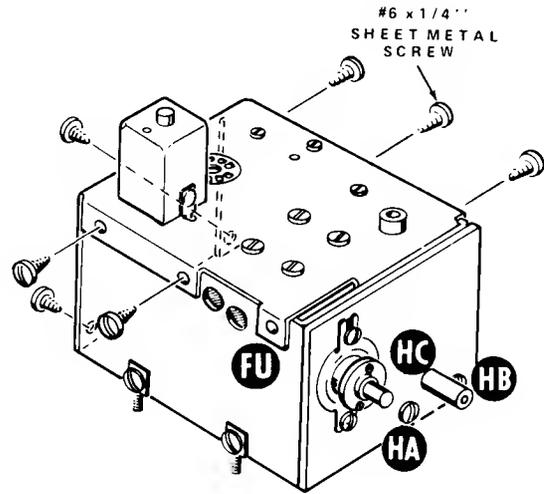


Detail 7-4C

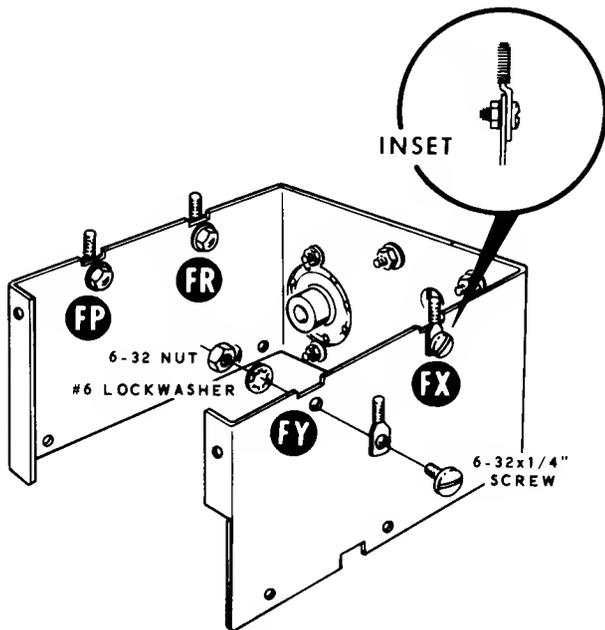
Refer to Detail 7-4C and mount the variable capacitor at FB on the VFO chassis as directed in the following steps.

- () Before permanently mounting the variable capacitor, temporarily mount it at FB with only two of the 6-32 x 1/4" screws. Then visually check to make sure nothing connected to lug TP of the coil FM touches the variable capacitor. If it does, move the component or lead as necessary. Then remove the two screws and the variable capacitor.
- () Place the capacitor on the VFO chassis base as shown.
- () Put a #6 lockwasher on each of four 6-32 x 1/4" screws and place the screws in a convenient position.
- () Center a #6 lockwasher carefully over each of the four mounting holes on the capacitor frame. A small amount of silicone grease around each hole will help to hold the lockwashers in position. Refer to the inset drawing of the Detail.
- () Hold the VFO chassis with its mounting holes aligned with those in the capacitor frame. Be careful not to disturb the lockwashers. Start one of the four 6-32 x 1/4" screws with lockwashers in each of the four capacitor holes. After all have been started, seat them finger-tight only.

- () Connect the 1-3/4" black hookup wire from lug 3 of coil FM to lug 1 of the variable capacitor (NS).
- () Connect the free lead of the 4.7 pF ceramic tubular capacitor to lug 1 of the variable capacitor (S-2).
- () Connect the free leads of the 56 pF and 47 pF disc capacitors to lug 2 of the variable capacitor (S-2). Spread these capacitors as far apart as possible without touching any other component.
- () Refer to Detail 7-4D and mount #6 spade bolts at FP, FR, FX, and FY. Use 6-32 x 1/4" hardware.
- () Carefully inspect the interior of the VFO to make sure all joints are soldered and that there are no short circuits to the chassis. Shake out any wire clippings or bits of solder.

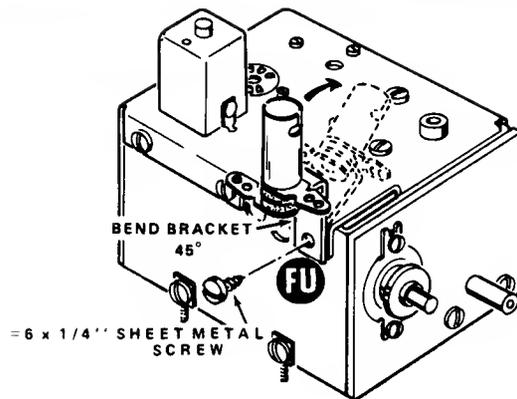


Detail 7-4E



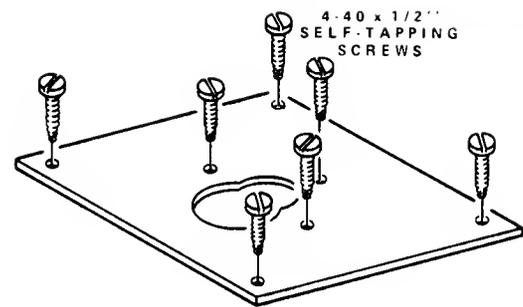
Detail 7-4D

- () Refer to Detail 7-4E and assemble the VFO chassis base to the VFO chassis. Place the variable capacitor shaft into the recess in the Jackson drive. Note that the chassis base is notched out to clear components at terminal strip FF. Use #6 x 1/4" sheet metal screws at the seven holes shown. Leave hole FU open. Make sure the wires from FZ are not pinched.
- () Tighten the hardware in the following sequence:
 1. Four variable capacitor mounting screws.
 2. Two Jackson drive mounting screws.
 3. Loosen the four capacitor mounting screws.
 4. Spacer screw at hole HC.
 5. Screws at holes HA and HB.
 6. Setscrews in the Jackson drive hub.
 7. Tighten the four capacitor mounting screws.



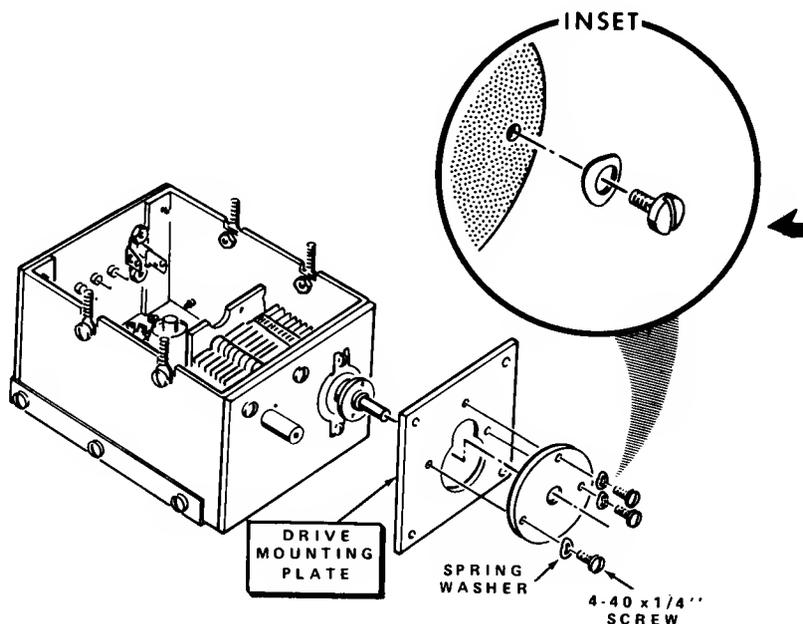
Detail 7-4F

- () Refer to Detail 7-4F and mount a pilot lamp socket at FU. Use a #6 x 1/4" sheet metal screw.
- () Bend the socket mounting bracket to an angle of approximately 45 degrees.
- () Check to make sure that one of the sheet metal screws does not touch lug 3 of terminal strip FF. If necessary, loosen the terminal strip mounting screw and turn the terminal strip slightly.



Detail 7-4G

- () Refer to Detail 7-4G and insert seven 4-40 x 1/2" self-tapping screws in the drive mounting plate (#205-761). Insert the screws until about one-third of their length emerges on the back side of the plate.
- () Remove the seven screws. Four of these screws will be used later in "Chassis Assembly" section. Discard the other three screws.



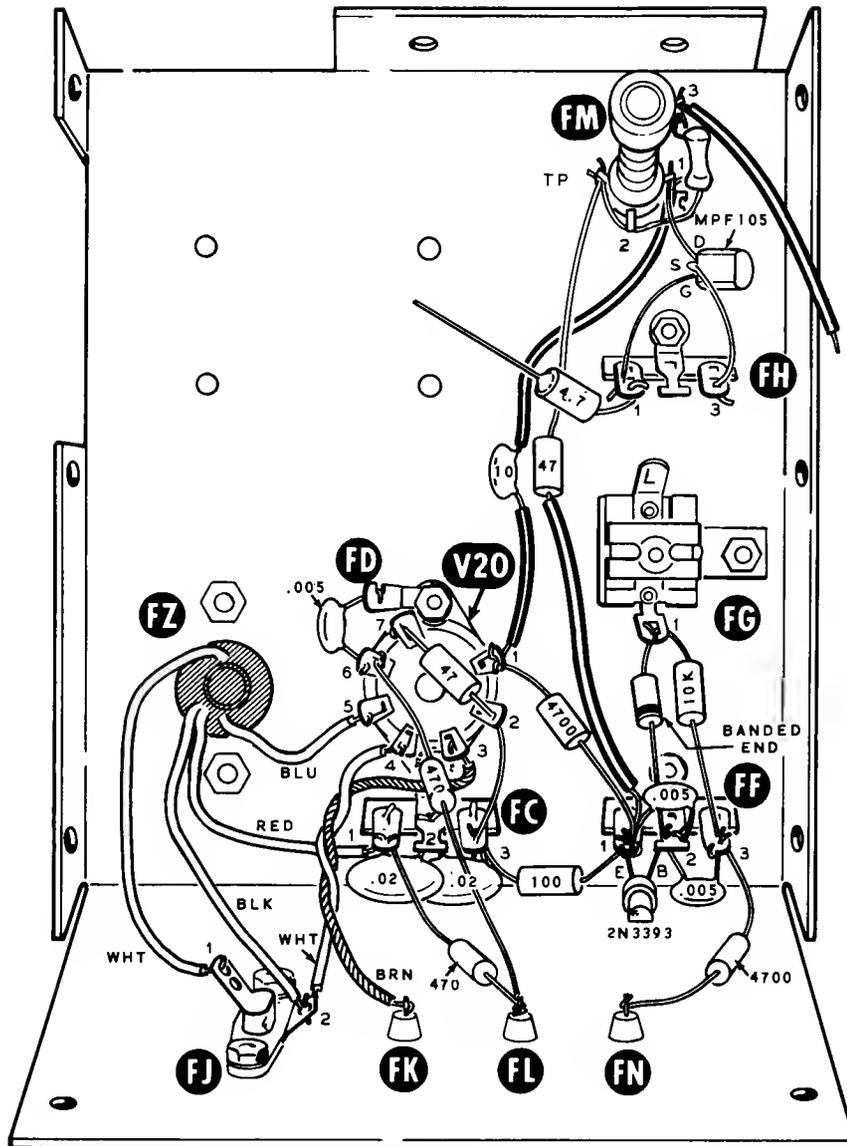
Detail 7-4H

Refer to Detail 7-4H for the next two steps.

- () Place the larger portion of the opening in the drive mounting plate over the collar of the Jackson drive and slide the plate down behind the collar.
- () Place the plastic clutch (#266-200) on the Jackson drive shaft and secure it to the drive mounting plate with three 4-40 x 1/4" screws and three #4 spring washers. Do not tighten these screws. Note the inset drawing for the position of the washers.

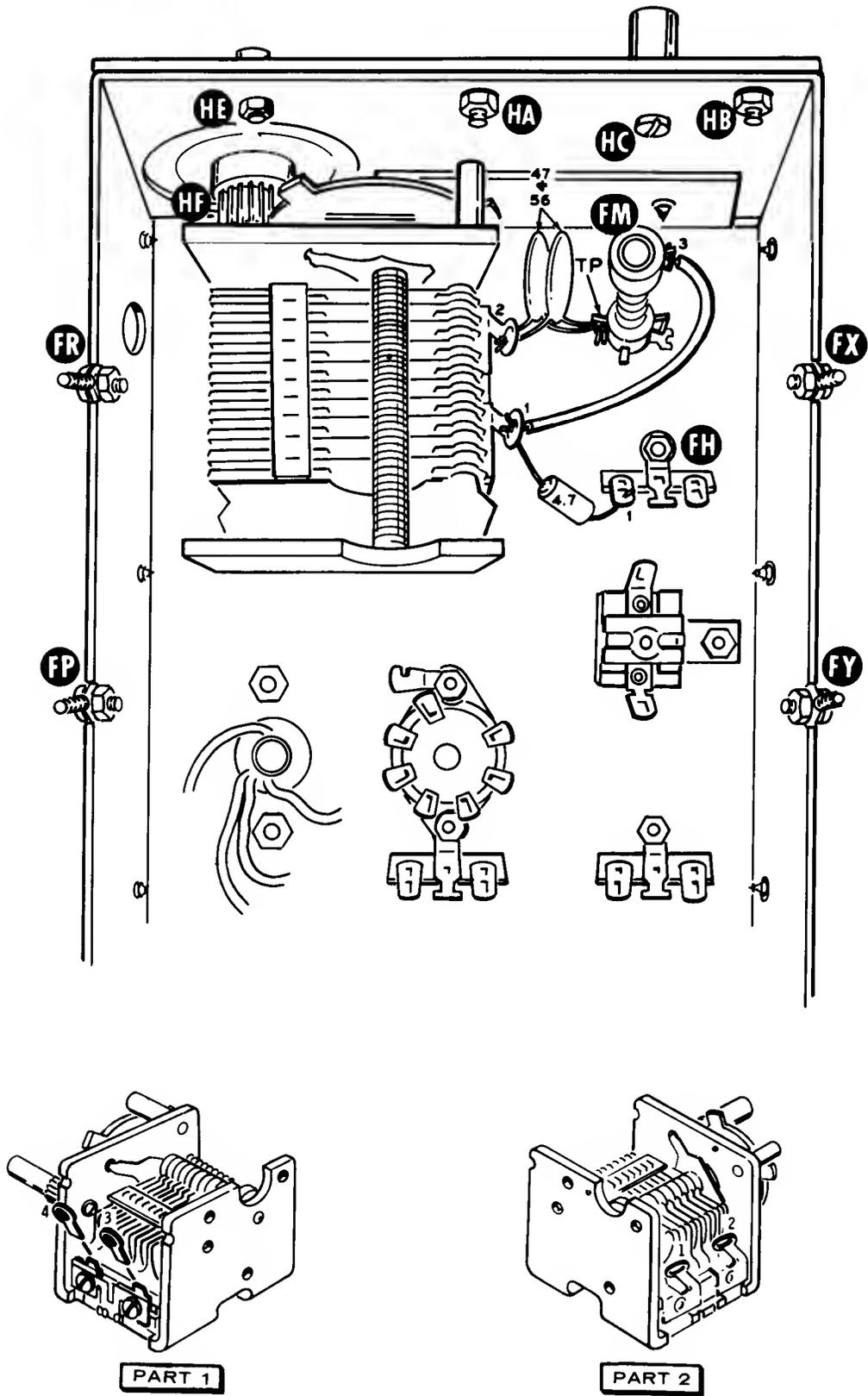
- () Adjust each of the three 4-40 screws until its end is flush with the inner surface of the drive mounting plate. Then turn each screw one turn counterclockwise. The white clutch disc should then be parallel with the drive mounting plate, which, when turned by hand, should be quite stiff.
- () Refer to the fold-out from Page 34 and tip C946 so that it touches the side of the VFO chassis. Then use the cement provided to secure the capacitor to the chassis side.
- () Place the VFO to one side. It will be mounted later.

NOTE: Retain items such as wire, sleeving, silicone grease, etc., for use later.



PICTORIAL 7-2





PICTORIAL 7-4

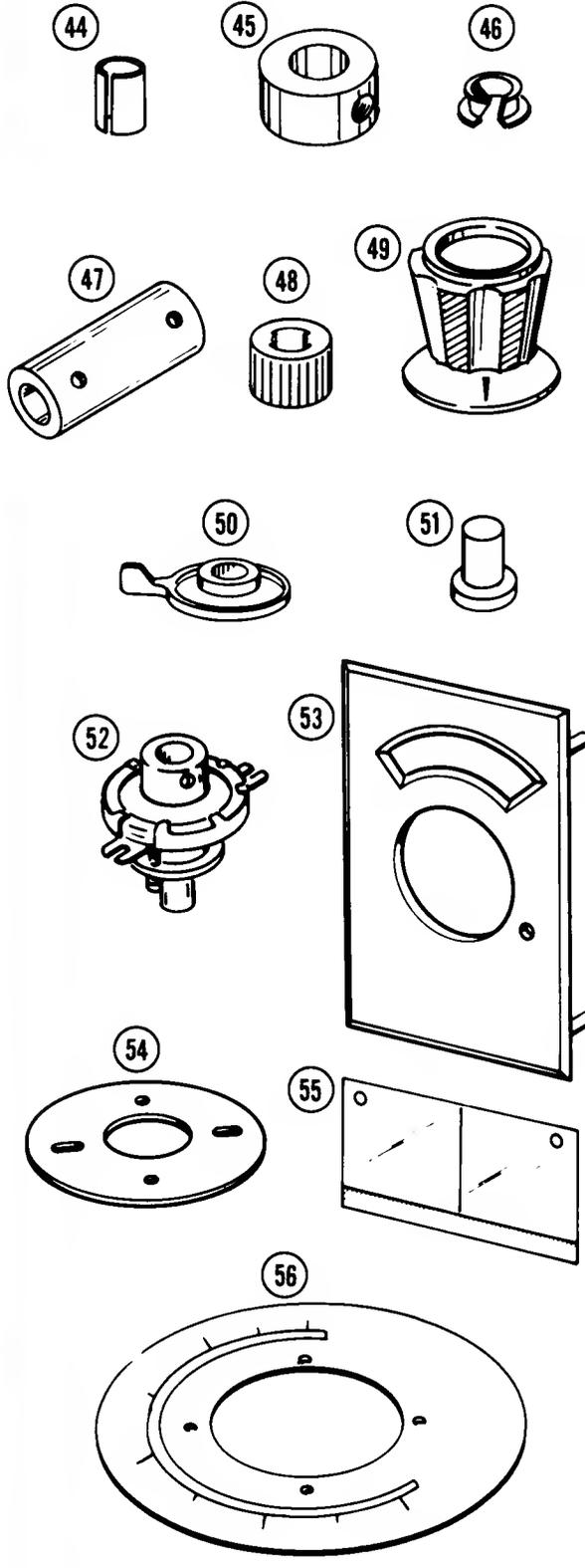
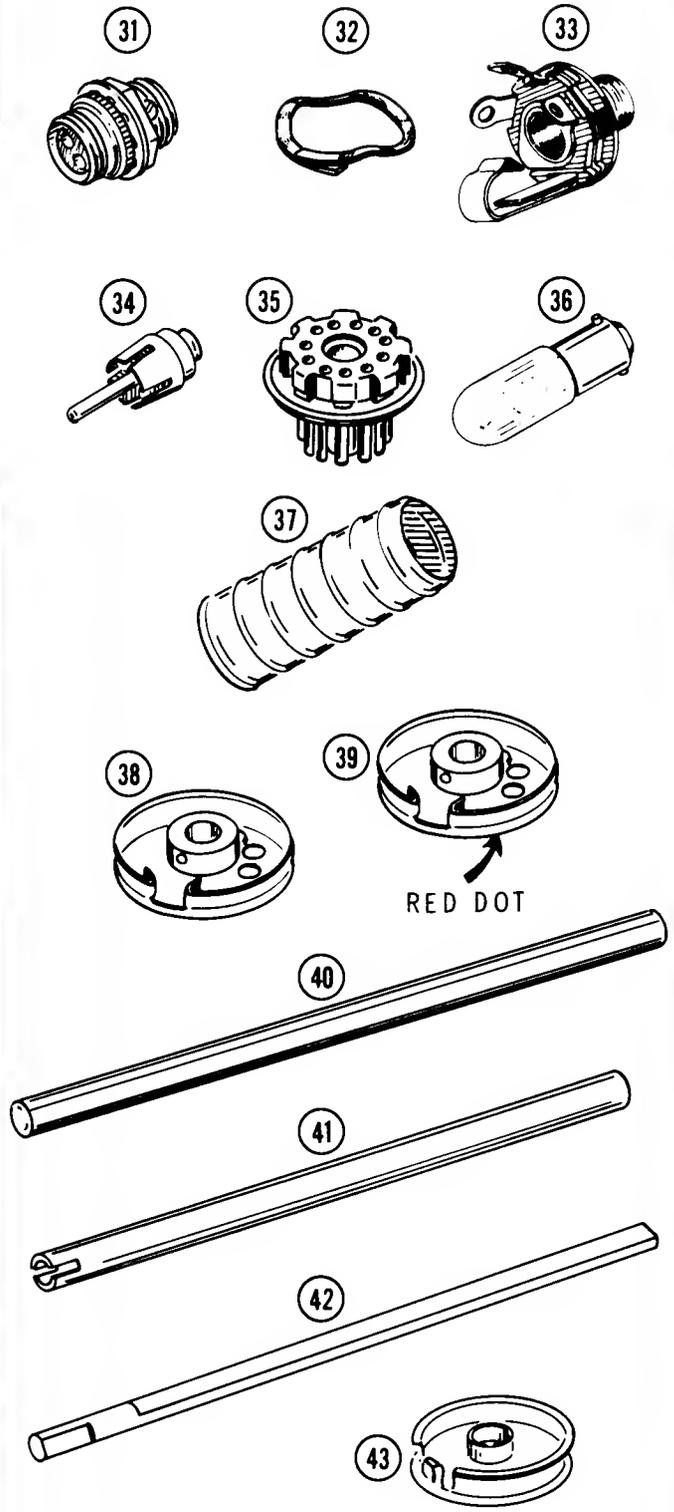
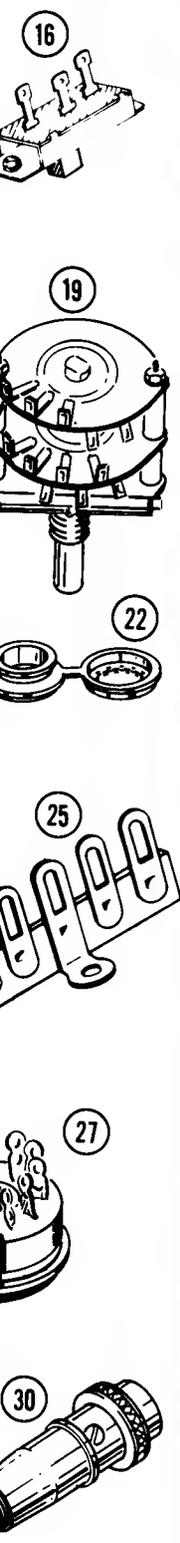
CHASSIS

PARTS LIST #8

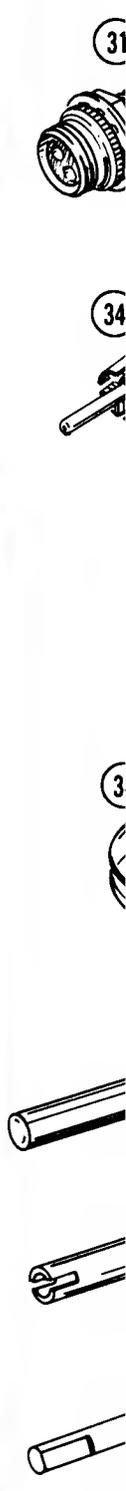
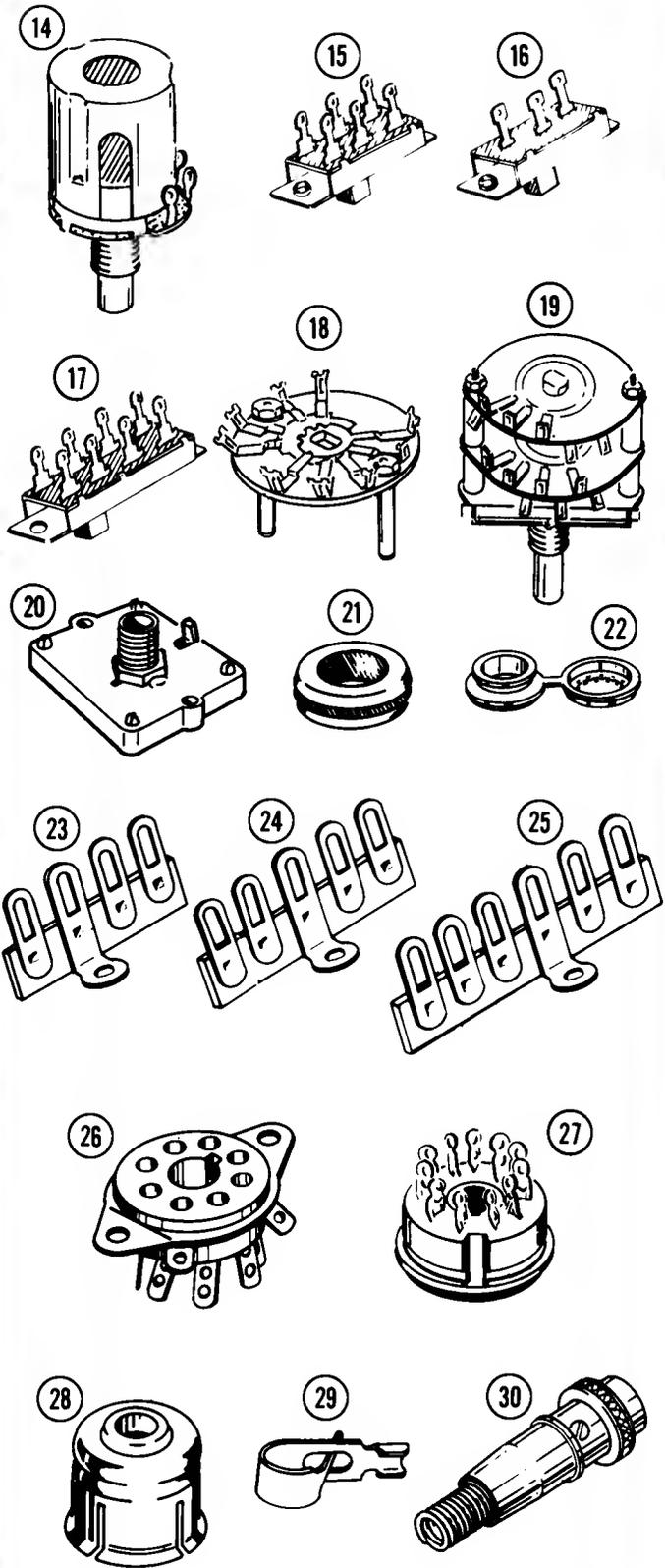
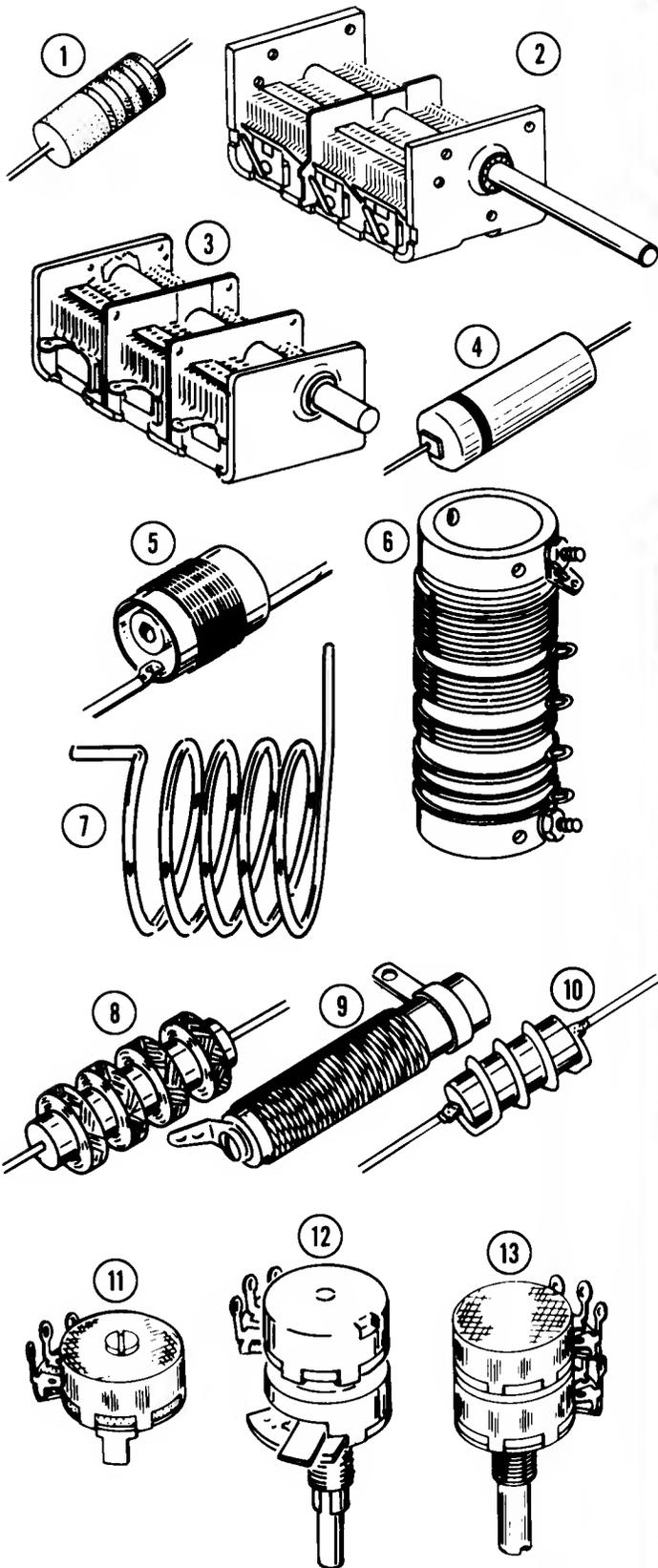
Check each of the remaining parts against the following parts list. The key numbers correspond to the numbers in the Parts Pictorial. Parts that have been illustrated previously have been omitted from this Parts Pictorial. Replace parts in the small envelopes with a part number on them until those parts are called for in steps. For pricing information, refer to the separate "Heath Parts Price List."

KEY PART No.	KEY PART No.	PARTS Per Kit	DESCRIPTION	KEY PART No.	KEY PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS				Mica (cont'd.)			
1/2-Watt				20-102		1	100 pF
6-470		1	47 Ω (yellow-violet-black)	20-105		3	180 pF
6-101		4	100 Ω (brown-black-brown)	Disc			
6-331		2	330 Ω (orange-orange-brown)	21-33		1	3.3 pF
6-471		2	470 Ω (yellow-violet-brown)	21-13		1	500 pF
6-202		1	2000 Ω (red-black-red)	21-140		4	.001 μ F
6-472		1	4700 Ω (yellow-violet-red)	21-27		15	.005 μ F
6-103		2	10 k Ω (brown-black-orange)	21-44		2	.005 μ F, 1.6 kV
6-223		2	22 k Ω (red-red-orange)	21-16		1	.01 μ F
6-473		1	47 k Ω (yellow-violet-orange)	21-31		4	.02 μ F
6-104		1	100 k Ω (brown-black-yellow)	Variable			
6-154		1	150 k Ω (brown-green-yellow)	2 26-92		1	3-section
6-224		1	220 k Ω (red-red-yellow)	26-122		1	2-section
6-105		2	1 M Ω (brown-black-green)	3 26-116		1	3-section, wide spaced
6-225		1	2.2 M Ω (red-red-green)				
6-335		1	3.3 M Ω (orange-orange-green)				
2-Watt							
1	3-5-2	1	2.2 Ω (red-red-gold)				
CAPACITORS				Other Capacitors			
Mica				4 23-59		1	.05 μ F tubular
	20-130	2	12 pF	25-147		1	10 μ F electrolytic
	20-77	2	24 pF	27-34		2	.2 μ F Mylar
				31-48		1	3-30 pF mica trimmer

PARTS PICTORIAL



PARTS PICTORIAL



KEY PART			KEY PART		
No.	No.	PARTS Per Kit	No.	No.	PARTS Per Kit
COILS-CHOKES			SOCKETS		
5	40-546	1	26	434-39	2
6	40-548	1		434-42	4
7	40-549	1		434-44	1
8	45-30	1	27	434-118	1
9	45-41	1	28	440-1	1
10	45-53	2			

CONTROLS

11	10-57	2	10 k Ω , tab-mount
	10-127	2	1 M Ω , tab-mount
	10-115	1	7.5 M Ω , tab-mount
12	10-208	1	100 k Ω with switch arm
13	12-48	1	Dual-10 k Ω and 1 M Ω
14	19-67	1	1 M Ω , with switch

DIODES

	57-27	5	1N2071
	56-26	1	1N191 (brown-white-brown)
	56-56	1	1N4149

SWITCHES

15	60-2	1	DPDT slide
16	60-4	1	SPDT slide
17	60-22	2	DPTT slide
18	63-395	1	Rotary wafer (blue dot)
19	63-399	1	Rotary, 4 position, 2 section
20	266-1116	2	Rotary switch detent.

INSULATORS

21	73-3	4	1/2" rubber grommet
22	73-46	7	5/16" plastic grommet

TERMINAL STRIPS

	431-62	3	3-lug (miniature)
23	431-12	2	4-lug
24	431-11	1	5-lug
25	431-45	1	6-lug

PLUGS-JACKS-CONNECTORS

29	260-39	2	Anode clip
30	432-38	1	Microphone cable connector
31	432-39	1	Microphone chassis connector
32	435-1	1	Mounting ring for #438-29
33	436-4	2	3-lug jack
34	438-4	5	Phono plug
35	438-29	1	11-pin plug

TUBES-PILOT LAMPS

NOTE: Some tubes that you receive may have the suffix A or B, etc., following the type number. Example: 6AU6A instead of 6AU6.

	411-11	4	6AU6
	411-24	2	12AT7
	411-25	1	12AU7
	411-59	1	OA2
	411-63	1	6CL6
	411-67	1	6CB6
	411-75	2	6146
	411-124	4	6EA8
	411-128	1	6BN8
	411-173	1	6GW8
	411-247	2	6HS6
36	412-1	2	#47 pilot lamp

TUBE SHIELDS

37	206-68	1	9-pin, 1-3/4"
	206-206	1	9-pin, 2"
	206-77	1	7-pin

KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION
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SHAFTS-PULLEYS

38	100-19	1	1-1/4" pulley, small hole
39	100-458	1	1-1/4" pulley, large hole (red dot)
40	453-17	1	9" shaft
	453-125	1	9-3/8" shaft
41	453-146	1	8-1/4" tubular shaft
42	453-147	1	11-1/4" flatted shaft
43	466-6	2	3/4" pulley

BUSHINGS-COUPPLINGS

44	455-11	3	Split bushing
45	455-15	2	Shaft collar
46	455-44	1	Nylon bushing
47	456-4	1	Shaft coupling

KNOBS-KNOB INSERT

48	455-52	2	Knob insert
49	462-191	7	Small knob
50	462-218	2	Lever knob
51	462-265	1	Pushbutton
	462-327	1	Large knob

DIAL PARTS

52	100-1041	1	Jackson drive
53	203-744	1	Escutcheon
54	205-756	1	Dial drive plate
55	446-688-1	1	Dial window
56	464-29-10	1	Circular dial

KEY PART No.	PARTS No.	PARTS Per Kit	DESCRIPTION
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METAL PARTS

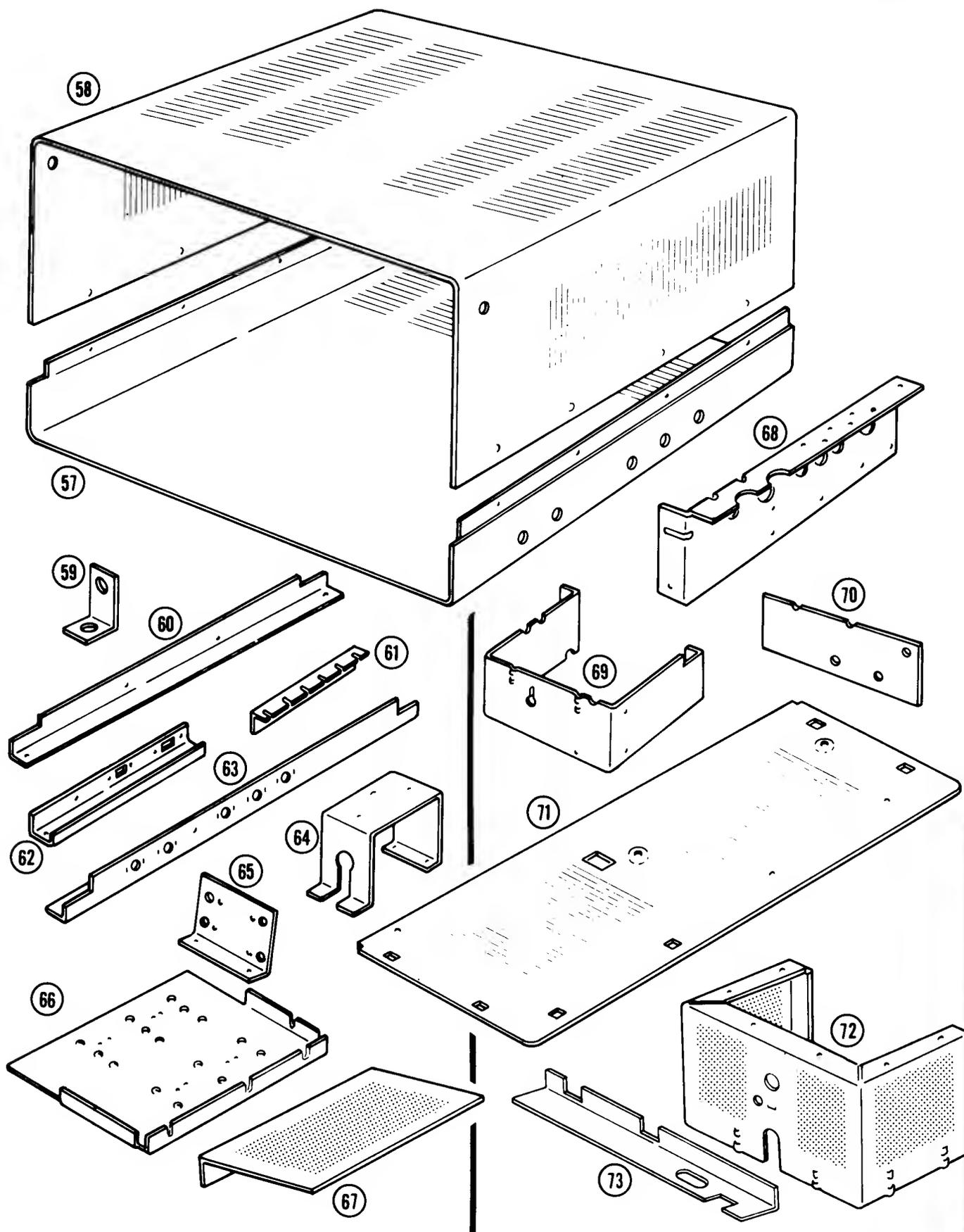
57	90-362-2	1	Cabinet bottom
58	90-363-2	1	Cabinet top
	203-743-1	1	Front panel
	200-593-1	1	Chassis
59	204-102	1	L bracket
60	204-560	1	Support rail
61	204-2096	2	Comb bracket
62	204-738	1	Support bracket
63	204-2256-1	1	Control bracket
64	204-793	1	Capacitor mounting bracket
65	204-737	1	Filter mounting bracket
66	205-493-1	1	Coil cover
67	205-562	1	RF cage top plate
68	206-280	1	Center shield
69	206-281	1	Final switch shield
70	206-519	2	Switch shield
71	206-351-1	1	Rear panel
72	206-352-1	1	RF cage
73	266-97	1	Switch slider

HARDWARE**#3 Hardware**

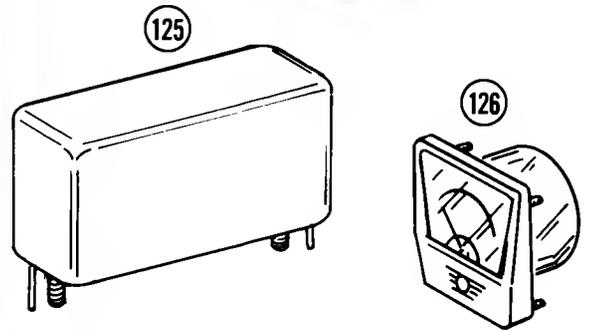
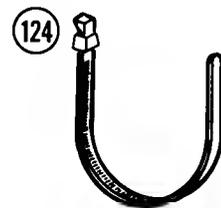
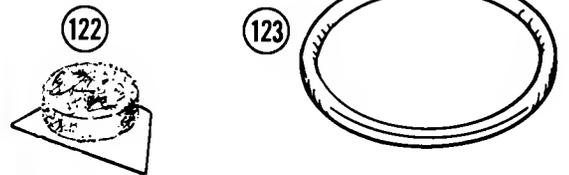
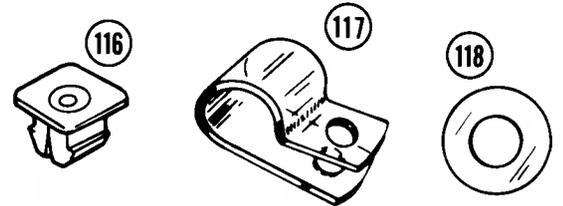
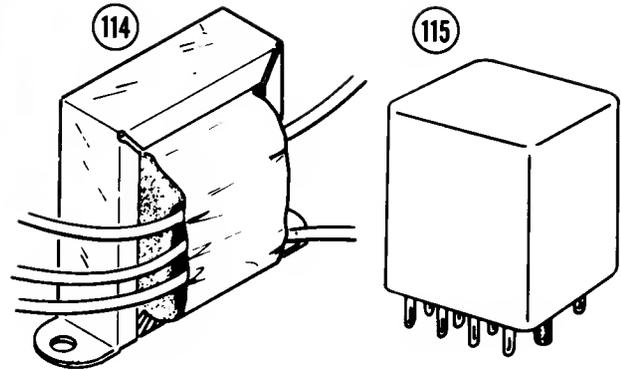
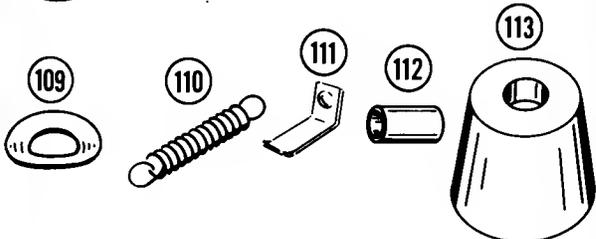
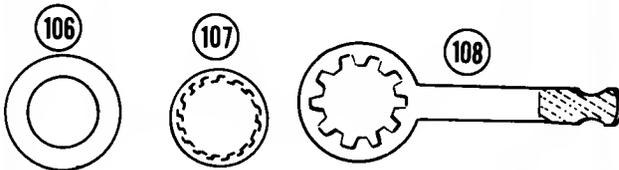
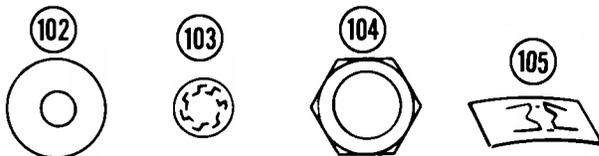
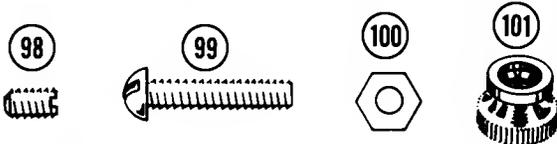
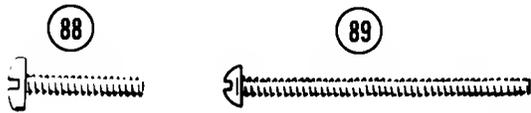
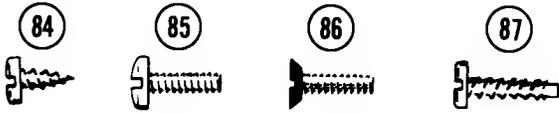
74	250-49	5	3-48 x 1/4" screw
75	250-172	87	3-48 x 3/8" screw
77	252-1	94	3-48 nut (3 extra)
78	254-7	174	#3 lockwasher (3 extra)

KEY PART			DESCRIPTION			KEY PART			DESCRIPTION		
No.	No.	Per Kit				No.	No.	Per Kit			
#4 Hardware						OTHER HARDWARE					
79	250-273	2	4-40 x 3/8" screw			104	252-7	8	Control nut		
80	252-15	4	4-40 x 3/16" nut			105	252-10	4	Speednut		
81	254-9	6	#4 lockwasher			106	253-10	9	Control washer		
#6 Hardware						107	254-5	3	Control lockwasher		
82	250-8	14	#6 x 3/8" sheet metal screw			108	259-10	3	Control solder lug		
83	250-56	12	6-32 x 1/4" screw			109	253-36	1	Spring brass washer		
84	250-170	7	#6 x 1/4" sheet metal screw			110	258-1	1	Dial cord spring		
85	250-89	40	6-32 x 3/8" screw			111	258-5	10	Spring clip		
86	250-276	6	6-32 x 3/8" flat head screw (black)			112	255-49	4	5/16" long spacer		
87	250-284	8	#6 x 1/2" sheet metal screw			113	255-59	2	Black tapered spacer		
88	250-26	4	6-32 x 5/8" screw			MISCELLANEOUS					
89	250-40	2	6-32 x 1-1/2" screw			114	51-123	1	Output transformer		
90	252-3	49	6-32 nut (2 extra)			115	69-35	2	Relay		
91	252-22	9	#6 speednut				74-6		Masking tape		
92	253-1	1	#6 flat fiber washer			116	75-53	6	Nylon insert		
93	253-2	3	#6 shoulder fiber washer				134-253	1	Wiring harness		
94	253-60	5	#6 flat washer			117	207-22	1	Cable clamp		
95	254-1	62	#6 lockwasher (3 extra)			118	253-49	2	Nylon washer		
96	259-1	5	#6 solder lug			119	255-42	2	3/4" phenolic spacer		
97	259-6	3	#6 small solder lug			120	255-79	1	3/8" shoulder spacer tapped 6-32		
#8 Hardware						121	261-9	4	Rubber foot		
98	250-43	15	8-32 x 1/4" setscrew			122	263-7	1	Felt pad		
99	250-72	1	8-32 x 3/4" screw			123	268-7	2	Rubber belt		
100	252-4	1	8-32 nut				349-3	1	Dial cord		
101	252-28	1	8-32 knurled nut			124	354-5	3	Cable tie		
102	253-45	2	#8 flat washer			125	404-328	1	SSB crystal filter		
103	254-2	1	#8 lockwasher			126	407-99	1	Meter		

PARTS



PARTS PICTORIAL (cont'd.)



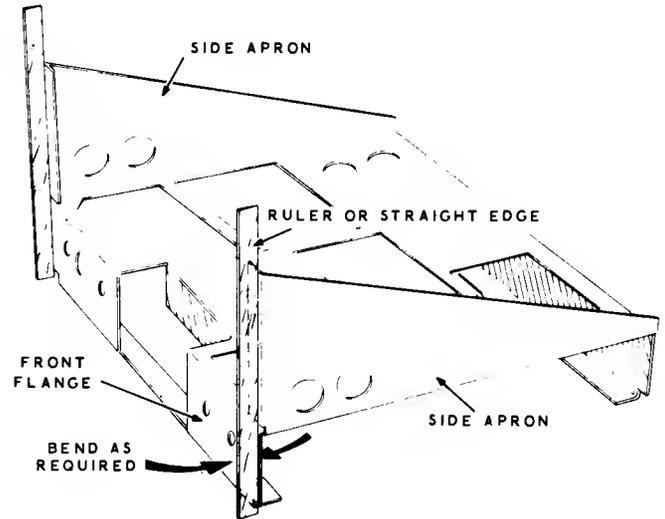
STEP-BY-STEP ASSEMBLY

PARTS MOUNTING

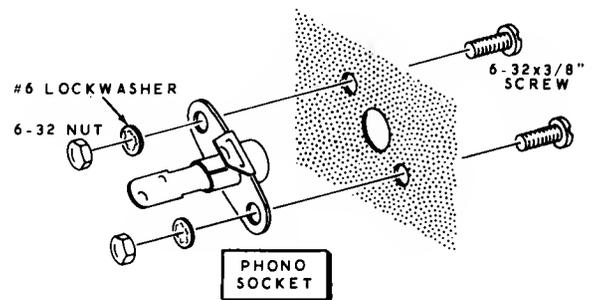
Refer to Pictorial 8-1 for the following steps.

It is important that the front edges of the chassis be in perfect alignment. This is checked at the factory. However, if the kit receives rough handling in shipment, this alignment might be changed. Check the alignment of the front edges of the chassis as directed in the following step; use care in handling the chassis throughout the assembly of the kit.

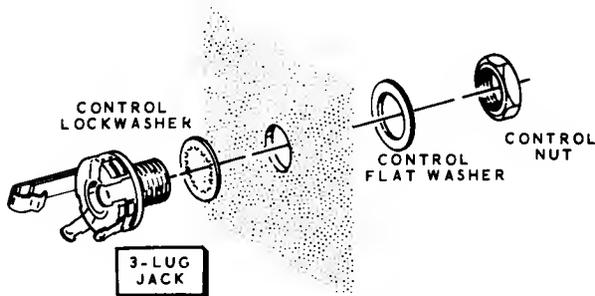
- () Refer to Detail 8-1A and check to see that the front flange of the chassis is in alignment with the front edges of the side aprons. This can be done by placing a ruler or other straight edge along this surface as shown. Straighten the front flange of the chassis as required, by carefully bending the flange.
- () Refer to Detail 8-1B and install a phono socket at AB. Use 6-32 x 3/8" hardware. Position the socket as shown.
- () In a like manner, install phono sockets at AC, AD, and AG. Use 6-32 x 3/8" hardware. Position each socket as shown. Note the position of the lugs of AC.
- () Refer to Detail 8-1C and install a 3-lug jack at AA. Use control lockwasher, control flat washer, and a control nut. Position the jack as shown in Pictorial 8-1.



Detail 8-1A

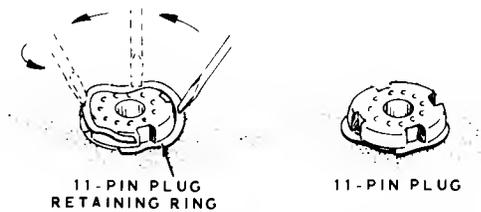


Detail 8-1B



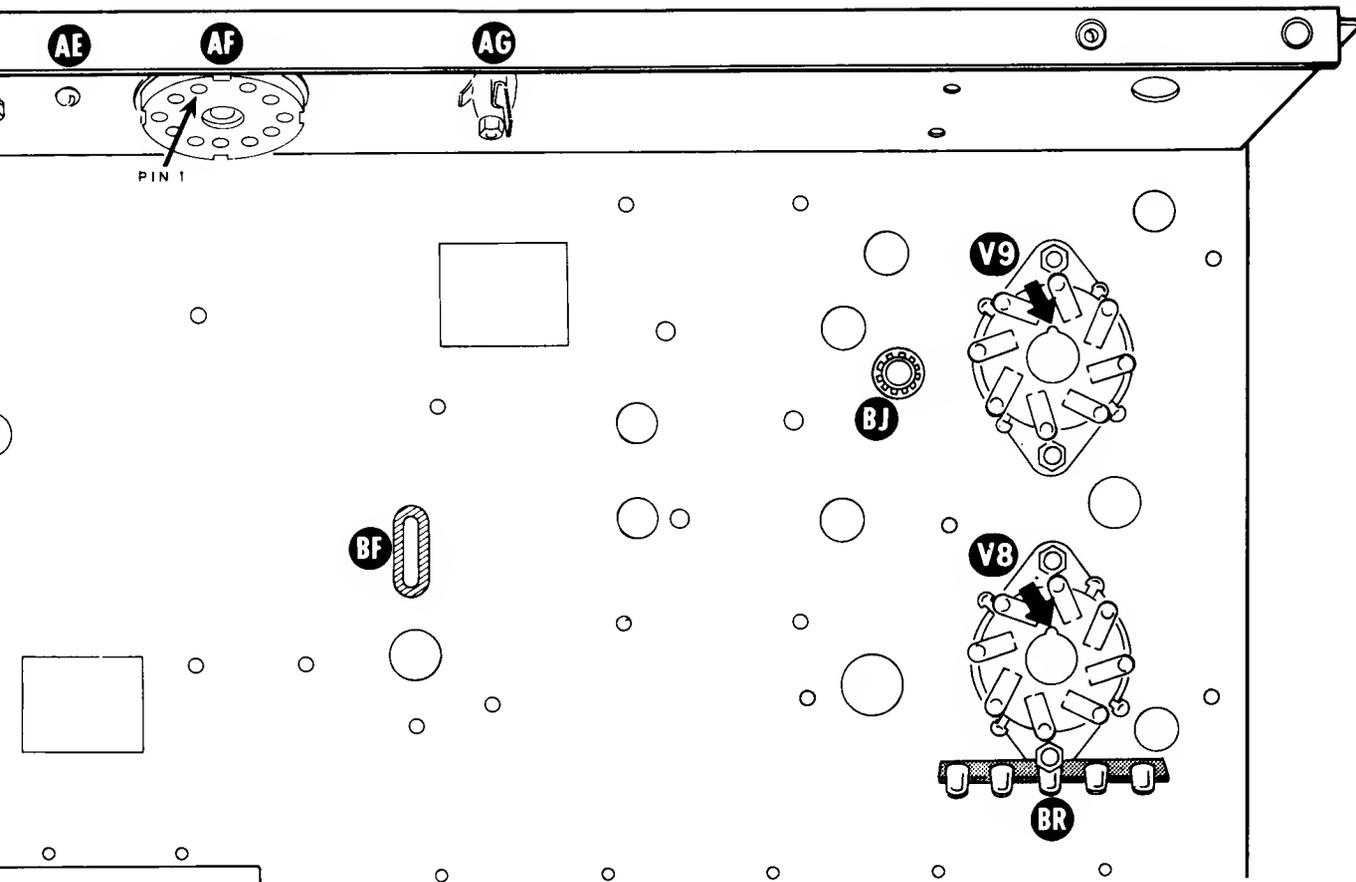
Detail 8-1C

- () Refer to Detail 8-1D and mount the 11-pin plug at AF, using the 11-pin plug retaining ring. Position pin 1 of the plug as shown. The pin numbers are molded into the plug.

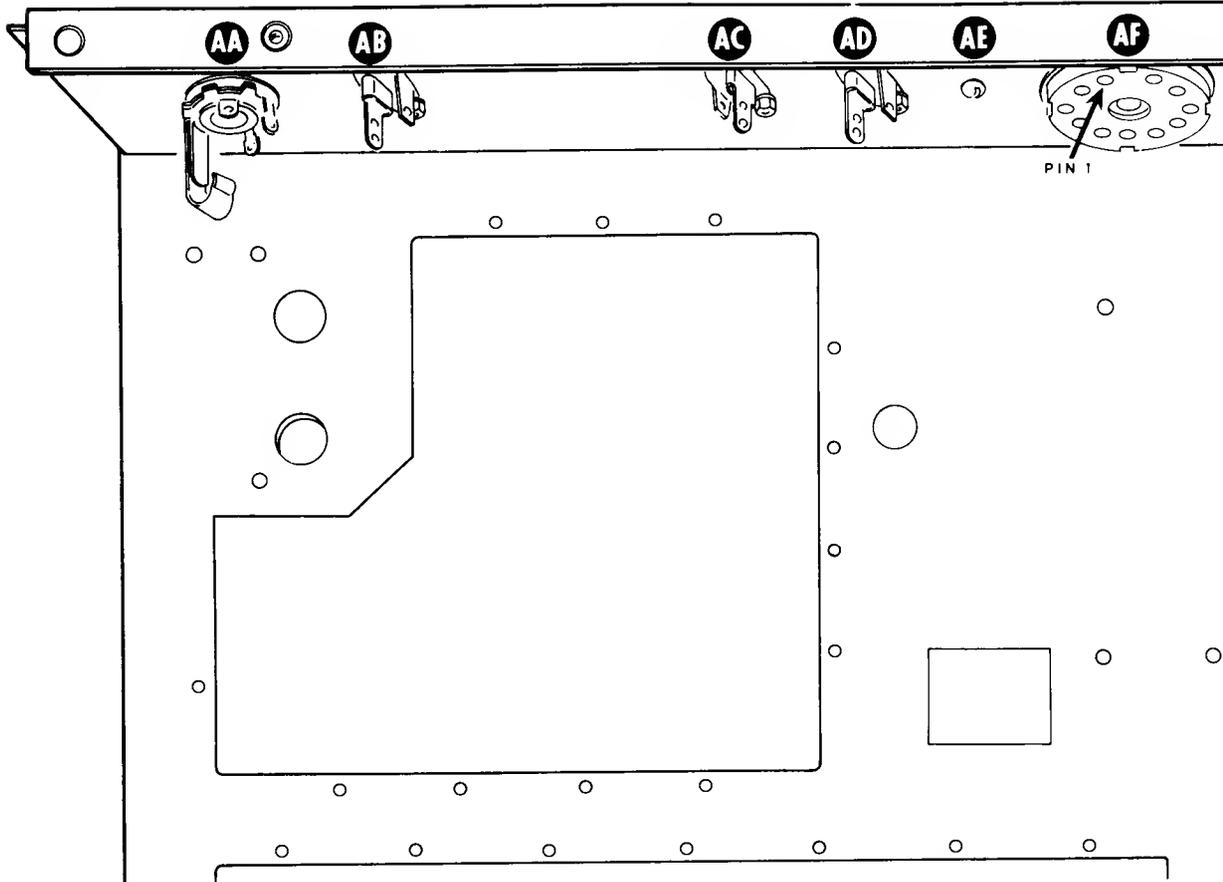


HOLD THE PLUG IN THE CHASSIS HOLE AND PLACE ONE END OF THE RING INTO THE GROOVE OF THE PLUG. USING A SCREWDRIVER, PRESS THE RING INTO THE GROOVE AROUND THE PLUG.

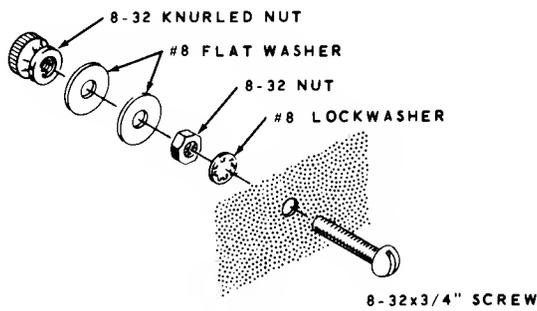
Detail 8-1D



PICTORIAL 8-1

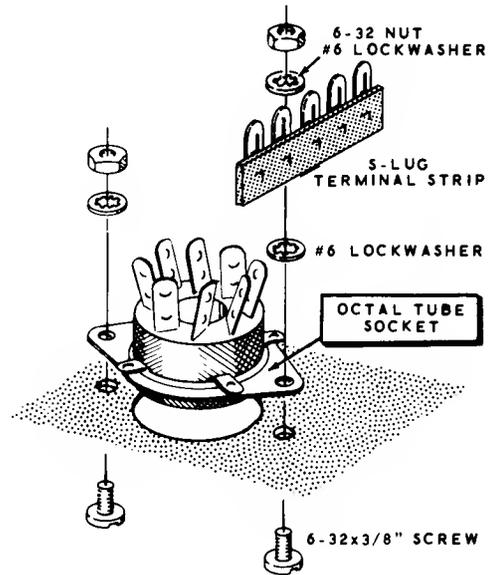


PICTORIAL



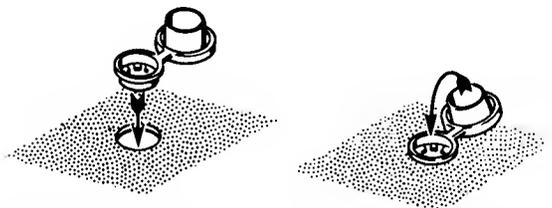
Detail 8-1E

- () Refer to Detail 8-1E and install the 8-32 x 3/4" screw at AE. Use a #8 lockwasher, an 8-32 nut, two #8 flat washers, and an 8-32 knurled nut.
- () Install a 1/2" rubber grommet at BF.
- () Refer to Detail 8-1F and install a 5/16" plastic grommet at BJ from the top of the chassis.



Detail 8-1G

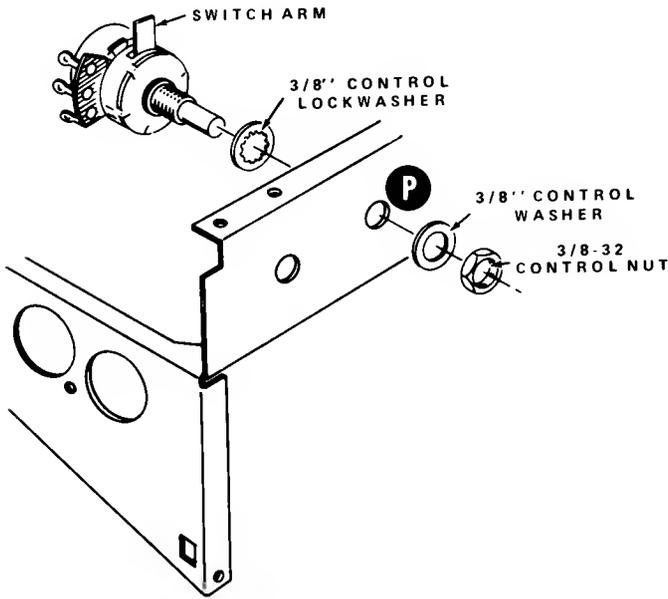
- () Refer to Detail 8-1G and install an octal tube socket at V8 with a 5-lug terminal strip at BR. Use 6-32 x 3/8" hardware. Position the terminal strip, and the socket keyway (indicated by an arrow), as shown in Pictorial 8-1.
- () In a similar manner, but without the terminal strip, install an octal tube socket at V9. Use 6-32 x 3/8" hardware. Position the keyway of the socket as shown by the arrow.



POSITION THE SMALL PORTION OF THE GROMMET INTO THE CHASSIS HOLE.

BEND THE LARGE PORTION OF THE GROMMET OVER AND INTO THE SMALL PORTION. PRESS IT FIRMLY INTO PLACE.

Detail 8-1F



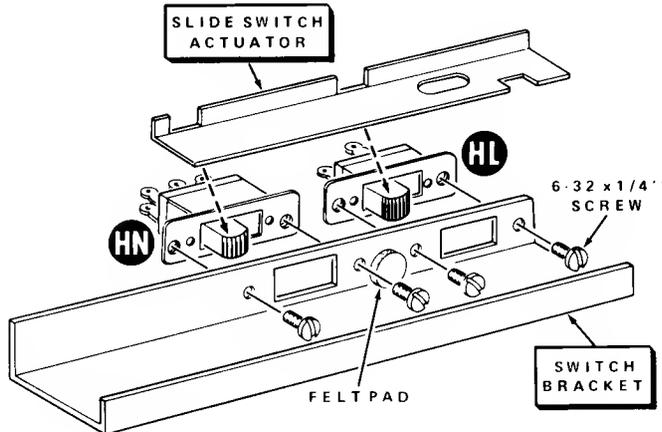
Detail 8-2A

Refer to Pictorial 8-2 (fold-out from Page 53) for the following steps.

- () Refer to Detail 8-2A and install a 100 kΩ control with switch arm (#10-208) at P. Use a 3/8" control lockwasher, a 3/8" control flat washer, and a 3/8-32 control nut. Position the control as shown.

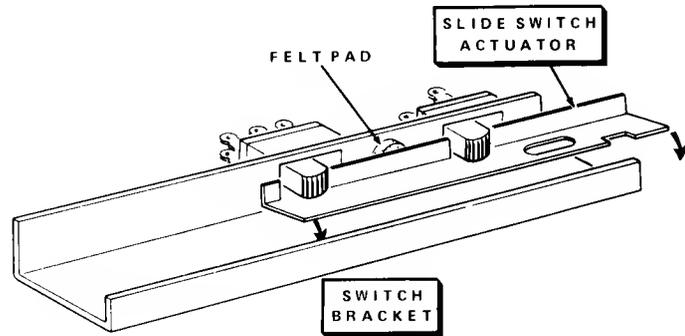
Refer to Detail 8-2B for the following three steps.

- () Install an SPDT slide switch (#60-4) at HL on the switch bracket. Use two 6-32 x 1/4" screws.



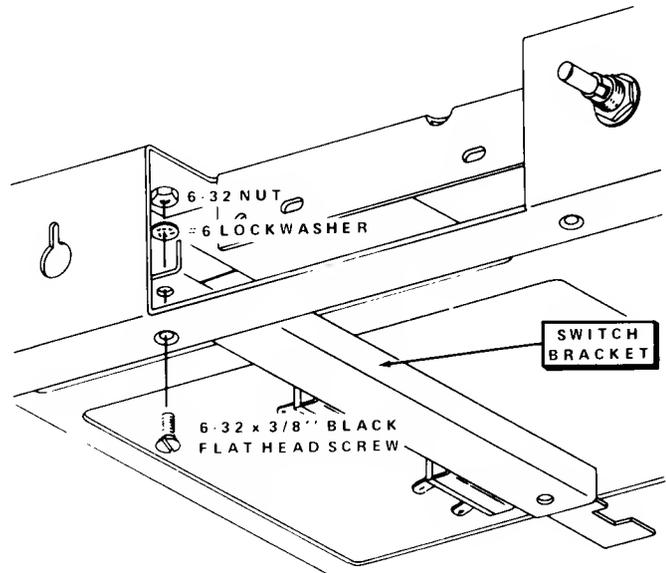
Detail 8-2B

- () Similarly, install a DPDT slide switch (#60-2) at HN on the switch bracket. Use two 6-32 x 1/4" screws.
- () Remove the clear protective backing from the felt pad. Then press the felt pad in between the screw heads and onto the switch bracket as shown.
- () Refer to Detail 8-2C and place the slide switch actuator in position on the switch bracket. The two black switch levers must fit easily into the two slots in the actuator. If they do not, loosen the switch mounting screws and readjust.

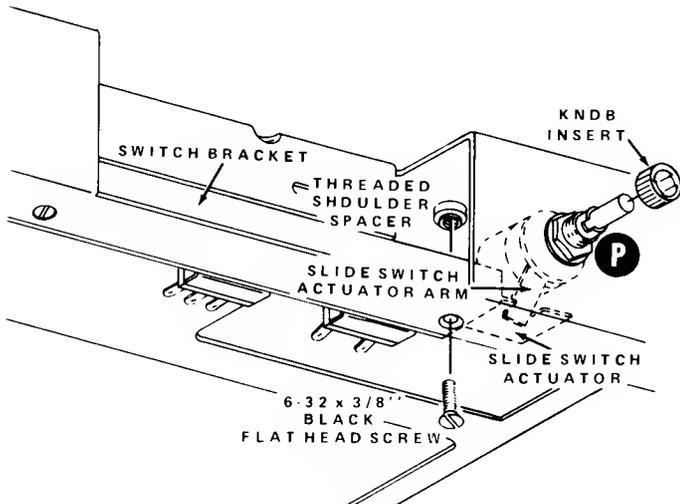


Detail 8-2C

- () Place the switch bracket in position as shown in Detail 8-2D and secure one end to the chassis. Use a 6-32 x 3/8" black flat head screw, a #6 lockwasher, and a 6-32 nut. Do not tighten the nut at this time.



Detail 8-2D

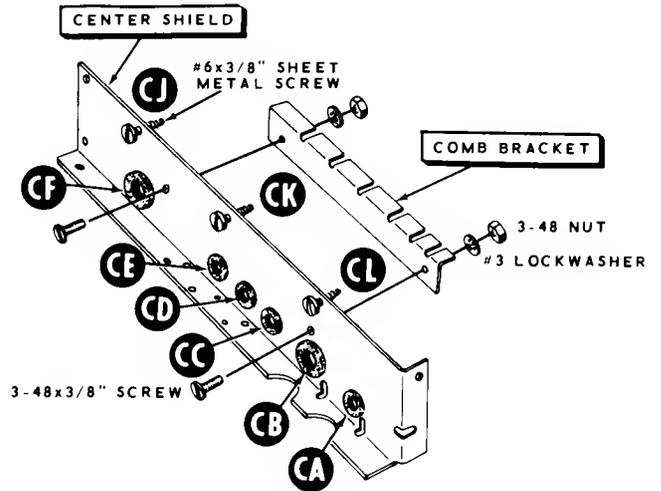


Detail 8-2E

- () Refer to Detail 8-2E and swing the free end of the switch bracket into position. The slot in the slide switch actuator should fit over the switch actuator arm on control P. Secure the switch bracket with a 6-32 x 3/8" black flat head screw and a threaded shoulder spacer as shown. Securely tighten both 6-32 screws holding the switch bracket.
- () Place a knob insert on the outer (slotted) shaft of control P.
- () Rotate the knob insert back and forth two or three times to make sure the slide switches operate properly. If, at any point in its travel, the end of the switch actuator arm touches the chassis, loosen the control nut and move the control away from the lower chassis lip to clear the actuator arm. Then tighten the nut.
- () Remove the knob insert from control P.

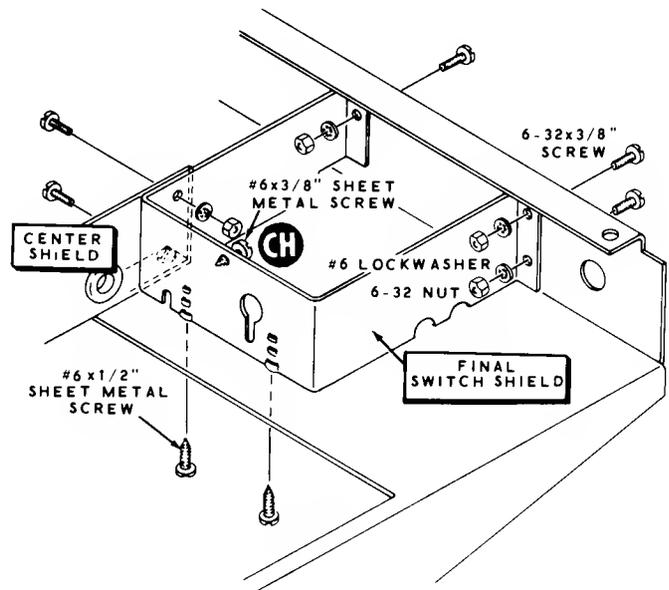
Refer to Detail 8-2F for the following steps.

- () Install 5/16" plastic grommets at CA, CC, CD, and CE on the center shield.
- () Install 1/2" rubber grommets at CB and CF on the center shield.
- () Install #6 x 3/8" sheet metal screws in the center shield at CJ, CK and CL. Position the screws as shown. Leave 1/16" between underside of the screw heads and the center shield.
- () Install a comb bracket on the center shield, with 3-48 x 3/8" hardware. Position the comb bracket as shown.



Detail 8-2F

- () Mount the center shield in the chassis with 6-32 x 3/8" hardware at BZ, BM, and BW. Do not tighten the hardware at this time.
- () Refer to Detail 8-2G and insert a #6 x 3/8" sheet metal screw in the final switch shield at CH. Leave 1/16" between the underside of the screw head and the shield.
- () Refer to the same Detail and mount the final switch shield. Use 6-32 x 3/8" hardware and #6 x 1/2" sheet metal screws.

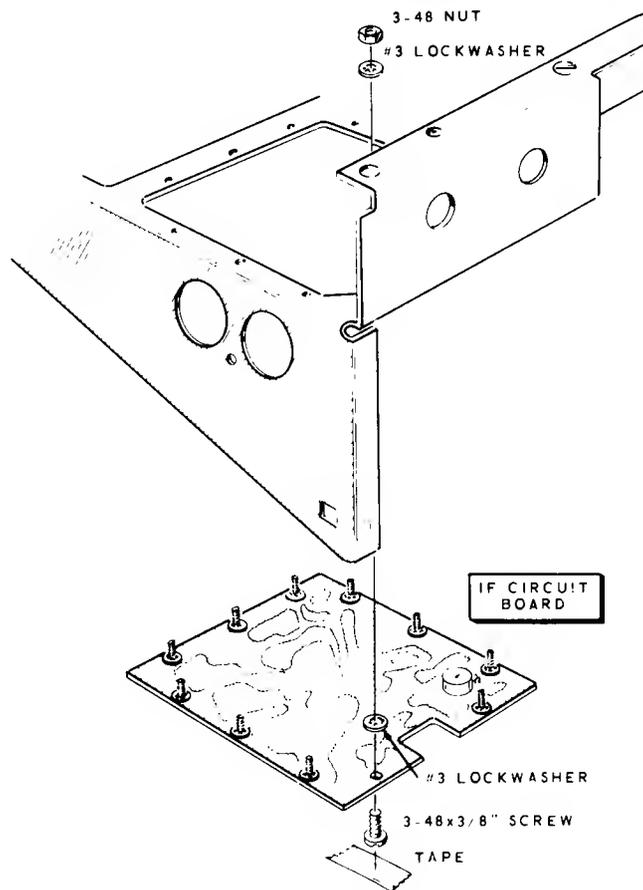


Detail 8-2G

Refer to Pictorial 8-2 for the following steps.

NOTE: When the circuit boards are mounted, lockwashers must be installed between the chassis and the foil sides of the circuit boards. This assures a good ground between the circuit boards and the chassis. This operation can be simplified if you place a piece of masking tape over the screw heads after the screws are installed on the lettered side of the circuit board. This will hold the screws in place until lockwashers and nuts are installed. The tape should be removed after the nuts are installed. Mount all five circuit boards on the chassis before tightening the hardware.

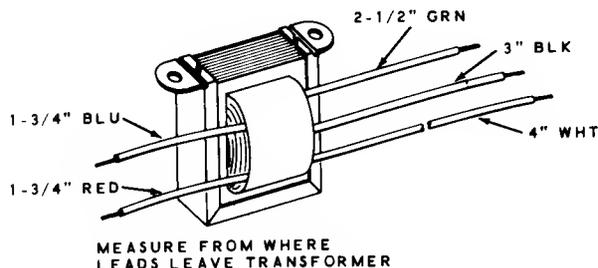
- () Refer to Detail 8-2H and the inset of Pictorial 8-2, and mount the IF circuit board (#85-128-4) on the chassis. Use 3-48 x 3/8" hardware. Do not tighten the hardware at this time.
- () In a like manner, mount the bandpass circuit board (#85-129-5). Use 3-48 x 3/8" hardware. Be sure to position the circuit board properly. Do not tighten the hardware at this time. Refer to the inset drawing on Pictorial 8-2 for the proper installation of the hardware that goes through the center shield.
- () Mount the modulator circuit board (#85-127-2) using a 3-48 x 3/8" hardware.
- () Mount the RF driver circuit board (#85-131-6) with a small #6 solder lug at BT. Use 3-48 x 3/8" hardware, with a lockwasher on each side of the solder lug. Position and bend the solder lug as shown. Do not tighten the hardware at this time.
- () Cut the leads of the output transformer to the lengths indicated in Detail 8-2J. Remove 1/4" of insulation from the end of each lead. If not already done, melt a small amount of solder on each exposed lead end to hold any loose strands of wire together. This transformer will be mounted later.



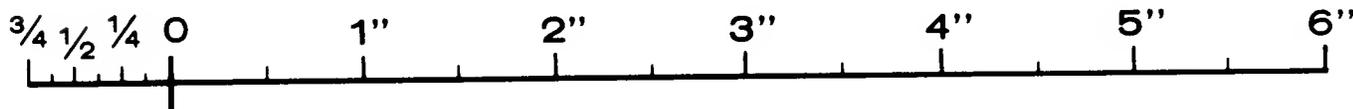
Detail 8-2H

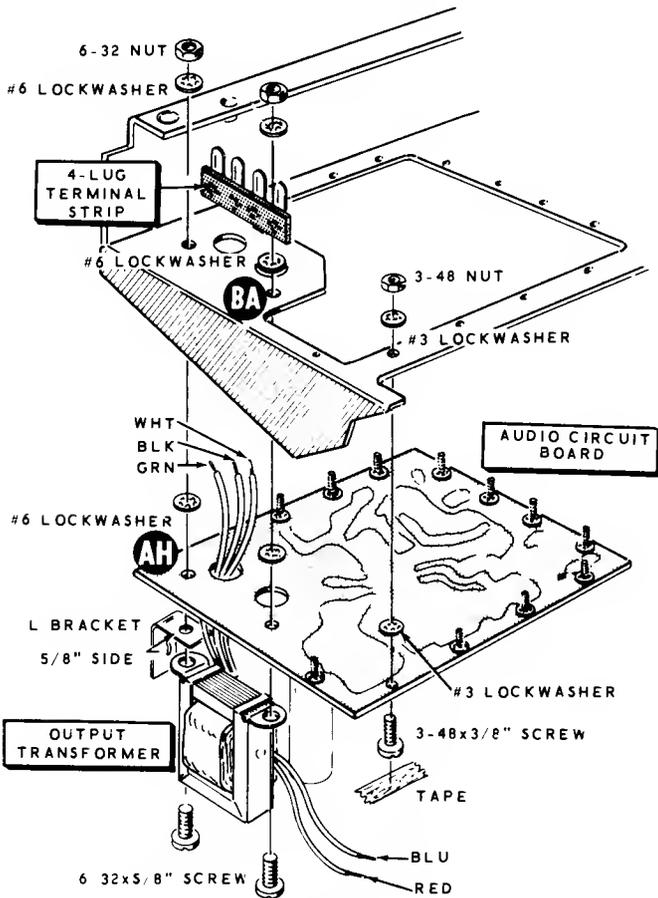
NOTE: In the next step, the #6 lockwashers can be more easily installed between the circuit board and chassis if 6-32 x 5/8" screws are taped in place first, along with the 3-48 x 3/8" hardware. Then, the 6-32 x 5/8" screws can be removed, and the #6 lockwashers will remain in place while the output transformer is being installed.

