



the hallicrafters co.

MANUFACTURERS OF RADIO, TELEVISION AND ELECTRONIC EQUIPMENT, CHICAGO 24 U. S. A.



92X5014

Fig. 1. HT-31 Linear Power Amplifier

GENERAL DESCRIPTION

The Hallicrafters model HT-31 is a precision built linear power amplifier. This unit has been especially engineered to provide highly efficient operation when used in conjunction with Hallicrafters model HT-30 SSB (single sideband with suppressed carrier) exciter unit. Other exciter units may be employed if they are capable of delivering sufficient output power to utilize the full capabilities of the HT-31 (see specifications on page 7). The exciter should also be capable of approaching the high performance standards of the Hallicrafters HT-30 as applied to signal quality and stability. The maximum power output rating from the HT-31 is 330 watts P.E.P. (peak envelope power) on 80 meters with 10 watts P.E.P. input at 20 db. third order distortion product level. When using the HT-30 as an SSB driver unit 285 watts P.E.P. output power can be obtained at 30 db. third order distortion product level. Thus the HT-31 is fully capable of delivering a fine quality signal equivalent in "TALK POWER" to a full one kilowatt conventional AM modulated phone rig.

The circuit employs two 811A tubes operated in parallel as class B linear power amplifiers. The completely self contained power supply uses two 866As connected in a full wave rectifier circuit. Overload protection is provided by separate fuses in the primary circuits of the plate and filament supplies. Continuous antenna loading control is provided within a Pi tuning network that eliminates in many instances, the need for separate antenna tuning units. All amateur bands from 80 meters through 10 meters are easily tuned without the use of plug-in coils.

TVI (Television Interference) SUPPRESSION

Every consideration has been given to possible local TVI problems in the design of the HT-31. Circuitry has been used that discourages harmonic generation. A low pass filter has been included in series with the AC power leads. The completely enclosed metal cabi-

net greatly aids in shielding. A screen has been provided over the dial and meter openings. In addition to these factory installed precautions a 50 ohm low pass TVI filter that connects in series with the output is available as an accessory. This unit is installed in the space provided on the under side of the chassis and may be ordered from your Hallicrafters dealer under part number 1X2621.

ADDITIONAL FEATURES

Many additional features have been included for operating convenience that give the HT-31 a real professional standing among fine units of amateur equipment. The meter scale becomes illuminated when the filament switch is turned on. The Power Amplifier tuning dial illuminates with the energizing of the plate circuit. As a special convenience in approximating input plate power a separate meter scale has been provided that is calibrated directly in watts. The scale calibration represents the value of plate current multiplied by 1500 (the value of dc plate voltage) and thus eliminates the inconvenience of making the calculation. The appropriate meter shunts for reading grid current or plate current are automatically connected as the meter switch is thrown to either the grid or the plate position. The entire unit is power ventilated by means of a built-in blower motor and fan and optional cabinet or rack mounting is provided.

INSTALLATION

UNPACKING - Check all shipping tags and labels for further instructions before removing or destroying them.

LOCATION - The HT-31 should be located reasonably close to the exciter unit.

The power ventilator pulls air through the openings provided in the cabinet bottom and exhausts the warm air through the top of the cabinet. The unit should be installed so that the air may circulate freely with no obstructions.

POWER SOURCE REQUIREMENTS - The HT-31 operates from 105 to 125 volts, 50 to 60 cycle AC only. The source must be capable of supplying a maximum of 750 watts.

IMPORTANT

The power source must have good voltage regulation as the load presented by this equipment will vary greatly during normal operation. Poor regulation of the AC supply can seriously impair the linear operation of the amplifier and limit the peak power output available.

RACK MOUNTING - If rack mounting is desired remove the four screws at each side of the front panel and two chassis mounting bolts at each rear corner on bottom of cabinet. Then slide the amplifier forward from the cabinet. The slots at the edges of the front panel are properly spaced to accommodate mounting screws in a standard 19 inch rack.

