UNCLASSIFIED

TECHNICAL MANUAL

for

TRANSMITTING MODE SELECTOR, SBE-3

(MODULATOR POWER SUPPLY GROUP, AN/URA-28)

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

UNCLASSIFIED

TECHNICAL MANUAL

for

TRANSMITTING MODE SELECTOR, SBE-3

(MODULATOR POWER SUPPLY GROUP, AN/URA-28)

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

IN-224

Issue Date: 1 February 1961

TABLE OF CONTENTS

SECTION 1—GENERAL DESCRIPTION

SECTION 2—INSTALLATION

SECTION 3—OPERATOR'S SECTION

SECTION 4—PRINCIPLES OF OPERATION

SECTION 4—PRINCIPLES OF OPERATION (C nt.)

SECTION 5—TROUBLE-SHOOTING

SECTION 6—MAINTENANCE

SECTION 7—PARTS LIST

SECTION 8—SCHEMATIC DIAGRAMS

LIST OF ILLUSTRATIONS

LIST OF TABLES

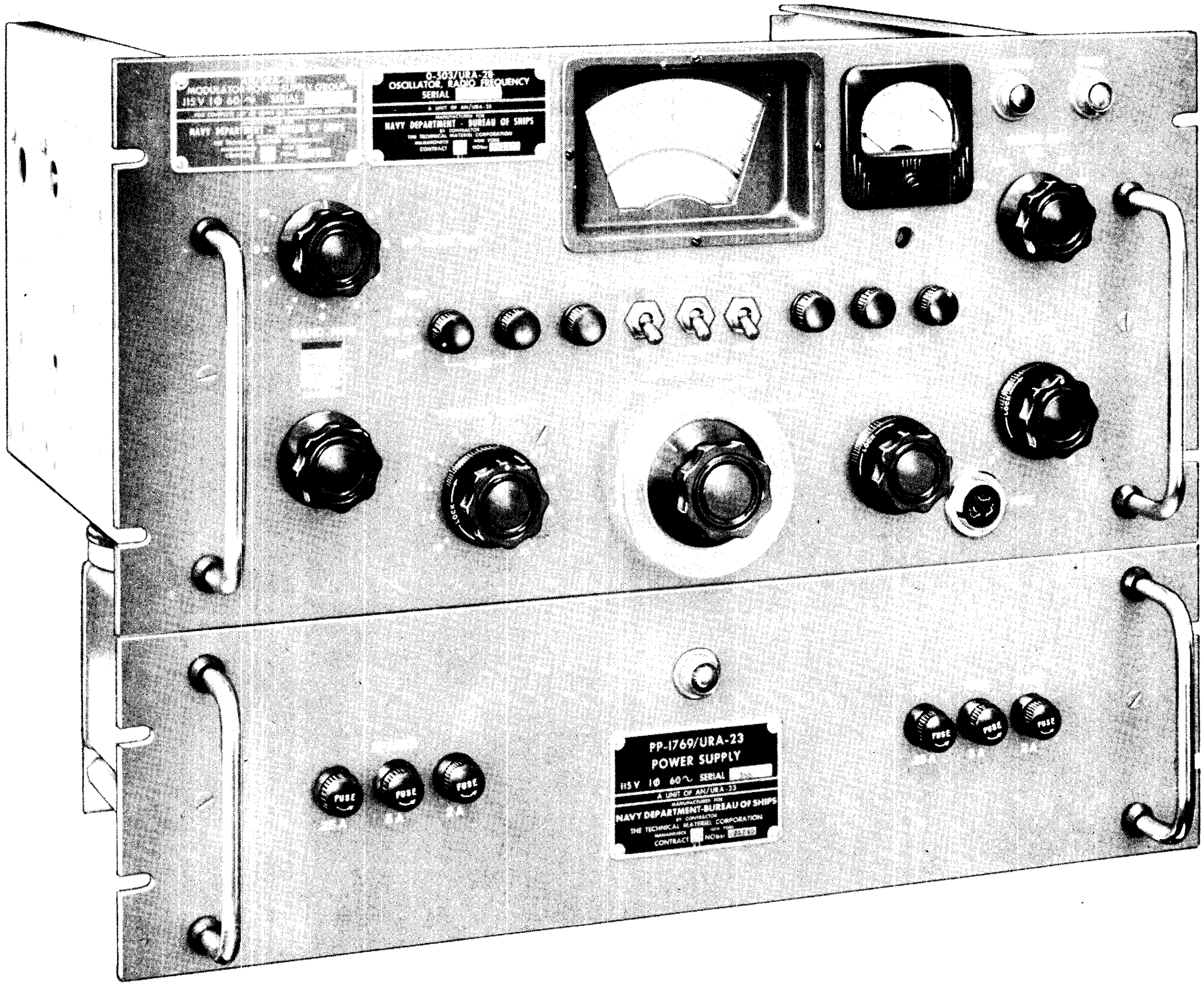


Figure 1-1-a. Front Angle View, Transmitting Mode Selector, SBE-3, and Power Supply

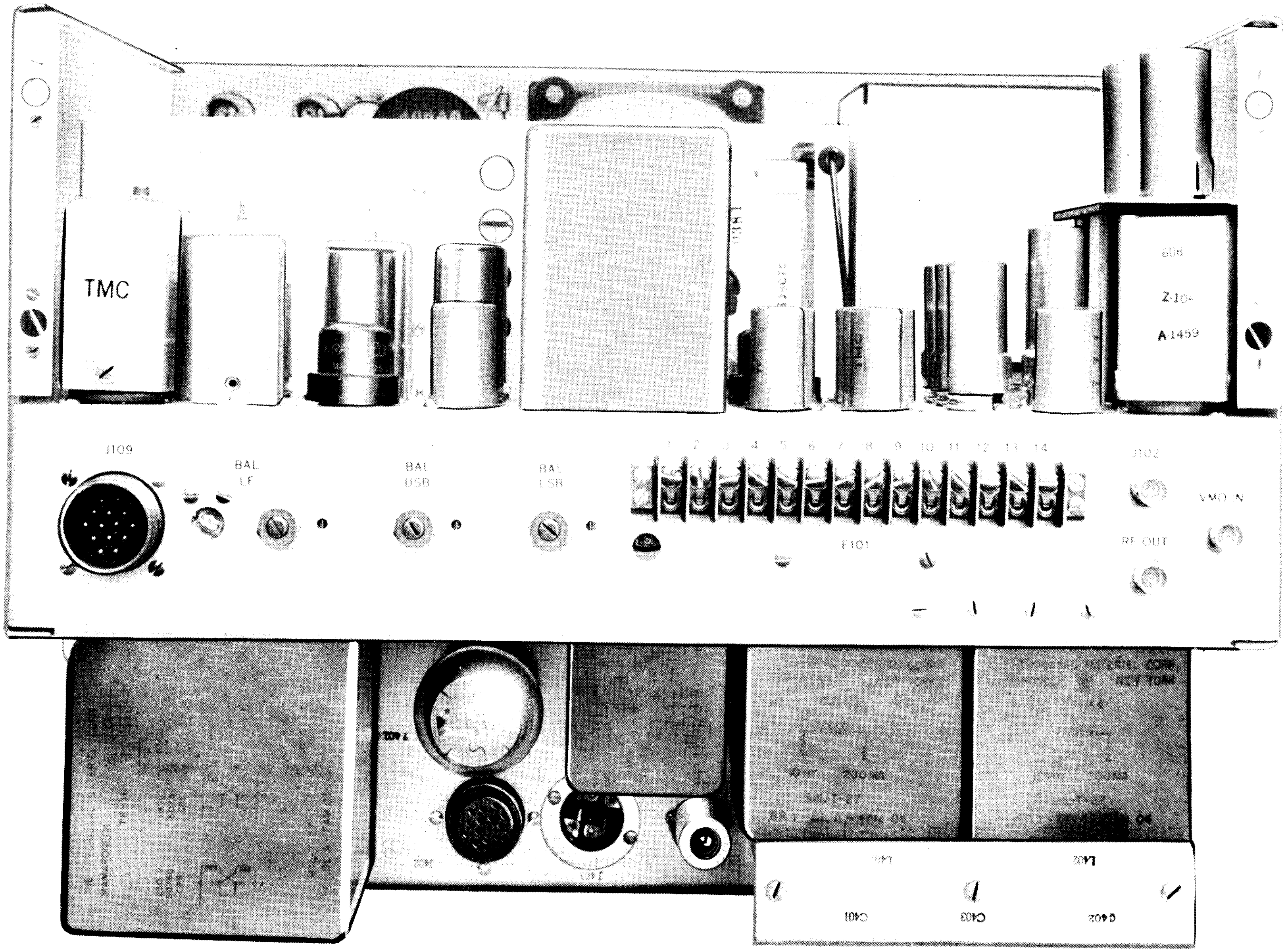


Figure 1-1-b. Rear Angle View, Transmitting Mode Selector, SBE-3, and Power Supply

SECTION 1
GENERAL DESCRIPTION

1-1. INTRODUCTION.

The Transmitting Mode Selector, SBE-3, is a filter-type single or double sideband generator designed for radio telephone, telegraph, and frequency-shift operation. It is continuously tunable from 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.

Commerical and military nomenclature for the SBE is as follows:

Commercial	Military
Transmitting Mode Selector, SBE-3	Modulator Power Supply Group, AN/URA-28
a. Exciter Unit AO-101	a. Oscillator, Radio Frequency, O-672/URA-28
b. Power Supply	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. Carrier Amplitude Modulation (AM)
b. Single Sideband (SSB)
c. Double Sideband (DSB)
d. Independent Sideband (Separate intelligence on each sideband.)
e. Frequency-Shift Keying (FSK)
f. CW Telegraphy (A1 or A2) (CW)

The SBE 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 space and the power supply an additional 5-1/4 inches.

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 7-feet long with two connectors, AN-3057-12P and AN-3057-12S.

(2) Signal Interconnecting Cable CA-427. Approximately 12-feet long; 14 wires E/W tinned ends; 5 coaxials E/W connectors.

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

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

(5) Microphone Connector PL-132-3.

(6) Two UG-260/U connectors.

b. SHIPPING DATA. - Exciter Unit AO-101: in crate 27 x 22-1/4 x 13-3/4 inches; 87 pounds. Power Supply Unit A-1397: in crate 24-3/4 x 10 x 15-1/4 inches; 62 pounds.

TABLE 1-1. ELECTRICAL CHARACTERISTICS

ITEM	CHARACTERISTIC
Frequency range:	2 to 32 mc continuous, bandswitched.
Operating modes:	* Single sideband * Double sideband * Independent sideband (separate intelligence on each sideband) Frequency-shift keying Amplitude modulation, CW or MCW
Frequency control:	Temperature-controlled crystals or external VFO.
Frequency determining elements:	Contained in two temperature-controlled high mass aluminum ovens designed for high thermal inertia.
Crystal oven temperatures:	75°C for 250-kc oscillator, and 70°C for MF and HF oscillator.
Stability:	1 PPM for 24-hour period.
MF injection requirements, crystal or VMO:	Crystal positions: 10 crystals, each with independent trimmer. Selection by front panel switch. Crystals CR-27/U to be inserted in holders HC-6/U. VMO input frequency: 2 to 4.0 mc to serve for entire SBE output range of 2 to 32 mc. VMO input impedance: 72 ohms nominal. VMO input voltage: Approximately 1.5 V RMS.
Tuning controls:	Directly calibrated in frequency
Output power:	Continuously adjustable from zero to a maximum of 1 watt.
Output impedance:	72 ohms nominal.
Carrier suppression:	At least 55 db down from PEP level.
Carrier insertion:	Continuously adjustable.
Connections:	VFO input - BNC RF output - BNC Monitor - BNC Audio control - Terminal Barrier Mike input - 3 pin MIKE jack
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.
Rejection of unused sideband:	500-cps tone 60 db below transmitter PEP.
Audio input:	Two independent 600-ohm channels, balanced or unbalanced, -20-db level for full RF output. 500 k for high impedance crystal or dynamic mike, -50 db for full RF output.
Audio response per sideband:	Within 3 db from 350 to 7500 cps.
VOX operation:	Voice control with anti-trip features, adjustable gain, and squelch controls.

* May be used with any degree of carrier insertion.

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. FRONT PANEL CONTROLS

CONTROL	FUNCTION
MF XTAL SW	Selects either external oscillator (VMO) or proper crystal for mid frequency oscillator.
Two Section Dial	Upper dial coordinates with OUTPUT TUNING (disc, vernier) and lower dial with MF TUNING (knob).
XMTR ON-OFF	ON - Activates associated transmitter. Eliminates need for VOX or push-to-talk, through EXCITER ON-STANDBY (below) by completing the ground circuit of the XMTR final plates relay. OFF - Associated transmitter operated by VOX or push-to-talk circuit when EXCITER ON-STANDBY switch is in STANDBY position.
EXCITER ON-STANDBY	ON - Activates SBE without need for VOX or push-to-talk input and without associated operating transmitter. STANDBY - Allows VOX or push-to-talk to activate the SBE and its associated transmitter.
POWER ON-OFF	ON - Applies line voltage to SBE. OFF - Turns off entire SBE.
OUTPUT meter	Indicates power levels in circuits selected by METER SW.
EXCITER lamp	Glows during operation when EXCITER ON-STANDBY switch is in ON position or SBE is activated by VOX or push-to-talk.
OVEN lamp	Glows during operation when thermostats demand oven heating (automatic).
METER SW	Selects point in system to be measured by built-in VTVM circuit. CAL position is used to zero meter.
CAL	Meter adjustment located directly beneath meter. Use screwdriver to zero meter when METER SW is in CAL position.

TABLE 1-2. FRONT PANEL CONTROLS (C nt.)

CONTROL	FUNCTION
USB (channels, gain)	Switch selects audio input source for upper sideband channel. GAIN - Adjusts level of USB audio input.
OUTPUT	Adjusts SBE output power level.
MIKE	Microphone input (substitute for 600-ohms channel input).
MF TUNING	Selects setting of mid frequency as indicated in lower section of main tuning dial.
SQUELCH GAIN	Used in conjunction with VOX GAIN. (Refer to paragraph 4-6).
OUTPUT TUNING (disc) (vernier capacitor)	Selects frequency of output stages of SBE as indicated in upper section of main tuning dial.
OUTPUT TUNING (knob) (selector switch)	Selects output frequency band and adjusts setting of main tuning dial centrally located above knob.
VOX GAIN	Voice operated associated transmitter circuit gain control.
CARRIER INSERT	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)	Switch selects audio input source for lower sideband channel. GAIN - Adjusts level of LSB audio input.
POWER SUPPLY	
Indicator lamp	Glows during operation. Indicates MAIN fuse intact and power is applied. (110 volts / 220 volts) B+ fuse: 0.25 amp / 0.25 amp Main fuse: 3.0 amp / 1.5 amp Oven fuse: 2.0 amp / 1.0 amp These fuses protect their respective circuits.

TABLE 1-3. VACUUM TUBE COMPLEMENT

SYMBOL	TYPE	FUNCTION
V101	6AB4	Audio pre-amplifier
V105	12AU7	250-kc oscillator
V106	OA2	Voltage regulator
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
V117B	1/2 6U8	Not used
V118	6AH6	1st RF amplifier
V119	6CL6	2nd RF amplifier
V120	6146	RF output amplifier
V121	OA2	Voltage regulator
V122A	1/2 AT7	Audio amplifier
V122B	1/2 AT7	USB meter amplifier
V123A	1/2 AT7	Audio amplifier
V123B	1/2 AT7	LSB meter amplifier
V124	6AB4	LF amplifier
V125	6AB4	LF amplifier
V126	6AH6	250-kc amplifier
POWER SUPPLY		
V401	5R4	Rectifier
V402	OA2	Voltage regulator

SECTION 2
INSTALLATION

2-1. GENERAL

The following general procedure outlines the steps taken by TMC in packaging its test and exciter units:

a. Place the unit in a cardboard carton, cover with paper to avoid scratches, and wedge with heavy cardboard corrugated fillers. Include desiccant, accessories, and spare parts if practicable. Seal carton.

b. Place carton (item a) in moisture-proof barrier bag and seal.

c. Place barrier bag (item b) in waterproof outer carton and seal.

d. Place outer carton (item c) in strong wooden packing box and wedge to tightness.

e. Encircle packing box with two steel straps. Top side of packing box is identified by seals on straps. When seals are removed, this side may be readily pried open.

2-2. INITIAL INSPECTION.

Since SBE-3 units have been tested and calibrated before shipment, only minor preparations are required to put the units into operation.

Inspect the case and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items." Although the carrier is liable for any damage in the equipment, Technical Materiel Corporation assists in describing and providing for repair or replacement of damaged items. The equipment is shipped with all tubes 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 of the power supply to J109 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 of the power supply to an AC source.

e. Connect RF OUT (J103) of the SBE to the input of the associated transmitter. Use one of the two (supplied) connectors UG-260/U.

f. If an external VMO is to be used, connect it to VMO in (J104) 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.

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.

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

Proceed as follows:

a. Set POWER ON-OFF switch to ON. Allow 1-hour warm-up period.

b. Turn METER SW to CAL and zero meter by screwdriver adjustment through 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 adjustment, beat crystals against any accurate frequency standard. An adjustment tool is provided for trimmer adjustments.

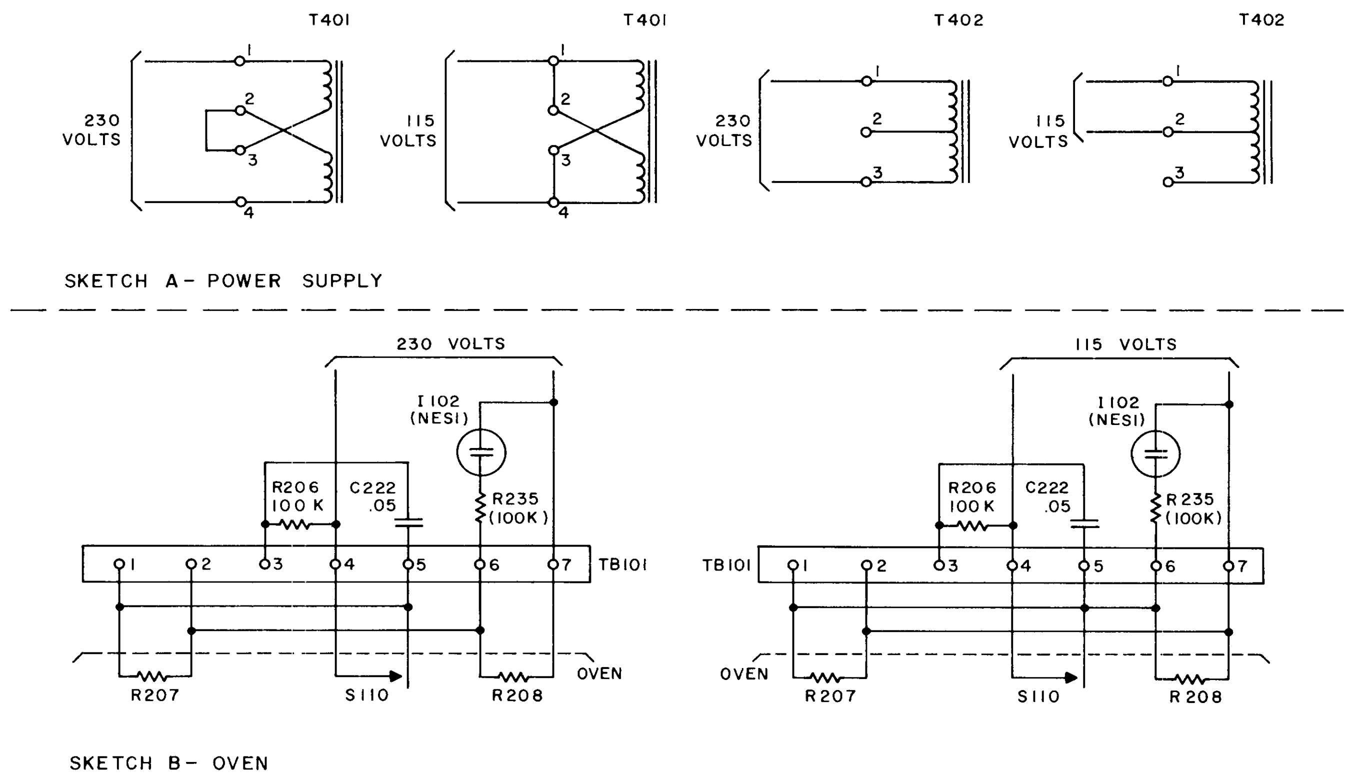


Figure 2-1. Installation Diagram Showing 115- vs 230-Volt Power Supply Connections

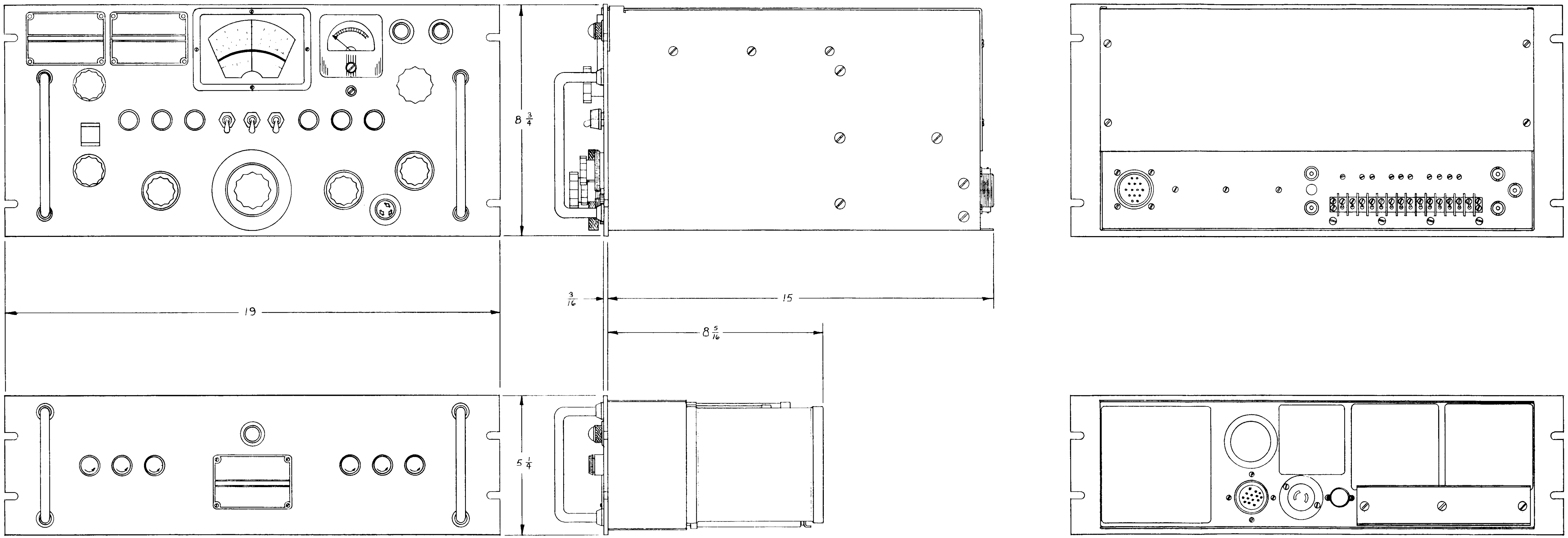


Figure 2-2. Outline Dimensional Drawing

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. Input circuit controls.

c. Output frequency desired (crystal selection or use of VMO, bandwidth switch settings, etc.).

d. 250-kc carrier insertion.

e. MF circuit controls.

f. HF circuit controls.

g. Meter circuit and miscellaneous controls.

Mode of transmission breaks down into the following:

a. Single sideband with any degree of carrier insertion.

b. Double sideband with any degree of carrier insertion.

c. Independent sideband with any degree of carrier insertion.

d. Conventional AM operation.

e. Frequency-shift telegraphy.

f. CW or MCW telegraphy.

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 into 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 a VMO or a 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 whether supplied by a VMO or a crystal. In the 2- to 4.25-mc range of the SBE-3, the lower sideband output of the medium frequency modulator reaches the antenna without further modulation. The VMO or crystal frequency (f_x), therefore, is determined by the formula: $f_o = f_x - 0.25$. If the output frequency (f_o) is 2.00 mc, the crystal or VMO frequency (f_x) is 2.25 mc. Note that for f_o between 3.75 and 4.25, the VMO or crystal frequency ranges between 4.00 and 4.50 mc. To provide an f_o between 3.75 and 4.25 mc with VMO and XTAL frequencies below 4.00 mc, the medium frequency modulator is operated so as to pass its upper sideband to the antenna. The VMO or crystal frequency, therefore, is determined by the formula: $f_o = f_x + 0.25$. Under this arrangement, when f_o is 3.75, f_x becomes 3.50 mc; when f_o is 4.00, f_x becomes 3.75 mc; and when f_o is 4.25, f_x becomes 4.00 mc.

In the 4.25- to 32.25-mc range of the SBE-3, the output of the medium frequency modulator is modulated by the high frequency modulator whose lower sideband output, in turn, reaches the antenna. Consequently, the VMO or crystal frequency in this case is determined by the formulae:

$f_o = f_{hf} - (f_{mf} - 0.25)$; MF modulator passing lower sidebands

$f_o = f_{hf} - (f_{mf} + 0.25)$; MF modulator passing upper sidebands

The f_{hf} (high frequency) crystals provide modulating frequencies of 8 to 34 mc in 2-mc steps; the f_{mf} (medium frequency) crystals range between 2 and 4 mc. For example:

f_o	f_{hf}	f_{mf}
4.25	8.00	4.00
8.00	10.00	2.25
15.00	18.00	3.25
21.50	24.00	2.75
27.25	30.00	3.00
32.25	34.00	2.50

Referring to 250-kc carrier insertion, the degree of carrier insertion is controlled by the setting of front panel potentiometer designated CARRIER INSERT (19). The magnitude of carrier relative to sidebands may be readily determined in transmitter operation by the use of a frequency spectrum analyzer.

Referring to medium frequency circuit controls, the following front panel controls are used to adjust the medium frequency modulator: CARRIER INSERT, MF TUNING, and METER SW and its associated meter. The medium frequency modulator receives 250-kc sideband signals and VMO or MF XTAL frequencies; its output circuit is tuned to (passes) the lower sideband of the VMO or MF XTAL frequency.

Referring to high frequency circuit controls, the following front panel controls are used to adjust the high frequency modulator together with the SBE's RF circuit's tuning elements: BAND MCS, OUTPUT TUNING (bandswitch, tuning elements), OUTPUT (level), METER SW and its associated meter. 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; its output circuit and that of the SBE's RF circuit is tuned to (passes) the lower sideband of the high frequency crystal oscillator''s frequency.

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

For further details, refer to Section 4.

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

Step	Panel Serial Desig.	Operation	Purpose
Part I - Tuneup on Carrier:			
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.
10	19	CARRIER INSERT, fully CW.	Provides 100% carrier.
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 Serial Desig.	Operation	Purpose
Part I - Tuneup on Carrier (Cont.)			
13	14, 6, 19, 2	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 vernier switch 17 slightly to peak the reading on the SBE's meter. **NOTE** 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 switch 19.
17		The SBE is now tuned on carrier.	
Part II - Tuneup on SSB with Any Degree of Carrier Insertion:			
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%.
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.)	**CAUTION** 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 Serial Desig.	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.
NOTE 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 Serial Desig.	Operation	Purpose
Part II - Tuneup on DSB with Any Degree of Carrier Insertion:			
	NOTE 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 — Audio Peaks 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 control 22 to OFF.	To cut off desired audo channel in lower sideband.

