MASTER COPY

DO NOT DESTROY

TECHNICAL MANUAL

for

SPEECH PROCESSING UNIT MODEL SPU-2

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

TECHNICAL MANUAL

for

SPEECH PROCESSING UNIT MODEL SPU-2

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

IN-2026A Issue Date: 1 March 1963

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

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

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

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

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

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

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

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

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

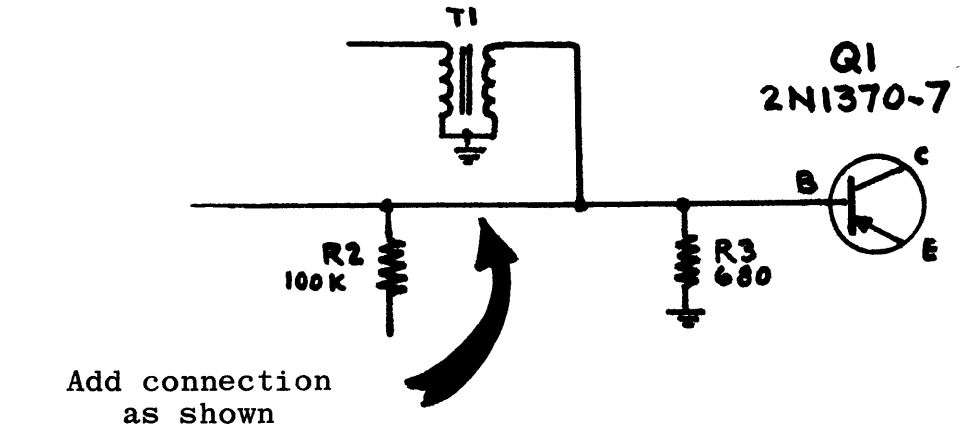
CHANGE NO. 1 SPU-2 (Sh. 1 of 3)

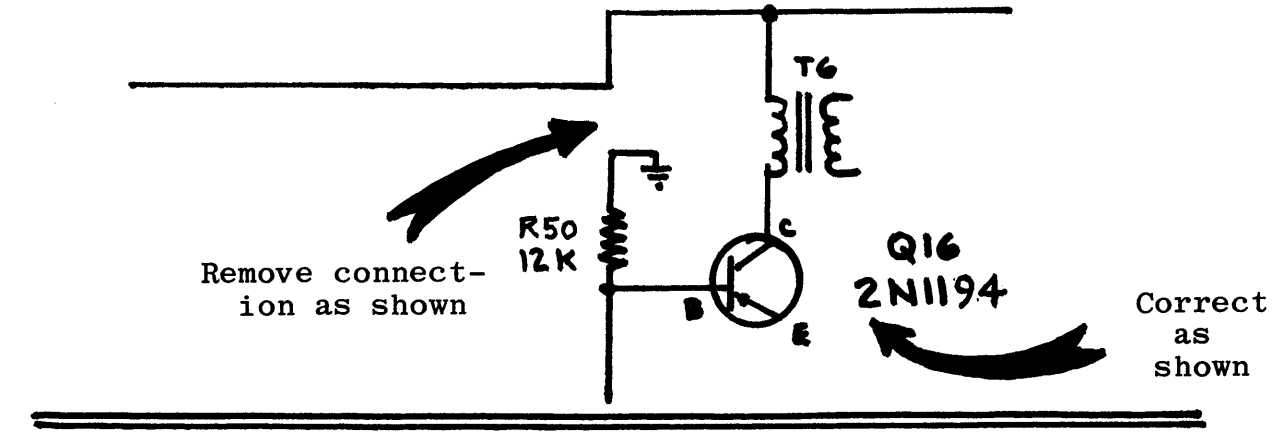
INSTRUCTION BOOK CHANGE NOTICE

Date April 24, 1964

Manual affected: Speech Processing Unit, Model SPU-2 IN -2026A

The following corrections are to be incorporated on the schematic diagram, figure 8-1 and applicable simplified schematics in Section 4.





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

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

Attn.: Director of Eng. Services.

CHANGE NO. 1 SPU-2 (Sh. 2 of 3)

INSTRUCTION BOOK CHANGE NOTICE

Date April 24, 1964

Manual affected: Speech Processing Unit, Model SPU-2 IN -2026A

The following corrections are to be incorporated in Section 7, Parts List, schematic diagram figure 8-1 and applicable simplified schematics in Section 4.

(1) C4 - Delete, Not Used.

(2) C7 - Use description and part no. of C4 for C7. (CE-105-30-15)

(3) C8 - Change to read: Same as C7.

(4) C23 - Change to read: 2000 uuf, 25 wvdc, polarized. TMC Part No. CE-115-5

(5) C24 - Use description and part no. of previous C23. (CE-105-100-25)

(6) C43 - Change to read: TMC Part No. CM15B390K.

(7) C51 - Delete, Not Used.

(8) C55 - Add to parts list: Same as C2.

(9) Q6 - Change to read: TRANSISTOR, germanium; junction type contacts; PNP configurations; ratings at VCB 25; PT 0.15; wire lead type terminals; hermetically sealed metal case, .370" x .375" overall dimensions. TMC Part No. 2N1194.

(10) Q7 - Change to read: TMC Part No. 2N1190.

(11) Q9 - Change to read: Same as Q1.

(12) Q16 - Change to read: Same as Q6.

(13) R6 - Change to read: 330 ohms, TMC Part no. RC20GF331J.

(14) R7 - Change to read: 22,000 ohms, TMC Part no. RC20GF223J.

(15) R8 - Change to read: TMC Part no. RV4ATRD103C.

(16) R11 - Change to read: Same as R7.

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

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

Attn.: Director of Eng. Services.

CHANGE NO. 1 SPU-2 (Sh. 3 of 3)

INSTRUCTION BOOK CHANGE NOTICE

Date April 24, 1964

Manual affected: Speech Processing Unit, Model SPU-2 IN -2026A

(17) R18 - Change to read: Same as R7.

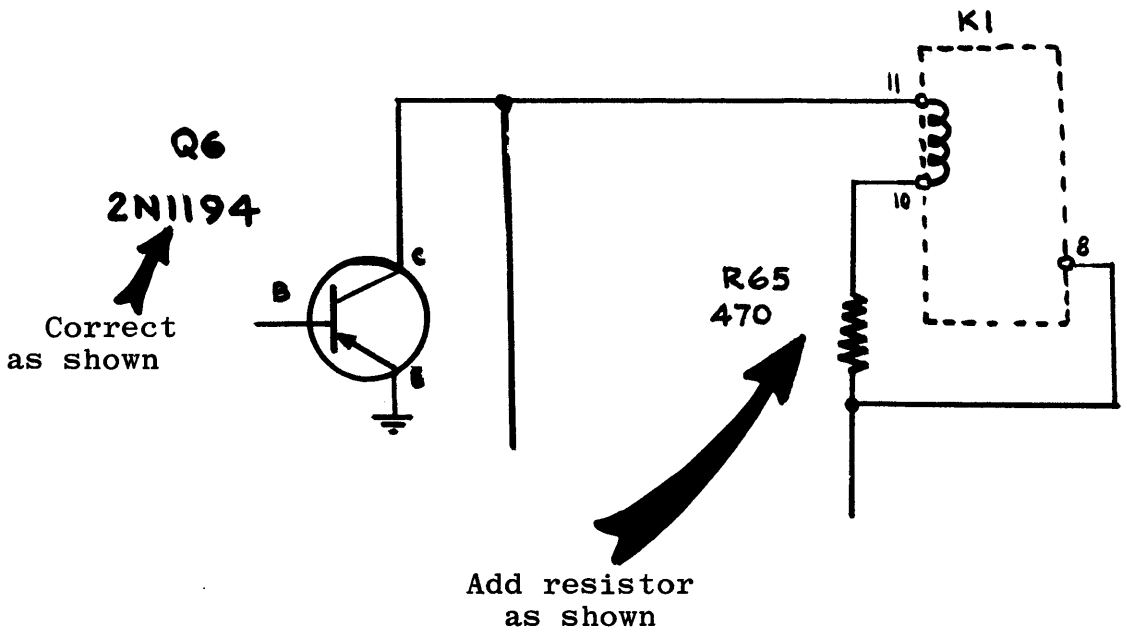
(18) R26 - Change to read: RESISTOR, FIXED, COMPOSITION; 2200 ohms,+5%, 1/2 watt TMC Part No. RC20GF222J.

(19) R27 - Change to read: Same as R7.

(20) R61 - Change to read: Same as R60.

(21) R64 - Add to parts list: RESISTOR, FIXED, COMPOSITIONS; 1800 ohms, +10%, 1/2 watt. TMC Part No. RC20GF182K.

(22) R65 - Add to parts list: RESISTOR, FIXED, COMPOSITION; 470 ohms, +10%, 1/2 watt. TMC Part No. RC20GF471K.



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

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

Attn.: Director of Eng. Services.

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

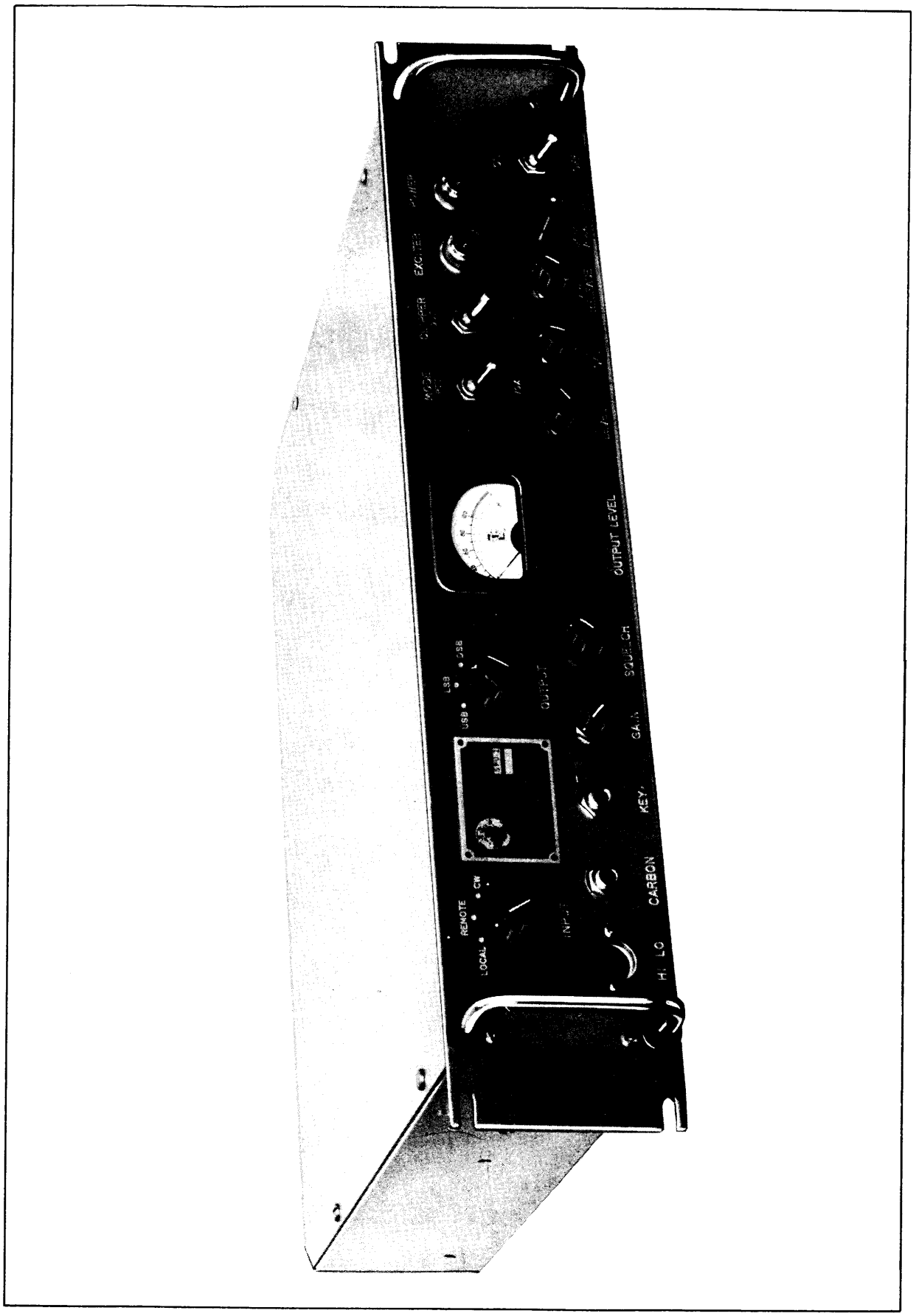


Figure 1-1. Speech Processing Unit, Model SPU-2, Front Angle View

SECTION 1
GENERAL DESCRIPTION

1-1. PHYSICAL DESCRIPTION

The Speech Processing Unit, Model SPU-2 (figure 1-1) is designed to be mounted on a standard 19-inch wide relay rack. The physical dimensions are given in paragraph 1-3. Dust covers are provided for the top and bottom of the unit. All switches, controls, and meters necessary for operation of the SPU-2 are readily accessible on the front panel.

