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HEATH HO 5404 STATION MONITOR

HEATHKIT® MANUAL

for the

STATION MONITOR

Model HO-5404

S/N 02-59605

ASSEMBLY 595-3374-01

Recd 11-3-87, FINIS 6-5-90. INSTALL 6-23-90

HEATH COMPANY • BENTON HARBOR, MICHIGAN

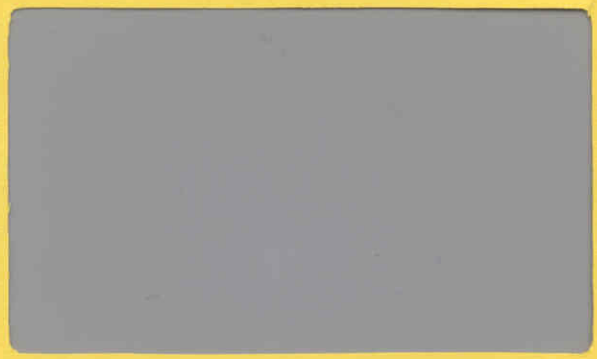
HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
Computers — Hardware	(616) 982-3309
Computers — Software:	
Operating Systems, Languages, Utilities	(616) 982-3860
Application Programs	(616) 982-3884
Heath Craft Wood Works	(616) 982-3423



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 componen, 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.

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for the

STATION MONITOR

Model HO-5404

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ASSEMBLY 595-3374-01

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87110301

With:-

HOA-5404-1, PAN ADAPTOR MODULE

S/N 02-59983

87110302

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

The Heathkit Model HO-5404 Station Monitor is a convenient instrument for use with an amateur radio station to continuously observe "on-the-air" signals. It can be used on all bands and frequencies from the 160-meter through the 6-meter amateur bands without additional tuning or modification. Ten watts of RF energy will provide a useful display, and a front-panel-controlled attenuator allows you to adjust a full 1000 watts of RF input for any display height.

The primary function of the Station Monitor is to display RF envelope (SSB), RF trapezoid (TRAP), or radioteletype (RTTY) transmitted signal patterns. You can also use it to monitor audio signals from other stations when you use it in conjunction with a receiver. The Monitor aids in proper alignment and tuning of a transmitter in AM, CW, or SSB; its display indicates nonlinearity, insufficient or excessive drive, poor carrier or sideband suppression, regeneration, parasitics, and CW key clicks. Several CRT display illustrations are shown and outlined in this Manual to help you identify transmitter problems.

For limited test applications, you can use the Station Monitor as an oscilloscope. In this function, the Monitor will display audio signals from 10 Hz to 40 kHz with good sync capability and high input sensitivity. Also featured is a 10:1 vertical and horizontal input switch attenuator, which maintains a constant input impedance regardless of the switch position.

A Pan Adaptor Module, Model HOA-5404-1, is available so you can view signals ± 20 kHz (nominal) or ± 100 kHz (nominal) from the tuned frequency on a particular band. This Accessory fits entirely inside the Station Monitor and requires a simple connection to the IF circuits of your receiver.

All-solid-state circuits are used in this monitor, except for the display tube, and the push-pull CRT drivers improve the display focus and linearity. The RF input to the CRT deflection plates is also push-pull, and a CRT shield minimizes stray magnetic field effects. Automatic clamp circuitry is included for trapezoid displays.

The color and styling of the Station Monitor was designed to match that of the Heathkit line of amateur radio equipment. You can use this unit, however, with similar amateur or commercial transmitters whose output levels and frequencies are within its specified limits. The Station Monitor is powered by its own 110 to 130 VAC, 60 Hz power supply. With two circuit boards and a wide-open layout, this Station Monitor is both an easy kit to assemble and a useful addition to your "ham shack."

UNPACKING

DO NOT UNPACK ANY PART OF YOUR KIT UNTIL A STEP DIRECTS YOU TO DO SO.

Locate the "Pack Index Sheet" that is packed inside the main shipping carton for your Transceiver. Note that the shipping carton is divided into four smaller sections. These sections make up Packs 1 and 2 and the Final Pack, and may be made up of several bags, envelopes, small boxes, and loose parts. Do not unpack any of these parts until a step specifically directs you to do so.

When you check parts against a "Parts List," return any part or group of parts packaged in a bag or other container, with a part number on it, to its container after you identify it. Leave these parts there until you actually use them in a step. This will help prevent you from mixing up the parts, and help you identify the parts when you need them.

Some parts, however, are in a bag or envelope that is not marked with an actual part number, but with a packaging number that begins with the number "173-." These numbers are used for packaging purposes only and do not appear in the Manual "Parts Lists." Open each bag or envelope that is marked with only a "173-" packaging number to identify the parts it contains.

NOTE: Never use a "173-" packaging number if you must order a replacement part. Use only the part numbers listed in the Manual Parts List for this purpose.

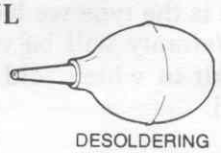
Save all of the packaging material until you account for all of the parts.

ASSEMBLY NOTES

TOOLS

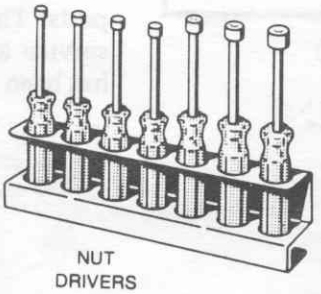
You will need these tools to assemble your kit.

OTHER HELPFUL TOOLS

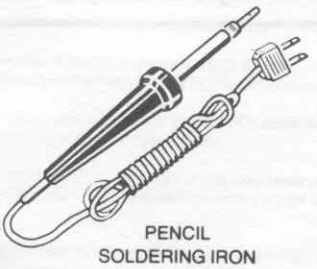

DESOLDERING BULB*


NUT STARTER (May Be Supplied With Kit)


DESOLDERING BRAID*


NUT DRIVERS

*To Remove Solder From Circuit Connections.


PENCIL SOLDERING IRON (22 to 25 WATTS)

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. Refer to the separate "Illustration Booklet" for the Pictorials and Details. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in the proper sequence, as called for in the steps.

3. Pictorials show the overall operation for a group of assembly steps; Details generally 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.

4. Position all parts as shown in the Pictorials.

5. Solder instructions are generally given only at the end of a series of similar steps. You may solder more often if you desire.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In Troubleshooting Charts,

   — In the Schematic,

   — In the sections at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

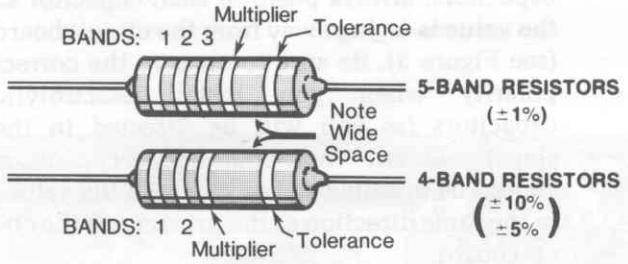
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8″ or 3/16″ chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS



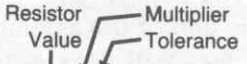
Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). They are usually identified by a color code of four or five color bands, where each color represents a number. These colors will be given in the steps in their proper order (except for the last band, which indicates a resistor's "tolerance"; see the "Resistor Tolerance" chart, below). Therefore, the following color code is given for information only.

	Band 1	Band 2	Band 3 (if used)	Multiplier
Color	1st Digit	2nd Digit	3rd Digit	
Black	0	0	0	1
Brown	1	1	1	10
Red	2	2	2	100
Orange	3	3	3	1,000
Yellow	4	4	4	10,000
Green	5	5	5	100,000
Blue	6	6	6	1,000,000
Violet	7	7	7	0.01
Gray	8	8	8	0.1
White	9	9	9	

Occasionally, a "precision" or "power" resistor may have the value stamped on it. The letter R, K, or M may also be used at times to signify a decimal point, as in: 2R2 = 2.2 Ω
2K2 = 2.2 kΩ, or 2200 Ω
2M2 = 2.2 MΩ

RESISTOR TOLERANCE		
	COLOR OR LETTER	
±10%	SILVER	
± 5%	GOLD	J
± 2%	RED	G
± 1%	BROWN	F
±0.5%	GREEN	D
±0.25%	BLUE	C
±0.1%	VIOLET	B
±0.05%	GRAY	

Precision resistors may also be marked as shown in the following examples. The values of the multipliers are shown in the "Multiplier Chart," and the tolerance values are shown in the "Resistor Tolerance" chart.



EXAMPLES: 1009C = 100 × 0.1 = 10 Ω, ±0.25%
1001D = 100 × 10 = 1000 Ω, ±0.5%

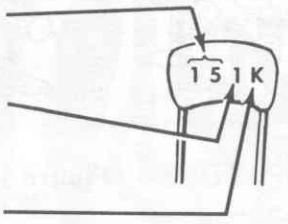
MULTIPLIER CHART			
FOR THE NUMBER:	MULTIPLY BY:	FOR THE NUMBER:	MULTIPLY BY:
0	1	4	10,000
1	10	5	100,000
2	100	8	0.01
3	1000	9	0.1

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar®, electrolytic, etc. Some capacitors may have their value printed in the following manner:

First and second digits of capacitor's value: 15

Multiplier: Multiply the first & second digits by the proper value from the "Multiplier Chart."

To find the tolerance of the capacitor, look up this letter in the capacitor Tolerance chart.



EXAMPLES: 151K = 15 × 10 = 150 pF
759 = 75 × 0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point, as in: 2R2 = 2.2 (pF or μF).

CAPACITOR TOLERANCE		
LETTER	10 pF OR LESS	OVER 10 pF
B	±0.1 pF	
C	±0.25 pF	
D	±0.5 pF	
F	±1.0 pF	±1%
G	±2.0 pF	±2%
H		±3%
J		±5%
K		±10%
M		±20%

SPECIAL ASSEMBLY NOTES

NOTE: The following suggestions will not necessarily improve the operation of your kit. They will, however, help you troubleshoot it (if it ever becomes necessary), and help you perform the "Circuit Board Checkout" steps at the end of the assembly sections of this Manual. And you will have a more professionally-built kit when you finish.

1. When you install resistors, always position each resistor so you can read the bands on the resistor in the same direction as you can read the printing on the circuit board (see Figure 1). For resistors that have the value printed on them instead of color bands, install these resistors so the values are facing away from the circuit board and read in the same direction as the printing on the circuit board.

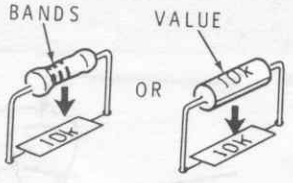


Figure 1

2. When you install ceramic, Mylar, or mica capacitors, always position each capacitor so you can read the value on the capacitor in the same direction as you can read the printing on the circuit board (see Figure 2).

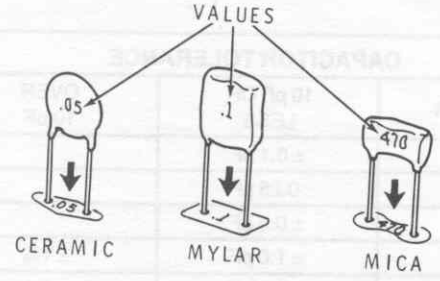


Figure 2

3. When you install electrolytic or other tubular capacitors, always position each capacitor so the value is facing away from the circuit board (see Figure 3). Be sure to observe the correct polarity when you install electrolytic capacitors (as you will be directed in the steps). Other, non-polarized, capacitors should be installed so you can read the values in the same direction as the printing on the circuit board.

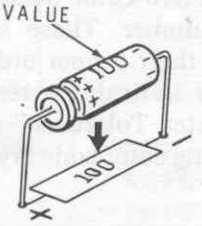


Figure 3

4. Install diodes so the type numbers or part numbers are facing away from the circuit board. Be sure to match the band on one end of each diode with the band mark on the circuit board.

DEMODULATOR CIRCUIT BOARD

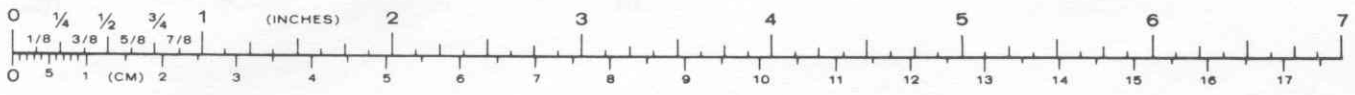
PARTS LIST

Refer to the Pack Index Sheet and locate Pack #1. Notice that pack is in two areas of the main shipping carton. Then remove the parts from this pack and check each part against the following list. The key numbers correspond to the numbers on the "Demodulator Circuit Board Parts Pictorial." If a part is packed in an individual envelope, with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you account for all of the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS				
	NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed. A 5% tolerance is indicated by a fourth color band of gold.			
A1	6-221-12	1	220 Ω (red-red-brn)	R205
A2	6-152-2	1	1500 Ω, 2-watt (brn-grn-red)	R201
A1	6-103-12	1	10 kΩ (brn-blk-org)	R207
A1	6-153-12	1	15 kΩ (brn-grn-org)	R202
A1	6-183-12	1	18 kΩ (brn-gry-org)	R206
A3	6-183-1	1	18 kΩ, 1-watt (brn-gry-org)	R203
A3	6-473-1	1	47 kΩ, 1-watt (yel-viol-org)	R2
A2	6-473-2	1	47 kΩ, 2-watt (yel-viol-org)	R1
A4	6-335	1	3.3 MΩ, 1/2-watt (org-org-grn)	R204
CAPACITORS				
B1	20-102	2	100 pF mica	C201, C202
B1	20-115	1	300 pF mica	C203
B2	21-56	1	470 pF ceramic	C207

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Capacitors (cont'd)				
B1	20-122	1	1000 pF mica	C204
B2	21-163	2	.001 μF (1000 pF) ceramic	C205, C208
B2	21-99	1	.2 μF ceramic	C206
WIRE—CABLE—SLEEVING				
	340-3	8″	Bare wire	
	343-15	11.5′	Shielded cable	
	344-90	18″	Small black stranded wire	
	344-13	21″	Large blue solid wire	
	344-34	14″	Large brown solid wire	
	344-35	21″	Large orange solid wire	
	344-55	15″	Small green solid wire	
	344-2	33″	Large black stranded wire	
	344-94	30″	Small yellow stranded wire	
	344-97	32″	Small violet stranded wire	
	344-99	54″	Small white stranded wire	
	344-185	21″	Large green solid wire	
	344-186	21″	Large violet solid wire	
	344-214	12″	Large yellow wire (pretinned)	
	346-1	9″	Small sleeving	
	346-64	1″	Large sleeving	
	347-2	22″	300 Ω flat cable	



KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
MISCELLANEOUS				
C1	40-1736	1	Toroid coil	L201
C2	56-26	4	1N191 diode (may be marked brn-wht-brn)	D201, D202, D203, D204
	85-1518-2	1	Demodulator circuit board	

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Miscellaneous (cont'd)				
C3	417-291	1	2N5458 transistor	Q201
C3	417-801	1	MPSA20 transistor	ZD201
C4	390-2893	1	Front panel label*	
C5		1	Blue and white label*	
		1	Assembly Manual (See Page 1 for the part number.)	
	597-260	1	Parts Order Form*	
		1	Taped Component Chart*	
			Solder	

*These items may be packed inside the Manual. Set them aside until they are called for in a step.

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1-1 for the following steps.

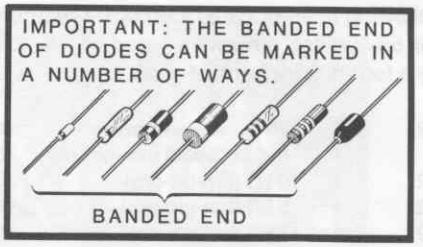
In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

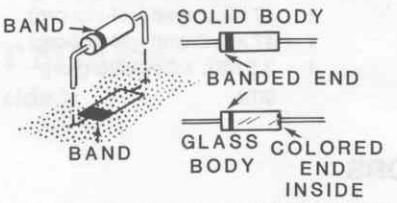
NOTE: In general, solder instructions are given only at the end of a series of steps. You may solder more often, if you desire.

Note that the circuit board has foil on one side and component outlines on the other. The side with the component outlines is referred to as the "component side."

Position the circuit board as shown in the Pictorial with the component side up. Always install components on the component side of the circuit board, and solder the leads to the foil on the other side unless a step specifically directs you otherwise.

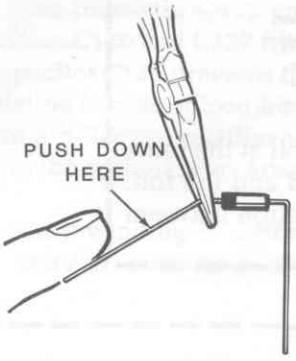
NOTE: In some of the following steps, you will install diodes. Whenever you install a diode, always match the banded end of the diode with the band mark on the circuit board. A diode will not work properly if it is installed backwards.





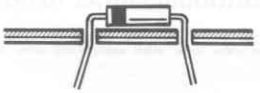
CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

( ) D201: Hold a 1N191 diode (#56-26) as shown and bend the leads straight down to fit the hole spacing on circuit board.



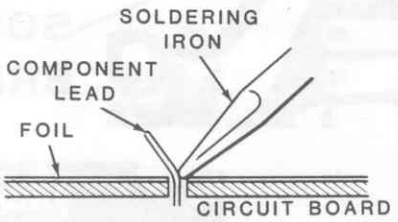
( ) Start the leads into the circuit board holes at the top of the circuit board.

( ) Press the diode against the circuit board. Then bend the leads outward slightly to hold it in place.

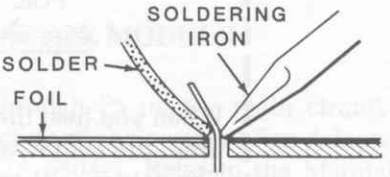


( ) Use the following procedure to solder the diode leads to the foil:

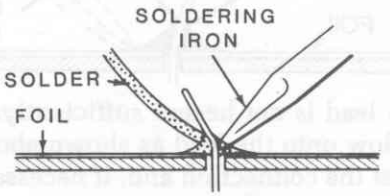
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



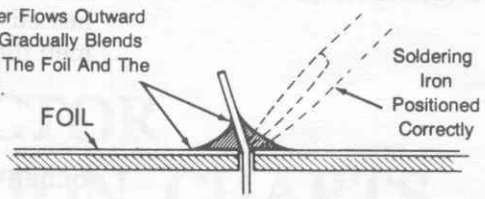
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



( ) Cut off the excess wire ends close to the connection. WARNING: Clip the lead ends so they will not fly toward your eyes.

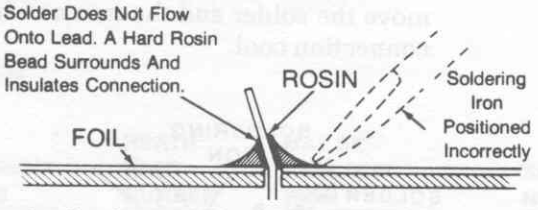
( ) Check each connection. Compare it to the illustrations on Page 12. After you have checked the solder connections, proceed with the assembly on Page 13. Use a similar soldering procedure for each connection.

A GOOD SOLDER CONNECTION

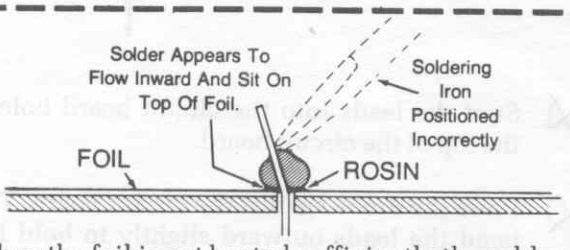


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



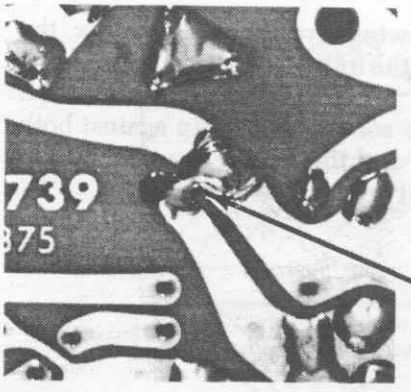
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.