FUNCTION AND USE OF OPERATING CONTROLS		
NAME OF CONTROL	TYPE	FUNCTION AND USE
GRID RANGE	ROTARY SWITCH (4 position)	SELECTS THE APPROPRIATE GRID COIL FOR THE DESIRED FREQUENCY BAND.
METER	ROTARY SWITCH (2 position)	CONNECTS THE METER TO READ GRID CURRENT OR PLATE CURRENT. SEPARATE METER SCALES ARE PROVIDED FOR GRID AND PLATE READINGS. THE SETTING OF THE SWITCH AUTOMATICALLY CONNECTS THE APPROPRIATE METER SHUNTS.
GRID TUNING	VARIABLE CAPACITOR	RESONATES THE GRID CIRCUIT. USED IN CONJUNCTION WITH THE EXCITER OUTPUT ADJUSTMENTS TO LOAD THE GRID CIRCUIT.
FILAMENT POWER SWITCH	TOGGLE SWITCH (DPST)	CONNECTED IN SERIES WITH THE POWER LINE. USED TO ENERGIZE FILAMENT AND BLOWER MOTOR CIRCUITS OR TO DISABLE THE ENTIRE UNIT.
PLATE POWER SWITCH	TOGGLE SWITCH (SPST)	CONNECTED IN SERIES WITH THE PRIMARY OF THE HIGH VOLTAGE PLATE SUPPLY TRANSFORMER. ENERGIZES OR DISABLES THE PLATE SUPPLY AND ASSOCIATED PILOT LIGHT. (ILLUMINATES PA TUNING DIAL)
P. A. TUNING	VARIABLE CAPACITOR MECHANICALLY LINKED TO A MOVABLE INDUCTANCE TAP.	VARIES THE RESONANT FREQUENCY OF THE PLATE TANK CIRCUIT WHILE MAINTAINING AN OPTIMUM LC RATIO.
ANTENNA LOADING COARSE	ROTARY SWITCH (ten position)	VARIES THE CAPACITY OF THE ANTENNA TUNING CIRCUIT IN STEPS.
ANTENNA LOADING FINE	VARIABLE CAPACITOR	PROVIDES VERNIER ADJUSTMENT BETWEEN THE STEPS PROVIDED BY THE ANTENNA LOADING COARSE CONTROL.

INPUT CONNECTOR - The input connector, located on the rear of the chassis, will mate with an Amphenol type 83 - 1SP coax connector (not supplied with the amplifier). Excitation from the exciter unit should be applied through this connector. The input circuit is designed to be fed from a 50 to 75 ohm unbalanced line. See Fig. 3.

OUTPUT CONNECTOR - The output connector, located on the rear of the chassis, will mate with an Amphenol type 83 - 1SP coax connector (not supplied with the amplifier). The amplifier is designed to work into an antenna system that presents a 50 to 600 ohm non-reactive load. See Fig. 3.

TUNING

GENERAL - The general tuning procedures are similar to those for any conventional power amplifier. Additional considerations are necessary, however, to insure linear operation and to prevent overloading during the tune up procedure. Improper loading may result in non-linearity and consequently a high distortion product level being radiated.

Initial tuning should be made at the desired operating frequency using CW excitation and final adjustments for other types of operation will then be simplified. Tuning procedures for CW, SSB (single sideband with suppressed carrier), and AM (double sideband with carrier) operation are given on pages 4, 5 and 6. A description of the function of the operating controls is given above.

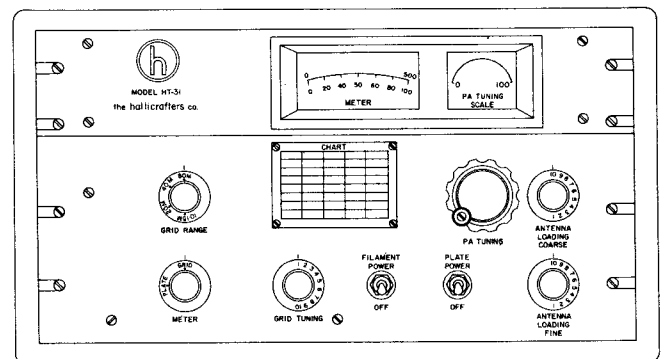
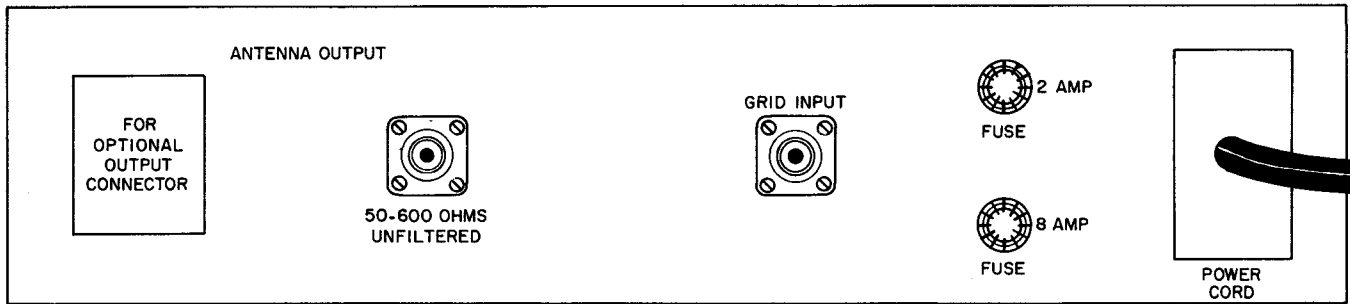