1-2. FUNCTIONAL DESCRIPTION

The SPU-2 is a completely transistorized, volume compressed, peak clipped and filtered, low distortion audio amplifier. This unit is flat within ±1.5 db from 200 to 3000 cycles with a 30 db per octave roll-off above 3000 cps.

The SPU-2 may be used as a constant level audio amplifier for transmission or reception, with a 40 db dynamic range to prevent overloading transmitters or "singing" through voice hybrids.

When the SPU-2 is used for transmitting applications, a speech clipper and pre-emphasis circuit, with a 6 db per octave slope peaked at 2500 cps, may be switched in to increase system efficiency by providing uniform power density in the transmitted intelligence.

Front panel SQUELCH, VOX GAIN and VOX RELEASE controls allow flexibility in adjustment of the voice operated relay circuit to compensate for ambient noise, voice input level and VOX (VOICE operated exciter) decay rate.

1-3. TECHNICAL SPECIFICATIONS OF SPU-2

INPUTS:	Audio line 0 dbm, ±20 dbm, 600 ohm balanced and center tapped.
	Carbon microphone at -25 db. Carbon mike input to either Western Electric type 309 ring-tip sleeve plug (or equivalent) or six-connector microphone jack. (Rear apron connections also provided.)
	High and low impedance microphones at -55 db. Six-connector input jack. (Rear apron connections also provided.)
	Anti-VOX input.
	Push-to-talk keying input. (Rear apron connections also provided.)
	CW key input. Western Electric, type 309, or equivalent, jack with normally closed contacts. (Rear apron output connections provided.)
PRE-EMPHASIS:	Provides a 6 db per octave slope peaked at 2500 cps.
CLIPPING:	Nominal 12 db.
AUDIO OUTPUT:	Upper sideband - 0 db, 600 ohm balanced and center tapped.
	Lower sideband - 0 db, 600 ohm balanced and center tapped (same intelligence as above selectable by front panel switch).
DISTORTION:	Nominal 5%. (white noise)
KEYING CONTROL: (DRY CONTACT)	From voice-operated relay.
	From push-to-talk input.
	From CW key inputs.
KEYING RELAY:	The keying relay provides either normally-open or normally-closed contacts that may be used to mute a receiver when the transmitter is keyed.
DYNAMIC RANGE:	The unit incorporates automatic audio level control circuitry to maintain the output within ±2 db with input variations of 40 db. The speed of response for increasing audio levels is at syllabic rate (approximately 7 cps.)
FREQUENCY RESPONSE:	±1.5 db 200-3000 cycles, roll-off 30 db per octave above 3000 cps.
HUM LEVEL:	-40 db minimum.
METERING:	Output level on 600 ohm line.
POWER REQUIREMENTS:	115/230 volts AC, 50/60 cps, 1 phase, 7 watts.
MOUNTING:	Standard 19" relay rack.
SIZE:	3-12/" x 19" x 15".
WEIGHT:	8 lbs.
LOOSE ITEMS:	Mating plugs for all signal connections and instruction books provided.
COMPONENT AND CONSTRUCTION:	All equipment manufactured in accordance with JAN/MIL specifications wherever practicable.

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION

Each Speech Processing Unit, Model SPU-2 has been calibrated and tested at the factory before shipment. Upon arrival at the operating site, inspect the packing case and its contents immediately for possible equipment 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 to the equipment, caused during shipment, the Technical Materiel Corporation will assist in describing and providing for repair or replacement of damaged items.

2-2. POWER SUPPLY INPUT VOLTAGE CONNECTIONS

The SPU-2 power supply is designed for 105- to 250-volt, 50- or 60-cps input power. It is factory wired for 115-volt AC operation. Provision has been made to accept a variety of voltage inputs. The SPU-2 power supply, with the proper wiring change, can operate with a 105-, 115-, or 125-volt AC or a 210-, 230-, or 250-volt AC input. The necessary wiring changes are shown in figure 2-1. The 1/4-ampere fuse should be replaced with a 1/8-ampere fuse for 210- to 250-volt operation.

2-3. MECHANICAL INSTALLATION

The SPU-2 is equipped with a standard 19-inch rack panel for mounting in any suitable equipment rack. It is also supplied with top and bottom dust covers. Refer to figure 2-2 for outline dimensional measurements.

2-4. ELECTRICAL INSTALLATION

Power is applied to the SPU-2 immediately upon connection of the line cord to a suitable power source and setting the POWER switch to the ON position. The SPU-2 is factory wired for 115 volts, 60 cps. Refer to figure 2-1 for conversion to 230 volts.

Figure 2-3 illustrates the interconnections, input connections, and output connections for the SPU-2.

2-5. INITIAL ADJUSTMENT

Before any SPU-2 unit is shipped, it is thoroughly checked against the manufacturers specifications. Therefore, no initial adjustments are necessary other than the SQUELCH control adjustment and those listed in the operation chart, table 3-2.

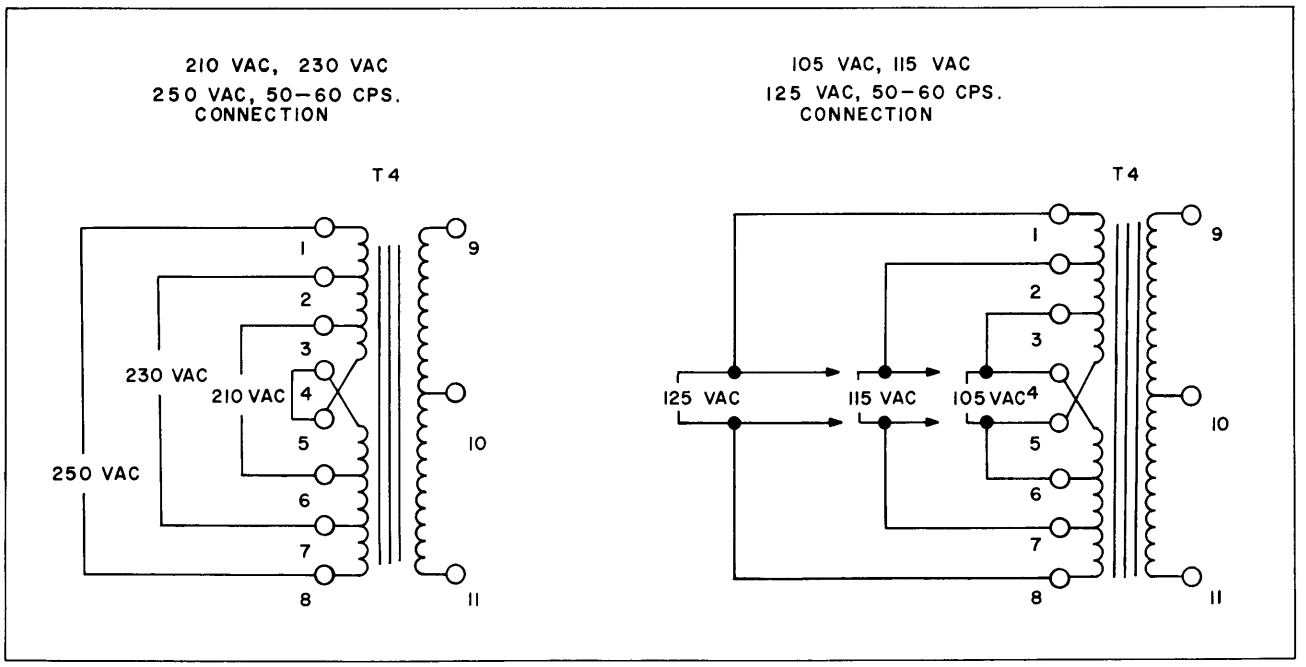


Figure 2-1. Installation Diagram Showing 115-Volt Vs. 230-Volt Power Supply Connections

a. SQUELCH CONNECTION

For squelch operation, connect the squelch input terminals, pins 10 and 11 of terminal board E1, to a 4-, 8, or 16-ohm receiver voice coil or output transformer. If this arrangement is not available, connection to a 600-ohm audio output with attenuation so as not to exceed 10 volts RMS may be used. Exceeding this limit may cause possible failure of the squelch input capacitor. As an aid in determining proper input voltage to the squelch circuit, use the formula shown:

$$E = \sqrt{PR}$$

b. SQUELCH CONTROL ADJUSTMENT

1. Place MODE switch in the VOX position.

2. With a mike connected to the SPU-2, connect the audio output from a receiver into pin 10 and 11 (squelch input) of terminal board E1 at rear of panel. (Refer to paragraph 2-5a.)

3. Adjust receiver to obtain a normal level of voice from receiver loudspeaker. Note that the EXCITER indicator lamp is now illuminated by the loudspeaker voice output.

