Assembly
and
Operation
of the

HEATHKIT

LINEAR AMPLIFIER

MODEL SB-200

TABLE OF CONTENTS

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

SPECIFICATIONS

Band Coverage	80, 40, 20, 15, and 10 meters.
Maximum Power Input	SSB 1200 watts P.E.P. CW: 1000 watts.
Driving Power Required	100 watts.
Duty Cycle	SSB continuous voice modulation. CW. 50% (key down time not to exceed 5 minutes).
Third Order Distortion	-30 db or better at 1000 watts P.E.P.
Output Impedance	50 to 75 Ω unbalanced; variable pi-output circuit. SWR not to exceed 2:1.
Input Impedance	52 Ω unbalanced, broad-band pretuned input circuit requires no tuning.
Meter Functions	0-100 ma grid current (white area). 0-1000 ma plate current. 0-1000 relative power. 1:1 to 3:1 SWR. 1500-3000 volts high voltage.
Front Panel Controls	LOAD: 1 to 10. TUNE: 80, 40, 20, 15, and 10 meters. BAND: 80, 40, 20, 15, and 10 meters. RELative Power SENSitivity. Meter Switch: GRID, PLATE, REL PWR, SWR, and HV. Power Switch OFF, ON.
Tube Complement	Two 572-B (or two T-160-L) in parallel.
Power Requirements	120 volts AC at 16 amperes (maximum). 240 volts AC at 8 amperes (maximum).
Cabinet Size	14-7/8" wide x 6-5/8" high x 13-3/8" deep.
Net Weight	35 lbs.

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

INTRODUCTION

With the increasing popularity of single sideband, suppressed-carrier phone transmission as a mode of amateur radio communication, more Amateurs are finding it possible to run higher transmitter power inputs than they could previously afford with conventional AM equipment. Since high-level modulating equipment is not necessary in single-sideband service, the cost of converting to high power is considerably reduced.

In keeping with this trend toward higher power in single-sideband service, the Heathkit Model SB-200 Linear Amplifier was designed to provide high power capability and complete versatility. Nearly any of the popular SSB and CW exciters available today can be used as a driver for this Amplifier.

The amplifier RF compartment is completely enclosed by perforated aluminum shielding. This type of construction increases stability and greatly decreases radiation that could cause TVI. The Amplifier is forced-air cooled to prolong tube life.

CIRCUIT DESCRIPTION

POWER SUPPLY

The power supply uses a power transformer which has dual-primary and triple-secondary windings. The primary winding may be connected for either 120 or 240 volt AC operation. The blower fan is connected across one-half of the primary winding. The transformer is protected against overload by reset type circuit breakers CB1 and CB2.

One secondary winding of the power transformer supplies 6.3 volts AC for the tube filaments and the pilot lamp in the meter. Another secondary winding is used with silicon diodes D1 through D16 and electrolytic capacitors C4 through C9 in a full-wave voltage-doubler circuit to provide plate voltage for the tubes. Resistors R5 through R10 insure that the voltage across each of the electrolytic capacitors is equalized; these resistors also serve as a bleeder network.

Resistor R11 at the bottom of the bleeder network provides an ALC threshold voltage of approximately 10 volts DC. Resistor R12 provides a means of measuring plate current independently, without also measuring bleeder current.

The third secondary winding, with resistors R1 and R2, capacitor C3, and silicon diode D17 forms a half-wave rectifier circuit. This circuit provides antenna relay control voltage and cut-off bias voltage for the grids of the amplifier tubes.

INPUT CIRCUIT

Tubes V1 and V2 are connected in parallel in a cathode-driven (grounded grid), class B configuration. Driving power for each band is coupled through a broad-band network, consisting of a coil and associated capacitors, and through capacitor C16 to the cathodes of tubes V1 and V2. Coils L1 through L5 with their associated capacitors are used to make up these impedance-matching networks, which reduce distortion and increase efficiency.

The correct input network, as well as the correct output circuit coil tap, for each band is selected with the Band switch. (The coils in the input networks are factory aligned and require no further adjustment.)

To keep the capacitance of the transformer filament winding from shunting the RF driving power to ground, the filament winding is isolated from the cathode circuit by a bifilar-wound filament choke. Also, this choke provides a cathode current path to ground.

OUTPUT CIRCUIT

High voltage is applied to the plates of tubes V1 and V2 through RF choke RFC1 and parasitic chokes PC1 and PC2. Tuning capacitor C25 is connected on the input side of tapped final coils L6 and L7. C26 is switched in parallel with the Tuning capacitor on the 80 meter band.

Loading capacitors C28A and C28B are on the output side of final coils L6 and L7. Capacitor C27 is switched in parallel with the Loading capacitor on the 80 meter band. Output power is applied through antenna change-over relay RL1 and through the SWR (standing wave ratio) bridge circuit to the RF Output connector. The SWR bridge consists of L8, L9, and L10, capacitors C20 and C23, resistors R19 and R20, and crystal diodes CR1 and CR2.

ANTENNA CHANGE-OVER AND CUTOFF BIAS CIRCUITS

Antenna change-over relay RL1 is controlled by a VOX (voice operated transmitter) relay in the exciter used with the Linear Amplifier. The relay in the exciter is connected to the Antenna Relay jack of the Linear Amplifier. When transmitting, the VOX relay grounds the Antenna Relay: when receiving, the Antenna Relay is ungrounded.

While receiving, cut-off bias voltage from the power supply bias circuit is applied through the coil of relay RL1, and through resistor R15 and choke RFC2, to the grids of tubes V1 and V2. The Antenna Relay jack is ungrounded and no current will flow through the coil of relay RL1, which allows the relay to remain open. Thus it connects the RF Output jack (antenna) to the RF Input jack of the Linear Amplifier.

When transmitting, the Antenna Relay jack is grounded by the VOX relay of the exciter. This allows current to flow through the coil of relay RL1 and actuate the relay. When actuated, relay RL1 connects the RF Output jack (antenna) to the output circuit of the Linear Amplifier. Grounding the Antenna Relay jack also grounds the grids of tubes V1 and V2 through RFC2, and resistors R15 and R16. This removes all but -2 volts from the grids of the tubes. This -2 volts is operating bias, which limits resting plate current to approximately 90 milliamperes.

When operating with the Linear Amplifier turned OFF, there is no bias voltage to operate relay RL1 and the RF Input jack remains connected to the antenna, through RF Output jack. This permits low power operation directly from the exciter into the antenna without changing any cables. Because silicon rectifiers and instant-heating-filament tubes are used in the Linear Amplifier, you can go to high power operation as soon as the Linear Amplifier is turned ON.