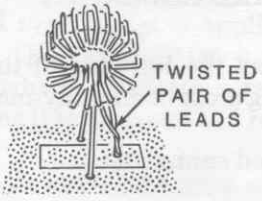
NOTE: You will now install the remainder of the components on the circuit board in a top-to-bottom, left-to-right sequence. For your convenience, component numbers have been added to the Pictorial to match the steps.

( ) R202: 15 kΩ (brn-grn-org) resistor. NOTE: The ends with the bands may be positioned either way.

( ) C203: 300 pF mica capacitor.

( ) C202: 100 pF mica capacitor.

( ) L201: Toroid coil (#40-1736). Be sure to install this coil as shown below.



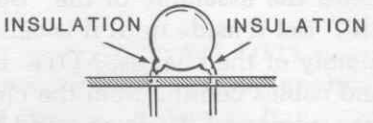
( ) C201: 100 pF mica capacitor.

( ) R201: 1500 Ω, 2-watt (brn-grn-red) resistor.

( ) R203: 18 kΩ, 1-watt (brn-gry-org) resistor.

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

NOTE: In some of the following steps, you will install disc-type ceramic capacitors. When you install these ceramic capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



( ) C205: .001 µF (1000 pF) **ceramic** capacitor.

( ) D202: 1N191 diode (#56-26).

( ) D203: 1N191 diode (#56-26).

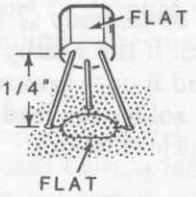
( ) C204: 1000 pF **mica** capacitor.

( ) C206: .2 µF ceramic capacitor.

( ) R204: 3.3 MΩ, 1/2-watt (org-org-grn) resistor.

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

NOTE: When you install a transistor, position it so the flat side is over the outline of the flat on the circuit board. Then start the leads into the corresponding holes in the circuit board. Position the transistor 1/4" above the circuit board. Then solder the leads to the foil and cut off any excess lead lengths.



( ) ZD201: MPSA20 transistor (#417-801). NOTE: Since this transistor is used as a zener diode, the foil around the base (B) lead is not connected to anything.

( ) Q201: 2N5458 transistor (#417-291).

( ) R205: 220 Ω (red-red-brn) resistor.

( ) C208: .001 µF (1000 pF) **ceramic** capacitor.

( ) C207: 470 pF ceramic capacitor.

( ) R207: 10 kΩ (brn-blk-org) resistor.

( ) D204: 1N191 diode (#56-26).

( ) R206: 18 kΩ (brn-gry-org) resistor.

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

Refer to Pictorial 1-2 for the following steps.

( ) Cut a 2-1/2" length of 300 Ω flat cable. Then refer to Detail 1-2A and prepare the cable as shown. Be careful you do not pull the wire out of the insulation.

NOTE: The other ends of the cables and components, which you will install in the following steps, will be connected later.

( ) Connect and solder the wires at one end of the prepared flat cable to the circuit board at holes C and D. Cut off any excess wire ends.

( ) Cut a 4" length of **small green solid** wire and remove 1/4" of insulation from each end. Then connect and solder one end of the wire to circuit board hole E. Cut off any excess wire end.

( ) R1: Push one lead of a 47 kΩ, **2-watt** (yel-viol-org) resistor into circuit board hole F. Position the resistor so its body is 1/4" away from the circuit board. If the nearby mica capacitor interferes, bend it over toward diodes D202 and D203. Then solder the lead to the foil and cut off the excess lead length.

( ) R2: Similarly, push one lead of a 47 kΩ, **1-watt** (yel-viol-org) resistor into circuit board hole P so its body is 1-1/4" away from the circuit board. Then solder the lead to the foil and cut off the excess lead length.

( ) Cut a 23" length of shielded cable. Then refer to Detail 1-2B and prepare each end of the cable as shown.

Connect and solder the wires at one end of the prepared shielded cable to the circuit board as follows. Cut off any excess wire ends.

( ) Inner wire to hole B.

( ) Shield wire to hole A.

( ) Cut two 16" lengths of shielded cable. Then refer again to Detail 1-2B and prepare each end of each cable as shown.

Connect and solder the wires at one end of a prepared shielded cable to the circuit board as follows. Cut off any excess wire ends.

( ) Inner wire to hole K.

( ) Shield wire to hole L.

Connect and solder the wires at one end of the remaining prepared shielded cable to the circuit board as follows. Cut off any excess wire ends.

( ) Inner wire to hole M.

( ) Shield wire to hole N.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most-commonly-made errors:

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns (refer to the X-ray view on Page 72).

( ) Protruding leads which could touch each other or the chassis when the circuit board is mounted later.

Refer to the illustrations where parts were installed as you make the following visual checks:

( ) Diodes for the proper installation.

( ) Transistors for the proper **type** and **installation**.

This completes the assembly of the "Demodulator Circuit Board." Set it aside until it is called for during the assembly of the chassis. NOTE: Do not flex the wires and cables coming from the circuit board any more than necessary. To do so could break some of the wires.

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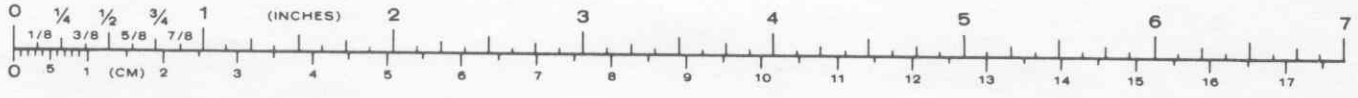

MAIN CIRCUIT BOARD

PARTS LIST

Refer to the Pack Index Sheet and locate Pack #2. Then remove the parts from this pack and check each part against the following list. The key numbers correspond to the numbers on the "Main Circuit Board Parts Pictorial." Do not remove components from the tape until you use them in a step. If a part is packed in an individual envelope, with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you account for all of the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS				
NOTE: The following resistors have a 5% tolerance.				
A1	3-9-5	2	3000 Ω (3 kΩ), 5-watt wire-wound resistor	R155, R156
A2	5-3-7	4	10 kΩ, 7-watt resistor	R148, R149, R151, R152
A3	6-105-1	1	1 MΩ, 1-watt (brn-blk-grn) resistor	R154
CAPACITORS				
Ceramic				
B1	21-147	2	47 pF	C104, C105
B1	21-56	4	470 pF	C113, C115, C117, C118
B1	21-163	1	.001 µF (1000 pF)	C125
B1	21-141	1	.0033 µF (3300 pF)	C116
B1	21-176	2	.01 µF, 100V	C101, C103
B2	21-42	1	.01 µF, 1600V (1.6 kV)	C119
Electrolytic				
B3	25-917	4	10 µF	C111, C112, C114, C131
B3	25-883	3	47 µF	C107, C108, C126
B4	25-956	2	68 µF	C124, C128
B3	25-887	2	220 µF	C127, C129
Other Capacitors				
B5	20-100	1	30 pF mica	C106
B6	23-62	3	.1 µF paper	C121, C122, C123
B7	27-77	2	.1 µF Mylar	C102, C109

TRANSISTORS

NOTE: Transistors may be marked for identification in any of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	417-91	4	2N5232A	Q103, Q105, Q117, Q119
C1	417-94	1	2N3416	Q122
C1	417-169	4	MPF105	Q101, Q102, Q115, Q116
C1	417-201	4	X29A829	Q109, Q111, Q112, Q113
C1	417-294	1	MPSA42	Q114
C1	417-801	6	MPSA20	D101, D102, D103, D104, Q107, Q108
C1	417-811	1	MPSL01	Q123
C2	417-834	4	MPSU10	Q104, Q106, Q118, Q121

MISCELLANEOUS

D1	10-1140	2	500 Ω control	R128, R139
D2	10-941	1	100 kΩ control	R162
	85-2978-2	1	Main circuit board	
D3	215-85	4	Heat sink	
D4	250-1469	4	4-40 × 5/16″ screw	
D5	252-2	4	4-40 nut	
D6	254-9	4	#4 lockwasher	
D7	352-13	1	Silicone grease	
D8	432-121	5	PCB pin	
D9	490-5	1	Nut starter	
D10	490-205	1	Pin insertion tool	

TAPED COMPONENTS

NOTE: These parts are taped on a strip which was checked before shipment. Since these parts are taped in the order of assembly, you may not wish to check them against the following list.

RESISTORS

NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed. A 5% tolerance is indicated by q fourth color band of gold.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
	6-680-12	1	68 Ω (blu-gry-blk)	R158
	6-101-12	5	100 Ω (brn-blk-brn)	R122, R131, R132, R142, R143
	6-181-12	1	180 Ω (brn-gry-brn)	R126
	6-471-12	7	470 Ω (yel-viol-brn)	R117, R123, R133, R134, R145, R146, R164
	6-102-12	17	1000 Ω (brn-blk-red)	R103, R105, R112, R114, R115, R118, R124, R127, R129, R135, R136, R137, R138, R141, R144, R147, R157
	6-472-12	5	4700 Ω (yel-viol-red)	R104, R106, R113, R121, R163
	6-123-12	1	12 kΩ (brn-red-org)	R159
	6-153-12	1	15 kΩ (brn-grn-org)	R153
	6-104-12	3	100 kΩ (brn-blk-yel)	R116, R119, R161
	6-105-12	2	1 MΩ (brn-blk-grn)	R107, R109
	6-155-12	2	1.5 MΩ (brn-grn-grn)	R101, R125
	6-565-12	1	5.6 MΩ (grn-blu-grn)	R102
	6-106-12	1	10 MΩ (brn-blk-blu)	R111

DIODES

	56-48	1	BZT110A	ZD101
	56-67	1	1N4740A	ZD103
	56-68	1	2VR68	ZD102
	57-27	4	1N2071	D109, D111, D112, D113
	57-52	2	DO-7	D105, D106
	57-65	4	1N4002	D114, D115, D116, D117

STEP-BY-STEP ASSEMBLY

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Refer to Pictorial 2-1 for the following steps.

NOTES:

1. Many circuit board drawings, such as the one shown in Pictorial 2-1, are divided into two or more sections. These sections show you which area of the circuit board you are working in for a specific series of steps.

2. Refer to the "Taped Component Chart." Note that it is divided into numbered sections that match the sections on the circuit board.

3. Each series of steps has you installing parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a component out of sequence. These components are each identified in the step and on the Pictorial with a special callout.

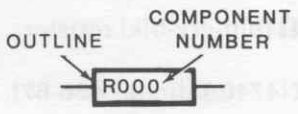
4. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.

5. In general, solder instructions are given only at the end of a series of steps. You may solder more often if you desire. Use the same procedure as you did when you assembled the demodulator circuit board.

(X) Position the main circuit board as shown in Pictorial 2-1.

Section 1

(X) R113: 4700 Ω (yel-viol-red) resistor. NOTE: resistors are identified on this circuit board by the following outline:



(X) R107: 1 MΩ, **1/4-watt** (brn-blk-grn) resistor.

(X) R121: 4700 Ω (yel-viol-red) resistor.

(X) R109: 1 MΩ, **1/4-watt** (brn-blk-grn) resistor.

(X) R111: 10 MΩ (brn-blk-blu) resistor.

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

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Section 2

(X) R127: 1000 Ω (brn-blk-red) resistor.

(√) R131: 100 Ω (brn-blk-brn) resistor.

(√) R129: 1000 Ω (brn-blk-red) resistor.

(√) R136: 1000 Ω (brn-blk-red) resistor.

(√) R132: 100 Ω (brn-blk-brn) resistor.

(√) R137: 1000 Ω (brn-blk-red) resistor.

(√) R138: 1000 Ω (brn-blk-red) resistor.

(√) R142: 100 Ω (brn-blk-brn) resistor.

(√) R141: 1000 Ω (brn-blk-red) resistor.

(√) R112: 1000 Ω (brn-blk-red) resistor.

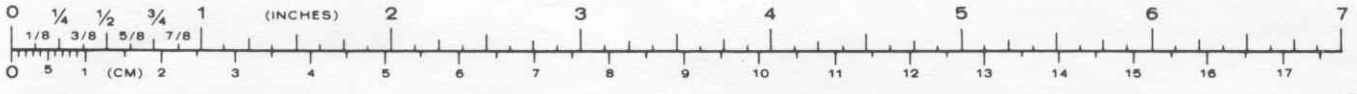
(√) R143: 100 Ω (brn-blk-brn) resistor.

(√) R144: 1000 Ω (brn-blk-red) resistor.

(√) R101: 1.5 MΩ (brn-grn-grn) resistor.

(√) R102: 5.6 MΩ (grn-blu-grn) resistor.

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



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Section 3

- [ ] R133: 470 Ω (yel-viol-brn) resistor.
- [ ] R135: 1000 Ω (brn-blk-red) resistor.
- [ ] R134: 470 Ω (yel-viol-brn) resistor.
- [ ] R145: 470 Ω (yel-viol-brn) resistor.
- [ ] R147: 1000 Ω (brn-blk-red) resistor.
- [ ] R146: 470 Ω (yel-viol-brn) resistor.
- [ ] R103: 1000 Ω (brn-blk-red) resistor.
- [ ] R105: 1000 Ω (brn-blk-red) resistor.
- [ ] R114: 1000 Ω (brn-blk-red) resistor.
- [ ] R104: 4700 Ω (yel-viol-red) resistor.
- [ ] R116: 100 kΩ (brn-blk-yel) resistor.
- [ ] R106: 4700 Ω (yel-viol-red) resistor.
- [ ] R115: 1000 Ω (brn-blk-red) resistor.
- [ ] Solder the leads to the foil and cut off the excess lead lengths.

Section 4

- [ ] R117: 470 Ω (yel-viol-brn) resistor.
- [ ] R118: 1000 Ω (brn-blk-red) resistor.
- [ ] R124: 1000 Ω (brn-blk-red) resistor.
- [ ] R123: 470 Ω (yel-viol-brn) resistor.
- [ ] R119: 100 kΩ (brn-blk-yel) resistor.
- [ ] R122: 100 Ω (brn-blk-brn) resistor.
- [ ] R164: 470 Ω (yel-viol-brn) resistor.
- [ ] Solder the leads to the foil and cut off the excess lead lengths.

Section 5

- [ ] R159: 12 kΩ (brn-red-org) resistor.
- [ ] R157: 1000 Ω (brn-blk-red) resistor.
- [ ] R125: 1.5 MΩ (brn-grn-grn) resistor.
- [ ] R126: 180 Ω (brn-gry-brn) resistor.
- [ ] R153: 15 kΩ (brn-grn-org) resistor.
- [ ] Solder the leads to the foil and cut off the excess lead lengths.

Section 6

NOTE: When you install diodes in the following steps, be sure to match the band on each diode with the band on the circuit board.

- [ ] D106: DO-7 diode (#57-52).
- [ ] D105: DO-7 diode (#57-52).
- [ ] D111: 1N2071 diode (#57-27).
- [ ] D109: 1N2071 diode (#57-27).
- [ ] D112: 1N2071 diode (#57-27).
- [ ] D113: 1N2071 diode (#57-27).
- [ ] ZD102: 2VR68 diode (#56-68).
- [ ] ZD101: BZT110A diode (#56-48).
- [ ] D114: 1N4002 diode (#57-65).

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- [ ] D115: 1N4002 diode (#57-65).
- [ ] D117: 1N4002 diode (#57-65).
- [ ] D116: 1N4002 diode (#57-65).
- [ ] R158: 68 Ω (blu-gry-blk) resistor.
- [ ] ZD103: 1N4740A diode (#56-67).

( ) R163: 4700 Ω (yel-viol-red) resistor.

( ) R161: 100 kΩ (brn-blk-yel) resistor.

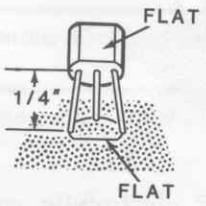
( ) Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 2-2 for the following steps.

NOTE: The following parts are not taped on strips.

Section 1

NOTE: When you install a transistor, position it so the flat side is over the outline of the flat on the circuit board. Then start the leads into the corresponding holes in the circuit board. Position the transistor 1/4" above the circuit board. Then solder the leads to the foil and cut off any excess lead lengths.



( ) Q101: MPF105 transistor (#417-169).

( ) D102: MPSA20 transistor (#417-801).

( ) D101: MPSA20 transistor (#417-801).

( ) Q115: MPF105 transistor (#417-169).

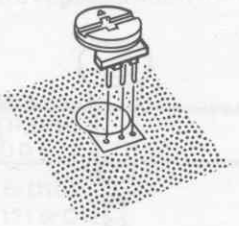
( ) D104: MPSA20 transistor (#417-801).

( ) D103: MPSA20 transistor (#417-801).

Section 2

( ) Q102: MPF105 transistor (#417-169).

NOTE: In some of the following steps, you will install controls. Match the shape of each control with the outline on the circuit board. Then start the leads of the control into the circuit board holes, push the control down tight against the board, and solder the leads to the foil. Cut off any excess lead lengths.



( ) R128: 500 Ω control (#10-1140).

( ) W101: Prepare a 1-7/8" small green solid wire by removing 1/4" of insulation from each end. Then install the wire on the circuit board at W101. Solder the wire ends to the foil and cut off the excess ends.

( ) Q116: MPF105 transistor (#417-169).

( ) R139: 500 Ω control (#10-1140).

Section 3

Install 2N5232A transistors (#417-91) at the following locations:

( ) Q103.

( ) Q105.

( ) Q117.

( ) Q119.

( ) Q107: MPSA20 transistor (#417-801).

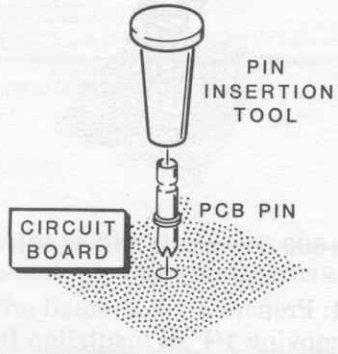
Section 4

( ) Q108: MPSA20 transistor (#417-801).

( ) Q109: X29A829 transistor (#417-201).

Section 5

NOTE: When a step directs you to install a PCB pin in the circuit board, push the longer end of the pin into the bottom end of the pin insertion tool as shown. Then press the shorter end of the pin into the circuit board hole firmly until it seats properly.



( ) P2: PCB pin.

( ) P1: PCB pin.

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

( ) Q113.

( ) Q111.

( ) Q112.

Section 6

( ) R154: 1 MΩ, **1-watt** (brn-blk-grn) resistor. Solder the leads to the foil and cut off the excess lead lengths.

( ) P5: PCB pin.

( ) P3: PCB pin.

( ) P4: PCB pin.

( ) Q122: 2N3416 transistor (#417-**94**).

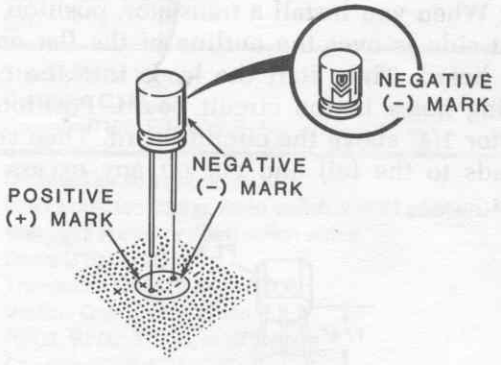
( ) Q123: MPSL01 transistor (#417-811).

( ) Q114: MPSA42 transistor (#417-**294**). Note that the center lead of this transistor is **toward** the flat.

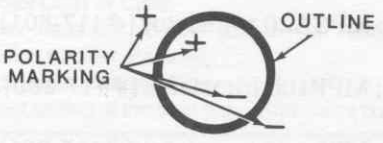
Refer to Pictorial 2-3 for the following steps.

