

★  
UNCLASSIFIED

TECHNICAL MANUAL

*for*

**TRANSMITTING MODE  
SELECTOR, SBE-2  
(MODULATOR POWER SUPPLY)  
GROUP, AN/URA-23**



THE TECHNICAL MATERIEL CORPORATION  
MAMARONECK, N. Y.                      OTTAWA, CANADA



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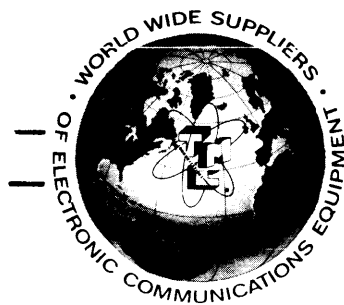


THE TECHNICAL MATERIEL CORPORATION  
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# THE TECHNICAL MATERIEL CORPORATION

C O M M U N I C A T I O N S   E N G I N E E R S

700 FENIMORE ROAD

MAMARONECK, N. Y.

## W a r r a n t y

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes, fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

CHANGE NO. 1



INSTRUCTION BOOK CHANGE NOTICE

Date Feb. 7, 1964

Manual affected: Transmitting Mode Selector, SBE-2 IN -2008

Page 7-14, Parts List

In DESCRIPTION column, change power rating of R205  
from 2 watts to 1 watt. ✓

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director of Eng. Services.

CHANGE NO. 2 SBE-2



## INSTRUCTION BOOK CHANGE NOTICE

Date 4/16/64

Manual affected: TRANSMITTING MODE SELECTOR MODEL SBE-2IN -2008

Page 7-20

REF SYMBOL Y109 under TMC PART NUMBER column

Change "CR-50/U" to "CR-112."

There is no military equivalent of the CR-112; however,  
it is contained in a HC-13/U holder.

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director of Eng. Services.



INSTRUCTION BOOK CHANGE NOTICE

Date June 29, 1964

Manual affected: Transmitting Mode Selector, Model IN -2008  
SBE-2

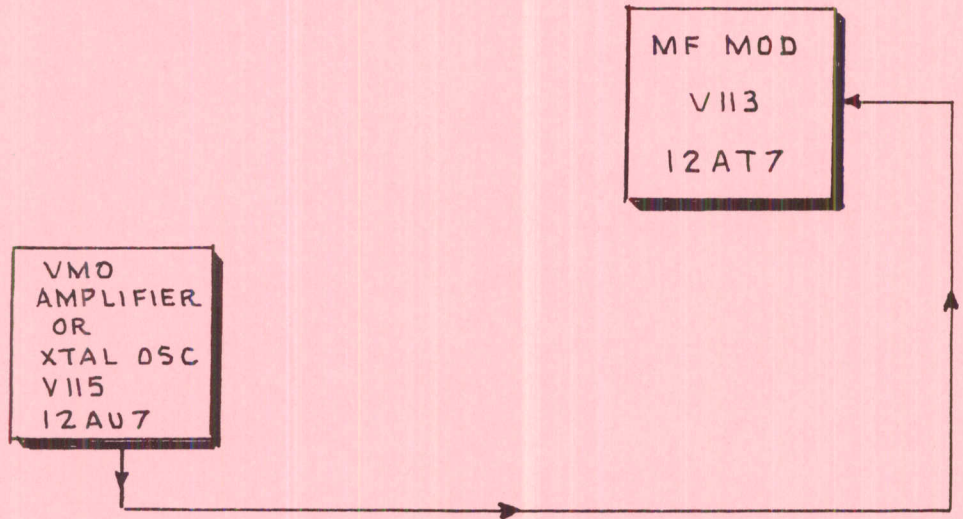
Incorporate the following changes and corrections to Section 7, Parts List.

Page 7-7. CR101, CR102, CR103  
Change TMC Part No. from: CK-711A ✓  
to: DD-115

Page 7-17. T107, T108  
Change TMC Part No. from: TT-100 ✓  
to: A-1444

Page 7-21. Z103  
Change description to read: ✓  
from: 250 kc oscillator.  
to: 287 kc oscillator.

Incorporate the interconnection line shown in the figure below to Figure 4-1. Block Diagram, SBE-2. Page 4-4/4-5.



The above modifications made in accordance with Engineering Modification Notice: 11592.







# TABLE OF CONTENTS

<b>SECTION 1—GENERAL DESCRIPTION</b>		<b>SECTION 5—TROUBLESHOOTING</b>	
Paragraph	Page	Paragraph	Page
1-1	Introduction . . . . .	1-1	5-1
1-2	Reference Data . . . . .	1-1	5-2
	a. Auxiliary Equipment Supplied . . . . .	1-1	5-0
	b. Shipping Data . . . . .	1-1	5-0
<b>SECTION 2—INSTALLATION</b>			
2-1	General . . . . .	2-1	5-0
2-2	Initial Inspection . . . . .	2-1	5-0
2-3	115- vs 230-Volt Power Supply Connections . . . . .	2-1	5-0
2-4	Interconnecting Procedure . . . . .	2-1	5-0
2-5	Initial Adjustments and Installation of MF Crystals . . . . .	2-2	5-0
<b>SECTION 3—OPERATOR'S SECTION</b>			
3-1	Preliminary Considerations . . . . .	3-1	5-0
3-2	Single Sideband with Any Degree of Carrier Insertion . . . . .	3-2	5-0
3-3	Double Sideband with Any Degree of Carrier Insertion . . . . .	3-4	5-0
3-4	Independent Sideband with Any Degree of Carrier Insertion . . . . .	3-5	5-0
3-5	Conventional AM Operation . . . . .	3-7	5-0
3-6	Frequency-Shift Telegraph Operation . . . . .	3-7	5-0
3-7	CW Telegraph Operation . . . . .	3-7	5-0
3-8	VOX and SQUELCH Circuit Operation . . . . .	3-7	5-0
	a. VOX Adjustment . . . . .	3-8	5-0
	b. SQUELCH GAIN Adjustment . . . . .	3-8	5-0
<b>SECTION 4—PRINCIPLES OF OPERATION</b>			
4-1	Introduction . . . . .	4-0	5-0
4-2	Audio Input Section . . . . .	4-1	5-0
4-3	17-kc and 287-kc Oscillators and Balanced Modulators Section . . . . .	4-2	5-0
4-4	2- to 4-mc MF Section . . . . .	4-2	5-0
4-5	4- to 32-mc HF Section . . . . .	4-3	5-0
4-6	SQUELCH and VOX Section . . . . .	4-3	5-0
4-7	M101 Meter Section . . . . .	4-4	5-0
4-8	Power Supply Section . . . . .	4-4	5-0
		<b>SECTION 6—MAINTENANCE</b>	
		6-1	General . . . . .
		6-2	Operator's Maintenance . . . . .
		6-3	Preventive Maintenance . . . . .
		6-4	Corrective Maintenance . . . . .
			a. 17-kc Oscillator . . . . .
			b. 287-kc Oscillator . . . . .
			c. Mid-Frequency Oscillator . . . . .
			d. High-Frequency Oscillator . . . . .
			e. 17-kc Carrier Balance Resistors R110 and R112 . . . . .
			f. Transformer T108 . . . . .
			g. Transformer T107 and Long- Frequency Balance Resistor R113 . . . . .
			h. MF Modulator . . . . .
			i. MF Balance Resistor R130 . . . . .
			j. RF Balance Resistor R150 . . . . .
			k. RF Output Circuit Adjustment . . . . .
		<b>SECTION 7—PARTS LIST</b>	
		<b>SECTION 8—SCHEMATIC DIAGRAMS</b>	

## LIST OF ILLUSTRATIONS

SECTION 1—GENERAL DESCRIPTION		SECTION 4—PRINCIPLES OF OPERATION (Cont.)	
Figure	Page	Figure	Page
1-1-a	Front Angle View, Transmitting Mode Selector, SBE-2, and Power Supply. . . . .	4-4	Schematic Diagram, 2- to 4-mc MF Section . . . . .
			4-11/4-12
1-1-b	Rear View, Transmitting Mode Selector, SBE-2 . . . . .	4-5	Schematic Diagram, 4- to 32-mc HF Section . . . . .
			4-13/4-14
1-2	Modulator-Power Supply Group AN/URA-23A. . . . .	4-6	Schematic Diagram, SQUELCH and VOX Section . . . . .
			4-15/4-16
		4-7	Schematic Diagram, M101 Meter Circuits . . . . .
			4-17/4-18
		4-8	Schematic Diagram, Power Supply Section . . . . .
			4-19
<b>SECTION 2—INSTALLATION</b>			
2-1	Installation Diagram Showing 115- vs 230-Volt Power Supply Connections . . . . .		
			2-3/2-4
2-2	Outline Dimensional Drawing. . . . .		2-5/2-6
<b>SECTION 3—OPERATOR'S SECTION</b>			
3-1	Operating Controls . . . . .		3-10
<b>SECTION 4—PRINCIPLES OF OPERATION</b>			
4-1	Block Diagram, SBE-2 . . . . .		4-5/4-6
4-2	Schematic Diagram, Audio Input Section, SBE-2 . . . . .		4-7/4-8
4-3	Schematic Diagram, 17-kc and 287-kc Oscillators and Balanced Modulators Section, SBE-2 . . . . .		4-9/4-10
<b>SECTION 5—TROUBLESHOOTING</b>			
5-1	Voltage and Resistance Diagram . . . . .		5-5/5-6
5-2	Location Diagram of Major Electronic Equipment Components, Top View . . . . .		5-7
5-3	Location Diagram of Major Electronics Equipment Components, Bottom View . . . . .		5-8
<b>SECTION 8—SCHEMATIC DIAGRAMS</b>			
8-1	Schematic Diagram, SBE-2 . . . . .		8-3/8-4
8-2	Schematic Diagram, Power Supply . . . . .		8-5/8-6

## LIST OF TABLES

<b>SECTION 1—GENERAL DESCRIPTION</b>		<b>SECTION 3—OPERATOR'S SECTION (Cont.)</b>	
Table	Page	Table	Page
1-1	Electrical Characteristics . . . . .	3-2	Front Panel
1-2	Vacuum Tube Complement . . . . .		Control Functions . . . . . 3-11
	1-4		
<b>SECTION 3—OPERATOR'S SECTION</b>		<b>SECTION 5—TROUBLESHOOTING</b>	
3-1	Table of Equivalent Control Designations . . . . .	5-1	Troubleshooting Chart . . . . .
	3-9		5-2

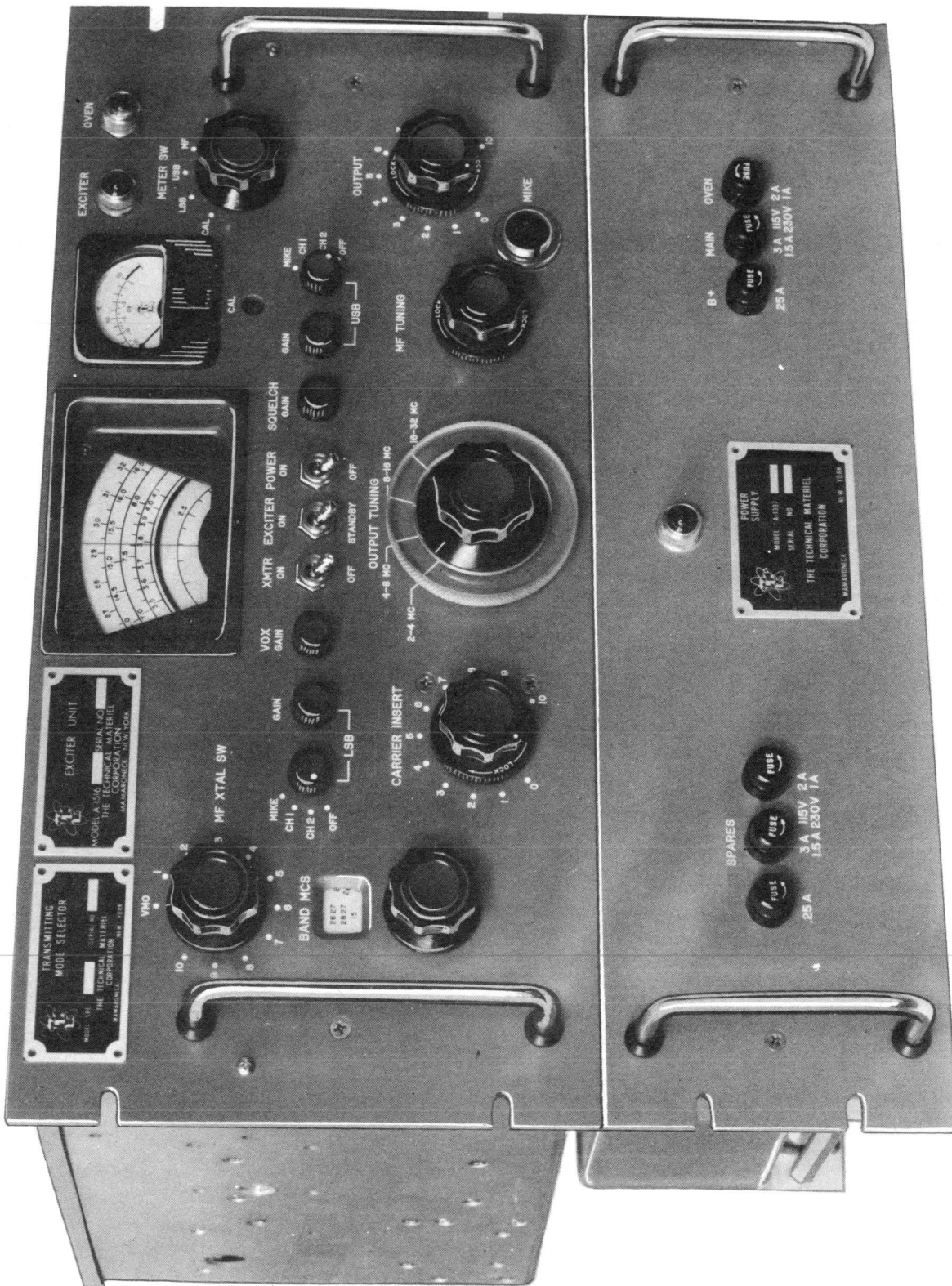


Figure 1-1-a. Front Angle View, Transmitting Mode Selector, SBE-2, and Power Supply

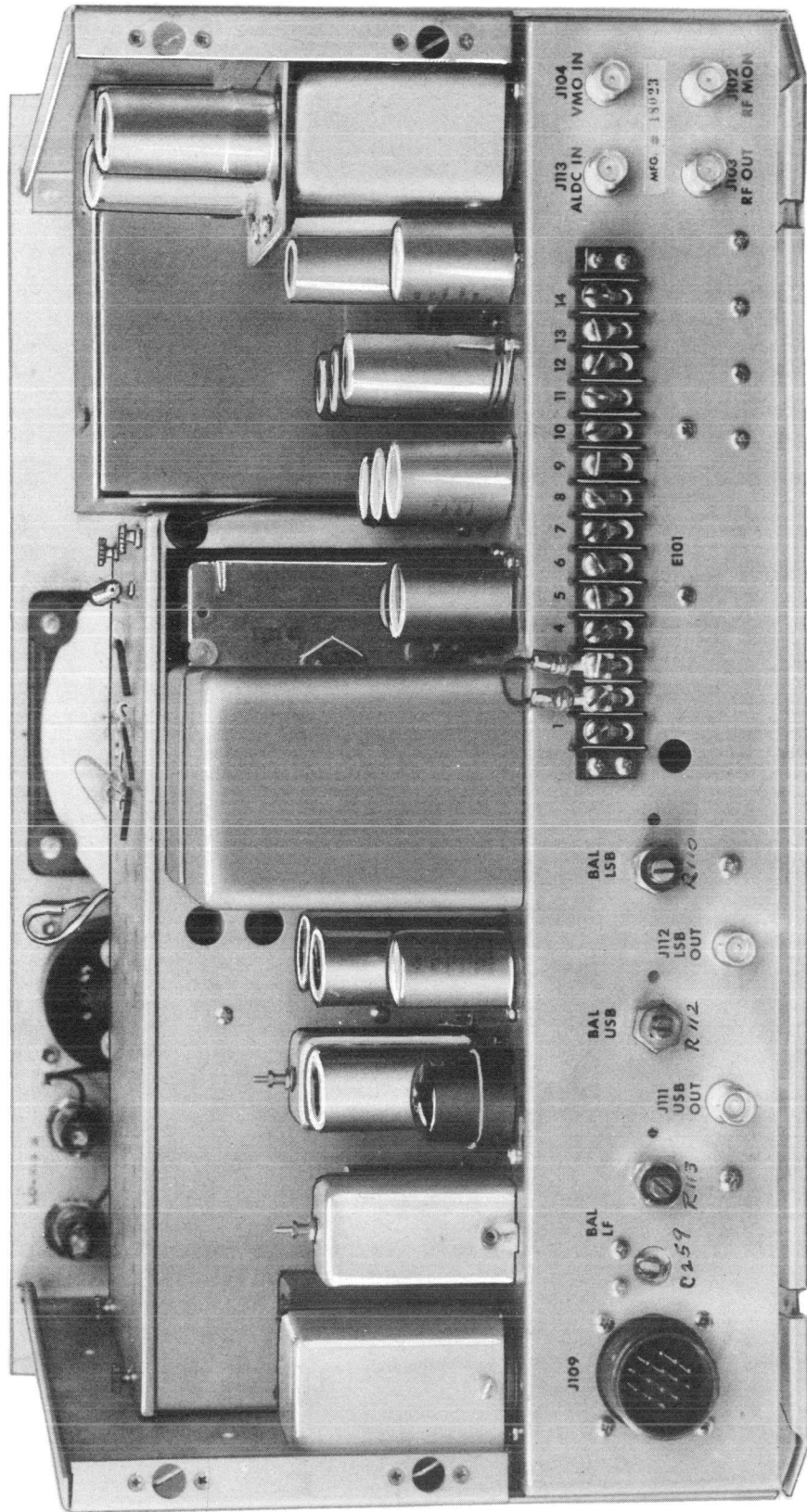


Figure 1-1-b. Rear View, Transmitting Mode Selector, SBE-2

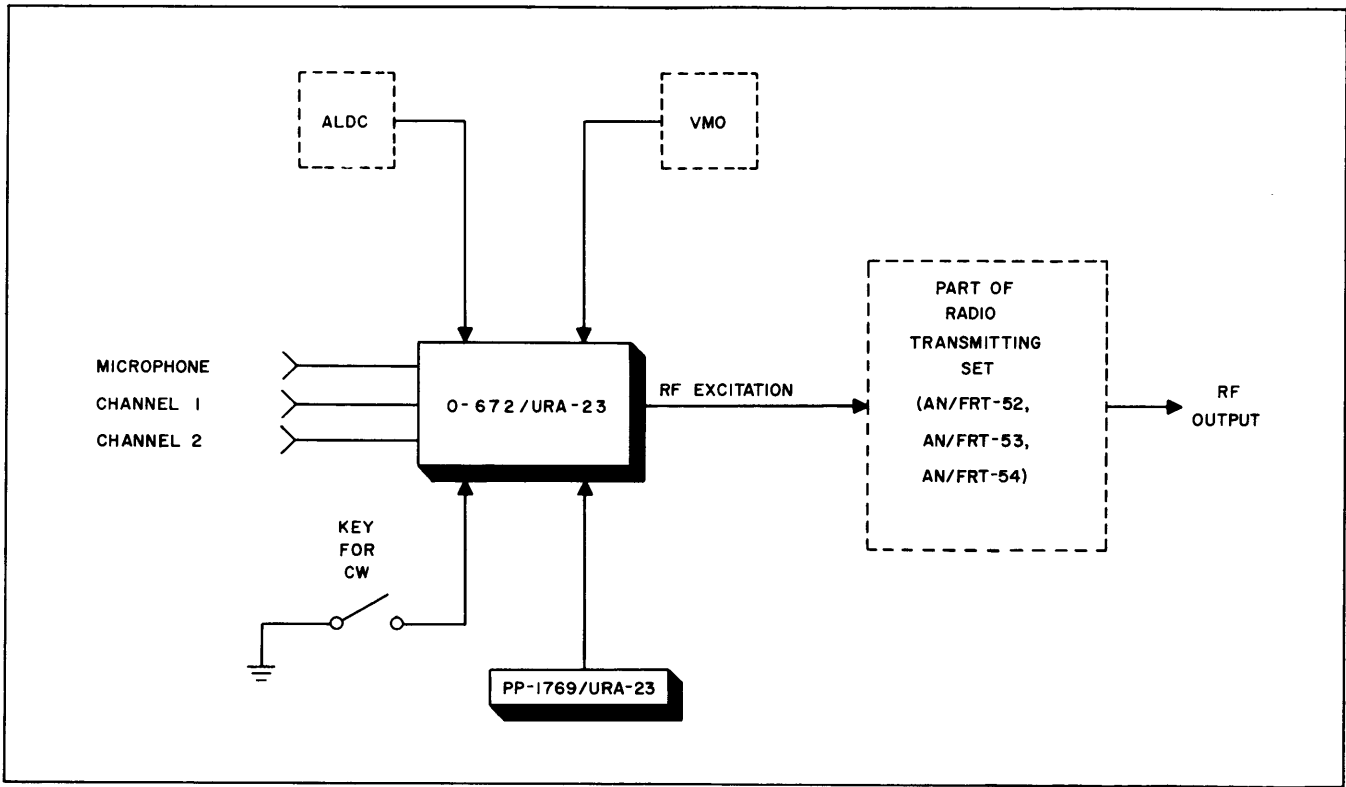


Figure 1-2. Modulator - Power Supply Group AN/URA-23A

# SECTION 1

## GENERAL DESCRIPTION

### 1-1. INTRODUCTION.

The Transmitting Mode Selector, Model SBE-2, is a filter type sideband exciter. It provides at least 1 watt PEP for single or independent sideband operation and 0.5 watts average for AM equivalent, CW, MCW, FSK, and FAX modes of operation over the range of 2 to 32 mc.

The SBE is primarily intended for use as an exciter in single sideband communication systems. The equipment may be used to develop single, double, or independent sideband transmissions with various degrees of carrier insertion as desired. It is excellently suited to serve as an exciter for any well designed, linear radio frequency amplifier that requires up to 1 watt (PEP) excitation through 72-ohm input impedance.

Commercial and military nomenclature for the SBE is as follows:

<u>Commercial</u>	<u>Military</u>
Transmitting, Mode Selector, SBE-2	Modulator Power Supply Group, AN/URA-23
a. Exciter Unit A1516	a. Oscillator, Radio Frequency 0-503 A/URA-23
b. Power Supply A-1397	b. Power Supply, PP-1769/URA-23

A voice-operated (VOX) control circuit is provided to ensure that transmission occurs only when the operator is speaking directly into the microphone. A squelch circuit is used to prevent the audio from local receivers from operating the VOX circuit. Both are front panel controls and may be easily adjusted for best performance over a wide range of operating conditions. Manual push-to-talk control may be used instead of VOX, if desired.

The following modes of operation may be selected and used with continuously adjustable amounts of carrier insertions.

- a. AM with full carrier (same intelligence on both sidebands) (A3)
- b. AM Equivalent
- c. Single Sideband (SSB) with any degree of carrier suppression from -55 db to 0 db. (A3A, A3J, A7A).
- \*d. MCW (Telegraphy) (A2) (with appropriate tone keyer)
- e. Independent Sideband (ISB, separate intelligence on each sideband with any degree of carrier suppression from -55 db to 0 db.) (A3B, A9B)

- \*\*f. Frequency-Shift Keying (FSK) (F1)
- \*\*g. CW telegraphy
- \*\*h. Facsimile (FAX) (F4)

The SBE-2 requires 14 inches of height and 15 inches of depth in any standard 19 inch relay rack. The exciter and the power supply (figures 1-1-a and 1-1-b) weigh 35 and 36 pounds, respectively. Each is easily supported by its 3/16-inch thick front panel. The exciter unit requires 8-3/4 inches of vertical panel space and the power supply unit requires an additional 5-1/4 inches of panel space.

The equipment is manufactured in accordance with JAN/MIL specifications wherever practicable. All parts and assemblies meet or exceed the highest quality standards.

### 1-2. REFERENCE DATA.

SBE's dimensions and weights are given in preceding paragraph 1-1. SBE's electrical characteristics, front panel controls, and vacuum tube complement are given in tables 1-1, 1-2, and 1-3, respectively.

#### a. AUXILIARY EQUIPMENT SUPPLIED.

(1) Power Interconnecting Cable CA-346. Approximately 3' - 9" long with two connectors, AN-3057 12P and AN-3057-12S.

(2) AC (Power Supply) Cable CA-103.72. Approximately 6-feet long; interconnects 115-volt source to power supply.

(3) Terminal Strip TM-105-14AL.

(4) Microphone Connector PL-132-3.

(5) Two UG-260/U connectors.

#### b. SHIPPING DATA.

(1) SIZE: Exciter Unit A1516 - 19 inches wide x 15 inches deep x 8-3/4 inches high. Power Supply Unit A-1397 - 19 inches wide x 8-5/8 inches deep x 5-1/4 inches high. Approximately 6 cubic feet domestic pack. Approximately 9 cubic feet export pack.

(2) WEIGHT: Exciter Unit A1516 - 35 pounds net weight. Power Supply Unit A-1397 - 36 pounds net weight. Combined domestic gross weight - 130 pounds. Combined export gross weight - 140 pounds.

\*With appropriate tone generator, such as TMC Model RTC.

\*\*With appropriate keyer, such as TMC Model XFK or TMC Model TIS-3

**TABLE 1-1. ELECTRICAL CHARACTERISTICS**

ITEM	CHARACTERISTICS
Frequency Range:	2 to 32 mc bandswitched.
Operating Modes:	AM, AM equivalent *SSB, *ISB, *DSB, CW, FSK and FAX.
Frequency control:	Temperature controlled crystals or external Variable Master Oscillator.
Frequency determining elements:	Contained in two temperature controlled, high-mass aluminum ovens designed for high thermal inertia.
Crystal oven temperatures:	75° C for 287 KC and 17 KC oscillators and 70° C for Medium Frequency and High Frequency oscillators.
MF injection requirements, crystal or variable master oscillator:	<p>Crystal positions: 10 crystals, each with independent trimmer. Selection by front panel selector switch.</p> <p>Variable master oscillator input frequency: 2 to 4.540 mc, provided by an external VMO, such as the TMC Model PMO or TMC Model VOX-5.</p> <p>VMO input impedance: 72 ohms nominal.</p> <p>VMO input voltage: Approximately 1.0 V RMS.</p>
Tuning controls:	Directly calibrated in frequency
Output power	Continuously adjustable from zero to a maximum of 1 watt PEP.
Output impedance:	72 ohms nominal.
Carrier suppression:	At least 55 db down from PEP level.
Carrier insertion:	Continuously adjustable. From -55 db to 0 db.
Connections:	<p>VMO input - BNC</p> <p>RF output - BNC</p> <p>RF monitor - BNC</p> <p>ALDC input - BNC</p> <p>Audio control - Terminal Barrier</p> <p>Mike input - 3 pin MIKE jack</p>
Spurious output:	At least 60 db below PEP output.
Distortion products:	At full PEP output, odd order distortion products are at least 45 db below either tone of a standard two tone test.
Harmonic radiation:	Second harmonic at least 40 db below PEP output. All other harmonics at least 50 db below PEP output.
Unwanted Sideband Rejection:	A signal of 500 cps in the unwanted sideband is at least 60 db down from full PEP in the wanted sideband.
Audio Input	Two independent 600-ohm channels, balanced or unbalanced +10 to -20 db level for full RF output. High impedance crystal or dynamic mike, -50 db input will produce full RF output.
Audio response per sideband:	Within ±1.5 db from 350 to 3300 cps.
VOX operation:	Voice control with anti-trip features, adjustable gain, and squelch controls.
* May be used with any degree of carrier insertion, from -55 db to 0 db.	



**TABLE 1-1. ELECTRICAL CHARACTERISTICS (Cont.)**

ITEM	CHARACTERISTIC
Metering:	Peak reading VTVM indicates: a. Audio level in USB or LSB channel. b. Mid frequency level for tuning purposes. c. SBE RF output (percent of maximum power).
Input power:	115 or 230 volts, 50 or 60 cps, single-phase, 120 watt average consumption; 140 watts at intervals when oven cycles.