Fig. 2. Front Panel Controls



92 D 2464

Fig. 3. Rear Chassis Connections

TUNING PROCEDURE – GENERAL

TUNE UP FOR CW OPERATION

THE FOLLOWING STEPS APPLY TO ALL TYPES OF OPERATION

1. Apply CW excitation from the exciter unit and rough tune the grid for about 50 ma. of grid current.
2. Remove the excitation and set the PLATE POWER SWITCH to "ON".

1. Set all controls to their respective starting position as illustrated in Fig. 2.
2. Set the FILAMENT POWER SWITCH to "ON" and allow a ten minute warm up period.
3. Turn the GRID RANGE SWITCH to the proper position for the desired frequency band.
4. Pre-set the P. A. TUNING CONTROL to the approximate correct setting for the desired operating frequency. Refer to the rough calibration chart as illustrated in Fig. 4.

CAUTION

Always remove excitation before turning on plate power. If the plate power is applied with full excitation, and the plate circuit should be mistuned, damage to the tubes or a blown high voltage fuse may result.

NOTE

A permanent calibration chart has been included with the amplifier whereon you may note the proper control settings for commonly used frequencies and antenna load impedances.

3. Set the METER SWITCH to indicate plate current and slowly increase excitation until the plate current is between 50 and 100 ma. Resonate the P. A. TUNING control (tune for plate current dip).
4. Slowly increase the excitation while alternately observing the grid current and plate current values. The maximum allowable values without over load for CW

NAME OF CONTROL	THE SETTINGS GIVEN BELOW ARE APPROXIMATE ONLY. THEIR PURPOSE IS TO PROVIDE A CLOSE ENOUGH STARTING POINT IN THE TUNING PROCEDURE TO PREVENT TUNING TO A HARMONIC OR OBTAINING A FALSE LOADING INDICATION. THESE READINGS WERE TAKEN USING CW EXCITATION TUNED FOR 315 MA PLATE CURRENT WITH 60 MA GRID CURRENT. Tuning and loading settings will vary somewhat depending upon the impedance presented by the antenna system. The readings given below were taken with non-reactive loads of 52 ohms and 600 ohms. Linear interpolation between these extremes will give the approximate correct settings for other impedance values within this range.																			
	FRONT PANEL DIAL SETTINGS FOR																			
	80 METERS				40 METERS				20 METERS				15 METERS				10 METERS			
	3500 kc	4000 kc	7000 kc	7300 kc	14000 kc	14350 kc	21000 kc	21450 kc	28000 kc	297000 kc	3500 kc	4000 kc	7000 kc	7300 kc	14000 kc	14350 kc	21000 kc	21450 kc	28000 kc	297000 kc
GRID TUNING	52	600	52	600	52	600	52	600	52	600	52	600	52	600	52	600	52	600	52	600
P. A. TUNING	7.5	7.5	6.5	6.5	6	6	6	6	5	5	4.5	4.5	6	6	6	6	3	3	2.5	2.5
ANTENNA LOADING COARSE	88	96	80	88	49	54	47	53	24	28	23	27	15	17	15	17	10	12	9	10
ANTENNA LOADING FINE	8	3	8	3	5	2	5	2	3	1	3	1	2	1	2	1	1	1	1	1
	10	7.5	4	6.5	5	7.5	4	7	1	7	1	6.5	5.5	4.5	5	4.5	7.5	4	7.5	3.5

