

# OPERATION and MAINTENANCE MANUAL

## SB2-LA LINEAR AMPLIFIER



**SBE** SIDEBAND  
ENGINEERS

317 ROEBLING RD—SOUTH SAN FRANCISCO, CALIF.



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## I. INTRODUCTION AND GENERAL INFORMATION

### A. GENERAL DESCRIPTION

Sideband Engineers' Model SB2-LA is a linear amplifier designed primarily for use with the SB-34 single-sideband transceiver and similar equipment. The unit is self-contained and operates on the authorized amateur frequencies within the spectrum 3.8 - 21.45 mc/s. The SB2-LA is capable of peak power inputs up to 1000 watts (750 watts on 15 meters) and will accept any of the emission types normally employed in this frequency range (SSB, AM, PM, FM, FSK, etc.).

The self-contained power supply operates from a nominal 117-volts AC, 50/60 cycle source. Mobile operation is possible through the use of a solid-state inverter (Sideband Engineers' Model SB3-DCP) which is available as an accessory item. The linear amplifier is designed for operation into a 50-ohm, unbalanced antenna load with a vswr of 2:1 or less.

The SB2-LA contains a flexible control system which permits operation with transceivers (or exciters) other than the SB-33. To obtain full power capability of the amplifier, approximately 65 watts of drive is required. Operation at reduced output is possible with lower amounts of drive. The amplifier will provide approximately 10 db power amplification to any input signal up to maximum rated power.

### B. SPECIFICATIONS

Frequency Range: Amateur bands within the spectrum 3.8 - 21.45 mc/s

Input Power Ratings: SSB - 1000 watts peak  
AM - 300 watts  
CW, FM, FSK - 400 watts

Power Requirements: 117V AC, 50/60 cycles, 1.4 kva peak  
12.6V DC, 110 amp peak when operated with  
SB3-DCP mobile inverter

Tube Complement: 6JE6 (6)  
Input Impedance: 75 ohms, resistive  
Drive Requirements: 65 watts maximum  
Output Impedance: 50 ohms, unbalanced, vswr not to exceed 2:1  
Dimensions: 5-3/4 in. high, 12 in. wide, 12-1/2 in. deep  
Weight: 40 lbs.



## II. INSTALLATION

### A. UNPACKING

Remove the unit from shipping carton and inspect for any visible signs of damage. If the unit has been damaged in shipment, save the shipping carton and packing material and notify the transportation company. Fill out and mail the equipment warranty card.

Check all controls to see that they operate freely. Remove the screws on each side of the cabinet and lift off the top cover. Remove the packing material around the tubes and check that tubes are firmly seated in their sockets. Replace the top cover and screws.

### B. FIXED STATION INSTALLATION

The amplifier may be located at any convenient position within the length of the coaxial cable provided for connection to the transceiver. Adequate ventilation around the unit is essential; at least two inches of free air space must be provided around the top and sides. Do not restrict air flow under the amplifier by placing it on a softly padded surface. The unit should never be stacked with other equipment unless adequate air space is maintained above and below. Remember that several hundred watts of heat are generated by the amplifier when operating at full ratings and improper ventilation can cause permanent damage to tubes and other components.

Interconnections to the SB-34 transceiver are shown in Fig. 1. Connections to other types of transceivers are shown in Fig. 2.

Information for connecting the SB2-LA to any exciter or transceiver not shown may be obtained by writing to the factory. Be sure to enclose the schematic diagram of the unit with which the amplifier is to be used.

A good water-pipe ground (#12 wire or heavier) should be connected to the ground lug at the rear of the amplifier. Connect the power plug to any wall outlet; make certain that all switches are off before inserting the plug.

The amplifier is intended for operation with a 50-ohm unbalanced (coaxial line) antenna. If other types of antennas are to be used, an external antenna tuner must be provided. Occasionally, the trap type of antennas fail due to arcing at the high power level generated by the SB2-LA amplifier. If meter readings are erratic or intermittent during tune-up, the antenna should be investigated. In some cases, arcing due to dirty insulators can occur. The cure is to provide an antenna installation capable of withstanding high power levels and to clean the insulators as necessary.