4. Advance the SQUELCH control slowly until the EXCITER indicator lamp extinguishes.

5. While the receiver is on, talk normally into the mike. Your voice should make the EXCITER indicator lamp illuminate.

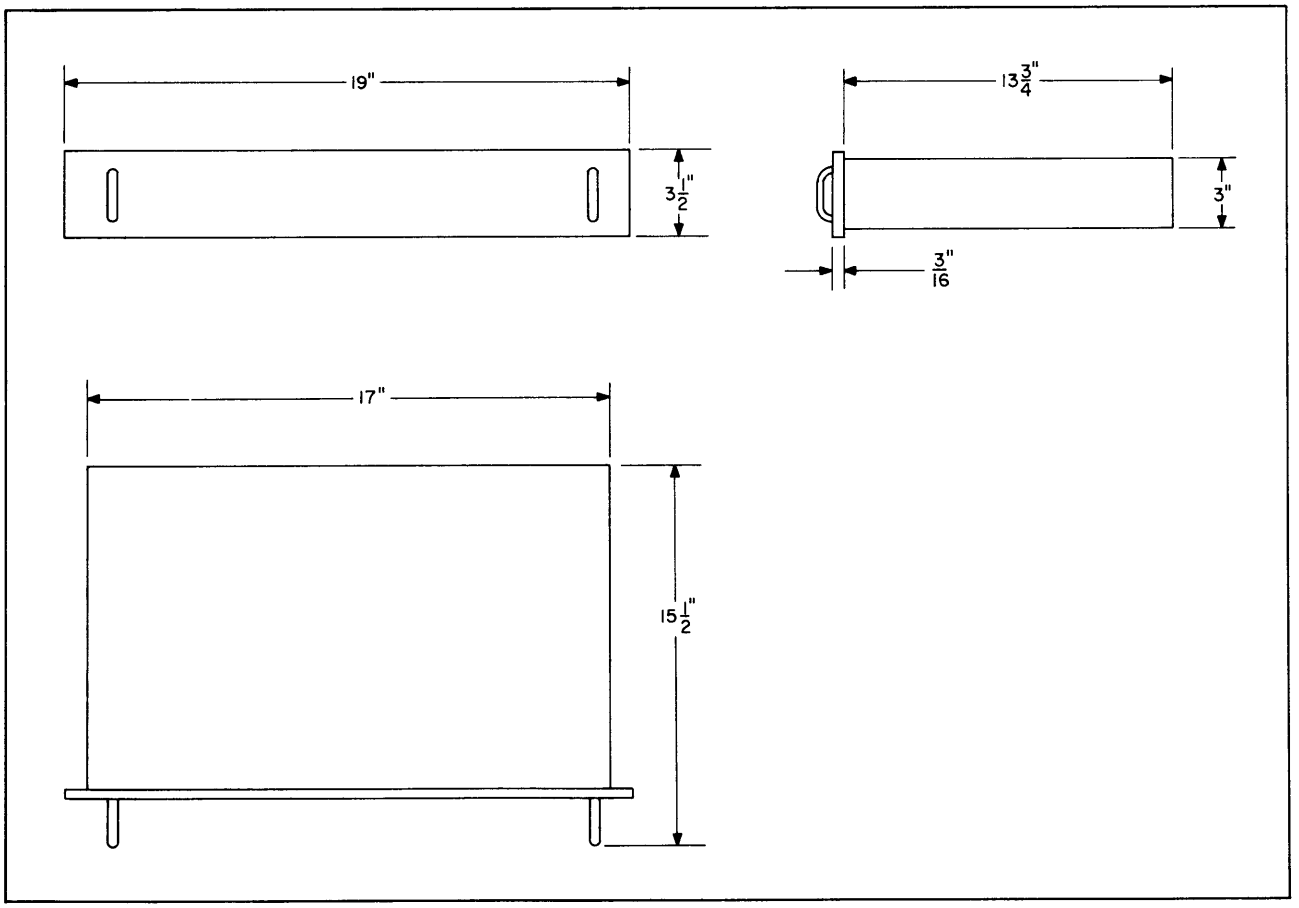


Figure 2-2. Outline Dimensional Drawing, SPU-2

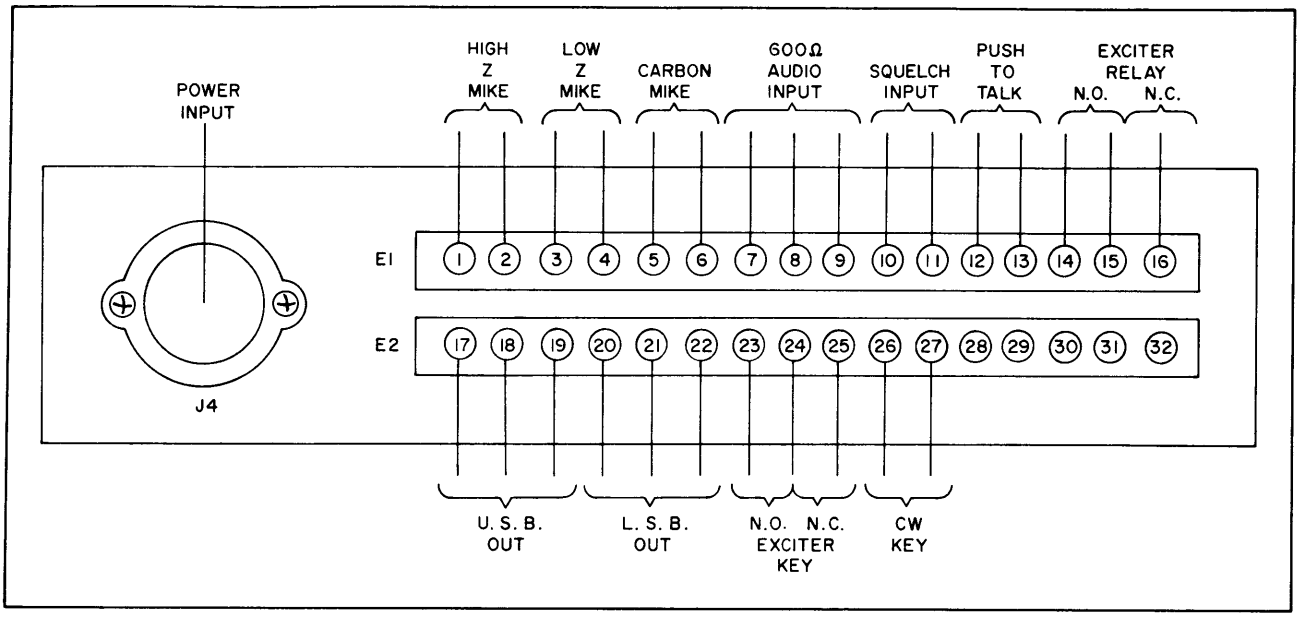


Figure 2-3. Interconnection Diagram, SPU-2

SECTION 3
OPERATOR'S SECTION

3-1. GENERAL

Operation of the Speech Processing Unit, Model SPU-2 has been designed for a high degree of simplicity and versatility. The front panel controls allow complete flexibility for the voice operated relay control, push-to-talk control and CW control of transmitters. Speech clipping and pre-emphasis may also be switched in to provide uniform power density in the transmitted intelligence. (See paragraph 3-2.)

By referring to the operation chart, table 3-2, the operator can easily set the panel controls to the proper positions for any desired mode of operation.

3-2. OPERATOR'S INSTRUCTIONS

When the INPUT switch S1 is set to the LOCAL or REMOTE position, speech processing may be desired to increase the voice power level to the transmitter. This is accomplished by setting the CLIPPER switch S2 to the IN position, thus connecting the signal to the input of a pre-emphasis network. When the signal is fed to the pre-emphasis network, the low level high frequencies are enhanced, 6 db per octave, peaked at 2500 cps. The signal is then fed through a speech clipping network where it is clipped (a nominal 12 db) to a uniform power level.

When the SPU-2 is used with the output of a receiver, speech processing may not be desired. Therefore, the CLIPPER switch S2 may be set to the IN or OUT position as desired.

Table 3-1 provides equivalent control designations for the operating controls shown in figure 3-1. Table 3-2 is an operating chart to be used in conjunction with figure 3-1 and table 3-1.

3-3. OPERATOR'S MAINTENANCE

The operator should note the general settings of panel switches and controls, cleanliness of the unit, and proper connection of all interconnecting cables and plugs.

TABLE 3-1. TABLE OF EQUIVALENT CONTROL DESIGNATIONS

SERIAL DESIGNATION	PANEL DESIGNATION	COMPONENT REFERENCE DESIGNATION NO.
1	INPUT-LOCAL-REMOTE-CW selector knob control	S1
2	OUTPUT selector knob control	S3
3	OUTPUT LEVEL meter	M1
4	MODE toggle switch	S4
5	CLIPPER IN-OUT toggle switch	S2
6	EXCITER red indicator lamp	DS-1
7	POWER green indicator lamp	DS-2
8	HI LO mike jack	J1
9	CARBON mike jack	J2
10	KEY jack	J3
11	GAIN knob control	R8
12	SQUELCH knob control	R15
13	LINE LEVEL knob control	R48
14	VOX GAIN knob control	R13
15	VOX RELEASE knob control	R20
16	FUSE: 1/4 amp. 115 V 1/8 amp. 230 V	F1
17	POWER ON-OFF toggle switch	S5

TABLE 3-2. SPU-2 OPERATION CHART

STEP	CONTROL	OPERATION	PURPOSE
1	INPUT knob control (1)	LOCAL	Mike input operation
		REMOTE	600-ohm line input operation
		CW	CW key operation
2	OUTPUT knob control (2)	USB	Upper side band operation
		LSB	Lower side band operation
		DSB	Double side band operation
3	MODE toggle switch (4)	VOX	Voice operated excitation
		PUSH-TO-TALK	Mike push-to-talk button operation, VOX circuitry bypassed
4	CLIPPER toggle switch (5)	IN	Pre-emphasis and speech clipper circuits operative
		OUT	Pre-emphasis and speech clipper circuits bypassed
5	GAIN knob control (1)	Desired position	Clockwise rotation for maximum gain
6	SQUELCH knob control (12)	Desired position	Prevents local receiver from exciting the K1 exciter relay when in VOX operation
7	LINE LEVEL knob control (13)	Desired position	Clockwise rotation for maximum output level
8	VOX GAIN knob control (14)	Desired position	Clockwise rotation for maximum VOX gain
9	VOX RELEASE knob control (15)	Desired position	Clockwise rotation for maximum VOX decay rate
10	POWER toggle switch (17)	ON	Introduces power, permitting SPU-2 operation
		OFF	Removes power, disabling SPU-2 operation

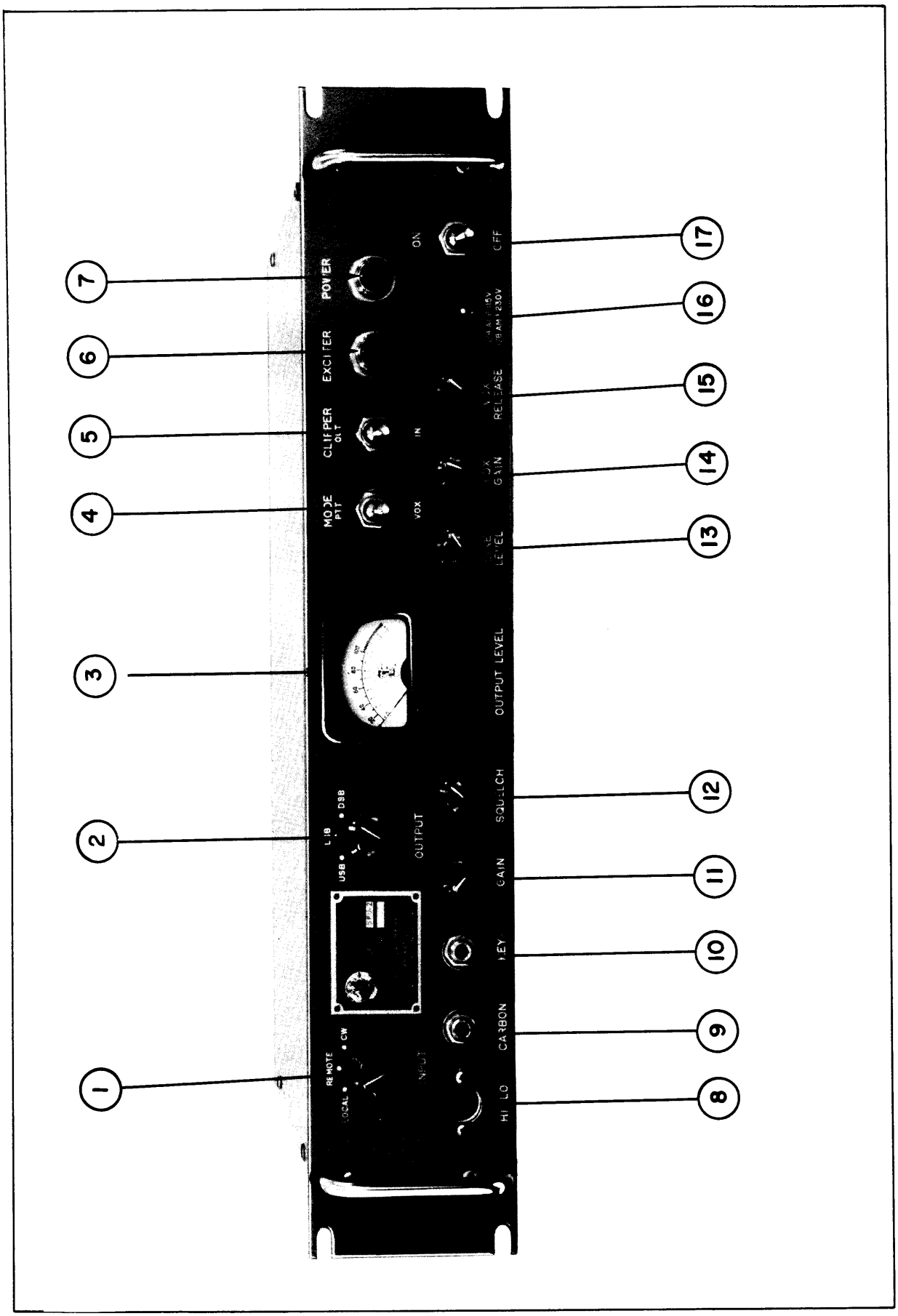


Figure 3-1. Panel View of SPU-2, Showing Operating Controls

SECTION 4
PRINCIPLES OF OPERATION

4-1. INTRODUCTION

The following text covers the principles of operation of the Speech Processing Unit, Model SPU-2. A brief description of circuitry operation is given, supported by a simplified block diagram, figure 4-1 and simplified schematic diagrams, figures 4-2 through 4-6.