Step	Panel Serial Desig.	Operation	Purpose
Part II - Tuneup on DSB 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 Wanted — Audio Peaks 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 Wanted — Audio Peaks 0 — 100 10% (-20 db) — 90	
NOTE 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 Serial Desig.	Operation	Purpose
Part II - Tuneup on ISB with Any Degree of Carrier Insertion:			
NOTE 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, 21	Adjust LSB GAIN until the meter shows the following readings on audio peaks: Carrier Insertion Eventually Wanted — Audio Peaks 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 control 22 to OFF.	To cut off desired channel in lower sideband.
24	10, 11	USB circuit to CH 2; 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 Wanted — Audio Peaks 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 or CH 2 in both sidebands. Meter 6 should now read as follows on peaks: Carrier Insertion Finally Wanted — Audio Peaks 0 — 100 10% (-20 db) — 90	

Step	Panel Serial Desig.	Operation	Purpose
Part II - Tuneup on ISB with Any Degree of Carrier Insertion: (Cont.)			
NOTE 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:

Carrier Insertion Eventually Wanted	Audio Peaks
50% (-6 db)	25

b. Step 32 should be modified as follows:

Carrier Insertion Finally Wanted	Audio Peaks
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.

Part I, tuneup on carrier, is the same as part I in paragraph 3-2. In frequency-shift telegraph operation, part II, only part of the SBE unit is used. In the SBE-3, the medium frequency modulator unit is supplied with a 250-kc carrier as well as the XFK's medium frequency output signal (for example from an associated transmitter's XFK unit). This means that SBE's CARRIER INSERT potentiometer 19 should be in position 10, SBE's MF XTAL SW control 1 should be in position VMO, and XFK's medium frequency output signal should reach SBE's modulator. Since SBE's medium frequency modulator is supplied with a 250-kc carrier as well as XFK's medium frequency output signal of frequency f_{mf} - (200 kc ±425 cps), the lower sideband of SBE's medium frequency modulator has a passband frequency of f_{mf} - (450 kc ±425 cps). In SBE's medium frequency output range, the lower sideband of the medium frequency modulator reaches the antenna without further modulation. The relationship between f_{mf} and antenna output frequency f_o, for the case of the SBE-3, therefore, is determined by the formula $f_o = f_{mf} - (0.45 \text{ mc} \pm 425 \text{ cps}) = f_{mf} - 0.45$ mc, approximately. This gives the following relationship between f_o and f_{mf}:

f_o	f_{mf}
2.00	2.45
2.50	2.95
3.00	3.45
3.55	4.00
4.00	4.45

Note that for f_o between 3.55 and 4.00, f_{mf} ranges from 4.00 to 4.45. This means that if a suitable VMO is unavailable and the highest medium frequency crystal available for use in the XFK unit is 4.00 mc, SBE's highest lower sideband medium frequency output frequency is 3.55 mc. If SBE's high frequency modulator is now used with 8-mc crystal injection, along with SBE's medium frequency modulator's output, SBE's high frequency modulator's lower sideband frequency becomes $f_o = 8.00 - f_m + 0.45$, which gives the following relationship between f_o and f_{mf}:

f_o	f_{mf}
4.00	4.45
4.45	4.00
5.00	3.45
5.50	2.95
6.45	2.00

Note, once more, that if a suitable VMO is unavailable and the highest medium frequency crystal available for use in the XFK unit is 4.00, SBE's lowest high frequency modulator output frequency is 4.45 mc. Consequently, for the SBE unit to cover the frequency range of 3.55 to 4.45 requires a medium frequency crystal in the XFK unit, or a VMO, in the 4.00- to 4.45-mc range. As previously stated in paragraph 3-1, it is more practical to supply FSK signals in the 3.55- to 4.45-mc range, when required by a transmitter, by using 4.0- to 4.45-mc crystals or a VMO that supplies these frequencies.

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 1 and 3. (E101 on rear of SBE.)

b. Attach key from pin 3 to ground.

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

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 reasonably 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 the 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 R263
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

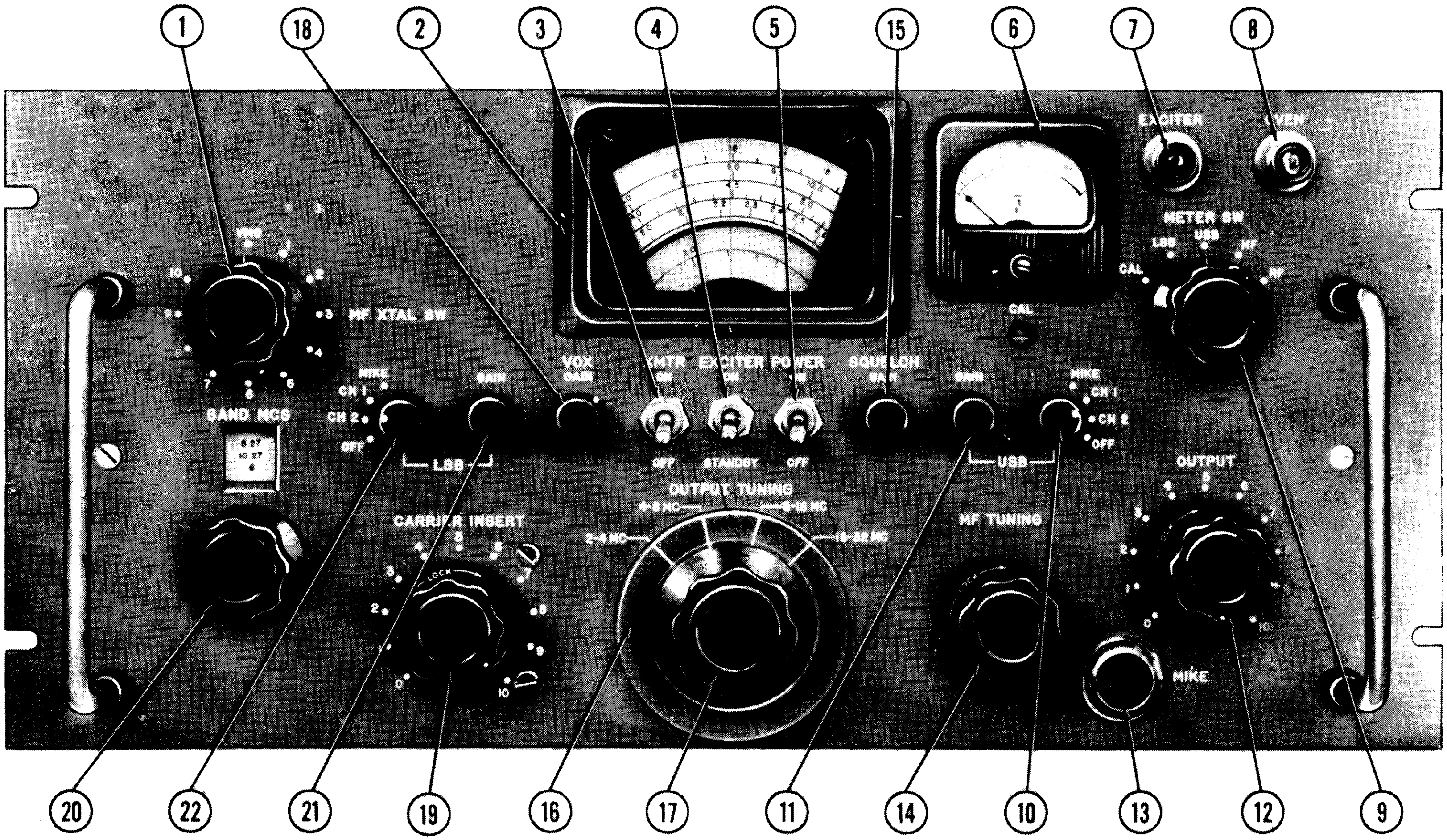


Figure 3-1. Operating Controls

SECTION 4
PRINCIPLES OF OPERATION

4–1. INTRODUCTION.

As shown in figure 4-1, the SBE-3, together with its power supply, consists of the following seven principle sections:

a. Audio input section

b. 250-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 V122A and/or V123A. For example, the microphone input may be routed to V122A, V123A, or V122A and V123A; 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 V122A and V123A, respectively. Likewise, microphone and LINE channel 1 signals may be simultaneously and independently routed to V122A and V123A, respectively. The functional switches provide flexibility in the routing of audio signals singly or independently in pairs to V122A and V123A. The audio input section is also provided with two meter amplifiers, V122B and V123B, and associated meter rectifiers CR111 and CR112. These circuits indicate the power level of incoming audio signals, which are important factors from the standpoint of avoiding the overloading of the following 250-kc balanced modulator section.

The 250-kc oscillator and balanced modulator section modulates the audio outputs from the audio input section, placing the intelligence in the 250-kc upper and/or lower sideband frequency regions (250 ±7.5 kc). The output of LSB filter Z110 consists of a small amount of 250-kc carrier and signals in the 250 -7.5 kc frequency range; the output of USB filter Z111 consists of a small amount of 250-kc carrier and signals in the 250 +7.5 kc frequency range. The 250-kc notch filter Z112 removes the 250-kc carrier in these two sidebands. The output of 6AH6 amplifier V126 contains the LSB and USB signals, with as much 250-kc carrier reinsertion as desired by the setting of CARRIER INSERT potentiometer R263. The signal bandwidth at this point is 15 kc with LSB and USB operation, or 7.5 kc with either LSB or USB operation.

The 2- to 4-mc MF section provides the second stage of modulation. In this stage, the incoming 250-kc sidebands from 6AH6 amplifier V126 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 T127 and T109, respectively, comprises a balanced modulator in which the 250-kc sidebands from V126 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 third 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 indicates 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, CH2, 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 3.75- to 4.25-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 V122A and V123A. Audio is also taken from the center arms of R168 (USB GAIN) and R169 (LSB GAIN) to feed meter amplifiers V122B and V123B. Outputs of these amplifiers are connected to CR111 and CR112, 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. 250-KC OSCILLATOR AND BALANCED MODULATOR SECTION.

(See figure 4-4.)

Audio amplifiers V122A and V123A operate as either lower or upper sideband amplifiers, respectively, as explained in the preceding paragraph. However, T104 and CR115 are referred to as the LSB 250-kc balanced modulator, and T103 and CR116 as the USB 250-kc balanced modulator. This sideband relationship is always true when the OUTPUT TUNING knob control is placed in 2-4 mc. (See figure 4-3.)

T104 couples incoming audio (from S106D amplified by V122A) to CR115, a bridge-type diode modulator. Z103 and Z108 are in a very stable amplitude regulated 250-kc crystal oscillator circuit, the output of which is coupled to the center arms of R265 and R266. These resistors are used to equalize the injection voltage to CR115 and CR116. When this is achieved, the tuned outputs of T125 and T126 consist of 250 kc-audio (LSB) and 250 kc+audio (USB), respectively. The 250-kc carrier is almost completely balanced out by the proper adjustment of R265 and R266. LSB filter T125 is designed to pass only frequencies from approximately 250 kc to 242.5 kc; thus, only the sideband below the suppressed 250-kc carrier is passed on to Z110. USB filter T126 performs in the same manner as T125, differing in that it passes frequencies between approximately 250 kc and 257.5 kc, or the upper sideband, on to Z111.

The 250-kc notch filter Z112 has considerable loss in the immediate region of 250 kc. This means that as the upper or lower or upper and lower sidebands pass through the filter, the 250-kc carrier residue from the 250-kc balanced modulators is greatly attenuated. On the other hand, the 250-kc modulated audio signals experience relatively small loss. The 250-kc amplifier V126 amplifies these signals; its output is fed to the following 2- to 4-mc MF section via modulator IF transformer T127.

Front panel control R263 (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 250-kc output from 250-kc oscillator V105.

Function of the front panel control that applies to this section is as follows:

CARRIER INSERT R263 (control 19 on figure 3-1) which controls level of carrier insertion.

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

a. SLM OUTPUT jacks J111 and J112.

b. 250-kc modulator balance of potentiometers R265 and R266.

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

(See figure 4-5.)

Sideband energy centering around 250 kc is coupled by T127 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 250 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 250 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 250-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 4.25 mc are required from the SBE. For output frequencies greater than 4.25 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 8.25- to 10.25-mc range. The crystal to be selected by the position of MF XTAL SW S107 should have a frequency of 2 x 6 + 0.250 - 10.235 mc or 2.015 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.

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. 2- TO 32-MC HF SECTION.

(See figure 4-6.)

The function of high frequency modulator Z107 is to provide final output frequencies from 4.25 to 32.25 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 1.75 mc and 3.75 mc higher than the output of Z107 because one input of Z107 is supplied by the medium frequency amplifier (whose output is the 0.25-mc lower sideband from its crystal; that is, 1.75 to 3.75 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 4.25 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 18-mc injection and the sidebands produced in Z107 are not passed by the RF amplifiers which are tuned to 4.25 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 3.75- to 4.25-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 indicates 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 4-7.)

The VOX circuit is operated by a portion of the 250-kc USB and/or LSB energies taken from 250-kc amplifier V126 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 C282 and amplified by relay amplifier V127 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 V127 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-OFF S104 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 3-9 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 4-8.)

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 RF position, the reading on meter M101 reflects the level at SBE's RF OUT jack J103.

4-8. POWER SUPPLY SECTION. (See figure 4-9.)

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.

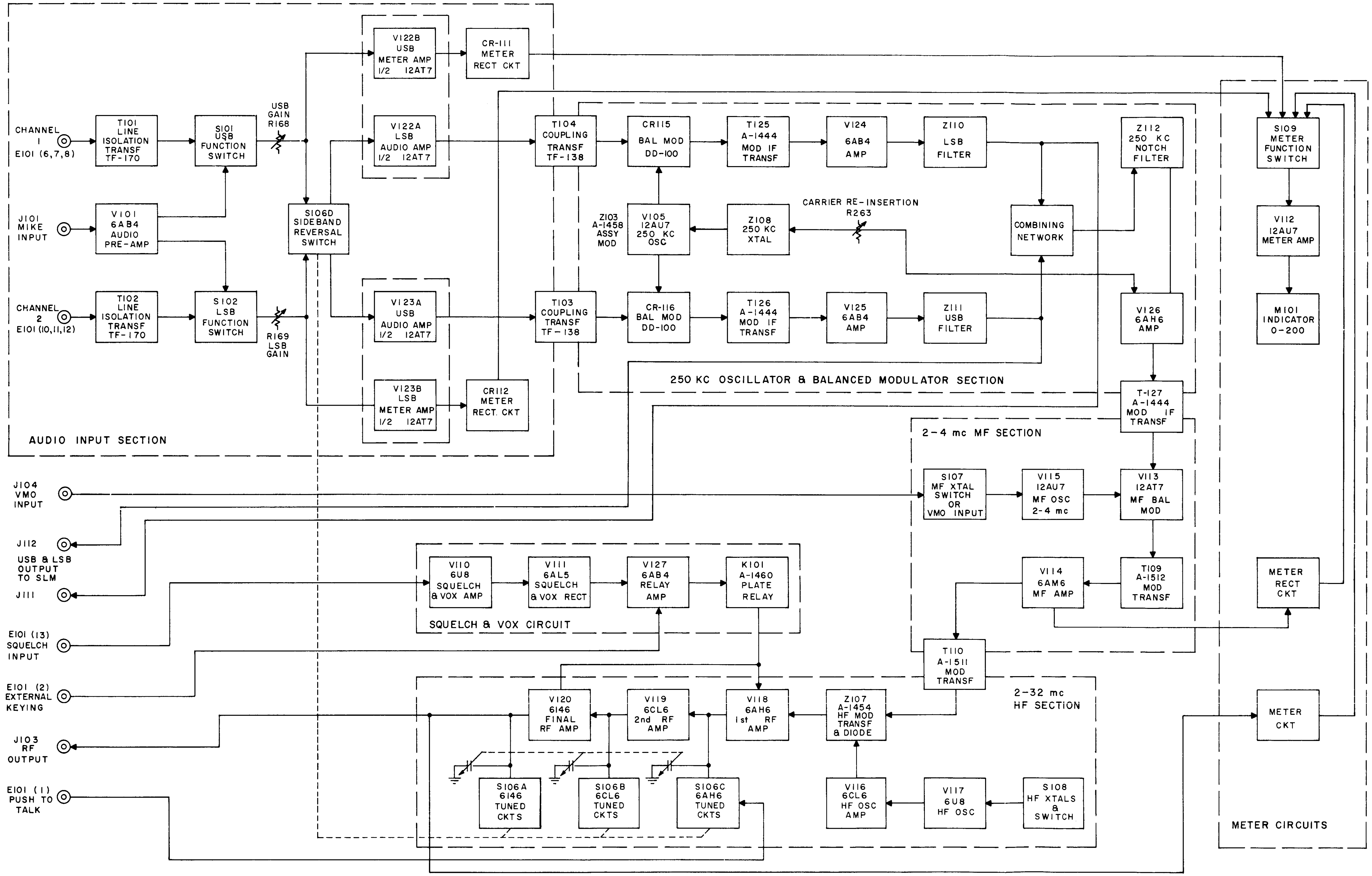


Figure 4-1. Block Diagram, SBE-3 and Its Power Supply

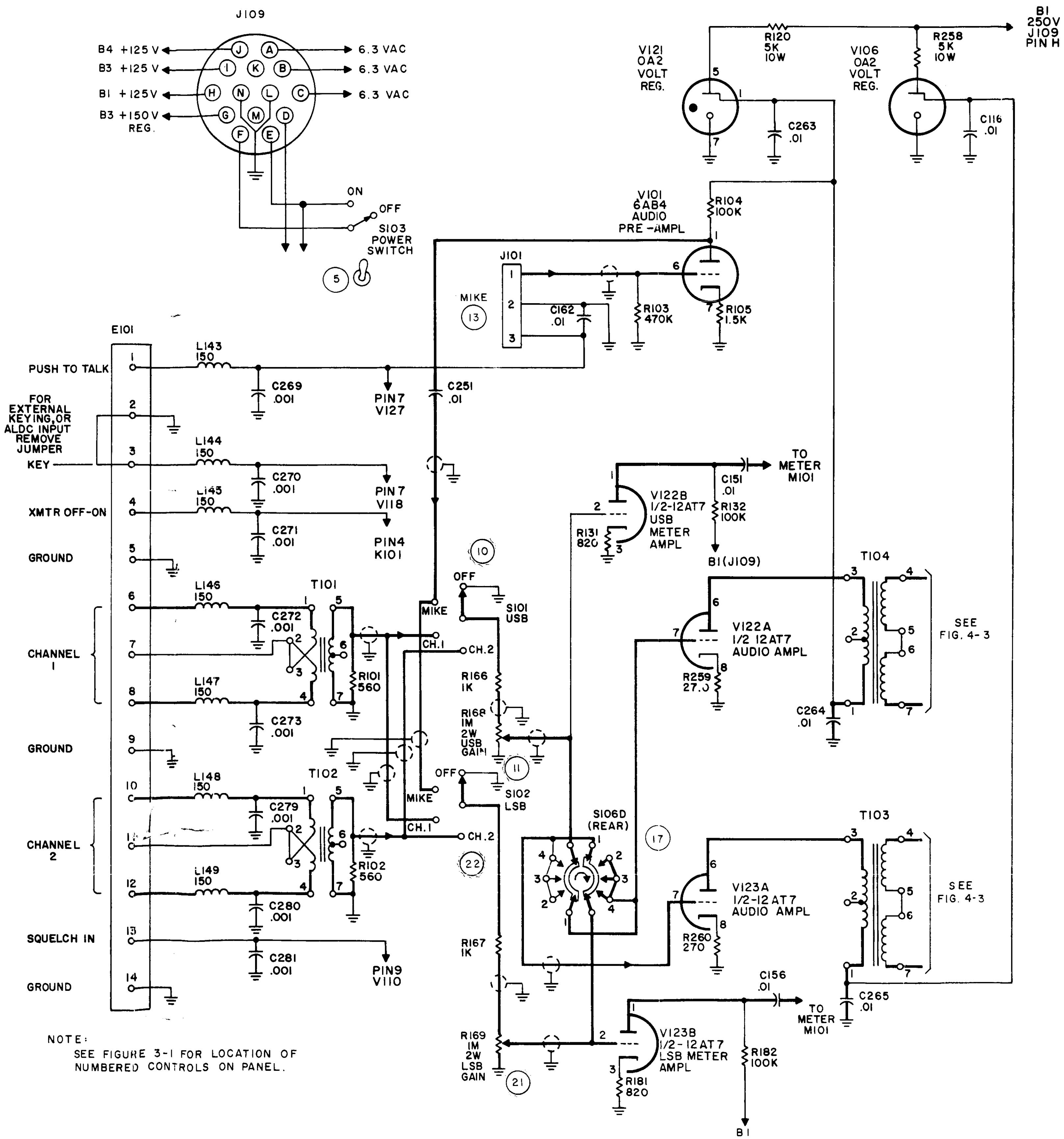
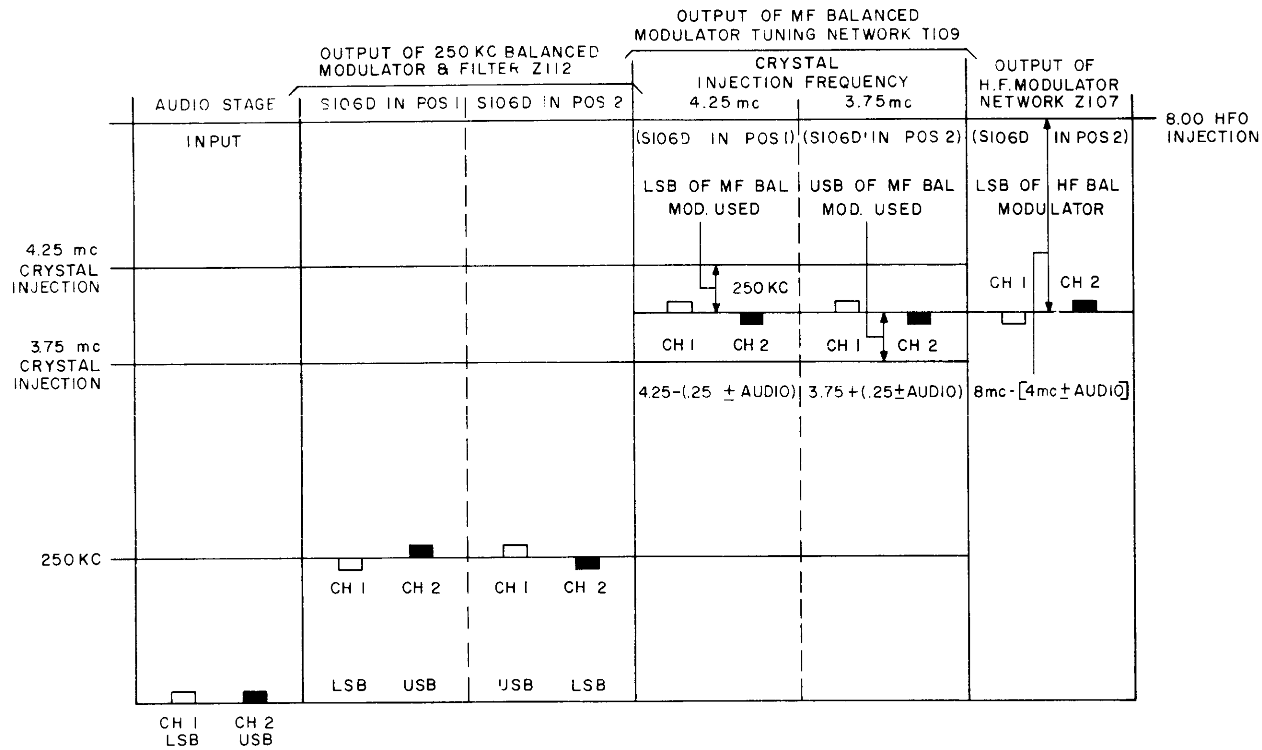


Figure 4-2. Schematic Diagram, Audio Input Section



NOTE:

