

# SERVICE MANUAL



## HAMMOND X-5 COMBO ORGAN

The Hammond X-5 is the first truly portable organ that embodies all the traditional capabilities of Hammond tonebar organs. It's a synthesis organ that allows you to create your own sound. It's easy to set-up, compact, and weighs only 165 lbs.

- Two 44-note keyboards with overhang keys.
- 13-note pedalboard.
- Nine harmonic tonebars for upper keyboard.
- Seven harmonic tonebars for lower keyboard.
- One 16' harmonic tonebar for bass.
- Vibrato: 3 degrees and off.
- Reverberation: 3 degrees and off.
- 4 presets plus upper and lower tonebar positions.
- Synthesis touch-response percussion.
- Fast and Slow Decay.
- Variable speed repeat/reiteration on percussive voices.
- Acoustic tremolo speaker outlet (Leslie® 910), plus two-speed on/off control tabs.
- 16' and 8' pedal tabs.
- Two String Bass tabs: 3 decay times, plus Mute tab.
- Brilliance Knob, continually variable.
- Volume control knob.
- Input jack for external instruments.
- Line-out jack for other amplifiers.
- External speaker jack.

SPECIFICATIONS: Weight: 165 lbs. • Power Source: 60 cycle AC 120 V. • Dimensions: 44½" W., 36" H., 25" D.  
• Accessories: Legs.



# TABLE OF CONTENTS

## SECTION I-HOW THE ORGAN OPERATES

1-1	GENERAL	1-1
1-2	CABINETY	1-1
1-3	TONE SOURCE	1-1
1-4	MANUAL	1-1
1-5	TONE BARS	1-1
1-6	PRESET OR TAB VOICING	1-1
1-7	PERCUSSION	1-1
1-8	REPEAT	1-1
1-9	PEDALS	1-2
1-10	VIBRATO	1-2
1-11	VOLUME	1-2
1-12	BRILLIANCE	1-2
1-13	EXPRESSION PEDAL	1-2
1-14	REVERBERATION	1-2
1-15	EXTERNAL INPUT	1-2
1-16	REMOTE TONE CABINET	1-2
1-17	AMPLIFIER	1-2

## SECTION II – DISASSEMBLY AND MAINTENANCE

2-1	GENERAL	2-1
2-2	TOP PANEL	2-1
2-3	UPPER MANUAL ASSEMBLY	2-1
2-4	END BLOCKS-LOWER MANUAL	2-1
2-5	LOWER MANUAL ASSEMBLY	2-1
2-6	TONE BAR ASSEMBLY	2-1
2-7	POWER SWITCH AND UPPER RIGHT END BLOCK	2-1
2-8	END BLOCK POTENTIOMETER	2-1
2-9	ROCKER TAB (REMOVAL)	2-1
2-10	PRINTED WIRING BOARDS	2-2
2-11	UPPER OR LOWER MANUAL KEYS	2-2
2-12	POWER SUPPLY	2-2
2-13	REVERB UNIT ACCESS	2-2
2-14	EXPRESSION PEDAL	2-2
2-15	LOWER SECTION COVER	2-2
2-16	POWER SUPPLY (LOWER SECTION)	2-2
2-17	PEDAL KEY BOARD ASSEMBLY	2-2

### MAINTENANCE AND SERVICE HINTS

2-18	TEST AND ADJUSTMENT PROCEDURE	2-4 thru 2-10
------	-------------------------------	---------------

## SECTION III – DIAGRAM AND TEXT

GENERAL	3-1
---------	-----

TABLE OF CONTENTS

SECTION I - HOW THE ORGAN OPERATES

Figure		GENERAL	1-1
3-1	LOGIC DIAGRAM (2-1)	CABINTRY	3-2
3-2	LOGIC DIAGRAM (2-2)	TONE SOURCE	3-3
3-3	DIVIDER BOARD LAYOUT & R.C. LIST (229-20316)	MANUAL	3-4
3-4	DIVIDER BOARD THEORY (229-20316)	TONE BAR	3-5
3-5	GATE AND PERCUSSION AMP BOARD LAYOUT AND THEORY (219-04312)	PRESET OR TAB VOICING	3-6
3-6	PRE. AND REVERB AMP BOARD LAYOUT AND THEORY (219-51306)	PERCUSSION	3-7
3-7	PEDAL BOARD LAYOUT AND THEORY (223-17311)	REPEAT	3-8
3-8	MIXTONE BOARD LAYOUT AND THEORY (232-02311)	PEDALS	3-9
3-9	POWER SUPPLY BOARD LAYOUT AND THEORY (224-05311)	VIBRATO	3-10
3-10	30W POWER AMPLIFIER MODULE LAYOUT AND THEORY (218-02311)	VOLUME	3-11
3-11	MDD GENERATOR-TWO PACAGE SYSTEM VIBRATOABLE LAYOUT AND THEORY (228-19312)	BRIGHTNESS	3-12
3-12	MDD BUFFER BOARD LAYOUT AND THEORY (223-35341)	EXPRESSION PEDAL	3-13

