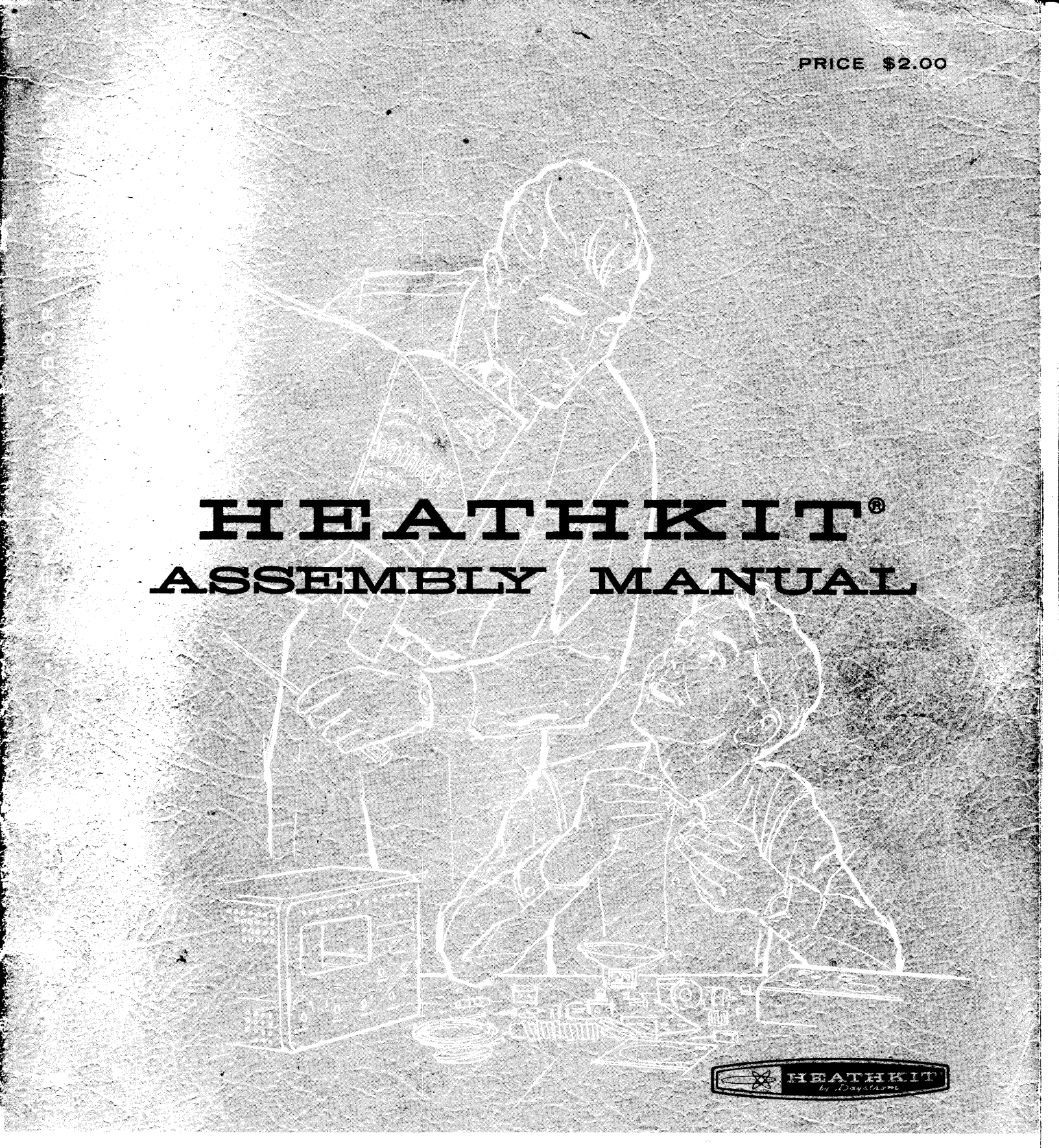
PRICE $2.00

HEATHKIT®
ASSEMBLY MANUAL



HEATHKIT by Daystrom

MONITOR SCOPE

MODEL HO-10

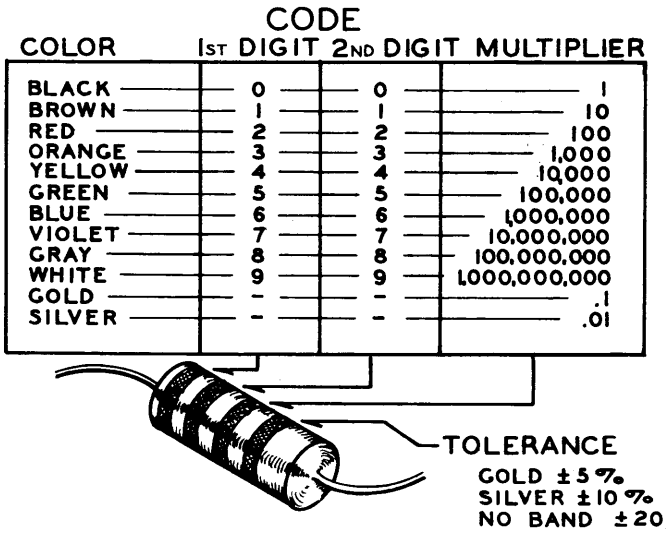
RESISTOR AND CAPACITOR COLOR CODES

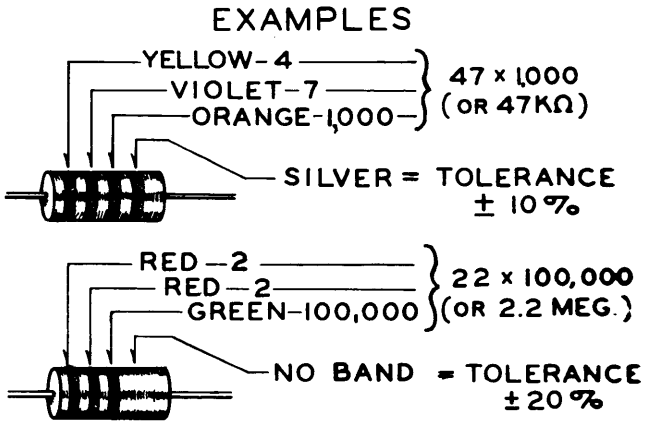
RESISTORS

The colored bands around the body of a color coded resistor represent its value in ohms. These colored bands are grouped toward one end of the resistor body. Starting with this end of the resistor, the first band represents the first digit of the resistance value; the second band represents the second digit; the third band represents the number by which the first two digits are multiplied. A fourth band of gold or silver represents a tolerance of ±5% or ±10% respectively. The absence of a fourth band indicates a tolerance of ±20%.

The physical size of a composition resistor is related to its wattage rating. Size increases progressively as the wattage rating is increased. The diameters of 1/2 watt, 1 watt and 2 watt resistors are approximately 1/8", 1/4" and 5/16", respectively.

The color code chart and examples which follow provide the information required to identify color coded resistors.

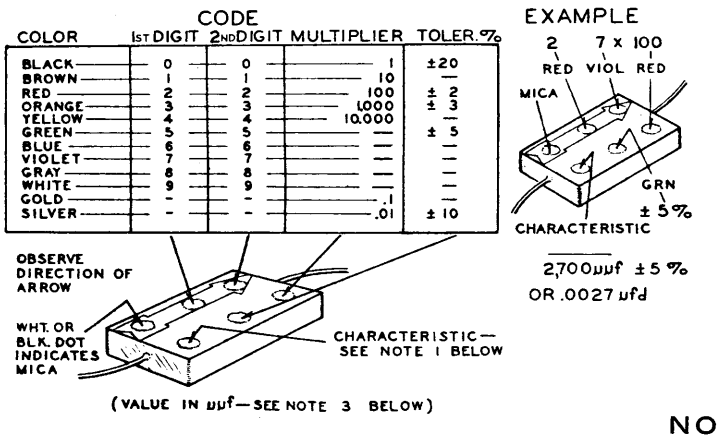




CAPACITORS

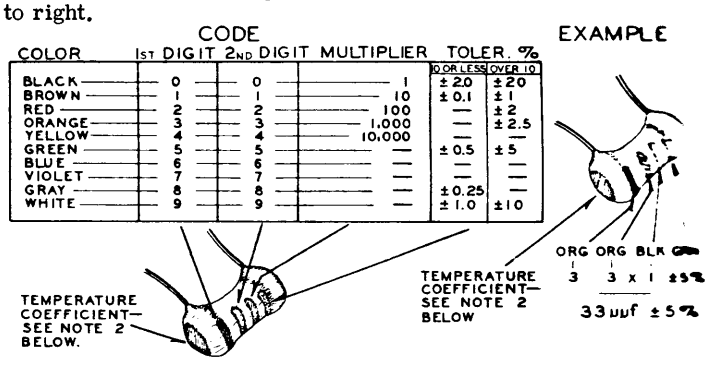
Generally, only mica and tubular ceramic capacitors, used in modern equipment, are color coded. The color codes differ somewhat among capacitor manufacturers, however the codes shown below apply to practically all of the mica and tubular ceramic capacitors that are in common use. These codes comply with EIA (Electronics Industries Association) Standards.

MICA



TUBULAR CERAMIC

Place the group of rings or dots to the left and read from left to right.



NOTES:

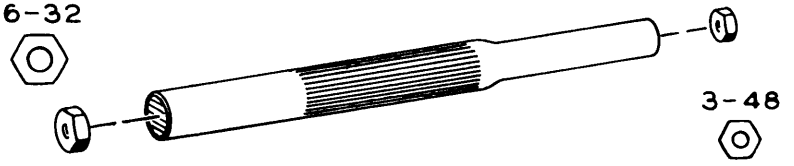
1. The characteristic of a mica capacitor is the temperature coefficient, drift capacitance and insulation resistance. This information is not usually needed to identify a capacitor but, if desired, it can be obtained by referring to EIA Standard, RS-153 (a Standard of Electronic Industries Association.)

2. The temperature coefficient of a capacitor is the predictable change in capacitance with temperature change and is expressed in parts per million per degree centigrade. Refer to EIA Standard, RS-198 (a Standard of Electronic Industries Association.)

3. The farad is the basic unit of capacitance, however capacitor values are generally expressed in terms of μfd (microfarad, .000001 farad) and μμf (micro-micro-farad, .000001 μfd); therefore, 1,000 μμf = .001 μfd, 1,000,000 μμf = 1μfd.

USING A PLASTIC NUT STARTER

A plastic nut starter offers a convenient method of starting the most used sizes: 3/16" and 1/4" (3-48 and 6-32). When the correct end is pushed down over a nut, the pliable tool conforms to the shape of the nut and the nut is gently held while it is being picked up and started on the screw. The tool should only be used to start the nut.

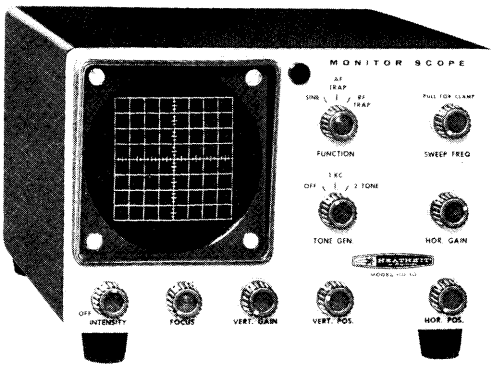


Assembly and Operation of the

HEATHKIT® by Daystrom

MONITOR SCOPE

MODEL HO-10



HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

a subsidiary of
DAYSTROM, INCORPORATED

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

10/11/63

SPECIFICATIONS

VERTICAL AMPLIFIER

Frequency Response	±3 db from 10 cps to 500 kc.
Sensitivity	500 mv per inch deflection.
Input Resistance	50 KΩ.

HORIZONTAL AMPLIFIER

Frequency Response	±3 db from 3 cps to 30 kc.
Sensitivity	800 mv per inch deflection.
Input Resistance	1 megohm.

SWEEP GENERATOR

Recurrent Type	Linear sawtooth produced by internal sweep generator.
Frequency	15 to 200 cps (variable).

TONE OSCILLATORS

Frequencies	Approximately 1000 cps and 1700 cps.
Output Voltage	15 mv (nominal).

GENERAL

Frequency Coverage	160 through 6 meters (50-75 Ω coaxial input).
Power Limits (At rear coaxial connector)	5 watts to 1 kilowatt output.
Tube And Diode Complement	1 - 3RP1 CRT, medium persistence, green trace. 1 - 6BN8 Clamper, low level RF detector. 1 - 6C10 Sweep generator, horizontal amplifier. 1 - 6J11 Twin phase shift tone generator. 1 - 12AU7 Vertical amplifier. 1 - 1V2 High voltage rectifier. 4 - Silicon diodes, B+ rectifiers.

Front Panel Controls	FUNCTION Selector. SWEEP FREQ. TONE GEN. HOR GAIN. HOR POS. VERT POS. VERT GAIN. FOCUS. INTENSITY/OFF.
Rear Control	XMTR ATTEN. Attenuates 0 to 24 db at approximately 6 db per step.
Power Supply	Transformer operated, fused at 1/2 ampere.
Power Requirements	105-125 VAC, 50/60 cps, 35 watts.
Dimensions	5-1/4" high x 7-3/8" wide x 11" deep (including knobs).
Net Weight	8-1/4 lbs.
Shipping Weight	10 lbs.

INTRODUCTION

Your HEATHKIT Model HO-10 Monitor Scope was designed as a small, compact instrument to be used with an amateur station for "on-the-air" signal monitoring. The Scope can be used on ham bands, 160 through 6 meters, without additional tuning or modification.

The Monitor Scope will present envelope, AF trapezoid, and RF trapezoid patterns by connecting it to the transmitter and/or power amplifier. It is also possible to monitor other amateur radio signals by using the Monitor Scope in conjunction with your receiver.

A two-tone (1000 and 1700 cps) sine wave audio oscillator for single sideband adjustment and other test work is built into the Scope. The Scope also features a special CRT shield to minimize stray field effects on the trace.

Its small physical size and built-in, transformer-operated power supply permit the Scope to be placed most anywhere in the ham shack for convenience in operation.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram to follow the circuit and to identify circuit components while reading this description.

The RF signal from a transmitter is monitored on the Scope by sampling a portion of the RF voltage from the coaxial antenna feed line. This signal is coupled through the XMTR ATTEN switch to the vertical deflection plates of CR tube V5. The XMTR ATTEN switch provides a capacitive divider network with attenuation of approximately 6 db per step. When it is connected into a properly terminated 50 or 75 Ω transmission line, transmitters as low as five watts and as high as several kilowatts can be used. Since the Scope input is untuned it is essentially independent of frequency from several kilocycles to more than 100 megacycles, although some distortion of pattern may exist when used on 2 meters.

A receiver signal display is accomplished by sampling a portion of the signal voltage in the IF circuit of the receiver. This signal is applied to the VERT input jack on the rear of the Scope. The proper amount of receiver IF signal is coupled from the VERT input jack through VERT GAIN control R3 to the grid of vertical amplifier tube V2A. The signal is amplified and coupled through capacitor C3 to the grid of deflection amplifier tube, V2B. Again, the signal is amplified and then coupled through capacitor C5 to the vertical deflection plates of CR tube, V5.

HORIZONTAL AMPLIFIER

The horizontal amplifier uses the third section of a type 6C10 triple triode compactron tube, V3C. The signal voltage applied to this stage is adjusted by HOR GAIN control R20. The choice of horizontal input signals is determined by the position of the FUNCTION switch. In the SINE position, the horizontal signal is obtained from the variable frequency sweep generator; in the AF TRAP position, the horizontal signal is obtained externally from the transmitter or other source through the HOR input jack. When the FUNCTION switch is in the RF TRAP position, rectified RF voltage, obtained from the EXCIT input jack, is applied to horizontal deflection amplifier tube, V3C. The amplified horizontal signal is coupled through capacitor C15 to the horizontal deflection plates of the CR tube.

SWEEP GENERATOR

The sweep generator circuit is made up of the first two sections of the 6C10 triple triode compactron tube, V3A and V3B. These two tube sections are connected in such a manner that they operate as a free-running multivibrator sawtooth generator. The sweep frequency can be varied over a range of approximately 15 to 200 cps by adjusting SWEEP FREQ control R21.

TWO-TONE OSCILLATOR

The two-tone oscillator circuit uses a twin pentode compactron tube, V4, as two nearly identical phase shift oscillators. Each section uses a P.E.C. (packaged electronic circuit) phase shift network containing five 500 $\mu\mu$f capacitors and four 470 KΩ resistors. (See insert on Schematic.) This circuit is a 3-terminal network designed to produce 180 degrees phase shift from terminal 1 to terminal 3 at approximately 1000 cps.

In either tube section the circuit will oscillate at the frequency where the total phase shift around the loop (grid to plate and back to grid again by way of the P.E.C.) is zero degrees (or 360 degrees). In the case of the 1000 cps section, the large electrolytic capacitor in the cathode circuit is adequate to provide complete bypassing with the result that the tube exhibits the 180 degrees phase inversion of a normal RC coupled amplifier at mid-frequencies. This section will therefore oscillate at the frequency where the P.E.C. can give an added 180 degrees shift or approximately 1000 cps.

In the 1700 cps section, the cathode is not completely bypassed; that is, the reactance of the .05 μfd capacitor is appreciable in comparison to the resistance it bypasses. This results in some added phase shift within the tube which requires that the shift of the P.E.C. be somewhat less than 180 degrees. The nature of the phase shift network is such that as the frequency is increased, the phase shift through the unit decreases. At a higher frequency (approximately 1700 cps), the phase shifts contributed by the P.E.C., the effect of incomplete cathode bypassing, plus the tube inversion add up to the required zero or 360 degrees which determines the frequency of oscillation of this section.

Although the potentiometers in the cathode circuits will change frequency slightly, they are primarily provided to adjust gain of these stages for good class A operation and allow balancing of the two oscillator outputs. Under these conditions, the output will be a relatively harmonic-free waveform.

CLAMPER CIRCUIT

During a setup for a trapezoid display of a transmitted signal, the trace will reduce to a spot when no signal is present. This spot can burn the phosphor on the face of the CR tube if it is left at a high brightness for a prolonged length of time. A clamper circuit made up of triode V1B and diode V1C causes the spot to be deflected off the screen during no-signal conditions. This circuit is activated when the FUNCTION switch is in either of the TRAP positions and the pull switch on the SWEEP FREQ control is pulled out.

POWER SUPPLY

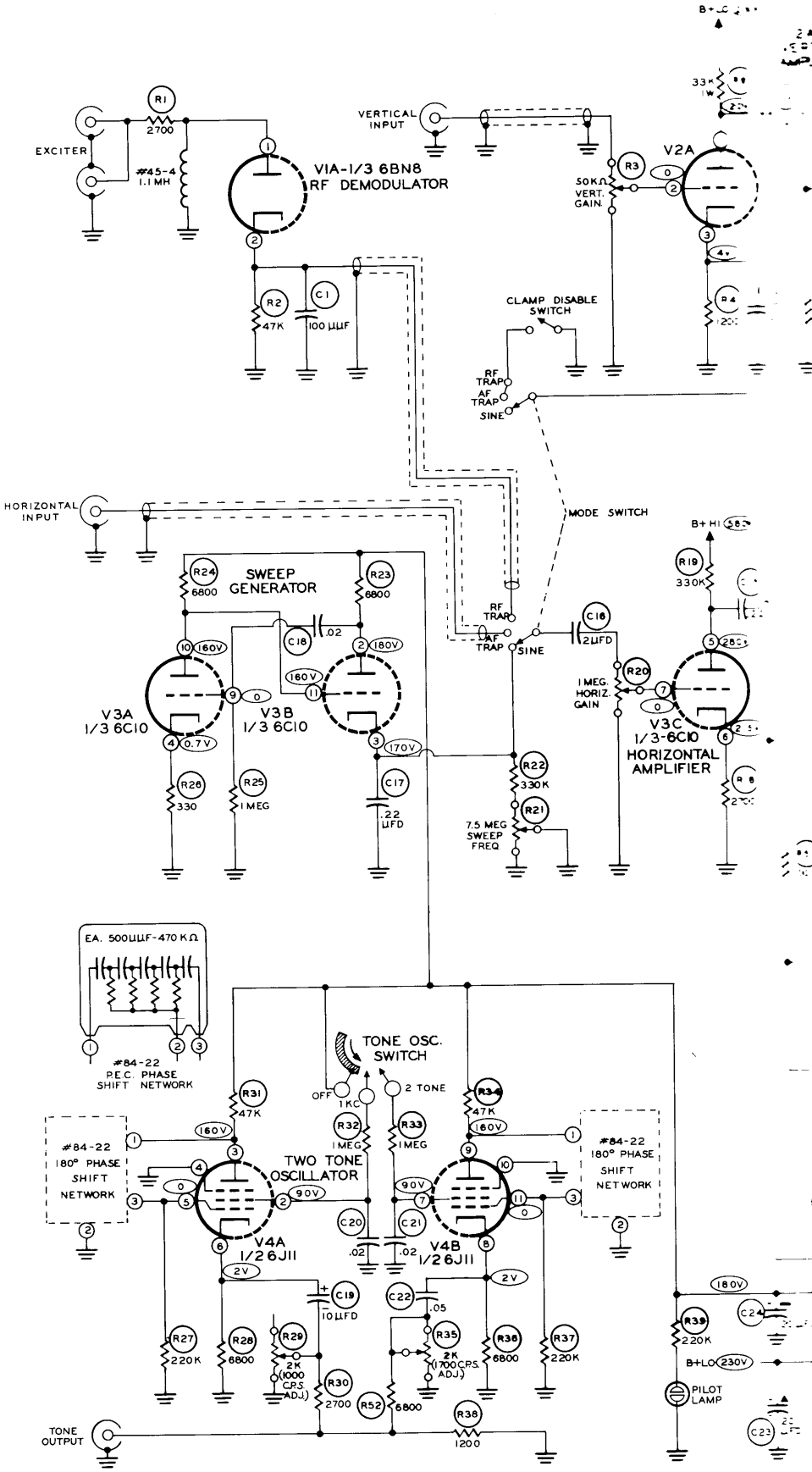
The transformer operated power supply uses a 1V2 tube, V6, in a half-wave rectifier circuit to provide -1600 volts for the CR tube. Also, a full-wave voltage doubler circuit provides +270 and +580 volts. This circuit uses four silicon diode rectifiers. Resistors R40, R41, R42, and R43, and capacitors C23, C24, C25, C26, C28, and C29 make up the B+ filtering network; resistor R44 and capacitors C30 and C31 make up the high voltage filtering circuit.

CONSTRUCTION NOTES

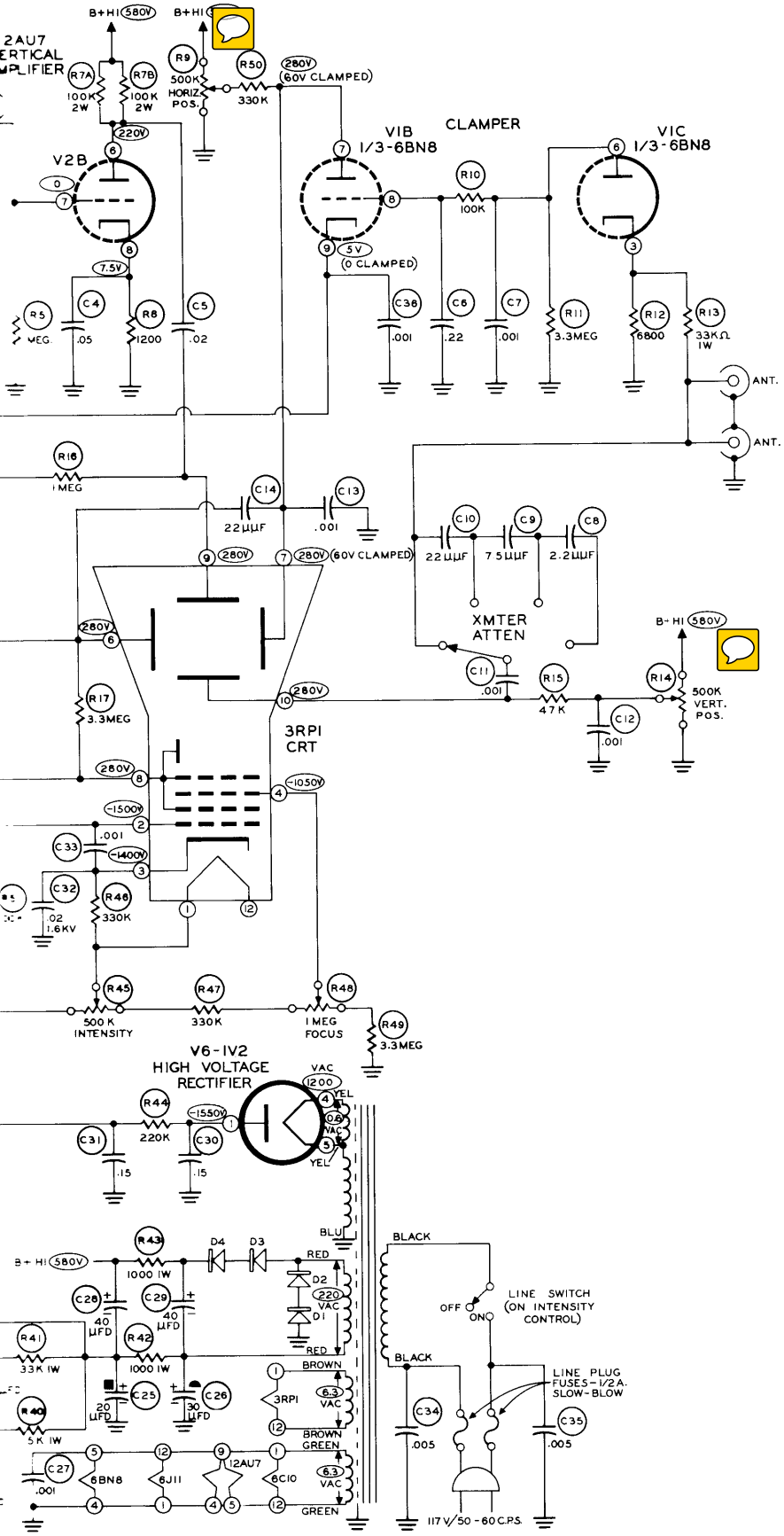
This manual is supplied to assist you in every way to complete your kit with the least possible chance for error. The arrangement shown is the result of extensive experimentation and trial. If followed carefully, the result will be highly stable and dependable performance. We suggest that you retain the manual in your files for future reference, both in the use of the equipment and for its maintenance.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read the Replacements section and supply the information called for therein. Include all inspection slips in your letter to us.