**TABLE 1-2. VACUUM TUBE COMPLEMENT**

SYMBOL	TYPE	FUNCTION
V101	6AB4	Audio pre-amplifier
V102	6AB4	Audio amplifier
V103	6AB4	Audio amplifier
V104	6U8	17-kc oscillator
V105	12AU7	287-kc oscillator
V106	OA2	Voltage regulator
V107A	1/2-12AT7	USB meter amplifier
V107B	1/2-12AT7	LSB meter amplifier
V108A	1/2-12AT7	LF amplifier
V108B	1/2-12AT7	LF amplifier
V109A	1/2-12AT7	Relay amplifier
V109B	1/2-12AT7	270-kc amplifier
V110	6U8	SQUELCH and VOX amplifier
V111	6AL5	SQUELCH and VOX rectifier
V112	12AU7	Meter tube
V113	12AT7	MF modulator
V114	6AH6	MF amplifier
V115	12AU7	2- to 4-mc oscillator
V116	6CL6	HF oscillator amplifier
V117A	1/2 6U8	HF oscillator

**TABLE 1-2. VACUUM TUBE COMPLEMENT (C nt.)**

SYMBOL	TYPE	FUNCTION
V117B	1/2 6U8	Not used
V118	6AH6	1st RF amplifier
V119	6CL6	2nd RF amplifier
V120	6146	RF output amplifier
POWER SUPPLY		
V401	5R4	Rectifier
V402	OA2	Voltage regulator

## SECTION 2 INSTALLATION

### 2-1. GENERAL.

The following text explains in detail, the steps taken by TMC in packaging its electronic equipment. This packaging procedure may be used as an aid in unpacking or repacking the equipment for shipping or storage.

The unit is first covered with paper, to avoid scratches, then placed in a cardboard carton. Heavy corrugated cardboard fillers are then wedged around the unit to obtain a tight fit. The necessary connecting cables, supplied with the SBE, are also included in this carton. The carton is then sealed and placed in a moisture-proof barrier bag which is also sealed. The barrier-bag enclosed carton is then placed into a strong wooden packing box and wedged to obtain a tight fit. The wooden packing box cover is then nailed on and secured by two steel straps sealed at the top of the packing box.

### 2-2. INITIAL INSPECTION.

Since SBE-2 units have been thoroughly tested and calibrated before shipment, only minor preparations are required to put the units into operation.

Upon arrival of the equipment at the operating site, inspect the packing case and its contents immediately for possible equipment damage. Unpack the equipment carefully and inspect all packing material for parts which may have been shipped as "loose items."

With respect to damage to the equipment for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

The equipment is shipped with all tubes and other plug-in devices installed. Check that all such components are properly seated in their sockets.

### 2-3. 115- VS 230-VOLT POWER SUPPLY CONNECTIONS.

SBE's power supply is designed for 115- or 230-volt, 50- or 60-cps, single-phase power; it is factory wired for 115 volts. If 230-volt operation is required, minor wiring changes to SBE's power supply and crystal oven are necessary. These are shown in figure 2 1.

### 2-4. INTERCONNECTING PROCEDURE.

Proceed as follows:

a. Mount the SBE and its power supply in a standard 19-inch relay rack or other housing as desired. Figure 2-2 is an outline dimensional drawing of the SBE and its power supply.

b. Connect cable CA-346 (supplied) from J402 (ref. 1, figure 2-2) power supply to J109 (ref. 2, figure 2-2) of the SBE.

c. Set the three toggle switches in the center of the front panel to the following positions: XMTR ON-OFF to OFF, EXCITER ON-STANDBY to STANDBY, POWER ON-OFF to OFF.

d. Connect Cable CA-103.72 (supplied) from J401 (ref. 3, figure 2-2) of the power supply to an AC source.

e. Connect RF OUT connector J103 (ref. 4, figure 2-2) of the SBE to the input of the associated transmitter. Use one of the two (supplied) connectors UG-260/U, or RG-59/U.

f. If an external VMO is to be used, connect it to VMO IN connector J104 (ref. 5, figure 2-2) on the rear of the SBE and use the MF XTAL SW in the VMO position. Use one of the two (supplied) connectors UG-260/U, or RG-59/U.

g. For local voice operation, connect high impedance (1/2-megohm) crystal or dynamic microphone to the MIKE jack on the front panel of the SBE. Use microphone connector PL-132-3 supplied.

h. ALDC INPUT connector J113 (ref. 6, figure 2-2), connected on the rear apron of the chassis, is furnished for connection of an ALDC (Automatic Load and Drive Control) signal. This ALDC signal may be obtained from any TMC linear amplifier.

i. Two sideband monitor connectors, LSB OUT J111 and USB OUT J112 (ref. 7 and ref. 8, figure 2-2) are provided on the rear apron of the chassis. These connectors are provided for audio sampling of the upper sideband and lower sideband signals with any suitable audio monitoring device.

j. An r-f monitor connector, RF MON J102 (ref. 9, figure 2-2) is provided on the rear apron of the chassis. This connector is provided for sampling of the r-f output signal with any suitable r-f monitoring device, such as the TMC Model PTE-3.

## 2-5. INITIAL ADJUSTMENTS AND INSTALLATION OF MF CRYSTALS.

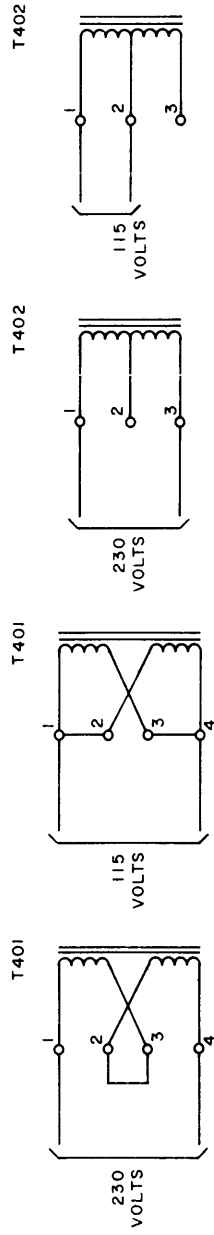
Proceed as follows:

a. Set POWER ON-OFF switch to the ON position. Allow 1-hour warm-up period to allow crystal ovens to reach their operating temperatures ensuring frequency stability.

b. After the 1-hour warm-up period, turn the METER switch to CAL and zero meter M101 (if necessary) by screwdriver adjustment through the front panel opening located directly beneath the meter.

c. The equipment is now ready to be tuned. (refer to Section 3.)

Refer to paragraph 4-4 for proper crystal selection for desired output frequency. To insert crystals, open oven top by turning snap screws half-turn counterclockwise. Remove cover and celotex insulation and install crystals. Sockets 1, 2, 3, etc., correspond to positions of front panel switch MF XTAL SW. The crystal trimmers are factory adjusted for average crystals, but for more accurate frequency standard, an adjustment tool is provided for trimmer adjustments.



SKETCH A - POWER SUPPLY

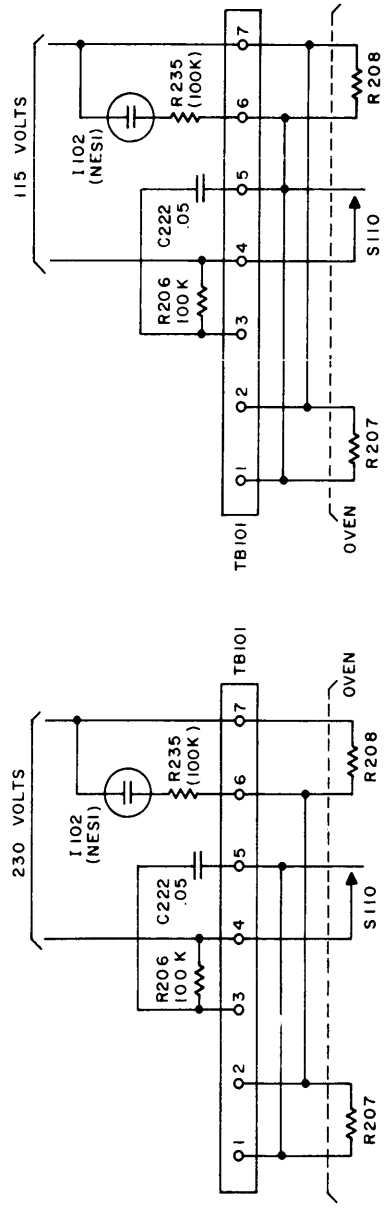


Figure 2-1. Installation Diagram Showing 115- vs 230-Volt Power Supply Connections



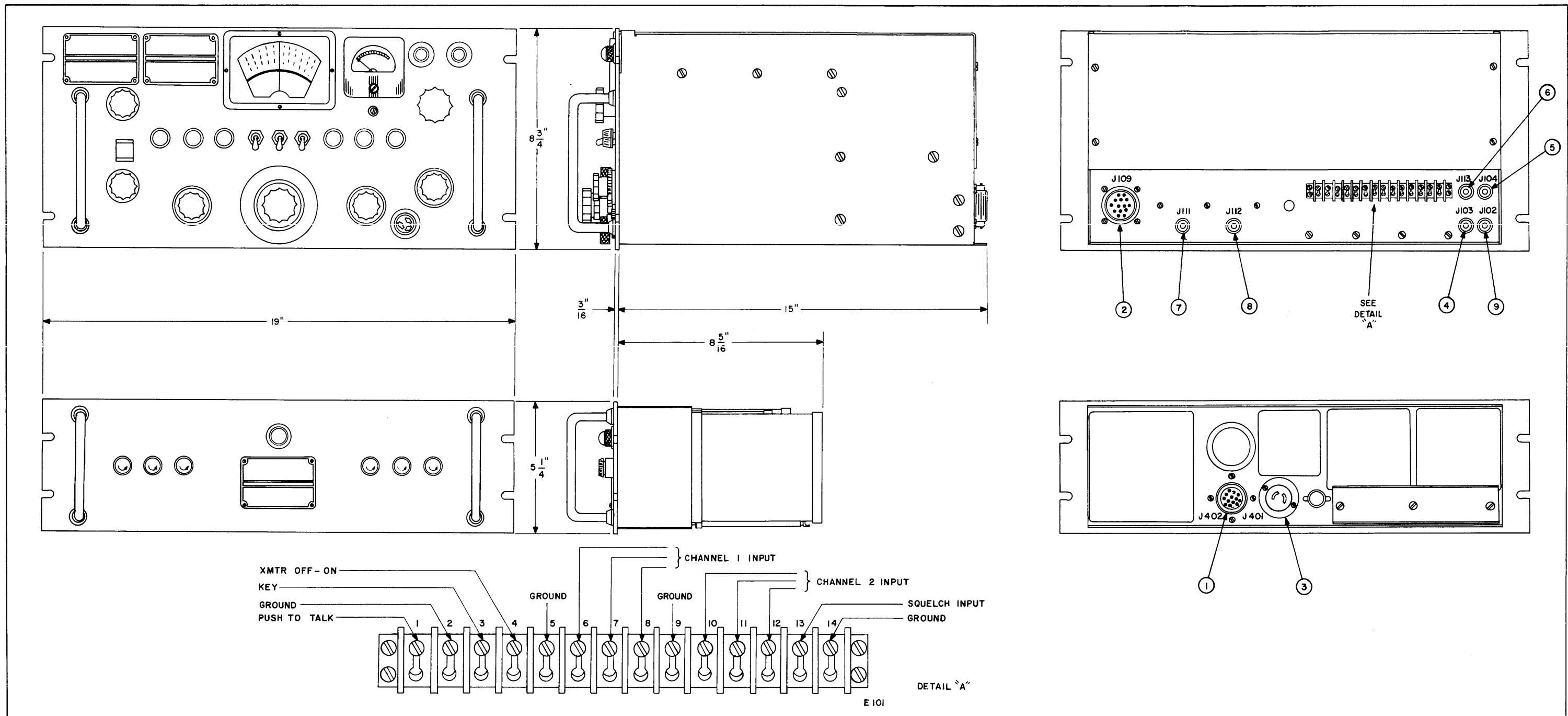


Figure 2-2. Outline Dimensional Drawing

## SECTION 3 OPERATOR'S SECTION

### 3-1. PRELIMINARY CONSIDERATIONS.

Before attempting to operate the SBE (table 3-1 and figure 3-1), the following must be considered:

- a. Mode of transmission desired.
- b. Output frequency desired (crystal selection or use of VMO, bandwidth switch settings, etc.)

Input circuit controls are as follows:

- a. LSB (channels, GAIN).
- b. USB (channels, GAIN).
- c. MIKE

LSB control places audio channel 1, 2, or MIKE in the lower sideband position; USB control places audio channel 1, 2, or MIKE in the upper sideband position. A microphone connection is made to MIKE connector.

Initially, output frequency requirements are concerned with the following front panel controls: MF XTAL SW (1), BAND MCS (20), and OUTPUT TUNING knob (bandswitch element 17). Subsequently, tuning concerns the following front panel controls: OUTPUT TUNING disc (tuning element 16), MF TUNING (14), OUTPUT (level control 12), and METER SW (9) and its associated meter.

In this category of operations, the first consideration is whether the medium frequency (2 to 4 mc) is to be supplied by an external VMO or an internal crystal. If by a VMO, the MF XTAL SW is placed in the VMO position; if by a crystal, MF XTAL SW is placed in the position that selects the proper crystal. More information on this phase of operation is given in the discussion below of medium frequency circuit controls.

The output frequency ( $f_o$ ) desired requires the use of the proper medium frequency ( $f_{mf}$ ) whether supplied by an external VMO or a crystal. If the desired output frequency ( $f_o$ ) is between 4.27 and 32.27 mc, adjust the BAND MCS switch (20, figure 3-1) to the frequency range containing the output frequency desired. Located below the desired frequency range on the BAND MCS dial is a number hereafter referred to as the Dial Numeric. This Dial Numeric is used to compute the crystal or VMO frequency ( $f_x$ ).

This frequency is computed by using the following formula:

$$f_x = (2N - f_o) + .270 \text{ mc}$$

where:  $f_x$  = Internal crystal or external VMO frequency.

$f_o$  = output frequency.

N = Dial Numeric (see chart below)

0.270 mc = Internally generated mixing frequency.

#### BAND MCS DIAL MARKINGS

( $f_o$ ) OUTPUT FREQ. RANGE	(N) DIAL NUMERIC	INJECTION FREQ.
2.0 - 4.27 mc	0	(see note)
4.27- 6.27 mc	4	8 mc
6.27- 8.27 mc	5	10 mc
8.27-10.27 mc	6	12 mc
10.27-12.27 mc	7	14 mc
12.27-14.27 mc	8	16 mc
14.27-16.27 mc	9	18 mc
16.27-18.27 mc	10	20 mc
18.27-20.27 mc	11	22 mc
20.27-22.27 mc	12	24 mc
22.27-24.27 mc	13	26 mc
24.27-26.27 mc	14	28 mc
26.27-28.27 mc	15	30 mc
28.27-30.27 mc	16	32 mc
30.27-32.27 mc	17	34 mc

#### NOTE

When the desired output frequency falls in the frequency range of 2.0 to 4.27 mc, there is no dial numeric. Therefore, an 18 mc injection frequency is applied to the HF Balanced Modulator. This is done to maintain bias on the modulator diodes, to prevent intermodulation distortion. Since the RF amplifiers are tuned to the 2.0 to 4.27 mc range, the sum and difference frequencies, produced by the 18 mc injection frequency will be far removed, and thus will have no effect on circuit operation.

Example:

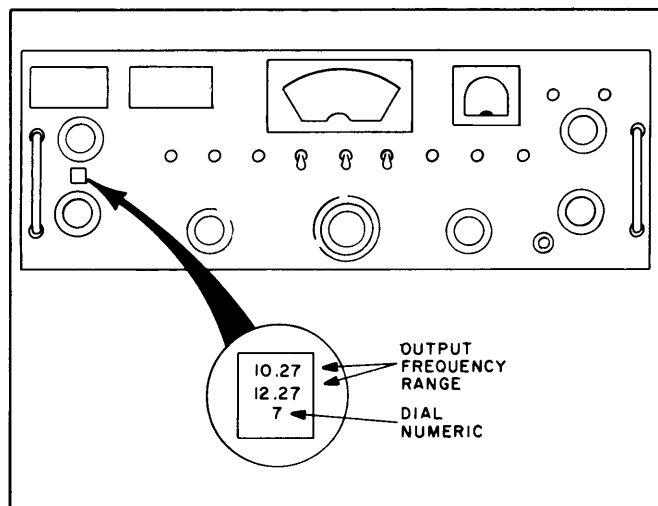
Suppose an output frequency of 10.5 mc is desired:

$$f_x = 2N - f_o + .270 \text{ mc}$$

$$f_x = 14.0 \text{ mc} - 10.5 \text{ mc} + .270 \text{ mc}$$

$$f_x = 3.770 \text{ mc}$$





### NOTE

The MF dial, moving in conjunction with the MF TUNING control (ref. 14, figure 3-1) is calibrated to read 270 kc above the actual MF frequency. Therefore, the MF dial reads the VMO or crystal MF injection frequency resulting in  $f_x - \text{MF dial reading}$ .

The degree of 270 kc carrier insertion is controlled by the front panel CARRIER INSERT (19) control which varies the level of carrier in relation to sideband intelligence. The magnitude of the carrier relative to sidebands may be determined by use of a spectrum analyzer.

The medium frequency modulator is adjusted by the CARRIER INSERT (19), MF TUNING (14) and METER SW (9) controls. The medium frequency modulator receives 270 kc sideband signals and VMO or MF XTAL frequencies. Its output circuit is tuned to the lower sideband of the VMO or MF XTAL frequency.

The high frequency modulator, together with the RF circuit tuning elements, are adjusted by the front panel BAND MCS (20), OUTPUT TUNING (16) (17), OUTPUT (12) and METER SW (9) controls.

The high frequency modulator receives the lower sideband output of the medium frequency modulator in addition to the output of the high frequency crystal oscillator. The output and RF circuits are tuned to the lower sideband of the high frequency crystal oscillator's frequency, to prevent signal inversion.

Referring to meter circuit and miscellaneous controls, the transmitter is operated with the front panel controls listed below as shown:

VOX GAIN (18):	Fully ccw
XMTR (3):	ON
EXCITER (4):	ON
POWER (5):	ON
SQUELCH GAIN (15):	Fully ccw

Refer to Section 4, Principles of Operation for further details.

### 3-2. SINGLE SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION.

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
<b>Part I - Tuneup on Carrier:</b>			
1	3	XMTR toggle switch, ON.	Not effective on tuneup on carrier. Refer to paragraph 4-6.
2	4	EXCITER toggle switch, ON.	
3	18	VOX GAIN, fully ccw.	
4	15	SQUELCH GAIN, fully ccw.	
5	21, 22	LSB, OFF/GAIN, fully ccw.	Not in circuit on tuneup on carrier.
6	10, 11	USB, OFF/GAIN, fully ccw.	
7	5, 8	POWER toggle switch, ON	Energizes unit. OVEN indicator 8 should go on.
8	1	MF XTAL SW, use correct MF VMO/XTAL, frequency.	Refer to paragraph 3-1.
9	20	BAND MCS, use correct MF frequency.	Refer to paragraph 3-1. Provides 100% carrier. (0 db)
10	19	CARRIER INSERT, fully cw.	
11	9	METER SW, MF position.	In preparation for step 13.
12	16, -17, 2	OUTPUT TUNING switch: knob 17 (coarse setting) for proper band, and disc 16 (vernier setting) for a frequency slightly below the desired output frequency on multi-scale dial 2.	In preparation for step 13.

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
<b>Part I - Tuneup on Carrier (Cont.)</b>			
13	14, 6, 19	MF TUNING knob 14, tune MF. Peak SBE's meter 6 reading.	Decrease CARRIER INSERT 19 as necessary to avoid an off-scale reading. The reading on single-scale dial 2 should agree with the frequency of VMO on MF XTAL SW 1.
14	9	METER SW, RF position.	In preparation for step 15.
15	16, 6	OUTPUT TUNING disc 16, tune RF PEAK SBE's meter 6 reading.	Advance the OUTPUT TUNING <del>disc</del> <del>control</del> 16 slightly to peak the reading on the SBE's meter.
			<b>Note</b>
			Several peaks, due to modulation products, are possible. The correct (lower sideband) peak is the first one encountered as the vernier switch is slightly advanced.
16	12, 19	Adjust OUTPUT knob 12 to control magnitude of the RF output.	Operation of OUTPUT knob 12 controls the magnitude of the RF output. The same is true by operating CARRIER INSERT <del>control</del> 19.
17		The SBE is now tuned on carrier.	<u>CONTROL</u>
<b>Part II - Tuneup on SSB with Any Degree of Carrier Insertion:</b>			
18	21, 22	LSB circuit to CH 1, CH 2, or MIKE as required. Set GAIN to mid position.	To place audio channel in lower sideband.
19	10, 11	USB circuit to CH 1, CH 2, or MIKE as required. Set GAIN to mid position.	To place audio channel in upper sideband.
20	19	Set CARRIER INSERT to 0.	To suppress carrier 100% (-55 db)
21	6, 9, 10, 11, 21, 22	Set METER SW 9 to USB or LSB. Advance or decrease GAIN control 11 or 21 as required until meter shows a maximum reading of 100 on audio peaks. (Lower peak values are frequently compatible with sufficient RF output as determined by the subsequent setting of OUTPUT control 12.)	<b>CAUTION</b>
			With METER SW 9 in USB, LSB, or RF position, meter peaks must never exceed 100 as intermodulation distortion may become excessive beyond this point.
22	9	Set METER SW 9 to RF position.	Preparatory to step 23.
23	12, 19	Adjust OUTPUT control 12 for desired level simultaneously with adjusting CARRIER INSERT control 19 for desired degree of carrier insertion.	

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
Part II - Tuneup on SSB with Any Degree of Carrier Insertion (Cont.)			
24	6, 9, 12, 19	With METER SW 9 in RF position and CARRIER INSERT 19 in 0 position, set OUTPUT control 12 to give meter 6 reading of 90 with one of the audio channels in operation. Now advance CARRIER INSERT control 19 until meter 6 reading becomes 100.	Steps 24 and 25 illustrate the procedure to inject a carrier 20 db down from full PEP. Increasing a meter reading of 90 due to audio with no carrier and to 100 with carrier (audio level unchanged) signifies a carrier level of 10% (-20 db) of the combined audio and carrier level
<b>Note</b>			
As explained more fully in Section 5, the SBE's meter circuit, as is the case with most VTVM's, has a small amount of waveform error. For this reason, carrier and sideband additions may not be precisely linear.			
25	12	Decrease OUTPUT control 12 for desired PEP output. Do not change audio and carrier settings (11, 19, and 21).	Decreases audio and carrier proportionately.

### 3-3. DOUBLE SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION.

Part I, tuneup on carrier, is the same as part I in paragraph 3-2. After completing part I, proceed as follows: (For convenience, the following steps, 18

through 32, assume that channel 1 is used on both lower and upper sidebands with either 0- or 10-percent carrier insertion. In case channel 2 is used on both lower and upper sidebands with either 0- or 10-percent carrier insertion, substitute CH 2 for CH 1 in the settings of USB 10 and LSB 22 controls.)

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
Part II - Tuneup on DSB with Any Degree of Carrier Insertion:			
<b>Note</b>			
Step numbering begins with 18 since this part II follows part I of paragraph 3-2.			
18	21, 22	LSB circuit to CH 1; set GAIN to quarter-scale.	To place desired audio channel in lower sideband.
19	19	CARRIER INSERT, set to 0.	To suppress carrier 100%.
20	10, 11	USB circuit to OFF; set GAIN to quarter-scale.	To cut off desired audio channel in upper sideband.
21	9	Set METER SW to LSB.	To measure desired audio channel level in lower sideband.
22	6, 20	Adjust LSB GAIN until the meter shows the following readings on audio peaks: Carrier Insertion Eventually Wanted <u>0</u> 10% (-20 db)	To obtain proper desired audio channel level in lower sideband with or without 10% carrier insertion.
23	22	Set control 22 to OFF.	To cut off desired audio channel in lower sideband.

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
Part II - Tuneup on DBS with Any Degree of Carrier Insertion (Cont.)			
24	10, 11	USB circuit to CH 1; set GAIN to quarter-scale.	To place desired audio channel in upper sideband.
25	19	CARRIER INSERT, leave on 0.	To suppress carrier 100%.
26	9	Set METER SW to USB.	To measure desired audio channel level in upper sideband.
27	6, 11	Adjust USB GAIN until the meter shows the following readings on audio peaks: Carrier Insertion Eventually                      Audio <u>Wanted</u> <u>Peaks</u> 0    50 10% (-20 db)                      45	To obtain proper desired audio channel level in upper sideband with or without 10% carrier insertion .
28	9	Set METER SW to RF.	To measure audio levels after RF modulation.
29	12, 6	Advance OUTPUT control 12 from 0 until meter 6 reads same as in step 27.	Check that LSB switch is OFF and USB switch is in desired channel.
30	10, 22	Set USB switch to OFF and LSB switch to its desired channel.	Check that METER SW is in RF position.
31	6, 21	Note reading on meter 6. Readjust LSB GAIN control 21 until meter 6 reads same as in step 22.	
32	6, 22, 10	Turn controls 22 and 10 to place CH 1 in both sidebands. Meter 6 should now read as follows on peaks: Carrier Insertion Finally                              Audio <u>Wanted</u> <u>Peaks</u> 0    100 10% (-20 db)                      90	
<b>Note</b>			
As explained more fully in Section 5, the SBE's meter circuit, as is the case with most VTVM's, has a small amount of waveform error. For this reason, carrier and sideband additions may not be precisely linear.			
33	19	Set CARRIER INSERT to give desired amount of carrier insertion. For 0 insertion: turn control 19 to 0; peak readings on meter 6 should reach 100. For 10%(-20 db) insertion: advance control 19 until peak readings on meter 6 rise from 90 to 100.	

### 3-4. INDEPENDENT SIDEBAND WITH ANY DEGREE OF CARRIER INSERTION.

Part I, tuneup on carrier, is the same as part I in paragraph 3-2. After completing part I, proceed as follows: (For convenience, the following steps, 18 through 32, assume that channel 1 is used on the lower

sideband and channel 2 is used on the upper sideband with either 0- or 10-percent carrier insertion. In case channel 1 is used on the upper sideband and channel 2 is used on the lower sideband with either 0- or 10-percent carrier insertion, substitute CH 2 or CH 1 and vice versa in the settings of USB 10 and LSB 22 controls.)

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
<u>Part II - Tuneup on ISB with Any Degree of Carrier Insertion:</u>			
<b>Note</b>			
Step numbering begins with 18 since this part II follows part I of paragraph 3-2.			
18	21, 22	LSB circuit to CH 1; set GAIN to quarter-scale.	To place desired audio channel in lower sideband.
19	19	CARRIER INSERT, set to 0.	To suppress carrier 100%(-55 db).
20	10, 11	USB circuit to OFF; set GAIN to quarter-scale.	To cut off desired audio channel in upper sideband.
21	9	Set METER SW to LSB.	To measure desired audio channel level in lower sideband.
22	6, 20	Adjust LSB GAIN until the meter shows the following readings on audio peaks: Carrier Insertion Eventually <u>Wanted</u> <u>Audio Peaks</u> 0                                      50 10% (-20 db)                      45	To obtain proper desired audio channel level in lower sideband with or without 10% carrier insertion.
23	22	Set LSB channel control 22 to OFF.	To cut off desired channel in lower sideband.
24	10, 11	USB circuit to CH 1; set GAIN to quarter-scale.	To place desired audio channel in upper sideband.
25	19	CARRIER INSERT, leave on 0.	To suppress carrier 100% (-55 db).
26	9	Set METER SW 9 to USB.	To measure desired audio channel level in upper sideband.
27	6, 11	Adjust USB GAIN until the meter shows the following readings on audio peaks: Carrier Insertion Eventually <u>Wanted</u> <u>Audio Peaks</u> 0                                      50 10% (-20 db)                      45	To obtain proper desired audio channel level in proper sideband with or without 10% carrier insertion.
28	9	Set METER SW 9 to RF.	To measure audio levels after RF modulation.
29	12, 6	Advance OUTPUT control 12 from 0 until meter 6 reads same as in step 27.	Check that LSB switch is OFF and USB switch is in desired position.
30	10, 22	Set USB switch to OFF and LSB switch to its desired channel.	Check that METER SW is in RF position.
31	6, 21	Note reading on meter 6. Readjust LSB GAIN control 21 until meter 6 reads same as in step 22.	
32	6, 22, 10	Turn controls 22 and 10 to place CH 1 or CH 2 in both sidebands. Meter 6 should now read as follows on peaks: Carrier Insertion <u>Finally Wanted</u> <u>Audio Peaks</u> 0                                      100 10% (-20 db)                      90	

STEP	PANEL CALLOUT NO.	OPERATION	PURPOSE
Part II - Tuneup on ISB with Any Degree of Carrier Insertion: (Cont.)			
<b>Note</b>			
As explained more fully in Section 5, the SBE's meter circuit, as is the case with most VTVM's has a small amount of waveform error. For this reason, carrier and sideband additions may not be precisely linear.			
33	19	Set CARRIER INSERT to give desired amount of carrier insertion. For 0 insertion: turn control 19 to 0; peak readings on meter 6 should reach 100. For 10% (-20 db) insertion: advance control 19 until peak readings on meter 6 rise from 90 to 100.	