SECTION IV - ILLUSTRATION PARTS LIST

4-1	INDEX	REVERB	4-1
		EXTERNAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REVERB	
		EXTERNAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
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		EXPRESSION PEDAL	
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		VOLUME	
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		EXPRESSION PEDAL	
		REPEAT	
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		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REPEAT	
		PEDALS	
		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
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		VIBRATO	
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		REPEAT	
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		VIBRATO	
		VOLUME	
		BRIGHTNESS	
		EXPRESSION PEDAL	
		REPEAT	
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		EXPRESSION PEDAL	
		REPEAT	
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		EXPRESSION PEDAL	
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		BRIGHTNESS	
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		EXPRESSION PEDAL	



# SECTION I. HOW THE ORGAN OPERATES

## X-5 – 18050K

### GENERAL PERFORMANCE DESCRIPTION

#### 1-1 GENERAL

This section contain a brief description of the various sections of the instrument.

#### 1-2 CABINETYRY

The metal frame and wood panels-coated with vinyl leather and CHS- form the case work. Case has a metal handle for carring and a removable key cover.

#### 1-3 TONE SOURCE

The X-5 (18050K) utilizes the single master oscillator with the multiderivative divider (MDD) system. The twelve (12) I.C.'s mounted on the 229-20316 (DV-4B) Divider Generator Board provide the division of outputs and provide the sine wave tones -seventy nine (79) tones- made use of by the instrument.

#### 1-4 MANUAL

The 18050K uses two (2) 44 note Manual that Upper Manual has 10 contacts under each key. The Manuals provide means of switching signals from 229-20316 Generator Board and keying voltage to the 219-04312 Gate & Percussion Board. The lowest one of these contacts is used for switching voltage for Gate & Percussion, and Others are used for switching the signal directly.

#### 1-5 TONE BARS

Three Groups of Tone Bars complement the Upper Manual, Pedal and Lower Manual. They carry the footage markings and vary loudness.

#### 1-6 PRESETS OR TAB VOICING

The three (3) Presets Tabs may bring in pre-set tones instead of the setting of the upper Tone Bars, And the One (1) Preset Tab may bring in those of lower Tone Bars.

They may be used individually. The presets have the following Tone Bar structure.

Lower Tone Bars  
Preset Ensemble 068666 444

Upper Tone Bars  
String 008888 666  
Full Tibias 806808 006  
Theater Brass 848868 666

Depression of either Preset Tab disconnects the setting of the Tone Bars, and all Tabs turn to "Off" position and restore the Tone Bars. On Upper Presets, the right-hand Tab has priority over the left-hand Tabs. The Tabs used are of the current switch type. The Preset Tabs are located on the lower left-hand End Block Assembly. The End Block also contains other Tabs whose functions are the following: Percussion (Second Harmonic, Third Harmonic, Decay, Repeat), Vibrato and Leslie (Acoustic-Tremolo).

#### 1-7 PERCUSSION

Percussion Tones are switched on by the Tabs, which are Second Harmonic and Third Harmonic. Each footage of the pitch corresponds to 4' and 2-2/3' of Tone Bars. Percussion affects all upper Tone Bar setting, but not Preset Tones. It has two decay times, approximately 1.5 seconds (Slow) and 80 msec. (Fast).

#### 1-8 REPEAT

The same Percussion gate can be activated by a reiteration or repeat Oscillator, and affect the same Percussions. The Oscillator rate is variable from 13 times/10 seconds to 500 msec. The Repeat Rate control is located on the lower right-hand End Block Assembly. The End Block also contains other Tabs and controls whose functions are the following: Pedal, String Bass, Mute, Reverb, Volume, and Brilliance.