Resistors generally have a tolerance rating of 10% unless otherwise stated in the Parts List. Tolerances on capacitors are generally even greater. Limits of +100% and -20% are common for electrolytic capacitors.

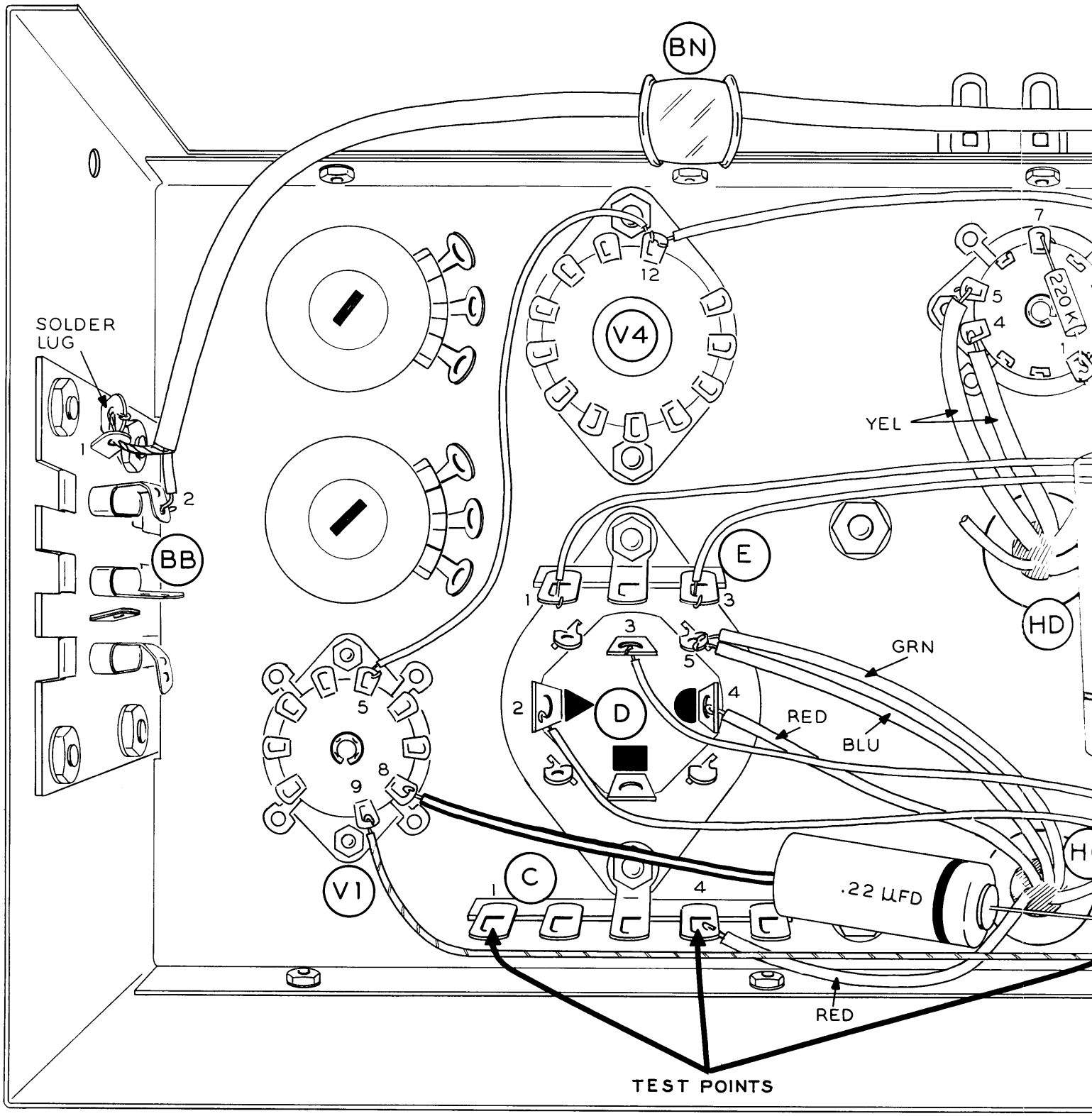


SCHEMATIC OF THE HEATHKIT® MONITOR SCOPE MODEL HO-10

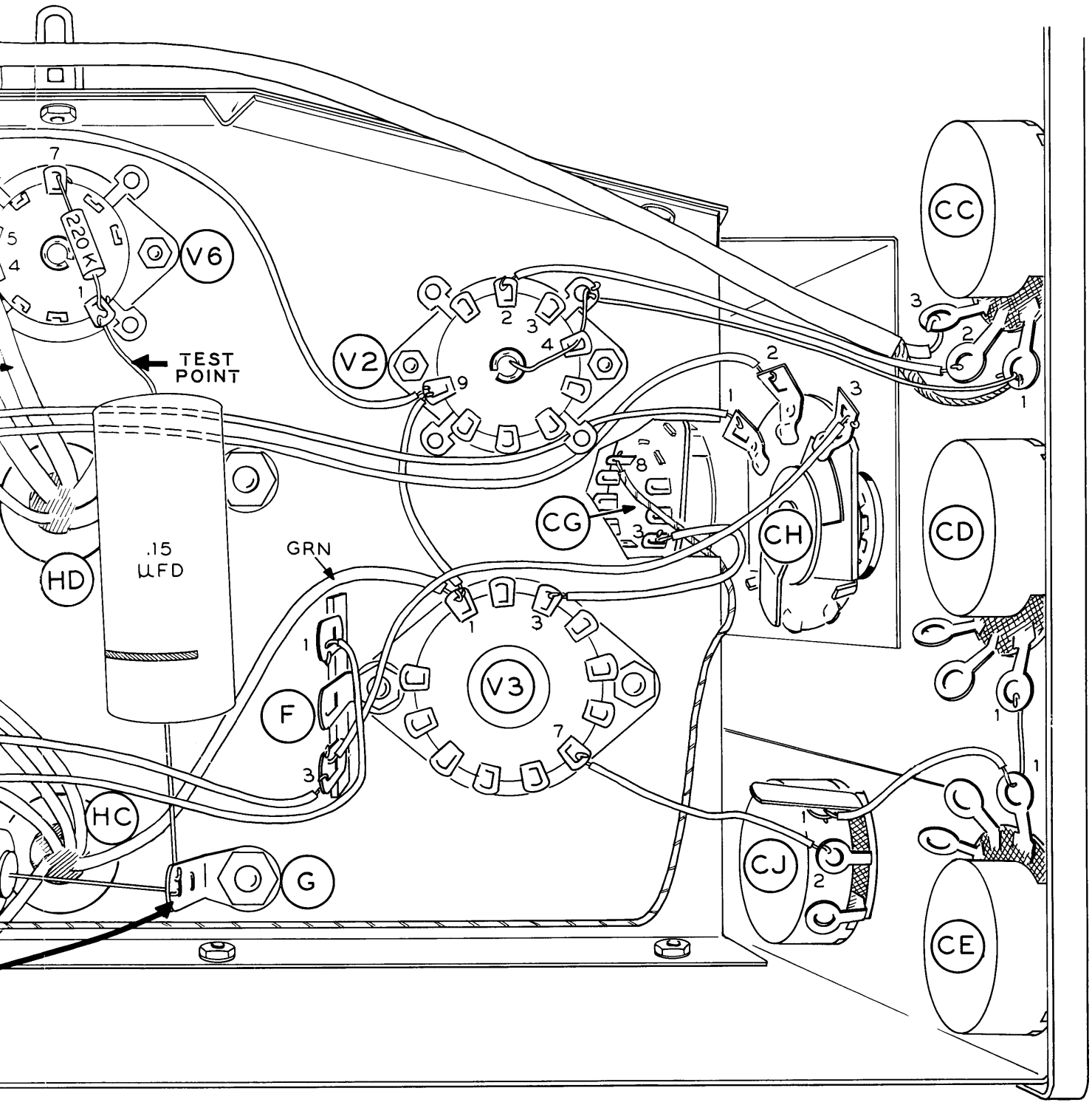


NOTES:

ALL SWITCHES SHOWN IN FULLY COUNTERCLOCKWISE POSITION AS VIEWED FROM SHAFT END.
⬭ INDICATES VOLTAGE.
ALL VOLTAGES MEASURED WITH 20,000/Ω/VOLT (OR HIGHER) METER.
ALL VOLTAGES MEASURED FROM POINT INDICATED TO GROUND EXCEPT AC TRANSFORMER VOLTAGES.
ALL RESISTORS 1/2 WATT UNLESS OTHERWISE SHOWN.
ALL CAPACITORS LISTED ARE IN μfd UNLESS OTHERWISE SHOWN.



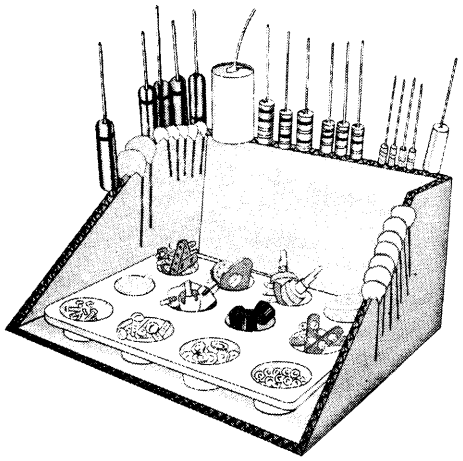
Pictorial 12


V6
220K
TEST POINT
V2
CC
CG
CH
CD
.15 μFD
HD
GRN
V3
F
HC
G
CJ
CE

We suggest that you do the following before work is started:

1. Lay out all parts so that they are readily available.
2. Provide yourself with good quality tools. Basic tool requirements consist of a screwdriver with a 1/4" blade; a small screwdriver with a 1/8" blade; long-nose pliers; wire cutters, preferably separate diagonal cutters; a penknife or a tool for stripping insulation from wires; a soldering iron (or gun) and rosin core solder. A set of nut drivers and a nut starter, while not necessary, will aid extensively in construction of the kit.

Most kit builders find it helpful to separate the various parts into convenient categories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed with their lead ends inserted in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used.



PARTS LIST

The numbers in parentheses in the Parts List are keyed to the numbers in the Parts drawings to aid in parts identification.

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
(1)1-4	1	330 Ω 1/2 watt (orange-orange-brown)
1-10	3	1200 Ω 1/2 watt (brown-red-red)
1-13	3	2700 Ω 1/2 watt (red-violet-red)
1-19	6	6800 Ω 1/2 watt (blue-gray-red)
1-25	4	47 KΩ 1/2 watt (yellow-violet-orange)
1-26	2	100 KΩ 1/2 watt (brown-black-yellow)
Resistors (cont'd.)		
1-29	4	220 KΩ 1/2 watt (red-red-yellow)
1-31	5	330 KΩ 1/2 watt (orange-orange-yellow)
1-35	5	1 megohm 1/2 watt (brown-black-green)
1-38	3	3.3 megohm 1/2 watt (orange-orange-green)
(2)1A-2	2	1000 Ω 1 watt (brown-black-red)
1A-26	1	15 KΩ 1 watt (brown-green-orange)

(1)

(2)

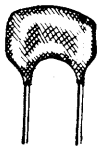
PART No.	PARTS Per Kit	DESCRIPTION
Resistors (cont'd.)		
1A-27	3	33 KΩ 1 watt (orange-orange-orange)
(3) 1B-24	2	100 KΩ 2 watt (brown-black-yellow)

(3)

Capacitors

(4) 20-52	1	7.5 μμf resin dipped mica
20-99	2	22 μμf resin dipped mica
20-102	1	100 μμf resin dipped mica
(5) 21-14	7	.001 μfd disc ceramic
21-72	2	.005 μfd 1.4 KV disc ceramic
21-31	5	.02 μfd 500 V disc ceramic
21-38	1	.02 μfd 1.6 KV disc ceramic
21-94	3	.05 μfd 10 V disc ceramic
23-94	2	.15 μfd 1.6 KV tubular
(6) 23-49	3	.22 μfd 400 V tubular
27-21	1	2 μfd 200 V mylar tubular
28-1	1	2.2 μμf tubular (red-red-white)
(7) 25-54	1	10 μfd 10 or 15 V electrolytic

(4)



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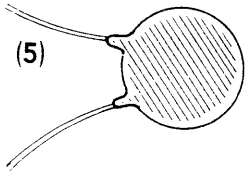

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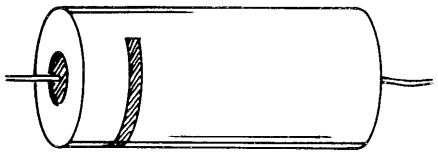

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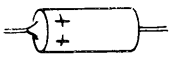
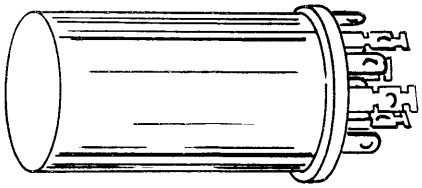


PART No.	PARTS Per Kit	DESCRIPTION
Capacitors (cont'd.)		
(8) 25-63	1	30-20-20-20 μfd at 450-400-350-300 V twist-prong electrolytic
(9) 25-41	2	40 μfd 350 V electrolytic tubular

(8)



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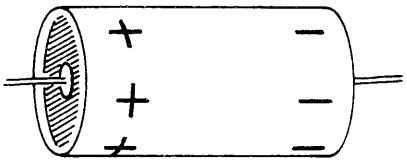
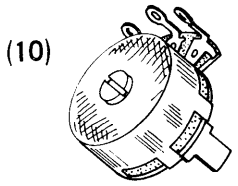


Controls-Switches

(10) 10-52	2	2 KΩ linear control (tab mount)
(11) 10-11	1	50 KΩ linear control
10-26	2	500 KΩ linear control
(12) 19-78	1	500 KΩ linear control with SPST switch
10-32	2	1 megohm linear control
(13) 19-76	1	7.5 megohm linear control with SPST push-pull switch
(14) 63-40	1	2-pole 3-position rotary switch

(10)



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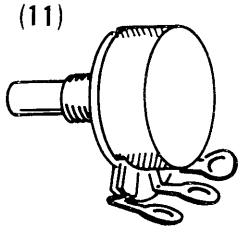

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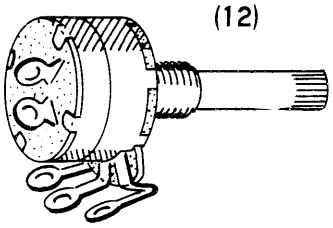

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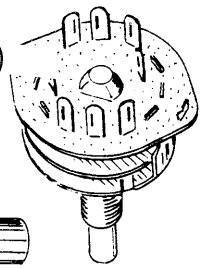

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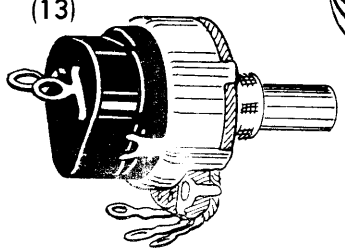
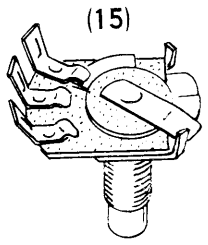
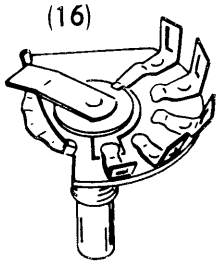
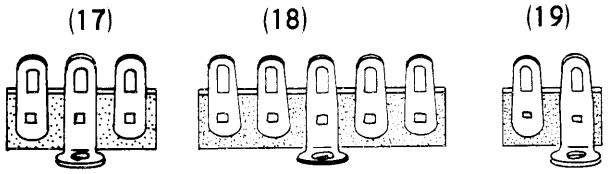


PART No.	PARTS Per Kit	DESCRIPTION
Controls-Switches (cont'd.)		
(15) 63-77	1	1-pole 3-position progessively-shorting rotary switch
(16) 63-138	1	1-pole 4-position rotary switch

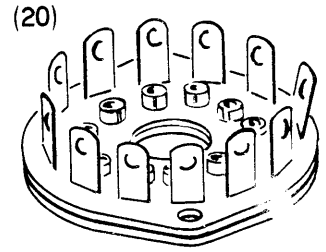


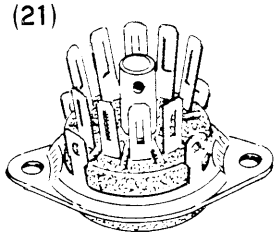


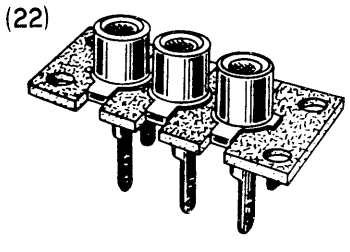
Terminal Strips-Sockets		
(17) 431-10	6	3-lug terminal strip
(18) 431-11	1	5-lug terminal strip
(19) 431-14	2	2-lug terminal strip

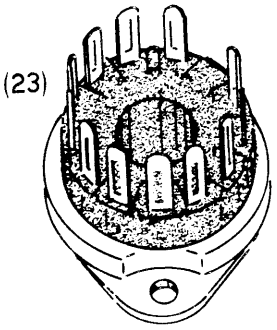


(20) 434-41	1	12-pin CRT socket
(21) 434-56	3	9-pin miniature socket
(22) 434-76	1	Triple phono socket
434-82	1	Double phono socket
(23) 434-121	2	12-pin compactron socket

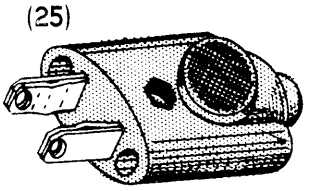




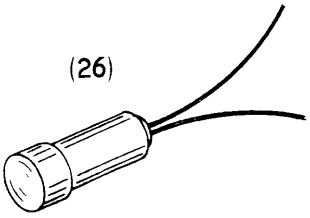




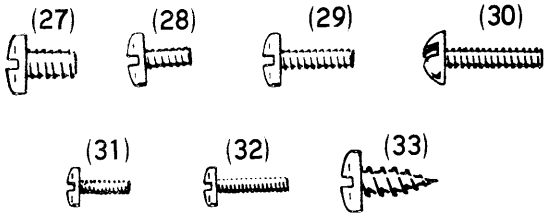
PART No.	PARTS Per Kit	DESCRIPTION
Plugs		
(24) 438-4	5	Phono plug
(25) 438-11	1	Fused AC plug



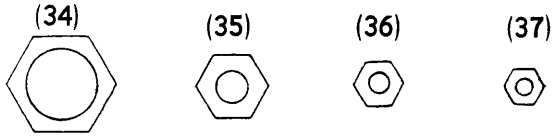
Tubes-Lamp		
411-25	1	12AU7 tube
411-65	1	1V2 tube
411-128	1	6BN8 tube
411-142	1	3RP1 CR tube
411-167	1	6C10 tube
411-168	1	6J11 tube
(26) 412-13	1	Pilot lamp (red neon)



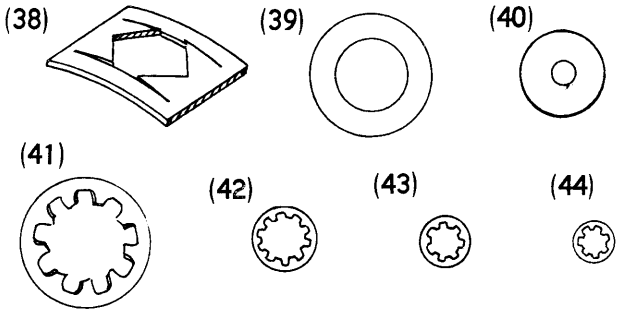
Hardware		
(27) 250-174	4	8-32 x 1/4" screw
(28) 250-56	14	6-32x 1/4" screw
(29) 250-89	15	6-32 x 3/8" screw
(30) 250-48	2	6-32 x 1/2" screw (round head)
(31) 250-49	23	3-48 x 1/4" screw
(32) 250-172	1	3-48 x 3/8" screw
(33) 250-51	2	#10 x 3/8" sheet metal screw



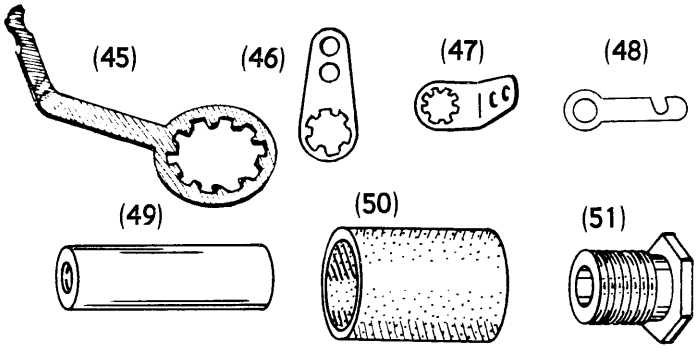
PART No.	PARTS Per Kit	DESCRIPTION
Hardware (cont'd.)		
34) 252-7	15	Control nut
35) 252-4	4	8-32 nut
36) 252-3	25	6-32 nut
37) 252-1	24	3-48 nut



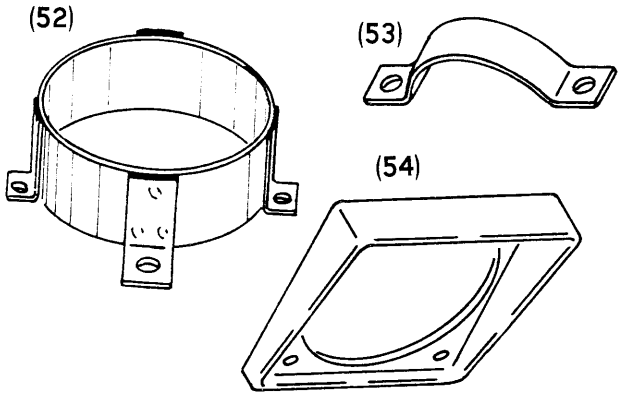
38) 252-32	1	Large push-on speednut
39) 253-10	10	Control flat washer
40) 253-40	1	Spring steel washer
41) 254-4	5	Control lockwasher
42) 254-2	3	#8 lockwasher
43) 254-1	48	#6 lockwasher
44) 254-7	25	#3 lockwasher



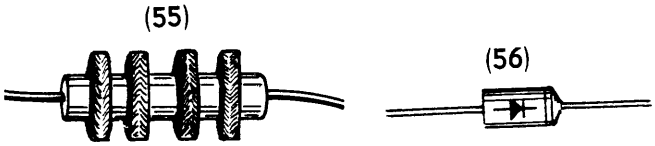
45) 259-10	1	Control solder lug
46) 259-2	1	#8 solder lug
47) 259-1	3	#6 solder lug (large)
48) 259-6	1	#6 solder lug (small)
49) 255-11	2	5/16" x 1" 6-32 spacer
50) 255-55	1	5/8" x 3/4" phenolic spacer
51) 455-9	1	3/8" x 3/8" brass bushing



PART No.	PARTS Per Kit	DESCRIPTION
Wire-Sleeving		
89-4	1	Line cord
340-9	1	Length bare wire
343-5	1	Length RG-62U cable
343-6	1	Length audio cable
344-1	1	Length hookup wire
344-13	1	Length #22 HV hookup wire
346-1	1	Length sleeving
Sheet Metal Parts		
90-230	1	Cabinet
(52) 100-M329	1	CRT front mounting ring
200-M357F823	1	Chassis
200-M358F739	1	Chassis enclosure
203-319F738	1	Front panel
(53) 207-M1	2	CRT rear mounting clamp
(54) 210-20F	1	Front bezel

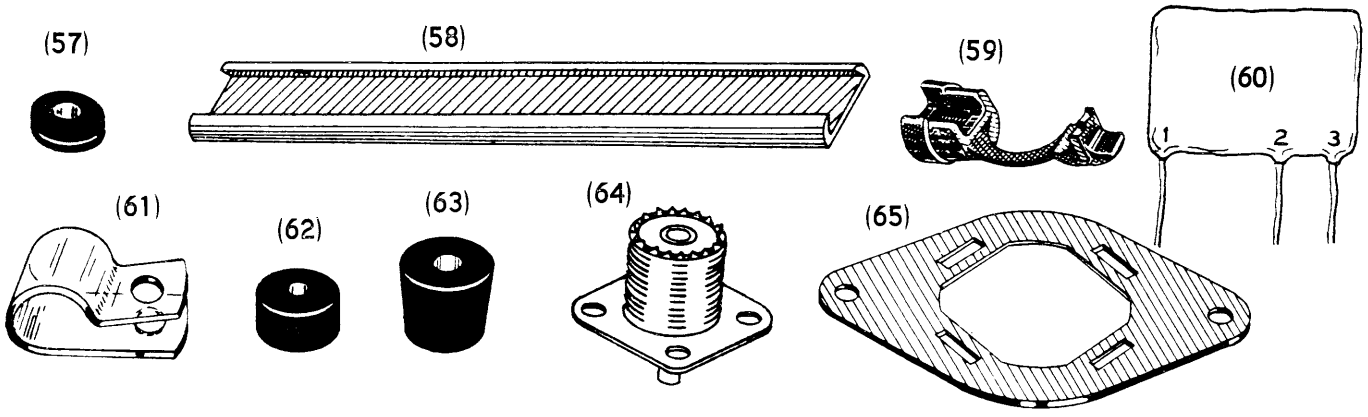


Miscellaneous		
(55) 45-4	1	RF choke
54-130	1	Power transformer
(56) 57-27	4	Silicon rectifier



PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous (cont'd.)		
(57) 73-4	2	Grommet
(58) 73-5	1	Rubber cushion strip
(59) 75-30	1	Line cord strain relief
(60) 84-22	2	Phase shift network (PEC)
206-180	1	CR tube shield
(61) 207-22	1	Plastic clamp
(62) 261-9	4	Feet (short)
(63) 261-20	2	Feet (long)

PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous (cont'd.)		
414-9	1	Grid screen
421-20	2	1/2 ampere slow-blow fuse
(64) 436-5	2	Coaxial jack
462-168	10	Knob
(65) 481-1	1	Electrolytic capacitor mounting wafer (metal)
331-6		Solder
595-578	1	Manual



PROPER SOLDERING TECHNIQUES

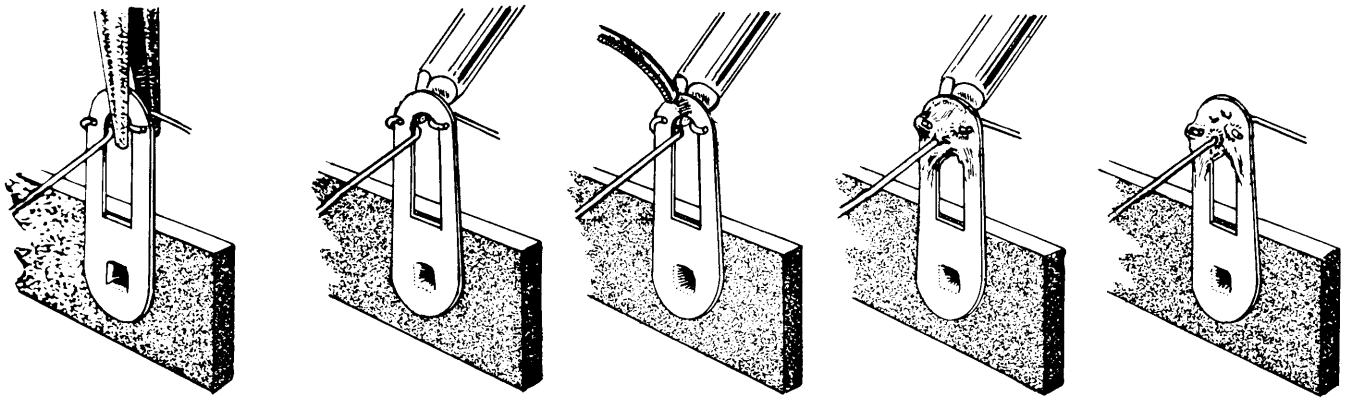
Only a small percentage of customers find it necessary to return equipment for factory service. By far the largest portion of malfunctions in this equipment are due to poor or improper soldering.