## CAUTION

Do not operate the SB2-LA into an antenna load with a standing-wave ratio greater than 2:1. The equipment will not load properly and damage to the antenna cable can result. Never operate the amplifier at full load with a continuous tone for more than 30 seconds. The tubes and power supply may be damaged. Never operate at power inputs higher than given in the SPECIFICATIONS section of this manual; the life of the tubes will be greatly shortened. Do not replace the fuse with a slow-blow type or with a size larger than 15 amp. Always reduce power by decreasing drive to the amplifier, never by decreasing antenna loading.

### C. MOBILE INSTALLATION

Mobile operation of the SB2-LA linear amplifier is entirely practicable by use of the SB3-DCP DC/AC inverter. Installation may be made in any automobile with a negative ground 12-volt supply. The amplifier and inverter are normally installed in the trunk of the vehicle; installation in the cab is not advised since the heat generated by the amplifier is considerable. The ventilation precautions for fixed-station use also apply when operating mobile. In addition, a reasonable amount of air flow must be provided around the inverter. Connections for mobile operation are given in Fig. 3. Detailed installation instructions for the SB3-DCP inverter are provided with the unit.

High-power mobile operation, particularly on the lower frequencies, has presented an antenna problem for many years due to corona discharge and excessive loss due to loading-coil heat. These problems have been solved in the "Webster KW Top Sider Series" mobile antenna and its use with the SB2-LA linear amplifier is highly recommended. Do not attempt to operate with conventional mobile antennas; the high power generated will almost certainly damage the antenna or completely destroy it. In some cases, a normal whip antenna may be operated on 20 and 15 meters provided that a plastic top cap is installed to suppress corona, but no conventional centerloaded mobile antenna will withstand the power generated by the SB2-LA.

### III. TUNING AND OPERATING PROCEDURE

Power to the amplifier is controlled by the FIL and POWER toggle switches. Turn the fil switch to ON position. The amber indicator lamp should glow. Wait thirty seconds for the tubes to reach operating temperature. Then set the power switch to HI position. The power circuits of the amplifier are now ready for tune-up and operation. The two switches are electrically interlocked so that power cannot be turned on until the tube heaters have been actuated. In addition, the amplifier cannot be controlled from the transceiver



unless both switches are to the right. With either switch left, operation of the transceiver will be "straight through"\* when the microphone button is pressed.

**CAUTION: POWER PLUG POLARITY CAN AFFECT OPERATION OF SB2-LA. IN CASE OF ERRATIC METER ACTION OR LOUD HUM IN TRANSCEIVER SPEAKER, REVERSE 115V AC POWER PLUG ON SB2-LA.**

Prior to actual tune-up of the amplifier, the transceiver (or exciter) should be loaded to the desired band into the antenna to be used. This may be done by temporarily turning the power toggle switch to LO position and tuning the transceiver in the normal manner. Then turn the TUNE-OPERATE switch to OPERATE position and the power switch to HI. With the transceiver microphone button pressed but not delivering output (microphone gain control to zero) see that the PLATE AMPERES meter on the amplifier reads .3. If not, adjust the bias control on the rear panel as required. Be sure transceiver or exciter carrier has been nulled before checking idling current.

Set the BAND switch to the desired band and the LOAD control fully counter-clockwise. With the power switch on HI, tune-operate switch on TUNE, band-switch on desired band, and load control fully counter-clockwise, put transceiver in TUNE position. Then adjust the tune control for a sharp dip in the plate amperes meter and a rise in the OUTPUT meter. Check transceiver output for maximum drive into linear amplifier. Place amplifier tune-operate switch in OPERATE position and adjust amplifier controls for plate amperes meter reading of 1.2 (.95 on 15 meters). CAUTION: DO NOT OPERATE THE AMPLIFIER IN "TUNE" POSITION FOR MORE THAN 30 SECONDS CONTINUOUSLY.

This completes the tune-up procedure for single-sideband operation. Turn the transceiver mode selector to USB or LSB position and set the microphone gain control for an amplifier plate amperes reading of about .5 while speaking a steady "AHHH" into the microphone. This setting may be made more accurately if output from the amplifier is monitored by an oscilloscope. The setting should be increased to just below the point where peak clipping (flat-topping) occurs. On-the-air checks should be taken with caution; they are subject to error and may be quite misleading.

The SB2-LA linear amplifier is designed to operate with any mode of emission normally employed on the high-frequency amateur bands. For amplitude modulated (AM) service, the above tune-up procedure is followed except that the final drive adjustment is made for a plate amperes reading of not more than .38. Similarly, for FM or FSK operation, the final drive adjustment is made

\* Transceiver output directly connected to antenna through SB2-LA.



for a plate amperes reading of not more than .5. With CW operation, the plate amperes reading may be increased to 1.0 (.75 on 15 meters) provided that the key is not held down for extended periods (not more than 20 seconds).