- () Refer to Detail 8-2K and mount the audio circuit board (#85-130-2) using 3-48 x 3/8" hardware.
- () Place the output transformer on the audio circuit board and pass the white, the black, and the green leads through the hole near AH.
- () At BA, mount a 4-lug terminal strip on the bottom side of the chassis positioned as shown. Use 6-32 x 5/8" hardware. Note the lockwashers used.



Detail 8-2J



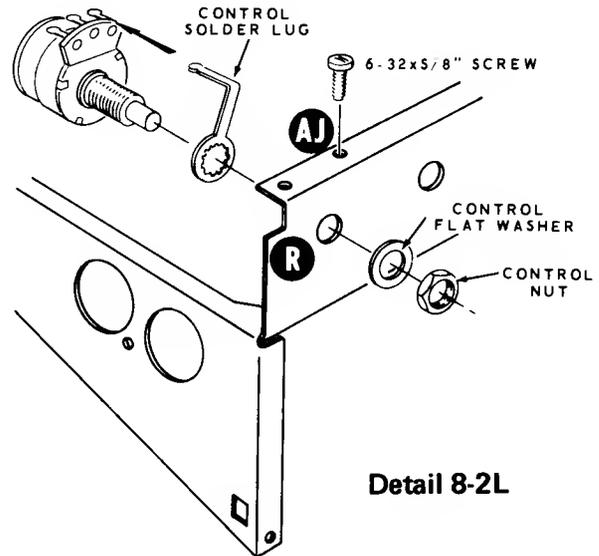


Detail 8-2K

- () On top of the chassis at AH, mount an L bracket with the 5/8" (long) side against the circuit board under the transformer foot. Use 6-32 x 5/8" hardware.
- () Remove any remaining tape from the screw heads.
- () Now tighten all the hardware of the circuit boards and the center shield.

Refer to Detail 8-2L for the following three steps.

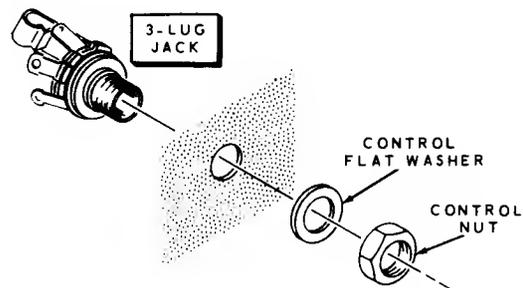
- () Insert a 6-32 x 5/8" screw into the captive nut in the chassis lip at AJ.
- () Prepare a 1 MΩ control with switch (#19-67). Place a control solder lug on the control mounting bushing and hold it in place with a control flat washer and a



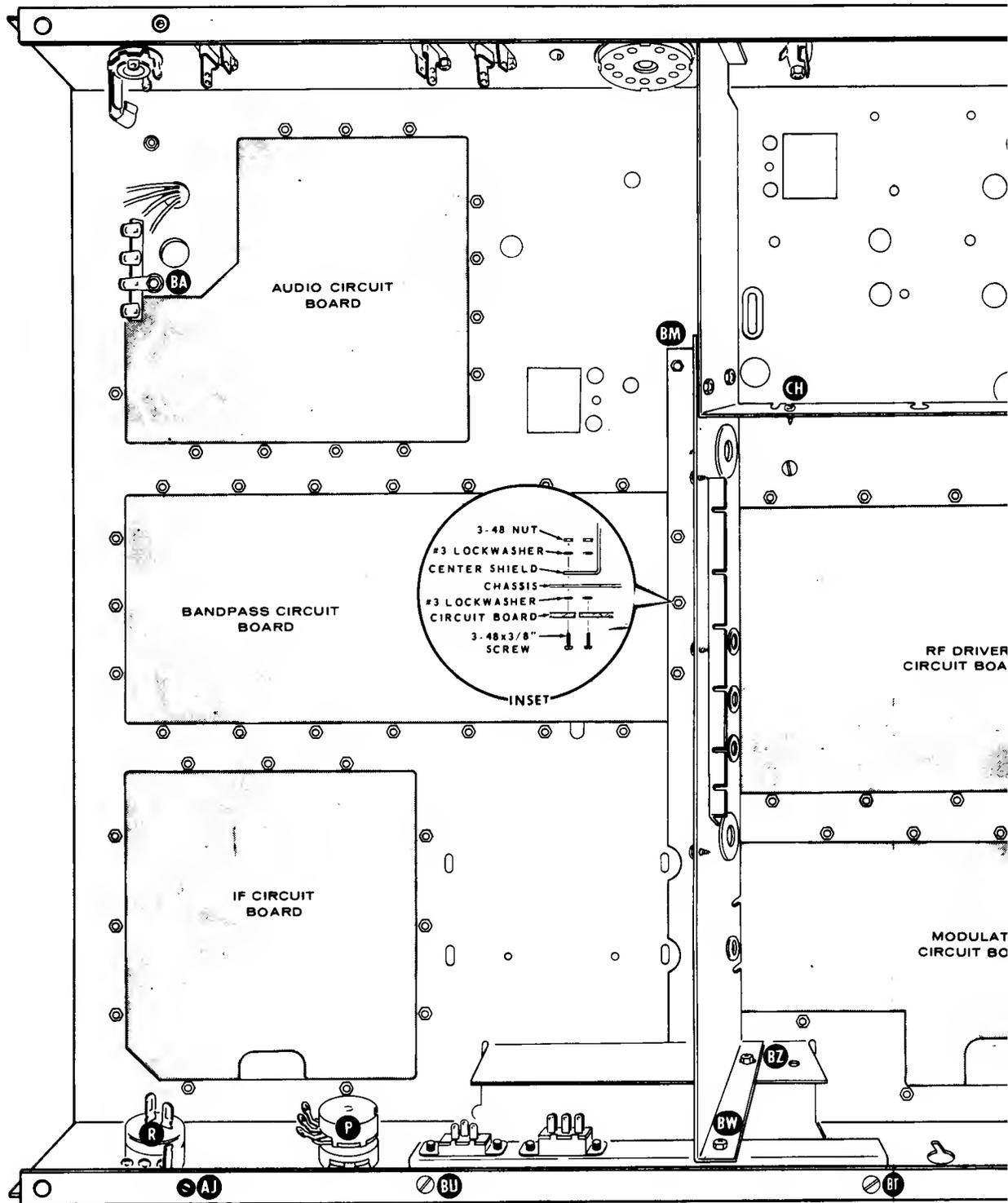
Detail 8-2L

control nut. Form the control solder lug against terminal 1 of the control. Before soldering, check to see that the formed lugs will fit under the chassis lip at R. Solder lug 1 (S-1), and then remove the control flat washer and control nut.

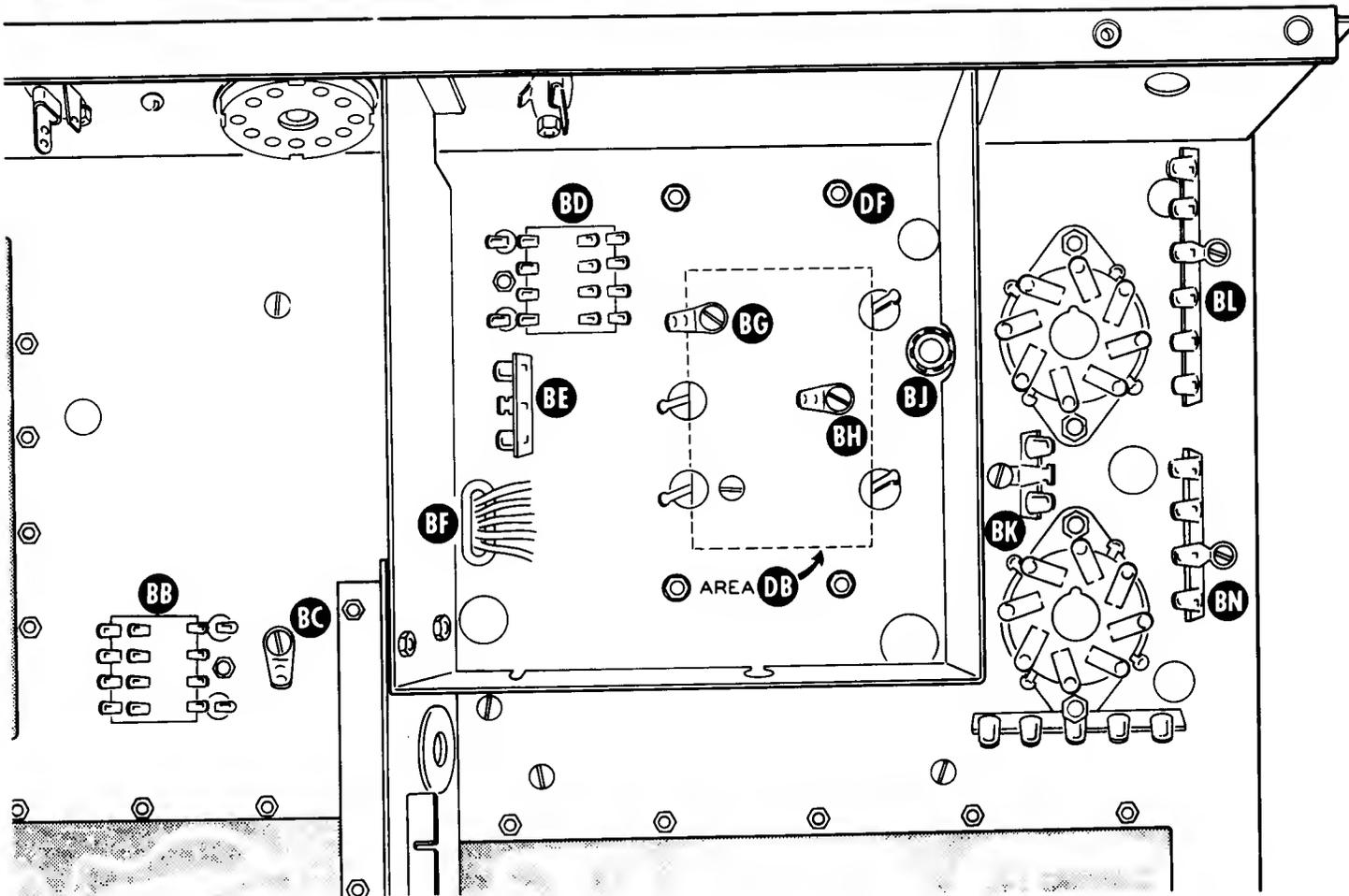
- () Again refer to Detail 8-2L and install this control and solder lug assembly at R. Use a control washer and a control nut. Position the lugs as shown so that lug 1 clears the screw at AJ. This insures that the control lugs will not interfere with the rubber foot to be installed later.
- () Remove the screw from AJ.
- () Remove the switch cover (it will be reinstalled later).
- () Refer to Detail 8-2M and install a 3-lug jack at L. Use a control washer and a control nut. Position the jack as shown in Pictorial 8-2.



Detail 8-2M



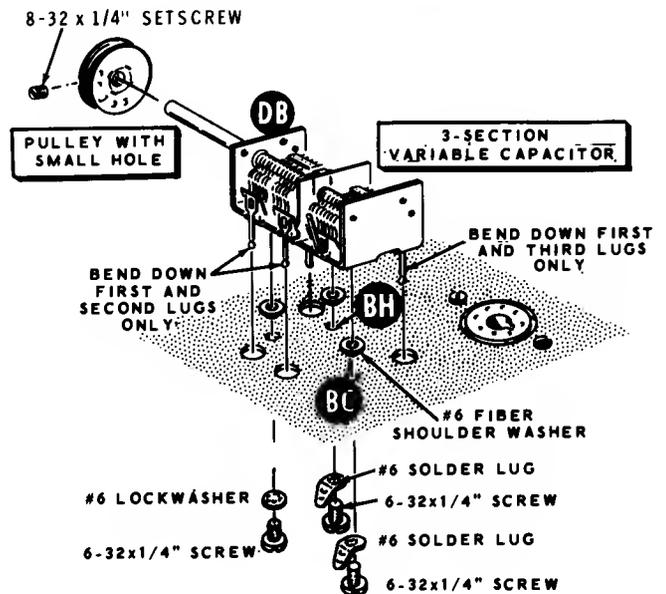
PICTORIAL 8-2



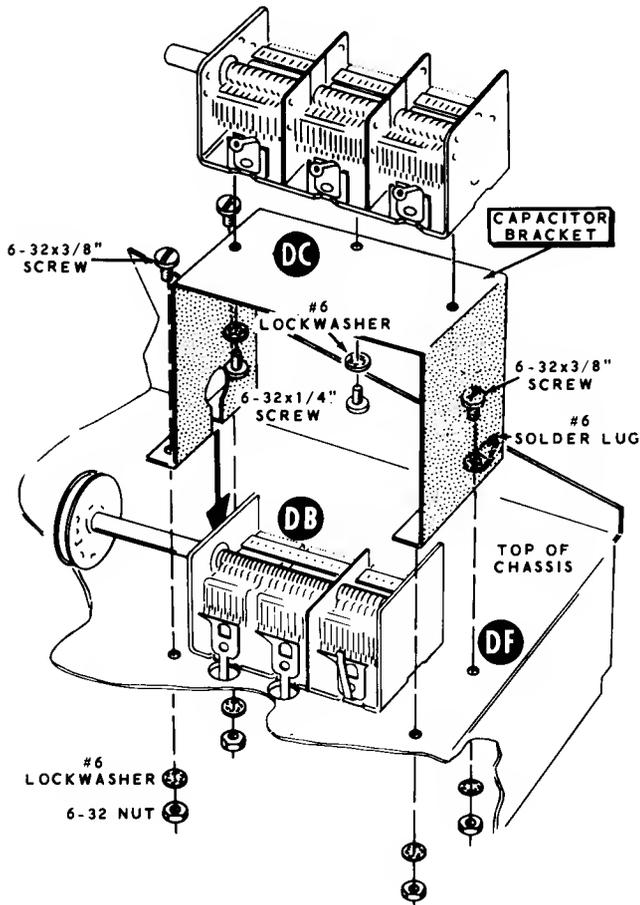
PICTORIAL 8-3

Refer to Pictorial 8-3 for the following steps.

- () Refer to Detail 8-3A and bend down, as shown, the four indicated lugs of the 3-section variable capacitor (#26-92). The remaining two lugs should be left bent up.
- () Mount this capacitor on top of the chassis at area DB as marked on Pictorial 8-3. Use a 6-32 x 1/4" screw, a #6 solder lug, and a #6 shoulder fiber washer at BG and BH. Position the solder lugs as shown in the Pictorial. At the remaining hole, use a 6-32 x 1/4" screw, a #6 lockwasher, and a #6 shoulder fiber washer.
- () Connect an ohmmeter from the chassis to one of the three capacitor stator sections. Rotate the capacitor through its entire range to make sure there is no contact between the stator and the rotor plates. Repeat this check at the other two stator sections. Locate and repair the cause of any resistance reading less than infinity before proceeding.



Detail 8-3A

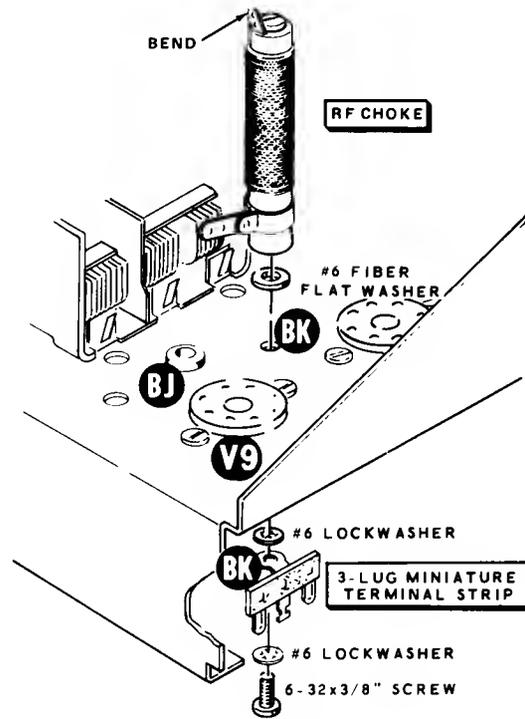


Detail 8-3B

- () Install the pulley with the small hole (#100-19) flush with the end of the shaft of capacitor DB. Use an 8-32 x 1/4" setscrew. Fully mesh the plates of the capacitor and position the opening in the pulley as shown.

Refer to Detail 8-3B for the following steps.

- () Mount a 3-section, wide-spaced, variable capacitor (#26-116) at DC on the capacitor bracket. Use 6-32 x 1/4" screws and #6 lockwashers at each of the three mounting holes. Bend all six solder lugs straight out before mounting the capacitor.
- () Mount capacitor DC and the capacitor bracket over capacitor DB on the chassis. Use a 6-32 x 3/8" screw, a #6 solder lug, a #6 lockwasher, and a 6-32 nut at DF. Use 6-32 x 3/8" hardware at the other three mounting holes.
- () Refer to Detail 8-3C and prepare RF choke (#45-41) by bending the solder lug at the top to a vertical position as shown. Be careful not to break the connecting wire.



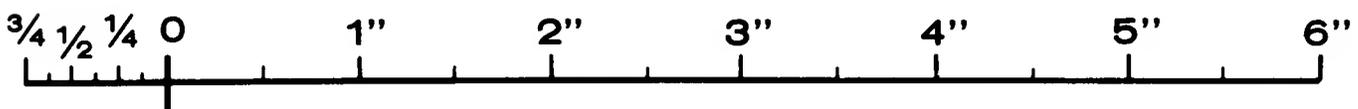
Detail 8-3C

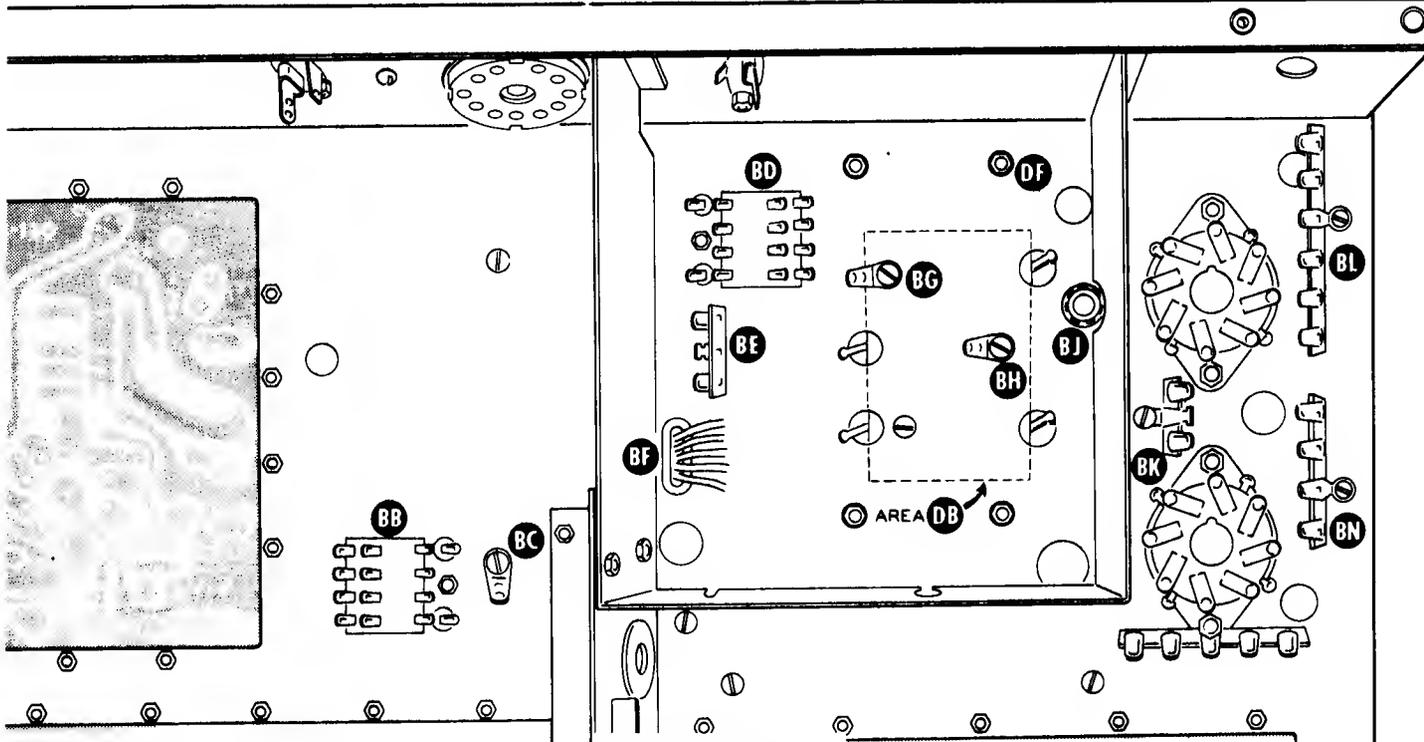
- () Install the prepared RF choke at BK on top of the chassis, with a 3-lug miniature terminal strip on the bottom of the chassis. Use a 6-32 x 3/8" screw, #6 lockwashers, and a #6 fiber flat washer. Position the terminal strip as shown, and place the bottom lug of the choke over grommet BJ. Do not tighten the mounting screw at this time.
- () Insert a 6146 tube in socket V9, and make sure there is at least 1/8" clearance between either solder lug of the choke and any other metal part. Tighten the mounting screw and remove tube V9 from its socket.

NOTE: When wiring this kit, you will be instructed to prepare lengths of wire ahead of time, as in the next step. When wire is called for, use the small hookup wire of the indicated color unless other wire is specified. To prepare a wire, cut it to the indicated length and remove 1/4" of insulation from each end. After the insulation is removed from the ends of the large red wire, if any of the small wire strands are loose, twist them together and melt a small amount of solder on the exposed wire ends.

- () Prepare the following lengths of large red wire:

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



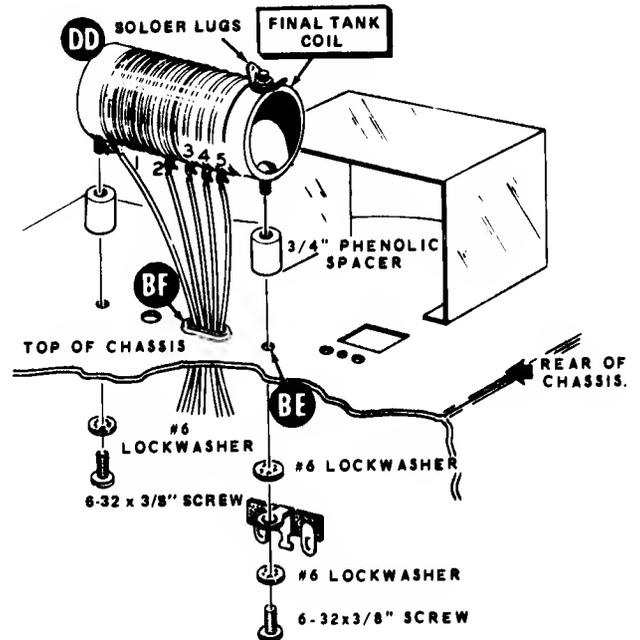


PICTORIAL 8-3
(Repeat)

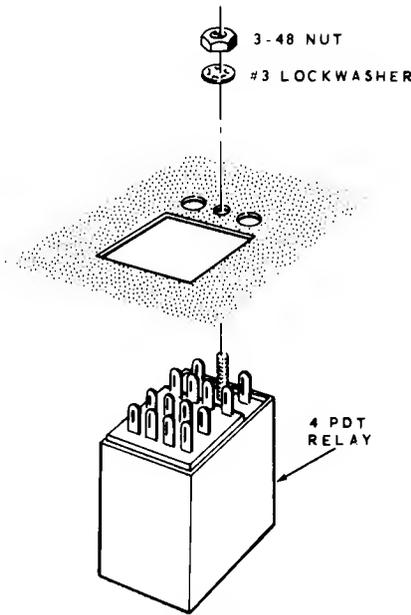
Refer to Detail 8-3D for the following steps.

Connect the following lengths of large red wire to the lugs of the final tank coil (#40-548). Only one end of each wire will be connected at this time.

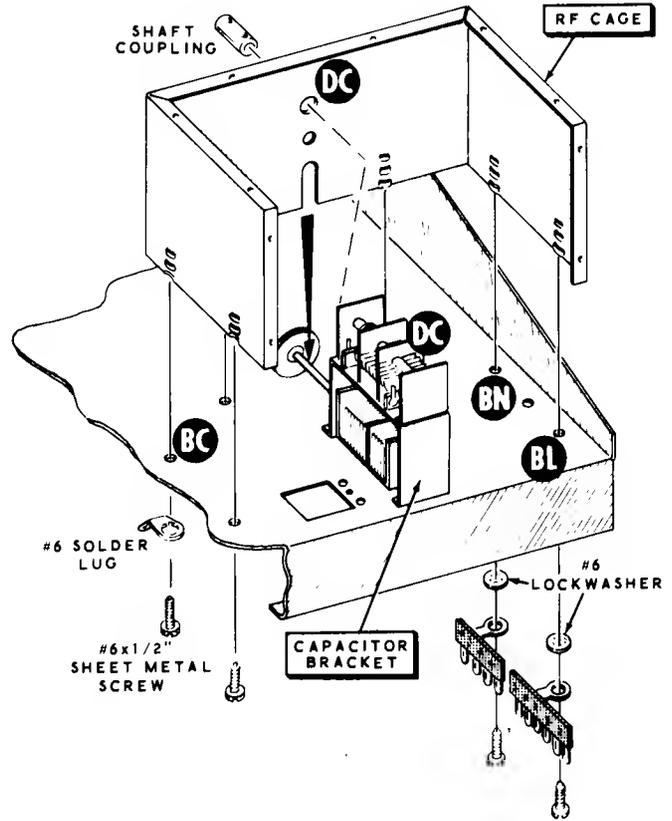
- () 3-1/2" to lug 1 (S1).
- () 3" to lug 2 (S-1).
- () 3" to lug 3 (S-1).
- () 3-1/2" to lug 4 (S-1).
- () 4" to lug 5 (S-1).
- () Install two 3/4" phenolic spacers on the final tank coil. Do not overtighten the spacers as the threads can be damaged.
- () Mount the final tank coil at DD on top of the chassis with a three-lug miniature terminal strip at BE on the bottom of the chassis. Use a 6-32 x 3/8" screw and two #6 lockwashers. At the front end of the coil, use a 6-32 x 3/8" screw and a #6 lockwasher. Position the coil as shown with its leads in proper sequence through grommet BF.



Detail 8-3D



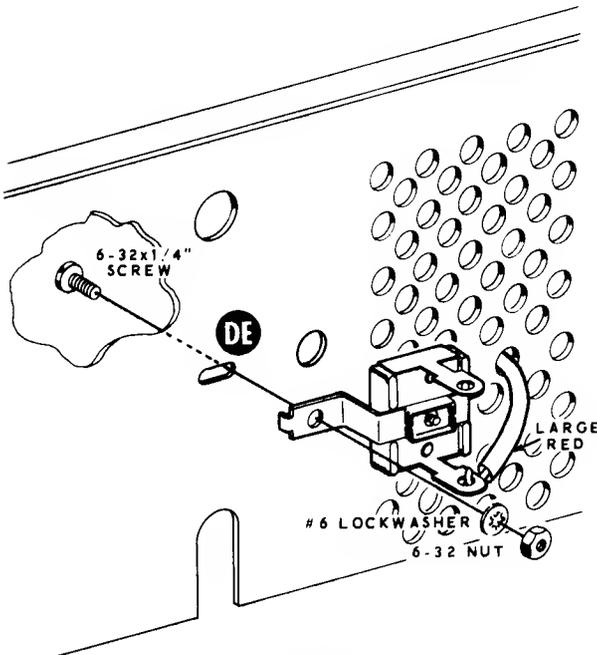
Detail 8-3E



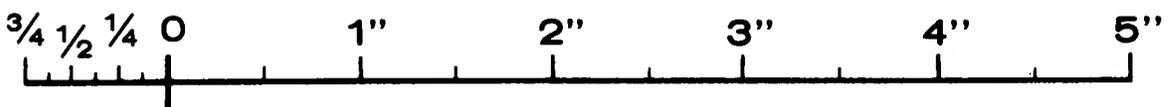
Detail 8-3G

- () Refer to Detail 8-3E and mount relays at BB and BD. Use a 3-48 nut and a #3 lockwasher for each.
- () Refer to Detail 8-3F and mount a 3-30 pF mica trimmer capacitor (#31-48) on the inside of the RF cage at DE. Use 6-32 x 1/4" hardware. Be sure to position the tongue of the mounting bracket in the slot.

- () Pass the large red wire from the variable capacitor on the RF driver circuit board through an adjacent hole in the RF cage and connect this wire to the lower contact of the trimmer capacitor (S-1).
- () Refer to Detail 8-3G and mount the RF cage on the chassis. Use six #6 x 1/2" sheet metal screws, a #6 solder lug at BC, a 6-lug terminal strip at BL, a 4-lug terminal strip at BN, and two #6 lockwashers, all on the bottom of the chassis. Position the solder lug and terminal strips as shown.
- () Position the shaft coupling on the shaft of variable capacitor DC to see that it is centered in hole DC of the RF cage. If it is not, loosen the capacitor bracket hardware and make the necessary adjustments. Retighten the hardware.
- () Start two #8 x 1/4" setscrews in the shaft coupling.
- () Close the capacitor.
- () Position the shaft coupling with the setscrews pointing straight up; the setscrew at the front end of the coupling should just clear the front of the RF cage. Tighten the rear setscrew onto the capacitor shaft.



Detail 8-3F



HARNESS WIRING

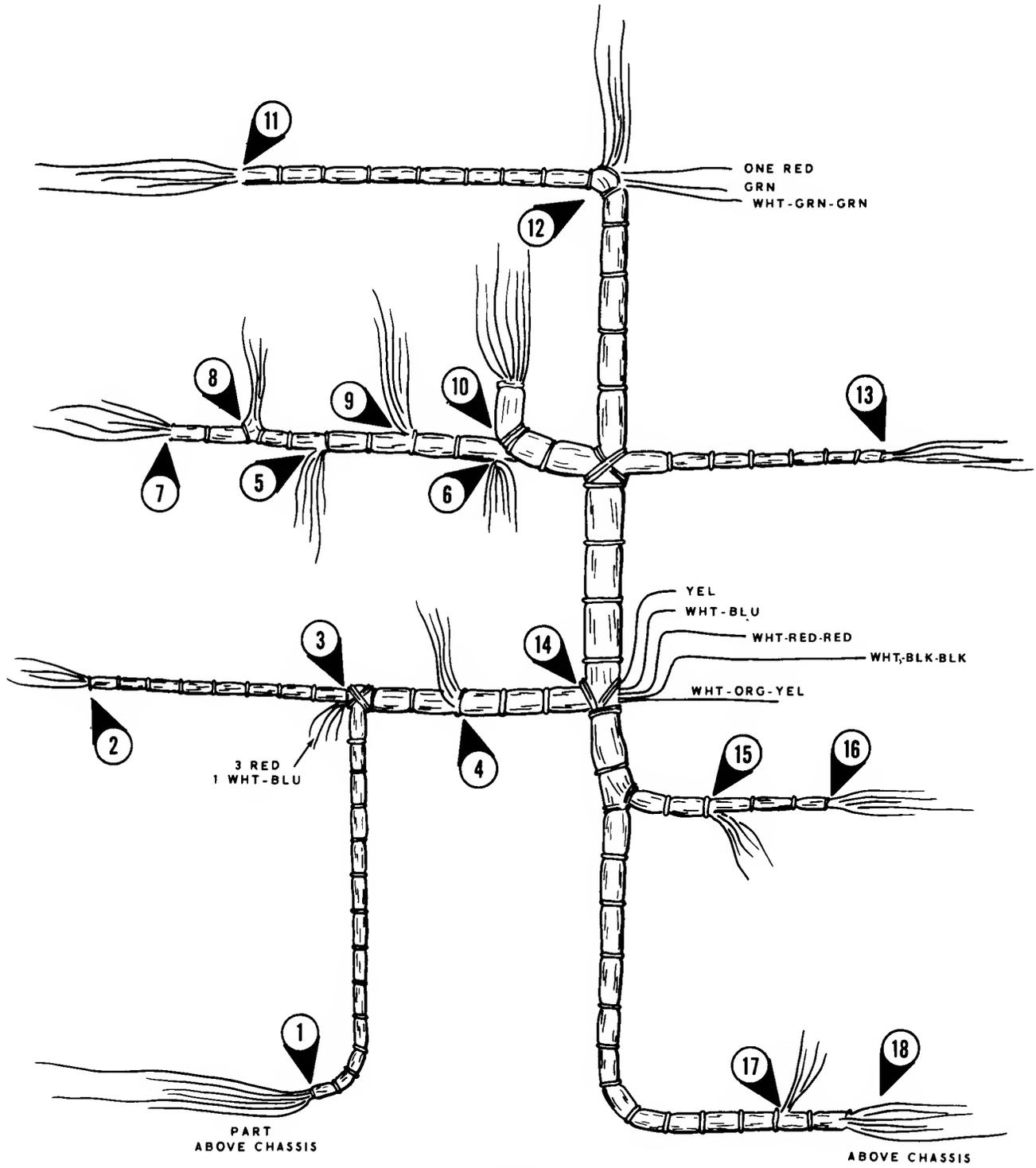
CAUTION: As you handle the chassis in the following steps, avoid damaging the 20 μ F capacitor on the audio circuit board.

Refer to Pictorial 8-4 (fold-out from Page 54) for the following steps.

- () Work a 1/2" rubber grommet into square notch CG at the rear end of the center shield.
- () Place a 1" length of masking tape over each of the two metal edges near BW and BZ at the front end of the center shield. Also tape the metal edges at breakouts 1 and 17.

Each wiring harness wire is colored in one of the following three ways:

1. A plain solid color such as green.
 2. A solid color (usually white) with one stripe, such as white-orange. Body color is called out first.
 3. A solid color with two stripes, such as white-red-red. Body color is called out first.
-
- () Straighten out each branch of the wiring harness and the individual wires at each "breakout." For orientation, locate breakout #3, where three short red wires and one white-blue (white with blue tracer) wire leave the harness.
 - () Form the wiring harness as shown in Detail 8-4A, and position the chassis bottom side up with the front toward you.



Detail 8-4A

- () Hold the formed wiring harness to the left of the center of the chassis and start the longest wires through the appropriate grommet in the center shield. Then move the entire harness to the right and start the next shorter wires through their grommet. Bend the harness so that breakout #17 and #18 will pass around the front end of the center shield to the position shown in the Pictorial. Make sure the main harness is snug against the grommets.
- () Before proceeding, check to make sure the wires have been correctly placed, as follows:

<u>GROMMET</u>	<u>WIRES</u>
CB	BO (breakout) #15 and #16
CC	WHT-ORG-YEL
CD	WHT-RED-RED, WHT-BLK-BLK
CE	YEL and WHT-BLU
CF	BO #13
CG	RED, GRN, and WHT-GRN-GRN

To get the best performance from your transceiver, it should be wired neatly. All insulated wires should be positioned down against the chassis whenever possible, but should clear screw threads and metal edges. All components should be positioned as close as possible to the locations shown. Check periodically with the Chassis Photos at the rear of the Manual to see how the finished kit should appear.

Because of the many wires in the Transceiver, it is not possible to show the hookup of every wire in one Pictorial. Therefore, the wires not connected in the first Pictorial will be connected in a later one.

Do not cut off or shorten any wires coming from the wiring harness. Those that are too long should be doubled back against themselves to take up the slack.

- () Pass the following wires from BO#1 up through the notch in the IF circuit board to the top of the chassis:

- Blue
- White
- White-green-green
- White-red-red

Connect the following wires from BO#1 as directed:

- () Gray to lug 4 of switch R (S-1).
- () White-gray to lug 5 of switch R (S-1).
- () White-violet to lug 1 of control P (S-1).
- () White-yellow-yellow to lug 3 of control P (S-1).

Connect the remaining wires from BO#1 to the IF circuit board as follows:

- () Red to 10 (S-1).
- () White-red to 9 (S-1).
- () Brown to 8 (S-1).
- () Two white-brown to 6 (S-2).
- () Yellow to 12 (S-1).
- () White-green to 7 (S-1).
- () Place the switch wires in the notch of the switch cover and replace the cover of switch R. Be careful not to pinch the wires. The cover may be keyed to fit one way only.

Connect the wires from BO#3 to the IF circuit board as follows:

- () Three red to 1 (S-3).
- () White-blue to 5 (S-1).

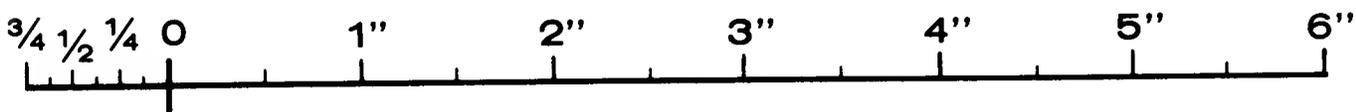
Connect three of the wires from BO#2 to the IF circuit board as follows:

- () Two yellow to 13 (S-2).
- () White-red-red to 11 (S-1).

Connect two of the wires from BO#2 to the bandpass circuit board as follows:

- () White-orange-yellow to 18 (S-1).
- () Red to 17 (S-1).

The two green wires and the two white-black-black wires will be connected later.



Connect the wires from BO#4 to the bandpass circuit board as follows:

- () Three white-orange-yellow to 7 (S-3).
- () Three brown to 2 (S-3).
- () Place a 1" length of small black sleeving on the white-gray wire and insert the wire through hole BY so that at least 1-3/4" protrudes on the top of the circuit board. Make any necessary adjustments in harness positioning to insure this length. The free end of this wire will be connected later.

Connect the wires from BO#5 to the bandpass circuit board as follows:

- () Green to 10 (S-1).
- () Gray to 11 (S-1). Check the Pictorial for the correct hole in this foil.
- () Two white-red-red to 8 (S-2).
- () Two brown wires to 12 (S-2).
- () White-yellow-yellow to 9 (S-1).

Connect the wires from BO#6 to the bandpass circuit board as follows:

- () White to 3 (S-1).
- () Three white-brown to 4 (S-3).
- () One (either) red to 5 (S-1).
- () One red to 6 (S-1).

Connect four of the wires from BO#7 to the bandpass circuit board as follows:

- () Two red to 15 (S-2).
- () Black to 16 (S-1).
- () White-brown to 13 (S-1).

Connect three of the wires from BO#7 to the audio circuit board as follows:

- () White-red to 19 (S-1).
- () Two brown to 17 (put both wires in one hole) (S-2).

Connect the wires from BO#8 to the audio circuit board as follows:

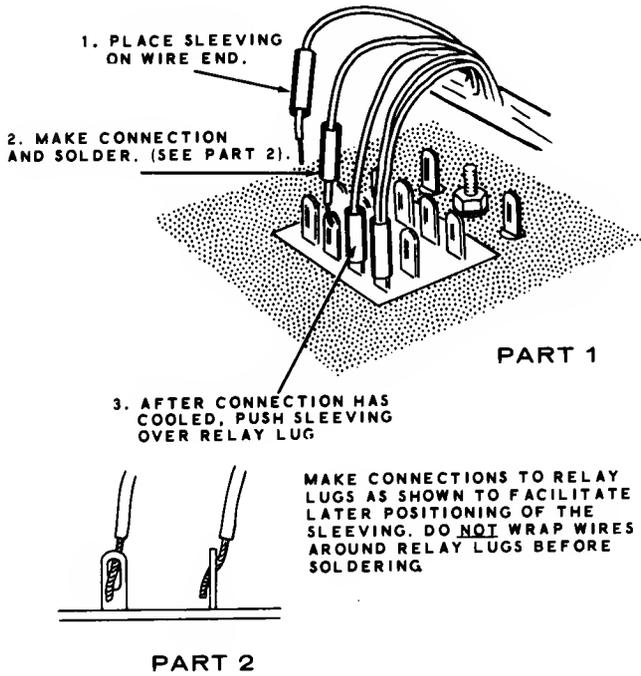
- () Red to 14 (S-1).
- () Two white-yellow-yellow to 18 (S-2). NOTE: The number 18 may be partially obscured by the chassis. If so, locate the proper holes by reference to the surrounding wires and foils.
- () Two brown to 13 (one hole) (S-2).
- () Two white-brown to 12 (S-2).

Connect the wires from BO#9 to the audio circuit board as follows:

- () Two white-green to 5 (S-2).
- () White-yellow-yellow to 4 (S-1).
- () White-violet to 3 (S-1).
- () Gray to 2 (S-1).
- () White-black-black to 7 (S-1).
- () White-orange to 1 (S-1).

NOTE: All of the wires from BO#10 will be connected to relay BB in the following steps, single wires to some lugs and two wires to others. Before you connect two wires to the same lug, place a length of clear sleeving over both of them. Place a length of small black sleeving over a single wire to a single lug. Do not put sleeving on the bare wire. After soldering a wire to a lug, let it cool; then push the sleeving down over the lug.

- () Cut eight 1/2" lengths of small black sleeving and five 1/2" lengths of clear sleeving. These will be used in the following steps.



Detail 8-4B

Refer to Pictorial 8-4 (fold-out from Page 54) and to Detail 8-4B and connect the wires from BO#10 to the relay BB as follows:

- () Green to lug 13 (S-1).
- () White-blue-blue to lug 9 (S-1).
- () Yellow to lug 5 (S-1).
- () White-red to lug 1 (S-1).

Refer to Inset #1 and connect four wires from BO#10 and a bare wire as follows:

- () Connect a 1-1/2" small bare wire from solder lug BC (S-1) to lug 10 (S-1).
- () Two blue to lug 6 (S-2).
- () Two white-yellow-yellow to lug 2 (S-2).

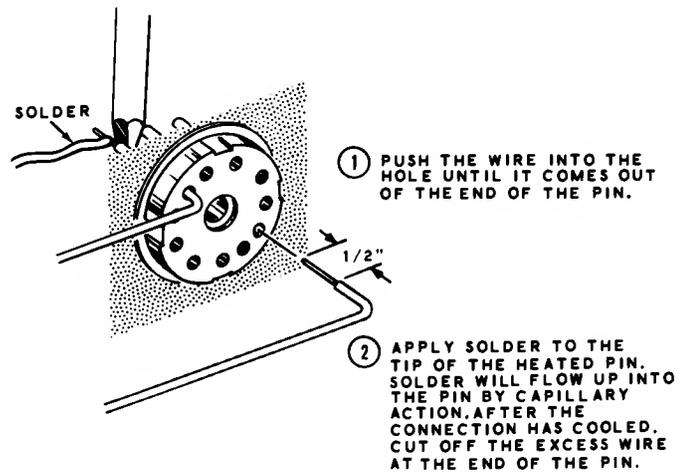
Refer to Inset #2 and connect the following wires from BO#10 as follows:

- () White-orange to lug 11 (S-1).
- () White-orange-orange to lug 7 (S-1).
- () Two white-red-red to lug 3 (S-2).

Refer to Inset #3 and connect the wires from BO#10 as follows:

- () Gray to lug 14 (S-1).
- () White-green to lug 12 (S-1).
- () Two white-violet-violet to lug 8 (S-2).
- () Two white-blue to lug 4 (S-2).

NOTE: When connecting wires to 11-pin plug AF, remove 1/2" of insulation from the end of each wire, insert the wire into the plug pin from inside the chassis, and solder it as shown in Detail 8-4C. Be sure to note the pin numbers on the back of the plug.



Detail 8-4C

Connect wires from BO#12 to 11-pin plug AF as follows:

- () Strip the insulation from the white-brown wire to a total length of 1/2". Then connect this wire to pin 6 (S-1).
- () Gray to pin 9 (S-1).
- () White-gray to pin 10 (S-1).
- () White-yellow-yellow to pin 1 (S-1).
- () Red to pin 3 (S-1).

Connect the following wires from BO#12 (which were placed through grommet CG) as follows:

- () Place a 1/2" length of small black sleeving over the red wire and connect it to lug 13 of relay BD (S-1). Push the sleeving down over the lug.
- () Connect the green wire to lug 14 of relay BD (NS).
- () Connect the white-green-green wire to lug 3 of terminal strip BE (NS).

Connect three of the wires from BO#11 as follows:

- () Yellow to lug 1 of phono jack AC (NS).
- () White-black to lug 3 of jack AA (NS).
- () White-violet-violet to lug 2 of terminal strip BA (NS).

Connect the remaining wires from BO#11 to the audio circuit board as follows:

- () Three red to 21 (S-3).
- () White-orange to 15 (S-1).
- () White-orange-yellow to 16 (S-1).
- () White-brown to 12 (S-1). There is no hole provided. Solder the wire directly to the foil.
- () Blue to 6 (S-1).
- () White-green to 8 (S-1).
- () White-yellow to 9 (S-1).
- () Violet to 10 (S-1).
- () Orange to 22 (S-1).

Connect the wires from BO#13 as follows:

- () Blue to lug 3 of terminal strip BK (NS).
- () White-brown to lug 7 of V8 (NS).
- () Brown to lug 2 of V8 (NS).
- () Green to lug 2 of terminal strip BR (NS).

- () White-red to lug 4 of terminal strip BN (NS).
- () White-orange-orange to lug 1 of terminal strip BN (NS).
- () Two white-violet-violet to lug 6 of terminal strip BL (NS).
- () Yellow to lug 6 of terminal strip BL (NS).
- () Make sure the wires coming from BO#13 are positioned down against the chassis as shown. Also refer to the photograph on Page 183.

Connect the wires from BO#14 to the RF driver circuit board as follows:

- () White-blue through grommet CE to 14 (S-1).
- () Yellow through grommet CE to 13 (S-1).
- () White-red-red through grommet CD to 11 (S-1).
- () White-orange-yellow through grommet CC to 6 (S-1). Be sure you connect to 6, and not to 9.

The white-black-black wire from grommet CD will be connected later.

Connect the wires from BO#15 to the modulator circuit board as follows:

- () White-violet-violet to 9 (S-1).
- () White-red to 12 (S-1).
- () Two orange to 13 (S-2).
- () White-brown to 11 (S-1).
- () Brown to 10 (S-1).

Connect the wires from BO#16 to the modulator circuit board as follows:

- () Two yellow to 7 (S-2).
- () Brown to 8 (S-1).
- () Two white-yellow to 2 (S-2).
- () Red to 1 (S-1).

The orange wire will be connected later.



- () Place all the wires from BO#18 in the notch at the front of the modulator circuit board and push them up to the top of the chassis. They will be connected later.
- () Connect the white-violet-violet wire from BO#17 to lug 3 of jack L (S-1).

Connect the remaining wires from BO#17 to the modulator circuit board as follows:

- () Two white-red to 6 (S-2).
- () Green to 5 (S-1).
- () Brown to 4 (S-1).
- () White-orange-orange to 3 (S-1).

The two black wires will be connected later.

CHASSIS BOTTOM-COMPONENTS AND WIRING

Refer to Pictorial 8-5 (fold-out from Page 67) for the following steps.

- () Prepare the following lengths of black hookup wire:
 - 2-1/2"
 - 2-1/4"
 - 2-1/2"
 - 4-1/2"
 - 2"
- () Connect a 2-1/2" black hookup wire from lug 3 of control R (S-1) to hole 14 on the IF circuit board (S-1).
- () Connect a 2-1/4" black hookup wire from GA (S-1) to GB (S-1) on the bandpass circuit board. Check the locations carefully before soldering.
- () Connect one end of a 2-1/2" black hookup wire to 14 on the bandpass circuit board (S-1). The other end of this wire will be connected later.
- () Connect one end of a 4-1/2" black hookup wire to D on the bandpass circuit board (S-1). The other end of this wire will be connected later.

- () Connect one end of a 2" black hookup wire to B on the audio circuit board (S-1). The other end of this wire will be connected later.

- () Connect a 100 Ω (brown-black-brown) resistor from lug 2 (S-1) to lug 1 (NS) of phono socket AB.

Connect the leads from the output transformer as follows:

- () Green to lug 1 of phono socket AB (S-2).
- () White to lug 4 of terminal strip BA (NS).
- () Black to lug 2 of terminal strip BA (S-2).

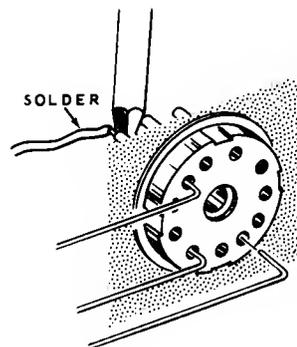
NOTE: When bare wire is called for in a step, use small bare wire unless the large bare wire is specifically called for.

- () Prepare the following lengths of wire:

- 2-1/2" bare
- 3" bare
- 3-1/4" bare
- 1-1/4" bare
- 4-1/2" black hookup
- 1-1/4" large bare
- 8-1/2" large red (strip one end 5/8")
- 3" large bare

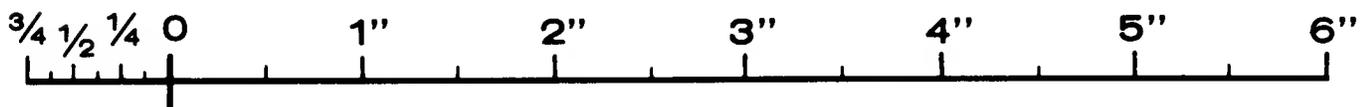
CAUTION: Before soldering bare wires in the following steps, make sure they do not touch any insulated wires.

- () Refer to Detail 8-5A and connect a 2-1/2" bare wire from lug 2 of phono socket AD (NS) to pin 2 of 11-pin plug AF (S-1).

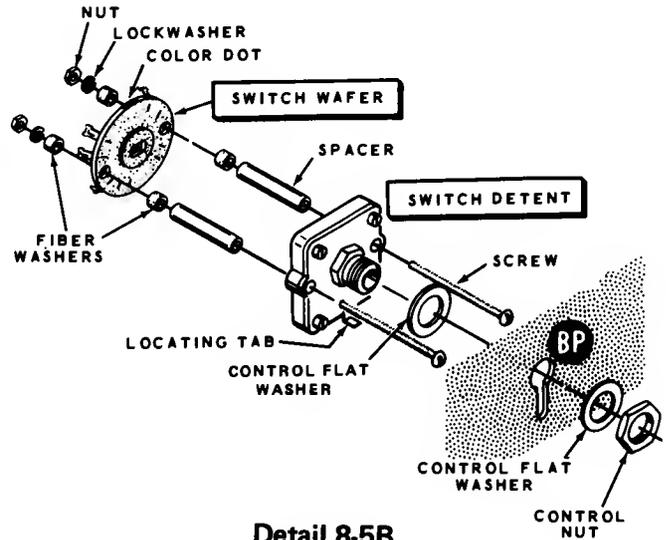


- ① PUSH THE WIRE INTO THE HOLE UNTIL IT COMES OUT OF THE END OF THE PIN
- ② APPLY SOLDER TO THE TIP OF THE HEATED PIN. SOLDER WILL FLOW INTO THE PIN BY CAPILLARY ACTION. AFTER THE CONNECTION HAS COOLED, CUT OFF THE EXCESS WIRE AT THE END OF THE PIN.

Detail 8-5A



- () Connect a 3" bare wire from lug 2 of phono socket AD (NS) to pin 5 of 11-pin plug AF (S-1).
- () Connect a 3-1/4" bare wire from lug 2 of phono socket AD (S-3) to pin 7 of 11-pin plug AF (S-1).
- () Connect a 1-1/4" bare wire from lug 2 of phono socket AG (S-1) to lug 9 of relay BD (S-1).
- () Connect a 4-1/2" black hookup wire to pin 11 of 11-pin socket AF (S-1). Pass the other end of this wire through grommet CG, through a 1/2" length of small black sleeving, and connect it to lug 5 of relay BD (S-1). After the solder cools, push the sleeving down over the lug.
- () Connect a 1-1/4" length of large bare wire from lug 1 of phono socket AG (S-1) to lug 12 of relay BD (S-1).
- () Pass the 5/8" stripped end of the 8-1/2" large red wire through grommet CG to pin 4 of 11-pin plug AF (S-1). Pass the other end of this wire through grommet BJ. This end of the wire will be connected later.



Detail 8-5B

- () Pass one end of a 3" large bare wire through lug 10 of switch BP (S-2) to lug DB3 (NS). Form the other end so it contacts lug DB2 (S-2) and connects to lug 8 of relay BD (NS).

NOTE: In the following step, the hardware supplied with the switch wafer may be different from the hardware shown in the Detail. Use only the hardware supplied with the switch when assembling the switch wafer to the switch detent.

Refer to Detail 8-5B for the next two steps.

- () Remove the hardware from switch wafer #63-395 and note the sequence in which it is removed.
- () Assemble the rotary switch wafer to a switch detent. Note the relationship of the color dot on the switch wafer and the locating tab on the switch detent. Then mount the assembly at BP, using two control flat washers and a control nut. Place the locating tab in the slot.

Connect the large red wires coming from grommet BF as follows:

- () Wire coming from lug 1 of the final tank coil DD (lug nearest the front of the chassis) to variable capacitor lug DB3 (S-2).
- () Wire from lug 2 of the final tank coil to lug 11 of switch BP (S-1).
- () Wire from lug 3 of the final tank coil to lug 12 of switch BP (S-1).
- () Wire from lug 4 of the final tank coil to lug 1 of switch BP (S-1).
- () Wire from lug 5 of final tank coil to lug 2 of switch BP (S-1).



() Prepare the following lengths of wire.

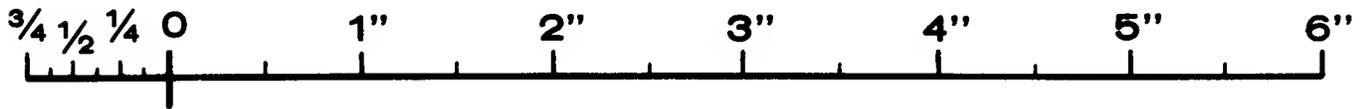
<u>BROWN</u>	<u>WHITE</u>	<u>BLACK</u>	<u>OTHER</u>
3-1/2"	4-1/2"	2-3/4"	5" Red
6-1/2"	5-1/2"	2"	3/4" Bare
5"	5-1/2"	4-1/2"	

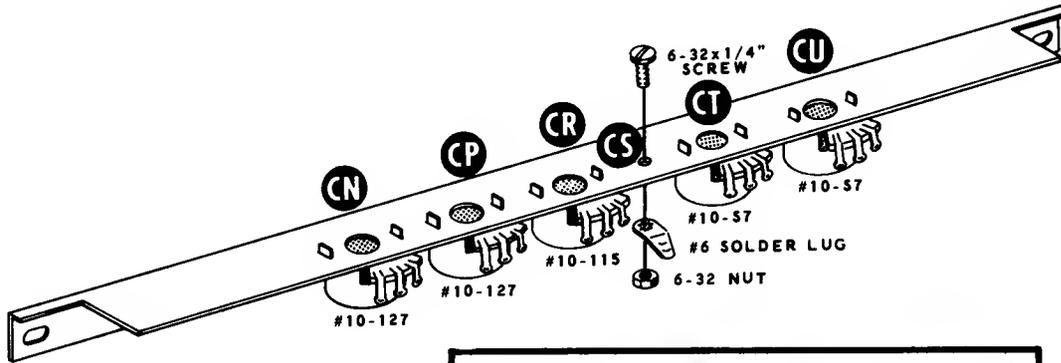
- () Connect a 3-1/2" brown hookup wire from lug 2 of tube socket V9 (S-1) to lug 2 of tube socket V8 (NS).
- () Connect a 6-1/2" brown hookup wire from lug 2 of tube socket V8 (NS) to 10 on the RF driver circuit board (S-1).
- () Connect a 4-1/2" white hookup wire from lug 7 of tube socket V8 (NS) to 8 on the RF driver circuit board (S-1).
- () Connect a 5-1/2" white hookup wire from lug 1 of terminal strip BN (NS) to 5 on the RF driver circuit board (S-1).
- () Connect a 2-3/4" black hookup wire from lug 2 of terminal strip BN (NS) to lug 5 of terminal strip BL (NS).
- () Connect a 2" black hookup wire between lug 4 (NS) and lug 6 (NS) of terminal strip BL.

- () Connect a 5" red hookup wire to 1 on the modulator circuit board (S-1). The other end of this wire will be connected later.
- () Connect a 3/4" bare wire between lug 1 (S-1) and lug 2 (S-1) of phone jack L.
- () Refer to Detail 8-5C and mount a 10 kΩ tab-mount control (#10-57) at CU (ZERO ADJ) on the control bracket. Secure the control as shown in the inset drawing.

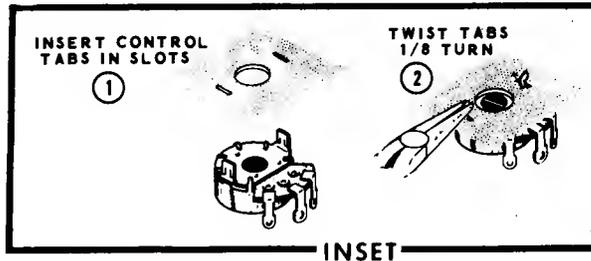
Similarly, mount the following controls:

- () 10 kΩ (#10-57) at CT (Bias).
- () 7.5 MΩ (#10-115) at CR (VOX Delay).
- () 1 MΩ (#10-127) at CP (VOX Sens).
- () 1 MΩ (#10-127) at CN (Anti-Trip).
- () Mount a #6 solder lug at CS. Use a 6-32 x 1/4" screw, and a 6-32 nut.
- () Mount the control bracket at CX and CY as shown in the Pictorial. Use a 6-32 x 3/8" flat head (black) machine screw, a #6 lockwasher and a 6-32 nut at each mounting hole.

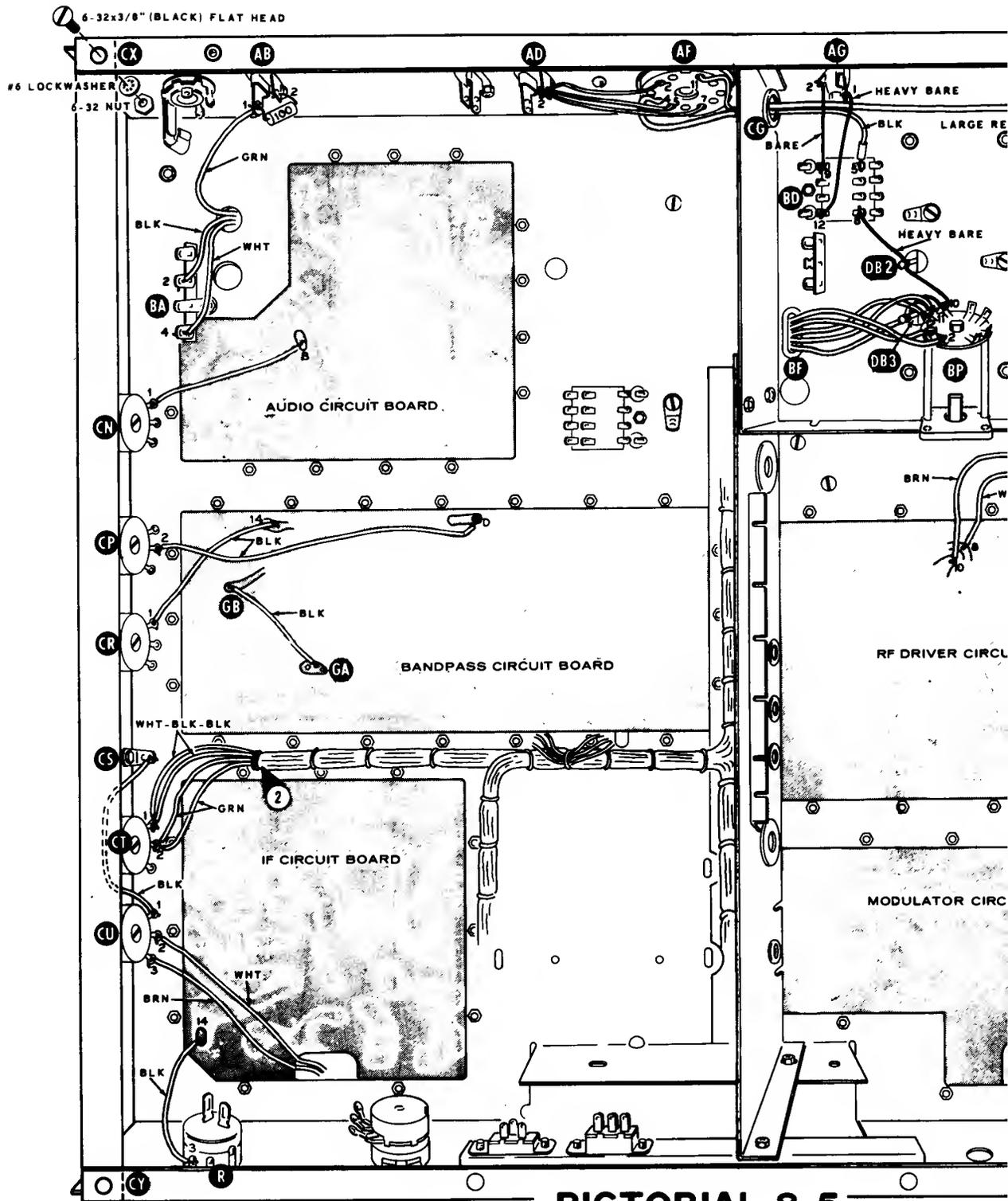




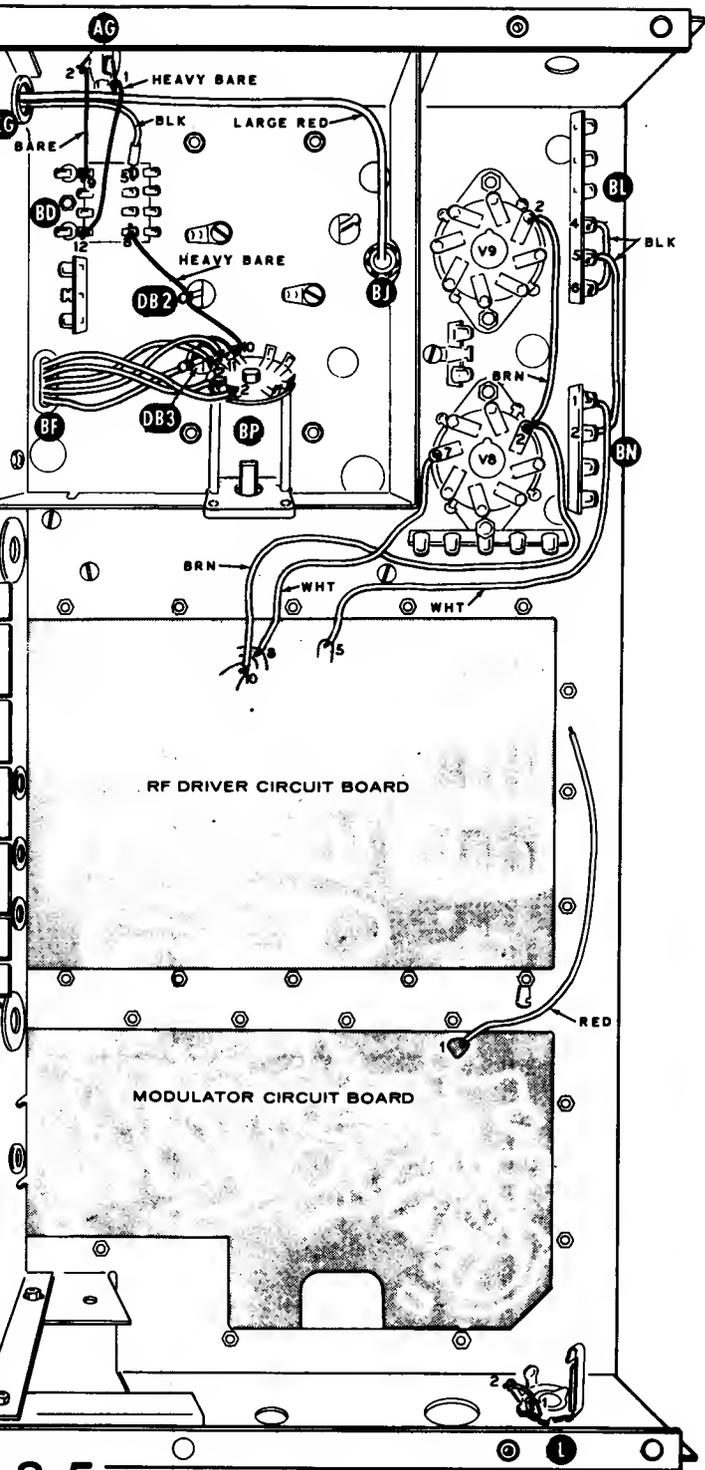
Detail 8-5C



- () Connect a 5" brown hookup wire to lug 3 of control CU (S-1). Place the other end of this wire up through the notch in the IF circuit board. It will be connected later.
- () Connect the two green wires from BO#2 to lug 2 of control CT (S-2).
- () Connect a 5-1/2" white hookup wire to lug 2 of control CU (S-1). Place the other end of this wire up through the notch in the IF circuit board. It will be connected later.
- () Connect two white-black-black wires from BO#2 to lug 1 of control CT (S-2).
- () Connect the black wire from point 14 on the bandpass circuit board to lug 1 of control CR (S-1).
- () Connect the black wire from D on the bandpass circuit board to lug 2 of control CP (NS).
- () Connect a 4-1/2" black hookup wire from lug 1 of control CU (NS) to solder lug CS (NS).
- () Connect the black wire from B of the audio circuit board to lug 1 of control CN (S-1).



PICTORIAL 8-5

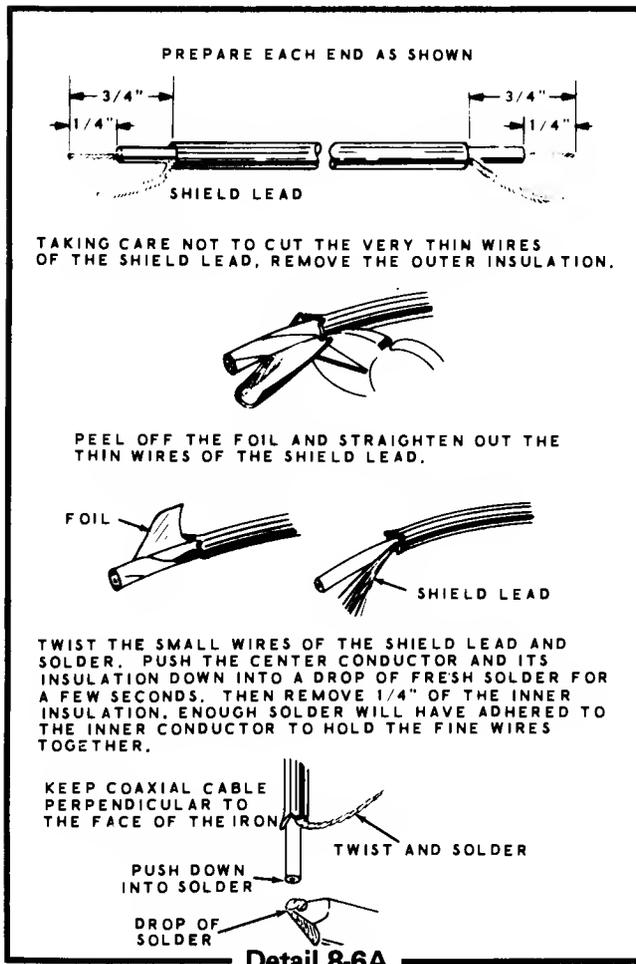


COAXIAL CABLE WIRING

CAUTION: The insulation on the inner lead of a coaxial cable melts quite easily; therefore, the connections should be soldered as quickly as possible to prevent these cables from shorting. When soldering the shield leads, it is advisable to use a pair of long-nose pliers as a heat sink. Grip the shield between the connection and the cable. This will prevent the heat from reaching the insulation of the inner lead. A rubber band around the handles of the pliers will keep them in place to free both hands for soldering.

Refer to Pictorial 8-6 (fold-out from Page 68) for the following steps.

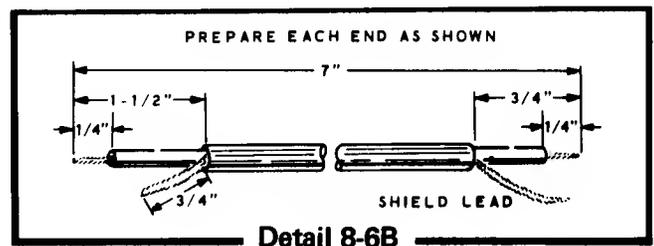
- () Cut the following four lengths of coaxial cable and prepare the ends as shown in Detail 8-6A:
 - One 14-1/2"
 - One 6"
 - Two 7"
- () At one end of the 14-1/2" coaxial cable, connect the center conductor to B (S-1) and the shield lead to the ground foil at GJ (S-1) on the IF circuit board.

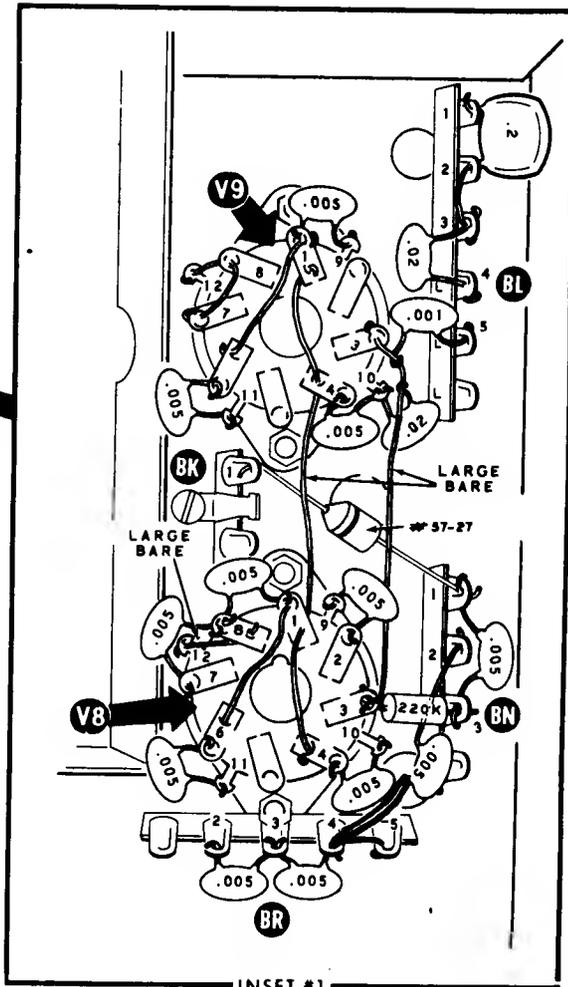
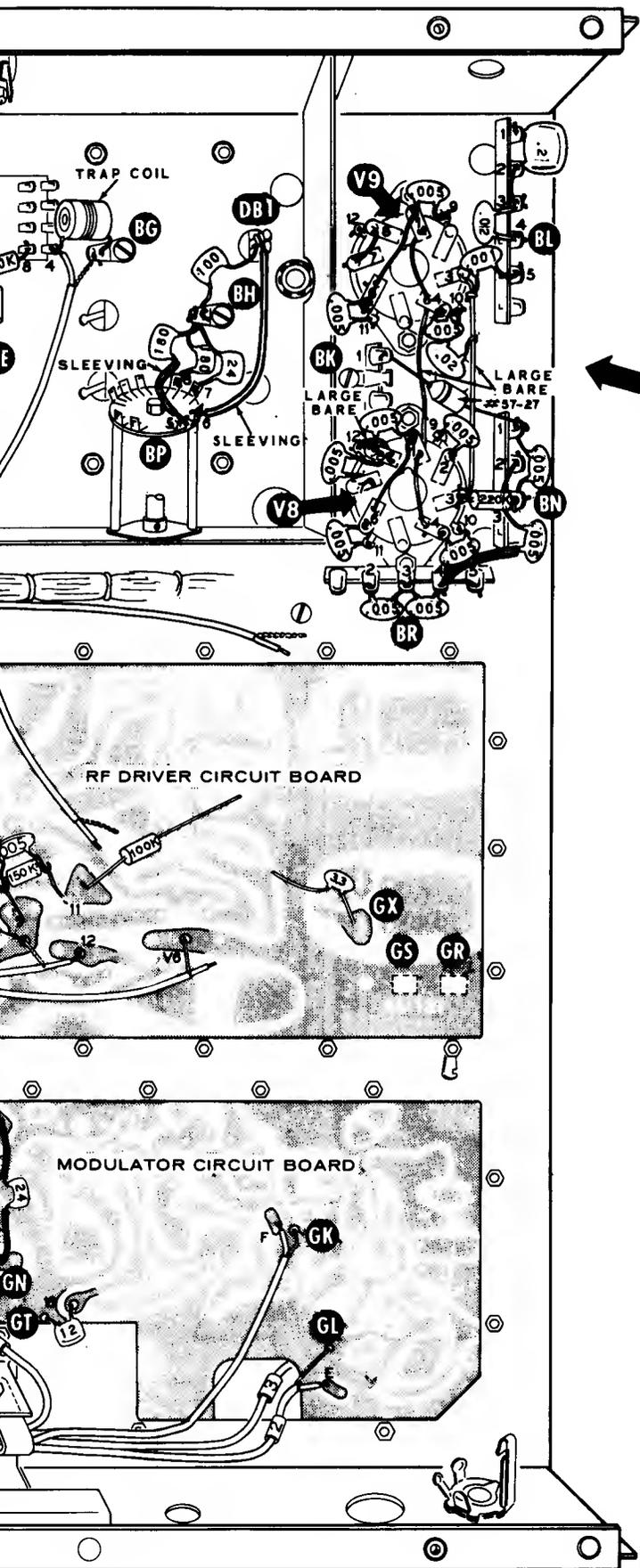


- () At the other end of this cable, connect the center conductor to F (S-1) and the shield lead to the ground foil at GK (S-1) on the modulator circuit board.

NOTE: In the following step, be careful that the lead to GH does not protrude beyond the face of the circuit board.

- () Pass one end of a 6" coaxial cable through grommet CF. Connect the center conductor to A (S-1) and the shield lead to the ground foil at GH (S-1) on the bandpass circuit board. The other end of the cable will be connected later.
- () Pass one end of a 7" coaxial cable along the chassis under other wiring, and through the notch in the final switch shield as shown. Connect the center conductor to lug 4 of relay BD (NS). Put 1/2" of small black sleeving on the shield lead and connect it to solder lug BG (NS). The other end of this cable will be connected later.
- () Pass one end of a 7" coaxial cable through grommet CC to the bandpass circuit board. Connect the center conductor to B (S-1) and the shield lead to GG (S-1) on the bandpass circuit board.
- () At the other end of this 7" cable, connect the shield lead to the center pin of tube socket V6 (S-1). The center conductor will be connected later.
- () Refer to Detail 8-6B and prepare a 7" coaxial cable as shown.
- () Pass the 1-1/2" end of this cable through grommet CC to the bandpass circuit board. You may apply petroleum jelly to the cable to make it easier to pull it through grommet CC. At the 3/4" end, connect the center conductor to 12 on the RF driver circuit board (S-1). Connect shield lead to the foil at GP. Solder the lead directly, to the foil.
- () At the 1-1/2" end, connect the center conductor to C (S-1) and the shield lead to GF (S-1) on the bandpass circuit board.
- () Cut the large black sleeving to a length of 11-3/8". Put aside a piece 1/2" long for use later. Discard any remainder.



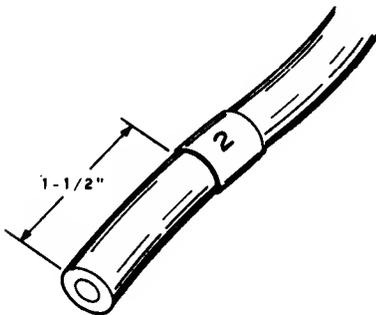


() Cut a 19", a 22-1/2", a 21-1/2", and a 24" length of coaxial cable. Do not prepare the ends.

() Group the four lengths of coaxial cable together in one hand, even the ends, and push them through the 11-3/8" large black sleeving. NOTE: You may wish to cut the sleeving into three equal lengths so you can more easily insert the coaxial cables. You may also use petroleum jelly to make it easier to slide the cables into the sleeving; use a cloth to clean the cables after they are inserted in the sleeving.

() Use scissors to cut out the area in the number sheet containing the numbers 1, 2, 3, and 4. Discard the remainder of the sheet.

NOTE: At the time you are instructed to apply a number to a coaxial cable, peel a strip of six numbers off the waxed paper backing and cut the strip into two pieces of three numbers each. Then wrap one of these strips around each end of the cable as shown in Detail 8-6C.



Detail 8-6C

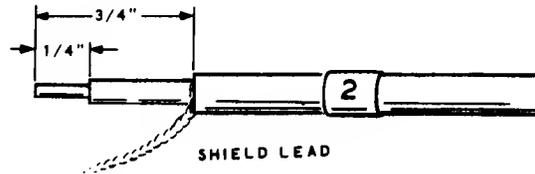
In the following step, you will have to identify and mark both ends of each cable that was placed in the large black sleeving. To identify a cable, hold the sleeving in one hand and pull gently on the cable while watching for movement at the other end of the sleeving. (An ohmmeter can also be used to identify the cables.) After each cable is identified, mark both ends as directed in the following steps.

() Identify the longest (24") coaxial cable and apply #1 strips near each end.

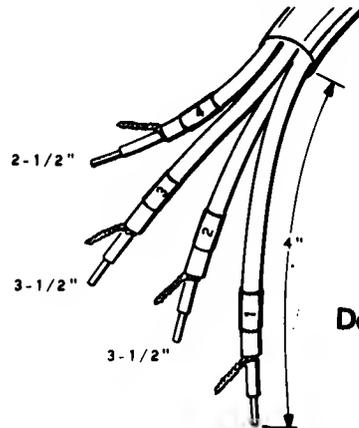
() Identify and mark the other three coaxial cables as follows:

- | | |
|---------|----|
| 21-1/2" | #2 |
| 22-1/2" | #3 |
| 19" | #4 |

() Refer to Detail 8-6D and prepare all the ends of the four coaxial cables in the large sleeving.