Fig. 4. Rough Calibration Chart

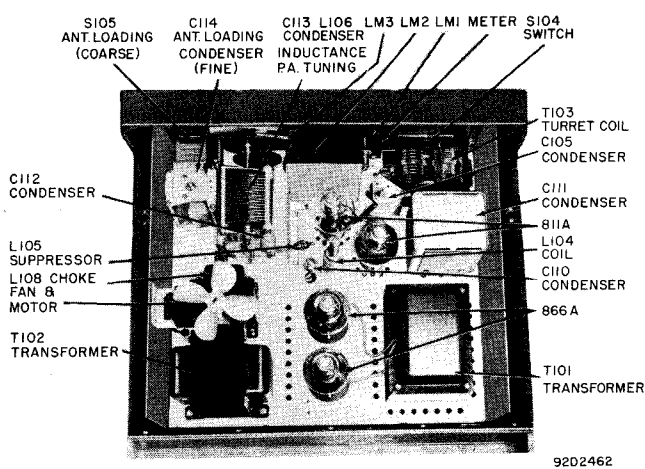


Fig. 5. Top View of Chassis

excitation are 315 ma. of plate current with 60 ma. of grid current.

CAUTION

The setting of the ANTENNA LOADING controls will determine whether or not the maximum plate current rating will be exceeded as the grid current is increased. If the plate current approaches 315 ma. before the grid current reaches 60 ma. the ANTENNA LOADING COARSE CONTROL should be set to a position that results in reduced plate current. Each time the loading is changed the P.A. TUNING control should be retuned for minimum plate current.

- Continue to slowly advance the excitation until a value of 60 ma. is reached. This will be possible without exceeding the 315 ma. plate current limit by repeating the procedure given in the caution note above as required to hold the plate current to a safe level.
- If when the 60 ma. grid current is obtained the plate current is less than 315 ma. it may be brought up to this level by increasing the output loading. The P.A. TUNING should of course be "redipped" each time loading is changed.

CAUTION

When operating on the higher frequencies (especially 10 meters) the step action of the ANTENNA LOADING COARSE control may provide too great a change in loading that may result in serious overload. In addition arcing may occur at the control contacts depending upon the impedance presented by the antenna system. As a precautionary measure the excitation should be removed and the ANTENNA LOADING FINE control reset to 10 each time the ANTENNA LOADING COARSE control is advanced one position. This system will result in nearly continuous control over the loading of the amplifier. Turning the ANTENNA LOADING FINE control from 10 to 1 will increase the loading between

the steps of the ANTENNA LOADING COARSE control. (This control also increases loading as it is switched from 10 toward 1).

TUNE UP FOR SSB OPERATION

GENERAL - When properly tuned for SSB operation the amplifier must be operating in a linear manner over a relatively wide range of current values. Since the carrier is suppressed a meter indication will be obtained only during modulation. Unless test equipment is available (see caution note on page 6) it is therefore desirable to make the final tuning adjustments for SSB operation with the carrier inserted (CW excitation). The object of the tuning procedure will be to alter the loading to obtain a plate current to grid current ratio of 10 to 1 and to maintain this ratio over a reasonable range of current values. For example when sufficient drive is applied to produce 20 ma. of grid current the plate current should be 200 ma. This gives a ratio of 200/20 or 10 to 1. When the grid current is increased to 30 ma. the plate current should increase to a value of 300 ma. This gives ratio of 300/30 or maintains the 10 to 1 relationship.

The recommended procedure is as follows:

- Tune and load the amplifier at the desired operating frequency for CW operation as outlined previously.
- Reduce the excitation until the grid current is 30 ma. Then check the plate current reading. If the value is not 300 ma. alter the loading to produce this value.
- Continue to slowly reduce the excitation while alternately observing the plate current and grid current readings. At 25 ma. grid current the plate current should be about 250 ma. At 20 ma. grid current the plate current should be about 200 ma. In other words the 10 to 1 ratio should be maintained at least down to the point where 15 ma. of grid current will result in 150 ma. of plate current. If the correct ratio is not maintained over this range it will be necessary to alter the loading at the 15 ma. grid current point to produce