NOTE: Output meter (top meter in SB2-LA) should be peaked for highest possible meter reading. DO NOT EXCEED 1.2 AMPS. ON PLATE METER.

#### IV. CIRCUIT DESCRIPTION

The Sideband Engineers' Model SB2-LA linear amplifier consists of six type 6JE6 tubes, parallel-connected, operated Class AB<sub>1</sub> (no grid current) with a passive grid input circuit and a pi-section output network. Due to the high perveance of the 6JE6 tubes, efficient operation is obtained with low anode voltage and high current. Thus, most of the expensive and bulky components normally required for amplifiers of this power capability are eliminated. Power supplies required for heater, bias and anode circuits of the amplifier are self-contained.

##### A. INPUT CIRCUITS

Since the amplifier tube grids require no power for operation, a bank of non-inductive resistors connected to the input jack absorb the power generated by the transceiver (or exciter). These resistors are arranged to present an input impedance of approximately 75 ohms, essentially resistive. Anti-parasitic resistors are provided in each grid lead. Fixed bias is shunt-fed to the grids from a small voltage-doubler supply with an adjustment provided on the rear panel.

##### B. OUTPUT CIRCUITS

The output network of the amplifier is a conventional pi-section coupler although the electrical (and physical) sizes of the various components are unusual. Because of the low plate load impedance required (about 300 ohms), the input capacitor required is large in value. Likewise, the inductance required is small. Since the plate voltage is relatively low, a small air gap is completely adequate for the input capacitor.

The bandswitch selects the amount of inductance for each band, provides extra fixed amounts of load capacitor on 80 and 40 meters, and adds a fixed input capacitor on 80 meters.

A small diode, together with a resistor/capacitor network, actuates the output meter, which provides a relative indication of the voltage existing on the output terminal.



### C. POWER CIRCUITS

Anode power for the amplifier is obtained from two voltage-doubler rectifier circuits, series-connected. Output voltage under load is 800 volts nominal at 1.2 amperes. Rectification is by parallel-connected silicon diodes and filtering is accomplished by large electrolytic capacitors.

Also obtained from the main power transformer is the bias voltage. This is a voltage-doubler rectifier circuit.

Heater voltage is taken from a separate transformer. Inter-connections within the power plug arrange the heater circuit such that it may be operated directly from a 12-volt battery source when operating mobile.

A resistor in the primary of the main power transformer protects the silicon rectifiers from the high surge current produced when the unit is first turned on. Relay contacts short this resistor when actually transmitting so that full output voltage is produced.

### D. CONTROL CIRCUITS

Necessary antenna switching is accomplished within the amplifier by relay contacts. When on receive (or transmitting with the power switch in LO position) the antenna is passed directly through the amplifier to the transceiver. When transmitting, output from the transceiver is connected to the grid input circuit and the antenna is connected to the amplifier output terminal.

In standby (receive) condition, cut-off bias to the amplifier tubes is applied to prevent tube noise. When transmitting, the bias is reduced to the correct value by grounding a voltage-divider network consisting of resistors R38 and R40, and bias potentiometer R39 through K2. Grounding this lead also actuates relay K1. Energizing voltage for this relay is supplied by diode D12 and the heater supply voltage. This diode also prevents the high negative voltage existing on pin 9 (when in receive) from shorting to the heater line. In mobile operation, actuating voltage for K2 is obtained directly from the battery source.

Sections of the fil and power switches are inserted into the control line to relay K2 so that the relay does not close except when the fil switch is ON and the power switch is HI.

### V. TROUBLE SHOOTING AND MAINTENANCE

No periodic maintenance is required on the SB2-LA amplifier. If the unit is located in an unusually dusty position, the top cover should be removed occasionally and accumulated dust removed. Remove six screws on the sides





of the cover and lift straight up. A small soft-bristle brush and a vacuum cleaner works best for this operation. Be sure that none of the components is disturbed when cleaning.

The amplifier tubes are operated conservatively and, unless a heavy overload is applied for an extended period, they should operate for several thousand hours without deterioration. Should replacement be indicated by loss in output or low plate current (usually both), it is recommended that a complete new set be installed.