Detail 8-6D

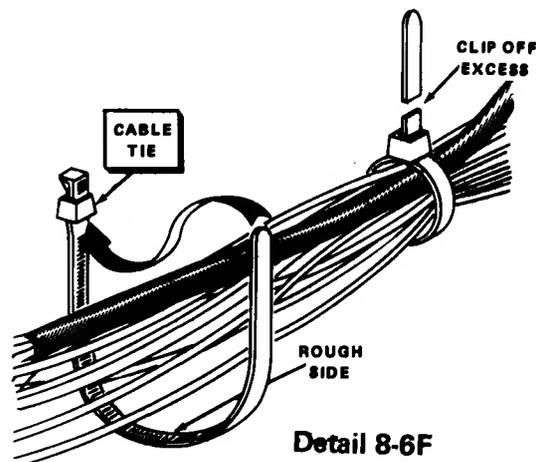


Detail 8-6E

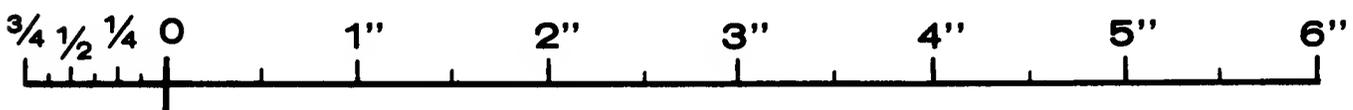
() Refer to Detail 8-6E and, at one end of the black sleeving, adjust the coaxial cables to the lengths shown.

() Form the coaxial cable assembly as shown in the Pictorial, with the end of the black sleeving described in the preceding step positioned between BO#5 and BO#8. Position the other end of the sleeving as shown.

() Refer to Detail 8-6F and pass cable ties (#354-5) around the wiring harness and the coaxial cable assembly at the three points shown in the Pictorial. Pull each cable tie snug and clip off the excess length of the tie.



Detail 8-6F



Connect the ends of the coaxial cables coming from the black sleeving between BO#5 and BO#8 as follows:

- () #1: Center conductor to C on the audio circuit board (S-1), and the shield lead to the adjacent ground foil as shown. (S-1).
- () #2: Center conductor to lug 2 of control CN (S-1), and the shield lead to lug 3 (S-1).
- () #3: Center conductor to lug 3 of control CP (S-1) and the shield lead to lug 1 (NS).
- () #4: Center conductor to E on the bandpass circuit board (S-1) and the shield lead to point GD (S-1). Make sure the end of the shield lead does not protrude beyond the surface of the circuit board.

Connect the four coaxial cables coming from the other end of the large black sleeving as follows:

- () #1: Center conductor to lug 2 of control R (S-1), and shield lead to lug 1 (S-1). Loosen and retighten the control, if necessary, to make the connection.
- () #2: Center conductor to E on the modulator circuit board (S-1) and the shield lead to GL (S-1).
- () #3: Pass the end of the cable up to the top of the chassis through the notch in the modulator circuit board. This end will be connected later.
- () #4: Center conductor to G on the modulator circuit board (S-1) and the shield lead to GN (S-1).

COMPONENT MOUNTING-CHASSIS BOTTOM

Refer to Pictorial 8-6 for the following steps.

- () Connect a 180 pF mica capacitor from lug 8 of switch BP (S-1) to solder lug BH (NS).
- () Connect a 100 pF mica capacitor from lug DB1 (NS) to solder lug BH (NS).
- () Connect a 24 pF mica capacitor from lug 7 of switch BP (S-1) to solder lug BH (NS).
- () Place a 3/4" length of black sleeving on one lead of a 180 pF mica capacitor. Connect this lead to lug 5 of switch BP (S-1). Connect the other lead to solder lug BH (S-4).

- () Place a 1-1/2" length of black sleeving over a 2" length of large bare wire. Connect this bare wire from lug 6 of switch BP (S-1) to lug DB1 (S-2).

- () Connect a .02 μ F disc capacitor from lug 2 of terminal strip BE (NS) to lug 14 of relay BD (S-2).

- () Connect a .01 μ F disc capacitor between lugs 2 (NS) and 3 (NS) of terminal strip BE.

- () Connect a 330 Ω (orange-orange-brown) resistor between lugs 1 (NS) and 2 (S-3) of terminal strip BE.

- () Connect a 10 k Ω (brown-black-orange) resistor from lug 1 of terminal strip BE (NS) to lug 8 of relay BD (S-2). NOTE: In the following step, mount the diode so the body is 3/8" above the terminal strip.

- () Connect the lead from the banded end of a 1N191 diode (#56-26) to lug 1 (S-3) and the other lead to lug 3 (S-3) of terminal strip BE.

- () Connect either lead of an 8.5 MHz trap coil (#40-546) to lug 4 of relay BD (S-2). Connect the other lead to solder lug BG (S-2).

- () Connect a 1" length of large bare wire from lug 12 (S-1), through lug 8 (S-2) to lug 7 (S-1) of tube socket V9.

- () Connect a 3/4" length of large bare wire from lug 12 (S-1) to lug 8 (NS) of tube socket V8. Note that there are two holes in each lug. Position this wire in the lower hole (next to the body of the socket).

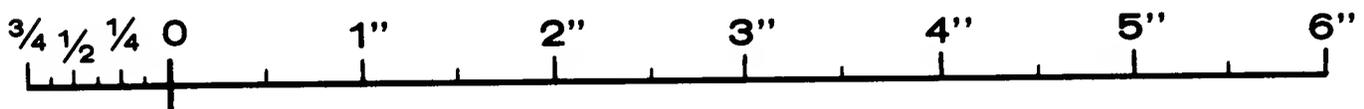
- () Push a 3" length of bare wire through lugs 4 (NS) and 1 (NS) of tube socket V8 and through lug 4 (NS) to lug 1 (NS) of tube socket V9. Place this wire in the lower hole of the lugs.

NOTE: Do not use the .005 μ F 1.6 kV disc capacitors unless they are specifically called for in a step.

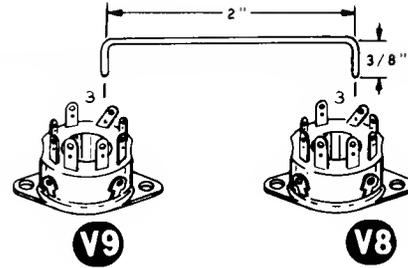
- () Pass one lead of a .005 μ F disc capacitor through lug 1 (S-3) to lug 6 (NS) of tube socket V9. Connect the other lead to lug 9 (S-1).

- () Connect a .005 μ F disc capacitor from lug 11 (S-1) to lug 6 (NS) of tube socket V9.

- () Connect a .005 μ F disc capacitor from lug 4 (S-3) to lug 10 (NS) of tube socket V9.

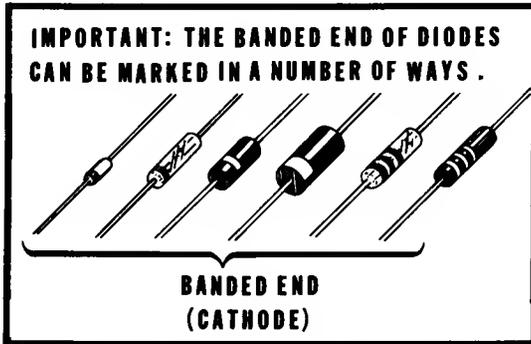


- () Pass one lead of a .005 μF disc capacitor through lug 1 (S-4) to lug 6 (NS) of tube socket V8. Connect the other lead to lug 8 of the same tube socket (NS).
- () Connect a .005 μF disc capacitor from lug 6 (S-2) to lug 11 (S-1) of tube socket V8.
- () Connect a .005 μF disc capacitor from lug 4 (S-2) to lug 10 (S-1) of tube socket V8.
- () Connect a .005 μF disc capacitor between lugs 7 (S-3) and 8 (NS) of tube socket V8.
- () Connect a .005 μF disc capacitor between lugs 2 (S-4) and 9 (S-1) of tube socket V8.
- () Connect a .005 μF disc capacitor from lug 2 (NS) to lug 3 (NS) of terminal strip BR.
- () Connect one lead of a .005 μF disc capacitor to lug 3 of terminal strip BR (S-2). Pass the other lead of this capacitor through lug 4 (NS) to lug 5 (NS) of this terminal strip.
- () Connect a 220 k Ω (red-red-yellow) resistor from lug 3 of socket V8 (NS) to lug 3 of terminal strip BN (NS).
- () Place a 1/2" length of small black sleeving on one lead of a .005 μF disc capacitor. Connect this lead to lug 4 of terminal strip BR (NS), and the other lead to lug 2 of terminal strip BN (NS).



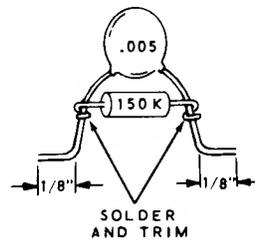
Detail 8-6H

- () Refer to Detail 8-6H and form a 2-3/4" length of large bare wire as shown. Connect this wire from lug 3 of tube socket V8 (S-2) to lug 3 of tube socket V9 (S-1). Bend the lugs out to permit the wire to enter the lugs easily. Do not attempt to bend the wires around the lugs.
- () Connect a .02 μF disc capacitor from lug 10 of tube socket V9 (S-2) to the bare wire in the preceding step (S-1).
- () Connect a .001 μF disc capacitor from lug 5 of terminal strip BL (NS) to the same bare wire (S-1).
- () Refer to Detail 8-6J, and solder each lead of a .005 μF disc capacitor to a 150 k Ω (brown-green-yellow) resistor. Cut the leads below the resistor to 3/8". Then bend a 1/8" "foot" on each lead, as shown.



Detail 8-6G

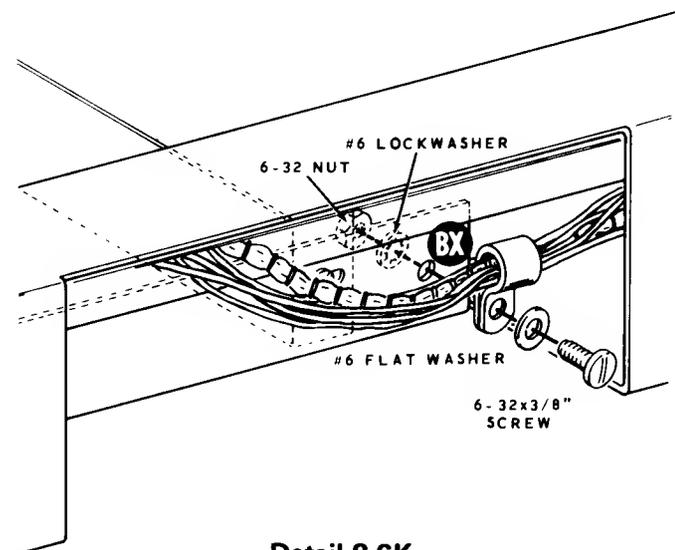
- () Connect the banded end of a 1N2071 diode (#57-27) to lug 1 of terminal strip BK (NS). Connect the other lead to lug 1 of terminal strip BN (NS).
- () Connect a .005 μF disc capacitor between lugs 1 (NS) and 3 (S-2) of terminal strip BN.
- () Connect a .02 μF disc capacitor between lugs 3 (NS) and 4 (NS) of terminal strip BL.
- () Pass the lead at the banded end of a .2 μF Mylar capacitor through lug 2 (NS) to lug 3 (NS) of terminal strip BL. Connect the other lead to lug 1 (NS).

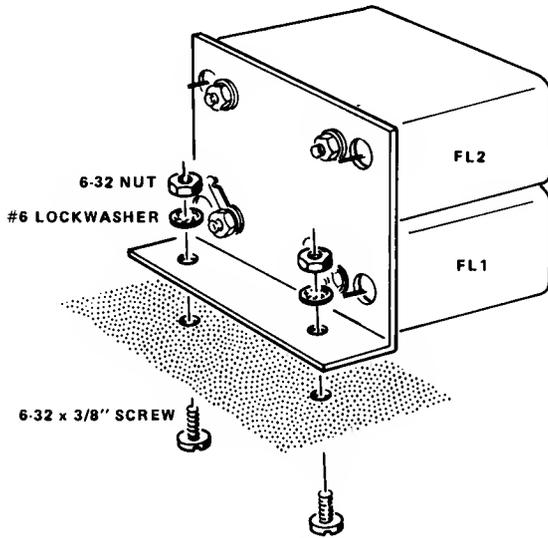
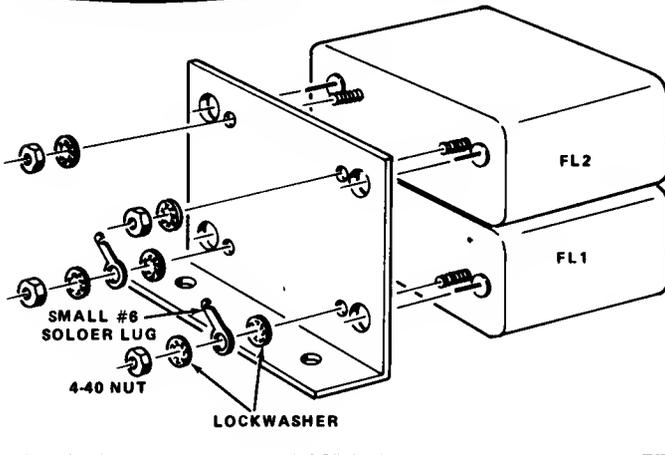


Detail 8-6J

- () Position this resistor-capacitor combination so one foot is at point 11 (S-1) and the other at point GP (S-1) on the RF driver circuit board.
- () Bend a 1/8" foot on the end of one lead of a 100 k Ω (brown-black-yellow) resistor and position this foot on point 11 as in the preceding step (S-1). DO NOT shorten the leads of this resistor. The other lead of this resistor will be connected later.

- () Cut each lead of a 3.3 pF disc capacitor to 5/8". Bend a 1/8" foot on the end of one lead and position this foot at point GX on the RF driver circuit board (S-1). The other lead of this capacitor will be connected later.
- () Place a 5/8" length of black sleeving on each lead of a 24 pF mica capacitor. Connect this capacitor between points 15 (S-1) and 16 (S-1) on the modulator circuit board.
- () Cut each lead of a 12 pF mica capacitor to a length of 3/8", and bend a 1/8" foot on each lead. Connect this capacitor between points 18 (S-1) and GT (S-1) on the modulator circuit board.
- () Cut each lead of a .005 μ F disc capacitor to a length of 3/8" and form a "foot" on each. Connect one foot to center pin GE of V12 (S-1) and the other foot to 12 (S-1) on the bandpass circuit board.
- () Cut each lead of a .001 μ F disc capacitor to 3/8". Bend a 1/8" foot on the end of each lead. Solder one foot to the foil at 8 and the other lead to the foil at GU on the bandpass circuit board.
- () Connect the lead at the banded end of a .05 μ F tubular capacitor to lug 4 of terminal strip BA (S-2). Place a 1/2" length of sleeving on the other lead and connect it to hole 20 on the audio circuit board (S-1).
- () Connect the lead at the banded end of a .2 μ F Mylar capacitor to lug 3 of jack AA (NS). Connect the other end of this capacitor to lug 1 of terminal strip BA (NS).
- () Connect a 330 Ω (orange-orange-brown) resistor between lugs 1 (S-2) and 3 (S-1) of terminal strip BA.
- () Connect the lead at the positive (+) end of a 10 μ F electrolytic capacitor (#25-147) to lug 2 of phono socket AC (NS). Connect the other lead to point GC on the audio circuit board (S-1). There is no hole at this location.
- () Connect a .005 μ F disc capacitor between lugs 1 (S-2) and 2 (S-2) of socket AC.
- () Connect a 500 pF disc capacitor between lugs 1 (S-2) and 2 (S-2) of control CP.
- () Pass one lead of a 2.2 M Ω (red-red-green) resistor through lug 3 (S-2) to lug 2 (S-1) of control CR. Connect the other lead to solder lug CS (S-2).
- () Connect one lead of a 4700 Ω (yellow-violet-red) resistor to lug 3 of control CT (S-1). Connect the other lead to lug 1 of control CU (S-2).
- () Connect the cathode end of a 1N2071 diode (#57-27) to lug 2 of control P (S-1). Connect the other lead to 12 on the IF circuit board (S-1).
- () Place a 5/8" length of black sleeving on each lead of a 1N2071 diode (#57-27). Connect the cathode lead to lug 3 of jack AA (S-3). Connect the other lead to 16 (S-1) on the audio circuit board.
- () Refer to Detail 8-6K and place a 1/2" cable clamp over the wiring harness and the four coaxial cables that pass in front of the chassis center shield. Mount the cable clamp at BX on the front of the chassis, as shown, with 6-32 x 3/8" hardware.





Detail 8-6L

Refer to Detail 8-6L for the following steps.

- () Mount the SSB crystal filter (#404-328) on the filter mounting bracket at FL-1. Use two small #6 solder lugs, four #4 lockwashers, and two 4-40 nuts as shown in the Detail.

NOTE: If you have purchased the 400 Hz CW crystal filter, mount it to the crystal filter bracket at FL-2. Use #4 lockwashers and 4-40 nuts.

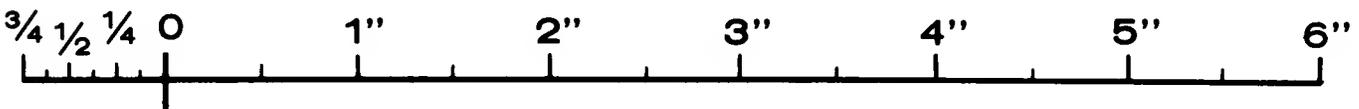
- () Mount the crystal filter and bracket assembly at BU. Use 6-32 x 3/8" hardware.

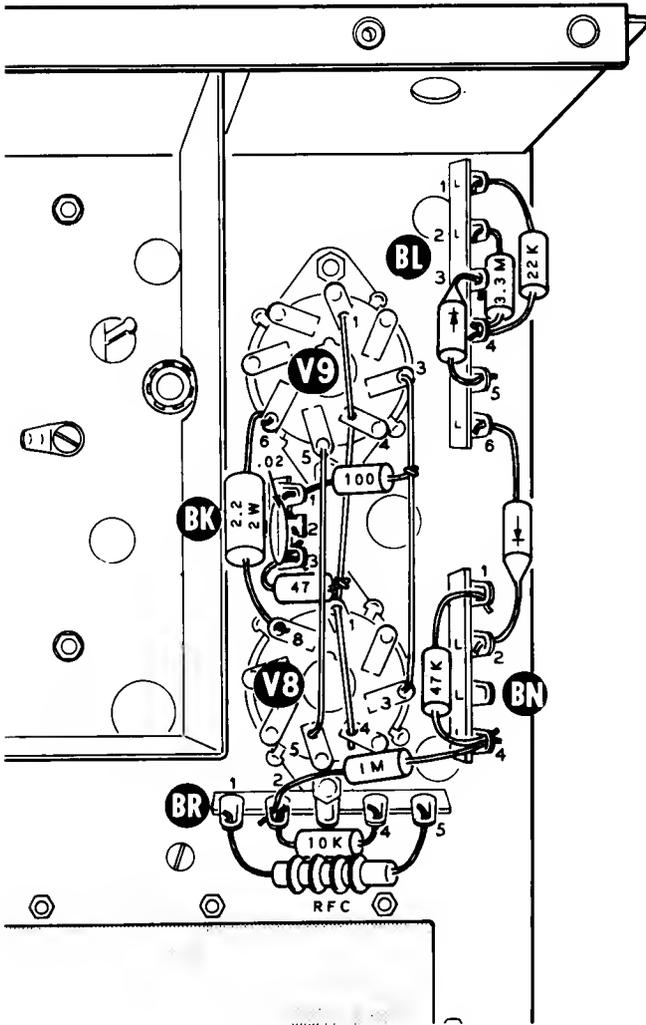
NOTE: Use 1/2 watt resistors unless the step directs otherwise.

- () Connect a 1-3/4" bare wire from lug 1 of crystal filter FL-1 (S-1) to lug 3 of switch EB (S-1).
- () Connect a 2000 Ω (red-black-red) resistor from solder lug 2 of crystal filter FL-1 (S-1) to lug 2 of switch EB (NS).
- () Place a 3/4" length of sleeving over one lead of a .001 μF disc capacitor. Connect this lead to lug 2 of switch EB (S-2) and connect the other lead to hole 15 on the IF circuit board (S-1). Check the Pictorial for the correct hole.
- () Connect a 1-1/2" bare wire from lug 4 of crystal filter FL-1 (S-1) to lug 5 of switch EC (S-1).
- () Place a 1" length of sleeving over one lead of a .001 μF capacitor. Insert this lead through grommet CA in the center shield and connect it to hole 14 in the modulator circuit board (S-1). Check the Pictorial for the correct hole.
- () Place the other lead of this capacitor through lug 6 (S-2) to lug 1 (S-1) of switch EC. Use a 1/2" length of sleeving on the lead between lugs 1 and 6.
- () Connect a 2-1/2" bare wire from lug 3 of switch EC (S-1), through solder lug 3 of crystal filter FL-1 (S-2), to lug 4 of switch EC (S-1). Use a 1" length of sleeving on the wire between lug 3 of EC and solder lug 3.

NOTE: If you have the 400 Hz CW crystal filter installed, perform the next two steps. If this filter is not used, disregard the next two steps.

- () Connect a 1" bare wire from lug 2 of crystal filter FL-2 (S-1) to lug 2 of switch EC (S-1).
- () Connect a 1" bare wire from lug 1 of crystal filter FL-2 (S-1) to lug 1 of switch EB (S-1).





PICTORIAL 8-7

Refer to Pictorial 8-7 for the following steps.

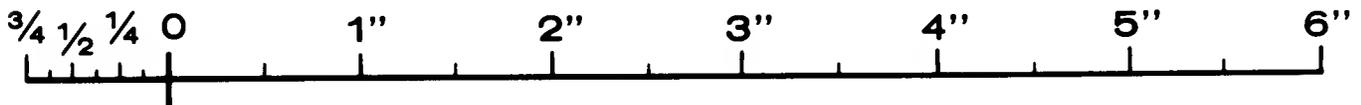
- () Connect a 47 Ω (yellow-violet-black) resistor from lug 3 of terminal strip BK (NS) to the bare wire between lug 1 of tube socket V8 and lug 4 of tube socket V9 (S-1).
- () Connect a .02 μF disc capacitor between lugs 2 (S-1) and 3 (S-3) of terminal strip BK.
- () Connect a 100 Ω (brown-black-brown) resistor from lug 1 of terminal strip BK (S-2) to the bare wire

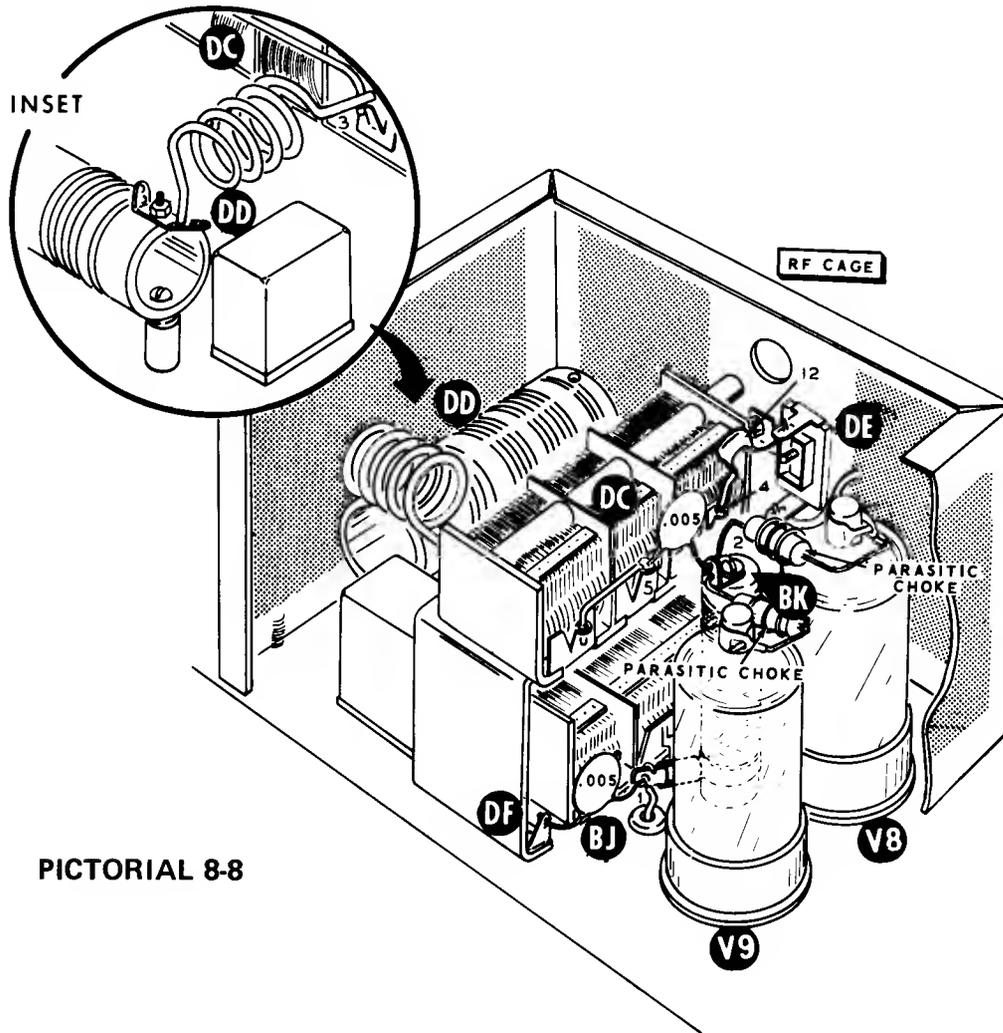
between lug 3 of tube socket V8 and lug 3 of tube socket V9 (S-1).

- () Connect a 2.2 Ω (red-red-gold) 2 watt resistor from lug 6 of tube socket V9 (S-3) to lug 8 of tube socket V8 (S-4).
- () Connect a 3.3 MΩ (orange-orange-green) resistor between lugs 2 (S-3) and 4 (NS) of terminal strip BL.
- () Connect a 22 kΩ (red-red-orange) resistor between lugs 1 (S-2) and 4 (S-4) of terminal strip BL.
- () Connect a 47 kΩ (yellow-violet-orange) resistor between lugs 1 (S-5) and 4 (NS) of terminal strip BN.
- () Connect a 1 MΩ (brown-black-green) resistor from lug 2 of terminal strip BR (NS) to lug 4 of terminal strip BN (S-3).
- () Connect a 10 kΩ (brown-black-orange) resistor between lugs 2 (S-4) and 4 (S-4) of terminal strip BR.
- () Connect a .5 mH RF choke (#45-30) between lugs 1 (NS) and 5 (S-2) of terminal strip BR.
- () Connect the cathode lead of a 1N2071 diode to lug 3 (S-3) and the other lead to lug 5 (S-3) of terminal strip BL.
- () Connect the cathode lead of a 1N2071 diode to lug 2 of terminal strip BN (S-3). Connect the other lead to lug 6 of terminal strip BL (S-5).
- () Refer to Detail 8-7A and form a 2-7/8" large bare wire. Connect one end of this wire to lug 5 of tube socket V9 (S-1) and the other end to lug 5 of tube socket V8 (NS). Bend the lugs out enough so that the wire can enter the lugs without more bending.



Detail 8-7A





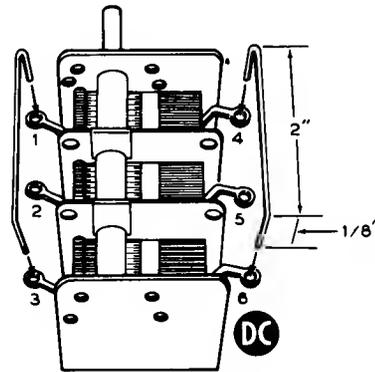
PICTORIAL 8-8

WIRING RF SECTION-CHASSIS TOP

Refer to Pictorial 8-8 for the following steps.

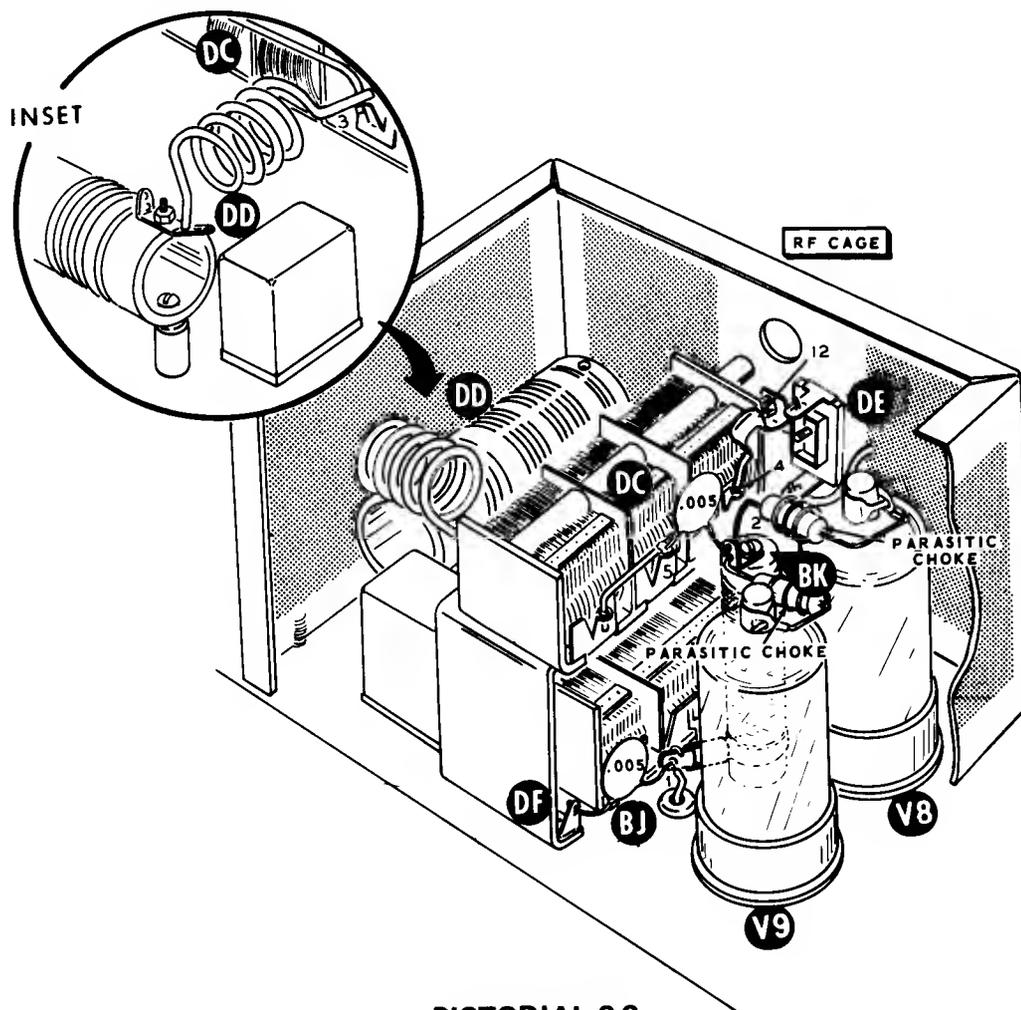
CAUTION: To prevent voltage flash-over, make sure that the spacing between the bare wire in the following step and any other undesired metal parts is greater than the spacing between the rotor and stator plates of the capacitor.

- () Refer to Detail 8-8A and cut two heavy bare wires 2-1/4" long. Bend down each end of each wire 1/8".
- () Fit one end of one wire into lug 1 (S-1), and the other end into lug 3 (NS) of capacitor DC.
- () Form lug 2 of the capacitor to touch this bare wire (S-2).
- () Fit the remaining bare wire into lugs 4 (NS) and 6 (S-1) and to touch lug 5 (NS) of the capacitor.



Detail 8-8A

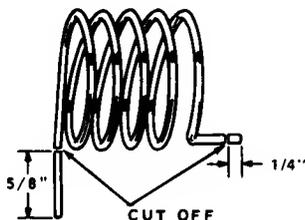
- () Place 1/2" of black sleeving on one lead of a 12 pF mica capacitor and connect this lead to lug 4 of variable capacitor DC (S-2).
- () Connect the other lead of this capacitor to the upper terminal of mica trimmer capacitor DE (S-1).



PICTORIAL 8-8
(Repeat)

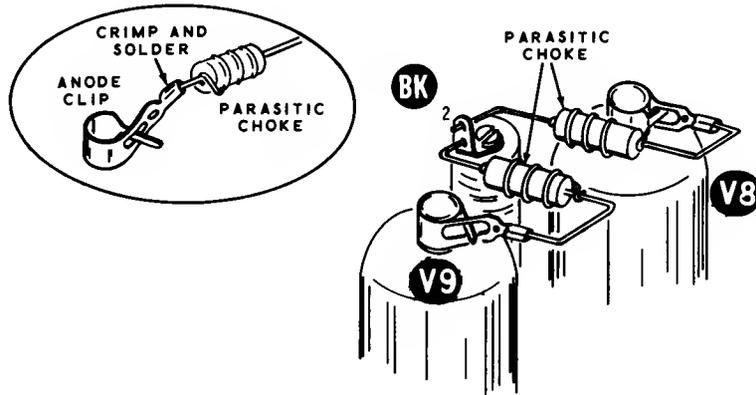
- () Refer to Detail 8-8B and cut 5/8" from the long end and 1/4" from the short end of the 10 meter final tank coil (#40-549).

NOTE: Turn the shaft of capacitor DC fully clockwise (open) before fitting the coil in the following steps. This will avoid the possibility of mechanical obstruction. After fitting the coil, close the capacitor plates again.



Detail 8-8B

- () Connect the 10 meter final tank coil from the solder lug on coil DD (S-1) to lug 3 of capacitor DC (S-2). Place the coil leads on the lugs and hold them securely with the solder.
- () Place a 1/2" length of large black sleeving (previously prepared) over lug 1 (the lower solder lug) of the RF choke at BK. Connect the free end of the large red wire coming from grommet BJ to this lug (NS).
- () Cut each lead of a .005 μ F, 1.6 kV, disc capacitor to a length of 5/8". Connect one lead to lug 1 of the RF choke (S-2). Connect the other lead to solder lug DF (S-1).



Detail 8-8C

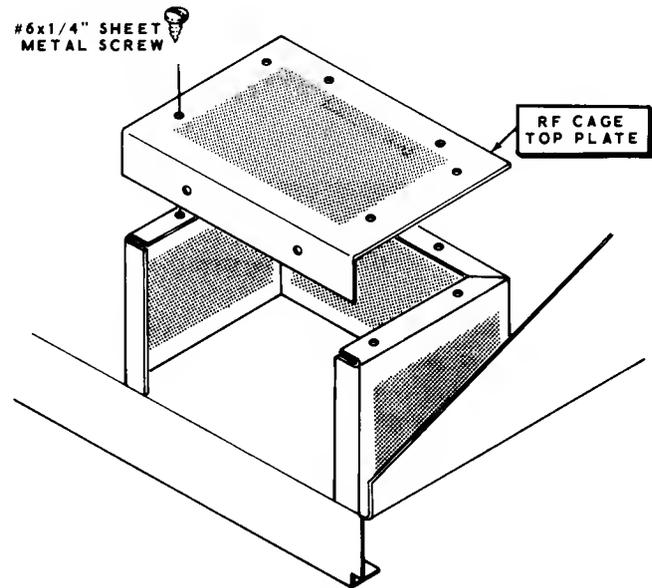
NOTE: Tube types 6146 and 6146A may be directly interchanged.

- () Install type 6146 tubes in tube sockets V8 and V9. Place an anode clip on the cap of each (the appearance of the anode clip may vary).
- () Refer to Detail 8-8C and form the two parasitic chokes (#45-53) as shown. Connect one lead of a choke to the anode clip of tube V8 (S-1), and connect one lead of the other choke to the anode clip of tube V9 (S-1).

NOTE: In the following step, if either hole of the solder lug is filled with solder, melt it out and clear the hole before attempting to connect the parasitic chokes.

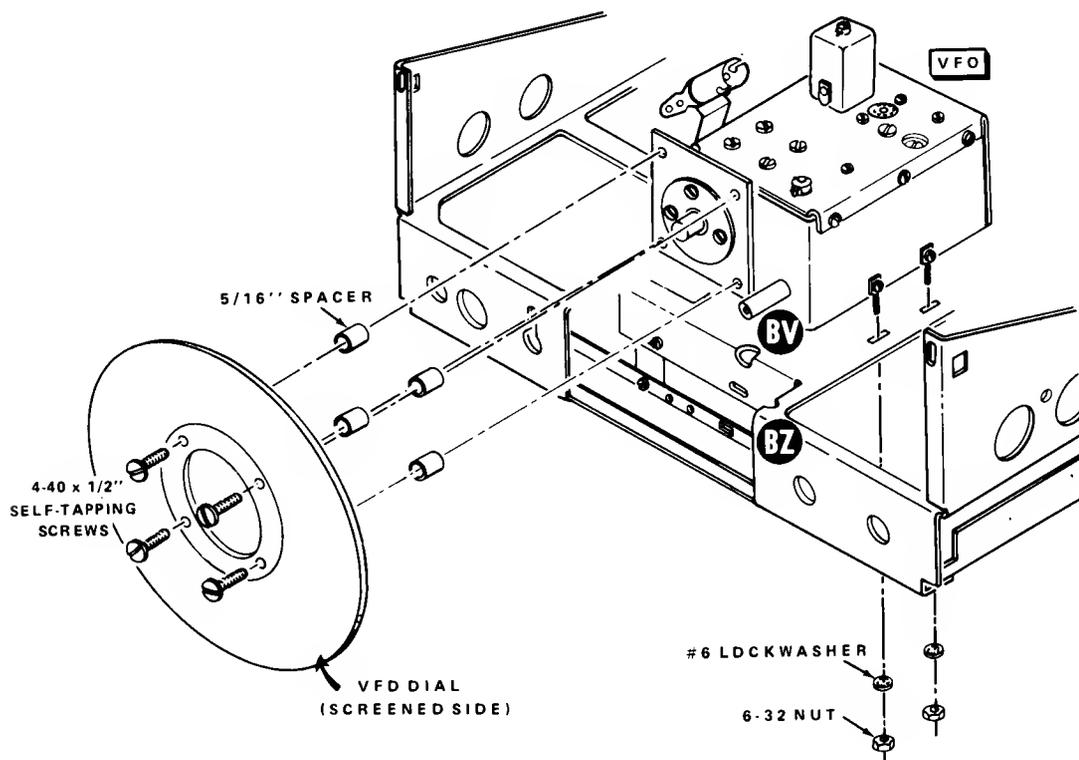
- () Place the other lead of the V9 parasitic choke in the lower hole of lug 2 on top of RF choke BK (NS).
- () Place the free lead of the V8 parasitic choke in the upper hole of lug 2 on top of RF choke BK (NS).
- () Connect a .005 μ F, 1.6 kV, disc capacitor from lug 2 of RF choke BK (S-3) to lug 5 of capacitor DC (S-3).

- () Refer to Detail 8-8D and mount the RF cage top plate on the RF cage. Use #6 x 1/4" sheet metal screws in the six holes on top of the cage.



Detail 8-8D

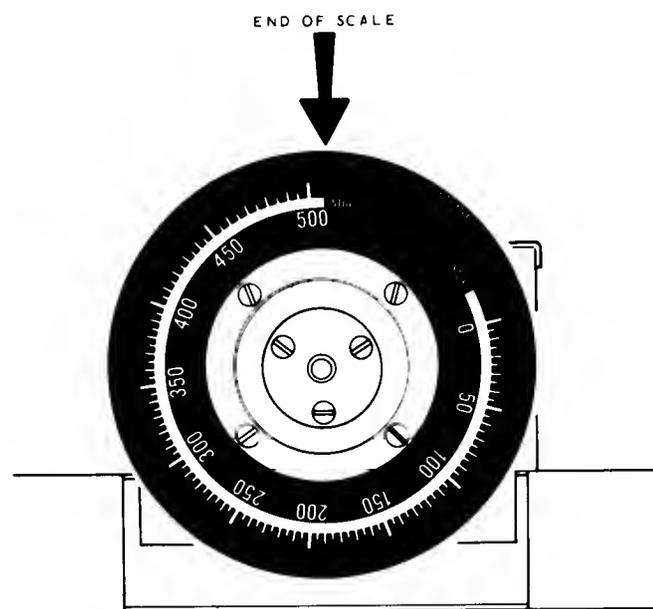




PICTORIAL 8-9

Refer to Pictorial 8-9 for the following steps.

- () Squeeze out some grease from the silicone grease pod and apply a small amount to the gears of the VFO tuning capacitor at the point where they meet. Rotate the shaft several times to distribute the grease to all the gear teeth.
- () Remove the protective backing from the circular dial. Then mount the dial on the drive mounting plate. Use the 4-40 x 1/2" self-tapping screws, which were put aside earlier, and the 5/16" long spacers.
- () Turn the VFO shaft to its full counterclockwise position. Then slip the circular dial with one hand until the "500" end of the scale is at the 12 o'clock position as shown in Detail 8-9A.
- () Mount the VFO assembly at area BV with one spade bolt in each of the four slots. Use #6 lockwashers and 6-32 nuts. The nuts will be tightened later. Be sure the edge of the circular dial is positioned in the circular notch at BZ.



Detail 8-9A

MOUNTING PARTS-FRONT PANEL

Refer to Pictorial 8-10 for the following steps.

- () Lay a soft cloth on the work area to prevent scratching of the front panel. Position the panel as shown.
- () Mount the Jackson drive on the dial drive plate. Use 3-48 x 1/4" hardware. Remove and discard the two small brass screws as before.
- () Fit the escutcheon to the front of the panel with one mounting stud in each of the four holes. Align the openings in the escutcheon and the panel.
- () Remove the protective strip from the dial window (#446-41-2). Fit the two holes over the upper two escutcheon studs, and press the adhesive against the back of the panel.
- () Place a speednut over each of the four escutcheon studs and press the nuts firmly against the back of the panel.
- () Mount this dial drive assembly on the front panel at D. Use 4-40 x 3/8" screws in the two tapped holes. Leave these screws finger-tight only.

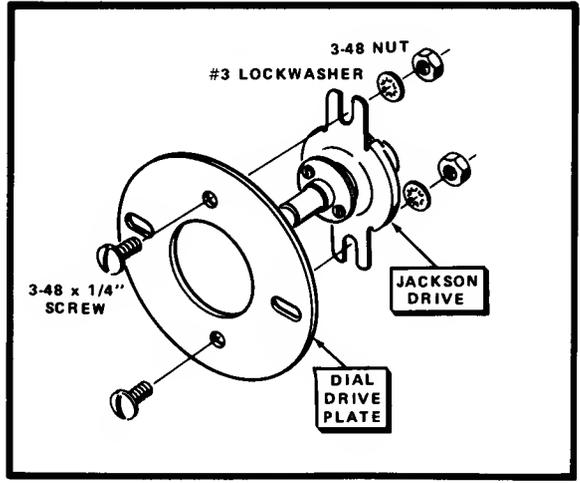
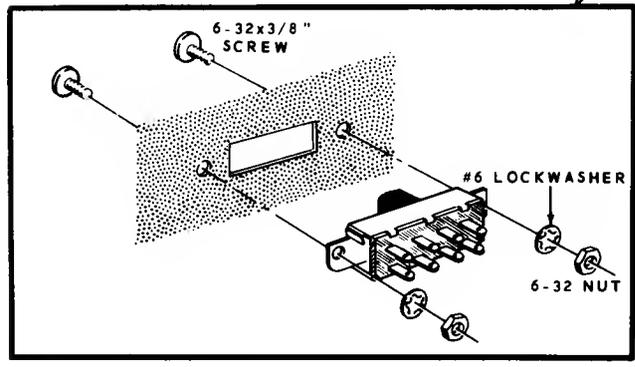
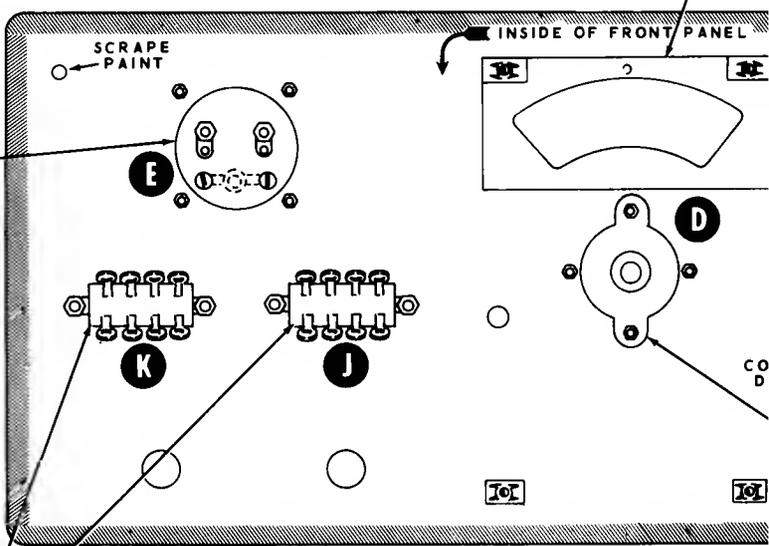
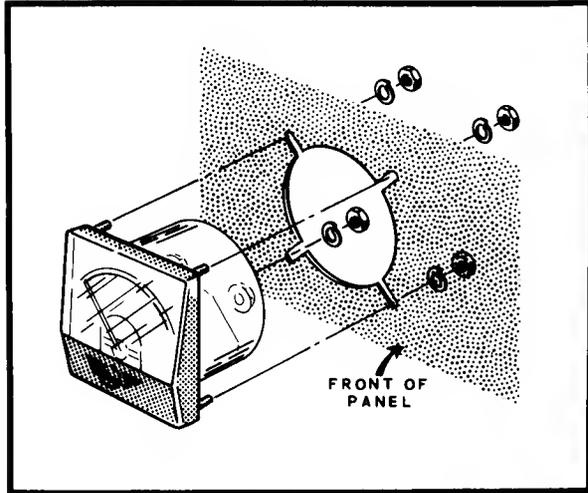
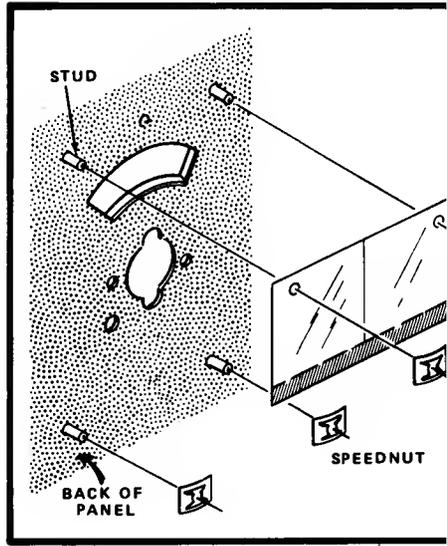
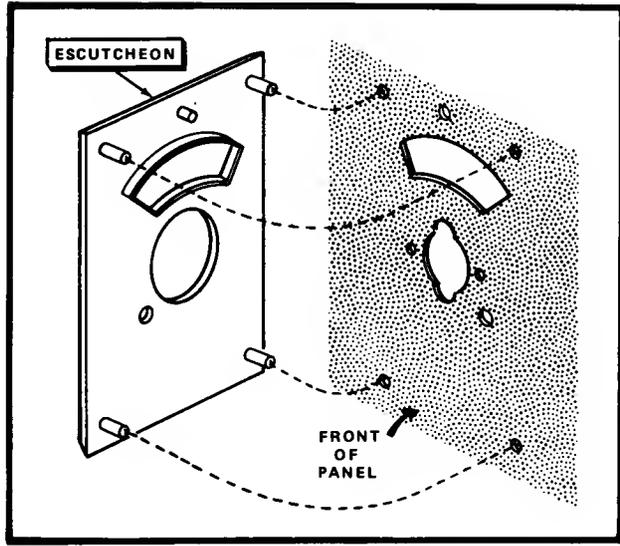
NOTE: Wherever solder lugs are used on the front panel, scrape off any excess paint around the hole on the inside of the panel, and at the points shown on the Pictorial.

- () Mount a 10 k Ω - 1 M Ω dual control (#12-48) at F. Use a control solder lug, a control flat washer, and a control nut. Position the control and solder lug as shown in the Pictorial. Bend the solder lug against lug 1 (NS) and cut off the 1/4" excess.

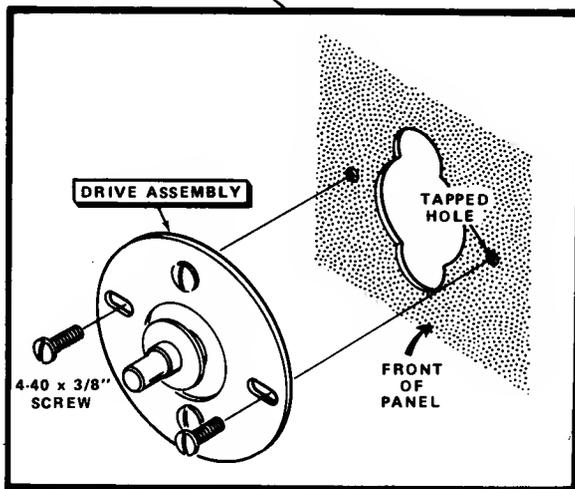
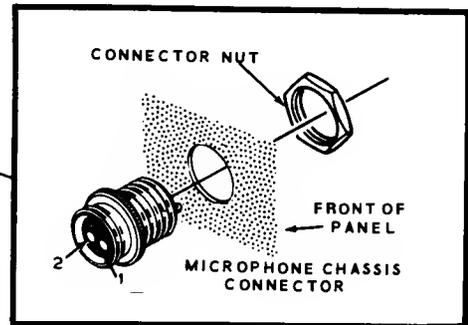
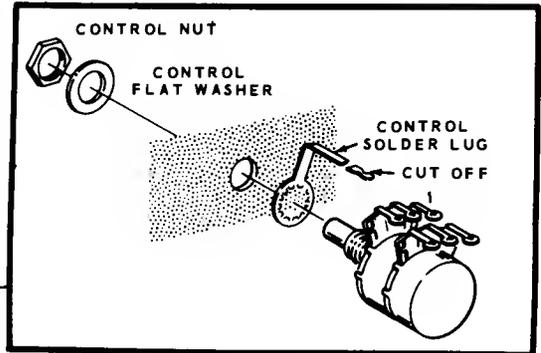
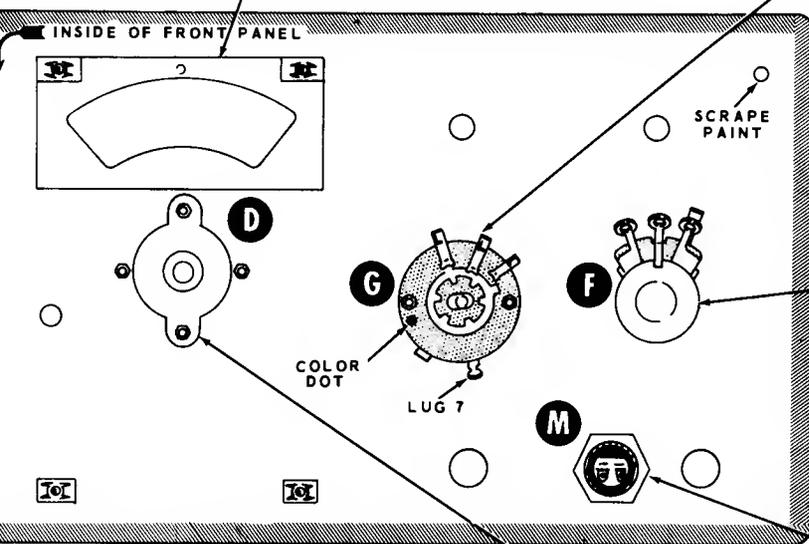
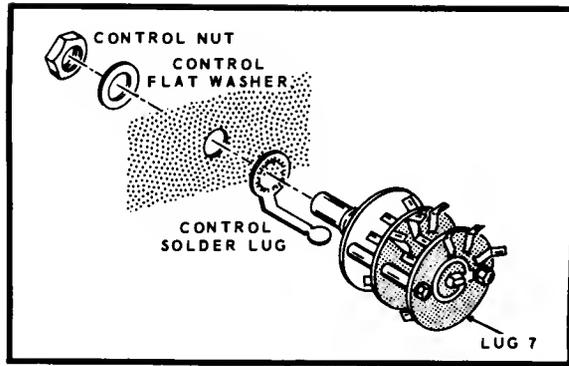
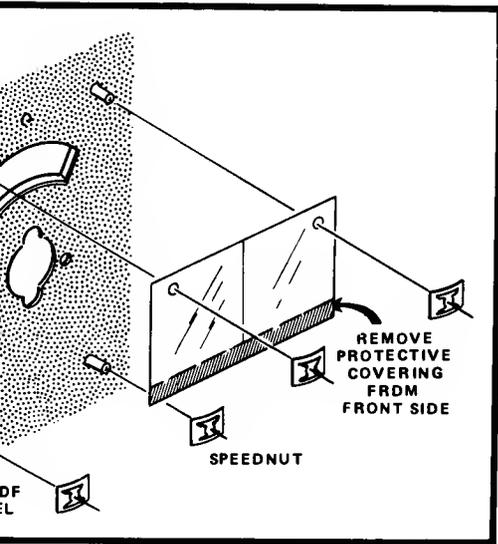
- () Mount a 4-position 2-section switch (#63-399) at G. Use a control solder lug, a control flat washer, and a control nut. Reshape the solder lug as shown so it will touch lug 7 of the rear wafer.
- () Mount a DPTT slide switch at J. Use 6-32 x 3/8" hardware .
- () Mount a DPTT slide switch at K. Use 6-32 x 3/8" hardware.
- () Remove and discard the wire shorting clip from between the lugs of the meter.
- () Mount the meter at E, using the lockwashers and nuts furnished with the meter. Do not overtighten the nuts.

NOTE: Before mounting the microphone chassis connector in the following step, be sure the small screw that holds the connector together is snug, but not too tight. Place a drop of fingernail polish or glue over the head of this screw to keep it from working loose.

- () Mount the microphone chassis connector on the front of the panel at M with only the nut supplied with the connector. Position lug 1 as shown. Lug numbers are molded into the connector. Tighten the nut to draw the connector into the panel. Then, without disturbing the connector, remove the nut. It will be reinstalled later, together with the lockwasher.



PICTORIAL 8-1



FRONT PANEL WIRING

Refer to Pictorial 8-11 for the following steps.

- () Prepare the following lengths of hookup wire:
- 1-1/4" black
 - 2-1/4" black
 - 2-3/4" black
- () Connect a 1-1/4" black wire between lugs 1 (S-2) and 6 (NS) of control F. Be sure the control solder lug is soldered to lug 1 of the control.
- () Connect a 2-1/4" black hookup wire to lug 4 of control F (NS). The other end of this wire will be connected later.
- () Similarly, connect a 2-3/4" black hookup wire to lug 5 of control F (S-1).

NOTE: To make it easier to locate the lugs, each lug location (hole) of the rotary switches will be given a number, even though every hole does not have a lug. Lug locations are numbered starting at the color dot and proceeding clockwise (viewed from the knob end).

- () Solder the control solder lug to lug 7 on the rear wafer of switch G.
- () Position the bottom edge of the front panel against the front of the chassis. It may be necessary to prop the top edge of the front panel up slightly to make wiring easier.
- () Connect the violet wire from BO#18 of the wire harness to lug 3 of control F (S-1).

Connect the wires from BO#18 of the wire harness to the front wafer (nearest the front panel) of switch G as follows:

- () White-yellow to lug 11 (S-1).
- () Blue to lug 9 (S-1).
- () White-violet-violet to lug 6 (S-1).
- () White-black to lug 3 (S-1).
- () White-green to lug 1 (S-1).

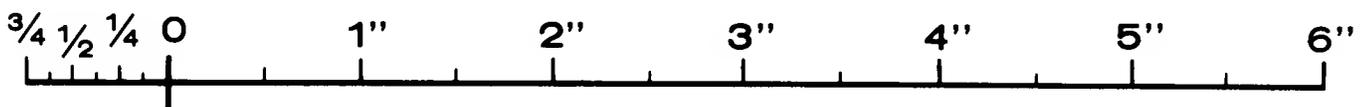
- () Connect a 5" black wire from lug 2 of control F (S-1) to lug 4 on the front wafer of switch G (S-1).
- () Green to lug 16 (S-1).
- () White-gray to lug 18 (S-1).
- () White-orange to lug 20 (S-1).
- () White-orange-orange to lug 13 (S-1).
- () White-blue-blue to lug 15 (S-1).
- () Yellow to lug 17 (S-1).
- () White-red to lug 19 (S-1).

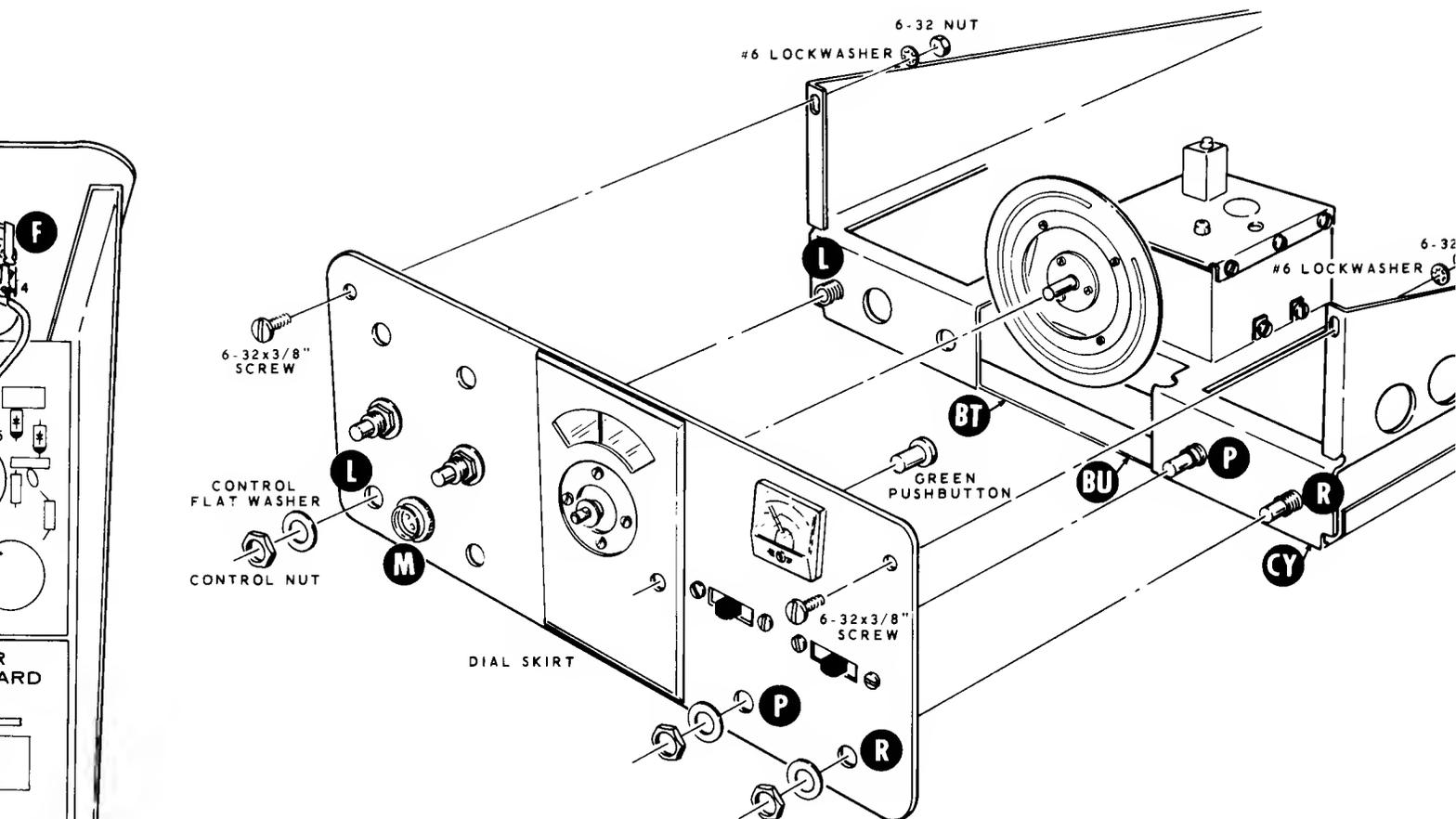
Connect the wires from BO#18 of the wire harness to the rear wafer of switch G as follows:

- () White-red-red to lug 18 (S-1).
- () Black to lug 20 (S-1).
- () Gray to lug 3 (S-1).
- () Prepare the following lengths of wire:
- 2" black
 - 2-3/4" black
 - 3" black
 - 3" black

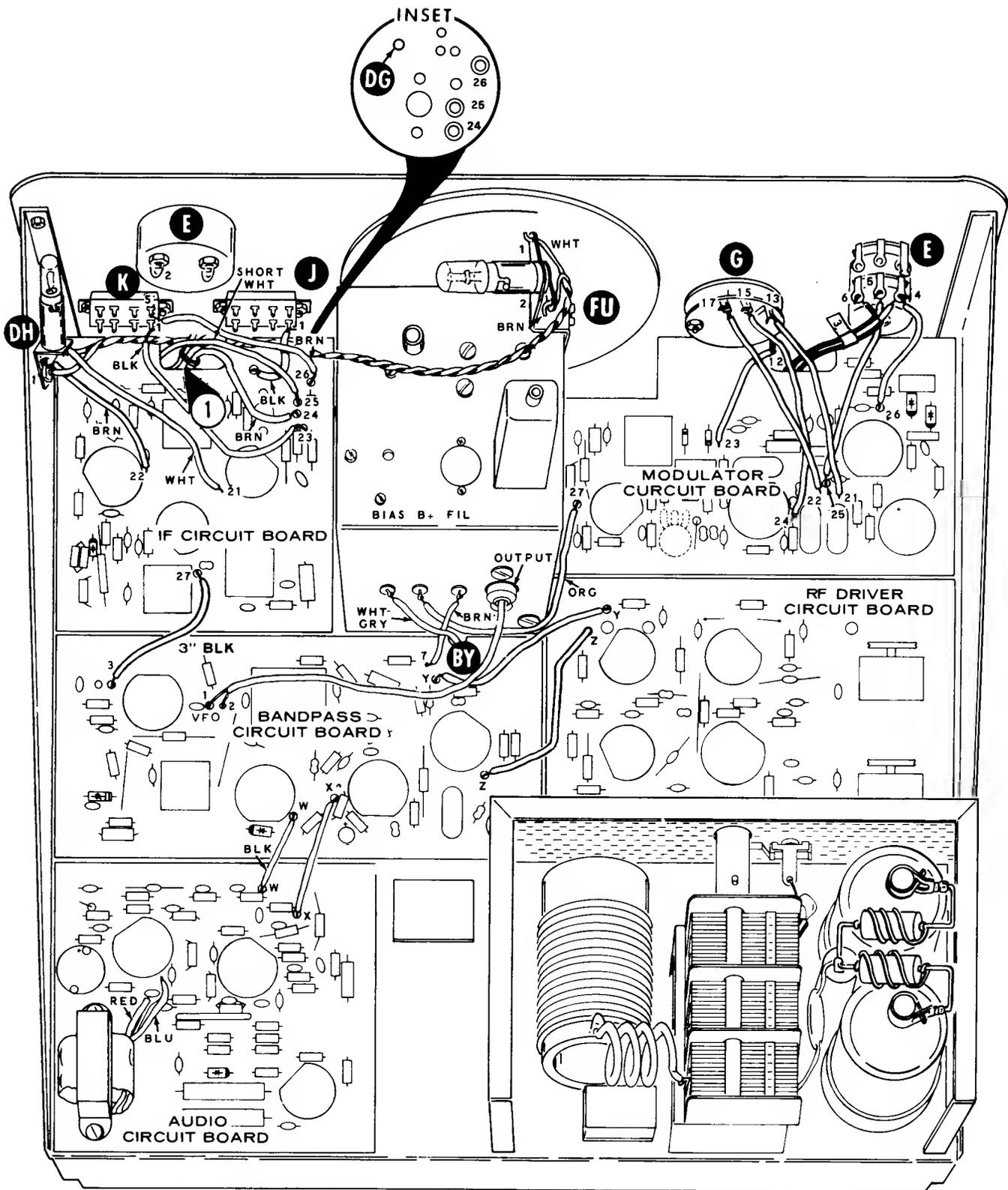
NOTE: In the following four steps, connect only one end of each wire to the rear wafer of switch G. The free ends will be connected later.

- () 2" black wire to lug 12 (S-1).
- () 2-3/4" black wire to lug 13 (S-1).
- () 3" black wire to lug 15 (S-1).
- () 3" black wire to lug 17 (S-1).

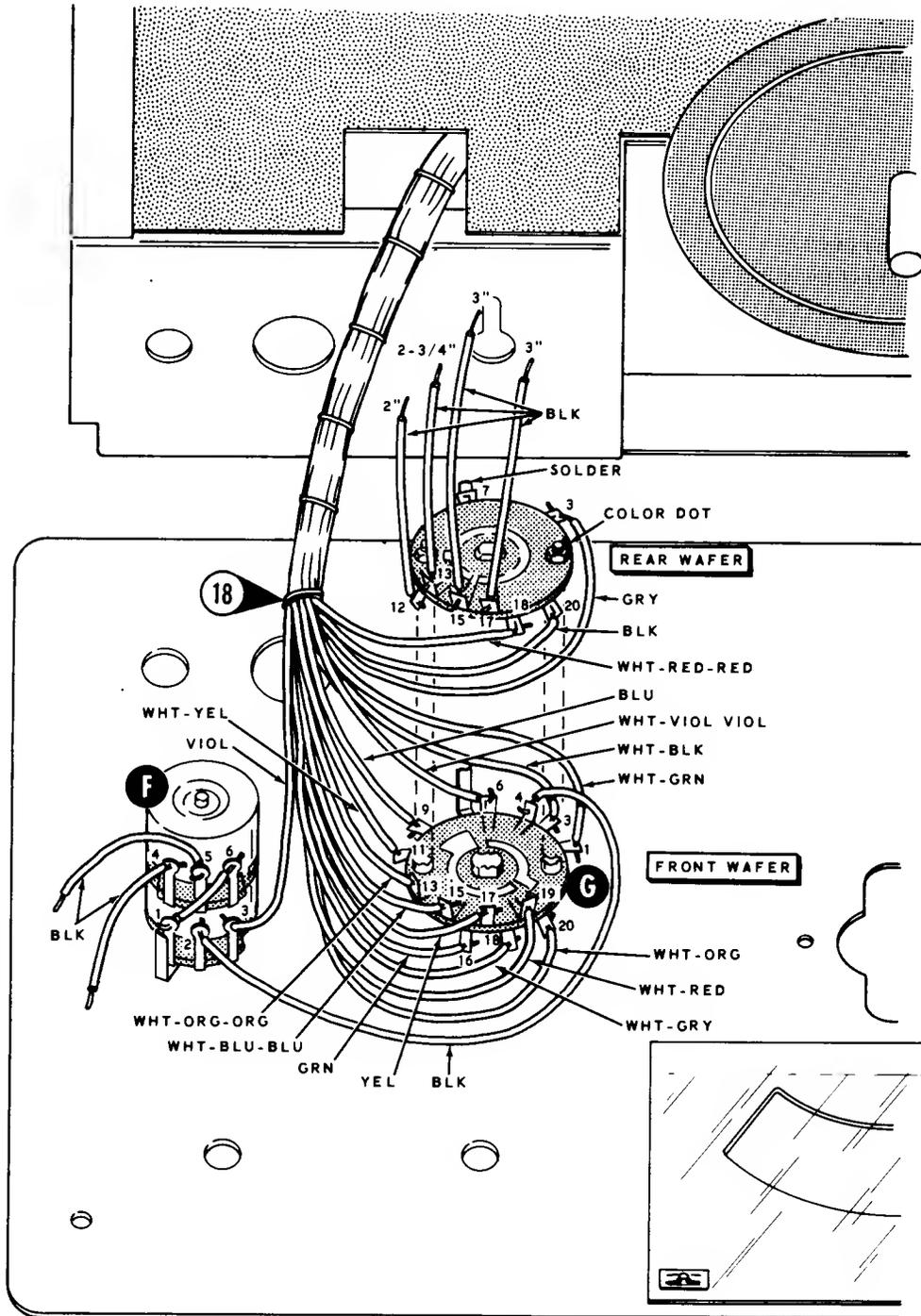




PICTORIAL 8-13



PICTORIAL 8-14



PICTORIAL 8-11

Refer to Pictorial 8-12 for the following steps.

() Prepare the following lengths of hookup wire:

- 4" black
- 3-1/2" black
- 2-1/2" black
- 3-1/4" brown
- 4" black (strip one end 1/2")
- 1-1/2" black (strip one end 1/2")
- 1-1/2" black

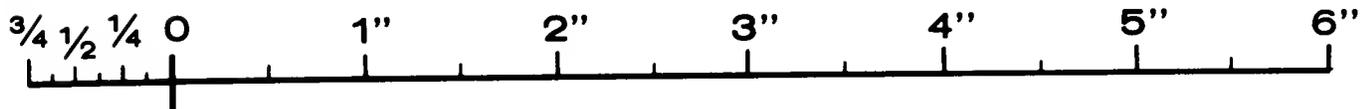
NOTE: In the following steps, if only one end of a wire is connected, its free end will be connected later.

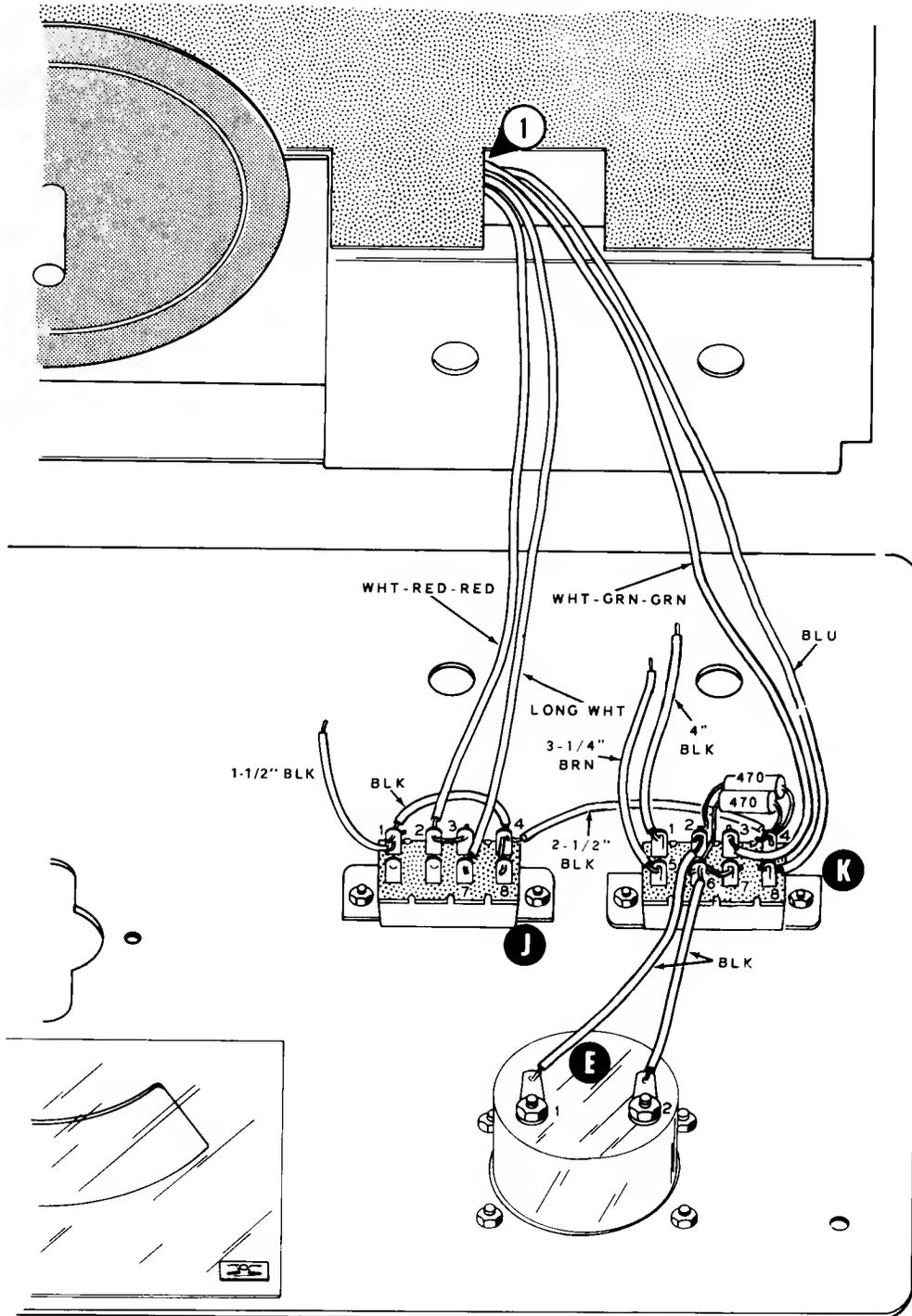
- () Connect a 4" black wire to lug 1 of switch K (S-1).
- () Connect a 3-1/2" black wire to lug 2 of switch K (NS). Connect the other end of this wire to lug 1 of the meter (S-1).
- () Connect a 2-1/2" black wire to lug 4 of switch K (NS). Connect the other end of this wire to lug 4 of switch J (NS).
- () Connect a 3-1/4" brown wire to lug 5 of switch K (S-1).

- () Push the 1/2" stripped end of a 4" black wire through lug 6 (NS) to lug 7 (S-1) of switch K. Connect the other end of this wire to lug 2 of the meter (S-1).
- () Push the 1/2" stripped end of a 1-1/2" black wire through lug 4 (S-3) to lug 8 (S-1) of switch J. Connect the other end of this wire to lug 1 of switch J (NS).
- () Connect one end of the remaining 1-1/2" black wire to lug 1 of switch J (S-2).

Connect the wires from BO#1 as follows:

- () Remove an additional 1/4" of insulation from the white-red-red wire. Push this end of the wire through lug 2 (S-2) to lug 3 (S-1) of switch J.
- () Long white to lug 7 of switch J (S-1).
- () White-green-green to lug 3 of switch K (S-1).
- () Blue to lug 8 of switch K (S-1).
- () Connect a 470 Ω (yellow-violet-brown) resistor from lug 2 (S-2) to lug 4 (NS) of switch K.
- () Connect a 470 Ω (yellow-violet-brown) resistor from lug 6 (S-3) to lug 4 (S-3) of switch K.



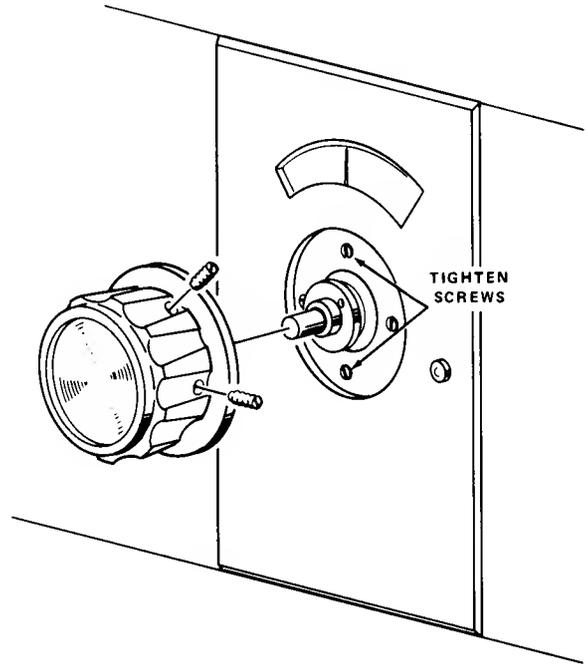


PICTORIAL 8-12

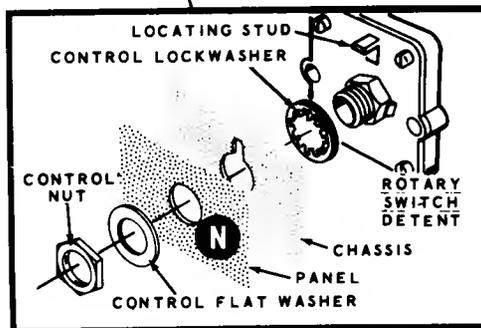
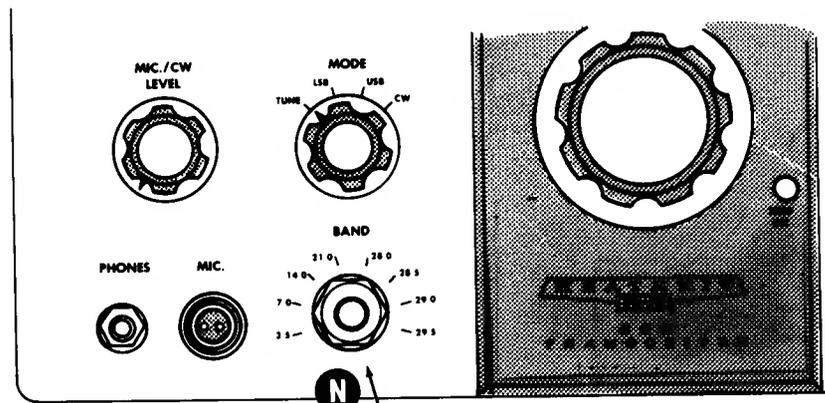
FRONT PANEL MOUNTING

Refer to Pictorial 8-13 (fold-out from Page 80) for the following steps.

- () Remove the control nuts and control flat washers from the controls at R and P, and from jack L.
- () Insert the pushbutton into the Zero Set hole from the back of the panel.
- () Tip the front panel up into place while carefully bending the cable assemblies and wires to the switches so the front panel will fit against the front of the chassis. Do not pinch any wires between the front panel and chassis. Be careful not to break the switches. The end of the VFO shaft must enter the recess in the Jackson drive on the panel.
- () Replace the control nuts and control flat washers at R, P, and L. Do not tighten the nuts at this time.
- () Place the lockwasher and the nut (removed earlier) on the back of the microphone connector. Do not tighten the nut yet.



Detail 8-13A



Detail 8-13B

- () Start 6-32 x 3/8" screw, a #6 lockwasher and a 6-32 nut at each upper corner of the panel. Do not tighten the hardware at this time.
- () Position the front panel so its bottom edge is even with the bottom of the chassis. Tighten the nuts at L and R just enough to hold it in this position.

Refer to Detail 8-13A for the two following steps.