### 3-5. CONVENTIONAL AM OPERATION.

Part I, tuneup on carrier, is the same as part I in paragraph 3-2, Part II, conventional AM operation (50-percent carrier insertion) is the same as part II in paragraph 3-3 except for the following modifications:

- a. Steps 22 and 27 should be modified as follows:

<u>Carrier Insertion Eventually Wanted</u>	<u>Audio Peaks</u>
50% (-6 db)	25

- b. Step 32 should be modified as follows:

<u>Carrier Insertion Finally Wanted</u>	<u>Audio Peaks</u>
50% (-6 db)	50

c. Step 33 should be modified as follows: Set CARRIER INSERT to give desired amount of carrier insertion. For 50% (-6 db) insertion: advance control 19 until peak readings on meter 61 rise from 50 to 100.

### 3-6. FREQUENCY-SHIFT TELEGRAPH OPERATION.

In frequency - shift telegraph operation, the SBE-2 must obtain a frequency - shift signal from any suitable external source, such as a TMC Model XFK, Frequency Shift Exciter or a TMC Model TIS-3, Tone Intelligence Unit. To obtain frequency-shift telegraph operation, perform the following steps:

- a. Perform the procedure shown in paragraph 3-2, Step 1 in this manual.

b. Set the CARRIER INSERT potentiometer (ref. 19, figure 3-1) to position 10.

c. Set the MF XTAL SW (ref. 1, figure 3-1) to the VMO position.

d. Connect the external frequency-shift signal to the SBE-2 VMO IN connector J104.

### 3-7. CW TELEGRAPH OPERATION.

Part I, tuneup on carrier, is the same as part I in paragraph 3-2. Part II, CW telegraph operation, is as follows:

a. Remove jumper from pins 2 and 3. (E101 on rear of SBE.)

b. Connect key, proper TIS-3 or XFK output from pins 3 to ground.

c. Turn LSB and USB switches 22 and 10 to OFF.

d. Turn CARRIER INSERT 19 to fully cw position.

e. Turn METER SW 9 to RF position.

f. Advance OUTPUT 12 control to drive transmitter with proper SBE output.

### 3-8. VOX AND SQUELCH CIRCUIT OPERATION.

The VOX and SQUELCH circuits may be used when transmitters are actuated by speech into an associated microphone. In this case, the VOX circuit should be adjusted so that only the intermittent voice peaks actuate the VOX relay which turns on the transmitter. The

time constant of the VOX circuit is such that the intermittent voice peaks keep the transmitter turned on so long as there is reasonable strong speech coming into the MIKE, otherwise, a transmitter is turned on manually or by keying. The SQUELCH circuit, on the other hand, should be adjusted so that extraneous sounds that reach the MIKE do not turn on the transmitter. Of course, if the extraneous sounds are loud enough the action of the VOX circuit overpowers that of the SQUELCH circuit; consequently, the transmitter is turned on in this case. General field practice is such that the VOX and SQUELCH circuits are rarely used.

a. VOX ADJUSTMENT. - The VOX circuit functions only in SSB and DSB operation of the unit and not with conventional AM or SSB with carrier. Proceed as follows:

(1) Set EXCITER ON-STANDBY switch 4 to STANDBY position.

(2) Talking directly into the mike, adjust VOX GAIN control 18 until EXCITER lamp 7 remains on with normal speech level but extinguishes with no speech input. Further adjustment may be necessary to prevent background noises from actuating the exciter.

b. SQUELCH GAIN ADJUSTMENT. - Proceed as follows:

(1) Make connection from the 600-ohm audio output terminals of the station receiver to terminal 13 and ground on terminal board E101 of the SBE.

(2) Advance SQUELCH GAIN 15 until audio from the station receiver no longer trips the VOX circuit.

**TABLE 3-1. TABLE OF EQUIVALENT CONTROL DESIGNATIONS**

SERIAL DESIGNATION (SEE FIGURE 3-1)	PANEL DESIGNATION (SEE FIGURE 3-1)	COMPONENT DESIGNATION ON OVERALL SCHEMATIC DIAGRAM
1	MF XTAL SW	Knob (11-position) selector switch S107
2	2-position dial (no designation)	_____
3	XMTR ON-OFF	Toggle switch S104
4	EXCITER ON-OFF	Toggle switch S105
5	POWER ON-OFF	Toggle switch S103
6	Output meter (No designation)	Meter M101
7	EXCITER	Indicator I101
8	OVEN	Indicator I102
9	METER SW	Knob (5-position) selector switch S109
10	USB (audio channels)	Knob (4-position) selector switch S101
11	USB GAIN	Knob potentiometer R168
12	OUTPUT	Knob potentiometer R205
13	MIKE	3-conductor jack J101
14	MF TUNING	Knob variable capacitor C167, A and B
15	SQUELCH GAIN	Knob potentiometer R129
16	OUTPUT TUNING (disc)	Disc variable capacitor C181, A, B, and C
17	OUTPUT TUNING (knob)	Knob (4-position) selector switch S106, A, B, C, and D
18	VOX GAIN	Knob potentiometer R140
19	CARRIER INSERT	Knob potentiometer R106
20	BAND MCS	Knob (18-position) selector switch S108, A and B
21	LSB GAIN	Knob potentiometer R169
22	LSB (channels)	Knob (4-position) selector switch S102



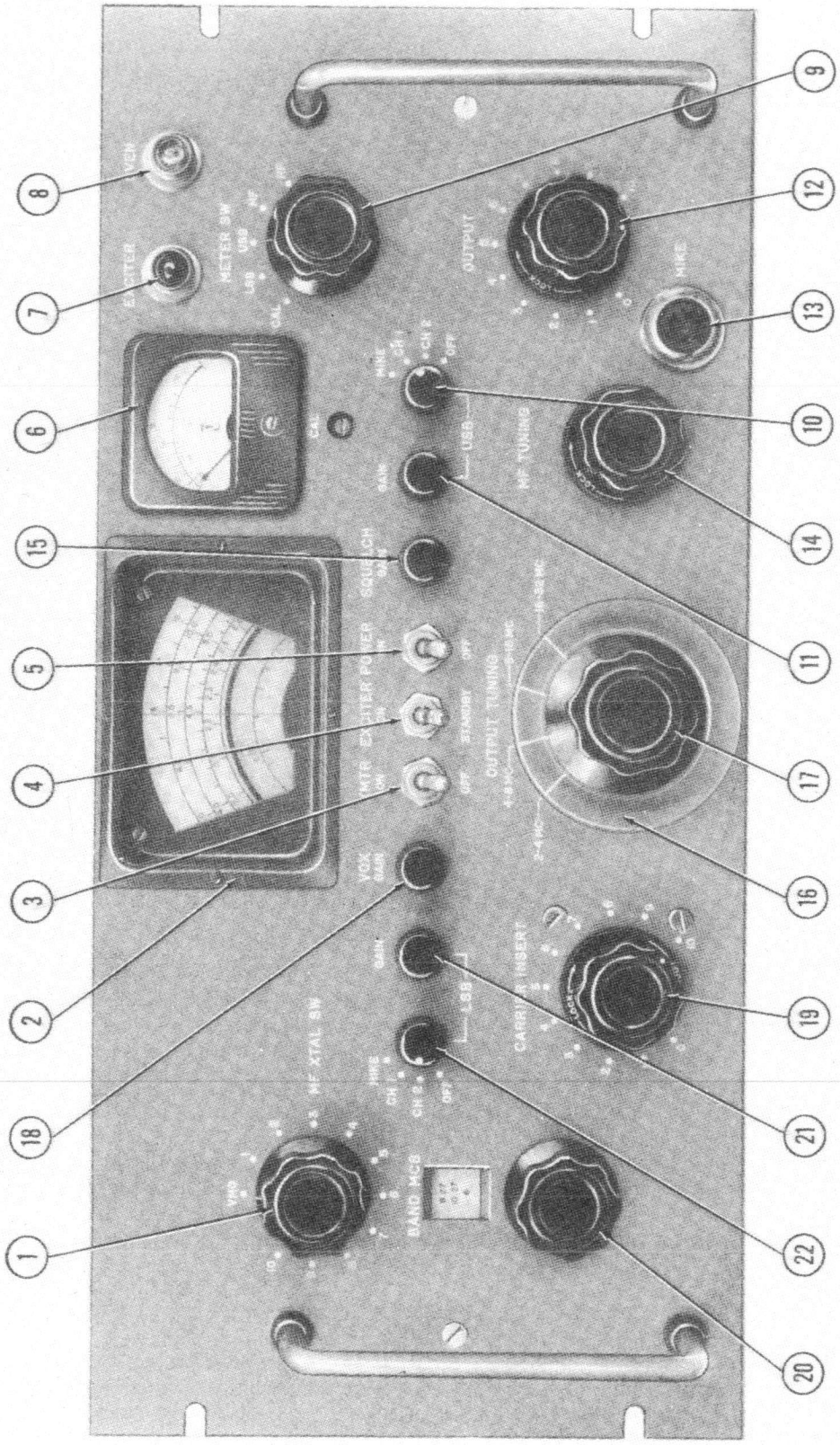


Figure 3-1. Operating Controls

**TABLE 3-2. FRONT PANEL CONTROL FUNCTIONS**

CONTROL	FUNCTION												
MF XTAL SW, S107	Selects either external VMO (variable master oscillator) or proper internal crystal for medium frequency oscillator.												
Two Section Dial	Upper dial coordinates with OUTPUT TUNING (disc, vernier) and lower dial with MF TUNING (knob).												
XMTR ON-OFF, S104	<p>ON-activates associated transmitter. Eliminates need for VOX or push-to-talk, through EXCITER ON-STANDBY (below) by completing the ground circuit of the SMTR final plates relay.</p> <p>OFF-associated transmitter operated by VOX or push-to-talk circuit when EXCITER ON-STANDBY switch is in STANDBY position.</p>												
EXCITER ON-STANDBY, S105	<p>On-activates SBE without need for VOX or push-to-talk input and without associated operating transmitter.</p> <p>STANDBY - allows VOX or push-to-talk operation to activate the SBE and its associated transmitter.</p>												
POWER ON-OFF, S103	<p>ON-applies line voltage to SBE power supply.</p> <p>OFF - turns off entire SBE.</p>												
OUTPUT meter, M101	Indicates signal levels in circuits selected by METER SW, S109.												
EXCITER lamp, I101	Glow during operation when EXCITER ON-STANDBY switch is in ON position or SBE is activated by VOX or push-to-talk.												
OVEN lamp, I102	Glow during operation when thermostats demand crystal-Oven heating (automatic).												
METER SW, S109	Selects point in system to be measured by built-in VTVM circuit. CAL position is used to zero meter.												
CAL, R135	<p>Meter adjustment located directly beneath meter. Use screw-driver to zero meter when METER SW is in CAL position.</p> <p>Balances the conduction of both halves of V112, Meter Tube.</p>												
USB (channels, GAIN), S101, R168	<p>Switch (S101) - selects audio input source for upper sideband channel. Gain (R168) - adjusts level of USB audio input.</p>												
OUTPUT, R205	Adjusts SBE output power level.												
MIKE, J101	Microphone input (substitute for 600-ohms channel input).												
MF TUNING, C167, A, B	Selects setting of medium frequency as indicated in lower section of main tuning dial.												
SQUELCH GAIN, R129	Used in conjunction with VOX GAIN. (Refer to paragraph 4-6).												
OUTPUT TUNING (disc) (vernier capacitor) S106, A, B, C, D.	Selects output frequency band and adjusts setting of main tuning dial centrally located above knob.												
VOX GAIN, R140	Voice - operated exciter circuit gain control.												
CARRIER INSERT, R263	Controls level of carrier insertion.												
BAND MCS	Indicates injection frequency range of high - frequency modulator in 2 mc increments. It is controlled by the knob beneath the dial.												
LSB (channels, GAIN) S102, R169	<p>Switch (S102) - selects audio input source for lower sideband channel. Gain (R169) - adjusts level of LSB audio input.</p>												
<b>POWER SUPPLY</b>													
Indicator lamp, I401	<p>Glow during operation. Indicates MAIN fuse intact and power is applied.</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;"><u>115 volts</u></td> <td style="text-align: center;"><u>230 volts</u></td> </tr> <tr> <td>B + fuse</td> <td style="text-align: center;">0.25 amp</td> <td style="text-align: center;">0.25 amp</td> </tr> <tr> <td>MAIN fuse</td> <td style="text-align: center;">3.0 amp</td> <td style="text-align: center;">1.5 amp</td> </tr> <tr> <td>OVEN fuse</td> <td style="text-align: center;">2.0 amp</td> <td style="text-align: center;">1.0 amp</td> </tr> </table> <p>These fuses protect their respective circuits.</p>		<u>115 volts</u>	<u>230 volts</u>	B + fuse	0.25 amp	0.25 amp	MAIN fuse	3.0 amp	1.5 amp	OVEN fuse	2.0 amp	1.0 amp
	<u>115 volts</u>	<u>230 volts</u>											
B + fuse	0.25 amp	0.25 amp											
MAIN fuse	3.0 amp	1.5 amp											
OVEN fuse	2.0 amp	1.0 amp											

## SECTION 4

### PRINCIPLES OF OPERATION

#### 4-1. INTRODUCTION.

As shown in figure 4-1, the SBE-2, together with its power supply, consists of the following seven principle sections:

- a. Audio input section
- b. 17- and 287-kc oscillator and balanced modulator section
- c. 2- to 4-mc MF section
- d. 2- to 32-mc HF section
- e. SQUELCH and VOX section
- f. M101 meter section
- g. Power supply section

The audio input section is provided with two "line" channels and one "microphone" channel which are equipped with functional switches S101, S102, and S106D to route incoming intelligence to audio amplifiers V103 and/or V102. For example, the microphone input may be routed to V103, V102, or V103 and V102; the same is true of signals received from LINE channel 1 or 2. If desired, signals received from LINE channel 1 and from LINE channel 2 may be simultaneously and independently routed to V103 and V102, respectively. Likewise, microphone and LINE channel 1 signals may be simultaneously and independently routed to V103 and V102, respectively. The functional switches provide flexibility in the routing of audio signals singly or independently in pairs to V103 and V102. The audio input section is also provided with two meter amplifiers, V107 and V107B, and associated meter rectifiers CR104 and CR105. These circuits indicate the power level of incoming audio signals, which are important factors from the standpoint of avoiding the overloading of the following 17-kc balanced modulator section.

The 17-kc oscillator and balanced modulator section modulates the audio outputs from the audio input section, placing the intelligence in the 17-kc upper and/or lower sideband frequency regions ( $17 \pm 3$  kc). The output of LSB filter Z101 consists of a small amount of 17-kc carrier and signals in the 17 -3 kc frequency range; the output of USB filter Z102 consists of a small amount of 17-kc carrier and signals in the 17 +3 kc frequency range. The 17-kc notch filter Z106 removes the 17-kc carrier in these two sidebands. The output of 17-kc amplifier (V108, 12AT7) contains the LSB and USB signals with as much 17-kc carrier reinsertion as desired by the setting of R106, a front panel knob potentiometer

control. The signal bandwidth at this point is 6 kc with LSB and USB operation, or 3 kc with either LSB or USB operation.

The 287-kc oscillator and balanced modulator section modulates the 17-kc sidebands (with or without carrier reinsertion), placing the intelligence in the 287-kc lower sideband in the frequency range of  $270 \pm 3$  kc. The principal components in this section comprise bridge-type modulator CR103 with input and output transformers T106 and T108, and, of course, the 17-kc sideband input and 287-kc modulator oscillator. The 270-kc output is amplified by a double-tuned (input, output) amplifier (V109B, 1/2 12AT7), and the amplifier feeds the following 2- to 4-mc section.

The 2- to 4-mc MF section provides the third stage of modulation. In this stage, the incoming 270-kc sidebands from 1/2 12AT7 amplifier V109B are heterodyned into the 2- to 4-mc frequency range. Crystals in the 2- to 4-mc range, associated with MF XTAL SW S107, may be used in the modulation process or an external VMO may be used. The arrangement of V113, with input and output transformers T107 and T109, respectively, comprises a balanced modulator in which the 270-kc sidebands from V109B are mixed with the MF output of crystal oscillator V115 (with its crystal in S107) or with an external VMO.

The 2- to 32-mc HF section provides the fourth and final stage of modulation. In this stage, the incoming sidebands in the 2- to 4-mc range are heterodyned into the 2- to 32-mc frequency range. The arrangement of Z107, with input and output transformers T110 and T111 (part of Z107), respectively, comprises a balanced modulator in which the incoming sidebands in the 2- to 4-mc range from V114 are mixed with the HF output of the crystal oscillator consisting of V117 (with its crystal in S108) and amplifier V116; The 2- to 32-mc HF section also contains three stages of RF amplification V118, V119, and V120, together with RF amplifier tuning circuits, comprising components mounted on bandswitch wafers S106A, S106B, and S106C.

The end result of the SQUELCH and VOX section, when not disabled by setting the XMTR ON-OFF and the EXCITER ON-STANDBY toggle switches to OFF and STANDBY positions, respectively, is as follows: Operation of plate relay K101 places a local ground in the SBE on the associated transmitter's ON-OFF remote control circuit. In the case of the GPT-10K, there is no remote control ON-OFF circuit. In the case of other types of transmitters, however, when used with the SBE, provision is made for remote transmitter operation by the SBE unit.

Again, operation of plate relay K101 places plate voltage on the tubes comprising the SBE's HF section. Whether or not plate relay K101 operates depends as before on the audio signal level at any instant (a function of VOX GAIN potentiometer setting) and the sensitivity of the SQUELCH circuit during idle periods of speech (a function of SQUELCH GAIN potentiometer setting). GPT-10K's are usually operated with the XMTR ON-OFF and the EXCITER ON-STANDBY toggle switches both in ON position; in this case, the SQUELCH and VOX section is disabled (insofar as SBE and GPT-10K control by this section is concerned).

The M101 meter section provides means of indicating audio input power levels, the 2- to 4-mc MF power level, and the 2- to 32-mc HF power level. The five-position METER SW provides the following services:

- a. USB meter position indicated only the USB channel audio level.
- b. LSB meter position indicates only the LSB channel audio level.
- c. MF meter position indicates sum total of both sidebands and carrier when used. This meter position is used only to indicate proper tuning of the MF dial and, therefore, its absolute level has no real meaning.
- d. RF meter position indicates the sum total of both sidebands and carrier when used.
- e. CAL position zeroes the meter.

The power supply section provides 6.3-volt AC filament, +250-volt DC plate, +180-volt DC plate, +125-volt DC plate, and +150-volt DC regulated plate voltages.

HF adjustments, tuning, and amplification are accomplished in the RF amplifier stages. The maximum output of the SBE is approximately 1 watt (PEP), which is considerably more than ample to drive a single sideband GPT-10K.

#### 4-2. AUDIO INPUT SECTION.

(See figure 4-2.)

Connections for two audio input channels (600-ohm balanced or unbalanced) are provided on terminal board E101. External LINE channel 1 connects to terminals 6, 7, and 8; external LINE channel 2 connects to terminals 10, 11, and 12. Terminals 7 and 11 may be grounded for systems balanced to ground. Terminals 8 and 12 may be grounded when used for systems unbalanced to ground. Approximately -20 db of 1000 cps is required at each channel input for full output of the SBE. When a high impedance mike is plugged into the front panel MIKE jack J101, a pre-amp stage (V101) raises the signal level to the level required for direct channel input. The outputs of V101, T101, and T102 are fed to S101 upper (USB) and S102 lower (LSB) sideband selector switches. The audio selected by these switches (CH 1, CH 2,

or MIKE) then goes to R168 (USB GAIN) and R169 (LSB GAIN) controls. R168 and R169 center arms are connected to S106D for inverting upper and lower sideband inputs when the SBE is operating in the 3.73- to 4.27-mc range. Inversion takes place at this point to allow for a modulation inversion which occurs in a later circuit (Z107). (See figure 4-3.) The audio taken from S106D is amplified by audio amplifiers V103 and V102. Audio is also taken from the center arms of R168 (USB GAIN) and R169 (LSB GAIN) to feed meter amplifiers V107A and V107B. Outputs of these amplifiers are connected to CR104 and CR105, respectively, where incoming peaks are rectified and coupled to V112/M101, a bridge-type VTVM. This circuit is a peak reading device rather than an RMS indicating meter circuit. For example, it would read 0.7 mv on a continuous sine wave of 1-mv peak or on a single short pulse of 1-mv peak.

Other inputs on terminal board E101 include the following:

- a. Terminal 1 and ground are intended for push-to-talk keying line when the VOX and SQUELCH circuits are not in use.
- b. Terminal 2 (ground) and terminal 3 (key) are CW keying terminals and are normally connected by a jumper when CW is not being used.
- c. Terminal 4 is grounded by K101 (SBE control relay) and can be used to energize an associated RF amplifier or transmitter.
- d. Terminal 13 is in the SQUELCH input which is normally obtained from the 600-ohm output of a receiver at the operating position.

- e. Terminals 5, 9, and 14 grounded.

Functions of front panel controls that apply to this section are as follows:

a. POWER ON-OFF S103 is a toggle-switch control designated 5 on figure 3-1. ON, applies line voltage to power supply. OFF, turns SBE off entirely.

b. LSB S102 is a switch control designated 22 on figure 3-1. Selects audio input source for lower sideband channel.

c. LSB GAIN R169 is a potentiometer control designated 21 on figure 3-1. Adjusts level of LSB audio input.

d. USB S101 is a switch control designated 10 on figure 3-1. Selects audio input source for upper sideband channel.

e. USB GAIN R168 is a potentiometer control designated 11 on figure 3-1. Adjusts level of USB audio input.

f. OUTPUT TUNING KNOB S106 is part of switch control designated 17 on figure 3-1. Selects output frequency band. The associated outer disc designated 16 tunes the RF output circuits that are a part of the 2- to 32-mc HF section.

g. MIKE J101 is a connector control designated 13 on figure 3-1. Input jack to audio pre-amplifier for all high impedance microphones.

#### 4-3. 17-KC AND 287-KC OSCILLATORS AND BALANCED MODULATORS SECTION.

(See figure 4-3.)

Audio amplifiers V103 and V102 operate as either lower or upper sideband amplifiers, respectively, as explained in the preceding paragraph. However, T104 and CR101 will be referred to as the LSB 17-kc balanced modulator, and T103 and CR102 as the USB 17-kc balanced modulator. This sideband relationship is always true when the OUTPUT TUNING knob control is placed in position 1.

T104 couples incoming audio (from S106D amplified by V103) to CR101, a bridge-type diode modulator. Z104 and Z105 are in a very stable amplitude regulated 17-kc crystal oscillator circuit, the output of which is coupled to the center arms of R110 and R112. These resistors are used to equalize the injection voltage to CR101 and CR102. When this is achieved, the tuned outputs of Z101 and Z102 will consist of 17 kc-audio (LSB) and 17 kc-audio (USB), respectively. The 17-kc carrier is almost completely balanced out by the proper adjustment of R110 and R112. LSB filter Z101 is designed to pass only frequencies from approximately 17 kc to 14 kc; thus, only the sideband below the suppressed 17-kc carrier is passed on the Z106. USB filter Z102 performs in the same manner as Z101, differing in that it passes frequencies between approximately 17 kc and 20 kc, or the upper sideband, on to Z106.

The 17-kc notch filter Z106 has considerable loss in the immediate region of 17 kc. This means that as the upper or lower or upper and lower sidebands pass through the filter, the 17-kc carrier residual from the 17-kc balanced modulators will be greatly attenuated. On the other hand, the 17-kc modulated audio signals will experience relatively small loss. The 17-kc amplifier V108 amplifies these signals; its output is fed to the following 287-mc section via modulator IF transformer T107.

Front panel control R106 (CARRIER INSERT), designated 19 on figure 3-1, selects any degree of carrier insertion from -55 db to full output of the SBE. It does so by taking the required amount of 17-kc output from 17-kc oscillator Z105.

T106 couples the 17-kc modulated audio signals to a bridge-type diode modulator which also receives 287-kc voltages from 287-kc oscillator Z103. The latter voltages are injected into the modulator at LF BAL resistor R113. The double-tuned 270-kc amplifier (V109B, 1/2 12AT7) passes the LOWER sideband (287 kc - 17 kc ± audio) or 270 kc frequencies. These are fed to the following 2- or 4-mc MF modulator section.

A function of a front panel control that applies to this section is CARRIER INSERT R106 which controls level of carrier insertion. Chassis-mounted controls that apply to this section are as follows:

- (1) SLM OUTPUT jacks J111 and J112.

- (2) Modulator balance potentiometers R110, R112, and R113.

#### 4-4. 2- TO 4-MC MF SECTION.

(See figure 4-4.)

Sideband energy centering around 270 kc is coupled by T107 to pins 2 and 7 of push-pull amplifier V113. A 2- to 4-mc injection is obtained from V115 which, in turn, is fed by the crystal oscillator section or the VMO input from J104. This injection frequency is 270 kc higher than the lower sideband output of the medium frequency modulator. The mid frequency dial (the single-scale dial of control designated 2 on figure 3-1) is calibrated to read directly in terms of the MF injection frequency; however, its associated circuit is actually tuned 270 kc below it by variable capacitors C167A and C167B (knob control 14 on figure 3-1). The grids of tubes V113A and V113B are supplied with 270-kc sideband voltages as well as MF injection voltages, and the lower sideband is passed by the tuned circuits of the modulator. The balancing out of the 2- to 4-mc injection supply is accomplished by MF balance control R130 which varies the gain of the A and B sections of V113; thus, the 2- to 4-mc injection cancels in the primary of T109. The medium frequency modulator serves as the final modulation stage when output frequencies of less than 4.27 mc are required from the SBE. For output frequencies greater than 4.27 mc, its output is further raised in frequency by the high frequency modulator.

Selection of the proper crystal for use with MF XTAL SW S107 (control designated 1 on figure 3-1) is as follows: Suppose the desired RF output of the SBE is 10.235 mc. BAND MCS switch S108 (control designated 20 on figure 3-1; a part of the 2- to 32-mc HF section, refer to paragraph 4-5) shows a multiplying factor of 6 on its dial for an 8.27- to 10.27-mc range. The crystal to be selected by the position of MF XTAL SW S107 should have a frequency of  $2 \times 6 + 0.270 - 10.235$  mc or 2.035 mc. The crystal sockets associated with MF XTAL SW S107 may hold up to 10 crystals, each corresponding to a particular RF output of the SBE.

When a VMO is used to supply 2- to 4-mc MF injection, the input is via VMO IN jack J104. In this case, MF XTAL SW S107 is placed in its VMO position.

#### Note

The ALDC INPUT jack J113 provides a connection point for an ALDC (Automatic Load and Drive Control) varying negative d-c signal with a desirable attack time of 2 milliseconds and a decay time of 100 milliseconds. This requirement can be fulfilled by use of a TMC Model PAL-1K Power Amplifier.

The negative d-c signal has the effect of cutting down the output of V113 (MF modulator) by increasing its bias. An increase of negative d-c from the PAL-1K is the result of the PAL-1K approaching an over-driven condition as the result of PAL-1K load decrease or an increase in drive by the SBE.

Functions of front panel controls that apply to this section are as follows:

a. MF XTAL SW S107 is a switch control designated 1 on figure 3-1. Selects either external oscillator (VMO) or proper crystal for mid frequency oscillator.

b. MF TUNING C167A and C167B is a variable capacitor control designated 14 on figure 3-1. Tunes MF (2- to 4-mc) modulator and is associated with the single-scale dial of control designated 2 in figure 3-1.

Chassis-mounted controls that apply to this section are as follows:

a. 2- to 4-mc modulator balance potentiometer R130

b. MF OUT jack J106

c. VMO IN jack J104

#### 4-5. 4- TO 32-MC HF SECTION.

(See figure 4-5.)

The function of high frequency modulator Z107 is to provide final output frequencies from 4.27 to 32.27 mc by modulating the output of the medium frequency amplifier with an injection frequency from the high frequency oscillator. The medium frequency amplifier output is received at terminal 2 of Z107, and the HFO output at jack J110. Final output frequencies between 2 and 32 mc are fed directly into the control grid of the first RF amplifier, V118. The high frequency dial (the multi-scale dial of control designated 2 on figure 3-1) is calibrated to read directly in terms of the frequency to which RF amplifiers V118, V119, and V120 are tuned.

Injection frequencies from 8 to 34 mc in 2-mc steps are supplied by crystal-controlled high frequency oscillator V117. The proper injection is selected by the use of BAND MCS switch S108A and S108B, a front panel control designated 20 on figure 3-1. The injection is always between 1.73 mc and 3.73 mc higher than the output of Z107 because one input of Z107 is supplied by the medium frequency amplifier (whose output is the 0.27-mc lower sideband from its crystal; that is, 1.73 to 3.73 mc) and the other input is supplied by the HFO injection. The BAND MCS switch is used in the 0 position when SBE outputs below 4.27 mc are required. In this case, an 18-mc injection is applied to Z107 to prevent intermodulation distortion by keeping diodes CR107 and CR108 properly biased. The 19-mc injection and the sidebands produced in Z107 are not passed by the RF amplifiers which are tuned to 4.27 mc or less (approximately 14 mc away) in this instance.

The output of Z107 is also coupled to V118, the first RF amplifier.