If terminals are bright and clean and free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Correctly soldered connections are essential if the performance engineered into a kit is to be fully realized. If you are a beginner with no experience in soldering, a half hour's practice with some odd lengths of wire may be a worthwhile investment.

For most wiring, a 25 to 100 watt iron or its equivalent in a soldering gun is very satisfactory. A lower wattage iron than this may not heat the connection enough to flow the solder smoothly. Keep the iron tip clean by wiping it from time to time with a cloth.

CHASSIS WIRING AND SOLDERING

1. Unless otherwise indicated, all wire used is the type with colored insulation (hookup wire). In preparing a length of hookup wire, 1/4" of insulation should be removed from each end unless directed otherwise in the assembly step.



CRIMP WIRES | HEAT CONNECTION | APPLY SOLDER | ALLOW SOLDER TO FLOW | PROPER SOLDER CONNECTION

2. To avoid breaking internal connections when stripping insulation from the leads of transformers or similar components, care should be taken not to pull directly on the lead. Instead, hold the lead with pliers while it is being stripped.

3. Leads on resistors, capacitors, and similar components are generally much longer than need be to make the required connections. In these cases, the leads should be cut to proper length before the part is installed. In general, the leads should be just long enough to reach their terminating points.

4. Wherever there is a possibility of bare leads shorting to other parts or to the chassis, the leads should be covered with insulating sleeving. Where the use of sleeving is specifically intended, the phrase "use sleeving" is included in the associated assembly step. In any case where there is the possibility of an unintentional short circuit, sleeving should be used. Extra sleeving is provided for this purpose.

5. Crimp or bend the lead (or leads) around the terminal to form a good joint without relying on solder for physical strength. If the lead is too large to allow bending or if the step states that it is not to be crimped, position it so that a good solder connection can still be made.

6. Position the work, if possible, so that gravity will help to keep the solder where you want it.

7. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated sufficiently to melt the solder.

8. Then place the solder and it will immediately flow over the joint; use only enough solder to thoroughly wet the junction. It is usually not necessary to fill the entire hole in the terminal with solder.

9. Remove the solder and then the iron from the completed joint. Use care not to move the leads until the solder is solidified.

A poor or cold solder joint will usually look crystalline and have a grainy texture, or the solder will stand up in a blob and will not have adhered to the joint. Such joints should be reheated until the solder flows smoothly. In some cases, it may be necessary to add a little more solder to achieve a smooth, bright appearance.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

STEP-BY-STEP PROCEDURE

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important as it may prevent errors or omissions, especially if your work is interrupted. Some kit builders have also found it helpful to mark each wire and part in colored pencil on the Pictorial as it is added.

The fold-out diagrams in this manual may be removed and attached to the wall above your working area; but because they are an integral part of the instructions, they should be returned to the manual after the kit is completed.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

The abbreviation "NS" indicates that a connection should not be soldered yet as other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number will appear after each solder instruction. This number indicates the number of leads that are supposed to be connected to the terminal in point before it is soldered. For example, if the instruction reads, "Connect a wire to lug 1 (S-2)," it will be understood that there will be two wires connected to the terminal at the time it is soldered. (In cases where a wire passes through a terminal or lug and then connects to another point, it will count as two wires, one entering and one leaving the terminal.)

The steps directing the installation of resistors include color codes to help identify the parts. Also, if a part is identified by a letter-number designation (R1, C1, etc.) on the Schematic, its designation will appear at the beginning of the assembly step which directs its installation.

STEP-BY-STEP ASSEMBLY

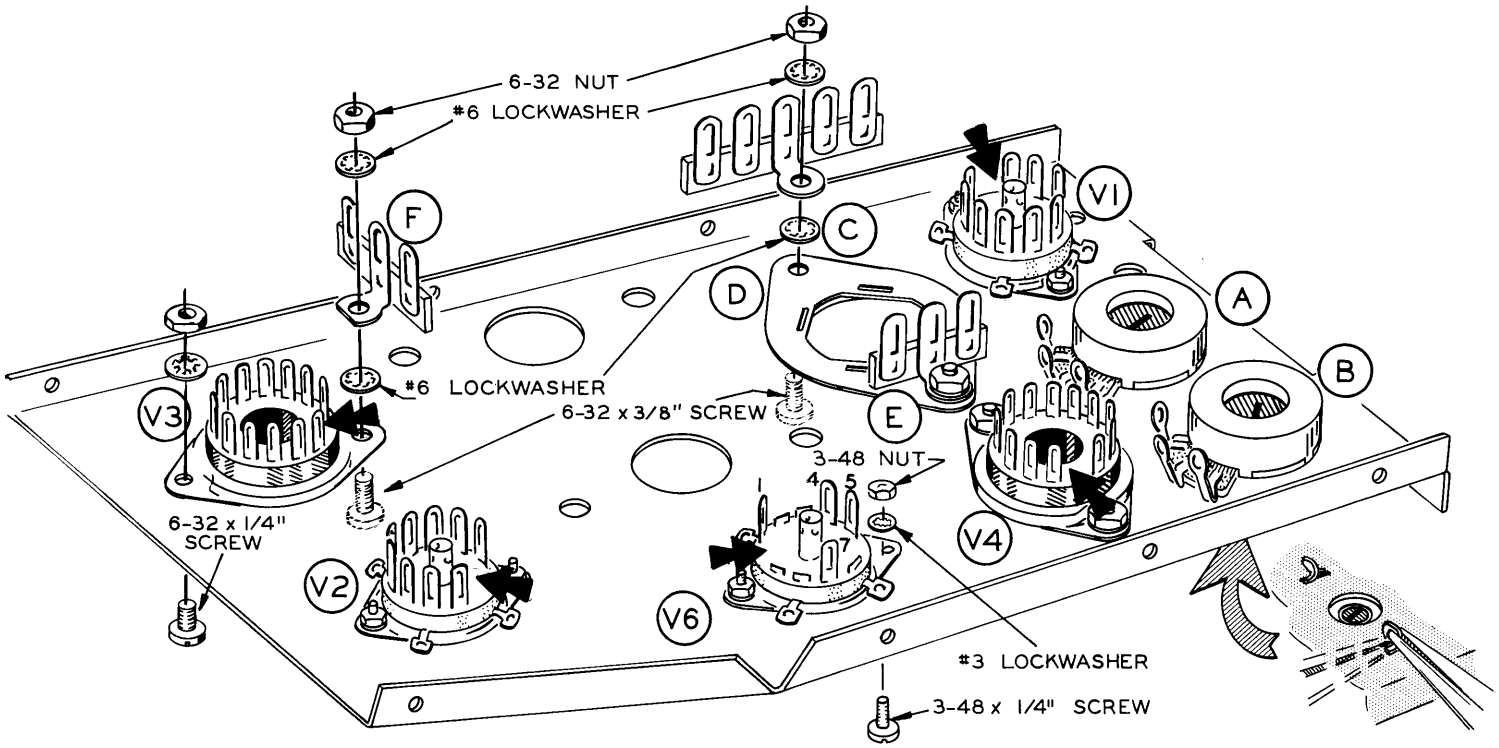
Refer to Pictorial 1 for the following steps.

NOTE: Lockwashers will be used with all screws and nuts when mounting parts, unless directed otherwise. The following steps will call out only the size and type of the hardware to be used. Where 6-32 x 1/4" hardware is specified, a 6-32 x 1/4" screw, a #6 lockwasher, and a 6-32 nut should be used. When 3-48 x 1/4" hardware is specified, a 3-48 x 1/4" screw, a #3 lockwasher, and a 3-48 nut should be used. In the case of terminal strip mounting, an additional lockwasher is to be used under the mounting foot as shown in Pictorial 1.

( ) Position the chassis as shown in Pictorial 1.

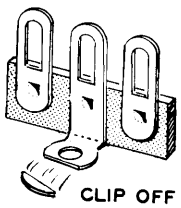
( ) Mount a 9-pin tube socket at location V6. Use 3-48 x 1/4" hardware as shown in Pictorial 1. Be sure to place the blank space as shown. Now, using diagonal cutters, clip off lugs 2, 3, 6, 8, and 9 of tube socket V6.

( ) Mount 9-pin tube sockets at locations V2 and V1. Use 3-48 x 1/4" hardware. Be sure to place the blank space of each socket as shown. Bend the ground lugs on tube sockets V1, V2, and V6 away from the socket, as shown in Pictorial 1.



Pictorial 1

( ) Clip off the very edge of the mounting foot of a 3-lug terminal strip as shown in Detail 1A.



Detail 1A

( ) Mount a 12-pin compactron tube socket at V3 with the 3-lug terminal strip at F. Use 6-32 x 3/8" hardware for the terminal strip mounting and 6-32 x 1/4" hardware at the other tube socket mounting foot. Be sure to place the blank space of the tube socket as shown.

( ) Mount the remaining 12-pin compactron tube socket at V4. Use 6-32 x 1/4" hardware. Be sure to place the blank space as shown.

( ) Mount the electrolytic capacitor mounting wafer on the bottom of the chassis at location D, along with a 5-lug terminal strip at C and a 3-lug terminal strip at E. Use 6-32 x 3/8" hardware as shown in Pictorial 1. Be sure to position the terminal strips as shown.

( ) R35, R29. Mount the 2 KΩ twist-tab controls (#10-52) at locations A and B as shown in Pictorial 1. Twist each mounting tab 1/4 turn with long nose pliers. Be sure to position the control lugs as shown.

Set the Chassis aside until called for later.

Refer to Pictorial 2 for the following steps.

( ) Locate the chassis enclosure and position it as shown.

( ) Mount the double phono socket at location BA on the rear of the chassis enclosure. Use 6-32 x 1/4" hardware with four additional lockwashers and two large #6 solder lugs as shown. Be sure that the solder lugs are positioned against the ground lugs on the phono socket and are bent up at a 90 degree angle to the chassis enclosure.

( ) Note that the triple phono socket is not symmetrical and mount this socket at location BB. Use 6-32 x 1/4" hardware with four additional lockwashers and one large #6 solder lug. Be sure that the solder lug is placed against the ground lug on the socket and bent up at a 90 degree angle to the chassis enclosure.

( ) Mount coax jacks at locations BC and BD. Use 3-48 x 1/4" hardware as shown in Pictorial 2.

( ) Mount the 1-pole 4-position rotary switch (#63-138) at location BE. Use a control lockwasher, control flat washer, and a control nut as shown in Pictorial 2. Position the switch lugs as shown.

( ) Be sure the control shaft is turned fully counterclockwise, then install a knob on the shaft with the white dot at the 11 o'clock position.

( ) Install rubber grommets in holes HE and HF.

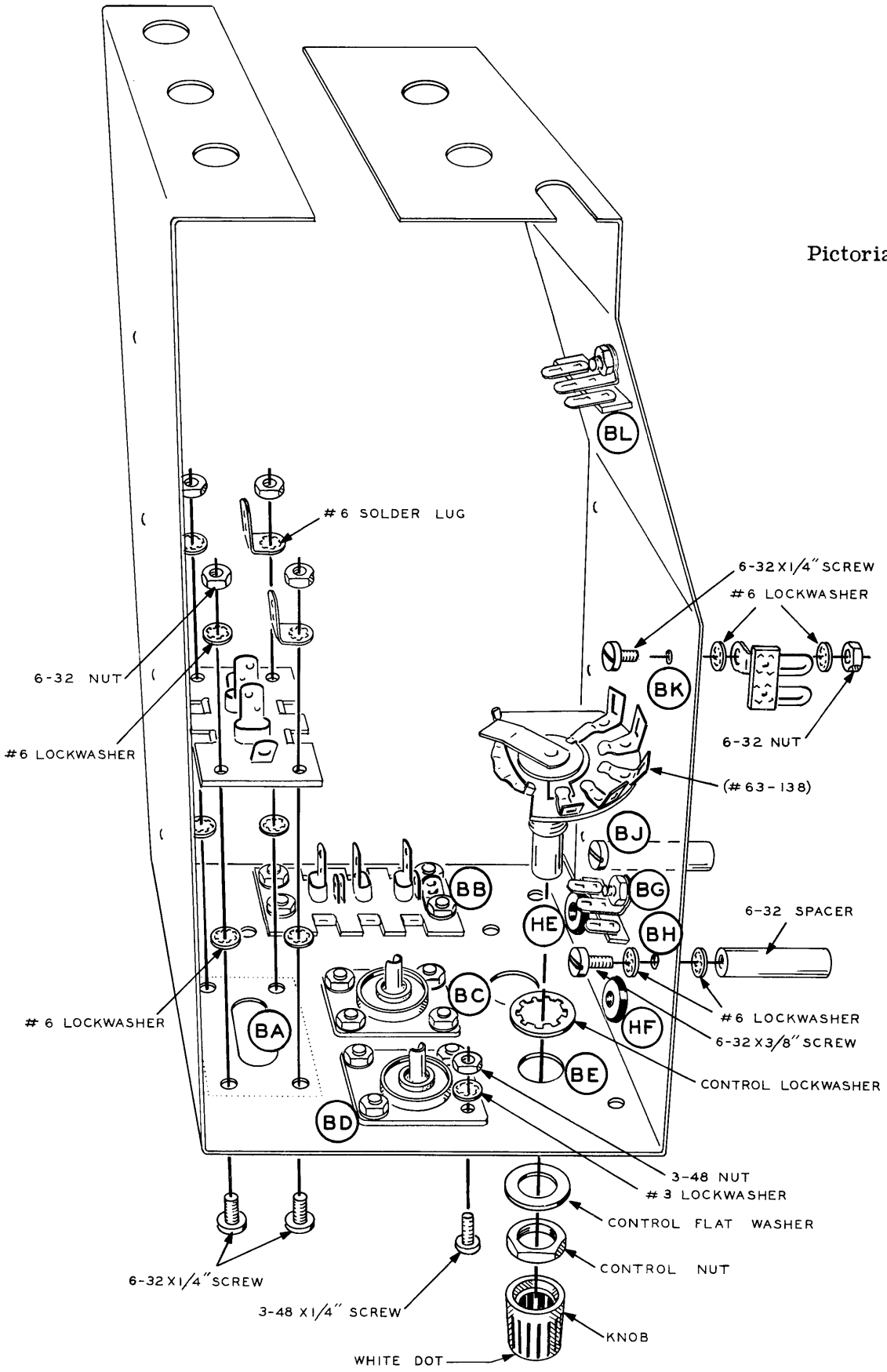
( ) Mount 5/16" x 1" tapped 6-32 spacers at locations BH and BJ. Use 6-32 x 3/8" screws, and #6 lockwashers as shown in Pictorials 2 and 3.

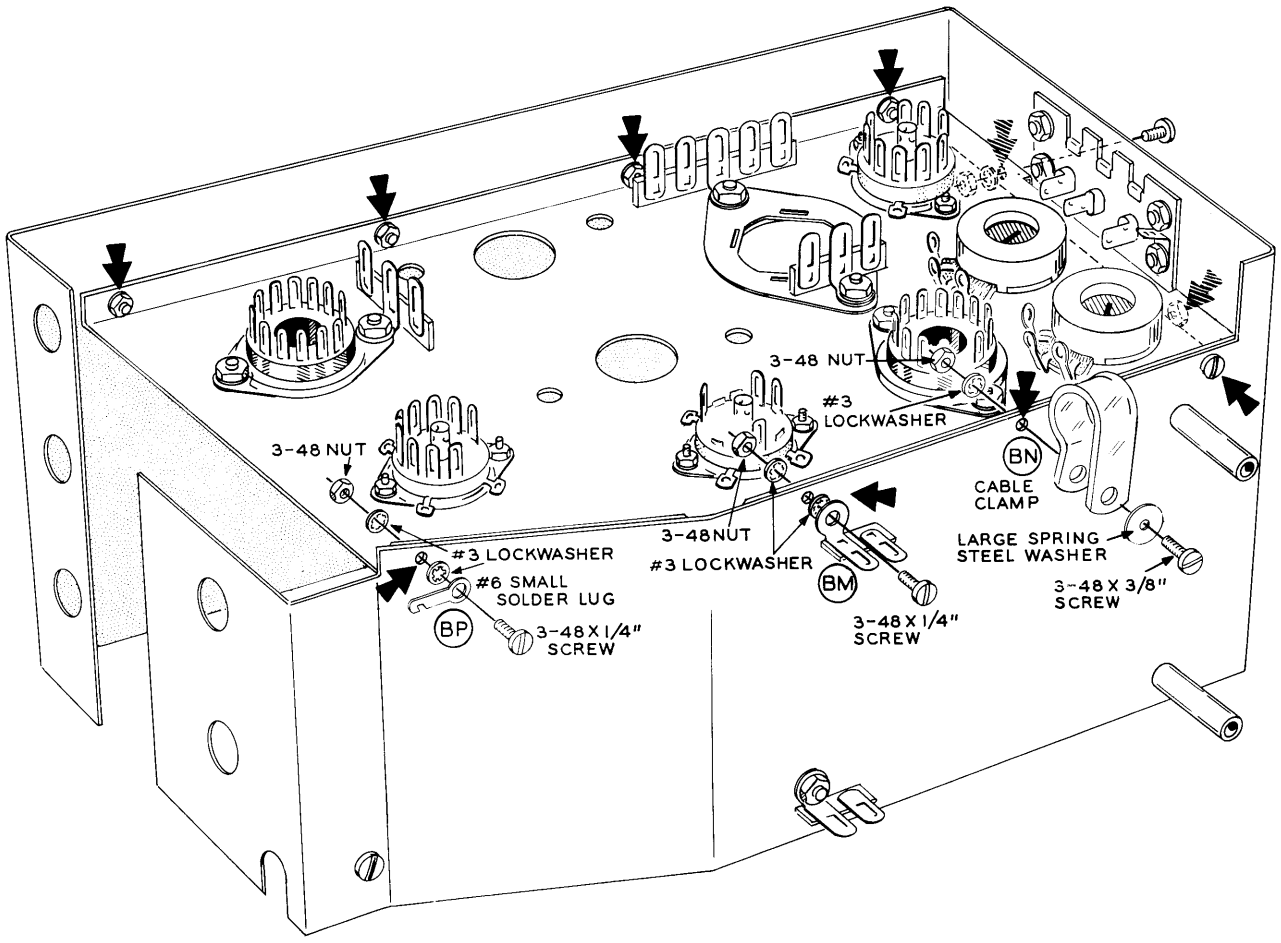
( ) Mount a 3-lug terminal strip at BG. Use 6-32 x 1/4" hardware.

( ) Mount a 2-lug terminal strip at location BK. Use 6-32 x 1/4" hardware.

( ) Mount a 3-lug terminal strip at location BL. Use 6-32 x 1/4" hardware.

Pictorial 2


BL
#6 SOLDER LUG
6-32 X 1/4" SCREW
#6 LOCKWASHER
6-32 NUT
BK
6-32 NUT
#6 LOCKWASHER
(#63-138)
BJ
BB
BG
HE
BH
6-32 SPACER
#6 LOCKWASHER
BC
HF
#6 LOCKWASHER
BA
6-32 X 3/8" SCREW
CONTROL LOCKWASHER
BE
BD
3-48 NUT
#3 LOCKWASHER
CONTROL FLAT WASHER
CONTROL NUT
6-32 X 1/4" SCREW
3-48 X 1/4" SCREW
KNOB
WHITE DOT



Pictorial 3

Refer to Pictorial 3 for the following steps.

( ) Mount the chassis inside the chassis enclosure as shown. Secure the chassis in place with 3-48 x 1/4" screws, #3 lockwashers and 3-48 nuts as indicated by the arrows in Pictorial 3. Do not install hardware at locations BP, BM, and BN.

( ) Mount a small #6 solder lug at BP. Use a 3-48 x 1/4" screw, #3 lockwashers, and a 3-48 nut.

( ) Mount a 2-lug terminal strip at location BM. Use 3-48 x 1/4" hardware.

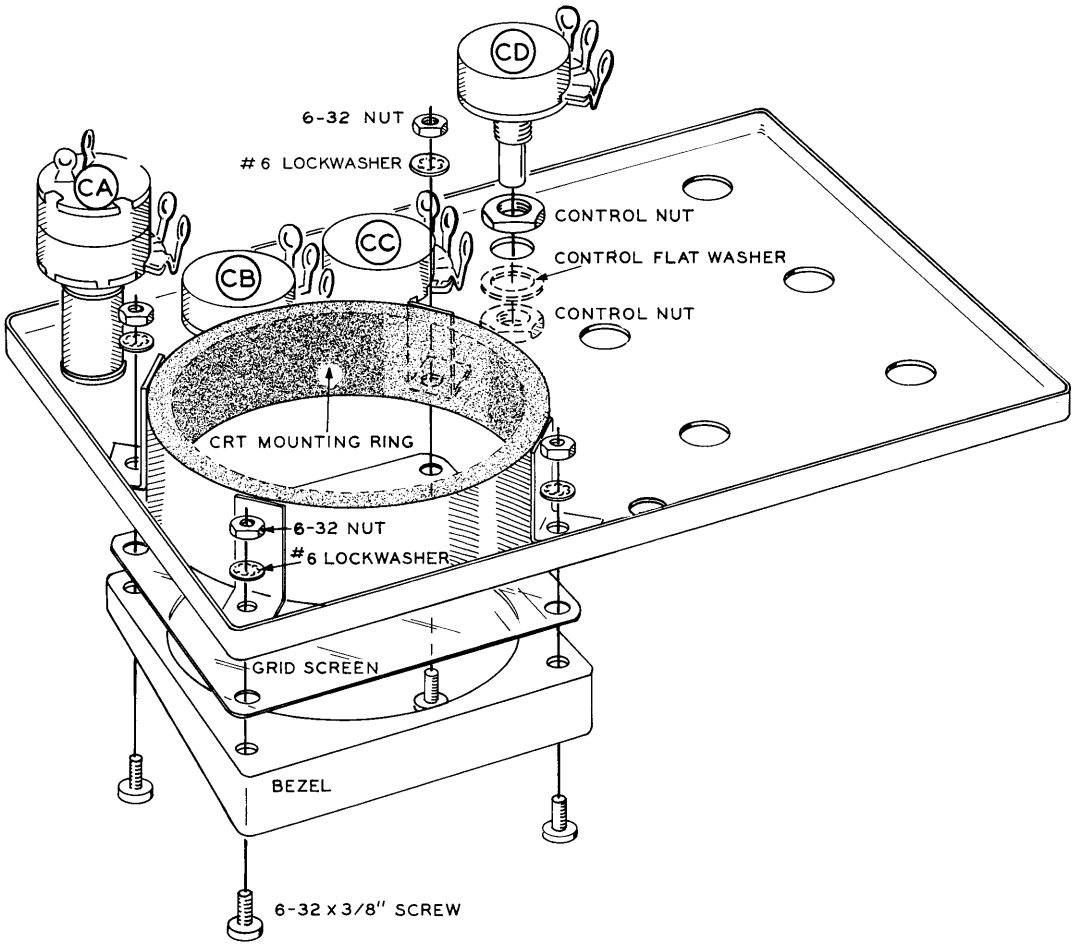
( ) Mount the plastic cable clamp at location BN. Use the 3-48 x 3/8" screw, the large flat spring steel washer, and a #3 lockwasher and 3-48 nut. Be sure to position the clamp as shown.

Set this assembly aside until called for later.

Refer to Pictorial 4 for the following steps.

( ) Place a cloth on your work area to protect the finish of the front panel during the following steps.

( ) Mount the bezel, grid screen (with printed side out), and the CRT panel mounting ring on the front panel as shown in Pictorial 4. Use 6-32 x 3/8" hardware.



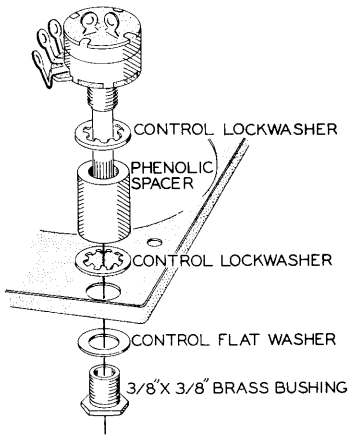
Pictorial 4

( ) R14. Locate a 500 KΩ control (#10-26) and turn a control nut onto the bushing as far as it will go. Now loosen the nut three complete turns and mount the control to the front panel at location CD (VERT POS). Use a control flat washer and control nut as shown in Pictorial 4. Be sure to position the control lugs as shown.

( ) R3. Mount a 50 KΩ control (#10-11) at location CC (VERT GAIN). Use a control lockwasher, control flat washer, and a control nut. Position the control lugs as shown.

( ) R48. Locate a 1 megohm control (#10-32) and place a control nut on the control bushing. Tighten this nut snugly on the control bushing and then loosen it three complete turns. Now mount this control on the front panel at location CB (FOCUS). Use a control flat washer and a control nut. Position the control lugs as shown.

( ) R45. Referring to Detail 4A, mount the 500 KΩ control with the SPST switch (#19-78) at location CA (INTENSITY). Use two control lockwashers, a phenolic spacer, a control flat washer, and the 3/8" x 3/8" brass bushing as shown.



Detail 4A

Refer to Pictorial 5 for the following steps.

( ) Place the chassis enclosure assembly on the rear of the front panel as shown in Pictorial 5.

( ) R9. Turn a control nut onto the bushing of a 500 KΩ control (#10-26) until it is tight. Now mount this control at CE (HOR POS) with a control lockwasher, control flat washer, and a control nut. Do not tighten yet.