#### IMPORTANT

THE (6JE6) TUBES USED IN THE SB2-LA ARE FACTORY BALANCED. WHEN REPLACING, BALANCED TUBES MAY BE OBTAINED THROUGH YOUR SBE DEALER OR CHECK STOCK TUBES FOR BALANCED MU.

It will be found that standby current will run rather high for the first hour or so of operation and this will gradually fall to the correct level. If necessary, the bias should be adjusted as required until the new tubes age a bit.

A slight blue glow within the tube does not necessarily indicate a defective tube. However, if plate current is radically high or low, suspect a defective tube. This is usually indicated by excessive blue glow, color on the plate or the tube envelope abnormally cool.

NOTE: In the event of any component failure, fuse F2 should always be checked to see that it is intact. The unit will transmit properly if the fuse is open, but undue stress will be placed on the power supply components which will reduce their life. F2 should not fail except under a prolonged B supply short circuit.



## VI. PARTS LIST

<u>Symbol</u>	<u>Description</u>	<u>Part No.</u>
C1, C19	Cap. .001 mfd, 3KV	0395-10
C2, C27, C28		
C35, C38	Cap. .001 mfd, 500V	0393-00
C3-C14	Cap. .01 mfd, 1 KV	0406-00
C15-C18	Cap. 500 PFD, 6KV	0392-20
C20	Cap. variable, plate tuning	235-7180P1
C21	Cap. 500 PFD, 5KV	0384-38
C22-C25	Cap. 500 PFD, 1200V, "H" mica	0456-00
C26	Cap. variable, load	235-7181P1
C29-C30	Cap. 8 mfd, 250V, tub. elec.	0517-90
C31-C34	Cap. 200 mfd, 250V, CD BR2-0025	0531-80
C36, C37	Cap. 100 mfd, 15V, tub. elec.	0529-90
C39	Cap. 1.0 pfd, tub. bakelite	0370-00
D1	Diode, germanium, Amperex S-262	0721-50
D2, D3, D12	Diode, silicon, Silitron HC-70	0725-50
D4-D11	Diode, silicon, Silitron HC-71	0727-70
F1	Fuse, 15 amp., AGC	0672-00
F2	Fuse, 3 amp., 3AG w/pigtails	0668-10
I1	Lamp, NE-2	0736-00
K1	Relay, 3PDT, 12V DC, Advance GHB-3C-12V	0583-85
K2	Relay, SPST, 12V DC, Advance EWO-942	0583-50
L1	Choke, RF special	375-7191P1
L2	Coil, tank, 15 meters	375-7189P1
L3	Coil, tank, 80-20 meters	375-7190P1
L4	Coil, RF, 2+ uh	0014-00
M1	Meter, 0-1.5 amps., DC	0700-92
M2	Meter, 0-5 amps., RF	0700-90
R1-R20	Resistor, 1500 $\Omega$ , 2W, + 10%, carbon	0207-50
R21	Resistor, 3300 $\Omega$ , 1/2W, + 10%, carbon	0120-00
R22-R27	Resistor, 27 $\Omega$ , 1/2W, + 10%, carbon	0108-00
R28	Resistor, 56K, 1W, + 10%, carbon	0176-00
R29	Resistor, 5.6K, 1/2W, + 10%, carbon	0122-00
R30, R38	Resistor, 10K, 1/2W, + 10%, carbon	0124-00
R31	Resistor, 25K, 10W, + 10%, Wire wound	0270-00
R32-R35	Resistor, 47K, 2W, + 10%, carbon	0216-00
R36	Resistor, 1 $\Omega$ , 10W, + 10%, Wire wound	0237-50
R37	Resistor, 1500 $\Omega$ , 1/2W, + 10%, carbon	0118-50
R39	Resistor, variable, 10K	0349-20
R40	Resistor, 15K, 1/2W, + 10%, carbon	0125-00
R41	Resistor, 10 $\Omega$ , 25W, + 10%, Wire wound	0305-20
R42	Resistor, 470K, 1/2W, + 10%, carbon	0132-60
S1, S2	Switch, DPST, toggle	0653-00