METERING CIRCUITS

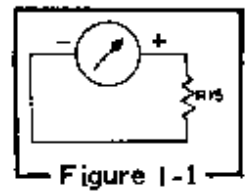


Figure 1-1

GRID - Figure 1-1

In the Grid position of the meter switch, the meter is connected to measure the voltage across grid resistor R15. The voltage across this resistor is directly proportional to the grid current which flows through it; therefore, the meter will indicate grid current. Since grid current in tubes V1 and V2 should not exceed 100 ma, only half (white area) of the 0-200 ma meter scale is used for this measurement.

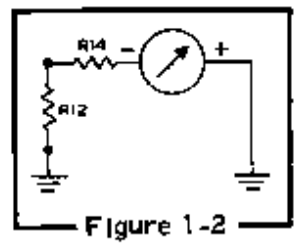


Figure 1-2

PLATE - Figure 1-2

Plate current is read on the top scale of the meter. This scale is divided into 20 ma divisions from 0 to 1000 ma. Plate current readings are obtained by measuring the voltage across resistor R12, through series resistor R14.

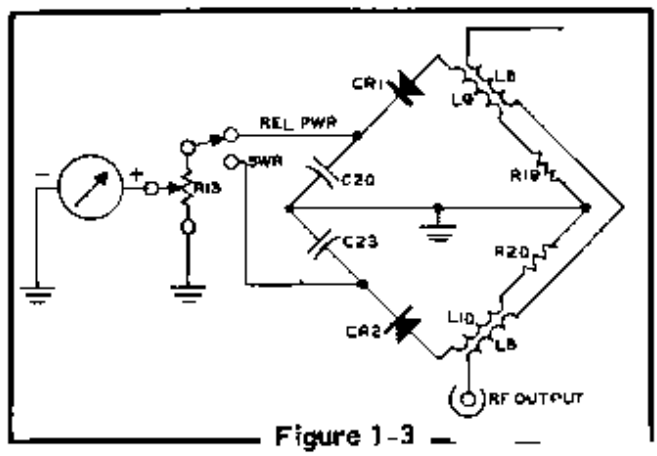


Figure 1-3

REL PWR And SWR - Figure 1-3

Relative Power and Standing Wave Ratio are measured with a bridge circuit, consisting of coils L8, L9, and L10, diodes CR1 and CR2, resistors R19 and R20, and capacitors C20 and

C23. Relative Power Sensitivity control R13 sets the sensitivity of the meter. The REL PWR position is used when adjusting the TUNE and LOAD controls for maximum output of the Linear Amplifier; this meter function is also used to establish a "set" meter level for making SWR measurements.

Because coil L8 of the bridge circuit is connected in series between the RF Input and RF Output jacks when the Linear Amplifier is turned OFF, the meter can be used to measure REL PWR and SWR when operating the exciter alone. This method of checking SWR is recommended for accurately determining antenna performance.

In the bridge circuit, RF current is inductively and capacitively coupled from L8, to L9 and L10. The RF currents in L9 and L10 are rectified by diodes CR1 and CR2, and then filtered by capacitors C20 and C23.

For REL PWR measurements, the rectified RF voltage from L9 is applied to the meter. For SWR (reflected power) measurements, the rectified RF voltage from L10 is applied to the meter.

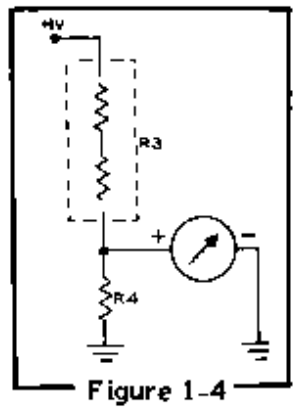


Figure 1-4

HV - Figure 1-4

High Voltage is measured with a voltage divider network consisting of resistors R3 and R4. The voltage across resistor R4 is applied to the meter. High voltage is read on the lower right-hand meter scale (1500 to 3000).

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.

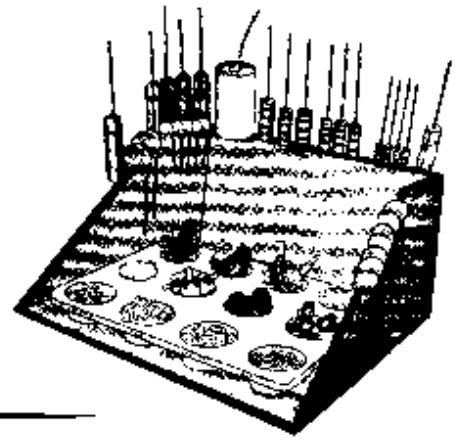
UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with the parts. Refer to the information on the inside covers of the manual to help you identify the components. If some shortage or parts damage is found in checking the Parts List, please read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

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 -30% are common for electrolytic capacitors.

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; phillips screwdriver; 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 parenthese in the Parts List are keyed to the numbers on the Parts Pictorial to aid in parts identification

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

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 WATT		
(1) 1-140	1	1.5 Ω (brown-green-gold-silver)
1-3	2	100 Ω (brown-black-brown)
1-16	2	4700 Ω (yellow-violet-red)
1-21	1	15 KΩ (brown-green-orange)
2-121	1	3600 Ω precision
1 WATT		
(2) 1-14-1	3	33 Ω (orange-orange-black)
1-3-1	1	3300 Ω (orange-orange-red)
1-38-1	3	4.7 megohm (yellow-violet-green)
OTHER RESISTORS		
(3) 1-3-2	1	10 KΩ 2 watt (brown-black-orange)
(4) 3-25-5	1	1 Ω 5 watt
3-12-7	1	700 Ω 7 watt
3-14-7	1	2000 Ω 7 watt
5-2-7	6	30 KΩ 7 watt
(5) 3-2-17	1	485 Ω 15 watt
CAPACITORS		
(6) 20-40	1	470 μμf silver mica
20-123	1	500 μμf 2 KV silver mica (.0005)
20-42	1	510 μμf silver mica

PART No.	PARTS Per Kit	DESCRIPTION
CAPACITORS (Cont'd.)		
(7) 20-76	1	68 μμf mica
20-110	1	75 μμf mica
20-108	3	200 μμf mica
20-112	1	310 μμf mica
20-131	1	360 μμf mica
(8) 21-78	1	5 μμf disc
21-80	1	18 μμf disc
21-72	2	.005 μfd 1.4 KV disc
21-90	1	.001 μfd 3 KV disc
21-31	12	.02 μfd disc
(9) 21-109	1	100 μμf 5 KV tubular ceramic
21-165	1	1000 μμf 6 KV tubular ceramic
(10) 25-39	1	2 μfd 150 V electrolytic
25-19	1	20 μfd 150 V electrolytic
(11) 25-34	6	125 μfd 450 V electrolytic
26-96	1	150 μμf, 3 KV, variable
26-97	1	874.8 μμf variable, 2-section
CONTROLS-SWITCHES		
(12) 10-12	1	100 KΩ control
(13) 61-14	1	DPST rocker switch
63-351	1	3-wafer rotary switch
63-352	1	1-wafer rotary switch
(14) 65-15	2	8 ampere circuit breaker
89-5	1	DPDT 110 V AC relay