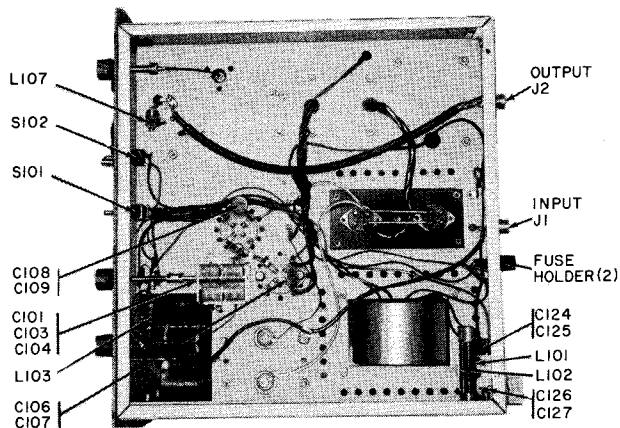


Fig. 6. Bottom View of Chassis

about 150 ma. of plate current and then recheck the current ratio at several points up to the maximum values of 30 ma. grid current and 300 ma. plate current. Some compromise adjustment may be necessary. When properly tuned and loaded the ratio will be close to 10 to 1 but the most important requirement is that current ratio remain linear over the operating range.

4. Suppress the carrier as desired at the exciter unit and proceed with SSB operation.

During modulation the meter should not swing beyond 20 ma. of grid current or 200 ma. of plate current. These are average current values and make a reasonable allowance for the fact that the instantaneous values will appreciably exceed these values.

TUNE UP FOR DOUBLE SIDEBAND WITH CARRIER

(Conventional AM operation)

When using the HT-31 as a linear amplifier when the exciter is supplying a modulated double sideband signal (conventional low level modulation) the following procedure is recommended:

1. Tune and load the amplifier at the desired operating frequency for CW operation as outlined on page 4.
2. Reduce the excitation until the grid current is 15 ma. Then alter the loading to produce a plate current of 150 ma.
3. Modulate the exciter unit and proceed with double sideband operation. On modulation peaks the plate current as indicated on the meter should not swing higher than 160 ma.

CAUTION

Any modulated transmitter is subject to spurious radiation if improperly tuned or if the modulation limits are exceeded. Continuous monitoring of the modulated output by means of an

oscilloscope is an excellent method of insuring compliance with FCC regulations. This is especially true in the case of SSB operation. An oscilloscope together with an audio signal generator will also provide a means of tuning the amplifier by the "Two-Tone Test" method. A complete discussion of this procedure is given in the publication. "SINGLE SIDEBAND FOR THE RADIO AMATEUR", an ARRL publication. For best results the two tone test method of tuning is recommended.

SERVICE OR OPERATING QUESTIONS

For further information regarding operation or servicing of your receiver, contact your Hallicrafters dealer. The Hallicrafters Company maintains an extensive system of Authorized Service Centers where any required service will be performed promptly and efficiently at a nominal charge. All Hallicrafters Authorized Service Centers display the sign shown below. For the location of the one nearest you, consult your local dealer or telephone directory. Make no service shipments to the factory as the Hallicrafters Company will not accept the responsibility for unauthorized shipments.

The Hallicrafters Company reserves the privilege of making revisions in current production of equipment and assumes no obligation to incorporate these revisions in earlier models.



SERVICE DATA

TYPICAL MAXIMUM POWER INPUT REQUIREMENTS

AMATEUR BAND IN METERS	80	40	20	15	10
POWER INPUT IN WATTS	8.5	11	14	17	20 - 25

VALUES GIVEN ABOVE ARE EFFECTIVE POWER VALUES USING CW EXCITATION. SSB OPERATION WILL REQUIRE A CORRESPONDING PEP (PEAK ENVELOPE POWER) EXCITATION SOURCE.

NOTE

Some types of SSB exciter units may be optimistically or incompletely rated with respect

to their output signal. In order to obtain the stability necessary to properly drive a high power linear amplifier it may be necessary to provide swamping of a portion of the exciter

signal either in the coupling between the two units or in the grid circuit of the amplifier. This swamping is to improve the dynamic stability of the exciter.

When using the Hallicrafters HT-30 as the exciter unit the output signal will be of sufficient quality and stability so that swamping will not be necessary.

WARNING – HIGH VOLTAGE

D.C. voltage in excess of 1500 volts and AC

voltage in excess of 3000 volts is present in this equipment. Do not attempt to measure voltages with hand held test leads nor attempt to service this unit with the plate supply turned on. In addition to the danger of serious injury or death from the high voltage supply serious radio frequency burns can be caused by coming in contact with or close proximity to, the plate and output circuits. USE EXTREME CARE IN WORKING WITH THIS EQUIPMENT.