Section 1

NOTE: In some of the following steps, you will install electrolytic capacitors. Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a positive (+) mark or a negative (−) mark near it. Be sure to install the positive lead in the positive-marked hole, or the negative lead in the negative-marked hole.



( ) C107: 47 µF electrolytic capacitor. NOTE: Electrolytic capacitors are identified on the circuit board by the following outline:



( ) C105: 47 pF ceramic capacitor.

( ) C101: .01 µF, **100V** ceramic capacitor.

( ) C108: 47 µF electrolytic capacitor.

( ) C104: 47 pF ceramic capacitor.

( ) C103: .01 µF, **100V** ceramic capacitor.

( ) C102: .1 µF **Mylar** capacitor.

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

Section 2

( ) C113: 470 pF ceramic capacitor.

( ) C117: 470 pF ceramic capacitor.

( ) C112: 10 µF electrolytic capacitor.

( ) C115: 470 pF ceramic capacitor.

( ) C118: 470 pF ceramic capacitor.

( ) C114: 10 µF electrolytic capacitor.

( ) C106: 30 pF mica capacitor.

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

Section 3

( ) C131: 10 µF electrolytic capacitor.

( ) C111: 10 µF electrolytic capacitor.

( ) C109: .1 µF **Mylar** capacitor.

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

Section 4

( ) C129: 220 µF electrolytic capacitor.

( ) C127: 220 µF electrolytic capacitor.

( ) C125: .001 µF (1000 pF) ceramic capacitor.

( ) C126: 47 µF electrolytic capacitor.

( ) C116: .0033 µF (3300 pF) ceramic capacitor.

( ) C119: .01 µF, **1.6 kV (1600V)** ceramic capacitor.

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

Refer to Pictorial 2-4 for the following steps.

Section 1

NOTE: Use the plastic nut starter to hold and start 4-40 and 6-32 nuts on screws.

( ) Q104: Use the following procedure to install an MPSU10 transistor (#417-834) on the circuit board at Q104:

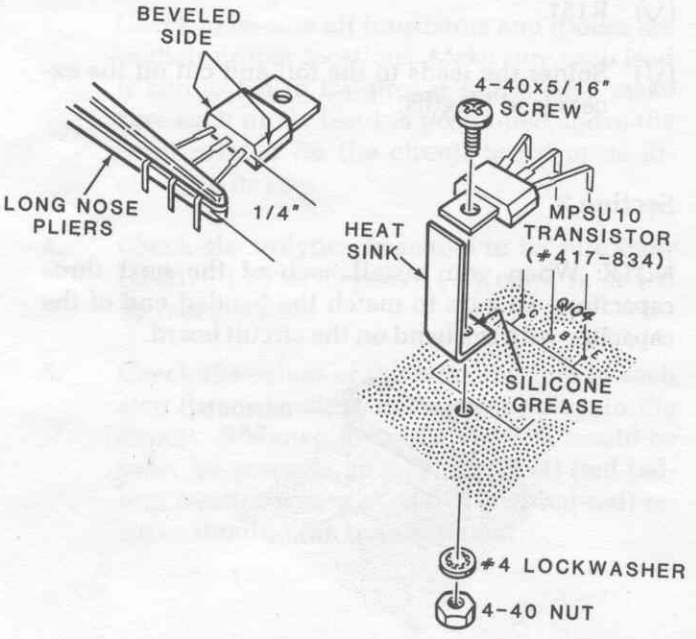
1. Position the transistor so the beveled side is up as shown. Then use long-nose pliers to bend down the leads at a point 1/4" away from the transistor body as shown.

2. Refer to the inset drawing on the Pictorial and cut open the silicone grease pod.

3. Apply a small amount of silicone grease to the indicated area of a heat sink.

4. Use a 4-40 × 5/16" screw, a #4 lockwasher, and a 4-40 nut to mount the heat sink and transistor to the circuit board at Q104. Be sure to position the transistor and heat sink as shown before you tighten the hardware.

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



Use the same procedure to mount MPSU10 transistors and heat sinks to the circuit board at the following locations:

(√) Q106.

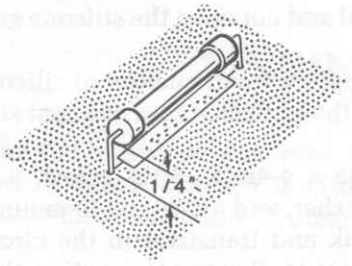
(√) Q118.

(√) Q121.

NOTE: Discard the left over silicone grease.

Section 2

Install 10 kΩ, 7-watt resistors at the following locations. NOTE: Position each resistor so its body is 1/4" above the circuit board as shown.



(√) R148.

(√) R149.

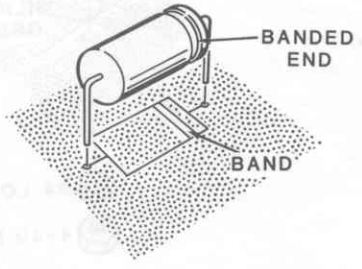
(√) R152.

(√) R151.

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

Section 3

NOTE: When you install each of the next three capacitors, be sure to match the banded end of the capacitor with the band on the circuit board.



(√) C121: .1 μF **paper** capacitor.

(√) C122: .1 μF **paper** capacitor.

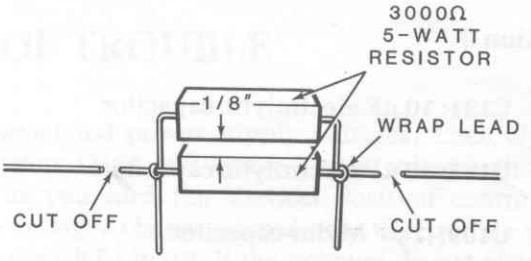
(√) C123: .1 μF **paper** capacitor.

NOTE: Be sure to observe the correct polarity when you install the next two capacitors.

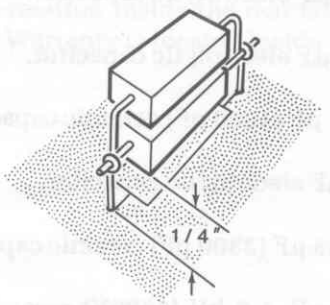
(√) C128: 68 μF electrolytic capacitor.

(√) C124: 68 μF electrolytic capacitor.

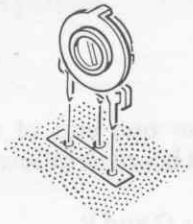
(√) Wrap the leads of a 3000 Ω (3 kΩ), 5-watt resistor around the leads of another 3000 Ω, 5-watt resistor so the two resistors are 1/8" apart. Then solder the leads together and cut off the excess length from the indicated leads.



(√) R155/R156: Install the prepared resistor combination on the circuit board at R155/R156. Position the combination 1/4" above the circuit board. Then solder the leads to the foil and cut off any excess lead lengths.



( ) R162: Start the lugs of 100 kΩ control (#10-941) into the circuit board holes at R162 and push the control down tight against the circuit board. Then solder the lugs to the foil.



Refer to Pictorial 2-5 for the following steps.

NOTE: When you are directed to prepare a **stranded** wire, cut the wire to the indicated length and remove 1/4" of insulation from each end. Twist together the fine strands at each end of the wire. Then melt a small amount of solder on these ends to hold the strands together.

( ) Prepare the following lengths of **small stranded** wires:

one 4-1/2" violet

one 4-1/2" yellow

two 4-1/2" white

two 6" black

two 6" white

one 6" violet

Loosely twist together (approximately one turn per inch) the prepared 4-1/2" violet wire and a 4-1/2" white wire. Then connect and solder one end of the 2-wire pair to the circuit board as follows. The other ends of these wires will be connected later.

( ) White wire to hole W.

( ) Violet wire to hole X.

Loosely twist together the prepared 4-1/2" yellow wire and the remaining 4-1/2" white wire. Then connect and solder one end of the 2-wire pair to the circuit board as follows:

( ) Yellow wire to hole KK.

( ) White wire to hole Y.

Loosely twist together a prepared 6" white wire and a 6" black wire. Then connect and solder one end of the 2-wire pair to the circuit board as follows:

( ) Black wire to hole BB.

( ) White wire to hole CC.

Loosely twist together the remaining 6" white and 6" black wires. Then connect and solder one end of the 2-wire pair to the circuit board as follows:

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( ) White wire to hole NN.

( ) Black wire to hole AA.

( ) Connect and solder one end of the prepared 6" violet wire to hole 180V.

( ) Prepare the following lengths of **large solid** wire:

12" blue

7" blue

12" yellow

19" orange

12" brown

Connect and solder one end of the prepared wires to the circuit board as follows:

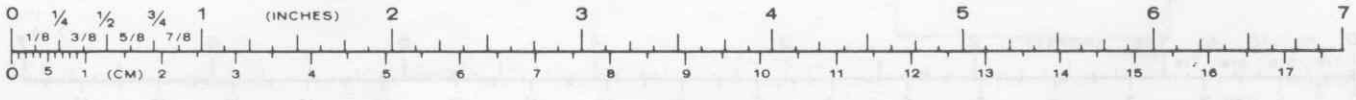
( ) 12" blue wire to hole D.

( ) 7" blue wire to hole C.

( ) 12" yellow wire to hole RR.

( ) 19" orange wire to hole M.

( ) 12" brown wire to hole N.



( ) Prepare the following lengths of shielded cable. Use the same procedure as you did when you prepared shielded cables for the demodulator circuit board. If necessary, refer back to Detail 1-2B (Illustration Booklet, Page 2).

Two 8″

One 21″

Connect and solder one end of a prepared 8″ shielded cable to the circuit board as follows:

( ) Inner wire to hole EE.

( ) Shield wire to hole FF.

Connect and solder one end of the remaining prepared 8″ shielded cable to the circuit board as follows:

( ) Inner wire to hole PP.

( ) Shield wire to hole QQ.

Connect and solder one end of the prepared 21″ shielded cable to the circuit board as follows:

( ) Inner wire to hole U.

( ) Shield wire to hole V.

( ) Prepare the following lengths of **small stranded** wire:

20″ yellow

20″ violet

23″ white

Loosely twist together the three prepared wires (keep the ends even at one end of the wires). Then connect the even end of the twisted group to the circuit board as follows:

( ) Yellow to hole T.

( ) White to hole Z.

( ) Violet to hole DD.

( ) Refer to Detail 2-5A and prepare the following lengths of 300 Ω flat cable. Be careful you do not pull the wire out of the insulation.

4-1/2″

14″

Connect and solder one end of the prepared flat cables to the circuit board as follows:

( ) 4-1/2″ to holes Q and P.

( ) 14″ to holes R and S.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most-commonly-made errors:

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns (refer to the X-ray view on Page 73).

( ) Protruding leads which could touch each other or the chassis when the circuit board is mounted later.

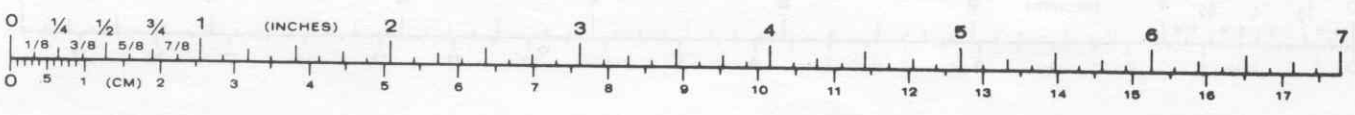
Refer to the illustrations where parts were installed as you make the following visual checks:

( ) Diodes for the proper **type** and **installation**.

( ) Transistors for the proper **type** and **installation**.

( ) Electrolytic capacitors for the correct position of the positive (+) or negative (−) marked lead.

This completes the assembly of the "Main Circuit Board." Set it aside until it is called for during the assembly of the chassis. NOTE: Do not flex the wires and cables coming from the circuit board any more than necessary. To do so could break some of the wires.



CHASSIS

PARTS LIST

Unpack the remainder of the kit and check each part against the following list. The key numbers correspond to the numbers on the "Chassis Parts Pictorial." If a part is packed in an individual envelope, with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you account for all of the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS				
NOTE: The following resistors have a tolerance of 5% unless otherwise listed. A 5% tolerance is indicated by a fourth color band of gold.				
A1	2-51	2	900 kΩ, 1/2-watt, 1% precision	R3, R5
A2	6-104-12	2	100 kΩ, 1/4-watt (brn-blk-yel)	R4, R6
A3	6-474-1	1	470 kΩ, 1-watt (yel-viol-yel)	R16
A4	6-105	2	1 MΩ, 1/2-watt (brn-blk-grn)	R18, R19
A3	6-225-1	1	2.2 MΩ, 1-watt (red-red-grn)	R14
CAPACITORS				
Ceramic				
B1	21-78	1	5 pF	C5
B1	21-61	2	6.8 pF	C13, C19
B1	21-3	1	10 pF (may be marked 10K)	C6
B1	21-5	1	20 pF	C7
B1	21-147	3	47 pF	C8, C14, C21
B1	21-75	1	100 pF (may be marked 100K)	C9
B1	21-11	1	150 pF	C11
B1	21-17	2	270 pF	C22, C23
Other Capacitors				
B2	20-159	1	39 pF mica	C1
B3	25-197	1	1 μF tantalum	C16
B4	25-917	1	10 μF electrolytic	C15
B5	27-77	1	.1 μF, 50 V or 100 V Mylar	C17
B6	27-112	2	.1 μF, 600 V Mylar	C12, C18
B7	28-3	1	.56 pF phenolic (grn-blu-gry-silv)	C2
B7	28-2	1	1 pF phenolic (brn-blk-wht-silv)	C3
B7	28-1	1	2.2 pF phenolic (red-red-wht)	C4
CONTROLS—SWITCHES				
C1	10-1221	2	1000 Ω (1k)	R7, R13
C1	10-1222	2	5000 Ω (5k)	R8, R9
C1	10-1223	1	10 kΩ	R12
C1	10-1224	1	250 kΩ	R17
C1	10-1225	1	1 MΩ	R15
C2	60-2	1	Slide switch	SW2A/SW2B
C3	63-1418	1	Rotary switch wafer	SW1
C4	64-943	1	Pushbutton switch assembly	SW3, SW4, SW5, SW6, SW7, SW8, SW9

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

INSULATORS—GROMMETS

D1	73-5	1	Cushion strip
D2	73-47	1	Square gasket
	74-4	1	Roll of black tape
D3	75-741	1	Insulator paper
D4	75-754	1	Strain relief

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW#4, or HDW#6, etc.). You may have to open more than one packet in this pack to locate all of the hardware of any one size (#6, for example).

#4 Hardware

E1	250-1412	16	4-40 × 3/8" screw
E2	252-2	10	4-40 nut
E3	254-9	10	#4 lockwasher

#6 Hardware

F1	250-33	8	6-32 × 1/8" setscrew
F2	250-1325	14	6-32 × 1/4" screw
F3	250-1307	16	#6 × 1/4" sheet metal screw
F4	250-1280	4	6-32 × 3/8" screw
F5	250-1305	1	#6 × 5/8" self-tapping screw
F6	250-1331	4	6-32 × 5/8" screw
F7	252-3	14	6-32 nut
F8	254-1	18	#6 lockwasher
F9	255-708	2	6-32 × 1-3/4" spacer
F10	259-1	2	#6 solder lug
F11	259-6	2	Plain #6 solder lug

Other Hardware

G1	250-16	1	8-32 × 3/16" setscrew
G2	250-1436	2	8-32 × 3/8" screw
G3	252-4	2	8-32 nut
G4	252-7	7	Control nut
G5	253-10	7	Control flat washer
G6	253-721	1	Spring washer
G7	254-2	4	#8 lockwasher
G8	254-5	5	Control lockwasher
G9	259-10	2	Control solder lug
G10	455-15	1	Shaft collar

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

SHEET METAL PARTS

H1	90-1334-1	1	Cabinet shell
H2	200-1479-1	1	Chassis
H3	206-584	1	CRT shield
H4	206-1493	1	Input shield
H5	206-1494	1	Demodulator shield
H6	207-1	2	CRT clamp

SOCKETS—TERMINAL STRIPS

J1	434-41	1	CRT socket	
J2	434-82	2	Dual phono socket	S3/S4, S5/S6
J3	436-5	2	Coaxial socket	S1, S2
J4	431-2	2	2-lug terminal strip	
J5	431-609	1	5-lug terminal strip	

MISCELLANEOUS

K1	45-6	2	8.48 μH RF choke	RFC2, RFC3
K2	45-30	2	500 μH RF choke	RFC1, RFC4
K3	54-1034	1	Power transformer	T1
	89-54	1	Line cord	
K4	261-28	4	Foot	
K5	354-5	7	Cable tie	
K6	411-142	1	3RP1A cathode-ray tube (CRT)	V1
K7	421-20	1	1/2-ampere, 3AG, slow-blow fuse	F1
K8	453-358	1	Shaft	
K9	455-44	1	Shaft bearing	
K10	462-1130	4	Large knob	
K11	462-1151	4	Small knob	

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STEP-BY-STEP ASSEMBLY

PARTS MOUNTING

Refer to Pictorial 3-1 for the following steps.

( ) Position the chassis bottom-side-up as shown in Detail 3-1A. Then carefully peel the backing paper from the four feet and press them onto the bottom of the chassis in the indicated areas.

( ) Reposition the chassis as shown in the Pictorial.

( ) Refer to Detail 3-1B and scrape or sand the excess paint away from the indicated holes on the inside of the chassis. It is important that the parts that will be mounted at these locations make a good mechanical contact with the chassis.

( ) Cut the square gasket into four equal-sized squares. Carefully peel away the backing paper from the four square gaskets and press them onto the tabs on the front of the chassis as shown in the Pictorial.

( ) Carefully peel the backing paper from the front panel label. Then refer to Detail 3-1C and use the following procedure to install the label onto the front of the chassis:

1. Carefully peel the backing paper from the label.
2. Line up the holes in the label with the holes in the front of the chassis.
3. Press the label onto the chassis. NOTE: Be sure you have the label properly lined up; it is almost impossible to remove once it adheres to the chassis.

( ) Refer to Detail 3-1D and install a shaft bearing into hole A in the front of the chassis. NOTE: You may have to cut the bearing a small amount so it will fit into the chassis hole. Cut away only as much as necessary so you can push it into the hole (refer to the inset drawing on the Detail).

NOTE: When you mount each of the following controls, be sure you position it as shown in the Pictorial before you tighten the hardware.

( ) R9: Refer to Detail 3-1E and mount a 5000 Ω (5k) control (#10-1222) on the inside front of the chassis at R9 as shown. Use a control lockwasher, a control flat washer, and a control nut.

( ) R7: Similarly mount a 1000 Ω (1k) control (#10-1221) on the inside front of the chassis at R7. Use a control lockwasher, a control flat washer and a control nut.

( ) R8: Similarly mount a 5000 Ω (5k) control (#10-1222) on the inside front of the chassis at R8. Use a control lockwasher, a control flat washer, and a control nut.

( ) R13: Similarly mount a 1000 Ω (1k) control (#10-1221) on the inside front of the chassis at R13. Use a control lockwasher, a control flat washer, and a control nut.

( ) R12: Refer to Detail 3-1F and mount a 10 kΩ control (#10-1223) onto the inside front of the chassis at R12 as shown. Use control solder lug, a control flat washer, and a control nut. Be sure to position the control and the solder lug as shown in the Pictorial before you tighten the hardware.

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( ) R15: Mount a 1 MΩ control (#10-1225) onto the inside front of the chassis at R15. Use a control **lockwasher**, a control flat washer, and a control nut.

( ) R17: Mount a 250 kΩ control (#10-1224) onto the inside front of the chassis at R17. Use a control **solder lug**, a control flat washer, and a control nut. Be sure to position the control and the solder lug as shown in the Pictorial before you tighten the hardware.