THE 4.25 mc INJECTION GIVES NORMAL OUTPUTS OF CHANNEL 1 LSB OF 4mc AND CHANNEL 2 USB OF 4mc

THE 3.75 mc INJECTION GIVES INVERTED OUTPUTS OF CHANNEL 1 USB OF 4mc AND CHANNEL 2 LSB OF 4mc

Figure 4-3. Diagram Illustrating Modulation Inversion

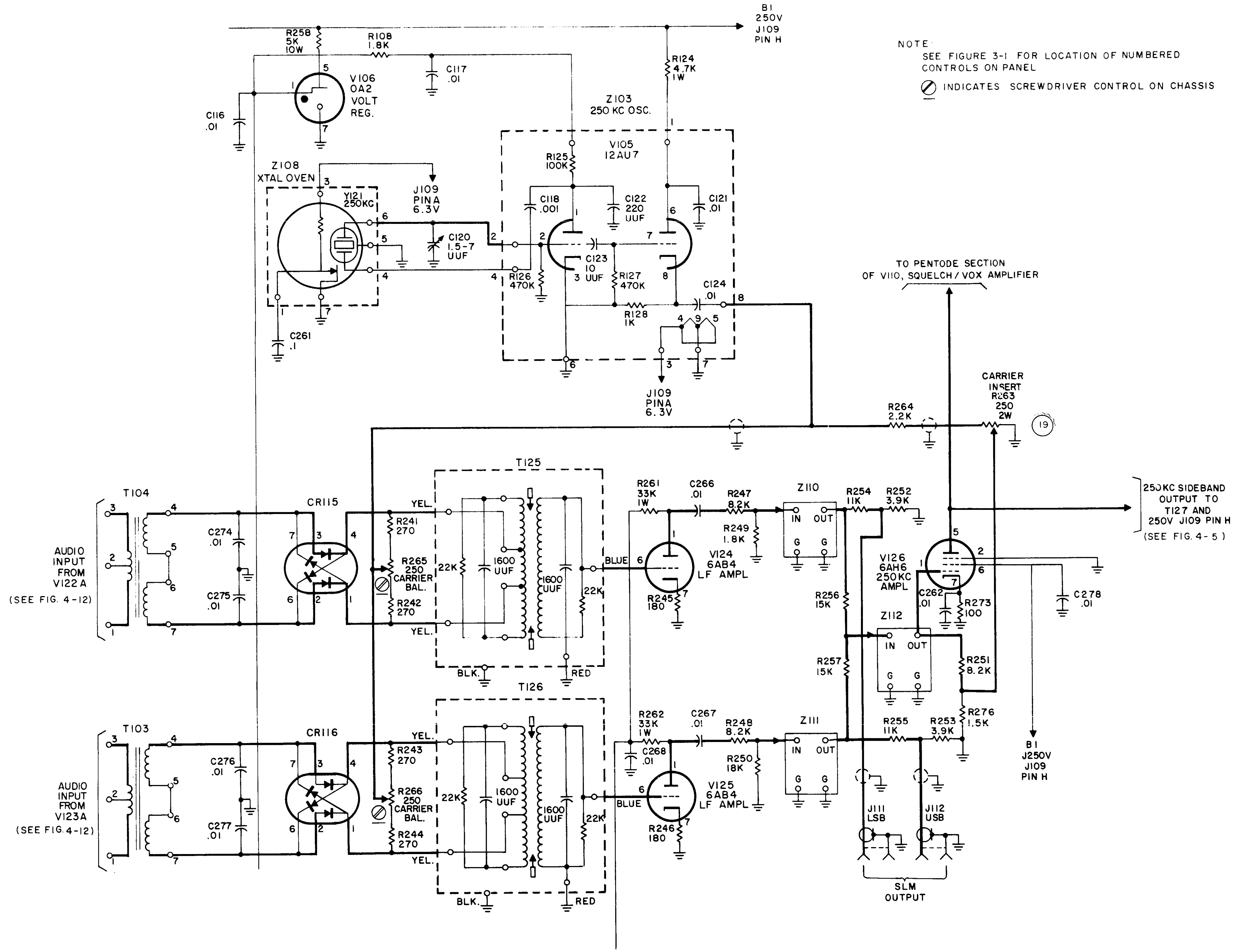


Figure 4-4. Schematic Diagram, 250-kc Oscillator and Balanced Modulator Section

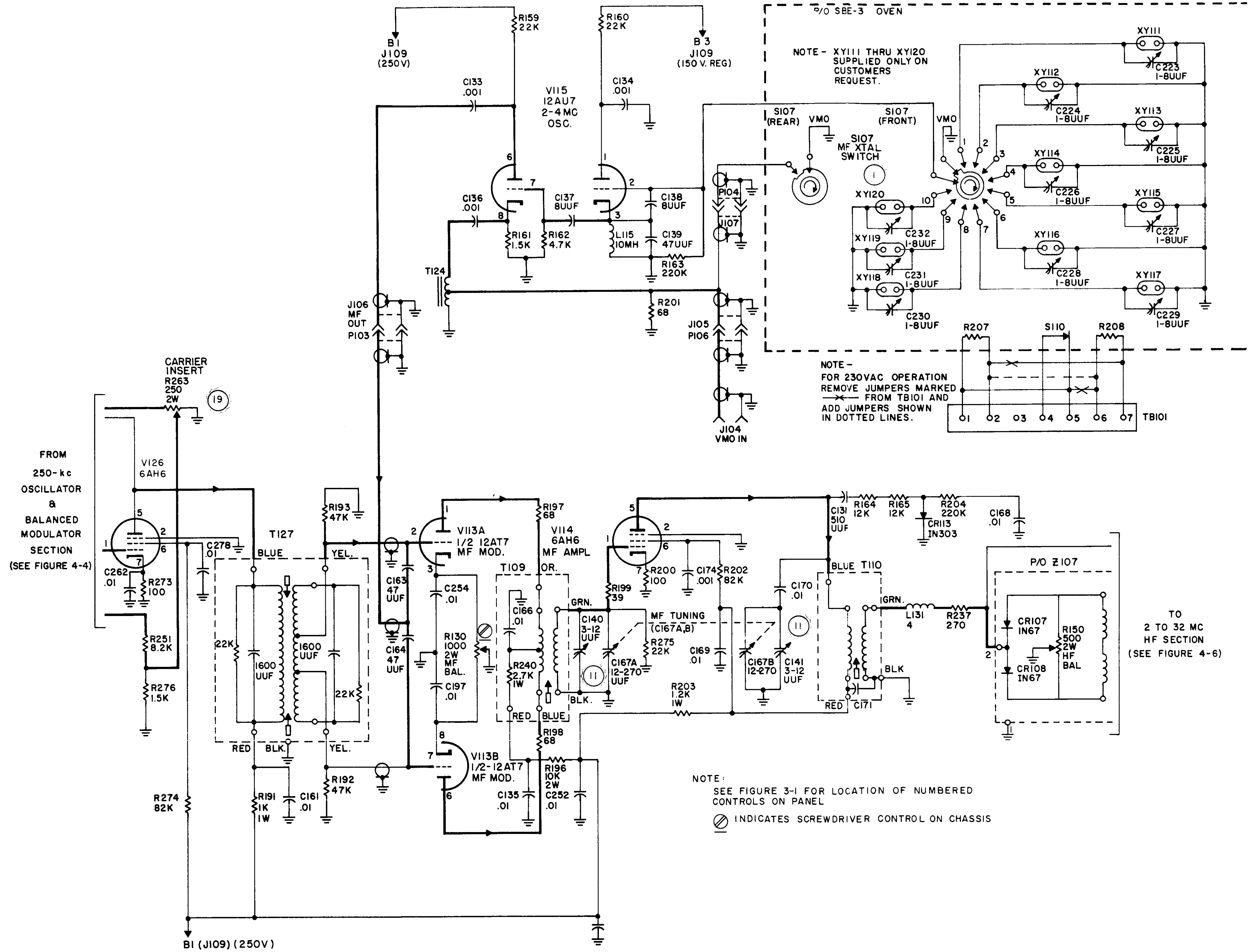
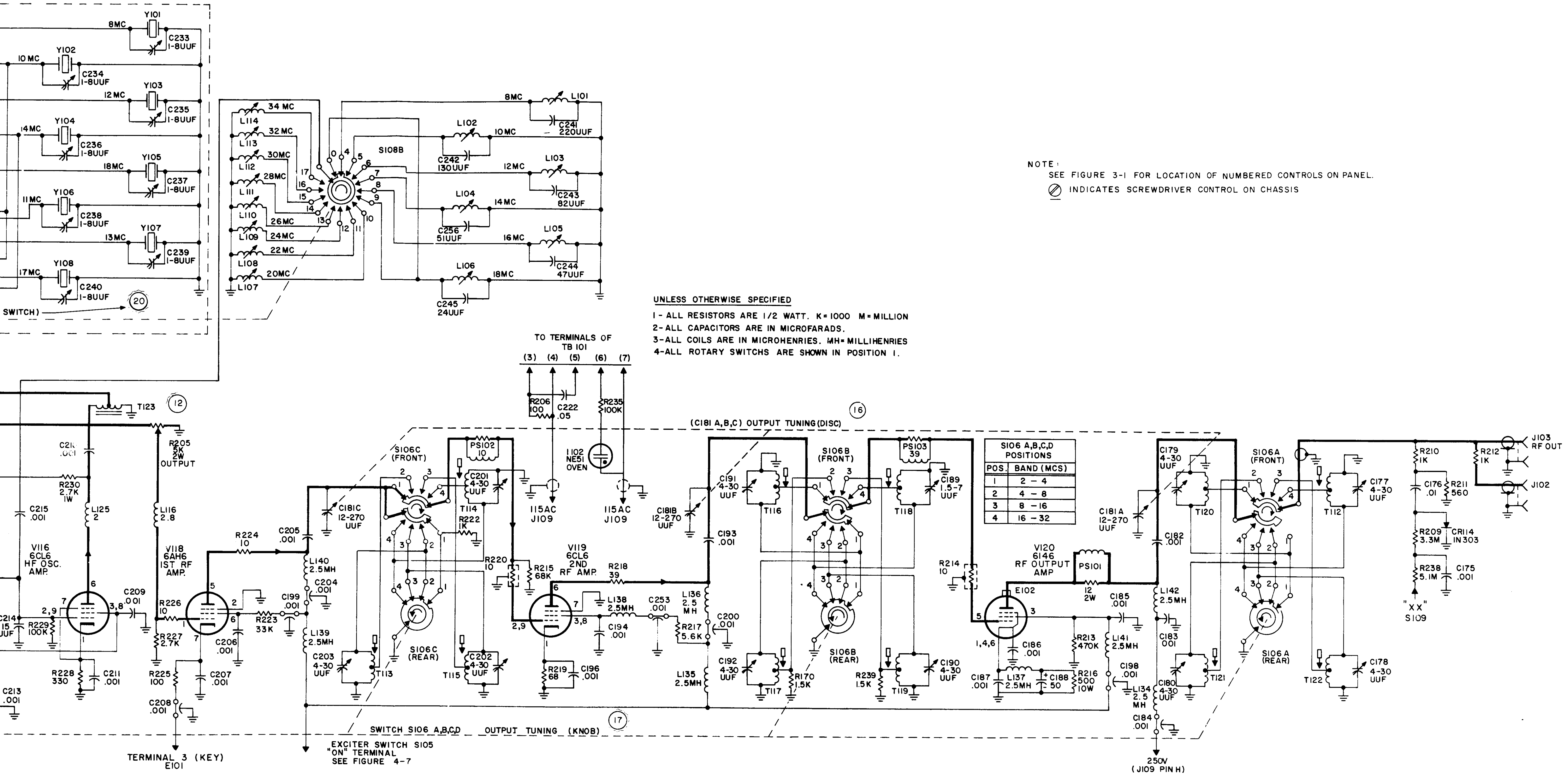


Figure 4-5. Schematic Diagram, 2- to 4-mc MF Section

NOTE:
SEE FIGURE 3-1 FOR LOCATION OF NUMBERED CONTROLS ON PANEL.
⊘ INDICATES SCREWDRIVER CONTROL ON CHASSIS

UNLESS OTHERWISE SPECIFIED

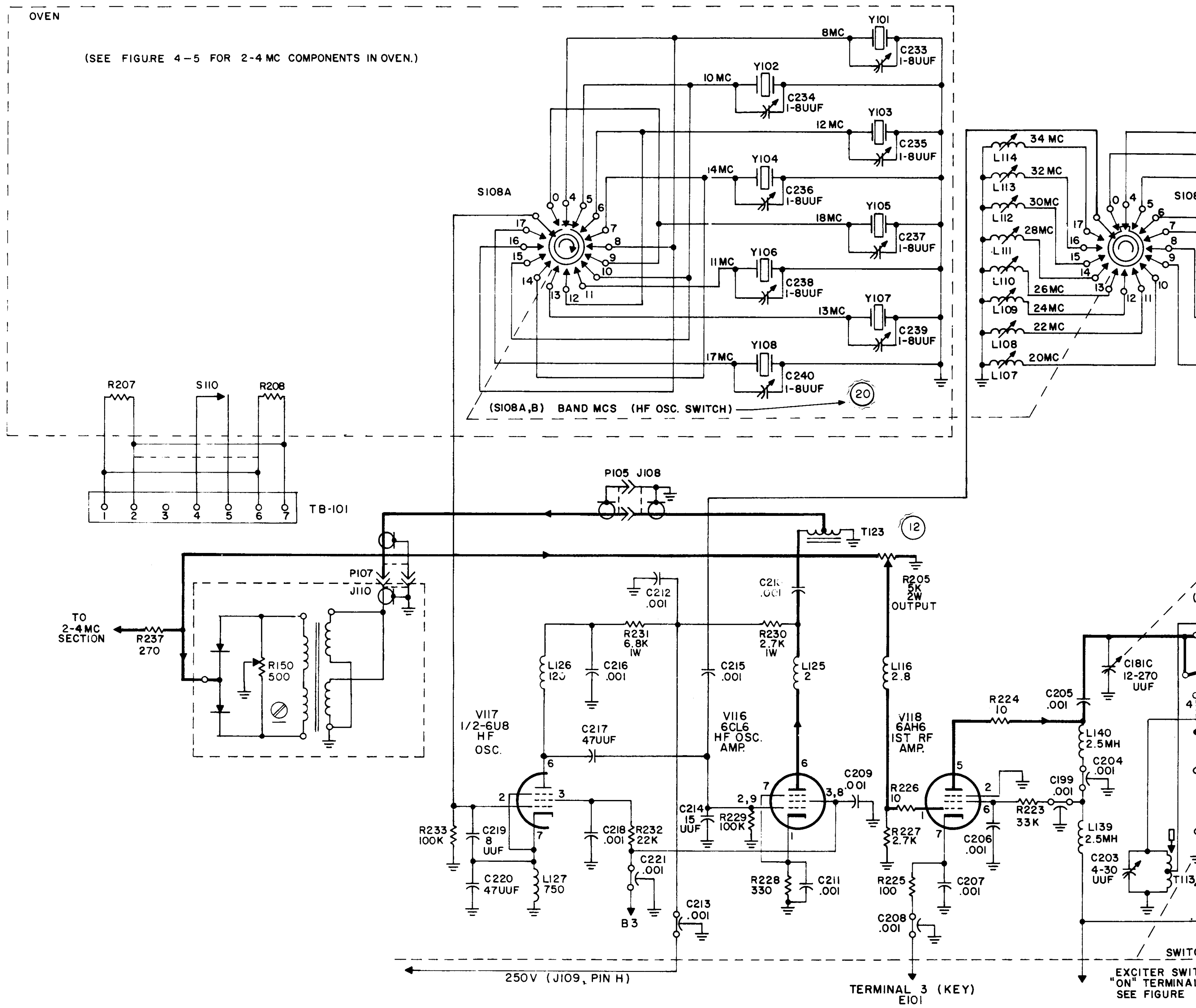
1 - ALL RESISTORS ARE 1/2 WATT. K = 1000 M = MILLION
2 - ALL CAPACITORS ARE IN MICROFARADS.
3 - ALL COILS ARE IN MICROHENRIES. MH = MILLIHENRIES
4 - ALL ROTARY SWITCHS ARE SHOWN IN POSITION 1.



S106 A,B,C,D POSITIONS	
POS.	BAND (MCS)
1	2 - 4
2	4 - 8
3	8 - 16
4	16 - 32

Figure 4-6. Schematic Diagram, 2- to 32-mc HF Section

4-17—4-18


OVEN
(SEE FIGURE 4-5 FOR 2-4 MC COMPONENTS IN OVEN.)
S108A
(S108A,B) BAND MCS (HF OSC. SWITCH)
8MC Y101 C233 1-8UUF
10 MC Y102 C234 1-8UUF
12 MC Y103 C235 1-8UUF
14MC Y104 C236 1-8UUF
18MC Y105 C237 1-8UUF
11MC Y106 C238 1-8UUF
13MC Y107 C239 1-8UUF
17MC Y108 C240 1-8UUF
34 MC L114
32 MC L113
30MC L112
28MC L111
L110 26MC
L109 24MC
22MC L108
20MC L107
R207 S110 R208
TB-101
P105 J108
T123
R205 5K 2W OUTPUT
P107 J110
TO 2-4MC SECTION
R237 270
R150 500
C212 .001
R231 6.8K 1W
R230 2.7K 1W
L126 120
C216 .001
C215 .001
L125 2
L116 2.8
V117 1/2-6U8 HF OSC.
C217 47UUF
V116 6CL6 HF OSC. AMP.
V118 6AH6 1ST RF AMP.
C209 .001
R226 10
R224 10
C205 .001
C181C 12-270 UUF
L140 2.5MH
C204 .001
C199 .001
R223 33K
L139 2.5MH
C203 4-30 UUF
T113
R233 100K
C219 8 UUF
C220 47UUF
L127 750
C218 .001
R232 22K
C221 .001
B3
C214 15 UUF
R229 100K
R228 330
C211 .001
C213 .001
R227 2.7K
C206 .001
C207 .001
R225 100
C208 .001
250V (J109, PIN H)
TERMINAL 3 (KEY) E101
EXCITER SWIT "ON" TERMINAL SEE FIGURE

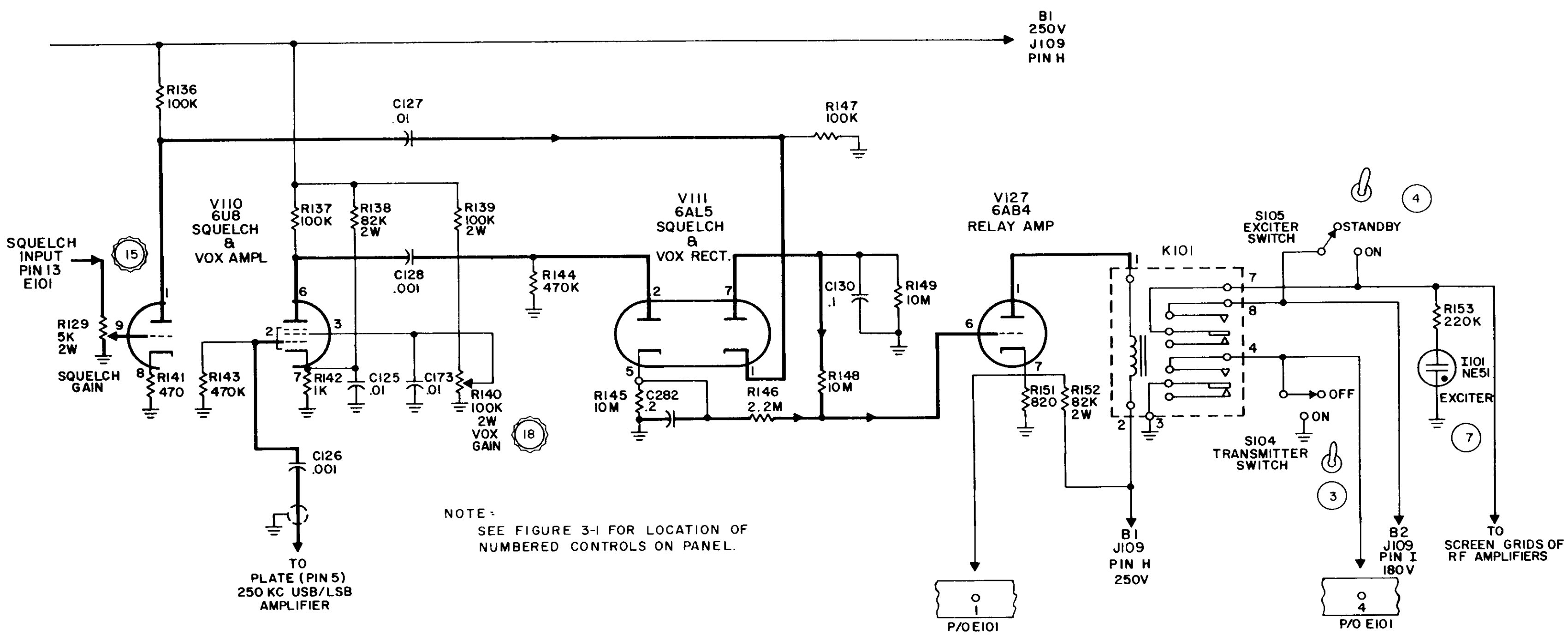
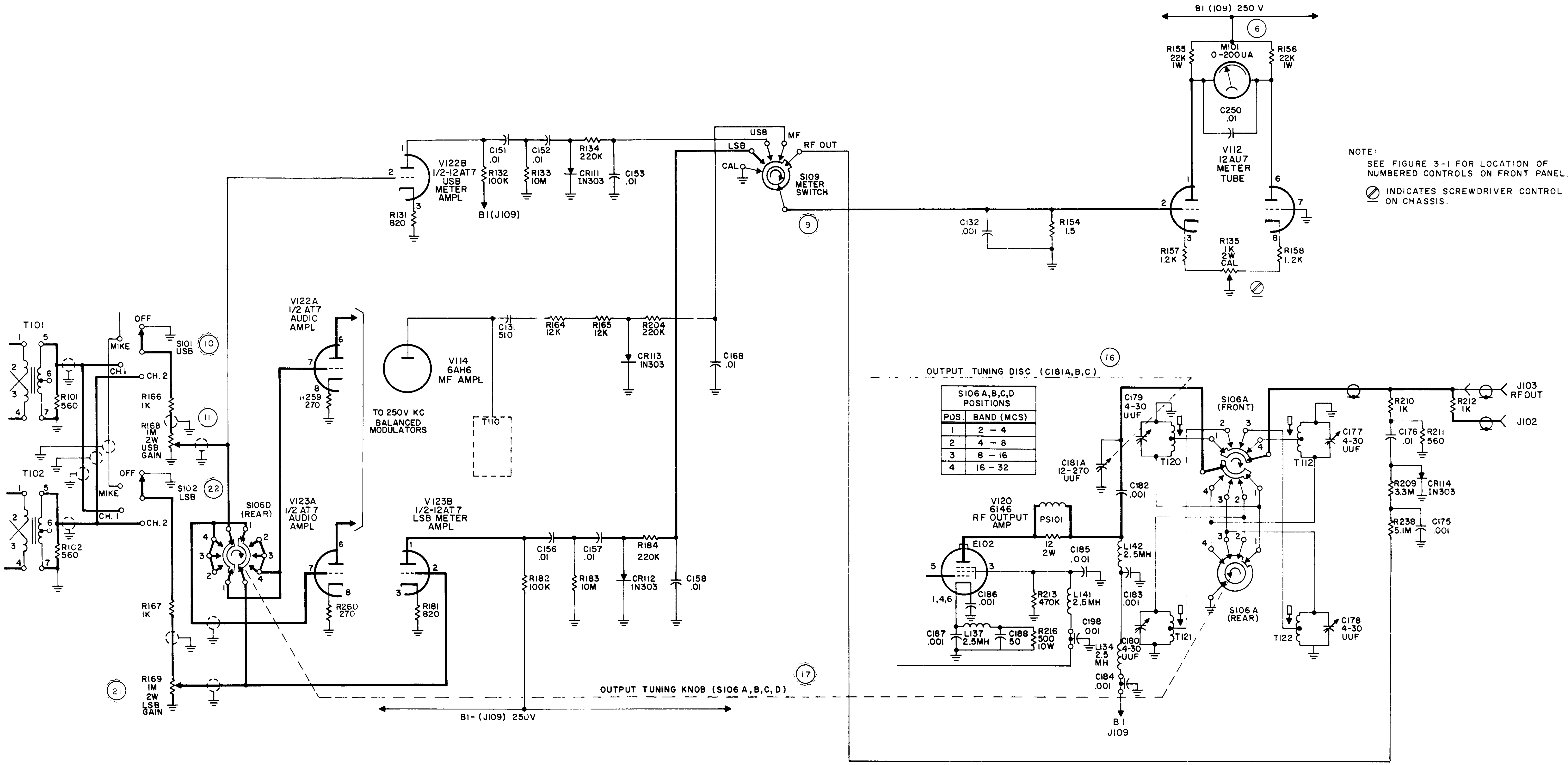


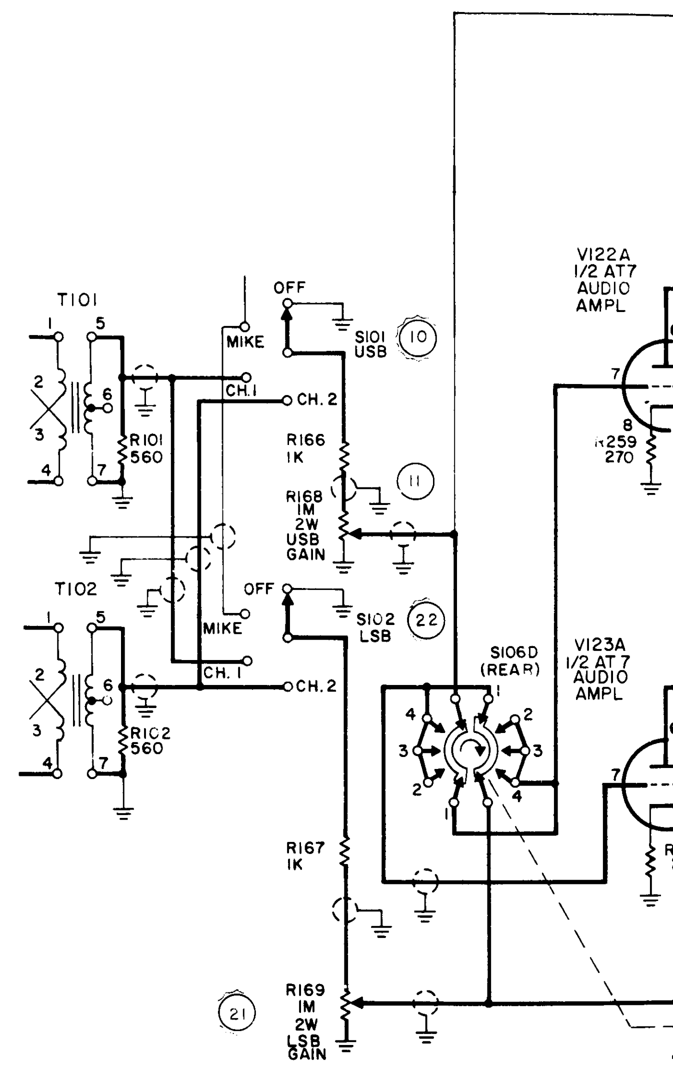
Figure 4-7. Schematic Diagram, SQUELCH and VOX Section



S106A,B,C,D POSITIONS	
POS.	BAND (MCS)
1	2 – 4
2	4 – 8
3	8 – 16
4	16 – 32

NOTE:
SEE FIGURE 3-1 FOR LOCATION OF NUMBERED CONTROLS ON FRONT PANEL.
⊘ INDICATES SCREWDRIVER CONTROL ON CHASSIS.

Figure 4-8. Schematic Diagram, M101 Meter Circuits



T101
R101
560
T102
RIC2
560
MIKE
CH.1
CH. 2
OFF
S101
USB
10
R166
1K
11
R168
1M
2W
USB
GAIN
OFF
S102
LSB
22
MIKE
CH. 1
CH. 2
R167
1K
R169
1M
2W
LSB
GAIN
21
S106D
(REAR)
V122A
1/2 AT7
AUDIO
AMPL
R259
270
V123A
1/2 AT7
AUDIO
AMPL

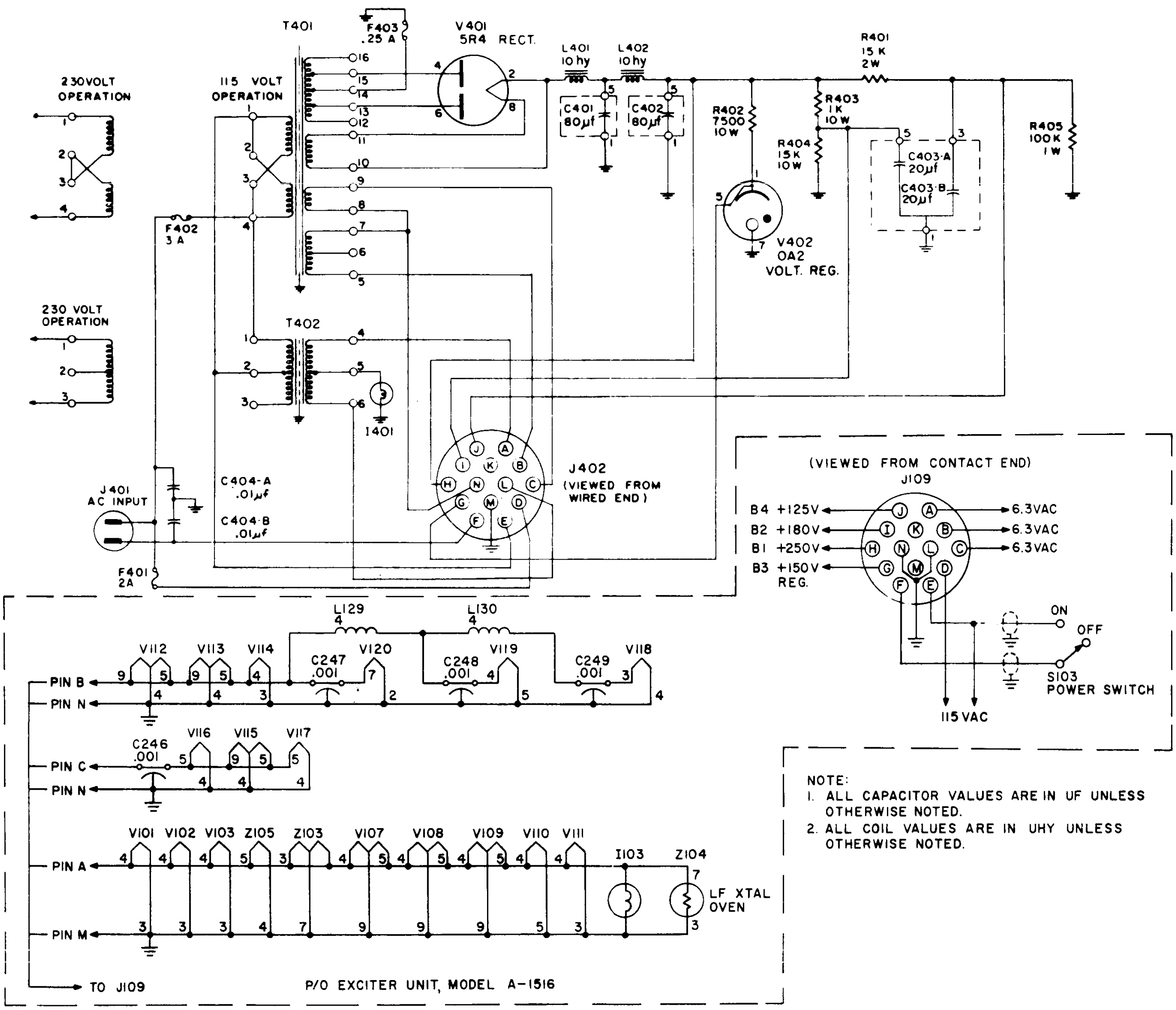


Figure 4-9. Schematic Diagram, Power Supply Section

SECTION 5
TROUBLE-SHOOTING

5-1. GENERAL.