The RF output taken from OUTPUT R205, a front panel control designated 12 on figure 3-1, is now at the output frequency of the SBE. The purpose of V118, V119, and V120 is to build up the generated signal to the rated 1-watt PEP output of the SBE. These stages are gang-tuned by C181A, C181B, C181C, and bandswitched by S106A, S106B, and S106C to cover the frequency range of 2 to 32 mc continuously. A fourth section of this switch, S106D, is used for inverting upper and lower sideband inputs when the SBE is operating in the 3.73- to 4.27-mc range as stated in paragraph 4-2. A small portion of the output is applied to R210 and R211 where, through C176 and CR114, a small DC voltage is produced which is proportional to the output envelope peaks of the SBE. This voltage is indicated by the V112/M101 metering circuit. An output indication of 100 equals 1-watt PEP when METER SW S109 switch is in RF out position.

Functions of front panel controls that apply to this section are as follows:

a. BAND MCS S108A and S108B is a switch control designated 20 on figure 3-1. Determines injection frequency range of high frequency modulator in 2-mc increments. Associated dial indicated frequency.

b. OUTPUT TUNING disc C181A, C181B, and C181C is a variable capacitor control designated 16 on figure 3-1. Ganged variable capacitors tune output circuits that are part of the 2- to 32-mc HF section. The associated knob selects the output frequency band.

c. OUTPUT TUNING knob S106A, S106B, S106C, and S106D. Switch control, designated 17 on figure 3-1, selects output frequency band. The associated disc tunes the RF output circuits and is associated with the multi-scale dial of control designated 2 on figure 3-1.

d. OUTPUT R205 is a potentiometer control designated 12 on figure 3-1. Adjusts SBE output power level.

The chassis-mounted control that applies to this section is 2- to 32-mc modulator balance potentiometer R150.

#### 4-6. SQUELCH AND VOX SECTION.

(See figure 4-6.)

The VOX circuit is operated by a portion of the 17-kc USB and/or LSB energies taken from 17-kc amplifier V108 and coupled to pin 2 (control grid) of V110 SQUELCH and VOX amplifier. The gain of this amplifier is controlled by VOX GAIN R140. The output is coupled to pin 2 (plate) of V111 SQUELCH and VOX rectifier. DC output is developed across R145 and C129 and amplified by relay amplifier V109 which operates K101, the SBE actuating relay. The threshold of the signal level required to operate this circuit is controlled by VOX GAIN R140.

Some negative DC is also applied to the control grid of V109 by the SQUELCH section of V111 rectifier, pins 1 through 7. The actuating signal for this part of the circuit is supplied by the SQUELCH amplifier section of V110, pins 1, 8, and 9, the input for which is terminal 13, E101, through SQUELCH GAIN control R129. The action of the SQUELCH circuit is such that audio, originating from a receiver audio output terminal, causes the opposite action of the VOX circuit. The purpose of the SQUELCH circuit is to prevent the audio from any nearby receiver from actuating the SBE. When VOX GAIN and SQUELCH GAIN are properly set, only the operator talking directly into the mike actuates the SBE.

Functions of front panel controls that apply to this section are as follows:

a. EXCITER ON-STANDBY S105 is a toggle-switch control designated 4 on figure 3-1. STANDBY allows VOX or push-to-talk input to activate the SBE and the transmitter which the SBE serves. ON activates SBE without need for VOX or push-to-talk input and without operating associated transmitter.

b. XMTR ON-OFFS104 is a toggle-switch control designated 3 on figure 3-1. ON: activates transmitter. Eliminates need for VOX or push-to-talk, through S105 (above), by completing the ground circuit of the XMTR final plate relay. OFF: transmitter operated by VOX or push-to-talk circuit when EXCITER switch is in STANDBY position.

c. VOX GAIN R140 is a potentiometer control designated 18 on figure 3-1. Voice-operated transmitter circuit gain control.

d. SQUELCH GAIN R129 is a potentiometer control designated 15 on figure 3-1. Used in conjunction with VOX GAIN. (Refer to paragraphs 3-8 and 3-8 of operator's section.)

e. EXCITER I101 is an indicator designated 7 on figure 3-1. Lights during operation when EXCITER switch is on or EXCITER is activated by VOX or push-to-talk.

#### 4-7. M101 METER SECTION. (See figure 4-7.)

M101 is a peak reading VTVM and indicates audio level in USB and LSB channel, 2- to 4-mc MF level for tuning purposes, and 2- to 32-mc HF level, namely, SBE RF output.

With METER SW S109 in its CAL position, CAL potentiometer R135 zeroes the reading on meter M101.

With METER SW S109 in its LSB or USB positions, the reading on meter M101 reflects the output level of LSB or USB meter amplifiers V123B or V122B, respectively.

With METER SW S109 in its MF position, the reading on meter M101 reflects the output level of 2- to 4-mc MF amplifier V114.

With METER SW S109 in its <sup>RF</sup> position, the reading on meter M101 reflects the level at SBE's RF OUT jack J103.

#### 4-8. POWER SUPPLY SECTION.

(See figure 4-8.)

The power supply is a conventional electronic type supplying 6.3-volt AC filament supply and the following DC plate supplies; +125 volts unregulated, +180 volts unregulated, +150 volts regulated, and +125 volts unregulated.

Functions of front panel controls that apply to this section are as follows:

a. EXCITER I101 is an indicator designated 7 on figure 3-1. Lights during operation. Indicates MAIN fuse is intact and power is applied.

b. OVEN I102 is an indicator designated 8 on figure 3-1. Lights during operation when thermostats demand oven heating (automatic).

c. Fuses on the power supply are B+, MAIN, and OVEN.

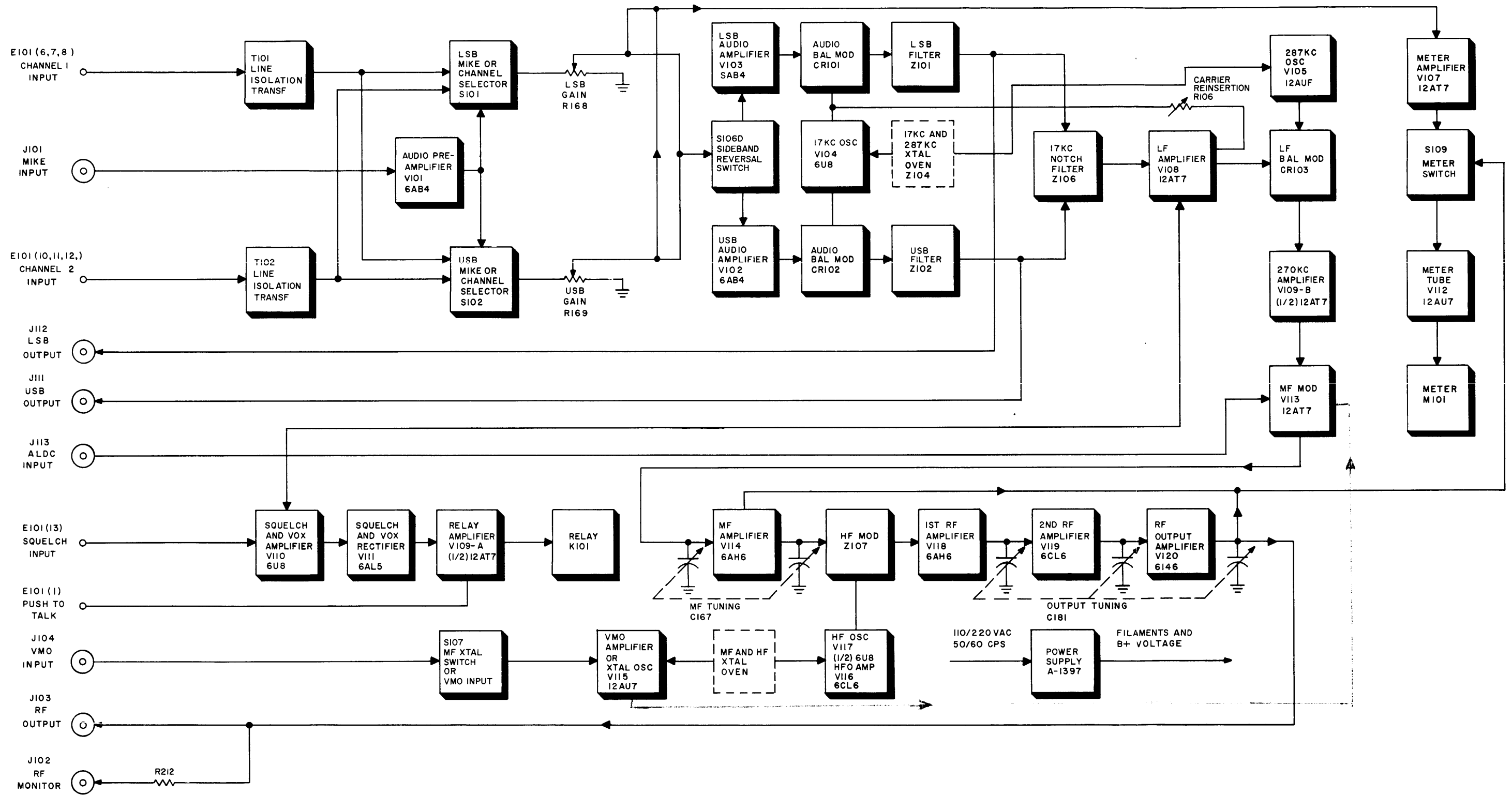


Figure 4-1. Block Diagram, SBE-2



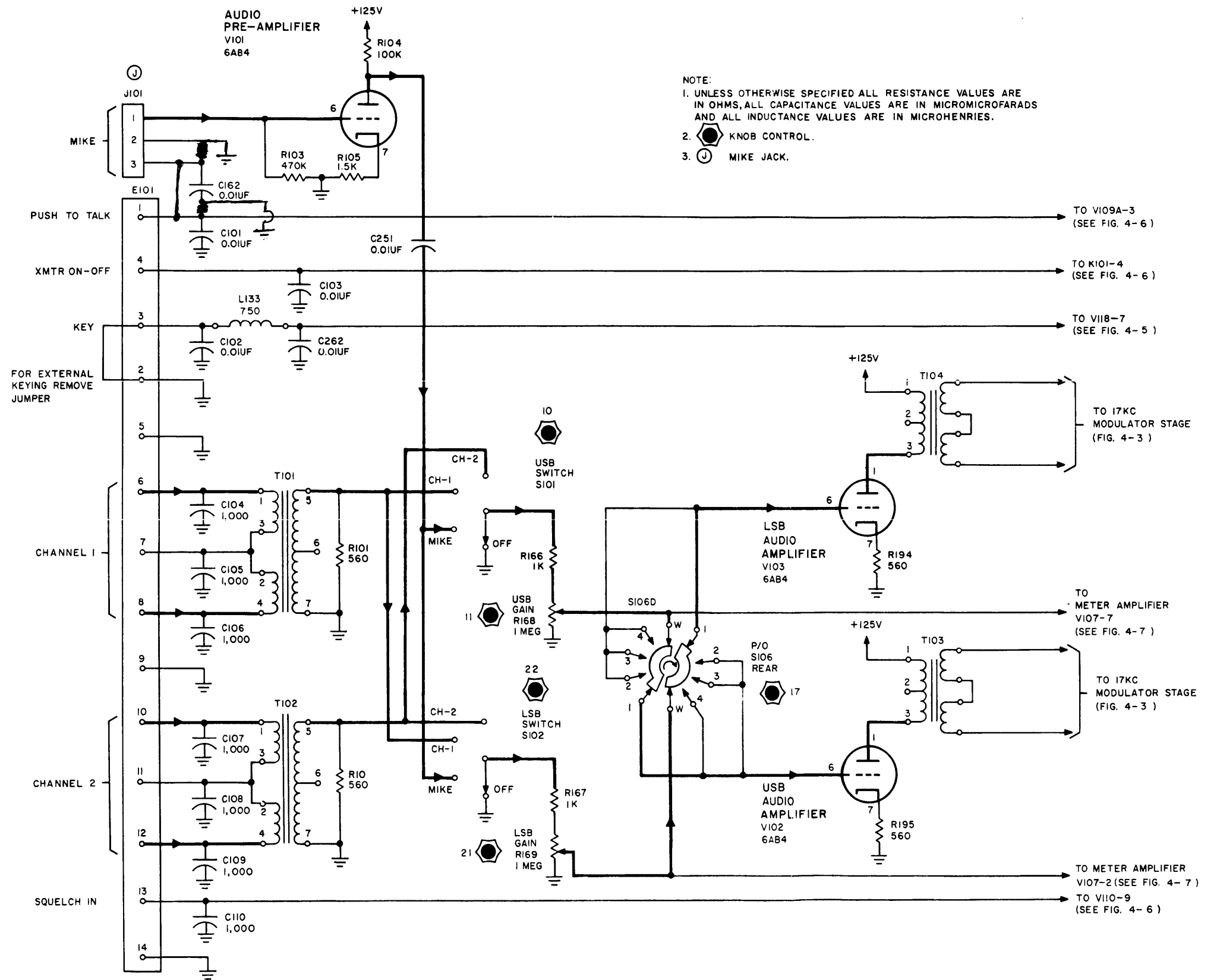
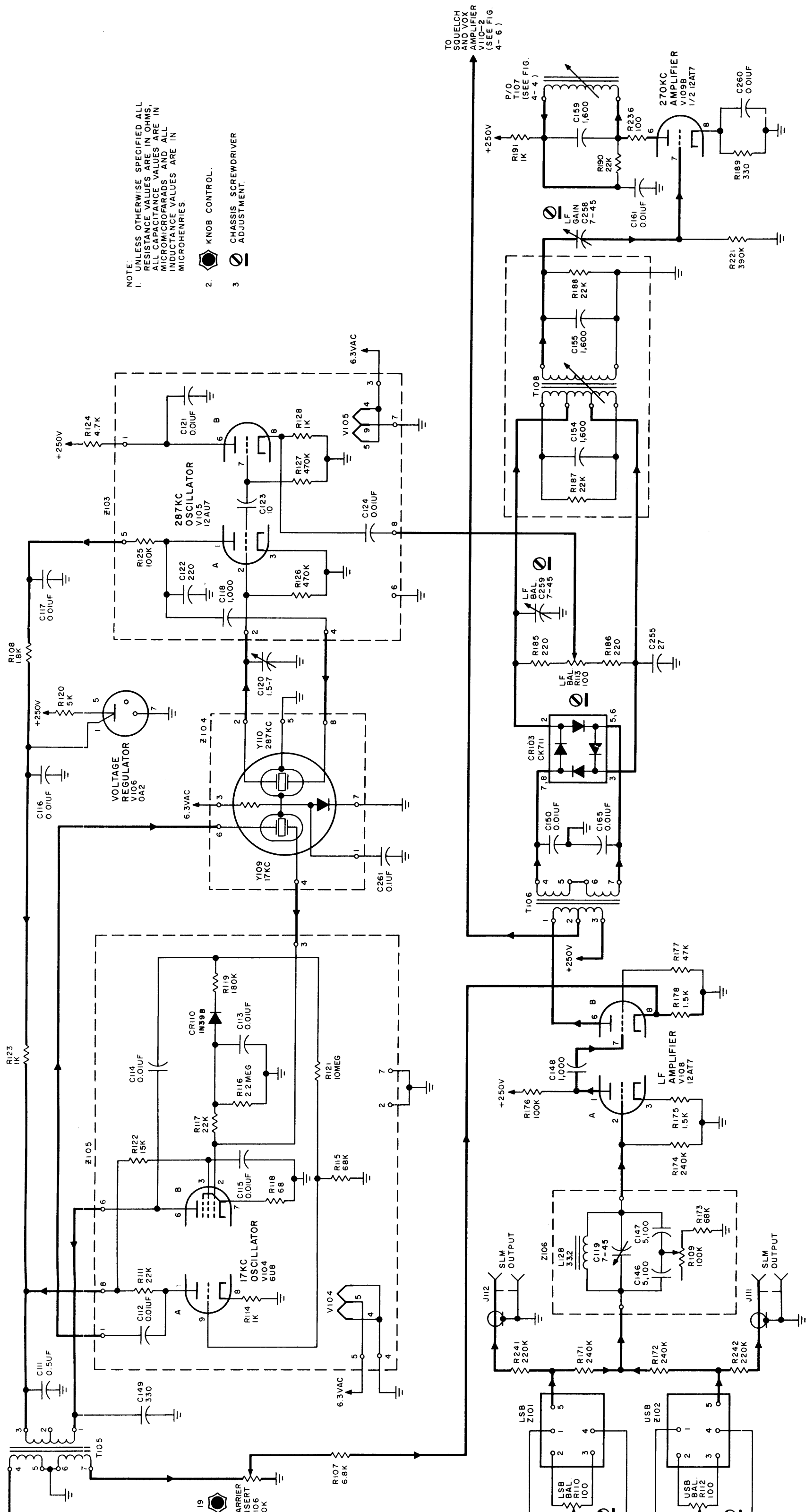


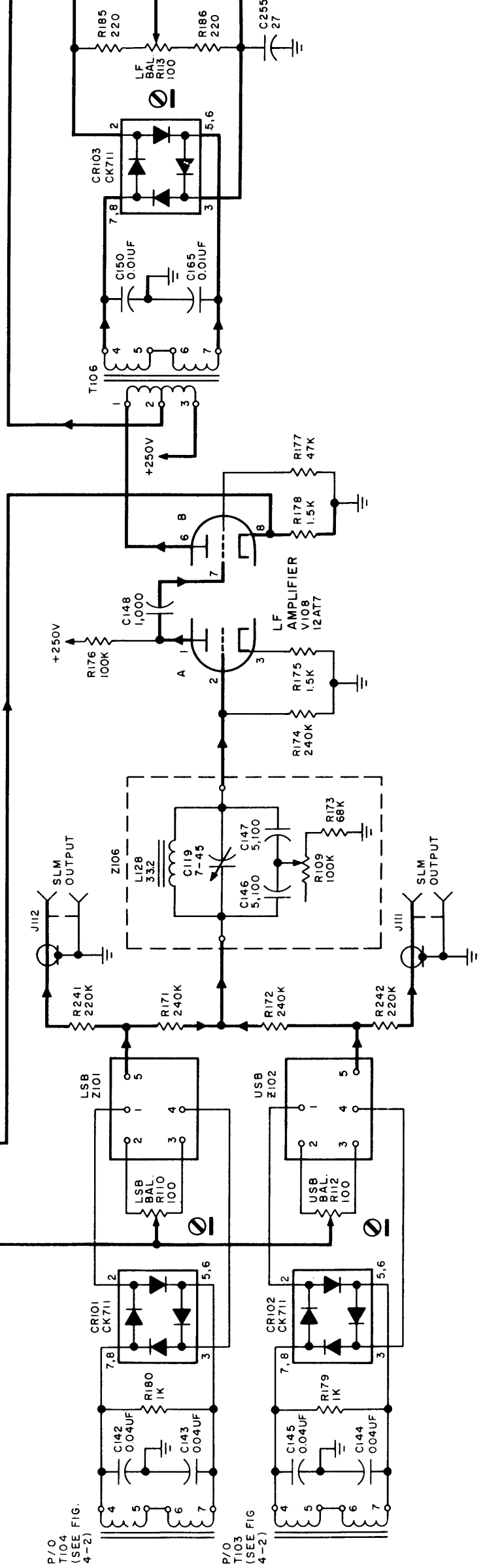
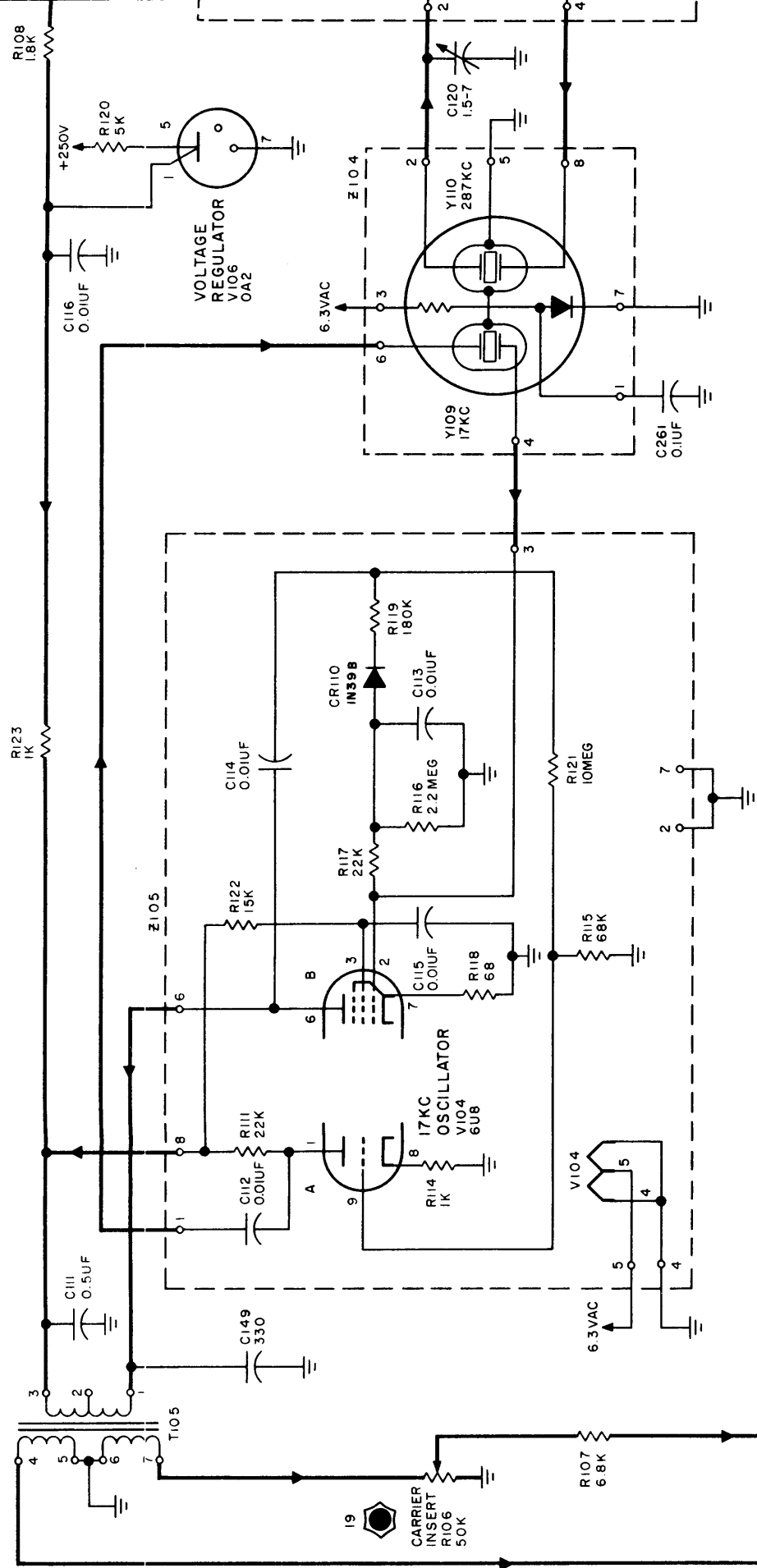
Figure 4-2. Schematic Diagram, Audio Input Section, SBE-2



NOTE: UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

1. RESISTOR
2. KNOB CONTROL
3. CHASSIS SCREWDRIVER ADJUSTMENT

Figure 4-3. Schematic Diagram, 17-kc and 287-kc Oscillators and Balanced Modulators Section, SBE-2



P/O T104 (SEE FIG. 4-2)

P/O T103 (SEE FIG. 4-2)

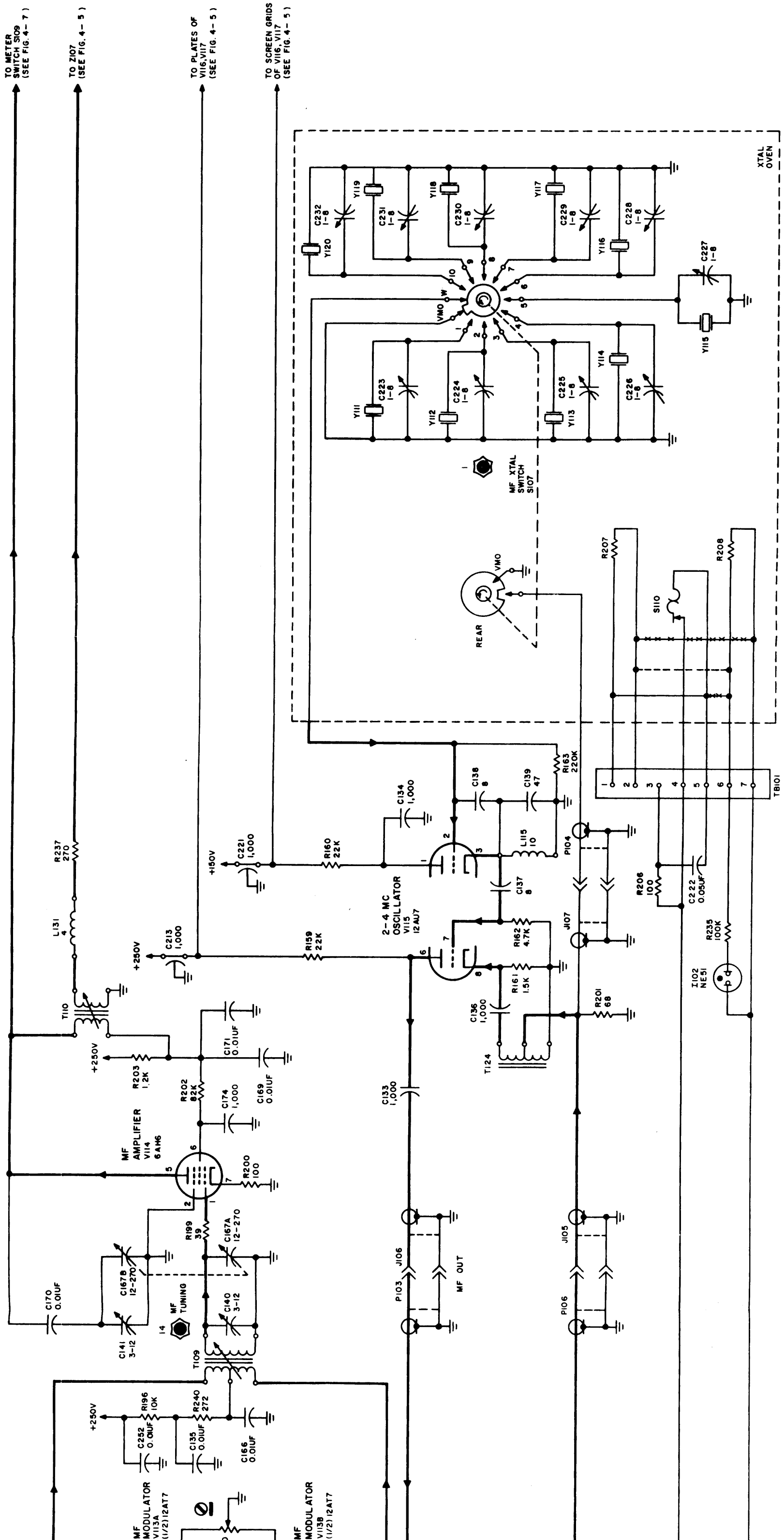


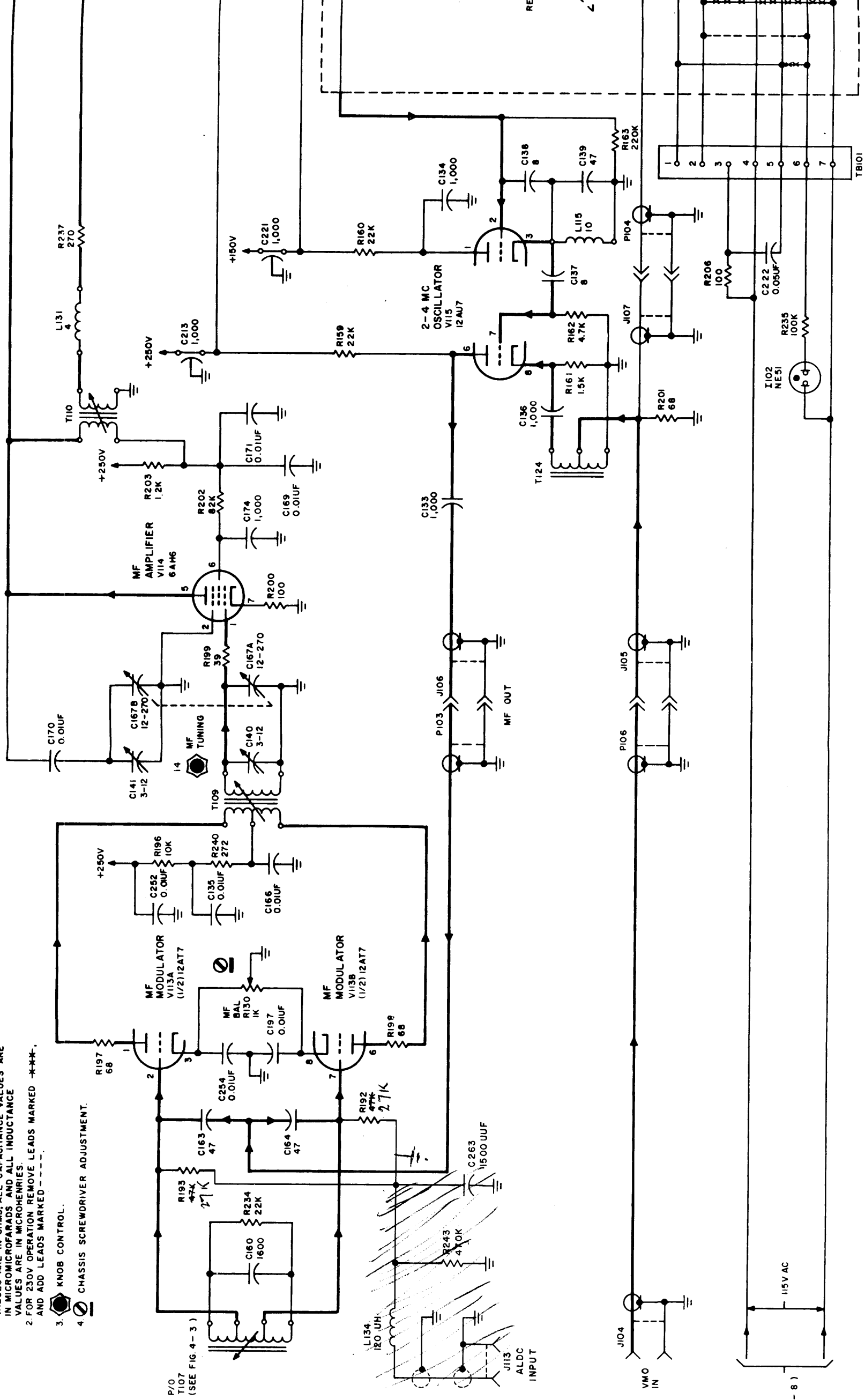


Figure 4-4. Schematic Diagram, 2- to 4-mc MF Section

NOTE:  
 1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICRONHENRIES.  
 2. FOR 250V OPERATION REMOVE LEADS MARKED \*\*\* AND ADD LEADS MARKED ----.  
 3.  KNOB CONTROL.  
 4.  CHASSIS SCREWDRIVER ADJUSTMENT.