( ) R20. Locate a 1 megohm control (#10-32) and place a control solder lug on the control bushing. Rebend the solder lug until it touches lug 1 of the control. Now secure the solder lug on the bushing with a control nut. Mount this control at location CJ (HOR GAIN). Use a control flat washer and control nut. Position the control lugs as shown. Do not tighten yet.

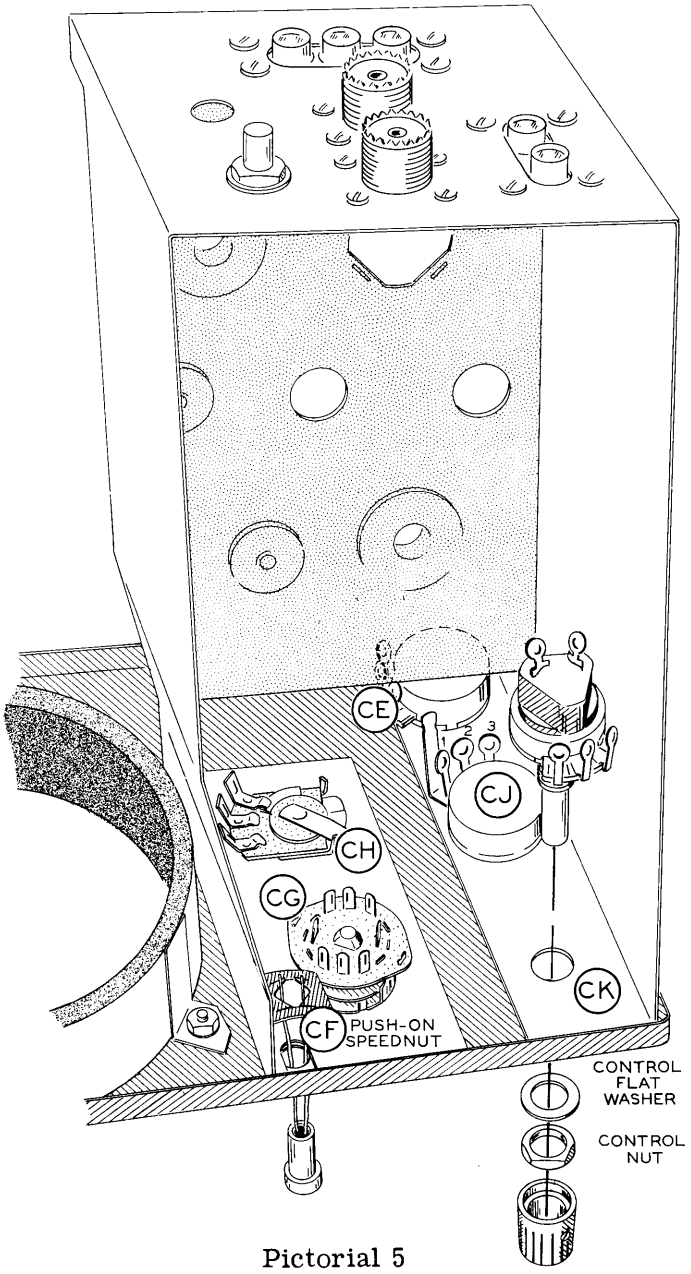
( ) R21. Break the small index tab from the front of the 7.5 megohm control (#19-76) with the SPST push-pull switch by bending the tab back and forth. Now, secure this control at location CK with a control flat washer and a control nut. Position the control lugs as shown. Do not tighten yet.

( ) Turn a control nut onto the bushing of the 1-pole 3-position rotary switch (#63-77) until it is snug. Now loosen the nut four complete turns and mount the switch at location CH (TONE GEN). Use a control flat washer and a control nut. Position the switch lugs as shown. Do not tighten yet.

( ) Turn a control nut onto the bushing of the 2-pole 3-position switch (#63-40) until it is snug. Now loosen the nut one full turn and mount the switch at location CG (FUNCTION). Use a control flat washer, and a control nut. Position the switch lugs as shown. Note that the switch is symmetrical and can be mounted properly in either of two ways.

( ) Install the neon pilot lamp at location CF. Secure the lamp with the large push-on speednut. Now tighten all controls.

( ) Be sure all control shafts are turned to their maximum counterclockwise positions and install a knob on each shaft. With the exception of those controls where the switch positions are marked, the white dot on each knob should be set at 7 o'clock for full counterclockwise rotation of the control.



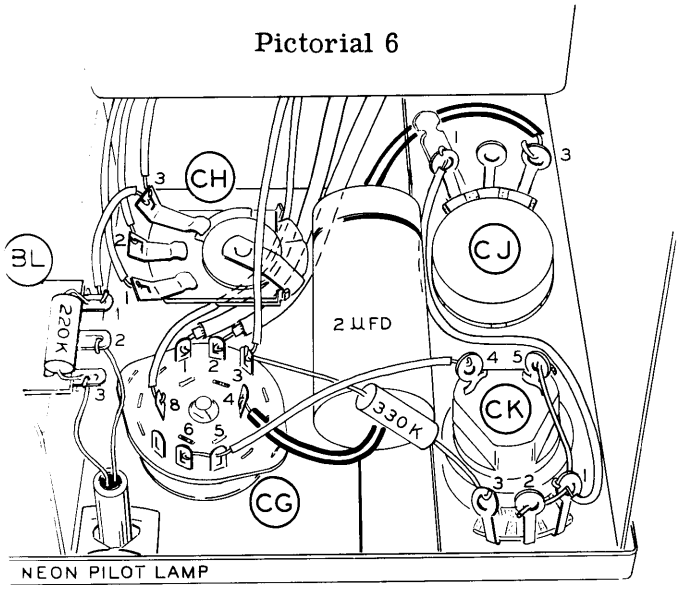
Pictorial 5

Refer to Pictorial 6 for the following steps.

( ) Connect one end of a 4-1/2" wire to lug 3 of switch CH (NS). Route this wire as shown and leave the other end free. It will be connected later.

( ) Connect a 3" wire from lug 3 of switch CH (S-2) to lug 1 of terminal strip BL (NS).

Pictorial 6



( ) Connect one end of a 7-1/2" wire to lug 2 of switch CH (S-1). Route this wire as shown and leave the other end free. It will be connected later.

( ) Connect one end of an 8-1/2" wire to lug 1 of switch CH (S-1). Route this wire as shown and leave the other end free. It will be connected later.

( ) Connect either of the pilot lamp leads to lug 2 of terminal strip BL (S-1).

( ) Connect the other pilot lamp lead to lug 3 of terminal strip BL (NS).

( ) R39. Connect a 220 KΩ (red-red-yellow) 1/2 watt resistor from lug 1 (S-2) to lug 3 (S-2) of terminal strip BL.

( ) Connect a 4-1/2" wire from lug 1 of control CJ (NS) to lug 1 of control CK (NS).

( ) Place one end of a bare wire through lug 1 (NS) to lug 2 (S-1) of control CK. Connect the other end of this wire to lug 5 of control CK (S-1). Now solder lug 1 of CK (S-3).

( ) Referring to Detail 6A, prepare two 13-3/4" lengths of the smaller shielded cable.

( ) At the end with no shield, of either audio cable, connect the inner conductor to lug 1 of switch CG (S-1). Route this cable as shown and leave the other end free. It will be connected later.

( ) At the end with no shield of the remaining prepared audio cable, connect the inner conductor to lug 2 of switch CG (S-1). Route this cable as shown and leave the other end free. It will be connected later.

( ) Connect one end of a 13" wire to lug 8 of switch CG (S-1). Route this wire as shown and leave the other end free. It will be connected later.

( ) C16. Connect the 2 µfd mylar capacitor from lug 3 of control CJ (S-1) to lug 4 of switch CG (S-1). Use sleeving on both leads. Place the marked end of this capacitor as shown.

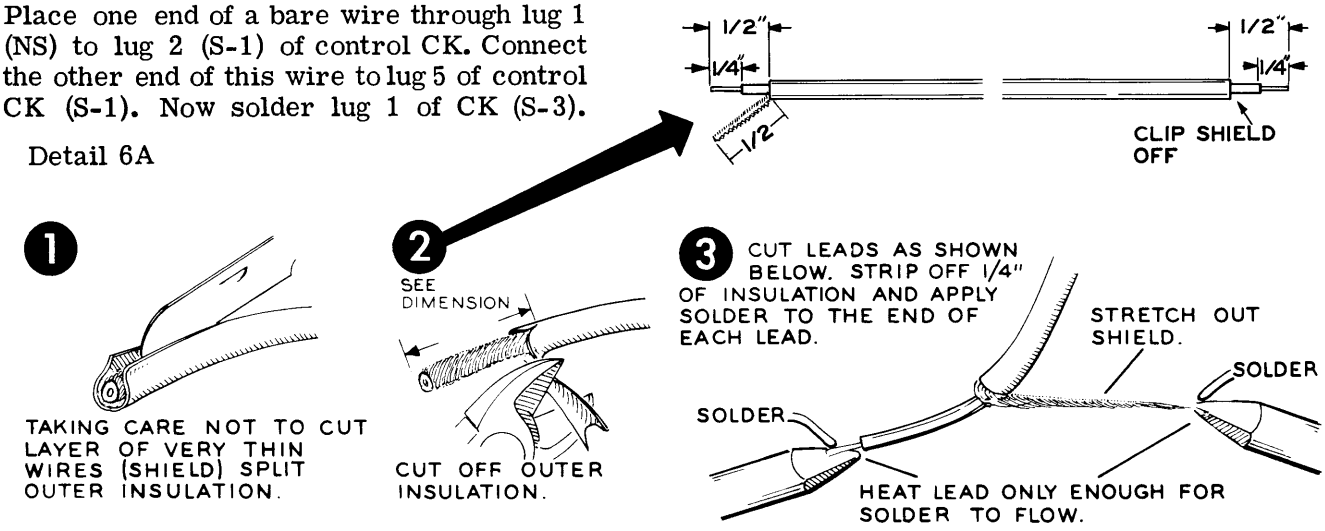
NOTE: All resistors used in the following steps are 1/2 watt unless specified otherwise.

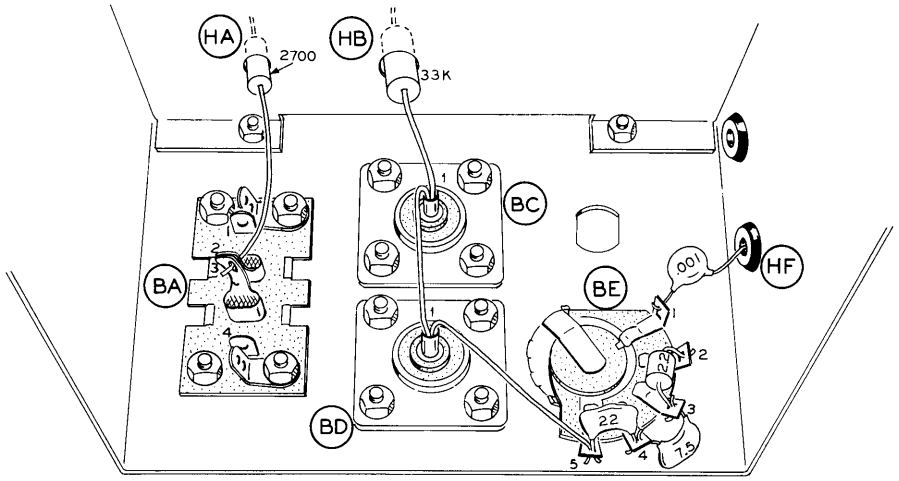
( ) R22. Connect a 330 KΩ (orange-orange-yellow) resistor from lug 3 of control CK (S-1) to lug 3 of switch CG (NS).

( ) Connect one end of a 4" wire to lug 3 of switch CG (S-2). Route this wire as shown and leave the other end free. It will be connected later.

( ) Place one end of a 2-1/4" wire through lug 5 (NS) to lug 6 (S-1) of switch CG. Now solder lug 5 of CG (S-2). Connect the other end of this wire to lug 4 of control CK (S-1).

Detail 6A





Pictorial 7

Refer to Pictorial 7 for the following steps.

( ) Solder the solder lugs on phono socket BA to ground lugs 1 and 4.

( ) Bend phono socket lugs 2 and 3 together as shown in Pictorial 7.

( ) R1. Place one lead and the body of a 2700 Ω (red-violet-red) resistor through hole HA in the chassis. Connect the other lead of this resistor to lugs 2 and 3 of phono socket BA (S-3). Be sure that the resistor body is centered in hole HA.

( ) R13. Place one end and the body of a 33 KΩ (orange-orange-orange) 1 watt resistor through hole HB in the chassis. Connect the other lead of this resistor to lug 1 of coax jack BC (NS).

( ) Connect a length of bare wire from lug 1 of coax jack BC (S-2) to lug 1 of coax jack BD (NS).

( ) Connect a length of bare wire from lug 1 of coax jack BD (S-2) to lug 5 of switch BE (NS).

( ) C10. Connect a 22 μμf resin dipped mica capacitor between lugs 5 (S-2) and 4 (NS) of switch BE.

( ) C9. Connect a 7.5 μμf resin dipped mica capacitor between lugs 4 (S-2) and 3 (NS) of switch BE.

( ) C8. Connect a 2.2 μμf (red-red-white) tubular capacitor between lugs 3 (S-2) and 2 (S-1) of switch BE.

( ) C11. Cut one lead of a .001 μfd disc ceramic capacitor to 3/8". Do not cut the other lead. Place the uncut lead of this capacitor through grommet HF. It will be connected later. Connect the 3/8" lead to lug 1 of switch BE (S-1).

Refer to Pictorial 8 for the following steps.

( ) Mount the power transformer (#54-130) on the chassis as shown. Place the two brown, two yellow, and two black leads through hole HD, and the two red, two green, and blue leads through hole HC in the chassis. Secure the transformer with 8-32 x 1/4" hardware. Be sure to mount solder lug G and bend it up at an angle to the chassis as shown.

( ) C23, C24, C25, C26. Mount the twist-prong electrolytic capacitor at location D. Be sure to place the capacitor lug markings as shown in Pictorial 8. Secure the capacitor by twisting each mounting tab 1/4 turn with long-nose pliers.

WARNING: The cathode ray tube used in this Oscilloscope is essentially a small sized "picture tube" as used in your TV set. It should be handled with all due respect as its sudden breakage might result in flying glass that could cause considerable personal injury to those in the near vicinity. Avoid a sharp blow or undue tension on the tube!

( ) Very carefully unpack the CR tube from its carton and insert it into the CRT mounting ring on the front panel. The tube should be positioned so the face of the tube is approximately 1/16" from the grid screen. Rotate the tube so that pin 1 of the tube base is in the 6 o'clock position directly toward the side of the chassis enclosure as shown in Pictorial 8. (The tube keyway should point toward the nearest grommet.)

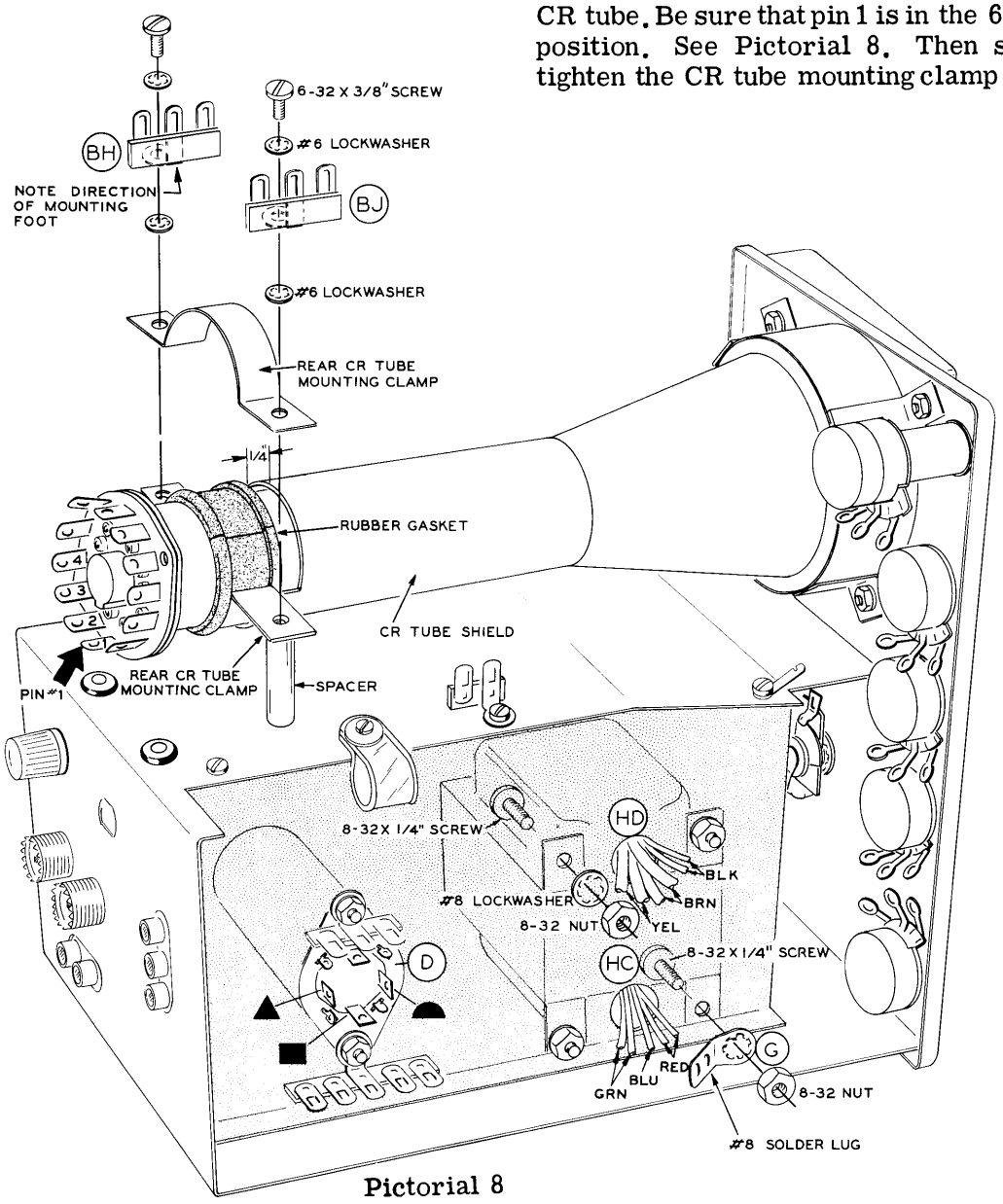
( ) Place the CR tube shield over the rear of the CR tube as shown.

( ) Insert the rubber cushion strip in one half of the CR tube mounting clamp, then slip this half of the mounting clamp under the CR tube neck and onto the spacers as shown in Pictorial 8.

( ) Slide the lip of the CRT shield between the tube base and cushion strip so that approximately 1/4" exists between the full portion of the shield and the cushion strip. See Pictorial 8.

( ) Now form the rubber cushion strip into the other half of the CR tube mounting clamp. Secure the mounting clamp and 3-lug terminal strips BH and BJ to the spacers. Use 6-32 x 3/8" screws, and #6 lockwashers.

( ) Place the CR tube socket on the rear of the CR tube. Be sure that pin 1 is in the 6 o'clock position. See Pictorial 8. Then securely tighten the CR tube mounting clamp screws.



Pictorial 8

Refer to Pictorial 9 for the following steps.

NOTE: In the following wiring of components and wires to the CRT socket, leave some slack as it may be necessary to rotate the CR tube later.

( ) Connect one end of a 13-1/4" HV blue wire to lug 6 of CR tube socket V5 (NS). Route this wire under the CR tube and place the other end through cable clamp BN. Connect the free end to lug 8 of tube socket V3 (NS).

( ) Connect one end of a 12-1/2" HV blue wire to lug 4 of CR tube socket V5 (S-1). Place the other end of this wire under the CR tube, through cable clamp BN, and connect it to lug 2 of control CB (S-1).

( ) Connect one end of a 10" HV blue wire to lug 1 of CR tube socket V5 (NS). Place the other end of this wire under the CR tube, through cable clamp BN, and connect it to lug 2 of control CA (S-1).

( ) R49. Connect a 3.3 megohm (orange-orange-green) resistor from lug 3 of control CB (S-1) to the solder lug BP on the edge of the chassis flange (S-1).

( ) Connect one end of a 6-1/4" HV blue wire to lug 11 of CR tube socket V5 (NS). Place this wire through cable clamp BN, and connect it to lug 7 of tube socket V6 (NS).

( ) Connect a 4-1/2" HV blue wire from lug 7 of tube socket V6 (NS) to lug 3 of control CA (NS).

( ) Connect one end of a 9-1/2" wire to lug 5 of control CA (S-1). Place the other end of this wire through cable clamp BN and through rubber grommet HE. Leave this end free. It will be connected later.

NOTE: In the following steps with transformer leads, route the leads as shown, leaving some slight slack. Cut the lead off, remove 1/4" of insulation from the end, and tin the exposed lead end.

( ) Connect either black power transformer lead extending from hole HD in the chassis to lug 4 of control CA (S-1).

( ) Place the other black power transformer lead through cable clamp BN and through rubber grommet HE. It will be connected later.

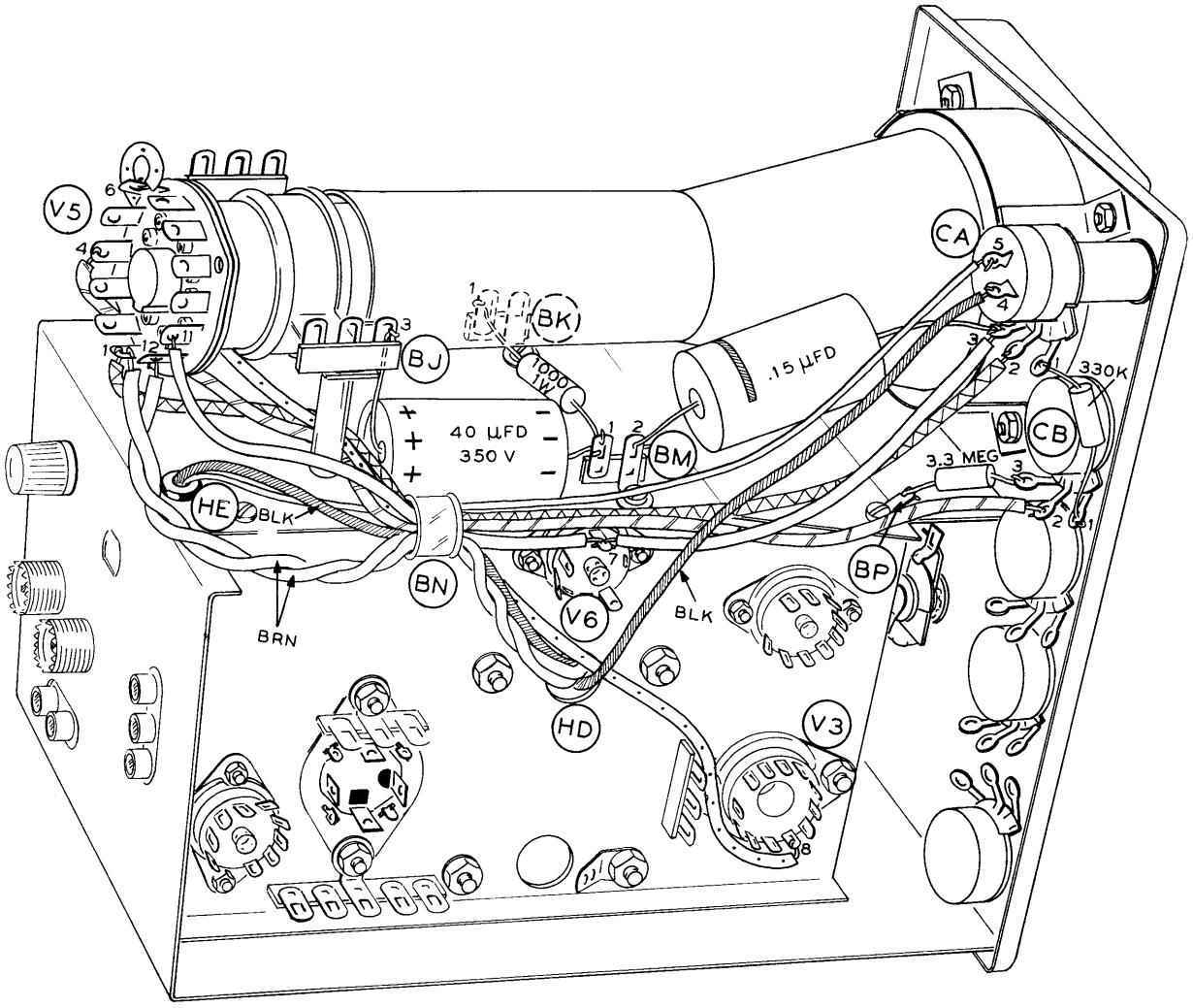
( ) Twist together the two heavy brown power transformer leads extending from hole HD in the chassis. Place them through plastic cable clamp BN. Connect either brown wire to lug 12 (S-1) and the other brown wire to lug 1 (NS) of CR tube socket V5.

( ) R42. Place one end of a 1000 Ω (brown-black-red) 1 watt resistor under the CR tube, between terminal strips BK and BM. Connect the end of the resistor nearest terminal strip BK to lug 1 of BK (NS). Connect the other lead of this resistor to lug 1 of terminal strip BM (NS).

( ) C28. Connect the positive (+) lead of a 40 μfd 350 V electrolytic capacitor to lug 3 of terminal strip BJ (NS). Connect the other lead of this capacitor to lug 1 of terminal strip BM (NS).

( ) C31. Connect a .15 μfd tubular capacitor from lug 2 of terminal strip BM (S-1) to lug 3 of control CA (S-2). Place the marked end of this capacitor as shown.

( ) R47. Connect a 330 KΩ (orange-orange-yellow) resistor from lug 1 of control CA (S-1) to lug 1 of control CB (S-1).


V5
CA
BK
BJ
.15 µFD
1000 V
40 µFD
350 V
BM
330K
CB
3.3 MEG
HE
BLK
BN
BRN
V6
BLK
BP
HD
V3

Pictorial 9

Refer to Pictorial 10 for the following steps.