- () Tighten the two Jackson drive mounting screws.
- () Start two 8-32 x 1/4" setscrews in the 2-1/2" knob. Place the knob on the VFO shaft and tighten the two setscrews.
- () Temporarily tighten one of the setscrews in the hub of the Jackson drive back of the panel.
- () Turn the VFO knob so the dial moves through its range. If the dial drags on the zero set button, loosen the screws and move the VFO farther from the panel.
- () Tighten both setscrews in the hub of the Jackson drive.
- () Tighten the VFO mounting hardware.
- () Refer to Detail 8-13B and mount a rotary switch detent at N with a control lockwasher, a control flat washer, and a control nut. Be sure the locating stud is positioned in its slot.
- () Tighten all panel hardware.

WIRING-CHASSIS TOP

Refer to Pictorial 8-14 (fold-out from Page 80) for the following steps.

NOTE: In the following steps, many of the wires are inserted from the top side of the circuit boards but the soldering must be done on the foil (bottom) side of the boards.

Connect each of the following wires to the designated hole in the IF circuit board:

- () Connect the black wire from lug 1 of switch J to hole DG on the IF circuit board (S-1), as shown in the inset drawing on the Pictorial. Before soldering the wire, make sure it is connected to the ground (outside) foil of the circuit board.
- () Brown wire from lug 5 of switch K: Hole 26 (S-1).
- () Short white wire from the notch in IF circuit board: Hole 25 (S-1).
- () Brown wire from notch in IF circuit board: Hole 24 (S-1).
- () Black wire from lug 1 of switch K: Hole 23 (S-1).
- () Connect the center conductor of coaxial cable #3 to lug 4 (S-2) and the shield lead to lug 6 (S-2) of control F.

Connect each of the following black hookup wires to the designated hole on the modulator circuit board:

- () Wire from lug 4 of control F: Hole 26 (S-1).
- () Wire from lug 5 of control F: Hole 25 (S-1).

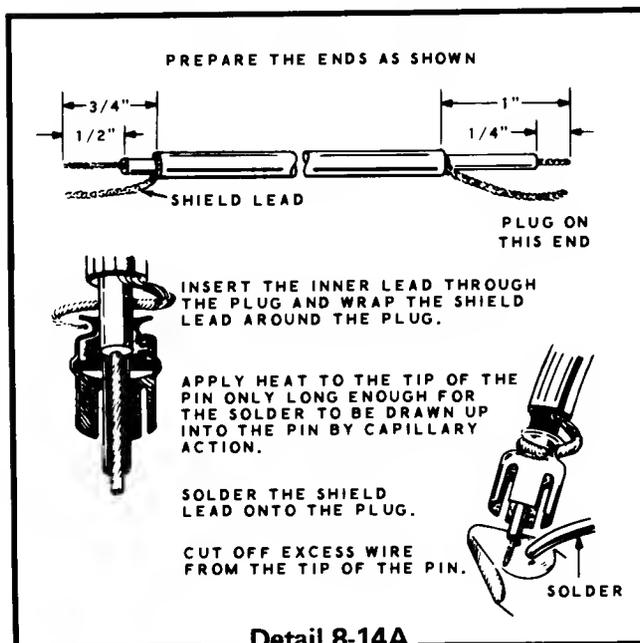
Connect each of the following black hookup wires from the rear wafer of switch G to the designated hole on the modulator circuit board:

- () Wire from lug 12: Hole 23 (S-1).
- () Wire from lug 13: Hole 21 (S-1).
- () Wire from lug 15: Hole 24 (S-1).
- () Wire from lug 17: Hole 22 (S-1).
- () Prepare the following lengths of hookup wire.

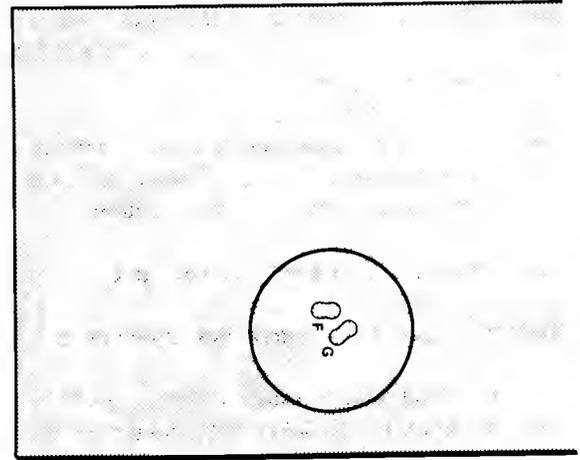
6" orange	1-3/4" black
1-1/4" brown	2-1/2" black
3-1/4" black	5-1/4" black



- () Connect a 6" orange wire from 27 on the modulator circuit board (S-1) to the B+ terminal on the back of the VFO chassis (S-1).
- () Connect the white-gray wire coming from hole BY in the bandpass circuit board to the Bias terminal on the VFO chassis (S-1).
- () Connect a 1-1/4" brown wire from the previously unused hole at 7 on the bandpass circuit board (S-1) to the FIL terminal on the VFO chassis (S-1).
- () Connect a 3-1/4" black wire from Y on the RF driver circuit board (S-1) to Y on the bandpass circuit board (S-1).
- () Connect the red lead (S-1) and the blue lead (S-1) from the output transformer to the similarly marked holes on the audio circuit board.
- () Connect a 1-3/4" black wire from hole W on the audio circuit board (S-1) to hole W on the bandpass circuit board (S-1).
- () Connect a 2-1/2" black wire from hole X on the audio circuit board (S-1) to hole X on the bandpass circuit board (S-1).
- () Connect a 5-1/4" black wire to hole Z on the bandpass circuit board (S-1). From the wire as screened on the top of the circuit board. Pass the other end down through hole Z on the RF driver circuit board. It will be connected later.
- () Refer to Detail 8-14A and prepare a 6-1/2" coaxial cable. Assemble a phono plug to the end shown.

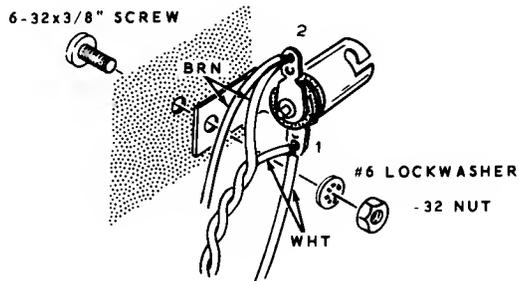


Detail 8-14A



Detail 8-14B

- () At the other end of this cable, insert the center conductor in hole VFO 1 on the bandpass circuit board. Then refer to Detail 8-14B and, on the foil side of the circuit board, bend this conductor over and solder it to the foil at G and at F.
- () Push the shield lead of this coaxial cable through hole VFO 2 (S-1). This is the large hole between the V and the 2 on the circuit board.
- () Insert the phono plug into the Output jack on the back of the VFO chassis.
- () Prepare the following lengths of hookup wire:
 - 3" black
 - 12" brown
 - 12" white
 - 4-1/2" white
 - 4" brown
- () Connect a 3" black wire between hole 27 on the IF circuit board (S-1) (this hole has a circle around it) and hole 3 on the bandpass circuit board (S-1). Before you solder, make sure this wire has entered one of the three holes in the foil which connects to pin 2 of V5.
- () Form a twisted pair of about three turns per inch from a 12" brown and a 12" white wire.

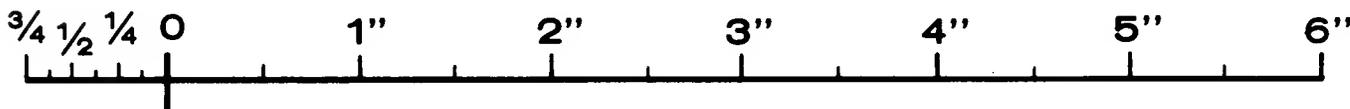


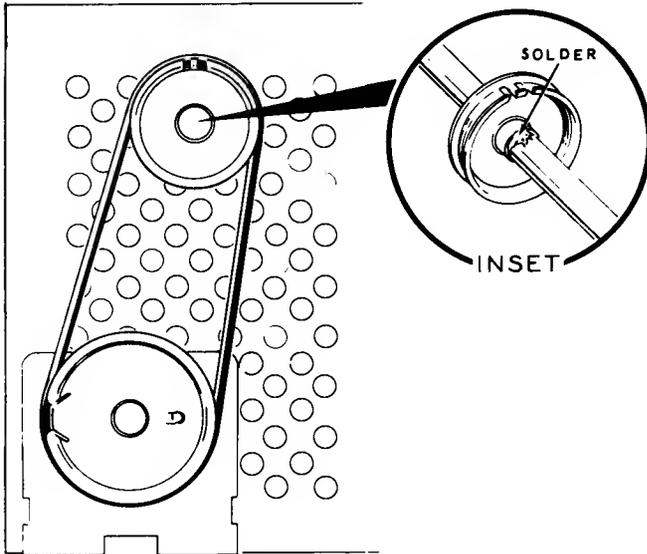
Detail 8-14C

- () Refer to Detail 8-14C and at one end of the twisted pair, connect the brown wire to lug 2 (NS) and the white wire to lug 1 (NS) of a pilot lamp socket.
- () Connect a 4-1/2" white wire to lug 1 of the pilot lamp socket (S-2).
- () Connect a 4" brown wire to lug 2 of the pilot lamp socket (S-2).
- () Mount this pilot lamp socket at DH. Use 6-32 x 3/8" hardware.
- () Connect the short white wire from lug 1 of the pilot lamp socket to hole 21 on the IF circuit board (S-1).
- () Connect the short brown wire from lug 2 of the pilot lamp socket to hole 22 of the IF circuit board (S-1).
- () At the free end of the twisted pair, connect the brown wire to lug 2 (S-1) and the white wire to lug 1 (S-1) of pilot lamp socket FU.
- () Install a #47 pilot lamp in each of the pilot lamp sockets.

Refer to Pictorial 8-15 (fold-out from Page 89) for the following steps.

- () Refer to Detail 8-15A and install a nylon bushing at DJ in the RF cage.
- () Install a 1-1/8" diameter knob on one end of the 9" shaft. Use an 8-32 x 1/4" setscrew.
- () Place two nylon washers on this 9" shaft, and pass the end of the shaft through the hole at A in the front panel.
- () Start an 8-32 x 1/4" setscrew in a shaft collar, and slide the shaft collar onto the 9" shaft.
- () Slide two 3/4" diameter pulleys on this shaft. Be sure the open sides of the pulleys are positioned as shown.
- () Place two rubber belts over the shaft.
- () Now, insert the end of this shaft into the nylon bushing at DJ. With the end of the shaft flush with the inside edge of the nylon bushing, push the shaft collar against the inside of the front panel at A and tighten the setscrew.
- () Install a split bushing in the open end of the shaft coupling installed earlier on capacitor DC.
- () Pass one end of the 9-3/8" shaft through the hole at B on the front panel.
- () Start an 8-32 x 1/4" setscrew in the tapped hole of the pulley with the large hole (red dot). Flatten the tab inside this pulley. Then place this pulley on the 9-3/8" shaft with the open side of the pulley as shown in the Pictorial at DC.
- () Insert the end of the 9-3/8" shaft into the shaft coupling until the other end of the shaft extends approximately 7/8" from the front of the panel. Tighten the setscrew.

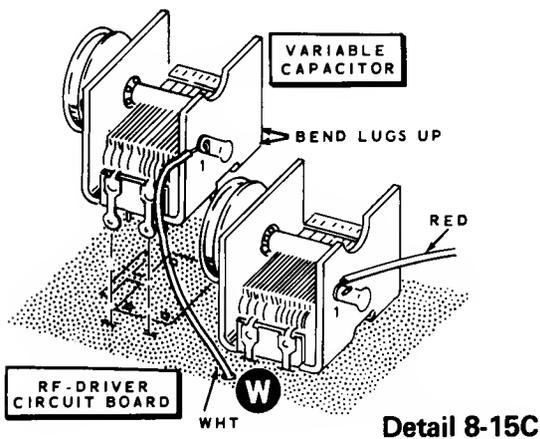




Detail 8-15B

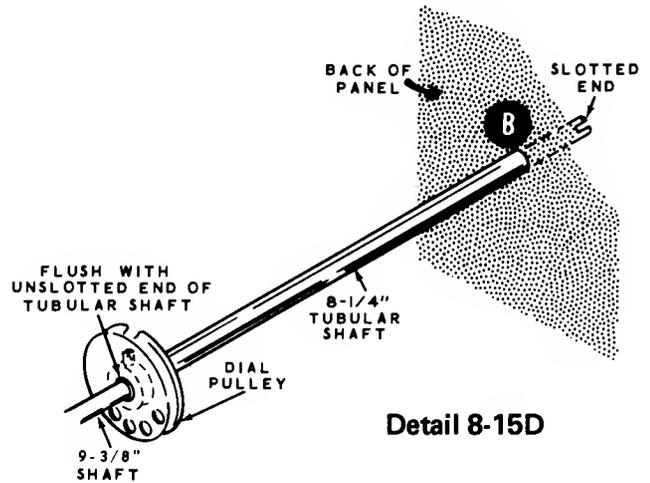
Refer to Detail 8-15B for the following steps.

- () Slide the rear 3/4" diameter pulley on the shaft in hole A until it is directly in line with the pulley on the variable capacitor mounted on the RF driver circuit board.
- () Solder the pulley to the shaft as shown in the inset drawing in Detail 8-15B. Allow the pulley to cool before installing the rubber belt in the next step.
- () Install one of the rubber belts (placed on the shaft earlier) over the lower pulley and then over the upper pulley.
- () Remove 1/4" of insulation from only one end of a 2-1/2" white wire. Then connect this wire to lug 1 (S-1) of the remaining 2-section variable capacitor (#26-122). Bend the lug out as before.
- () Bend the two indicated lugs of this capacitor up tight against the capacitor insulator.
- () Mount this capacitor at the forward position on the RF driver circuit board. Solder the four pins and two lugs of the capacitor to the circuit board foil.
- () Insert the white wire from lug 1 of this capacitor down through hole W (about 1/8") on the circuit board. This is the neutralizing wire and its free end is left unconnected.
- () Position the forward 3/4" diameter pulley so it is directly in line with the pulley on the forward variable capacitor on the RF driver circuit board.
- () Rotate both the pulleys so their slots are straight up. Solder the loose pulley to the shaft. Allow the pulley to cool before installing the rubber belt in the next step.
- () Place the remaining rubber belt over the lower pulley and then the upper pulley.



Detail 8-15C

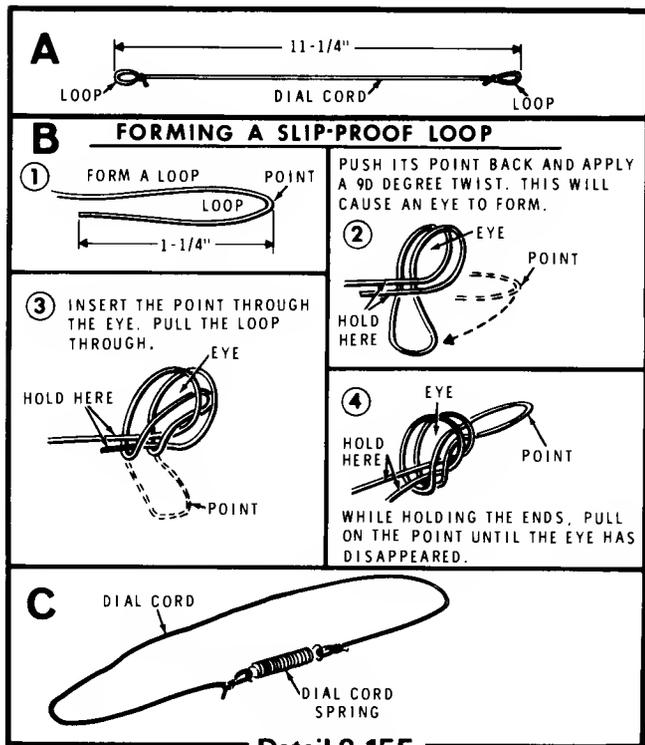
Refer to Detail 8-15C for the following steps.



Detail 8-15D

Refer to Detail 8-15D for the following steps.

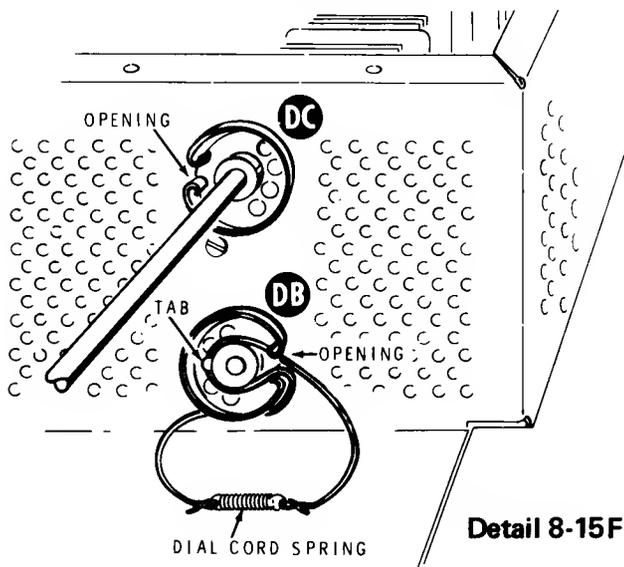
- () Pass the unslotted end of the 8-1/4" tubular shaft over the shaft at B (put silicone grease on the solid shaft first) and into the pulley as shown.
- () Position this pulley even with the rear of the tubular shaft, and tighten the setscrew. Do not overtighten the setscrew, as this could bend the tubular shaft against the inner shaft and cause them to bind.



Detail 8-15E

Refer to Detail 8-15E for the following steps.

- () Prepare the dial cord with a slip-proof loop on each end as shown in parts A and B of the detail.
- () Hook the ends of the dial cord spring into the loops of the dial cord as shown in part C.

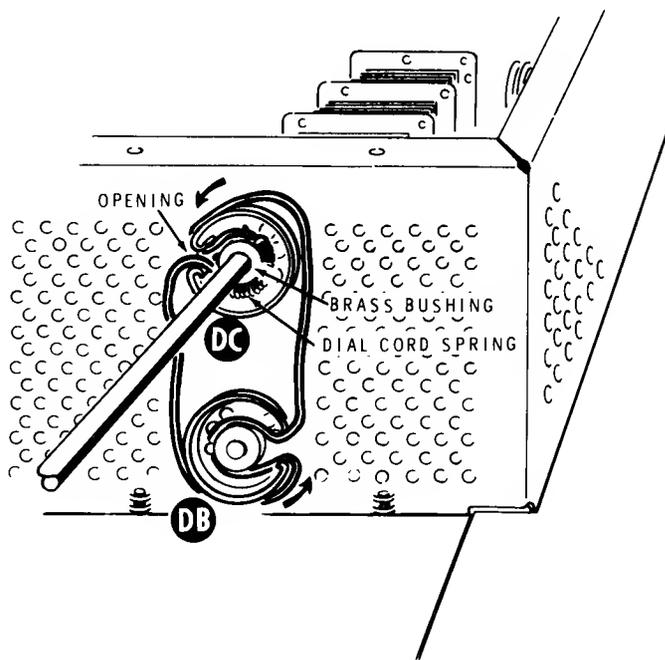


Detail 8-15F

- () Position pulleys DC and DB with their openings as shown in Detail 8-15F.

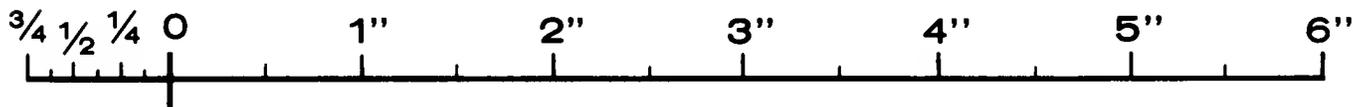
"IMPORTANT: Before you proceed with the following steps, make sure the tuning capacitors attached to pulleys DB and DC are fully meshed, and that the two pulley openings are as shown in Detail 8-15G. If necessary, loosen the pulley or shaft collar setscrews, reposition the pulleys, making sure the capacitors remain meshed, and then retighten the setscrews."

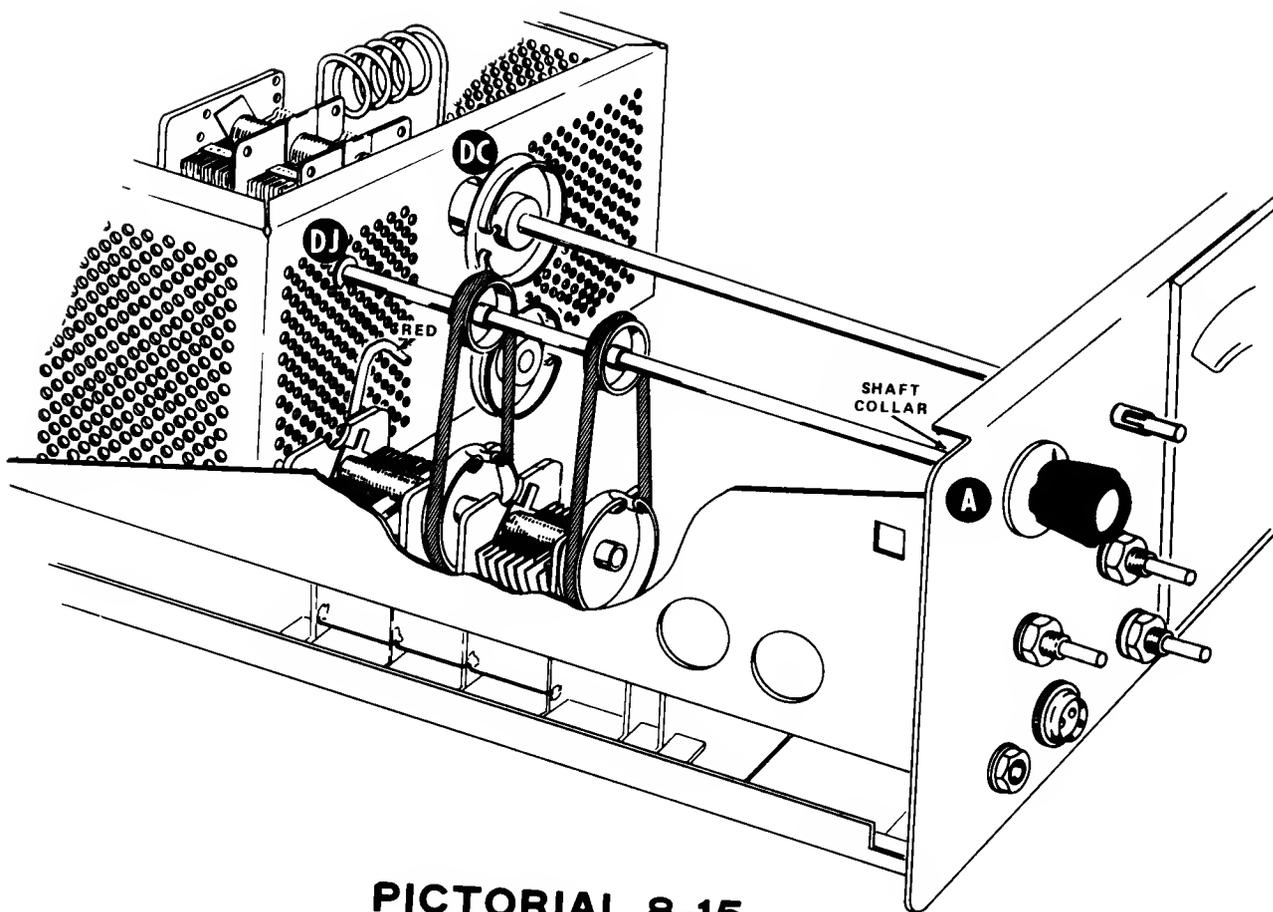
The following dial cord installation is done best as a continuous operation. Therefore, read the next three steps before you follow the instructions to familiarize yourself with the routing shown in Details 8-15F and 8-15G.



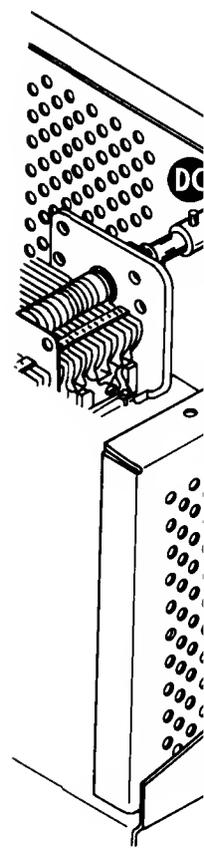
Detail 8-15G

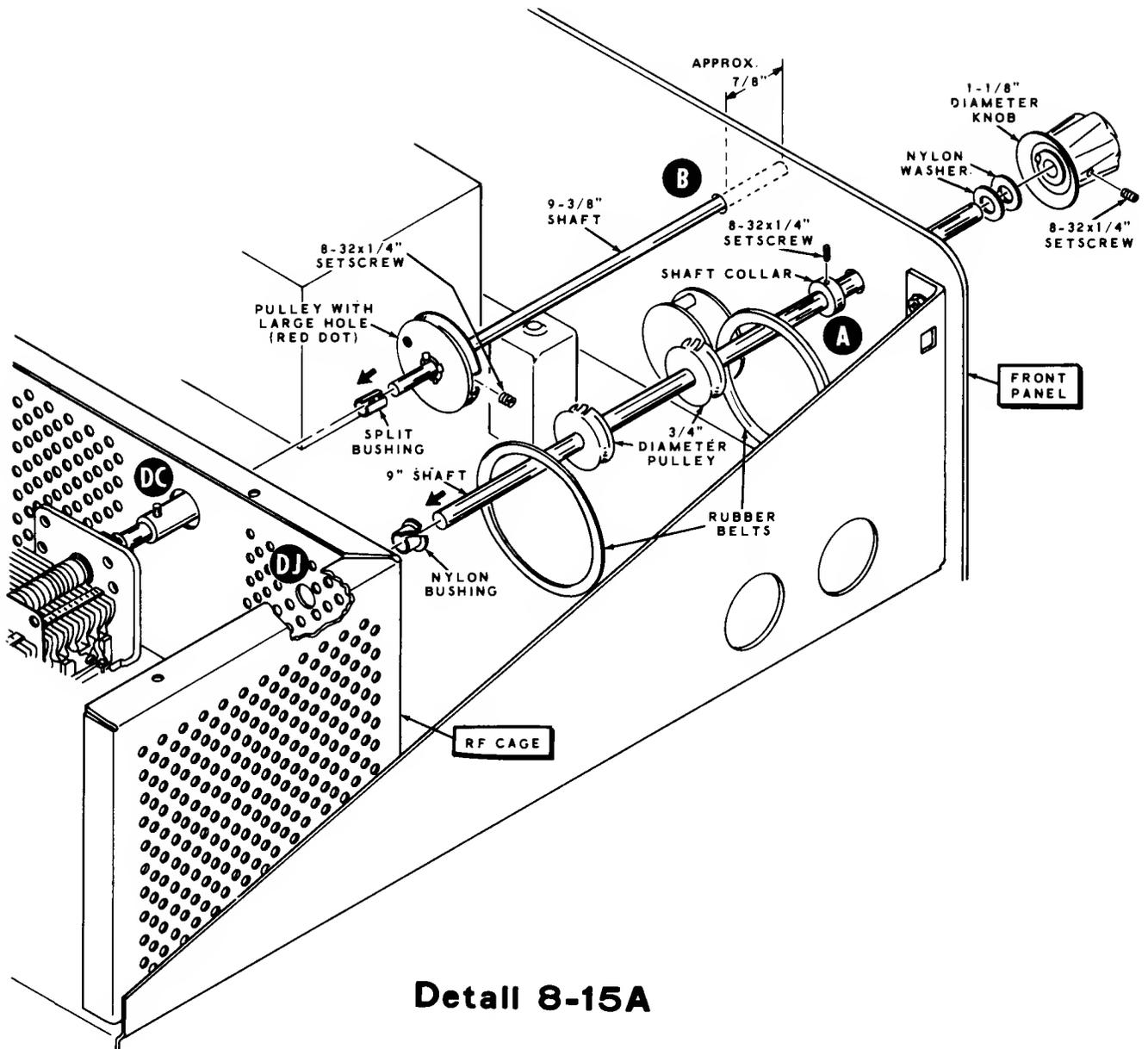
- () On the dial cord, locate the point exactly opposite the dial cord spring.
- () Position this point (and the dial cord) behind the tab of pulley DB. Then route both ends of the dial cord out of the pulley as shown in Detail 8-15F.
- () Route the remaining end of the dial cord loop into pulley DC. Seat the dial cord spring around the brass bushing of this pulley as shown in Detail 8-15G.





PICTORIAL 8-15





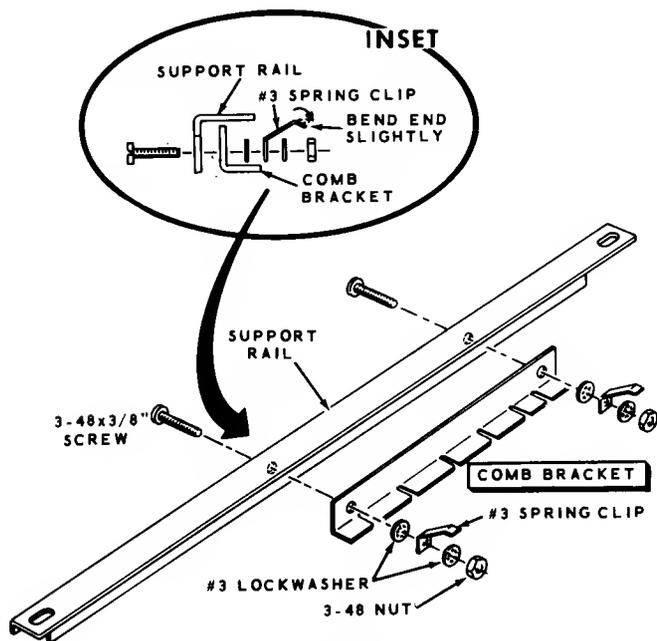
Detail 8-15A

FINAL WIRING-CHASSIS BOTTOM

NOTE: Be extra careful when soldering to the Switch-Boards in the following steps. The driver plate, driver grid, and the heterodyne oscillator Switch-Boards are mounted in these steps. Best results can be obtained if the chassis is positioned so the foil side of the Switch-Board is horizontal. This will keep the solder from running down the board, and causing possible short circuits between the foils. Do not rest the weight of the Transceiver on the dial shafts, as this could damage the dial mechanism.

Refer to Pictorial 8-16 for the following steps. This Pictorial has been drawn to show both sides of the driver plate Switch-Board.

- () Position as shown the black wire extending through the RF driver circuit board, the orange wire from BO#16, and the WHT-BLK-BLK wire from grommet CD.
- () Refer to Detail 8-16A and mount a comb bracket and two #3 spring clips to the support rail with 3-48 x 3/8" hardware. Position the comb bracket and spring clips as shown in the inset drawing. Bend the ends of the spring clips slightly as shown.



Detail 8-16A

Refer to Detail 8-16B for the following steps.

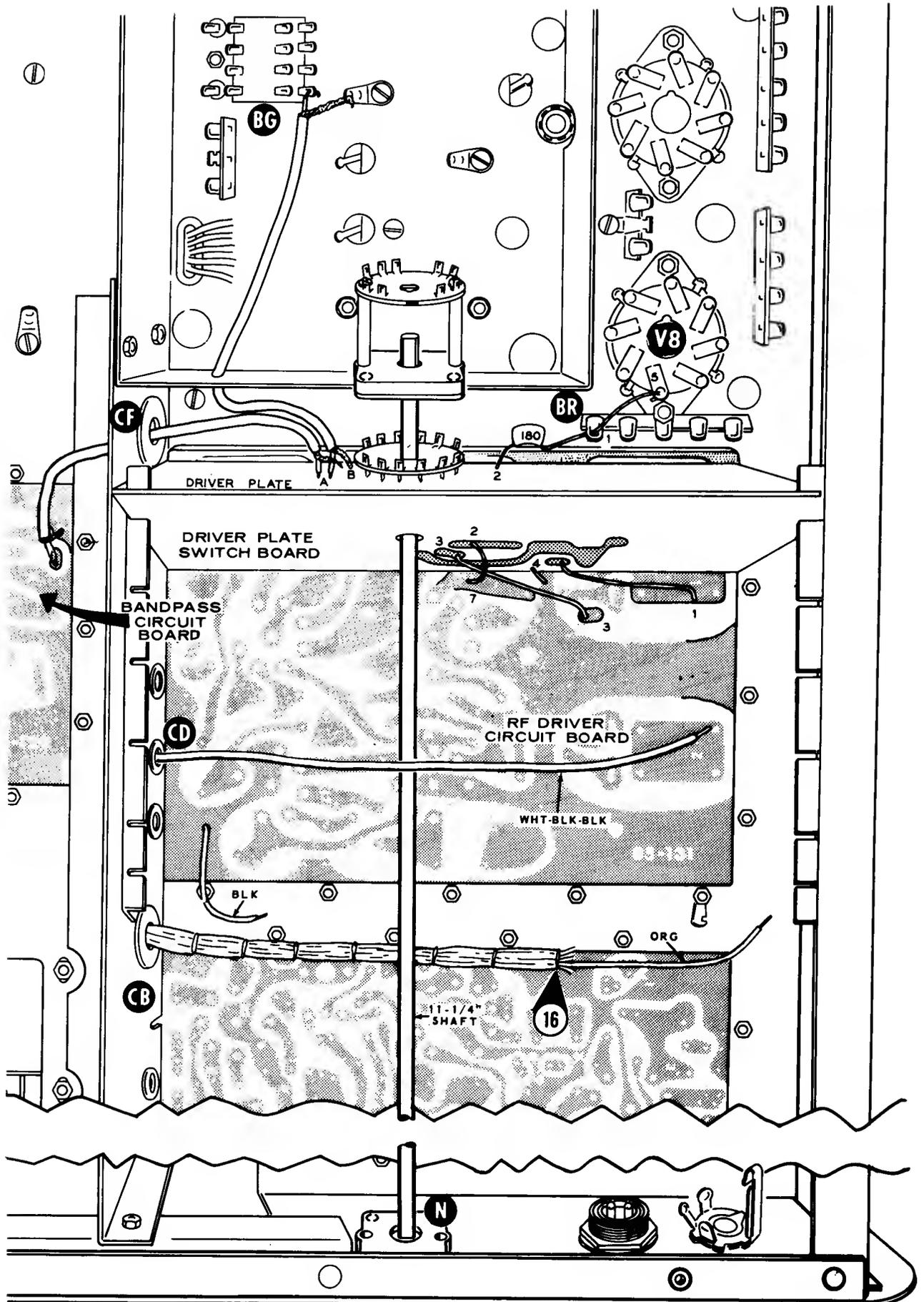
- () Attach the proper end of the support rail to the rear flange of the chassis as shown. Use 6-32 x 3/8" flat head hardware. Tighten the hardware just enough to hold the support rail in place, yet permit it to swing out away from the side of the chassis.
- () Swing the support rail out from the chassis.

Locate the driver plate Switch-Board.

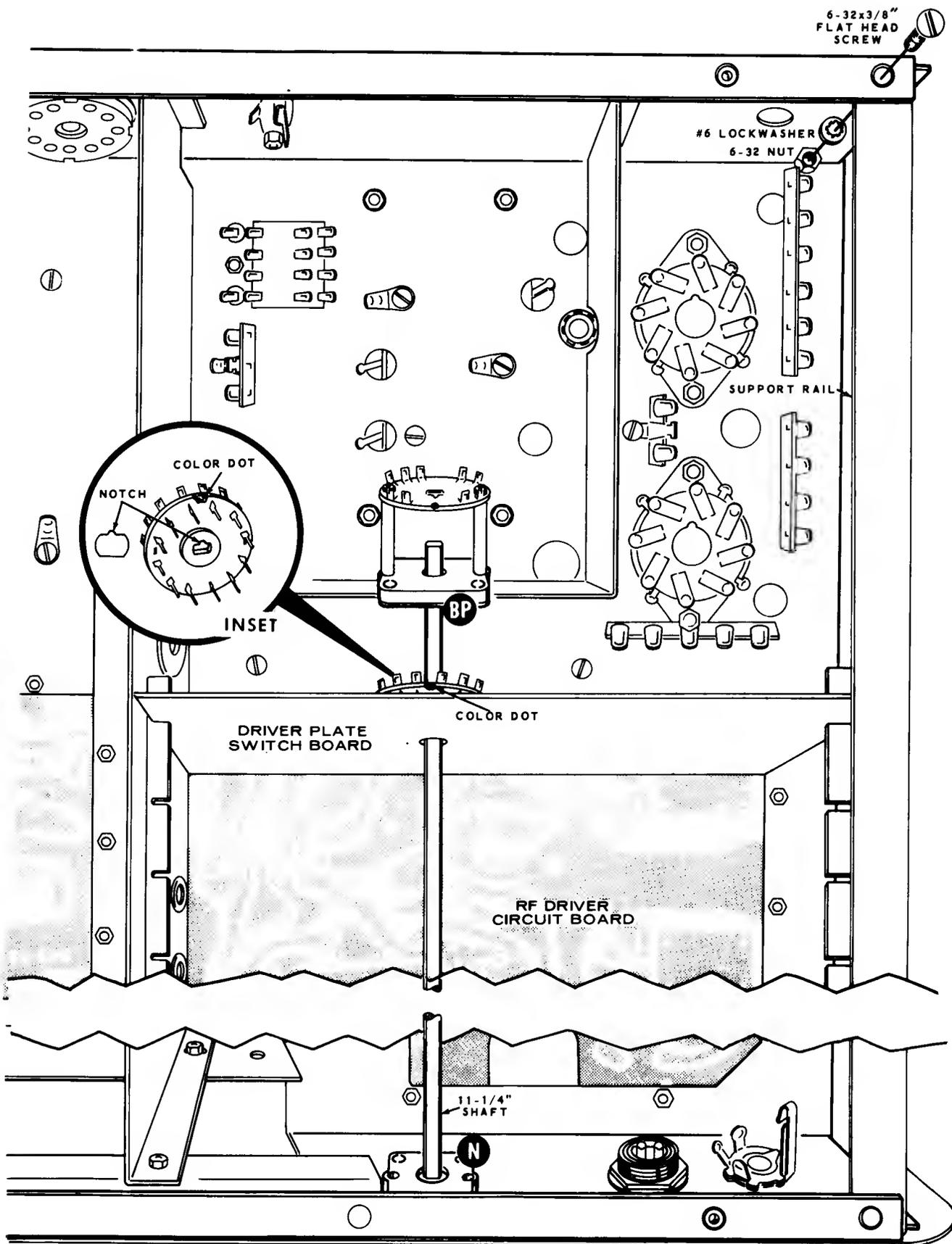
- () Make sure that the notch of the rotor and the color dot of the switch wafer are aligned with each other. See the inset drawing on Detail 8-16B and the lettered side of the Switch-Board.
- () Position the driver plate Switch-Board in place over the RF driver circuit board as shown. Fit the left end of the Switch-Board into the rear notch of the comb bracket mounted on the center shield. Make sure the free ends of the two coaxial cables are between the driver plate Switch-Board and the final switch shield.
- () Swing the support rail back into place with the right end of the Switch-Board in the rear notch of the comb bracket. Do not fasten the support bracket at the front of the chassis, as it must swing out to allow the mounting of the other Switch-Boards.
- () Install an 8-32 x 1/4" setscrew in a 1-1/8" diameter knob and install the knob on the round end of the 11-1/4" shaft.

NOTE: In the following step, be very careful not to break the switches. It may be necessary to loosen the nut at BP and adjust the switch detent for better alignment.

- () Be sure the switch detents at N and BP are at their fully counterclockwise positions. Then insert the end of the shaft through the switch detent at N in the front panel, through the switch rotor, and into the bushing of the switch detent at BP on the final switch shield. Check to see that the shaft is not binding. If necessary, loosen the nuts on the detents and adjust the detents to eliminate any binding.



PICTORIAL 8-16



Detail 8-16B

Refer to Pictorial 8-16 for the following steps.

NOTE: Before connecting the coaxial cables in the two steps following, carefully observe two holes at A in the same foil, and two holes at B in another foil. Be careful not to confuse the holes for each letter.

Connect the coaxial cable coming from relay BG to the driver plate Switch-Board as follows:

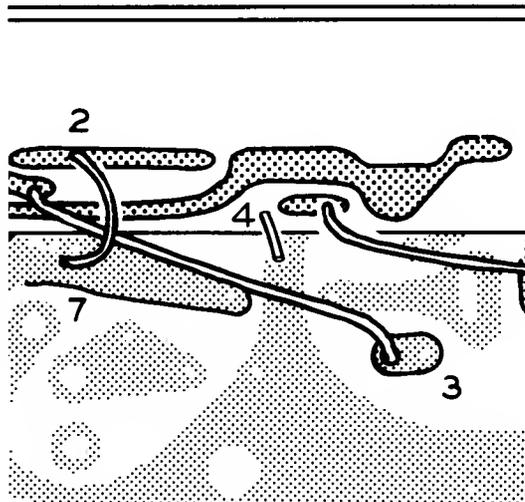
- () Inner lead to A (S-1) and the shield to B (S-1).

Connect the coaxial cable coming from the bandpass circuit board to the driver plate Switch-Board as follows:

- () Inner lead to A (S-1) and the shield to B (S-1). Bend the switch lug near B out of the way.
- () Pass one lead of a 180 pF mica capacitor through lug 1 of terminal strip BR (S-3) to lug 5 of tube socket V8 (S-2). Connect the other lead to 2 on the driver plate Switch-Board (S-1).

NOTE: Position the driver plate Switch-Board perpendicular to the RF driver circuit board before making the following connections.

- () Refer to Detail 8-16C, and connect a 3/4" bare wire from the ground foil on the driver plate switch-board to the ground foil on the RF driver circuit board as shown.
- () Connect a 1-3/4" bare wire from 3 on the driver plate Switch-Board (S-1) to 3 on the RF driver circuit board (S-1).
- () Connect a 1-1/2" bare wire from 2 on the driver plate Switch-Board (S-1) to 7 on the RF driver circuit board (S-1).
- () Connect a 1-1/2" bare wire from 4 on the driver plate Switch-Board (S-1) to 1 on the RF driver circuit board (S-1). Do not allow this wire to extend more than 1/8" through the lettered side of the RF driver circuit board, as this would short circuit the variable capacitor mounted on top of the circuit board.

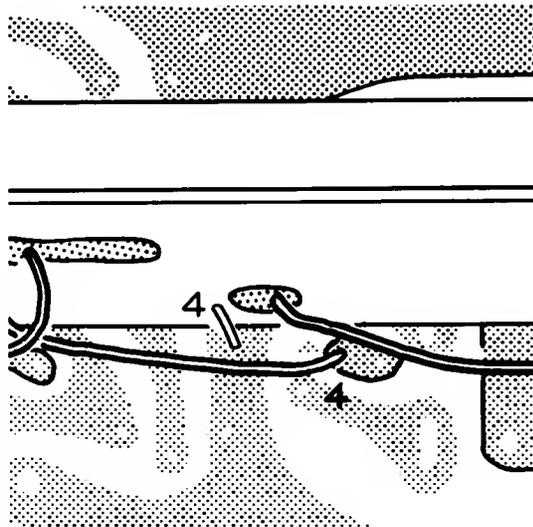


Detail 8-16C

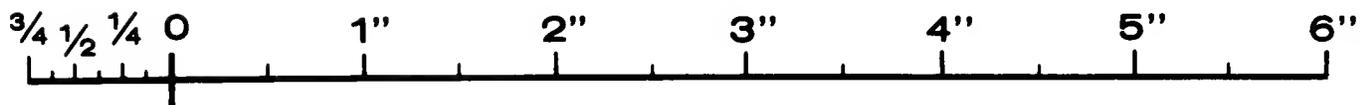


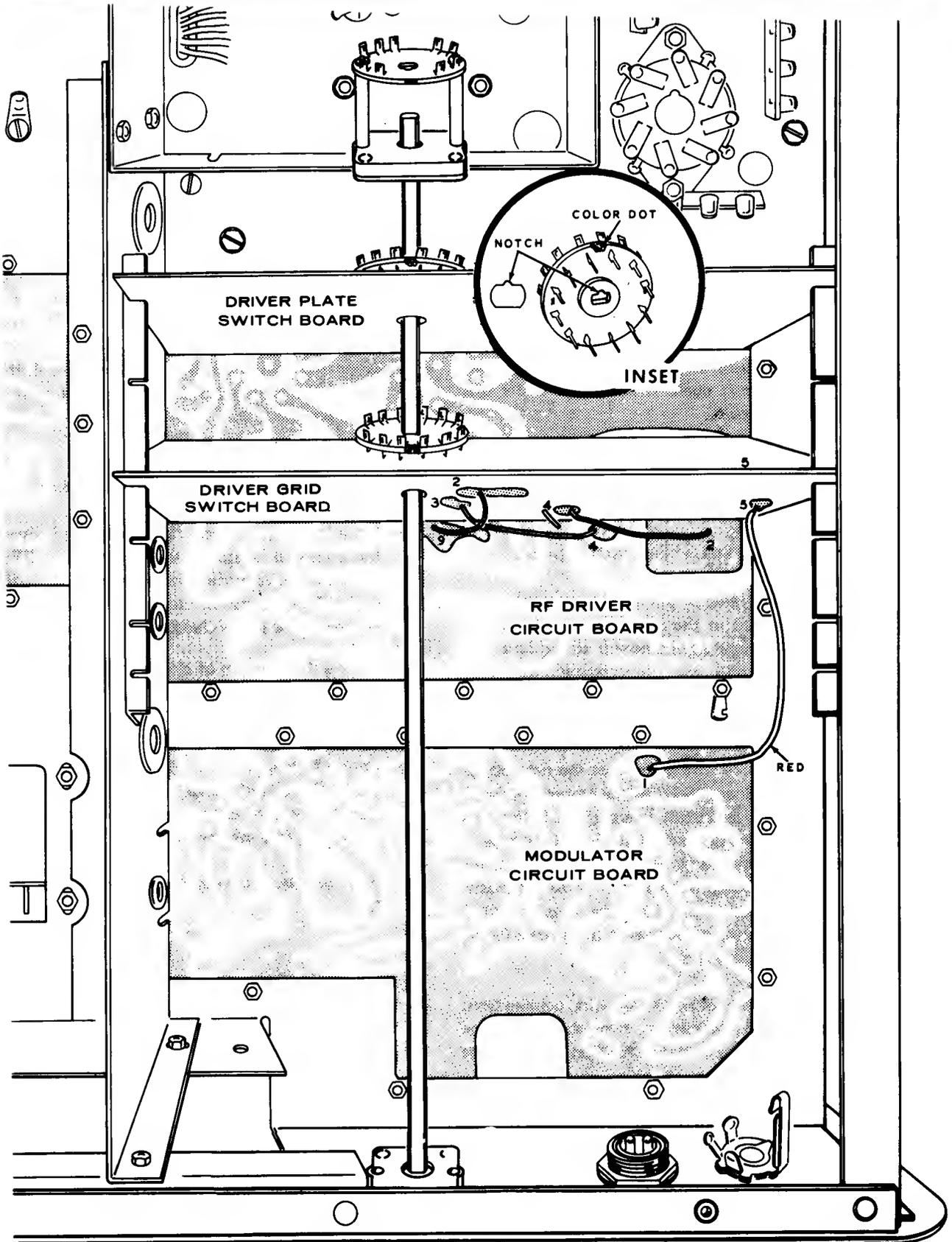
Refer to Pictorial 8-17 for the following steps.

- () Remove the shaft and swing the support rail outward.
- () Make sure the notch of the rotor and the color dot of the switch wafer of the driver grid Switch-Board are aligned with each other.
- () Position the driver grid Switch-Board in front of the RF driver circuit board as shown. Insert the left end of the Switch-Board into the third notch from the rear of the comb bracket that is mounted on the center shield.
- () Swing the support rail back into place, with the right end of the Switch-Board in the correct notch of the comb bracket on the support rail.
- () Carefully install the 11-1/4" shaft as before.
- () Refer to Detail 8-17A, and connect a 3/4" bare wire from the ground foil on the driver grid switch-board to the ground foil on the RF driver circuit board as shown.
- () Connect a 1-3/4" bare wire from 3 on the driver grid Switch-Board (S-1) to 4 on the RF driver circuit board (S-1).
- () Connect a 1-3/4" bare wire from 2 on the driver grid Switch-Board (S-1) to 9 on the RF driver circuit board (S-1).
- () Connect a 1-1/2" bare wire from 4 on the driver grid Switch-Board (S-1) to 2 on the RF driver circuit board (S-1). Do not allow this wire to extend more than 1/8" through the lettered side of the RF driver circuit board, as this would short circuit the variable capacitor mounted on top of the circuit board.
- () Connect the free end of the red wire, coming from 1 on the modulator circuit board, to 5 on the driver grid Switch-Board (S-1).



Detail 8-17A





PICTORIAL 8-17

Refer to Pictorial 8-18 for the following steps.

- () Remove the shaft and swing the support rail outward.

() Position the notch in the rotor of the switch wafer on the heterodyne oscillator Switch-Board so it is pointing AWAY FROM the color dot on the switch wafer. See the inset drawing and the lettered side of the circuit board.

- () Position the heterodyne oscillator Switch-Board over the RF driver circuit board as shown. Insert the left end of the Switch-Board into the second notch from the front of the comb bracket that is mounted on the center shield. Be sure the black wire extending from the RF driver circuit board is positioned under this Switch-Board as shown.

- () Swing the support rail back into place, with the right end of the Switch-Board in the correct notch of the comb bracket mounted on the support rail.

- () Carefully install the 11-1/4" long shaft as before.

- () Connect the inner lead of the coaxial cable (that has its shield connected to the center pin of tube socket V6 on the RF driver circuit board) to lug 10 of the switch wafer on the heterodyne oscillator Switch-Board (S-1). NOTE: Lug 10 is the long, or rotor, contact on the switch.

- () Connect a 3/4" bare wire from 1 of the heterodyne oscillator Switch-Board (S-1), to the ground (outside) foil of the RF driver circuit board (S-1). Solder this end of the wire directly to the foil. There is no hole at this location. At this time make sure the heterodyne oscillator Switch-Board is perpendicular to the chassis and that the second coil from the support rail is aligned with the large, round hole in the ground foil of the RF driver circuit board.

- () Connect the free end of the orange wire, coming from BO#16 of the wire harness, to 5 on the heterodyne oscillator Switch-Board (S-1). Position the wire as shown.

Refer to Pictorial 8-19 (fold-out from Page 99) for the following steps.

- () Remove the shaft and swing the chassis support rail outward.

- () Make sure the notch on the rotor and the color dot of the switch wafer of the crystal Switch-Board are aligned with each other.

- () Position the crystal Switch-Board over the chassis.

- () Connect the free end of the black wire, extending from hole Z in the RF driver circuit board, to 1 on the crystal Switch-Board (S-1).

- () Insert the left end of the crystal Switch-Board into the front notch of the comb bracket that is mounted on the center shield. Make sure the black wire from Z is properly positioned.

- () Swing the chassis rail back into place, with the right end of the Switch-Board in the correct notch of the comb bracket.

- () Carefully install the 11-1/4" shaft as before.

- () Make sure the lower right corner of the crystal Switch-Board is against the solder lug at BT on the chassis and solder the two together (S-1). Bend solder lug BT as required to keep the Switch-Board perpendicular to the chassis.

- () Place a 1/2" length of clear sleeving over the ends of the two black wires from BO#17 of the wire harness. Connect these wires to lug 2 of connector M (S-2).

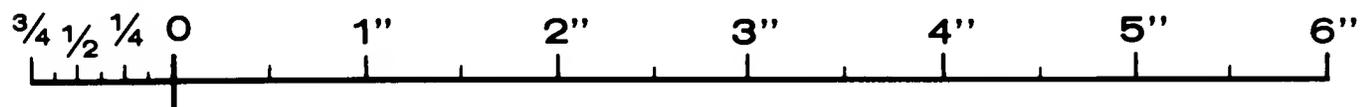
- () Place a 1" length of small black sleeving on one lead of a 22 k Ω (red-red-orange) resistor. Then connect this lead to lug 1 of connector M (S-1), and connect the other lead to B on the modulator circuit board (S-1).

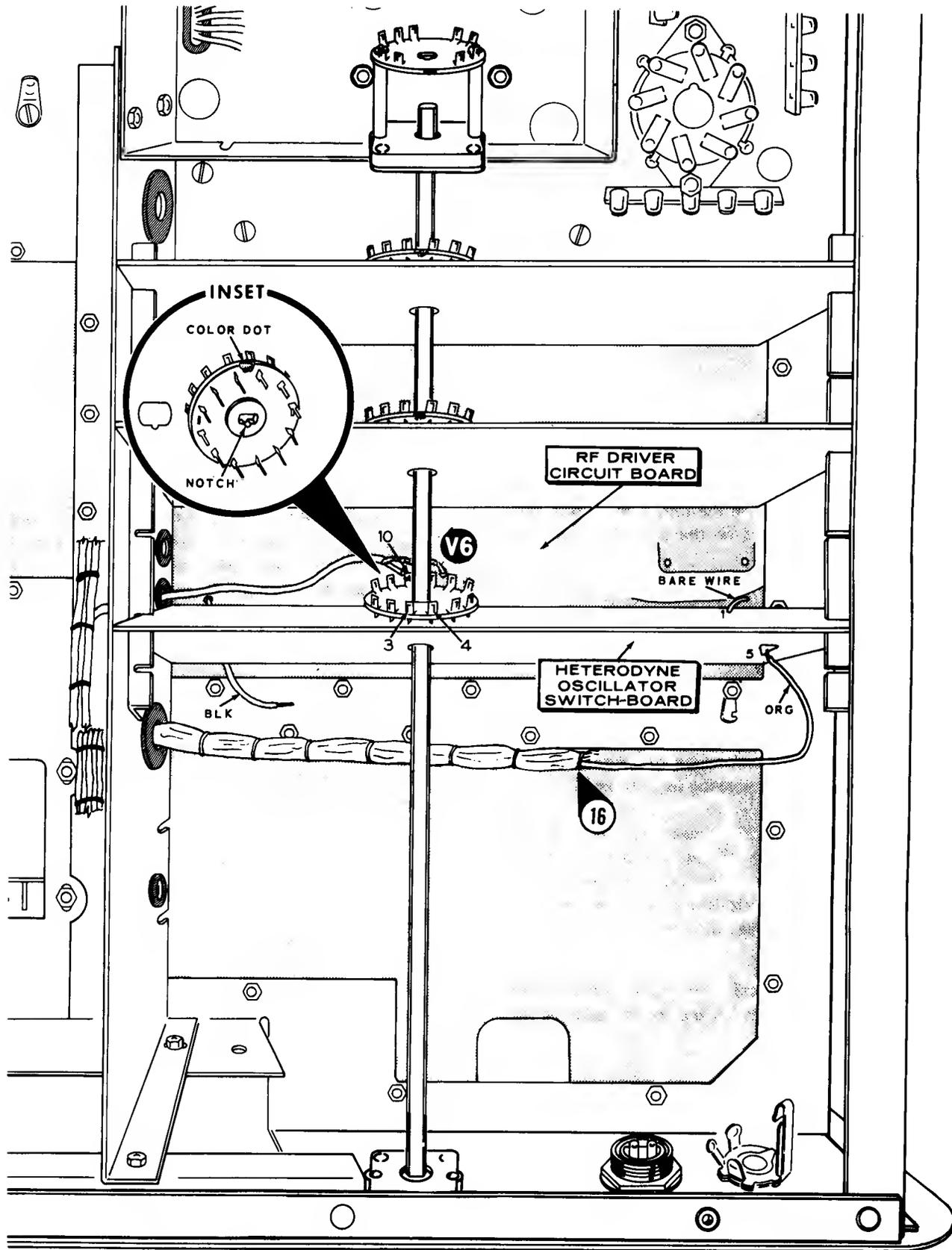
- () Push the clear sleeving down over lug 2 of connector M.

Refer to Detail 8-19A (fold-out from Page 99) for the following steps.

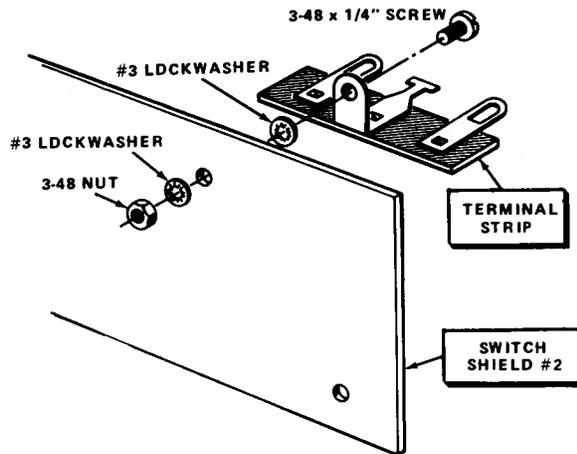
- () Remove the shaft and swing the support rail outward.

- () Position switch shield #1 into place over the RF driver circuit board, with the left end in the proper slot in the comb bracket mounted on the center shield. Be sure the small hole in the shield is positioned in the lower right corner next to the circuit board.





PICTORIAL 8-18

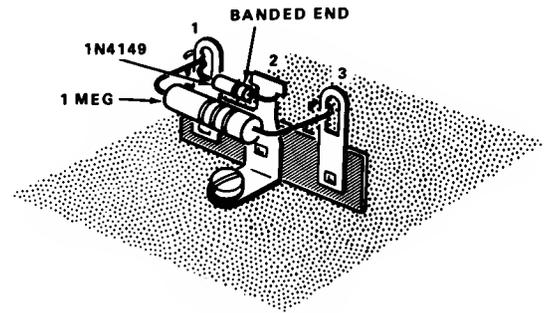


Detail 8-19B

- () Refer to Detail 8-19B and mount the 3-lug terminal strip on switch shield #2 as shown in the Pictorial. Use 3-48 hardware as shown in the Detail. Make sure the terminal strip is mounted on the correct side of the shield.

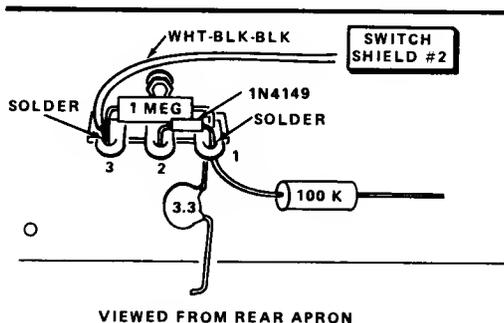
Refer to Detail 8-19C for the two following steps.

- () Connect the lead at the banded end of a 1N4149 (#56-56) diode to lug 2 (S-1) and the other lead to lug 1 (NS) of a 3-lug terminal strip.
- () Connect a 1 M Ω (brown-black-green) resistor from lug 1 (NS) to lug 3 (NS) of the 3-lug terminal strip.
- () Position switch shield #2 into place over the RF driver circuit board with the left end in the proper slot in the comb bracket mounted on the center shield. Be sure the small hole in the shield is positioned in the lower right corner next to the circuit board.
- () Swing the support rail back into place, with the right end of the switch shields in the correct slots of the comb bracket.



Detail 8-19C

- () Install the 11-1/4" long shaft as before. Be sure that the knob points to 3.5 and that the notches in the rotating portions of the switch wafers are positioned in correct relationship to the color dots on the bodies of the switch wafers.
- () Fit one of the two small notches in the bottom edge of switch shield #1 so it is on top of the center pin of tube socket V7. The bottom edge of the switch shield should be approximately 1/8" above the RF driver circuit board, with the center hole of the switch shield centered around the shaft.
- () Solder the switch shield #1 to the center pins of tube socket V7 (S-1).
- () Connect a 1" bare wire from the hole in the lower right corner of switch shield #1 (S-1) to the ground (outside) foil of the RF driver circuit board (S-1). Solder the end of the wire directly to the foil. There is no hole at this location.
- () Fit one of the small notches in the bottom edge of switch shield #2 so it is on top of the center pin of tube socket V6. The bottom edge of the switch shield should be approximately 1/8" above the RF driver circuit board, with the center hole of the switch shield centered around the shaft.
- () Solder the switch shield to the center pin of tube socket V6 (S-1).

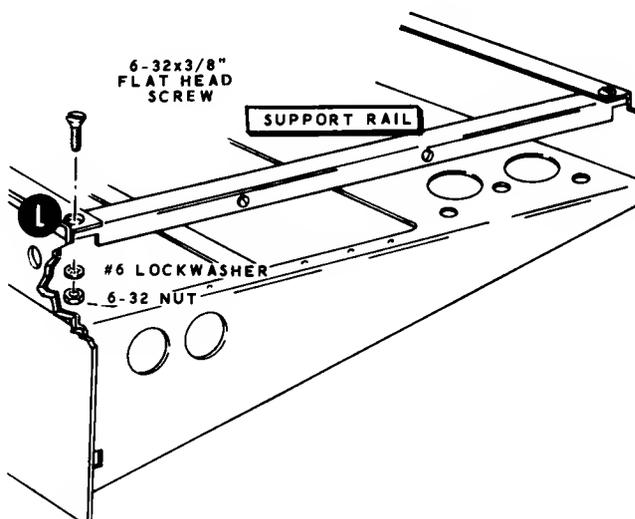


Detail 8-19D

Refer to Detail 8-19D for the next three steps.

- () Connect the free end of the 100 k Ω resistor from the RF driver circuit board to lug 1 of the 3-lug terminal strip on switch shield #2 (NS).
- () Connect the free lead of the 3.3 pF disc capacitor to lug 1 of the 3-lug terminal strip (S-4).
- () Connect the end of the white-black-black wire from grommet CD to lug 3 of the terminal strip (S-2). Pass this wire over the band switch shaft as shown in Detail 8-19A.
- () Connect a 3/4" bare wire from the hole in the lower right corner of switch shield #2 (S-1) to the ground (outside) foil of the RF driver circuit board (S-1). Solder this end of the wire directly to the foil. There is no hole at this location. Be sure the ground foil is used.
- () Cut two 1/2" pieces of small black sleeving.
- () Cut each lead of a 100 Ω (brown-black-brown) resistor to 3/4" and place a 1/2" piece of sleeving on each resistor lead. Then form the leads as shown so the resistor can be mounted around the end of switch shield #2.
- () Solder one lead of this resistor directly to the foil marked 2 on the RF Driver circuit board. Solder the other lead directly to the ground foil on the panel side of switch shield #2 (there is no hole at either soldering location).

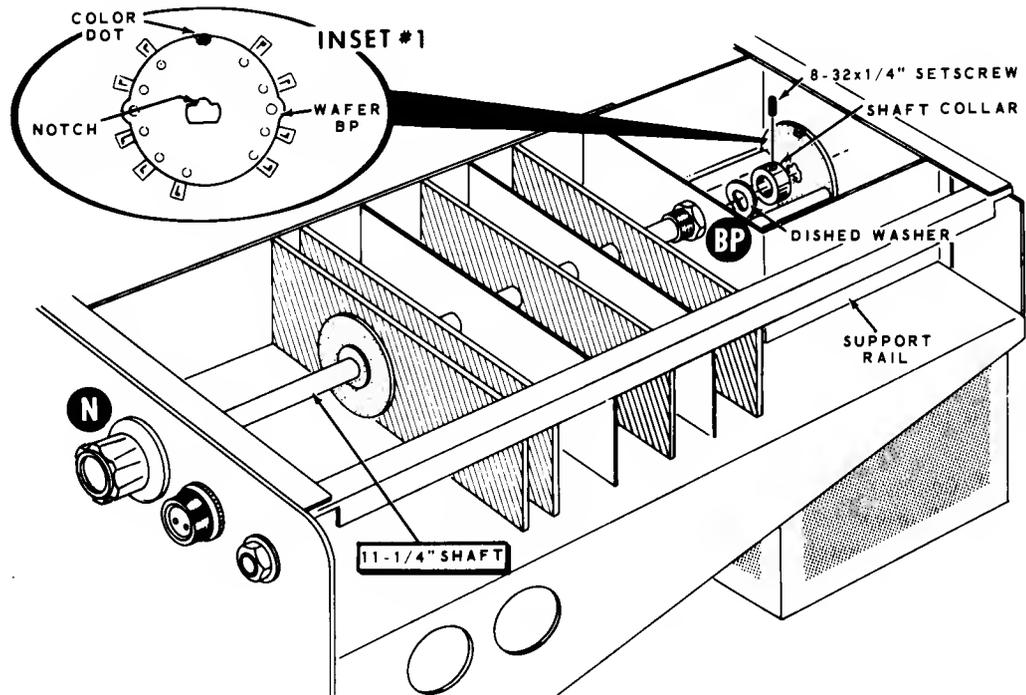
- () Cut each lead of a 100 Ω (brown-black-brown) resistor to 1". Connect the resistor from 5 on the driver plate Switch-Board (S-1) to 5 on the driver grid Switch-Board (S-1). Position this resistor around the end of switch shield #1.
- () Refer to Detail 8-19E and secure the front of the support rail to the front flange of the chassis. Use 6-32 x 3/8" flat head hardware. Tighten the hardware at the rear of this support rail. Be sure the front screw clears the lugs of the phone jack at L.



Detail 8-19E

Refer to Detail 8-19F for the following steps.

- () Pull the 11-1/4" shaft out about an inch.
- () Place a small amount of silicone grease around the shaft holes in switch detents BP and N.
- () Push the shaft so the end near the rear of the chassis fits through the switch detent, but not into the rear section of the switch.
- () Start an 8-32 x 1/4" setscrew in a shaft collar.



Detail 8-19F

- () Place a dished washer and the shaft collar over the end of the shaft.
- () Make sure that the notch of the rotor and color dot of the switch wafer at BP are aligned as shown in inset drawing #1 of Detail 8-19F.

- () Make sure the lugs on the rear of the crystal switch do not touch the lugs on the front of the heterodyne oscillator switch.
- () Refer again to Detail 8-19A (on the fold-out from Page 99) and solder the two switch shields to the comb brackets as shown.

CAUTION: In the following step, it is very easy to damage switch BP. Be SURE the hole in the switch rotor is correctly aligned before inserting the band switch shaft.

- () Push the shaft in as far as possible, carefully fitting it through the rotor switch BP.
- () Push the shaft collar forward, depressing the dished washer slightly against the rear of the detent, and tighten the setscrew.

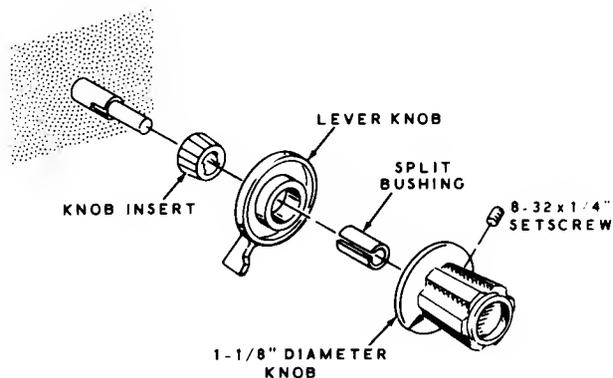
() With the band switch shaft still in its fully counterclockwise position, make sure you **CANNOT** see the notch in the switch rotor of the "HET OSC" Switch-Board and that you **CAN** see the notches in the rotors of the other four switch wafers. If any switch rotor is not positioned as shown in the inset drawings for each, correctly position the rotor before proceeding.

This completes the wiring of the Transceiver. Check it very carefully to see that all connections are soldered, and that no solder bridges exist between the foils of the circuit boards. Also see that the bare wires connected from the driver plate and driver grid Switch-Boards to the RF driver circuit board are not touching each other or other foils of the circuit boards. Shake out any wire clippings or solder splashes. Clip off the excess lengths of any bare hookup or harness wires extending through the circuit board on either side.

KNOB INSTALLATION

Refer to Pictorial 8-20 for the following steps.

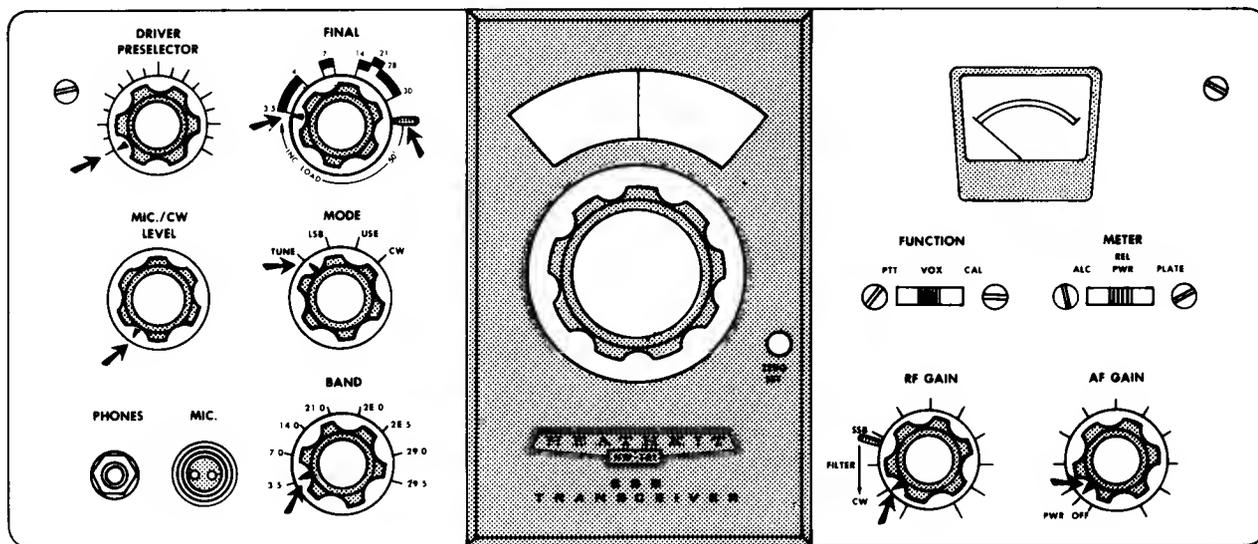
- () Turn all switch and control shafts fully counterclockwise.
- () Turn all variable capacitor shafts (extending from the front panel) so the plates of the capacitors are fully meshed (closed).
- () Refer to Detail 8-20A and install knob bushings on the tubular shafts at the Final and Filter locations. Position each lever as indicated by the arrow on the Pictorial and push the lever knobs on to the bushings. Then, without pulling the lever knobs off the bushings, remove the knob-bushing combinations from the shafts. Press the bushings into the knobs until they are flush with the front of the knobs. Replace both lever knobs on the shafts.
- () Refer to Detail 8-20A and install 1-1/8" diameter knobs and split bushings on the small shafts at the Final and RF Gain locations. Position the pointer on each knob as indicated by the arrow on the Pictorial.
- () Install the 1-1/8" diameter knobs on the remaining front panel knob locations. Position the pointers on the knobs as indicated by the arrows. Tighten the setscrews.



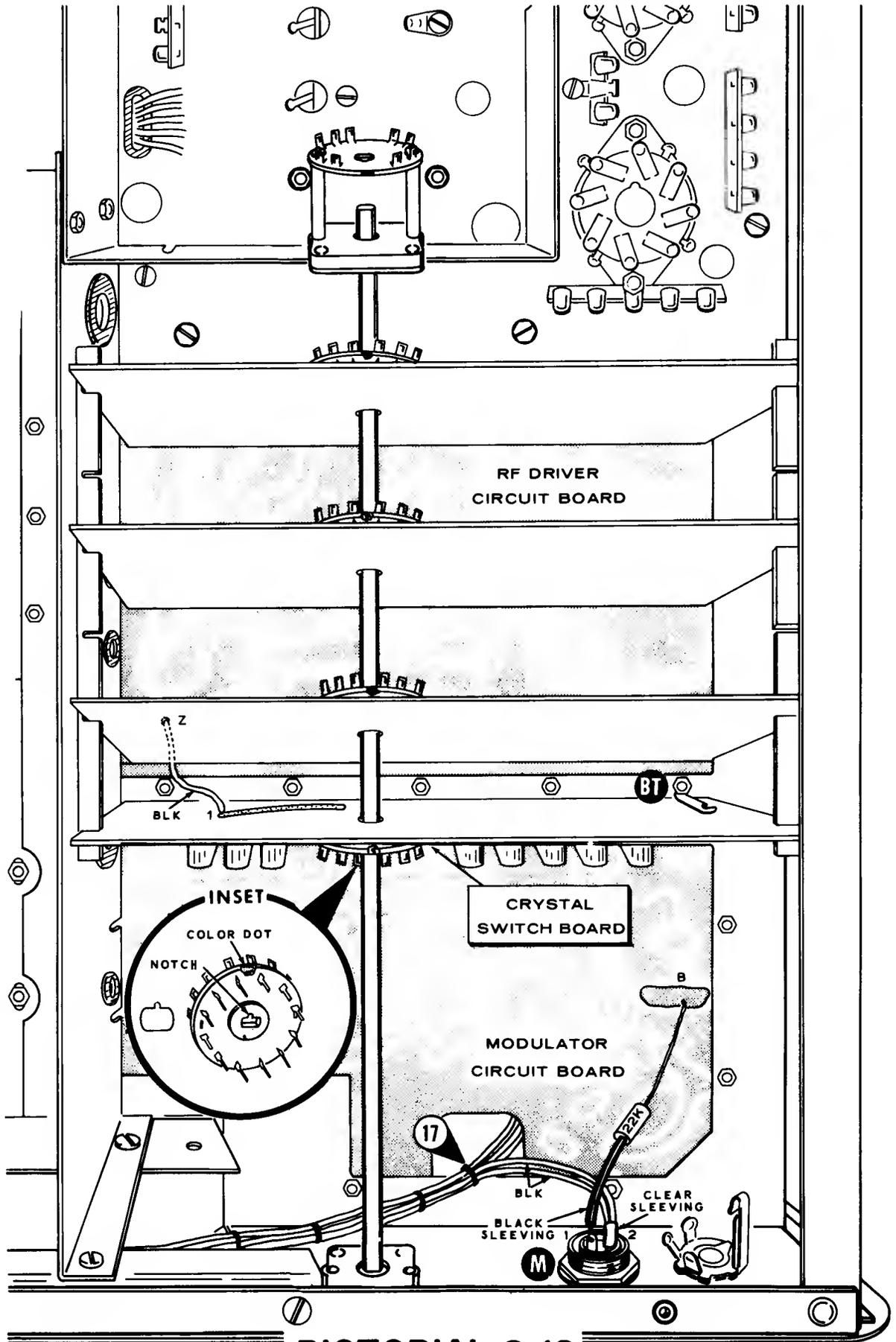
Detail 8-20A

- () Turn the knob at the Driver Preselector location counterclockwise until the capacitors hit the stop and then continue to turn the knob until the knob pointer is at the position shown by the arrow. The belts on the pulleys will slip to allow knob setting. This also will assure that the capacitors are both against their stops and will track with each other.

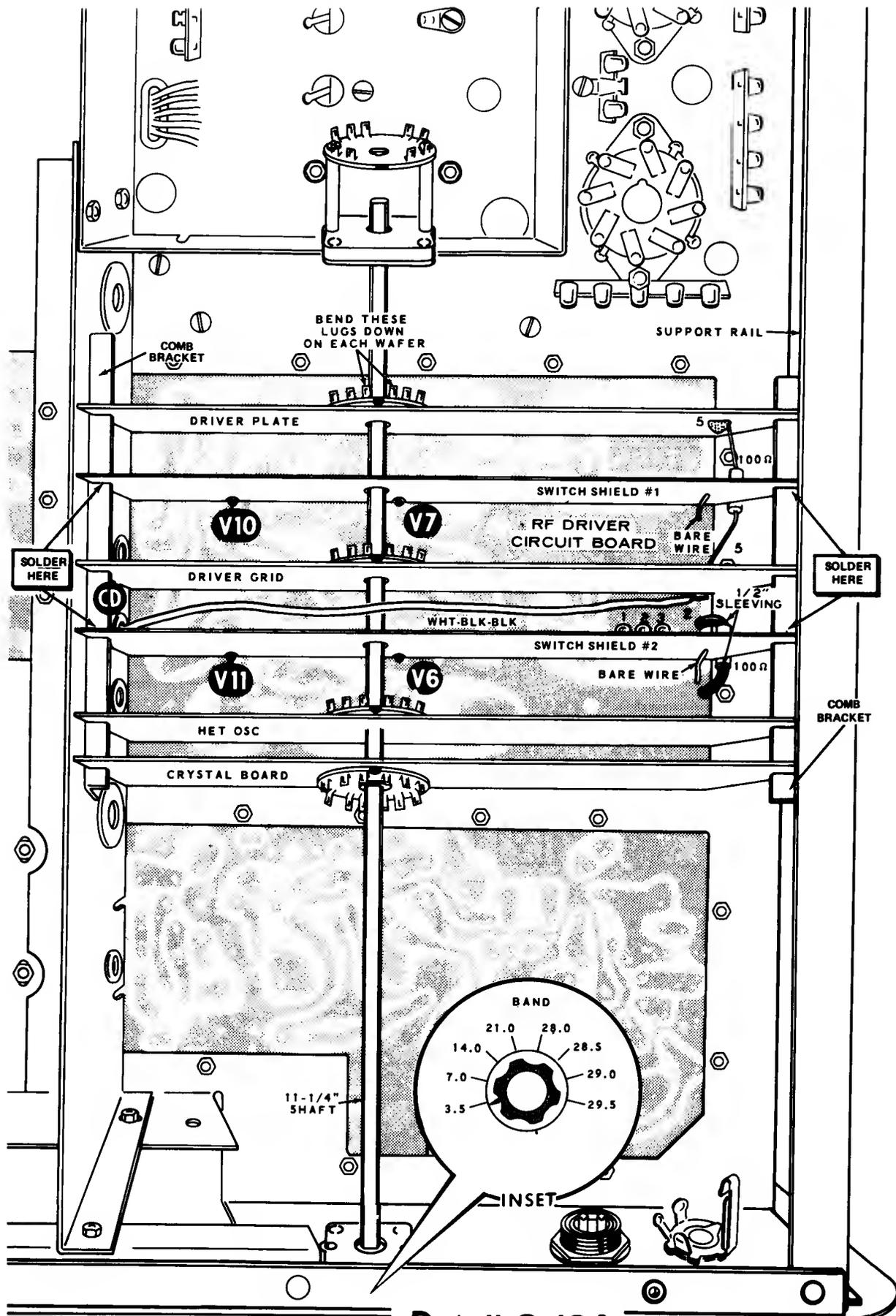
This completes the "Step-by-Step Assembly" section of the Manual. Proceed to "Control and Connector Functions."