NOTES:

1. When a step calls for hardware, only the screw size is given. If a step calls for "4-40 × 3/8" hardware", for example, it means you should use a 4-40 × 3/8" screw, one or more #4 lockwashers, and a 4-40 nut. The Detail referred to in the step shows the proper number of lockwashers and their proper use.

2. When you mount a terminal strip, as in the next step, be sure you position it as it is shown in the Pictorial before you tighten the hardware.

( ) Refer to Detail 3-1G and mount a 2-lug terminal strip onto the inside bottom of the chassis at B as shown. Use 6-32 × 1/4" hardware.

( ) Similarly mount a 2-lug terminal strip onto the inside bottom of the chassis at C. Use 6-32 × 1/4" hardware.

( ) Similarly mount a 5-lug terminal strip on the inside bottom of the chassis at D. Use 6-32 × 1/4" hardware.

( ) Refer to Detail 3-1H and mount a 6-32 × 1-3/4" spacer onto the inside bottom of the chassis at E. Use a 6-32 × 5/8" screw, two #6 lockwashers, and a 6-32 nut as shown.

( ) Similarly mount a 6-32 × 1-3/4" spacer onto the inside bottom of the chassis at F. Use a 6-32 × 5/8" screw, two #6 lockwashers, and a 6-32 nut.

( ) Refer to Detail 3-1J and mount a #6 solder lug onto the inside bottom of the chassis at G as shown. Use a 6-32 × 1/4" screw and a 6-32 nut. Be sure to position the solder lug as shown in the Pictorial before you tighten the hardware.

( ) T1: Refer to Detail 3-1K and use the following procedure to mount the power transformer onto the inside bottom of the chassis:

1. Shorten the black and black-red transformer leads to 3". Measure the leads from the point where they exit the transformer. Then remove 3/8" of insulation from the ends of these leads. Do not shorten the other transformer leads.

2. Sand or scrape any excess varnish from the two transformer mounting tabs.

3. Use 8-32 × 3/8" hardware to mount the transformer onto the chassis as shown. Be sure to position the transformer so the black leads are toward terminal strip D as shown in the Pictorial.

( ) S1: Refer to Detail 3-1L and mount a coaxial socket onto the inside rear of the chassis at S1 as shown. Use 4-40 × 3/8" hardware. Be sure to position this socket so the hole in lug 1 faces upward.

( ) S2: Similarly mount a coaxial socket onto the inside rear of the chassis at S2 as shown. Use 4-40 × 3/8" hardware. Be sure to position the socket so lug 1 faces upward.

( ) S3/S4: Refer to Detail 3-1M and mount a dual phono socket on the inside rear of the chassis at S3/S4. Use 6-32 × 1/4" hardware.

( ) SW1: Refer to Detail 3-1N and mount the rotary switch wafer onto the inside rear of the chassis at SW1. Use 4-40 × 3/8" hardware. Be sure to position the rotary switch so the three close-spaced lugs are in the indicated locations.

(✓) Carefully bend the lugs on switch SW1 away from the chassis a small amount so you can connect components to these lugs later.

(✓) S5/S6: Mount a dual phono socket onto the inside rear of the chassis at S5/S6. Use 6-32 × 1/4" hardware.

(✓) SW2: Refer to Detail 3-1P and mount the slide switch onto the inside rear of the chassis at SW2 as shown. Use two 6-32 × 1/4" screws and a #6 solder lug. Be sure to position the solder lug as shown in the Pictorial before you tighten the hardware.

WIRING

Refer to Pictorial 3-2 for the following steps.

(✓) Position the chassis as shown in the Pictorial.

NOTES:

1. In the following steps, (NS) means not to solder the connection because you will add other wires later. "S-" with a number, such as (S-2), means to solder the connection. The number following the "S-" tells you how many wires should be at the connection. This helps you check your work for errors as you go.

2. You will connect small capacitors to the lugs of switch SW1 in the following steps. Before you connect each capacitor, cut both of its leads to 1/4."

(✓) C2: Connect a .56 pF phenolic capacitor (grn-blu-gry-silv) between lugs 2 (S-1) and 3 (NS).

(✓) C3: Connect a 1 pF phenolic capacitor (brn-blk-wht-silv) between lugs 3 (S-2) and 4 (NS).

(✓) C4: Connect a 2.2 pF phenolic capacitor (red-red-wht) between lugs 4 (S-2) and 5 (NS).

(✓) C5: Connect a 5 pF ceramic capacitor between lugs 5 (S-2) and 6 (NS).

(✓) (10K) C6: Connect a 10 pF ceramic capacitor between lugs 6 (S-2) and 7 (NS).

(✓) C7: Connect a 20 pF ceramic capacitor between lugs 7 (S-2) and 8 (NS).

(✓) C8: Connect a 47 pF ceramic capacitor between lugs 8 (S-2) and 9 (NS).

(✓) 100K C9: Connect a 100 pF ceramic capacitor between lugs 9 (S-2) and 10 (NS).

(✓) C11: Connect a 150 pF ceramic capacitor between lugs 10 (S-2) and 11 (NS).

(✓) Use four 4-40 × 3/8" screws to mount the demodulator circuit board to the chassis as shown. Be sure to position the circuit board as shown in the Pictorial.

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(X) Cut a 1-3/4" length of bare wire. Then connect the wire from coaxial socket S2 lug 1 (S-1) to coaxial socket S1 lug 1 (NS).

(X) Cut a 3/4" length of small sleeving and slide it over the free lead of resistor R1 (coming from hole F of the demodulator circuit board). Then connect the free end of the lead to the bare wire that is connected between coaxial sockets S1 and S2 (S-1).

(X) Connect the free end of the green wire coming from the demodulator circuit board to switch SW1 lug 11 (S-2).

(X) Pass the free lead of resistor R2 (coming from hole P of the demodulator circuit board) through socket S4 lug 1 and connect it to socket S3 lug 1 (S-1). Now solder the lead to socket S4 lug 1.

(X) C1: Cut two 1" lengths of small sleeving and slide the sleeving onto each lead of a 39 pF mica capacitor. Then connect the capacitor from coaxial socket S1 lug 1 (S-2) to switch SW1 lug 12 (S-1).

100 101 100 101 .000,000 K

10PF = 10K

100 PF = 100K

( ) Carefully inspect the lugs on switch SW1. Be sure none of the leads, wires, or solder connections on this switch touch the chassis or the switch mounting hardware.

( ) C22: Cut both leads of a 270 pF ceramic capacitor to 1/4". Then connect the capacitor between the **eyelet** of terminal strip B lug 1 (S-1) and the center eyelet (NS).

( ) C23: Cut both leads of a 270 pF ceramic capacitor to 1/4". Then connect the capacitor between the **eyelet** of terminal strip B lug 2 (S-1) and the center eyelet (S-2).

( ) RFC1: Cut both leads of a 500 µH RF choke (#45-30) to 3/4". Then connect the choke from terminal strip B lug 1 (NS) to terminal strip C lug 1 (NS).

( ) RFC4: Cut both leads of a 500 µH RF choke (#45-30) to 3/4". Then connect the choke from terminal strip B lug 2 (NS) to terminal strip C lug 2 (NS).

( ) Cut two 3/4" lengths of small sleeving. You will use these lengths of sleeving in the next two steps.

( ) RFC2: Cut both leads of an 8.48 µH RF choke (#45-6) to 1". Slide a 3/4" length of sleeving onto one lead of the choke. Then connect this lead to terminal strip C lug 1 (S-2). The other choke lead will be connected later.

( ) RFC3: Cut both leads of an 8.48 µH RF choke (#45-6) to 1". Slide a 3/4" length of sleeving onto one lead of the choke. Then connect this lead to terminal strip C lug 2 (S-2). The other choke lead will be connected later.

NOTE: Refer to the inset drawing on the Pictorial whenever a step directs you to "make a mechanically secure connection."

( ) Connect the black-red power transformer lead to terminal strip D lug 1 (NS). Make a mechanically secure connection.

( ) Connect the black power transformer lead to terminal strip D lug 5 (NS). Make a mechanically secure connection.

( ) Refer to Detail 3-2A and use the following procedure to prepare the end of the line cord:

1. Remove 3-1/2" of outer insulation from the line cord.
2. Shorten the white wire to 2-1/2" and the black wire to 3".
3. Carefully remove 3/8" of insulation from the end of each wire and prepare the ends.

( ) Push the end of the line cord through hole H in the rear of the chassis. Then refer to the numbers on Detail 3-2B and use the following procedure to install the strain relief on the line cord:

1. Push the end of the line cord through the flanged hole of the strain relief so the end of the green wire is 5" away from the strain relief.
2. Loop the line cord over and through the other hole in the center of the strain relief.
3. Pull the end of the line cord through the remaining hole in the strain relief as shown.
4. Hold the end of the line cord so that 4" of it protrudes from the strain relief.
5. Work all of the excess line cord back through the first two holes. Make sure the center loop is down in the center recess.
6. Position the flanged end of the strain relief hole into rear chassis hole H. Then use a #6 × 5/8" self-tapping screw to secure the strain relief to the chassis.

(X) Connect the end of the green line cord wire to solder lug G (S-1). Make a mechanically secure connection. NOTE: Do not shorten this wire even though it seems to be too long.

(X) Connect the end of the white line cord wire to terminal strip D lug 1 (S-2). Make a mechanically secure connection.

(X) Connect the end of the black line cord wire to terminal strip D lug 2 (S-1). Make a mechanically secure connection.

(X) Cut two 16″ lengths of large black stranded wire. Remove 3/8″ of insulation from each end of each wire and prepare the ends.

Loosely twist together the two prepared black wires. Then connect one end of the 2-wire pair to terminal strip D as follows:

(X) Either wire to lug 4 (S-1). Make a mechanically secure connection.

(X) Remaining wire to lug 5 (S-2). Make a mechanically secure connection.

(X) Route the free end of the 2-wire twisted pair toward the front of the chassis as shown. It will be connected later.

(X) Route the three shielded cables coming from the demodulator circuit board toward the front of the chassis as shown. The free ends of these cables will be connected later.

Refer to Pictorial 3-3 for the following steps.

(X) Position the chassis as shown in the Pictorial.

(X) Prepare two 2″ lengths of **small green solid** wire. Use these wires in the next two steps.

(X) Connect a 2″ green wire from control R8 lug 3 (NS) to the nearby control solder lug (NS).

(X) Connect the remaining 2″ green wire from control R9 lug 3 (NS) to the nearby solder lug (NS).

(X) Cut a 2″ length of **small green solid** wire. Then remove all of the insulation from this wire and cut it into two 1″ bare wires. Use these bare wires in the next two steps.

(X) Connect a 1″ bare wire from control R13 lug 3 (S-1) to control R8 lug 3 (S-2).

(X) Connect the remaining 1″ bare wire from control R7 lug 3 (S- 1) to control R9 lug 3 (S-2).

(X) R16: Cut both leads of a 470 kΩ, 1-watt (yel-viol-yel) resistor to 1/2″. Then connect the resistor from control R17 lug 1 (S-1) to control R15 lug 3 (S-1).

(X) R14: Cut both leads of a 2.2 MΩ, 1-watt (red-red-grn) resistor to 1/2″. Then connect the resistor from control R15 lug 1 (S-1) to the nearby control solder lug (S-2).

(X) Prepare the following lengths of **small stranded** wire:

4″ black

4″ white

5″ white

(X) Connect one end of the 4″ black wire to the control solder lug that is mounted on control R12 (S-2). Route the other end of this wire up toward the top of the chassis as shown. It will be connected later.

(X) Connect one end of the 4″ white wire to control R9 lug 2 (NS). Route the other end of this wire up toward the top of the chassis as shown. It will be connected later.

(X) Connect one end of the 5″ white wire to control R13 lug 1 (NS). Route the other end of this wire up toward the top of the chassis. It will be connected later.

(X) Prepare the following lengths of **large solid** wire:

20″ violet

20″ green

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Loosely twist together the prepared violet and green wires. Then connect one end of this twisted pair as follows:

( ) Violet wire to control R17 lug 2 (S-1).

( ) Green wire to control R15 lug 2 (S-1).

( ) Route the violet and green twisted pair along the front and toward the rear of the chassis as shown. The free ends of these wires will be connected later.

Refer to Pictorial 3-4 for the following steps.

( ) Set the main circuit board into the chassis as shown in the Pictorial.

( ) Temporarily route the two green power transformer wires out through hole J in the rear panel to keep them out of the way while you perform the following steps. These wires will be connected later.

NOTE: Do not shorten the power transformer wires in the following steps. To do so will make it difficult to raise the main circuit board in the event service ever becomes necessary.

Loosely twist together the two brown power transformer wires. Then connect the free end of this twisted pair to the main circuit board as follows:

( ) Either wire to hole A (S-1).

( ) Remaining wire to hole B (S-1).

Loosely twist together the two red power transformer wires. Then connect the free end of this twisted pair to the main circuit board as follows:

( ) Either wire to hole G (S-1).

( ) Remaining wire to hole H (S-1).

Loosely twist together the white, yellow, and white-yellow power transformer wires. Then connect the free ends of these wires to the main circuit board as follows:

( ) White wire (not the white-yellow wire) to hole J (S-1).

( ) Yellow wire to hole F (S-1).

( ) White-yellow wire to hole E (S-1).

Route the shielded cable coming from holes A and B of the demodulator circuit board as shown. Then connect the free end of this cable to the main circuit board as follows:

( ) Inner wire to hole LL (S-1).

( ) Shield wire to hole MM (S-1).

( ) Use four 6-32 × 3/8″ screws to secure the main circuit board to the studs on the bottom of the chassis at MA, MB, MC, and MD.

( ) Route the free end of the large blue wire coming from main circuit board hole D as shown. Then connect the free end of this wire to control R17 lug 3 (S-1).

( ) Route the shielded cable coming from main circuit board holes EE and FF along the front of the chassis as shown. The free end of this cable will be connected later.

( ) Route the shielded cable coming from main circuit board holes QQ and PP along the front of the chassis as shown. The free end of this cable will be connected later.

Connect the free end of the twisted pair of wires coming from main circuit board holes AA and NN to control R13 as follows:

( ) Black wire to lug 2 (S-1).

( ) White wire to lug 1 (S-2).

Connect the free end of the twisted pair of wires coming from main circuit board holes BB and CC to control R8 as follows:

( ) White wire to lug 2 (S-1).

( ) Black wire to lug 1 (S-1).

Connect the free end of the twisted pair of wires coming from main circuit board holes Y and KK to control R7 as follows:

( ) White wire to lug 2 (S-1).

( ) Yellow wire to lug 1 (S-1).

Connect the free end of the twisted pair of wires coming from main circuit board holes W and X to control R9 as follows:

( ) Violet wire to lug 2 (S-2).

( ) White wire to lug 1 (S-1).

Route the 3-wire group coming from main circuit board holes T, Z, and DD as shown. Then connect two of the wires to control R12 as follows:

( ) Yellow wire to lug 2 (S-1).

( ) Violet wire to lug 3 (S-1).

NOTE: The white wire will be connected later.

Refer to Pictorial 3-5 for the following steps.

( ) Refer to Detail 3-5A and use the following procedure to prepare and mount the pushbutton switch assembly inside the front of the chassis:

1. Refer to inset drawing #1 on the Pictorial and cut off the indicated pins (without the holes) of switch SW9. Cut them off as close as possible to the switch body.

2. Use two 4-40 × 3/8" screws and two plain #6 solder lugs to mount the switch assembly to the front panel at FA and FB. Be sure to mount the switch so the switch lugs that have holes are up as shown. Also be sure to position the solder lugs as shown in the Pictorial before you tighten the screws.

( ) Cut a 5-5/8" length of bare wire. Then connect the wire from solder lug FA (S-1) to solder lug FB (S-1).

NOTES:

1. When a wire passes through one lug and goes on to another lug, it counts as two wires in the solder instructions; one entering and one leaving the connection.

2. Refer to inset drawing #2 on the Pictorial for the proper lug numbers when you connect wires to the pushbutton switches.

( ) Remove all of the insulation from a 1" length of **small green solid** wire. Then pass one end of the wire through switch SW5 lug 5 (NS), through switch SW4 lugs 2 (S-2) and 8 (S-2), to switch SW3 lug 1 (S-1). Now solder the end of the wire to switch SW5 lug 5 (S-1) and cut off any excess wire length.

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( ) Prepare a 1-1/4" length of **small violet stranded** wire. Then connect the wire from switch SW5 lug 2 (S-1) to switch SW6 lug 11 (S-1).

( ) Prepare a 1-1/4" length of **small green solid** wire. Then remove an additional 1/4" (total 1/2") of insulation from one end.

( ) Pass the longer bared end of the prepared wire through switch SW7 lug 5 (S-2) to switch SW6 lug 2 (NS). Connect the other wire end to switch SW8 lug 5 (S-1).

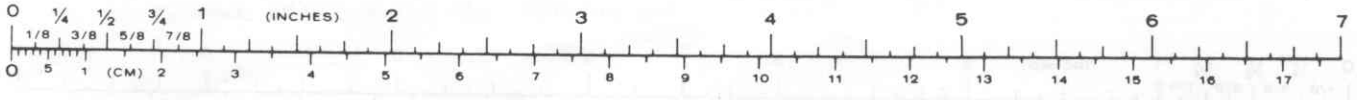
( ) Prepare a 4" length of **small yellow stranded** wire. Then connect the wire from switch SW6 lug 2 (S-2) to switch SW3 lug 3 (NS). Be sure to route this wire under the switch assembly as shown.

( ) Connect the free end of the white wire coming from the 3-wire group (coming from the main circuit board) to switch SW6 lug 9 (NS).

( ) Connect the free end of the white wire coming from control R9 to switch SW4 lug 5 (S-1).

( ) Connect the free end of the black wire coming from the control solder lug, near control R9, to switch SW4 lug 6 (S-1).

( ) Connect the free end of the white wire coming from R13 to switch SW4 lug 11 (S-1).



(✓) Connect the free end of the violet wire coming from main circuit board hole 180V to switch SW3 lug 5 (S-1).

(✓) Route the large orange wire coming from main circuit board hole M as shown. Then connect the free end of this wire to switch SW3 lug 6 (S-1).

(✓) Remove an additional 1/4" (total 5/8") of insulation from the free ends of the large black twisted pair of wires coming from terminal strip D.

(✓) Pass the end of one of the black wires coming from the twisted pair through switch SW9 lug 2 (S-2) to lug 5 (S-1). Make mechanically secure connections. NOTE: You may wish to twist these lugs 90 degrees to make it easier to pass the wire through them.

(✓) Pass the end of the remaining black wire coming from the twisted pair through switch SW9 lug 3 (S-2) to lug 6 (S-1). Make mechanically secure connections.

Refer to Pictorial 3-6 for the following steps.

(✓) Slide the 1" length of large sleeving onto switch SW9 so it completely covers all of the lugs. Then refer to the inset drawing on the Pictorial and use the heat of a match or lighter to shrink the sleeving so it fits tightly around the switch.

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(X) C17: Cut both leads of a .1 µF, 50V or 100V Mylar capacitor to 1/2". Then connect the capacitor from switch SW8 lug 6 (S-1) to switch SW7 lug 6 (NS).

NOTE: The positive lead of the tantalum capacitor that you will install in the next step may be marked with a positive (+) mark or a color dot.

(X) C16: Cut both leads of a 1 µF tantalum capacitor to 1/2". Then connect the lead at the positive end of this capacitor to switch SW6 lug 3 (NS). Connect the other capacitor lead to switch SW7 lug 6 (S-2). Position this capacitor so its leads do not touch any switch lugs other than those it is connected to.

check

(X) C15: Cut both leads of a 10 µF electrolytic capacitor to 1/2". Then connect the positive (+) lead of this capacitor to switch SW6 lug 9 (S-2). Connect the negative (−) lead to switch SW6 lug 3 (S-2).

(X) Cut seven 1/2" lengths of small sleeving. Slide a length of sleeving onto each of the shield wires when you connect them in the following steps.