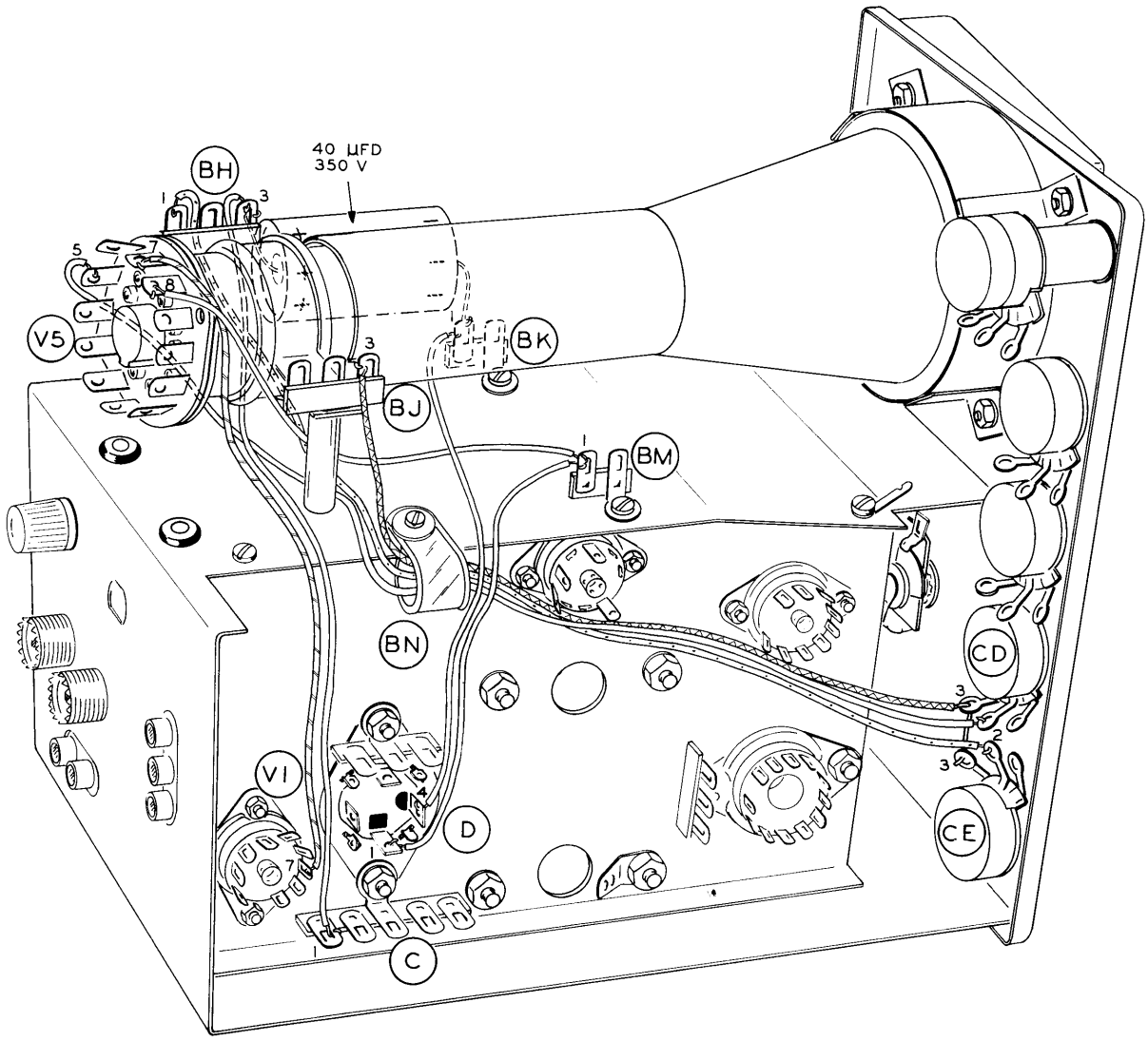
( ) Remove 1" of insulation from either end of a 10-3/4" wire. Place this end through lug 3 of control CD (NS) to lug 3 of control CE (NS). Route this wire through cable clamp BN as shown and connect the other end to lug 3 of terminal strip BJ (NS).

( ) Connect one end of a 13" wire to lug 1 of terminal strip BH (NS). Place the other end of this wire through cable clamp BN and connect it to lug 2 of control CE (S-1).

(✓) Connect one end of a 13-1/2" wire to lug 5 of the CR tube socket V5 (NS). Place the other end of this wire under the CR tube, through cable clamp BN, and connect it to lug 2 of control CD (S-1).

(✓) Connect a 7-1/2" wire from lug 7 of CR tube socket V5 (NS) to lug 7 of tube socket V1 (S-1). Route this wire as shown in Pictorial 10.

(✓) Connect a 6-1/2" wire from lug 8 of CR tube socket V5 (NS) to lug 1 of terminal strip BM (NS).



Pictorial 10

( ) Connect one end of a 7-3/4" wire to lug 1 of terminal strip BK (NS). Place the other end of this wire under the CR tube and connect it to lug 4 of electrolytic capacitor D (NS).

( ) Connect a 5-3/4" wire from lug 1 of terminal strip BM (S-4) to lug 1 of electrolytic capacitor D (NS).

( ) Connect a 9-1/2" wire from lug 3 of terminal strip BH (NS) to lug 1 of terminal strip C (NS).

( ) C29. Connect the positive (+) lead of a 40 μfd 350 V tubular electrolytic capacitor to lug 3 of terminal strip BH (NS). Connect the other lead to lug 1 of terminal strip BK (S-3).

Refer to Pictorial 11 for the following steps.

( ) R43. Connect a 1000 Ω (brown-black-red) 1 watt resistor from lug 3 of terminal strip BH (S-3) to lug 3 of terminal strip BJ (S-3).

( ) C13. Connect a .001 μfd disc ceramic capacitor from lug 7 of tube socket V5 (NS) to lug 2 of terminal strip BH (NS).

( ) R50. Connect a 330 KΩ (orange-orange-yellow) resistor from lug 7 of tube socket V5 (NS) to lug 1 of terminal strip BH (S-2).

( ) C14. Connect a 22 μμf resin dipped mica capacitor between lugs 6 (NS) and 7 (S-4) of tube socket V5.

( ) R17. Connect a 3.3 megohm (orange-orange-green) resistor between lugs 6 (S-3) and 8 (NS) of tube socket V5.

( ) R16. Connect a 1 megohm (brown-black-green) resistor between lugs 8 (S-3) and 9 (NS) of tube socket V5.

( ) C5. Connect a .02 μfd 500 V disc ceramic capacitor from lug 9 of tube socket V5 (S-2) to lug 1 of terminal strip BJ (NS).

( ) R15. Connect a 47 KΩ (yellow-violet-orange) resistor between lugs 10 (NS) and 5 (NS) of tube socket V5.

( ) C12. Connect a .001 μfd disc ceramic capacitor from lug 5 of tube socket V5 (S-3) to lug 2 of terminal strip BH (NS).

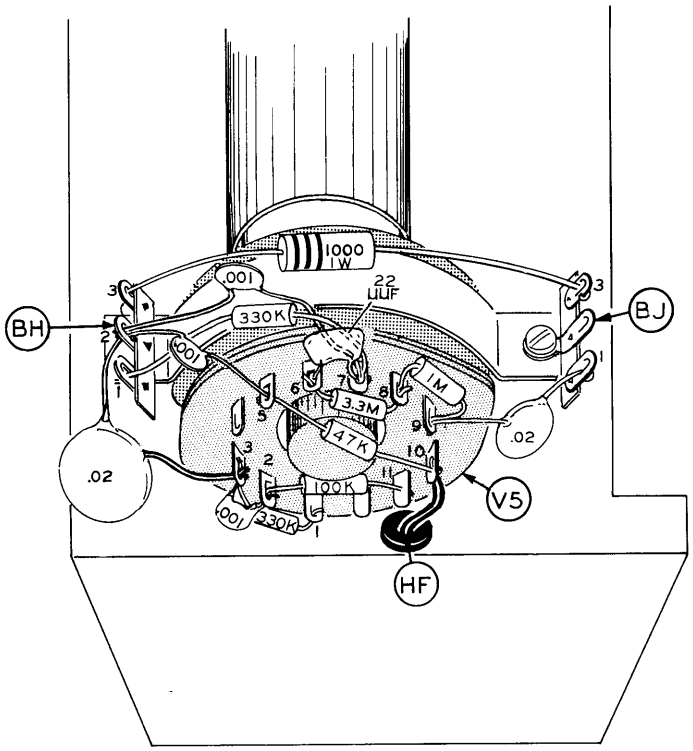
( ) R46. Connect a 330 KΩ (orange-orange-yellow) resistor between lugs 1 (S-3) and 3 (NS) of tube socket V5.

( ) C33. Connect a .001 μfd disc ceramic capacitor between lugs 2 (NS) and 3 (NS) of tube socket V5.

( ) C32. Connect a .02 μfd 1.6 kv disc ceramic capacitor from lug 3 of tube socket V5 (S-3) to lug 2 of terminal strip BH (S-3).

( ) R51. Connect a 100 KΩ (brown-black-yellow) 1/2 watt resistor between lugs 2 (S-2) and 11 (S-2) of tube socket V5.

( ) C11. Connect the free lead of the .001 μfd disc ceramic capacitor extending from grommet HF in the chassis to lug 10 of tube socket V5 (S-2). Use sleeving on this lead.



Pictorial 11

Refer to Pictorial 12 (fold-out from Page 6) for the following steps.

( ) Connect the blue and either green power transformer lead extending from hole HC in the chassis to lug 5 of electrolytic capacitor D (S-2). Apply enough heat and solder to this lug to solder it firmly to the capacitor mounting wafer.

( ) Connect either red power transformer lead extending from hole HC in the chassis to lug 4 of electrolytic capacitor D (S-2).

( ) Connect the remaining red lead to lug 4 of terminal strip C (NS).

( ) Connect the other green power transformer lead extending from hole HC in the chassis to lug 1 of tube socket V3 (NS). Be sure to route this wire as shown in Pictorial 12.

( ) Connect either yellow power transformer lead extending from hole HD in the chassis to lug 4 of tube socket V6 (S-1).

( ) Connect the other yellow lead to lug 5 of V6 (S-1).

( ) C30. Connect the .15 μfd tubular capacitor from lug 1 of tube socket V6 (NS) to solder lug G (NS). Be sure to connect the marked end of this capacitor to solder lug G.

( ) R44. Connect a 220 KΩ (red-red-yellow) resistor between lugs 1 (S-2) and 7 (S-3) of tube socket V6.

( ) C6. Connect a .22 μfd tubular capacitor from solder lug G (S-2) to lug 8 of tube socket V1 (NS). Use sleeving on the lead to V1.

( ) Connect the free end of the wire coming from lug 3 of switch CH to lug 3 of terminal strip F (NS).

( ) Connect the free end of the wire coming from lug 2 of switch CH to lug 3 of terminal strip E (NS).

( ) Connect the free end of the wire coming from lug 1 of switch CH to lug 1 of terminal strip E (NS).

( ) Connect the free end of the wire coming from lug 8 of switch CG to lug 9 of tube socket V1 (NS).

( ) Connect the free end of the wire coming from lug 3 of switch CG to lug 3 of tube socket V3 (NS).

( ) Connect one end of a 3-1/4" wire to lug 1 of control CJ (S-2). Also solder the control solder lug at this point to lug 1 of CJ.

( ) At the other end of this wire, remove 1" of insulation and pass the end through lug 1 of control CE (NS) to lug 1 of control D (S-1).

( ) Connect a 2" wire from lug 2 of control CJ (S-1) to lug 7 of tube socket V3 (S-1).

( ) Connect a 2-1/2" wire from lug 2 of control CC (S-1) to lug 2 of tube socket V2 (S-1).

( ) Connect a bare wire from lug 1 of control CC (NS) to the ground lug nearest lug 3 of tube socket V2 (NS).

( ) Place one end of a bare wire through lug 4 (S-2) to the center post (NS) of tube socket V2. Connect the other end of this wire to the ground lug nearest lug 3 of V2 (S-2).

( ) Connect a 2" wire from lug 1 of tube socket V3 (S-2) to lug 9 of socket V2 (NS).

( ) Connect a 6" wire from lug 9 of tube socket V2 (S-2) to lug 12 of socket V4 (NS).

( ) Connect a 4" wire from lug 12 of tube socket V4 (S-2) to lug 5 of tube socket V1 (NS).

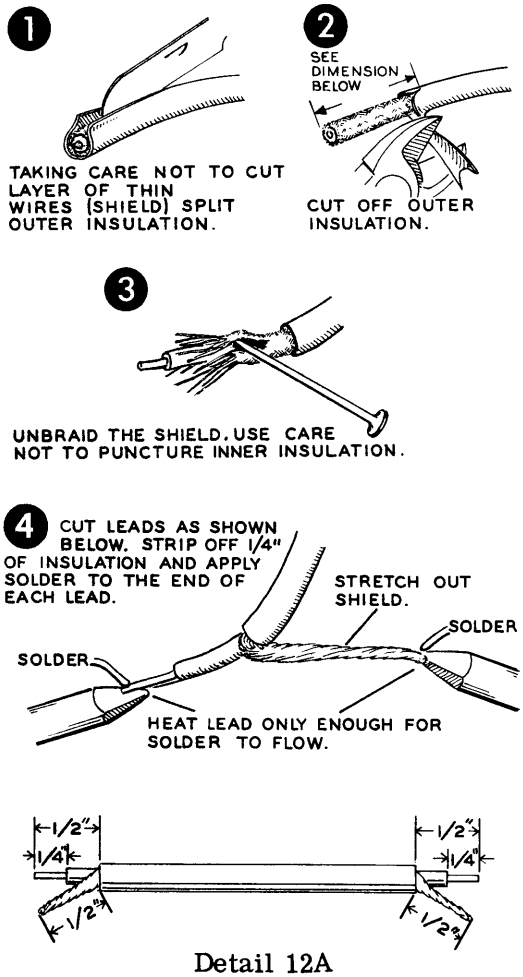
( ) Connect a 6-1/2" wire from lug 2 of electrolytic capacitor D (NS) to lug 1 of terminal strip F (NS).

( ) Connect a 5-1/2" wire from lug 3 of electrolytic capacitor D (NS) to lug 3 of terminal strip F (NS).

( ) Referring to Detail 12A, prepare a 10-3/4" length of RG-62U coaxial cable.

( ) Place one end of this cable through plastic clamp BN and connect the shield to both the solder lug and ground lug 1 of phono socket BB (S-1). Connect the inner conductor at this end to lug 2 of BB (S-1). Bend the lug slightly as required to clear the control.

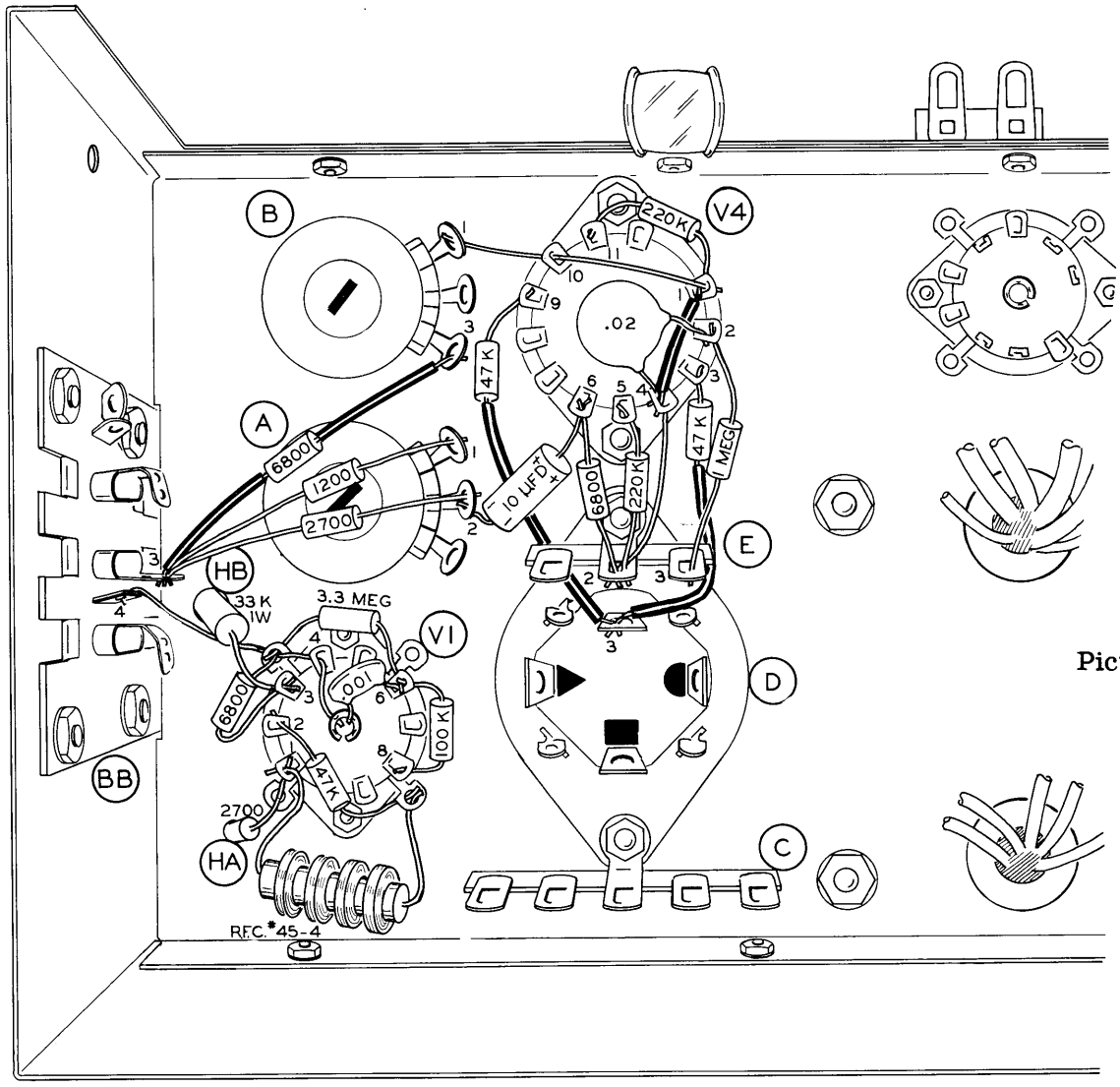
( ) At the other end of this coaxial cable, connect the inner conductor to lug 3 of control CC (S-1). Connect the shield at this end to lug 1 of CC (S-2).



Detail 12A

Refer to Pictorial 13 for the following steps.

	VALUE-TYPE	FROM LUG	TO LUG
( )	R1. Free lead of 2700 Ω (red-violet-red)	from hole HA	1 of V1 (NS).
( )	Bare wire	4 of phono socket BB (NS)	through ground lug nearest lug 3 of V1 (NS) through lug 4 (S-2) to the center post (NS) of V1.
( )	R12. 6800 Ω (blue-gray-red)	3 of V1 (NS)	ground lug nearest lug 3 of V1 (NS).
( )	R11. 3.3 megohm (orange-orange-green)	6 of V1 (NS)	ground lug nearest lug 3 of V1 (S-4).
( )	R13. Free lead of 33 KΩ 1 watt (orange-orange-orange)	from hole HB	3 of V1 (S-2).
( )	R10. 100 KΩ 1/2 watt (brown-black-yellow)	6 of V1 (NS)	8 of V1 (S-2).
( )	C7. .001 μfd disc ceramic	6 of V1 (S-3)	center post of V1 (NS).
( )	R2. 47 KΩ (yellow-violet-orange)	2 of V1 (NS)	ground lug nearest lug 8 of V1 (NS).
( )	RFC (#45-4)	1 of V1 (S-2)	ground lug nearest lug 8 of V1 (S-2).
( )	R30. 2700 Ω (red-violet-red)	2 of control A (NS)	3 of phono socket BB (NS). Bend lug as required to clear other components.
( )	R38. 1200 Ω (brown-red-red)	3 of phono socket BB (NS)	1 of control A (NS).
( )	R52. 6800 Ω (blue-gray-red)	3 of phono socket BB (S-3). Use sleeving.	3 of control B (NS).
( )	Bare wire	1 of control B (S-1)	through lug 10 of V4 (NS) to lug 1 of V4 (NS).
( )	R34. 47 KΩ (yellow-violet-orange)	9 of V4 (NS).	3 of electrolytic capacitor D (NS). Use sleeving on the lead to D and place it under terminal strip E.
( )	R31. 47 KΩ (yellow-violet-orange)	3 of V4 (NS)	3 of electrolytic capacitor D (NS). Use sleeving on the lead to D and place it under terminal strip E.
( )	C19. 10 μfd electrolytic capacitor	positive (+) lead to lug 6 of V4 (NS)	2 of control A (S-2).



Pictorial 13

	VALUE-TYPE	FROM LUG	TO LUG
( )	Bare wire	2 of terminal strip E (NS)	through lug 4 of V4 (NS) to lug 1 of V4 (NS). Use sleeving as shown.
( )	R28. 6800 Ω (blue-gray-red)	6 of V4 (S-2)	2 of terminal strip E (NS).
( )	R27. 220 KΩ (red-red-yellow)	5 of V4 (NS)	2 of terminal strip E (NS).
( )	R32. 1 megohm (brown-black-green)	2 of V4 (NS)	3 of terminal strip E (S-2).
( )	C20. .02 μfd disc ceramic	2 of V4 (S-2)	4 of V4 (NS). Place this capacitor as shown in Pictorial 13.
( )	R37. 220 KΩ (red-red-yellow)	1 of V4 (S-3)	11 of V4 (NS).

Refer to Pictorial 14 for the following steps.

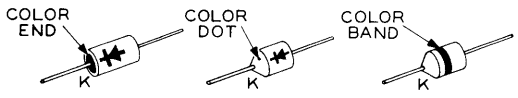
( ) R40. Connect a 15 KΩ (brown-green-orange) 1 watt resistor between lugs 1 (NS) and 2 (S-2) of electrolytic capacitor D.

( ) R41. Connect a 33 KΩ (orange-orange-orange) 1 watt resistor between lugs 1 (S-3) and 3 (S-4) of electrolytic capacitor D.

NOTE: Refer to Detail 14A in the following steps to determine the proper polarity of the silicon diodes. Be sure that the diodes are installed as specified to prevent damage to them and related components.

NOTE: WHEN INSTALLING SILICON DIODES, THE CATHODE END SHOULD BE PLACED AS DIRECTED. THE CATHODE END IS MARKED WITH EITHER A COLOR END, COLOR DOT, OR COLOR BAND. IN THE ILLUSTRATIONS, THE SYMBOL K INDICATES THE CATHODE END.

Detail 14A



( ) D4. Connect the cathode (+) lead of a silicon diode to lug 1 (S-2) and the other lead to lug 2 (NS) of terminal strip C.

( ) D3. Connect the cathode (+) lead of a silicon diode to lug 2 (S-2) and the other lead to lug 4 (NS) of terminal strip C.

( ) D2. Connect the cathode (+) lead of a silicon diode to lug 4 (S-3) and the other lead to lug 5 (NS) of terminal strip C.

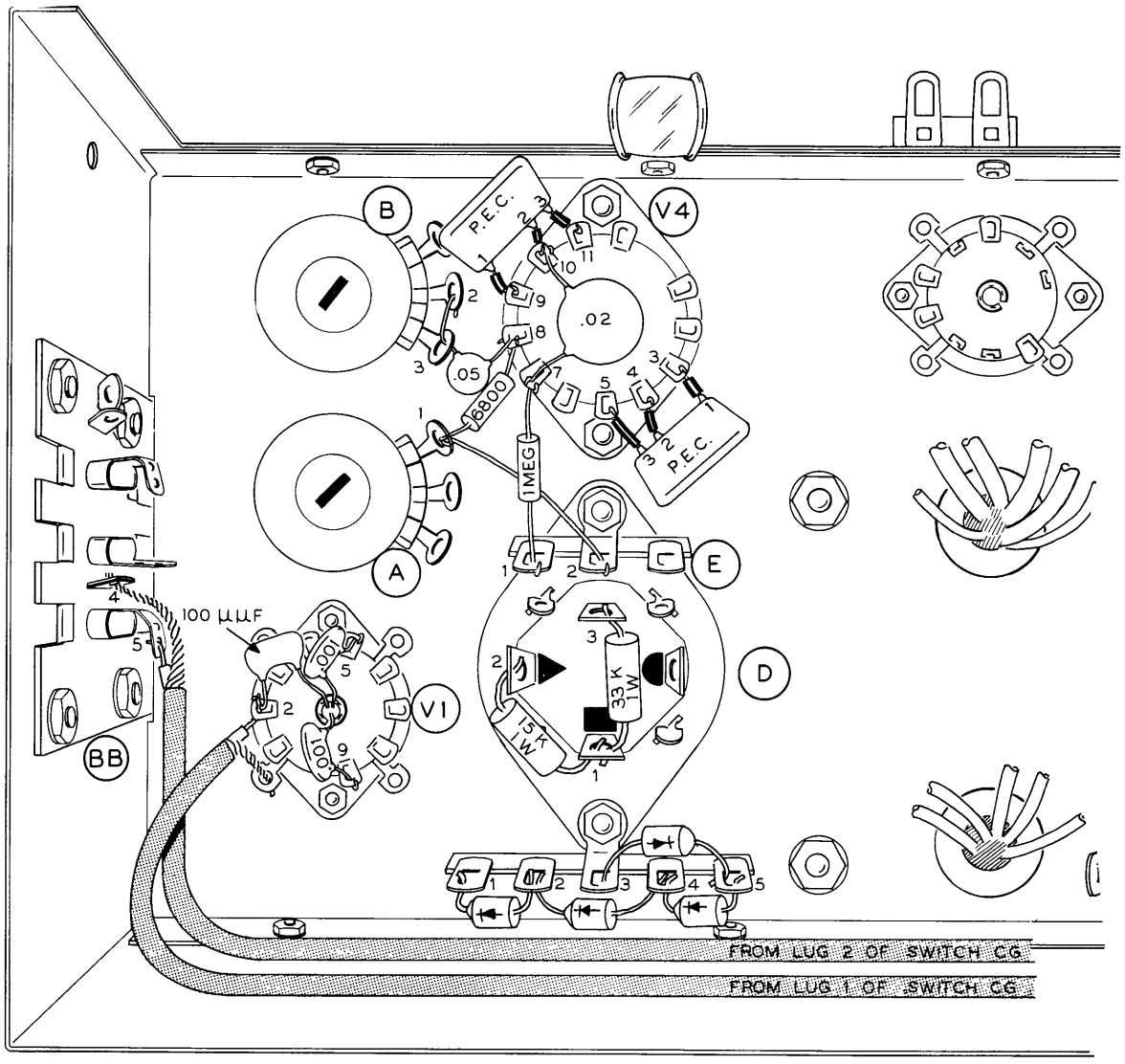
( ) D1. Connect the cathode (+) lead of a silicon diode to lug 5 (S-2) and the other lead to lug 3 (S-1) of terminal strip C.

( ) Route the free end of the two audio cables coming from switch CG as shown in Pictorial 14. Be careful not to overheat the cable insulation as it could cause a short to the inner conductor.