Trouble-shooting 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."

Trouble-shooting tools may, for convenience, be divided into the following six categories:

a. Accurate schematic diagrams

b. Tables of voltage and resistance; waveform data

c. Location data (photographs with callouts of the major electronic equipment elements)

d. Trouble-shooting techniques

e. Trouble-shooting charts based on operating procedures

f. Trouble-shooting procedures based on circuit sectionalization

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

5-2. TROUBLE-SHOOTING 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 trouble-shooting 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. TROUBLE-SHOOTING 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. TABLES OF VOLTAGE AND RESISTANCE; WAVEFORM DATA. - 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. TROUBLE-SHOOTING 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-3.

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-3.

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

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - The following paragraphs present selected factory checkout performance data of the SBE-3.

(1) POWER SUPPLY. - The SBE-3 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 in 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) 250-KC OSCILLATOR. - Use a reliable VTVM with an RF probe to check for a reading of 1.0 to 1.5 volts (250 kc) from the center arm of R263 to ground. If this requirement is not fulfilled, check the 250-kc oscillator section (Z103). See figure 5-1 and check the tube pin sockets voltages with a reliable 20,000 ohms-per-volt meter.

(3) 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:

MF XTAL SW	Volts (approximately)
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.

(4) 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.

(5) VOX SECTION. - The VOX circuit functions only in the SSB or DSB operation of the unit and not with conventional AM or SSB with full carrier. The VOX GAIN and SQUELCH GAIN controls (R140 and R129, respectively) are set properly only when the operator talking directly into the mike energizes the EXCITER; outputs from nearby receivers or background noise should not energize the exciter. If the VOX circuit is not working properly, see figure 5-1 and check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

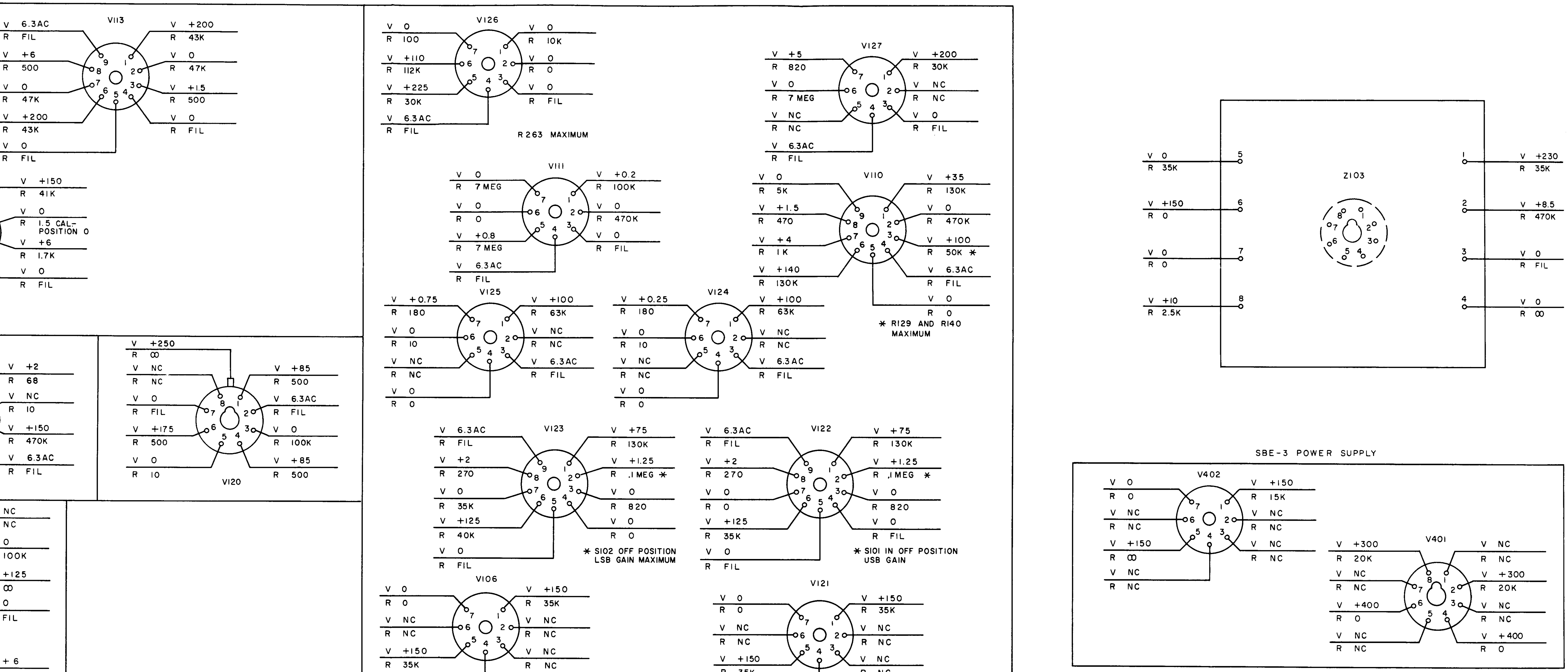
(6) USB AND LSB SECTIONS. - Turn two-tone test generator (TTG) on to SBE-3 and note correlation of TTG with SBE LSB and USB levels on meter. Both sideband outputs can be adjusted through the LSB GAIN or USB GAIN controls and the gain indicated on the output meter. If either sideband (USB or LSB) cannot 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. TROUBLE-SHOOTING 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	a. Set XMTR ON-OFF switch S104 to OFF position. b. Set EXCITER ON-STANDBY switch S105 to STANDBY position. 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. d. At conclusion of this step, return XMTR ON-OFF and EXCITER ON-STANDBY switches to their ON positions.	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	MF TUNING a. Turn METER SW S109 to CAL position and zero meter. b. Turn METER SW to MF position. c. Turn MF XTAL SW to VMO or crystal. d. Set MF dial to frequency of VMO or XTAL by use of MF TUNING control. e. Turn USB, LSB, and XMTR switches to their OFF positions. f. Turn CARRIER INSERT control fully CW. g. Adjust MF TUNING control slightly.	Meter reads zero for step a. In step b as the MF TUNING control is rotated, the meter deflection needle should read maximum.	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: 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.

TABLE 5-1. TROUBLE-SHOOTING CHART (C nt.)

STEP	CONTROL OPERATED	NORMAL INDICATION	REMEDY
6	RF TUNING a. Do not alter previous settings of MF TUNING control. b. Turn BAND MCS switch to frequency range desired. c. Turn OUTPUT TUNING bandswitch to frequency range desired. d. Turn METER SW to RF position. e. Using OUTPUT TUNING control, set OUTPUT TUNING dial to output frequency. f. Advance OUTPUT control for any indication on the meter. g. Adjust OUTPUT TUNING control slightly.	Maximum meter needle deflection.	In the event of a malfunction, visually check all control wire connections. If these are normal, the probable cause is within the RF section.
7	DOUBLE SIDEBAND (Without Carrier) a. Turn USB switch to desired channel. b. Turn CARRIER INSERT to 0. c. Turn LSB switch to OFF. d. Turn METER SW to USB. e. Advance USB GAIN until meter reads 50. f. Turn USB switch to OFF. g. Turn LSB switch to desired channel. h. Turn METER SW to LSB. i. Advance LSB GAIN until meter reads 50. j. Turn METER SW to RF. k. Advance OUTPUT control until meter reads 50. l. Turn LSB switch to OFF. m. Turn LSB switch to position selected in step a. n. Adjust USB GAIN to obtain a meter reading of 50. o. Turn LSB switch to desired channel as selected in step g.	Combined gain settings of USB and LSB GAIN controls should read approximately 100 on the meter. **NOTE** 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.	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.



CONDITIONS

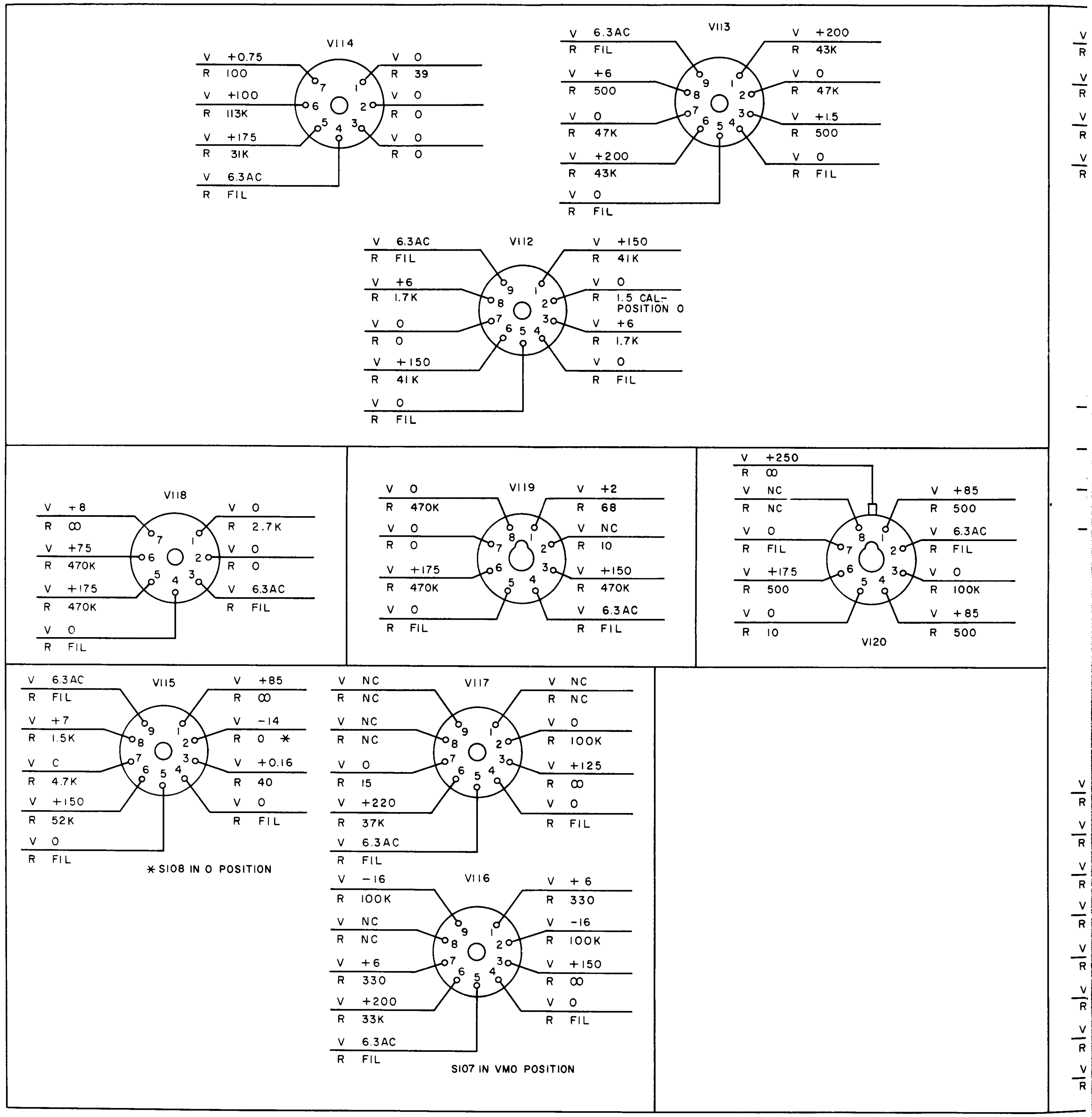
VOLTAGE MEASUREMENTS:

1. OUTPUT TUNED TO 8 OMCS.
2. BANDSWITCH 4 - 8 MCS.
3. METER SWITCH IN RF POSITION.
4. OUTPUT CONTROL SET TO 100% ON METER.
5. RF OUTPUT TERMINATED WITH 70 OHM NON-INDUCTIVE LOAD.
6. MF XTAL SWITCH IN VMO POSITION.
7. LSB AND USB GAIN CONTROL MIN.
8. MIKE/CHANNEL SELECTOR "OFF."
9. MAIN POWER "ON."
10. EXCITER "ON."
11. XMTR "OFF."
12. 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 EQUIVILENT.
4. ALL FRONT PANEL SWITCHES AND CONTROLS IN MAX CW POSITION.
5. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS.

Figure 5-1. Voltage and Resistance Diagram



V114
V +0.75 R 100
V +100 R 113K
V +175 R 31K
V 6.3AC R FIL
V 0 R 39
V 0 R 0
V 0 R 0
V113
V 6.3AC R FIL
V +6 R 500
V 0 R 47K
V +200 R 43K
V 0 R FIL
V +200 R 43K
V 0 R 47K
V +1.5 R 500
V 0 R FIL
V112
V 6.3AC R FIL
V +6 R 1.7K
V 0 R 0
V +150 R 41K
V 0 R FIL
V +150 R 41K
V 0 R 1.5 CAL-POSITION 0
V +6 R 1.7K
V 0 R FIL
V118
V +8 R ∞
V +75 R 470K
V +175 R 470K
V 0 R FIL
V 0 R 2.7K
V 0 R 0
V 6.3AC R FIL
V119
V 0 R 470K
V 0 R 0
V +175 R 470K
V 0 R FIL
V +2 R 68
V NC R 10
V +150 R 470K
V 6.3AC R FIL
V120
V +250 R ∞
V NC R NC
V 0 R FIL
V +175 R 500
V 0 R 10
V +85 R 500
V 6.3AC R FIL
V 0 R 100K
V +85 R 500
V115
V 6.3AC R FIL
V +7 R 1.5K
V C R 4.7K
V +150 R 52K
V 0 R FIL
V +85 R ∞
V -14 R 0 *
V +0.16 R 40
V 0 R FIL
* S108 IN 0 POSITION
V117
V NC R NC
V NC R NC
V 0 R 15
V +220 R 37K
V 6.3AC R FIL
V NC R NC
V 0 R 100K
V +125 R ∞
V 0 R FIL
V116
V -16 R 100K
V NC R NC
V +6 R 330
V +200 R 33K
V 6.3AC R FIL
V + 6 R 330
V -16 R 100K
V +150 R ∞
V 0 R FIL
S107 IN VMO POSITION

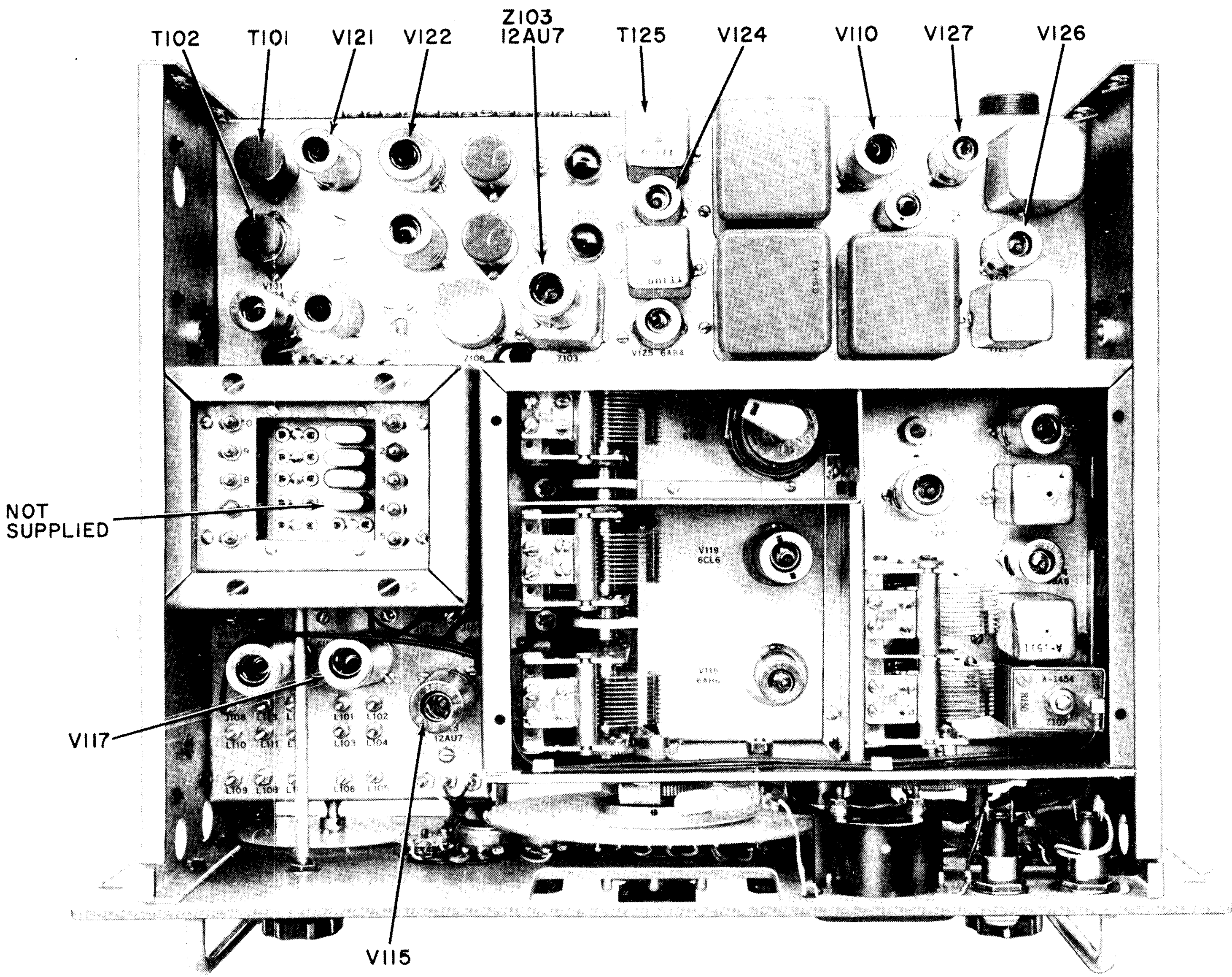


Figure 5-2. Location Diagram of Major Electronic Equipment Components, Top View

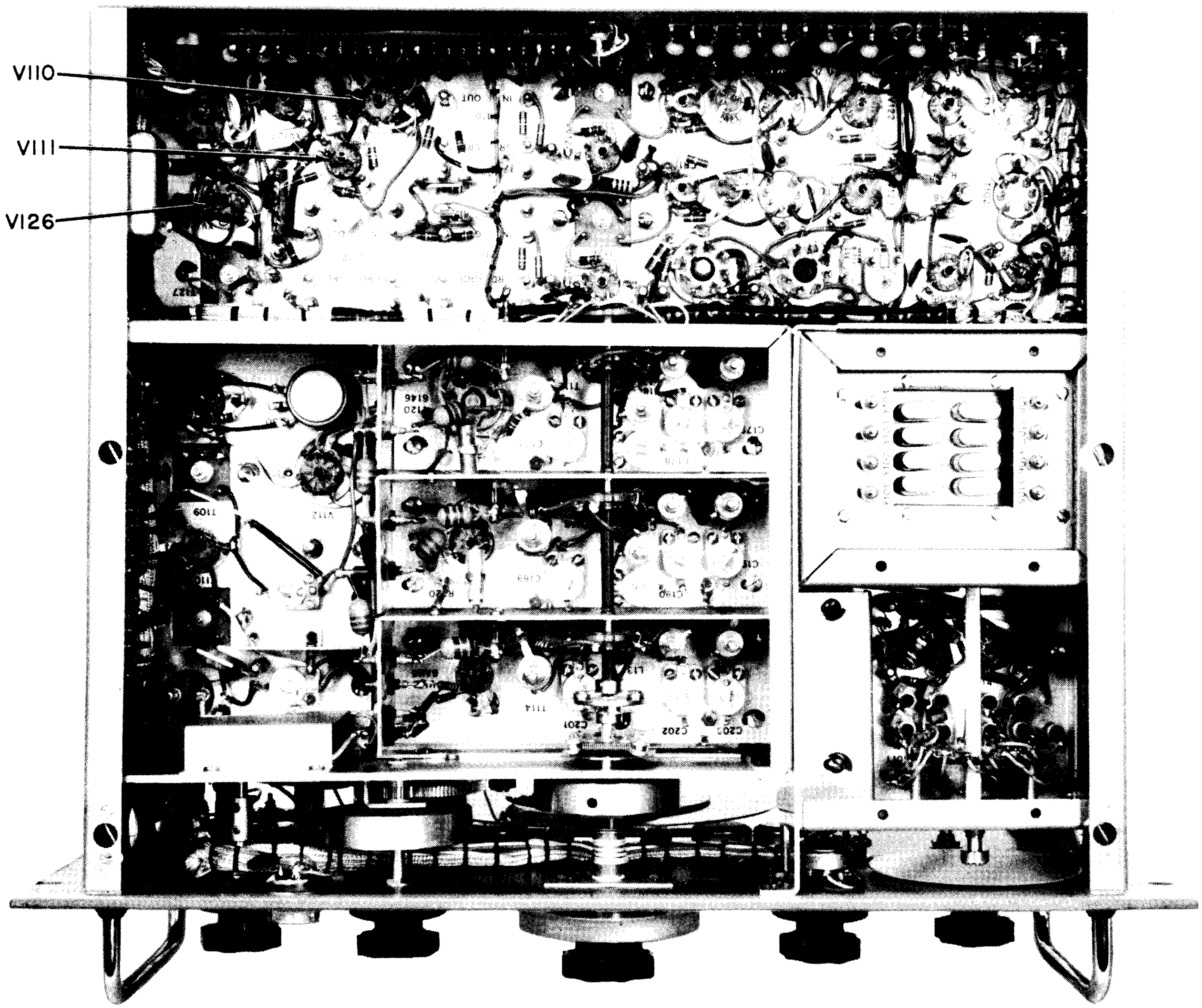


Figure 5-3. Location Diagram of Major Electronic Equipment Components, Bottom View

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; in particular, the tube sockets should be carefully 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_4) 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.

WARNING

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. 250-KC OSCILLATOR. - With a frequency counter (Hewlett-Packard model 524C or 524D), check the 250-kc output at pin 8 of Z103. This oscillator is factory adjusted and should not require attention in the field. If adjustment is proven necessary, this may be accomplished via C120, located under the chassis deck behind the crystal oven. The 250-kc output voltage at pin 8 of Z103 should equal approximately 1 volt.

b. TRANSFORMERS T125 AND T126. - For simplicity, the procedure for T125 only is given. Connect a sensitive VTVM at the junction of C266 and R247. Unbalance carrier balance resistor R265 to feed 250 kc to T125. Adjust top and bottom slugs of T125 to obtain maximum VTVM reading.

c. CARRIER BALANCE RESISTORS R265 AND R266. - For simplicity, the procedure for R265 only is given. After completing item (b) above, adjust R265 to obtain minimum VTVM reading.

d. TRANSFORMER T127. - Connect a sensitive VTVM at grid 2 or 7 of V113. Turn CARRIER INSERT resistor R263 for appreciable 250-kc carrier reinsertion. Adjust top and bottom slugs of T127 to obtain maximum VTVM readings.

e. 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 suffices. Connect a sensitive VTVM at terminal 2 of Z107. Keep CARRIER INSERT resistor R263 for appreciable 250-kc carrier reinsertion. 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 or 1.75 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 suffices. Keep VTVM at terminal 2 of Z107 and CARRIER INSERT resistor R263 for appreciable 250-kc carrier reinsertion. 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 or 3.75 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 at both 1.75 and 3.75 mc, corresponding to MF TUNING knob settings of 2 and 4 mc, respectively.

f. MF BALANCE RESISTOR R130. - Set CARRIER INSERT resistor R263 for zero 250-kc carrier reinsertion. Insert 2.25-mc supply at junction of C163 and C164. A 2.25-mc crystal associated with V115 or a 2.25-mc VMO rejection suffices. Keep VTVM at terminal 2 of Z107. Turn MF TUNING knob for a dial reading of 2.5 mc. At this setting, the MF modulator circuit is tuned to 2.25 mc which corresponds to the 2.25-mc injection. Adjust R130 for minimum VTVM reading.

g. HF BALANCE RESISTOR R150. - Supply voltage D terminal 2 of Z107 from J110. Plug VTVM's coaxial connector into V110. Adjust R150 for minimum deflection of VTVM. Repeat with 32-mc supply. Set R150 for minimum deflection of VTVM at the two extreme injection frequencies.

h. IF 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 ganged OUTPUT TUNING capacitors, C181A, C181B, and 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)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C101	NOT USED.		
C102	NOT USED.		
C103	NOT USED.		
C104	NOT USED.		
C105	NOT USED.		
C106	NOT USED.		
C107	NOT USED.		
C108	NOT USED.		
C109	NOT USED.		
C110	NOT USED.		
C111	NOT USED.		
C112	NOT USED.		
C113	NOT USED.		
C114	NOT USED.		
C115	NOT USED.		
C116	CAPACITOR, fixed: ceramic dielectric; ±.01 uf, +80% -20%.	RF Bypass V106	CC-100-16
C117	CAPACITOR, fixed: ceramic dielectric; ±.01 uf, +80% -20%. (Same as C116)	250 Kc Decoupling, V106	CC-100-16
C118	CAPACITOR, fixed: mica dielectric; 1000 uuf, ±10%, 500 wvdc, char. D. (C118 p/o Z103)	Coupling V105	CM20D102K
C119	NOT USED.		
C120	CAPACITOR, variable: ceramic; 1.5-7 uuf, 500 wvdc. char. A.	250 Kc Adj. Z103	CV11A070
C121	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116, p/o Z103)	RF Bypass Z103	CC-100-16
C122	CAPACITOR, fixed: mica dielectric; 220 uuf, ±10%, 500 wvdc, char. D. (p/o Z103)	RF Bypass Z103	CM20D221K
C123	CAPACITOR, fixed: ceramic; 10 uuf, .5 uuf, 500 wvdc, char. SL. (p/o Z103)	Coupling Z103	CC21SL100D

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C124	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116, p/o Z103)	Coupling Z103	CC-100-16
C125	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V110	CC-100-16
C126	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%.	Coupling V110	CC-100-29
C127	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling V110	CC-100-16
C128	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Coupling V110	CC-100-29
C129	NOT USED.		
C130	CAPACITOR, fixed: mylar dielectric; .1 uf, ±10%, 200 wvdc.	Time Constant V111	CN108C1003K
C131	CAPACITOR, fixed: composition; 510 uuf ±5%, 500 wvdc, char. C.	Coupling V114	CM15C11J
C132	CAPACITOR, fixed: ceramic dielectric, 1000 uuf, +80% -20%. (Same as C126)	RF Bypass V112	CC-100-29
C133	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Coupling V115	CC-100-29
C134	CAPACITOR, fixed: ceramic dielectric; 1000 uf, +80% -20%. (Same as C126)	Bypass V115	CC-100-29
C135	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V113	CC-100-16
C136	CAPACITOR, fixed: ceramic dielectric; 1000 uf, +80% -20%. (Same as C126)	Coupling V115	CC-100-29
C137	CAPACITOR, fixed: ceramic dielectric; 8 uuf, ±10%, 500 wvdc, char. SL.	Coupling V115	CC21SL080K
C138	CAPACITOR, fixed: ceramic dielectric; 8 uuf, ±10%, 500 wvdc, char. SL. (Same as C137)	Coupling V115	CC21SL080K
C139	CAPACITOR, fixed: ceramic dielectric; 47 uuf, ±2%, 500 wvdc, char. SL.	Cath. Bypass V115	CC21SL470G
C140	CAPACITOR, variable: ceramic; 3-12 uuf, 500 wvdc, char. A.	MF Trimmer V114	CV11A120
C141	CAPACITOR, variable: ceramic; 3-12 uuf, 500 wvdc, char. A. (Same as C140)	MF Trimmer V114	CV11A120
C142	NOT USED.		
C143	NOT USED.		