### 1-9 PEDALS

A 13 note Spinet Pedal of the Block Module Design is used. The keying contacts are used the Rocker type, with the middle contact used for Common. A series of latching D.C. gates determines the desired bass note. These contacts are wired High-Note Select. The latching Keyer Gates hold for at least two (2) seconds, but release instantly with the next pedal depressed. The selected output is then amplified to produce the 8' bass note and then frequency-divided one (1) time in F-F circuit to produce the 16' bass note. An output gate controls the Pedal Sustain envelope. The sustain decay time is selected by String Bass Tabs, those its decay times are follows:

Tab	Decay Time
String Bass I	350 msec.
String Bass II	700 msec.
String Bass III (I + II)	1.5 sec.

The Bass Note is selected 8' and 16' by Pedal Tab. The Mute Tab affects all Bass Tones.

### 1-10 VIBRATO

A Master Oscillator Vibrato offers three (3) widths at one speed that affects all voices. This rate is  $6.6 \pm 0.2$  Hertz. Vibrato II is wider than I, and the two Tabs are additive, so the Vibrato is widest when both on.

### 1-11 VOLUME

This Knob controls the overall volume of the organ soft to loud, and its variable range is about 30 dB.

### 1-12 BRILLIANCE

This Knob controls the overall tone of the organ soft to bright, then gradually attains a slope of 6 dB/octave and alters the response about 16 dB at 3000 Hz.

### 1-13 EXPRESSION PEDAL

The assembly is made of steel frame, utilizing a single channel. The variable range is about 22 dB at minimum position.

### 1-14 REVERBERATION

Three (3) degrees of Reverb. are available, which affects all organ tones.

### 1-15 EXT. INPUT

An input suitable for other Signal-generating devices is provided and located under the right-hand Lower End Block of the cabinet.

### 1-16 REMOTE TONE CABINET

A jack is provided suitable for an 8 ohm Speaker. A socket is provided suitable for a Leslie 910 Tone Cabinet. The signals are taken from the organ output following the Leslie Selector Tabs, and On/Off, Fast/Slow control Tabs are coupled through the Standard Cable to the Tone Cabinet. Jack and socket are located on amplifier in the Pedal Cabinet.

### 1-17 AMPLIFIER

A single channel 30 Watt Block Module Design is provided and located in the Pedal Unit Assembly.

## SECTION II. DISASSEMBLY

### 2-1 GENERAL

This section contains instructions for removal of specific assemblies of the organ. Step 2-2 thru 2-13 provide disassembly procedures for the Upper Section (Manual Keyboard) of the organ. Steps 2-14 thru 2-17 provide disassembly procedures for the Lower Section of the organ. The removal of some sub-assemblies and unplugging connectors or unsoldering is obvious. These will not be discussed.

For reassembly, use reverse procedures.

### UPPER SECTION

#### 2-2 TOP PANEL

- a) Two (2) bronze screws (6½" long) located under Upper Section must be removed FIRST. (Note – See Figure 2-1 for location).
- b) Near top and center of each side of Upper Section remove bronze screw.
- c) From front of top panel, lifting evenly, raise top to swing up position.

#### 2-3 UPPER MANUAL ASSEMBLY

- a) See figure 2-1 for location – Remove six (6) 1" long bronze screws from under side of Upper Section.
- b) Raise manual to swing up position. (Do not lift by keys).

#### 2-4 END BLOCKS – LOWER MANUAL

- a) Remove two (2) phillips screws from rear of each End Block Assembly.
- b) Carefully lift up and avoid marring or scratching.

#### 2-5 LOWER MANUAL ASSEMBLY

- a) Lower Manual End Blocks should be removed first to avoid damage to case or other assemblies.
- b) See Figure 2-1 for location. Remove four (4) 1" long bronze screws from under side and toward front of Upper Section.
- c) Carefully, Manual can be placed in up right position. (Do not lift by keys).

#### 2-6 TONE BAR ASSEMBLY

- a) Unplug Upper and Lower tone bar connectors for T.G-15 (B) PWB assembly located under Upper Manual Assembly.
- b) Remove self tapping screws mounting Tone Bars to Upper Manual Assembly.

#### 2-7 POWER SWITCH AND UPPER MANUAL RIGHT HAND END BLOCK.

- a) Follow steps 2-2 thru 2-3.
- b) Remove End Block, by removing one (1) screw at rear, top of End Block. Screw located under felt.
- c) Raise manual and from under End Block remove screw.
- d) Between Front Strip, remove small screw fastening strip to End Block. Lift up End Block.
- e) From under side of End Block, remove two (s) screws fastening cover to switch. Remove cover.
- f) To remove power switch – after End Block is loose from Manual, remove two (2) black screws from top of End Block. Switch now can be removed from under side of End Block. Reassemble in reverse procedure.