( ) Connect the inner conductor of the audio cable coming from lug 1 of switch CG to lug 2 of tube socket V1 (NS). Connect the shield to the ground lug nearest lug 1 of V1 (S-1).

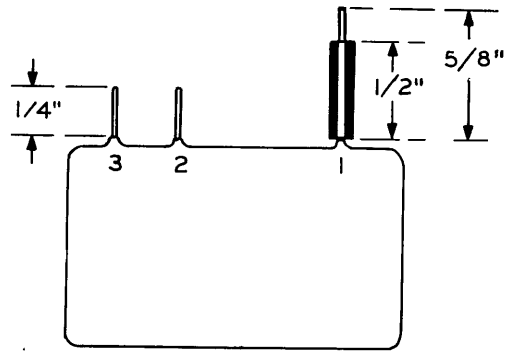
( ) Connect the inner conductor of the audio cable coming from lug 2 of switch CG to lug 5 of the phono socket BB (S-1). Connect the shield to lug 4 of BB (S-2).

VALUE TYPE	FROM LUG	TO LUG
( ) C27. .001 μfd disc ceramic	5 of V1 (S-2)	to center post of V1 (NS).
( ) C36. .001 μfd disc ceramic	9 of V1 (S-2)	to center post of V1 (NS).
( ) C1. 100 μμf resin dipped mica	2 of V1 (S-3)	to center post of V1 (S-5).
( ) C22. .05 μfd disc ceramic	pass one lead through lug 3 (S-3) to lug 2 (S-1) of control B	8 of V4 (NS).
( ) R36. 6800 Ω (blue-gray-red)	8 of V4 (S-2)	1 of control A (NS).
( ) Bare wire	1 of control A (S-3)	2 of terminal strip E (S-4).
( ) R33. 1 megohm (brown-black-green)	1 of terminal strip E (S-2)	7 of V4 (NS).
( ) C21. .02 μfd disc ceramic	7 of V4 (S-2)	10 of V4 (NS). Place this capacitor as shown in Pictorial 14.



Pictorial 14

( ) Cut the leads on the two P.E.C. networks as shown in Detail 14B.



Detail 14B

Connect the leads of either P.E.C. network as follows:

( ) Lead 1 to lug 9 of V4 (S-2). Use sleeving.

( ) Lead 2 to lug 10 of V4 (S-4). Use sleeving.

( ) Lead 3 to lug 11 of V4 (S-2). Use sleeving.

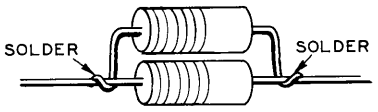
Connect the leads of the remaining P.E.C. network as follows:

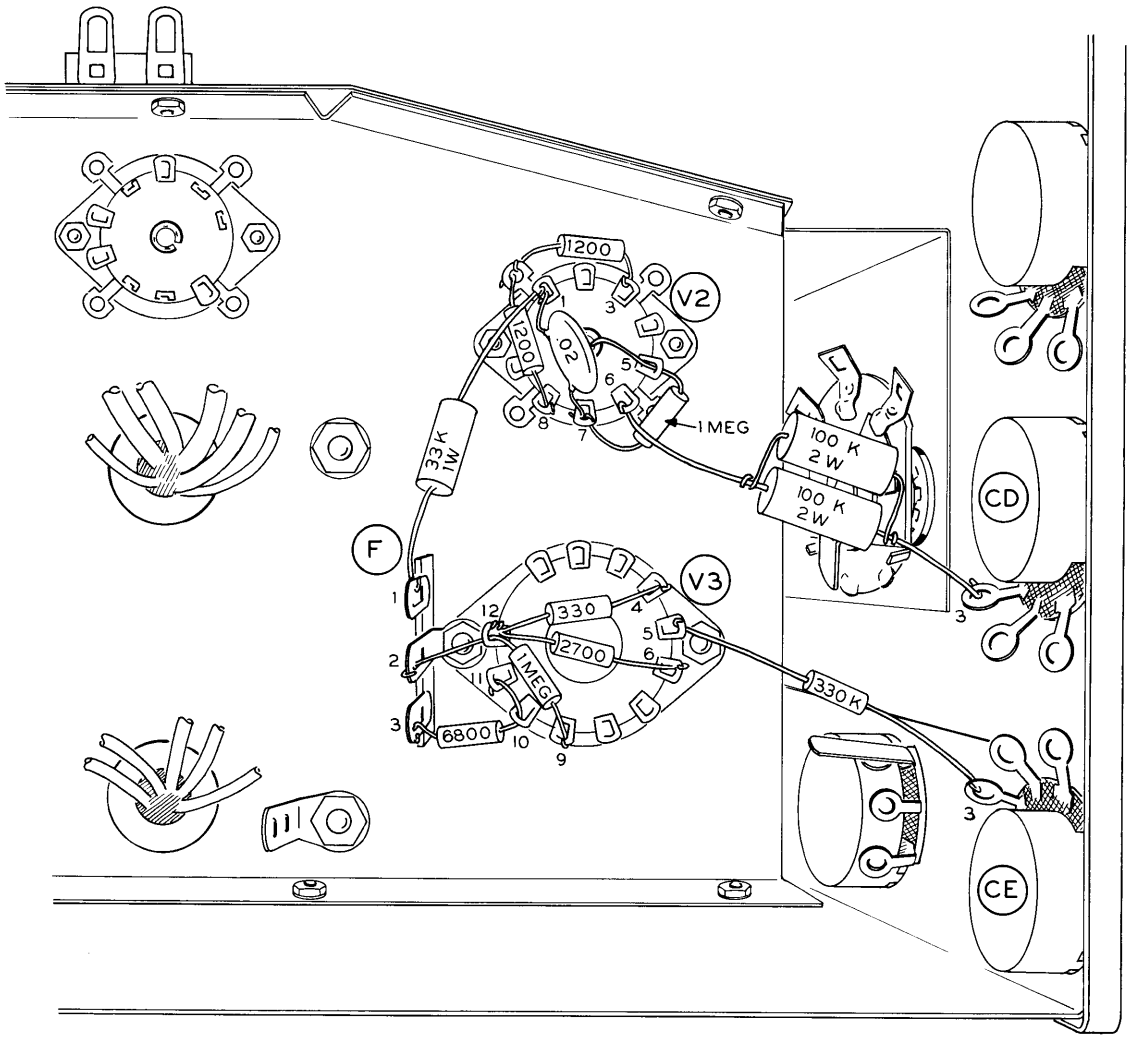
( ) Lead 1 to lug 3 of V4 (S-2). Use sleeving.

( ) Lead 2 to lug 4 of V4 (S-4). Use sleeving.

( ) Lead 3 to lug 5 of V4 (S-2). Use sleeving.

Refer to Pictorial 15 for the following steps.

	VALUE-TYPE	FROM LUG	TO LUG
( )	R4. 1200 Ω (brown-red-red)	3 of V2 (NS)	ground lug nearest lug 1 of V2 (NS).
( )	R8. 1200 Ω (brown-red-red)	8 of V2 (NS)	ground lug nearest lug 1 of V2 (S-2).
( )	R5. 1 megohm (brown-black-green)	7 of V2 (NS)	through lug 5 (S-2) to the center post (NS) of V2.
( )	C3. .02 μfd disc ceramic	1 of V2 (NS)	7 of V2 (S-2).
( )	R6. 33 KΩ 1 watt (orange-orange-orange)	1 of V2 (S-2)	1 of terminal strip F (S-2).
( )	R7A, R7B. Referring to Detail 15A, prepare two 100 KΩ (brown-black-yellow) 2 watt resistors in parallel.		 Detail 15A
( )	Resistor combination	6 of V2 (NS)	3 of control CD (S-3).
( )	R26. 330 Ω (orange-orange-brown)	12 of V3 (NS)	4 of V3 (S-1).
( )	R18. 2700 Ω (red-violet-red)	12 of V3 (NS)	6 of V3 (S-1).
( )	R25. 1 megohm (brown-black-green)	9 of V3 (NS)	through lug 12 of V3 (S-4) to lug 2 of terminal strip F (S-1).
( )	R24. 6800 Ω (blue-gray-red)	3 of terminal strip F (NS)	through lug 10 (S-2) to lug 11 (S-1) of V3.
( )	R19. 330 KΩ (orange-orange-yellow)	5 of V3 (NS)	3 of control CE (S-2).



Pictorial 15

Refer to Pictorial 16 for the following steps.

	VALUE-TYPE	FROM LUG	TO LUG
( )	R23. 6800 Ω (blue-gray-red)	2 of V3 (NS)	3 of terminal strip F (S-4).
( )	C18. .02 μfd disc ceramic	2 of V3 (S-2)	9 of V3 (S-2).
( )	C15. .22 μfd tubular capacitor	8 of V3 (S-2)	5 of V3 (S-2). Use sleeving on the lead to lug 8 of V3.
( )	C2. .05 μfd disc ceramic	3 of V2 (S-2)	center post of V2 (NS).
( )	C4. .05 μfd disc ceramic	8 of V2 (S-2)	center post of V2 (S-4).
( )	C17. .22 μfd tubular capacitor	3 of V3 (S-2)	1 of control CE (S-3). Use sleeving on the lead to V3.

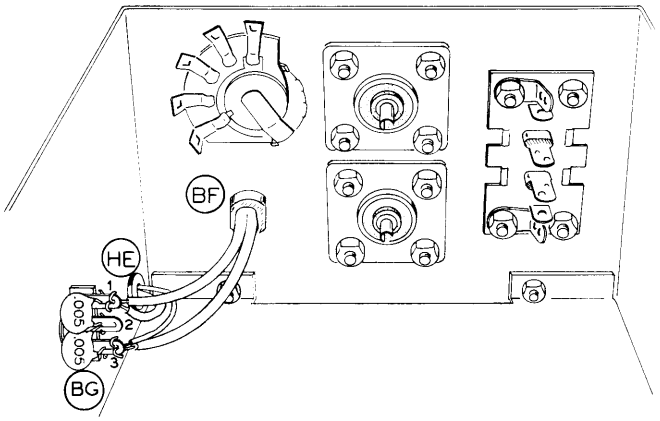
( ) Connect an 8-1/2" HV blue wire from lug 6 of tube socket V2 (S-2) to lug 1 of terminal strip BJ (S-2). Space this wire away from the other wiring and DO NOT place it through the cable clamp.

Refer to Pictorial 17 for the following steps.

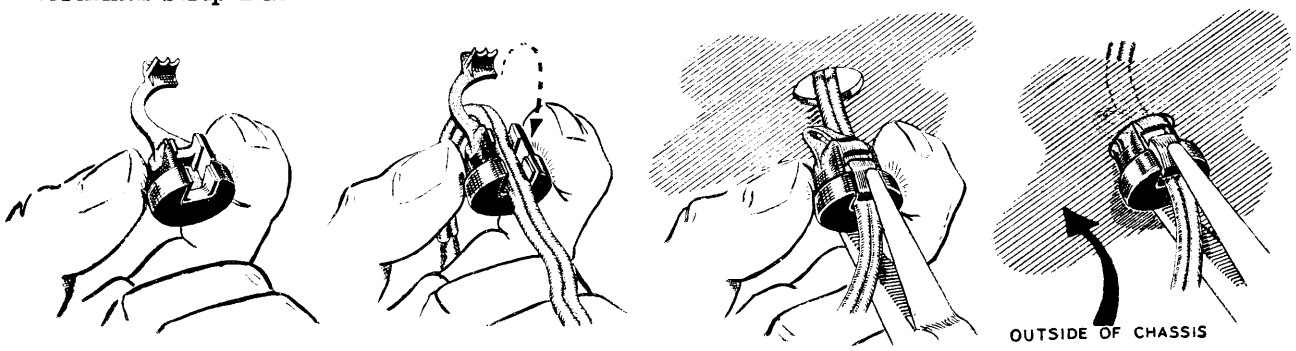
( ) Connect the free end of the black power transformer lead coming from grommet HE to lug 1 of terminal strip BG (NS). Trim to length.

( ) Connect the free end of the wire coming from grommet HE to lug 3 of terminal strip BG (NS).

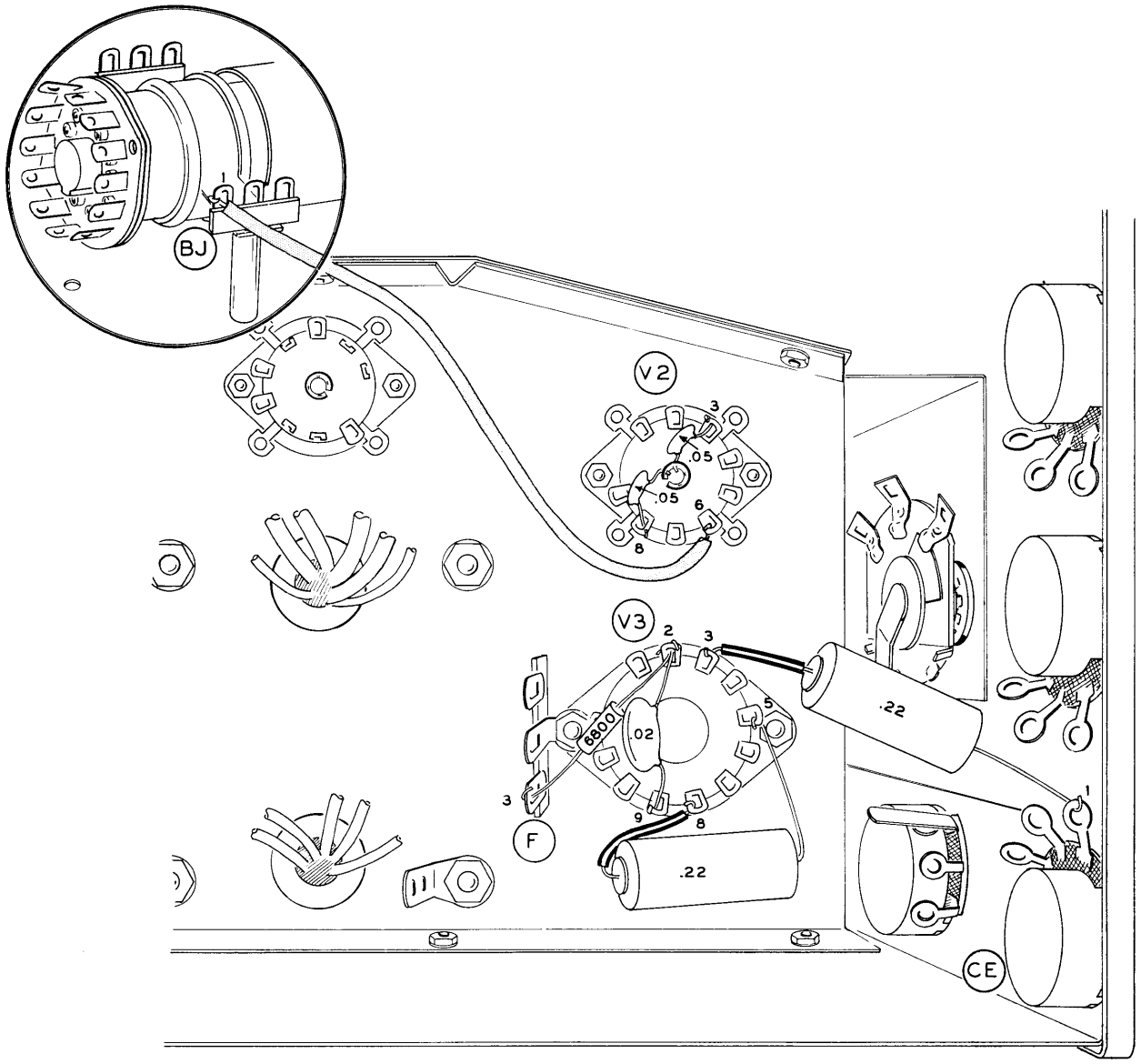
( ) C34. Connect a .005 μfd disc ceramic capacitor between lugs 1 (NS) and 2 (NS) of terminal strip BG.



Pictorial 17



Detail 17A



Pictorial 16

( ) C35. Connect a .005 μfd disc ceramic capacitor between lugs 2 (S-2) and 3 (NS) of terminal strip BG.

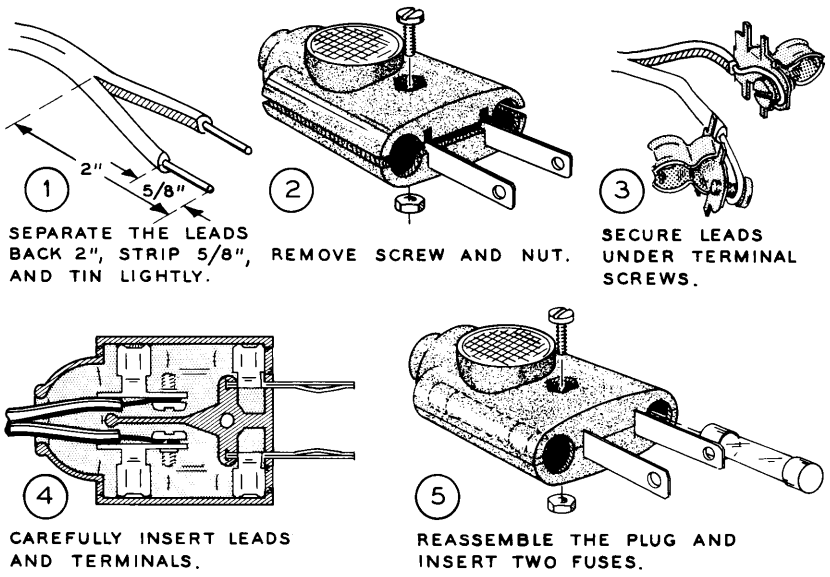
( ) Separate the line cord wires for approximately 1". Remove 1/4" of insulation from each wire and tin the exposed wire ends.

( ) Referring to Detail 17A, install the line cord and strain relief at location BF. Leave approximately 1-1/4" of line cord inside the chassis enclosure.

( ) Connect either line cord wire to lug 1 (S-3) and the other wire to lug 3 (S-3) of terminal strip BG.

( ) Referring to Detail 17B, prepare the free end of the line cord and wire it to the fuse plug.

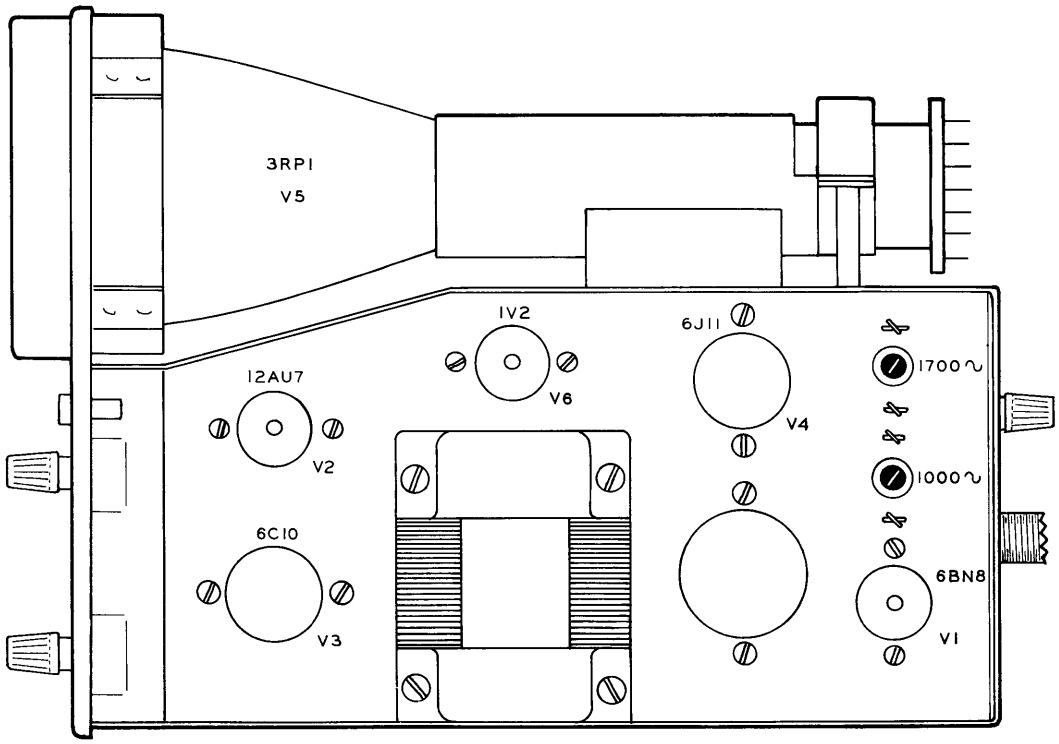
Detail 17B



( ) Referring to Pictorial 18, install the tubes in their respective sockets.

This completes the wiring of your Monitor Scope. Proceed to Test And Adjustment.

NOTE: The excess RG-62 coaxial cable is used to later connect the Scope vertical input to the Receiver IF. See Page 41.



Pictorial 18

TEST AND ADJUSTMENT

INITIAL CHECK

If an ohmmeter is available, the following checks should be made PRIOR TO APPLYING POWER to the unit. Refer to Pictorial 12 (fold-out from Page 6) for the test points indicated.

( ) With the negative meter lead to ground lug G and the positive lead to lug 1 of V6, the resistance reading after a brief capacitor charging period should be approximately 5 megohms.

( ) With the negative meter lead to ground lug G and the positive lead to lug 4 of terminal strip C, the resistance reading should be greater than 100 KΩ after a sufficient capacitor charging period.

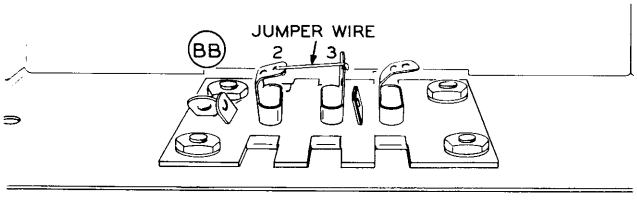
( ) With the negative meter lead to lug 4 of terminal strip C, and the positive lead to lug 1 of terminal strip C, the resistance reading should be greater than 100 KΩ after a sufficient capacitor charging period.

Refer to Pictorial 18 for the following steps.

CAUTION: VOLTAGES IN THIS INSTRUMENT ARE DANGEROUS. Extreme care should be exercised whenever the instrument is operated or handled without being installed in the cabinet. Some of the highest voltages in the circuit appear on the CR tube socket and INTENSITY control terminals, just below the CR tube socket. These voltages could be fatal.

We suggest that you pre-read this section of the manual before performing the following steps.

( ) Referring to Detail 18A, temporarily connect a jumper wire from lug 2 to lug 3 (VERT to TONE) of phono socket BB.



Detail 18A

( ) Set the controls as follows before connecting the line cord to an AC outlet.

FUNCTION-SINE
SWEEP FREQUENCY-Pushed in and full counterclockwise.
TONE GEN - OFF.
HOR GAIN - Full counterclockwise.
HOR POS - Center of rotation.
VERT POS - Center of rotation.
VERT GAIN - Full counterclockwise.
FOCUS - Center of rotation.
INTENSITY - OFF.
1000 ~ TONE ADJUSTMENT - Full clockwise.
1700 ~ TONE ADJUSTMENT - Full clockwise.

( ) Plug the line cord into a 105-125 volt 50/60 cps AC outlet. CAUTION: This instrument may be seriously damaged if connected to a DC power source or more than 125 volts AC.

( ) Turn the INTENSITY control approximately 3/4 of its rotation. This will apply power to the Scope. The red neon pilot lamp and all tube filaments should glow, except in the 1V2 tube. This tube uses a filament voltage of less than 1 volt and, for all practical purposes, there will be no glow. Allow one minute for the tubes to warm up.

( ) Watch the center of the screen until a spot appears. If no spot appears, rotate both the HOR POS and the VERT POS knobs simultaneously until a spot is located. If the spot can not be located, turn the unit off and refer to the In Case Of Difficulty section on Page 56.

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

( ) Adjust the FOCUS control for the smallest, sharpest dot.

( ) Rotate the HOR POS control and notice that the spot moves horizontally across the screen. Now turn the VERT POS control and the spot will move up and down. Adjust these two controls so that the spot is centered on the screen.

( ) With the spot centered, slowly turn the HOR GAIN control clockwise. The spot should now become a horizontal line.

NOTE: A small amount of ripple (hum) may be present on the trace. This is normal and will not interfere with the monitoring functions for which this Scope is intended.

If the angle of the trace is not perfectly horizontal, correct this condition as follows:

( ) Observe the position of the trace on the CR tube and estimate how far the CRT should be turned. Turn off the power, pull the line cord plug. Allow approximately 30 seconds for the filter capacitors to discharge. As an added safety precaution, pin 1 of the 1V2 high voltage rectifier and the (+) leads of the large electrolytic capacitors should be momentarily shorted to the chassis with an insulated screwdriver to provide complete discharge. Loosen the clamp at the neck of the CRT and rotate the tube the proper amount by turning its socket. Do not allow the tube to slide forward and come into contact with the grid screen.

This process may be repeated if the trace is still slightly tilted. When finished, carefully tighten the CR tube neck clamp to hold the tube in place.

( ) Turn the VERT GAIN control fully clockwise.

( ) Turn the SWEEP FREQ control to the 1 o'clock position.

( ) Turn the TONE GEN switch to the 1 KC position.

( ) Watch the line on the screen and very slowly turn the 1000~ TONE ADJUSTMENT control counterclockwise until a very small signal can be seen on the horizontal line. This indicates that the 1 kc oscillator is operating and the signal indication will be approximately 1/32". After obtaining the signal, turn this control 1/16 turn farther.

( ) Turn the TONE GEN switch to the 2-TONE position and repeat the above step turning the 1700 ~ TONE ADJUSTMENT control until a second signal can be seen superimposed on the 1 kc signal. Then turn this control 1/16 turn farther.

If the Scope is to be used with a SSB transmitter, the above two controls should be adjusted later to provide equal output from each tone. This requires connecting the transmitter and Scope as outlined under Transmit Envelope Patterns and adjusting the 1000 ~ and 1700 ~ controls to provide a clean "Trough" crossover as illustrated in Envelope pattern #10.

( ) Turn the tone generator switch OFF, the FUNCTION switch to AF TRAP, and rotate the HOR GAIN control fully clockwise. There should now be a spot. Pulling the Clamp switch on the sweep frequency control should cause the spot to move off the screen to the right.

( ) Return the Clamp switch to its off position and turn the Function switch to RF TRAP. There should again be a spot which can be clamped off the screen face by pulling the Clamp switch. Leave the Clamp switch in the off position and return the FUNCTION switch to AF TRAP.

( ) Turn the Scope off and remove the jumper wire previously connected between lugs 2 and 3 of phono socket BB. (See Detail 18A and Pictorial 13.)