PICTORIAL 8-20



PICTORIAL 8-19



Detail 8-19A

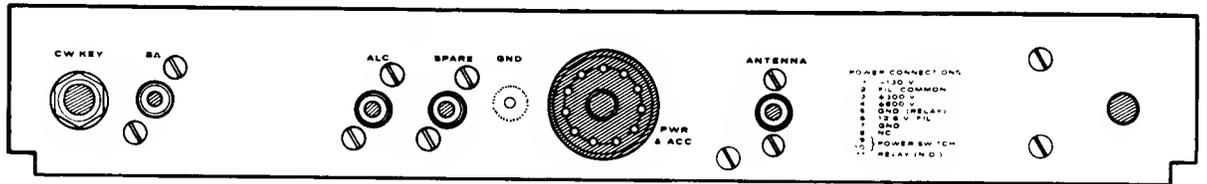
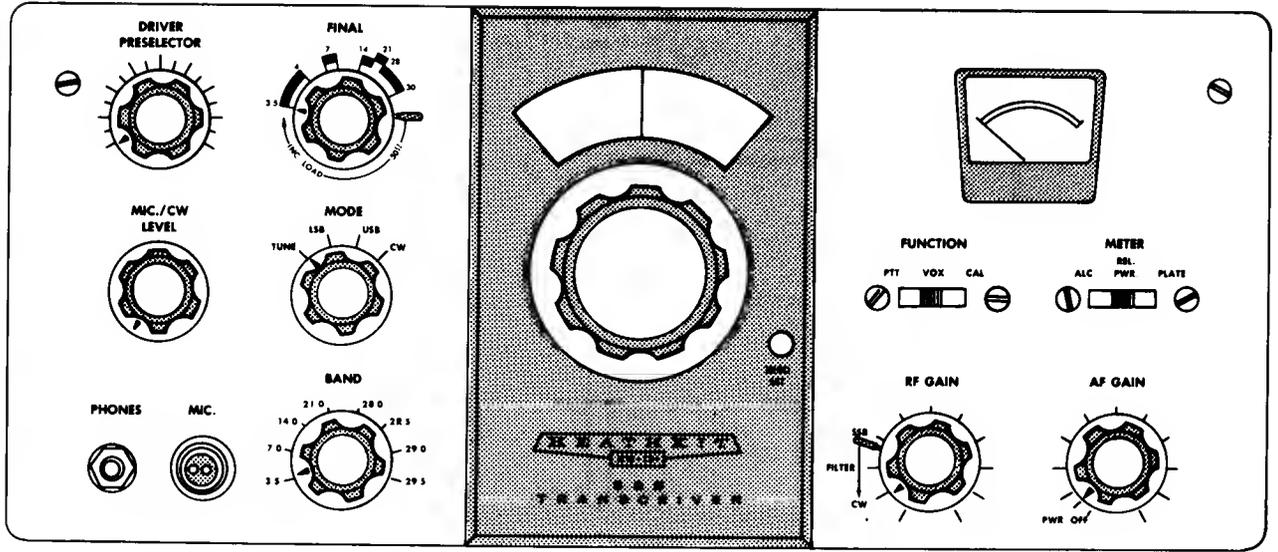
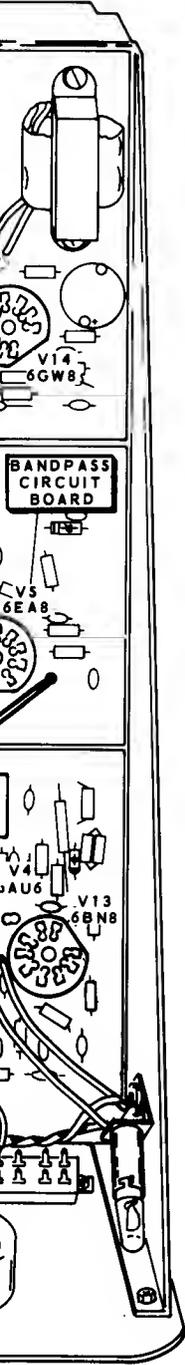


FIGURE 1-1

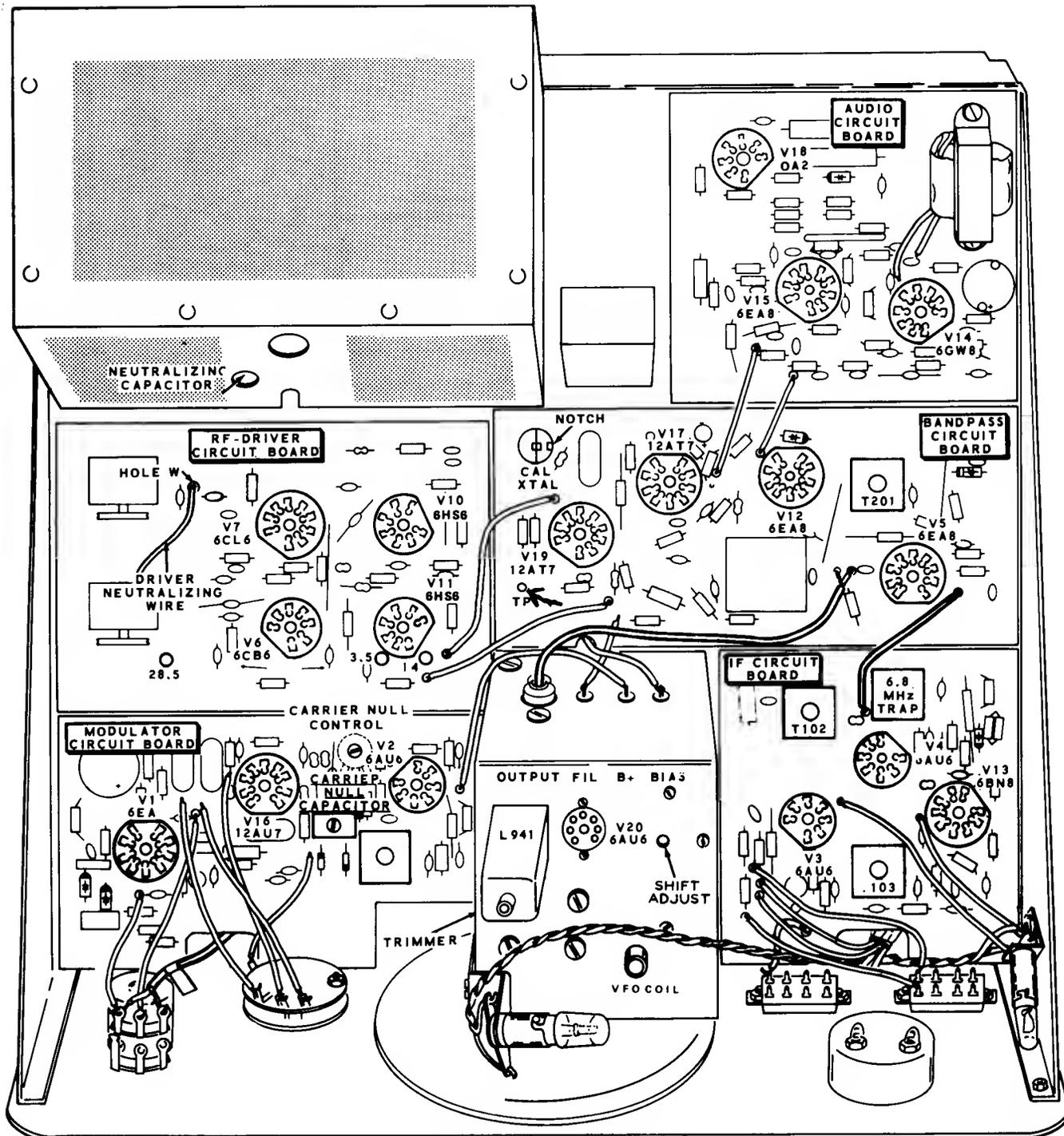


FIGURE 1-2

CONTROL AND CONNECTOR FUNCTIONS

The functions of the front panel and chassis controls are outlined in this section. Read the following paragraphs carefully, so you will be familiar with the operation of each control before starting to check, align, or operate this Transceiver. The location of the controls is shown in Figure 1-1 and Figure 1-2 (fold-out from Page 100).

FRONT PANEL FUNCTIONS

DRIVER PRESELECTOR

This control is used to peak the receiver RF amplifier and transmitter driver tuned circuits. The adjustment can be made in either the receive or transmit mode of operation, and must be adjusted at each position of the BAND switch. This adjustment should also be made when the operating frequency is changed appreciably.

MIC/CW LEVEL

When the MODE switch is in the LSB or USB position, this control is used to adjust the audio drive. The control has range enough to adjust for most high impedance crystal or dynamic microphones.

With the MODE switch in the Tune or CW position, the carrier output level of the transmitter is adjusted with this control.

PHONES

High impedance headphones can be connected to this jack. When the headphone plug is inserted, the speaker volume is reduced to a very low level.

MIC (Microphone)

A high-impedance microphone should be connected to this socket. Provisions are made in the socket for connecting a microphone with a push-to-talk switch.

FINAL TUNE AND LOAD

The round knob is the FINAL TUNE control. After the MAIN TUNING control has been set to the desired operating frequency, and the MODE switch set to the TUNE position, this control is adjusted for maximum (Relative Power) meter indication to tune the transmitter for maximum output.

The lever arm is the FINAL LOAD control. It is also tuned for a maximum (Relative Power) meter indication. At this point, there is the best possible impedance match between the final amplifier circuit and the antenna.

The FINAL TUNE and FINAL LOAD controls have some interaction and must be adjusted alternately until maximum relative power is achieved.

MODE

This switch selects the LSB, USB, or CW mode of operation for the receive and transmit sections. In the TUNE position, the transmitter is turned on so the driver and final RF stage can be tuned.

BAND

In the first four positions, this switch selects the following ranges: 3.5 to 4 MHz (80 meters); 7 MHz to 7.3 MHz (40 meters); 14 to 14.5 MHz (20 meters); and 21 to 21.5 MHz (15 meters).

The following 500 kHz portions of the 10-meter band are selected in the other four positions of this switch: 28.0 MHz to 28.5 MHz, 28.5 MHz to 29.0 MHz, 29.0 MHz to 29.5 MHz, and 29.5 MHz to 30.0 MHz.

MAIN TUNING

The MAIN TUNING dial controls the frequency of the VFO over its range of 500 kHz. The dial is scaled 0 to 500. To read frequency directly, calibrate the dial at the closest harmonic of the calibration oscillator. Then turn the dial to the desired frequency. Add the dial reading in kHz to the setting of the band switch in MHz. For example:

- | | | |
|----|------------------------|----------------|
| 1. | Band Switch reads: | 3.5 MHz |
| | Dial reads: | <u>335 kHz</u> |
| | Approximate frequency: | 3.835 MHz |
| | or | |
| 2. | Band Switch reads: | 14.0 MHz |
| | Dial reads: | <u>335 kHz</u> |
| | Approximate frequency: | 14.335 MHz |

ZERO SET

Pushing this button while turning the MAIN TUNING knob locks the dial scale while the VFO frequency is being changed. This permits the MAIN TUNING dial to be calibrated at 100 kHz intervals.

FUNCTION

This switch selects the PTT (push-to-talk) or the VOX (voice-operated transmit) methods of controlling the

Transceiver, and turns the CAL (calibration oscillator) on and off. This switch should be in the PTT or VOX position when the MODE switch is in the TUNE position.

In the PTT switch position, the Transceiver is changed from receive to transmit operation by closing a push-to-talk microphone switch, or by closing the key when set up for CW.

In the VOX position, the Transceiver is changed from receive to transmit operation when the operator talks into the microphone, or when the key is closed in the CW mode.

In the CAL position, the 100 kHz crystal oscillator is turned on to calibrate the MAIN TUNING dial at 100 kHz intervals. The harmonics of this oscillator are easily discernible throughout the range of the Transceiver.

FILTER

This lever switch selects the SSB crystal filter or the CW crystal filter (when installed).

RF GAIN

The receiver sensitivity is controlled by the RF GAIN control. This control is set at the full clockwise position for maximum gain. In the presence of extremely strong signals which tend to overload the receiver, or to eliminate background noise, the gain can be reduced by turning this control counterclockwise.

METER

See "Reading the Meter" on Page 139.

When the meter switch is in the ALC position, it causes the meter to act as an S Meter when receiving and to indicate ALC voltage when transmitting.

The REL PWR position indicates an uncalibrated amount of output power.

The PLATE position causes the meter to indicate total cathode current to the final stages.

AF GAIN

The AF GAIN control adjusts the audio output volume when receiving.

RIGHT SIDE CONTROL FUNCTIONS

VOX SENS

The VOX SENS (Sensitivity) control adjusts the VOX relay circuit to operate at the voice level desired by the operator. When the operator talks into the microphone, the VOX relay is energized and turns the transmitter on.

VOX DELAY

When the FUNCTION switch is set at VOX, this control adjusts the "hold-in" time (length of time the transmitter stays on) after a spoken word or a keyed character. Proper setting of the VOX DELAY control eliminates excessive keying of the transmitter between words or characters.

ANTI-TRIP

The ANTI-TRIP control adjusts the VOX circuit so the signal from the speaker will not turn on the transmitter by feeding back into the microphone.

ZERO ADJUST

The meter ZERO ADJ control is adjusted for a zero reading on the meter, in the receive mode of operation, with the antenna disconnected and with the RF GAIN control turned fully clockwise.

BIAS

This control adjusts the bias voltage on the final RF amplifier tubes for linear operation.

TOP CHASSIS CONTROL FUNCTIONS

CARRIER NULL CONTROL (Modulator Circuit Board)

This control balances the modulator to suppress the carrier.

CARRIER NULL CAPACITOR (Modulator Circuit Board)

The adjustment of this capacitor completes the modulator balance.

CAL XTAL (Bandpass Circuit Board)

This trimmer adjusts the 100 kHz oscillator to exact frequency.

REAR APRON CONNECTIONS

CW KEY: This jack is used to connect a key or keyer to the Transceiver. Use a phone plug having a 1/4" sleeve. Connect the hot lead of your key to the tip of the plug and the ground lead to the sleeve.

8Ω: This phono socket is used to connect a speaker to the Transceiver. It accepts a standard phono plug. The output transformer is designed for a speaker having an impedance of 8 ohms, although other speakers from 4 to 16 ohms impedance may be used.

ALC: Automatic level control voltage from an external amplifier may be applied to the Transceiver through this phono socket.

SPARE: For accessories.

GND: For safety, a low-resistance, heavy-duty ground connection should be connected to this terminal.

PWR. and ACC.: The cable socket from your power supply engages this plug.

ANTENNA: This socket is used to connect the antenna to the Transceiver. If the Transceiver is to be used with an amplifier or monitor scope, refer to the "Installation" section of this Manual.

NOTE: The unoccupied hole at one edge of the rear apron is used with the Heathkit Mobile Mount.

PRELIMINARY CHECKS

Before applying power to the Transceiver, complete the preliminary checks as outlined in this section. These checks are needed to be sure there are no short circuits or open connections that could cause damage to the Transceiver components.

- () Make sure the pointer of the panel meter is at zero. If it is not, adjust the screw in the front of the meter.
- () Turn the following front panel controls to a fully counterclockwise position.

DRIVER PRESELECTOR control
MIC/CW LEVEL control
MODE switch
BAND switch
RF GAIN control
AF GAIN control

- () Set the front panel slide switches as follows:

FUNCTION switch: PTT
METER switch: PLATE

- () Set the following controls to a fully counterclockwise position. Refer to Figure 1-1 (fold-out from Page 100) to help locate the controls.

ZERO ADJ
BIAS
VOX DELAY
VOX SENS
ANTI-TRIP
CARRIER NULL control

METER CIRCUIT CHECKS

An ohmmeter will be used for the resistance checks on the following pages. Before making the first check, the polarity of the ohmmeter test leads will be determined. Then the test points for the common and positive (+) leads will be called out in each step.

- () Set the ohmmeter to the RX1 range.

- () Check the polarity of the ohmmeter leads as follows: Connect one ohmmeter lead to the Transceiver chassis and the other lead to pin 1 of tube socket V9. If an "up-scale" deflection of the Transceiver panel meter is not obtained, reverse the ohmmeter leads. When an "up scale" meter indication is obtained, the meter lead connected to pin 1 of tube socket V9 should be marked (+) positive. This lead should be used as the positive (+) lead for the remaining checks.

NOTE: Perform the two steps in the following box. The panel meter should read up-scale, which shows that it is connected correctly. If the panel meter does NOT read up-scale, the meter or meter switch circuits are incorrectly wired (or faulty) and must be corrected before additional tests are made.

METER SWITCH	OHMMETER RANGE	COMMON LEAD	POSITIVE (+) LEAD
() ALC	RX1	Pin 7 of tube socket V3 (on IF circuit board)	Chassis
() REL PWR	RX1	lug 1 of terminal strip BE	Chassis

RESISTANCE CHECKS

Refer to Figure 1-2 (fold-out from Page 100), 1-3 (fold-out from Page 106), and 1-4 for the following resistance checks.

Complete the resistance checks listed in Charts #1, #2, and #3. Connect the common and positive (+) ohmmeter leads and set the switches as listed in the chart.

When more than one switch setting is given, make the resistance check at each setting of the switch. Also, observe the special instructions given in the NOTES column.

NOTE: If readings within 20% of the stated values are not obtained in the following steps, refer to "In Case of Difficulty" section on Page 144. Before doing any actual troubleshooting, however, complete all the checks. The resistance readings thus obtained may establish a pattern which will make the difficulty easier to locate.

IMPORTANT: The word "Diode" in the NOTES column of the following charts indicates that a diode is in the circuit under test. Therefore, the measured resistance can vary due to the forward current of the diode, and depending on the range setting of the ohmmeter. The ohmmeter readings in the chart were made with a Heath IM-11 VTVM. Readings made with other ohmmeters may be considerably different.

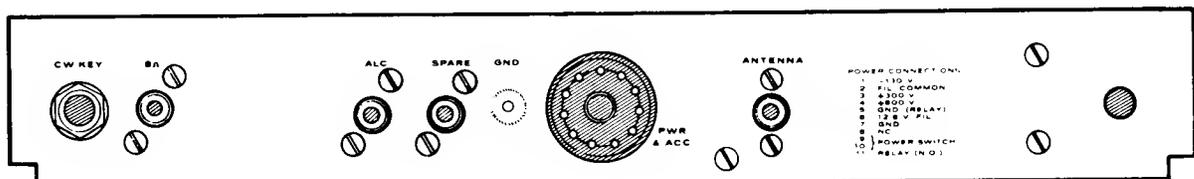


Figure 1-4

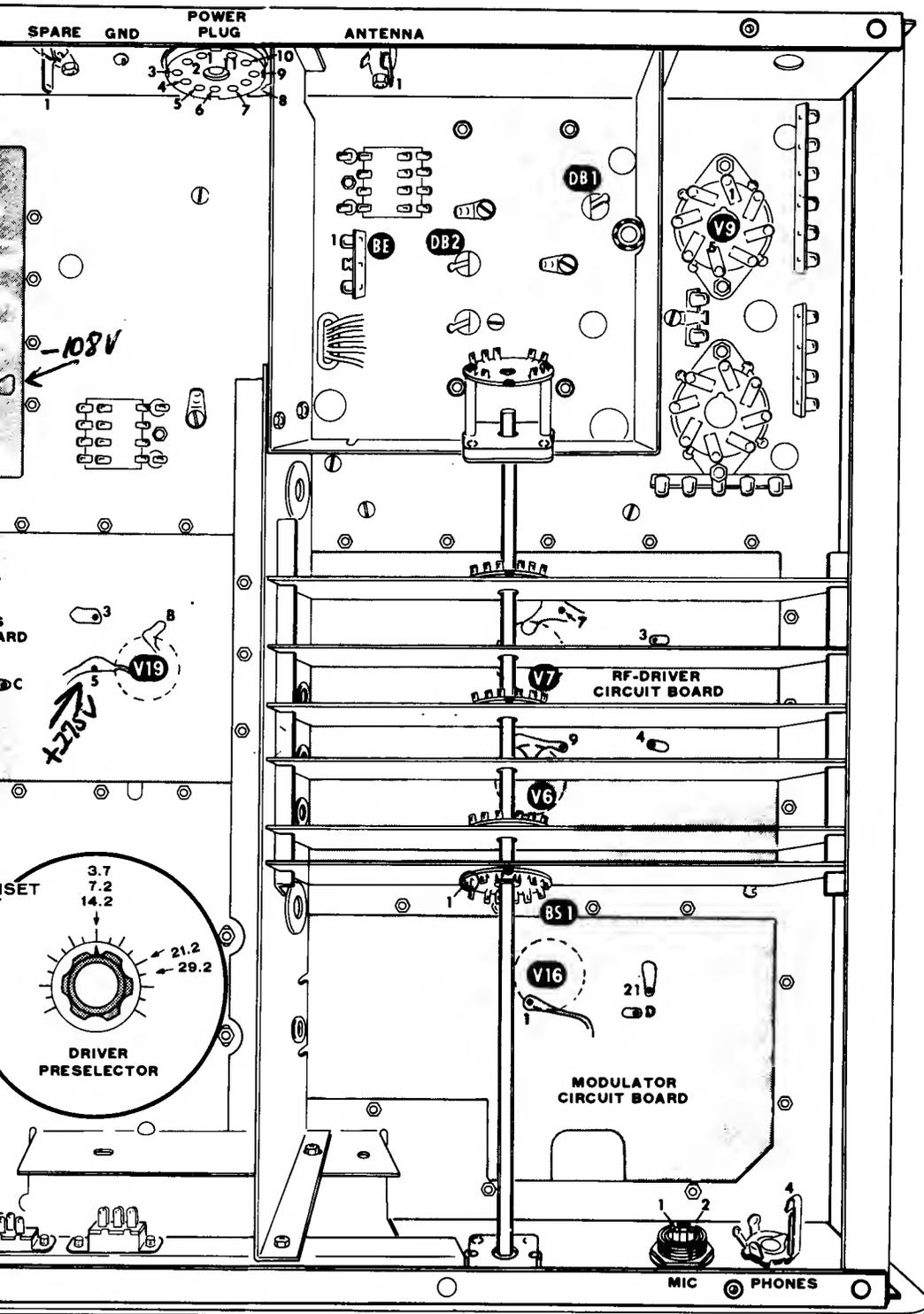


FIGURE 1-3

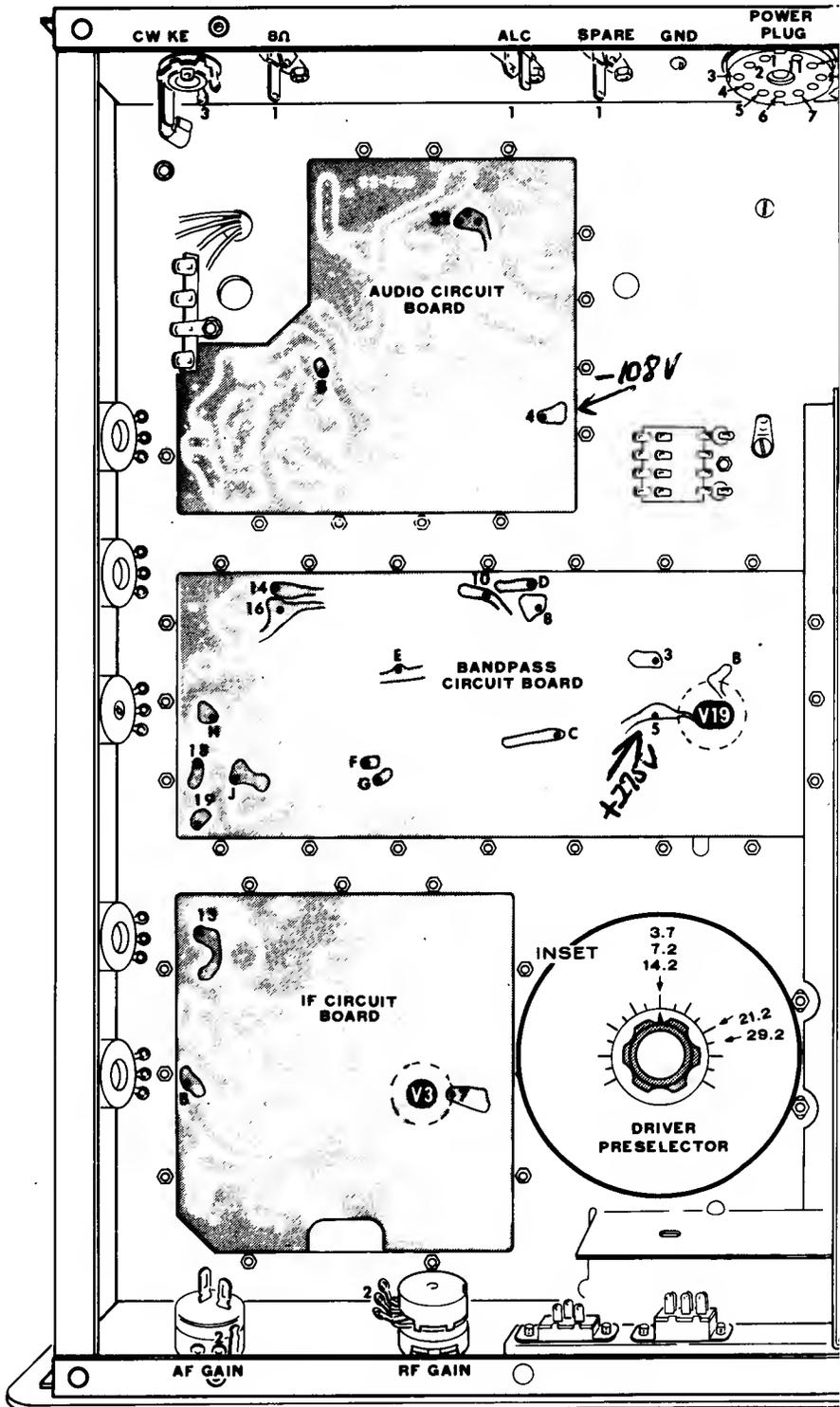


FIGURE 1

OHMMETER TEST POINTS		MODE SWITCH	RESISTANCE IN OHMS	NOTES
COMMON LEAD	POSITIVE (+) LEAD			
() Chassis	CW KEY jack, lug 3	CW	50 k	
() CW KEY jack, lug 3	Chassis	"	35 k	(Diode)
() "	"	TUNE, LSB, and USB	70 k	(Diode)
() Chassis	8 Ω jack, lug 1	TUNE	.6	
() "	Spare jack, lug 1	"	INF	
() "	ALC jack, lug 1	"	70	(Diode)
() ALC jack, lug 1	Chassis	TUNE and CW	10 k - low Ω (use RX100 scale)	(Diode) Varies with setting of MIC/ CW LEVEL control.
() "	"	LSB and USB	3.4 M	(Diode)
() Power plug, Pin 1	"	TUNE	13 k	
() Chassis	Power plug, Pin 2	"	0	
() "	" Pin 3	TUNE, USB, CW	25 k	
() "	" Pin 3	LSB	20 k	
() "	Power plug, Pin 4	TUNE	INF	
() "	" Pin 5	"	0	
() "	" Pin 6	"	1.6	
() "	" Pin 7	"	0	
() "	" Pin 8	"	INF	
() "	" Pin 9	"	INF	
() "	" Pin 10	"	INF	
() "	" Pin 11	"	INF	

CHART #1

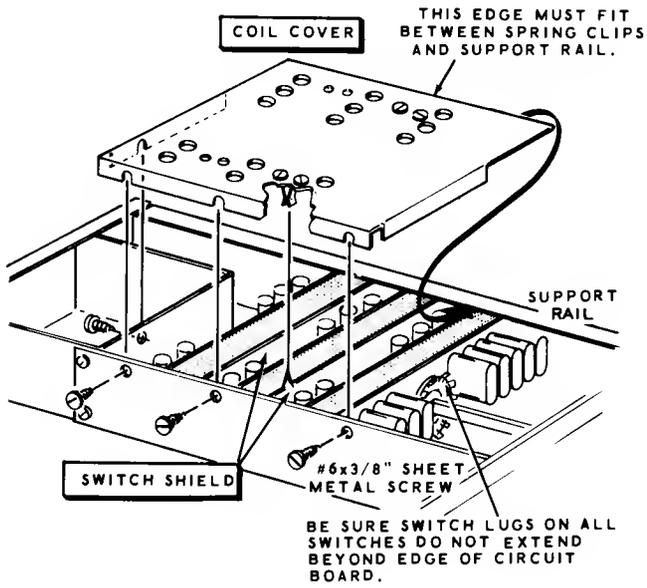
OHMMETER TEST POINTS				
COMMON LEAD	POSITIVE (+) LEAD	MODE SWITCH	RESISTANCE IN OHMS	NOTES
() Power plug, Pin 9	Power plug, Pin 10	TUNE	INF	
() " "	" "	"	0	Turn the AF GAIN control clockwise until a click is heard. Make the measurement. Then return the AF GAIN to the full counterclockwise (OFF) position.
() Chassis	ANTENNA jack, lug 1	"	0	
() "	PHONES jack, contact 4	"	Closed 0 Open 100 Ω	Press on contact 4 to open contact for lug 2.
() "	MIC socket, lug 1	"	1 M	
() "	" lug 2	"	0	
() "	" " "	LSB, USB, and CW	500 k	
() "	RF GAIN control, lug 2	TUNE	70 k to 10	Varies with setting of RF GAIN control.
() "	AF GAIN control, lug 2	"	25 to 1 M	Varies with setting of AF GAIN control.
() 13 on the IF circuit board	Chassis	All	5 M	

CHART #2

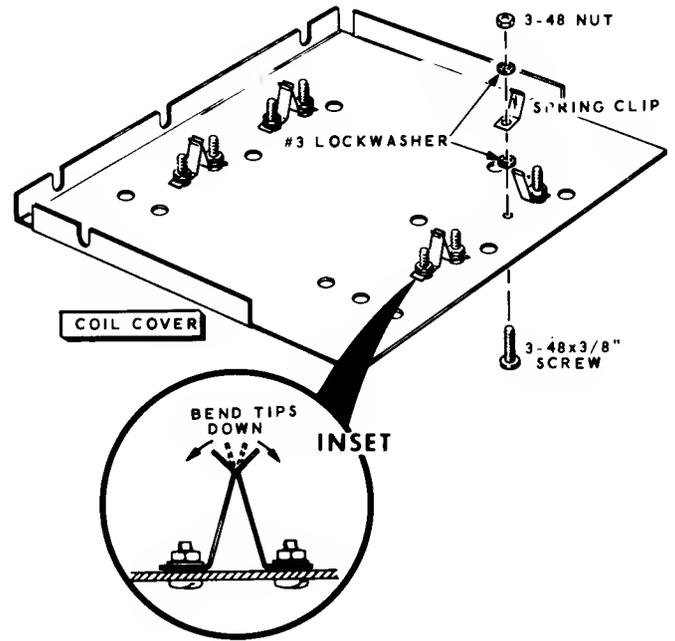
OHMMETER TEST POINTS			
COMMON LEAD	POSITIVE (+) LEAD	BAND SWITCH	RESISTANCE IN OHMS
() Chassis	Capacitor lug DB-1	3.5 and 7.0	10 k
() "	" " "	14.0 through 29.5	INF
	<u>CIRCUIT BOARD LOCATION</u>		
() Power Plug, Pin 3	RF DRIVER Foil 7	3.5	100
() "	" 3	"	100
() "	" 3	7.0 through 29.5	22 k
() "	" 9	3.5	1000
() "	" 4	"	1000
() "	" 4	7.0 through 29.5	INF
() Chassis	Lug 1 (Wafer BS1 of BAND switch)	3.5	5200
() "	"	7.0 through 29.5	INF
() "	Audio Circuit Board 22	3.5	30 k
() Audio Circuit Board 22	Bandpass Circuit Board B	All positions	100

This completes the "Preliminary Checks."

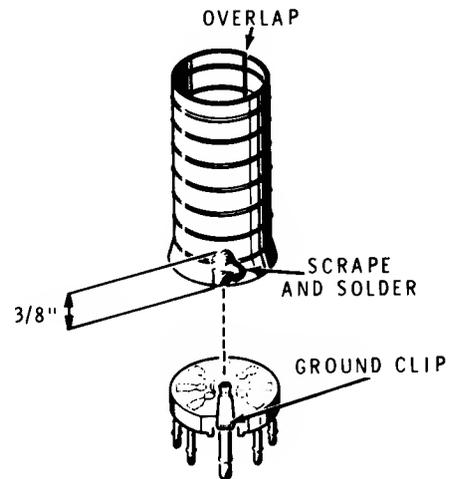
CHART #3



PICTORIAL 8-21



Detail 8-21A



Detail 8-21B

COIL COVER AND TUBE INSTALLATION

Refer to Pictorial 8-21 for the following steps.

- () Refer to Detail 8-21A and install four pairs of spring clips on the under side of the coil cover. Use 3-48 × 3/8" hardware. Bend the clip ends down slightly as shown in the insert drawing. Make sure the clips still touch each other after bending.

CAUTION: Be sure that none of the lugs of the switch wafers mounted on the circuit boards extend beyond the edges of the circuit boards so they cannot short-circuit when the coil cover is in place.

- () As shown in the Pictorial, push the plain edge of the coil cover under the support rail in such a manner that the spring clips on the under side of the coil cover will engage the metal switch shield. The slots in the two lips of the coil cover will fit under the heads of the four sheet metal screws in the center shield and final switch shield.
- () Tighten the four sheet metal screws.

Refer to Figure 1-3 (fold-out from Page 106) for the following three steps.

- () Connect the common lead of your ohmmeter to the chassis and check the resistance to pin 3 of the power plug. A resistance reading under 25 kΩ indicates that the coil cover is touching one or more of the switch lugs. This condition must be corrected before turning on the Transceiver.

- () Check the resistance between pin 4 of the power plug and the chassis. It should be infinity (∞).
- () Remove the common lead of the ohmmeter from the chassis and connect it to pin 1 of the power plug. The minimum resistance to the chassis should be 13 kΩ.

If resistances are below those shown, refer to the "In Case of Difficulty" section, or otherwise correct the trouble.

Place the tube shields on loose tubes as follows:

NOTE: You will install the three tube shields in the following steps. If a tube shield is too loose, remove it from the tube, squeeze on it to reduce its diameter, and then reinstall it.

- () Refer to Detail 8-21B and scrape each tube shield as shown (away from the overlap). Then apply a thin coat of solder to the scraped area. When you install these shields, be sure that the ground clip of the tube socket contacts the soldered area of the shield.
- () 7-pin tube shield on a 6CB6 tube (for V6).
- () 9-pin tube shield (2" long) on a 6CL6 (for V7).
- () 9-pin tube shield (1-3/4" long) on a 6EA8 (for V1).
- () Install all of the tubes in their sockets, as identified on the circuit boards as shown in Figure 1-2 (fold-out from Page 100). Make sure the socket ground clip contacts the soldered area.

POWER SUPPLY CONNECTIONS

The Transceiver was designed to operate with the Heathkit Models HP-13 (12 Vdc power source) and HP/PS-23 (117 Vac power source) Power Supplies. The following information will help you wire the 11-pin socket (supplied

with the Transceiver) for the power cable of the Power Supply you intend to use. The same cable and power supplies can be used with many other Heathkit models. Be sure to use the correct low B+ voltage for each model.

HP-13 SERIES POWER SUPPLY CONNECTIONS

CAUTION: Be sure the alternate connection in the low voltage dc circuit of the HP-13 Power Supply is connected for +300 volts output as outlined in the HP-13 Manual. Be sure the automobile voltage regulator is set to less than 14.5 volts. **NOTE:** If you use a different power supply, be certain that it is correctly fused for use with this Transceiver.

NOTE: If the Heathkit Mobile Mount is used, complete the power supply connections as directed in that manual.

Refer to Figure 1-5 for the following steps.

- () Install the 11-pin socket cap over the free end of the 8-wire cable from the Power Supply, as shown.
- () Remove 3/4" of the outer insulation from the end of the 8-wire cable. Then remove 1/4" of insulation from the end of each wire.
- () Melt a small amount of solder on each of the exposed wire ends to hold the small strands of wire together.
- () Insert the lead from the cap end of the fuse-holder (an in-line fuseholder with lead is supplied with the power supply) through the socket cap as shown.
- () Cut seven 5/8" lengths of clear sleeving and slip them over the indicated wires.
- () Connect the wires of the 8-wire cable and the fuseholder lead to the 11-pin socket lugs as shown. Solder each connection.
- () Push the lengths of sleeving over the lugs of the socket.
- () Snap the socket cap onto the 11-pin socket. **IMPORTANT:** When using the HP-13 Power Supply with the Transceiver, be sure the Bias control of the power supply is in its fully clockwise position. This setting will supply a maximum bias voltage at pin 9 of the power socket.

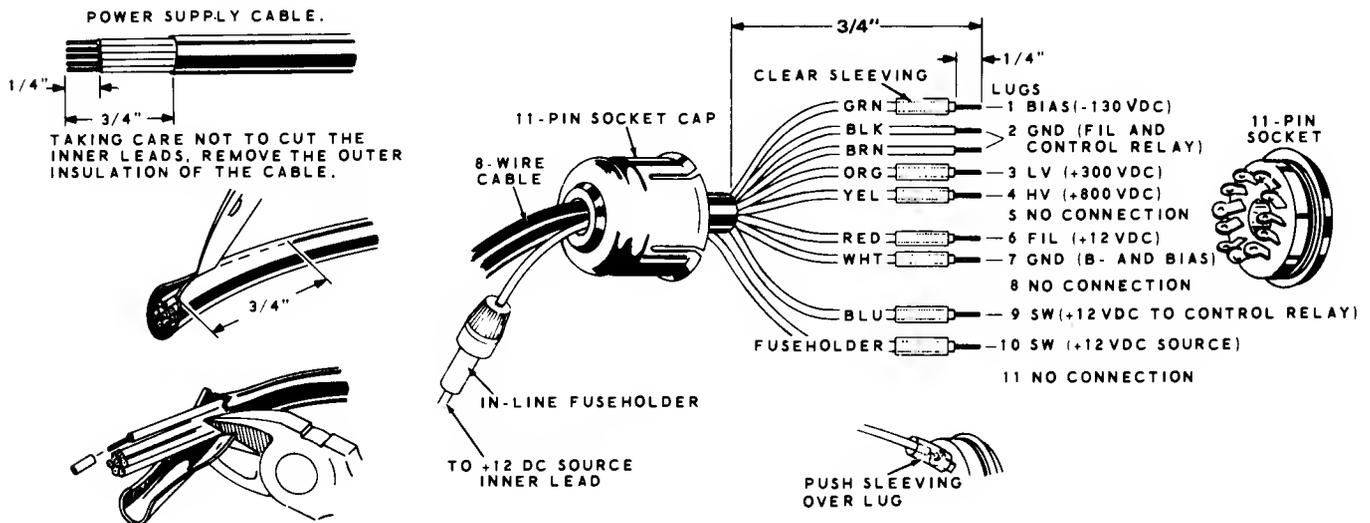


Figure 1-5

HP/PS-23 SERIES POWER SUPPLY CONNECTIONS

CAUTION: Be sure the low voltage dc circuit of the HP-23A Power Supplies are switched for 300 Vdc output. In the HP-23B, HP-23C, and PS-23 Power Supply, make the internal connections for 300 Vdc output.

Refer to Figure 1-6 for the following steps.

- () Install the 11-pin socket cap over the free end of the 8-wire cable from the Power Supply.
- () Remove 3/4" of the outer insulation from the end of the 8-wire cable. Then remove 1/4" of insulation from the end of each wire.
- () Melt a small amount of solder on each of the exposed wire ends to hold the small strands of wire together.

For the SB-201 and other linear amplifiers, use a piece of coaxial cable through the cap to bring out the relay connections.

- () Cut seven 5/8" lengths of clear sleeving and slip them over the indicated wires.
- () Connect the wires of the 8-wire cable and the coaxial cable (if a linear amplifier is used) to the 11-pin socket lugs as shown. Solder each connection.
- () Push the lengths of sleeving over the lugs of the socket.
- () Snap the socket cap onto the 11-pin socket. Be careful not to pinch any wires.

NOTE: With the above connections, the BIAS control in the HP-23 Power Supply is inoperative. Proper bias settings are accomplished with the BIAS control in the Transceiver.

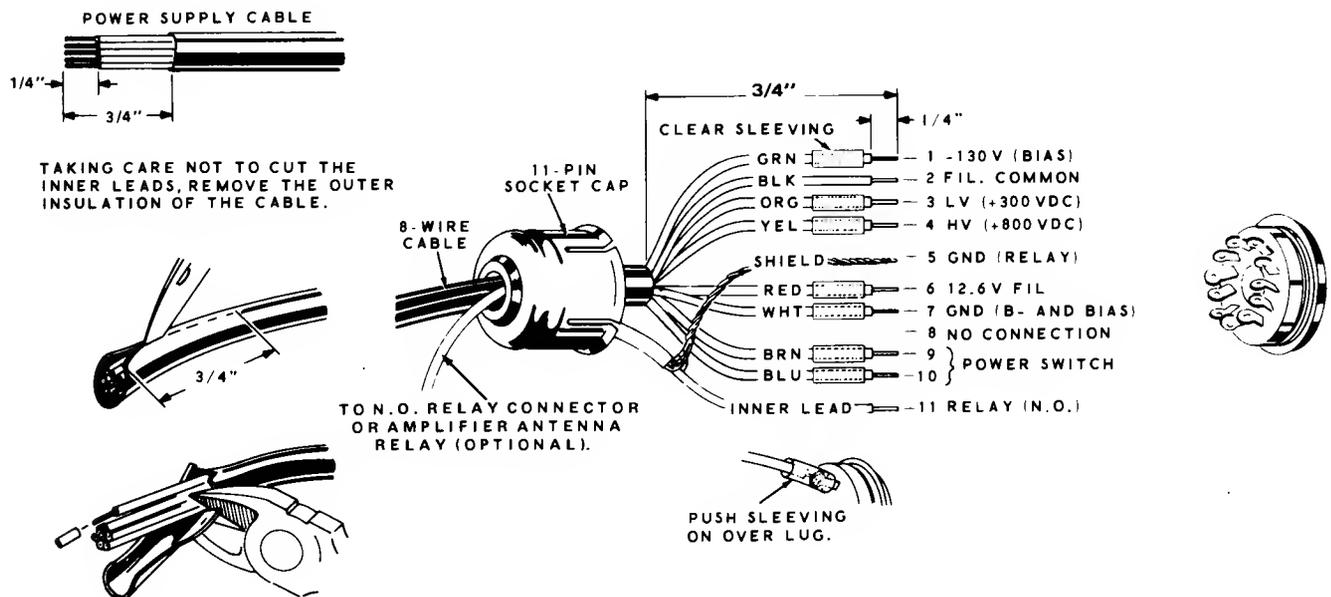


Figure 1-6

MICROPHONE CONNECTIONS

A high-impedance microphone equipped with a push-to-talk switch should be used with the Transceiver so either the PTT or VOX methods may be used to turn on the Transmitter. A two-pin microphone connector (Amphenol 80MC2M) is furnished for this purpose. It should be connected to the microphone cable as directed in the following steps.

Heath Microphones

- () Determine the desired length of your microphone cable, and cut off any excess.
- () Perform the numbered steps in Figure 1-7.

Other Microphones

If you use a microphone different than the one shown, connect the lead from the microphone element to pin 1 of the connector. If the microphone has a PTT switch, connect this lead to pin 2. Shield wires, to complete the ground side of the circuit, should be soldered to the spring as shown in Figure 1-7.

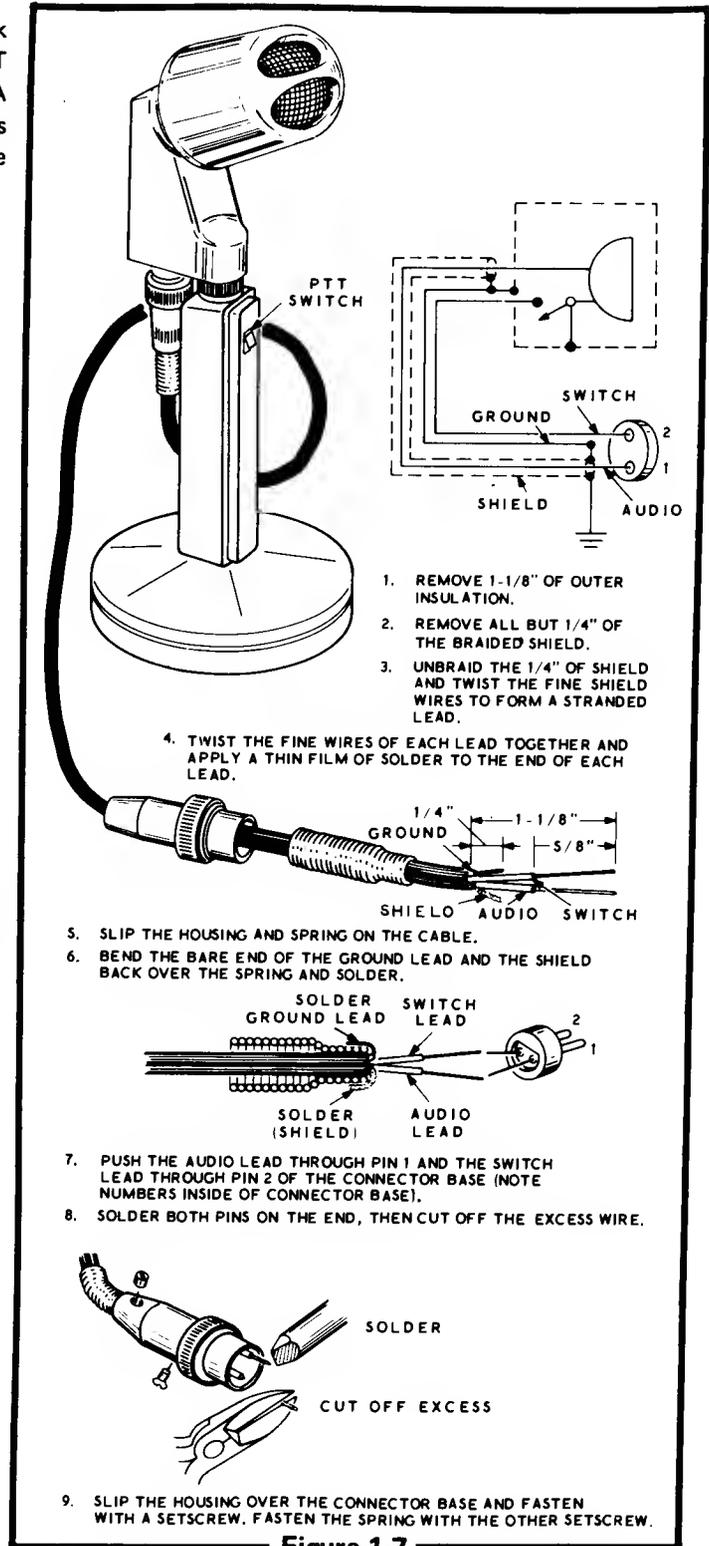


Figure 1-7



INITIAL TEST

CAUTION: BEFORE APPLYING POWER TO THE TRANSCEIVER, NOTE THAT LETHAL VOLTAGES ARE PRESENT BOTH ABOVE AND BELOW THE CHASSIS. DO NOT TOUCH ANY HIGH VOLTAGE POINTS WITH YOUR HANDS. USE WELL INSULATED TOOLS FOR ANY ADJUSTMENTS ON THE CHASSIS.

TO LESSEN THE SHOCK HAZARD, CONNECT A LEAD FROM A GOOD EARTH GROUND TO THE GROUND TERMINAL LOCATED ON THE REAR OF THE CHASSIS AND TO ALL TEST EQUIPMENT.

() Set the front panel controls as follows:

FINAL TUNE (round knob) to 10 o'clock.

FINAL LOAD (lever knob) to 4 o'clock.

MODE LSB.

FUNCTION PTT.

METER PLATE.

RF GAIN fully clockwise.

AF GAIN PWR OFF.

() Set the remaining front panel controls fully counterclockwise.

() Set the BIAS control (on the right side of the chassis) fully counterclockwise.

() Connect the socket on the power supply cable to the Transceiver power plug.

() Connect the power supply to the proper power source and set its switch at ON.

() Connect an 8 Ω speaker to the 8 Ω socket at the rear of the Transceiver. CAUTION: Never operate the Transceiver unless a speaker or headphones are connected. For safety reasons, it is recommended that headphones NOT be used during the testing of the Transceiver.

If abnormal operation is encountered at any time during the following tests, turn the Transceiver off immediately, and refer to the "In Case of Difficulty" section of the Manual on Page 144.

() Turn the AF GAIN clockwise until a click is heard. The Receiver is now On, and the pilot lamps should light.

() Visually check all parts for any signs of overheating, and check to see that each tube filament glows. The panel meter should indicate zero.

() Turn the AF GAIN control clockwise until noise is heard from the speaker. NOTE: If no noise is heard, check to be sure the transmitter is not keyed by a depressed switch on a PTT microphone, a closed key, or the MODE switch being in TUNE position.

() Turn the AF GAIN control to the 9 o'clock position.

Check the voltages listed in the next two steps with a voltmeter. Refer to Figure 1-3 (fold-out from Page 106) for the location of test points.

() +275 volts dc from point 5 on the bandpass circuit board to chassis ground.

() -108 volts dc (bias) from point 4 on the audio circuit board to chassis ground.

ALIGNMENT

The coils and transformers in your Transceiver have been preset at the factory. Only minor readjustments should be necessary during the following alignment procedure.

The following equipment is necessary for alignment of the Transceiver.

1. A test meter, such as an 11 megohm input voltmeter. (Vacuum tube and solid-state models are found in the Heath catalog.) A 20,000 ohm-per-volt VOM may be used, but will load the circuits to a greater extent.
2. A 50 Ω nonreactive dummy load that is capable of 100 watts dissipation, such as the Heathkit Cantenna. Do not use light bulbs for a dummy load as they present an impedance which varies with power and frequency.
3. A receiver capable of receiving WWV at 2.5, 5, 10, or 15 MHz. If this type of receiver is not available, a receiver tunable to a standard broadcast station which is operating at an even multiple of 100 kHz (such as 600 kHz, 1000 kHz, etc.) can be used.
4. An accurate 100 kHz standard oscillator may be used for the alignment of tuned circuits. DO NOT use such an oscillator to adjust the Transceiver crystal calibrator. For this purpose refer to the "Crystal Calibrator Alignment" section of this Manual.

For the alignment of the transmitter section it is recommended that you use an oscilloscope, such as the Heathkit Signal Monitor Scope to observe the output RF envelope.

WARNING: Do not place the Transceiver in the transmit mode of operation until directed to do so or the Transceiver may be seriously damaged.

- () Connect a 50 Ω dummy load, capable of 100 watts dissipation, to the ANTENNA jack on the rear of the chassis. CAUTION: Do not use light bulbs as a dummy load.
- () Be sure an 8 Ω speaker is connected to the 8 Ω jack on the rear of the chassis.
- () Preset the CAL XTAL trimmer so its notch is towards the 100 kHz crystal as shown in Figure 1-2 (fold-out from Page 100).
- () Preset the front panel controls as follows:
 - DRIVER PRESELECTOR – 12 o'clock position.
 - MIC/CW LEVEL – fully counterclockwise.
 - MODE – LSB.
 - BAND – 3.5.
 - MAIN TUNING Dial (VFO) – 200.
 - FUNCTION – PTT.
 - RF GAIN – fully clockwise.
 - METER – ALC.
 - AF GAIN – 9 o'clock position.

S METER ADJUSTMENT

- () Adjust the ZERO ADJ control (on the right side of the chassis) for a zero indication on the meter with the antenna disconnected and the RF GAIN control at the full clockwise position.

RECEIVER ALIGNMENT

- () Set the test meter switches so the meter will indicate a negative (-) dc voltage.
- () Connect the common lead of the test meter (11 megohm input voltmeter) to the chassis and the other lead to the circuit board foil at TP (Figure 1-2) on the screened side of the bandpass circuit board near tube V19. If your meter reads 0 at TP, contact instead the adjacent lead of the 100 k Ω (brown-black-yellow) resistor. A reading of -.82 V or higher is normal.
- () Similarly, check the heterodyne oscillator output voltage at all positions of the BAND switch. If necessary, adjust the correct heterodyne oscillator coil for any BAND switch position that does not give an indication of about -0.5 to -2 volts dc on the test meter. The heterodyne oscillator coils for bands 3.5, 14, and 28.5 are marked, and adjusted at the top side of the RF driver circuit board; the coils for the other bands are marked on the shield cover, and are adjusted from the bottom of the chassis.

The heterodyne oscillator output will be checked at each position of the BAND switch in the following steps. If necessary, the heterodyne oscillator coils will be adjusted to obtain a preliminary output voltage reading. Final adjustment will be made later. Carefully insert the slim end of the alignment tool fully into each slug before turning, to avoid core breakage.

NOTE: The heterodyne oscillator crystals that are supplied with the Transceiver provide coverage from 3.5 to 4.0 MHz, 7.0 to 7.3 MHz, 14.0 to 14.5 MHz, 21.0 to 21.5 MHz, and 28.0 to 30.0 MHz. As the driver grid and driver plate coils must be sequence-tuned (because of their series-parallel arrangement) other heterodyne crystals for out-of-band operation could introduce a wide variety of possible tuning conditions. Therefore, we recommend that you do not use crystals of frequencies other than those supplied.

It is not abnormal to receive "birdies" in the vicinity of 3740 kHz and 21,200 kHz.

- () With the BAND switch at 3.5, the test meter should indicate about -0.5 to -2 volts dc. If necessary, adjust coil 3.5 (near tube V11 on the top side of the RF driver circuit board) to bring the voltage into this range. **NOTE:** When adjusting this coil in one direction, the oscillator output voltage will change rapidly; when adjusting the coil in the opposite direction from the peak, the output voltage will change slowly. Adjust the coil in the direction that gives the slower change in output voltage.

- () Turn both VFO trimmer capacitor screws (through two holes on the left side of the VFO chassis) clockwise until just snug. Then turn each capacitor screw counterclockwise one-quarter turn.
- () Set the FUNCTION switch to CAL and the BAND switch to 3.5; then turn the MAIN TUNING dial back and forth around 400 to get a calibrator signal. Check for the calibrate signal by turning the FUNCTION switch to VOX and back to CAL; the signal should stop and then start again and should peak with the DRIVER PRESELECTOR.
- () Reset the DRIVER PRESELECTOR to the 12 o'clock position.
- () Disconnect the test meter leads from the Transceiver.

The S Meter will be used as an output indicator during the remaining alignment of the Transceiver and the 100 kHz calibrator will be used as a signal source.

When adjusting the transformers in the following steps, use the large end of the tuning tool for the top core. Use the long, thin end (which is inserted through the top core) for the bottom core.

CAUTION: The 6.8 MHz trap coil is sealed, and should not be turned.

NOTE: It should not be necessary to turn the cores of transformers T201 and T103 more than two turns.

- () Adjust transformer T201 for maximum volume.

- () Adjust the top and bottom slugs of transformer T102 for a maximum volume or S Meter indication.
- () Turn the slug of transformer T103 up (CCW) 14 turns. Then adjust it for a maximum S Meter reading (no more than about one turn).
- () Readjust transformers T201, T102, and T103 slightly for maximum S Meter reading.
- () As the two preceding adjustments interact to some extent, repeat them until the 3500 kHz and 4000 kHz CAL signals coincide respectively with the 0 and 500 marks on the dial.

NOTE: The VFO signal may be tuned in on a general coverage receiver at 5000 kHz for the "500" dial setting, and at 5500 kHz for the "0" dial setting.

VFO ALIGNMENT

- () Make sure the Transceiver has been warmed up for at least 30 minutes before making the following adjustments.

NOTE: Refer to Reading the Dial on Page 139.

- () Find the CAL signal within approximately 25 kHz of 3900 kHz (400 on the dial). A general coverage receiver tuned to 5100 kHz will aid in identifying the VFO signal. If you are receiving a CAL signal, it will cease when the Function switch is set at VOX.
- () Find the CAL signal near 4000 kHz (500 on the dial). Then carefully turn the dial to its counterclockwise stop. Hold the VFO knob with one hand and, with the other hand, slip the circular dial until the end of the scale marked "Stop" coincides with the hairline at the "500" end. See Detail 8-9A on Page 78.
- () Again tune in the 4000 kHz CAL signal near 500 on the dial.
- () Carefully tune off the 4000 kHz CAL signal to the side toward the 500 dial reading. Then adjust the VFO COIL to move the CAL signal to your listening frequency. By alternately moving your listening frequency and then adjusting the VFO COIL, you can "walk" the CAL signal in the desired direction until it coincides with the 500 dial reading.
- () Turn the dial to the vicinity of 0 and identify the 3500 kHz CAL signal. Move this signal so that it coincides with the 0 dial reading by adjusting both VFO TRIMMERS.

DRIVER GRID AND PLATE COILS

The driver grid and driver plate coils will be adjusted in the following steps. The coil locations are marked on the shield cover on the bottom of the chassis. These coils must be adjusted in the proper sequence as follows:

- () Set the MAIN TUNING dial to 200, and the DRIVER PRESELECTOR to the 12 o'clock position.
- () Adjust driver grid coil 3.5 and driver plate coil 3.5 for a maximum S Meter indication. The S Meter will move slowly during the adjustment of these two coils.
- () Change the setting of the front panel controls as follows:
 - DRIVER PRESELECTOR – 29.2 position. See the inset drawing on Figure 1-3 (fold-out from Page 106).
 - BAND – 29.0.
 - MAIN TUNING dial (VFO) – 200 kHz.
- () Turn the MAIN TUNING dial back and forth around 29.2 MHz to get the loudest signal. Check for the calibrate signal by turning the DRIVER PRESELECTOR to make sure there is a variation in volume. Return the DRIVER PRESELECTOR to the 29.2 position.
- () Adjust driver grid coil 29 and driver plate coil 29 for a maximum S Meter indication.

- () Change the setting of the front panel controls as follows:

DRIVER PRESELECTOR – 21.2 position. See the inset drawing on Figure 1-3.

BAND – 21.0

MAIN TUNING dial – 200 kHz

NOTE: In the following step, the CAL signal and the VFO harmonic will be found very close together, showing that the VFO is correctly calibrated. The CAL signal is much stronger and can be identified by switching the FUNCTION switch between CAL and VOX.

- () Turn the MAIN TUNING dial back and forth around 21.2 MHz for the loudest signal.
- () Adjust driver grid coil 21 and driver plate coil 21 for a maximum S Meter indication.

- () Turn the BAND switch to 14.0, the MAIN TUNING dial to 200 kHz, and the DRIVER PRESELECTOR to the 14.2 position.

- () Tune the MAIN TUNING dial for the loudest signal and check for the calibrate signal.

- () Adjust driver grid coil 14 and driver plate coil 14 for a maximum S Meter indication.

- () Set the BAND switch at 7.0 and the MAIN TUNING dial at 200 kHz.

- () Tune the MAIN TUNING dial for the loudest signal.

- () Adjust driver grid coil 7 and driver plate coil 7 for a maximum S Meter indication.

- () Set the FUNCTION switch to PTT.

Proper receiver operation will be indicated by minimum calibrator signals of S9 +20 dB at 3700 kHz and decreasing to S3 at 29.2 MHz.

TRANSMITTER ALIGNMENT

See the "Reading the Meter" section on Page 139 before making any more adjustments.

CAUTION: The coil cover MUST be in place for proper transmitter operation.

- () Connect a push-to-talk microphone to the MIC connector on the front panel.
- () If a Monitor Scope is available, connect it between the ANTENNA jack and the dummy load. Be sure the dummy load is capable of 100 watts dissipation. Do not use light bulbs for a dummy load, as damage may result.
- () Turn the adjusting screw of the NEUTRALIZING CAPACITOR (through the hole in the front of the RF Cage) clockwise until resistance is felt. Then turn the screw counterclockwise one full turn.
- () Set the front panel controls as follows:

DRIVER PRESELECTOR – 12 o'clock position.

MIC/CW LEVEL – fully counterclockwise.

FINAL (round knob) – to 10 o'clock.

FINAL (lever knob) – to 4 o'clock.

MODE – LSB.

BAND – 3.5.

MAIN TUNING dial – 200 kHz.

FUNCTION – PTT.

METER – PLATE.

- () Press the microphone button and turn the BIAS control (on the right side) of the Transceiver to set the meter needle at the ▼ mark (above the Figure 3) on the meter scale. This sets the resting cathode current. Do not press the microphone button more than a few seconds at one time until this resting cathode current has been properly adjusted.
- () Set the METER switch to REL PWR and press the microphone button. The meter needle should show 0.

- () Set the MODE switch at the TUNE position and slowly turn the MIC/CW LEVEL control in a clockwise direction until there is an indication of RF output on the meter or oscilloscope.
- () Turn the MIC/CW LEVEL control fully counterclockwise.
- () Adjust the DRIVER PRESELECTOR control for maximum RF output.
- () Turn the MODE switch to LSB, push the microphone button, and adjust the CARRIER NULL control for minimum RF output. Note that the smaller end of the nut starter fits the shaft of this control.
- () Adjust the FINAL tune (round knob) control for maximum RF output.
- () Adjust the CARRIER NULL capacitor for minimum RF output.
- () Adjust the MIC/CW LEVEL control for an RF output of not more than S-3.
- () Turn the MODE switch to USB and, with the microphone button pressed in, adjust the CARRIER NULL control for minimum RF output.
- () Turn the slug of transformer T1 up (CCW) 14 turns. Then adjust it for a maximum RF output (no more than about one turn).
- () Adjust the CARRIER NULL capacitor for minimum RF output.
- () Again reduce the MIC/CW LEVEL for a low meter indication and again adjust Transformer T1 for maximum output.
- () Repeat the adjustments of the CARRIER NULL control, and the CARRIER NULL capacitor until the RF output or null reading is about the same on both the LSB and USB positions of the MODE switch. A receiver with an S Meter can be used for the carrier null indication, and it is usually more sensitive for this purpose.
- () Turn the MIC/CW LEVEL control and DRIVER PRESELECTOR control to obtain maximum RF output on the meter or oscilloscope.

- () Place the MODE switch at LSB. Leave the MIC/CW LEVEL control at its present setting.

NOTE: The long step following accomplishes the preliminary neutralizing adjustment. Read this step thoroughly and visualize what the step requires. When you perform the adjustments, have the Transceiver at full power output for the minimum time necessary. Then place the MODE switch at LSB and let the final stage tubes cool for at least 30 seconds before turning the Transceiver on again.

- () Set the METER switch to the PLATE position.
- () Turn the MODE switch to TUNE.
- () Turn the MODE switch to TUNE and set the METER switch at the REL PWR position.
- () Adjust the FINAL tune control for minimum plate current. Set the METER switch to REL PWR or observe the output on a monitor scope. Then adjust the FINAL tune control for maximum meter indication and note the position of the control. If maximum relative power and minimum plate current do not occur at the same point of tuning, turn the neutralizing capacitor a small amount. Check the position of the FINAL tune control at minimum plate current and also at the maximum relative power indication. The neutralizing capacitor should be adjusted a small amount at a time until minimum plate current and maximum relative power occur at the same point of tuning the FINAL tune control.
- () Adjust the DRIVER PRESELECTOR and the FINAL TUNE and LOAD controls for maximum output. Then adjust the MIC/CW LEVEL control for a reading between 3 and 9 on the panel meter.
- () Adjust heterodyne oscillator coil 3.5 for maximum output, with the tuning on the "slow" side of the peak.
- () Repeat the two preceding steps for each position of the BAND switch, except adjust the HET OSC coil that has the same number as the BAND switch position.

- () Set the BAND switch at 21.0 and turn the MAIN TUNING dial to read 21.2 MHz.
 - () Adjust the DRIVER PRESELECTOR control and the FINAL TUNE and LOAD controls for maximum RF output; then turn the DRIVER PRESELECTOR control back and forth to see if this produces a smooth peaking in RF output.
 - () If turning the DRIVER PRESELECTOR control causes ragged changes in the RF output, readjust the position of, or bend, the free end of the driver neutralizing wire to produce a smooth peaking in RF output (this is the white, insulated wire inserted in hole W of the RF Driver circuit board, as shown in Figure 1-2, fold-out from Page 100).
 - () Set the BAND switch to 14.0 MHz and the MAIN TUNING dial to 14.2 MHz. As you did before on the 3.5 MHz band, peak the DRIVER PRESELECTOR and FINAL controls for maximum output. Compare the control settings at which maximum relative power output and minimum plate current occur. Again adjust the neutralizing capacitor until these points coincide. This completes the neutralization.
 - () Rezero the ALC position of the S Meter while receiving, with the BAND switch at 29.5. Then check to be sure the meter reads zero in each BAND switch position. If the S Meter does not read zero on any band, readjust the heterodyne oscillator coil for that band, as directed in previous steps.
- NOTE: The S Meter may rest below zero while you are transmitting. This condition is normal.

CRYSTAL CALIBRATOR ALIGNMENT

In the following steps, the 100 kHz crystal calibrator signal is adjusted by "zero beating" it against the accurate signal from WWV on another receiver, or against the signal from a standard broadcast station that is on a multiple of 100 kHz.

Zero beat will occur when a harmonic of the 100 kHz crystal calibrator signal corresponds to the frequency of the station tuned in on the external receiver. As zero beat is approached, a tone will be heard that decreases in frequency until it stops completely at the zero beat point; then the tone begins to increase again as the dial is turned.

If the external receiver has an S Meter, accurate alignment can be achieved by observing the S Meter as zero beat is approached. When you tune close to zero beat, the S Meter will start to pulsate. The closer you approach zero beat, the slower the pulsations will become. At zero beat the pulsations will stop. Use a "fast" AVC position, if one is available.

IMPORTANT: For greatest accuracy, be sure to adjust the crystal calibrator as close to zero beat as possible. A 20 Hz error at the 100 kHz calibrator frequency, for example, would cause a 740 Hz error at 3.7 MHz (where the 37th harmonic of 100 kHz would be used for dial calibration purposes; $100 \text{ kHz} \times 37 = 3.7 \text{ MHz}$; $20 \text{ Hz} \times 37 = 740 \text{ Hz}$). In view of this, it is recommended that the crystal calibrator be adjusted to the 15 MHz signal of station WWV.

- () Connect a random length of wire from the antenna connection of the external receiver to the ANTENNA connection of the Transceiver. If necessary, use one of the phono plugs furnished. It can be removed later.
- () Set the Transceiver controls as follows:
 - FUNCTION switch – CAL.
 - AF GAIN control – full counterclockwise.
 - MODE switch – CW, LSB, or USB.
- () Tune the external receiver to WWV, or a standard broadcast station transmitting at a frequency which is a multiple of 100 kHz.
- () Carefully adjust the CAL XTAL trimmer capacitor (on the bandpass circuit board) for a "zero beat" in the external receiver. When WWV is tuned in, the period when no tone modulation is present allows the zero beat to be more easily heard.
- () Switch the Transceiver FUNCTION switch to VOX and return it to CAL to be sure the external receiver S Meter stays steady, thus insuring a true zero beat.
- () Remove the external receiver antenna wire from the ANTENNA jack on the Transceiver.

NOTE: To make sure it is heard on each band, a high content of harmonic energy is needed in the 100 kHz calibrate signal. Because of this, some spurious signals may also appear when tuning across some segments of the bands. The desired 100 kHz calibrate signals are easily identified by their greater signal strength. Also, the proper harmonics may be peaked by the DRIVER PRESELECTOR.

VFO SHIFTER ADJUSTMENT

- () Adjust the MAIN TUNING dial to 200 kHz and the BAND switch to 3.5.
- () Set the FUNCTION switch to CAL.
- () Turn the MODE switch to USB.
- () Carefully zero beat the calibrator signal. Use the MAIN TUNING dial and peak the DRIVER PRESELECTOR control.
- () Set the MODE switch to LSB. Be careful not to touch the MAIN TUNING dial. Note that the calibrator signal may or may not be exactly at zero beat in the LSB position.
- () Turn the SHIFT ADJUST on the VFO for an exact zero beat in the LSB mode. See Figure 1-2 (fold-out from Page 100).
- () Recheck the zero beat in the USB mode to be certain of the adjustment. Repeat the procedure, if necessary.

DIAL CALIBRATION

NOTE: The instructions in this section use the 0 mark on the MAIN TUNING dial as the dial calibration point. The same instructions also apply at any 100 kHz marking.

- () Set the BAND switch at 3.5 and the MAIN TUNING dial at 0 kHz. Zero beat the crystal calibrator signal at 3.5 MHz. If the 0 mark on the dial is not behind the index line in the dial window, proceed with the following steps.
- () Note which way you turn the dial, and move the 0 on the dial behind the index mark in the dial window.
- () Push the ZERO SET button to lock the dial in place, and turn the dial knob in the opposite direction to bring the calibrate signal into zero beat at the 0 mark on the dial. Release the ZERO SET button.
- () Check the accuracy of the adjustment and repeat the above steps, if necessary.

This completes the alignment of your Transceiver.

NOTE: To verify that the VFO is operating on the proper frequency, tune in a signal of known frequency, such as time station CHU on 7335 kHz. This station is operated by the Dominion Observatory, Canada.

IMPORTANT

To avoid serious damage to the final amplifier tubes, DO NOT operate the transmitter until you have read and completely understand the tune-up procedure as outlined on Pages 140 through 143.

CABINET INSTALLATION

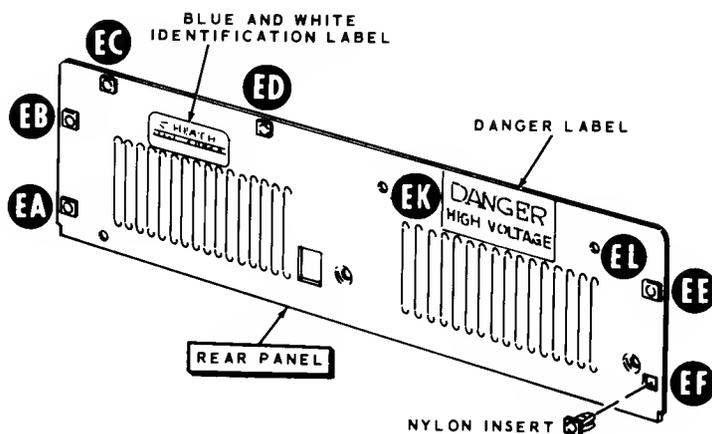


Figure 1-8

Refer to Figure 1-8 for the following steps.

- () Position the rear panel on your table or bench as shown, being sure to have square openings EC and ED to your left.
- () Remove the backing from the red Danger Label and press the label firmly into position between holes EK and EL.

- () In a like manner, mount the blue and white identification label on the rear panel as shown. NOTE: Refer to the numbers on the blue and white label in any communications with the Heath Company about this kit; this will assure you the most complete and up-to-date information in return.
- () Push nylon inserts into square openings EA, EB, EC, ED, EE, and EF.

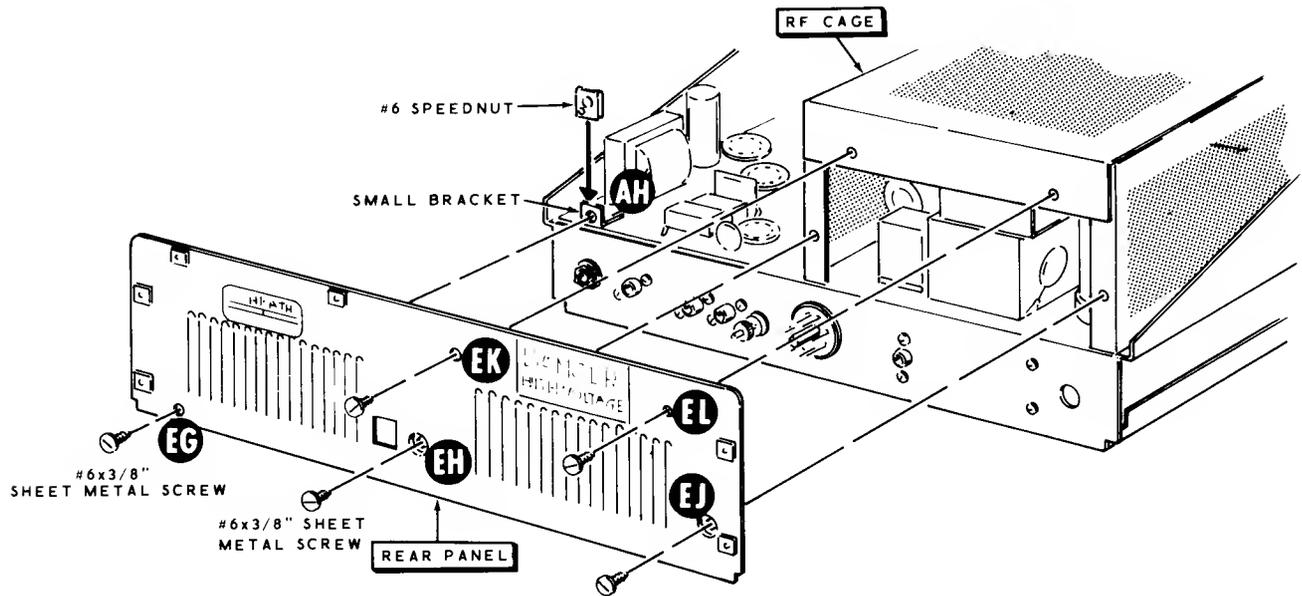


Figure 1-9

Refer to Figure 1-9 for the following steps.

- () Mount a #6 speednut on the angle bracket at AH. Position the curved lip of the speednut toward the audio transformer.
- () Mount the rear panel on the chassis. Use #6 x 3/8" sheet metal screws at EG, EH, EJ, EK, and EL.

Refer to Figure 1-10 for the following steps.

- () If a mobile mount is to be used, mount 5/16" grommets in holes ET and EU in the cabinet top.

- () Install #6 speednuts on the cabinet bottom at EN, EP, ER, ES, and at the four corresponding holes on the opposite lip of the cabinet bottom. Be sure the curved lip of each speednut is on the inside of the lip.
- () Place the chassis into the cabinet bottom so that the front panel is against the lips upon which the speednuts are mounted. Be sure the five control access holes are on the right side.
- () Fit the cabinet top over the chassis. The lips on the rear will be just outside the nylon inserts on the rear panel.

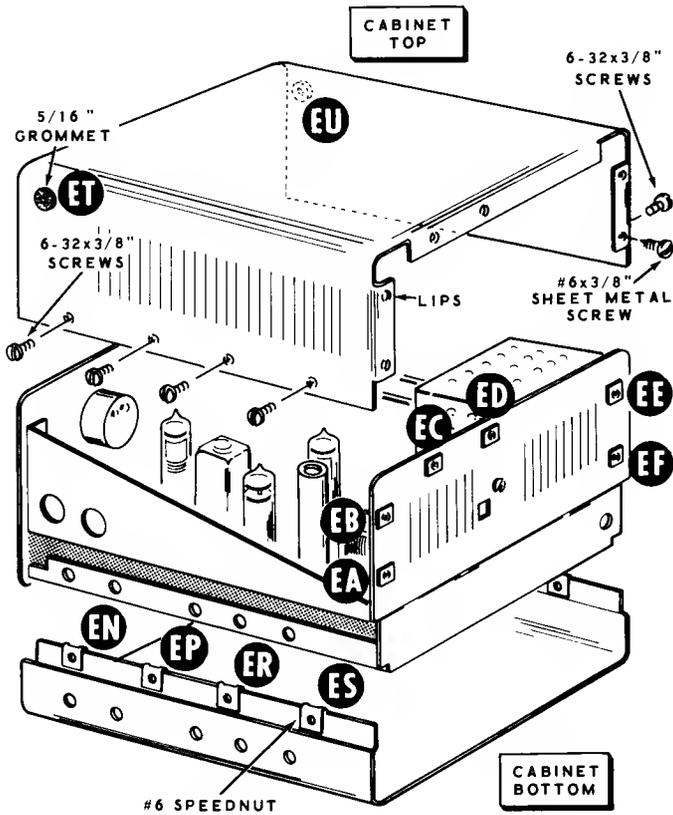


Figure 1-10

- () Attach the cabinet top to the rear panel. Use #6 x 3/8" sheet metal screws at EA, EB, EC, ED, EE, and EF.
- () Attach the cabinet top to the cabinet bottom. Use 6-32 x 3/8" screws at EN, EP, ER, ES, and the four corresponding holes on the opposite side of the cabinet.

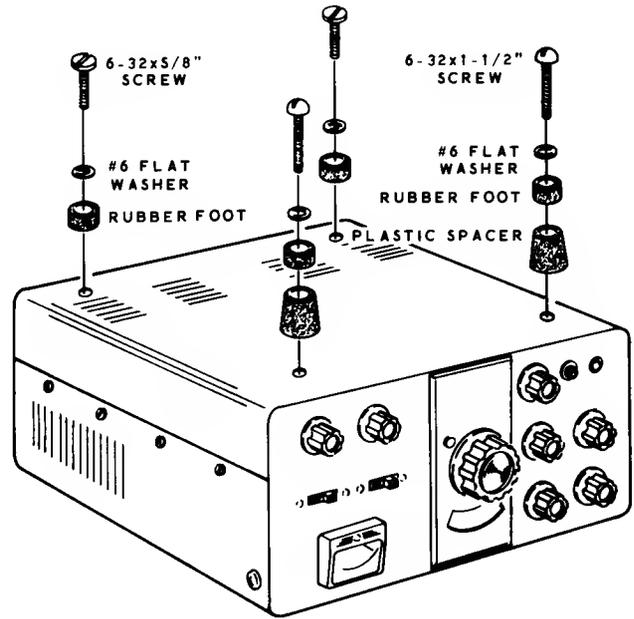


Figure 1-11

Refer to Figure 1-11 for the following steps.

- () Install plastic spacers and rubber feet at the front corners on the bottom of the cabinet. Use a plastic spacer, a rubber foot, a #6 flat washer, and a 6-32 x 1-1/2" screw at each corner.
- () Install a rubber foot at each rear corner of the bottom of the cabinet with a #6 flat washer, and a 6-32 x 5/8" screw.

This completes the assembly of your Transceiver.