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C144	NOT USED.		
C145	NOT USED.		
C146	NOT USED.		
C147	NOT USED.		
C148	NOT USED.		
C149	NOT USED.		
C150	NOT USED.		
C151	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling, Meter Circuit, V122B	CC-100-16
C152	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling, Meter Circuit, V122B	CC-100-16
C153	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V122B	CC-100-16
C154	NOT USED.		
C155	NOT USED.		
C156	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling, Meter Circuit, V123B	CC-100-16
C157	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling, Meter Circuit, V123B	CC-100-16
C158	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass, V123B	CC-100-16
C159	NOT USED.		
C160	NOT USED.		
C161	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass, T127	CC-100-16
C162	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass, J101	CC-100-16
C163	CAPACITOR, fixed: ceramic dielectric; 47 uuf, ±10%, 500 wvdc, char. SL.	MF Coupling V113	CC21SL470K
C164	CAPACITOR, fixed: ceramic dielectric; 47 uuf, ±10%, 500 wvdc, char. SL. (Same as C163)	MF Coupling V113	CC21SL470K
C165	NOT USED.		
C166	Not a replaceable item, part of T109.	Decoupling V113	
C167 A, B	CAPACITOR, variable: air dielectric; 2 sections, 12.5 to 270 uuf, each section.	MF Tuning, V114	CB-127-1

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C168	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass, MF Mtr. Ckt.	CC-100-16
C169	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass, V114	CC-100-16
C170	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	DC Blocking V114	CC-100-16
C171	Not a replaceable item, part of T110.		
C172	NOT USED.		
C173	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Screen Bypass V110	CC-100-16
C174	CAPACITOR, fixed: ceramic dielectric; 1000 uf, +80% -20%. (Same as C126)	RF Bypass, V114	CC-100-29
C175	CAPACITOR, fixed: ceramic dielectric; 1000 uf, +80% -20%. (Same as C126)	RF Bypass, RF Output Mtr. Ckt.	CC-100-29
C176	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling, RF Output Mtr. Ckt.	CC-100-16
C177	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C.	Tunes T112, V120	CV11C300
C178	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T122, V120	CV11C300
C179	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T120, V120	CV11C300
C180	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T121, V120	CV11C300
C181A	CAPACITOR, variable: air dielectric; 12.5 to 270 uuf, each section.	RF Tuning, V120	CB-137-1
C181B	CAPACITOR, variable: air dielectric; 12.5 to 270 uuf, each section.	RF Tuning, V119	CB-137-2
C181C	CAPACITOR, variable: air dielectric; 12.5 to 270 uuf, each section.	RF Tuning, V118	CB-137-3
C182	CAPACITOR, fixed: mica dielectric; 1000 uuf, ±10%, 500 wvdc, char. D. (Same as C118)	Coupling, V120	CM20D102K
C183	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	RF Bypass, V120	CC-100-29
C184	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M.	RF Bypass, V120	CK70A102M

TRANSMITTING MODE SELECTOR MODEL SBE-3
(SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C185	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Screen Bypass V120	CC-100-29
C186	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Cathode Bypass V120	CC-100-29
C187	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Cathode Bypass V120	CC-100-29
C188	CAPACITOR, fixed: dry electrolytic; 50 uf, 50 wvdc, char. C.	Cathode Bypass V120	CE63C500G
C189	CAPACITOR, variable: ceramic; 1.5-7 uuf, 500 wvdc, char. A. (Same as C120)	Tunes T118, V119	CV11A070
C190	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T119, V119	CV11C300
C191	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T116, V119	CV11C300
C192	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T117, V119	CV11C300
C193	CAPACITOR, fixed: mica dielectric; 1000 uuf, ±10%, 500 wvdc, char. D. (Same as C118)	Coupling V119	CM20D102K
C194	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Screen Bypass V119	CC-100-29
C195	NOT USED.		
C196	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Cathode Bypass V119	CC-100-29
C197	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Cathode Bypass V113	CC-100-16
C198	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V120	CK70A102M
C199	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V118	CK70A102M
C200	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V119	CK70A102M
C201	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T114, V118	CV11C300

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C202	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T115, V118	CV11C300
C203	CAPACITOR, variable: ceramic; 4-30 uuf, 500 wvdc, char. C. (Same as C177)	Tunes T113, V118	CV11C300
C204	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V118	CK70A102M
C205	CAPACITOR, fixed: mica dielectric; 1000 uuf, ±10%, 500 wvdc, char. D. (Same as C118)	Coupling, V118	CM20D102K
C206	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Screen Bypass V118	CC-100-29
C207	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Cathode Bypass V118	CC-100-29
C208	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V118	CK70A102M
C209	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	RF Bypass, V116	CC-100-29
C210	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Coupling, V116	CC-100-29
C211	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Cathode Bypass V116	CC-100-29
C212	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	RF Bypass, V116	CC-100-29
C213	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V116	CK70A102M
C214	CAPACITOR, fixed: ceramic dielectric; 15 uuf, ±5%, 500 wvdc, char. SL.	RF Bypass, V116	CC21SL150J
C215	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	Coupling V116	CC-100-29
C216	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	RF Bypass V117	CC-100-29
C217	CAPACITOR, fixed: ceramic dielectric; 47 uuf, ±2%, 500 wvdc, char. SL. (Same as C139)	Coupling, V117	CC21SL470G
C218	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, +80% -20%. (Same as C126)	RF Bypass V117	CC-100-29

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C219	CAPACITOR, fixed: ceramic dielectric; 8 uuf, ±10%, 500 wvdc, char. SL. (Same as C137)	Coupling, V117	CC21SL080K
C220	CAPACITOR, fixed: ceramic dielectric; 47 uuf, ±2%, 500 wvdc, char. SL. (Same as C139)	RF Bypass V117	CC21SL470G
C221	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V117	CK70A102M
C222	CAPACITOR, fixed: paper dielectric; .05 uf, +40% -10%, 400 wvdc. (p/o TB101)	Transient Sup. Oven Term. BD.	CN-100-3
C223	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap.	Freq. Adj. XY111	CV-101-1
C224	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY112	CV-101-1
C225	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY113	CV-101-1
C226	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY114	CV-101-1
C227	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY115	CV-101-1
C228	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY116	CV-101-1
C229	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY117	CV-101-1
C230	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY118	CV-101-1
C231	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY119	CV-101-1
C232	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. XY120	CV-101-1
C233	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y101	CV-101-1
C234	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y102	CV-101-1
C235	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y103	CV-101-1
C236	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y104	CV-101-1

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C237	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y105	CV-101-1
C238	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y106	CV-101-1
C239	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y107	CV-101-1
C240	CAPACITOR, variable: glass; 1-8 uuf, 1000 vdc at mid-cap. (Same as C223)	Freq. Adj. Y108	CV-101-1
C241	CAPACITOR, fixed: mica dielectric; 220 uuf, ±5%, 500 wvdc, char. D. (p/o L101)	Tunes L101, S108	CM15D221J
C242	CAPACITOR, fixed: mica dielectric; 130 uuf, ±5%, 500 wvdc, char. C. (p/o L102)	Tunes L102, S108	CM15C131J
C243	CAPACITOR, fixed: mica dielectric; 82 uuf, ±5%, 500 wvdc, char. C. (p/o L103)	Tunes L103, S108	CM15C820J
C244	CAPACITOR, fixed: mica dielectric; 47 uuf, ±5%, 500 wvdc, char. C. (p/o L105)	Tunes L105, S108	CM15C470J
C245	CAPACITOR, fixed: mica dielectric; 24 uuf, ±5%, 500 wvdc, char. C. (p/o L106)	Tunes L106, S108	CM15C240J
C246	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Fil Bypass V117	CK70A102M
C247	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Fil Bypass V120	CK70A102M
C248	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Fil Bypass V119	CK70A102M
C249	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Fil Bypass V118	CK70A102M
C250	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Meter Bypass V112	CC-100-16
C251	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling V101	CC-100-16
C252	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V113	CC-100-16

TRANSMITTING MODE SELECTOR MODEL SBE-3
(SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C253	CAPACITOR, fixed: ceramic dielectric; 1000 uuf, ±20%, 500 wvdc, char. M. (Same as C184)	RF Bypass V119	CK70A102M
C254	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Cathode Bypass V113	CC-100-16
C255	NOT USED.		
C256	CAPACITOR, fixed: mica dielectric; 51 uuf, ±5%, 500 wvdc, char. C. (p/o L104)	Tunes L104, S108	CM15C510J
C257	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V113	CC-100-16
C258	NOT USED.		
C259	NOT USED.		
C260	NOT USED.		
C261	CAPACITOR, fixed: mylar dielectric; .1 uf, ±10%, 200 wvdc. (Same as C130)	Arc Suppressor Z108	CN108C1003K
C262	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Cath. Bypass V126	CC-100-16
C263	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V121	CC-100-16
C264	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass T104	CC-100-16
C265	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass T103	CC-100-16
C266	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling V124	CC-100-16
C267	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Coupling V125	CC-100-16
C268	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass V125	CC-100-16
C269	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B.	RF Bypass Cap. E101	CB21PB102K
C270	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K
C271	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K
C272	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C273	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K
C274	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass T104	CC-100-16
C275	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass T104	CC-100-16
C276	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass T103	CC-100-16
C277	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	RF Bypass T103	CC-100-16
C278	CAPACITOR, fixed: ceramic dielectric; .01 uf, +80% -20%. (Same as C116)	Screen Bypass V126	CC-100-16
C279	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K
C280	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K
C281	CAPACITOR, fixed: mica; button type, 1000 uuf, ±10%, 300 wvdc, char. B. (Same as C269)	RF Bypass Cap. E101	CB21PB102K
C282	CAPACITOR, fixed: mylar dielectric; .2 uf, ±10%, 200 wvdc.	Time Constant V111	CN108C2003K
CR101	NOT USED.		
CR102	NOT USED.		
CR103	NOT USED.		
CR104	NOT USED.		
CR105	NOT USED.		
CR106	NOT USED.		
CR107	DIODE, germanium. (p/o Z107)	p/o HF Mod.	1N67
CR108	DIODE, germanium. (p/o Z107)	p/o HF Mod.	1N67
CR109	NOT USED.		
CR110	NOT USED.		
CR111	DIODE, silicon.	Meter Rect. Ckt.	1N303
CR112	DIODE, silicon. (Same as CR111)	Meter Rect. Ckt.	1N303
CR113	DIODE, silicon. (Same as CR111)	Meter Rect. Ckt.	1N303

TRANSMITTING MODE SELECTOR MODEL SBE-3
(SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
CR114	DIODE, silicon. (Same as CR111)	Meter Rect. Ckt.	1N303
CR115	DIODE ASSY., germanium; four diodes; hermetically sealed.	Balance Mod.	DD-100
CR116	DIODE ASSY., germanium; four diodes; hermetically sealed. (Same as CR115)	Balance Mod.	DD-100
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; 110/125 volts, 1/25 watt.	Exciter ON Ind.	BI-100-51
I102	LAMP, neon: min. bayonet base; 110/125 volts, 1/25 watt. (Same as I101)	Oven Ind.	BI-100-51
I103	LAMP, incandescent: min. bayonet base; 6-8 volts, .15 amp; frosted lens, T-3-1/4.	Main Pwr. Ind.	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 Monitor Out.	UG-625/U
J103	CONNECTOR, receptacle: female, 1 contact, chassis type. (Same as J102)	RF Out.	UG-625/U
J104	CONNECTOR, receptacle: female, 1 contact, chassis type. (Same as J102)	VMO In	UG-625/U
J105	CONNECTOR, receptacle: male, one contact, 50 ohm.	VMO Inj.	JJ-154
J106	CONNECTOR, receptacle: male, one contact, 50 ohm. (Same as J105)	MF In	JJ-154
J107	CONNECTOR, receptacle: male, one contact, 50 ohm. (Same as J105)	VMO Inj.	JJ-154
J108	CONNECTOR, receptacle: male, one contact, 50 ohm. (Same as J105)	HF Osc. Ing.	JJ-154
J109	CONNECTOR, receptacle: male.	Power Jack	MS3102A2027P
J110	CONNECTOR, receptacle: male, one contact, 50 ohm. (p/o Z107)	HF Out	JJ-154
J111	CONNECTOR, receptacle: female, 1 contact, coaxial. (Same as J102)	SLM Output LSB	UG-625/U

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
J112	CONNECTOR, receptacle: female, 1 contact, coaxial. (Same as J102)	SLM Output USB	UG-625/U
K101	RELAY ASSY, solenoid, plug in type, octal base.	VOX Relay	A-1460
L101	COIL, R.F.: 8 mc;.95 - 1.01 uh, Q greater than 115. (Consists of C241)	8 mc Tank Har. Gen. S108	CL-207
L102	COIL, R.F.: 10 mc; .95 - 1.01 uh, Q greater than 115. (Consists of C242)	10 mc Tank Har. Gen. S108	CL-208
L103	COIL, R.F.: 12 mc; .95 - 1.01 uh, Q greater than 115. (Consists of C243)	12 mc Tank Har. Gen. S108	CL-209
L104	COIL, R.F.: 14 mc; .95 - 1.01 uh, Q greater than 115. (Consists of C256)	14 mc Tank Har. Gen. S108	CL-210
L105	COIL, R.F.: 16 mc; .95 - 1.01 uh, Q greater than 115. (Consists of C244)	16 mc Tank Har. Gen. S108	CL-211
L106	COIL, R.F.: 18 mc; .95 - 1.01 uh, Q greater than 115. (Consists of C245)	18 mc Tank Har. Gen. S108	CL-212
L107	COIL, R.F.: 20 mc; .95 - 1.01 uh, Q greater than 115.	20 mc Tank Har. Gen. S108	CL-213
L108	COIL, R.F.: 22 mc; .77 - .83 uh, Q greater than 115.	22 mc Tank Har. Gen. S108	CL-214
L109	COIL, R.F.: 24 mc; .67 - .73 uh, Q greater than 115.	24 mc Tank Har. Gen. S108	CL-215
L110	COIL, R.F.: 26 mc; .58 - .64 uh, Q greater than 115.	26 mc Har. Gen. S108	CL-216
L111	COIL, R.F.: 28 mc; .46 - .50 uh, Q greater than 115.	28 mc Har. Gen. S108	CL-206
L112	COIL, R.F.: 30 mc; .40 - .45 uh, Q greater than 115.	30 mc Har. Gen. S108	CL-204
L113	COIL, R.F.: 32 - 34 mc; .29 - .34 uh, Q greater than 115.	32 mc Har. Gen. S108	CL-205
L114	COIL, R.F.: 32 - 34 mc; .29 - .34 uh, Q greater than 115. (Same as L113)	34 mc Har. Gen.	CL-205
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 uh, 100 ma.	Choke, RF, V119	CL-140-1
L119	COIL, R.F., fixed: 150 uh, 100 ma. (Same as L117)	Choke, RF, V119	CL-140-2

TRANSMITTING MODE SELECTOR MODEL SBE-3
(SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
L120	COIL, R.F., fixed: 150 uh, 100 ma. (Same as L117)	Choke, RF, V112	CL-140-2
L121	COIL, R.F., fixed: 2.5 uh, 100 ma. (Same as L118)	Choke, RF, V119	CL-140-1
L122	COIL, R.F., fixed: 150 uh, 100 ma. (Same as L117)	Choke, RF, V118	CL-140-2
L123	COIL, R.F., fixed: 2.5 uh, 100 ma. (Same as L118)	Choke, RF, V118	CL-140-1
L124	COIL, R.F., fixed: 2.5 uh, 100 ma. (Same as L118)	Choke, RF, V120	CL-140-1
L125	COIL, plate peaking. (Consists of R230)	Choke, RF, V116	CL-187
L126	COIL, R.F., fixed: 128 uh.	Choke, RF, V117	CL-177
L127	COIL, R.F., fixed: 750 uh, 75 ma, 2 Pi.	Choke, RF, V117	CL-100-5
L128	NOT USED.		
L129	COIL, R.F., fixed: 4 uh.	Choke, RF Fil. of V119	CL-105-2
L130	COIL, R.F., fixed: 4 uh. (Same as L129)	Choke, RF Fil. of V118	CL-105-2
L131	COIL, R.F., fixed: 4 uh. (Same as L129)	Coupling T110	CL-105-2
L132	COIL, R.F., fixed: 150 uh, 100 ma. (Same as L117)	Choke, RF, V120	CL-140-2
L133 thru L142	NOT USED.		
L143 thru L149	COIL, R.F., fixed: 150 uh, 100 ma. (Same as L117)	Filter, E101	CL-140-2
M101	METER, D.C.: micro amp., 0-20.	Relative Indication of USB, LSB, RF OUT, MF and Calibrate.	MR-100-8
P101	CONNECTOR, plug: male.	Exciter Unit Power	MS3106B2027P
P102	CONNECTOR, plug: female.	Exciter Unit Power	MS3106B2027S
P103	CONNECTOR, plug: min. coaxial type.	MF Osc. Output	PL-154
P104	CONNECTOR, plug: min. coaxial type. (Same as P103)	VMO Injection	PL-154
P105	CONNECTOR, plug: min. coaxial type. (Same as P103)	HF Osc. Inj.	PL-154

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
P106	CONNECTOR, plug: min. coaxial type. (Same as P103)	VMO Injection	PL-154
P107	CONNECTOR, plug: min. coaxial type.	HF Osc. Inj.	PL-155
PS101	SUPPRESSOR, parasitic.	Parasitic Supp. V120	AX-164
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 Res. T101	RC20GF561K
R102	RESISTOR, fixed: composition; 560 ohms, ±10%, 1/2 watt. (Same as R101)	Terminating Res. T102	RC20GF561K
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	NOT USED.		
R107	NOT USED.		
R108	RESISTOR, fixed: composition; 1800 ohms, ±10%, 1/2 watt.	Decoupling V106	RC20GF182K
R109	NOT USED.		
R110	NOT USED.		
R111	NOT USED.		
R112	NOT USED.		
R113	NOT USED.		
R114	NOT USED.		
R115	NOT USED.		
R116	NOT USED.		
R117	NOT USED.		
R118	NOT USED.		
R119	NOT USED.		
R120	RESISTOR, fixed: wire wound; 5000 ohms, ±5%, 10 watts.	Dropping V121	RW-109-32
R121	NOT USED.		

TRANSMITTING MODE SELECTOR MODEL SBE-3
(SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R122	NOT USED.		
R123	NOT USED.		
R124	RESISTOR, fixed: composition; 4700 ohms, ±10%, 1 watt.	Plate Load V105	RC30GF472K
R125	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104, p/o Z103)	Plate Load V105	RC20GF104K
R126	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. (Same as R103, p/o Z103)	Grid Return V105	RC20GF474K
R127	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. (Same as R103, p/o Z103)	Grid Return V105	RC20GF474K
R128	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (R128 p/o Z103)	Cathode V105	RC20GF102K
R129	RESISTOR, variable: composition; 5000 ohms, ±10%, 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 V122B	RC20GF821K
R132	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104)	Plate Load V122B	RC20GF104K
R133	RESISTOR, fixed: composition; 10 M, ±10%, 1/2 watt.	Dropping USB Meter Circuit	RC20GF106K
R134	RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt.	Dropping USB Meter Circuit	RC20GF224K
R135	RESISTOR, variable: composition; 1000 ohms, ±10%, 2 watts.	Meter Cal. V112	RV4ATSA102A
R136	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104)	Plate Load V110	RC20GF104K
R137	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104)	Plate Load V110	RC20GF104K
R138	RESISTOR, fixed: composition; 82,000 ohms, ±10%, 2 watts.	Cathode Bias V110	RC42GF823K
R139	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 2 watts.	Screen Dropping V110	RC42GF104K
R140	RESISTOR, variable: composition; 100,000 ohms, ±20%, 2 watts.	VOX Gain Control V110	RV4ATSA104B

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R141	RESISTOR, fixed: composition; 470 ohms, ±10%, 1/2 watt.	Cathode, V110	RC20GF471K
R142	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (Same as R128)	Cathode, V110	RC20GF102K
R143	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. (Same as R103)	Grid Return V110	RC20GF474K
R144	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. (Same as R103)	Plate Load V111	RC20GF474K
R145	RESISTOR, fixed: composition; 10 M, ±10%, 1/2 watt. (Same as R133)	Time Constant V111	RC20GF106K
R146	RESISTOR, fixed: composition; 2.2 M, ±10%, 1/2 watt.	Dropping V111	RC20GF225K
R147	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104)	Cathode V111	RC20GF104K
R148	RESISTOR, fixed: composition; 10 M, ±10%, 1/2 watt. (Same as R133)	Plate Load V111	RC20GF106K
R149	RESISTOR, fixed: composition; 10 M, ±10%, 1/2 watt. (Same as R133)	Time Constant V111	RC20GF106K
R150	RESISTOR, variable: composition; 500 ohms, ±10%, 2 watts. (p/o Z107)	HF Balance Z107	RV4ATSD501A
R151	RESISTOR, fixed: composition; 820 ohms, ±10%, 1/2 watt. (Same as R131)	Cathode V127	RC20GF821K
R152	RESISTOR, fixed: composition; 82,000 ohms, ±10%, 2 watts. (Same as R138)	Cathode Bias V127	RC42GF823K
R153	RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt. (Same as R134)	Dropping I101	RC20GF224K
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	RC30GF223K
R156	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1 watt. (Same as R155)	Plate Load V112	RC30GF223K
R157	RESISTOR, fixed: composition; 1200 ohms, ±10%, 1/2 watt.	Cathode V112	RC20GF122K
R158	RESISTOR, fixed: composition; 1200 ohms, ±10%, 1/2 watt.	Cathode V112	RC20GF122K
R159	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt.	Plate Load V115	RC20GF223K
R160	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt. (Same as R159)	Plate Load V115	RC20GF223K

TRANSMITTING MODE SELECTOR MODEL SBE-3
(SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R161	RESISTOR, fixed: composition; 1500 ohms, ±10%, 1/2 watt. (Same as R105)	Cathode V115	RC20GF152K
R162	RESISTOR, fixed: composition; 4700 ohms, ±10%, 1/2 watt.	Grid Return V115	RC20GF472K
R163	RESISTOR, fixed: composition; 220, 000 ohms, ±10%, 1/2 watt. (Same as R134)	Grid Return V115	RC20GF224K
R164	RESISTOR, fixed: composition; 12, 000 ohms, ±10%, 1/2 watt.	Dropping, MF Mtr. Ckt.	RC20GF123K
R165	RESISTOR, fixed: composition; 12, 000 ohms, ±10%, 1/2 watt. (Same as R164)	Dropping, MF Mtr. Ckt.	RC20GF123K
R166	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (Same as R128)	Dropping, USB Gain	RC20GF102K
R167	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (Same as R128)	Dropping, LSB Gain	RC20GF102K
R168	RESISTOR, variable: composition; 100, 000 ohms, ±20%, 2 watts. (Same as R140)	USB Gain Control	RV4ATSA104B
R169	RESISTOR, variable: composition; 100, 000 ohms, ±20%, 2 watts. (Same as R140)	LSB Gain Control	RV4ATSA104B
R170	RESISTOR, fixed: composition; 1500 ohms, ±10%, 1/2 watt. (Same as R105)	Loading, T117	RC20GF152K
R171	NOT USED.		
R172	NOT USED.		
R173	NOT USED.		
R174	NOT USED.		
R175	NOT USED.		
R176	NOT USED.		
R177	NOT USED.		
R178	NOT USED.		
R179	NOT USED.		
R180	NOT USED.		
R181	RESISTOR, fixed: composition; 820 ohms, ±10%, 1/2 watt. (Same as R131)	Cathode V123B	RC20GF821K
R182	RESISTOR, fixed: composition; 100, 000 ohms, ±10%, 1/2 watt. (Same as R104)	Plate Load V123B	RC20GF104K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R183	RESISTOR, fixed: composition; 10 M, ±10%, 1/2 watt. (Same as R133)	Dropping LSB, Meter Circuit	RC20GF106K
R184	RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt. (Same as R134)	Dropping LSB, Meter Circuit	RC20GF224K
R185	NOT USED.		
R186	NOT USED.		
R187	NOT USED.		
R188	NOT USED.		
R189	NOT USED.		
R190	NOT USED.		
R191	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1 watt.	Decoupling T127	RC30GF102K
R192	RESISTOR, fixed: composition; 47,000 ohms, ±10%, 1/2 watt.	Grid Return V113B	RC20GF473K
R193	RESISTOR, fixed: composition; 47,000 ohms, ±10%, 1/2 watt. (Same as R192)	Grid Return V113A	RC20GF473K
R194	NOT USED.		
R195	NOT USED.		
R196	RESISTOR, fixed: composition; 10,000 ohms, ±10%, 2 watts.	Decoupling T109	RC42GF103K
R197	RESISTOR, fixed: composition; 68 ohms, ±10%, 1/2 watt.	Parasitic Supp. V113A	RC20GF680K
R198	RESISTOR, fixed: composition; 68 ohms, ±10%, 1/2 watt. (Same as R197)	Parasitic Supp. V113B	RC20GF680K
R199	RESISTOR, fixed: composition; 39 ohms, ±10%, 1/2 watt.	Parasitic Supp. V114	RC20GF390K
R200	RESISTOR, fixed: composition; 100 ohms, ±10%, 1/2 watt.	Cathode, V114	RC20GF101K
R201	RESISTOR, fixed: composition; 68 ohms, ±10%, 1/2 watt. (Same as R197)	VMO Load J107	RC20GF680K
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 T110	RC30GF122K
R204	RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt. (Same as R134)	Dropping, MF Meter Ckt.	RC20GF224K