( ) Temporarily connect a jumper wire from lug 5 of phono socket BB (HOR input) to lug 5 of the 6BN8 socket, V1.

( ) Turn the unit on and note that there should now be a horizontal line whose width can be adjusted by the HOR GAIN control. Rotating the SWEEP FREQ control should have no effect and placing the FUNCTION switch in the RF TRAP position should reduce the line to a spot.

( ) Turn the Scope off and remove the temporarily installed jumper wire from lug 5 of phono socket BB to tube socket V1.

This completes the Test and Adjustment section. Proceed to Final Assembly.

FINAL ASSEMBLY

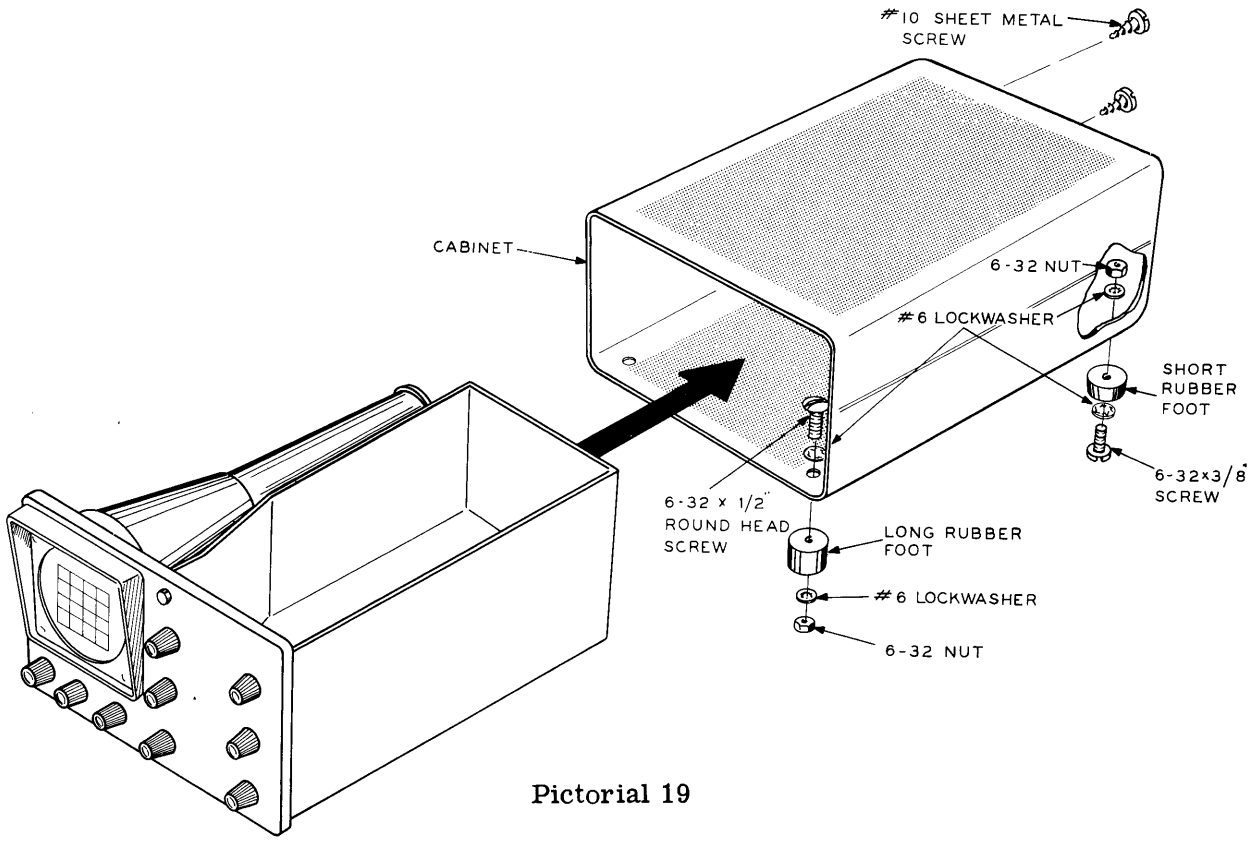
Refer to Pictorial 19 for the following steps.

) In order to increase the flexibility of the Monitor Scope two different size rubber feet are supplied. The Scope may be set level, tilted frontwards, or backwards, depending upon the use of the two large rubber feet. See Pictorial 19.

) Mount the rubber feet in each corner of the cabinet. Use a 6-32 x 3/8" screw, two #6 lockwashers, and a 6-32 nut on the short rubber feet and a 6-32 x 1/2" round head screw, two #6 lockwashers (one under the screw head), and 6-32 nuts for the tall rubber feet, if used.

( ) Slide the Scope into the cabinet as shown and secure it with the two #10 sheet metal screws on the rear panel.

This completes the Final Assembly of your kit. Refer to the Installation Section.



Pictorial 19

OPERATION

GENERAL INSTRUCTIONS

The Monitor Scope is now assembled and checked out. Before attempting to use the Scope, we suggest that your familiarize yourself with the operation of its various controls. They are listed below in the usual sequence of operation.

INTENSITY - The INTENSITY control incorporates the AC Power switch and also varies the brightness of the pattern on the screen. It should be adjusted for a clear trace. CAUTION: Excessive brightness for prolonged periods of time could burn the phosphor on the face of the CR tube.

FOCUS - There may be some interaction between the FOCUS and INTENSITY controls. Adjust each for the best focus at the desired intensity level.

HOR POS, VERT POS - These controls determine the position of the trace on the CR tube screen. During initial set up, these controls should be set to the center of their rotation.

HOR GAIN - The HOR GAIN control varies the input to the horizontal amplifier. Adjust the control until the display is approximately the width of the square grid screen printing.

VERT GAIN - The VERT GAIN control varies the input to the vertical amplifier during receiver monitoring conditions. Under transmit conditions, the vertical height can be varied with the XMTR ATTEN switch, located on the rear panel of the Scope.

FUNCTION - The FUNCTION switch selects the type of pattern displayed on the screen; SINE, AF TRAPezoid, or RF TRAPezoid.

TONE GEN - The TONE GEN switch controls operation of the built-in sine wave oscillators. By turning it to the desired position, either a single 1000 cps tone or the two-tones, 1000 and 1700 cps superimposed, may be obtained.

SWEEP FREQ - This control adjusts the sweep generator frequency. It should be adjusted to obtain the proper sweep rate for the desired display pattern.

CLAMP SWITCH - When the FUNCTION switch is in one of the TRAPezoid positions, the Clamp switch located on the SWEEP FREQ control may be pulled out to deflect the spot off the side of the screen when there is no output from the transmitter. Otherwise, if a focused spot is left stationary for a long period of time, it may result in a phosphor burn on the CR tube face.

When used with transmitters or sufficient power input (generally in excess of 100 watts), the clamp will automatically "release" and revert to a normal trapezoid pattern with the application of RF through the ANT terminals. When used with lower powered transmitters, the clamp feature is best left off, otherwise the clamp will not release completely or allow a stationary pattern.

PLACEMENT NEAR POWER TRANSFORMER

Although the Scope incorporates a magnetic shield, locating the unit in strong magnetic fields such as produced by large power transformers may induce objectionable ripple on the trace. Attempt to locate the Scope in a relatively hum-free area. This can best be determined experimentally.

INITIAL CONTROL SETTINGS

Each time a different setup is used for monitoring, set the front panel controls as follows: After a display is present on the screen of the Scope, adjust the controls for the desired display.

FUNCTION Switch	-	Desired function.
SWEEP FREQ	-	Pushed in and at the 12 o'clock position.
TONE GEN	-	As required.
HOR GAIN	-	12 o'clock
HOR POS	-	12 o'clock
VERT POS	-	12 o'clock
VERT GAIN	-	12 o'clock
FOCUS	-	12 o'clock
INTENSITY	-	3 o'clock

SCOPE CONNECTIONS

In addition to the following, much information on the use of oscilloscopes for amateur test purposes may be found in any recent edition of the ARRL, "The Radio Amateur's Handbook."

RECEIVER MONITORING (FIGURE 1)

The receiver monitoring feature of this Scope is designed to operate with tube type receivers having an IF frequency of 500 kc or below. As the Scope incorporates a broadband amplifier, no tuning is required.

In order to monitor received signals it is necessary to connect into the last IF stage of the receiver. A typical circuit is shown in Figure 1A. It is necessary to loosely couple the Scope to prevent excessive loading and detuning effects of the IF amplifier stage. This coupling capacitor will typically be between 5 and 15 $\mu\mu$f. The addition of this capacitor may slightly detune the preceding IF transformer, therefore, it should be retuned after all connections have been made.

1. Connect the RG-62 coaxial cable supplied from the grid (preferably) or plate of the last IF stage through a small value capacitor (5-15 $\mu\mu$f) to the VERT jack on the rear of the Scope.

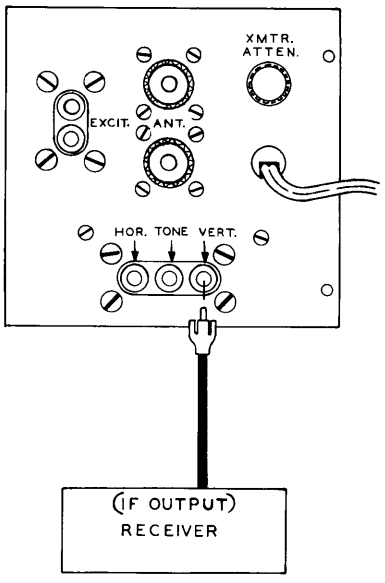


Figure 1

2. Place the front panel controls as directed in the Initial Control Settings section.

3. Adjust the VERT GAIN, HOR GAIN, and SWEEP FREQ controls for the desired display.

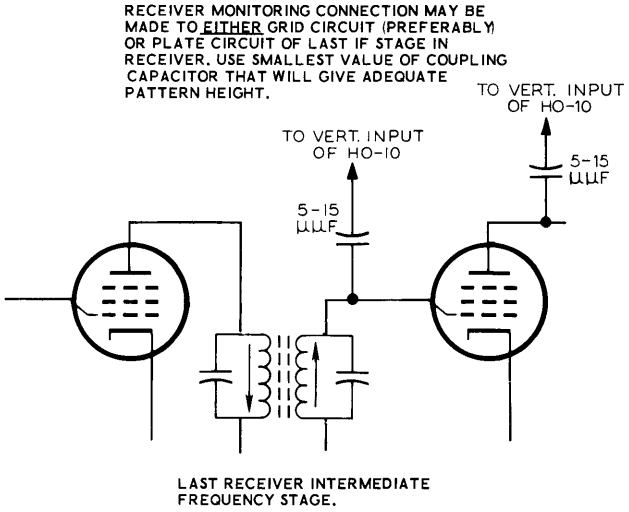


Figure 1A

RECEIVER ENVELOPE PATTERNS

With the receiver adjusted for normal operation on an average signal, the VERT GAIN control should be adjusted to produce a pattern approximately 1-1/2" high.

Many of the transmitter patterns described later may also be observed as a received signal. Bearing in mind the limitations described in the following paragraphs, refer to the appropriate sample patterns, depending on the type of signal 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 AVC and the narrow bandwidth employed in the newer receivers.

With AVC on during the observance of a pulsing signal such as CW or sideband, the leading portion of the waveform may be displayed with a considerably higher than normal amplitude. It will reduce in height as the AVC takes hold. This effect can most easily be seen by observing the difference between patterns 40 and 41 on Page 54.

The same distortion may be noted when watching voice patterns on sideband, producing momentary apparent flat-topping. This problem can be avoided if the AVC is turned off with the receiver RF gain sufficiently reduced to prevent overload.

RECEIVER PATTERNS

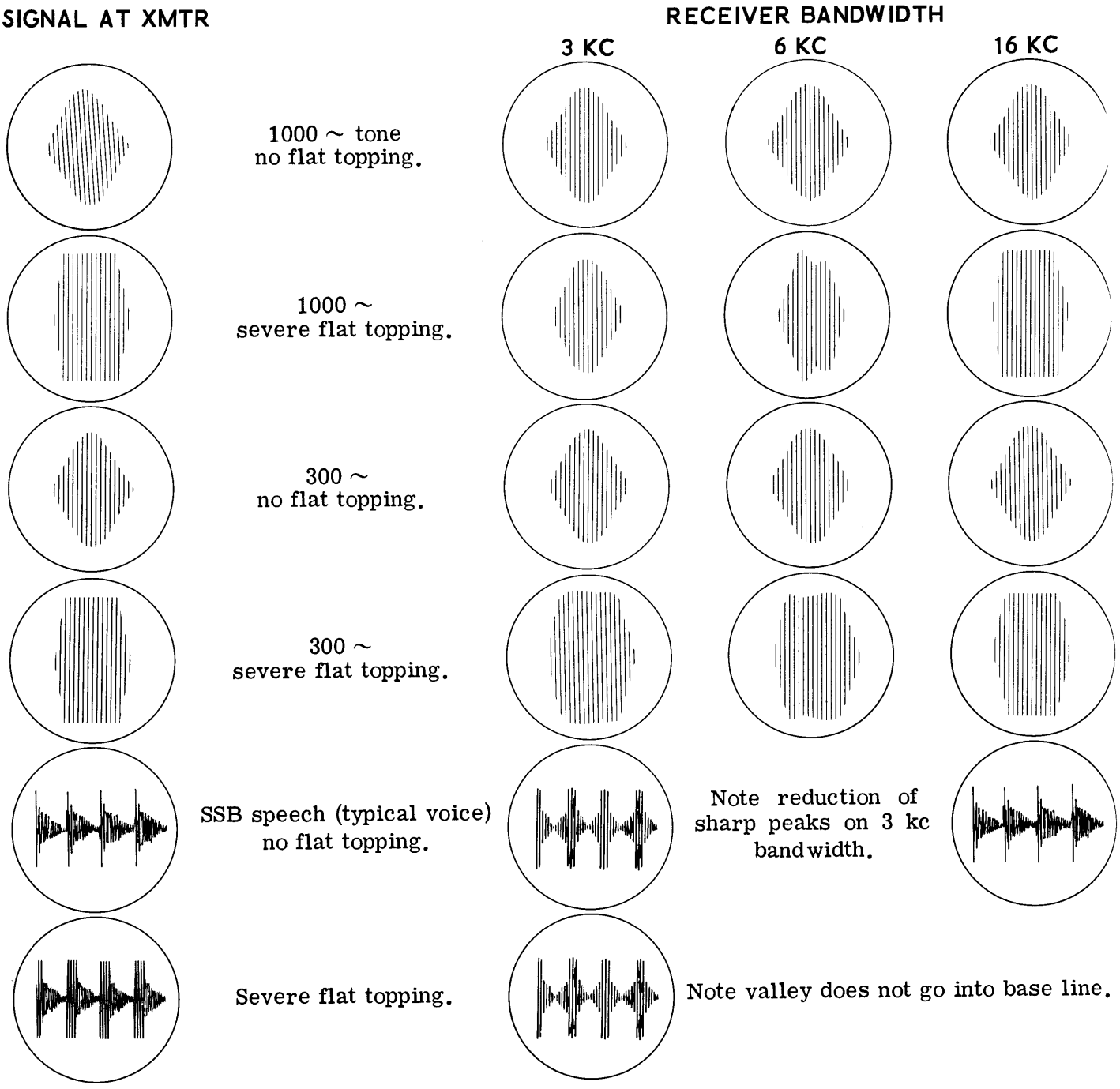


Figure 1B

The receiver IF bandwith determines the ability to obtain a true display of an over modulated or square-topped signal. Refer to the pattern sequence shown on Page 42. In order to obtain a true display, the IF bandwidth must be roughly 10 times the modulating frequency. For example, a 3 kc bandwidth will pass a 300 cps square wave but a 1000 cps square wave would be shown as a somewhat distorted sine wave. Therefore, SSB signals that are "flat-topping" may appear acceptable on the RF envelope patterns.

A flat-topped signal can best be determined by observing the lack of peaks and valleys in the IF envelope pattern. See Figure 1B. It is possible that the signal may be deliberately "shaped" by the use of premodulation clipping and filtering in the transmitter, producing a pattern that may appear somewhat flat topped.

TRANSMIT ENVELOPE PATTERNS (FIGURE 2)

Most transmitters have 50-72 Ω coax outputs. The following instructions are written for this type of connection, with either a dummy load or an antenna.

If the feed line to the antenna is other than coaxial cable, it is necessary to use a pickup antenna or a coax-coupled pickup link, placed near the final RF amplifier tank coil, and connected to only one (either) of the rear panel antenna jacks. With open wire or ribbon feed systems, a length of wire placed close to one of the feeders is recommended.

Make sure a dummy load or antenna is connected each time the transmitter is operated, either through the Scope as in the case of coaxial feed, or directly where other antenna transmission line systems are used. When used with the Heath HX-10 or HA-10 equipment, it is recommended that full RF output be connected through the Scope rather than using the special Scope output on these units.

1. Connect the RF output of the transmitter or linear amplifier to either ANT jack of the scope.

2. Connect the dummy load or antenna to the other Scope ANT jack.

3. Set the front panel controls as described on the Initial Control Settings section. Set the XMTR ATTEN switch fully clockwise.

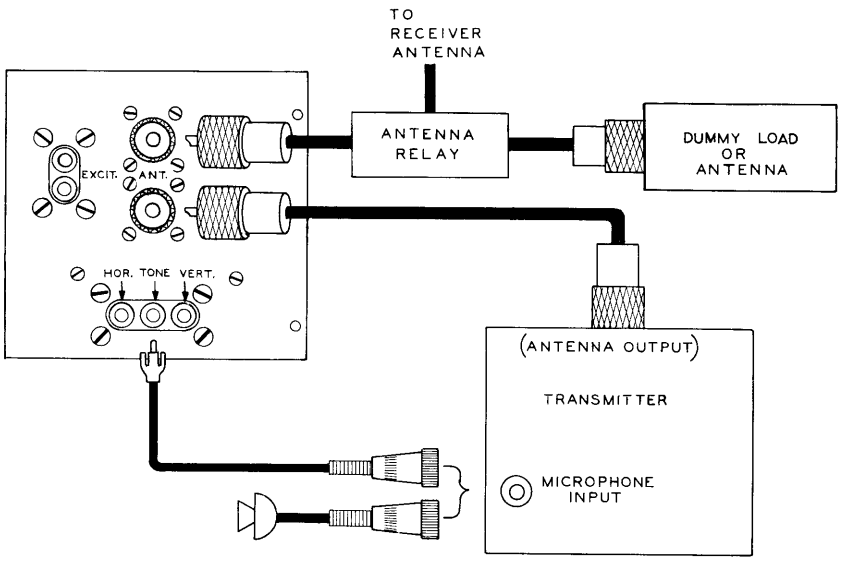


Figure 2

4. Turn on the transmitter and adjust the XMTR ATTEN, HOR GAIN, and SWEEP FREQ controls for the desired pattern height and display.

5. Modulation of an AM or SSB transmitter may be checked by connecting a shielded cable from the TONE output jack of the Scope to the microphone input of the transmitter. If this is done, place the TONE GEN switch to the 1 KC position. A two-tone position is also available for SSB checks and alignment. Voice modulation may be checked by using a microphone to voice modulate the transmitter.

6. Refer to the Transmit Envelope Patterns on Page 49 to evaluate the transmitter display.

TRANSMIT RF TRAPEZOID PATTERNS (FIGURE 3)

This setup is used to check a linear amplifier for linearity; therefore it is necessary to compare the exciter RF output with the RF output of the linear amplifier.

1. Connect a coaxial cable from the RF output of the exciter to either EXCIT input jack of the Scope.

2. Connect a coaxial cable from the other EXCIT jack on the Scope to the input jack of the linear amplifier.

3. Connect a coaxial cable from the RF output of the linear amplifier to either ANT jack of the Scope.

4. Connect the dummy load or antenna to the other ANT jack on the Scope.

5. Connect the TONE jack to the microphone input of the exciter.

6. Set all front panel controls on the Scope as directed in the Initial Control Settings section, but with the TONE GEN switch at 2 TONE and the FUNCTION switch in the RF TRAP position.

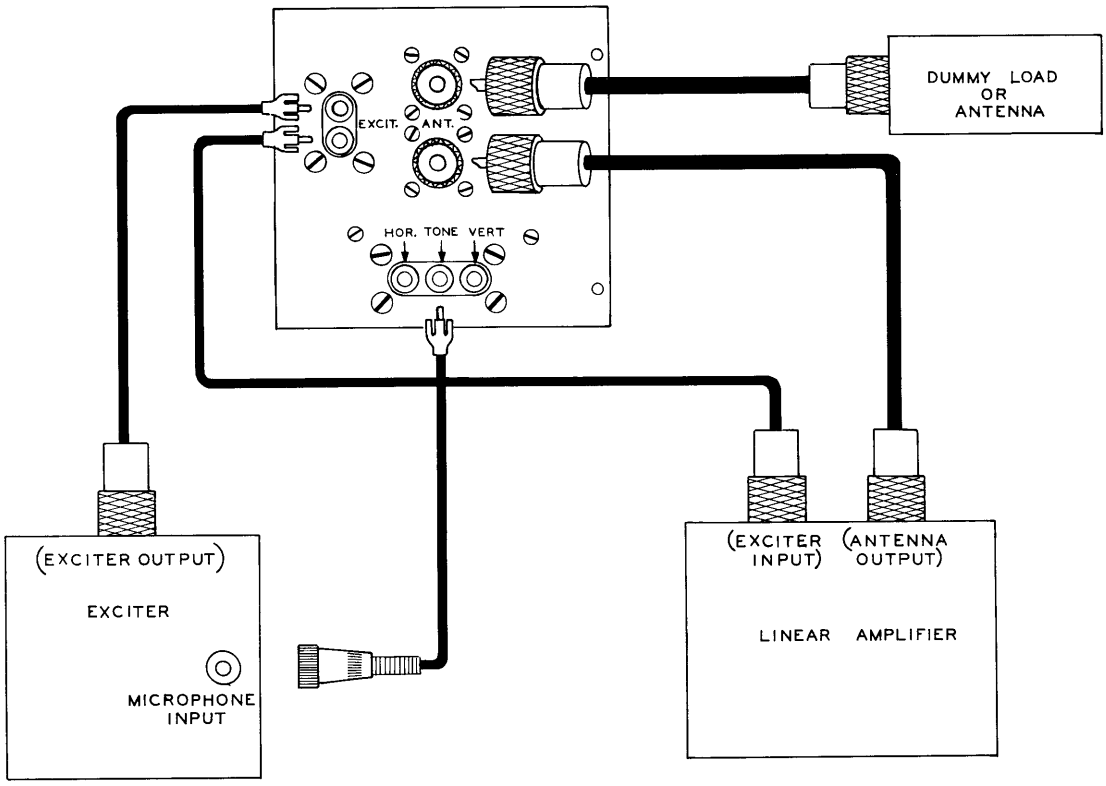


Figure 3

4. Turn on the exciter and linear amplifier and adjust the XMTR ATTEN, HOR-GAIN, and transmitter audio gain controls for the desired display height and pattern.

5. The trapezoid pattern is obtained by comparing the RF output signal of the exciter with the amplified RF output of the linear amplifier. Refer to the Trapezoid Patterns for display analysis.

NOTE: The RF trapezoid pattern only indicates the linearity of the linear amplifier. This set-up should not be used for general monitoring as it does not evaluate the exciter signal.

AF TRAPEZOID PATTERNS (FIGURE 4)

Trapezoid (AM) patterns are obtained by inserting the transmitter RF output to provide vertical deflection (as in the case of envelope display) with the actual modulating signal (audio) providing the horizontal sweep. With no modulation applied, this results in a straight vertical line of carrier amplitude displayed in the center of the screen. When audio is applied, the transmitter output (carrier plus side-bands) increases on the positive half cycle of modulation and decreases on the negative half, producing a trapezoid. In an ideal AM transmitter modulated 100%, the trapezoid extends to a triangle with perfectly straight sides and is essentially independent of the modulating waveform; that is, either voice or tone input to the transmitter may be used.

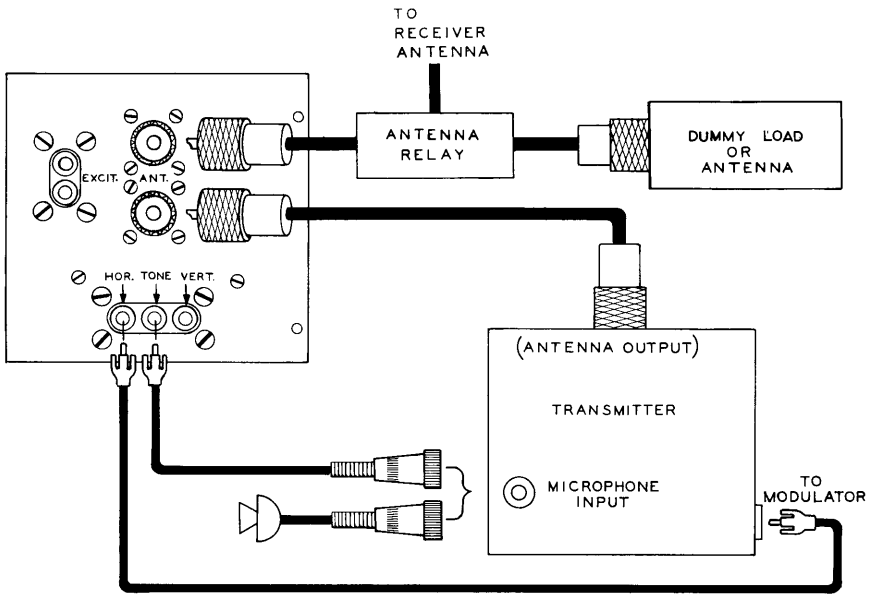


Figure 4

AF TRAPEZOID CONNECTIONS

1. Connect a coaxial cable from the RF output of the transmitter to either ANT jack of the Scope.

2. Connect the antenna or dummy load to the other ANT jack of the Scope.

3. Connect the TONE output jack of the Scope to the microphone jack of the transmitter.

4. It is necessary to obtain a sample of the transmitter audio signal where the audio modulates the RF. This point may be found at the plate or screen grid of the modulated tube. See Figure 4A. Add another 100 KΩ 2 watt resistor in series for each 350 volts over 750 volts. Capacitor CX (100 μμf to 200 μμf) may have to be added to compensate for audio phase shift. It should be a high voltage type, at least 2 KV for Figure 4A.