FROM J109 (SEE FIG. 4-8)

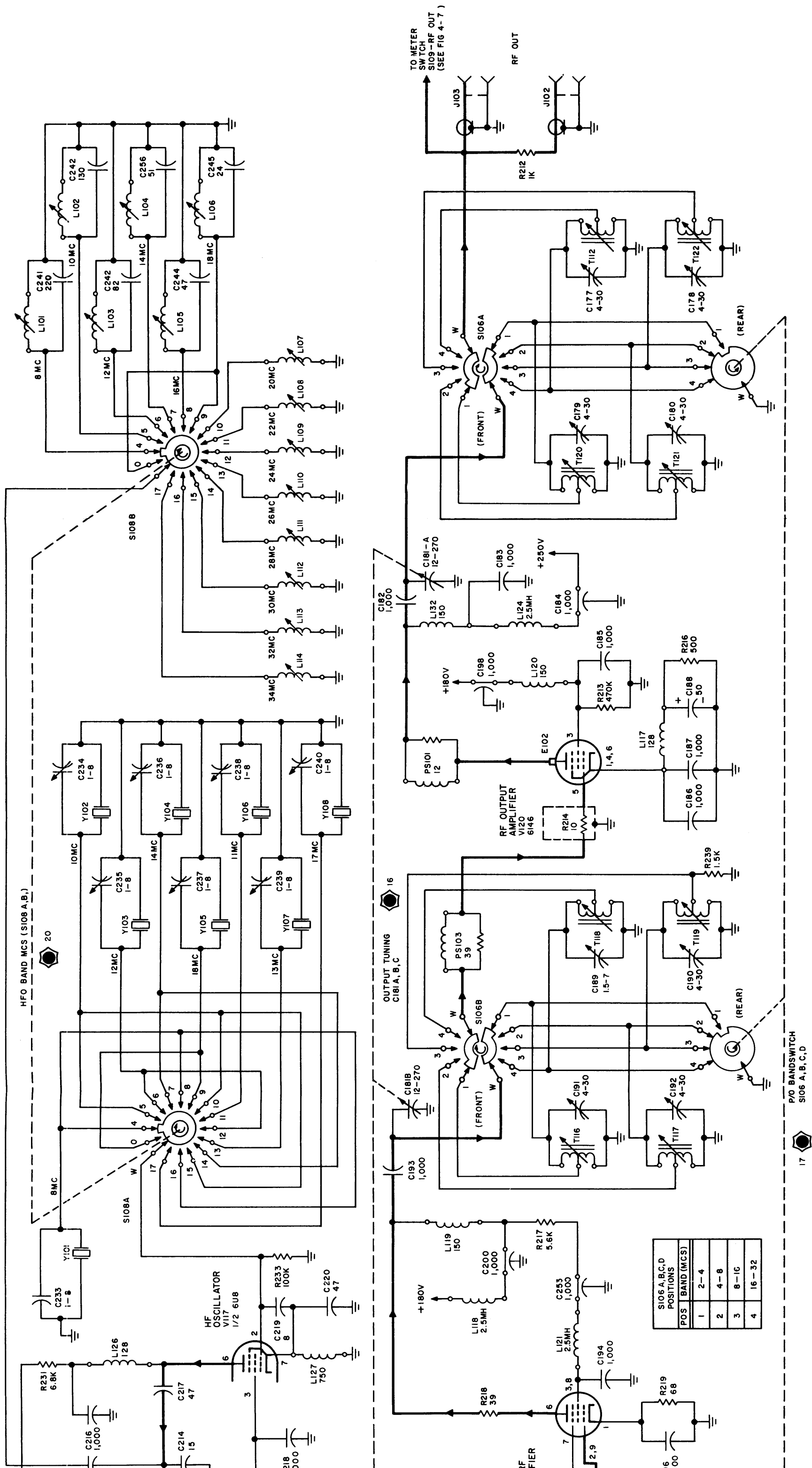
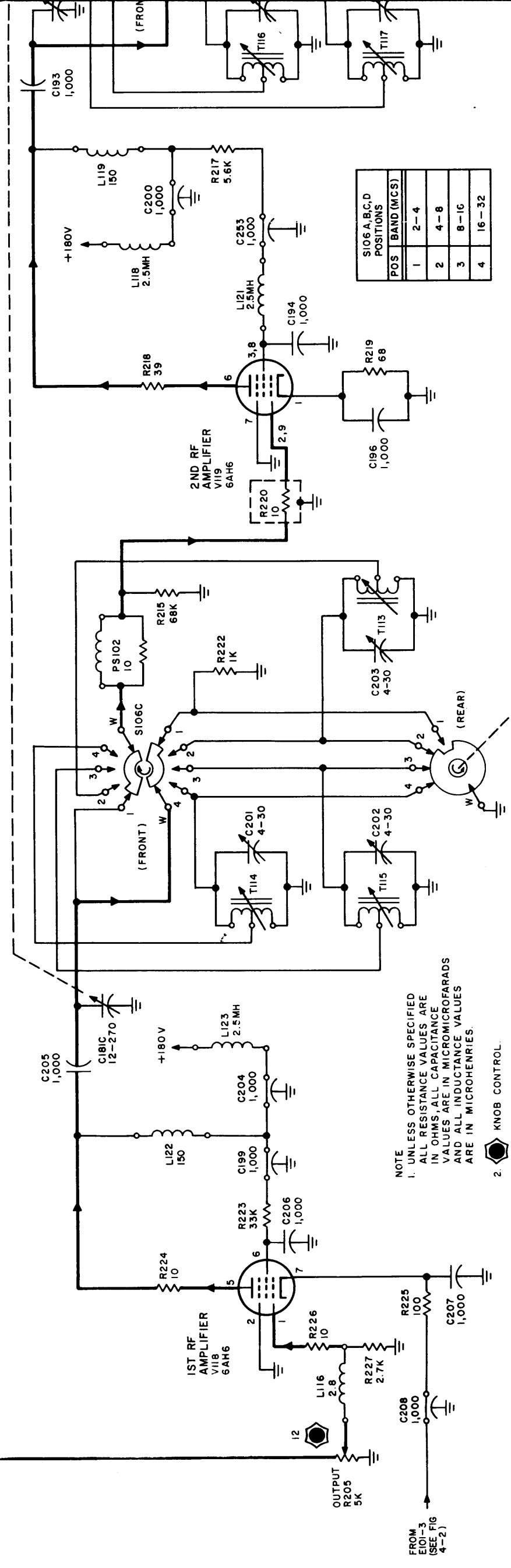
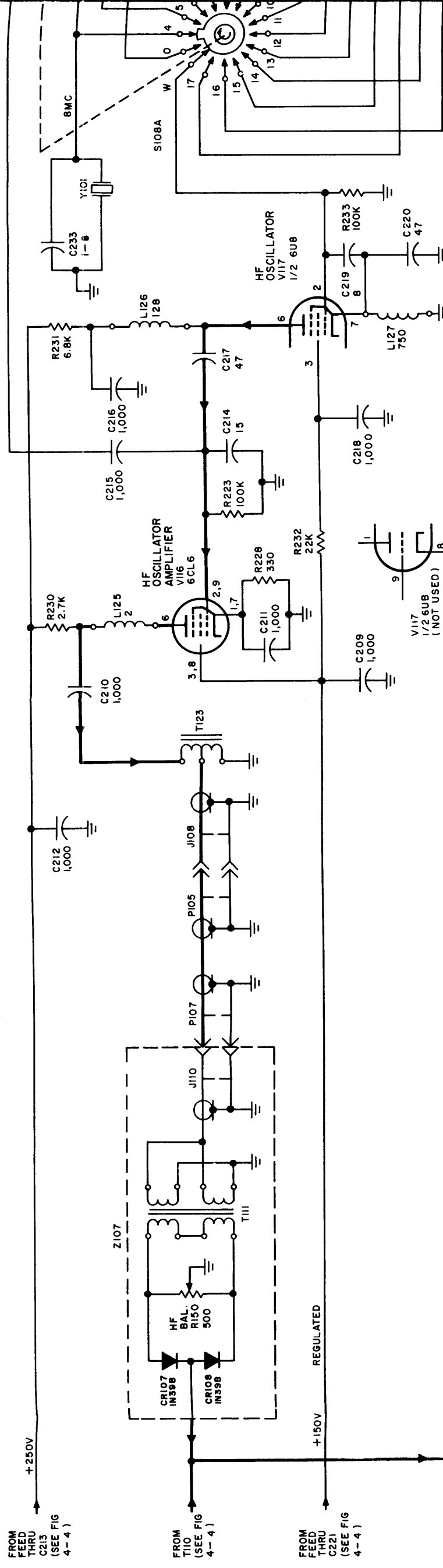


Figure 4-5. Schematic Diagram, 4- to 32-mc HF Section



FROM FEED THRU C213 (SEE FIG 4-4)

FROM FEED THRU C221 (SEE FIG 4-4)

FROM FEED THRU C221 (SEE FIG 4-4)

FROM FEED THRU C213 (SEE FIG 4-4)

FROM FEED THRU C221 (SEE FIG 4-4)

NOTE: UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

1. KNOB CONTROL

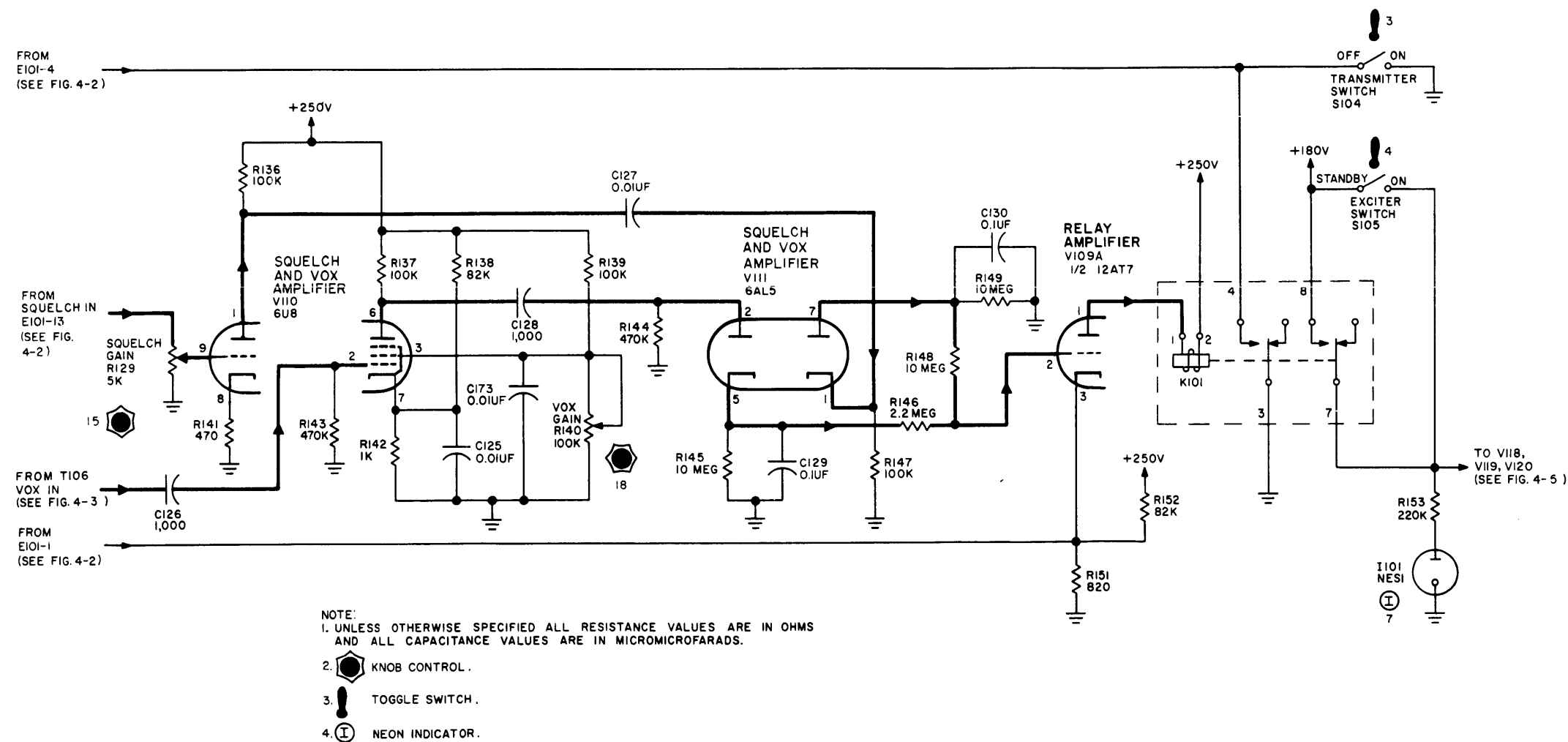


Figure 4-6. Schematic Diagram, SQUELCH and VOX Section



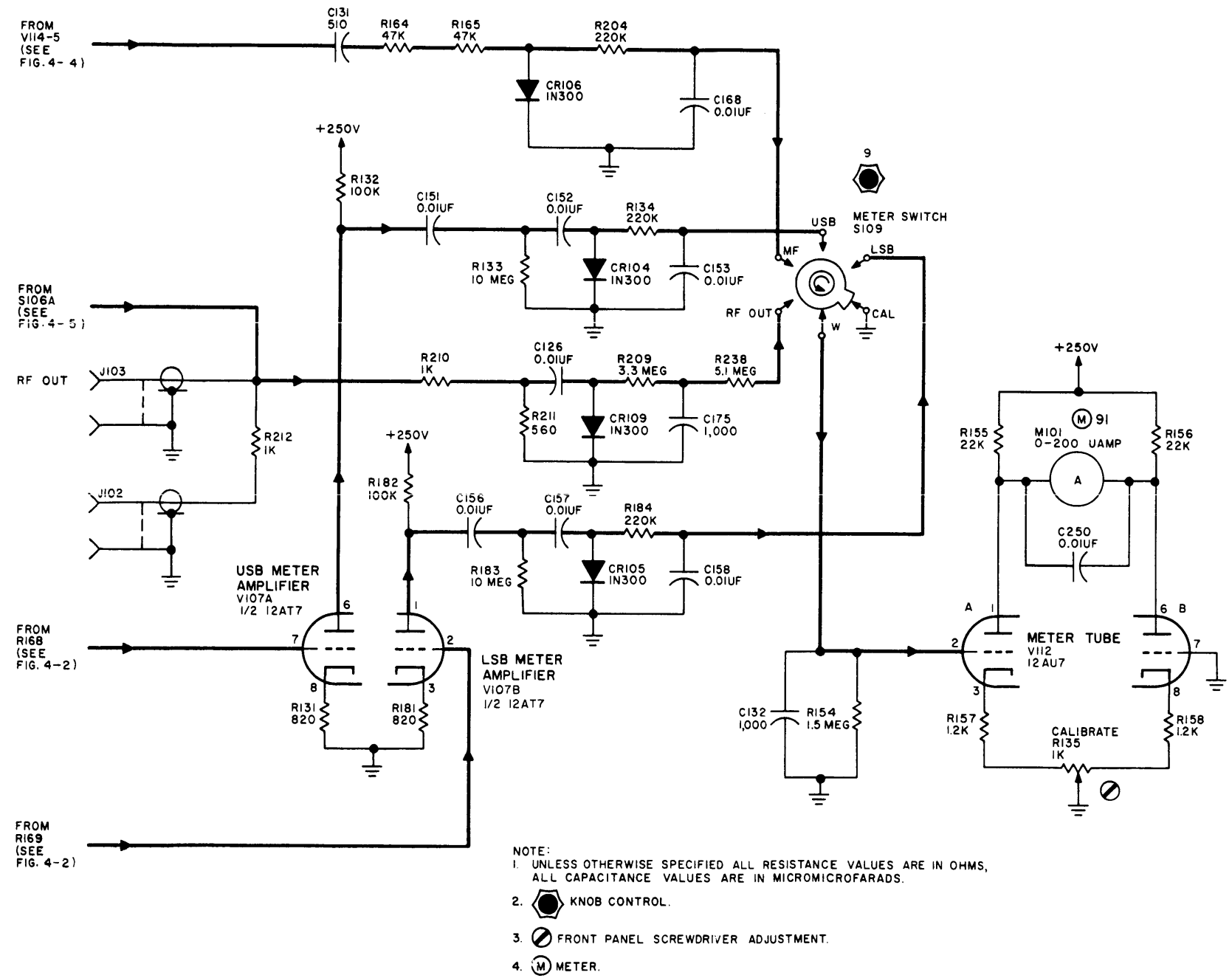


Figure 4-7. Schematic Diagram, M101 Meter Circuits

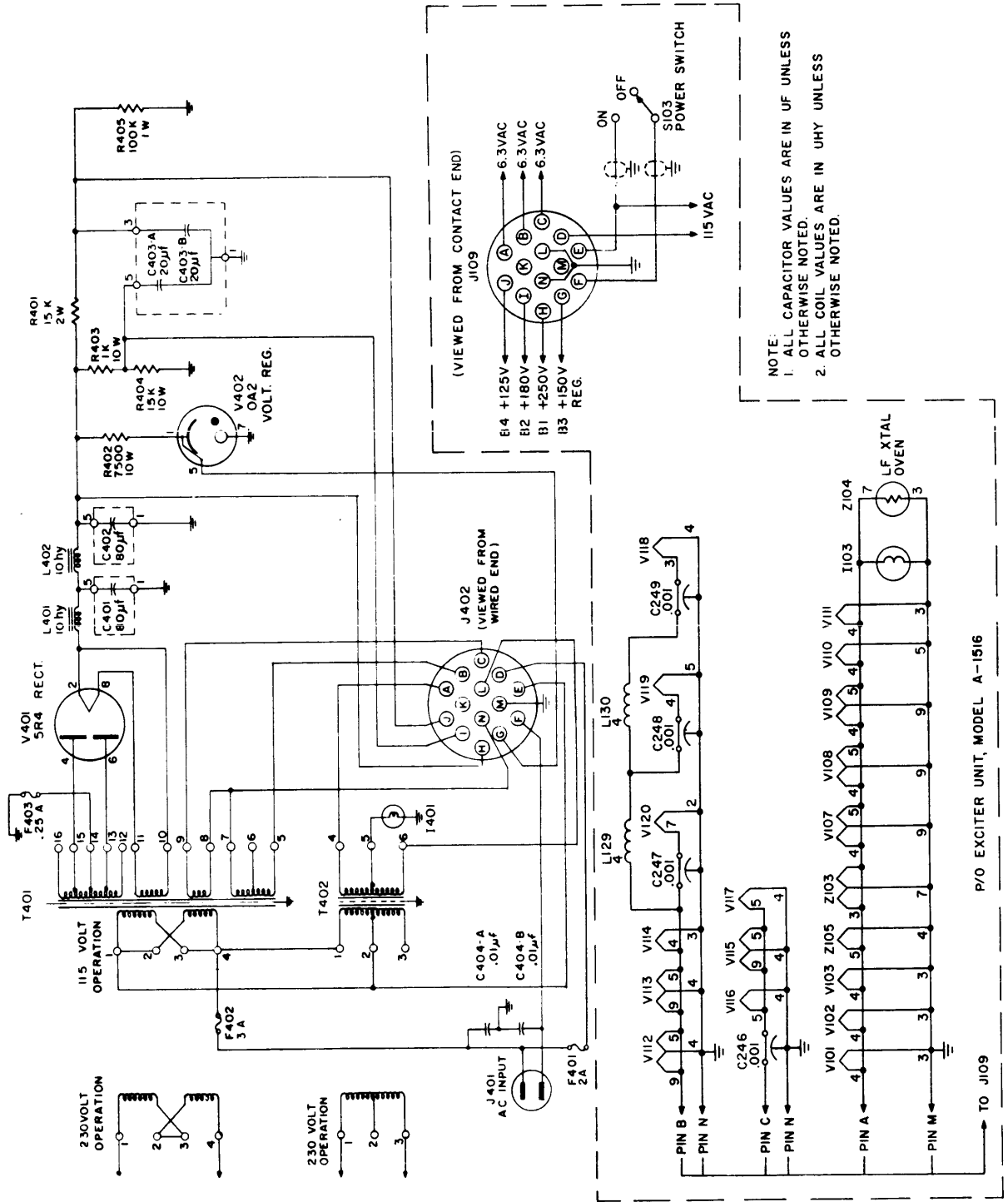


Figure 4-8. Schematic Diagram, Power Supply Section

## SECTION 5 TROUBLESHOOTING

### 5-1. GENERAL.

Troubleshooting is the art of locating and diagnosing equipment troubles and maladjustments; the information necessary to remedy the equipment troubles and maladjustments is reserved for Section 6 of the manual under the heading "Maintenance."

Troubleshooting tools may, for convenience, be divided into the following six categories:

- a. Accurate schematic diagrams
- b. Tables of voltage and resistance
- c. Location data (photographs with callouts of the major electronic equipment elements)
- d. Troubleshooting techniques
- e. Troubleshooting charts based on operating procedures
- f. Troubleshooting procedures based on circuit sectionalization

Troubleshooting techniques are about the same for all types of electronic equipment and are covered briefly in the following paragraph.

### 5-2. TROUBLESHOOTING TECHNIQUES.

a. GENERAL CONSIDERATIONS. - When a piece of equipment has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In this case, it is unnecessary to follow a lengthy and orderly course of trouble shooting in order to localize and isolate the faulty part.

A second short cut in troubleshooting is to ascertain that all tubes and fuses are in proper working order; also that the equipment receives proper supply voltages. Many times this eliminates further investigation.

A third short cut is to examine the equipment, section by section, for burned out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

It is important to recognize that defective elements may have become defective due to their own weakness or to some contributing cause beyond their control.

b. TROUBLESHOOTING CHARTS BASED ON OPERATING PROCEDURES. - The general purpose of these charts is to narrow the area of trouble to one or more sections of the equipment in order to minimize the labor of locating the source of trouble. These charts present a prescribed order "to turn on" the equipment, indicate what to expect as each step is taken, and give clues as to possible "troubled areas" when some expectation is not realized.

c. TABLE OF VOLTAGE AND RESISTANCE; MEASUREMENTS. - These tables give nominal values of voltage-to-frame and resistance-to-frame, generally at tube elements and sometimes at connectors and terminal board elements. Large deviations from the nominal values should be carefully investigated. During this process, accurate schematic diagrams and location data are highly essential. Schematic diagrams of equipment are found in Section 8.

A good oscilloscope is a good trouble shooting tool. It may be connected to a number of critical points along a circuit to detect extraneous voltages, distorted waveforms, and other symptoms of trouble.

d. TROUBLESHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - Equipments usually consist of a number of subassemblies or sections. It is frequently helpful to treat these subassemblies or sections as independent entities. In so doing, however, they must be properly powered. Observations may then be made with VTVMs, CROs, or other test equipment at selected points under given types and magnitudes of injection voltages. Again, the subassemblies or sections may be examined for rated performance, according to specification, for the presence of extraneous grounds, for opens, or unusual voltages.

### 5-3. TRANSMITTING MODE SELECTOR SBE-2.

a. VOLTAGE AND RESISTANCE DIAGRAM. - Figure 5-1 shows voltage- and resistance-to-chassis measurements at vacuum tube pins in the SBE and its power supply.

b. LOCATION DATA. - Figures 5-2 and 5-3 are photographs showing the major electronic equipment elements of the SBE-2.

c. TROUBLESHOOTING CHART BASED ON OPERATING PROCEDURES. See figure 8-1 for interpretation of control designations. Refer to table 5-1.

d. TROUBLESHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - The following paragraphs present selected factory checkout performance data of the SBE-2.

(1) POWER SUPPLY. - The SBE-2 power supply has triple fuse protection: oven heater, power supply primary, and high voltage. (Since a partial short across the B+ line may not blow the line fuse, this separate high voltage fuse has been incorporated in this unit.) If no meter readings can be obtained or the EXCITER lamp fails to go on when the EXCITER ON-STANDBY switch is on ON position, check fuse F402, (MAIN fuse). If after 1-hour warm-up period, the OVEN lamp fails to go on alternately every 4 or 5 minutes, check fuse F401 (OVEN fuse). See figure 5-1 and check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

(2) 17-KC OSCILLATOR. - A reading of 1.0 to 1.5 volts (17 kc) should be indicated between the center arm of R110 or R112 and ground. This reading should be made with a reliable AC VTVM. If a widely different reading is obtained, check for faults in the 17-kc oscillator section. See the SBE-2 voltage and resistance diagram, figure 5-1, and check the tube pin socket voltages (V104) with a reliable 20,000 ohms-per-volt meter.

(3) 287-KC OSCILLATOR. - Use a reliable VTVM with an RF probe to check for a reading of 1.0 to 1.5 volts (287 kc) from the center arm of R113 to ground. If a widely different reading is obtained, check for faults in the 287-kc oscillator section. See the SBE-2 voltage and resistance diagram, figure 5-1, and check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

(4) MEDIUM FREQUENCY OSCILLATOR. - Connect a VMO or signal generator (2 to 4 mc, 1.0 to 2.5 volts, see below) to VMO input. Place the 2- and 4-mc crystals in positions 1 and 2, respectively, in the MF crystal oven. Connect an RF voltmeter to the junction of C163 and C164. Check the following voltages:

<u>MF XTAL SW</u>	<u>Volts (approximately)</u>
Position 1 (2 mc)	2.5
Position 2 (4 mc)	1.2
VMO (2 mc)	2.5
VMO (4 mc)	1.4

If these voltages are not obtained, check for faulty components in the medium frequency section. See figure 5-1 and check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

(5) HIGH FREQUENCY OSCILLATOR. - Connect an RF voltmeter to the top of R205 (OUTPUT control); turn off medium frequency oscillator by turning MF XTAL SW to a vacant position. Voltage should vary from 2 to 5 volts as BAND MCS switch is rotated from 1 to 14. In the event that the high frequency oscillator appears to be faulty, see figure 5-1 and check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

(6) VOX SECTION. - The VOX circuit will function only in the SSB or DSB operation of the unit and not with conventional AM or SSB with full carrier. The VOX section contains a VOX and SQUELCH amplifier V110, VOX and SQUELCH rectifier V111, a RELAY amplifier V109, and relay K101. Amplifier V110 detects and amplifies a portion of the 17-kc LSB and USB signal; the signal is rectified through V111, generating a DC signal. It is then amplified in V109, energizing relay K101. When relay K101 is energized, it automatically provides a ground circuit for the GPT-10K (with EXCITER switch S105 in STANDBY position) when the operator talks directly into the mike. The VOX gain and SQUELCH gain controls (R140 and R129), respectively) are set properly only when the operator talking directly into the mike will energize the EXCITER; outputs from nearby receivers or background noise should not energize the exciter.