<u>Symbol</u>	<u>Description</u>	<u>Part No.</u>
S3	Switch, SPST, toggle	0648-00
S4	Switch, rotary, 4-pos., 2-sec.	228-7181P1
T1	Transformer, filament	292-7192P1
T2	Transformer, power	292-7190P1
V1-V6	Tube, type 6JE6	2150-10
	Line cord w/plug, Belden AA-333	W-69
	Terminal strip, 5-terminal	0988-00
	Terminal strip, 8-terminal	0988-55
	Phono Jack, female, Cinch-Jones 81A	1002-00
	Coaxial receptacle, SO-239	1004-00
	Socket, tube, Cinch 149-19-00-033	1036-49
	Connector, male, 9-pin, Cinch-Jones 9-PB	1043-46
	Connector, female, 9-pin (on W-69 cable)	1043-47

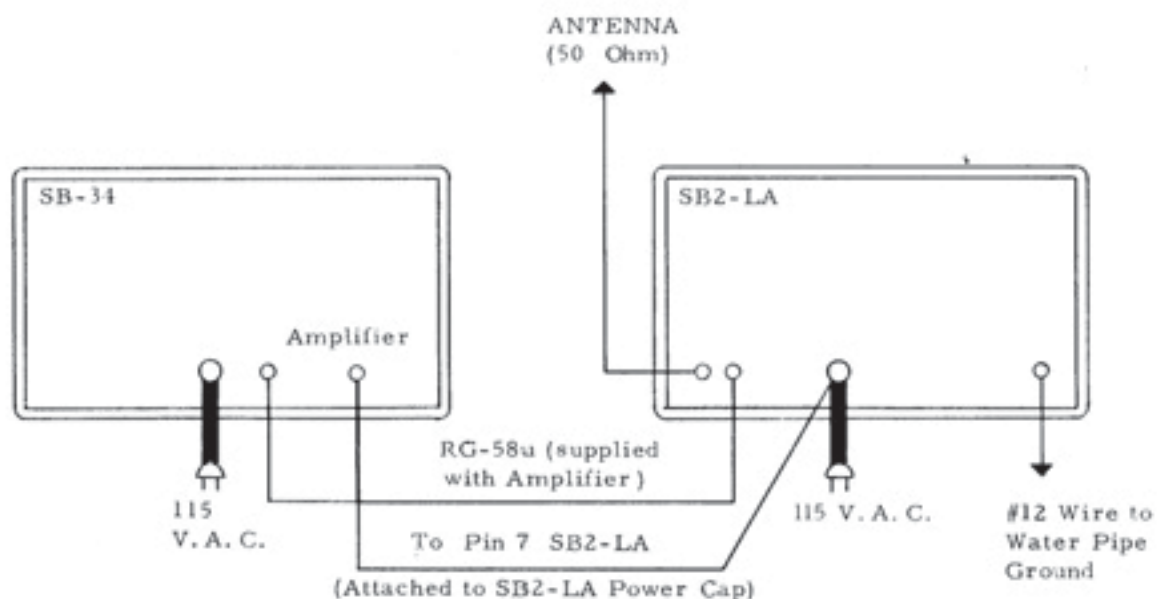
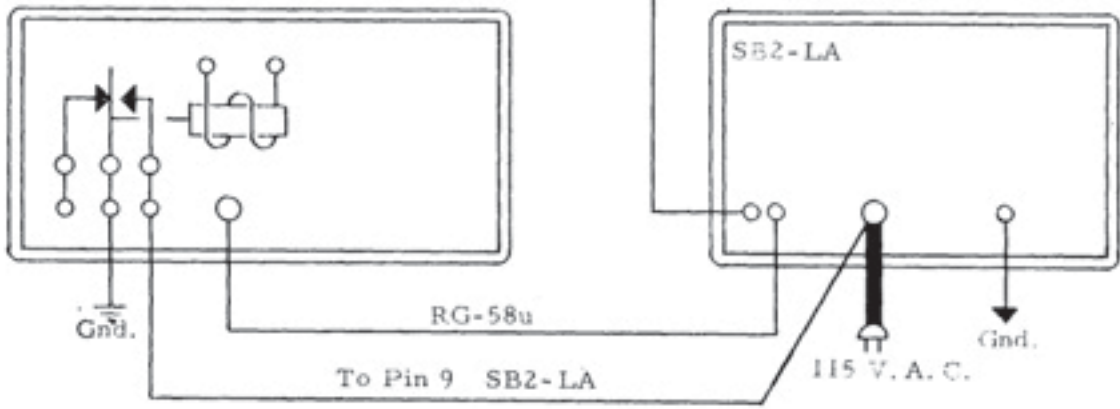


Fig. 1



Hallicrafter SR-150 & 160  
Collins, Swan, Drake  
National, etc.