4-2. BLOCK DIAGRAM DESCRIPTION OF SPU-2

As illustrated in the simplified block diagram, figure 4-1, the low or high impedance mike input signal is fed to the input of a preamplifier stage Q1. This amplified output is then coupled to an emitter follower amplifier stage, Q2, and on to a push-pull amplifier stage comprised of Q7 and Q8. The output of Q7 and Q8 is further amplified by Q9 and Q10 amplifier stages. The amplified output is then coupled to the AVC stages Q11 and Q12, Q13 and Q14, which act as temperature compensators, and supply AVC voltage and base current to the push-pull amplifier stage Q7 and Q8.

The emitter follower amplifier Q2 is also coupled to the input of the squelch controlled VOX circuits, Q3 through Q6, which in turn, activate the exciter relay K1.

The amplified output of Q10 is also fed to the CLIPPER switch S2. When S2 is in the OUT position, the signal is fed to the input of an emitter follower stage Q15. This output is then coupled to a low frequency bandpass filter Z1 and on to a power amplifier stage, Q16. This final amplified output is then fed to a level meter M1, for front panel monitoring and to the OUTPUT selector switch S3, for selection of USB, LSB or DSB output operation.

When the CLIPPER switch S2 is in the IN position, the output from Q10 is fed through a pre-emphasis and speech clipping network and then to the emitter follower stage Q15.

When the MODE switch S4 is set to the PUSH-TO-TALK position, the carbon mike or push-to-talk signal bypasses the VOX circuits activating the exciter relay K1.

Refer to paragraph 4-3 for a more detailed circuit description.

4-3. DETAILED CIRCUIT DESCRIPTION OF SPU-2

When the INPUT switch S1 is set to the LOCAL (mike input) position, the input signal is coupled through an impedance matching transformer T1 (for a high impedance mike input) or directly coupled (for a low impedance mike input) to the base of a preamplifier stage Q1. (See figure 4-2.)

The preamplifier output is then coupled through the INPUT switch S1 and the GAIN control R8 to the base of an emitter follower amplifier stage Q2. The output of Q2 is then coupled from the emitter to the input of the VOX stages comprised, of Q3, Q4, Q5, Q6, and exciter relay K1. The VOX circuits also include an anti-VOX or squelch circuit which can be controlled by a front panel SQUELCH control R15. VOX GAIN, R13, and VOX RELEASE, R20, controls are also available for front panel operation. (See figure 4-3.)

The emitter follower Q2 output is also coupled to an AGC controlled push-pull amplifier stage comprised of Q7 and Q8. The output signal is further amplified by amplifier stages Q9 and Q10. The amplified signal is then coupled to an AGC network comprised of Q11, Q12, Q13, and Q14. The two final AGC stages, Q13 and Q14, act as temperature compensating circuits and provide base current for the push-pull amplifier stages Q7 and Q8. (See figure 4-4.)

The amplified output from Q10 is also coupled to the CLIPPER switch S2. When the CLIPPER switch is set to the IN position, the signal is fed to a pre-emphasis network, C19 and R36, and through a speech clipper network comprised of CR8, CR9, CR10, CR11 and their associated components. This provides a 6 db per octave slope peaked at 2500 cps, thus providing a uniform power density output.

The clipped output is then coupled to emitter follower stage Q15. This output is then coupled to a low frequency bandpass filter, Z1, and through the LINE LEVEL control R48 to the input of a power amplifier, Q16. The amplified output signal is then coupled to the output LEVEL meter M1, and to the OUTPUT switch S3 for either USB, LSB or DSB selection. (See figure 4-5.)

When the CLIPPER switch S2 is in the OUT position, the pre-emphasis and speech clipper networks are bypassed.

When the INPUT switch S1 is set to the REMOTE position, the 600-ohm audio input terminals are connected to the input of the emitter follower stage Q2.

When the INPUT switch S1 is set to the CW position, the CW jack J3 is introduced into operation and the keying relay K1 is activated.

When the MODE switch S4 is set to the PUSH-TO-TALK position, the VOX circuit is disabled, allowing the exciter relay K1 to be excited by the push-to-talk button on the mike or by an externally connected push-to-talk button connected to the terminal board terminals.