GENERAL SPECIFICATIONS

Dimensions, overall.....	20" w X 12 1/4" h X 17 1/4" d.
Dimensions, front panel.....	10 3/4" h. X 19" w (fits standard 19" radio relay rack)
Mode of operation.....	Class B linear power amplifier
Power consumption	750 watts maximum from 105/125v, 50/60 cycles AC source
Plate power input.....	510 watts maximum
Power input.....	see chart, page 6
Power output.....	330 watts P.E.P. using SSB excitation (maximum rating)
Weight, net.....	92 lbs.
Weight, shipping.....	100 lbs.

CLEANING - Equipment that is continuously power ventilated may tend to collect dust within the unit depending upon the content of the air being circulated. The circuitry should be kept clean as any accumulation of dust in the high voltage or r-f areas may cause arcing and consequent damage. This applies to both the top side and the underside of the chassis. The parts are well spaced to permit efficient cleaning.

The preferred method of cleaning is the use of a vacuum cleaner while dusting with a clean brush. Gasoline should not be used as a cleaning agent.

NEUTRALIZATION

This unit has been carefully neutralized at the factory and the neutralizing capacitor securely locked in position. Additional adjustment should not be required except as a result of repair procedures. In the event that a tendency to oscillate is noted the following procedure is recommended:

1. Set the controls listed below to the positions indicated:

PLATE POWER SWITCH..... OFF
 ANTENNA COARSE LOADING..... # 1
 FILAMENT SWITCH..... ON
 and allow a ten minute warm up period.
 METER SWITCH..... GRID CURRENT
 ANTENNA FINE LOADING..... # 1

2. Set up the exciter unit to provide CW excitation at 29.7 mc and tune and load the grid circuit for about 60 ma. of grid current.

3. Loosen the lock nut on the neutralizing capacitor and set the plates for half mesh.

4. Connect a test light (6.3 v dial bulb or 3 watt S6 bulb) across the output connector and tune the P.A. TUNING control for maximum lamp brilliance.

5. Adjust the neutralizing capacitor for minimum lamp brilliance while maintaining plate resonance with the P.A. TUNING control.

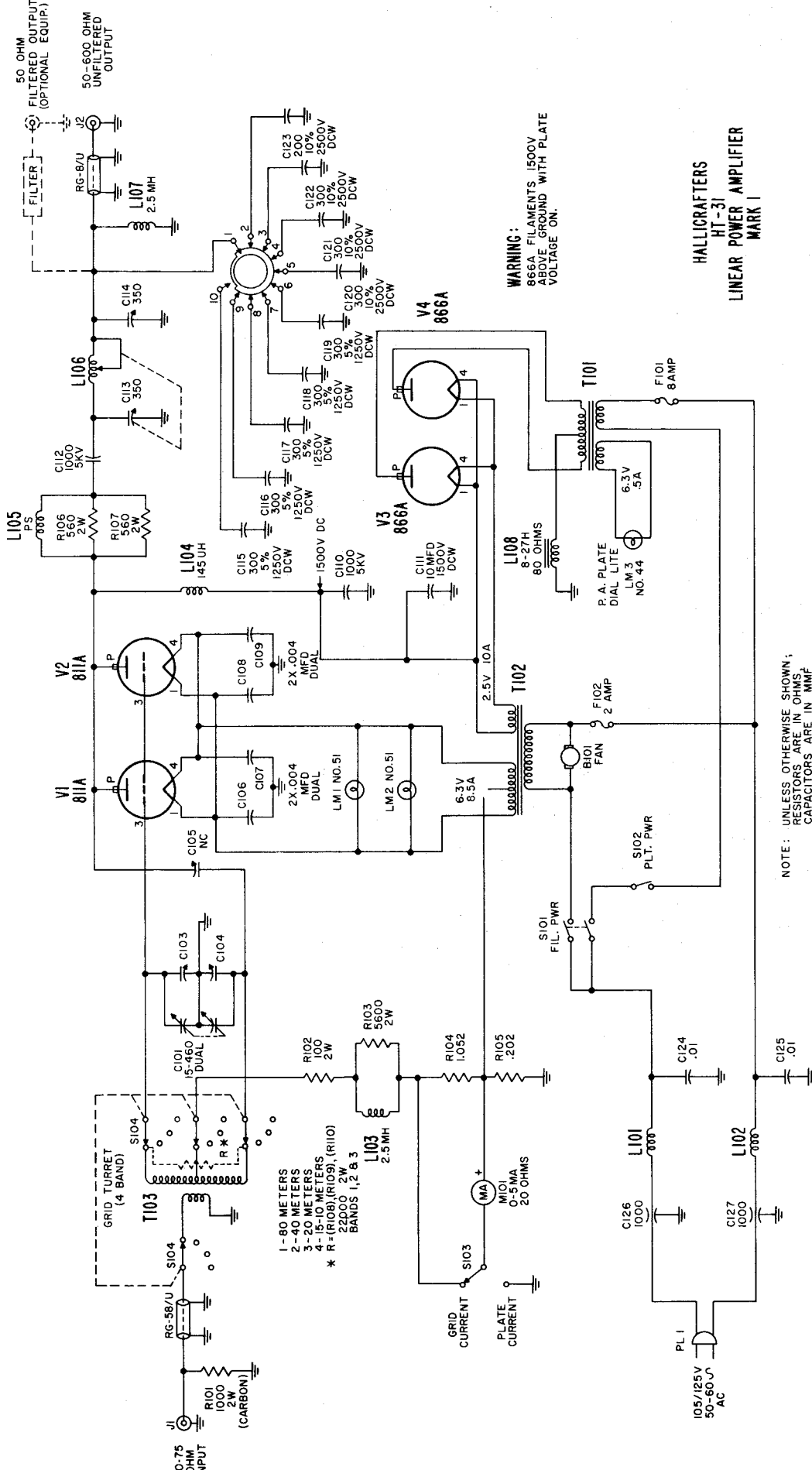
6. Remove the excitations, disconnect the test lamp and all cables attached to the amplifier and replace the 8 amp. fuse with a 5 amp. fuse.