CONNECTING SB2-LA TO TRANSCEIVER OF OTHER MANUFACTURE

NOTE: Remove wire from pin 7 (SB2-LA) and connect to pin 9. Connect opposite end to control relay in transceiver (relay closed in transmit). Ground mating contact.

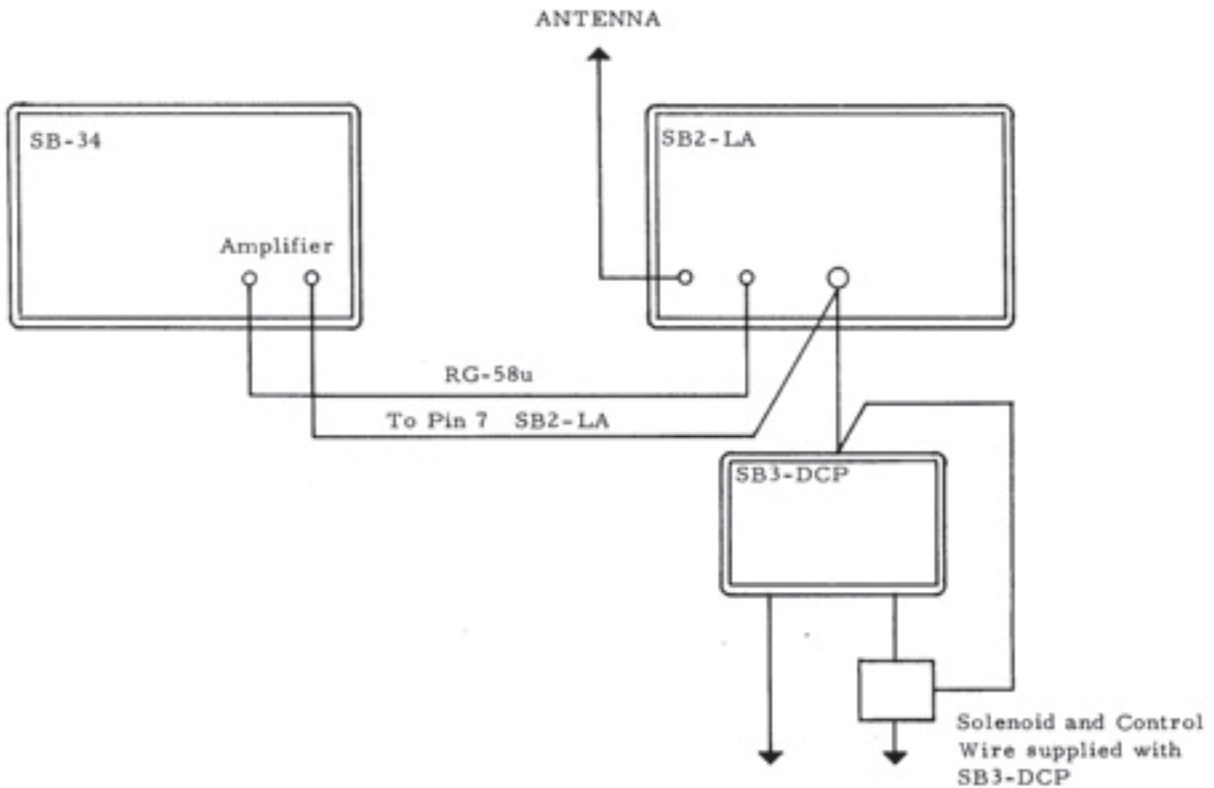