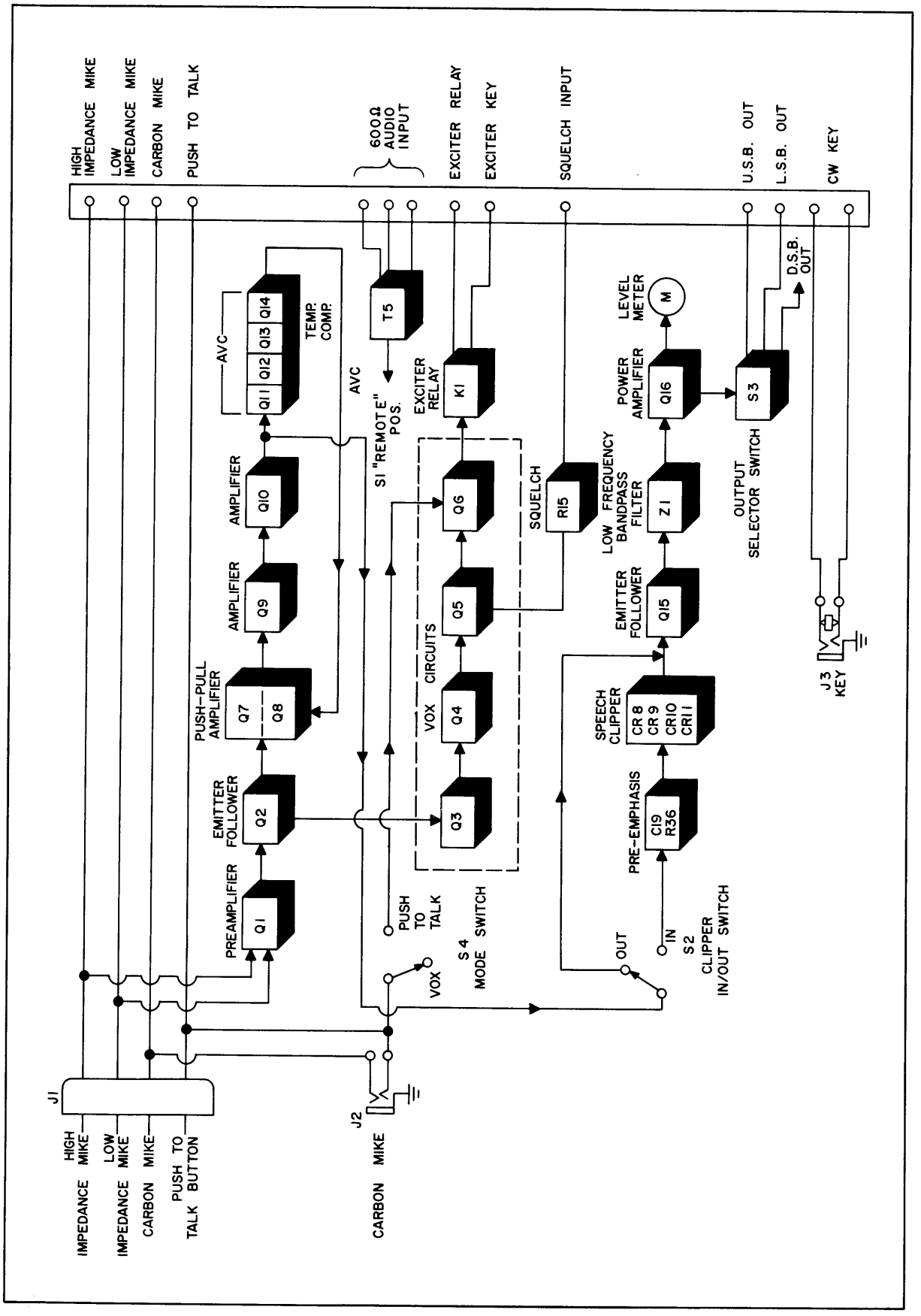


Figure 4-1. Simplified Block Diagram, SPU-2

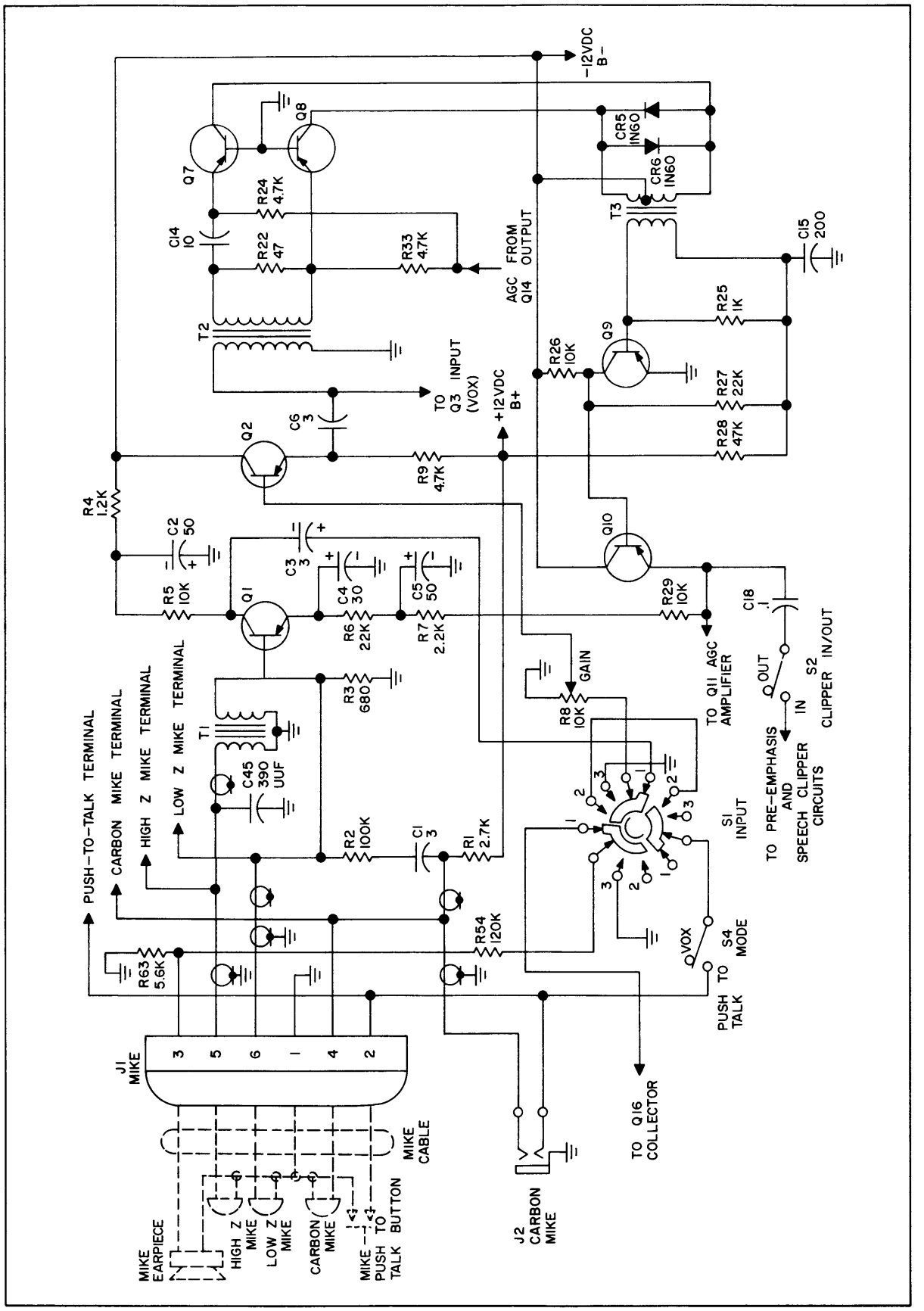


Figure 4-2. Audio Preamplifier and Amplifiers, Simplified Schematic Diagram

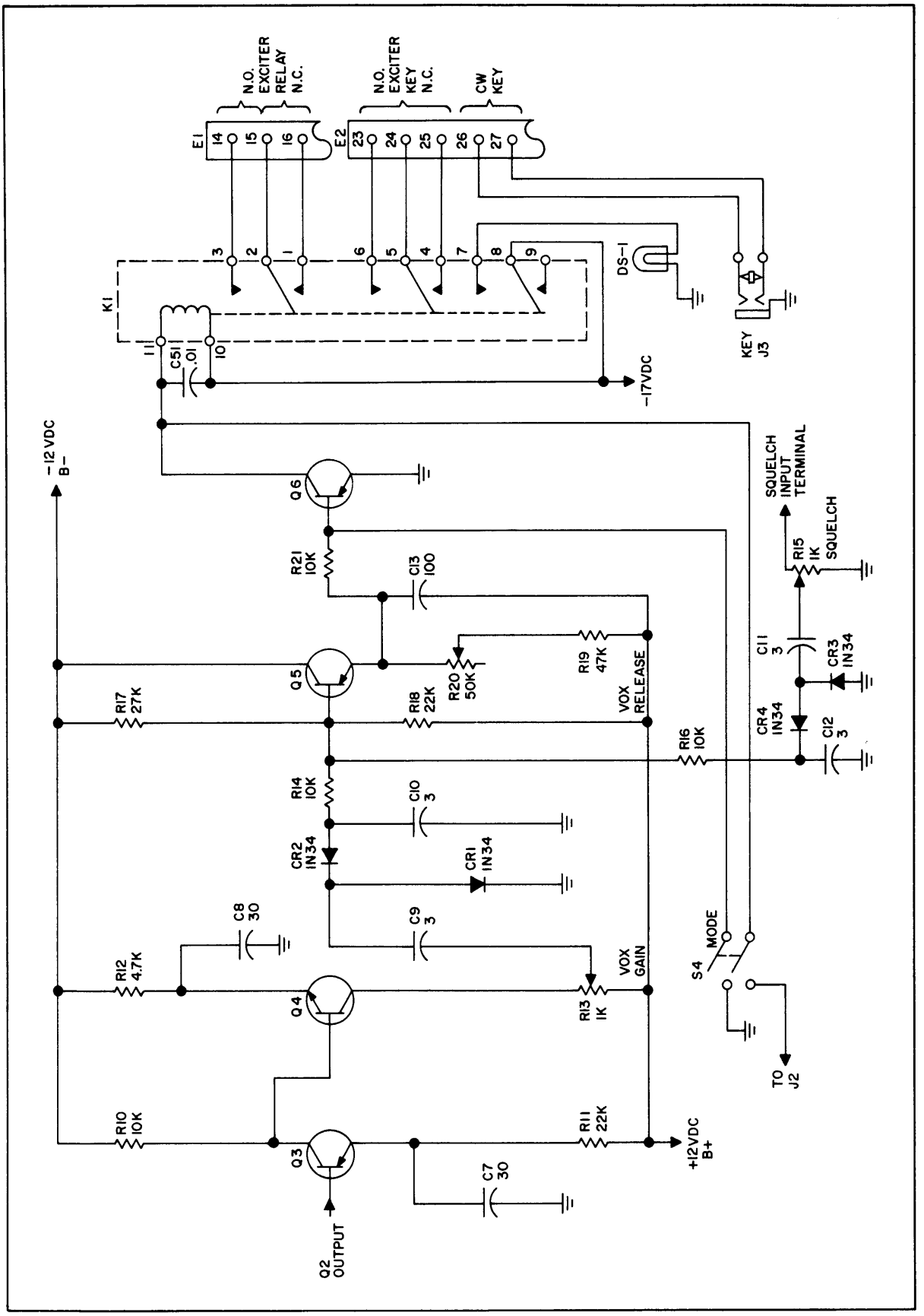


Figure 4-3. Voice Operated Exciter, Simplifier Schematic Diagram

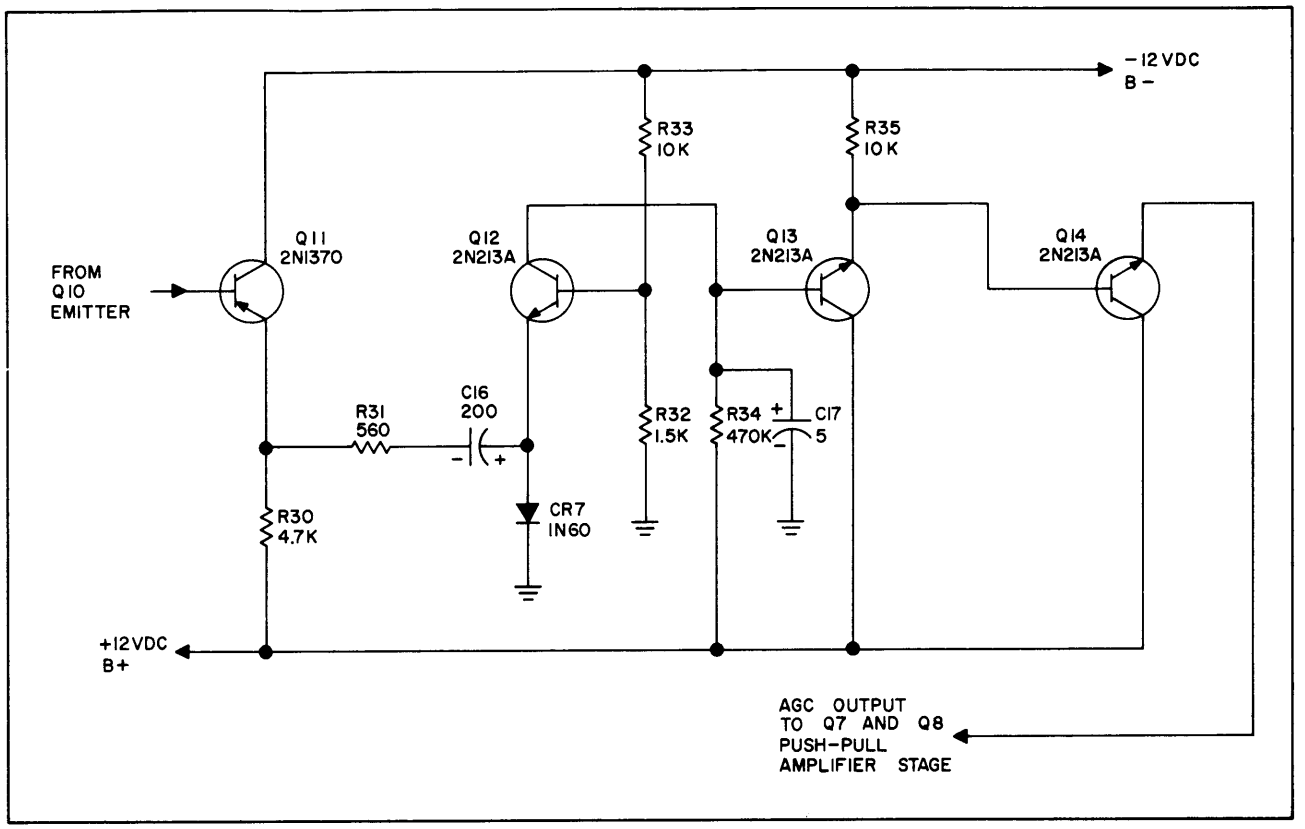


Figure 4-4. AGC and Temperature Compensators, Simplified Schematic Diagram

As illustrated in figure 4-6, the SPU-2 power supply receives its required operating voltage from any suitable AC power source, through a 3 conductor cable W1, to the input of connector J4. The input voltage is then fed to the primary of a step-down transformer T4, which has been previously wired for the correct input voltage. (Refer to paragraph 2-2 and figure 2-1). The output of the secondary winding of T4 is then rectified by diodes CR12, CR13, CR14, and CR15. The negative portion of the rectified output is fed to the solenoid (pin 10) of the exciter relay K1, and to the input of a highly stable filter network comprised of R55, R58, C23, C25, C52, and CR17. A -12-volt DC, B- potential is developed at this point for the necessary circuit operating voltage.

The positive portion of the rectified output is fed to the input of a highly stable filter network of R56, R57, C24, C53, and CR16. A +12-volt DC, B+ potential is developed at this point for the necessary circuit operating voltage.