PART No.	PARTS Per Kit	DESCRIPTION
COILS-CHOKES-TRANSFORMERS		
(15) 40-98	1	RF driver element
(16) 40-99	2	RF pickup element
(17) 40-591	1	80 meter input coil
40-592	1	40 meter input coil
40-593	1	20 meter input coil
40-727	1	15 meter input coil
40-728	1	10 meter input coil
(18) 40-596	1	10 and 15 meter final coil
(19) 40-597	1	20, 40, and 80 meter final coil
(20) 45-4	1	1.1 mh RF choke
(21) 45-60	1	10 µh RF choke
(22) 45-18	1	28 µh RF choke
(23) 45-61	1	50 µh RF choke
(24) 45-53	2	Parasitic RF choke
54-151	1	Power transformer
DIODES-TUBES		
(25) 56-26	2	1N191 crystal diode (brown-white-brown)
(26) 56-24	1	IN456 silicon diode (yellow-green-gray)
(27) 57-27	17	Silicon diode
411-196	2	572-B tube or T160-L
INSULATORS-GROMMETS-TERMINAL STRIPS-SOCKETS		
(28) 71-5	1	Ceramic standoff insulator with 6-32 stud
73-4	2	5/16" grommet
73-1	2	3/8" grommet
73-3	1	1/2" grommet
(29) 75-29	1	Line cord strain relief
(30) 431-50	1	1-lug terminal strip
(31) 431-16	1	2-lug terminal strip
431-10	2	3-lug terminal strip
431-11	1	5-lug terminal strip
431-45	2	8-lug terminal strip
431-13	1	Screw type terminal strip
(32) 434-9	2	4-lug tube socket
(33) 434-42	3	Phono socket
(34) 436-5	1	Coaxial socket
(35) 438-9	1	Coaxial plug
(36) 438-12	1	Coaxial plug insert
(37) 438-4	3	Phono plug

PART No.	PARTS Per Kit	DESCRIPTION
WIRE-CABLE-SLEEVING		
89-22	1	Line cord
134-107	1	Cable assembly
340-1	1	Bare wire
344-52	1	Red solid hookup wire
344-54	1	Yellow solid hookup wire
344-55	1	Green solid hookup wire
344-58	1	Gray solid hookup wire
344-13	1	Large blue hookup wire
343-2	1	Large shielded cable (RG-58 A/U)
343-3	1	Small shielded cable
345-4	1	Small sleeving
348-3	1	Large sleeving
HARDWARE		
SCREWS		
(38) 250-213	6	4-40 x 5/16"
(39) 250-28	1	6-32 x 1/4" setscrew
(40) 250-8	21	#6 x 3/8" sheet metal screw
(41) 250-138	2	6-32 x 3/16" screw
(42) 250-56	37	6-32 x 1/4"
(43) 250-89	21	6-32 x 3/8"
(44) 250-218	4	6-32 x 3/8" phillips head
(45) 250-32	8	6-32 x 3/8" flat head
(46) 250-26	1	6-32 x 5/8"
(47) 250-29	4	6-32 x 3/4"
(48) 250-40	2	6-32 x 1-1/2"
(49) 250-260	2	8-32 x 1/4"
(50) 250-43	8	8-32 x 1/4" setscrew
(51) 250-141	4	10-24 x 1/2"
(52) 250-126	2	10-32 x 1/2"
(53) 250-67	1	10-24 x 1-1/8" phillips head
(54) 251-1	2	6-32 spade bolt
NUTS		
(55) 252-15	6	4-40
(56) 252-3	63	6-32
(57) 252-30	5	10-24
(58) 252-31	1	10-24 wingnut
(59) 252-7	3	Control

PART No.	PARTS Per Kit	DESCRIPTION
WASHERS		
(60) 253-27	2	5/16" flat steel
(61) 253-8	4	7/16" flat brass
(62) 253-60	8	3/8" flat steel
(63) 253-1	2	3/8" fiber flat
(64) 253-3	4	1/2" fiber flat
(65) 253-7	2	1/2" fiber shoulder
(66) 253-10	3	Flat control
(67) 253-19	4	3/4" flat steel
(68) 254-9	6	#4 lockwasher
(69) 254-1	67	#6 lockwasher
(70) 254-3	5	#10 lockwasher
(71) 254-4	3	Control lockwasher
MISCELLANEOUS		
(72) 255-2	1	3/16" spacer
(73) 255-42	4	3/4" phenolic spacer
(74) 255-12	3	Plastic spacer
(75) 255-59	2	Tapered spacer
(76) 259-1	18	#6 solder lug
(77) 259-5	1	#10 solder lug
(78) 259-10	1	Control solder lug
(79) 260-34	2	Anode clip
(80) 435-1	2	Socket ring

PART No.	PARTS Per Kit	DESCRIPTION
METAL PARTS		
(81) 40-100	1	Coaxial cavity
90-341	1	Cabinet
200-403-1	1	Chassis
203-384-1	1	Front panel
(82) 205-492	1	Capacitor mounting bracket
(83) 204-560	2	Angle bracket
(84) 204-611	1	Circuit breaker mounting bracket
206-254	1	RF shield
(85) 206-255	1	Power supply shield
205-436	1	Top plate
MISCELLANEOUS		
85-88-2	1	Circuit board
(86) 261-9	4	Rubber foot
266-21	1	Fan blade
390-147	2	DANGER label
391-31	1	Nameplate
407-103	1	Meter
420-3	1	Motor
(87) 432-27	1	3-prong AC adapter
462-191	2	Small knob
462-210	3	Large knob
	1	Manual (See front cover for part number.)
		Solder

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.

INITIAL TEST

The input coils are factory adjusted and do not require any further alignment.

RESISTANCE CHECK

( ) The resistance between either anode clip and the chassis should measure approximately 180 KΩ after the meter stabilizes.

( ) The resistance between lug 3 of either tube socket V1 or V2 and the chassis should measure between 5000 Ω and 15,000 Ω.

If any difficulty is encountered in obtaining either of these resistance readings, refer to the In Case Of Difficulty section of the manual on Page 50.

CAUTION: LETHAL VOLTAGES ARE PRESENT IN THIS UNIT. USE EXTREME CARE WHEN MAKING ANY TESTS.

If at any time during the testing and operation the Linear Amplifier does not perform as described, unplug the Linear Amplifier line cord and refer to the In Case Of Difficulty section of the manual.

( ) Rotate all knobs to their fully counter-clockwise positions, except the TUNE knob which should be at its 9 o'clock position. Place the OFF-ON switch in the OFF position.