#### 2-8 TO REMOVE END BLOCK POTENTIOMETERS

- a) Follow step 2-2 thru 2-5.
- b) Remove knob of potentiometer. (Volume, Brilliance, or Repeat), by loosening small set screw in knob.
- c) Remove End Block by removing two (2) screws top rear of End Block. Lift Block.
- d) Remove hex nut securing potentiometer to End Block, Potentiometer can be removed from bottom side of Assembly.

#### 2-9 ROCKER TABS (REMOVAL)

- a) Proceed as stated in Steps 2-2 thru 2-4.
- b) From under side of End Block, remove top and bottom screw of associated Rocker Tab Assembly. Rocker Tab will lift out.

**DISASSEMBLY CONTINUED**

**2-10 PRINTED WIRING BOARDS (REMOVAL)**

a) The removal of PWB Assemblies is quite obvious and will not be necessary to describe.

**2-11 TO REPLACE UPPER OR LOWER MANUAL KEYS.**

a) Follow Steps 2-2 thru 2-3. Upper Manual and thru 2-5 Lower Manual.

b) Remove several locking "S" Springs holding plastic covered rod in area of key or keys to be replaced.

c) Remove key spring from rear of key channel.

d) Lift rear of key channel slightly and in a forward motion carefully remove key and channel assembly from manual. In the removal of sharp (black) keys, it will be necessary to remove neighboring keys. Reassemble in reverse procedure.

e) NOTE — Key contact adjustment can be made by turning most forward screw on key and channel assembly (in or out) for key depth.

**2-12 POWER SUPPLY**

a) Follow steps 2-2 thru 2-3.

b) Remove six (6) screws fastening cover above power supply assembly — Remove cover.

c) From under side, right rear of Upper Section remove four (4) screws. See Figure 2-1 for location.

d) Carefully unplug and lift assembly out.

**2-13 ACCESS TO REVERB UNIT**

a) Follow Steps 2-2 thru 2-3.

b) Remove six (6) screws fastening cover above power supply. Remove cover.

c) Remove two (2) screws and fasteners hold EF-12 PWB.

d) Remove four (4) screws fastening MG-4 PWB to hinged panel. Carefully unplug and remove.

e) Remove four (4) nuts and washers from rear of swing panel.

f) Carefully raise panel and gain access to reverb assembly.

**LOWER SECTION**

**2-14 EXPRESSION PEDAL ASSEMBLY**

a) Remove four (4) nuts fastening base of Assembly to Lower Section.

b) Lift out.

c) To remove pedal from the metal base. Rubber mat of pedal can be removed by lifting edges of mat. Mat will lift and peel off.

d) With mat removed, remove four (4) screws holding metal pedal to Base Section and separate. Reassembly in reverse procedure.

**2-15 TO REMOVE LOWER SECTION COVER**

a) From under side of Lower Section. Remove ten (10) phillips screws.

b) Cover will lift off.

**2-16 POWER SUPPLY ASSEMBLY**

a) Remove cover as stated in Step 2-15.

b) Remove four (4) nuts fastening amp to wood base.

**2-17 PEDAL KEYBOARD ASSEMBLY**

a) Remove six (6) nuts and washers mounting keyboard assembly to wood base.

b) Pedal assembly will lift off.

c) Contact switch assemblies can be removed by loosening screws at each end of switch module and slide away from screw and lift up. Reassemble in reverse procedure.