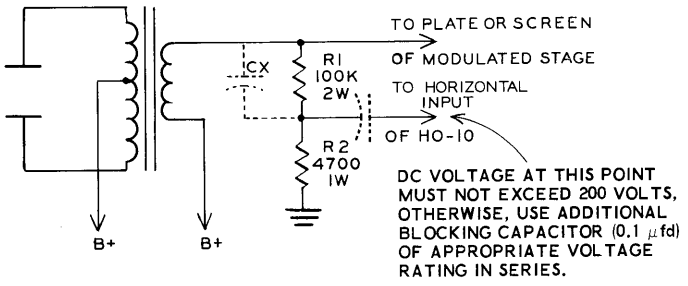


Figure 4A

5. Set the front panel controls as described in the Initial Control Setting section. Set the XMTR ATTEN switch fully clockwise.

6. Turn on the transmitter and adjust the XMTR ATTEN and HOR GAIN controls for the desired pattern height and display.

7. Refer to the AF Trapezoid Patterns for pattern analysis.

RTTY CROSS PATTERNS (FIGURE 5)

This setup enables you to observe the performance and tuning of teletype terminal equipment.

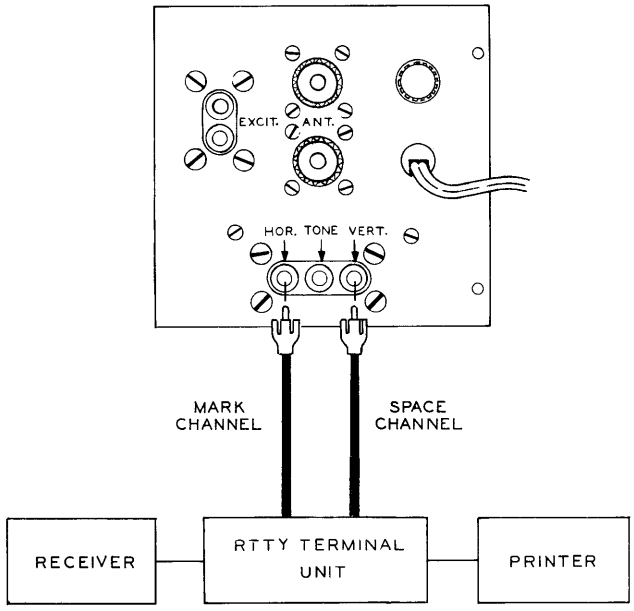


Figure 5

1. Connect a coaxial or shielded cable from the mark channel of the RTTY terminal unit to the HOR input jack of the Scope.

2. Connect a coaxial or shielded cable from the space channel of the RTTY terminal unit to the VERT input jack of the Scope.

3. Set the front panel controls as directed in the Initial Control Settings section.

4. Turn the terminal unit and Scope on, and place the scope FUNCTION switch in the AF TRAP position with the Clamp switch pushed in. The mark and space outputs of the TU should be adjusted to provide equal output voltages from the two channels when properly tuned in. This can be determined by alternately inserting mark and space signals into the Scope VERTical input and adjusting the TU balance control for equal height from both channels. Now, with space connected to the VERT input and mark connected to the HOR input, adjust the VERT and HOR GAIN controls on the Scope to produce a cross pattern with equal line (or elipse) lengths. Once the desired size of the cross pattern has been set, the gain controls on the Scope should not be changed as this will interact with the true setting of the balance control on the terminal unit.

5. Refer to RTTY Cross Patterns on Page 53.

OSCILLOSCOPE USE (FIGURE 6)

The Monitor Scope can be used as a normal oscilloscope for limited test applications where the need for internal sync, high sweep frequency or high vertical amplifier gain is not required. For most applications, the FUNCTION switch will be set in the SINE position where horizontal deflection is obtained from the internal sawtooth sweep generator. Where it is desirable to provide horizontal sweep from an external source, connect the horizontal signal to the HOR input and place the FUNCTION switch in the AF TRAP position (Clamp switch pushed in).

1. Connect a test lead to the VERT input jack, (the normal scope test probe).

2. Connect a test lead to the HOR input jack.

3. Adjust the VERT GAIN, HOR GAIN, and SWEEP FREQ controls for the desired pattern.

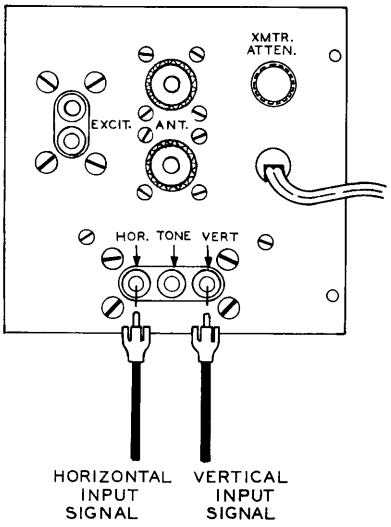


Figure 6

USE WITH CITIZEN'S BAND TRANSCEIVERS (FIGURE 7)

The Monitor Scope can be used with Citizen's Band Transceivers by making the following changes in the scope to increase its vertical sensitivity.

TRANSMIT ENVELOPE PATTERNS

1. Install a coil and capacitor in the Scope vertical input circuit as shown in Figure 7. The coil and capacitor can be obtained from Heath Company. Their part numbers are coil #40-187 and capacitor #20-98.

2. Connect the scope to the transceiver as shown in Figure 2 on Page 43.

AM TRAPEZOID PATTERNS

1. Install a coil and capacitor in the Scope vertical input circuit as shown in Figure 7. The coil and capacitor can be obtained from Heath Company. Their part numbers are coil #40-187 and capacitor #20-98.

2. Connect the Scope to the transceiver as shown in Figure 4 on Page 45. Also see Figure 7A which is a schematic diagram of a typical CB Transceiver output stage.

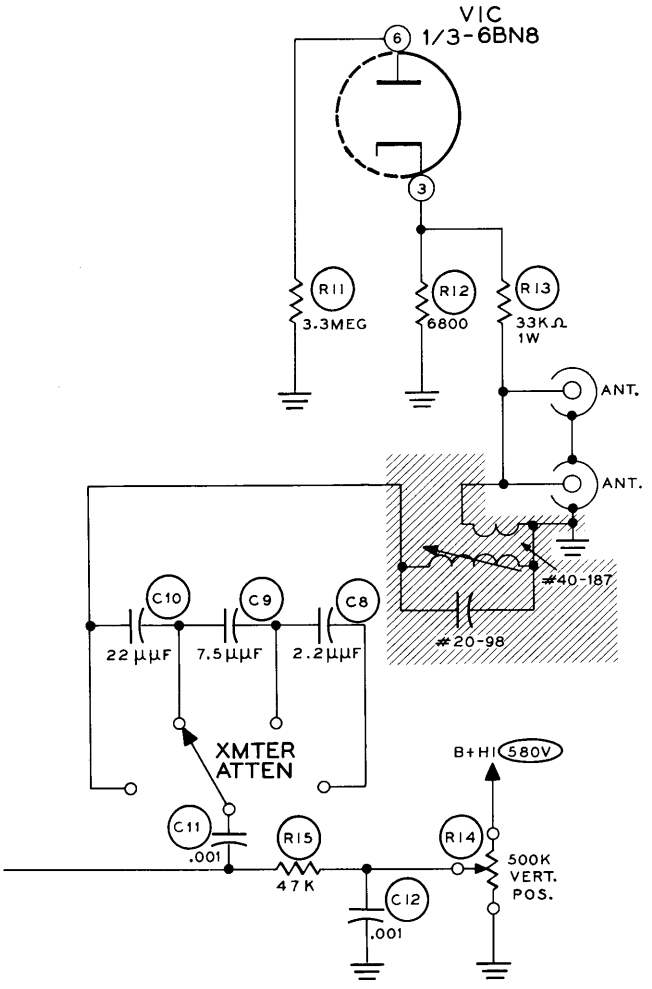


Figure 7

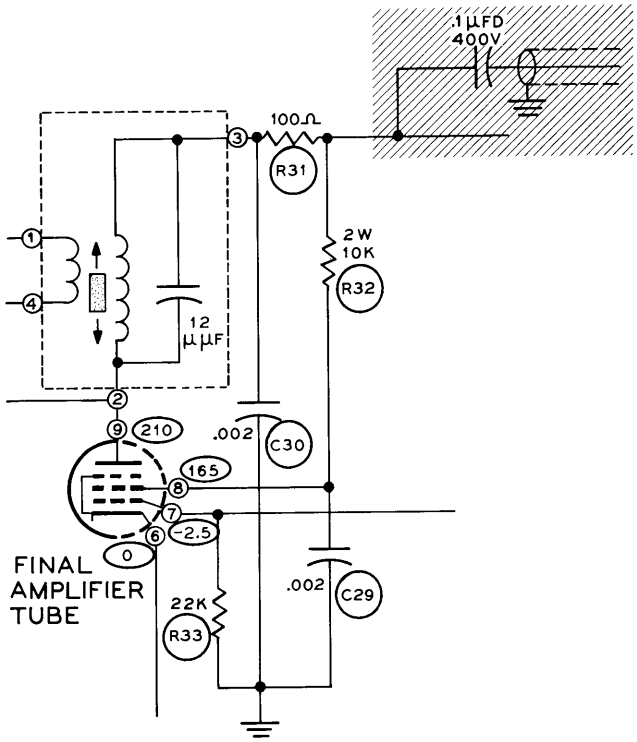
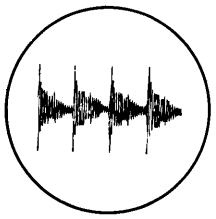


Figure 7A

TRANSMIT ENVELOPE PATTERNS

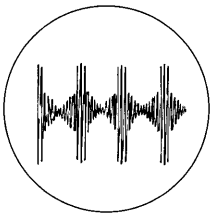
SSB signal, voice input, correctly adjusted.

1



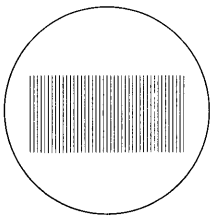
SSB signal, voice input, slightly excessive speech gain, or insufficient amplifier loading.

2



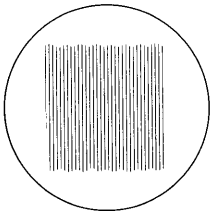
Pure CW carrier or perfect single tone input on SSB. May also occur on single tone SSB with excessive drive which results in amplifier "flat topping." Note absence of fine ripple.

3



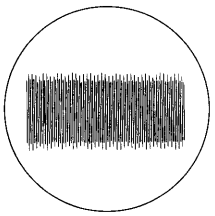
SSB signal, single tone input, sideband suppression down approximately 40 db or CW signal with spurious radiation down approximately 40 db.

4



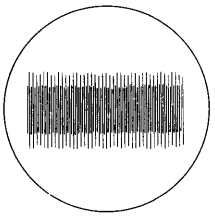
Same as 4 except down approximately 20 db. In SSB, the poor suppression may be due to audio unbalance or improper RF phase shift.

5



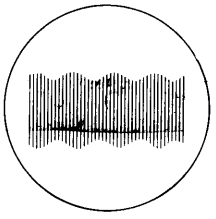
Same as 4, down approximately 10 db.

6



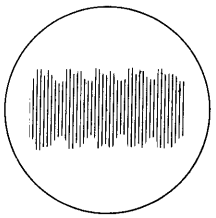
SSB signal, single tone input with carrier leakage. This pattern will have half the number of ripples due to poor sideband suppression. (See waveform 5.)

7



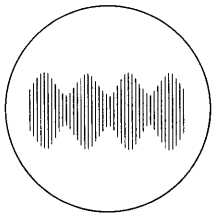
SSB signal, single tone input. Distortion in audio oscillator or audio system, balanced modulator detuned, or insufficient RF in balanced modulator.

(8)



SSB signal, single tone input. Very little sideband suppression. Caused by defective modulator tube; audio phase shift network; 90 degrees 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 on together.

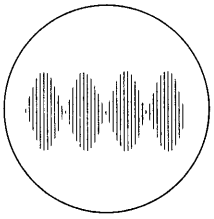
(9)



Normal double sideband, single tone input.

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

(10)



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

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

(11)

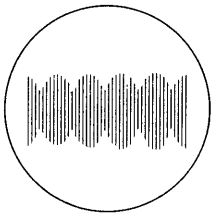
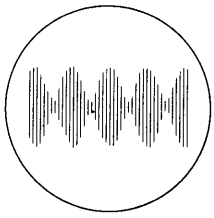


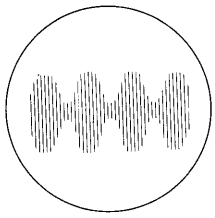
Plate modulated AM, or double sideband with carrier inserted, single tone input. Nearly 100% modulated. Excellent waveform.

(12)



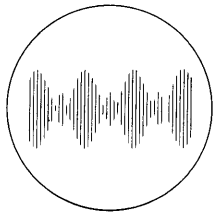
Double sideband with carrier inserted (low level AM), single tone input. Too much carrier inserted. Note that the positive peaks flatten before a fine base line is obtained. Peak flattening may also be caused by insufficient antenna loading, insufficient interstage loading, an overdriven linear amplifier,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

(13)

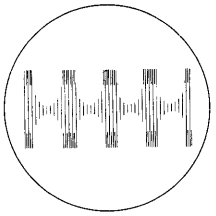


Double sideband with carrier inserted (low level AM), single tone input. Insufficient carrier insertion or excessive audio, resulting in high distortion (overmodulated). Also called Double Sideband Reduced Carrier (DSRC).

(14)

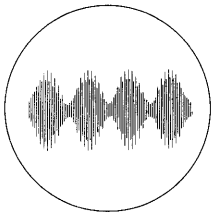


(15)



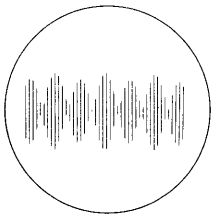
Low or high level AM with strong parasitics appearing on modulation peaks. Very fine, "Grassy" appearance on peaks would indicate parasitic in the UHF range.

(16)



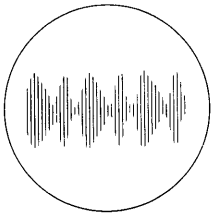
SSB, two tone input, or double sideband, single tone input; carrier leakage in either causes uneven height of successive half cycles of modulation envelope.

(17)



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

(18)



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.

(19)

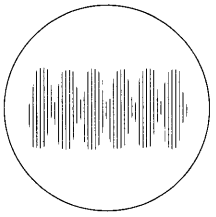


Plate modulated AM, single tone input. Overdriven modulator incapable of 100% modulation. May also result from deliberately "clipped" audio not properly filtered.

(20)

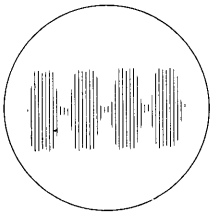
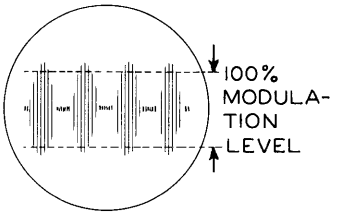


Plate modulated AM, single tone input. Modulator output more than ample. Modulation in excess of 100% in both directions.

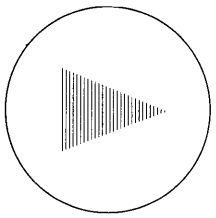
(21)



TRAPEZOID PATTERNS

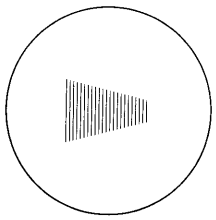
Plate modulation, single or double sideband with carrier, or RF trapezoid. Good linearity. Desirable pattern.

(22)



Plate, grid, or cathode modulation; double sideband or SSB with carrier. Modulation less than 100%. No distortion.

(23)



Nonlinear. With plate modulation, indicates lack of grid drive or insufficient grid bias. With grid modulation, SSB or DSB with carrier, or RF trapezoid through linear amplifier, indicates overdrive, insufficient antenna loading, grid current curvature or regeneration.

(24)

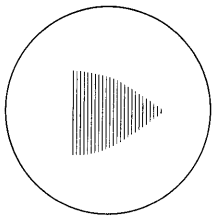


Plate modulation in excess of 100% in downward direction. Both modulator and final show good modulation capability.

(25)

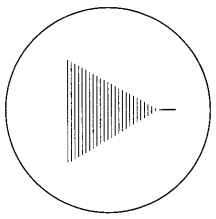


Plate modulation. Audio phase shift due to improper audio connection. Modulated approximately 80%.

(26)

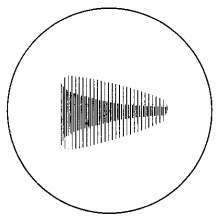


Plate modulation. Overmodulation in downward direction, with insufficient modulator capability.

(27)

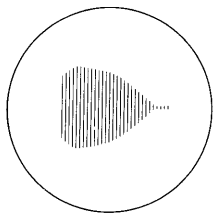
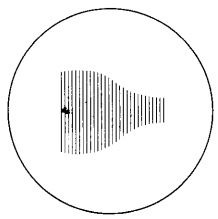
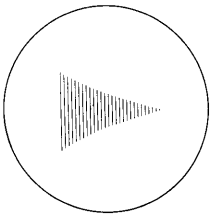


Plate modulation. Inadequate or mismatched modulator.

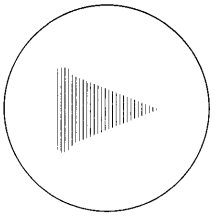
(28)



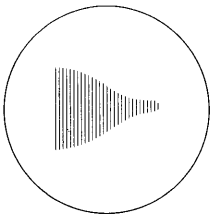
Nonlinear. With plate modulation this indicates regeneration due to improper neutralization. In linear operation this also indicates regeneration, or excessive grid bias. (29)



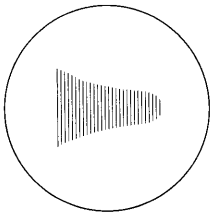
Parasitics occuring on modulation peaks. (30)



Screen grid or suppressor grid modulation, maximum modulation capability. (31)

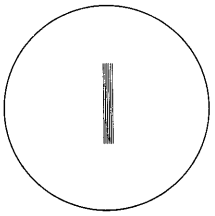


Grid modulation with improper neutralization and reactive load. (32)



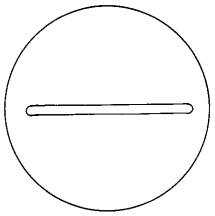
Unmodulated carrier. Can be caused by:
- No signal at horizontal deflection plates.
- Tone test oscillator inoperative.
- Gain control turned off on transmitter or oscilloscope.
- Audio failure in transmitter.

(33)



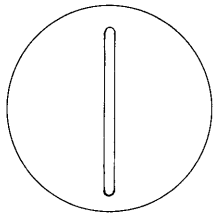
RTTY CROSS PATTERNS

Mark only. The relative narrowness of the elipse provides good indication of the channel separation capability in the terminal unit. (34)



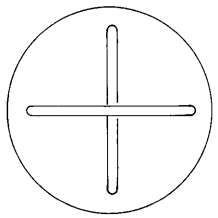
Space only. The relative narrowness of the elipse provides good indication of the channel separation capability in the terminal unit.

(35)



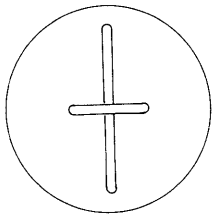
RTTY signal, proper shift, correctly tuned in.

(36)



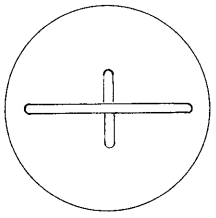
Incorrect shift, space tuned in.

(37)



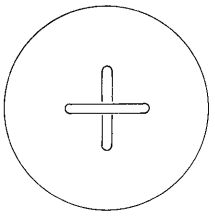
Incorrect shift, mark tuned in.

(38)



"Straddle" tuning of incorrect shift.

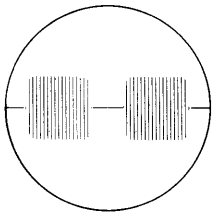
(39)



CW PATTERNS

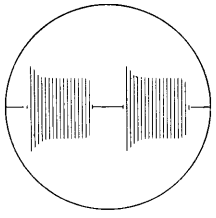
Good CW pattern, properly shaped keying, string of dots. Pattern can be approximately "locked" using automatic keyer or bug.

(40)

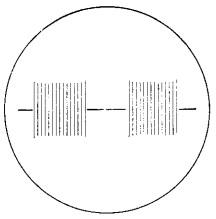


CW pattern showing effect of receiver AVC action or poor power supply regulation in the transmitter.

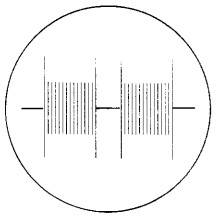
(41)



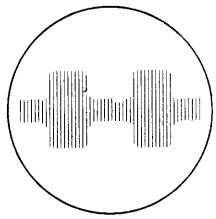
CW pattern, mild key clicks. (42)



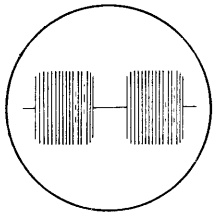
CW pattern, severe key clicks. (43)



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. (44)



CW pattern, string of dots indicating poor contacts or contact bounce in keying mechanism. (45)



IN CASE OF DIFFICULTY

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

2. It is interesting to note that about 90% of the kits that are returned for repair, do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Proper Soldering Techniques section of this manual.

3. Check to be sure that all tubes are in their proper locations. Make sure that all tubes light up properly.

4. Check the tubes with a tube tester or by substitution of tubes of the same types and known to be good.

5. Check the values of the parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

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

7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. NOTE: All voltage readings were taken with an 11 megohm input vacuum tube voltmeter. Voltages may vary as much as 10%.

8. A review of the Circuit Description will prove helpful in indicating where to look for trouble.

TROUBLESHOOTING CHART

TROUBLE	SUGGESTED TEST
Tube filaments do not light.	Check fuses. Check filament voltage.
No trace or spot.	Check clamper circuit voltages and tube. Check for high voltage.
No vertical deflection.	Check vertical tube and voltages.
No horizontal deflection.	Check horizontal and sweep tube and voltages.
A tube filament does not light.	Check tube. Check filament wiring
No B+.	Check fuses. Check silicon diodes. Check for open resistors, shorted capacitors or defective tubes.
Poor focusing.	Check V6. Check high voltage bleeder resistors: R44, R45, R47, R48, and R49. Check C30 and C31. Some astigmatism - defocusing at ends of trace- may be noted. This is normal, and should not interfere with the monitoring function.
Distorted waveform.	Too much signal input.
Unable to obtain tone waveform.	Check test jumper for proper installation. See Detail 18A and the preceding step. Vertical gain control not fully clockwise. Check wiring and voltages of V4 (6J11).

SERVICE INFORMATION

SERVICE

If, after applying the information in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units, and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit model number and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)

5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed equipment to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although charges for local service are generally somewhat higher than for factory service, the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally, improper operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the type and model number of kit in which it is used.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan

ATTACH A LETTER TO THE OUTSIDE OF THE CARTON BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Also, include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION , the article is inadequately packed for shipment.

WARRANTY

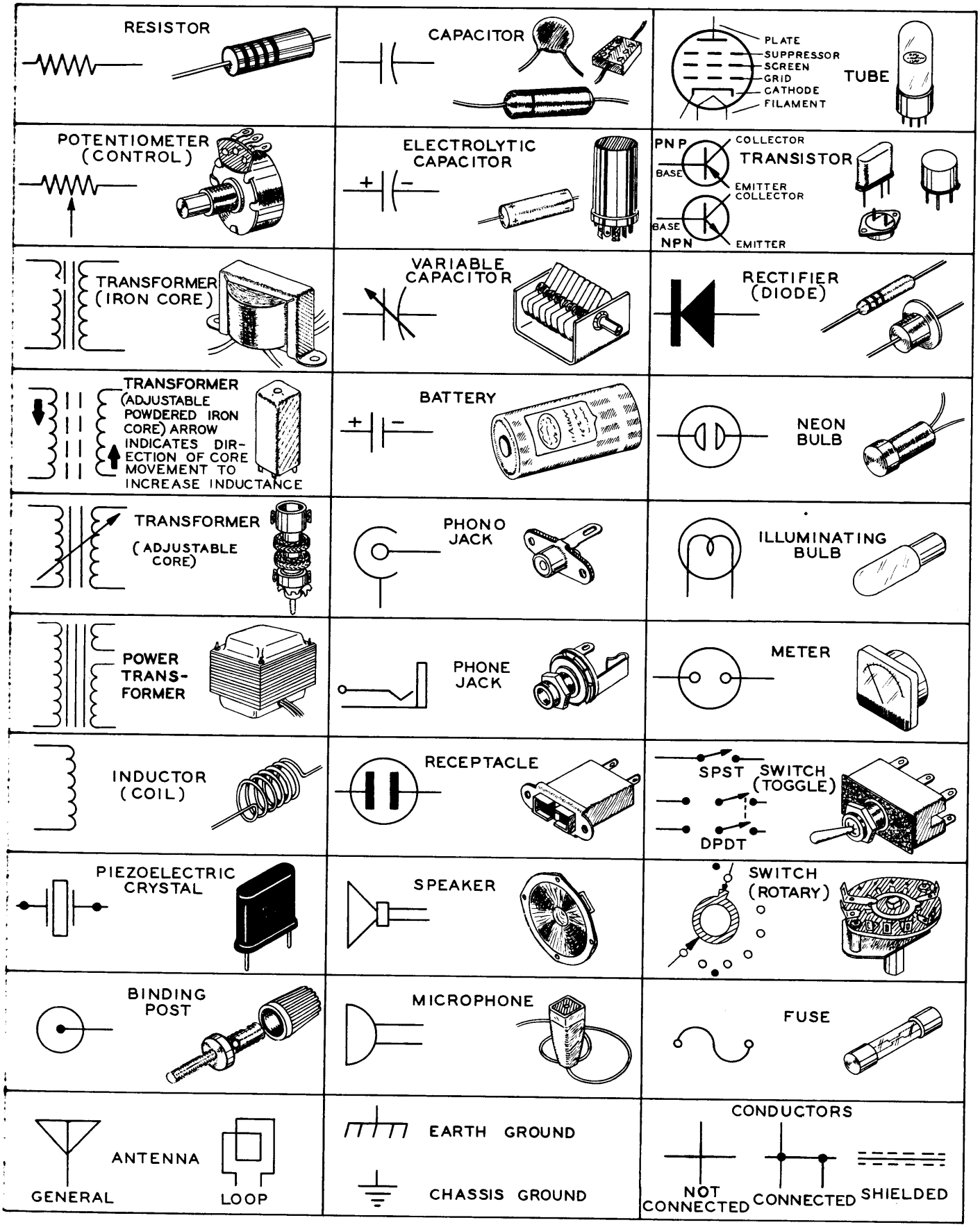
Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



HEATH COMPANY

BENTON HARBOR, MICHIGAN

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