( ) Plug the line cord plug into the power source for which the unit is wired, either 120 volts or 240 volts AC.

( ) Push the OFF-ON switch to ON.

( ) Check to see that the tube filaments and meter pilot lamp light, and that the fan operates.

( ) Rotate the meter switch through all of its positions. There should not be a meter indication in any position, except for HV which should read approximately 2400 volts.

( ) Push the OFF-ON switch to OFF and unplug the line cord.

( ) To insure the discharge of the filter capacitors and reduce the shock hazard, short the anode clip of one of the tubes to the chassis, using a screwdriver with an insulated handle.

FINAL ASSEMBLY

Refer to Pictorial 16 for the following steps.

( ) Install the top plate, using #6 x 3/8" sheet metal screws.

( ) Remove the protective backing from a DANGER label and press it firmly in place on the top plate, as shown.

( ) Slide the chassis into the cabinet.

( ) Install rubber feet at the rear of the cabinet, using 6-32 x 3/4" screws and 3/8" flat steel washers.

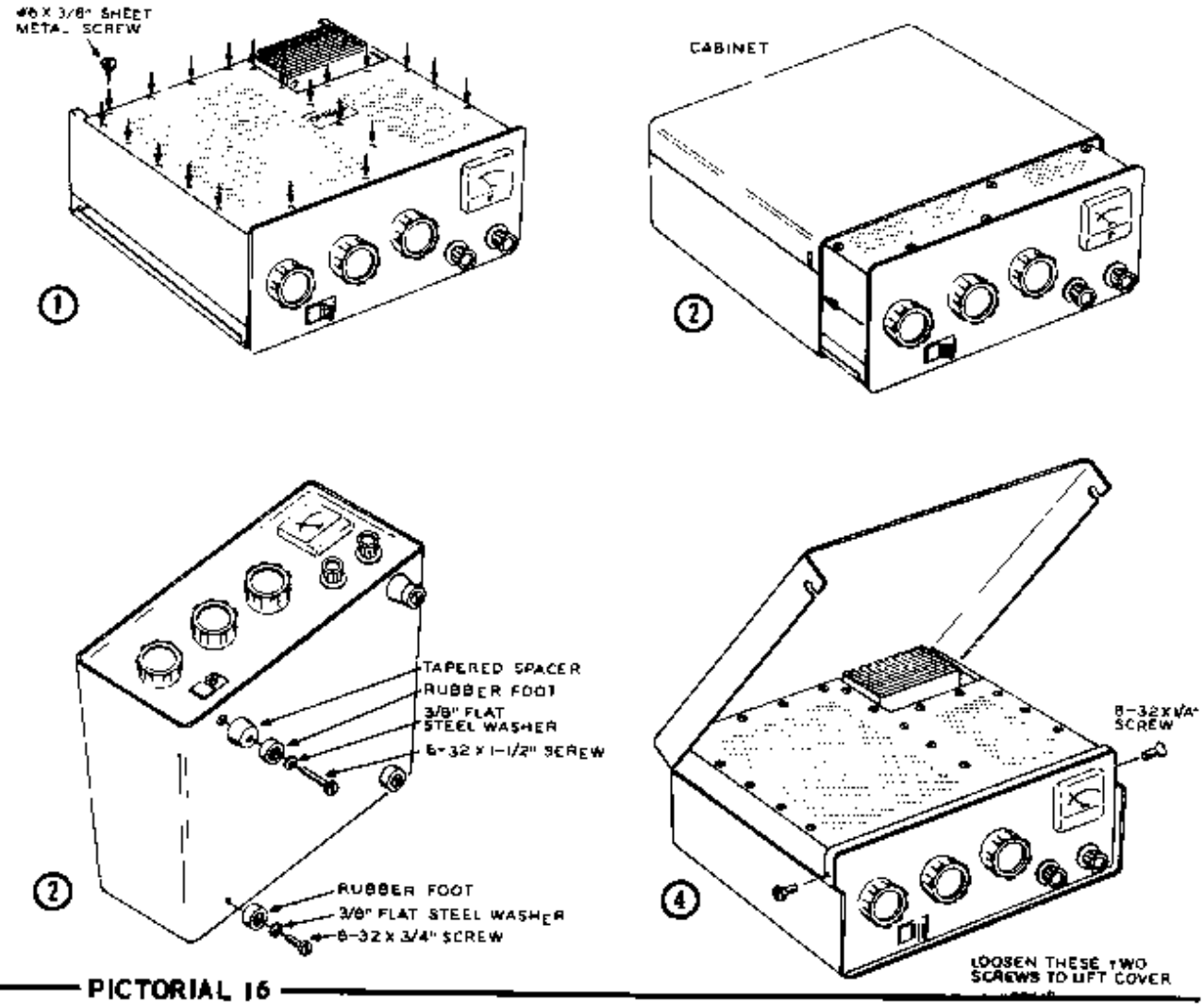
( ) Install rubber feet and tapered spacers at the front of the cabinet, using 6-32 x 1-1/2" screws and 3/8" flat steel washers. NOTE: If you wish to have the Linear Amplifier set flat, extra 6-32 x 3/4" screws are supplied for mounting feet at the front only.

( ) Install the 8-32 x 1/4" screws in the holes at each side of the cabinet frame. These screws need only be loosened slightly to permit the cover to be opened.

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

( ) Install the identification label in the following manner

1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the rear panel or the top of the chassis, or on the rear or bottom of the cabinet.
2. Carefully peel away the backing paper. Then press the label into position.



PICTORIAL 16

INSTALLATION

LOCATION

Although the Linear Amplifier has a built-in fan for cooling purposes, avoid excessively warm locations such as those near radiators and heating vents. The unit should be placed in a location that provides adequate space around it, permitting free air circulation through the cabinet openings.

POWER SOURCE

The Linear Amplifier is designed to operate from either a 120 volt or 240 volt AC, 60 cps power source, depending on the jumper installation on terminal strip S. The AC power outlet used should be properly fused and fed with not smaller than #14 wire.

The plug on the power cord for this kit is for standard 120 VAC outlets. For 240 VAC operation in the U.S.A. cut off this plug and replace it with a permanent plug that matches your 240 VAC receptacle. Be sure your power connection conforms with section 210 21 (b) of the National Electric Code, which reads in part

> "Receptacles connected to circuits having different voltages, frequencies or types of current (AC or DC) on the same premises shall be of such design that attachment plugs used on such circuits are not interchangeable."