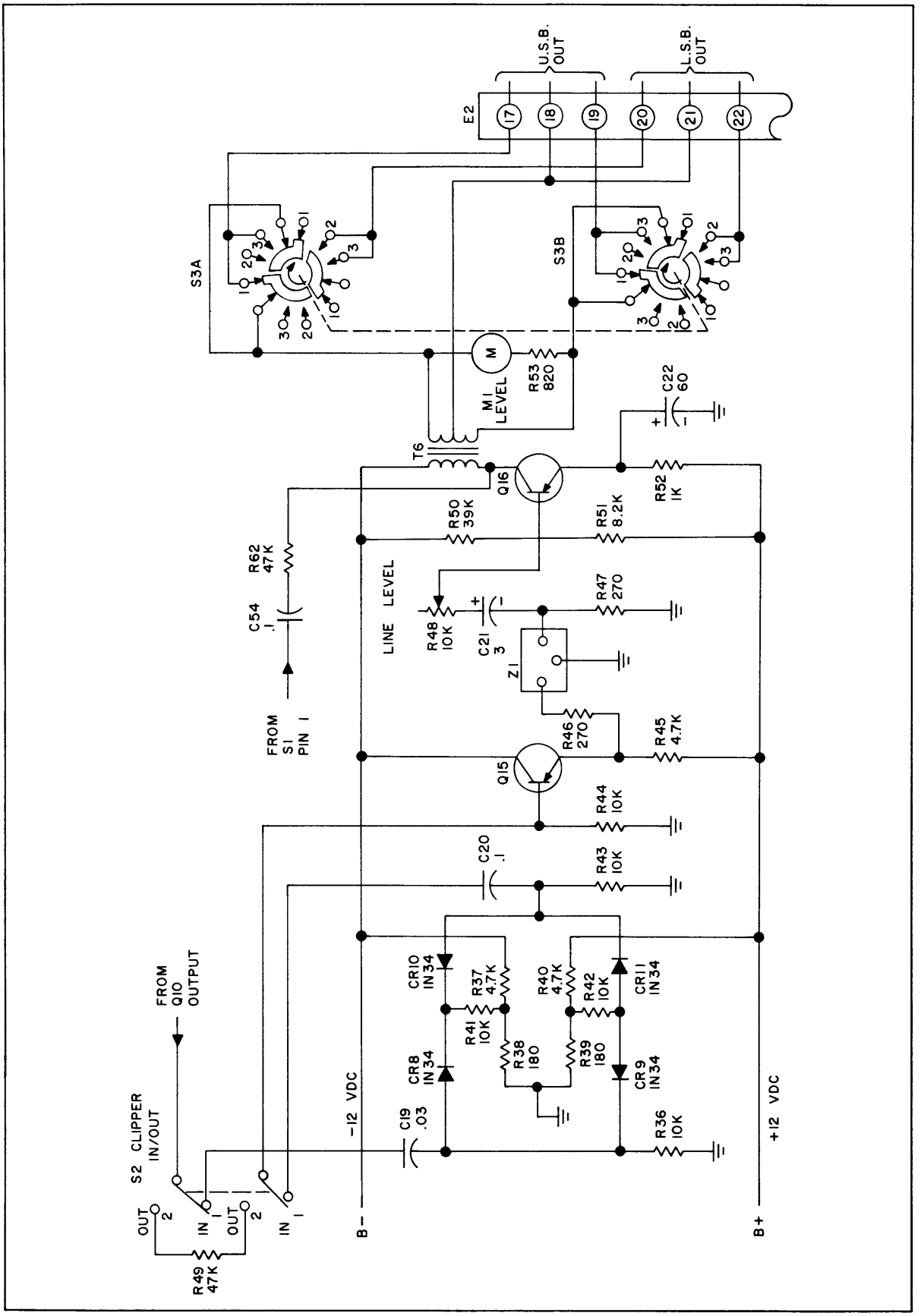


Figure 4-5. Pre-emphasis, Clipping and Selection, Simplified Schematic Diagram

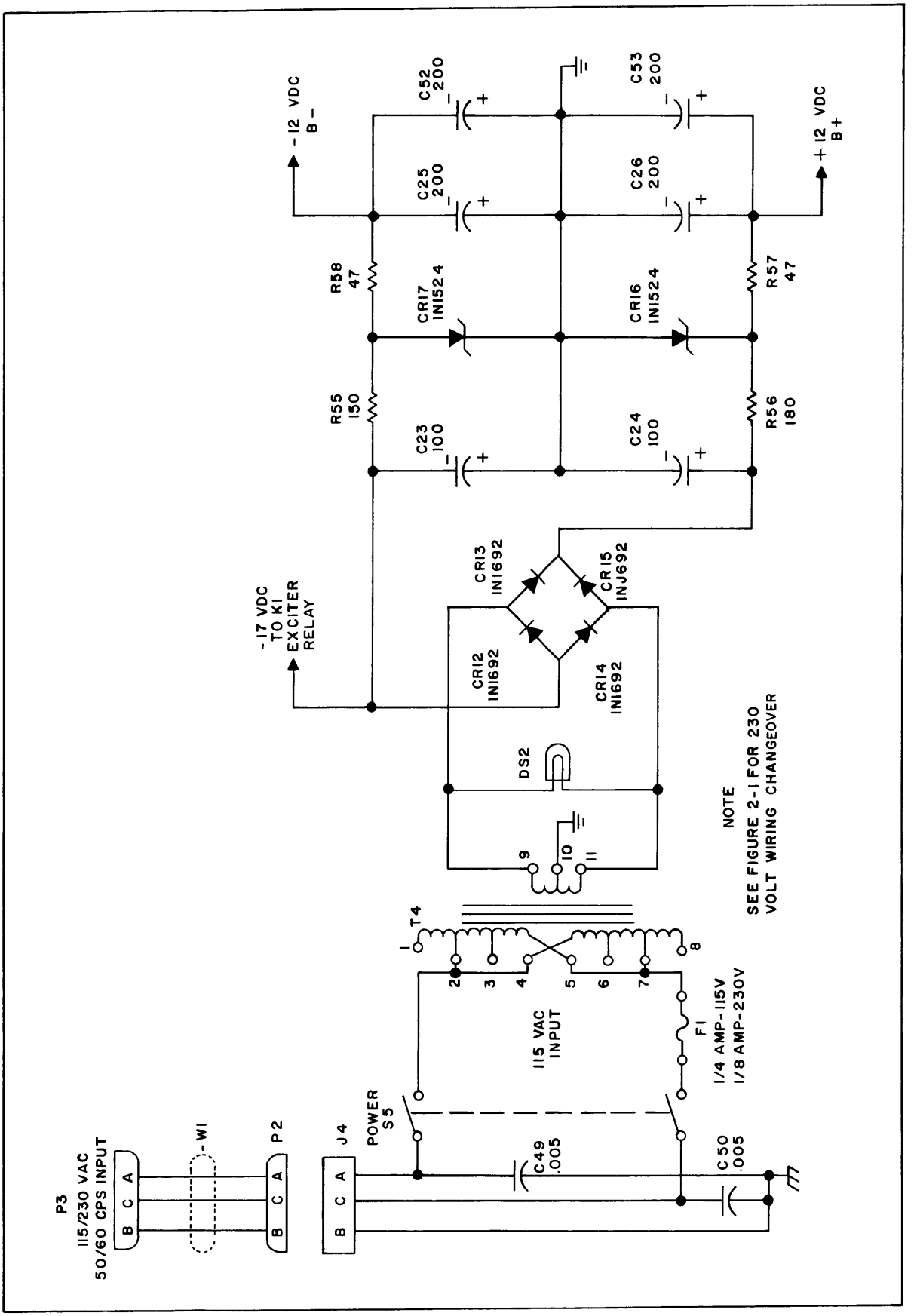


Figure 4-6. Power Supply, Simplified Schematic Diagram

SECTION 5
TROUBLESHOOTING

5-1. INTRODUCTION

This section explains how to locate and diagnos equipment troubles and malfunctions. The information necessary to remedy the troubles and maladjustments will be found in Section 6, Maintenance, of this manual.

The following aids to troubleshooting are provided:

a. Schematic diagrams.

b. Voltage measurement chart.

c. Troubleshooting techniques.

d. Resistance and Voltage Troubleshooting Chart.

5-2. TROUBLESHOOTING TECHNIQUES

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.

a. GENERAL CONSIDERATIONS

The first step in troubleshooting is to ascertain that the fuse is operative and that proper equipment operating voltages are present and all interconnecting cables are properly terminated. This may eliminate further investigation.

Upon removal of the dust covers from the unit, investigate for burned out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

CAUTION

Avoid the use of an ohmmeter in troubleshooting. Serious equipment damage may occur due to the critical characteristics of transistor circuits.

b. VOLTAGE MEASUREMENT CHART

The voltage measurement chart contained in this section indicates DC voltage and signal voltage measurements pertaining to each transistor element. Listed below are the conditions pertaining to the use of the voltage measurement chart, table 5-2. The necessary test equipment is listed in table 5-1.

CONDITIONS:

Insertion of 1 mv at 1 kc to the base of Q1. Terminal connections 17 and 19, 20 and 22 terminated with two 600-ohm resistors (1/2 watt) respectively.

Front panel operating controls as listed below:

POWER	ON
INPUT	LOCAL
OUTPUT	DSB
GAIN	Fully clockwise
VOX GAIN	Fully clockwise
MODE	VOX
CLIPPER	IN
LINE LEVEL	To obtain 0 vu on panel meter.

c. RESISTANCE AND VOLTAGE TROUBLESHOOTING CHART

The resistance and voltage troubleshooting chart, table 5-3 indicates normal circuitry measurements taken from factory test procedures. Do not attempt to take any resistance measurements other than those given in the resistance and voltage troubleshooting chart. All front panel controls are set as indicated in paragraph 5. 2b. This chart is to be followed assuming that operating voltages are correct and all indicator lamps and fuses are in operating condition. Refer to table 5-1 for test equipment needed.

TABLE 5-1. TEST EQUIPMENT FOR TROUBLESHOOTING

ITEM	MANUFACTURER
AC vacuum tube voltmeter.	Ballantine Model 314, or equivalent
Audio signal generator, 600-ohm output	Hewlett-Packard Model 200 CD, or equivalent
DC vacuum tube voltmeter	Hewlett-Packard Model 210 B, or equivalent
Two 600-ohm, 1/2-watt resistors to be used as loads.	Any manufacturer meeting the necessary specifications
Oscilloscope	Tectronix Model 515 A, or equivalent

TABLE 5-2. VOLTAGE MEASUREMENT CHART

Reference Symbol No.	Type		Base	Emitter	Collector
Q1	2N1370	DC voltage	0	+0.14 v	-6.8 v
		Signal voltage	1 mv		70 mv
Q2	2N1370	DC voltage	+1.2 v	+1.4 v	-12 v
		Signal voltage	70 mv	70 mv	
Q3	2N1370	DC voltage	0	+0.1 v	-6.8 v
		Signal voltage	66 mv		5.2 v
Q4	2N213A	DC voltage	-6.8 v	-0.17 v	+8.7 v
		Signal voltage	5.2 v		2.7 v
Q5	2N1370	DC voltage	-2.2 v	-2.1 v	-12 v
		Signal voltage			
Q6	2N1370	DC voltage	-2.1 v	0	-3.2 v
		Signal voltage			
Q7	2N207B	DC voltage	0	+0.04 v	-11.5 v
		Signal voltage		7.8 mv	4.2 mv
Q8	2N207B	DC voltage	0	+0.04 v	-11.5 v
		Signal voltage		7.8 mv	4.2 mv
Q9	2N1129	DC voltage	-0.07 v	0	-5 v
		Signal voltage	7 mv		.7 mv
Q10	2N1370	DC voltage	-5 v	-4.85 v	-12 v
		Signal voltage	0.7 v	0.7 v	
Q11	2N1370	DC voltage	-4.85 v	-4.7 v	-12 v
		Signal voltage	0.7 v	0.7 v	
Q12	2N213A	DC voltage	-1.55 v	-0.74 v	+0.42 v
		Signal voltage		0.7 v	
Q13	2N213A	DC voltage	+0.42 v	+0.03 v	+12 v
		Signal voltage			
Q14	2N213A	DC voltage	+0.03 v	+0.22 v	+12 v
		Signal voltage			
Q15	2N1370	DC voltage	+0.22 v	+0.35 v	-12 v
		Signal voltage	0.1 v	0.1 v	
Q16	1N1129	DC voltage	+6.9 v	+7	-9.3 v
		Signal voltage	6 mv		5.6 v

TABLE 5-3. RESISTANCE AND VOLTAGE TROUBLESHOOTING

STEP	INITIAL SETTING OR ADJUSTMENT	MEASURE FROM	MEASURE TO	NORMAL INDICATION	REMEDY
	NOTE Perform the following procedure with the power line cord disconnected from the power receptacle. Remove all interconnecting cable connections. Terminate pin 17 and 19 and pins 20 and 22 on E2 with two 600-ohm, 1/2-watt load resistors.				
1	Power switch in the ON position.	T4, pin 1	T4, pin 8	50 - 75 ohms	If a lower reading is obtained, check for shorted windings in T4. If no indication is obtained, check for opening winding in T4.
2		T4, pin 1	Ground	infinity	If normal indication is not obtained, check capacitors C49 and C50. Check for shorted T4 windings to ground.
3	Power switch in the OFF position.	Negative side of C23	Ground	500 - 650 ohms	If normal indication is not obtained, check capacitor C23 and associated circuitry.
4		Positive side of C24	Ground	1K - 1.5K ohms	If normal indication is not obtained, check capacitor C24 and associated circuitry.
5		E1 pin 7 pin 8 pin 9 pin 14 pin 15 pin 16 E2 pin 17 pin 18 pin 19 pin 20 pin 21 pin 22 pin 23 pin 24 pin 25 pin 26 pin 27	 Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground Ground	 Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity Infinity	If normal indication is not obtained, check associated circuitry for shorted capacitors to ground.
6		E1 pin 1	Ground	19K - 21K ohms	If normal indication is not obtained, check for shorted capacitor C45 or shorted primary winding of T1.