Connect the free end of the shielded cable coming from main circuit board holes QQ and PP as follows:

(X) Inner wire to switch SW3 lug 2 (S-1).

(X) Wrap the end of the shield wire around the bare wire that is connected between solder lugs FA and FB. Then solder the connection. Be sure to use a length of sleeving on this wire. NOTE: Use this same method whenever you connect a wire to the large bare wire.

Route the free end of the shielded cable coming from main circuit board holes EE and FF under switch SW5 as shown. Then connect the free end of this cable as follows:

(X) Inner wire to switch SW5 lug 3 (NS).

(X) Shield wire (with sleeving) to the bare wire that is connected between solder lugs FA and FB (S-1).

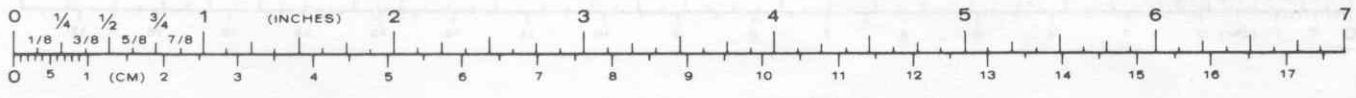
Route the free end of the shielded cable coming from main circuit board holes U and V as shown. Then connect the free end of the shielded cable as follows:

(X) Inner wire to switch SW3 lug 3 (S-2).

(X) Shield wire (and sleeving) to the bare wire that is connected between solder lugs FA and FB (S-1).

Connect the free end of the shielded cable coming from demodulator circuit board holes M and N as follows:

( ) Inner wire to switch SW4 lug 9 (S-1).



(X) Shield wire (and sleeving) to the bare wire that is connected between solder lugs FA and FB (S-1).

Connect the free end of the shielded cable coming from demodulator circuit board holes K and L as follows:

(X) Inner wire to switch SW4 lug 12 (S-1).

(X) Shield wire (and sleeving) to the bare wire that is connected between solder lugs FA and FB (S-1).

(X) Refer to Detail 3-6A and prepare the following lengths of shielded cable:

21″

20″

Route the prepared 21″ cable as shown and connect one end as follows. NOTE: The other end of the cable will be connected later.

(X) Inner wire to switch SW5 lug 6 (S-1).

(X) Shield wire (and sleeving) to the bare wire that is connected between solder lugs FA and FB (S-1).

Route the prepared 20″ cable as shown and connect one end as follows. NOTE: The other end of the cable will be connected later.

(X) Inner wire to switch SW5 lug 3 (S-2).

(X) Shield wire (and sleeving) to the bare wire that is connected between solder lugs FA and FB (S-1).

Connect the free end of the flat cable coming from main circuit board holes Q and P to terminal strip B as follows. NOTE: Be sure to connect the correct wire to the proper lug.

(X) Wire from hole P to lug 1 (S-2).

(X) Wire from hole Q to lug 2 (S-2).

WARNING: Handle the CRT very carefully. Because of its high vacuum, do not strike, scratch, or subject the CRT to more than moderate pressure at any time. A fracture of the glass could result in an implosion of considerable violence capable of causing personal injury.

(X) Carefully unpack the CRT.

(X) Cut seven 1″ pieces of black tape. Then refer to Detail 3-6B Part A and press four of the pieces onto the short side of the CRT shield as shown.

(X) Refer to Detail 3-6B Part B and tape the short side of the CRT shield to the CRT neck so the edge of the shield is even with the outer edge of the CRT plug insulator. Wrap the shield tightly around the CRT neck and use the three remaining pieces of tape to hold the shield in place at the ends and center. Then wrap three turns of tape over the three taped locations.

(X) Place the CRT face down on a cloth pad. Then align the CRT socket keyway with the CRT key and carefully, but firmly, press the socket into place on the base of the CRT.

(X) R19: Cut both leads of a 1 MΩ, 1/2-watt (brn-blk-grn) resistor to 1/2″. Then refer to Detail 3-6C and connect the resistor between CRT socket lugs 1 (NS) and 2 (NS).

(X) R18: Cut both leads of a 1 MΩ, 1/2-watt (brn-blk-grn) resistor to 3/4″. Then refer again to Detail 3-6C and connect the resistor between CRT socket lugs 3 (S-1) and 5 (NS).

(X) Position the larger end of the CRT into its opening in the front of the chassis as shown in the Pictorial. Position the CRT so the locating key is at the 8 o'clock position (as viewed from the rear of the CRT).

(X) Cut the cushion strip into two equal lengths.

(X) Refer to Detail 3-6D and press a length of cushion strip into each of the CRT clamps as shown.

( ) Install the two CRT clamps on spacers E and F and around the neck of the CRT as shown in Detail 3-6E. Then use two 6-32 × 5/8" screws to loosely secure the clamps to the spacers. Do not tighten these screws yet.

( ) Push the CRT toward the front of the chassis until its face just touches the back of the front panel label. Then tighten the screws at E and F.

( ) Route the free end of the large blue wire coming from main circuit board hole C as shown. Then connect the end of this wire to CRT socket lug 1 (NS).

Loosely twist together the two green power transformer wires. Then route the 2-wire twisted pair of wires as shown and connect the ends of these wires to the CRT socket as follows:

( ) Either wire to lug 1 (S-3).

( ) Remaining wire to lug 12 (S-1).

( ) Cut two 1/2" lengths of small sleeving. Use these lengths of sleeving in the next two steps.

( ) Slide a 1/2" length of sleeving onto the end of the lead coming from RFC3. Then connect the end of this lead to CRT socket lug 10 (NS). NOTE: Be sure to skip lug 11 of the socket.

( ) Slide a 1/2" length of sleeving onto the end of the lead coming from RFC2. Then connect the end of this lead to CRT socket lug 9 (NS).

Connect the free end of the flat cable coming from the demodulator circuit board to the CRT socket as follows. NOTE: Be sure this flat cable is **under** the shielded cable coming from demodulator circuit board holes A and B.

( ) Wire from hole D to lug 10 (S-2).

( ) Wire from hole C to lug 9 (S-2).

( ) Reposition chokes RFC2 and RFC3 so they are not touching the chassis, if this has not already been done.

( ) Route the large yellow wire coming from main circuit board hole RR as shown. Be sure this wire is under the flat cable that is connected between the CRT socket and the demodulator circuit board. Then connect the end of this wire to CRT socket lug 8 (S-1).

( ) Route the large brown wire coming from main circuit board hole N as shown. Then connect the end of this wire to CRT socket lug 2 (S-2).

Route the green and violet 2-wire pair of wires coming from the front of the chassis as shown. Be sure this 2-wire pair is **under** the two flat cables coming from the main circuit board. Then connect the free ends of these wires to the CRT socket as follows:

( ) Green wire to lug 4 (S-1).

( ) Violet wire to lug 5 (S-2).

Route the flat cable coming from main circuit board holes R and S over the top of the CRT as shown. Then connect the free end of this cable to the CRT socket as follows. NOTE: Be sure to connect the correct wire to the proper lug.

( ) Wire from hole S to lug 6 (S-1).

( ) Wire from hole R to lug 7 (S-1).

Refer to Pictorial 3-7 for the following steps.

( ) Position the chassis as shown in the Pictorial.

NOTE: Be sure in the next four steps that you connect the correct cable to the proper lugs of switch SW2.

Locate the free end of the shielded cable coming from switch SW5 **lug 3**. Be sure this cable is **under** the two flat cables coming from the main circuit board. Then connect the end of this cable as follows:

( ) Inner wire to switch SW2 lug 5 (S-1).

( ) Shield wire to socket S6 lug 2 (NS).

Locate the free end of the shielded cable coming from switch SW5 **lug 6**. Remove an additional 1/4" (total 1") of outer insulation from this end of the cable. Then connect the end of this cable as follows:

( ) Inner wire to switch SW2 lug 2 (S-1).

( ) Shield wire to socket S6 lug 2 (S-2).

NOTE: Refer to inset drawing #1 on the Pictorial for the next six steps.

( ) C18: Cut both leads of a .1 µF, 600V Mylar capacitor to 1/2". Then connect the capacitor from socket S6 lug 1 (S-1) to switch SW2 lug 1 (NS).

( ) C12: Cut both leads of a .1 µF, 600V Mylar capacitor to 1/2". Then connect the capacitor from socket S5 lug 1 (S-1) to switch SW2 lug 4 (NS).

( ) Refer to Detail 3-7A and wrap the leads of a 47 pF ceramic capacitor around the leads of a 100 kΩ (brn-blk-yel) resistor as shown. Solder the leads together and cut off the excess capacitor leads.

( ) R4/C14: Connect the prepared resistor-capacitor combination from switch SW2 lug 6 (NS) to the nearby solder lug (NS). Cut off the excess lead lengths.

( ) Use a 100 kΩ (brn-blk-yel) resistor and a 47 pF ceramic capacitor to prepare another resistor-capacitor combination.

( ) R6/C21: Connect the prepared resistor-capacitor combination from switch SW2 lug 3 (NS) to the nearby solder lug (S-2). Cut off the excess lead lengths.

( ) Refer to Detail 3-7B and wrap the leads of a 6.8 pF ceramic capacitor around the leads of a 900 kΩ, 1/2-watt, 1% precision resistor as shown. Then solder the leads together and cut off the excess resistor leads.

NOTE: Refer to inset drawing #2 on the Pictorial for the next three steps.

( ) R3/C13: Connect the prepared resistor-capacitor combination between switch SW2 lugs 4 (S-2) and 6 (S-2). Cut off any excess lead lengths.

( ) Use a 900 kΩ, 1/2-watt, 1% precision resistor and a 6.8 pF ceramic capacitor to prepare another resistor-capacitor combination.

( ) R5/C19: Connect the prepared resistor-capacitor combination between switch SW2 lugs 1 (S-2) and 3 (S-2). Cut off any excess lead lengths.

( ) F1: Push the 1/2-ampere, 3AG, slow-blow fuse into the fuse clips on terminal strip D.

NOTE: When you install the cable ties in the following steps, it is important that you install them around the correct wires and cables. This will make it easier for you to lift the main circuit board up in the event that repair ever becomes necessary.

( ) Refer to the inset drawing #3 on the Pictorial and install a cable tie around the following wires and cables at location #1 on the Pictorial:

five shielded cables

large orange wire

3-wire twisted group

( ) Install cables ties around all of the wires and cables at locations #2 and #3 on the Pictorial.

( ) Install a cable tie around the three shielded cables at location #4 on the Pictorial.

( ) Install a cable tie around the following wires and cables at location #5 on the Pictorial:

three shielded cables

large orange wire

large brown wire

large yellow wire

3-wire twisted group

( ) Install cables ties around the following wires at locations #6 and #7 on the Pictorial:

shielded cable

large brown wire

large orange wire

large yellow wire

3-wire twisted group

( ) Shake out any wire clippings, solder splashes, or other foreign matter that may be lodged in the wiring. Then check the chassis wiring for unsoldered connections, poor solder connections, and protruding leads that could touch the chassis or other connections.

Refer to Pictorial 3-8 for the following steps.

( ) Slide the demodulator shield into place on the rear of the chassis. Be sure the flat cable and the three shielded cables coming from the demodulator circuit board pass through the indicated holes. Also be sure the leads of the capacitors that are connected to switch SW1 do not touch the shield. Use four #6 × 1/4″ sheet metal screws to secure the shield to the chassis.

( ) Position the input shield into place on the rear of the chassis. Then use two #6 × 1/4″ sheet metal screws to secure the shield to the chassis. NOTE: Reposition the components behind the shield so their leads do not touch the shield.

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(X) Refer to Detail 3-8A Part A and use the following procedure to prepare an insulator:

1. Cut the insulator paper to 2-1/2″ × 3-1/2″.

2. Use a sharp knife to score the white side of the insulator 3/4″ from one end as shown. Do not cut all the way through the insulator paper.

3. Similarly score the gray side of the insulator paper 1-3/4″ from the same end as shown.

4. Fold the insulator into the shape shown in Part B of the Detail.

(X) Carefully peel away the backing paper from the smaller area at one end of the insulator. Then press the insulator onto the chassis as shown in the Pictorial so it completely covers terminal strip D.

(X) Start the 8-32 × 3/16″ setscrew into the shaft collar.

(X) Use the following procedure to install the shaft:

1. Slide the flatted end of the shaft through bearing A in the front of the chassis.

2. Refer to inset drawing #1 on the Pictorial and identify the curved side of the spring washer. Then slide the washer onto the flatted end of the shaft so the curved side of the washer is away from the front of the chassis.

3. Slide the shaft collar onto the flatted end of the shaft so it is against the spring washer.

4. Push the flatted end of the shaft through the indicated hole in the demodulator shield and into the flatted hole in switch SW1.

5. Hold the shaft in place while you slide the spring washer and shaft collar toward the front of the chassis until they are against the bearing at A.

6. Push the shaft collar against the spring washer and chassis. Then tighten the setscrew. NOTE: When you finish, there should be some tension on the spring washer.

NOTE: If you intend to install the Model HOA-5404-1 Pan Adaptor Accessory, install the label in the next step on the bottom of the chassis instead of on the rear of the chassis.

(X) Carefully peel away the backing paper from the blue and white label. Then press the label onto the rear of the chassis ~~so it covers the hole that is labeled PAN INPUT as shown~~ in inset drawing #2 on the Pictorial. Refer to the numbers on this label in any communications you may have with the Heath Company about your kit.

on Bottom Center of Rear Panel

Refer to Pictorial 3-9 for the following steps.

(X) Start a 6-32 × 1/8" setscrew into each of the knobs.

(X) Turn the shafts of controls R12, R15, R17, R9, R7, R8, and R13 fully counterclockwise.

(X) Install large knobs on the shafts of controls R9, R7, R8, and R13. Be sure each knob pointer is at the 7 o'clock before you tighten the setscrew.

(X) Install a small knob on the shaft of switch SW1(A) and tighten the setscrew. Disregard the knob pointer on this knob.

(X) Install small knobs on the shafts of controls R12, R15, and R17. Be sure each knob pointer is at the 7 o'clock position before you tighten the setscrew.

This completes the assembly of your Station Monitor. Proceed to "Tests and Adjustments."

A R12 R15 R17

R9 R7 R8 R13

TESTS & ADJUSTMENTS

INITIAL TESTS

In the following steps, you will perform certain tests to verify that your Station Monitor operates properly. If you do not obtain the correct results in any of the following steps, check the items listed in some of the steps or refer to the "Possible Cause" column, of the "Troubleshooting Chart" on Page 61. Correct the problem before you continue.

CAUTION: Do not connect the line cord to an AC outlet until a step directs you to do so.

PRIMARY WIRING TESTS

Refer to Pictorial 4-1 for the locations of the test points called out in the following steps.

IMPORTANT: A wiring error in the primary wiring circuit (line cord, power switch, etc.) of your kit could cause you to receive a severe electrical shock. These "Primary Wiring Tests" will help you eliminate any such wiring errors that may exist.

(X) Be sure the line cord plug is not connected to an AC outlet.

(X) Be sure the POWER switch (on the front panel) is in the OFF position (released).

NOTES:

1. If you do not have an ohmmeter, carefully check the line cord, switch SW9, and transformer wiring against that shown in Pictorials 3-2 and 3-5 (Illustration Booklet, Pages 12 and 15). Make sure there are no fine strands of wire or solder globs touching adjacent terminals or the chassis.

2. If you have an ohmmeter, perform the following resistance measurements. You will be instructed to connect one of the ohmmeter leads to ground. You may use the demodulator shield fastened to the rear of the chassis for this.

(X) Turn on your ohmmeter and allow it to warm up, if this has not already been done.

(X) Set the ohmmeter to the R x 10 k range.

NOTES:

1. The resistance readings in the following steps were taken with a VTVM. Readings taken with other ohmmeters (because of different measuring voltages and currents) may be considerably different.

2. The internal wiring of most ohmmeters is such that the positive terminal of the battery is connected to the negative (black) or common test lead. In some ohmmeters, this wiring is interchanged and erroneous readings may result. Interchange the ohmmeter leads if the measurements do not check out correctly the first time.

( ) Connect the negative ohmmeter lead to the chassis. Leave this lead connected to the chassis until a step directs you to disconnect it.

( ) Touch the positive ohmmeter lead to either flat prong of the line cord plug. The ohmmeter should indicate infinity with the POWER switch on or off. If you do not obtain the correct indication, check the wiring of terminal strip D and switch SW9.

( ) Touch the positive ohmmeter lead to the other flat prong of the line cord plug. The ohmmeter should indicate infinity with the POWER switch on or off. If you do not obtain the correct indication, check the wiring of terminal strip D and switch SW9.

( ) Set the ohmmeter to the R × 10 range.

( ) Touch the positive ohmmeter lead to the round prong of the line cord plug. The ohmmeter should indicate zero ohms with the POWER switch on or off. If you do not obtain the correct indication, make sure the green line cord wire is connected to solder lug G.

( ) Disconnect the negative ohmmeter lead from the chassis and connect it to either flat prong of the line cord plug.

( ) Connect the positive ohmmeter lead to the other flat prong of the line cord plug. The ohmmeter should indicate infinity with the POWER switch OFF and 10 to 30 ohms with the POWER switch ON. If you do not obtain the correct indications, check the wiring of terminal strip D and switch SW9.

( ) Disconnect the ohmmeter leads from the line cord plug.

SECONDARY WIRING TESTS

( ) Connect the negative ohmmeter lead to the chassis. Leave this lead connected to the chassis until a step directs you to disconnect it.

( ) Set the ohmmeter to the R × 1 M range.

( ) Touch the positive ohmmeter lead to CRT socket lug 1 (blue and green wires). The ohmmeter should indicate 3 MΩ or higher.

( ) Set the ohmmeter to the R × 10 k range.

( ) Touch the positive ohmmeter lead to the junction of resistors R148, R149, R151, and R152. The ohmmeter should indicate 90 kΩ or higher. NOTE: It may take several seconds for the ohmmeter to reach the indicated reading. This is due to the charging effect of some of the capacitors in the circuit.

( ) Set the ohmmeter to the R × 10 range.

( ) Touch the positive ohmmeter lead to the emitter (E) lead of transistor Q122. The ohmmeter should indicate 150 Ω or higher.

( ) Touch the positive ohmmeter lead to the collector (C) lead of transistor Q122. The ohmmeter should indicate 450 Ω or higher.

This completes the "Initial Tests." Proceed to "Adjustments."

ADJUSTMENTS

TRACE

Refer to Pictorial 4-2 for the locations of the test points and main circuit board controls called out in the following steps.

( ) Preset the front panel controls and switches as follows:

SSB pushbutton	Depressed.
1 kHz pushbutton	Depressed.
POWER pushbutton	Released.
ATTENUATOR control	Any position.
SWEEP control	Fully clockwise.
FOCUS control	Center of rotation.
INTENSITY control	Fully counterclockwise.
VERTICAL GAIN control	Fully counterclockwise.
VERTICAL POSITION control	Center of rotation.
HORIZONTAL GAIN control	Fully counterclockwise.
HORIZONTAL POSITION control	Center of rotation.

( ) Preset the main circuit board controls as follows:

ASTIGMATISM (R162)	Center of rotation.
VERTICAL BALANCE (R128)	So the arrow is at 7 o'clock (as shown in the Pictorial).
HORIZONTAL BALANCE (R139)	So the arrow is at 7 o'clock (as shown in the Pictorial).

( ) Preset the ATTENUATOR SWITCH on the rear panel to X1.

CAUTION: DANGEROUS VOLTAGES EXIST WITHIN THIS INSTRUMENT. Use extreme care whenever you operate or handle it when the cabinet is not installed. The dangerous voltage areas are shown in the Pictorial. Some of the highest voltages in this Monitor appear at the lugs of the CRT socket, the FOCUS control, and the INTENSITY control. **These voltages could be fatal.** Anytime you must handle a part in these areas, turn off the power, unplug the line cord, and allow the capacitors several minutes to discharge fully.

( ) Plug the line cord into the proper AC outlet.