When you install a new plug, make sure it is connected according to your local electrical code. Keep in mind that the green line cord wire is connected to the amplifier chassis

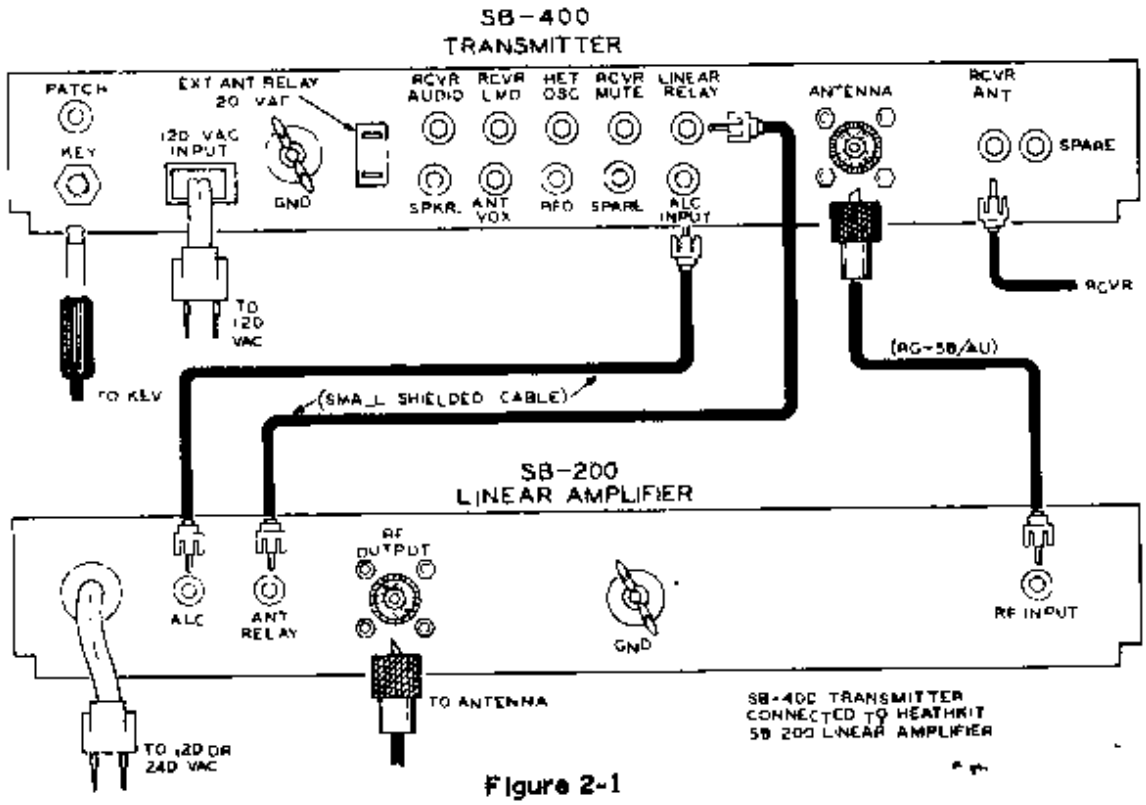


Figure 2-1

EXCITER

The Linear Amplifier can be driven by most commercial or home-built exciters with a power output of approximately 100 watts. The Heathkit SB-400 or SB-401 Transmitter or the SB-100 or SB-101 Transceiver is ideal for use with this Linear Amplifier.

Exciters in the 40 to 60 watt output class will not drive the Linear Amplifier to a full kilowatt, however, the Linear Amplifier will operate quite efficiently at lower power levels.

ANTENNA

The pi-network output is designed to work into a 50 to 75 Ω transmission line. Most commercial and home-built antennas are designed to be fed with 50 or 72 Ω coax. RG-8/U or RG-11/U coaxial cable is recommended for the transmission line, and every effort should be made to get the SWR of the antenna down to less than 2 to 1.

SWR MEASUREMENTS

( ) Connect the amplifier to the exciter and the antenna. Do not turn the Linear Amplifier ON, thus permitting the exciter to feed through the Linear Amplifier to the antenna.

( ) Place the Linear Amplifier Meter switch in the REL PWR position.

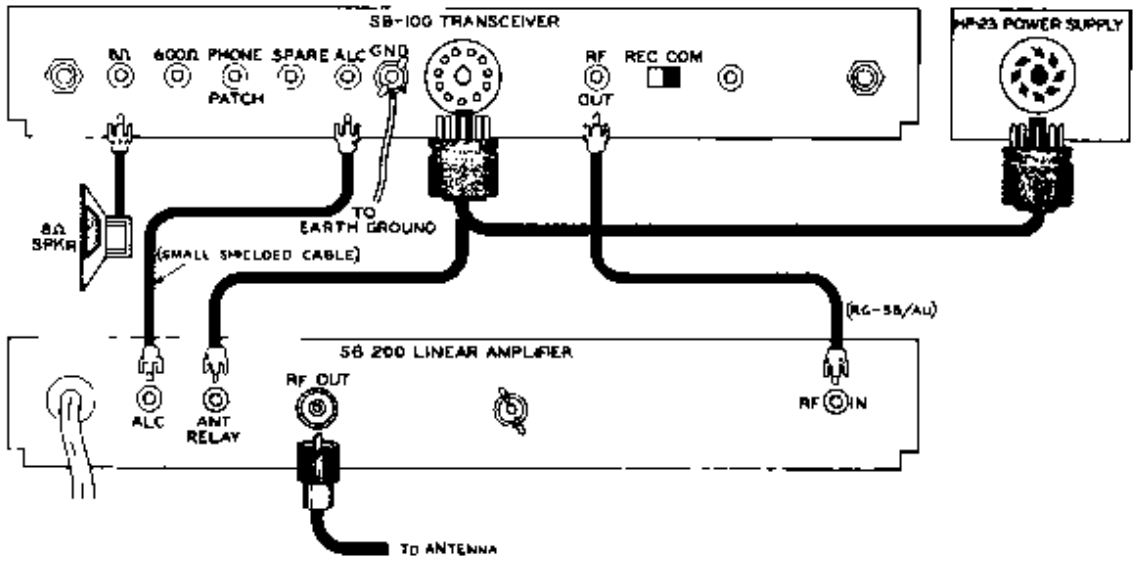


Figure 2-2

( ) Load the exciter to full output. The meter of the Linear Amplifier may be used for this purpose, as it will function in both the REL PWR and SWR positions without the Linear Amplifier being turned ON.

( ) Adjust the REL PWR SENS control of the Linear Amplifier for a SET (full-scale) indication on the meter.

( ) Turn the meter switch to SWR and read the standing wave ratio directly from the meter (1 to 3 scale).

NOTE: SWR checks can also be made with the Linear Amplifier operating at full power (1000 watts); however, due to the nonlinear characteristics of crystal diodes in the SWR circuit, the most accurate SWR readings are obtained at low power (70 to 100 watt) levels using only the exciter. If the exciter alone will not give full scale relative power readings, the Linear Amplifier may be used, however, limit the drive from the exciter to no more than necessary.