TABLE 5-3. RESISTANCE AND VOLTAGE TROUBLESHOOTING (Cont'd)

STEP	INITIAL SETTING OR ADJUSTMENT	MEASURE FROM	MEASURE TO	NORMAL INDICATION	REMEDY
	NOTE Perform the following steps with the front panel controls set to the positions indicated below: INPUT — LOCAL OUTPUT — DSB GAIN — Fully clockwise VOX GAIN — Fully clockwise SQUELCH — Fully counter-clockwise VOX RELEASE — Fully counter-clockwise MODE — VOX CLIPPER — IN LINE LEVEL — Fully clockwise Connect power cable CA-555-1 to J4.				
7	Connect audio signal generator set for 1 mv at 1 kc output to pin 3 and 4 of E1			Red EXCITER indicator illuminated	If normal indication is not obtained, check Q1 through Q6 circuitry. Check exciter relay K1.
8	Turn power ON. After an approximate period of one minute, adjust the LINE LEVEL control to obtain 0 vu on the front panel meter.	E2 pin 17	E2 pin 19	0.77 volts	If normal indication is not obtained, check S3 connections. Check T6 windings and associated circuitry.
9		E2 pin 20	E2 pin 22	0.77 volts	If normal indication is not obtained, perform step 8.
10		E2 pin 23	E2 pin 24	Short (5 ohms)	If normal indication is not obtained, check relay K1 contacts and associated circuitry for opens.
11		E2 pin 26	E2 pin 27	Short (5 ohms)	If normal indication is not obtained, check J3 contacts and associated circuitry.
12		E2 pin 24	E2 pin 25	Open	If normal indication is not obtained, check relay K1 contacts and associated circuitry for shorts.
13		E1 pin 14	E1 pin 15	Short (5 ohms)	If normal indication is not obtained, perform step 10.
14		E1 pin 15	E1 pin 16	Open	If normal indication is not obtained, perform step 12.

TABLE 5-3. RESISTANCE AND VOLTAGE TROUBLESHOOTING (C nt'd)

STEP	INITIAL SETTING OR ADJUSTMENT	MEASURE FROM	MEASURE TO	NORMAL INDICATION	REMEDY
15	Connect oscilloscope to observe indication at junction of C20 and R43.			0.225 volts peak to peak. Equal clipping on positive and negative half cycles.	If normal indication is not obtained, check components in speech clipper circuit.
16	Reduce VOX GAIN. EXCITER indicator should extinguish at same time as normal indication.	E2 pin 23	E2 pin 24	Open	If normal indication is not obtained, check relay K1 contacts and associated circuitry.
17		E2 pin 24	E2 pin 25	Short (5 ohms)	If normal indication is not obtained, perform step 16.
18		E1 pin 14	E1 pin 15	Open	If normal indication is not obtained, perform step 16.
19		E1 pin 15	E1 pin 16	Short (5 ohms)	If normal indication is not obtained, perform step 16.
	Return VOX GAIN fully clockwise.				
20	Set OUTPUT control to LSB position.	E2 pin 20	E2 pin 22	1.2 volts	If normal indication is not obtained, check T6 secondary winding and associated interconnecting circuitry.
21	Set OUTPUT control to USB position.	E2 pin 17	E2 pin 19	1.2 volts	If normal indication is not obtained, perform step 20.
	Return OUTPUT control to DSB position. Remove audio signal generator from pin 3 and pin 4 of E1. EXCITER indicator should extinguish.				
22	Plug PJ-309 (key plug) into KEY input jack.	E2 pin 26	E2 pin 27	Open	If normal indication is not obtained, check plug, key and J3 for shorts.
23	Short PJ-309 (key plug)	E2 pin 26	E2 pin 27	Short	If normal indication is not obtained, check J3 contacts and associated circuitry.

SECTION 6
MAINTENANCE

6-1. INTRODUCTION

The maintenance data contained in this section falls into two catagories: preventive maintenance and corrective maintenance. The purpose of preventive maintenance is to minimize equipment breakdown by performing periodic checks and those procedures which maintain normal equipment operation. Corrective maintenance may be considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments. The diagnostic type of information is presented under troubleshooting (Section 5); remedial type of information is presented in this section.

6-2. PREVENTIVE MAINTENANCE

In order to prevent actual failure of the SPU-2, it is suggested that a schedule of preventive maintenance be set up and adhered to. At periodic intervals (at least every six months) the SPU-2 should be removed from the equipment rack for cleaning and inspection. The chassis wiring should be inspected for dirt, corrosion, charring, discoloring, or grease. Dust may be removed with any soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichlorethylene or ethylene-dichloride. Remove dirt or grease from other parts with any good cleaning fluid.

WARNING

Carbon tetrachloride (CCl_4) may be used only if great care is exercised because it is a toxic substance. Do not inhale its fumes. Avoid contact with skin.

6-3. CORRECTIVE MAINTENANCE

When performing corrective maintenance, the technician should have at hand all the necessary tools and diagrams needed to accomplish this task in the minimum of time. The technician should also have a reasonable degree of experience in transistor circuitry operation.

When performing corrective maintenance, be sure that voltage is removed and that the replacement components are of the same value or type as that being removed.

SECTION 7
PARTS LIST

7-1. INTRODUCTION

Reference designations have been assigned to identify all component 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, capacitor, transistor, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as a transistor or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F1 is designated XF1. The parts for each major unit are grouped together. Column 1 lists the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and description of the various parts. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

PARTS LIST FOR SPEECH PROCESSING UNIT, MODEL SPU-2

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
C1	CAPACITOR, FIXED, ELECTROLYTIC: 3 uf, 15 wvdc; polarized.	Coupling	CE-105-3-15
C2	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf, 15 wvdc; polarized.	Bypass	CE-105-50-15
C3	Same as C1.	Coupling	
C4	CAPACITOR, FIXED, ELECTROLYTIC: 30 uf, 15 wvdc; polarized.	Bypass	CE-105-30-15
C5	Same as C2.	Bypass	
C6	Same as C1.	Coupling	
C7	Same as C4.	Emitter Bypass	
C8	Same as C4.	Emitter Bypass	
C9	Same as C1.	Coupling	
C10	Same as C1.	Filter	
C11	Same as C1.	Coupling	
C12	Same as C1.	Filter	
C13	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf, 15 wvdc; polarized.	Blocking	CE-105-100-15
C14	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, 15 wvdc; polarized.	Isolation	CE-105-10-15
C15	CAPACITOR, FIXED, ELECTROLYTIC: 200 uf, 15 wvdc; polarized.	Bypass	CE-105-200-15
C16	Same as C15.	Coupling	
C17	CAPACITOR, FIXED, ELECTROLYTIC: 5 uf, 15 wvdc; polarized.	Bypass	CE-105-5-15
C18	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .1 uf, 1000 wvdc; +80% -20%.	Coupling	CC-100-28
C19	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .03 uf, 1000 wvdc; +80% -20%.	P/o Pre-emphasis Network	CC-100-36
C20	Same as C18.	Coupling	
C21	Same as C1.	Coupling	
C22	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf, 60 wvdc; polarized.	Emitter Bypass	CE-107-1
C23	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf, 25 wvdc.	B- Filter	CE-105-100-25
C24	Same as C23.	B+ Filter	

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
C25	Same as C15.	B- Filter	
C26	Same as C15.	B+ Filter	
C27	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .001 uf, 500 wvdc; ±10%.	Filter	CC-100-9
C28	Same as C27.	Filter	
C29	Same as C27.	Filter	
C30	Same as C27.	Filter	
C31	Same as C27.	Filter	
C32	Same as C27.	Filter	
C33	Same as C27.	Filter	
C34	Same as C27.	Filter	
C35	Same as C27.	Filter	
C36	Same as C27.	Filter	
C37	Same as C27.	Filter	
C38	Same as C27.	Filter	
C39	Same as C27.	Filter	
C40	Same as C27.	Filter	
C41	Same as C27.	Filter	
C42	Same as C27.	Filter	
C43	CAPACITOR, FIXED, MICA DIELECTRIC: 39 uuf, 500 wvdc.	Filter	CM30B390K
C44	CAPACITOR, FIXED, MICA DIELECTRIC: .005 uf, 500 wvdc; GMV.	Filter	CC-100-15
C45	CAPACITOR, FIXED, MICA: 390 uuf, 500 wvdc.	RF Bypass	CM30B391K
C46	Same as C27.	Filter	
C47	Same as C27.	Filter	
C48	Same as C27.	Filter	
C49	Same as C44.	Line Filter	
C50	Same as C44.	Line Filter	
C51	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .01 uf, 500 wvdc; GMV.	Suppressor	CC-100-16

PARTS LIST FOR SPEECH PROCESSING UNIT, MODEL SPU-2 (Cont'd)

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
C52	Same as C15.	B- Filter	
C53	Same as C15.	B+ Filter	
C54	Same as C18.	Coupling	
CR1	SEMICONDUCTOR DEVICE diode; germanium, max peak inverse volts 60V, continuous average forward current 50 ma, max peak forward recurrent 150 ma, max surge current 500 ma.	VOX Signal Rectifier	1N34A
CR2	Same as CR1.	VOX Signal Rectifier	
CR3	Same as CR1.	Squelch Signal Rectifier	
CR4	Same as CR1.	Squelch Signal Rectifier	
CR5	SEMICONDUCTOR DEVICE, diode; germanium, max peak inverse volts 25V, max average 5 ma, max forward current 5.0 ma, max inverse 800 u amp at -50V.	Peak Clipping	1N60A
CR6	Same as CR5.	Peak Clipping	
CR7	Same as CR5.	AVC Signal Rectifier	
CR8	Same as CR1.	Speech Clipping	
CR9	Same as CR1.	Speech Clipping	
CR10	Same as CR1.	Speech Clipping	
CR11	Same as CR1.	Speech Clipping	
CR12	SEMICONDUCTOR DEVICE, rectifier, silicon, peak inverse voltage 100V, DC output current 250 ma, peak forward surge current (recurrent) 2.0 amps.	Voltage Rectifier	1N1692
CR13	Same as CR12.	Voltage Rectifier	
CR14	Same as CR12.	Voltage Rectifier	
CR15	Same as CR12.	Voltage Rectifier	
CR16	SEMICONDUCTOR DEVICE, zener diode; silicon voltage regulator 1 watt.	Voltage Regulation	1N1524
CR17	Same as CR16.	Voltage Regulation	
DS1	LAMP, INCANDESCENT, 20V; 0.10 amp bayonet base.	EXCITER Indicator	BI-101-1820
DS2	Same as DS1.	POWER Indicator	