(7) USB AND LSB SECTIONS. - Turn two-tone test generator (TTG) on to SBE-2 and note correlation of TTG with SBE LSB and USB levels on meter. Both sideband outputs can be adjusted through the LSB GAIN or USB GAIN controls and the gain indicated on the output meter. If either sideband (USB or LSB) cannot be peaked, this would be an indication of trouble. In this event, see figure 5-1 and check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

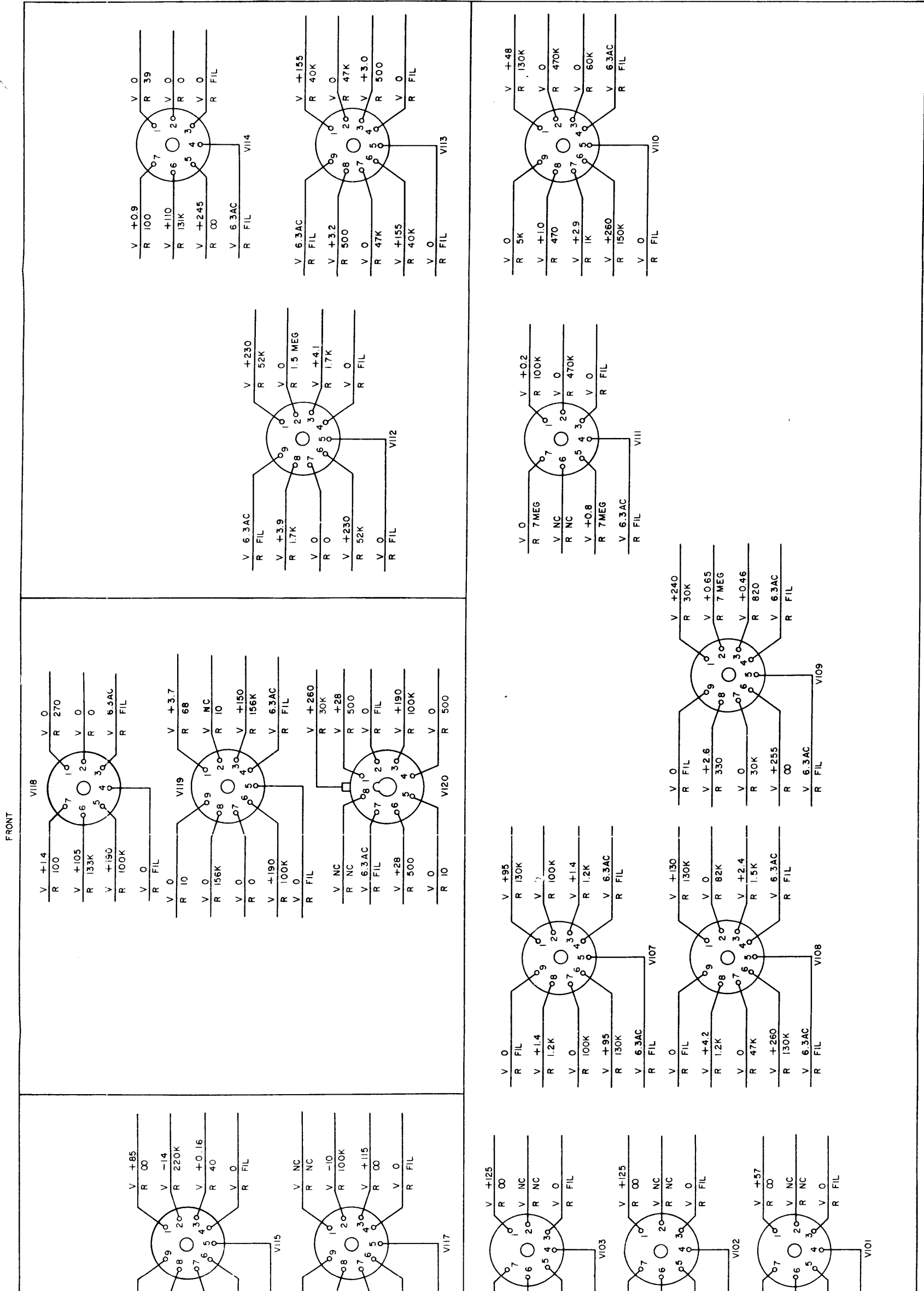
**TABLE 5-1. TROUBLESHOOTING CHART**

STEP	CONTROL OPERATED	NORMAL INDICATION	REMEDY
1	Set POWER ON-OFF switch S103 to ON position.	Power supply (red) indicator I103, OVEN indicator lamp I102, dial lamps, and tube filaments should all go on.	Set POWER switch S103 to OFF position. Check fuses F401 and F402, and the power cord. Check incoming power.
2	Set EXCITER ON-STANDBY switch S105 to ON position.	EXCITER indicator lamp I101 should go on.	Set POWER switch S103 to OFF position. Check fuse F403 and wire connections.
3	Set XMTR ON-OFF switch S104 to ON position.	Activates transmitter, eliminates need for VOX, or push-to-talk, through EXCITER switch S105.	Check the ground circuit of the transmitter for final plate relay.
4	<p>a. Set XMTR ON-OFF switch S104 to OFF position.</p> <p>b. Set EXCITER ON-STANDBY switch S105 to STANDBY position.</p> <p>c. Connect a mike to MIKE input jack J101. Start talking directly into the mike and at the same time slightly rotate VOX GAIN control R140.</p> <p>d. At conclusion of this step, return XMTR ON-OFF and EXCITER ON-STANDBY switches to their ON positions.</p>	Transmitter can be operated by VOX or push-to-talk circuits when EXCITER switch S105 is in STANDBY position. EXCITER indicator lamp I101 remains on with normal speech level and goes off with no speech input.	Visually check all wire connections to the XMTR and EXCITER switches, or fault may be in the VOX section. In the event that the EXCITER indicator lamp does not go on, set EXCITER ON-STANDBY switch S105 to ON position. This tests the EXCITER lamp; otherwise, the fault may be within the VOX section. Should the EXCITER pilot indicator lamp blink erratically with no direct speech input, SQUELCH GAIN control R129 is not adjusted properly; refer to the VOX section.
5	<p><b>MF TUNING</b></p> <p>a. Turn METER SW S109 to CAL position and zero meter.</p> <p>b. Turn METER SW to MF position.</p> <p>c. Turn MF XTAL SW to VMO or crystal.</p> <p>d. Set MF dial to frequency of VMO or XTAL by use of MF TUNING control.</p> <p>e. Turn USB, LSB, and XMTR switches to their OFF positions.</p> <p>f. Turn CARRIER INSERT control fully CW.</p> <p>g. Adjust MF TUNING control slightly.</p>	Meter reads zero for step a. In step b as the MF TUNING control is rotated, the meter deflection needle should read maximum.	<p>In the event the meter does not calibrate to zero or the meter does not indicate a reading with the METER SW in MF position, proceed as follows:</p> <p>Check V112 and R135. Visually check all meter and various control and switch wire connections. If these are normal, the probable cause is within the MF section.</p>

**TABLE 5-1. TROUBLESHOOTING CHART (Cont.)**

STEP	CONTROL OPERATED	NORMAL INDICATION	REMEDY
6	<p style="text-align: center;"><b>RF TUNING</b></p> <p>a. Do not alter previous settings of MF TUNING control.</p> <p>b. Turn BAND MCS switch to frequency range desired.</p> <p>c. Turn OUTPUT TUNING bandswitch to frequency range desired.</p> <p>d. Turn METER SW to RF position.</p> <p>e. Using OUTPUT TUNING control, set OUTPUT TUNING dial to output frequency.</p> <p>f. Advance OUTPUT control for any indication on the meter.</p> <p>g. Adjust OUTPUT TUNING control slightly.</p>	<p>Maximum meter needle deflection</p>	<p>In the event of a malfunction, visually check all control wire connections. If these are normal, the probable cause is within the RF section.</p>
7	<p style="text-align: center;"><b>DOUBLE SIDEBAND (Without Carrier)</b></p> <p>a. Turn USB switch to desired channel.</p> <p>b. Turn CARRIER INSERT to 0.</p> <p>c. Turn LSB switch to OFF.</p> <p>d. Turn METER SW to USB.</p> <p>e. Advance USB GAIN until meter reads 50.</p> <p>f. Turn USB switch to OFF.</p> <p>g. Turn LSB switch to desired channel.</p> <p>h. Turn METER SW to LSB.</p> <p>i. Advance LSB GAIN until meter reads 50.</p> <p>j. Turn METER SW to RF.</p> <p>k. Advance OUTPUT control until meter reads 50.</p> <p>l. Turn LSB switch to OFF.</p> <p>m. Turn LSB switch to position selected in step a.</p> <p>n. Adjust USB GAIN to obtain a meter reading of 50.</p> <p>o. Turn LSB switch to desired channel as selected in step g.</p>	<p>Combined gain settings of USB and LSB GAIN controls should read approximately 100 on the meter.</p> <p style="text-align: center;"><b>Note</b></p> <p>The meter circuit within the SBE, as is the case with most VTVM's has a small amount of waveform error. For this reason, when each sideband is set up independently of the other and when each is added on the meter, the sum of 50 percent and 50 percent may be slightly less than 100 percent. This is due to the presence of a modulated envelope which is generated when two or more frequencies are present in the output at the same time.</p>	<p>In the event the combined meter reading of the USB and LSB differs considerably from 100, alternately switch the USB and LSB ON-OFF switches and readjust each channel for a meter reading of 50. If either channel cannot peak to a meter reading of 50, the malfunction may be in either or both the LSB or USB audio sections.</p>





SBE-2 POWER SUPPLY

CONDITIONS:  
 VOLTAGE MEASUREMENTS:

- 1 HF OSCILLATOR SWITCH 4 27-6 27 MCS.
- 2 OUTPUT TUNED TO 80 MCS.
- 3 BAND SWITCH 4 -8 MCS.
- 4 METER SWITCH IN RF POSITION.
- 5 OUTPUT CONTROL SET TO 100% ON METER
- 6 RF OUTPUT TERMINATED WITH 70 OHM NONINDUCTIVE LOAD.
- 7 M.F. XTAL SWITCH IN VMO POSITION
- 8 LSB AND USB GAIN CONTROLS MIN.
- 9 MIKE/CHANNEL SELECTOR "OFF"
- 10 MAIN POWER "ON"
- 11 EXCITER "ON"
- 12 XMITR "OFF"
- 13 V104 AND V105 DATA TAKEN AT OCTAL SOCKET.

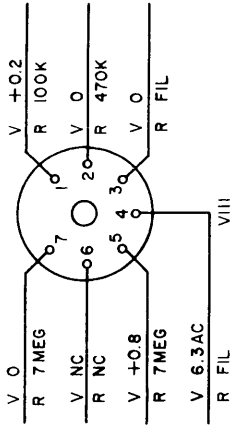
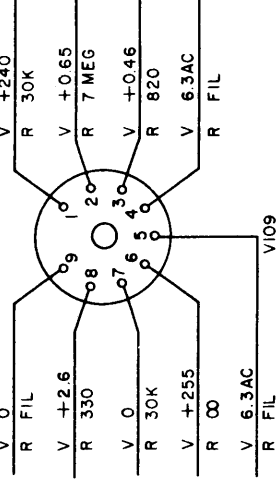
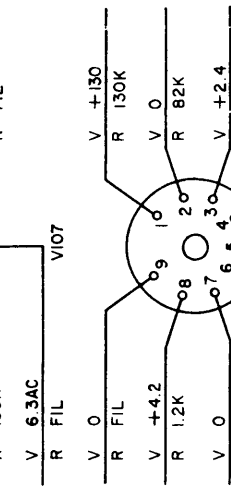
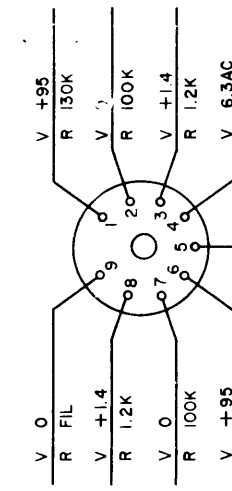
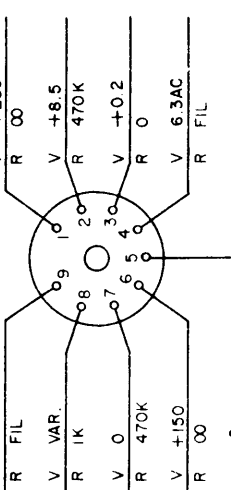
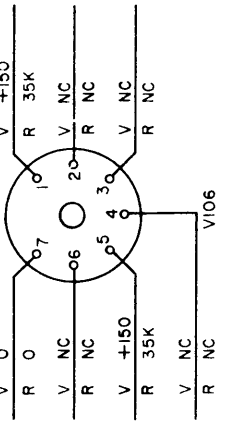
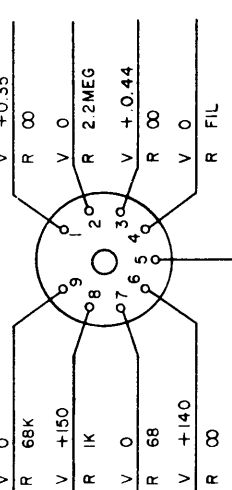
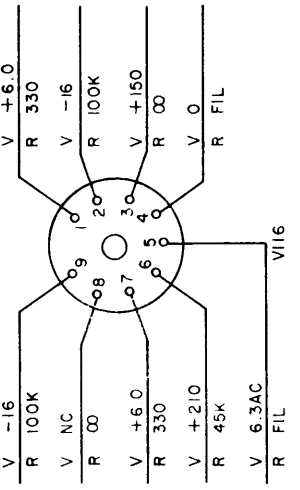
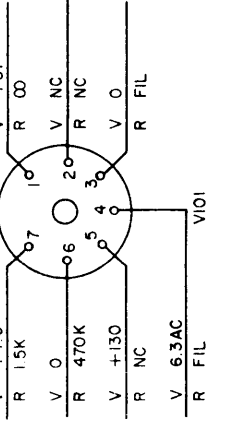
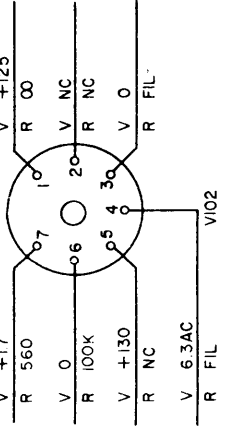
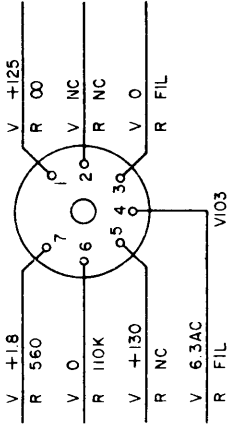
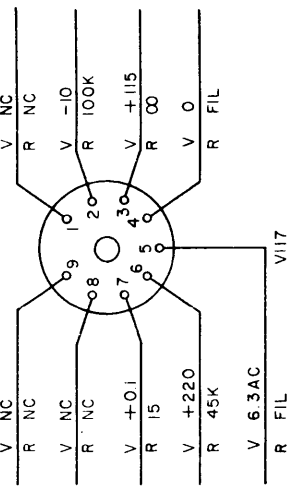
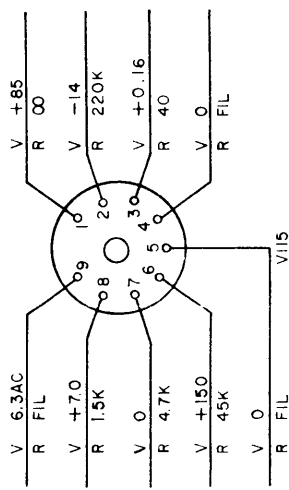
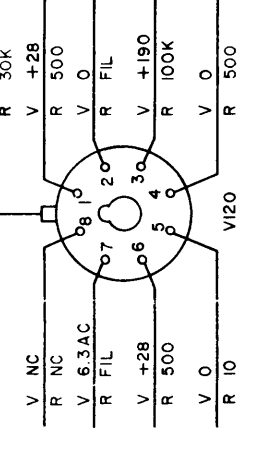
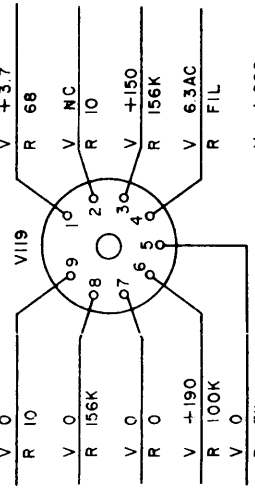
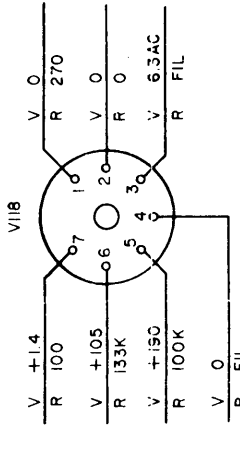
RESISTANCE MEASUREMENTS:

- 1 ALL POWER "OFF"
- 2 POWER PLUGS DISCONNECTED
- 3 ALL MEASUREMENTS TAKEN WITH RESPECT TO GROUND USING A HEWLETT-PACKARD MODEL 410B VTVM OR EQUIVALENT
- 4 ALL FRONT PANEL SWITCHES AND CONTROLS IN MAXIMUM CW POSITION.
- 5 UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS.

Figure 5-1. Voltage and Resistance Diagram



FRONT



REAR

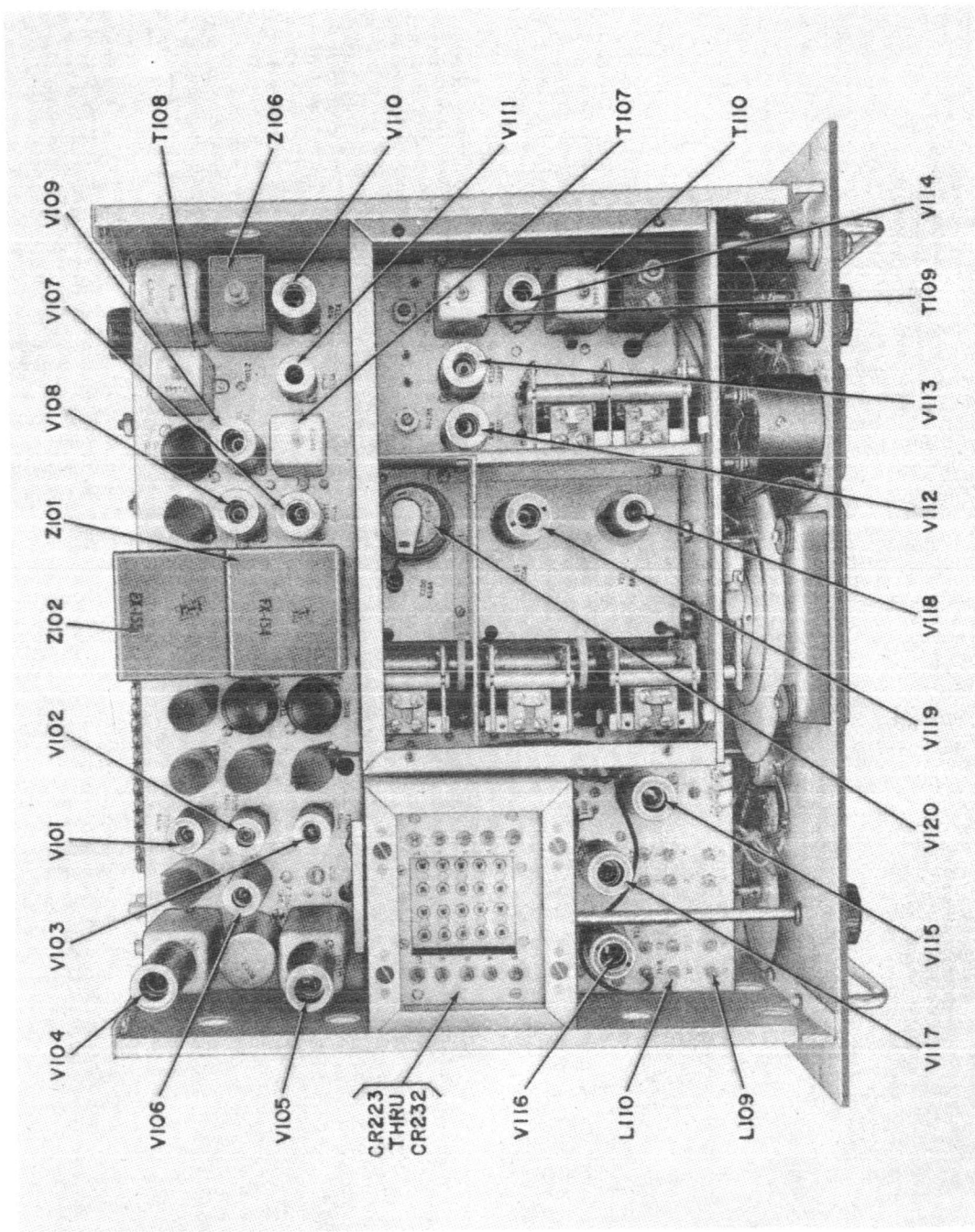


Figure 5-2. Location Diagram of Major Electronic Equipment Components, Top View

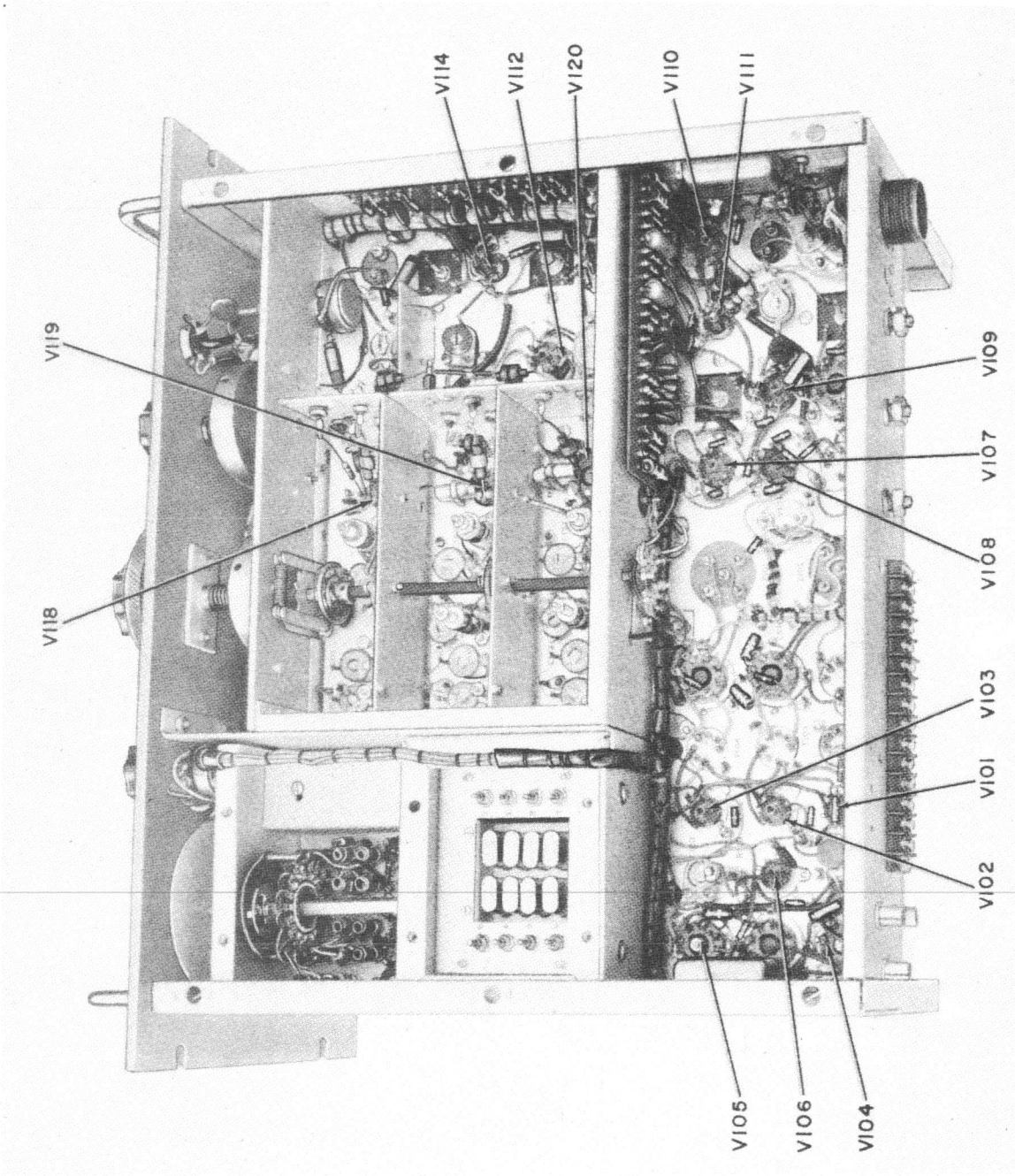


Figure 5-3. Location Diagram of Major Electronic Equipment Components, Bottom View

## SECTION 6 MAINTENANCE

### 6-1. GENERAL.

Maintenance may be divided into three categories: operator's maintenance, preventive maintenance, and corrective maintenance. Corrective maintenance is sometimes considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments, existing and/or pending, and information necessary to remedy the equipment troubles and maladjustments. For the reasons stated in Section 5, the remedial type of information is presented under corrective maintenance (Section 6) while the diagnosis type of information is presented under trouble-shooting (Section 5).

The SBE has been designed to provide long term, trouble-free operation under continuous duty conditions. It is recommended that any necessary maintenance be done by a competent maintenance technician familiar with sideband techniques. Otherwise advantage may be taken of the required specialized test equipment and personnel trained in its use in the Testing Department of Technical Materiel Corporation. If trouble develops which cannot be corrected by following the procedures outlined in the following paragraphs, it is recommended that the instrument be returned to Technical Materiel Corporation for servicing. To expedite the return of the serviced equipment to you, it is recommended that the equipment be shipped to us by Air Freight and that we be authorized to return it the same way.

### 6-2. OPERATOR'S MAINTENANCE.

The operator should make minor adjustments of tuning controls to verify proper tuning, note general condition of panel switches, observe whether panel indicator lamps light properly, and check the condition of the three panel fuses as well as that of all tubes. All fuses and a power indicator lamp are located on the front panel of the power supply. The locations of all tubes in the SBE are indicated by the tube location diagram action of figure 5-1.

The SBE has triple fuse protection: oven heater, power supply primary, and high voltage. (Since a partial short across the B+ line may not blow the line fuse, this separate high voltage fuse has been incorporated in the unit.)

If no meter readings can be obtained or the EXCITER lamp (control 7 on figure 3-1) fails to go on when the POWER ON-OFF switch (control 5 on figure 3-1) is in the ON position, check F403 (B+ fuse). If dial lights and tube filaments fail to go on when

POWER ON-OFF switch is in the ON position, check F402 (MAIN fuse). If after 1-hour warm-up period, the OVEN lamp control 8 on figure 3-1) fails to cycle every 4 or 5 minutes, check F401 (OVEN fuse).

#### CAUTION

Never replace a fuse with one of higher rating unless continued operation is more important than probable damage to the equipment. If a fuse burns out immediately after replacement, do not replace it a second time until the trouble has been located and corrected.

### 6-3. PREVENTIVE MAINTENANCE.

a. In order to prevent failure of the equipment due to corrosion, tube failure, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals (at least every six months) the equipment should be removed from the rack for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring, or grease; inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichlorethylene or ethylenedichloride. Remove dirt or grease from other parts with any good dry cleaning fluid.

#### WARNING

Carbon tetrachloride (CCL<sub>4</sub>) may be used if great care is exercised because it is a toxic substance. Do not inhale its fumes. Avoid contact with skin.

c. While unit is out of the rack and covers are removed, it is advisable to check the tubes, all of which are accessible from the top of the chassis.

#### CAUTION

Tubes should be removed and checked one at a time to eliminate the danger of replacing a tube in the wrong socket. Do not fail to replace tube shields.

d. Should the gear train (directly behind the front panel) show signs of becoming dry, apply one drop of any high quality light machine lubricant to each gear. Recommended time interval is once a year.

e. Carefully inspect for loose solder connections or screws, especially those on solder lugs. Recommended time interval is every 6 to 12 months, depending on the amount of vibration encountered in service.