Figure 2-1 shows the Linear Amplifier connected to the Heathkit Model SB-400 Transmitter. Other transmitters or exciters would be connected to the Linear Amplifier in a similar manner.

The Heathkit Model SB-100 Transceiver can be connected to the Linear Amplifier as shown in Figure 2-2.

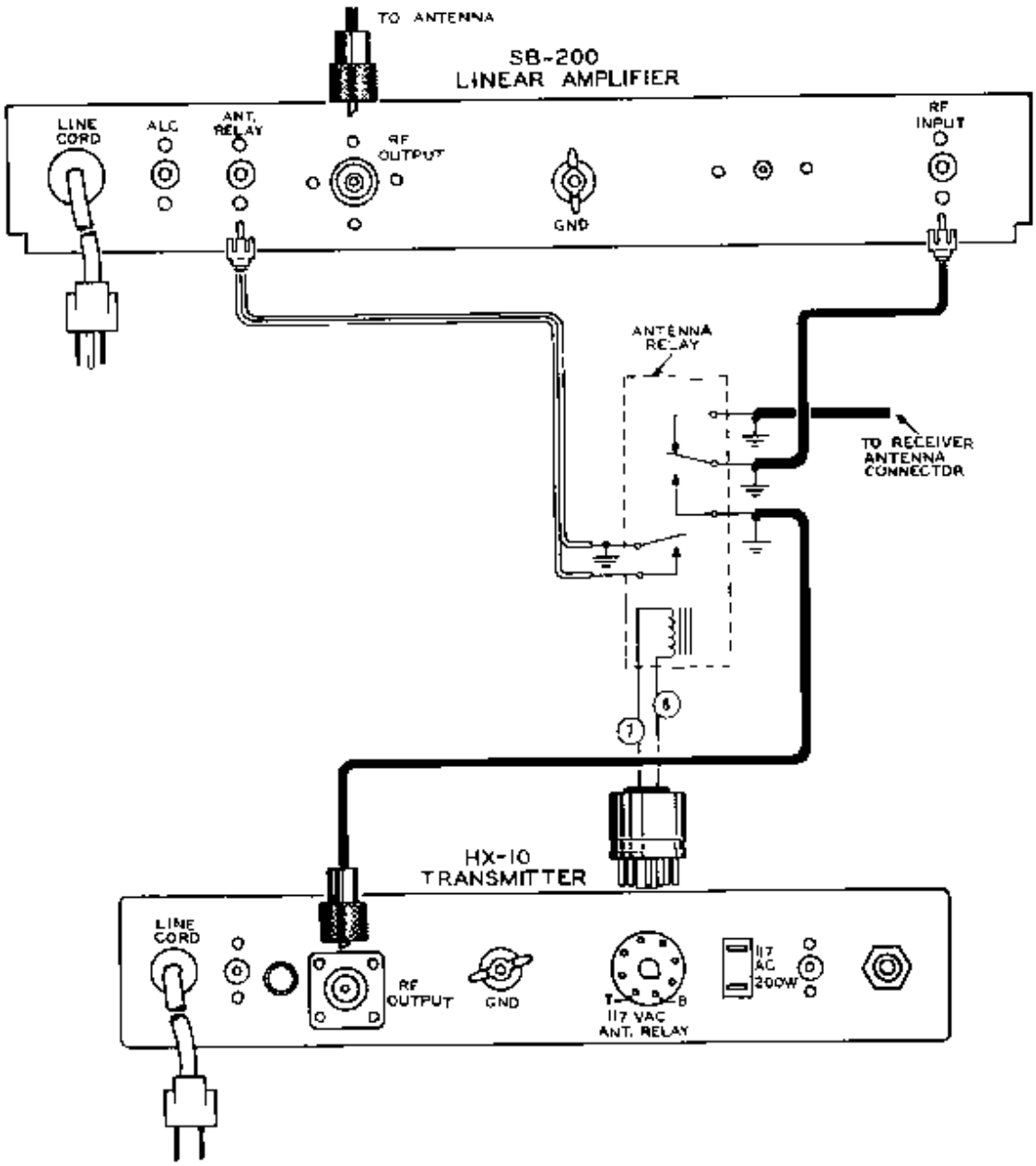


Figure 2-3

Observe in Figure 2-3 that an external antenna relay with extra contacts is necessary to obtain proper antenna switching, when connecting the Linear Amplifier to the Heathkit Model HX-10 Transmitter, and other transmitters not beving a built-in antenna relay.

NOTE: The ANT RELAY jack of the Linear Amplifier must be grounded by the exciter to place the Linear Amplifier into operation. (See the Circuit Description.) This grounding is accomplished by the VOX relay or a transmit-receive switch in the exciter.

OPERATION

METER READINGS

Refer to Figure 2-4 and study the meter scale, note how it indicates for the various positions of the Meter switch.

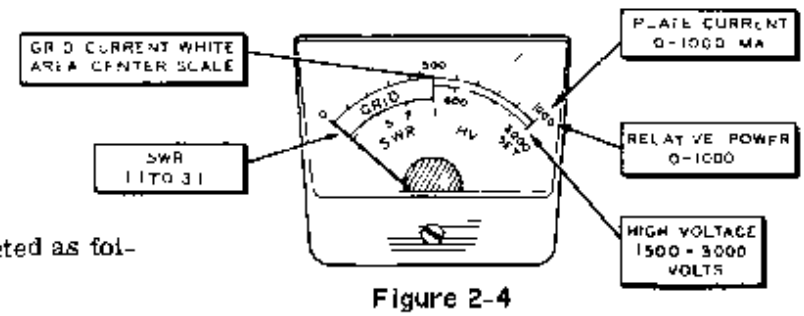


Figure 2-4

The meter scales should be interpreted as follows:

METER SWITCH POSITION	MEASURES	SCALE READING
GRID	Grid current	GRID (white area represents 0-100 ma)
PLATE	Plate current	0-1000 ma
REL PWR	Relative power output	0-1000
SWR	Standing wave ratio	1-1 to 3:1
HV	High voltage	1500-3000

OPERATING PROCEDURE

Make sure the Linear Amplifier is connected to your exciter properly.

( ) Set all switches and controls as follows:

SWITCH OR CONTROL	SWITCH OR CONTROL POSITION	COMMENTS
OFF-ON	OFF	Linear amplifier line cord connected to proper power source.
LOAD	4	Note desired position for antenna used and preset next time.
BAND	80 meters	Or desired band.
TUNE	80 meter segment	Or desired band segment.
METER	REL PWR	
REL PWR SENS	FULLY CLOCKWISE	Adjust to keep meter pointer on scale.

( ) Adjust the exciter for full CW output at the desired frequency. NOTE: With the Linear Amplifier turned OFF, the exciter output is fed through the Linear Amplifier to the RF OUTPUT jack. Also, the REL PWR and SWR functions of the Meter may be used to aid in tuning the exciter.