( ) Depress the POWER pushbutton. Then turn the INTENSITY control clockwise to approximately 3/4 of its rotation.

( ) Allow one minute for the CRT to warm up. A spot should appear on the CRT screen. If no spot appears, simultaneously adjust the VERTICAL POSITION and HORIZONTAL POSITION controls until you locate the spot. If you are not able to find the spot, release the POWER switch and refer to the "In Case of Difficulty" section of this Manual.

( ) Adjust the INTENSITY control until the spot is visible, but not too bright.

( ) Alternately adjust the FOCUS and ASTIGMATISM (R162 on the main circuit board) controls for the smallest, sharpest spot possible.

( ) Rotate the HORIZONTAL POSITION control and notice that the spot moves horizontally across the CRT screen.

( ) Rotate the VERTICAL POSITION control and notice that the spot moves vertically on the screen.

( ) Adjust the VERTICAL POSITION and HORIZONTAL POSITION controls to center the spot on the screen.

NOTE: The following steps require a voltmeter capable of measuring up to 150 volts DC.

( ) Connect the negative lead of your voltmeter to the chassis.

( ) Set the voltmeter to measure +150 VDC.

( ) Depress the RTTY pushbutton.

( ) Make sure the VERTICAL GAIN and HORIZONTAL GAIN controls are fully counterclockwise.

( ) Use the VERTICAL POSITION and HORIZONTAL POSITION controls to center the dot on the screen, if this has not already been done.

( ) Alternately touch the positive voltmeter probe to test points R and S and adjust the HORIZONTAL POSITION control until the two voltages are equal.

( ) Adjust the HORIZONTAL BALANCE control (R139 on the main circuit board) for 80 volts DC at test points R and S.

( ) Alternately touch the positive voltmeter probe to test points P and Q and adjust the VERTICAL POSITION control until the two voltages are equal.

( ) Adjust the VERTICAL BALANCE control (R128 on the main circuit board) for 80 volts DC at test points P and Q.

( ) Since the balance adjustments may interact with each other, repeat the above four steps once more to make sure you have 80 volts at all four test points.

( ) Disconnect the voltmeter from the Station Monitor.

( ) Depress the SSB pushbutton.

( ) Slowly turn the HORIZONTAL GAIN control clockwise until you obtain a horizontal line or trace.

( ) Adjust the FOCUS control for the best focus at the center of the trace. Then adjust the ASTIGMATISM control for the best focus at each end of the trace.

NOTE: If the horizontal line is not parallel with the horizontal lines on the grid screen, perform the next three steps. If the lines are parallel, skip the following steps and proceed to "RF Sampling Checkout."

( ) 1. Loosen the two screws in the clamp at the base of the CRT, if this has not already been done. CAUTION: DO NOT touch the lugs of the CRT socket; hazardous voltages are present there.

( ) 2. Grasp the exposed glass area of the CRT near the front of the chassis. Then rotate the CRT as necessary until the lines are parallel.

( ) 3. Make sure the CRT is still just touching the front panel label. Then tighten the two screws in the CRT clamp.

( ) Release the POWER pushbutton to turn the Station Monitor off.

RF SAMPLING CHECKOUT

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( ) Connect a transmitter and a 50 Ω dummy load to the ANTENNA sockets on the rear panel of the Station Monitor as shown in Pictorial 4-3.

( ) Refer to Pictorial 4-4 and temporarily connect a suitable length of wire from the bus wire that connects the ANTENNA sockets together and the wire that connects the EXCITER sockets together.

( ) Depress the Monitor's POWER pushbutton and allow the Monitor to warm up.

( ) Turn the transmitter on.

( ) Preset the Station Monitor's front panel controls and switches as follows. All other pushbuttons should be released.

SSB pushbutton	Depressed.
100 Hz pushbutton	Depressed.
VERTICAL GAIN control	Fully counterclockwise.
HORIZONTAL GAIN control	Adjust for a full screen-width trace.

IMPORTANT: Always keep the amplitude of the display within the graticule (screened lines). Set the front panel ATTENUATOR control as necessary so the VERTICAL GAIN control is near the center of its rotation. Failure to keep the display amplitude within the graticule viewing area can cause toroid coil L201 and resistor R201 (on the demodulator circuit board) to overheat, and may result in damage to either of these parts. A good height pattern is from 1/2" to 1". When you adjust the ATTENUATOR control, any RF pattern displayed will increase or decrease in small height increments; this is normal.

( ) Tune the transmitter for normal output. Observe the pattern on the Monitor screen.

( ) While your transmitter is still keyed, adjust the ATTENUATOR control for the smallest display possible. Then loosen the setscrew in its knob, position the knob pointer at 7 o'clock, and retighten the setscrew.

NOTE: A two-tone generator connected to the microphone input of your transmitter will produce a uniform trapezoid ("Christmas tree") pattern on the monitor screen. If you have a two-tone generator, use it in place of the microphone in the following steps.

( ) Transmit in the SSB mode of operation and talk into the microphone. Adjust the SWEEP control for a series of "Christmas tree" patterns on the Monitor screen. See Pictorial 4-5.

( ) Depress the TRAP pushbutton on the front panel of the Monitor.

( ) Key the transmitter in the SSB mode and talk into the microphone. You will see a trapezoid pattern similar to one of those shown on Page 54. Stop talking and observe that the CRT pattern becomes a spot and moves toward the right and off the screen.

( ) Turn off the transmitter and Station Monitor.

( ) Remove the temporary jumper wire between the ANTENNA and EXCITER sockets.

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This completes the "Tests and Adjustments" of your Station Monitor. Proceed to "Final Assembly."

FINAL ASSEMBLY

Refer to Pictorial 5-1 for the following steps.

( ) Position all wires and cables away from the cabinet mounting holes. Pay particular attention to the power transformer wires and the twisted black wires that are routed along the right side of the chassis.

( ) Set the cabinet shell onto the chassis as shown in the Pictorial. Be sure the side with the holes is toward the right as shown.

( ) Use ten #6 × 1/4" sheet metal screws to secure the cabinet shell to the chassis.

This completes the "Final Assembly." Proceed to "Installation and Operation."

INSTALLATION & OPERATION

The following pages show you how to hook up and use your Station Monitor in many installations. You can also find much information concerning the use of oscilloscope monitors for amateur purposes in many publications such as the "Radio Amateur's Handbook", published by the American Radio Relay League.

RECEIVER MONITORING

Connect a pair of wires or a cable to the receiver speaker terminals as shown in Pictorial 6-1. Then connect these wires or the cable to the VERT socket on the rear panel of the Monitor. NOTE: When you connect wires to your speaker terminals, be sure the ground side of the speaker lead is connected to the ground side of the VERT socket. If you do not do this, you will short out the audio signal.

Depress the 100 Hz pushbutton and set the SWEEP control to the center of its rotation. Adjust the VERTICAL GAIN and HORIZONTAL GAIN controls to produce the desired patterns as shown under "Transmit Envelope Patterns" (on Page 50).

Adjust the receiver for normal operation on an average signal. Then adjust the VERTICAL GAIN control to produce a pattern 1/2″ to 1″ high.

NOTE: If you observe negative clipping in the display, too much receiver audio signal is being coupled into the Monitor. Reduce the receiver audio gain, or slide the ATTENUATOR switch on the rear panel of the Monitor to the X10 position.

You can also observe many of the transmitter patterns, described later, as a received signal. Keep the limitations that are described in the following paragraphs in mind, and refer to the appropriate sample pattern shown in Pictorial 6-2 for the type of signal being received.

The receiver can produce several distinct effects which can alter or reshape the incoming signal into a display quite different from that which was transmitted. The two most pronounced effects are produced by the presence of AGC, and by the narrow bandwidth used in newer receivers.

As you observe a pulsing signal such as CW or sideband, with the AGC on, the leading portion of the waveform may be displayed with considerable higher-than-normal amplitude. This leading portion reduces the height as the AGC takes hold. Observe the difference between patterns 39 and 40 on Page 57 to see this effect.

You may note the same distortion when you watch voice patterns that produce momentary flat-topping on sideband. To avoid this problem, turn off the receiver AGC and reduce the RF gain sufficiently to prevent overload. Also try reducing the settings of the VERTICAL GAIN and HORIZONTAL GAIN controls so the Monitor circuits are not being overdriven.

The bandwidth of the receiver IF determines the ability of the Monitor to reproduce a display of the actual transmitted signal. Refer to the pattern sequence shown in Pictorial 6-2. To obtain an undistorted display, the IF bandwidth must be roughly 10 times the modulating frequency. For example, a 3 kHz bandwidth will pass a 300 Hz square wave without distorting it, but a 1000 Hz square wave will be shown as a somewhat distorted sine wave. SSB signals that are "flat-topping", therefore, may appear acceptable on the RF envelope patterns.

To most easily identify flat-topped signals, observe the lack of peaks and valleys in the pattern (see Pictorial 6-2). It is possible, however, that the signal may be deliberately "shaped" by premodulation clipping and filtering in the transmitter to produce a pattern that may appear somewhat flat-topped.

TRANSMITTER MONITORING

Many transmitters have 50 to 75 Ω coaxial outputs. The following instructions pertain to this type of connection with either a dummy load or an antenna. Make sure a dummy load is connected each time you operate the transmitter, either through the Monitor as in the case of coaxial feed or directly where other antenna transmission line systems are used.

Refer to Pictorial 6-3 and connect the transmitter, Station Monitor, and antenna or dummy load as follows:

NOTE: To avoid superimposed AC hum on the RF display, either use a shorting plug to terminate the VERT input socket on the rear panel of the Monitor, or terminate the station receiver speaker. When you monitor audio signals from the receiver, you must mute the receiver audio (or place the receiver in standby) during transmit intervals. If you do not do this, you may observe some superimposing of the RF and audio signals on the display.

1. Connect the RF output of the transmitter or linear amplifier to either ANTENNA socket on the rear panel of the Monitor.

2. Connect a dummy load or an antenna to the other ANTENNA socket on the Monitor.

3. Preset the front panel controls and switches as follows. NOTE: Pushbutton switches not mentioned should be in their released positions.

SSB pushbutton	Depressed.
1 kHz pushbutton	Depressed.
POWER pushbutton	Depressed.
ATTENUATOR control	Any position.
SWEEP control	Fully clockwise.
FOCUS control	For proper focus.
INTENSITY control	As desired.
VERTICAL GAIN control	Fully counterclockwise.
VERTICAL POSITION control	For on-screen trace.
HORIZONTAL GAIN control	Center of rotation.
HORIZONTAL POSITION control	For on-screen trace.

4. Turn on the transmitter and adjust the VERTICAL GAIN, HORIZONTAL GAIN, and SWEEP controls for the desired pattern height and display.

   IMPORTANT: Always keep the amplitude of the display within the graticule (screened lines). Set the front panel ATTENUATOR control as necessary so the VERTICAL GAIN control is near the center of its rotation. Failure to keep the display amplitude within the graticule viewing area can cause toroid coil L201 and resistor R201 (on the demodulator circuit board) to overheat, and may result in damage to either of these two parts. If the RF input of the Monitor approaches the 1000-watt limit, and if a steady CW or two-tone signal is being monitored, reduce the RF display to one-half the screen height and minimize the duration of the keyed signal. Normal keyed CW and SSB (voice modulated) signals may be displayed at full screen height for any period of time.

5. Connect a two-tone generator to the microphone input of the transmitter to check the modulation of an AM or SSB transmitter.

6. Refer to the "Transmit Envelope Patterns" on Page 50 to evaluate the transmitter display.

RF TRAPEZOID PATTERNS

To check a linear amplifier for linearity, it is necessary to compare the exciter output with the RF output of the linear amplifier. Refer to Pictorial 6-4 and the following steps for the proper connections.

1. Connect a coaxial cable from the RF output of the exciter to either EXCITER input socket of the Monitor.

2. Connect a coaxial cable from the other EXCITER socket of the Monitor to the input socket of the linear amplifier.

3. Connect a coaxial cable from the RF output of the linear amplifier to either ANTENNA socket on the Monitor.

4. Connect a dummy load or an antenna to the other ANTENNA socket of the Monitor.

5. Connect a two-tone generator to the microphone input of the exciter.

6. Preset the front panel controls and switches as follows. NOTE: Pushbutton switches not mentioned should be in their released positions.

TRAP pushbutton	Depressed.*
1 kHz pushbutton	Depressed.
POWER pushbutton	Depressed.
ATTENUATOR control	Any position.
SWEEP control	Fully clockwise.
FOCUS control	For proper focus.
INTENSITY control	As desired.
VERTICAL GAIN control	Fully counterclockwise.
VERTICAL POSITION control	Center of rotation.
HORIZONTAL GAIN control	Center of rotation.
HORIZONTAL POSITION control	Center of rotation.

*When you select the TRAP mode, the trace will be off the screen while no signal is present. The VERTICAL GAIN and HORIZONTAL GAIN controls will have no effect without a signal.

7. Turn on the exciter and linear amplifier and adjust the Monitor VERTICAL GAIN and HORIZONTAL GAIN controls, and the transmitter audio gain control, for the desired display height pattern. Also use the VERTICAL and HORIZONTAL GAIN controls to center the display on the screen. If the RF input to the Monitor approaches the 1000-watt limit, and if a steady CW or two-tone signal is being monitored, reduce the RF display to 1/2 the screen height and minimize the duration of the keyed signal.

8. The RF output signal from the exciter is compared with the amplified RF output of the linear amplifier to obtain the trapezoid pattern that is shown on the Monitor screen. Refer to "Trapezoid Patterns" on Page 54 to analyze the display.

NOTE: The RF trapezoid pattern only indicates the linearity of the linear amplifier. Do not use this setup for general monitoring, as it does not evaluate the exciter's signal.

RTTY CROSS PATTERNS

This Station Monitor makes an excellent tuning indicator for use with RTTY signals. Refer to Pictorial 6-5 and the following steps for the proper connections.

1. Connect a coaxial or shielded cable from the "mark" channel of your RTTY terminal unit to the VERT input socket on the rear panel of the Monitor.

2. Connect a coaxial or shielded cable from the "space" channel of your RTTY terminal unit to the HORIZ input socket on the rear panel of the Monitor.

3. Preset the front panel controls and switches as follows. NOTE: Switches not mentioned should be in their released positions.

RTTY pushbutton	Depressed.
1 kHz pushbutton	Depressed.

POWER pushbutton	Depressed.
ATTENUATOR control	Any position.
SWEEP control	Fully clockwise.
FOCUS control	For proper focus.
INTENSITY control	As desired.
VERTICAL GAIN control	Fully counterclockwise.
VERTICAL POSITION control	For on-screen trace.
HORIZONTAL GAIN control	Center of rotation.
HORIZONTAL POSITION control	For on-screen trace.

4. Push the ATTENUATOR switch on the rear panel to X10.

5. Turn the terminal unit and the Monitor on.

6. Properly tune in an RTTY signal on your receiver.

7. When you have the space channel connected to the HORIZ input and the mark channel connected to the VERT input, adjust the VERTICAL and HORIZONTAL GAIN controls on the Monitor to produce a cross pattern with equal height and width (about 3/4″ by 3/4″). Once you have the desired size of the cross pattern set, you should not change the setting of the gain controls on the Monitor, as this will interact with the true setting of the balance control on the terminal unit.

8. Refer to "RTTY Cross Patterns" on Page 55 to analyze the display.

USING THE MONITOR AS AN OSCILLOSCOPE

You can use the Station Monitor as an oscilloscope for limited test applications where high sweep frequency or high vertical amplifier gain are not required.

For most applications, depress the SSB pushbutton to use the internal sawtooth generator for horizontal sweep. To use an external source for horizontal sweep, connect the horizontal signal to the HORIZ input socket and depress the RTTY pushbutton.

To use the Monitor as an oscilloscope, connect the leads and adjust the controls as follows:

1. Connect a test lead to the VERT input socket. Use a suitable scope test probe.

2. Adjust the VERTICAL GAIN, HORIZONTAL GAIN, and SWEEP controls for the desired pattern.

NOTE: If negative clipping occurs, slide the rear panel ATTENUATOR switch to the X10 position.

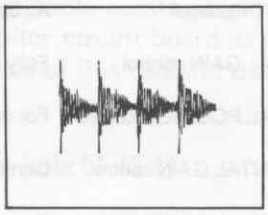
ABOUT THE SWEEP PUSHBUTTONS

The sweep rate pushbuttons (100 Hz, 1 kHz, and 10 kHz) are not self-releasing; you can depress more than one of them at a time. If more than one sweep rate pushbutton is depressed at the same time, the oscilloscope circuitry will use the lowest sweep rate that is selected and ignore the others.

Example: If the 1 kHz and 10 kHz pushbuttons are depressed at the same time, the sweep rate will be 1 kHz because it is the lowest sweep rate that is selected.

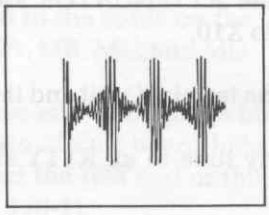
TRANSMIT ENVELOPE PATTERNS

1



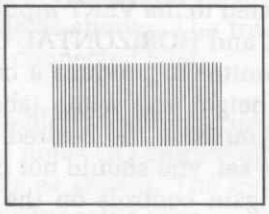
SSB signal, voice input, correctly adjusted.

2



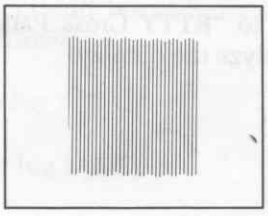
SSB signal, voice input, slightly excessive speech gain, or insufficient amplifier loading.

3



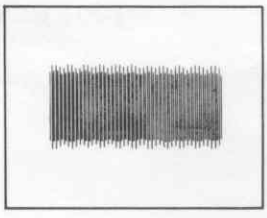
Pure CW carrier or perfect single-tone input on SSB. May also occur on single-tone SSB with excessive drive, which results in amplifier "flat-topping." Note the absence of fine ripple.

4



SSB signal, single-tone input, sideband suppression down approximately 40 dB; or CW signal with spurious radiation down approximately 40 dB.

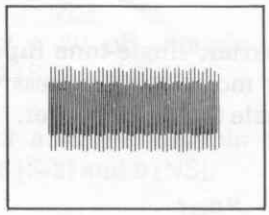
5



Same as pattern 4, except down approximately 20 dB. In SSB, the poor suppression may be due to audio unbalance or improper RF phase shift. (Phasing system.)

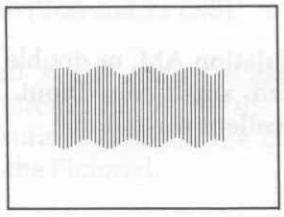
Same as pattern 4, except down approximately 10 dB.

6



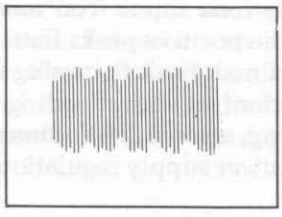
SSB signal, single-tone input with carrier leakage. This pattern will have half the number of ripples due to poor sideband suppression (also see pattern 5).

7



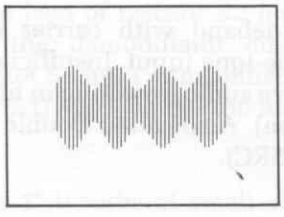
SSB signal, single-tone input. Distortion in audio oscillator or audio system, balanced modulator detuned, or insufficient RF in balanced modulator.

8



SSB signal, single-tone input. Very little sideband suppression. Caused by defective modulator stage, audio phase shift network, 90 degree RF phase-shift component, partially shorted modulation transformer, secondary of transformer that feeds audio phase-shift network shorted to ground, crystal oscillating on two adjacent frequencies simultaneously, or both heterodyne oscillators are on together.

9

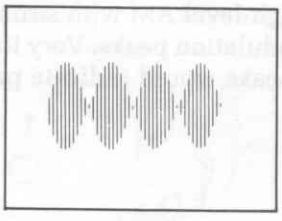


Normal double-sideband, single-tone input.