7. Turn on the plate power and observe the meter for any evidence of grid current. If grid current is present retouch the setting of the neutralizing capacitor to eliminate the grid current. Then lock the neutralizing capacitor in position.

NOTE

Neutralizing the unit at the highest operating frequency will usually be sufficient to maintain neutralization over the entire operating range. Upon completion of step 7 tune both grid and plate circuits over their entire range to check for any evidence of grid current. If retouching is necessary be sure to make a final check at the highest frequency tuning positions. Repeat this process as required to maintain neutralization at all frequencies.

8. Replace the 8 amp. fuse that was removed in step 6.



WARNING:
 866A FILAMENTS 1500V
 ABOVE GROUND WITH PLATE
 VOLTAGE ON.

**HALLCRAFTERS
 HT-31
 LINEAR POWER AMPLIFIER
 MARK I**

NOTE: UNLESS OTHERWISE SHOWN,
 RESISTORS ARE IN OHMS,
 CAPACITORS ARE IN MMF

1-80 METERS
 2-40 METERS
 3-20 METERS
 4-15-10 METERS
 * R = (R108),(R109),(R110)
 22000 2W
 BANDS 1,2 & 3

GRID TURRET
 (4 BAND)

50-75
 OHM
 INPUT

50 OHM
 FILTERED OUTPUT
 (OPTIONAL EQUIP.)

50-600 OHM
 UNFILTERED
 OUTPUT

105/125V
 50-60 AC

PL1

PLATE
 CURRENT

GRID
 CURRENT

2.5V 10A

8AMP

8AMP

SERVICE PARTS LIST (cont'd)

Schematic Symbol	Description	Hallicrafters Part Number	Schematic Symbol	Description	Hallicrafters Part Number
MISCELLANEOUS (cont)			MISCELLANEOUS (cont)		
	Shield Esc.	69C538		Socket, Meter Lamp	
	Socket, Dial Lamp			Assembly	86A193
	Assembly	86A194		Spacer (Loading Cap. Mtg.)	73A1113

NOTES

Empty rectangular box for notes.

NOTES

Warranty

"The Hallicrafter's Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to our authorized radio dealer, wholesaler, from whom purchased, or, authorized service center, intact, for examination, with all transportation charges prepaid within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory or authorized service center, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products."

Form No. 94X622

the Hallicrafters co.