( ) Reduce the drive level of the exciter to a minimum.

( ) Place the Meter switch of the Linear Amplifier in the PLATE position and push the OFF-ON switch to ON. With no driver output from the exciter, the Linear Amplifier meter should show idling plate current of approximately 90 ma.

( ) Advance the drive level of the exciter for a 200 ma plate current indication on the meter of the Linear Amplifier.

( ) Quickly switch the Linear Amplifier Meter switch to REL PWR. If necessary, reduce the REL PWR SENS control setting to keep the meter pointer within the scale.

( ) Adjust the TUNE and LOAD controls for a maximum REL PWR meter indication.

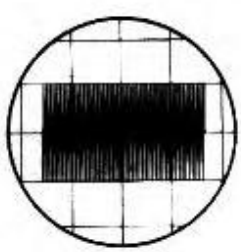
( ) Increase the drive level from the exciter to full output.

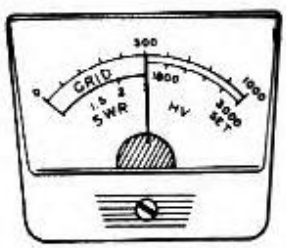
( ) Again, adjust the TUNE and LOAD controls for a maximum REL PWR meter indication.

( ) Check the GRID and PLATE meter readings. If the grid reading is greater than midscale, reduce the drive level of the exciter to bring grid current within the GRID range of the meter. If the plate current reading is higher than 500 ma, reduce loading by turning the LOAD control counterclockwise.

This procedure of tuning the Linear Amplifier should take only a few seconds, after you go through it a few times. Note the LOAD control position so it can be preset next time a particular band is used.

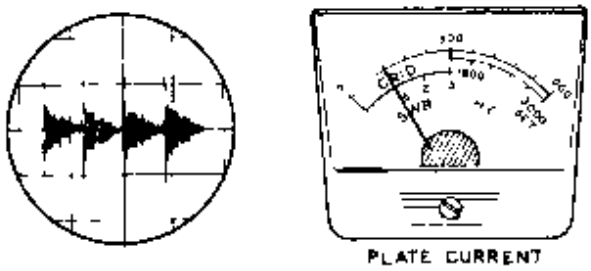
The Linear Amplifier is now loaded for operation at maximum input power. If an oscilloscope is being used for monitoring, a display similar to that shown in Figure 2-5 should be obtained.





Oscilloscope pattern and plate meter reading resulting from carrier or "single tone" modulation. The meter indicates maximum or CW power input.

Figure 2-5



Oscilloscope pattern and plate meter reading resulting from voice modulation. Notice the peaks on the oscilloscope pattern. They are sharp, indicating a clean signal, and they will attain a height slightly greater than the "single tone" pattern of Figure 2-5, indicating maximum power input. NOTE: Plate current peak reading is approximately 1/2 or less of maximum "single tone" reading due to meter inertia and voice characteristics.

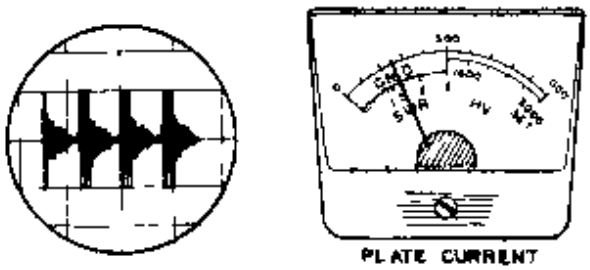
Figure 2-6

Turn the exciter to standby to remove drive from the Linear Amplifier.

The Linear Amplifier is now ready for SSB or CW transmission. An example of a proper oscilloscope pattern is shown in Figure 2-6. Note that there are sharp distinct peaks. The number of patterns or "christmas trees" will depend on the individual voice and the scope sweep speed. Set the scope for about a 30 cps sweep.

Note that the meter reading on voice peaks will not be high, however, the height of the oscilloscope pattern is slightly greater than that shown in Figure 2-5. This increase in peak power is due to dynamic characteristics of the power supply and allows the Linear Amplifier to develop approximately 20% greater peak envelope power for a given level of CW input. The meter will indicate only one-half or less of the single tone level, depending on the individual's voice, before "flat topping" occurs.

Figure 2-7 shows the same voice pattern but with extreme "flat topping." The oscilloscope shown that no more useful power is being developed. The meter reads higher, but only distortion is developed.



Oscilloscope pattern and plate meter reading resulting from over modulation. The meter reads higher, but the scope indicates peak flattening. Operation in this manner causes distortion and severe interference to adjacent frequencies.

Figure 2-7

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. Make sure that the 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.

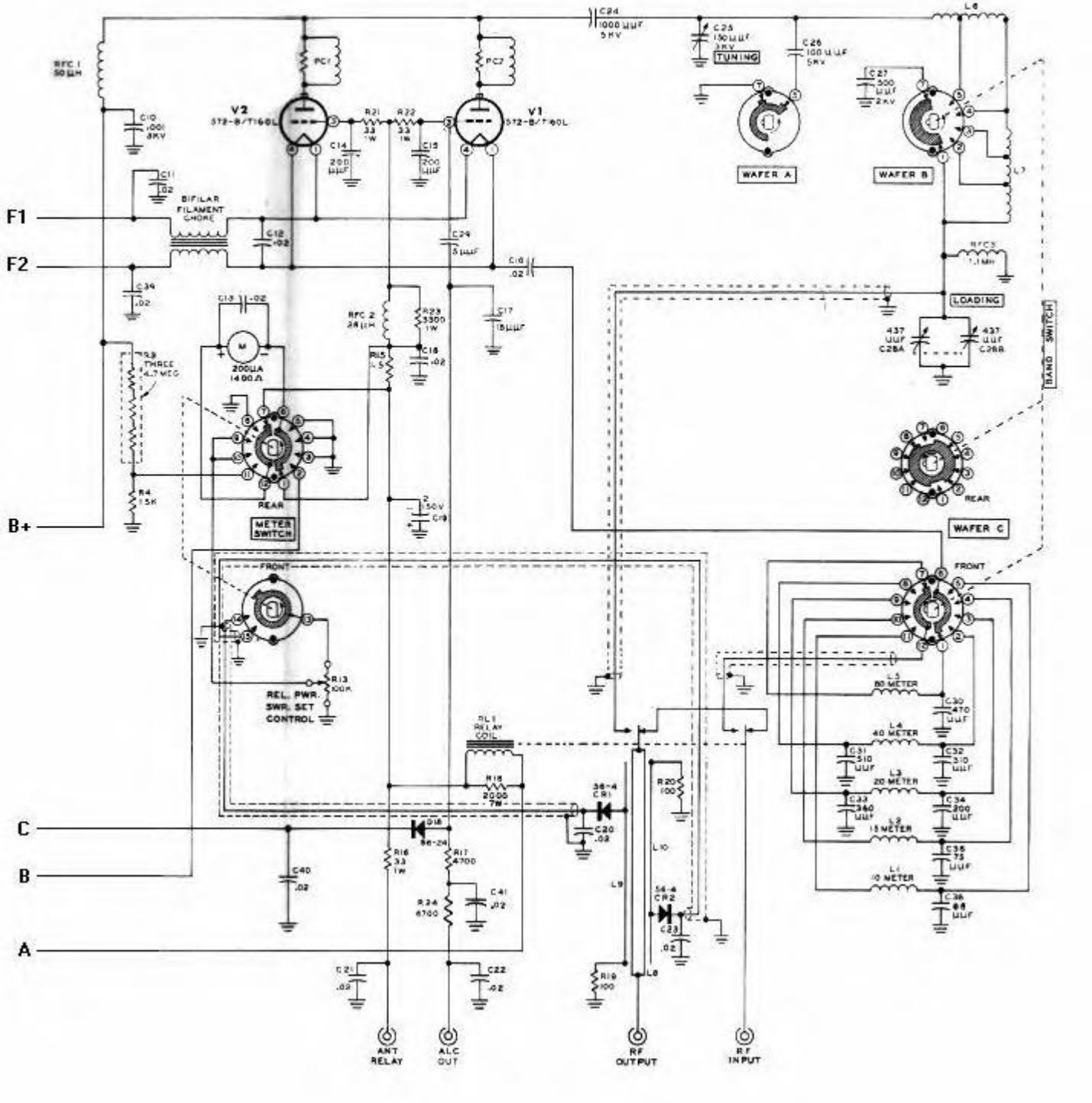
6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