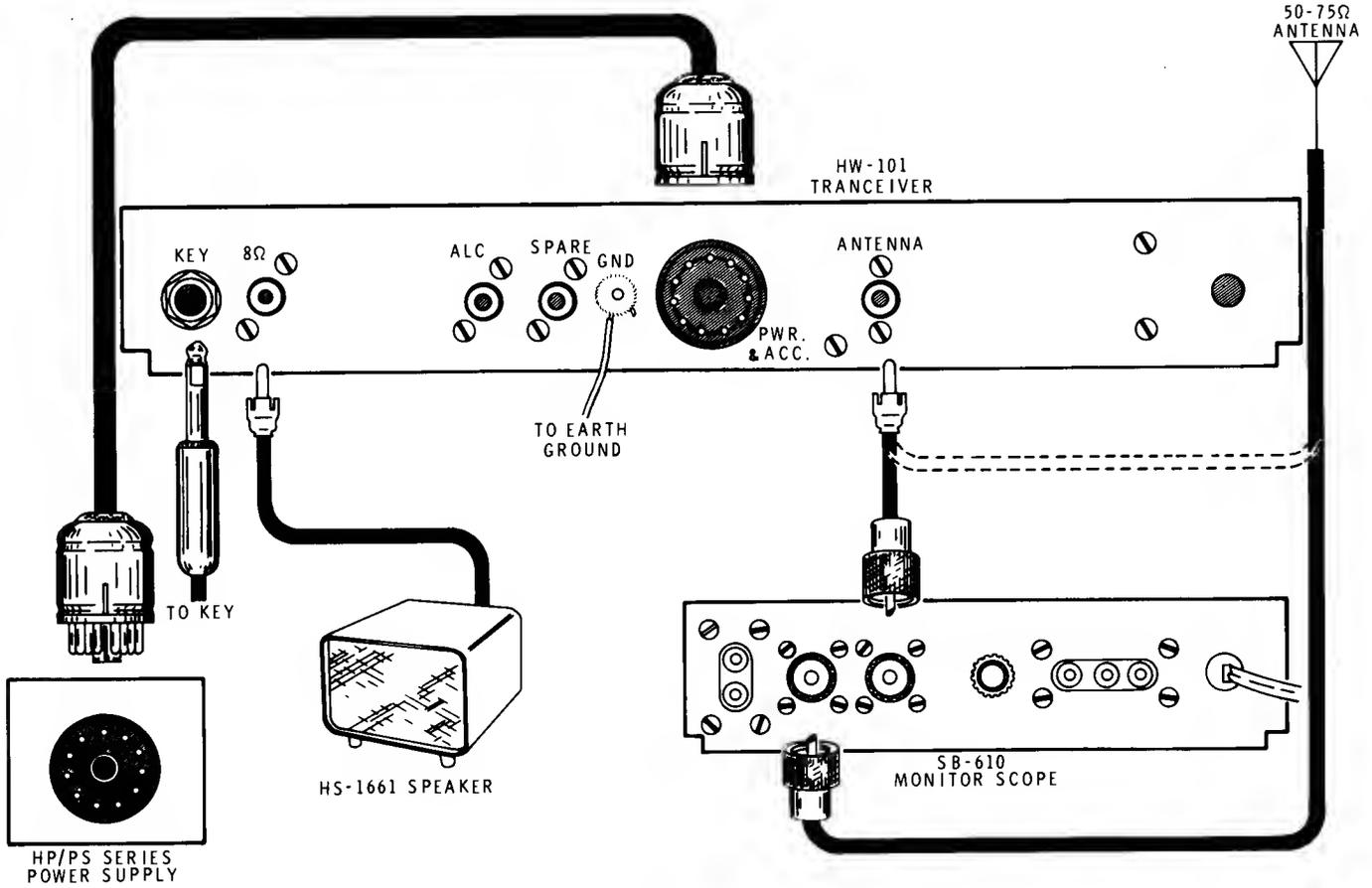


Figure 1-12

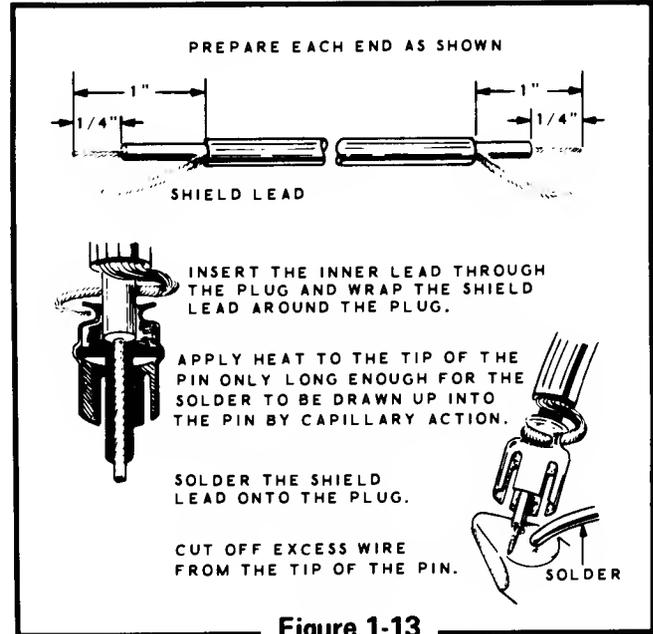
INSTALLATION

Be sure to allow for adequate heat dissipation from the Transceiver. Do not obstruct air passage through the unit by placing other equipment, papers, or objects under or on top of the Transceiver.

FIXED STATION INSTALLATION

Figure 1-12 shows a typical fixed station hookup. A Monitor Scope is shown that may be used with the Transceiver. The Transceiver may also be used with a linear amplifier; however, the linear amplifier is shown separately in Figure 1-14 for clarity.

Cables can be prepared following the instructions in Figure 1-13. Make the cables to the lengths required for your installation.



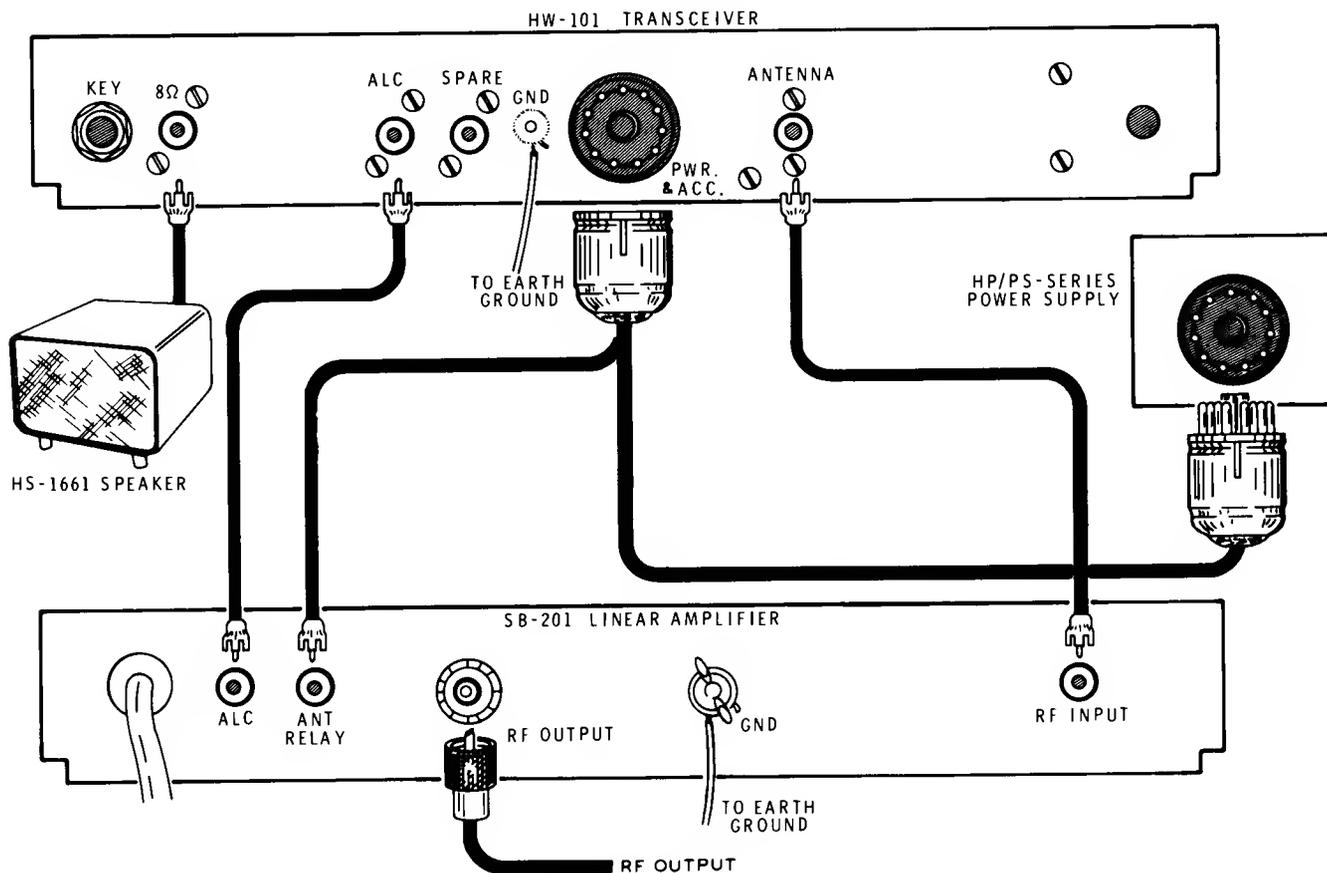


Figure 1-14

LINEAR AMPLIFIER CONSIDERATIONS

Heath Amplifiers

Figures 1-14 and 1-15 show typical installations using Heath amplifiers. These linear amplifiers provide ALC voltage for the exciter, and both have internal transmit-receiver relays. They do not normally require a swamping pad for the input.

Other Linear Amplifiers

Information regarding antenna switching, cutoff bias, and ALC should be obtained from the Linear Amplifier Instruction Manual.

ANTENNA RELAY CONNECTIONS

Many amplifiers have an internal transmit-receive relay which is actuated by grounding the relay coil circuit. Heath amplifiers are of this type. This Transceiver has relay contacts available to operate the relay. The connection may

be made by a shielded cable (or other two-conductor wire) connected to the power cable socket as shown in the "Power Supply Connections" section of this Manual. Another, and possibly more convenient, method is to install a jumper wire from pin 11 of the power plug to the spare phono socket, both on the chassis rear apron. To install the jumper, strip 1/2" of insulation from a hookup wire, melt the solder in pin 11 of the power plug, and insert the bare end of the added wire into the pin from the back side of the plug. Then solder the free end of the wire to lug 1 of phono socket AD (illustrated in Pictorial 8-5). The relay contacts are rated at 3 amperes maximum at 30 Vdc or 120 Vac.

T-Pad

If the output power of the Transceiver is too high for the drive requirements of the linear amplifier (not applicable to Heath equipment), a swamping T-pad must be used between the two units. Such a pad is shown in Figure 1-16. This pad will provide 10 dB attenuation with a terminal impedance of 50 ohms. This will allow adequate driving power for a linear amplifier that requires 10 watts input.

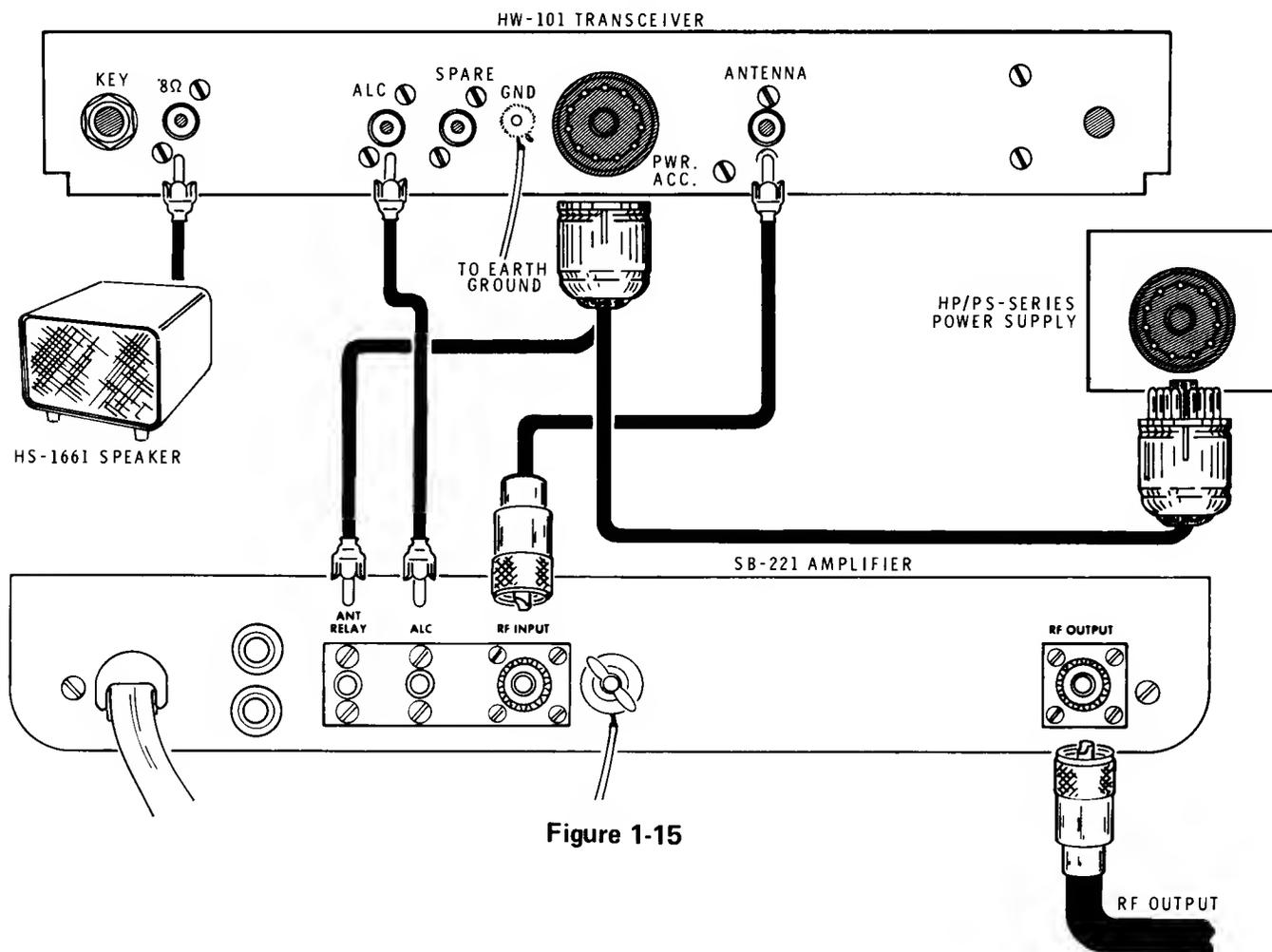


Figure 1-15

Resistors R1, R2, and R3 in Figure 1-16 can be made from combinations of common 2-watt, carbon resistors wired into a metal box with phono-type jacks or connectors. NOTE: Do not use wire-wound resistors; the resistors in the T-pad must be a noninductive type.

Combinations of 2-watt, 10%, carbon resistors for a pad suitable for SSB service at reduced power levels, are listed below. WARNING: Steady full level carrier excitation should be avoided except for very brief test periods, since the dissipation rating of the resistors will be exceeded.

R1 = thirteen 330 Ω, 2-watt carbon resistors in parallel.

R2 = two 47 Ω, 2-watt carbon resistors in parallel.

R3 = eight 270 Ω, 2-watt carbon resistors in parallel.

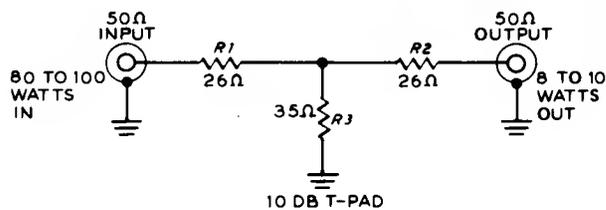


Figure 1-16

MOBILE INSTALLATION

CAUTION: Be sure the voltage regulator of the automobile is set in accordance with the manual for your dc power supply. Have the regulator adjusted at a competent garage.

MOBILE ANTENNAS

Mount the antenna according to the manufacturer's instructions. Make a good ground connection between the shield of the coaxial cable and the car body at the antenna base. Eliminate any coating between two adjacent metal surfaces which can add resistance to the ground connections. Be sure the antenna is grounded to large metal areas of the car body and NOT to small panels which may be isolated by paint or rubber from the metal mass of the body.

Mobile antennas present loading situations which must be carefully handled for each band. Because whip antennas must be kept short for mobile use, they represent only a fraction of a wavelength on the lower frequency bands. Their radiation resistance is extremely low and their reactance is capacitive. Therefore, loading coils must be used and the losses kept low to insure a minimum loss of radiated power in the form of heat in the loss resistances.

A good quality antenna will have low resistance losses, and with a high "Q" loading coil, its bandwidth on 75 meters could be less than the IF bandwidth of many receivers used for AM reception. A typical loading coil with a "Q" of 300 would have a bandwidth of 13 kHz to the half-power points at 3.9 MHz.

Because of this sharp tuning, deviation from the center frequency of the antenna will quickly introduce enough reactance to present an impossible loading situation to the transmitter. The antenna should be carefully adjusted for a low SWR (standing wave ratio) before placing the transmitter in operation.

The following is a list of antenna considerations for each band of the Transceiver.

3.5 MHz

This band presents the greatest problem. The normal tuning range of a good antenna on this band is about 10 kHz on each side of the antenna's resonant frequency.

Actual measured resistance at the base of an antenna at these frequencies is 15 to 20 ohms; this represents an SWR of nearly 3 to 1. In order to get proper matching to the 50 ohm line, some antennas may require a 1000 pF mica capacitor connected between the inner conductor and shield of the coaxial line at the base of the antenna. Other antennas may require a different value, somewhere between 300 and 1500 pF. This capacitor is part of an L network that is used to get a 50 ohm match. The inductive portion of this network is formed by a portion of the loading coil. The correct combination is the one which produces the lowest SWR at the desired operating frequency.

7 MHz

This band ordinarily does not need a correcting network, and has a useful bandwidth of about 50 kHz.

14 MHz

No network needed. Bandwidth is approximately 100 kHz.

21 MHz

No network needed. Bandwidth is about 150 kHz.

28 MHz

The antenna for this band is normally cut for 1/4 wavelength, with no loading coil required. The bandwidth is about 200 kHz.

TYPICAL TUNING PROCEDURE

The following is a typical tuning procedure.

A whip antenna that is properly tuned on 75 meters will have a high peak of receiver activity for about 25 kHz around the antenna's resonant frequency. Turn on the

receiver and tune through the band to discover where this high peak of receiver activity is for the present setting of your antenna. Then adjust the length of the whip in 1/4 inch increments and retune the receiver until the peak of receiver activity is centered around the frequency at which you normally operate. The antenna can then be tuned as described in the following steps. The receiver peaking may not be noticeable on bands other than 75 meters.

DETERMINING SWR

- () 1. Connect an SWR meter in series with the lead to your antenna.
- () 2. Set the SWR meter to the "forward" position.
- () 3. Set the Meter switch on your Transceiver to PLATE. If the meter needle does not point to the ▼ mark on the meter scale when the PTT button is depressed, perform the bias adjustment in the Transmitter Alignment section of this Manual.
- () 4. Turn the MODE switch to TUNE.
- () 5. Peak the FINAL TUNE, LOAD, and DRIVER PRESELECTOR controls. Adjust the SENSITIVITY control on the SWR meter for a full-scale meter indication.

- () 6. Switch the SWR meter to the "reverse" position. Note the SWR reading.
- () 7. Switch the SWR meter to the "forward" position. Then set the transmitter to several higher and lower frequencies in 5 kHz increments and repeat steps 5 and 6 at each frequency, until you find the minimum SWR.

Adjusting Antenna Length

- () Set the transmitter to the desired operating frequency. Then adjust the length of the antenna as follows:
 - A. If the point of the lowest SWR is lower than the desired operating frequency, shorten the antenna as described below.
 - B. If the point of lowest SWR is higher than the desired operating frequency, lengthen the antenna as described below.
 - C. Change the antenna length in 1/4" increments and repeat steps 2, 4, 5, and 6 at each new length until the minimum SWR is obtained. The SWR should be about 1.2 or less at the desired frequency. NOTE: It may be necessary to add a capacitor at the base of the antenna, as described previously, if you cannot get the SWR down to about 1.2.

Noise Suppression Troubleshooting Chart

TYPE OF NOISE	POSSIBLE CAUSE	RECOMMENDED REMEDY
Loud popping increasing with engine speed.	Ignition system.	<ol style="list-style-type: none"> 1. Replace plugs with resistor type. (Highly recommended.) 2. Loose crimped connections should be cleaned and soldered. 3. Place resistors in distributor system.
Whine - varies with engine speed.	Generator or alternator.	<ol style="list-style-type: none"> 1. Coaxial type capacitor in series with the armature or stator lead. 2. Clean commutator. 3. Replace brushes. 4. Ground generator shaft. 5. Parallel trap (#10 wire-coil and suitable capacitor) in series with armature lead, tuned to operating frequency.
Distinct but irregular clicking noise.	Voltage regulator.	<ol style="list-style-type: none"> 1. Coaxial type capacitor in series with the battery (B) and armature (A) leads. 2. A series combination of a .002 μF mica capacitor and a 4 Ω carbon resistor to ground from the field (F) terminal. All components should be mounted as shown in diagram, close to voltage regulator.
Same as above.	Energy transfer to primary system.	<ol style="list-style-type: none"> 1. Bypass at the following points: coaxial bypass in lead to coil from ignition switch; battery lead to ammeter; to gas gauge; to oil signal switch; head and tail light leads; accessory wiring from engine compartment.
Loud popping noise that changes from one type road to another. Most pronounced on concrete.	Wheel static.	<ol style="list-style-type: none"> 1. Installation of front wheel static collectors (available from most automotive distributors). These should be checked every 5000 miles for excessive wear.
Same as above.	Tire static.	<ol style="list-style-type: none"> 1. Injection of anti-static powder into tire through valve stem.
Irregular popping noise when on bumpy roads, particularly at slow speeds.	Body static.	<ol style="list-style-type: none"> 1. Tighten all loose screws. 2. Use heavy flexible braid and bond the engine to the frame and fire wall. Bond the control rods, speedometer cable, exhaust pipes, etc., to the frame.

If an extensive amount of suppression is required, the engine should be retimed and tuned up by a competent mechanic.

NOISE SUPPRESSION

To obtain good noise suppression, you must suppress electrical interference at its source, so it does not reach the input of the receiver. Once it has been radiated, noise cannot be suppressed by bypassing, etc.

It is difficult to determine the source of various types of noise, particularly when several items are contributing to the noise. Follow the procedure outlined below to isolate and identify the various noise sources.

In most case, one source of interference will mask others. Consequently, it will be necessary to suppress the strongest item first, and then continue with the other steps. Figure 1-17 (fold-out from Page 143) shows a typical ignition system and the suggested placement of noise suppression components.

1. Position the vehicle in an area that is free from other man-made electrical interference such as power lines, manufacturing processes and particularly other automobiles.
2. With the Transceiver on, run the automobile at medium speed. Then let up on the gas, and turn the ignition switch to the "accessory" position or "off." Allow the vehicle to coast in neutral. If the interference stops, the major source of interference is the ignition system.

3. If the noise has a "whine" characteristic and changes in pitch with varying engine speed, then the generator is the major source of interference.
4. A distinct but irregular clicking noise, or "hash" as it is sometimes called, that disappears with the engine idling, indicates the voltage regulator is at fault.
5. A steady popping noise that continues with the ignition off indicates wheel or tire static interference. This is more pronounced on smooth roads.
6. The same type of interference as in step 5, but more irregular when on bumpy roads, particularly at slow speeds, indicates body static.

Refer to the Troubleshooting Chart on Page 146 and Figure 1-17 (fold-out from Page 143), to help determine how to suppress most noise interference. Naturally, not all vehicles will require suppression to the extent shown in Figure 1-17, but some stubborn cases may require all the suppression components shown, plus shielding of the ignition system.

Bonding of various parts of the automobile, starting from the hood and continuing to the trunk, even including bonding of the transmission line every few feet from the antenna, may be necessary. Refer to the ARRL, and other amateur handbooks, on this subject.

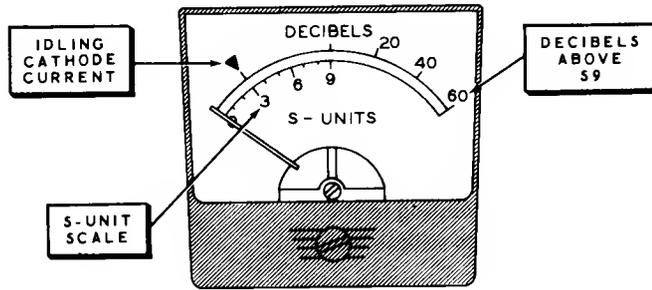


Figure 1-18

OPERATION

NOTE: YOU MUST HAVE AN AMATEUR RADIO OPERATOR AND A STATION LICENSE BEFORE PLACING THE TRANSMITTER SECTION OF THE TRANSCEIVER ON THE AIR. INFORMATION ABOUT LICENSING AND AMATEUR FREQUENCY ALLOCATIONS IN THE UNITED STATES IS AVAILABLE FROM PUBLICATIONS OF THE FEDERAL COMMUNICATIONS COMMISSION OR THE AMERICAN RADIO RELAY LEAGUE, 225 West Main Street, Newington, Connecticut 06111.

Operation of the Transceiver has been simplified as much as possible to permit rapid adjustment by the operator. Once

the initial settings have been made, it should not be necessary to readjust most of the controls. Read the following information carefully. Good operating techniques will provide good clean signals and long trouble-free life of the Transceiver.

CAUTION: Be sure a 50 to 75 Ω nonreactive load is connected to the ANTENNA jack before operating the Transceiver. This load can be an antenna, a dummy load, or a properly adjusted linear amplifier. (See the "Installation" section of the Manual on Page 131).

READING THE METER

Figure 1-18 illustrates the meter face. The figures 0 to 9 under the left half of the arc are read as "S units," and the figures above the right half of the arc are read as "decibels over S9." The ∇ mark is the point to which the cathode current is adjusted.

The ALC (automatic level control) position of the meter switch results in "S Meter" action during reception, and indicates the relative ALC voltage during transmission. No S Meter action can be secured with the meter switch in the REL PWR or PLATE positions.

The REL PWR position causes the meter to read an uncalibrated amount of rectified output power. This position is useful for determining the tuning conditions for maximum output power.

The PLATE position of the switch causes the meter to read cathode current to the final stages. There are six numbers on the S Meter (in addition to 0). When reading cathode current, each number represents 50 milliamperes. Thus:

<u>Scale Number</u>	<u>Milliamperes of Cathode Current</u>
0	0
3	50
6	100
9	150
20	200
40	250
60	300

READING THE DIAL

The tuning dial is calibrated in divisions from 0 to 500. Each represents 5 kHz. The dial reading (in kHz) is added to the Band switch setting (in MHz) to determine the frequency to which the Transceiver is tuned. For example:

Band switch	14. MHz
Dial reading	<u>235 kHz</u>
Frequency	14.235 MHz

RECEIVER SECTION

1. Set the MODE switch to either LSB or USB.
2. Turn the RF GAIN control to its fully clockwise position.
3. Turn the AF GAIN knob and allow the Transceiver to warm up.
4. Adjust the AF GAIN control clockwise until some receiver noise is heard.
5. Set the FILTER switch to SSB or CW, as appropriate.

If an extremely strong station overloads the receiver front end, leave the AF GAIN control set for comfortable listening; then adjust the receiver level with the RF GAIN control. This will keep the front end from overloading and masking weaker signals.

The S Meter will move with adjustment of the RF GAIN control, but will still read correctly with the RF GAIN set at less than maximum (if the received signal level is high

enough to register on the S Meter). For example, if the RF GAIN control is set for no-signal meter reading of S5, and the meter registers S9 with a signal, then the received signal is S9.

6. The Transceiver is now ready to receive. Turn the BAND switch to select the desired 500 kHz band segment. The frequency of the tuned signal is determined by adding together the settings of the BAND switch, and the circular dial.
7. Peak the DRIVER PRESELECTOR for maximum signal.
8. Set the FUNCTION switch to CAL. Rotate the MAIN TUNING dial (VFO) to the nearest 100 kHz point on the circular dial.
9. Adjust the MAIN TUNING dial until the calibrate signal is at zero beat. (To be sure that the correct calibrate signal is being used, check the DRIVER PRESELECTOR tuning. If the signal strength varies, you are tuned to the correct calibrator signal.)

TRANSMITTER SECTION

WARNING: Portions of each band are for CW operation only. DO NOT operate the Transceiver with voice modulation in any portion of a CW subband. To do so (in the U.S.A.) will invite disciplinary action by the Federal Communications Commission.

Make SURE your dial calibration is correct, since it is possible for the circular dial to be 100 kHz off frequency. For example, your dial could read 14.3 MHz but your actual transmitting frequency could be 14.4 MHz, which is out of the amateur band. Checking with the built-in calibrator can insure that the circular dial is exactly on a 100 kHz point, but you cannot be sure which one it is on. Therefore, before transmitting, make sure you hear other amateur signals on both sides of your chosen frequency. If you do not, check your dial by turning the MAIN TUNING KNOB counterclockwise to the end of its travel. The circular dial should now be at the "500" end of its scale (refer to Detail 8-9B). If the calibration is correct for one band, it will be correct for the other bands.

CAUTION: Each time you operate, you must perform all of the following "Initial Tune Up" steps. You must also follow this procedure any time you change the transmitter frequency by more than ± 20 kHz.

INITIAL TUNE UP

The 10 steps of this procedure must be performed for all modes of operation.

1. Set the BAND switch and Main Tuning dial for the desired frequency.
2. Place the METER switch in the PLATE position.
3. Turn the MIC/CW LEVEL control fully counterclockwise.
4. With the RF load connected to the ANTENNA jack, set the MODE switch to TUNE. The meter should read 50 mA (at the ▼ mark).

If the meter needle indicates other than 50 mA, perform the BIAS adjustment described on Page 123 under Transmitter Alignment.

CAUTION: Do not turn on full output power continuously for more than 30 seconds at one time, or the final amplifier tubes or power supply may be damaged. Each time full output power is turned off, allow the tubes to cool for at least a minute.

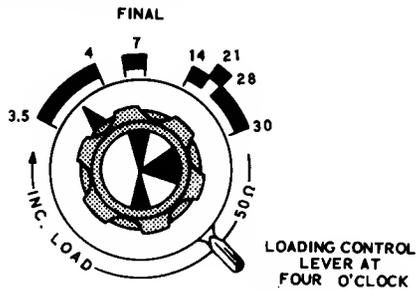


Figure 1-19

Refer to Figure 1-19 for settings of the FINAL TUNE knob and lever.

5. Set the METER switch to REL PWR and adjust the LOAD lever to the four o'clock position.
6. Set the FINAL TUNE knob to the position corresponding to the band in use.
7. Turn the MIC/CW LEVEL control clockwise to obtain a small up-scale indication on the meter. Then alternately adjust the PRESELECTOR, the FINAL TUNE knob, and the LOAD lever for a maximum indication on the meter.
8. Turn the MIC/CW LEVEL control clockwise until the meter reading no longer increases with knob rotation, and again peak the FINAL TUNE and FINAL LOAD controls for maximum output.
9. Set the METER switch to PLATE. The meter needle should read approximately 40 on the scale, indicating a plate current of 250 mA. (See "Reading the Meter," Page 139).

Important: Before you put the transmitter into operation for the first time, and any time you change the final amplifier tubes, make the following check: Tune the transmitter as outlined in Steps 1 through 9 above. Then operate the METER switch between REL PWR and PLATE. The maximum power output (REL PWR) should occur at approximately the same point on the FINAL TUNE knob as the maximum dip in PLATE current. If it does not occur at the same point, DO NOT operate the transmitter until you have re-neutralized the unit as outlined (starting in the left column) on Page 123.

10. Return the MIC/CW LEVEL control to its full counterclockwise position.

CAUTION: The Transceiver should be retuned if the frequency is changed by any great amount. Be sure to readjust the FINAL TUNE controls. It may also be necessary to repeak the DRIVER PRESELECTOR control.

This completes the Initial Tune Up. Before placing the Transceiver in operation, complete either the following CW or Single Sideband adjustments.

CW OPERATION

For CW operation, the FUNCTION switch can be set to either the PTT or VOX positions. Even though CW operation is possible in the Calibrate position, it is not recommended because of possible spurious outputs from calibrator signals being present at the grid of the driver stage.

For 400 Hz CW selectivity, the Heath SBA-301-2 CW crystal filter may be installed in addition to the SSB crystal filter supplied with the Transceiver. The filter switch will then select the SSB or the CW filter.

Be sure steps 1 through 10 have been satisfactorily completed before proceeding with the following adjustments.

- () Place the MODE switch in the CW position.
- () Plug a key into the CW KEY jack.

The VOX DELAY control is located on the right side of the Transceiver.

- () While sending a series of "V's", adjust the VOX DELAY control so the relays stay energized between groups of characters. Clockwise rotation of this control will increase the holding time of the relays.

The final setting of the VOX DELAY control will be determined by the sending speed of the operator. The slower the sending speed, the higher the setting of this control. NOTE: Be sure the VOX DELAY control is adjusted so the relays do not open after each character is sent.

- () Set the MIC/CW LEVEL control to the minimum position that produces full output (increasing the control setting above this level DOES NOT increase the output or the REL PWR reading).

CROSS-MODE OPERATION

After the dial is set to zero beat the calibrator signal, the frequency of the CW output signal is 1000 Hz higher than the dial reading. The received signal is actually in the USB position even though the MODE switch is set at CW. Consequently, cross-mode operation is possible between USB and CW without any resetting of the MAIN TUNING dial. For example, if two stations begin operation in the USB mode of operation and one operator changes to CW, the other station will hear a 1000 Hz note without retuning his receiver. Also, the station operating in the CW mode will receive the USB signal from the other station without

changing back to the USB position of the MODE switch. When two stations are operating in the LSB mode and the operator of one changes to USB or CW, contact will be lost until the other station changes to either USB or CW.

SINGLE SIDEBAND OPERATION

Be sure steps 1 through 10 have been satisfactorily completed before proceeding with the following adjustments.

- () Set the MODE switch to either the USB or LSB position.
- () Connect a microphone to the MIC connector.
- () Set the METER switch to ALC (the meter needle may "rest" below zero in the Transmit mode).
- () Place the FUNCTION switch in the PTT position. (If your microphone does not have push-to-talk capabilities, make the VOX Adjustments and disregard PTT Adjustments).
- () While speaking into the microphone, turn the VOX SENS control to just beyond a setting that will energize the relays. Be sure this control is not set so high that it will allow background noise to trip the relays.
- () Tune the receiver to a fairly strong signal and adjust the AF GAIN control for a comfortable listening level.
- () Place the microphone where it will normally be used. Advance the ANTI-TRIP gain control to just beyond a setting that will keep the speaker signal from tripping the VOX circuits. Be sure this control is not set so high that it completely disables the relay closing action.
- () Speak into the microphone and turn the VOX DELAY control to a setting that will hold the relays energized during the slight pauses between words. This prevents the relays from tripping at the beginning and end of each word.

NOTE: There will be a slight interaction between the VOX SENS, ANTI-TRIP, and VOX DELAY controls. Consequently, it may be necessary to readjust these controls to achieve the desired results.

The Transceiver is now ready for operation in the SSB mode. Speaking into the microphone (VOX) or using the microphone push-to-talk switch (PTT) will change the Transceiver from receive to transmit operation.

PTT Adjustments

- () Actuate the transmitter and, while speaking into the microphone, turn the MIC/CW LEVEL control clockwise until the peak deflections register at about S3 on the meter. Keep the meter deflection below the S6 point on voice peaks for the most linear output.

Vox Adjustments

- () Turn the MIC/CW LEVEL control fully counterclockwise. Leave this control in this position for the following adjustments.
- () Set the FUNCTION switch to VOX.

NOTE: Close-talk into the microphone when using VOX operation to prevent background noise from tripping the Transceiver into transmit operation.

OPERATION WITH A LINEAR AMPLIFIER

Operation with a linear amplifier is similar to operation with an antenna at the output of the Transceiver, except that the linear amplifier input may have a different impedance. This will make it necessary to adjust the FINAL TUNE controls for maximum output (input to the linear amplifier). Figures 1-14 and 1-15 (on Page 132 and 133) shows the proper connections between a linear amplifier and the Transceiver.

MOBILE OPERATION

If the Heathkit dc Mobile Power Supply is to be used with the Transceiver in a mobile installation, and the BIAS control in the Transceiver has already been preset for fixed station operation, make the following adjustments.

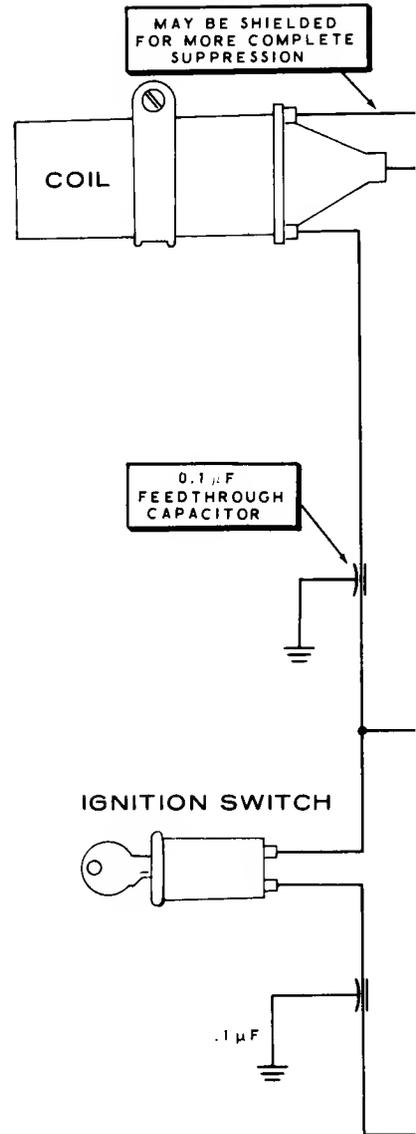
- () Turn the MIC/CW LEVEL control fully counterclockwise.
- () Place the MODE switch in either the USB or LSB position.
- () Set the FUNCTION switch to PTT.
- () Place the METER switch in the PLATE position.

NOTE: The following adjustment should be made with the automobile engine running at about a 30 mph speed so the battery is being charged.

Activate the transmitter with the push-to-talk button on the microphone, and adjust the bias control in the mobile power supply for a cathode current reading of ▼ (50 mA). This will make it unnecessary to readjust the BIAS control of the Transceiver each time it is changed from mobile to fixed station use.

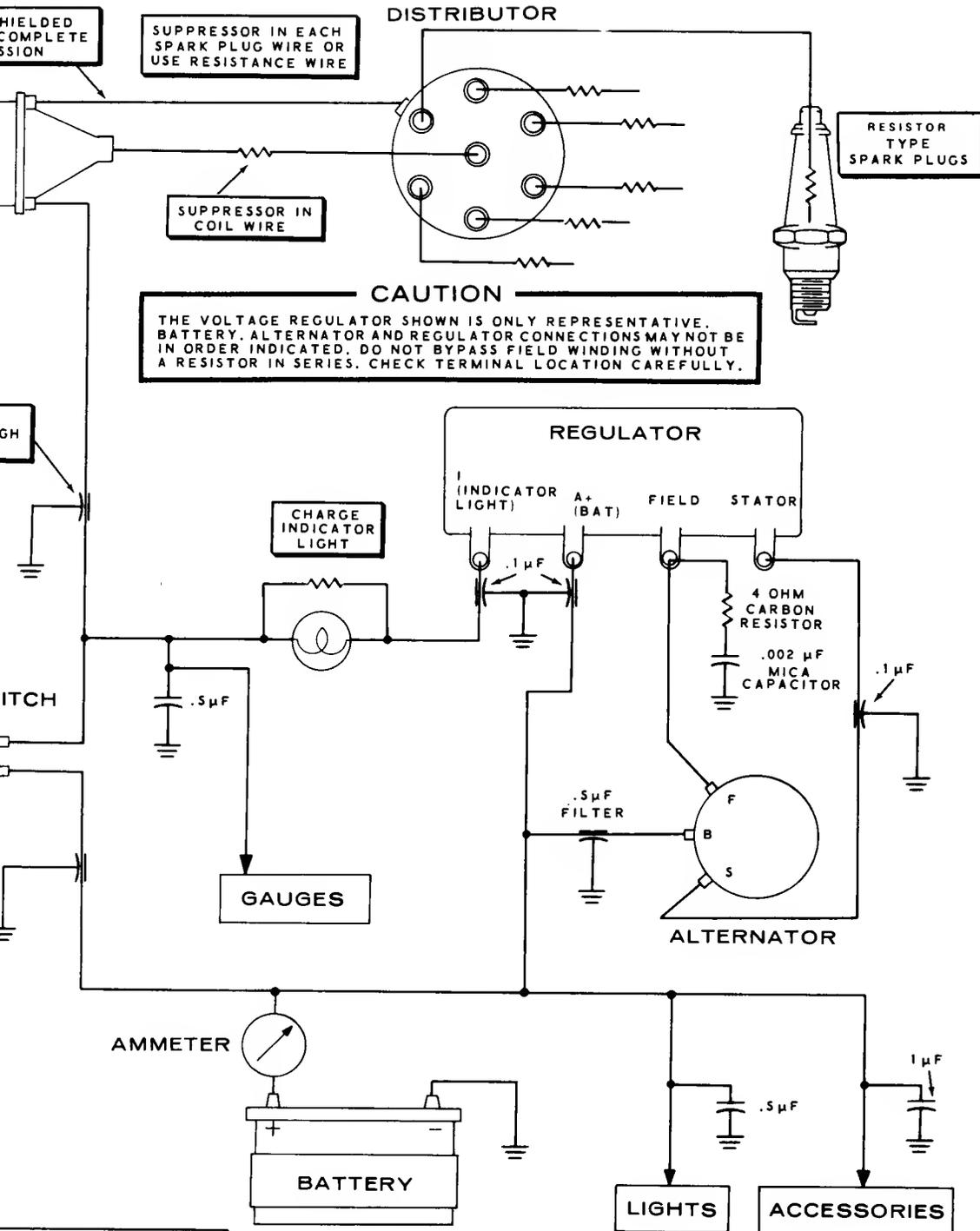
The VOX SENS, VOX DELAY, and ANTI-TRIP circuits will operate in mobile use, but because of the different power supplies, it may be necessary to readjust these controls.

Transmitter loading may be somewhat more critical on mobile antennas because of their sharper frequency characteristics. Consequently, the mobile antenna must be tuned as closely as possible to the desired operating frequency with the lowest possible SWR. Review "Typical Tuning Procedure" in "Mobile Installation" section (Page 134).



A

VALUE OF SUPPRESSOR	MANUFACTURER REPRESENTATIVE	
10K OHM	ERIE TYPE	LTV
SK OHM	ERIE TYPE	LTV
.5 μ F FEEDTHROUGH	SPRAGUE	48P18 BRACKET
.1 μ F FEEDTHROUGH	SPRAGUE	80P3 (2 BULK HEAD)
	SPRAGUE	48P9 (2 BRACKET)
.5 μ F	MALLORY	AG-
1 μ F	MALLORY	AG-



MANUFACTURER AND REPRESENTATIVE TYPE	
TYPE	L7VR-10ME
TYPE	L7VR-5ME
TYPE	48P18 (40 AMP), BRACKET MOUNT
TYPE	80P3 (20 AMP), BULKHEAD MOUNT
TYPE	48P9 (20 AMP), BRACKET MOUNT
TYPE	AG-451
TYPE	AG-452

NOTE: ALL GROUND CONNECTIONS SHOULD BE MADE TO THE COMPONENT BEING BYPASSED, PREFERABLY BY MOUNTING THE SUPPRESSOR DIRECTLY ON THE COMPONENT.

FIGURE 1-17

IN CASE OF DIFFICULTY

A review of the "Operation" and "Installation" sections of the Manual may indicate any conditions overlooked.

Refer to the Schematic Diagram (fold-out from Page 199) and to the "Chassis Photos" and "X-Ray Views" sections (Pages 182 to 189) for the locations of parts.

Check the receiver and transmitter voltage readings against those shown in Figures 1-20 and 1-21 (fold-out from Page 144). Check the resistance readings against the readings shown in Figure 1-22 (fold-out from Page 155). All voltage readings were taken with an 11 M Ω input electronic voltmeter. Voltages may vary as much as 10%.

Refer to the Receiver Signal Voltage Chart (Figure 1-20) if a signal generator is used to troubleshoot the Transceiver.

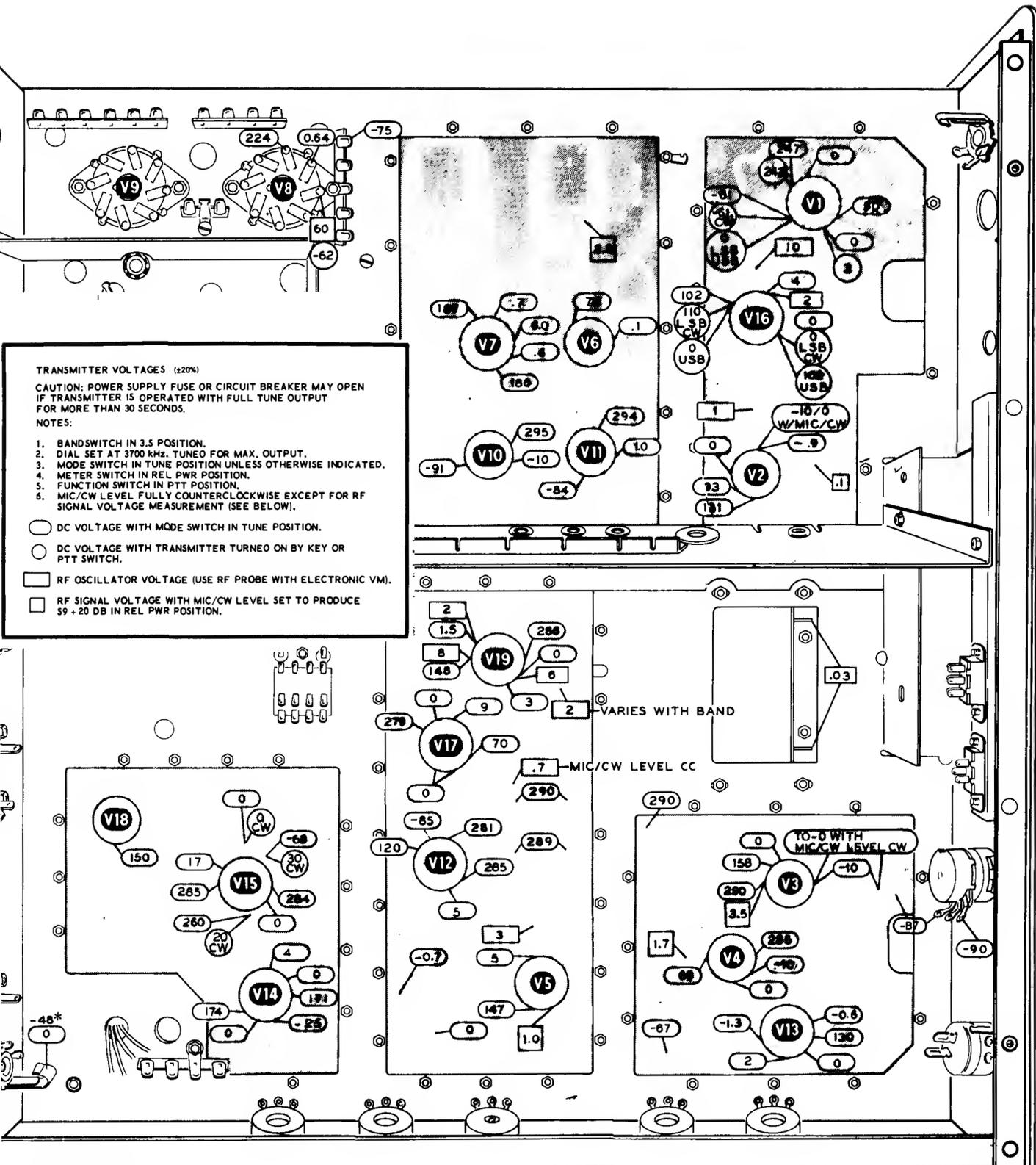
NOTE: Breaks in the foil of the circuit boards can be detected by placing a bright light under the foil side of the board and looking through the board from the lettered side. A break will appear as a hair-line crack in the foil.

Wiring errors and poor soldering are the most common causes of difficulty. Therefore, the first step in troubleshooting is to recheck all wiring against the Pictorials and Schematic Diagrams. Often, having a friend check the wiring will locate an error consistently overlooked by the builder.

Quite often, soldered connections that appear good will have an insulating coating or rosin between the wire, the terminal, and the solder. This results from insufficient heat being applied when you are soldering. You can eliminate many troubles by reheating each connection to make sure that it is properly soldered as illustrated in the "Kit Builders Guide." The power supply should be turned off and the power cable should be removed from the power supply for such tests. As additional insurance against shock, a screwdriver blade should be used to short from the chassis to the red B+ wires.

If fuses blow instantly when power is applied to the unit, check the power supply, B+ circuit, and filament circuits. Check all tubes for possible shorts. Also, refer back to the "Initial Test" section on Page 117. Check to be sure that all tubes are in their proper locations.

Be sure to read the "Circuit Description" so that "Cause-and-Effect" reasoning may be employed as the search for the trouble progresses. If some difficulty still persists after the steps outlined in the Troubleshooting Chart have been completed, try to localize the trouble to a particular stage in the circuit by using the voltage and resistance charts. Then refer to the Block Diagram and Schematic to visualize circuit relationships.



TRANSMITTER VOLTAGES (±20%)

CAUTION: POWER SUPPLY FUSE OR CIRCUIT BREAKER MAY OPEN IF TRANSMITTER IS OPERATED WITH FULL TUNE OUTPUT FOR MORE THAN 30 SECONDS.

NOTES:

1. BANDSWITCH IN 3.5 POSITION.
2. DIAL SET AT 3700 KHZ. TUNED FOR MAX. OUTPUT.
3. MODE SWITCH IN TUNE POSITION UNLESS OTHERWISE INDICATED.
4. METER SWITCH IN REL PWR POSITION.
5. FUNCTION SWITCH IN PTT POSITION.
6. MIC/CW LEVEL FULLY COUNTERCLOCKWISE EXCEPT FOR RF SIGNAL VOLTAGE MEASUREMENT (SEE BELOW).

- DC VOLTAGE WITH MODE SWITCH IN TUNE POSITION.
- DC VOLTAGE WITH TRANSMITTER TURNED ON BY KEY OR PTT SWITCH.
- RF OSCILLATOR VOLTAGE (USE RF PROBE WITH ELECTRONIC VM).
- RF SIGNAL VOLTAGE WITH MIC/CW LEVEL SET TO PRODUCE 59 + 20 DB IN REL PWR POSITION.

* WITH MODE SWITCH IN CW. KEY UP.

TRANSMITTER VOLTAGE CHART
FIGURE 1-21

RECEIVER VOLTAGE CHART NOTES

DC VOLTAGES ($\pm 20\%$)

1. POWER SUPPLY AND 8Ω SPEAKER CONNECTED.
2. ANTENNA NOT CONNECTED.
3. BAND SWITCH IN 3.5 POSITION.
4. MODE SWITCH IN LSB POSITION.
5. FUNCTION SWITCH IN PTT POSITION.
6. RF GAIN MAXIMUM CLOCKWISE.
7. AF GAIN AT 9 O'CLOCK POSITION.
8. FILAMENT VOLTAGES NOT SHOWN: -
 BROWN - 6.3 V AC/DC
 WHITE/BROWN - 12.6 V AC/DC
9. BIAS AT 50 MA PLATE CURRENT.

 MEASURED WITH 11 MEGOHM INPUT ELECTRONIC VM.

 RF VOLTAGES - NO SIGNAL (USE RF PROBE WITH ELECTRONIC VM).

SIGNAL VOLTAGES

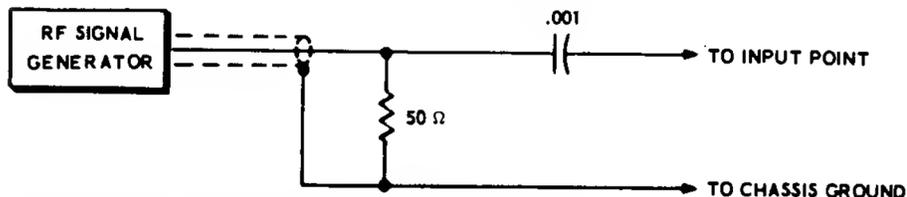
(Refer to Receiver DC Voltage Chart for Test Points)

CONTROL AND SWITCH SETTINGS AS IN DC VOLTAGE CHART EXCEPT AS FOLLOWS:

1. DIAL FREQUENCY - 3.900 MHz
2. MODE SWITCH - LSB OR USB.
3. AF GAIN - SET TO HEAR SIGNAL WITH APPROXIMATELY 1000 Hz TONE.
4. METER SWITCH IN ALC POSITION.

 SIGNAL INPUT POINTS.

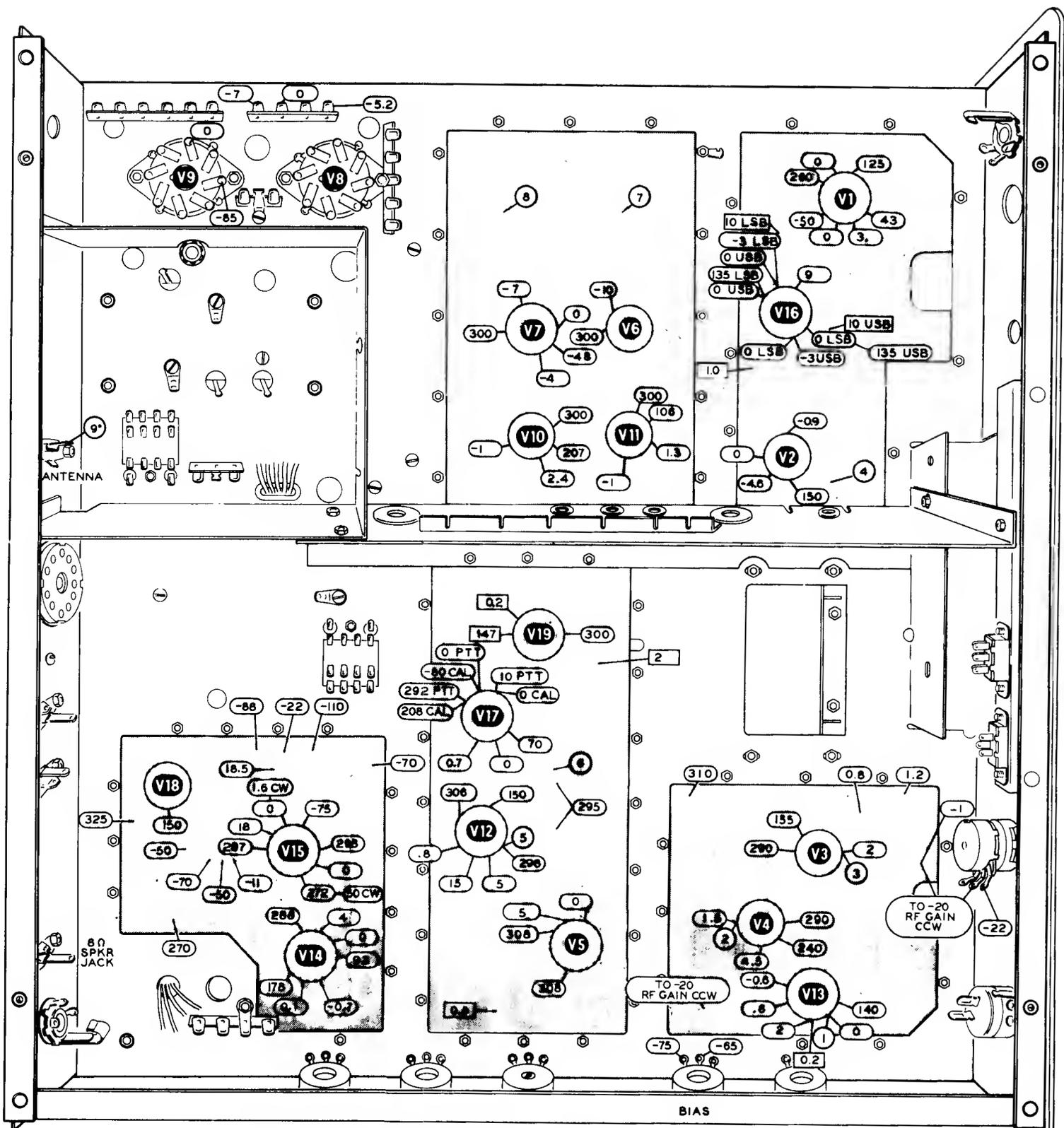
SIGNAL GENERATOR TERMINATION



IMPORTANT: The crystal filter is quite narrow and the signal generator must be very carefully adjusted for the strongest signal indication at the Input Frequency listed in the chart below.

INPUT POINT	INPUT FREQUENCY	INPUT LEVEL	ELECTRONIC VM OR S-METER READING
1	3.395 MHz	20 mV	(AF GAIN MAX. CLOCKWISE) 4 V RMS AT 8Ω JACK
2	"	10 mV	S-4
3	"	10 mV	S-9 + 60 DB.
4	"	10 mV	S-9 + 60 DB.
5	"	10 mV	S-9 + 10 DB.
6	8.5 MHz	10 mV	S-9 + 40 DB.
7	3.900 MHz	10 mV	S-9 + 20 DB.
8	3.900 MHz.	10 mV	S-9 + 40 DB PEAK DRIVER PRESELECTOR
XTAL CAL ON	3.900 MHz		S-9 + 20 DB PEAK DRIVER PRE SELECTOR
9 *	3.900 MHz	30 μ V	S-9 APPROXIMATELY

* GENERATOR CONNECTED DIRECTLY - NO TERMINATION.



RECEIVER DC VOLTAGE CHART
FIGURE 1-20

Most of the RF voltages can be measured with an RF probe connected to your VTVM. Read the comment under "RF Voltage Servicing."

A grid dip meter, or wavemeter, and a general coverage receiver are ideal instruments for checking operation of the RF circuits.

NOTE: If there is instability in the unit, check all circuit board mounting screws. These screws should be tight to the chassis and to the circuit board. Be sure lockwashers are against the foil side of the boards for good grounding.

The enclosed relays used in this unit should be troublefree for years of normal use.

DO NOT REMOVE ANY OF THE TUBES OR PILOT LAMPS WITH POWER APPLIED TO THE UNITS. Because of the series-parallel filament circuit arrangement, removing a tube with power applied may destroy other tubes due to an increase in filament current through them.

RF Voltage Servicing

On the Schematic at the end of this Manual, the symbol  encloses a number indicating the RF voltage at that point. Most of these symbols are found near the top of the Schematic, although others will be observed near V16, the VFO output, V19B, and the antenna output.

RF voltages are shown at the grid and plate of most tubes carrying RF so you can determine whether the problem lies in the grid or the plate circuit.

A Heathkit 11 M Ω input voltmeter with a Heathkit RF probe rated at 90-volts rms was used to measure the RF voltages. If your probe has a lower voltage rating, use the following procedure:

Turn the MIC/CW LEVEL control fully counterclockwise, touch the probe to the measurement point, and then turn the MIC/CW LEVEL clockwise until a meter reading of 30 volts is obtained. If this occurs, consider that the reading at this point is satisfactory. It should be expected that voltages will vary from Transceiver to Transceiver. Crystal oscillator voltages will vary considerably.

This procedure traces the RF signal voltage from stage to stage. By this method, it is easy to isolate a problem stage so that steps can be taken to correct the trouble. You should start at the carrier oscillator and work through to the final, as each stage is dependent on the previous stage.

Trace the RF up to the point it is lost; then back up one stage. Should one or two bands be operating properly and the rest have difficulty, make reference RF voltage measurements on one of the operating bands and make comparison measurements on the inoperative bands. In this way, the stage causing difficulty is quickly isolated.

Once the stage is isolated, steps can be taken to correct the problem. Check for wiring errors, intermittent solder connections, loose hardware and bent switch contacts first; then look for weak tubes, and last, for defective components.

VFO Troubleshooting

VFO troubleshooting instructions are included on Page 154.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover of the Manual.

TROUBLESHOOTING CHART

NOTE: References will often be made to previous Symptoms and Causes. Therefore, each Symptom is identified by a number, and each Possible Cause has an identifying letter. If you are directed, for example, to "check item 1C," refer to Symptom number 1, Possible Cause C.

SYMPTOM	POSSIBLE CAUSE
1. No power, pilot lamps and tube filaments do not light, no B+ or bias voltage.	<ul style="list-style-type: none"> A. Power supply switch at off position. B. Power plug wired incorrectly. C. Power cable from power supply wired incorrectly or has loose connections. D. Defective ac snap switch on AF Gain control switch. E. In mobile installation, power supply leads reversed to battery. F. Fuses or circuit breakers open. G. Defective power supply. H. Faulty battery or battery cables.
2. Pilot lamps and tube filament light, but no bias or B+ voltage.	<ul style="list-style-type: none"> A. Check items 1B and 1C. B. Rectifiers defective in power supply. C. Transistors defective in dc power supply.
3. Bias and B+ voltage OK, but pilot lamps and tube filaments do not light.	<ul style="list-style-type: none"> A. Check items 1B and 1C. B. Large brown-white wires in wire harness open, wired incorrectly, or shorted to ground.
4. Low and high filament voltages on various tubes or pilot lamps.	<ul style="list-style-type: none"> A. Check item 3B. B. Brown leads used to balance filament voltages connected incorrectly, or not connected.
5. No regulated B+ (+150).	<ul style="list-style-type: none"> A. Relay RL2 wired incorrectly. B. Bad OA2 regulator tube, V18. C. Resistor R304 and/or R305 open or wired incorrectly. D. B+ voltage is 250 V instead of 300 V.
6. Regulated B+ voltage too high.	<ul style="list-style-type: none"> A. Check item 5B. B. Resistor R304 and/or R305 wrong value.
7. Regulated B+ voltage too low.	<ul style="list-style-type: none"> A. Check items 5A, 5B, and 6B. B. Shorted bypass capacitor in regulated B+ line.

SYMPTOM	POSSIBLE CAUSE
8. No screen voltage at tubes V4, V10, and V11.	A. Lugs 3, 7, or 11 of relay RL2 wired wrong.
9. High-pitched audio oscillation unaffected by AF Gain control.	A. Red and blue audio output transformer leads reversed. B. AVC line shorted - no cutoff bias to V10 or V11.
10. No audio output from speaker or headphones.	A. Check items 5A, 5B, and 5C. B. Defective transformer T301. C. AF Gain control incorrectly wired, or defective. D. Filter capacitor C304 shorted or installed backwards. E. Audio amplifier output tube V14 defective. F. Coaxial cable connected to AF Gain control shorted. G. Leads reversed at lugs 3, 7, or 11 of relay RL2. H. Leads reversed at lugs 2, 6, or 10 of relay RL2. I. Speaker leads shorted.
11. No audio output from speaker, but headphone output OK.	A. Contacts 1 and 2 of Phones jack open. B. Leads to Phones jack improperly connected. C. Speaker lead connected to wrong phono socket. D. Defective speaker. E. Output transformer green, black, or white leads connected wrong.
12. Low or no audio output from headphones, but speaker output OK.	A. Phones jack wired incorrectly. B. Defective headphones.
13. No signal or noise output, but very low hum output can be heard (speaker or phones).	A. Check items 10A, 10F, and 10G. B. RFC101 open. C. Product detector tube V13 faulty. D. No carrier generator injection signal at product detector. (Check items 32A through 32F.) E. Coaxial cable #1 connected to AF Gain control open or shorted. F. IF transformer T102 misaligned or defective. G. IF amplifier tubes V3 or V4 defective. H. Coaxial cable #4 from V12 to crystal filter FL1 open or shorted. I. RF Gain control wired backwards, or turned down.

SYMPTOM	POSSIBLE CAUSE
<p>14. No signal output, but noise output can be heard.</p>	<p>A. Transformer T201 misaligned or defective. B. No VFO injection signal at the cathode of V12A. (Check item 34B). C. Coaxial cable connected between the bandpass and driver plate circuit boards, open or shorted. D. First IF amplifier tube V3 defective. E. Second receiver mixer tube V12A defective. F. No heterodyne oscillator injection signal at the cathode of V11. (Check items 36A through 36I). G. First receiver mixer V11 or RF amplifier V10 defective. Also check items 3B and 4B. H. Coaxial cable connected between relay RL1 and the driver plate circuit board, open or shorted. I. Relay RL1 wired incorrectly. J. Bandpass filter T202 defective. K. Crystal filter FL1 defective. L. Filter switch in wrong position. NOTE: One filter terminal may normally have a 3 Ω to 5 Ω resistance to ground.</p>
<p>15. Audio output with signal, but weak.</p>	<p>A. Low B+ supply voltage. B. Coils on driver plate, driver grid, and heterodyne oscillator circuit boards misaligned. C. Check items 3B, 5A, 5B, 6B, 13A through 13I and 14A through 14K. D. RF Gain control is partially counterclockwise or wired incorrectly.</p>
<p>16. Receiver tends to be unstable, oscillates. (Receiver noise may be extremely high, or many "birdies" appear across tuning range.</p>	<p>A. RF driver and IF circuit board mounting hardware not tight, or lockwashers left out between the chassis and circuit boards. B. Antenna transmission line open or shorted, or has high SWR. C. Supply voltage too high. (Check items 5B and 6B). D. Transmitter cutoff bias too low (V6 and V7).</p>
<p>17. Sideband reception reversed or highly distorted.</p>	<p>A. Carrier generator crystals Y1 and Y2 interchanged. B. CW carrier generator crystal Y3 interchanged with either Y1 or Y2. C. Leads reversed at lugs 13 and 17 on the Mode switch. D. Check VFO shifter adjustment.</p>

SYMPTOM	POSSIBLE CAUSE
<p>18. S Meter inoperative, indicates backwards, is inoperative in some Meter switch positions, does not zero, or zero shifts on some bands.</p> <p>NOTE: When transmitting, the meter may rest below zero in the ALC position without harm.</p>	<ul style="list-style-type: none"> A. Leads connected to the meter are reversed. B. Improper wiring of Meter switch. C. Meter Zero control improperly adjusted. D. One of the following resistors is a wrong value: R105, R106, R107, or R115. E. First or second IF amplifier tubes (V3 or V4) defective. F. AVC line shorted to chassis. G. Lugs 4, 8, or 12 of relay RL2 wired wrong. H. V19, wrong type. I. Heterodyne oscillator coils improperly set. Readjust (see steps on Page 120). J. Defective Meter switch.
<p>19. No screen voltage at driver tube V7.</p>	<ul style="list-style-type: none"> A. Relay RL2 not energized. B. Lugs 3, 7, and 11 of RL2 connected incorrectly.
<p>20. Bias voltage does not shift to operating levels in transmit conditions.</p>	<ul style="list-style-type: none"> A. Check item 19A. B. Lugs 2, 6, and 10 of relay RL2 wired wrong. C. Bias Adjust control set improperly.
<p>21. No RF output from final, regardless of Mode switch position.</p>	<ul style="list-style-type: none"> A. No high voltage B+ at the plates of final amplifier tubes V8 and V9. B. RF choke RFC901 open. C. Lugs 8 and 12 of relay RL1 wired wrong. D. Bias voltage too high at the grids of V8 and V9. (Check items 20A through 20C.) E. Final controls not adjusted properly. F. Final amplifier tubes V8 and/or V9 defective. G. Rotor in switch on driver plate circuit board, or final tank switch, 180 degrees out of rotation. H. Final knobs or shafts loose. I. Check items 23A and 23D.
<p>22. No RF output from driver regardless of Mode switch position. (Second transmitter mixer appears to be OK.)</p>	<ul style="list-style-type: none"> A. No B+ voltage at the screen of V7. (Check items 19A and 19B.) B. RFC801 open. C. Bias voltage at grids of V8 and V9 too high. (Check items 19A, 20B, and 20C.) D. Coils on the driver plate and grid circuit boards misaligned. E. Driver Preselector control not adjusted properly. F. Driver tube V7 defective.

SYMPTOM	POSSIBLE CAUSE
23. Low relative power reading.	<ul style="list-style-type: none"> A. MIC/CW Level control set too low. B. Transceiver not properly tuned. C. Antenna shorted, or too low impedance. D. Improper voltages to V8 or V9.
24. High relative power reading.	<ul style="list-style-type: none"> A. Antenna too high impedance. B. Open-circuited antenna.
25. No RF output from second transmitter mixer, regardless of the Mode switch setting. (First transmitter mixer appears to be OK.)	<ul style="list-style-type: none"> A. Check items 5A through 5C, 19A, 19B, 22D, and 22E. B. No heterodyne oscillator injection signal at cathode of V6. (Check items 36A through 36I.) C. Coaxial cable connected between the band-pass and driver plate circuit board open or shorted. D. Second transmitter mixer tube V6 defective.
26. No RF output from first transmitter mixer regardless of the Mode switch position. (First IF amplifier appears to be OK.)	<ul style="list-style-type: none"> A. Check items 19A, 19B, 20B, 20C, 22D, and 22E. B. No VFO output signal to cathode of V5 (pin 7). C. First transmitter mixer tube V5A defective. D. Bandpass filter T202 defective.
27. No RF output from first IF amplifier, regardless of the Mode switch position. (Isolation amplifier output appears to be OK.)	<ul style="list-style-type: none"> A. Check items 14A, 14C, 14D, 14K, 19A, and 19B.
28. No RF output from isolation amplifier, regardless of the Mode switch position.	<ul style="list-style-type: none"> A. Check items 20B and 20C. B. Resistors R18, R19, R23, R24, R937, and/or R938 wrong value. C. Transformer T1 misaligned or faulty. D. Isolation amplifier tube V2 defective. E. Carrier oscillator not operating. (Check items 31B through 31E.)

SYMPTOM	POSSIBLE CAUSE
29. No RF output with the Mode switch in USB or LSB, but output in Tune or CW positions OK.	A. Check items 19A and 25A. B. No carrier injection signal to balanced modulator. (Check items 30B, 30C, and 32A through 32F. C. Balanced modulator diodes CR1 through CR4, installed improperly, wrong type, or defective. D. Coaxial cable #3 connected to the MIC/CW Level control open or shorted. E. Wafer 1F or 1R of the Mode switch wired incorrectly. F. MIC connector wired wrong. G. Speech amplifier tube V1 defective. H. Microphone defective. I. MIC/CW Level control defective.
30. No RF output with the Mode switch in Tune or CW, but output in LSB or USB OK.	A. Check items 19A, 19B, 20C, and 29B. B. MIC/CW Level control defective. C. Rear wafer of Mode switch wired wrong.
31. No carrier oscillator injection signal with the Mode switch in Tune or CW positions, but LSB and USB output OK.	A. Check items 19A and 19B. B. CW crystal Y3 improper frequency or defective. C. Lugs 1, 5, and/or 9 of the Mode switch wired incorrectly. D. Incorrect wiring of Mode switch wafers 1F or 2R. E. Tube V16 defective.
32. No carrier oscillator injection signal with the Mode switch in either LSB or USB positions. Tune and CW output OK.	A. Check items 19A and 19B. B. Coaxial cable from IF circuit board to modulator circuit board shorted. C. USB crystal Y1, or LSB crystal Y2, improper frequency or defective. D. Capacitors C4 through C8, C16 and C17, wrong value. E. Resistors R6 through R9, or R11, wrong value. F. Tube V16 defective.

SYMPTOM	POSSIBLE CAUSE
33. Very low output in USB or LSB modes.	<ul style="list-style-type: none"> A. T1 not aligned. B. Microphone output level too low. C. Tube V1 defective. D. Check item 23A.
34. No VFO injection signal at cathodes of V5 or V12.	<ul style="list-style-type: none"> A. Check items 5A, 5B, and 5C. B. Tube V20 defective.
35. VFO frequency does not shift properly with Mode switch in various positions.	<ul style="list-style-type: none"> A. Check items 5A, 5B, 5C, 32D, and 32E. B. Mode switch wafer 1F wired incorrectly. C. Resistor R306 or R307 wrong value.
36. No heterodyne oscillator injection signal at cathodes of V6 and V11.	<ul style="list-style-type: none"> A. Check items 5A, 5B, and 5C. B. One of the crystals Y501 through Y508 defective, depending on the band being used. C. Coaxial cable from heterodyne oscillator circuit board to bandpass circuit board, open or shorted. D. Capacitors C208 or C223 wrong value. E. Tube V19 defective or wrong type. F. Coils L601 through L608 misaligned or faulty. G. Capacitor C604 wrong value. H. No 150 V B+ voltage to the heterodyne oscillator circuit board. I. Rotors reversed 180 degrees in the switch wafer on the crystal or heterodyne oscillator circuit boards.
37. Relays RL1 and RL2 do not energize with the Mode switch in the Tune position.	<ul style="list-style-type: none"> A. Tube V12B defective. B. Relays RL1 or RL2 defective. C. Wafer 2F of Mode switch wired incorrectly.
38. Relays RL1 and RL2 will not energize with Mode switch in LSB or USB, and Function switch in VOX position.	<ul style="list-style-type: none"> A. Check items 5A through 5C. B. VOX SENS control improperly adjusted. C. Tube V17A defective or wrong type. D. Diode D201 wrong type or installed backwards. E. Zener diode D202 installed backwards or defective. F. Function switch wired incorrectly. Check the white-red-red wire to lug 3. G. Anti-Trip control set too high.

SYMPTOM	POSSIBLE CAUSE
39. Relays energize and stay energized regardless of VOX Sens control setting.	A. PTT switch on microphone stuck closed or shorted. B. Key closed. C. C213 defective. D. V12 defective. E. Low B+, at 250 Vdc instead of 300 Vdc.
40. Transmitter tends to be unstable.	A. Final and/or driver neutralization not proper. B. Mounting hardware for Modulator and RF driver circuit board not tight. Lockwashers between circuit boards and chassis left out. C. Check items 16C and 16D. D. Coils L802 through L805 and/or L801 misaligned. E. Antenna impedance wrong. F. Coil shield cover loose or missing. G. Ground clips for tube shields bent out. H. Hardware loose on sockets V8 and V9. I. Excessive lead lengths of components around V8 and V9.
41. Receiver has slow recovery from transmit condition.	A. Diode D101 defective.
42. Transmit output falls off.	A. Excessive heat due to restricted air circulation. B. Incorrect bias setting. C. Improper load to RF output. D. Gassy 6146 tubes. E. Tube V7 weak.
43. Zero setting of main tuning dial changes considerably from band to band.	A. 100 kHz calibrator is not set exactly at 100 kHz. B. Heterodyne oscillators not properly tuned. C. Repeat the VFO alignment procedure on Page 121.
44. Low transmitter output, all modes.	A. Wire from IF circuit board is not in hole 3 on the bandpass circuit board.

VFO TROUBLESHOOTING

A tube adapter may be used to check "in circuit" voltages present at tube V20 in the VFO. Other than this, it will normally be necessary to remove the VFO chassis from the main chassis. Instructions follow for removing and replacing the VFO and dial assembly as a unit.

VFO ASSEMBLY REMOVAL

- () Remove tube V19 from its socket.
- () Remove the screw holding the pilot lamp socket to the VFO.
- () Unplug the coaxial cable from the VFO output socket.
- () Unsolder the bias, B+, and filament wires from the Bias, B+, and Fil terminals on the back of the VFO chassis.
- () Loosen the setscrews in the Jackson drive hub on the VFO shaft back of the panel.
- () Remove the knob from the VFO shaft. Then remove the screws at the 3 o'clock and 9 o'clock positions and withdraw the drive assembly from the panel.

- () Remove the 6-32 nuts and lockwashers from the spade bolts which hold the VFO chassis to the main chassis.
- () Work the VFO chassis upward until the spade bolts are out of their slots, and to the rear until the VFO shaft is free from the Jackson drive hub.
- () Tack solder extensions to the power wires that were removed from the back of the VFO chassis; tape the joints to avoid short circuits. Connect and solder the extensions to the appropriate terminals on the removed VFO chassis.
- () Use a clip lead or wire to ground the VFO chassis to the main chassis.
- () Turn the power on and test the unit in operation.

VFO ASSEMBLY REPLACEMENT

To replace the VFO, remove and discard the temporary power extension wires and, in reverse order, perform the steps detailed for VFO removal. Take care that the power wiring is reconnected properly (white-gray to BIAS; orange to B+; brown to FIL), and that the mounting hardware is tightened after the VFO is positioned.