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R205	RESISTOR, variable: composition; 5000 ohms, ±10%, 2 watts.	Output Control, Z107	RV4ATRD502C
R206	RESISTOR, fixed: composition; 100 ohms, ±10%, 1/2 watt. (Same as R200, p/o TB101)	Transient Supp. Heater T.B.	RC20GF101K
R207	RESISTOR, fixed: wire wound; 20 watts. (p/o TB101)	Oven Heater	RR-102-1
R208	RESISTOR, fixed: wire wound; 20 watts. (Same as R207, p/o TB101)	Oven Heater	RR-102-1
R209	RESISTOR, fixed: composition; 3.3 M, ±10%, 1/2 watt.	Dropping, RF Meter Ckt.	RC20GF335K
R210	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (Same as R128)	Dropping, RF Meter Ckt.	RC20GF102K
R211	RESISTOR, fixed: composition; 560 ohms, ±10%, 1/2 watt.	Dropping, RF Meter Ckt.	RC20GF561K
R212	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (Same as R128)	Dropping, RF Monitor	RC20GF102K
R213	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. (Same as R103)	Screen Dropping V120	RC20GF474K
R214	RESISTOR, fixed: composition; 10 ohms, ±10%, 1/2 watt.	Suppressor V120	RC20GF100K
R215	RESISTOR, fixed: composition; 68,000 ohms, ±10%, 1/2 watt.	Dropping V119	RC20GF683K
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	RC30GF562K
R218	RESISTOR, fixed: composition; 39 ohms, ±10%, 1/2 watt. (Same as R199)	Suppressor V119	RC20GF390K
R219	RESISTOR, fixed: composition; 68 ohms, ±10%, 1/2 watt. (Same as R197)	Cathode Bias V119	RC20GF680K
R220	RESISTOR, fixed: composition; 10 ohms, ±10%, 1/2 watt. (Same as R214)	Suppressor V119	RC20GF100K
R221	NOT USED.		
R222	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt. (Same as R128)	Loading V119	RC20GF102K
R223	RESISTOR, fixed: composition; 33,000 ohms, ±10%, 1/2 watt.	Screen Dropping V118	RC20GF333K
R224	RESISTOR, fixed: composition; 10 ohms, ±10%, 1/2 watt. (Same as R214)	Suppressor V118	RC20GF100K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R225	RESISTOR, fixed: composition; 100 ohms, ±10%, 1/2 watt. (Same as R200)	Cathode Bias V118	RC20GF101K
R226	RESISTOR, fixed: composition; 10 ohms, ±10%, 1/2 watt. (Same as R214)	Screen Decoup. V118	RC20GF100K
R227	RESISTOR, fixed: composition; 2700 ohms, ±10%, 1/2 watt.	Grid Return V118	RC20GF272K
R228	RESISTOR, fixed: composition; 330 ohms, ±10%, 1/2 watt.	Cathode Bias V116	RC20GF331K
R229	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104)	Grid Return V116	RC20GF104K
R230	RESISTOR, fixed: composition; 2700 ohms, ±10%, 1 watt. (p/o L125)	Decoupling V116	RC30GF272K
R231	RESISTOR, fixed: composition; 6800 ohms, ±10%, 1 watt.	Decoupling V116	RC30GF682K
R232	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt. (Same as R159)	Screen Decoup. V116	RC20GF223K
R233	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt. (Same as R104)	Grid Return V117	RC20GF104K
R234	NOT USED.		
R235	RESISTOR, fixed: composition; 100,000 ohms, ± 10%, 1/2 watt. (Same as R104)	Dropping, I102	RC20GF104K
R236	NOT USED.		
R237	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt.	Isolating T110	RC20GF271K
R238	RESISTOR, fixed: composition; 5.1 M, ±5%, 1/2 watt.	Dropping RF Meter Ckt.	RC20GF515J
R239	RESISTOR, fixed: composition; 1500 ohms, ±10%, 1/2 watt. (Same as R105)	Loading T119	RC20GF152K
R240	Not a replaceable item, p/o T109.	Decoupling R109	
R241	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt.	Dropping CR115	RC20GF271K
R242	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt. (Same as R241)	Dropping CR115	RC20GF271K
R243	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt. (Same as R241)	Dropping CR116	RC20GF271K
R244	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt. (Same as R241)	Dropping CR116	RC20GF271K
R245	RESISTOR, fixed: composition; 180 ohms, ±10%, 1/2 watt.	Cathode Res. V124	RC20GF181K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R246	RESISTOR, fixed: composition; 180 ohms, ±10%, 1/2 watt. (Same as R245)	Cathode Res. V125	RC20GF181K
R247	RESISTOR, fixed: composition; 8200 ohms, ±5%, 1/2 watt.	Dropping Z110	RC20GF822J
R248	RESISTOR, fixed: composition; 8200 ohms, ±5%, 1/2 watt. (Same as R247)	Dropping Z111	RC20GF822J
R249	RESISTOR, fixed: composition; 18, 000 ohms, ±5%, 1/2 watt.	Terminating Z110	RC20GF183J
R250	RESISTOR, fixed: composition; 18, 000 ohms, ±5%, 1/2 watt. (Same as R249)	Terminating Z111	RC20GF183J
R251	RESISTOR, fixed: composition; 8200 ohms, ±5%, 1/2 watt. (Same as R247)	Terminating	RC20GF822J
R252	RESISTOR, fixed: composition; 3900 ohms, ±10%, 1/2 watt.	Terminating SLM	RC20GF392K
R253	RESISTOR, fixed: composition; 3900 ohms, ±10%, 1/2 watt. (Same as R252)	Terminating SLM	RC20GF392K
R254	RESISTOR, fixed: composition; 11, 000 ohms, ±5%, 1/2 watt.	Terminating Z110	RC20GF113J
R255	RESISTOR, fixed: composition; 11, 000 ohms, ±5%, 1/2 watt. (Same as R254)	Terminating Z111	RC20GF113J
R256	RESISTOR, fixed: composition; 15, 000 ohms, ±5%, 1/2 watt.	Combining Z110 & Z112	RC20GF153J
R257	RESISTOR, fixed: composition; 15, 000 ohms, ±5%, 1/2 watt. (Same as R256)	Combining Z111 & Z112	RC20GF153J
R258	RESISTOR, fixed: wire wound; 5000 ohms, ±5%, 10 watts. (Same as R120)	Dropping V106	RW-109-32
R259	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt. (Same as R241)	Cath. Res. V122A	RC20GF271K
R260	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt. (Same as R241)	Cathode V123A	RC20GF271K
R261	RESISTOR, fixed: composition; 33, 000 ohms, ±10%, 1 watt.	Plate Load V124	RC30GF333K
R262	RESISTOR, fixed: composition; 33, 000 ohms, ±10%, 1 watt. (Same as R261)	Plate Load V125	RC30GF333K
R263	RESISTOR, variable: composition; 250 ohms, ±10%, 2 watts.	Carrier Insert	RV4ATRD251B
R264	RESISTOR, fixed: composition; 2200 ohms, ±10%, 1/2 watt.	Dropping Carrier Insert	RC20GF222K
R265	RESISTOR, variable: composition; 250 ohms, ±10%, 1/2 watt.	Carrier Balance CR115	RV106UX8B-251A

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R266	RESISTOR, variable: composition; 250 ohms, ±10%, 1/2 watt. (Same as R265)	Carrier Balance CR116	RV106UX8B-251A
R267	NOT USED.		
R268	NOT USED.		
R269	NOT USED.		
R270	NOT USED.		
R271	NOT USED.		
R272	NOT USED.		
R273	RESISTOR, fixed: composition; 100 ohms, ±10%, 1/2 watt. (Same as R200)	Cathode V126	RC20GF101K
R274	RESISTOR, fixed: composition; 82,000 ohms, ±10%, 1/2 watt. (Same as R202)	Dropping V126	RC20GF823K
R275	RESISTOR, fixed: composition; 22,000 ohms, ±5%, 1/2 watt.	Terminating T109	RC20GF223J
R276	RESISTOR, fixed: composition; 1500 ohms, ±10%, 1/2 watt. (Same as R105)	Voltage Divider Z112	RC20GF152K
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	SWITCH, rotary: non-shorting, 4 positions, double pole; glass melamine ins., contacts and wipers, silver alloy, 1/2 in. shaft, 11/32 in. lg., 1/4 in. flatted 2 sides. (Same as S101)	LSB Switch	SW-181
S103	SWITCH, toggle: SPST; solder lug terminals, 110/250 volts AC or DC.	Power ON/OFF	ST-103-1-62
S104	SWITCH, toggle: SPST; solder lug terminals, 110/250 volts AC or DC. (Same as S103)	Xmtr. ON/OFF	ST-103-1-62
S105	SWITCH, toggle: SPST; solder lug terminals, 110/250 volts AC or DC. (Same as S103)	Exciter ON/STANDBY	ST-103-1-62
S106A	WAFER, switch: four positions, shorting type.	RF Band, V120	WS-101
S106B	WAFER, switch: four positions, shorting type. (Same as S106A)	RF Band, V119	WS-101
S106C	WAFER, switch: four positions, shorting type. (Same as S106A)	RF Band, V118	WS-101

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
S106D	WAFER, switch: four positions, shorting type.	Sideband Reversal	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
TB101	HEATER TERMINAL BOARD ASSY.: consists of C222, R206, 207, 208, S110.	Oven Heater Terminal Board	A-1520
T101	TRANSFORMER, audio: pri. imp. 150/600 ohms sec. imp. 600 ohms CT; 7 terminals.	Input Channel 1	TF-170
T102	TRANSFORMER, audio: pri. imp. 150/600 ohms, sec. imp. 600 ohms CT; 7 terminals. (Same as T101)	Input Channel 2	TF-170
T103	TRANSFORMER, audio: pri. imp. 20, 000 ohms CT; sec. imp. 150/600 ohms: 7 terminals.	Audio, V123A	TF-138
T104	TRANSFORMER, audio: pri. imp. 20, 000 ohms CT; sec. imp. 150/600 ohms: 7 terminals. (Same as T103)	Audio V122A	TF-138
T105	NOT USED.		
T106	NOT USED.		
T107	NOT USED.		
T108	NOT USED.		
T109	TRANSFORMER, R.F.: 2-4 Mc; single tuned. (Consists of C166, R240)	MF Transformer V113	A-1512
T110	TRANSFORMER, R.F.: 2-4 Mc; single tuned. (Consists of C171)	MF Transformer V114	A-1511
T111	TRANSFORMER, R.F.: 2-4 Mc; double tuned. (p/o Z107)	Mod. Transformer Z107	TF-172
T112	TRANSFORMER, R.F.: 16-32 Mc; slug tuned.	16-32 Mc Band V120	CL-189

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
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	TRANSFORMER, R.F.: 4-8 Mc; slug tuned. (Same as T113)	4-8 Mc Band V119	CL-163
T118	TRANSFORMER, R.F.: 16-32 Mc; slug tuned. (Same as T114)	16-32 Mc Band V119	CL-188
T119	TRANSFORMER, R.F.: 8-16 Mc; slug tuned. (Same as T115)	8-16 Mc Band V119	CL-164
T120	TRANSFORMER, R.F.: 2-4.3 Mc; slug tuned.	2-4.3 Mc Band V120	CL-161
T121	TRANSFORMER, R.F.: 4-8 Mc; slug tuned. (Same as T113)	4-8 Mc Band V120	CL-163
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	TF-183
T125	TRANSFORMER, R.F.: 250 Kc; double tuned.	LF Transformer	TT-100
T126	TRANSFORMER, R.F.: 250 Kc; double tuned. (Same as T125)	LF Transformer	TT-100
T127	TRANSFORMER, R.F.: 250 Kc; double tuned. (Same as T125)	MF Mod. Input	TT-100
V101	TUBE, electron: RF triode: 7 pin miniature.	Audio Preampl.	6AB4
V102	NOT USED.		
V103	NOT USED.		
V104	NOT USED.		
V105	TUBE, electron: medium-mu duo-triode, 9 pin miniature. (V105 p/o Z103)	250 Kc Osc.	12AU7
V106	TUBE, electron: voltage regulator; 7 pin miniature.	150 Volt Reg.	OA2

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
V107	NOT USED.		
V108	NOT USED.		
V109	NOT USED.		
V110	TUBE, electron: 9 pin miniature.	Squelch & VOX Ampl.	6U8
V111	TUBE, electron: duo diode: 7 pin miniature.	Squelch & VOX Rect.	6AL5
V112	TUBE, electron: medium-mu duo-triode, 9 pin miniature. (Same as V105)	Meter Tube	12AU7
V113 A & B	TUBE, electron: duo triode: 9 pin miniature.	MF Modulator	12AT7
V114	TUBE, electron: sharp cutoff RF pentode; 7 pin miniature.	MF Ampl.	6AH6
V115	TUBE, electron: medium-mu duo-triode, 9 pin miniature. (Same as V105)	2-4 Mc Osc.	12AU7
V116	TUBE, electron: power pentode, wide band amp, 9 pin miniature.	HF Osc. Ampl.	6CL6
V117	TUBE, electron: 9 pin miniature. (Same as V110)	HF Osc.	6U8
V118	TUBE, electron: sharp cutoff RF pentode; 7 pin miniature. (Same as V114)	1st RF Ampl.	6AH6
V119	TUBE, electron: power pentode, wide band amp, 9 pin miniature. (Same as V116)	2nd RF Ampl.	6CL6
V120	TUBE, electron: beam power; large wafer octal base with sleeve.	RF Output Ampl.	6146
V121	TUBE, electron: voltage regulator; 7 pin miniature. (Same as V106)	150 V Regulator	OA2
V122 A & B	TUBE, electron: duo triode; 9 pin miniature.	(A) LSB Audio Ampl. (B) USB Meter Ampl.	12AT7
V123 A & B	TUBE, electron: duo triode; 9 pin miniature.	(A) USB Audio Ampl. (B) LSB Meter Ampl.	12AT7
V124	TUBE, electron: RF triode; 7 pin miniature. (Same as V101)	LF Amplifier	6AB4
V125	TUBE, electron: RF triode; 7 pin miniature. (Same as V101)	LF Amplifier	6AB4
V126	TUBE, electron: sharp cutoff RF pentode; 7 pin miniature. (Same as V114)	250 Kc Ampl.	6AH6

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
V127	TUBE, electron: RF triode; 7 pin miniature. (Same as V101)	Relay Ampl.	6AB4
XCR101 thru XCR114	NOT USED.		
XCR115	SOCKET, 7 pin miniature: moulded plastic.	Socket for CR115	TS-102-P01
XCR116	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for CR116	TS-102-P01
XI101	SOCKET, lens, miniature bayonet: red indicator lens.	Socket for I101	TS-106-1
XI102	SOCKET, lens, miniature bayonet: white indicator lens.	Socket for I102	TS-106-2
XI103	SOCKET, bracket, miniature bayonet.	Socket for I103	TS-107-2
XK101	SOCKET, octal: moulded plastic.	Socket for K101	TS-101-P01
XV101	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V101	TS-102-P01
XV102	NOT USED.		
XV103	NOT USED.		
XV104	NOT USED.		
XV105	SOCKET, plug in: w/can; plug in type, 9 pin miniature. (p/o Z103)	Socket for V105	PO-148-9-2
XV106	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V106	TS-102-P01
XV107	NOT USED.		
XV108	NOT USED.		
XV109	NOT USED.		
XV110	SOCKET, 9 pin miniature: moulded plastic.	Socket for V110	TS-103-P01
XV111	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V111	TS-102-P01
XV112	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V112	TS-103-P01
XV113	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V113	TS-103-P01
XV114	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V114	TS-102-P01

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XV115	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V115	TS-103-P01
XV116	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V116	TS-103-P01
XV117	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V117	TS-103-P01
XV118	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V118	TS-102-P01
XV119	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V119	TS-103-P01
XV120	SOCKET, octal: moulded plastic. (Same as XK101)	Socket for V120	TS-101-P01
XV121	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V121	TS-102-P01
XV122	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V122	TS-103-P01
XV123	SOCKET, 9 pin miniature: moulded plastic. (Same as XV110)	Socket for V123	TS-103-P01
XV124	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V124	TS-102-P01
XV125	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V125	TS-102-P01
XV126	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V126	TS-102-P01
XV127	SOCKET, 7 pin miniature: moulded plastic. (Same as XCR115)	Socket for V127	TS-102-P01
XY101	SOCKET, xtal: steatite; cadmium plated phosphor bronze.	Xtal Holder Y101	TS-104-1
XY102	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y102	TS-104-1
XY103	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y103	TS-104-1
XY104	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y104	TS-104-1
XY105	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y105	TS-104-1
XY106	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y106	TS-104-1
XY107	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y107	TS-104-1

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XY108	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y108	TS-104-1
XY109	NOT USED.		
XY110	NOT USED.		
XY111	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y111	TS-104-1
XY112	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y112	TS-104-1
XY113	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y113	TS-104-1
XY114	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y114	TS-104-1
XY115	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y115	TS-104-1
XY116	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y116	TS-104-1
XY117	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y117	TS-104-1
XY118	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y118	TS-104-1
XY119	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y119	TS-104-1
XY120	SOCKET, xtal: steatite; cadmium plated phosphor bronze. (Same as XY101)	Xtal Holder Y120	TS-104-1
XY121	SOCKET, xtal: part of Z108.	Xtal Holder Y121	P/O Z108
XZ103	SOCKET, octal: moulded plastic. (Same as XK101)	Socket for Z103	TS-101-P01
XZ104	NOT USED.		
XZ105	NOT USED.		
XZ106	NOT USED.		
XZ107	NOT USED.		
XZ108	SOCKET, octal: moulded plastic. (Same as XK101)	Socket for Z108	TS-101-P01
Y101	CRYSTAL, quartz: 8 mc.	HF Mod. Osc. 8 mc.	CR27/U-8.000P
Y102	CRYSTAL, quartz: 10 mc.	HF Mod. Osc. 10 mc.	CR27/U-10.000P
Y103	CRYSTAL, quartz: 12 mc.	HF Mod. Osc. 12 mc.	CR27/U-12.000P

TRANSMITTING MODE SELECTOR MODEL SBE-3 (SYMBOL SERIES 100 AND 200)

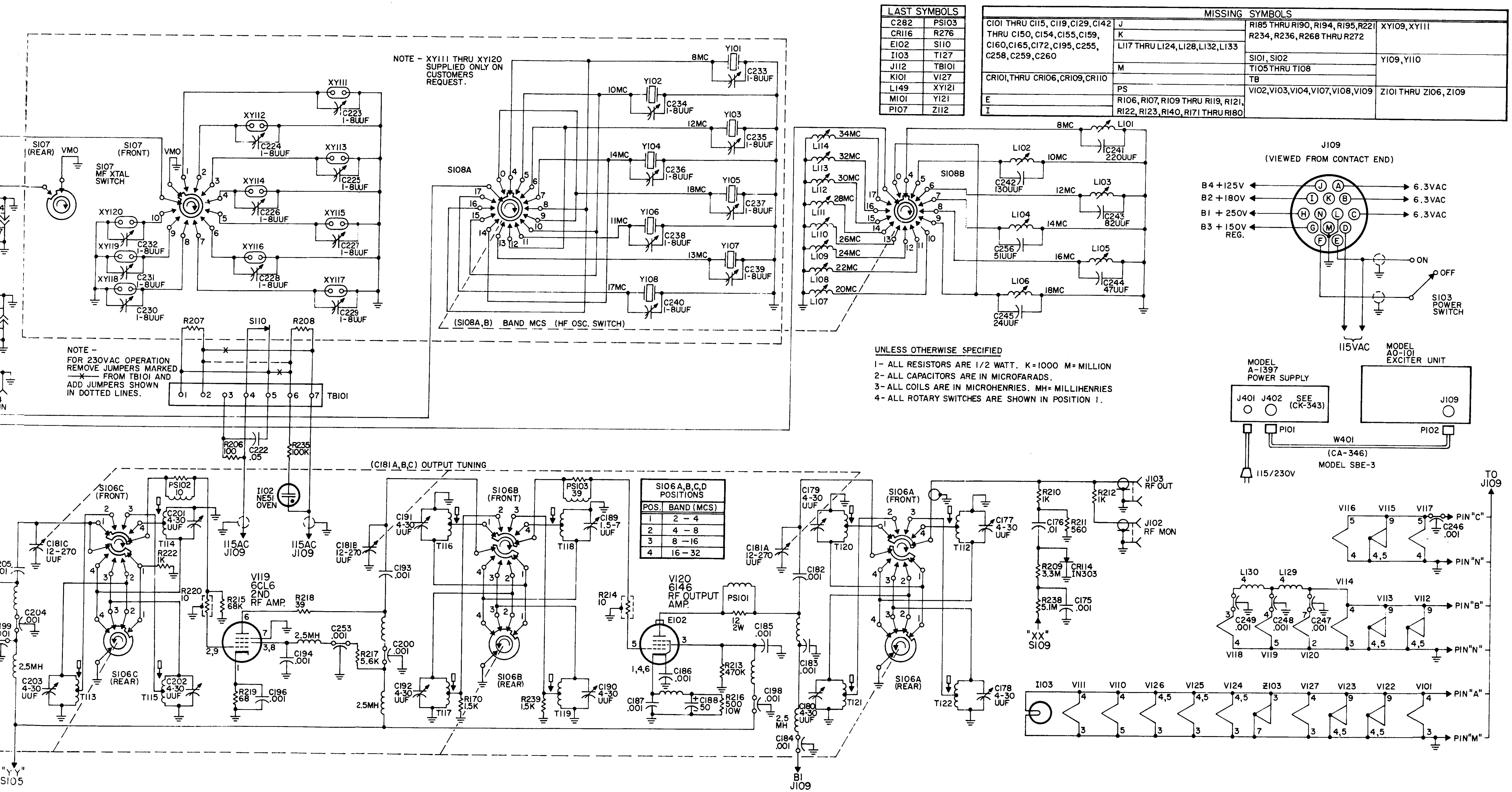
SYM	DESCRIPTION	FUNCTION	TMC PART NO.
Y104	CRYSTAL, quartz: 14 mc.	HF Mod. Osc. 14 mc.	CR27/U-14.000P
Y105	CRYSTAL, quartz: 18 mc.	HF Mod. Osc. 18 mc.	CR27/U-18.000P
Y106	CRYSTAL, quartz: 11 mc.	HF Mod. Osc. 11 mc.	CR27/U-11.000P
Y107	CRYSTAL, quartz: 13 mc.	HF Mod. Osc. 13 mc.	CR27/U-13.000P
Y108	CRYSTAL, quartz: 17 mc.	HF Mod. Osc. 17 mc.	CR27/U-17.000P
Y109	NOT USED.		
Y110	NOT USED.		
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.		
Y121	CRYSTAL, quartz: 250 Kc.	250 kc Osc.	CR47/U-.250P
Z101	NOT USED.		
Z102	NOT USED.		
Z103	ASSEMBLY, 250 kc oscillator: consists of C118, 121, 122, 123, 124, R125, 126, 128, V105, XV105.	250 kc Osc.	A-1458
Z104	NOT USED.		
Z105	NOT USED.		
Z106	NOT USED.		
Z107	MODULATOR ASSEMBLY, H.F.: consists of CR107, 108, R150, T111, J110.	HF Mod.	A1454
Z108	OVEN, crystal: 250 kc.	Oven, Crystal	PO-184
Z109	NOT USED.		
Z110	FILTER, bandpass.	Lower Sideband	FX-158
Z111	FILTER, bandpass.	Upper Sideband	FX-160
Z112	FILTER, carrier suppression.	Carrier Reject	FX-159

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C401	CAPACITOR, fixed: dry electrolytic; polarized, 80 uf, 450 wvdc.	Filter, V401	CE51F800R
C402	CAPACITOR, fixed: dry electrolytic; polarized, 80 uf, 450 wvdc. (Same as C401)	Filter, V401	CE51F800R
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 ea 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
J402	CONNECTOR, receptacle: female; AN pin type.	Power Interconnect	MS3102A2027S
L401	REACTOR, filter: 10 hy, 200 ma.	Filter Choke, V401	TF-144
L402	REACTOR, filter: 10 hy, 200 ma. (Same as L401)	Filter Choke, V401	TF-144
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, ±10%, 2 watts.	Voltage Dropping, I402	RC42GF153K
R402	RESISTOR, fixed: wire wound; 7500 ohms, 10 watts.	Voltage Dropping, V402	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, ±10%, 1 watt.	Bleeder	RC30GF104K

TRANSMITTING MODE SELECTOR POWER SUPPLY (SYMBOL SERIES 400)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
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. (Consists of P401, P402)	AC Power Cable	CA-103-72
XF401	FUSE HOLDER, extractor post type for single AGC type fuse.	F401 Holder	FH-100-1
XF402	FUSE HOLDER, extractor post type for single AGC type fuse. (Same as XF401)	F402 Holder	FH-100-1
XF403	FUSE HOLDER, extractor post type for single AGC type fuse. (Same as XF401)	F403 Holder	FH-100-1
XI401	SOCKET, indicator: w/red frosted lens.	Socket, I401	TS-106-1
XV401	SOCKET, tube: octal.	Socket, V401	TS-101-P01
XV402	SOCKET, tube: 7 pin miniature.	Socket, V402	TS-102-P01

SECTION 8
SCHEMATIC DIAGRAMS



LAST SYMBOLS	
C282	PS103
CR116	R276
E102	S110
I103	T127
J112	TB101
K101	V127
L149	XY121
M101	Y121
P107	Z112

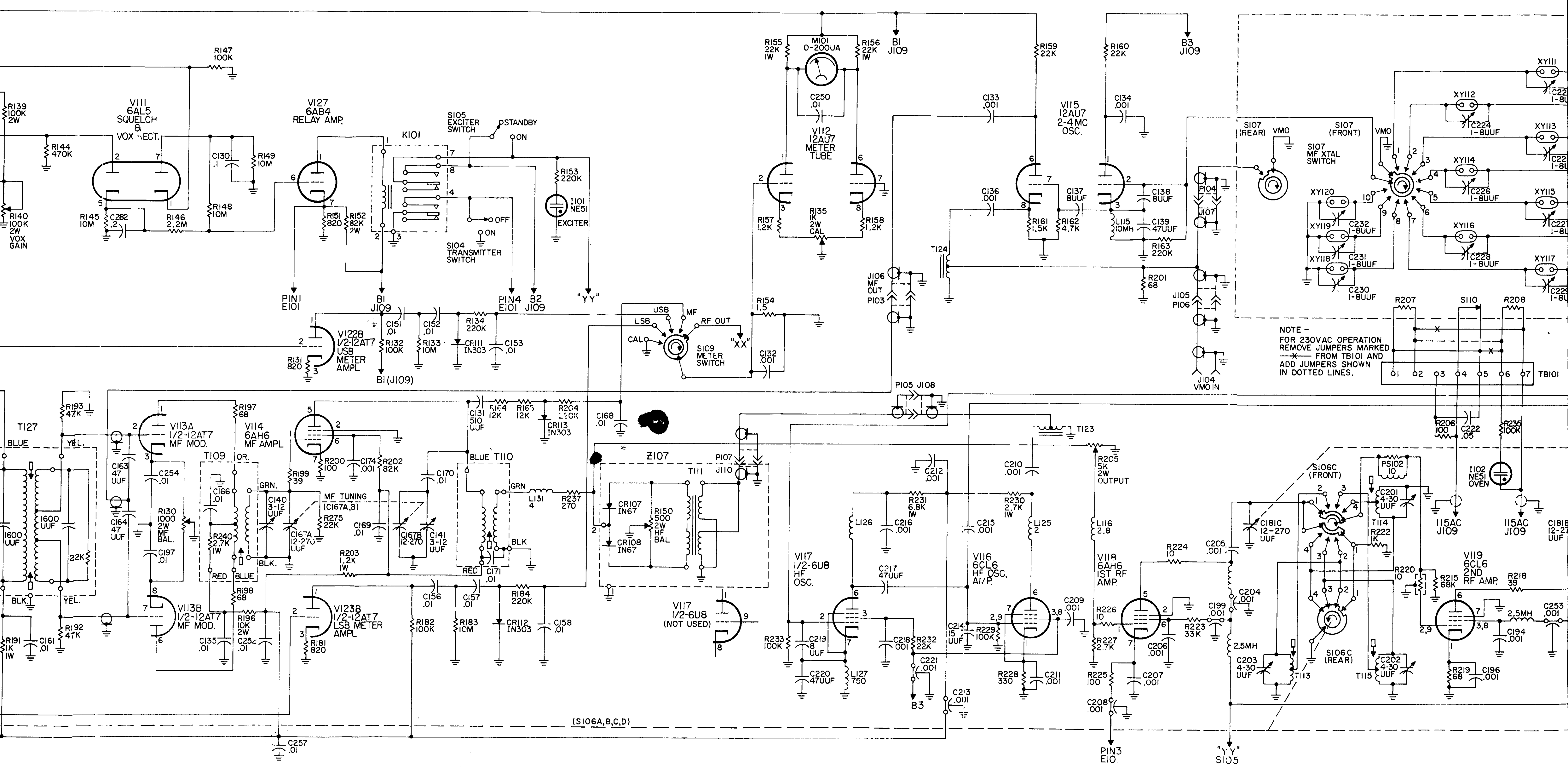
MISSING SYMBOLS			
C101 THRU C115, C119, C129, C142 THRU C150, C154, C155, C159, C160, C165, C172, C195, C255, C258, C259, C260	J	R185 THRU R190, R194, R195, R221 R234, R236, R268 THRU R272	XY109, XY111
	K		
	L117 THRU L124, L128, L132, L133	S101, S102	Y109, Y110
	M	T105 THRU T108	
CR101, THRU CR106, CR109, CR110		TB	
	PS	V102, V103, V104, V107, V108, V109	Z101 THRU Z106, Z109
E	R106, R107, R109 THRU R119, R121, R122, R123, R140, R171 THRU R180		
I			