SSB signal, single-tone input with no sideband suppression. May be due to one modulator stage dead, modulation transformer open or shorted, or defective bandpass filter.

Normal SSB signal, two-tone input, tones properly adjusted for equal amplitude.

10



SSB with carrier, single-tone input. Incorrect value of carrier or modulation. Excessively rounded tops would indicate too much carrier.

11

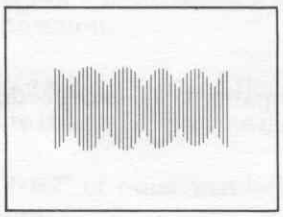
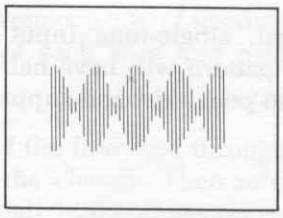


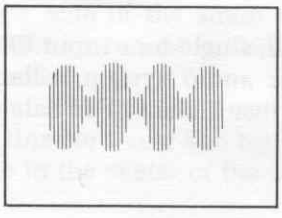
Plate modulation AM, or double sideband with carrier inserted, single-tone input. Nearly 100% modulated. Excellent waveform.

12



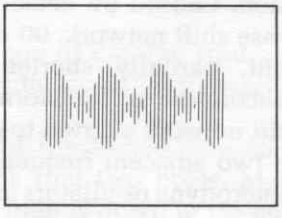
Double sideband with carrier inserted (low-level AM), single-tone input. Too much carrier inserted. Note that the positive peaks flatten before a fine base line is obtained. Peak flattening may also be caused by insufficient antenna loading, insufficient interstage loading, an overdriven linear amplifier, or poor dynamic power supply regulation, etc.

13



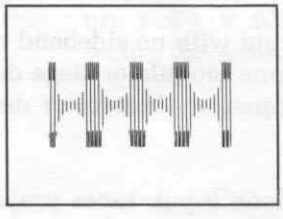
Double sideband with carrier inserted (low-level AM), single-tone input. Insufficient carrier insertion or excessive audio, resulting in high distortion (overmodulation). Also called Double Sideband Reduced Carrier (DSRC).

14

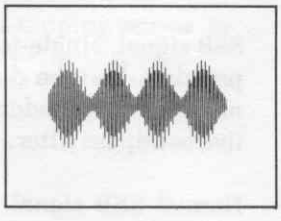


Low or high-level AM with strong parasitics appearing on modulation peaks. Very fine, "grassy" appearance on peaks would indicate parasitics in the UHF range.

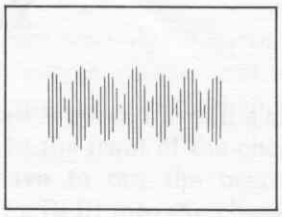
15



16

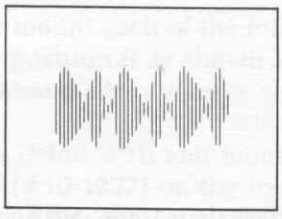


17



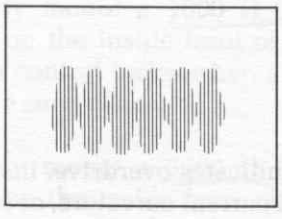
SSB, two-tone input, or double sideband, single-tone input. Carrier leakage in either causes uneven height of successive half cycles of modulation envelope.

18



Low or high-level AM, single-tone input. Severe distortion in modulation system, or AF tone generator, RF feedback to audio system, or RF feedback to previous low-level stage.

19



Nonlinearity in modulated RF stage, single-tone input, due to insufficient excitation of a plate-modulated stage, overdrive to a grid-modulated stage, or insufficient antenna loading of a grid-modulated stage.

20

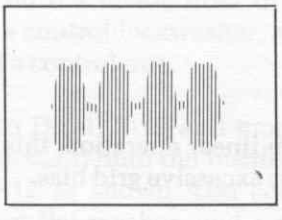


Plate-modulated AM, single-tone input. Overdriven modulator incapable of 100% modulation. May also result from deliberately clipped audio not properly filtered.

21

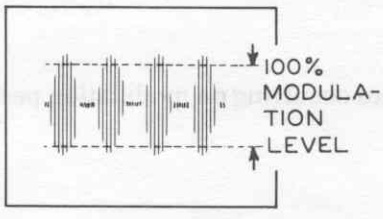
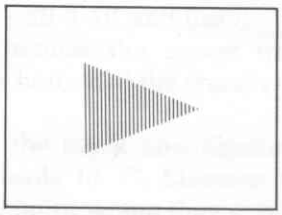


Plate-modulated AM, single-tone input. Modulator output more than ample. Modulation in excess of 100% in both directions.

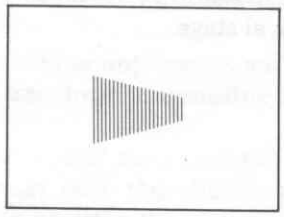
TRAPEZOID PATTERNS

22



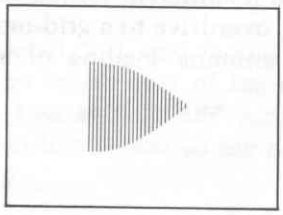
RF trapezoid. Good linearity. Desirable pattern. 100% modulation.

23



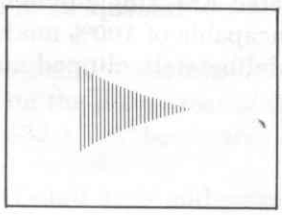
Modulation less than 100%. No distortion.

24



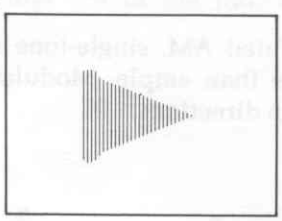
Nonlinear. Indicates overdrive, insufficient antenna loading, grid current curvature, or regeneration.

25



Nonlinear. In linear operation, this also indicates regeneration or excessive grid bias.

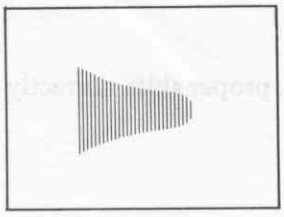
26



Parasitics occurring on modulation peaks.

Grid modulation with improper neutralization and reactive load.

27



Unmodulated carrier. May be caused by:

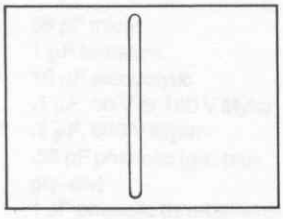
- No signal at horizontal deflection plates.
- Tone test oscillator inoperative.
- Gain control turned off on transmitter or oscilloscope.
- Audio failure in transmitter.

28

RTTY CROSS PATTERNS

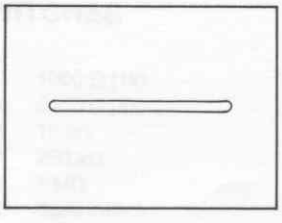
Mark only. The relative narrowness of the ellipse provides a good indication of the channel separation capability in the terminal unit.

29



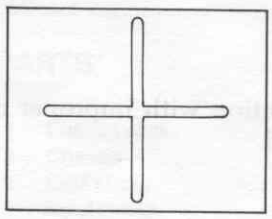
Space only. The relative narrowness of the ellipse provides a good indication of the channel separation capability in the terminal unit.

30



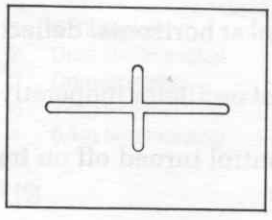
RTTY signal, proper shift, correctly tuned in.

31



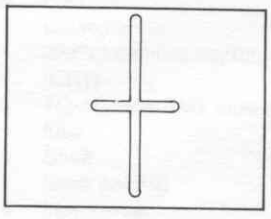
Incorrect shift, space tuned in, or selective fading.

32



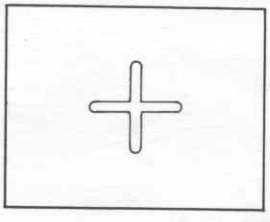
Incorrect shift, mark tuned in, or selective fading.

33



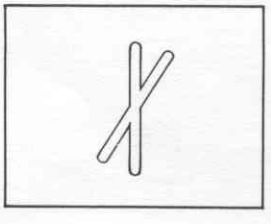
"Straddle" tuning of incorrect shift.

34



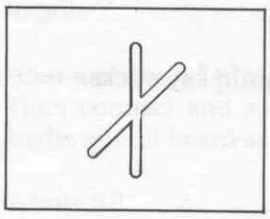
Typical 170 Hz shift pattern.

35



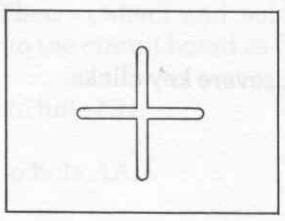
Typical 425 Hz shift pattern.

36



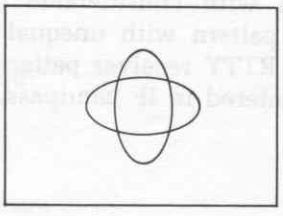
Typical 850 Hz shift pattern.

37



Proper shift, eliptical pattern may be caused by coupling between the filters in the terminal unit.

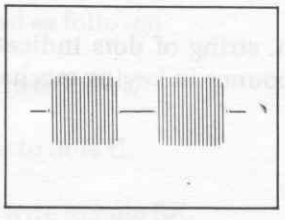
38



CW PATTERNS

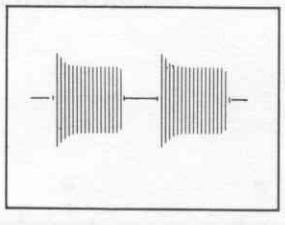
Good CW pattern, properly shaped keying, string of dots. Pattern can be synchronized using automatic keyer or bug.

39



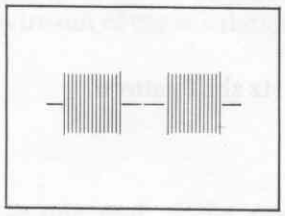
CW pattern showing effect of receiver AGC action, or poor power supply regulation in the transmitter.

40



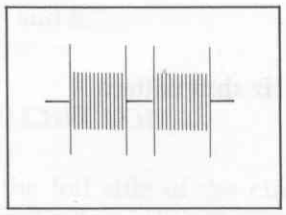
CW pattern, mild key clicks.

(41)



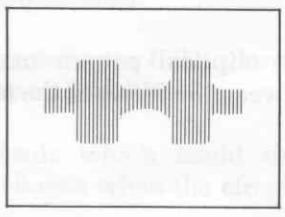
CW pattern, severe key clicks.

(42)



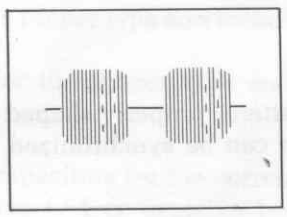
CW pattern with considerable backwave, RTTY transmitter pattern with unequal mark and space outputs, or RTTY receiver pattern with signal not properly centered in IF bandpass, or bandpass too narrow.

(43)



CW pattern, string of dots indicating poor contacts or contact bounce in keying mechanism.

(44)



IN CASE OF DIFFICULTY

This section of the Manual is divided into three parts. The first part, titled "Visual Checks," presents some items that you can check to begin your search for any trouble that may occur right after you assemble the kit.

The second part, titled "Finding the Area of Trouble," shows you how to locate a problem in the differential amplifier circuits.

Finally, the third part contains a "Troublehooting Chart" that lists some specific problems and possible causes.

Before you begin any troubleshooting procedure, try the various functions of the Monitor to see if you can narrow the problem down to a specific are.

NOTE: Refer to the "Circuit Board X-Ray Views" for the physical locations of parts on the circuit boards.

VISUAL CHECKS

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

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all of your connections to make sure they are soldered as described on Page 6 of this Manual. Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Also make sure each diode band is positioned above the band printed on the circuit board or as directed in its step.

4. Check electrolytic capacitors to be sure their positive (+) or negative (−) mark is at the correct location.

5. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 22 kΩ (red-red-org) resistor where a 2200 Ω (red-red-red) resistor should have been installed.

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

7. Be sure all the component leads are cut close to the foil on each circuit board so the leads do not short to the chassis after the circuit boards are installed.

8. A review of the "Circuit Description" may also help you determine where the trouble is.

If you have still not located the trouble after you complete the "Visual Checks" and a voltmeter is available, check the voltage readings against those shown on the Schematic. Read "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high-input impedance voltmeter. DC voltages may vary as much as ± 20%.

PRECAUTIONS FOR TROUBLESHOOTING

Be sure you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short across components or voltage sources, it is very likely to cause damage to one or more components.

CAUTION: Hazardous voltages are present at several places inside the Monitor. Use extreme caution whenever you have the cabinet shell removed from the chassis.

FINDING THE AREA OF TROUBLE

Refer to the Schematic as you read the following information. A Block Diagram is also provided to show you how the signals flow through the Monitor.

Because most of the circuits are DC coupled, it is almost impossible to list troubles in a "cause and effect" type of chart. For example, a saturated transistor on one side of a differential amplifier may appear as a trouble on the other side. A "Troubleshooting Chart" is provided, however, to help you isolate the problem to a particular area of the Monitor. Since the Position controls are at the front of the differential amplifiers and affect each succeeding stage, they serve as troubleshooting aids. When you troubleshoot the vertical amplifier, for instance, first check the associated power supply voltages. Then check transistors Q104 and Q106. These voltages should vary as you turn the Vertical Position control. If these voltages change accordingly, the trouble may be in the CRT circuit. If the voltages do not change, the problem is either Q104 or Q106 or the preceding stages. Move the voltmeter to the preceding stage (Q103 and Q105) and repeat the procedure until you locate the trouble.

NOTE: In the unusual event where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

TROUBLESHOOTING CHART

The following chart lists the condition and the possible causes of several malfunctions. If a particular part is mentioned as a possible cause, check that part to see if it was correctly installed. Also check the parts connected to it for poor connections. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
Resistance reading from CRT lug 1 to ground is less than 3 MΩ.	1. Diode D105 or D106. 2. Capacitor C121 or C123. 3. Power transformer T1. 4. Focus or Intensity controls are wired incorrectly. 5. Resistor R14 or R16.
Resistance reading from junction of R148, R149, R151, and R152 to ground is less than 100 kΩ.	1. Diode D109, D111, D112, or D113. 2. Zener diode ZD101 or ZD102. 3. Transistor Q104, Q106, Q118, Q121, or Q123. 4. Capacitor C124 or C128. 5. Capacitor C22, C23, C201, or C202.
Resistance from emitter (E) of Q122 to ground is less than 150 Ω.	1. Transistor Q102-Q105, Q107-Q111, Q115-Q117, or Q119.
Resistance from the collector (C) of Q122 to ground is less than 450 Ω.	1. Diode D114, D115, D116, or D117. 2. Zener diode ZD103. 3. Transistor Q122. 4. Capacitor C126, C127, or Q129.
CRT filament does not light.	1. Fuse F1. 2. Power transformer wiring. 3. Power switch SW1 wiring.
CRT filaments light, but no trace or spot on CRT screen.	1. No −1200 volt supply. 2. CRT socket wiring. 3. Capacitor C107, C108, C112, or C114. 4. Position control wiring. 5. Transistor Q102, Q103, Q105, Q116, Q117, or Q119. 6. SSB, Trap or RTTY switch wiring.
Unable to center spot or trace on CRT screen.	1. Wrong mode (SSB, Trap, or RTTY switch) selected. 2. Capacitor C107, C108, C112, or C114. 3. Position control wiring. 4. Transistor Q102, Q103, Q105, Q116, Q117, or Q119. 5. SSB, Trap, or RTTY switch wiring. 6. RFC1, RFC2, RFC3, or RFC4.
No horizontal trace deflection (SSB switch depressed).	1. SSB switch wiring. 2. Sweep control wiring. 3. Transistor Q109, Q111, Q112, Q113, or Q114. 4. Diode D103 or D104. 5. Capacitor C108. 6. No +9 or +180 volt supply.
No horizontal trace deflection (RTTY switch depressed).	1. No signal at Horiz Input socket. 2. RTTY switch wiring. 3. Horiz Input socket wiring. 4. Horizontal Gain control setting. 5. Rear panel Attenuator switch setting.

CONDITION	POSSIBLE CAUSE
No vertical deflection (SSB switch depressed).	1. No signal at Vert Input socket. 2. Low input level, Atten switch in X10 position. 3. Vert Input socket or Atten switch wiring. 4. Vertical Gain control wiring. 5. Diodes D101 or D102. 6. Transistor Q101 through Q106. 7. RFC1, RFC2, RFC3, or RFC4. 8. Capacitor C22, C23, C201, or C202. 9. No +9 or +180 volt supply.
Poor focus of trace or spot on CRT screen.	1. Astigmatism control R162. 2. CRT socket wiring. 3. Focus control wiring. 4. Resistor R14, R16, R154, R159, R161, or R163. 5. Low −1200 volt supply. 6. CRT.
Trace will not disappear when the Intensity control is fully counterclockwise.	1. Transistor Q114. 2. Capacitor C111. 3. Resistor R125, R126, or R153.
Distorted audio signal waveforms.	1. Distorted audio input signal. 2. Input signal too strong, Atten switch is in X1 position. 3. Vert Input socket or Atten switch wiring. 4. Diode D101 or D102. 5. Transistors Q101 through Q106. 6. Vertical Gain control wiring. 7. RFC1, RFC2, RFC3, or RFC4. 8. Capacitor C19, C21, C201, or C202. 9. No +9 or +180 volt supply.
Poor synchronization.	1. Diode D201. 2. Transistors Q107 through Q111.
Distorted RF waveforms.	1. Distorted input signal. 2. Diode D201. 3. Coil L201. 4. Capacitor C201 or C202. 5. Redress leads around CRT socket (see Pictorial 3-6 on Illustration Booklet, Page 16). 6. RF input signal too high (above 54 MHz). 7. Incorrect setting of the front panel Attenuator control.
Unable to obtain trapezoid pattern on CRT (Trap switch depressed).	1. Diode D202 or D203. 2. Transistor Q201. 3. Zener diode ZD201. 4. Capacitor C204, C205 or C206.
Spot will not clamp to right side of screen (Trap switch depressed).	1. Transistor Q101 or Q201. 2. Horizontal Position control setting. 3. Trap switch wiring.
Distorted trapezoid pattern, or only a vertical trace.	1. Exciter and linear amplifier connections. 2. Diode D204. 3. Capacitor C207 or C208. 4. Resistor R207. 5. Trap switch wiring. 6. Distorted input signal. 7. Diode D201. 8. Coil L201. 9. Capacitor C201 or C202. 10. RF input frequency too high (above 54 MHz).

CONDITION	POSSIBLE CAUSE
RF vertical display not high enough, or too high, for input level. Display behaves erratically when you turn Vertical Gain control.	1. Attenuator switch and associated capacitors.
Low – 1200 volt supply.	1. Diode D105 or D106. 2. Capacitor C121, C122, or C123. 3. Power transformer T1. 4. Focus or Intensity control wiring. 5. Resistor R14 or R16.
+180 volt supply too high or too low.	1. Diode D109, D111, D112, or D113. 2. Zener diode ZD101 or ZD102. 3. Transistor Q104, Q106, Q114, Q118, or Q121. 4. Capacitor C124 or C128. 5. Capacitor C22, C23, C201, or C202. 6. Resistor R155 or R156.
+9 volt supply too high or too low.	1. Transistor Q102, Q109,Q112, Q113, or Q116. 2. Diode D114, D115, D116, or D117. 3. Zener diode ZD103. 4. Transistor Q122. 5. Capacitor C126, C127, or C129.