#### 6-4. CORRECTIVE MAINTENANCE.

The corrective maintenance procedure presented below is essentially Technical Materiel Corporation's factory alignment procedure. Adjustment of the SBE resolves itself into the following eight general operations and requires the following test equipment: An RF frequency meter or counter accurate to one part per million; an RF generator accurate to one part per million; a sensitive RF VTVM (such as Ballantine); and a sensitive communications receiver (AM).

a. 17-KC OSCILLATOR. - A reading of 1.0 to 1.5 volts should be found between the center arm of R110 or R112 and ground. This reading should be made with a reliable AC VTVM. If it is not correct, check for faults in the 17-kc oscillator section (Z105).

b. 287-KC OSCILLATOR. - Use a reliable VTVM with an RF probe to check for a reading of 1.0 to 1.5 volts from the center arm of R113 to ground. If the reading is not correct, check for faults in the 287-kc oscillator section (Z103).

c. MID-FREQUENCY OSCILLATOR. - Connect VMO or signal generator (2 to 4 mc up to 2.5 volts, see below) to VMO input. Place 2-mc and 4-mc crystals in positions 1 and 2, respectively in the MF crystal oven. Connect RF voltmeter to the junction of C163 and C164. Measure for the following voltages:

MF XTAL SW	Volts (Approximate)
Position 1 (2 mc)	2.5
Position 2 (4 mc)	1.2
VMO (2 mc)	2.0
VMO (4 mc)	1.0

If these voltages are not obtained, check for faulty components in the mid frequency section.

d. HIGH-FREQUENCY OSCILLATOR. - Connect RF voltmeter to top of R205 (output control), and turn off medium-frequency oscillator by turning MF XTAL SW to a vacant position. Voltage should vary from 2 to 5 volts as BAND MCS switch is rotated from 0 to 14.

e. 17-KC CARRIER BALANCE RESISTORS R110 AND R112. - For simplicity, the procedure for R110 only is given. Connect a sensitive AC VTVM on R171's terminal remote from Z106. Adjust R110 for a minimum reading of the VTVM, with 17-kc oscillator providing normal 17-kc injection.

f. TRANSFORMER T108. - Reduce CARRIER INSERT resistor R106 to zero (knob fully counterclockwise). Connect a 270-kc voltage across terminals 1 and 3 of T106. Adjust top and bottom slugs of T108 for maximum reading of a sensitive VTVM connected between grid 7 of V109B and ground.

g. TRANSFORMER T107 AND <sup>LOW</sup> ~~HIGH~~-FREQUENCY BALANCE RESISTOR R113. - Connect sensitive RF VTVM at grid 2 of V113. Feed the 270-kc modulator circuit with a small amount of 17-kc carrier reinsertion and full output of the 287-kc oscillator. If an FSA is used as the RF VTVM, T107 may be tuned for maximum 270-kc response and then R113 set to minimize this response. The following alternate method, which requires a 270-kc signal generator and somewhat longer operations, may be used if desired.

For low-frequency balance resistor R113, reduce CARRIER INSERT resistor R106 to zero (knob fully counterclockwise). Remove Z103 (287-kc oscillator assembly) and energize lead from pin 8 to R113 with 1 to 1.5 volts of 270 kc. Adjust R113 for minimum reading on a sensitive VTVM connected between grid 7 of V109B and ground. Low-frequency balance capacitor C259 should also be adjusted simultaneously to minimize the VTVM's reading.

For transformer T107, disconnect P103 and J104 so that no 2- to 4-mc voltage reaches V113. Connect a sensitive VTVM between grid 2 of V113 and ground. Supply T107 with 270 kc. Adjust T107's bottom and top slugs for maximum reading on the VTVM.

h. MF MODULATOR. - Insert 2-mc supply at junction of C163, and C164. A 2-mc crystal associated with V115 or a 2-mc VMO injection will suffice. Connect a sensitive VTVM at terminal 2 of Z107. Provide T107 with normal 270-kc voltages due to 17-kc reinsertion (50-percent setting of CARRIER INSERTION resistor R106) and normal output of 287-kc oscillator. Turn MF TUNING knob for a dial reading of 2 mc. At this setting, the MF modulator circuit is tuned to the lower sideband of 2 mc or 1.73 mc. Align T109 and T110 for peak reading on VTVM.

Insert 4-mc supply at junction of C163 and C164. A 4-mc crystal associated with V115 or a 4-mc VMO injection will suffice. Keep VTVM at terminal 2 of Z107 and CARRIER INSERT resistor R106 as stated above. Turn MF TUNING knob for a dial reading of 4 mc. At this setting, the MF modulator circuit is tuned to the lower sideband of 4 mc or 3.73 mc. Align C140 and C141 for peak reading on VTVM.

Repeat the 2- and 4-mc procedures outlined above until the MF modulator circuit is tuned to both 1.73 and 3.73 mc corresponding to MF TUNING knob settings of 2 and 4 mc, respectively.

i. MF BALANCE RESISTOR R130. - Remove V109B in order that T107 will not receive any 270-kc supply. Insert 2.27-mc supply at junction of C163 and C164. A 2.27-mc crystal associated with V115 or a 2.27-mc VMO injection will suffice. Keep VTVM at terminal 2 of Z107. Turn MF TUNING knob for a dial reading of 2.54 mc. At this setting, the modulator circuit

is tuned to 2.27 mc which corresponds to the 2.27-mc injection. Adjust R130 for VTVM reading.

j. RFBALANCE RESISTOR R150. - Supply terminal 2 of Z107 with 2 mc and disconnect P107 from J110. Plug VTVM's coaxial connector into J110. Adjust R150 for minimum deflection of VTVM. Repeat with 32-mc supply. Set R150 for minimum deflection at the two extreme injection frequencies.

k. RF OUTPUT CIRCUIT ADJUSTMENT. - Maximum sensitivity of the RF output circuit is obtained by conventional adjustments of slug inductors and trimmer capacitors. Bandswitching establishes four sets of tuning devices associated with each of three RF linear amplifiers. A continuously variable set of gauged OUTPUT TUNING capacitors C181A, C181B, C181C work in conjunction with the above mentioned tuning devices.

# SECTION 7 PARTS LIST

## INTRODUCTION

Reference designations have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams, and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Parts of the exciter unit are numbered from 100 to 300; parts of the power supply from 400 to 500. Two consecutive series of numbers have been assigned to major units in which there are more than 100 parts of the same generic group. Sockets associated with a particular plug-in device, such as

electron tube or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F7 is designated XF7. The parts for each major unit are grouped together. Column 1 lists the reference series of each major unit, followed by the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and describes the various parts. Major part assemblies are listed in their entirety; subparts of a major assembly are listed in alphabetical and numerical order with reference to its major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

## CONTENTS

Transmitting Mode Selector Model SBE-3 (Symbol Series 100 and 200) . . . . .	7-2
Transmitting Mode Selector Power Supply (Symbol Series 400) . . . . .	7-22

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
C101	CAPACITOR, fixed; ceramic dielectric; 10000 uuf, 500 wvdc	Bypass and Coupling E101	CC-100-16
C102	Same as C101.		
C103	Same as C101.		
C104	CAPACITOR, fixed; ceramic dielectric; 1000 uuf, 500 wvdc	Same as C101.	CC-100-29
C105	Same as C104.		
C106	Same as C104.		
C107	Same as C104.		
C108	Same as C104.		
C109	Same as C104.		
C110	Same as C104.		
C111	CAPACITOR, fixed; paper dielectric; .5 uf, $\pm 10\%$ , 600 wvdc	17 Kc Decoupling Z105	CP53B1EF504K
C112	Same as C101.	Coupling Z105	
C113	Same as C101.	Bypass Z105	
C114	Same as C101.	Same as C112	
C115	Same as C101.	RF Bypass Z105	
C116	Same as C101.	RF Bypass V106	
C117	Same as C101.	287 Kc Decoupling, V106	
C118	CAPACITOR, fixed; mica dielectric; 1000 uuf, $\pm 10\%$ , 500 wvdc, char. D. (p/o Z103)	Coupling	CM20D102K
C119	CAPACITOR, variable; ceramic dielectric; 7-45 uuf, 500 wvdc, char. C.	17 Kc Notch Adj. Z106	CV11C450
C120	CAPACITOR, variable: ceramic; 1.5-7 uuf, 500 wvdc, char. A.	287 Kc Adj. Z103	CV11A070
C121	Same as C101.	RF Bypass Z103	
C122	CAPACITOR, fixed: mica dielectric; 220 uuf, $\pm 10\%$ , 500 wvdc, char. D. (p/o Z103)	RF Bypass Z103	CM20D221K
C123	CAPACITOR, fixed: ceramic; 10 uuf, $\pm .5$ uuf, 500 wvdc, char. SL. (p/o Z103)	Coupling Z103	CC21SL100D
C124	Same as C101	Coupling Z103	



**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
C125	Same as C101.	RF Bypass V110	
C126	Same as C104.	Coupling V110	
C127	Same as C101.	Coupling V110	
C128	Same as C104.	Coupling V110	
C129	CAPACITOR, fixed: mylar dielectric; .1 uf, $\pm 10\%$ , 200 wvdc.	Time Constant V111	CN106C104K
C130	Same as C129.		
C131	CAPACITOR, fixed: mica; 510 uuf $\pm 5\%$ , 300 wvdc, char. C.	Coupling V114	CM15C511J
C132	Same as C104.	RF Bypass V112	
C113	Same as C104.	Coupling V115	
C134	Same as C104.	Bypass V115	
C135	Same as C101.	Decoupling V113	
C136	Same as C104.	Coupling V115	
C137	CAPACITOR, fixed: ceramic dielectric; 8uuf, $\pm 10\%$ , 500 wvdc, char. SL.	Coupling V115	CC21SL080K
C138	Same as C137	Coupling V115	
C139	CAPACITOR, fixed: ceramic dielectric; 47 uuf, $\pm 2\%$ , 500 wvdc, char. SL.	RF Bypass V115	CC21SL470G
C140	CAPACITOR, variable: ceramic; 3-12 uuf, 500 wvdc, char. A.	MF Trimmer V114	CV11A120
C141	Same as C140.	MF Trimmer V114	
C142	CAPACITOR, fixed: metallized paper; .04 uf, 200 wvdc.	Audio Bypass V103	CN-111-5
C143	Same as C142.		
C144	Same as C142.		
C145	Same as C142.		
C146	CAPACITOR, fixed: mica dielectric; 5100 uuf, $\pm 1\%$ .	Freq. Det. Z106	CM350F5100F
C147	Same as C146.		
C148	Same as C104.		
C149	CAPACITOR, fixed: mica dielectric; 330 uuf, $\pm 2\%$ , 500 wvdc, char. D.	17 Kc Bypass	CM20D331G
C150	Same as C101.	LF Bypass T106	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER	
C151	Same as C101.	Coupling V107	CM20D162G	
C152	Same as C101.	Coupling		
C153	Same as C101.	Bypass V107		
C154	CAPACITOR, fixed: mica dielectric; 1600 uuf, $\pm 2\%$ , 500 wvdc, char. D.	P/o T108		
C155	Same as C154.			
C156	Same as C101.	Coupling V107		
C157	Same as C101.	Coupling V107		
C158	Same as C101.	Bypass V107		
C159	Same as C154.	p/o T107		
C160	Same as C154.			
C161	Same as C101.	Decoupling T107	CB-127-1	
C162	Same as C101.	RF Bypass J101		
C163	Same as C139.	MF Coupling V113		
C164	Same as C163.	MF Coupling V113		
C165	Same as C101.	LF Bypass V108		
C166	Same as C101.	Decoupling V113		
C167 A, B	CAPACITOR, variable: air dielectric; 2 sections, 12.5 to 270 uuf, each section.	MF Tuning V114		
C168	Same as C101.	RF Bypass V114		
C169	Same as C101.	Same as C168.		
C170	Same as C101.	DC Blocking V114		
C171	Same as C101.	Decoupling V114		
C172	NOT USED.			
C173	Same as C101.	RF Bypass		
C174	Same as C104.	Same as C173		
C175	Same as C104.	RF Bypass, RF Output		
C176	Same as C101.	Coupling, RF Output		
C177	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C.	Tunes T112, V120		CV11C300
C178	Same as C177.	Tunes T122, V120		

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
C179	Same as C177.	Tunes T120, V120	
C180	Same as C177.	Tunes T121, V120	
C181A	CAPACITOR, variable: air dielectric; 12 to 270 uuf, each section.	RF Tuning V120	CV-137-1
C181 B	CAPACITOR, variable: air dielectric; 12 to 270 uuf, each section.	RF Tuning V119	CB-137-2
C181C	CAPACITOR, variable: air dielectric; 12 to 270 uuf, each section.	RF Tuning V118	CB-137-3
C182	Same as C118.	Coupling V120	
C183	Same as C104.	Decoupling V120	
C184	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, $\pm 20\%$ , 500 wvdc, char. P.	RF Feed Thru	CK70A102M
C185	Same as C104.	RF Bypass V120	
C186	Same as C104.	Cathode Bypass V120	
C187	Same as C104.	Same as C186	
C188	CAPACITOR, fixed: dry electrolytic; 50 uf, 500 wvdc, char. C.	Cathode Bypass V120	CE63C500G
C189	Same as C120.	Tunes T118, V119	
C190	Same as C177.	Tunes T119, V119	
C191	Same as C177.	Tunes T116, V119	
C192	Same as C177.	Tunes T117, V119	
C193	Same as C118.	Coupling V119	
C194	Same as C104.	RF Bypass V119	
C195	NOT USED.		
C196	Same as C104.	Cathode Bypass V119	
C197	Same as C101.	Cathode Bypass V119	
C198	Same as C184.	RF Feed Thru V120	
C199	Same as C184.	RF Feed Thru V118	
C200	Same as C184.	RF Feed Thru V119	
C201	Same as C177.	Tunes T114, V118	
C202	Same as C177.	Tunes T115, V118	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
C203	Same as C177.	Tunes T113, V118	
C204	Same as C184.	RF Feed Thru V118	
C205	Same as C118.	Coupling V118	
C206	Same as C104.	RF Bypass V118	
C207	Same as C104.	Cathode Bypass V118	
C208	Same as C184.	RF Feed Thru V118	
C209	Same as C104.	RF Bypass V116	
C210	Same as C104.	Coupling V116	
C211	Same as C104.	Cathode Bypass V116	
C212	Same as C104.	RF Bypass V116	
C213	Same as C184.	RF Feed Thru V116	
C214	CAPACITOR, fixed: ceramic dielectric; 15 uuf, $\pm 5\%$ , 500 wvdc, char. SL.	RF Bypass V116	CC21SL150J
C215	Same as C104.	AC Blocking V116	
C216	Same as C104.	RF Bypass V117	
C217	Same as C139.	Coupling V117	
C218	Same as C104.	RF Bypass V117	
C219	Same as C137.	Coupling V117	
C220	Same as C139.	Bypass V117	
C221	Same as C184.	RF Feed Thru	
C222	CAPACITOR, fixed: mylar dielectric; .05 uf, $\pm 5\%$ , 400 wvdc.	Transient Sup. Oven Term. Bd.	CN-113-1
C223	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap.	Freq. Adj. Y111	CV-101-1
C224	Same as C223.	Freq. Adj. Y112	
C225	Same as C223.	Freq. Adj. Y113	
C226	Same as C223.	Freq. Adj. Y114	
C227	Same as C223.	Freq. Adj. Y115	
C228	Same as C223.	Freq. Adj. Y116	
C229	Same as C223.	Freq. Adj. Y117	
C230	Same as C223.	Freq. Adj. Y118	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
C231	Same as C223.	Freq. Adj. Y119	
C232	Same as C223.	Freq. Adj. Y120	
C233	Same as C223.	Freq. Adj. Y101	
C234	Same as C223.	Freq. Adj. Y102	
C235	Same as C223.	Freq. Adj. Y103	
C236	Same as C223.	Freq. Adj. Y104	
C237	Same as C223.	Freq. Adj. Y105	
C238	Same as C223.	Freq. Adj. Y106	
C239	Same as C223.	Freq. Adj. Y107	
C240	Same as C223.	Freq. Adj. Y108	
C241	CAPACITOR, fixed: mica dielectric; 220 uuf, $\pm 5\%$ , 300 wvdc, char. D.	Tunes L101	CM15D221J
C242	CAPACITOR, fixed: mica dielectric; 130 uuf, $\pm 5\%$ , 300 wvdc, char. C.	Tunes L101	CM15C131J
C243	CAPACITOR, fixed: mica dielectric; 82 uuf, $\pm 5\%$ , 300 wvdc, char. C.	Tunes L103	CM15C820J
C244	CAPACITOR, fixed: mica dielectric; 47 uuf, $\pm 5\%$ , 300 wvdc, char. C.	Tunes L105	CM15C470J
C245	CAPACITOR, fixed: mica dielectric; 24 uuf, $\pm 5\%$ , 300 wvdc, char. C.	Tunes L108	CM15C240J
C246	Same as C184.	RF Feed Thru Fil V116	
C247	Same as C184.	RF Feed Thru Fil V120	
C248	Same as C184.	RF Feed Thru Fil V119	
C249	Same as C184.	RF Feed Thru Fil V118	
C250	Same as C101.	Meter Bypass V112	
C251	Same as C101.	Coupling V101	
C252	Same as C101.	RF Bypass V113	
C253	Same as C184.	RF Feed Thru V119	
C254	Same as C101.	Cathode Bypass V113	
C255	CAPACITOR, fixed: mica dielectric; 27 uuf, $\pm 5\%$ , 300 wvdc, char. C.	RF Bypass T108	CM20C270J

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
C256	CAPACITOR, fixed: mica dielectric; 51 uuf, $\pm 5\%$ , 300 wvdc, char. C.	Tunes L104	CM15C510J
C257	Same as C101.	Bypass	
C258	Same as C119.	LF Gain	
C259	Same as C119.	LF Balance	
C260	Same as C101.	Bypass V109	
C261	CAPACITOR, fixed: mylar dielectric; .1 uf, $\pm 10\%$ , 200 wvdc.	AVC Suppressor Stablizing Z104	CN108B1003K
C262	Same as C101.	RF Bypass	
C263	CAPACITOR, fixed: mica dielectric; 1500 uuf, $\pm 10\%$ , 300 wvdc: button type.	ALDC RF Bypass	CB21PBP52K
CR101	DIODE ASSEMBLY, germanium: four diodes.	Balance Mod.	<del>CR101</del>
CR102	Same as CR101.		
CR103	Same as CR101.		
CR104	Diode, silicon.	Meter Rectifier	1N303
CR105	Same as CR104.		
CR106	Same as CR104.		
CR107	DIODE, germanium.	HF Mod.	1N39B
CR108	Same as CR107.		
CR109	Same as CR104.		
CR110	Same as CR107.	p/o 17 Kc osc.	
E101	BOARD, terminal; general purpose barrier type; 14 brass nickel plated 6-32 binding head machine screws; moulded phenolic body.	Terminal Bd. Rear Apron	TM-100-14
E102	CLIP, electrical: ceramic body.	Plate Cap V120	HB-102-2
I101	LAMP, neon: min. bayonet base; 110/120 volts, 1/25 watt.	Exciter ON Ind.	VI-100-51
I102	Same as I101.	Oven Indicator	
I103	LAMP, incandescent: min. bayonet base; 6-8 volts, .25 amp; frosted lens, T-3-1/4.	Main Power Indica- tor	BI-101-44(AF)
J101	CONNECTOR, receptacle: female, 3 contact, chassis type.	Mike Jack	JJ-133-3
J102	CONNECTOR, receptacle: female, 1 contact, chassis type.	RF Out.	UG-625/U
J103	Same as J102.	RF Out.	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
J104	Same as J102.	VMO In	
J105	CONNECTOR, receptacle: male, one contact, 50 ohm.	RF Connector	JJ-154
J106	Same as J105.		
J107	Same as J105.		
J108	Same as J105.		
J109	CONNECTOR, receptacle male.	Power Jack	MS3102A2027P
J110	Same as J105.		
J111	Same as J102.	LSB SLM Output	
J112	Same as J102.	USB SLM Output	
J113	Same as J102.	ALDC Input	
K101	RELAY ASSY, solenoid, plug in type, octal base	VOX Relay	A-1460
L101	COIL, R. F. : 8mc; .95 - 1.01 uh, Q greater than 115.	8 mc Tank	CL-207
L102	COIL, R. F. : 10 mc; .95 - 1.01 uh, Q greater than 115.	10 mc Tank	CL-208
L103	COIL, R. F. : 12 mc; .95 - 1.01 uh, Q greater than 115.	12 mc Tank	CL-209
L104	COIL, R. F. : 14 mc; .95-101 uh, Q greater than 115.	14 mc Tank	CL-210
L105	COIL, R. F. : 16 mc; .95 - 1.01 uh, Q greater than 115.	16 mc Tank	CL-211
L106	COIL, R. F. : 18 mc; .95 - 1.01 uh, Q greater than 115.	18 mc Tank	CL-212
L107	COIL, R. F. : 20 mc; .95 - 1.01 uh, Q greater than 115.	20 mc Tank	CL-213
L108	COIL, R. F. : 22 mc; .77 - .83 uh, Q greater than 115.	22 mc Tank	CL-214
L109	COIL, R. F. : 24 mc; .67 - .73 uh, Q greater than 115.	24 mc Tank	CL-215
L110	COIL, R. F. : 26 mc; .58 - .64 uh, Q greater than 115.	26 mc Tank	CL-216
L111	COIL, R. F. : 28 mc; .46 - .50 uh, Q greater than 115.	28 mc Tank	CL-206
L112	COIL, R. F. : 30 mc; .40 - .45 uh, Q greater than 115.	30 mc Tank	CL-204

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
L113	COIL, R. F. : 32 - 34 mc; .29 - .34 uh, Q greater than 115.	32 mc Har. Gen.	CL-205
L114	Same as L113.	34 mc Har. Gen.	
L115	COIL, R. F. : fixed: 10 uh, 75 ma, 3 Pi.	Choke, RF, V115	CL-101-4
L116	COIL, R. F. : fixed: 2.8 uh.	Choke, RF, V118	CL-105-3
L117	COIL, R. F. : fixed: 150 uh, 100 ma.	Choke, RF, V120	CL-140-2
L118	COIL, R. F. : fixed: 2.5 mh, 100 ma.	Choke, RF, V119	CL-140-1
L119	Same as L117.	Choke, RF, V119	
L120	Same as L117.	Choke, RF, V120	
L121	Same as L118.	Choke, RF, V118	
L122	Same as L117.	Choke, RF, V118	
L123	Same as L118.	Choke, RF, V118	
L124	Same as L118.	Choke, RF, V120	
L125	COIL, plate peaking.	Choke, RF, V116	CL-189
L126	COIL, R. F. : fixed: 128 uh.	Plate Load V117	CL-177
L127	COIL, R. F. : fixed: 750 uh, 75 ma, 2 Pi.	Choke, RF, V116	CL-100-5
L128	COIL, R. F. : fixed: 33.2 uh.	Choke, RF, V117	CL-141
L129	COIL, R. F. : fixed: 4 uh.	Choke, RF Fil. of V119	CL-105-2
L130	Same as L129.	Choke, RF Fil. of V118	
L131	Same as L129.	Coupling T110	
L132	Same as L117.	Choke, RF Plate	
L133	Same as L127.	Choke, RF, V119	
L134	COIL, R. F. : fixed: molded: 120.0 uh, 20 mc approx., 3.2 ohms, powdered iron coil form.	ALDC RF Filter Choke	CL-240-120
M101	METER, D. C. : micro amp., 0-200.	Relative Indication of USB, LSB, RF OUT, MF and Calibrate.	MR-100-8
P101	CONNECTOR, plug: male:	Power Intercon Cable Plug	MS3106B2027P
P102	CONNECTOR, plug: female.	Same as P101	MS3106B2027S



**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
P103	CONNECTOR, plug: min. coaxial type.	MF Osc. Output	PL-154
P104	Same as P103.	VMO Injection	
P105	Same as P103.	HF Osc. Inj.	
P106	Same as P103.	VMO Injection	
P107	CONNECTOR, plug: min. coaxial type.	HF Osc. Inj.	PL-155
PS101	SUPPRESSOR, parasitic.	Parasitic Supp.	AX-162
PS102	SUPPRESSOR, parasitic.	Parasitic Supp. V119	AX-160
PS103	SUPPRESSOR, parasitic.	Parasitic Supp. V120	AX-161
R101	RESISTOR, fixed: composition; 560 ohms, ±10%, 1/2 watt.	Terminating T101	RC20GF561K
R102	Same as R101.	Terminating T102	
R103	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt.	Grid Return V101	RC20GF474K
R104	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt.	Plate Load V101	RC20GF104K
R105	RESISTOR, fixed: composition; 1500 ohms, ±10%, 1/2 watt.	Cathode V101	RC20GF152K
R106	RESISTOR, variable: composition; 50,000 ohms, ±20%, 2 watts.	Carrier Insert T105	RV4ATRD503B
R107	RESISTOR, fixed: composition; 6800 ohms, ±10%, 1/2 watt.	Dropping T105	RC20GF682K
R108	RESISTOR, fixed: composition, 1800 ohms, ±10%, 1/2 watt.	Decoupling V106	RC20GF182K
R109	RESISTOR, variable: composition; 100,000 ohms, ±10%, 1/2 watt.	Notch Control Z106	RV106UX10C104A
R110	RESISTOR, variable: composition; 100 ohms, ±10%, 2 watts.	LSB Balance Z101	RV4ATXA101A
R111	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt.	Plate Load Z105	RC20GF223K
R112	Same as R110.		
R113	Same as R110.		
R114	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt.	Cathode Z105	RC20GF102K
R115	RESISTOR, fixed: composition; 68,000 ohms, ±10%, 1/2 watt.	Grid Return Z105	RC20GF683K

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
R116	RESISTOR, fixed: composition; 2.2M, ±10%, 1/2 watt.	Same as R115	RC20GF225K
R117	Same as R111.		
R118	RESISTOR, fixed: composition; 68 ohms, ±10%, 1/2 watt.	Same as R114	RC20GF680K
R119	RESISTOR, fixed: composition; 180,000 ohms, ±10%, 1/2 watt.	Dropping Z105	RC20GF184K
R120	RESISTOR, fixed: wire wound; 5000 ohms, ±5%, 10 watts.	Dropping V106	RW-109-32
R121	RESISTOR, fixed: composition; 15,000 ohms, ±10%, 1/2 watt.	Limiting Z105	RC20GF106K
R122	RESISTOR, fixed: composition; 15,000 ohms, ±10%, 1/2 watt.	Screen Dropping	RC20GF153K
R123	Same as R114.	Decoupling V106	
R124	RESISTOR, fixed: composition; 4700 ohms, ±10%, 1 watt.	Plate Load V105	RC32GF472K
R125	Same as R104.	Plate Load Z103	
R126	Same as R103.	Grid Return Z103	
R127	Same as R103.	Same as R126	
R128	Same as R114.	Cathode Z103	
R129	RESISTOR, variable: composition; 5000 ohms, ±20%, 2 watts.	Squelch Gain V110	RV4ATSA502B
R130	RESISTOR, variable: composition; 1000 ohms, ±10%, 2 watts.	MF Balance V113	RV4ATXA102A
R131	RESISTOR, fixed: composition; 820 ohms, ±10%, 1/2 watt.	Cathode V107	RC20GF821K
R132	Same as R104.	Plate Load V107	
R133	Same as R121.	Dropping V107	
R134	RESISTOR, fixed; composition; 220,000 ohms, ±10%, 1/2 watt.	Same as R133	RC20GF224K
R135	RESISTOR, variable: composition; 1000 ohms, ±10%, 2 watts.	Meter Bal. 112	RV4ATSA102A
R136	Same as R104.	Plate Load V110	
R137	Same as R104.	Plate Load V110	
R138	RESISTOR, fixed: composition; 82,000 ohms, ±10%, 2 watts.	Cathode Bias V110	RC42GF823K

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
R139	RESISTOR, fixed: composition; 1000,00 ohms, ±10%, 2 watts.	Screen Dropping V110	RC42GF104K
R140	RESISTOR, variable: composition; 100,000 ohms, ±20%, 2 watts.	VOX Gain V110	RV4ATSA104B
R141	RESISTOR, fixed: composition; 470 ohms, ±10%, 1/2 watt.	Cathode V110	RC20GF471K
R142	Same as R114.	Cathode V110	
R143	Same as R103.	Grid Return V110	
R144	Same as R103.	Plate Load V111	
R145	Same as R121.	Time Constant V111	
R146	Same as R116.	Dropping V111	
R147	Same as R104.	Cathode V111	
R148	Same as R121.	Dropping V111	
R149	Same as R121.	Time Constant V111	
R150	RESISTOR, variable: composition; 500 ohms, ±10%, 2 watts.	HF Balance Z107	RV4ATXA501A
R151	Same as R131.	Cathode V109	
R152	Same as R138.	Cathode Bias V109	
R153	Same as R134.	Dropping I101	
R154	RESISTOR, fixed: composition; 1.5 M, ±5%, 1/2 watt.	Grid Return V112	RC20GF155J
R155	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1 watt.	Plate Load V112	RC32GF223K
R156	Same as R155.	Plate Load V112	
R157	RESISTOR, fixed: composition; 1200 ohms, ±10%, 1/2 watt.	Cathode V112	RC20GF122K
R158	Same as R157.	Cathode V112	
R159	Same as R155.	Plate Load V115	
R160	Same as R155.	Plate Load V115	
R161	Same as R105.	Cathode V115	
R162	RESISTOR, fixed: composition; 4700 ohms, ±10%, 1/2 watt.	Grid Return V115	RC20GF472K
R163	Same as R134.	Grid Return V115	
R164	RESISTOR, fixed: composition; 47,000 ohms, ±10%, 1/2 watt.	Dropping V114	RC20GF473K