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
E1	TERMINAL BOARD: barrier type; 16 single screw type terminals, feed-thru.	For External Connections	TM-100-16
E2	Same as E1.	For External Connections	
F1	FUSE, CARTRIDGE: slow blow; 1/8 amp, (for 230 volt operation).	Line Fuse	FU-102-.125
F1	FUSE, CARTRIDGE: slow blow; 1/4 amp, (for 115 volt operation).	Line Fuse	FU-102-.250
J1	CONNECTOR, RECEPTACLE, ELECTRICAL: panel mount; 6 #20 female contact, straight type.	MIKE Input	JJ-212
J2	JACK, TELEPHONE: 2 contact, normally shorted.	CARBON MIKE Input	JJ-083
J3	Same as J2.	KEY Input	
J4	CONNECTOR, RECEPTACLE: male 2 male contacts, 1/2 round twist lock type polarized; 250 volts 10 amps; 125 volts 15 amps.	Power Input	JJ-175
K1	RELAY, SENSITIVE: 11 pin octal type; 3 pole double throw contacts, coil max pull-in current 20 ma at 12 vdc.	Exciter Relay	RL-146
L1	COIL, RF: FIXED: 120 uh, ±10% max dc resistance 3.2 ohms, Approx. Res. Freq. 20 mc.	Filter	CL-240-120
L2	Same as L1.	Filter	
L3	Same as L1.	Filter	
L4	Same as L1.	Filter	
L5	Same as L1.	Filter	
L6	Same as L1.	Filter	
L7	Same as L1.	Filter	
L8	Same as L1.	Filter	
L9	Same as L1.	Filter	
L10	Same as L1.	Filter	
L11	Same as L1.	Filter	
L12	Same as L1.	Filter	
L13	Same as L1.	Filter	
L14	Same as L1.	Filter	
L15	Same as L1.	Filter	

PARTS LIST FOR SPEECH PROCESSING UNIT, MODEL SPU-2 (Cont'd)

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
L16	Same as L1.	Filter	
L17	Same as L1.	Filter	
L18	Same as L1.	Filter	
L19	Same as L1.	Filter	
M1	METER, AUDIO LEVEL: internal impedance 3900 ohms; -20 to +3 db; 0 to 100% scale.	OUTPUT LEVEL Meter	MR-154
P1	CONNECTOR, PLUG, ELECTRICAL: 6 #20 male contacts rated at 3 amps.	MIKE Input	PL-208
P2	CONNECTOR, PLUG, ELECTRICAL: 2 female contacts; polarized; w/cable clamp.	P/o Power Line Cord	PL-176
P3	CONNECTOR, PLUG, ELECTRICAL: 2 male contacts; twist lock type.	P/o Power Line Cord	PL-171
Q1	TRANSISTOR: germanium; junction type contacts; rating at 25°C collector voltage 25V; collector current 150 ma; wire lead type terminals hermetically sealed nickle case; .370" X .260" overall dimensions.	Pre-amplifier	2N1370-7
Q2	Same as Q1.	Emitter Follower Amplifier	
Q3	Same as Q1.	VOX Amplifier	
Q4	TRANSISTOR: germanium; junction type contacts; NPN configurations; ratings at 25°C; collector to base, 40 volts; collector to emitter, 25 volts; collector current 100 ma; wire lead type terminals; hermetically sealed metal case; .190" X .340" X .320" overall dimensions.	VOX Amplifier	2N213A
Q5	Same as Q1.	VOX Amplifier	
Q6	Same as Q1.	VOX Amplifier	
Q7	TRANSISTOR: germanium; junction type contacts; PNP configurations; ratings at 25°C, VCB 12; PT 20; wire lead type terminals; hermetically sealed metal case; .115" X .180" overall dimensions.	P/o Push-pull Amplifier	2N207B
Q8	Same as Q7.	P/o Push-pull Amplifier	

PARTS LIST FOR SPEECH PROCESSING UNIT, MODEL SPU-2 (Cont'd)

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
Q9	TRANSISTOR: germanium; junction type contacts; PNP configurations; ratings at 25°C; VCB 25; PT 0.15; wire lead type terminals; hermetically sealed metal case; .370" X .375" overall dimensions.	Amplifier	2N1129
Q10	Same as Q1.	Amplifier	
Q11	Same as Q1.	AVC Amplifier	
Q12	Same as Q4.	AVC Amplifier	
Q13	Same as Q4.	AVC Amplifier	
Q14	Same as Q4.	AVC Amplifier	
Q15	Same as Q1.	Emitter Follower Amplifier	
Q16	Same as Q9.	Power Amplifier	
R1	RESISTOR, FIXED, COMPOSITION: 2700 ohms, ±5%, 1/2 watt.	Base Dropping - Q1	RC20GF272J
R2	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%, 1/2 watt.	Same as R1	RC20GF104J
R3	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±5%, 1/2 watt.	Biasing - Q1	RC20GF681J
R4	RESISTOR, FIXED, COMPOSITION: 1200 ohms, ±5%, 1/2 watt.	Collector Load - Q1	RC20GF122J
R5	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%, 1/2 watt.	Same as R4	RC20GF103J
R6	RESISTOR, FIXED COMPOSITION: 22,000 ohms, ±5%, 1/2 watt.	Emitter Bias - Q1	RC20GF223J
R7	RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±5%, 1/2 watt.	Same as R6	RC20GF222J
R8	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, ±10%, 2 watts.	GAIN Control	RV4ATRD103A
R9	RESISTOR FIXED, COMPOSITION: 4700 ohms, ±5%, 1/2 watt.	Emitter Bias - Q2	RC20GF472J
R10	Same as R5.	Collector Load - Q3	
R11	Same as R6.	Emitter Bias - Q3	
R12	Same as R9.	Collector Load - Q4	
R13	RESISTOR, VARIABLE, COMPOSITION: 1000 ohms, ±10%, 2 watts.	VOX GAIN Control	RV4ATRD102A
R14	Same as R5.	P/o Filter Network	
R15	Same as R13.	SQUELCH Control	
R16	Same as R5.	Same as R14	

PARTS LIST FOR SPEECH PROCESSING UNIT, MODEL SPU-2 (Cont'd)

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
R17	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±5%, 1/2 watt.	Bias	RC20GF273J
R18	Same as R6.	Same as R17	
R19	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%, 1/2 watt.	Emitter Bias	RC20GF473J
R20	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms, ±10%, 2 watts.	VOX RELEASE Control	RV4ATRD503B
R21	Same as R5.	Bias	
R22	RESISTOR, FIXED, COMPOSITION: 47, ohms, ±5%, 1/2 watt.	Impedance Matching	RC20GF470J
R23	Same as R9.	Emitter Bias	
R24	Same as R9.	Emitter Bias	
R25	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±5%, 1/2 watt.	Bias	RC20GF102J
R26	Same as R5.	Collector Load	
R27	Same as R6.	Bias	
R28	Same as R19.	Same as R25	
R29	Same as R5.	Emitter Bias	
R30	Same as R9.	Same as R29	
R31	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±5%, 1/2 watt.	Emitter Load	RC20GF561J
R32	RESISTOR, FIXED, COMPOSITION: 1500 ohms, ±5%, 1/2 watt.	Bias	RC20GF152J
R33	Same as R5.	Dropping	
R34	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±5%, 1/2 watt.	Bias	RC20GF474J
R35	Same as R5.	Dropping	
R36	Same as R5.	P/o Pre-emphasis Network	
R37	Same as R9.	P/o Speech Clipping Network	
R38	RESISTOR, FIXED, COMPOSITION: 180 ohms, ±5%, 1/2 watt.	P/o Speech Clipping Network	RC20GF181J
R39	Same as R38.	P/o Speech Clipping Network	
R40	Same as R9.	P/o Speech Clipping Network	
R41	Same as R5.	P/o Speech Clipping Network	
R42	Same as R5.	P/o Speech Clipping Network	

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
R43	Same as R5.	Termination	
R44	Same as R5.	Bias	
R45	Same as R9.	Emitter Bias	
R46	RESISTOR, FIXED, COMPOSITION: 270 ohms, ±5%, 1/2 watt.	Filter Load	RC20GF271J
R47	Same as R46.	Filter Termination	
R48	Same as R8.	LINE LEVEL Control	
R49	Same as R19.	Loading	
R50	RESISTOR, FIXED, COMPOSITION: 39,000 ohms, ±5%, 1/2 watt.	Dropping	RC20GF393J
R51	RESISTOR, FIXED, COMPOSITION: 8200 ohms, ±5%, 1/2 watt.	Same as R50	RC20GF822J
R52	Same as R25.	Emitter Bias	
R53	RESISTOR, FIXED, COMPOSITION: 820 ohms, ±5%, 1/2 watt.	Meter Load	RC20GF821J
R54	RESISTOR, FIXED, COMPOSITION: 6800 ohms, ±5%, 1/2 watt.	Loading	RC20GF682J
R55	RESISTOR, FIXED, COMPOSITION: 180 ohms, ±5%, 2 watts.	P/o B- Filter Network	RC42GF181J
R56	Same as R55.	P/o B+ Filter Network	
R57	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%, 1 watt.	P/o B+ Filter Network	RC32GF470J
R58	Same as R57.	P/o B- Filter Network	
R59	Same as R5.	Attenuator	
R60	RESISTOR, FIXED, COMPOSITION: 68 ohms, ±5%, 1/2 watt.	Attenuator	RC20GF680J
R61	Same as R5.	Attenuator	
R62	Same as R19.	Collector Load Q16	
R63	RESISTOR, FIXED, COMPOSITION: 5600 ohms, ±5%, 1/2 watt.	Termination	RC20GF562J
S1	SWITCH, ROTARY: 1 section, 3 position, 1 amp, 28 volts DC or 5 amp 110 volts AC.	INPUT Selector	SW-148
S2	SWITCH, TOGGLE: dpdt, 6 amps.	CLIPPER IN-OUT	ST-22N
S3	SWITCH, ROTARY: 2 section, 3 position, silver plated brass contacts; 1 amp 28 volts DC, 5 amps 110 volts AC.	OUTPUT Selector	SW-321

PARTS LIST FOR SPEECH PROCESSING UNIT, MODEL SPU-2 (Cont'd)

REF SYMBOL	DESCRIPTION	FUNCTION	TMC PART NO.
S4	SWITCH, TOGGLE: dpst, 6 amps.	MODE Selector	ST-22K
S5	Same as S4.	POWER ON-OFF	
T1	TRANSFORMER, AUDIO FREQUENCY: primary impedance 200,000 ohms, secondary 1000 ohms; dc resistance primary 6500; secondary 245 ohms.	Impedance Matching	TF-246-6X
T2	TRANSFORMER, AUDIO FREQUENCY: primary impedance 500 ohms, secondary 50 ohms; dc resistance primary 115 ohms; secondary 12 ohms.	Coupling	TF-246-4X
T3	TRANSFORMER, AUDIO FREQUENCY: primary impedance 600 ohms center taps, secondary impedance 600 ohms.	Coupling	TF-248
T4	TRANSFORMER, POWER STEP DOWN: primary 115V/230V 50/60 cps; secondary 28V center tap at 600 ma DC.	Power	TF-245
T5	TRANSFORMER, AUDIO FREQUENCY: primary impedance 500 ohms center tap, secondary 600 ohms.	Coupling	TF-246-19X
T6	TRANSFORMER, AUDIO FREQUENCY: primary impedance 10,000 ohms, secondary impedance 600 ohms center tap.	Output	TF-247
W1	CABLE, ASSEMBLY, POWER ELECTRICAL: 1 foot retracted length; consists of 2 connectors symbol numbers P2 and P3 and one 2 conductor AWG-18 wire.	Input Power	CA-551-1
XDS1	LIGHT, INDICATOR: miniature bayonet base; red frosted lens.	Holder for DS1	TS-106-1
XDS2	LIGHT, INDICATOR: miniature bayonet base; white clear lens.	Holder for DS2	TS-106-2
XF1	CLIP, ELECTRICAL: phosphor bronze; silver plated, accommodates 13/16 dia fuses.	Holder for F1	FH-103
XK1	SOCKET, ELECTRON TUBE: 5 prong.	Socket for K1	TS-100-5
Z1	FILTER, AUDIO: low pass; frequency response: within 3 db to 3 kc, attenuation: 6 kc to 100 kc at least -30 db.	Low Frequency Bandpass Filter	FX-181

SECTION 8
SCHEMATIC DIAGRAMS