S106A,B,C,D POSITIONS	
POS.	BAND (MCS)
1	2 - 4
2	4 - 8
3	8 - 16
4	16 - 32

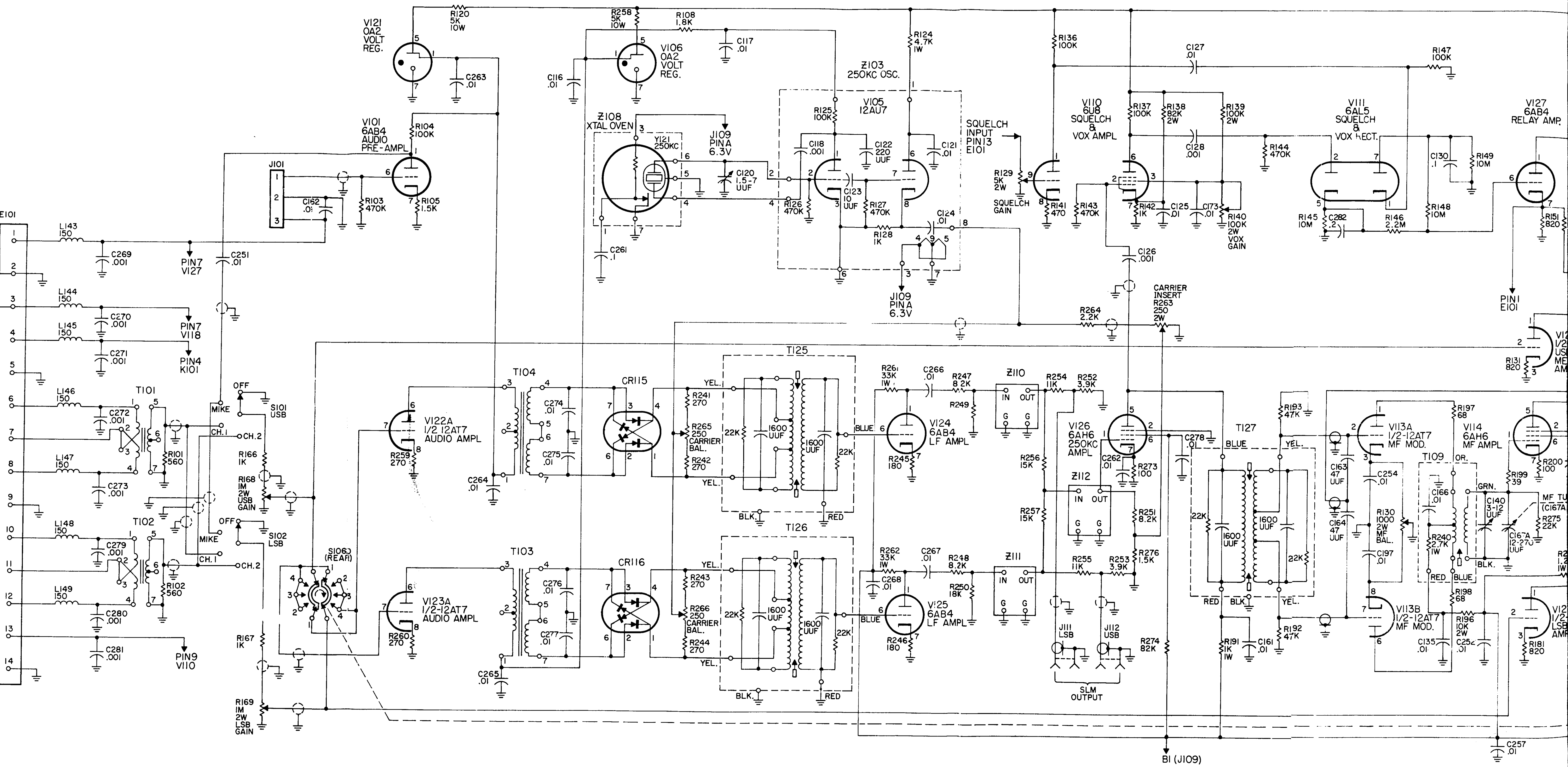
UNLESS OTHERWISE SPECIFIED

1- ALL RESISTORS ARE 1/2 WATT. K=1000 M=MILLION
2- ALL CAPACITORS ARE IN MICROFARADS.
3- ALL COILS ARE IN MICROHENRIES. MH= MILLIHENRIES
4- ALL ROTARY SWITCHES ARE SHOWN IN POSITION 1.

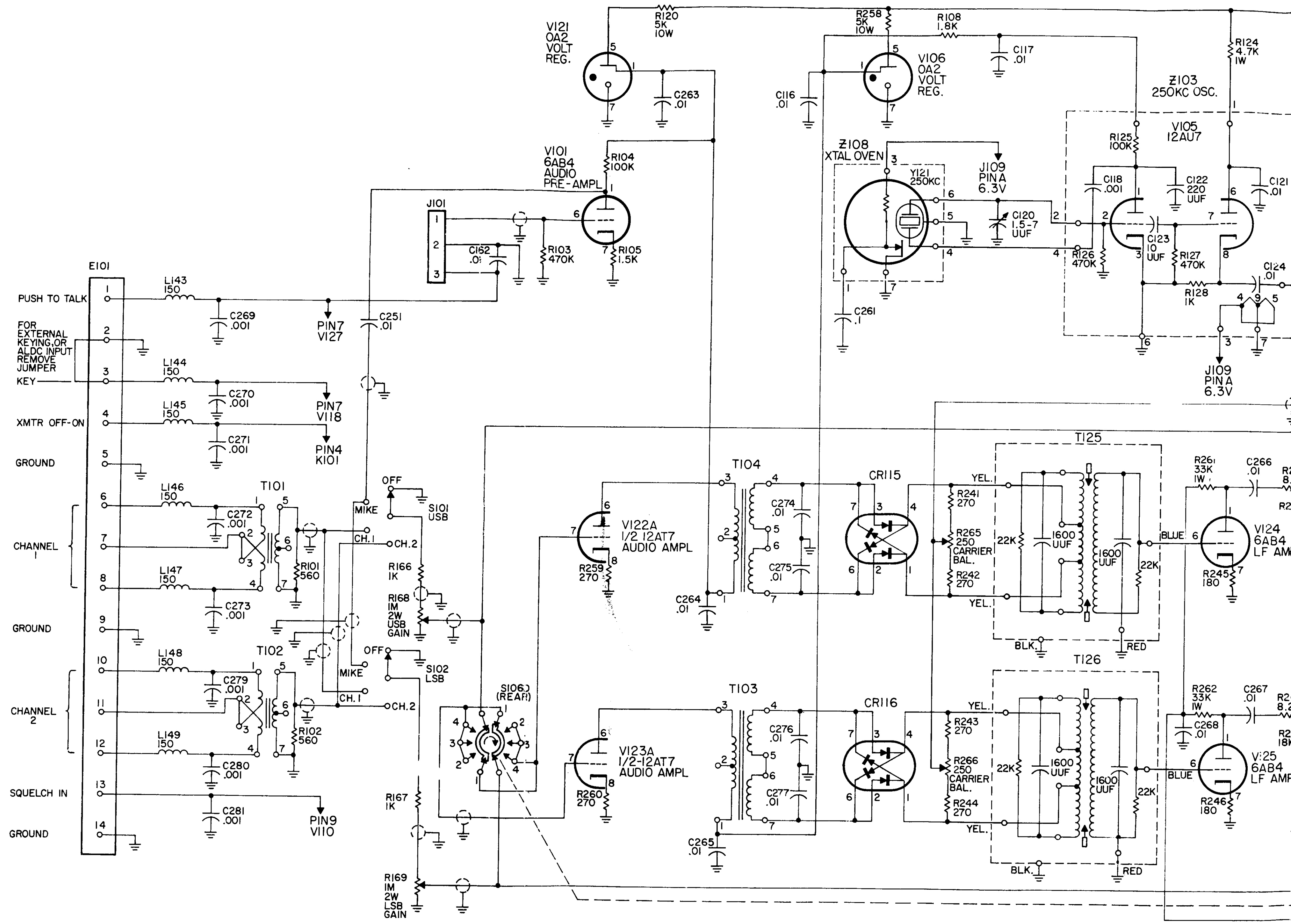
Figure 8-1. Schematic Diagram, SBE-3 and Power Supply (Sheet 1 of 2)



V111 6AL5 SQUELCH & VOX RECT.
V127 6AB4 RELAY AMP.
K101
S105 EXCITER SWITCH
STANDBY
ON
OFF
S104 TRANSMITTER SWITCH
I101 NE51 EXCITER
PIN1 E101
B1 J109
PIN4 E101
B2 J109
"YY"
V122B 1/2-12AT7 USB METER AMPL
B1 (J109)
M101 0-200UA
V112 12AU7 METER TUBE
R135 1K 2W CAL
USB
MF
RF OUT
LSB
CAL
S109 METER SWITCH
"XX"
V115 12AU7 2-4MC OSC.
B3 J109
T124
J106 MF OUT P103
J105 P106
J104 VMO IN
S107 (REAR)
VMO
S107 (FRONT)
S107 MF XTAL SWITCH
NOTE - FOR 230VAC OPERATION REMOVE JUMPERS MARKED —X— FROM TB101 AND ADD JUMPERS SHOWN IN DOTTED LINES.
TB101
T127
V113A 1/2-12AT7 MF MOD.
V113B 1/2-12AT7 MF MOD.
T109
R130 1000 2W MF BAL.
V114 6AH6 MF AMPL
MF TUNING (C167A,B)
T110
V123B 1/2-12AT7 LSB METER AMPL
Z107
T111
R150 500 2W HF BAL
V117 1/2-6U8 (NOT USED)
P105 J108
P107 J110
V117 1/2-6U8 HF OSC.
V116 6CL6 HF OSC. A/P.
T123
R205 5K 2W OUTPUT
V118 6AH6 1ST RF AMP
PIN3 E101
"YY" S105
S106C (FRONT)
S106C (REAR)
T113
T114
T115
I102 NE51 OVEN
115AC J109
V119 6CL6 2ND RF AMP.
(S106A,B,C,D)



V121 0A2 VOLT REG.
V106 0A2 VOLT REG.
V101 6AB4 AUDIO PRE-AMPL
Z108 XTAL OVEN
Y121 250KC
J109 PIN A 6.3V
Z103 250KC OSC.
V105 12AU7
SQUELCH INPUT PIN13 E101
R129 5K 2W SQUELCH GAIN
V110 6U8 SQUELCH & VOX AMPL
V111 6AL5 SQUELCH & VOX RECT.
V127 6AB4 RELAY AMP.
R140 100K 2W VOX GAIN
PIN1 E101
J101
E101
PIN7 V127
PIN7 V118
PIN4 K101
PIN9 V110
T101
T102
S101 USB
S102 LSB
R168 1M 2W USB GAIN
R169 1M 2W LSB GAIN
S106 (REAR)
V122A 1/2 12AT7 AUDIO AMPL
V123A 1/2-12AT7 AUDIO AMPL
T104
T103
CR115
CR116
R265 250 CARRIER BAL.
R266 250 CARRIER BAL.
T125
T126
V124 6AB4 LF AMPL
V125 6AB4 LF AMPL
CARRIER INSERT R263 250 2W
Z110
Z111
Z112
V126 6AH6 250KC AMPL
J111 LSB
J112 USB
SLM OUTPUT
T127
V113A 1/2-12AT7 MF MOD.
V113B 1/2-12AT7 MF MOD.
R130 1000 2W MF BAL.
T109
V114 6AH6 MF AMPL
B1 (J109)


E101
PUSH TO TALK
FOR EXTERNAL KEYING,OR ALDC INPUT REMOVE JUMPER
KEY
XMTR OFF-ON
GROUND
CHANNEL 1
GROUND
CHANNEL 2
SQUELCH IN
GROUND
L143 150
L144 150
L145 150
L146 150
L147 150
L148 150
L149 150
C269 .001
C270 .001
C271 .001
C272 .001
C273 .001
C279 .001
C280 .001
C281 .001
PIN7 V127
PIN7 V118
PIN4 K101
PIN9 V110
T101
T102
R101 560
R102 560
C251 .01
MIKE
CH.1
CH.2
OFF
S101 USB
S102 LSB
R166 1K
R167 1K
R168 1M 2W USB GAIN
R169 1M 2W LSB GAIN
S106 (REAR)
J101
C162 .01
R103 470K
R105 1.5K
R104 100K
V101 6AB4 AUDIO PRE-AMPL
V121 OA2 VOLT REG.
R120 5K 10W
C263 .01
V122A 1/2-12AT7 AUDIO AMPL
V123A 1/2-12AT7 AUDIO AMPL
R259 270
R260 270
C264 .01
C265 .01
T104
T103
C274 .01
C275 .01
C276 .01
C277 .01
CR115
CR116
R241 270
R242 270
R243 270
R244 270
R265 250 CARRIER BAL.
R266 250 CARRIER BAL.
YEL.
BLK.
RED
BLUE
T125
T126
22K
1600 UUF
R261 33K 1W
R262 33K 1W
C266 .01
C267 .01
C268 .01
V124 6AB4
V125 6AB4
R245 180
R246 180
R258 5K 10W
R108 1.8K
C116 .01
C117 .01
V106 OA2 VOLT REG.
Z108 XTAL OVEN
Y121 250KC
C261 .1
J109 PIN A 6.3V
C120 1.5-7 UUF
Z103 250KC OSC.
V105 12AU7
R124 4.7K 1W
R125 100K
R126 470K
R127 470K
R128 1K
C118 .001
C121 .01
C122 220 UUF
C123 10 UUF
C124 .01

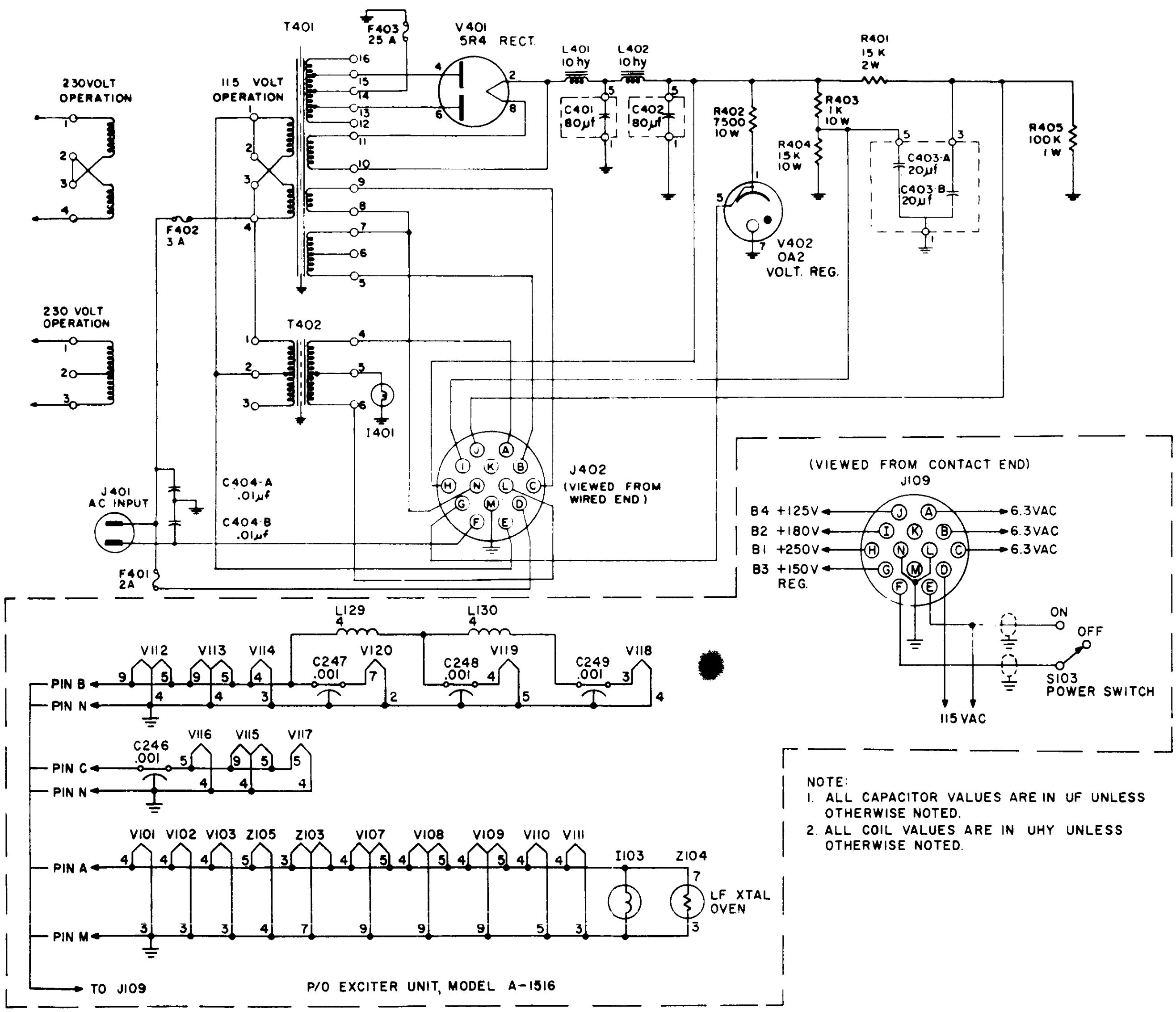
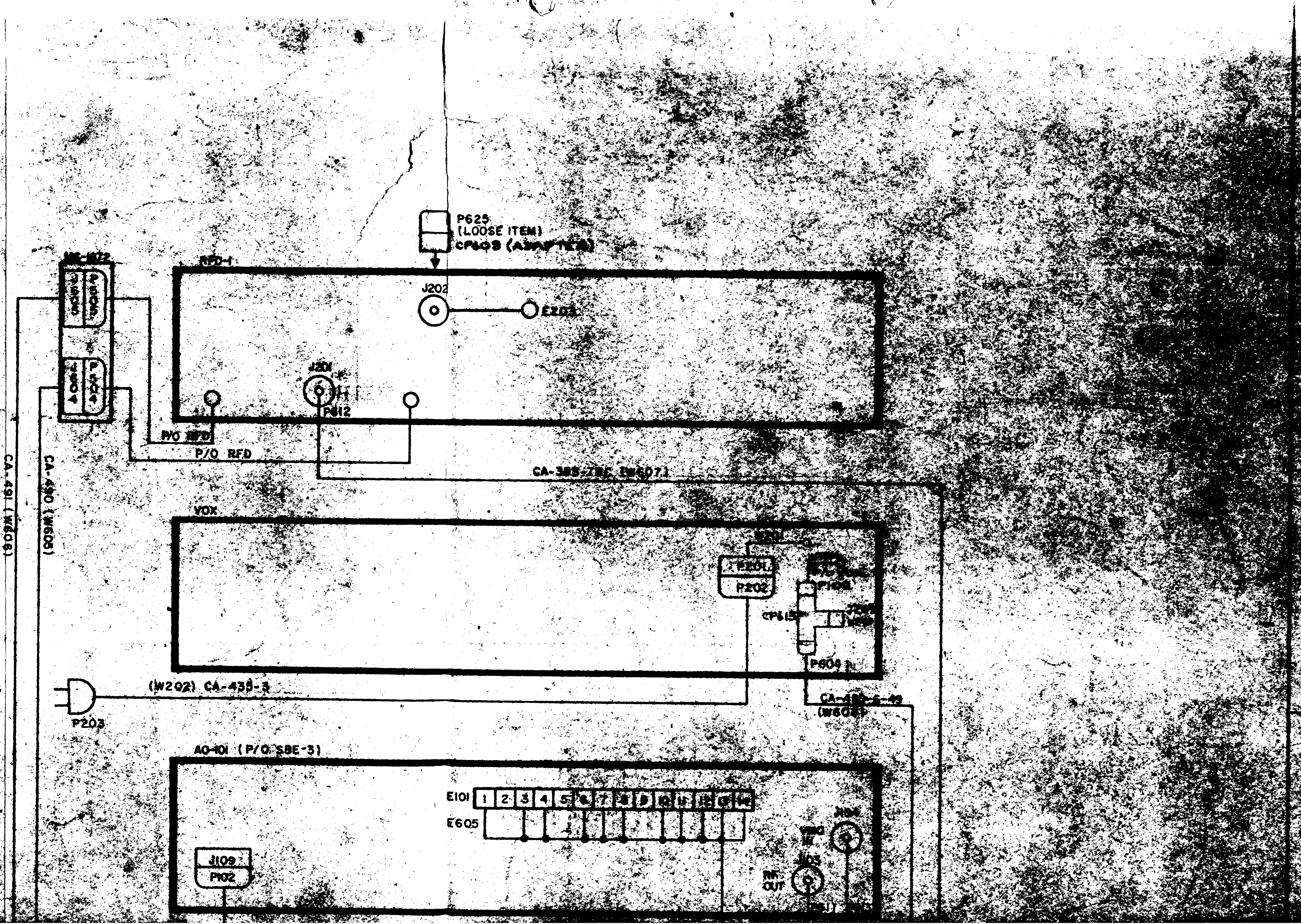
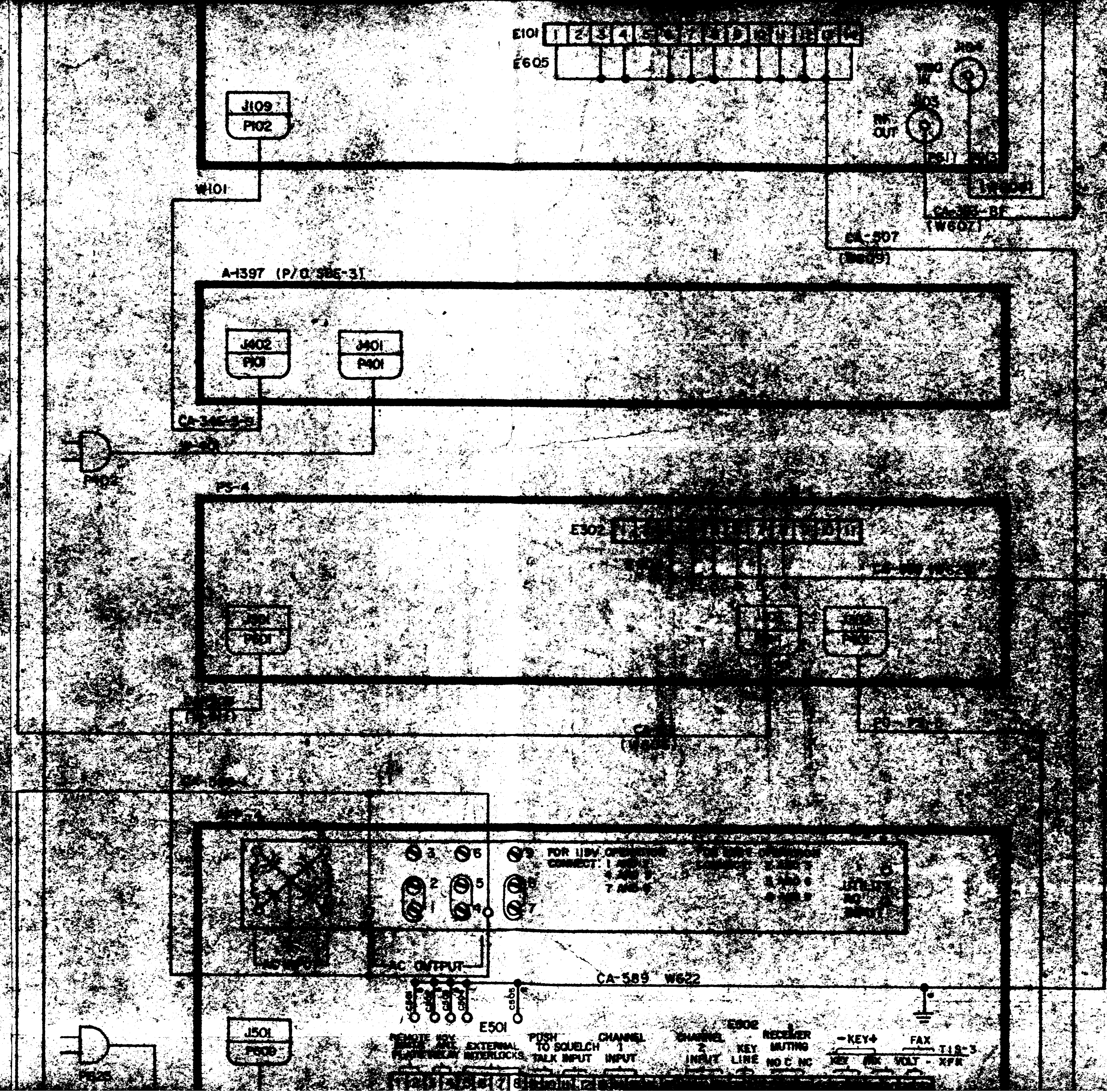
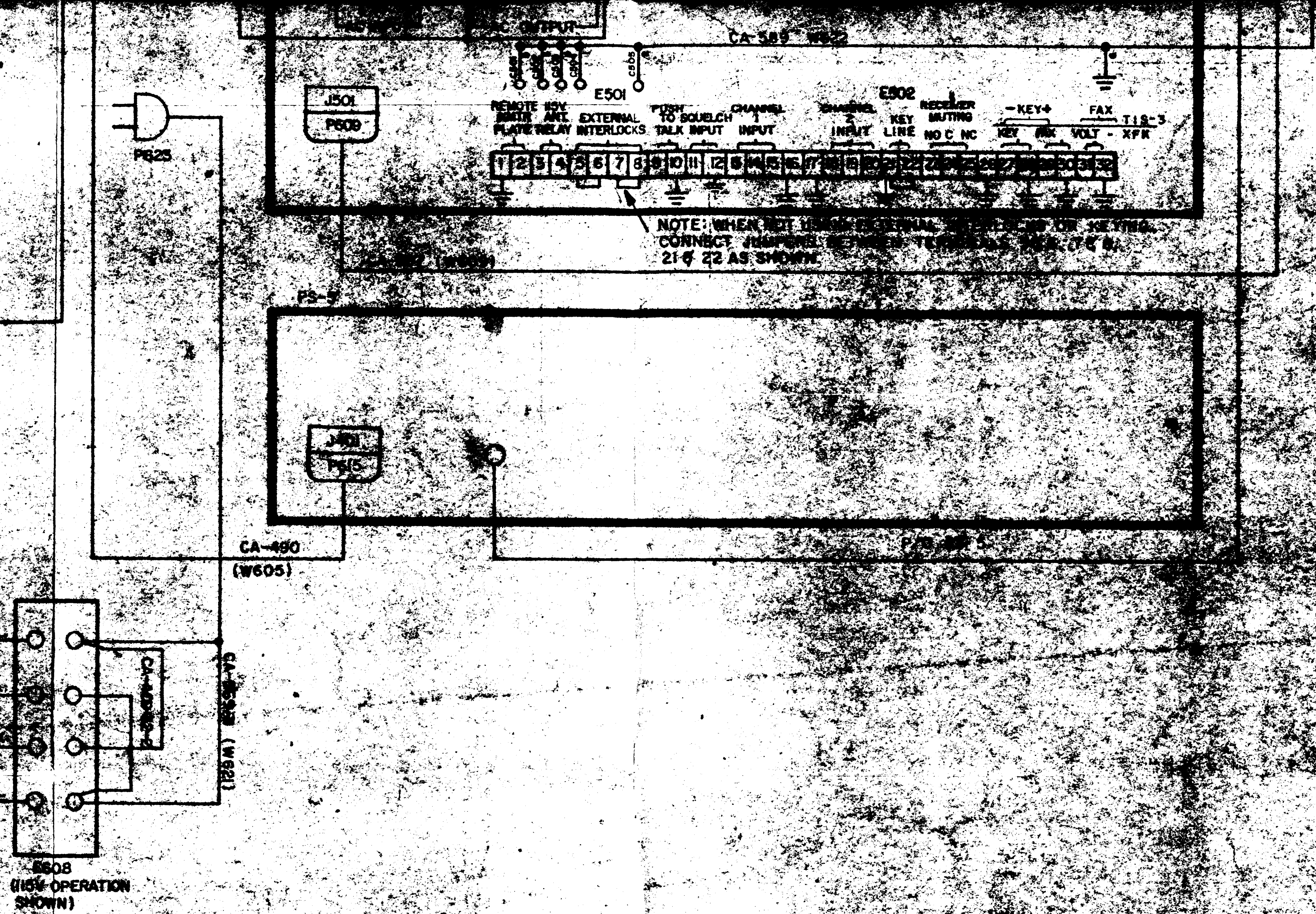