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
R165	Same as R164.	Dropping, MF Mtr. Ckt.	
R166	Same as R114.	Dropping, USB Gain	
R167	Same as R114.	Dropping, LBS Gain	
R168	Same as R140.	LBS Gain Control V102	
R169	Same as R140.	LBS Gain Control V103	
R170	Same as R105.	Dropping T117	
R171	RESISTOR, fixed: composition; 240,000 ohms, $\pm 10\%$ , 1/2 watt.	Dropping Z101	RC20GF244K
R172	Same as R171.	Dropping Z102	
R173	RESISTOR, fixed: composition; 68,000 ohms, $\pm 5\%$ , 1/2 watt.	Dropping Z106	RC20GF683J
R174	Same as R171.	Grid Return V108	
R175	Same as R105.	Cathode V108	
R176	Same as R104.	Plate Load V108	
R177	Same as R164.	Grid Return V108	
R178	Same as R105.	Cathode V108	
R179	Same as R114.	T103 Terminating	
R180	Same as R114.	T104 Terminating	
R181	Same as R131.	Cathode V107	
R182	Same as R104.	Plate Load V107	
R183	Same as R121.	Dropping V107	
R184	Same as R134.	Dropping V107	
R185	RESISTOR, fixed: composition; 220 ohms, $\pm 10\%$ , 1/2 watt.	Dropping CR103	RC20GF221K
R186	Same as R185.		
R187	Same as R111.	T108 Terminating	
R188	Same as R111.		
R189	RESISTOR, fixed: composition; 330 ohms, $\pm 10\%$ , 1/2 watt.	Cathode V109	RC20GF331K
R190	Same as R111.	T107 Terminating	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
R191	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1 watt.	Decoupling T107	RC32GF102K
R192	Same as R164.	Grid Return V113	
R193	Same as R164.	Grid Return V113	
R194	Same as R101.	Cathode Bias V103	
R195	Same as R101.	Cathode Bias V104	
R196	RESISTOR, fixed: composition; 10,000 ohms, ±10%, 2 watts.	Decoupling V113	RC42GF103K
R197	Same as R118.	Parasitic Supp. V113	
R198	Same as R118.	Parasitic Supp. V113	
R199	RESISTOR, fixed: composition; 39 ohms, ±10%, 1/2 watt.	Parasitic Supp. V114	RC20GF390K
R200	RESISTOR, fixed: composition; 150 ohms, ±10%, 1/2 watt.	Cathode V114	RC20GF151K
R201	Same as R118.	VMO Load J107	
R202	RESISTOR, fixed: composition; 82,000 ohms, ±10%, 1/2 watt.	Screen Dropping V114	RC20GF823K
R203	RESISTOR, fixed: composition; 1200 ohms, ±10%, 1 watt.	Decoupling V114	RC30GF122K
R204	Same as R134.	Dropping V114	
R205	RESISTOR, variable; composition; 5000 ohms, ±10%, 1/2 watt.	Output Control Z107	RV4ATRD502C
R206	Same as R200.	Transient Supp.	
R207	RESISTOR, fixed: wire wound; 20 watts.	Oven Heater	RR-102-1
R208	Same as R207.		
R209	RESISTOR, fixed: composition; 3.3M, ±10%, 1/2 watt.	Dropping, RF Meter Ckt.	RC20GF335J
R210	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt.	Dropping, RF Meter Ckt.	RC20GF102J
R211	RESISTOR, fixed: composition; 560 ohms, ±10%, 1/2 watt.	Dropping, RF Meter Ckt.	RC20GF561J
R212	Same as R114.	Dropping, RF Output	
R213	Same as R103.	Screen Dropping V120	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
R214	RESISTOR, fixed: composition; 10 ohms, ±10%, 1/2 watt.	Suppressor V120	RC20GF100K
R215	Same as R115.	Dropping V119	
R216	RESISTOR, fixed: wire wound; 500 ohms, ±5%, 10 watt.	Cathode Bias V120	RW-109-19
R217	RESISTOR, fixed: composition; 5600 ohms, ±10%, 1 watt.	Screen Dropping V119	RC32GF562K
R218	Same as R199.	Suppressor V119	
R219	Same as R118.	Cathode Bias V119	
R220	Same as R214.	Suppressor V119	
R221	RESISTOR, fixed: composition; 390,000 ohms, ±10%, 1/2 watt.	Dropping V109B	RC20GF394K
R222	Same as R114.	Dropping V119	
R223	RESISTOR, fixed: composition; 33,000 ohms, ±10%, 1/2 watt.	Screen Dropping V118	RC20GF333K
R224	Same as R214.	Suppressor V118	
R225	Same as R200.	Cathode Bias V118	
R226	Same as R214.	Suppressor V118	
R227	RESISTOR, fixed: composition; 2700 ohms, ±10%, 1/2 watt.	Grid Return V118	RC20GF272K
R228	Same as R189.	Cathode Bias V116	
R229	Same as R104.	Grid Return V116	
R230	RESISTOR, fixed: composition; 2700 ohms, ±10%, 1 watt.	Decoupling V116	RC32GF272K
R231	RESISTOR, fixed: composition; 6800 ohms, ±10%, 1 watt.	Decoupling V116	RC32GF682K
R232	Same as R111.	Screen Dropping V116	
R233	Same as R104.	Grid Return V116	
R234	Same as R111.	Part of T107	
R235	Same as R104.	Dropping I102	
R236	Same as R200.	Plate Dropping V109B	
R237	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt.	Isolating T110	RC20GF271K

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
R238	RESISTOR, fixed: composition; 5.1 M, ±5%, 1/2 watt.	Voltage Divider Meter	RC20GF515J
R239	Same as R105.	Loading T119	
R240	Same as R230.	B + Decoupling	
R241	Same as R134.	Terminating SLM	
R242	Same as R134.		
R243	Same as R103.	ALDC Voltage Divider	
S101	SWITCH, rotary: non-shorting, 4 positions, double pole; glass melamine ins., contacts and wipers, silver alloy, 1/4 in. shaft, 11/32 in. lg., 1/4 in. flatted, 2 sides.	USB Switch	SW-181
S102	Same as S101.	LBS Switch	
S103	SWITCH, toggle: SPST; solder lug terminals, 110/250 volts AC or DC.	Exciter ON/STANDBY	ST-103-1-62
S104	Same as S103.	Xmtr. ON/OFF	
S105	Same as S103.	Exciter ON/STANDBY	ST-103-1-62
S106A	WAFER, switch: four positions shorting type.	RF Band V120	WS-101
S106 B	Same as S106A.	RF Band V119	
S106C	Same as S106A.	RF Band V118	
S106D	WAFER, switch; four positions, shorting type.	Sideband Reversal V103	WS-103
S107	SWITCH, rotary: 11 position, shorting type, single pole, 30° detent.	MF Xtal Switch	SW-200
S108A	WAFER, switch: 15 positions, single pole, shorting type.	HF Mod. Switch	WS-102
S108B	SWITCH, rotary: 15 positions, single pole, 20° detent.	HF Mod. Switch	SW-191
S109	SWITCH, rotary: 5 positions, shorting type, single pole, 30° detent.	Meter Switch	SW-199
S110	SWITCH, sensitive: bi-metallic; 80° breaking temperature, ± 2° . (p/o TB101)	Thermostat Oven	SS-100-3
T101	TRANSFORMER, audio: pri. imp. 150/600 ohms sec. imp. 600 ohms CT; 7 terminals.	Input Channel 1	TF-170
T102	Same as T101	Input Channel 2	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
T103	TRANSFORMER, audio: pri. imp. 20,000 ohms CT; sec. imp. 150/600 ohms; 7 terminals.	Audio V102	TF-138
T104	Same as T103.		
T105	Same as T103.	Output 17 Kc V104	
T106	Same as T103.	CP Amp. V108	
T107	TRANSFORMER, R. F. : 270 Kc; double tuned.	LF Transformer V109	<del>TF-100</del> A-14442
T108	Same as T107.		
T109	TRANSFORMER, R. F. : 2-4 Mc; single tuned.	MF Transformer V113	A-1512
T110	TRANSFORMER, R. F. : 2-4 Mc; single tuned.	MF Transformer V114	A-1511
T111	TRANSFORMER, R. F. : 2-4 Mc; double tuned.	Mod. Transformer Z107	TF-172
T112	TRANSFORMER, R. F. : 16-32 Mc; slug tuned.	16-32 Mc Band V120	CL-189
T113	TRANSFORMER, R. F. : 4-8 Mc; slug tuned.	4-8 Mc Band V118	CL-163
T114	TRANSFORMER, R. F. : 16-32 Mc; slug tuned.	16-32 Mc Band V118	CL-188
T115	TRANSFORMER, R. F. : 8-16 Mc; slug tuned.	8-16 Mc Band V118	CL-164
T116	TRANSFORMER, R. F. : 2-4.3 Mc; slug tuned.	2-4.3 Mc Band V119	CL-162
T117	Same as T113.	4-8 Mc Band V119	
T118	Same as T114.	16-32 Mc Band V119	
T119	Same as T115.	8-16 Mc Band V119	
T120	TRANSFORMER, R. F. : 2-4.3 Mc; slug tuned.	2-4.3 Mc Band V120	CL-161
T121	Same as T113.	4-8 Mc Band V120	
T122	TRANSFORMER, R. F. : 8-16 Mc; slug tuned.	8-16 Mc Band V120	CL-165
T123	TRANSFORMER, H. F. : Osc. output; ferrite core.	HF Output Xmfr Z107	TF-173
T124	TRANSFORMER, H. F. : VMO input.	VMO Input Xmfr V115	TR-166



**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
V101	TUBE, electron: RF triode: 7 pin miniature.	Mike Preamplifier	6AB4
V102	Same as V101.	Audio Amplifier	
V103	Same as V101.		
V104	TUBE, electron: 9 pin miniature.	17 Kc Oscillator	6U8
V105	TUBE, electron: medium-mu duo-triode, 9 pin miniature.	287 Kc Oscillator	12AU7
V106	TUBE, electron: voltage regulator; 7 pin miniature.	150 Volt Regulator	OA2
V107	TUBE, electron: RF triode; 7 pin miniature.	Meter Amplifier	12AT7
V108	Same as V107.	LF Amplifier	
V109	Same as V107.	Relay Amp/270 Kc Amp.	
V110	Same as V104.	Squelch/VOX Amplifier	
V111	TUBE, electron: duo diode: 7 pin miniature.	Squelch/VOX Rectifier	6AL5
V112	Same as V105.	Meter Tube	
V113 A, B	Same as V107.	MF Modulator	
V114	TUBE, electron: shart cutoff pentode; 7 pin minature.	MF Amplifier	6AH6
V115	Same as V105.	2-4 Mc Oscillator	
V116	TUBE, electron: power pentode, wide band amp, 9 pin miniature.	HF Oscillator/ Amplifier	6CL6
V117	Same as V104.	HF Oscillator	
V118	Same as V114.	1st RF Amplifier	
V119	Same as V116.	2nd RF Amplifier	
V120	TUBE, electron: beam power; large wafer octal base with sleeve.	RF Output Amplifier	6146
W101	CABLE, power interconnect: 3'9" long, consists of P101 and P102.	Power Cable	CA-346-3-9
XCR101 thru XCR103	SOCKET, octal: moulded plastic.	Sockets for CR101 thru CR103	TS-101-P01
X1101	SOCKET, lens, miniature bayonet: red indicator lens.	Socket for 1101	TS-106-1

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
X1102	SOCKET, lens, miniature bayonet: white indicator lens.	Socket for I102	TS-106-2
X1103	SOCKET, bracket, miniature bayonet.	Socket for I103	TS-107-2
XK101	Same as XCR101.	Socket for K101	
XV101	SOCKET, 7 pin miniature: moulded plastic.	Socket for V101	TS-102-P01
XV102	Same as XV101.	Socket for V102	
XV103	Same as XV101.	Socket for V103	
XV104	SOCKET, plug in: w/can; plug in type, 9 pin miniature.	Socket for V104	PO-148-9-2
XV105	Same as XV104.	Socket for V105	
XV106	Same as XV101.	Socket for V106	
XV107	SOCKET, 9 pin miniature: moulded plastic.	Socket for V107	TS-103-P01
XV108	Same as XV107.	Socket for V108	
XV109	Same as XV107.	Socket for V109	
XV110	Same as XV107.	Socket for V110	
XV111	Same as XV101.	Socket for V111	
XV112	Same as XV107.	Socket for V112	
XV113	Same as XV107.	Socket for V113	
XV114	Same as XV101.	Socket for V114	
XV115	Same as XV107.	Socket for V115	
XV116	Same as XV107.	Socket for V116	
XV117	Same as XV107.	Socket for V117	
XV118	Same as XV101.	Socket for V118	
XV119	Same as XV107.	Socket for V119	
XV120	Same as XCR101.	Socket for V120	
XY101	SOCKET, xtal: steatite; cadmium plated phosphor bronze.	Xtal Holder Y101	TS-104-1
XY102	Same as XY101.	Xtal Holder Y102	
XY103	Same as XY101.	Xtal Holder Y103	
XY104	Same as XY101.	Xtal Holder Y104	
XY105	Same as XY101.	Xtal Holder Y105	
XY106	Same as XY101.	Xtal Holder Y106	

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
XY107	Same as XY101.	Xtal Holder Y107	
XY108	Same as XY101.	Xtal Hblder Y108	
XY109	Not replaceable.	Xtal Holder Y109	
XY110	Same as XY109.	Xtal Holder Y110	
XY111	Same as XY101.	Xtal Holder Y111	
XY112	Same as XY101.	Xtal Holder Y112	
XY113	Same as XY101.	Xtal Holder Y113	
XY114	Same as XY101.	Xtal Holder Y114	
XY115	Same as XY101.	Xtal Holder Y115	
XY116	Same as XY101.	Xtal Holder Y116	
XY117	Same as XY101.	Xtal Holder Y117	
XY118	Same as XY101.	Xtal Holder Y118	
XY119	Same as XY101.	Xtal Holder Y119	
XY120	Same as XY101.	Xtal Holder Y120	
XZ103	Same as XCR101.	Socket for Z103	
XZ104	Same as XCR101.	Socket for Z104	
XZ105	Same as XCR101.	Socket for Z105	
Y101	CRYSTAL, quartz: 8 mc.	HF Mod. Osc. 8 mc	CR27/U-8.000P
Y102	CRYSTAL, quartz: 10 mc.	HF Mod. Osc.	CR27/U-10.000P
Y103	CRYSTAL, quartz: 12 mc.	HF Mod. Osc.	CR27/U-12.000P
Y104	CRYSTAL, quartz: 14 mc.	HF Mod. Osc.	CR27/U-14.000P
Y105	CRYSTAL, quartz: 18 mc.	HF Mod. Osc.	CR27/U-18.000P
Y106	CRYSTAL, quartz: 11 mc.	HF Mod. Osc.	CR27/U-11.000P
Y107	CRYSTAL, quartz: 13 mc.	HF Mod. Osc.	CR27/U-13.000P
Y108	CRYSTAL, quartz: 17 mc.	HF Mod. Osc.	CR27/U-17.000P
Y109	CRYSTAL, quartz: 17 kc.	17 Kc Osc.	<del>CR-112</del> CR-112
Y110	CRYSTAL, quartz: 287 kc.	287 Kc Osc.	CR47/U-.287P

**TRANSMITTING MODE SELECTOR MODEL SBE-2  
(SYMBOL SERIES 100 AND 200)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
Y111	SUPPLIED ON CUSTOMERS REQUEST.		
Y112	SUPPLIED ON CUSTOMERS REQUEST.		
Y113	SUPPLIED ON CUSTOMERS REQUEST.		
Y114	SUPPLIED ON CUSTOMERS REQUEST.		
Y115	SUPPLIED ON CUSTOMERS REQUEST.		
Y116	SUPPLIED ON CUSTOMERS REQUEST.		
Y117	SUPPLIED ON CUSTOMERS REQUEST.		
Y118	SUPPLIED ON CUSTOMERS REQUEST.		
Y119	SUPPLIED ON CUSTOMERS REQUEST.		
Y120	SUPPLIED ON CUSTOMERS REQUEST.		
Z101	FILTER, band pass.	Lower Side Band	FX-154
Z102	Same as Z101.	Upper Side Band	FX-155
Z103	ASSEMBLY, <del>250</del> <sup>250</sup> kc oscillator: consists of C118, 121, 122, 123, 124, R125, 126, 128, V105, XV105.	287 Kc Osc.	A-1458
Z104	OVEN, crystal: 17 and 287 kc.	Oven	PO-147
Z105	ASSEMBLY, 17 kc osc.	17 Kc Oscillator	A-1459
Z106	REJECTION NETWORK, 17 kc.	17 Kc Notch	A1591
Z107	MODULATOR ASSEMBLY, H. F. : consists of CR107, 108, R150, T111, J110.	HF Mod.	A-1454
C401	CAPACITOR, fixed: dry electrolytic; polarized, 80 uf, 450 wvdc.	Filter V401	CE51F800R
C402	Same as C401.		
C403 A, B	CAPACITOR, fixed: dry electrolytic; dual; polarized, 20 uf, 450 wvdc.	Filter	CE52E200R
C404 A, B	CAPACITOR, fixed: ceramic, disc type; two section; .01 uf, 500 wvdc each section.	Line Bypass	CC-100-23
F401	FUSE, cartridge: 2 amp.	Oven Fuse	FU-102-2
F402	FUSE, cartridge: 3 amp.	Main Power Fuse	FU-102-3
F403	FUSE, cartridge: 1/4 amp.	BT Fuse	FU-102-.250
I401	LAMP, incandescent: 6-8 V; .250 amp. . T-3-1/4 clear bulb	Main Power Indicator	BI-101-47
J401	CONNECTOR, receptacle: two prong, male.	AC Input	JJ-100

**TRANSMITTING MODE SELECTOR POWER SUPPLY  
(SYMBOL SERIES 400)**

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NUMBER
J402	CONNECTOR, receptacle: female; AN pin type.	Power Interconnect	MS3102A2027S
L401	REACTOR, filter: 10 hy, 200 ma.	Filter Choke V401	TF-144
L402	Same as L401.		
P401	CONNECTOR, plug, female, AC, twist lock, p/o W401.	p/o Power Cable	
P402	CONNECTOR, plug, male, AC, p/o W401.	p/o Power Cable	
R401	RESISTOR, fixed: composition; 15,000 ohms, $\pm 10\%$ , 2 watts.	Voltage Dropping	RC42GF153K
R402	RESISTOR, fixed: wire wound; 7500 ohms, 10 watts.	Voltage Dropping	RW-109-33
R403	RESISTOR, fixed: wire wound, 1000 ohms, 10 watts.	Voltage Dropping	RW-109-24
R404	RESISTOR, fixed: wire wound, 15,000 ohms, 10 watts.	Bleeder	RW-109-36
R405	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$ , 1 watt.	Bleeder	RC30GF104K
T401	TRANSFORMER, power.	Power Xfmr.	TF-161
T402	TRANSFORMER, filament.	Fil. Xfmr.	TF-104
V401	TUBE, electron: duo diode; rectifier.	Rectifier	5R4
V402	TUBE, electron: voltage regulator.	Voltage Reg.	OA2
W401	CABLE, AC power: w/connector, plug, 2 prong.	AC Power	CA-103-72
XF401	FUSE HOLDER, extractor post type for single AGC type fuse.	Holder for F401	FH-100-1
XF402	Same as XF401.	Holder for F402	
XF403	Same as XF401.	Holder for F403	
XI401	SOCKET, indicator: w/red frosted lens.	Socket for I401	TS-106-1
XV401	SOCKET, tube: octal.	Socket for V401	TS-101-P01
XV402	SOCKET, tube: 7 pin miniature.	Socket for V402	TS-102-P01

**SECTION 8**  
**SCHEMATIC DIAGRAMS**

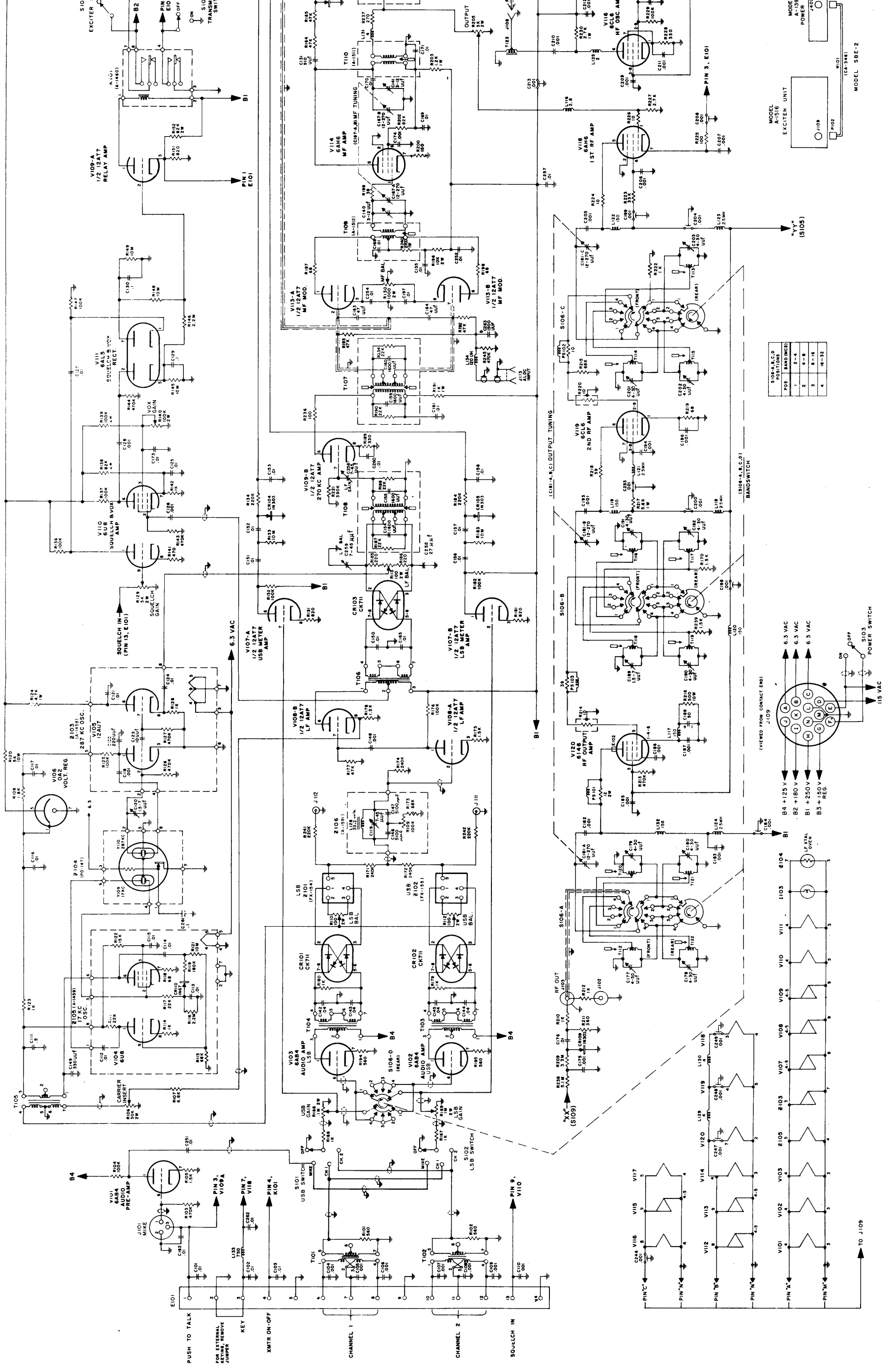
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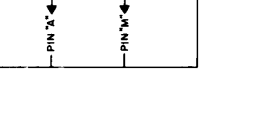
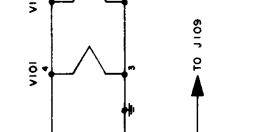
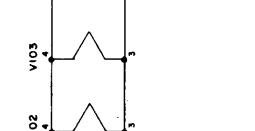
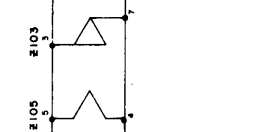
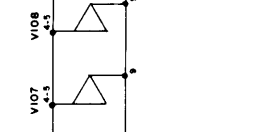
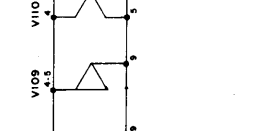
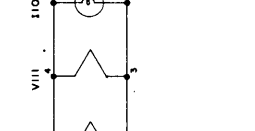
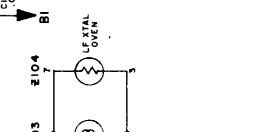
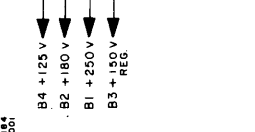
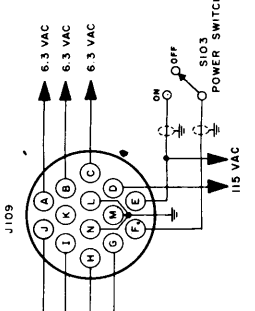
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TUNING RANGE	POS	BAND MCH
1	1	2-4
2	2	4-8
3	3	8-16
4	4	16-32



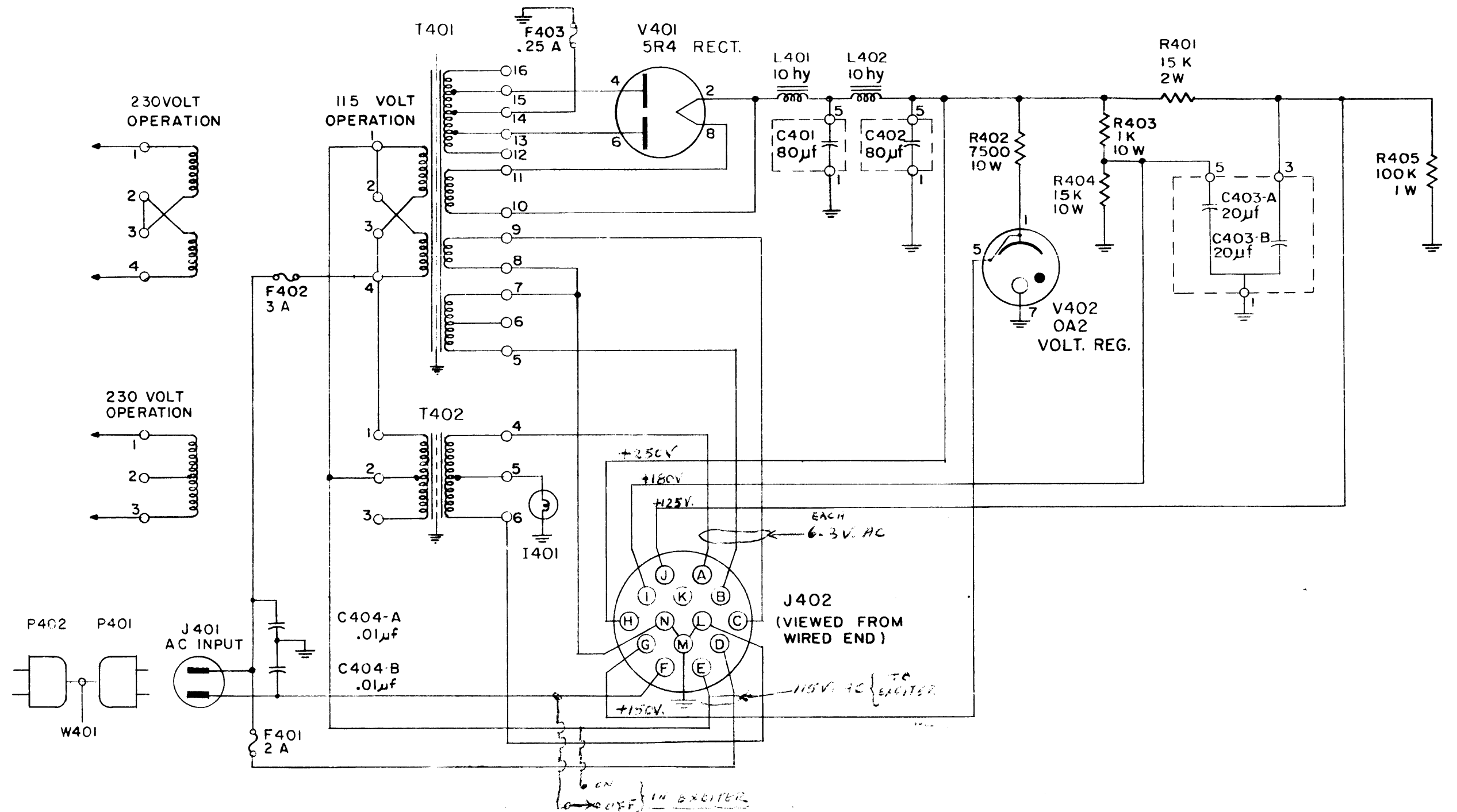


Figure 8-2. Schematic Diagram, Power Supply