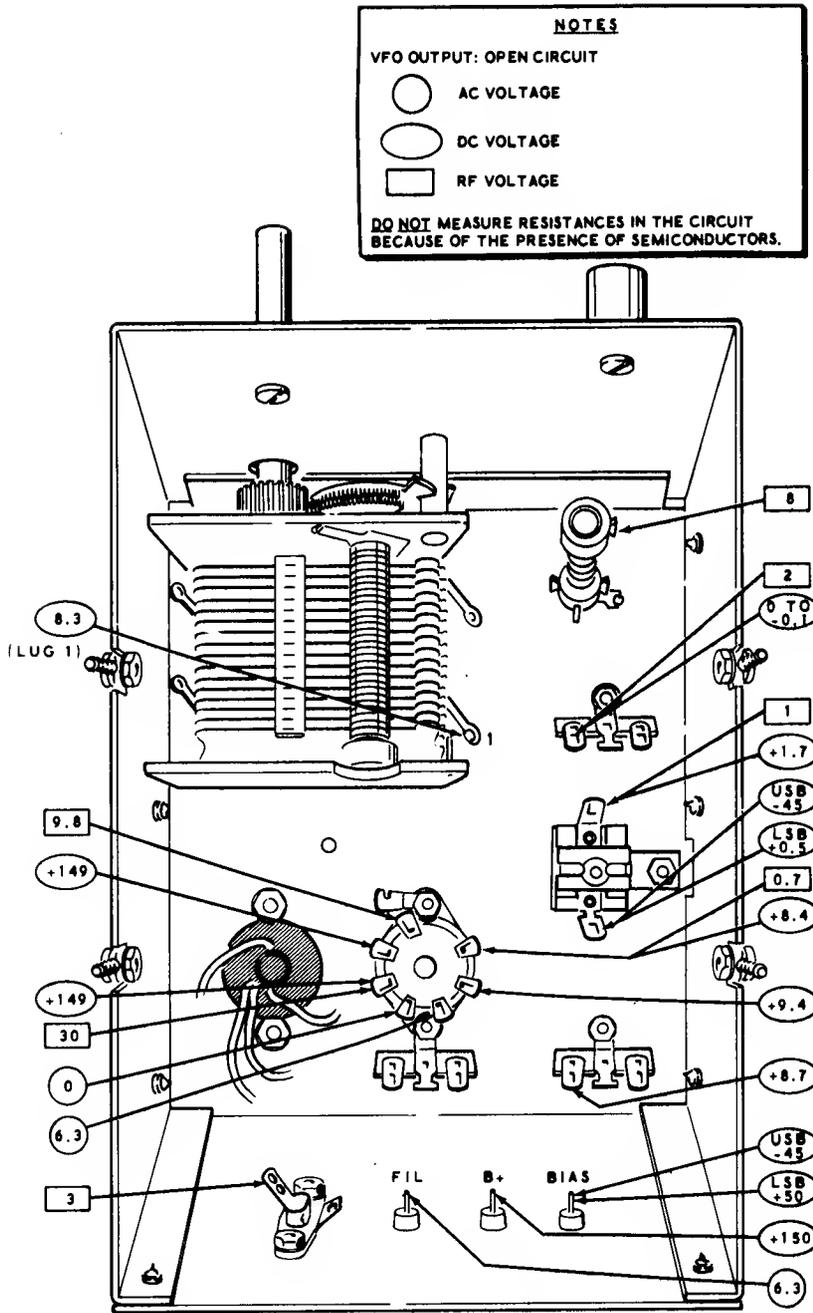
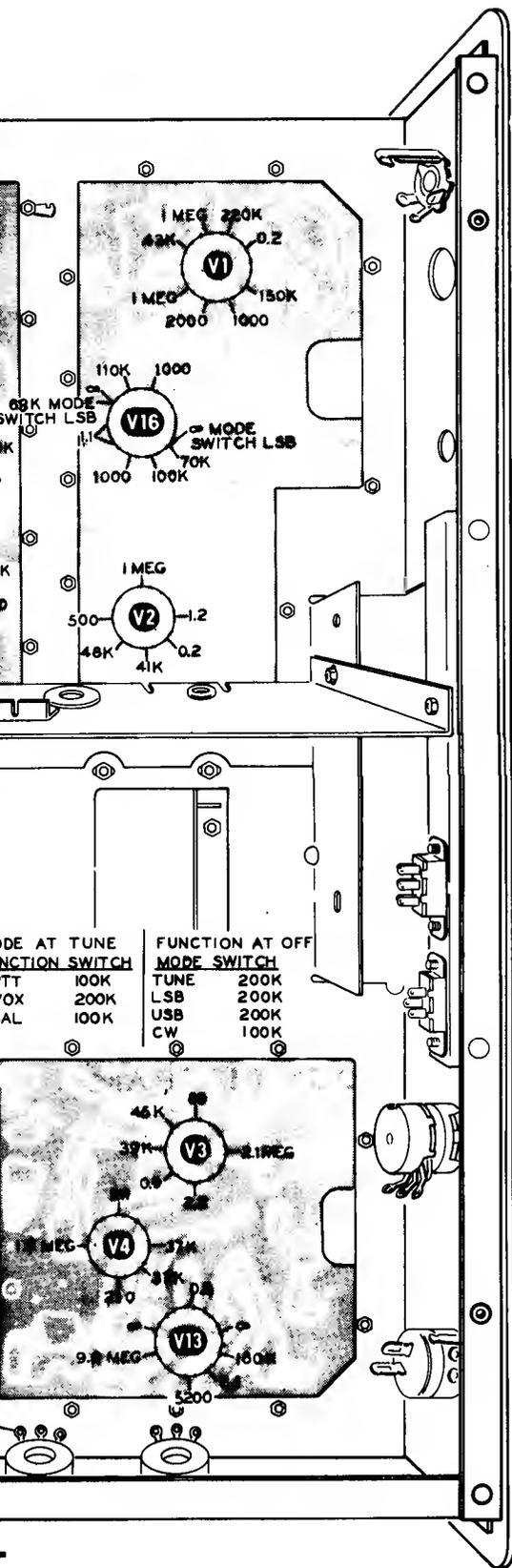
VFO Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE
1. Output low (after calibration).	A. Tube V20 weak. B. Turn the Main Tuning dial to 300 and tune the top core of coil FM for maximum VFO output.
2. Output high.	A. Resistor R221 not soldered to point F on the bandpass circuit board. B. Core of VFO coil turned to wrong end. It should be approximately 1-1/4" below the end of the coil.
3. No output.	A. Q942 connected backwards. B. Q941 connected wrong. C. Lugs of C950 touching the chassis. D. Output cable shorted. E. Lead of C951 not connected through lug 2 to TP terminal of L941.
4. VFO shifter does not work.	A. CR941 reversed.
5. Microphonics generated by tapping VFO chassis.	A. Bend the leads of, or reposition, the two 56 pF disc capacitors so their surfaces are separated more than 1/8". B. Component leads too long, permitting vibrations or motion.

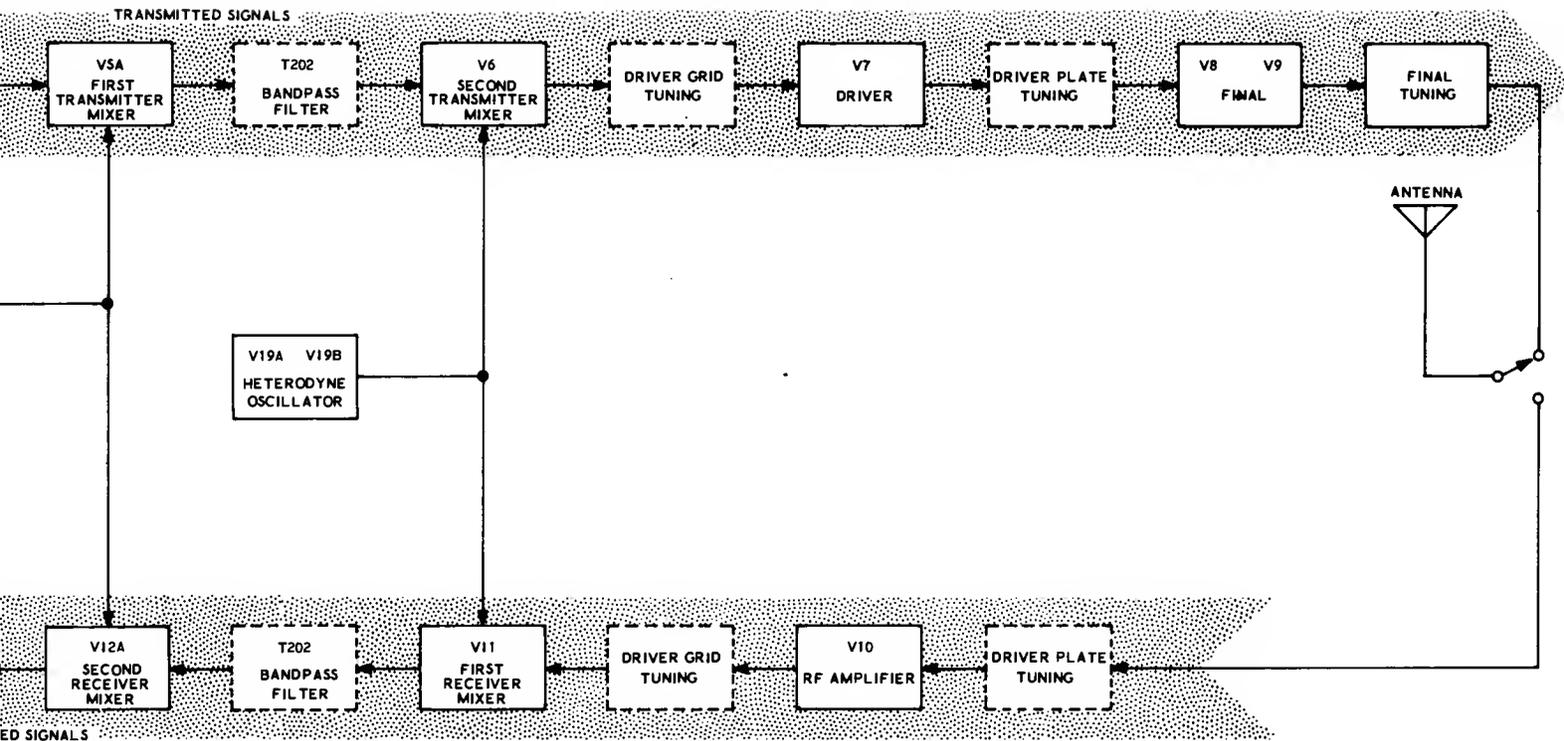
VFO RF TROUBLESHOOTING

Figure 1-23 shows the ac, dc, and RF voltages to be expected in the VFO. These measurements were made with an 11 M Ω input voltmeter and, in the case of RF voltages only, a Heathkit RF probe. RF voltage measurements were made at 3700 kHz, LSB, receiving, with VFO output open circuited. RF voltages may vary 25%.

Follow the same step-by-step procedure as outlined for the other parts of the Transceiver. Look for poorly soldered joints, stray bits of wire or solder, and component leads improperly touching each other or the chassis.

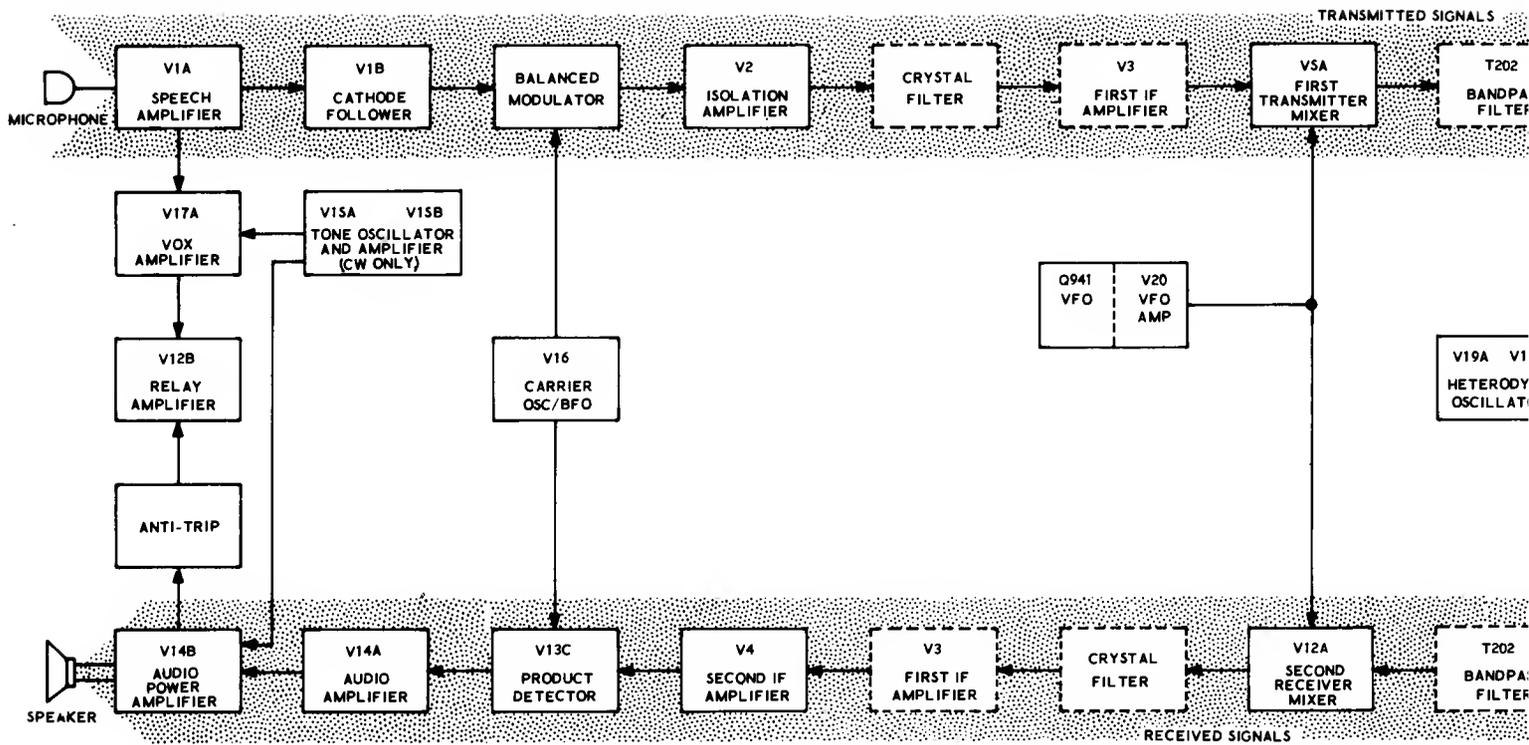


**VFO VOLTAGE CHART
FIGURE 1-23**




 THESE BLOCKS ARE FOR
 THE CIRCUITS THAT ARE
 USED IN BOTH THE TRANSMITTING
 AND RECEIVING MODES OF OPERATION.

BLOCK DIAGRAM



BLOCK DIAGRAM

SPECIFICATIONS

RECEIVER

Sensitivity	Less than .3 microvolt for 10 dB signal-plus-noise to noise ratio for SSB operation.
SSB Selectivity	2.1 kHz minimum at 6 dB down, 7 kHz minimum at 60 dB down (3.395 MHz filter).
CW Selectivity (With Optional SBA-301-2 CW Filter Installed)	400 Hz minimum at 6 dB down, 2.0 kHz maximum at 60 dB down.
Power Output	2 watts with less than 10% distortion.
Spurious Response	Image and IF rejection better than 50 dB.

TRANSMITTER

DC Power Input	SSB: (A3J emission) 180 watt P.E.P. (normal voice, continuous duty cycle). CW: (A1 emission) 170 watts (50% duty cycle).
RF Power Output	100 watts on 80 through 15 meters; 80 watts on 10 meters (50 Ω nonreactive load).
Output Impedance	50 Ω to 75 Ω with less than 2:1 SWR.
Oscillator Feedthrough or Mixer Products	55 dB below rated output.
Harmonic Radiation	40 dB below rated output.
Transmit-Receive Operation	SSB: PTT or VOX. CW: Provided by operating VOX from a keyed tone, using grid-block keying.

CW Side-Tone	Internally switched to speaker to headphones, in CW mode. Approximately 1000 Hz tone.
Microphone Requirement	High impedance with a rating of -45 to -55 dB.
Carrier Suppression	45 dB down from single-tone output.
Unwanted Sideband Suppression	45 dB down from single-tone output at 1000 Hz reference.
Emissions not possible or not recommended	A0, A2, A3b, A4 through A9, F0 through F9, and P0 through P9.
Third Order Distortion	30 dB down from two-tone output.
RF Compression (TALC*)	10 dB or greater at .1 mA final grid current.

GENERAL

Frequency Coverage	3.5 to 4.0; 7.0 to 7.3; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 (megahertz).
Frequency Stability	Less than 100 Hertz per hour drift after 45 minutes warmup from normal ambient conditions. Less than 100 Hz for $\pm 10\%$ line voltage variations.
Modes of Operation	Selectable upper or lower sideband (suppressed carrier) and CW.
Dial Calibration	5 kHz divisions.
Calibration	100 kHz crystal.
Bandspread	35 -1/3 revolutions for 500 kHz.
Audio Frequency Response	350 to 2450 Hz.
Front Panel Controls	Main tuning dial. Driver Preselector. Final tuning. Final loading. Mic and CW Level control. Mode switch. Band switch. Function switch. Meter switch. RF Gain control. Audio Gain control. Filter selector switch.

*Triple Action Level Control™.

Side Controls	<ul style="list-style-type: none"> Meter Zero control. Bias Adjust. VOX Sensitivity. VOX Delay. Anti-Trip.
Internal Controls	<ul style="list-style-type: none"> Carrier Null (control and capacitor). Neutralizing. Crystal calibrator. VFO trimmer. VFO shifter. VFO coil.
Tube Complement	<ul style="list-style-type: none"> OA2 Regulator (150 V). 6HS6 RF amplifier. 6HS6 1st receiver mixer. 6AU6 Isolation amplifier. 6AU6 1st IF amplifier. 6AU6 2nd IF amplifier. 6BN8 Product detector and AVC. 6AU6 VFO Amplifier. 6CB6 2nd transmitter mixer. 6CL6 Driver. 6EA8 Speech Amplifier and cathode follower. 6EA8 1st transmitter mixer. 6EA8 2nd receiver mixer and relay amplifier. 6EA8 CW side-tone oscillator and amplifier. 6GW8 Audio amplifier and audio output. 12AT7 Heterodyne oscillator and cathode follower. 12AT7 VOX amplifier and calibrator oscillator. 12AU7 Sideband oscillator. 6146 Final amplifiers (2).
Diode Complement	<ul style="list-style-type: none"> 6 Germanium Diodes: Balanced modulator, RF sampling, and crystal calibrator harmonic generator. 9 Silicon Diodes: ALC rectifiers, anti-trip rectifiers, and DC blocking. 1 Zener Diode: cathode bias.
Transistors	<ul style="list-style-type: none"> MPF-105 FET-VFO. 2N3393 Voltage regulator.
Rear Apron Connectors	<ul style="list-style-type: none"> CW Key. 8 Ω output. ALC input. Power and accessory plug. Antenna. Spare.
Power Requirements	<ul style="list-style-type: none"> 700 to 850 volts at 250 mA with 1% maximum ripple. 300 volts at 150 mA with .05% maximum ripple. -115 volts at 10 mA with .5% maximum ripple. 12 volts ac/dc at 4.76 amps.



Cabinet Dimensions	14-13/16" wide x 6-5/16" high x 13-3/8" deep.
Net Weight	17-1/2 lbs.
Equipment Used to Prepare Specifications	Heath HN-31 "Antenna." Heath SB-610 Monitor Scope. Heath IM-11 VTVM. Heath MM-1 VOM. Heath IG-72 Audio Generator. Heath HDP-21 A Microphone. Hewlett-Packard Electronic Counter, Model 5246L. Tektronix Oscilloscope, Model 581 A. Hewlett-Packard Signal Generator, Model 606A. Panoramic Radio Products Inc., "Panalyzer," Model SB-12A. Boonton RF Voltmeter, Model 91-CA. Dynascan Digital Voltmeter, Model 111.

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 Block Diagram (fold-out from Page 156) and to the Schematic (fold-out from Page 199) while reading this Circuit Description. Small sections of the Schematic are also included in this description to make the circuits easier to follow.

Note that the receiver circuits are across the bottom, and the transmitter circuits are across the top of the Schematic and Block Diagrams. Also, several of the circuits that are used for transmitting are also used for receiving (such as the crystal filter and the first IF amplifier). These circuits, which are shown in both the transmitter and receiver portions of the Block Diagram, are identified in the Block Diagram by dotted lines.

Each rotary switch is identified by the front panel name of the switch, and by a letter-number designation that shows the position of that wafer in the switch. See Figure 2-1.

Letter-number designations for the resistors, capacitors, coils, etc., are placed in the following groups:

- 0-99 Modulator circuit board.
- 100-199 IF circuit board.
- 200-299 Bandpass circuit board.
- 300-399 Audio circuit board.
- 400-499 RF driver circuit board.
- 500-599 Crystal Switch-Board.
- 600-699 Heterodyne oscillator Switch-Board.
- 700-799 Driver grid Switch-Board.
- 800-899 Driver plate Switch-Board.
- 900-999 Chassis and VFO.

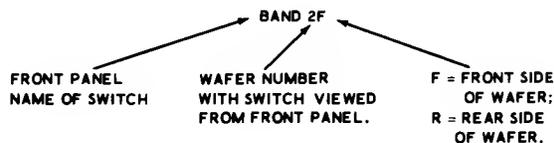


Figure 2-1

TRANSMITTER CIRCUITS

The chart in Figure 2-2 lists the various frequencies that will be found throughout the transmitter on each band. The transmitted lower sideband frequency of 3.895 MHz, modulated with a 1400 hertz audio tone, which is shown on the first line, will be used when tracing through the transmitter circuits. The other frequencies referred to in the Circuit Description will also be found on the first line.

RELAY AND VOX AMPLIFIER (Figures 2-3 and 2-4)

The Transceiver can be switched from receive to transmit by either the VOX (voice controlled operation) or the push-to-talk method. The VOX circuit works in the following manner.

The audio signal from the microphone is coupled through speech amplifier V1A and capacitor C9 to the VOX Sensitivity control. From the arm of this control, the signal is coupled through resistors R213 and R214 to the grid of VOX amplifier V17A. The signal is amplified in V17A. It is then coupled through capacitor C211, rectified by diode D201, and applied to relay amplifier V12B, which actuates the transmit-receive relays. V12B is biased to cutoff by zener diode D202 in the cathode circuit. When the grid

voltage overcomes the cathode bias, the tube conducts and both relays close.

In the PTT and Calibrate positions of the Function switch, and in the CW position of the Mode switch, the lead from the VOX Sensitivity control to the grid of V17A is connected to ground. This keeps stray microphone signals from activating the VOX circuit during PTT and CW operation, or during calibration. Relay amplifier V12B is held in cutoff during receive operation by the positive voltage that is maintained at its cathode by zener diode D202. V12B is made to conduct for transmit operation by the VOX voltage at its grid, or by the push-to-talk switch on the microphone which shorts the cathode to ground. (The cathode of V12B is also shorted to ground by wafer 2F of the Mode switch in the Tune position.) Diode D201 rectifies the audio signal from the VOX amplifier so that a positive voltage appears at the grid of relay amplifier V12B. The positive voltage at the grid causes the relay amplifier to conduct, and the plate current of V12B causes relays RL1 and RL2 to close and place all circuits in the transmit mode of operation.

The VOX hold-in time is adjusted by varying the discharge time for capacitor C213 with the VOX Delay control.

BAND	CARRIER OSCILLATOR (3393.6 kHz plus 1400 Hz modulation), CRYSTAL FILTER AND IF FREQUENCIES	VFO FREQUENCY (BETWEEN 5 AND 5.5)	SIGNAL FREQUENCY AT BANDPASS FILTER (BETWEEN 8.395 AND 8.895)	HETERODYNE OSCILLATOR FREQUENCY (CRYSTAL FIXED)	TRANSMITTED SIGNAL FREQUENCY
3.5 to 4	3.395	5.105	8.5	12.395	3.895
7 to 7.5	3.395	5.3	8.695	15.895	7.2
14 to 14.5	3.395	5.3	8.695	22.895	14.2
21 to 21.5	3.395	5.2	8.595	29.895	21.3
28 to 28.5	3.395	5.4	8.795	36.895	28.1
28.5 to 29	3.395	5.3	8.695	37.395	28.7
29 to 29.5	3.395	5.3	8.695	37.895	29.2
29.5 to 30	3.395	5.4	8.795	38.395	29.6

All frequencies are in MHz.

Figure 2-2

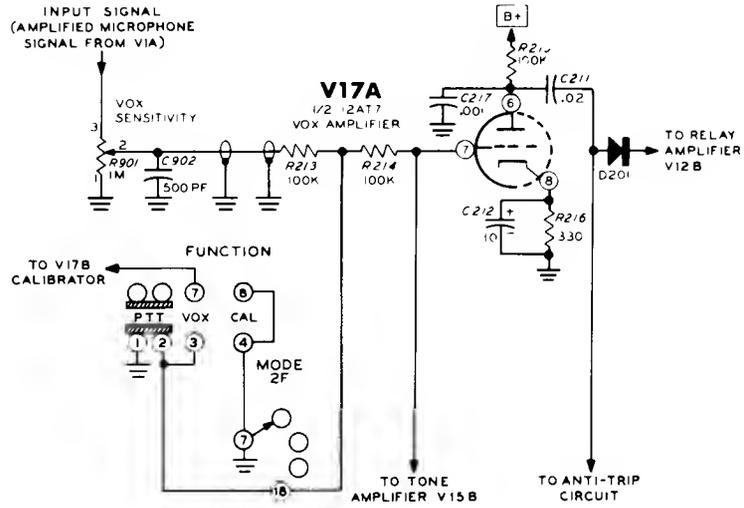


Figure 2-3

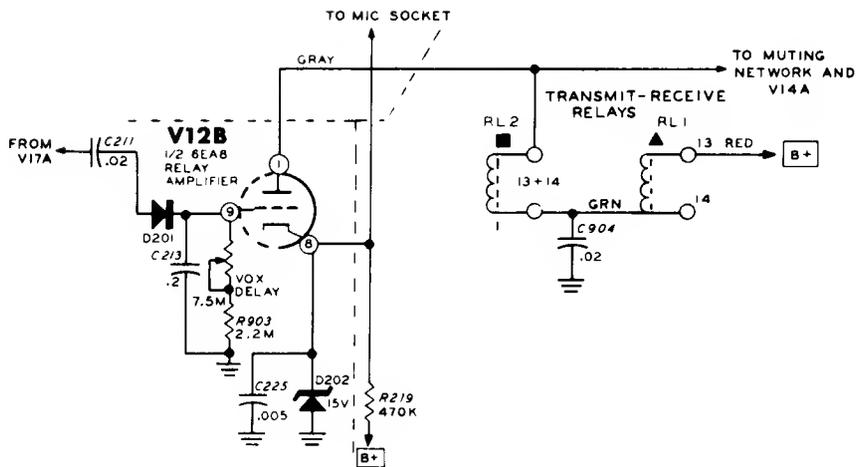


Figure 2-4

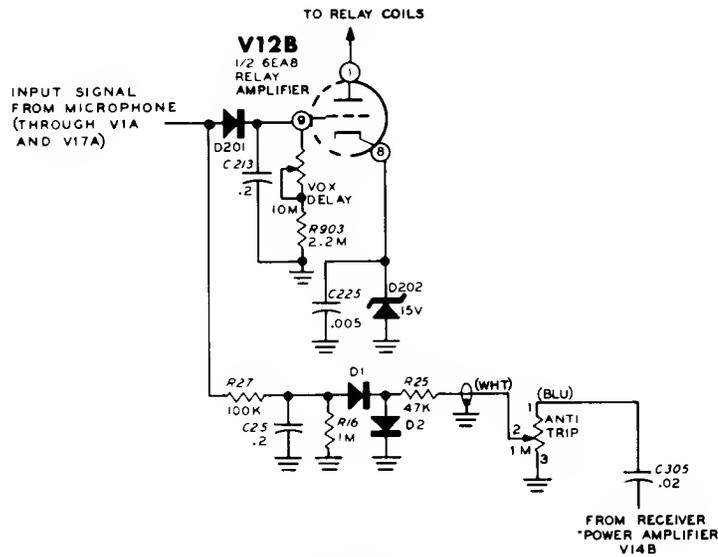


Figure 2-5

ANTI-TRIP CIRCUIT (Figure 2-5)

The anti-trip circuit is used in the receive mode of operation to keep the speaker signals from activating relay amplifier V12B.

An audio signal is coupled through capacitor C305 from audio power amplifier V14B to the Anti-Trip control. This audio signal is then coupled through isolation resistor R25 and rectified by diodes D1 and D2, resulting in a negative dc voltage across capacitor C25 and resistor R16. This negative voltage is then coupled through resistor R27 to diode D201 as back bias, where it cancels out the voltage from the VOX amplifier. Thus, with no positive voltage at its grid, relay amplifier V12B remains cut off, and the relays remain in the receive position.

SPEECH AMPLIFIER AND CATHODE FOLLOWER (Figure 2-6)

The audio signal from the microphone is coupled directly from lug 1 of the Microphone socket through resistor R931 to the grid of speech amplifier V1A. Capacitor C1, at the grid of V1A, limits the high frequency response of this stage and bypasses to ground any RF signals present at this point. The amplified signal from the plate of V1A is coupled through capacitor C9 to the Microphone Level section of the Mic/CW Level control and also to the VOX amplifier.

The setting of the Microphone Level control determines the amount of modulation since it adjusts the amount of speech signal that is coupled through cathode follower V1B to the

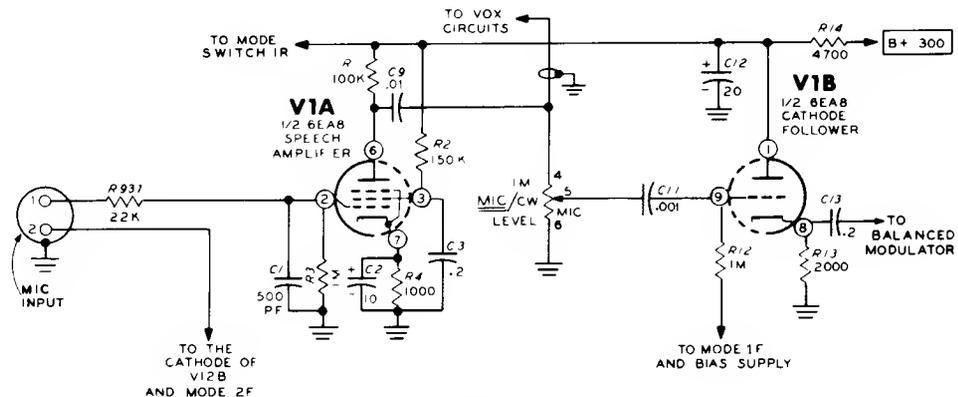


Figure 2-6

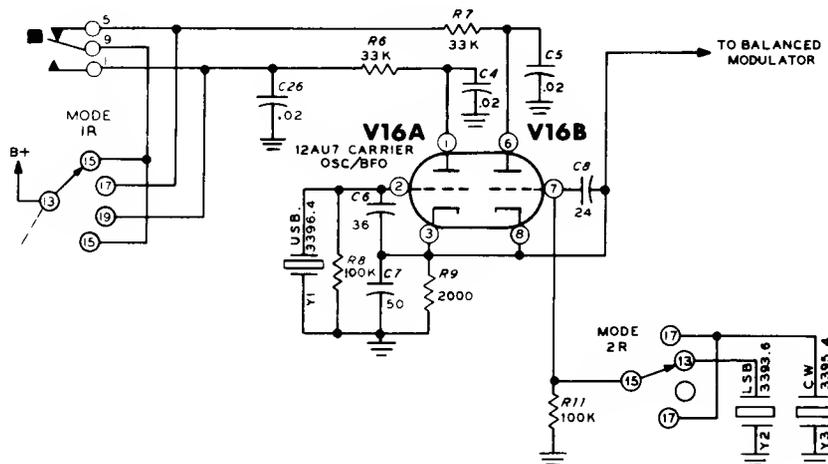


Figure 2-7

balanced modulator circuit. For LSB and USB operation, V1B grid resistor R12 is returned to ground through wafer 1F of the Mode switch and contacts 6 and 10 of relay RL2. When the Mode switch is in the Tune or CW position, cathode follower V1B is cut off by a bias voltage that is supplied to it from the junction of bias voltage divider resistors R308 and R309.

CARRIER OSCILLATOR (Figure 2-7)

The carrier oscillator consists of two Colpitts crystal oscillators. These oscillators supply an RF signal to the balanced modulator for transmit operation, and a heterodyne signal to product detector stage V13C for receive operation. Tube V16A and crystal Y1 (3396.4 kHz) serve as the USB (upper sideband) carrier oscillator, and tube V16B with crystals Y2 (3393.6 kHz) and Y3 (3395.4 kHz) acts as the LSB (lower sideband) and CW carrier oscillator.

The desired carrier oscillator, V16B, for the transmitted frequency being used in this Description (3393.6 kHz), is placed in operation by wafer 1R of the Mode switch which

connects its plate circuit to B+. Wafer 2R of the Mode switch connects the proper crystal to the grid of V16B: Y2 for LSB operation and Y3 for tune or CW transmit operation.

When the Mode switch is in the CW position, B+ is connected through part of relay RL2 to either V16A (for receive) or V16B (for transmit).

For receiving CW signals, lugs 9 and 1 of relay RL2 place tube V16A and crystal Y1 in operation. For transmitting CW, lugs 9 and 5 of relay RL2 place tube V16B and crystal Y3 in operation.

When receiving a 1000 Hz CW signal, the receiver is tuned 1 kHz below the incoming signal (this signal is zero beat against your transmitting frequency) by V16A and crystal Y1, which are used as a VFO (beat frequency oscillator). This generates a 1000 Hz audible signal. When transmitting, tube V16B and crystal Y3 cause the output signal of the Transceiver to be at the same frequency as the incoming signal from the other station.

BALANCED MODULATOR (Figure 2-8)

Diodes CR1, CR2, CR3, and CR4, are connected in a ring type balanced modulator circuit. When the audio signal from cathode follower V1B and the RF signal from carrier oscillator V16 are applied to this balanced modulator, two additional frequencies are produced: one is equal to the sum of the audio and carrier frequencies; and the other is equal to the difference between them. These sum and difference frequencies are the upper and lower sidebands; and only these upper and lower sideband signals appear at the output of the balanced modulator circuit.

The 3393.6 kHz LSB carrier oscillator signal is applied through capacitor C16 and across a bridge circuit that consists of the Carrier Null control, resistors R15 and R17, and diodes CR1, CR2, CR3, and CR4 of the modulator diode ring. The carrier signal is balanced out by the Carrier Null control and the Carrier Null capacitor; so there is no output signal from this circuit (until audio signal is applied).

The audio signal that is coupled to diodes CR1, CR2, CR3, and CR4 from cathode follower V1B unbalances the modulator at an audio rate, causing the sum and difference sideband frequencies to appear at the output of balanced modulator transformer T1. When no audio signal appears at the input, there is no output signal from the balanced modulator circuit. Capacitor C15 is an RF bypass.

When the Mode switch is turned to the CW or Tune position, wafer 2F connects one side of the diode ring to ground. This ground connection unbalances the nulled circuit and the unbalance causes an RF output signal to be produced at the secondary of balanced modulator transformer T1. This signal is then coupled through capacitor C22 to isolation amplifier V2. The secondary of transformer T1 is tuned to the CW carrier frequency.

ISOLATION AMPLIFIER (Figure 2-9)

Both the sideband and CW signals from the balanced modulator circuit are coupled through capacitor C22 to the cathode of isolation amplifier V2, which operates as a grounded grid amplifier. V2 isolates the balanced modulator circuit from the crystal filter, and provides proper impedance matching to the crystal filter. The gain of isolation amplifier V2 is varied by the ALC (automatic level control) voltage, or bias voltage from the Mic/CW Level control, connected to its grid circuit through resistors R21 and R22. The complete ALC circuit will be described later under the heading "ALC Circuit."

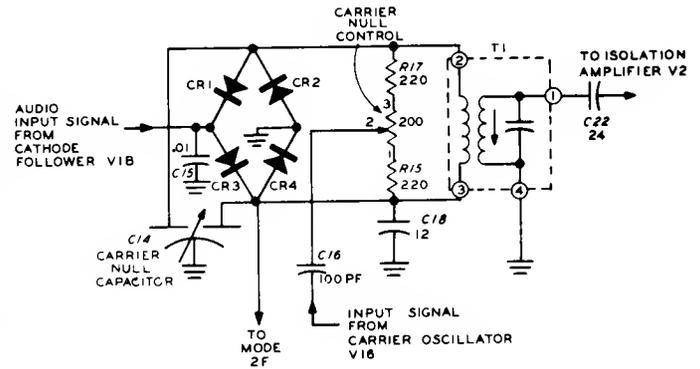


Figure 2-8

When transmitting, the output of V2 is coupled through capacitor C506 to the crystal filter. In the CW mode of operation, the gain of V2 is controlled by the CW section of the Mic/CW Level control. This control supplies a variable negative bias to the grid of V2 through wafer 1R of the Mode switch and resistors R22 and R21.

B+ is supplied to the screen of V2 in the transmit mode only, through resistor R937 and contacts 7 and 11 of relay RL2.

CRYSTAL FILTER (Figure 2-10)

Crystal filter FL1 has a center frequency of 3395 kHz and a usable bandwidth of 2.1 kHz (3393.95 kHz to 3396.05 kHz at the 6 dB points). See Figure 2-10. This filter, in the LSB mode of operation, passes only the sum frequencies (the 3393.6 kHz carrier frequency plus all the audio frequencies from 350 to 2450 Hz), which contain the upper sideband

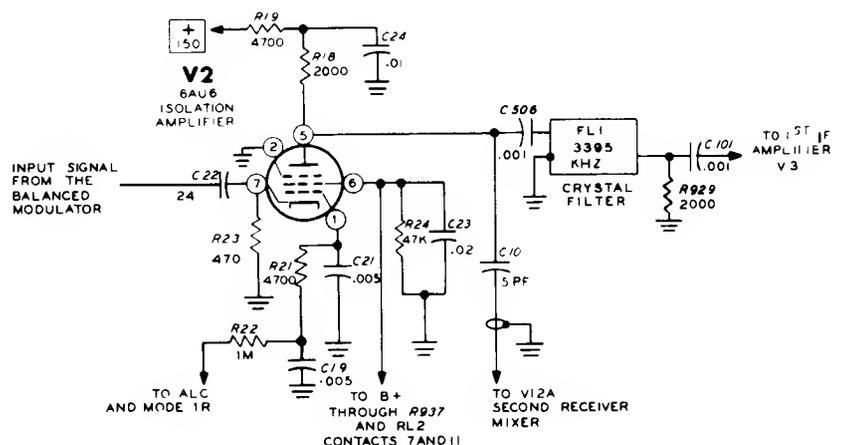


Figure 2-9

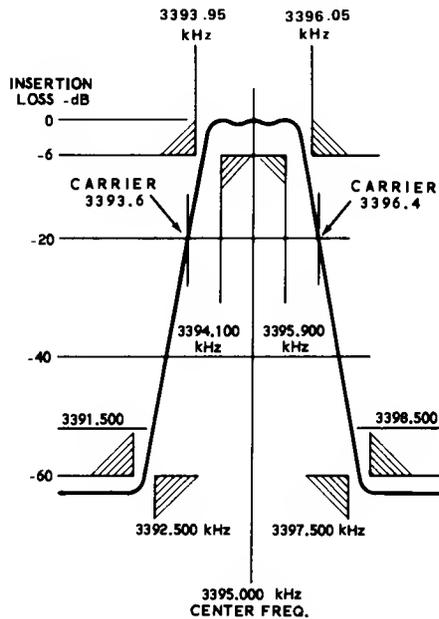


Figure 2-10

intelligence. The carrier amplitude itself is further reduced 20 dB by the crystal filter. This attenuation plus the attenuation of the balanced modulator gives an ultimate carrier attenuation of at least 50 dB. (The apparent frequency discrepancy here in sidebands and carrier is overcome later, when the sidebands are inverted in the second mixer.)

In the USB Mode, the filter passes only the difference frequencies (the 3396.4 kHz carrier oscillator frequency minus the audio frequencies from 450 to 2550 Hz); this contains the lower sideband intelligence. In the CW Mode, a

carrier of 3395.4 kHz passes through the crystal filter with virtually no attenuation.

If the SBA-301-2 Accessory CW Crystal Filter is installed, the signal passes through it when the Filter switch is in CW. The 400 Hz bandpass of the CW Filter will not pass the normal audio range, so SSB signals are unintelligible.

IF AMPLIFIER (Figure 2-11)

IF amplifier V3 amplifies the signal received from crystal filter FL1. The second IF amplifier, V4, is not used in transmit operation. IF transformer T102, which is tuned to 3.395 MHz, acts as the plate load for V3. The output signal from V3 is then coupled through capacitor C111 to the grid of first transmitter mixer stage V5A. The 6.8 MHz trap is used to remove the second harmonic of the 3.395 MHz signal.

ALC voltage is applied through lugs 8 and 12 of relay RL2 to the grid circuit of V3 to provide automatic level control for the transmitted signal. When the Mode switch is in the CW and Tune positions, the gain of IF amplifier V3 is controlled by a variable dc bias applied to its grid. This bias voltage, which originates at the arm of the Mic/CW Level control, is coupled to V3 through wafer 1R of the Mode switch, and through lugs 8 and 12 of relay RL2.

The front panel meter, in the ALC position, is connected in a dc bridge between the screen and cathode circuits of V3. The metering circuits are explained separately on Page 180 of this Circuit Description.

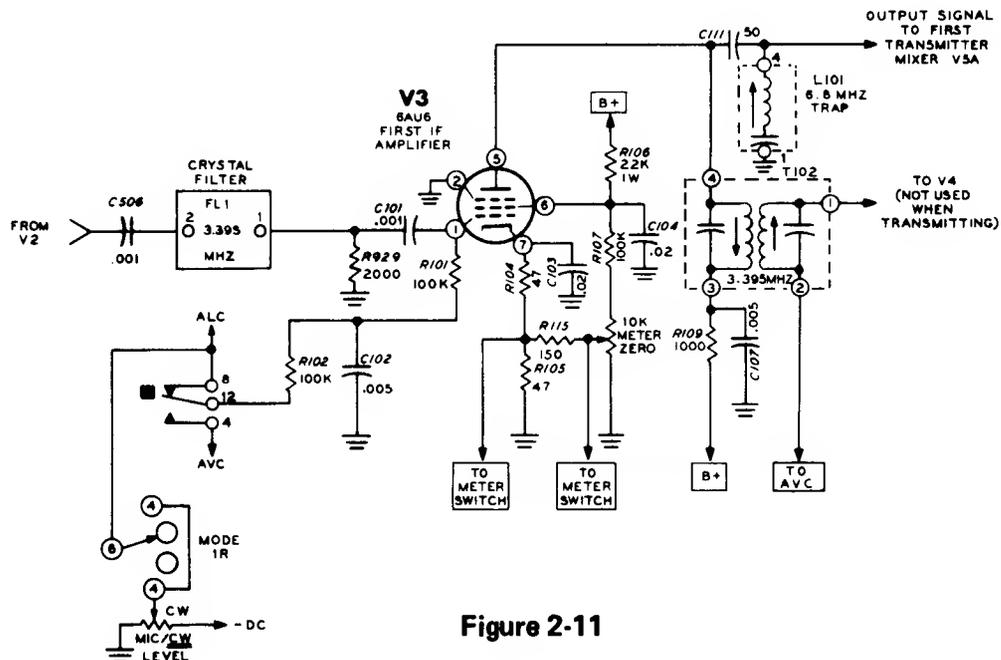


Figure 2-11

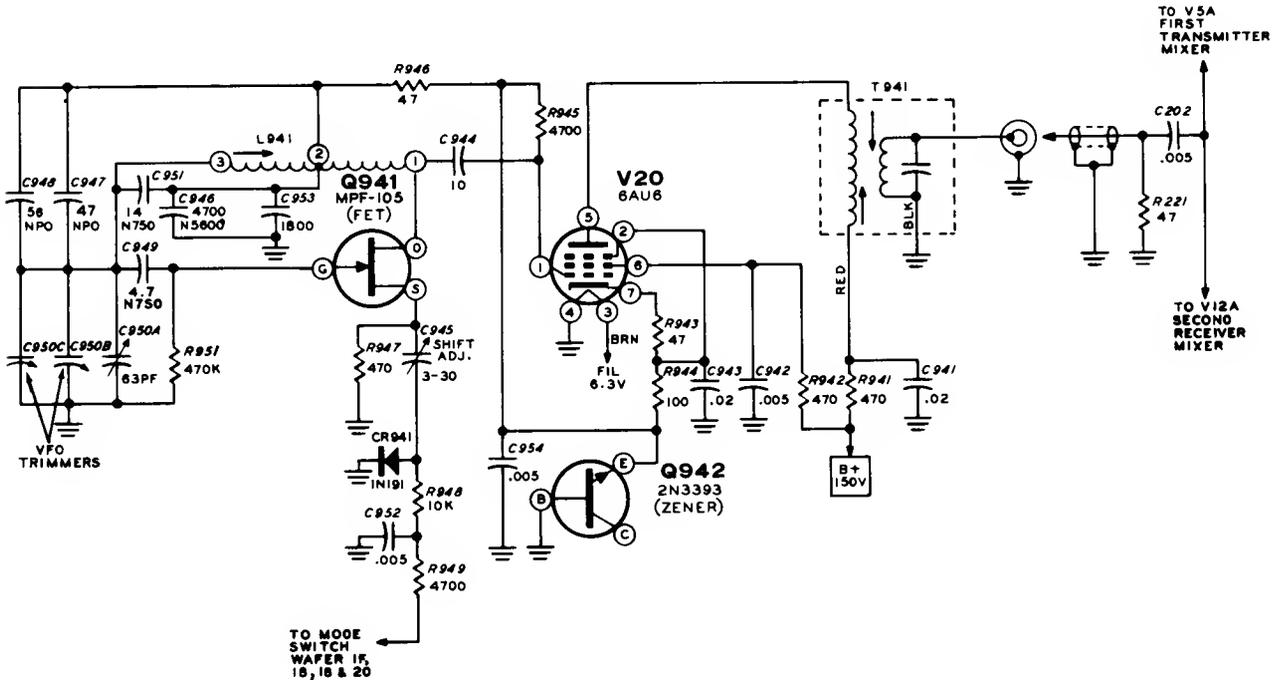


Figure 2-12

VFO (Figure 2-12)

A field effect transistor is used in a type of Hartley oscillator circuit in the VFO. Part of coil L941, variable capacitor C950A (the main tuning capacitor), and fixed temperature compensating capacitors are used in the frequency determining circuits. The remaining part of coil L941 is used for feedback to maintain oscillation.

Diode CR941 acts as a switch to add or remove C945 from the circuit. This capacitor shifts the VFO frequency so the output carrier-frequency remains the same when you switch sidebands. CR941 is switched by the polarity of the voltage applied to its anode by contacts 16, 18, and 20 of Mode switch wafer 1F.

Capacitor C944 couples the signal to the grid of tube V20, which amplifies the VFO signal and couples it through T941 to the cathode of mixer tube V5A.

The transistor in the cathode circuit of V20 acts as a Zener diode, using the base to emitter junction only.

FIRST TRANSMITTER MIXER (Figure 2-13)

The 3.395 MHz IF signal at the grid, and the 5.105 MHz VFO signal at the cathode, are mixed in first transmitter mixer tube V5A to produce sum and difference frequencies. The 8.5 MHz sum of these two signals is coupled from the plate of V5A through bandpass filter T202 to second transmitter mixer V6.

The Bandpass filter T202 is tuned to pass only those signal frequencies between 8.395 and 8.895 MHz; all other frequencies are attenuated. Only the 8.5 MHz sum of the IF and VFO signals falls within this frequency range, so it only is passed on to the second mixer.

First transmitter mixer V5A, second transmitter mixer V6, and driver V7 are cut off during the receive mode of operation by a negative voltage that is applied to their grids through diode D301 and resistor R301. This negative voltage is removed for the transmit mode by contacts 6 and 10 of relay RL2, which cause the cathode side of diode D301 to be grounded.

HETERODYNE OSCILLATOR AND CATHODE FOLLOWER (Figure 2-14)

Heterodyne oscillator V19A operates as a tuned-plate crystal oscillator. The proper plate coil for each band, L601 through L608, is selected by wafer 2F on the Band switch. The output signal from the plate of the oscillator is coupled through cathode follower V19B to the cathode of second transmitter mixer V6 and to the cathode of first receiver mixer V11. The correct oscillator crystal for each band is selected by wafer 1R of the Bandswitch. The crystals below 20 MHz are fundamental types, and the higher frequency crystals operate on their third overtones.

The grid voltage of V19A can be metered at TP to check oscillator activity.

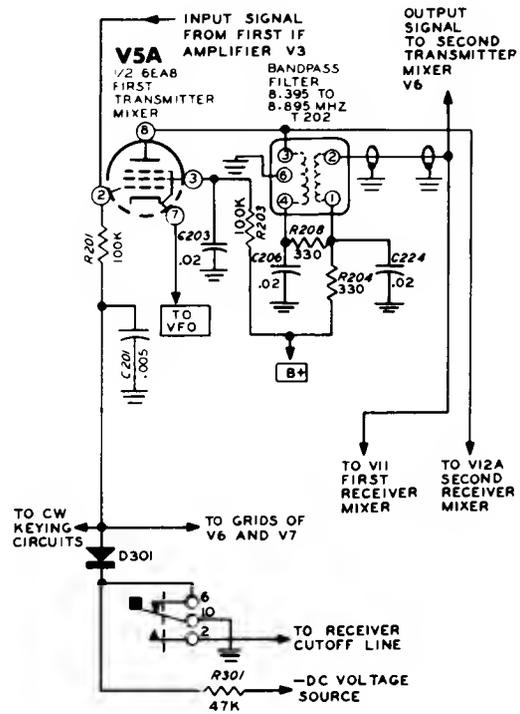


Figure 2-13

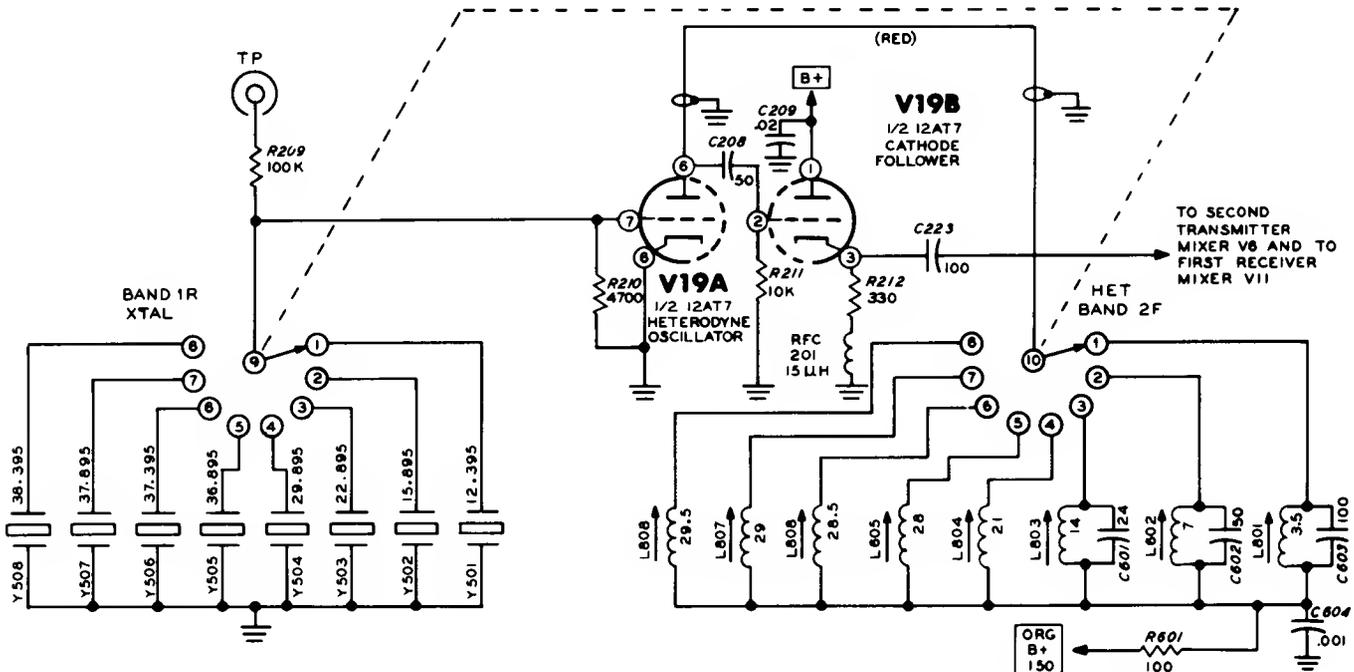


Figure 2-14

SECOND TRANSMITTER MIXER (Figure 2-15)

The 8.5 MHz signal from the first transmitter mixer and bandpass filter is coupled to the grid of second mixer tube V6. The 12.395 MHz output from the heterodyne oscillator is coupled to the cathode of V6. These signals are mixed in V6 to produce the operating frequency of 3.895 MHz.

The frequency of the tuned plate circuit of second mixer, V6, is the operating frequency. All other frequencies are attenuated.

The difference between the 8.5 MHz input frequency and the 12.395 MHz heterodyne oscillator frequency results in a second mixer output frequency of 3.895 MHz. This output signal is coupled to the grid of driver stage V7.

The 3.5 MHz plate tuning coil, L701, is connected across the plate tuned circuit on all bands. Band switch wafer 3F connects the correct amount of inductance in parallel with L701 to tune each band, except the 3.5 MHz (80 meter) band, which uses coil L701 only.

Tuning capacitor, C421B, is connected across the tuned circuit on all bands. Band switch wafer 3R connects tuning capacitor C421A on the 3.5 MHz band only, C703 on 3.5 and 7.0 MHz bands, and C704 on 14 MHz and lower frequencies.

DRIVER (Figure 2-16)

Driver stage V7 amplifies the 3.895 MHz signal from second transmitter mixer V6 to a level that is sufficient to drive the final amplifiers.

The 3.5 MHz plate tuning coil, L801, is connected across the plate tuned circuit on all bands. A secondary (link) winding on L801 is used in the receive mode of operation to couple the received signal into the Transceiver.

Band switch wafer 4F connects the correct amount of inductance in parallel with L801 to tune each band, except the 3.5 MHz (80 meter) band, which uses coil L801 only. Band switch wafer 4R connects additional capacitance in parallel with tuning capacitor C422B for the 80 meter (3.5 MHz), 40 meter (7 MHz), and 20 meter (14 MHz) bands.

Neutralization of V7 is accomplished by feeding a portion of the plate signal back to the grid through a "neutralizing wire" capacitor to the plate tuned circuit of the second transmitter mixer.

FINAL AMPLIFIERS (Figure 2-17, fold-out from Page 173)

Final amplifier tubes, V8 and V9, are connected in parallel and function as class AB1 linear amplifiers. A fixed negative

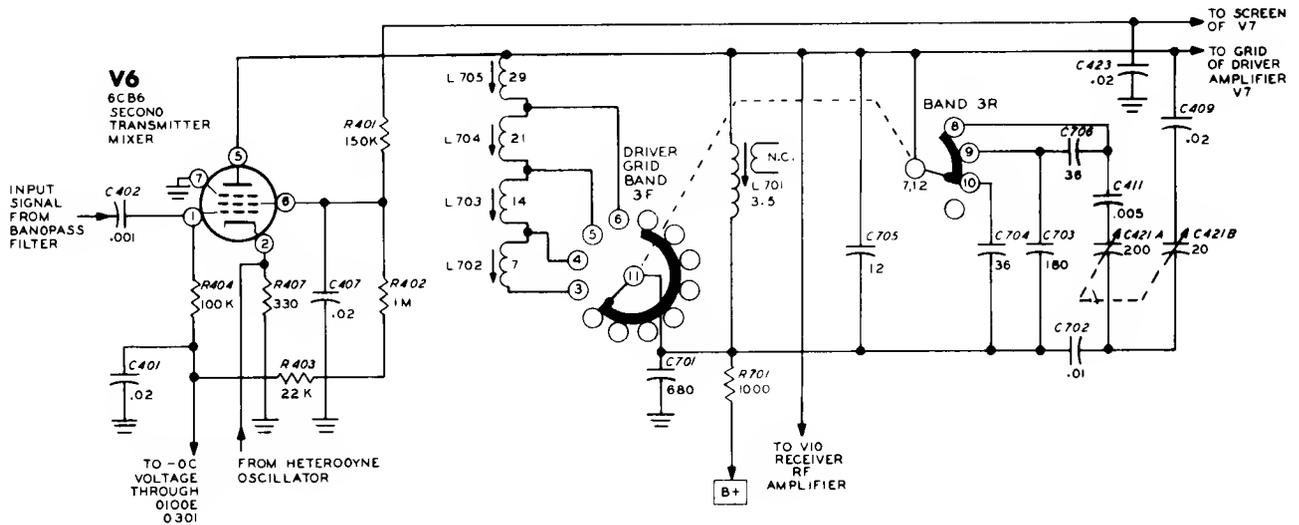


Figure 2-15

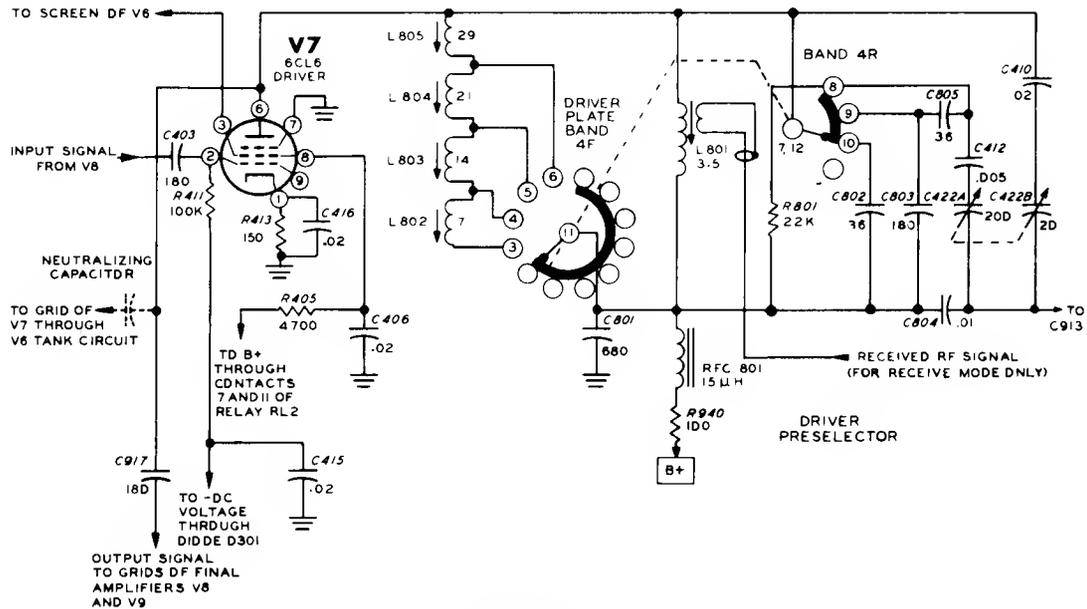


Figure 2-16

bias is applied to the grids of these tubes through resistor R916 and choke RFC 902. This bias limits zero-signal plate current. B+ is removed from the screen grids under receive conditions, by lugs 7 and 11 of relay RL2 to reduce the plate current to zero and cut off the tubes. RF driving voltage is developed across RFC 902. Plate voltage is shunt fed through RFC 901.

For the LSB and USB modes of operation, the driving voltage is controlled by the Microphone level control (in the grid circuit of V1B) and the limiting action of the ALC (automatic level control) voltage. This ALC voltage is fed back to isolation amplifier V2 and IF amplifier V3.

The output signal from V8 and V9 is coupled through RF parasitic chokes L901 and L902 and through capacitor C915 to the final tuning capacitor C925 and plate tank coils L903 and L904. The Parasitic chokes eliminate any tendency toward VHF parasitic oscillation.

Wafer 5R of the Band switch connects the proper portion of the plate tank coil in the circuit for each band by shorting out the unused section. Wafer 5R also selects the proper combination of final tank tuning and loading capacitors for each band.

Neutralization of the final amplifier is accomplished by feeding a portion of the plate signal back to the grid through neutralizing capacitors C913 and C914, and across C801 in a bridge circuit.

The output signal from the final tank coil is coupled through lugs 8 and 12 of relay RL1 to the Antenna socket.

D901 and R953 aid in providing quick return of the receiving function after release of the key or the microphone switch when the Function Switch is at PTT.

ALC CIRCUIT (Figure 2-17, fold-out from Page 173)

The ALC (automatic level control) bias voltage is developed from a small portion of the signal in the final amplifier stage. This signal is rectified, filtered, and fed back to the preceding stages to adjust their gain automatically, as needed. ALC voltage assures maximum transmitter output without overloading.

The ALC voltage for this Transceiver is developed in the Heath TALC* (Triple Action Level Control) circuit. This circuit keeps the transmitter from overloading by compressing the speech waveform. The triple action of this circuit is described below in paragraphs 1, 2, and 3.

1. Any peak voltages at the grids of final tubes V8 and V9 that drive the grids positive into grid current will develop bursts of voltage across resistor R916. This forms an audio-frequency voltage that is coupled through capacitor C911 to voltage doubler rectifiers D902 and D903. The rectified negative output voltage goes to the ALC line.

2. The variations that occur in the final amplifier screen supply voltage on speech peaks produce a varying voltage which is coupled through capacitor C908 to rectifiers D902 and D903. This second voltage source produces additional ALC voltage.
3. Additional ALC voltage can be obtained from an external linear power amplifier. This voltage is applied to the ALC Input and goes directly to an RC network, which is explained below.

The rectified voltage from diode D903 (and the voltage from an external amplifier, if used) is applied to an RC network consisting of resistors R914 and R915, and capacitors C931 and C932. This network filters the dc bias voltage, and allows it to build up quickly and decay slowly.

From the RC filter network, the ALC voltage is applied to the grid of isolation amplifier V2, where it limits the output, thus, reducing the drive available to the final amplifiers. The ALC voltage is also coupled through lugs 8 and 12 of relay RL2 to IF amplifier V3.

ALC voltage is not developed for CW operation. Adjustable bias from the Mic/CW Level control is used instead.

TONE OSCILLATOR AND AMPLIFIER (Figure 2-18)

The tone oscillator circuit, V15, generates a 1000 Hz audio signal that is used for CW operation only. This tone is inserted into the VOX circuit to turn on the transmitter. It is also coupled to the receiver audio amplifier so the operator can monitor his keying.

Tone oscillator V15A is turned on when its cathode is connected to ground through wafer 2F of the Mode switch. The output frequency of V15A is determined by the phase-shift network in its grid circuit. From the plate of V15A, the 1000 Hz tone is coupled through capacitor C315 and resistor R329 to the grid of tone amplifier V15B.

Tone amplifier V15B is normally cut off by a negative bias that is applied to its grid from the junction of resistors R311 and R312. When the CW key is closed, this cut-off bias is removed (resistor R311 is shorted out through Mode switch wafer 1F and the key), and V15B conducts.

From the plate of V15B, the 1000 Hz tone is coupled through capacitor C311 to audio amplifier V14B. The 1000 Hz tone is also coupled through capacitor C313 and resistor R328 to the grid of VOX amplifier V17A, where it causes the transmitter to be turned on.

CW OPERATION (Full Schematic)

When the Mode switch is turned to the CW position, the following circuit changes occur:

1. Cathode follower V1B is cut off and the arm of VOX Sensitivity control is grounded so stray microphone signals do not reach the balanced modulator or VOX circuits.
2. CW crystal Y3 is connected to the grid of carrier oscillator V16B.
3. The balanced modulator circuit is unbalanced so it will produce an output signal (see Mode switch wafer 2F).

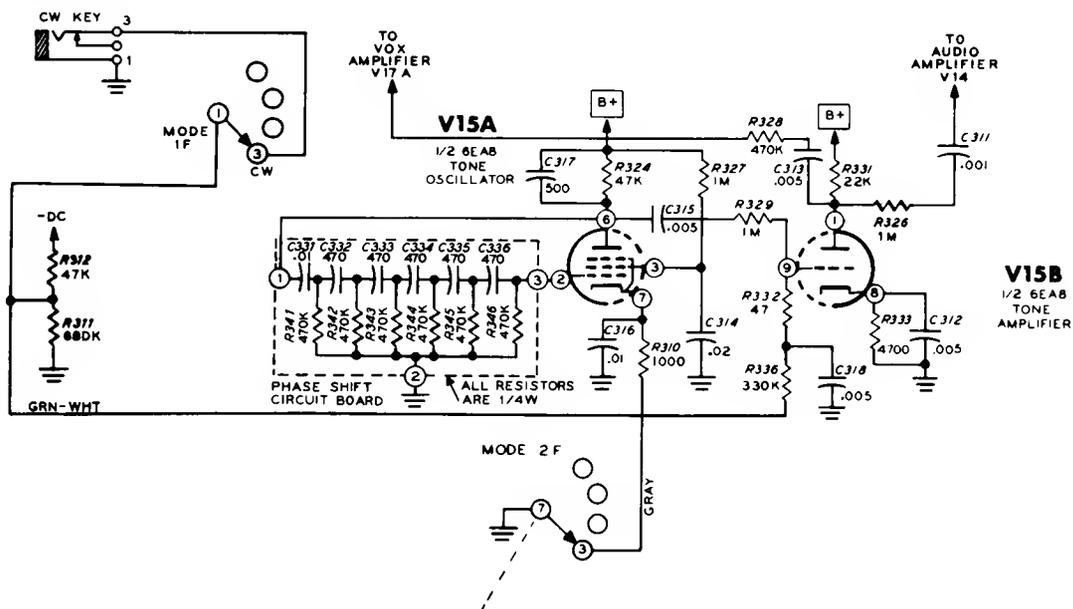


Figure 2-18

4. The transmitter CW signal passes through the SSB Filter.
5. The drive to the final amplifiers is controlled by the CW section of the MIC/CW Level control, which adjusts the bias of isolation amplifier V2 and IF amplifier V3.
6. Cutoff bias is applied to the grids of transmitter mixers V5A and V6, and to the grid of driver amplifier V7, through Mode switch wafer 1F and diode D904.
7. Tone oscillator V15A is turned on.

When the key is closed, the 1000 Hz tone signal is coupled to the VOX circuit, where it causes the relays to be switched to the transmit position.

The relays stay in this position for a length of time that is determined by the setting of the VOX Delay control.

At the same time, the key shorts out the cutoff bias that is applied to the transmitter mixer stages and to the driver amplifier stage, allowing them to conduct and place the transmitter on the air.

The RF output signal from CW carrier oscillator V16B is coupled to the balanced modulator stage. The unbalanced condition of this stage causes the RF signal to be coupled through transformer T1 to isolation amplifier V2. From V2, the signal proceeds through the transmitter in the same manner as the LSB and USB signals.

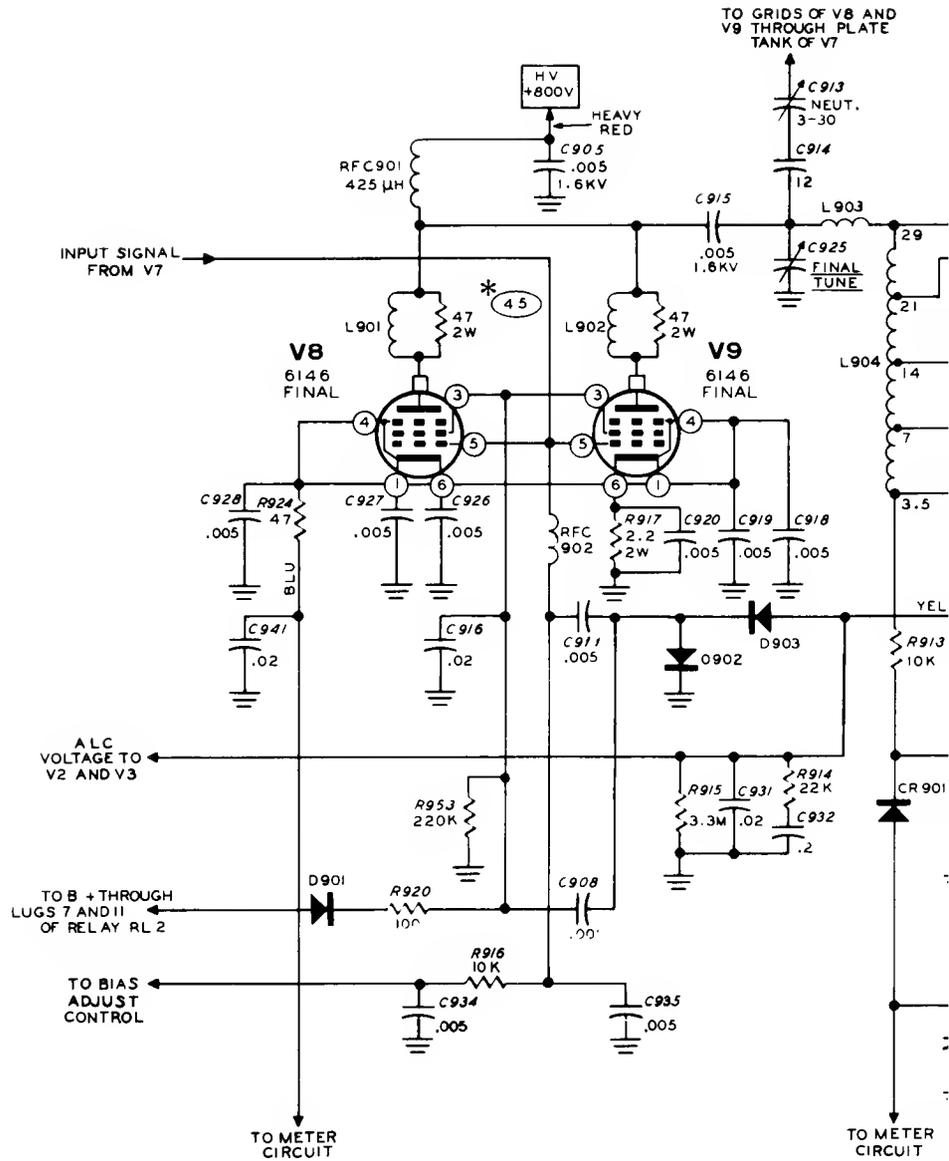


FIGURE 2-17

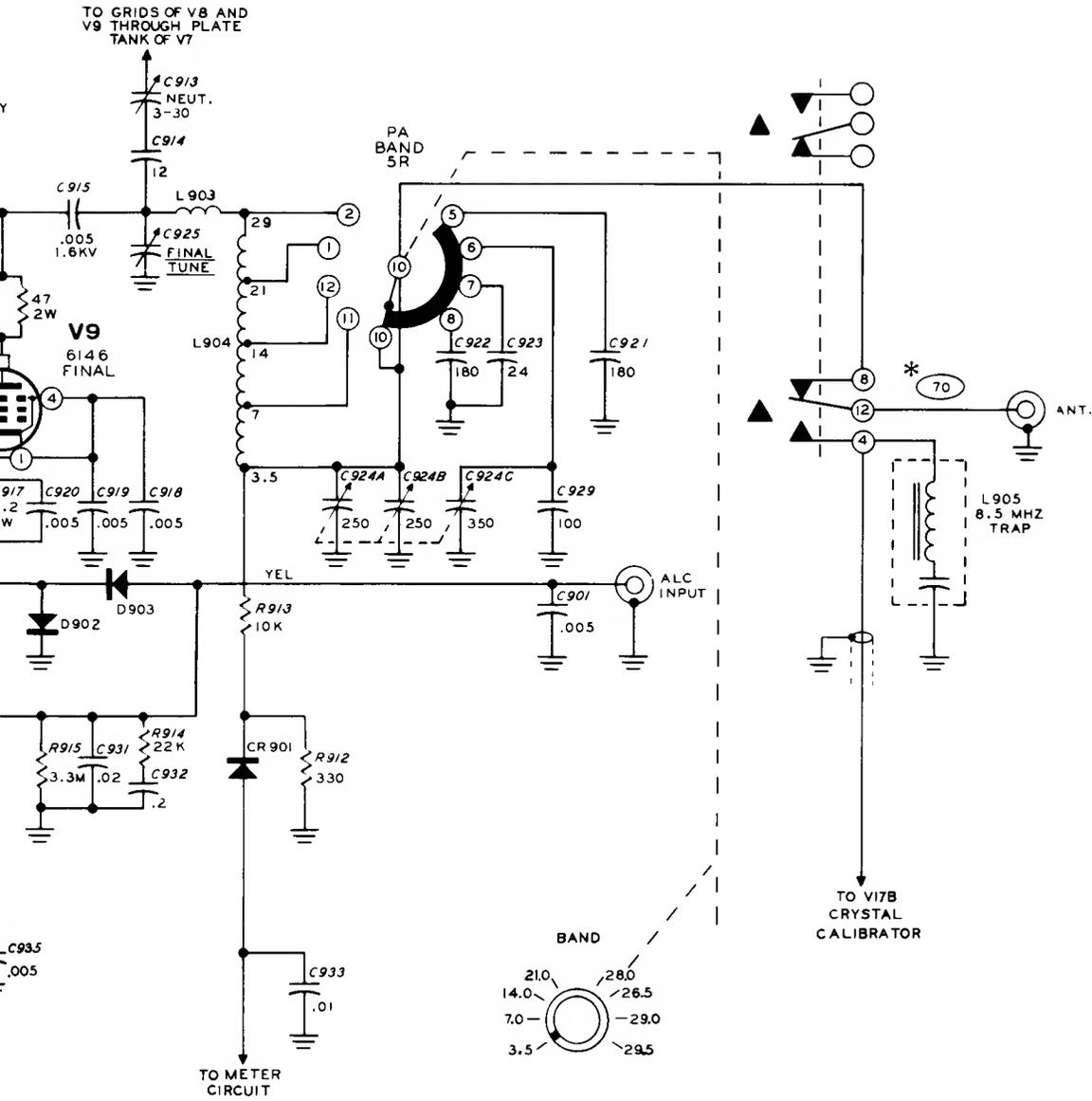


FIGURE 2-17

T-R SWITCHING

Figure 2-19 (fold-out from this page) shows the position and assigns an identifying number to each of the relay sections on the Main Schematic. The numbers will be used in the following paragraphs to explain how each section is used.

1. This section applies B+ voltage to the correct half of carrier oscillator tube V16 in the Tune and CW positions of the Mode switch.
2. This section is connected to the Power and accessory plug for external use with linear amplifiers and other devices. The contacts have a rating of 3 amperes at 117 Vac or 30 Vdc.
3. These contacts apply B+ voltage to the screens of V2, V7, V8, and V9 in the transmit mode, and to the screen of V4, V10, and V11 in the receive mode of operation.
4. These contacts ground the receiver cutoff bias in the receive mode. In the transmit mode, they ground the cutoff bias that is applied through diode D301 to transmitter stages V5A, V6, and V7.
5. In the transmit mode, these contacts apply ALC voltage (or CW bias) to the grid of V3. In the receive mode they apply AVC voltage to V3.
6. This section switches the antenna between the receive and transmit circuits.

Refer to the Schematic diagram for the following portion of the Circuit Description.

When the Transceiver is in the transmit mode, a large negative bias (approximately -90 volts) is applied through the RF Gain control and diode D905 to the grids of RF amplifier V10 and first receiver mixer V11. Small amounts

of negative bias are also applied to second receiver mixer V12A, second IF amplifier V4, and audio amplifier V14A. The large bias is necessary at V10 to keep the transmitter signal at the driver plate from causing V10 to conduct on large voltage peaks. (If this happens, spikes will appear at the peaks of the envelope on the transmitted signal.)

First audio amplifier V14B is cut off by the bias voltage to quiet the receiver audio stages when LSB or USB signals are being transmitted. A negative pulse is also applied to the grid of V14A to cut it off before the relay contacts close. This is done so the switching transients, which cause a "popping" sound, will not be heard in the speaker.

The negative pulse that is applied to V14B is formed by the sudden voltage change that occurs at the plate of relay amplifier V12B when that stage is turned on by the VOX circuit. This pulse is shaped by a network that consists of resistors R337, R338, R339, and R340 and capacitors C320, C321, C322, and C323.

The plate tank circuit of V6, the second transmitter mixer, is used in the receive mode as the plate circuit of V10, RF amplifier. Due to tube and stray capacity differences, additional capacity is required when receiving to permit the driver preselector to peak at the same dial setting in both transmit and receive modes. Automatic diode switching is used to add the required compensating capacity:

1. A negative voltage is always applied through R302 and R954 to the anode of D907. This back bias cuts off the diode and causes it to act as an open switch. Therefore, capacitor C955 has no ground connection and is out of the circuit.
2. In the receive mode, a higher positive voltage through contacts 11 and 3 of RL2 is applied through R955 as forward bias to the anode of D907. The diode now conducts and acts as a closed switch to connect C955 to ground. This action increases the plate circuit capacity of V10, RF amplifier.

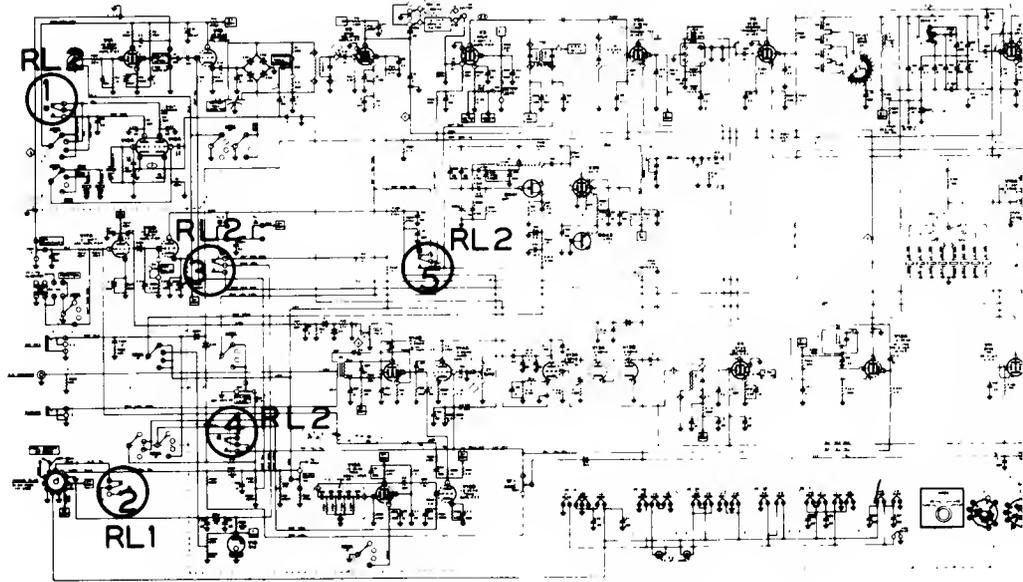


FIGURE 2-19

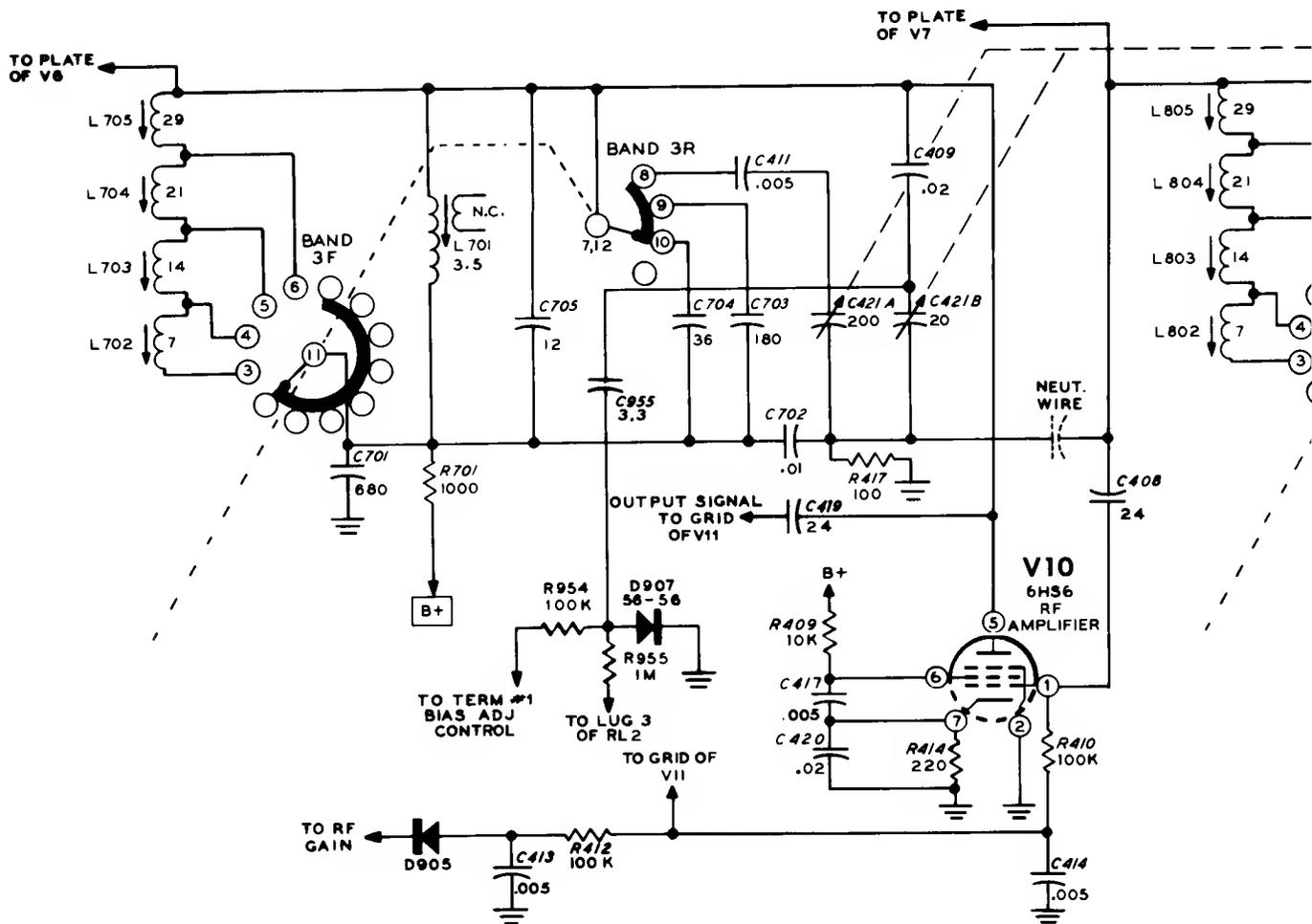


FIGURE 2-21

RECEIVER CIRCUITS

NOTE: Figure 2-20 shows the various frequencies that will be found throughout the Transceiver on the different bands. A received signal (lower sideband) frequency of 3.895 MHz, shown on the first line of the chart, will be used when tracing through the receiver circuits. The other associated frequencies used in this Description are also shown on the first line.