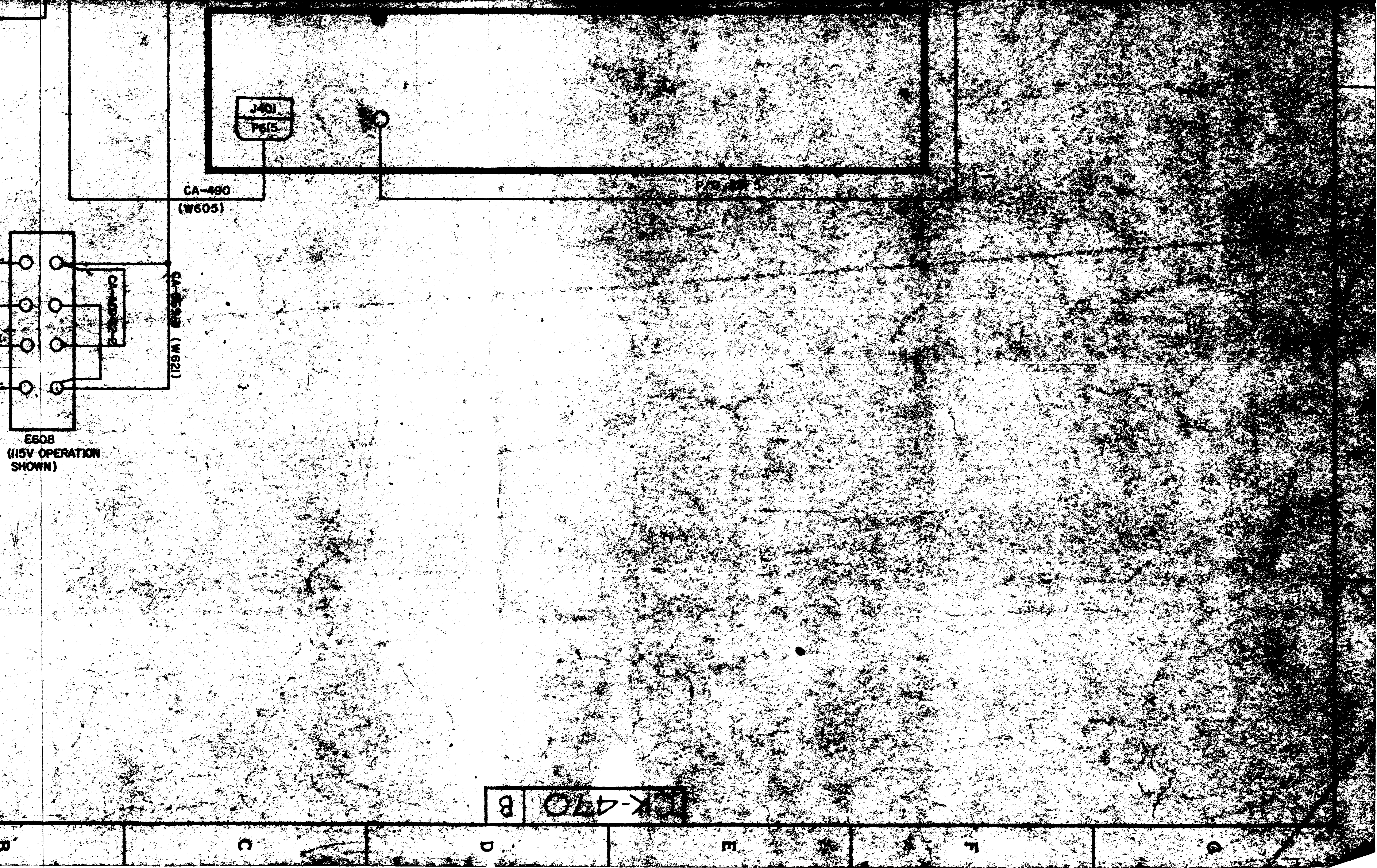
Figure 8-1. Schematic Diagram, SBE-3 and Power Supply (Sheet 2 of 2)


P625
(LOOSE ITEM)
RFD-1
J202
E203
J201
P612
P/O RFD
P/O RFD
VOX
P202
P604
(W202) CA-435-3
P203
AO-101 (P/O SBE-3)
E101
E605
J109
P102
CA-490 (W605)
CA-491 (W606)

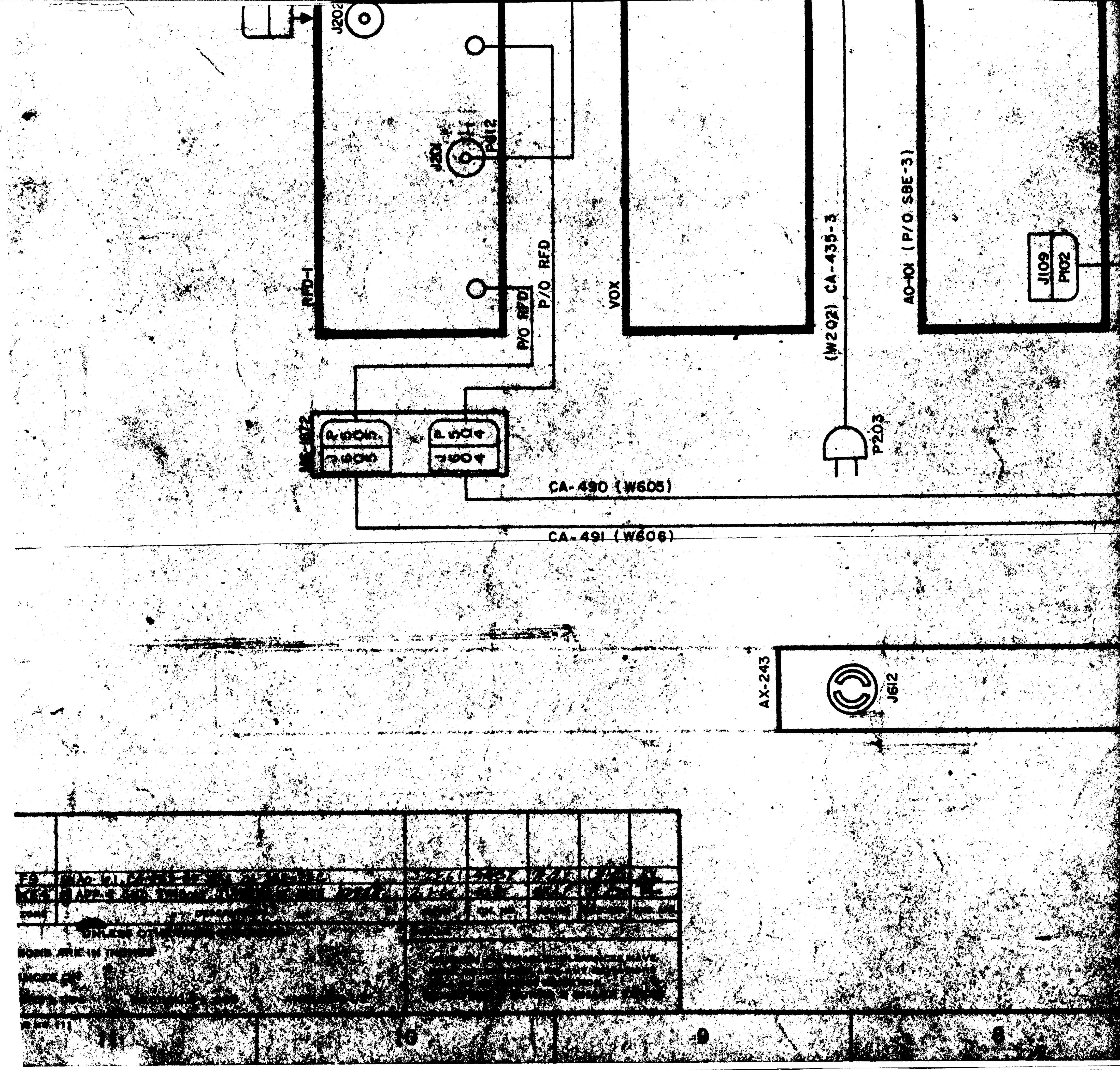


E101
E605
J109
P102
W101
INF. OUT
CA-3?? -BF
(W607)
CA-307
A-1397 (P/O 3B6-3)
J402
P101
J401
P401
PS-4
E302
FOR 115V OPERATION CONNECT 1 AND 3
4 AND 6
7 AND 9
AC OUTPUT
CA-589 W622
E501
J501
REMOTE
EXTERNAL INTERLOCKS
PUSH TO TALK
SQUELCH INPUT
CHANNEL 1 INPUT
CHANNEL 2 INPUT
KEY LINE
E502
RECEIVER MUTING
NO C NC
-KEY+
FAX
VOLT - XFR
TIS-3

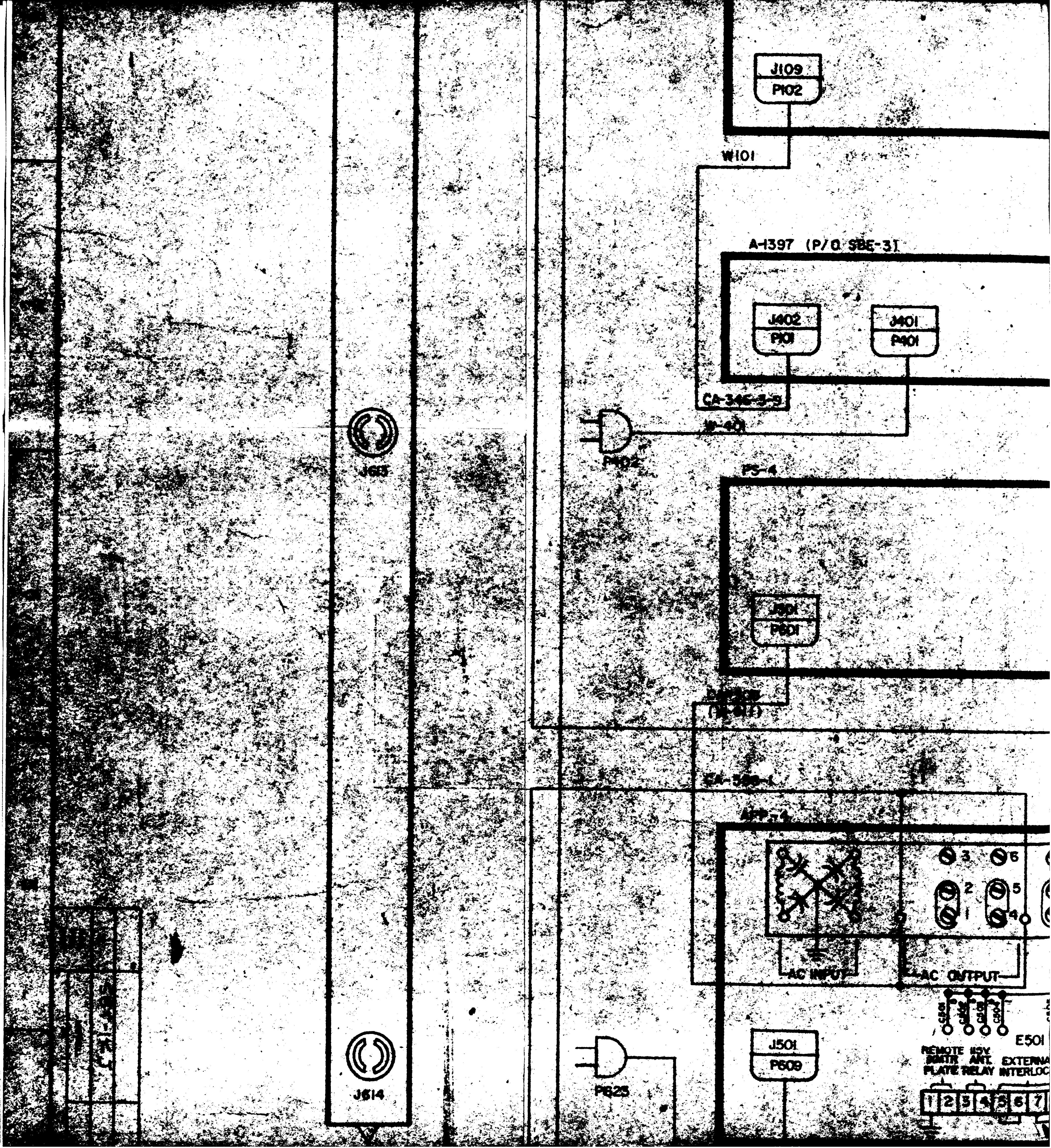

OUTPUT
CA-589
E501
E502
J501
P609
P625
REMOTE PLATE
115V ANT. RELAY
EXTERNAL INTERLOCKS
PUSH TO TALK
SQUELCH INPUT
CHANNEL 1 INPUT
KEY LINE
RECEIVER MUTING
NO C NC
-KEY+
FAX
VOLT - XFK
TIS-3
NOTE: WHEN NOT USING EXTERNAL INTERLOCKS OR KEYING CONNECT JUMPERS BETWEEN TERMINALS 7 & 8, 21 & 22 AS SHOWN.
PS-5
CA-490
(W605)
(W621)
E608
(115V OPERATION SHOWN)



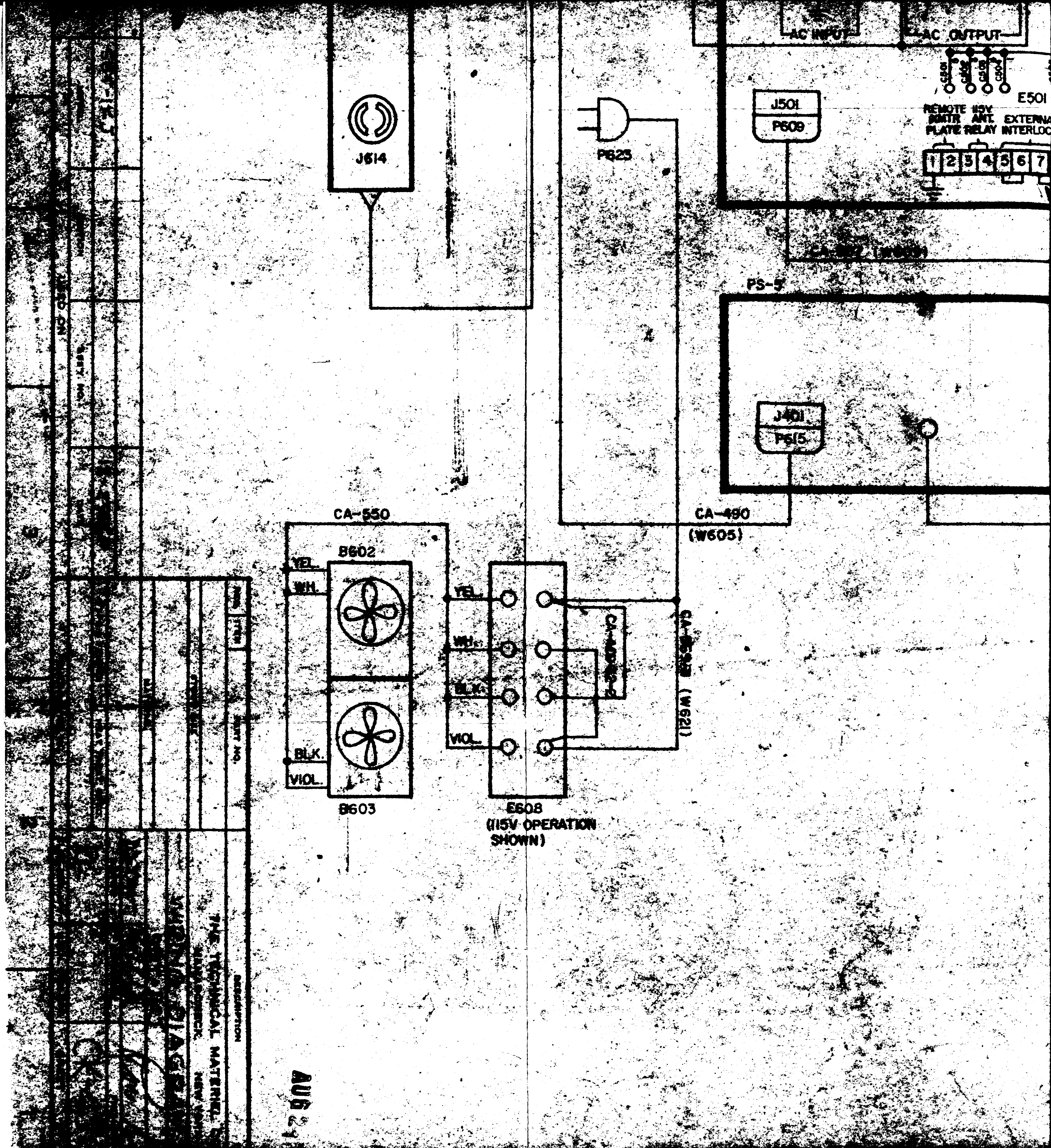
J401
P615
CA-480
(W605)
(W621)
E608
(115V OPERATION
SHOWN)
B
C
D
E
F
G

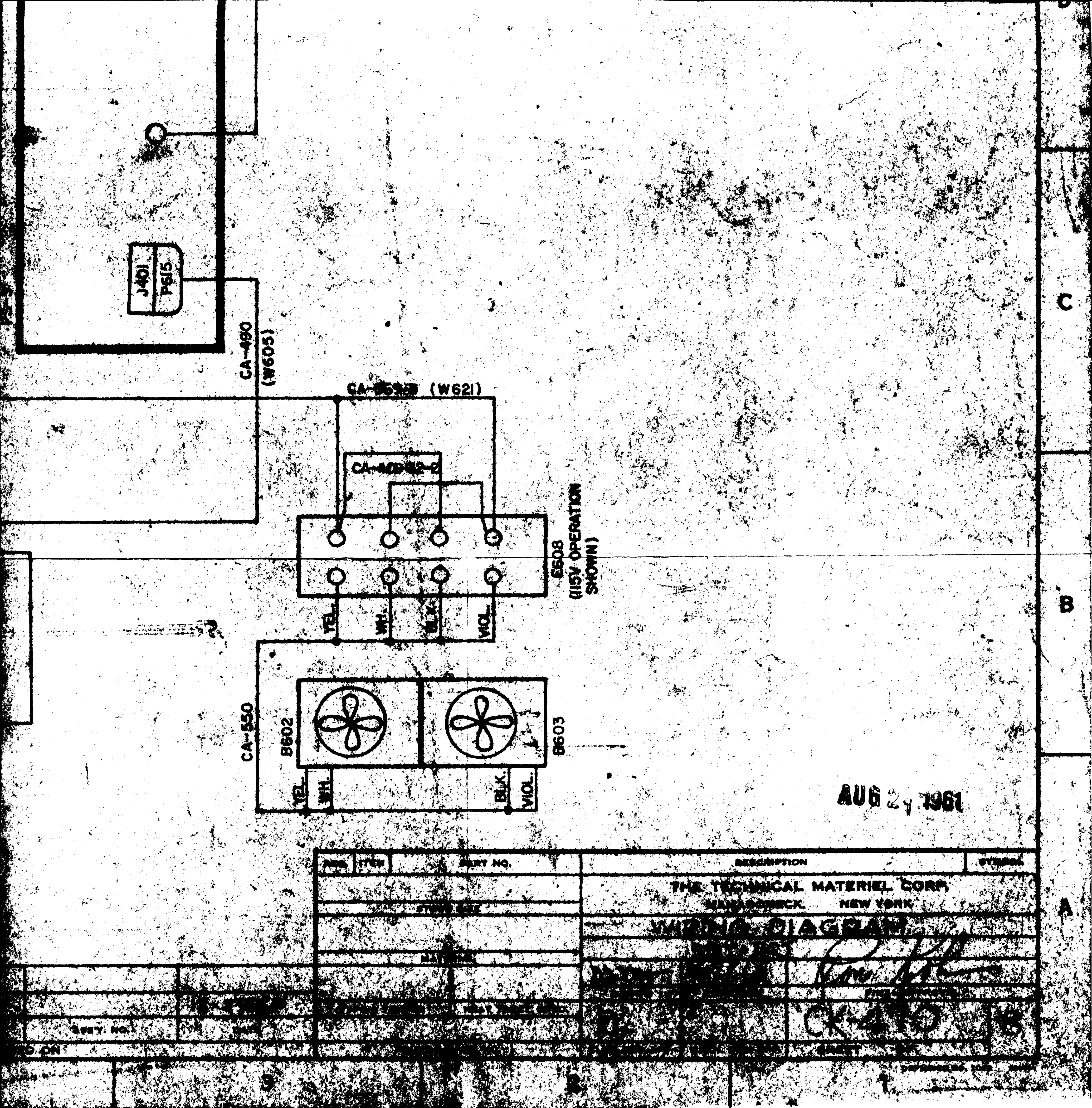


J202
J201
P612
RFD-1
P/O RFD
P/O RFD
VOX
(W202) CA-435-3
P203
AO-101 (P/O SBE-3)
J109
P102
P504
J504
P503
J503
CA-490 (W605)
CA-491 (W606)
AX-243
J612



J109
P102
W101
A-1397 (P/O SBE-3)
J402
P101
J401
P401
CA-346-5-5
P402
PS-4
J601
P601
APP-4
AC INPUT
AC OUTPUT
E501
REMOTE PWR PLATE
RCV. ANT. RELAY
EXTERNAL INTERLOCK
1 2 3 4 5 6 7
J501
P609
P625
J613
J614


AC INPUT
AC OUTPUT
E501
REMOTE XMTR PLATE
115V ANT. RELAY
EXTERNA INTERLOC
1 2 3 4 5 6 7
J501
P609
J614
P625
PS-5
J401
P615
CA-490
(W605)
CA-550
B602
B603
YEL.
WH.
BLK.
VIOL.
(W621)
E608
(115V OPERATION SHOWN)
DESCRIPTION
THE TECHNICAL MATERIEL
NEW YORK
PART NO.
USED ON
AUG 2



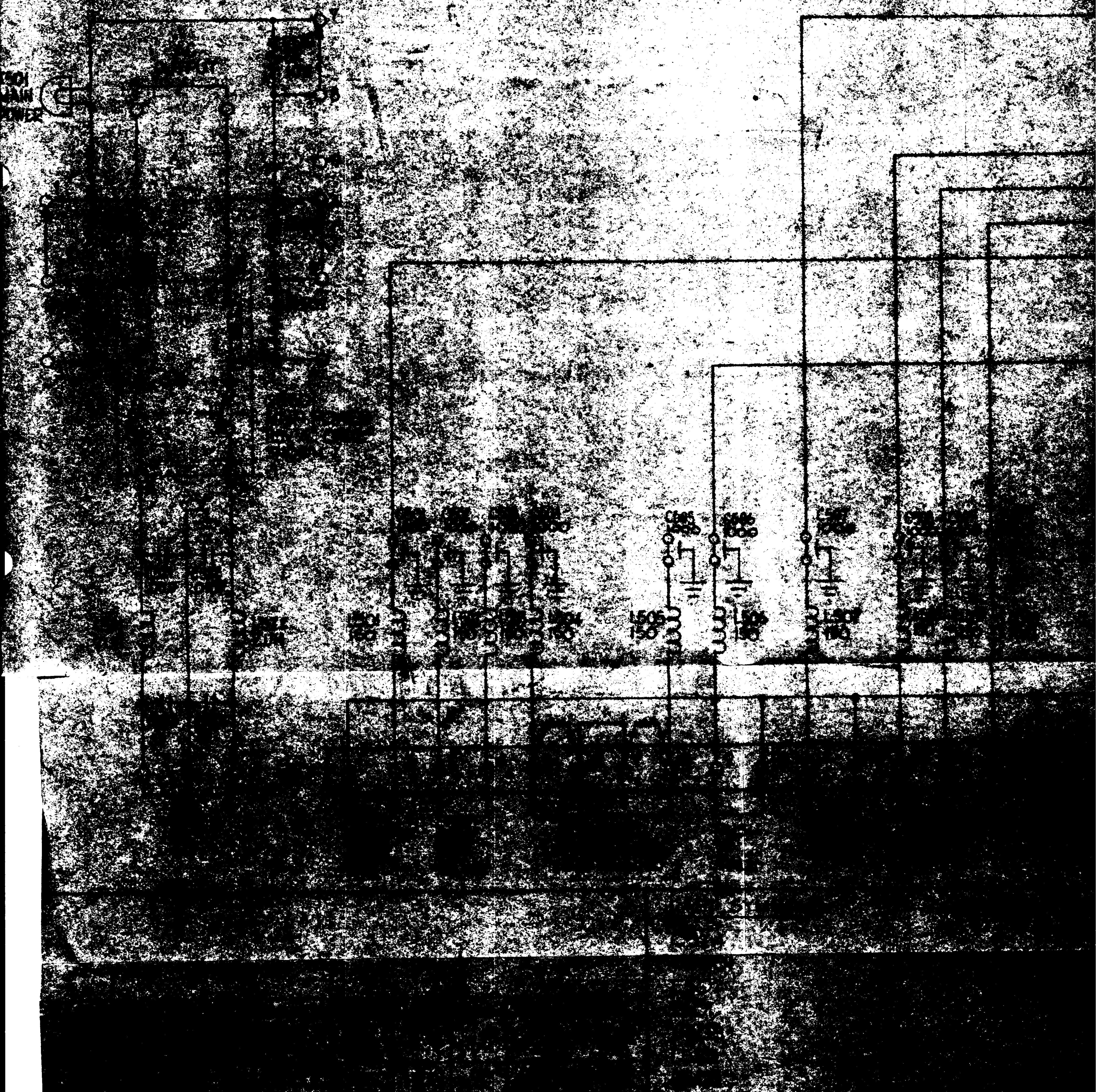
J401
P615
CA-490
(W605)
(W621)
E608
(115V OPERATION SHOWN)
YEL.
WH.
BLK.
VIOL.
CA-550
B602
B603
AUG 2, 1961
THE TECHNICAL MATERIEL CORP.
NEW YORK
WIRING DIAGRAM
C
B
A

[illegible]

REMOVE STRAP MARKED [illegible] FROM TERMINAL 1 AND ATTACH TO TERMINAL 3.

[illegible] 4 [illegible] 6.

[illegible] 7 [illegible] 9.



NOTE [illegible]

STRAPS MARKED [illegible]