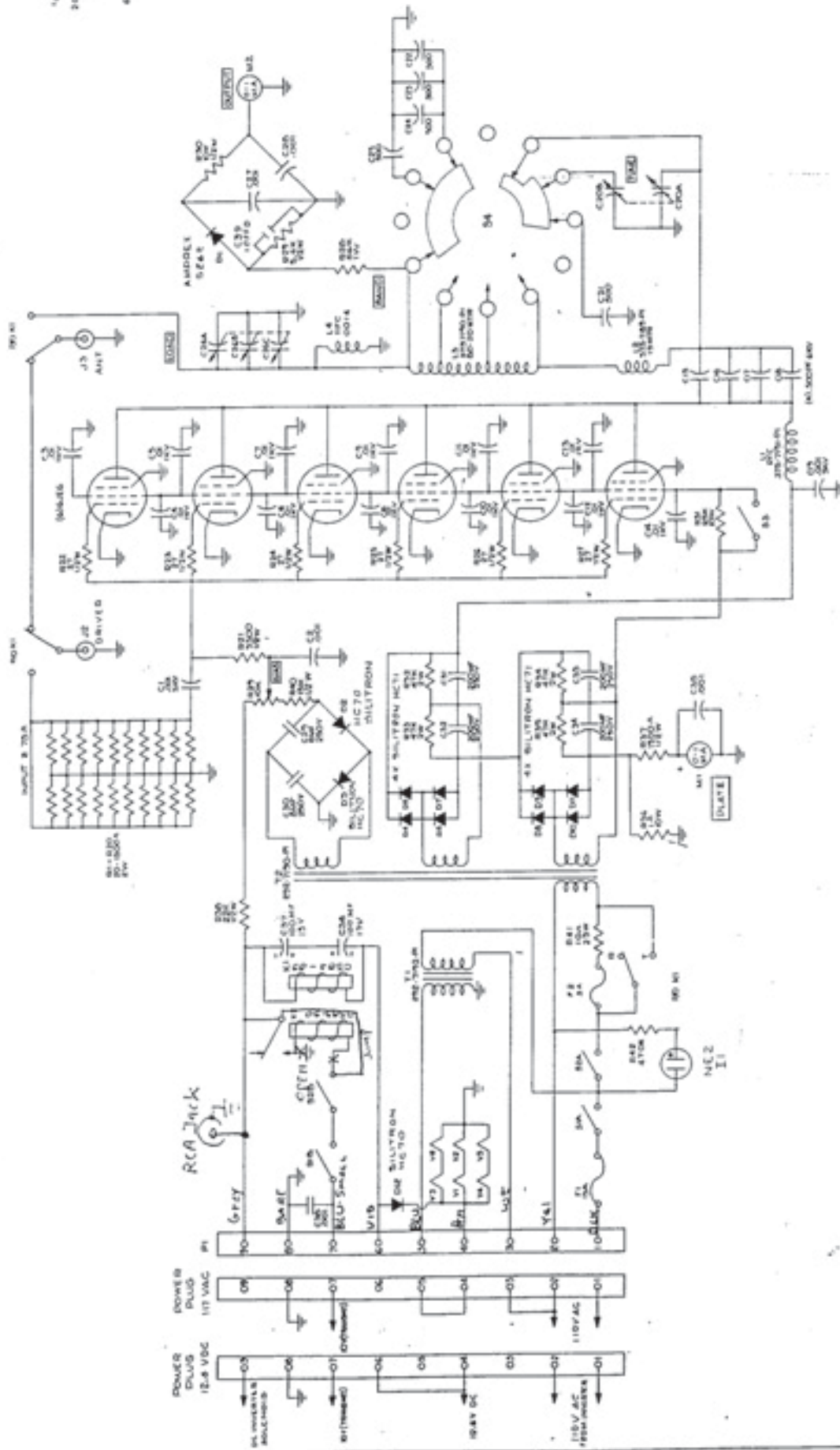
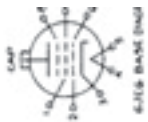


Fig. 3





LINEAR AMPLIFIER

SB2-LA



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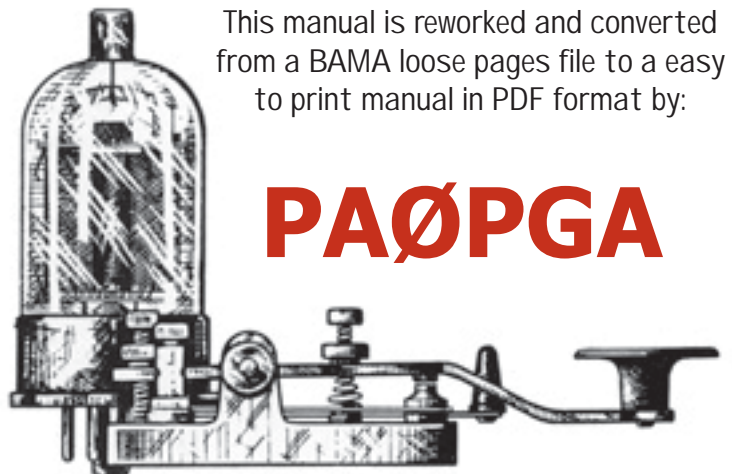
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