BAND	RECEIVED SIGNAL FREQUENCY	HETERODYNE OSCILLATOR FREQUENCY (CRYSTAL)	SIGNAL FREQUENCY AT BANDPASS FILTER (BETWEEN 8.395 AND 8.895)	2ND RECEIVER MIXER CRYSTAL FILTER AND IF FREQUENCIES	VFO FREQUENCY (BETWEEN 5 AND 5.5)
3.5 to 4	3.895	12.395	8.5	3.395	5.105
7 to 7.3	7.2	15.895	8.695	3.395	5.3
14 to 14.5	14.2	22.895	8.695	3.395	5.3
21 to 21.5	21.3	29.895	8.595	3.395	5.2
28 to 28.5	28.1	36.895	8.795	3.395	5.4
28.5 to 29	28.7	37.395	8.695	3.395	5.3
29 to 29.5	29.2	37.895	8.695	3.395	5.3
29.5 to 30	29.6	38.395	8.795	3.395	5.4

All frequencies in MHz.

Figure 2-20

RF AMPLIFIER (Figure 2-21, fold-out from Page 174)

The 3.895 MHz input signal from the antenna is coupled through lugs 4 and 12 of the antenna relay (RL1) to the link winding of coil L801. The secondary of L801, part of the driver preselector capacitor, and the other components in the driver plate tank circuit, are also used as the input tuned circuit for RF amplifier V10. From L801, the signal is coupled through capacitor C408 to the grid of V10.

The received signal is amplified in V10, and then coupled through capacitor C419 to first receiver mixer V11. The plate tuned circuit of V10 consists of coil L701, part of the

driver preselector capacitor, and the other components of the second transmitter mixer plate tank circuit. The automatic switching of C955 into the plate circuit of V10 is described under "T-R Switching."

The gain of RF amplifier V10 and first receiver mixer V11 is controlled by the AVC voltage, and an adjustable negative bias that is coupled to their grids from the RF Gain control.

The 8.5 MHz trap at the antenna switching relay helps to prevent entry of very strong signals (at this frequency) which might interfere with the IF circuits.

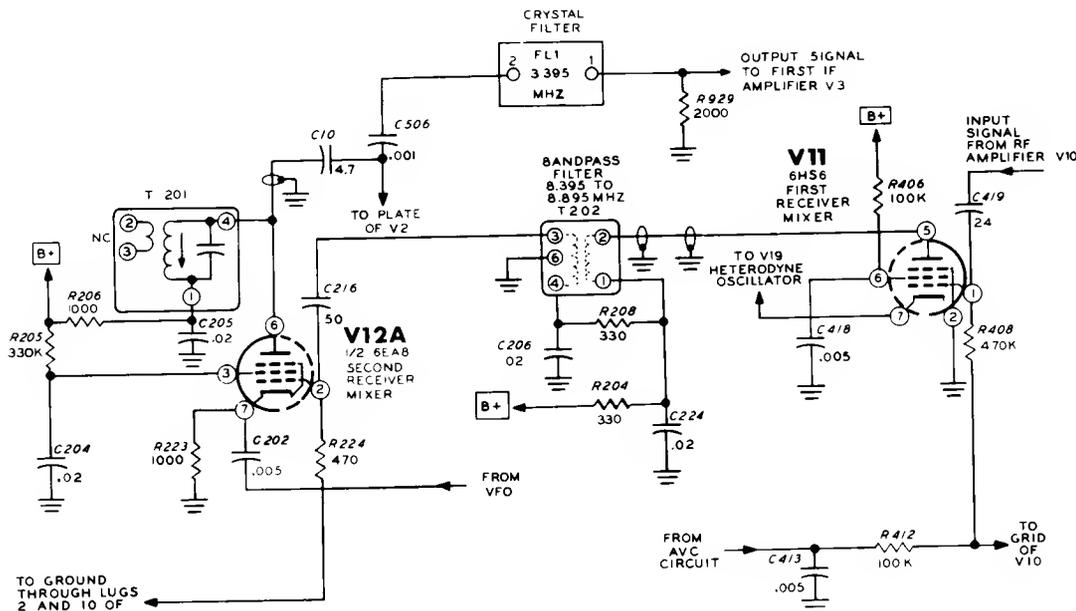


Figure 2-22

FIRST AND SECOND RECEIVER MIXERS (Figure 2-22)

The amplified 3.895 MHz signal from RF amplifier V10 is coupled through capacitor C419 to the grid of V11, the first receiver mixer. At the same time, a crystal controlled 12.395 MHz signal is coupled to the cathode of V11 from V19B, the heterodyne oscillator cathode follower. These two signals are then mixed together in V11 and the sum and difference frequencies are coupled to the bandpass filter.

The bandpass filter, which passes only the frequencies between 8.395 and 8.895 MHz, allows the 8.5 MHz difference frequency to pass on from V11 to the grid of second mixer tube V12A.

A 5.105 MHz signal is coupled from VFO to the cathode of V12A. The 8.5 MHz signal at the grid and the 5.105 MHz signal at the cathode are then mixed together in tube V12A and the 3.395 MHz difference frequency is coupled through crystal filter FL1 to the IF amplifiers.

IF AMPLIFIERS (Figure 2-23)

The signal from crystal filter FL1 is coupled through capacitor C101 to first IF amplifier V3. The amplified signal from V3 is coupled to two places: to grid of V5A, which is cut off in receive operation; and to second IF amplifier V4 through IF transformer T102.

The amplified signal from V4 is coupled through IF transformer T103 to the product detector, V13C. The same signal is also coupled through capacitor C112 to the plate of AVC rectifier V13B. Supply voltage for the screen of IF amplifier V4 is switched through lugs 3 and 11 of relay RL2.

AVC voltage is supplied to the grid of V4 by the AVC line. AVC voltage is switched to the grid of V3 through lugs 4 and 12 of relay RL2.

AVC CIRCUIT (Figure 2-24)

The negative bias at the control grids determines the amount of amplification that will be obtained from RF amplifier

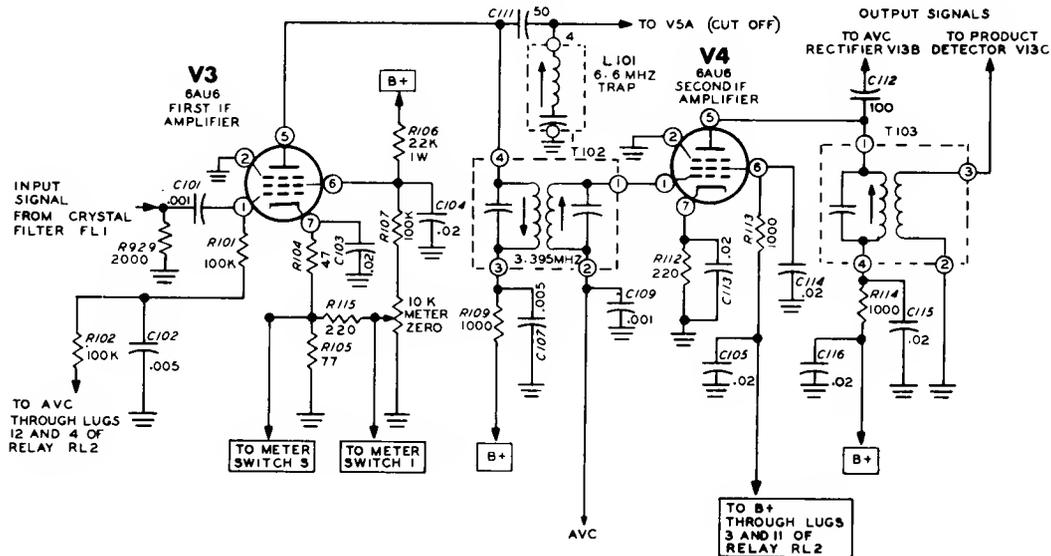


Figure 2-23

V10, first receiver mixer V11, and IF amplifiers V3 and V4. The dc bias for these stages comes from the following two sources: from the -dc voltage at the arm of the RF Gain control; and from the AVC voltage. These two voltage sources are connected to diodes D101 and D905, which act as a diode gate. This diode gate permits either voltage to control the gain (of V10, V11, etc.) without interacting with each other.

From the two diodes, the bias voltage is coupled through resistor R412 to the grids of V10 and V11, and through resistor R415 to the grids of V3 and V4. Voltage divider resistors R415 and R416 cause only one half of the total bias voltage to be coupled to the grids of IF amplifiers V3 and V4.

AVC voltage is obtained by coupling part of the IF signal through capacitor C112 to AVC diodes V13A and V13B. These diodes produce a negative dc voltage at pin 1 of V13A that is proportional to the signal strength. This negative voltage is developed across resistors R124 and R117, and capacitors C110 and C124. Capacitor C124 charges quickly to the peak voltage so the AVC will respond quickly to keep large signals from being distorted in V3, V4, V10, and V11. Capacitor C110 charges more slowly, and causes the AVC voltage to be proportional to the average signal level of the received signal. This produces a fast-attack, slow-release AVC characteristic.

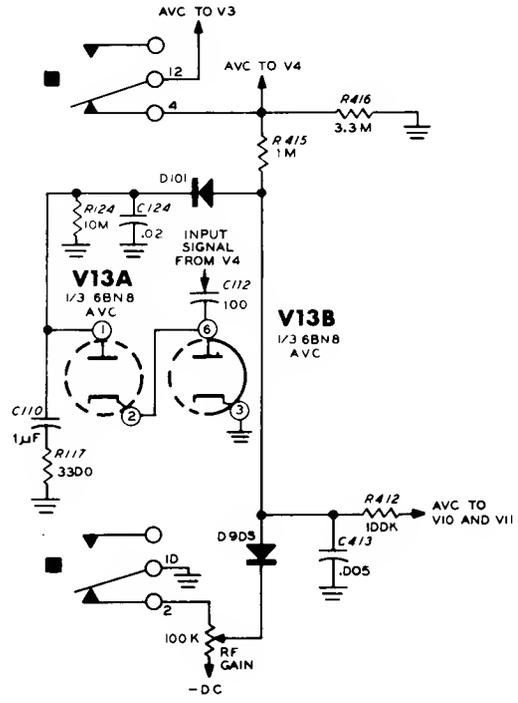


Figure 2-24

An incoming signal that produces a negative AVC voltage that is significantly higher than the bias voltage from the RF Gain control causes the gain of V10, V11, V3, and V4 to be reduced. This keeps the output of the RF and IF amplifier stages at a nearly constant level despite wide amplitude changes in the received signal.

PRODUCT DETECTOR (Figure 2-25)

The 3.395 MHz signal from IF amplifier V4 is coupled to the grid of product detector tube V13C. At the same time, the signal from carrier oscillator V16 is fed to the cathode of V13C (3.3936 MHz for the lower sideband, or 3.3964 MHz for the upper sideband and CW).

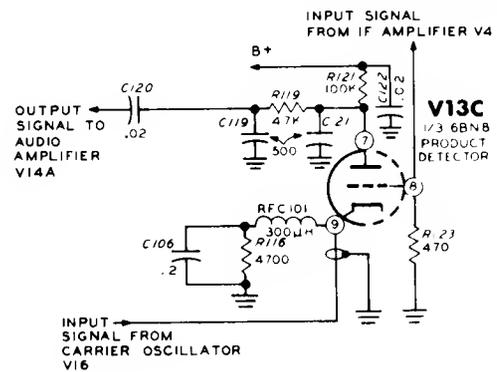


Figure 2-25

These two signals are then mixed together in V13C, resulting in an audio output signal which is the difference frequency between these two signals. Capacitors C119 and C121, and resistor R119 are connected in a filter network that bypasses any RF signal coming from V13C to ground, but permits the audio signal to pass through to audio amplifier V14A.

through output transformer T301 to the output connectors. Capacitor C912 couples a portion of the output back to the cathode of V14B as negative feedback for less distortion.

AUDIO AND POWER AMPLIFIER (Figure 2-26)

The signal from the product detector is applied to the grid of audio amplifier V14A. The audio signal is amplified in V14A and then coupled to power amplifier V14B. Tube V14B amplifies the signal further and supplies the audio power

Two outputs are provided by the secondary of transformer T301: a headphone output and an 8 Ω speaker output. Audio power to the 8 Ω speaker jack is rated at 2 watts maximum.

An audio signal is also supplied to the anti-trip network from the plate of V14B. In the CW mode, a sidetone signal is supplied to the network from the plate of V15B.

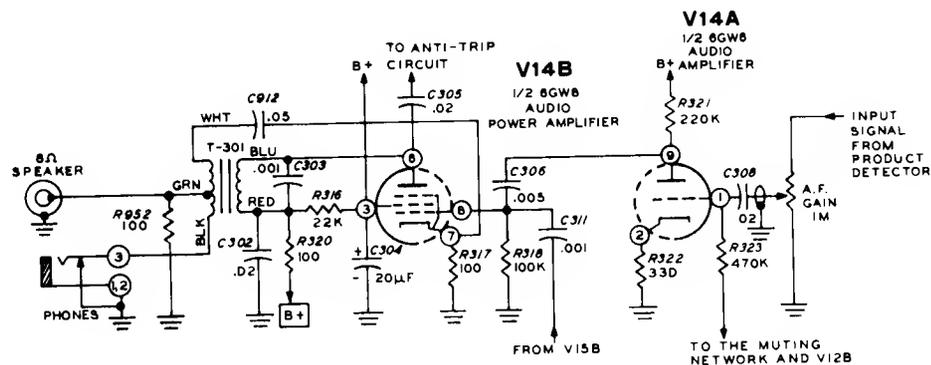


Figure 2-26

CRYSTAL CALIBRATOR (Figure 2-27)

Crystal calibrator stage V17B is connected as a Pierce crystal oscillator. When the Function switch is placed in the Calibrate position, the cathode of V17B is grounded, and an accurate 100 kHz signal is connected through capacitor C218 and diode CR201 to the antenna input of the receiver. The harmonics of this signal are then used for dial calibration checks.

Capacitor C220 may be adjusted to set the crystal calibrator to exactly 100 kHz using some standard such as WWV.

The Calibrate position of the Function switch also connects the grid of VOX amplifier V17A to ground to avoid accidental energizing of the transmitter when using the crystal calibrator.

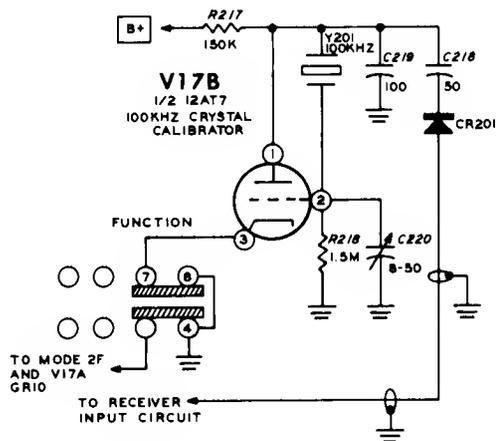


Figure 2-27

METERING CIRCUITS

Refer to Figure 2-28.

For the transmitting mode of operation, there are three different settings of the Meter switch: Plate (Final Power Amplifier cathode current), ALC voltage, and Relative Power output. In the ALC position, in the receive mode, the meter operates as an S Meter.

To measure power amplifier cathode current, the meter is connected between the cathodes of the finals and ground, in parallel with the cathode resistor. To read cathode current on the meter, consider that each of the figures on the meter scale (3, 6, 9, 20, 40, and 60) represents 50 mA of current. For example, if the meter needle is at the figure 9, it shows 150 mA of cathode current (three 50 mA units), and the full scale reading at 60 represents 300 mA of final cathode current (six 50 mA units).

To measure ALC voltage, the meter is connected between the cathode and screen circuits of IF amplifier V3. When V3 receives a signal, the resulting current fluctuations in the

cathode are indicated on the meter. Since the ALC voltage at the grid controls the gain of V3, the cathode current of V3 gives a relative indication of the ALC voltage level.

For Relative Power measurements, a small portion of the transmitter output signal is developed across resistor R912, rectified by diode CR901, and filtered by capacitor C933. The resulting dc voltage is then indicated by the meter.

When the Transceiver is in the receive condition, and the Meter switch is at ALC, the meter indicates the relative strength of the received signal in S units. The circuit operates just as it does when it measures ALC voltage, except that the current in V3 is now controlled by the AVC voltage at the grid of V3.

The meter Zero Adj control is adjusted for a zero indication on the meter with the antenna disconnected and RF Gain control at the full clockwise position. The decrease in plate current (due to a larger AVC voltage) that occurs when a signal is received by tube V3 then appears as an indication on the S Meter.

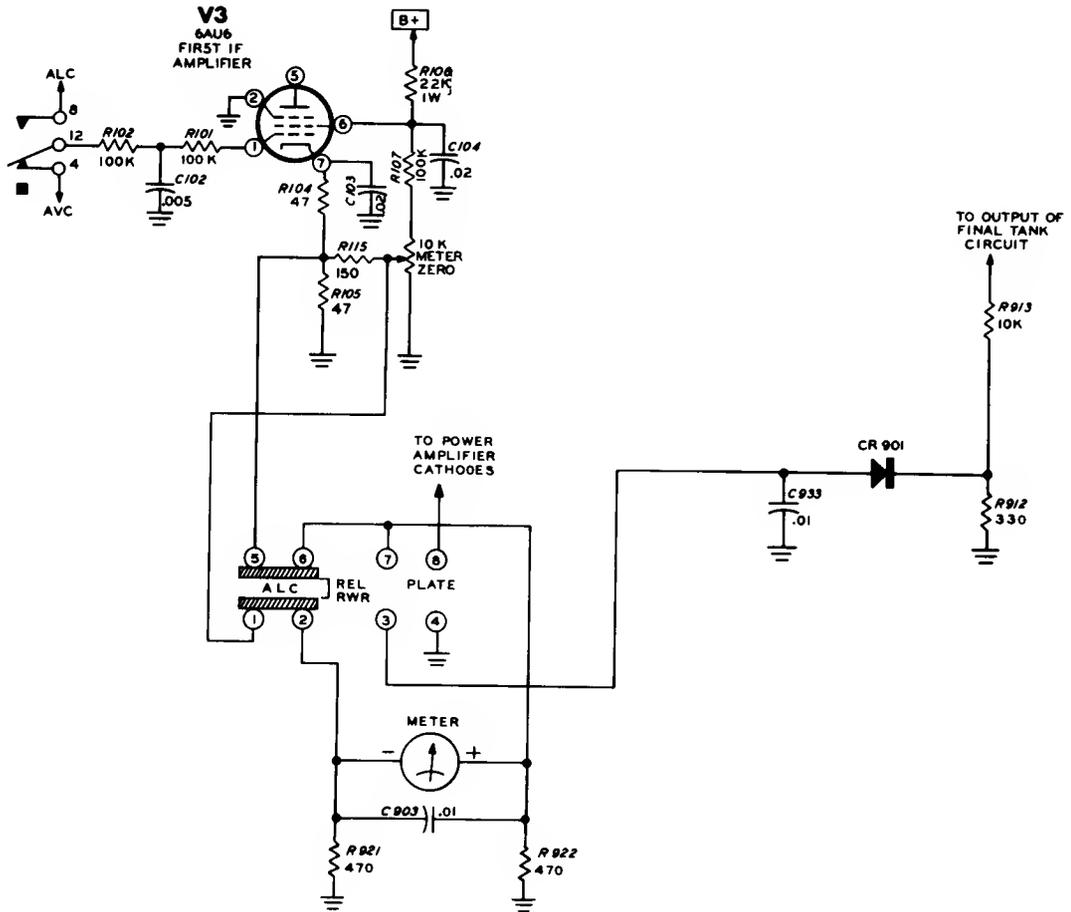
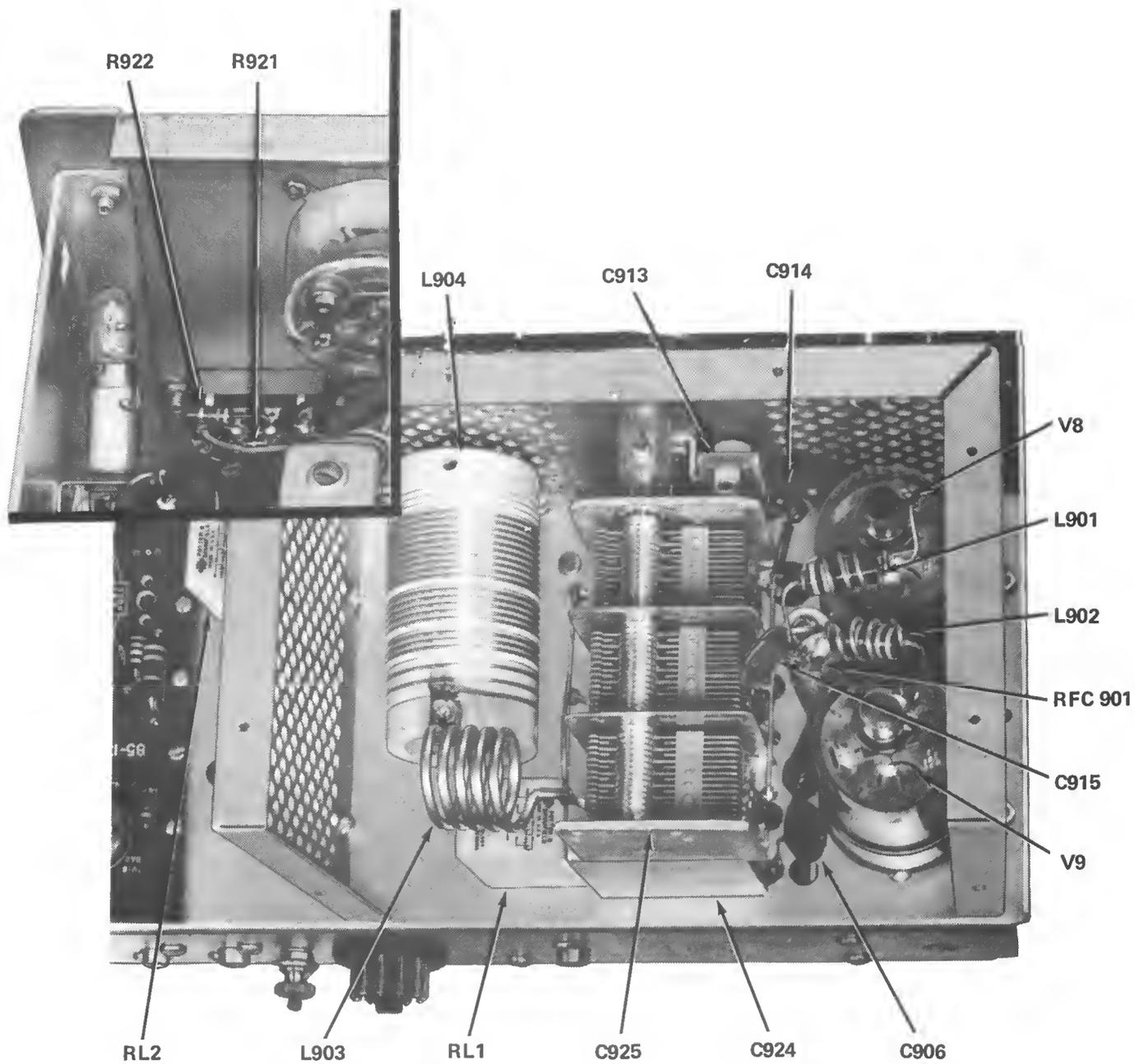
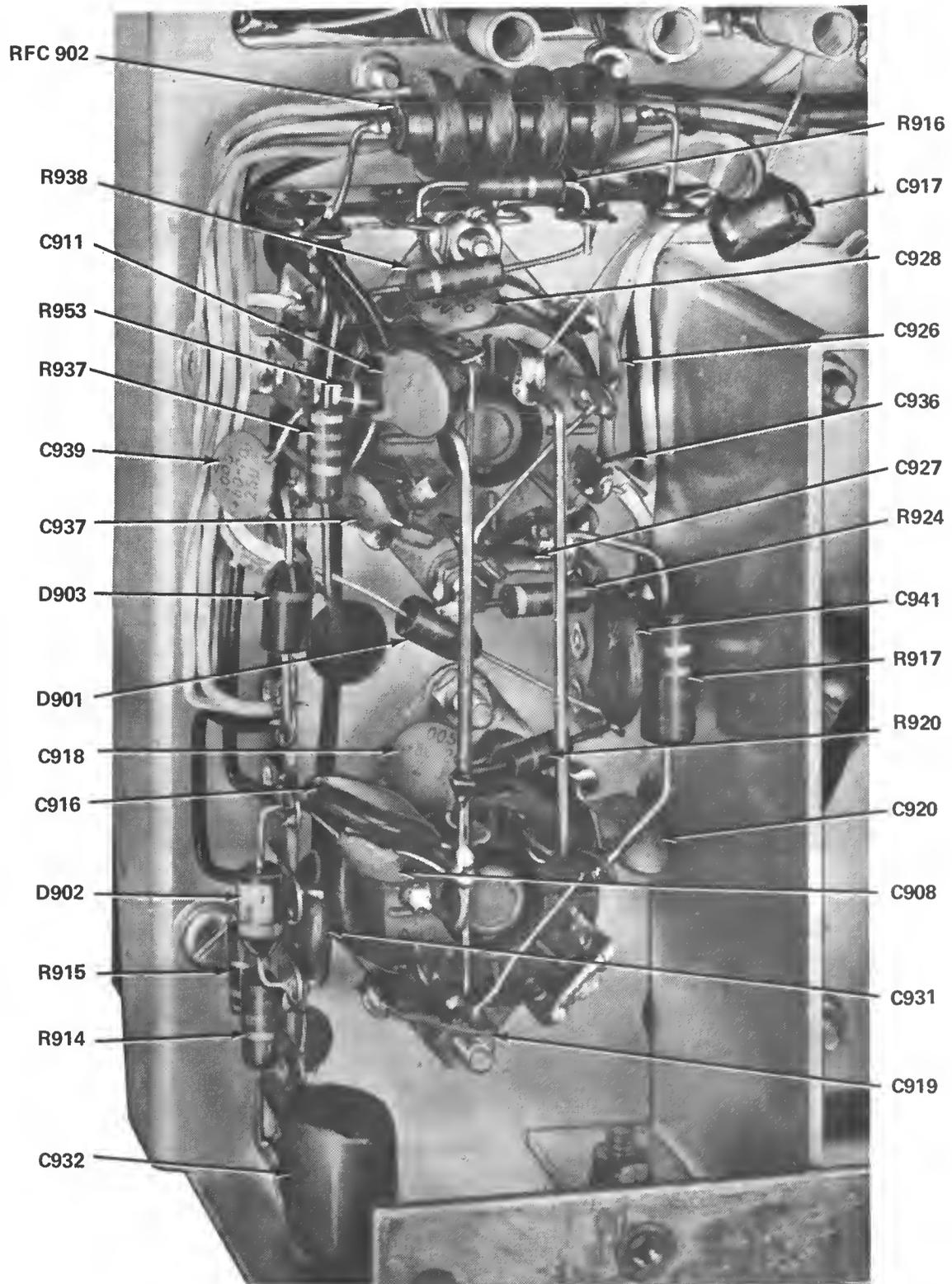
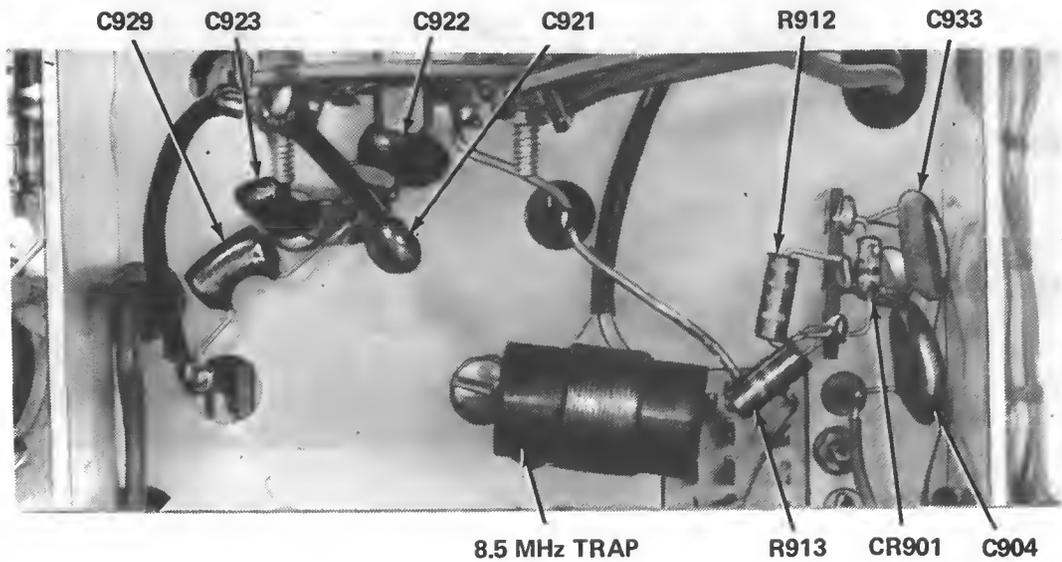
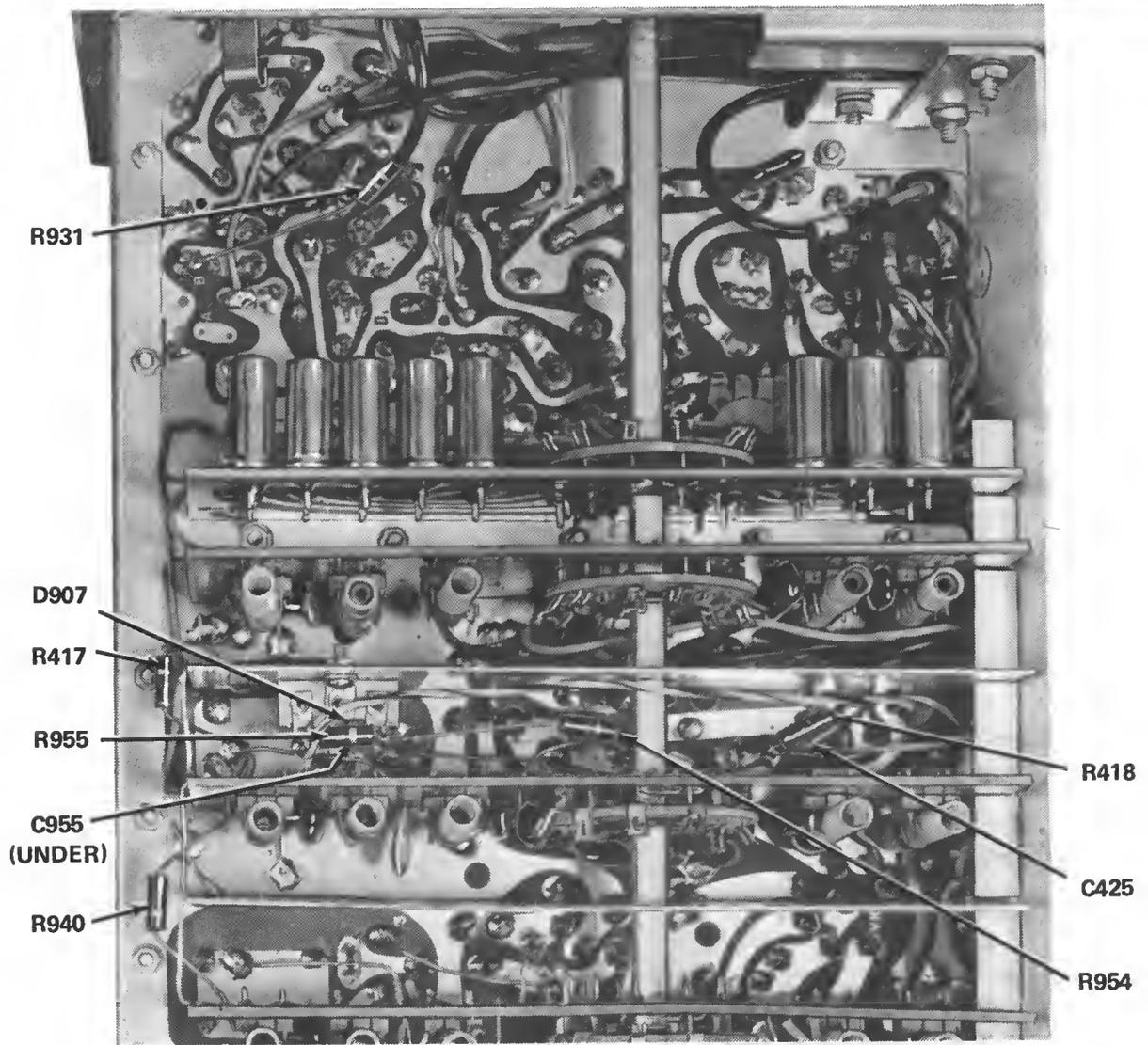


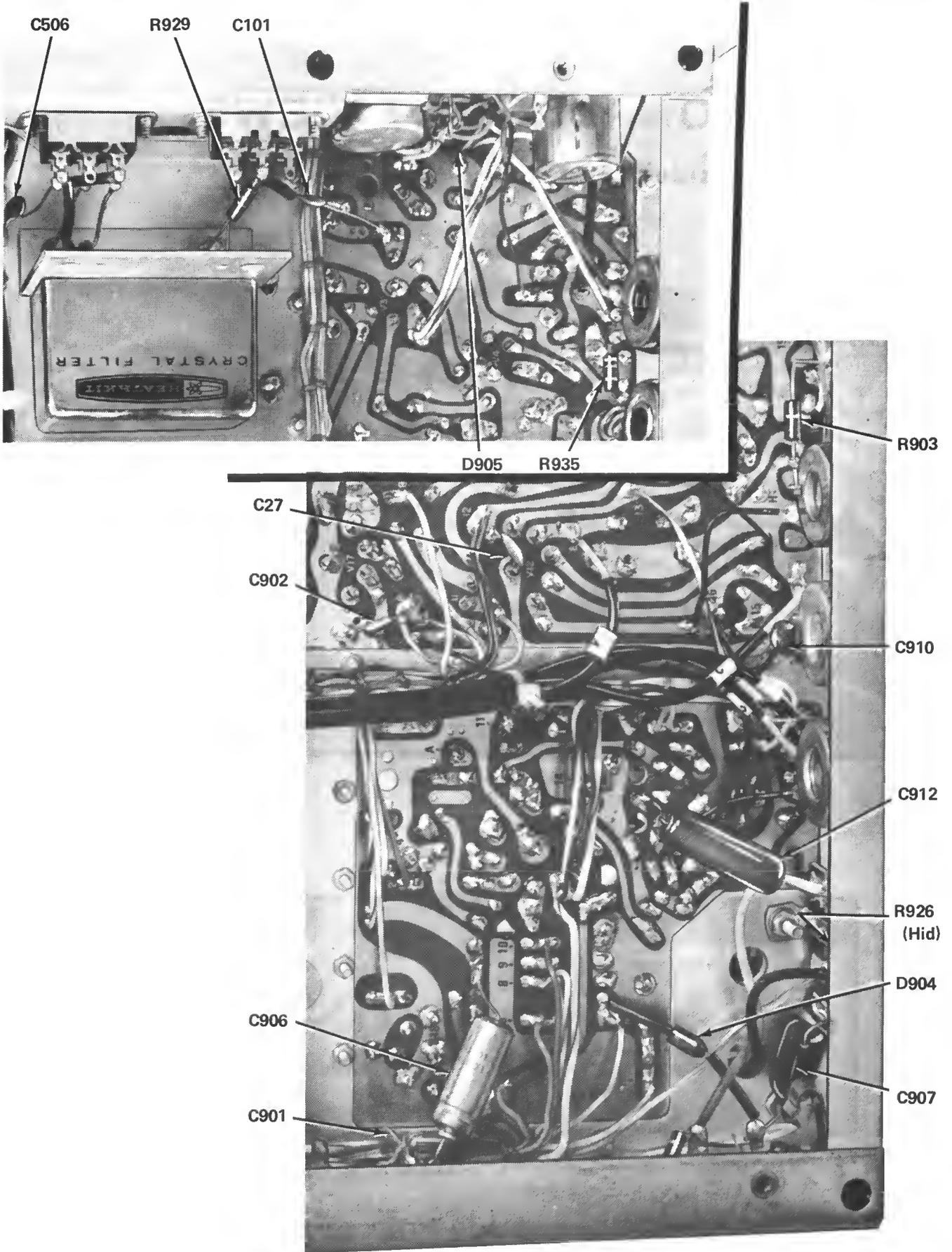
Figure 2-28

CHASSIS PHOTOGRAPHS



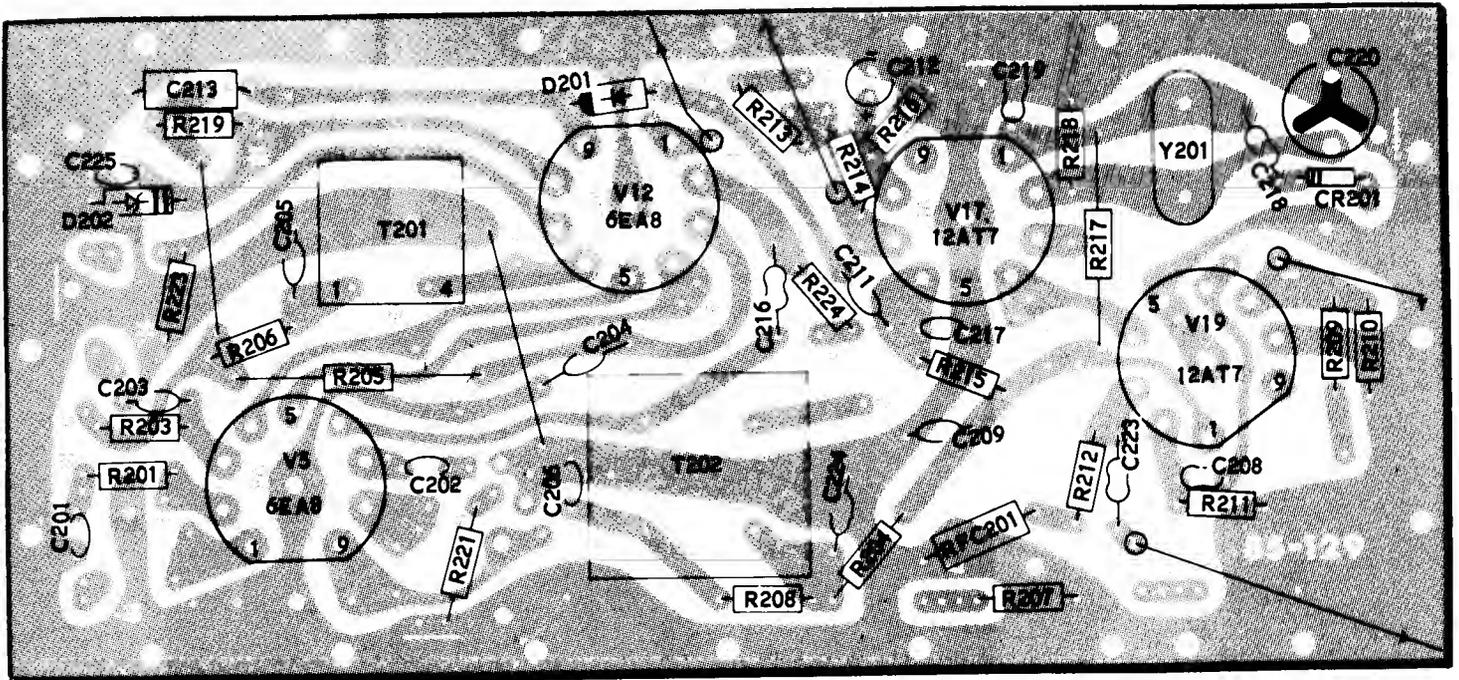




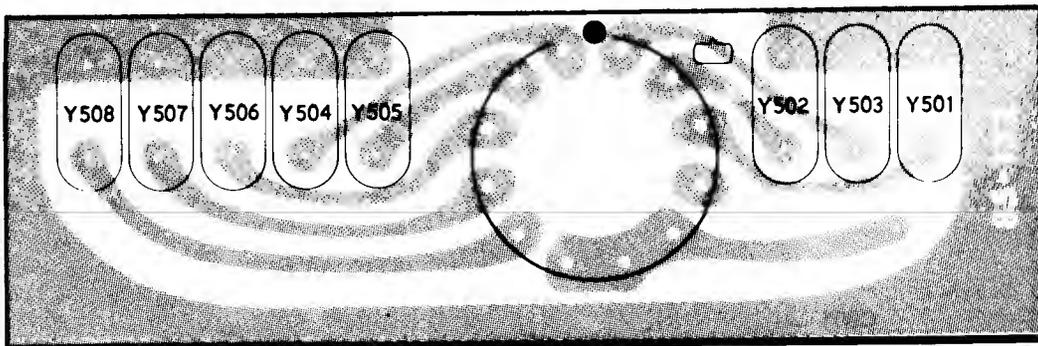


CIRCUIT BOARD X-RAY VIEWS

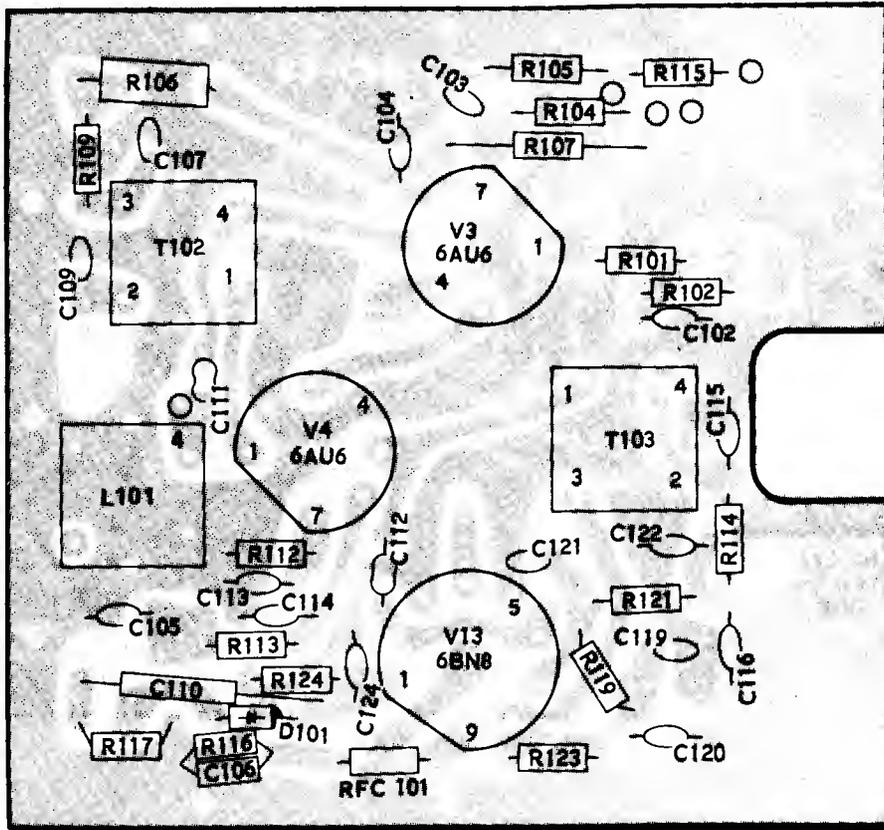
(viewed from foll side)



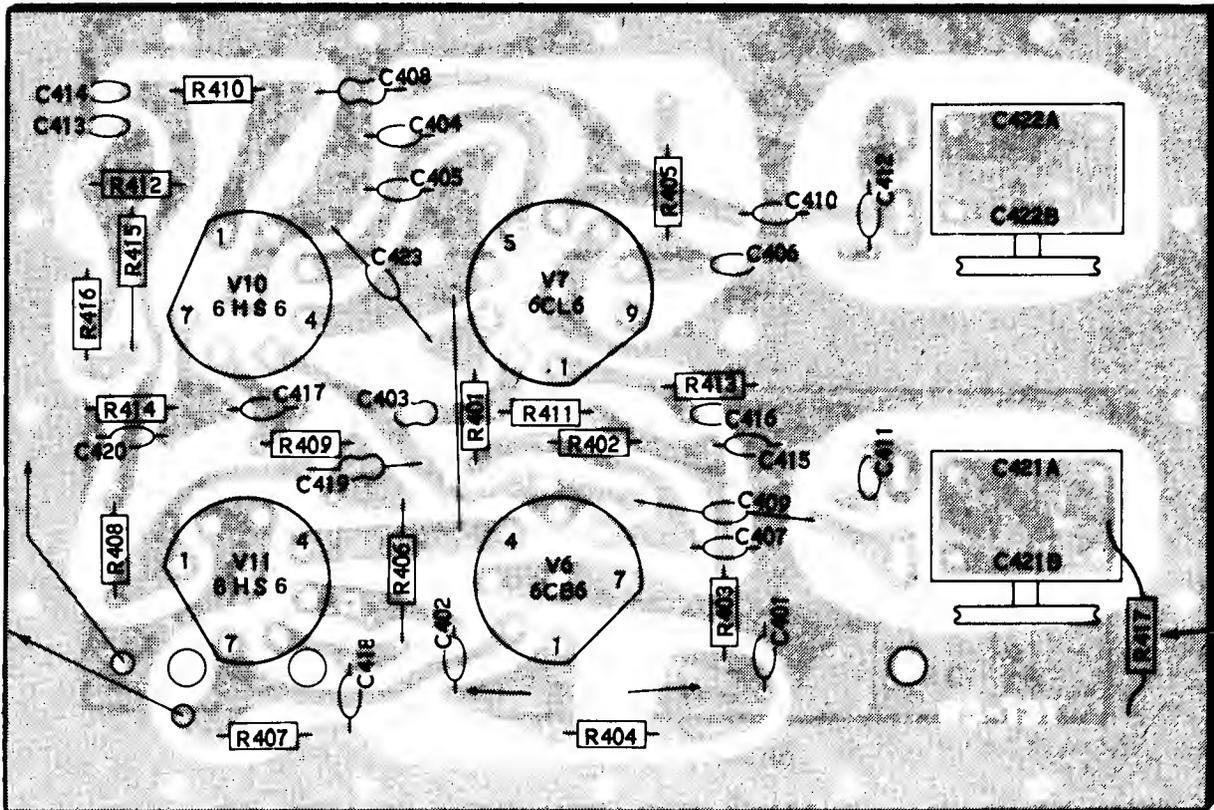
BANDPASS CIRCUIT BOARD



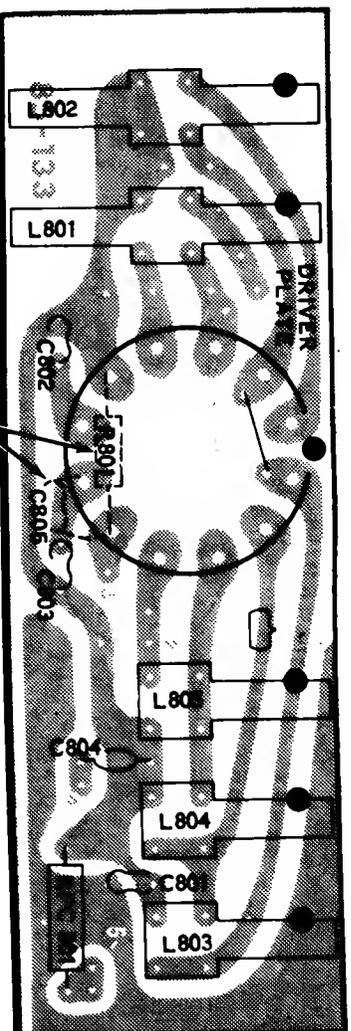
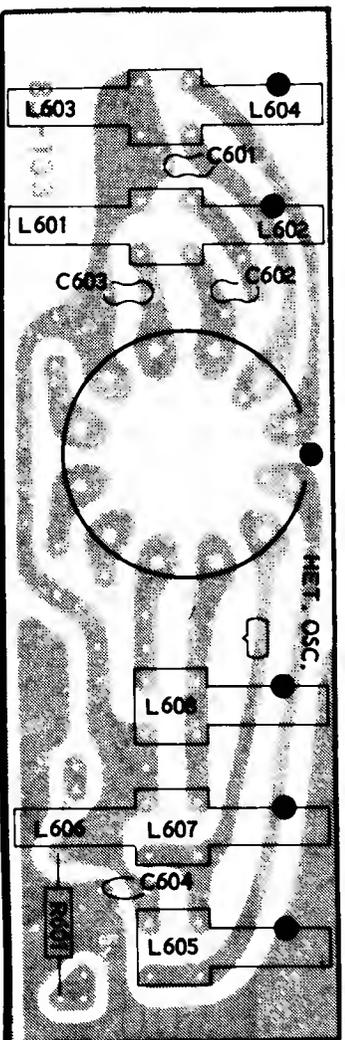
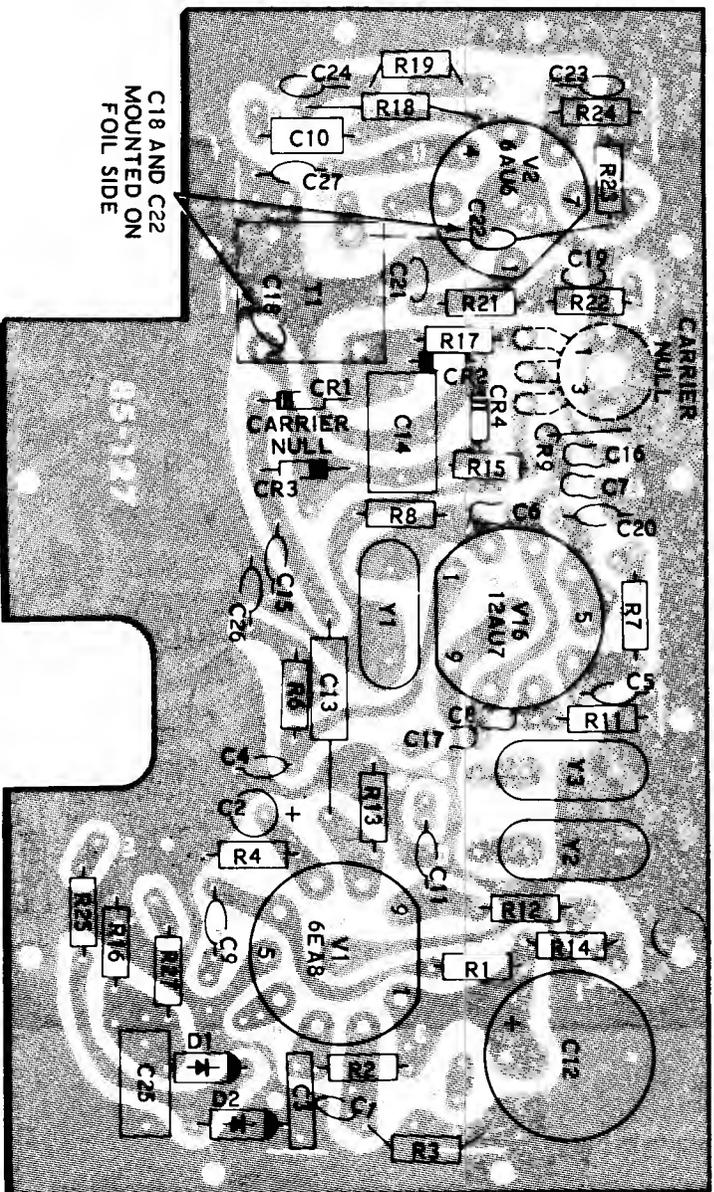
CRYSTAL SWITCH-BOARD



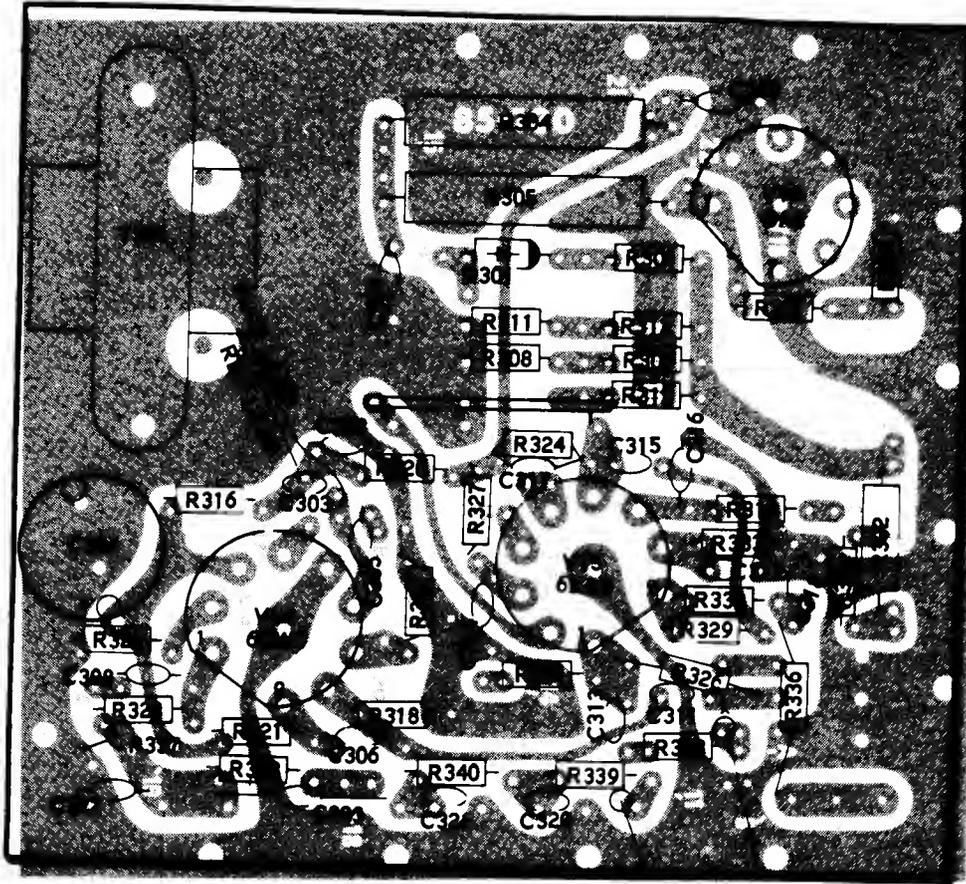
IF CIRCUIT BOARD



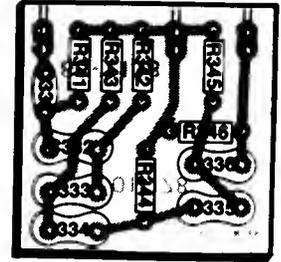
RF DRIVER CIRCUIT BOARD



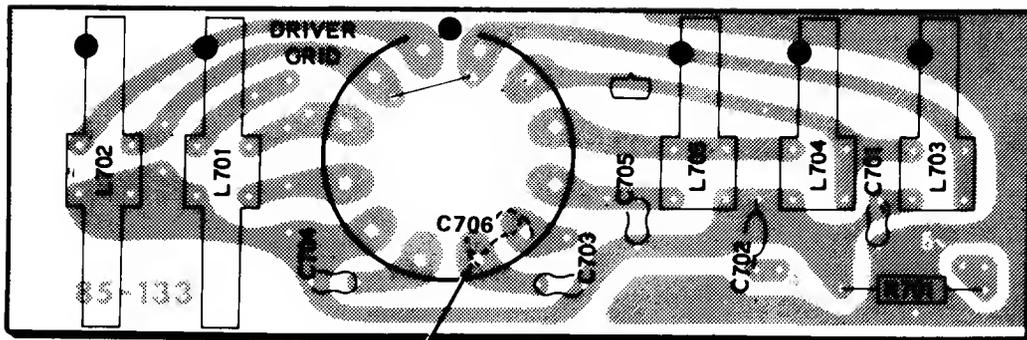
DRIVER PLATE SWITCH-BOARD



AUDIO CIRCUIT BOARD



PHASE SHIFT
CIRCUIT BOARD



ON SWITCH WAFER

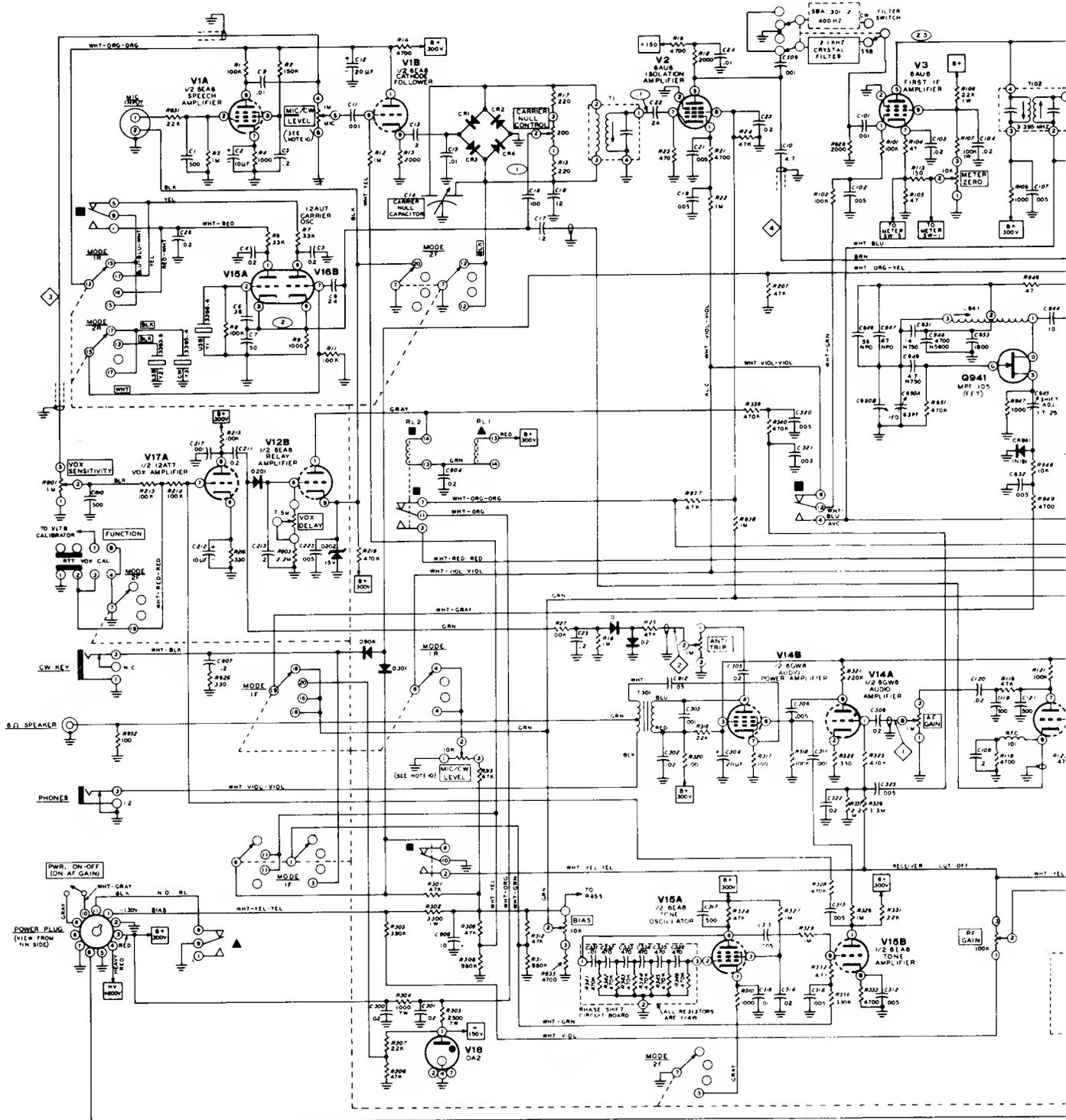
DRIVER GRID SWITCH-BOARD

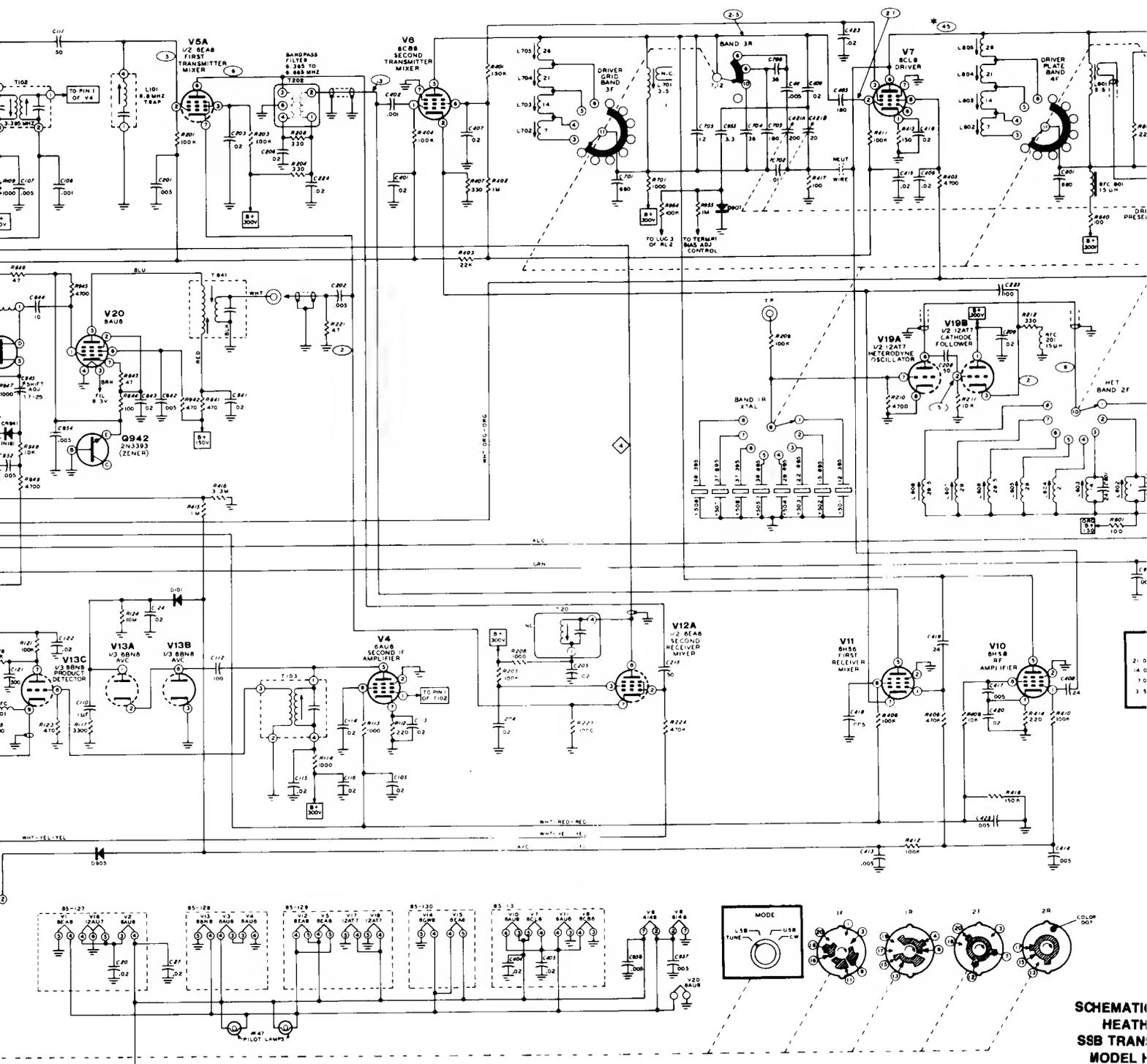
PARTS IDENTIFICATION

Most small parts which are not marked, or whose markings are illegible, may be identified from their locations on the circuit board X-Ray views, or from the chassis photographs. Reference to the Schematic will then give the value of the part in many instances. Cross reference charts to Heath part numbers follow (or are included on the Schematic) for transistors, diodes, coils, and transformers. Once the part number has been determined, refer to the "Replacement Parts Price List."

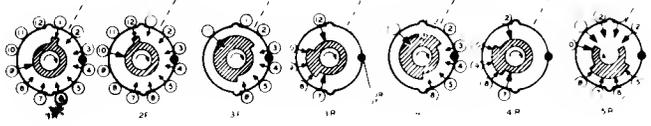
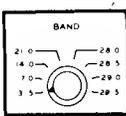
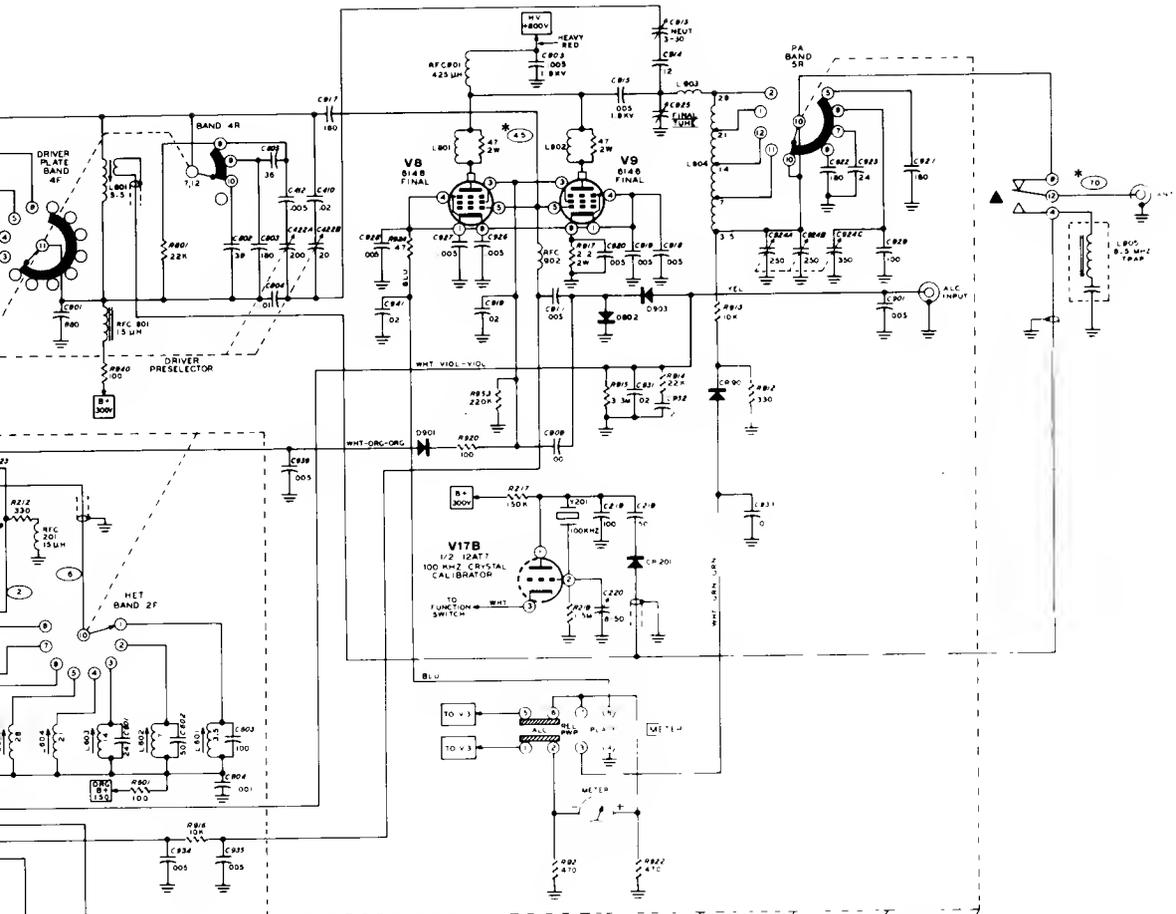
INDUCTOR CROSS REFERENCE TABLE

COMPONENT DESIGNATION	HEATH PART NO.	COMPONENT DESIGNATION	HEATH PART NO.
L101	40-587	L904	40-548
L601, 602	40-689	L905	40-546
L603, 604	40-690	L941	40-1076
L605	40-693	P.E.C.	84-22
L606, 607	40-691	RFC 101	40-487
L608	40-692	RFC 201	45-51
L701	40-685	RFC 801	45-51
L702	40-686	RFC 901	45-41
L703, 704	40-687	RFC 902	45-30
L705	40-688	T1	52-79
L801	40-685	T102	52-73
L802	40-686	T103	52-79
L803, 804	40-687	T201	40-1023
L805	40-688	T202	52-65
L901, 902	45-53	T301	51-123
L903	40-549	T941	52-103





**SCHEMATIC
HEATH
SSB TRAN
MODEL H**



NOTES:

- LETTER NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC. HAVE BEEN PLACED IN THE FOLLOWING GROUPS:
 - 0 99 PARTS ON MODULATOR CIRCUIT BOARD
 - 100 999 IF
 - 200 999 BANDPASS
 - 300 999 AUDIO
 - 400 999 RT DRIVER
 - 500 999 CRYSTAL
 - 600 999 HETERODYNE
 - 700 999 OSCILLATOR
 - 800 999 DRIVER GRID
 - 900 999 DRIVER PLATE
 - 000 999 PARTS MOUNTED ON THE CHASSIS
- 1 ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. ALL RESISTOR VALUES ARE IN OHMS IF 1000 Ω, 100,000 Ω.
 - 2 UNLESS OTHERWISE MARKED, ALL CAPACITOR VALUES OF 1 OR OVER ARE IN μF AND ALL VALUES LESS THAN 1 ARE IN P.
 - 3 REFER TO THE X-RAY AND CHASSIS VIEWS FOR PHYSICAL LOCATION OF PARTS.
 - 4 SEE THE VOLTAGE CHARTS AND THE RESISTANCE CHART FOR ALL MEASUREMENTS.
 - 5 ALL SWITCHES ARE IN THE POSITION INDICATED BY THE KNOB POINTERS.
 - 6 ARROW ↻ INDICATES CLOCKWISE ROTATION OF KNOB VIEWED FROM KNOB END.
 - 7 () NUMBERED COAXIAL CABLE.
 - 8 () INDICATES RF VOLTAGE WITH CONTROLS SET PER FIGURE 1-21.
 - 9 ALL RELAY CONTACTS SHOWN IN TRANSMIT TUNE POSITION.
 - 10 MIC CW LEVEL IS A DUAL CONTROL.
 - 11 FOR GREATER CLARITY, RELAY SECTIONS ARE SHOWN CLOSEST TO THE CIRCUITS IN WHICH THEY ARE USED. ONE OF THE FOLLOWING MARKS IS USED TO IDENTIFY THE SEPARATED SECTION OF THE RELAYS:
 - ▲ PART OF RELAY RL1
 - PART OF RELAY RL2
 - 12 SWITCH WAFERS ARE IDENTIFIED AS IN THE FOLLOWING EXAMPLE:

BAND	2	F
	4	6
- FRONT PANEL: WAFER NUMBER WITH THE SWITCH VIEWED FROM THE FRONT PANEL.
 WAFER NUMBER: WITH THE SWITCH VIEWED FROM THE FRONT PANEL.
 F: FRONT SIDE OF THE WAFER.
 R: REAR SIDE OF THE WAFER.
- * VOLTAGE 5 BEYOND THE RANGE OF THE HEATHKIT RF PROBE.

SCHEMATIC OF THE HEATHKIT® SSB TRANSCEIVER MODEL HW-101

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Part of 595-1277-17

DIODES		
COMPONENT DESIGNATION	TYPE	HEATH PART NO.
CR101	1N34A	101-001
CR102	1N34A	101-001
CR103	1N34A	101-001
CR104	1N34A	101-001
CR105	1N34A	101-001
CR106	1N34A	101-001
CR107	1N34A	101-001
CR108	1N34A	101-001
CR109	1N34A	101-001
CR110	1N34A	101-001
CR111	1N34A	101-001
CR112	1N34A	101-001
CR113	1N34A	101-001
CR114	1N34A	101-001
CR115	1N34A	101-001
CR116	1N34A	101-001
CR117	1N34A	101-001
CR118	1N34A	101-001
CR119	1N34A	101-001
CR120	1N34A	101-001
CR121	1N34A	101-001
CR122	1N34A	101-001
CR123	1N34A	101-001
CR124	1N34A	101-001
CR125	1N34A	101-001
CR126	1N34A	101-001
CR127	1N34A	101-001
CR128	1N34A	101-001
CR129	1N34A	101-001
CR130	1N34A	101-001
CR131	1N34A	101-001
CR132	1N34A	101-001
CR133	1N34A	101-001
CR134	1N34A	101-001
CR135	1N34A	101-001
CR136	1N34A	101-001
CR137	1N34A	101-001
CR138	1N34A	101-001
CR139	1N34A	101-001
CR140	1N34A	101-001
CR141	1N34A	101-001
CR142	1N34A	101-001
CR143	1N34A	101-001
CR144	1N34A	101-001
CR145	1N34A	101-001
CR146	1N34A	101-001
CR147	1N34A	101-001
CR148	1N34A	101-001
CR149	1N34A	101-001
CR150	1N34A	101-001
CR151	1N34A	101-001
CR152	1N34A	101-001
CR153	1N34A	101-001
CR154	1N34A	101-001
CR155	1N34A	101-001
CR156	1N34A	101-001
CR157	1N34A	101-001
CR158	1N34A	101-001
CR159	1N34A	101-001
CR160	1N34A	101-001
CR161	1N34A	101-001
CR162	1N34A	101-001
CR163	1N34A	101-001
CR164	1N34A	101-001
CR165	1N34A	101-001
CR166	1N34A	101-001
CR167	1N34A	101-001
CR168	1N34A	101-001
CR169	1N34A	101-001
CR170	1N34A	101-001
CR171	1N34A	101-001
CR172	1N34A	101-001
CR173	1N34A	101-001
CR174	1N34A	101-001
CR175	1N34A	101-001
CR176	1N34A	101-001
CR177	1N34A	101-001
CR178	1N34A	101-001
CR179	1N34A	101-001
CR180	1N34A	101-001
CR181	1N34A	101-001
CR182	1N34A	101-001
CR183	1N34A	101-001
CR184	1N34A	101-001
CR185	1N34A	101-001
CR186	1N34A	101-001
CR187	1N34A	101-001
CR188	1N34A	101-001
CR189	1N34A	101-001
CR190	1N34A	101-001
CR191	1N34A	101-001
CR192	1N34A	101-001
CR193	1N34A	101-001
CR194	1N34A	101-001
CR195	1N34A	101-001
CR196	1N34A	101-001
CR197	1N34A	101-001
CR198	1N34A	101-001
CR199	1N34A	101-001
CR200	1N34A	101-001

TRANSISTORS			
COMPONENT DESIGNATION	HEATH PART NO.	MANUFACTURER'S NUMBER	(BOTTOM VIEW) BASING
6X4	6X4-001	6X4-001	
6BE6	6BE6-001	6BE6-001	
6AV6	6AV6-001	6AV6-001	
6AR5	6AR5-001	6AR5-001	
6X4	6X4-002	6X4-002	
6BE6	6BE6-002	6BE6-002	
6AV6	6AV6-002	6AV6-002	
6AR5	6AR5-002	6AR5-002	

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HEATHKIT®
888 TRANSCEIVER
MODEL HW-101**

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DIODES		
COMPONENT DESIGNATION	TYPE	HEATH PART NO.
D 1, 2, 101, 201, 301, 902, 903, 904, 905, 906	1N2071 (1 A, 600 PRV)	57 27
D901	1N4149	56 56
CR 1, 2, 3, 4, 201, 401, 441	1N191	56 26 1
D 202	15 V Zener	56 25

TRANSISTORS			
COMPONENT DESIGNATION	HEATH PART NO.	MANUFACTURER'S NUMBER	(BOTTOM VIEW) BASING
Q941	417 169	MPF 105 FE1	
Q942	417 118	2N3393	

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022