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.

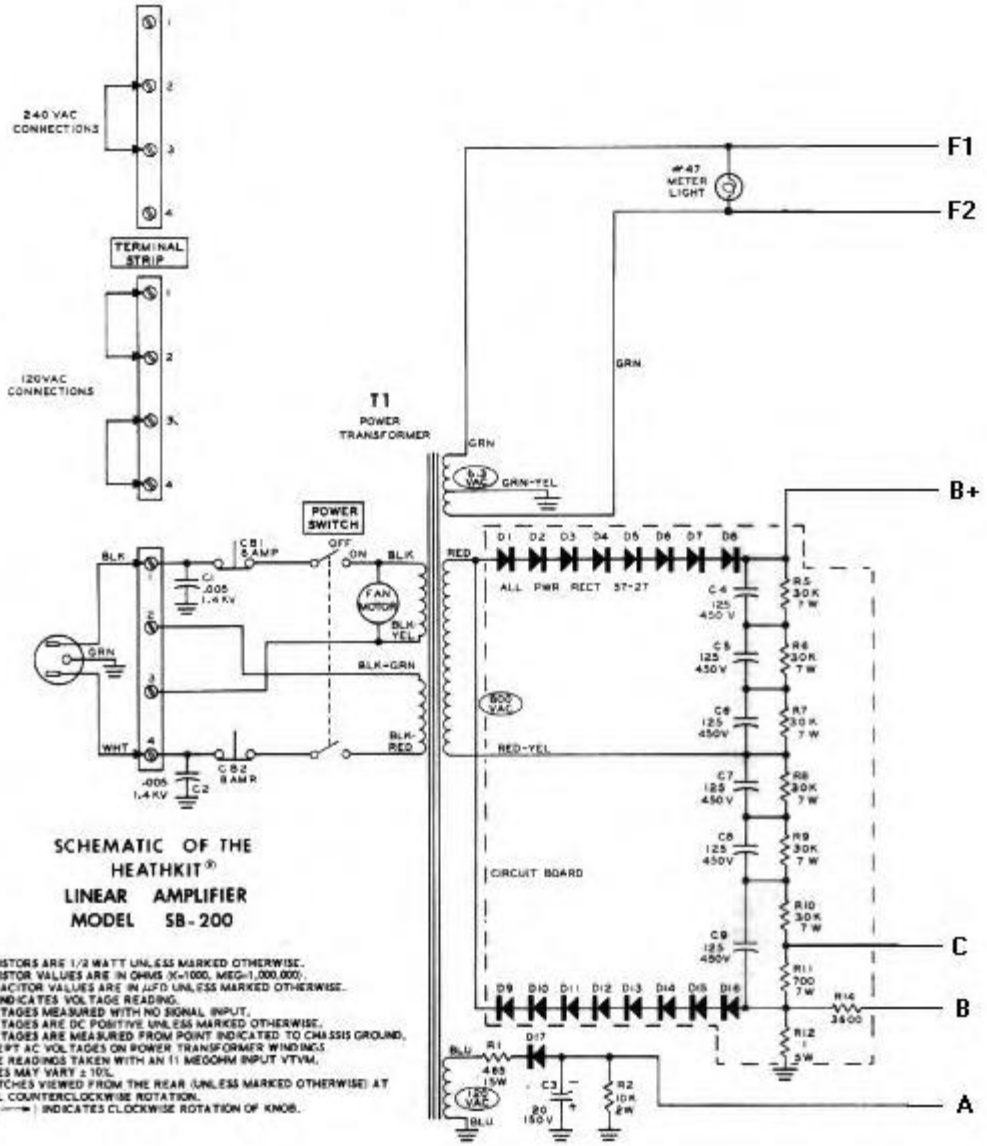
NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty sections of the "Kit Builders Guide", and to the "Factory Repair Service" information on Page 51 of this Manual.

Heathkit SB-200 Linear Amplifier



Heathkit SB-200 Linear Amplifier

Power Supply



SCHEMATIC OF THE HEATHKIT® LINEAR AMPLIFIER MODEL SB-200

NOTES:
ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE.
ALL RESISTOR VALUES ARE IN OHMS (K=1000, MEG=1,000,000).
ALL CAPACITOR VALUES ARE IN μFD UNLESS MARKED OTHERWISE.
INDICATES VOLTAGE READING.
ALL VOLTAGES MEASURED WITH NO SIGNAL INPUT.
ALL VOLTAGES ARE DC POSITIVE UNLESS MARKED OTHERWISE.
ALL VOLTAGES ARE MEASURED FROM POINT INDICATED TO CHASSIS GROUND, EXCEPT AC VOLTAGES ON POWER TRANSFORMER WINDINGS
VOLTAGE READINGS TAKEN WITH AN 11 MEGOHM INPUT VTVM.
VOLTAGES MAY VARY ± 10%.
ALL SWITCHES VIEWED FROM THE REAR (UNLESS MARKED OTHERWISE) AT FULL COUNTERCLOCKWISE ROTATION.
ARROW (⟶) INDICATES CLOCKWISE ROTATION OF KNOB.