SPECIFICATIONS

RF SAMPLING SECTION

Frequency Coverage	160 through 6 meters (1.8—54 MHz).
Sensitivity	1/4" vertical deflection at 10 watts, 80 through 6 meters. 3/4" vertical deflection at 100 watts, 80 through 6 meters. 1/4" vertical deflection at 100 watts, 160 meters.
RF Power Limits	
Exciter Input (50—75Ω)	10 to 300 watts.
Antenna Input (50—75Ω)	10 to 1000 watts.
Insertion Loss	Negligible.

VERTICAL AMPLIFIER

Input Impedance	1 MΩ shunted by 125 pF.
Sensitivity	60 millivolts per 1/4" vertical deflection.
Attenuator	2-position switch: X1: 1 volt rms maximum. X10: 10 volts rms maximum.
Frequency Response	10 Hz to 40 kHz typical.

HORIZONTAL AMPLIFIER

Input Impedance	1 MΩ shunted by 160 pF.
Sensitivity	60 millivolts rms per 1/4″ horizontal deflection.
Frequency Response	10 Hz to 300 kHz typical.
Attenuator	2-position switch: X1: 1 volt rms maximum. X10: 10 volts rms maximum.

SWEEP GENERATOR

Type	Recurrent, automatic sync.
Frequency Range	10 Hz to 10 kHz in three steps.

GENERAL

CRT	3RP1A; flat face; green, medium-persistence phosphor.
Graticule	1/4-inch squares; 6 x 8 1.5″ × 2″ viewing area).
Power Supplies	Solid-state rectifiers, regulated amplifier supplies.
Power Requirements	110—130 VAC, 60 Hz, 22 watts.
Dimensions (overall)	11-1/4″ W × 12-1/8″ D × 4-3/8″ H (28.6 × 30.8 × 11.1 cm).
Net Weight	10.6 lbs. (4.8 kg).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic (large fold-in) and the Block Diagram while you read the following paragraphs. The component numbers are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and chassis:

1-99	Parts mounted on the chassis.
100-199	Parts mounted on the main circuit board.
200-299	Parts mounted on the demodulator circuit board.

VERTICAL AMPLIFIER

A signal applied to the Vertical Input socket first passes through the frequency-compensated attenuator network formed by resistors R3 and R4 and capacitors C13, and C14. Capacitor C12 blocks any DC from reaching the attenuator circuit. From the attenuator circuit, a portion of the input signal is coupled through resistor R107 and capacitor C101 to the gate of transistor Q101. Resistor R107 protects Q101 from being damaged in case a high potential is applied to the Input socket when vertical Attenuator switch SW2B is in the X1 position. Diodes D101 and D102 are transistors connected to provide a zener action. These diodes limit the input signal to approximately ± 9 volts, which further protects Q101 from excessive gate voltage. Capacitor C101 improves high-frequency response by forming a high-frequency path around R107.

Transistor Q101 is a field-effect transistor (FET) connected as a source follower. This type of transistor provides the high-impedance input necessary to prevent loading of the signal source.

Capacitor C107 AC-couples the signal to Vertical Gain control R9. A portion of this signal is directly applied to the gate of source follower Q102. Since the following stages are DC coupled, capacitor C107 DC-isolates Q101 from Q102. This prevents any trace shift due to varying signal levels.

The output from source follower transistor Q102 is amplified by transistor Q103. A portion of the signal applied to the base of Q103 appears at its emitter. Because transistors Q103 and Q105 have a common emitter resistance, the signal present at the emitter of Q103 is effectively coupled to the emitter of Q105.

Transistor Q105 functions as a common base amplifier whose base is held constant by Vertical Position control R7. This control positions the trace by applying a DC voltage to the base of transistor Q105, causing a DC unbalance in the vertical amplifier. When the collector output voltage of Q103 decreases, its emitter voltage will increase. An increased emitter voltage at Q105 reduces its forward bias and increases its collector output voltage. The signal at the collector of transistor Q105 is 180 degrees out of phase with the signal at the collector of Q103, forming a "push-pull" type of amplifier required to drive the CRT deflection plates. Capacitor

C113 is an emitter bypass capacitor to boost the gain at high frequencies. Emitter resistors R131 and R132, with Vertical Balance control R128, establish the DC gain of the vertical amplifier.

Output amplifiers Q104 and Q106 again amplify the differential signal and drive the vertical plates of the CRT.

SWEEP GENERATOR

Capacitor C203 couples a portion of the vertical input RF signal to the base of transistor Q107 through resistor R202 and diode D201, a shaping network. Diode D201 also demodulates any AM or SSB RF signal applied to the RF sampling circuit.

The preshaped sync signal is applied to a Schmitt trigger circuit, Q107 and Q108, a regenerative bistable circuit which produces a rectangular pulse output each time it is triggered and reset.

Transistors Q111 and Q112 form an astable multivibrator. When transistor Q112 is conducting and Q111 is cut off, one or more of the timing capacitors (C15 through C17) are charged through transistor Q112. As the voltage at the emitter of Q112 approaches the voltage at the base, as a result of charging the capacitor, Q112 will cut off and drive Q111 into conduction. The charged timing capacitor will now discharge through the constant current source circuit of Q113. The setting of Sweep control R12 determines the current flowing through Q113, which determines the discharge current (and discharge time) of the timing capacitor. As the timing capacitor discharges, a positive-going ramp voltage (sawtooth) is generated and coupled to the horizontal amplifier. The frequency of the horizontal sweep is determined by the particular timing capacitor that is selected by switch SW6, SW7, or SW8 and the discharge current.

Since transistors Q109 and Q111 have a common emitter resistor (R117), a signal applied to the base of Q109 is emitter coupled to transistor Q111. The pulse output (sync signal) of Schmitt trigger Q108 is, therefore, coupled to Q111. This causes Q111 to turn on and Q112 to cut off and start the sweep just prior to the time it would normally begin.

When the signal at the emitter of Q109 goes positive, a positive pulse is coupled through capacitor C111 to the base of blanking amplifier Q114.

A negative-going output pulse is coupled through capacitor C119 to the grid of the CRT. This pulse turns off the electron beam during retrace, preventing the retrace from appearing on the CRT.

RF SAMPLING CIRCUIT

Transmitted RF signals as high as 1000 watts (PEP) may be viewed on the Station Monitor when these signals are properly terminated in a 50 or 75 ohm transmission line or dummy load. The transmitting antenna feedline is coupled through the Antenna sockets on the rear of the Monitor. A portion of the RF signal is sampled from the feedline and coupled through cpacitor C1 to RF attenuator switch SW1, which reduces the amplitude of the RF in 11-step intervals. Capacitors C2 through C11 are connected in series in descending value on switch SW1, which has no detent.

From the RF attenuator switch, the RF signal is coupled to toroid coil L201, a bifilar-wound coil on a toroid core. It is connected as an unbalanced-to-balanced balun. The balanced output of coil L201 couples the RF signal through DC blocking capacitors C201 and C202 to the vertical deflection plates of the CRT. Resistor R201 broadens the frequency response of the balun.

RF chokes RFC1 through RFC4 offer a high impedance to the RF signals on the vertical deflection lines to prevent the RF sample signals from affecting the vertical deflection amplifier circuits of Q104 and Q106.

HORIZONTAL DEFLECTION

Switches SW3, SW4, and SW5 determine the type of signal that will be used for horizontal deflection in the CRT. When you depress SSB switch SW3, the sawtooth signal from the sweep generator is coupled from the collector of transistor Q113 to the gate of transistor Q115. The operation of the horizon-

tal amplifier is identical to that of the vertical amplifier. The positive-going sawtooth voltage is amplified and applied to the horizontal deflection plates of the CRT. This increasing voltage causes the electron beam to sweep across the face of the CRT, producing a visible trace.

When you depress TRAP switch SW4, the signal present at the Exciter input socket is rectified by RF demodulator diode D204. This rectified RF voltage passes through capacitor C208 and through the contacts of switch SW3 to the gate of transistor Q115. When a modulated RF signal is applied directly to the vertical deflection plates of the CRT, and the modulating audio signal is applied to the horizontal deflection plates, a trapezoid pattern is presented on the screen of the CRT. Resistors R2 and R206 form an RF voltage divider network so the voltage limitation of diode D204 is not exceeded. RF filtering is accomplished through resistor R207 and capacitor C207.

In the RTTY mode of operation, any appropriate signal applied to the Horiz Input socket passes through capacitor C18, a frequency-compensated attenuator network (just like the network at the vertical input), and the contacts of RTTY switch SW5 to the gate of transistor Q115.

Switches SW3, SW4, and SW5 are interlocked so that only one switch is normally depressed at a time.

CLAMPER CIRCUIT

In the Trap mode of operation, when no RF signal is present at the Monitor's input sockets, the trace is reduced to a small spot. Since the small spot could burn a hole in the CRT phosphor coating, a clamp voltage is generated to prevent this. A supply voltage, coupled to transistor Q201, causes Q201 to conduct. Resistor R112, in the base bias network to transistor Q119, also becomes the drain load for transistor Q201, causing it to conduct. Since Q201 is in parallel with the Horizontal Position control, the base bias on Q119 is reduced. This unbalances the horizontal amplifier transistors, which moves the spot off the right side of the CRT screen.

When the RF signal is applied to the Antenna Sockets, a small portion of the signal is coupled through capacitor C204 from voltage divider network R1 and R203 to the negative voltage doubler circuit consisting of diodes D202 and D203 to produce a negative bias. This negative DC voltage is applied to the gate of Q201, causing the transistor to stop conducting, which causes the drain voltage and the base bias of Q119 to return to normal. This causes the trace to return to the center of the CRT screen.

Capacitor C205 and resistor R204 form the filter network. Capacitor C206 is a timing capacitor which holds a slight charge to keep transistor Q201 cut off. This causes a slight time delay to momentarily hold the spot on the screen. The display, therefore, remains visible and is kept from jumping to the edge of the display area during normal voice modulation. The gate of the transistor is protected by the zener action of diode ZD201.

When you select the Trap mode of operation, the gate of transistor Q102 is shorted to chassis ground. Shorting this gate avoids any "blooming" of the spot when the spot is clamped to the right side of the display area.

POWER SUPPLY

Line voltage is connected through slow-blow fuse F1 and Power switch SW9 to the primary winding of the power transformer.

A high-voltage secondary winding of the power transformer is connected to the voltage doubler circuit consisting of diodes D105 and D106 and capacitors C122 and C123. Capacitor C121 filters this negative high voltage which is fed through resistor R154 to the grid of the CRT. Intensity and focusing voltages are also supplied to the CRT from the voltage-divider network consisting of resistors R14 through R17. A separate 6.3-volt winding supplies the CRT filament voltage.

A low-voltage secondary winding is connected to a full-wave rectifier consisting of diodes D114 and D116.

Capacitor C129 provides filtering for this rectified voltage. Zener diode ZD103 and resistor R157 maintain a constant voltage to the base of pass transistor Q122. The output voltage is regulated at +9.0 volts DC by series pass transistor Q122 and zener diode ZD103. Capacitors C126 and C127 filter the rectified voltage and capacitor C125 prevents the pass transistor from oscillating in case of load loss. Diodes D115 and D117 form a full-wave rectifier which supplies −18 volts DC to the optional Pan Adaptor Module.

Another secondary winding is connected to a full-wave bridge rectifier consisting of diodes D109 through D113. Capacitors C128 and C124 filter the rectified voltage. Zener diodes ZD101 and ZD102, and resistors R155 and R156, provide a regulated +180 volt DC output.

PAN ADAPTOR MODULE

Pins P1 through P5 on the main circuit board are for connection of the optional Pan Adaptor Module, Model HOA-5404-1. Refer to the Manual supplied with that kit for more information.

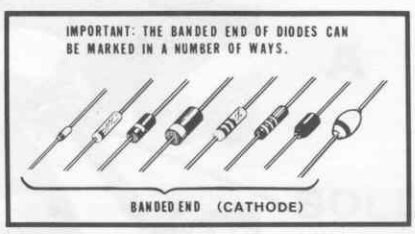
SEMICONDUCTOR IDENTIFICATION CHARTS

DIODES

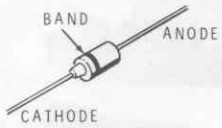
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
D101	417-801	MPSA20	A1
D102	417-801	MPSA20	A1
D103	417-801	MPSA20	A1
D104	417-801	MPSA20	A1
D105	57-52	D0-7	A2 or A3
D106	57-52	D0-7	A2 or A3
D109	57-27	1N2071	A2
D111	57-27	1N2071	A2
D112	57-27	1N2071	A2
D113	57-27	1N2071	A2
D114	57-65	1N4002	A2
D115	57-65	1N4002	A2
D116	57-65	1N4002	A2
D117	57-65	1N4002	A2
D201	56-26	1N191	A2
D202	56-26	1N191	A2
D203	56-26	1N191	A2
D204	56-26	1N191	A2

A1

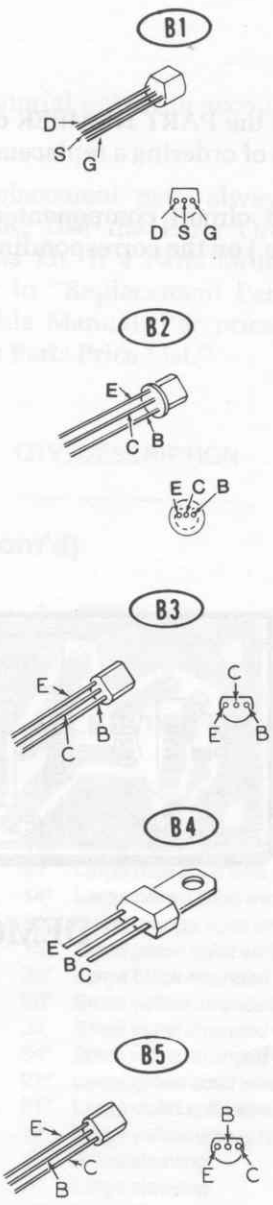
A2



A3



COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
Diodes (cont'd)			
ZD101	56-48	BZT110A	A2
ZD102	56-68	2VR68	A2
ZD103	56-67	1N4740A	A2
ZD201	417-801	MPSA20	A1
TRANSISTORS			
Q101	417-169	MPF105	B1
Q102	417-169	MPF105	B1
Q103	417-91	2N5232A	B2 or B3
Q104	417-834	MPSU10	B4
Q105	417-91	2N5232A	B2 or B3
Q106	417-834	MPSU10	B4
Q107	417-801	MPSA20	B5
Q108	417-801	MPSA20	B5
Q109	417-201	X29A829	B2 or B3
Q111	417-201	X29A829	B2 or B3
Q112	417-201	X29A829	B2 or B3
Q113	417-201	X29A829	B2 or B3
Q114	417-294	MPSA42	B5
Q115	417-169	MPF105	B1
Q116	417-169	MPF105	B1
Q117	417-91	2N5232A	B2 or B3
Q118	417-834	MPSU10	B4
Q119	417-91	2N5232A	B2 or B3
Q121	417-834	MPSU10	B4
Q122	417-94	2N3416	B2
Q123	417-811	MPSL01	B5
Q201	417-291	2N5458	B1



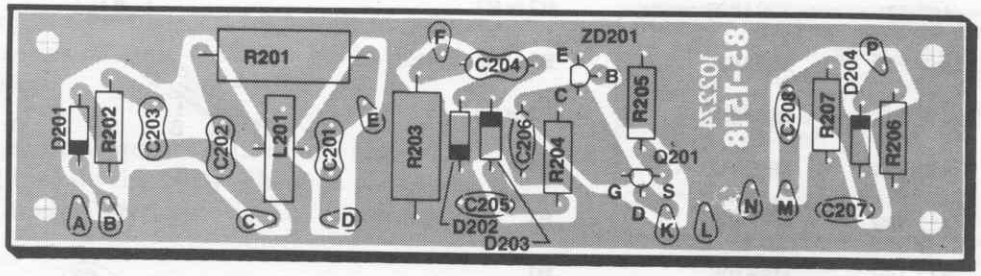
CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (C101, R103, etc.) on the corresponding X-Ray View.

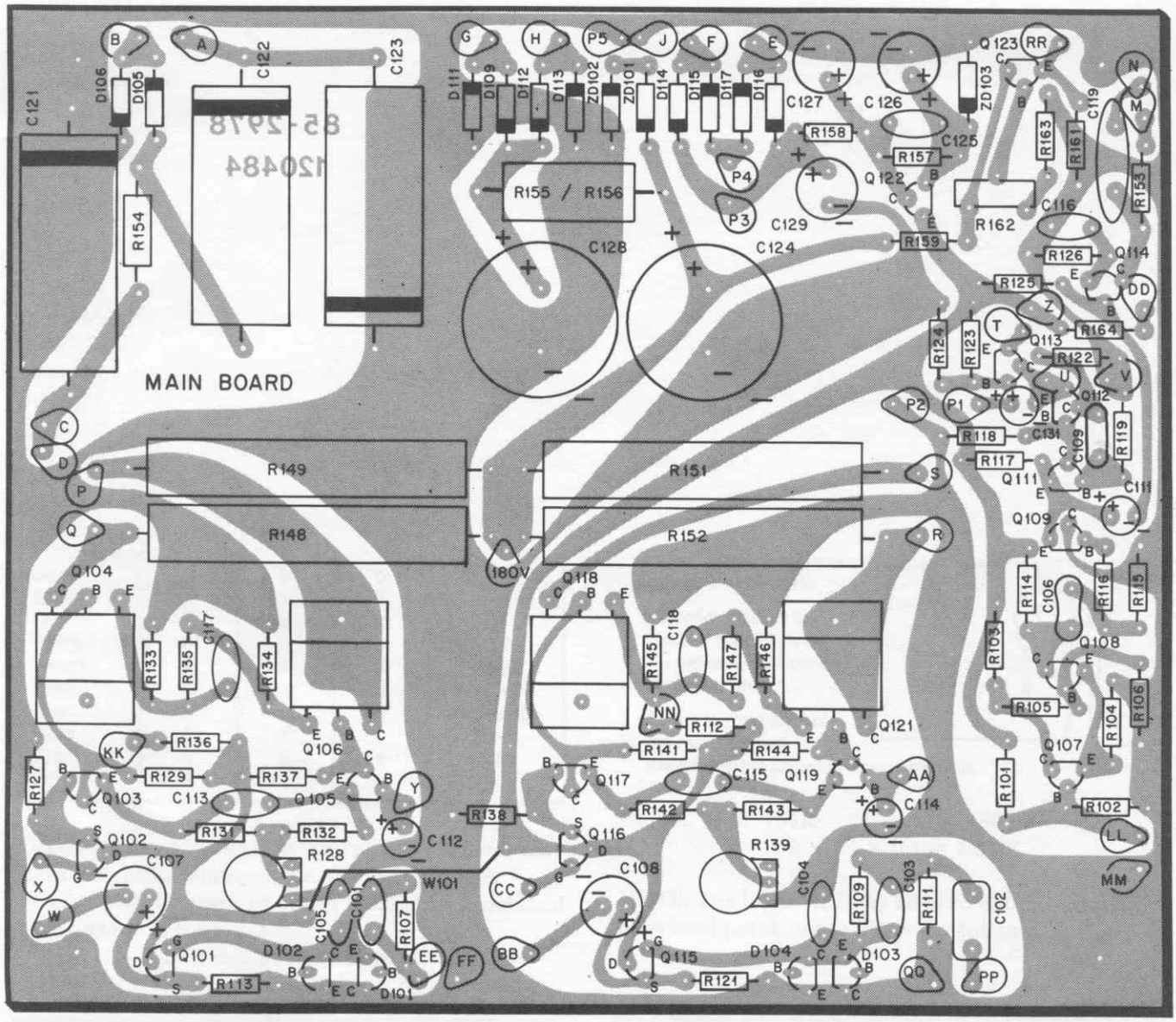
B. Locate this same number in the "Circuit Component Number" column of the appropriate "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION, which must be supplied when you order a replacement part.



DEMODULATOR CIRCUIT BOARD

(Shown from the component side.)



MAIN CIRCUIT BOARD

(Shown from the component side.)

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

HEATH
ZENITH

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