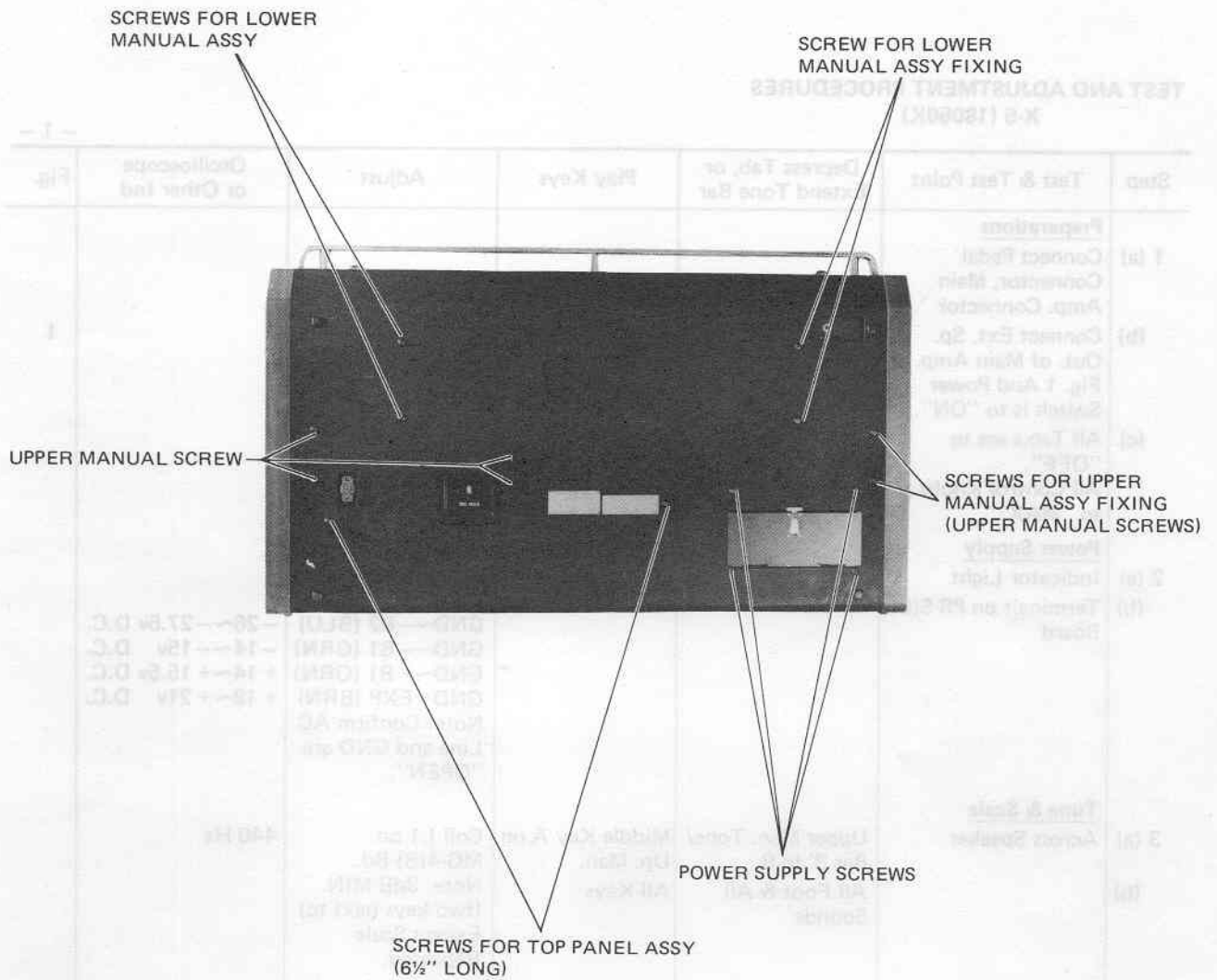


FIGURE 2-1



TEST AND ADJUSTMENT PROCEDURES  
X-5 (18050K)

- 1 -

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
<b>Preperations</b>						
1 (a)	Connect Pedal Connector, Main Amp. Connector					1
(b)	Connect Ext. Sp. Out. of Main Amp. as Fig. 1 And Power Switch is to "ON".					
(c)	All Tab.s are to "OFF". All Control Knobs are to "MAX.".					
<b>Power Supply</b>						
2 (a)	Indicator Light			Note: Confirm Light "ON".		
(b)	Terminals on PS-5(B) Board			GND~-B2 (BLU) -26~-27.5v D.C. GND~-B1 (GRN) -14~-15v D.C. GND~+ B1 (ORN) +14~+15.5v D.C. GND~EXP (BRN) +18~+21v D.C. Note: Confirm AC Line and GND are "OPEN".		
<b>Tune &amp; Scale</b>						
3 (a)	Across Speaker	Upper Man. Tone/Bar 8' to 8	Middle Key A on Up. Man.	Coil L1 on MG-4(B) Bd. Note: 3dB MIN. (two keys next to) Except Scale Repeated.	440 Hz	
(b)		All Foot & All Sounds	All Keys			
<b>Output Level</b>						
4 (a)	Across Speaker	Up. Man. 8' Tone/Bar to 8 Low. Man. 8' Tone/Bar to 8	Middle Key C on Upper & Lower Man.	Pot. VR1 on PA-33(B) Bd.	Conform Upper Man. & Lower Man. is same level.	
(b)		Ensemble Tab. to "ON".	Mid. C, E, & G on Lower Manual	Pot. VR1 on PA-56 Bd.	3.4v rms.	
(c)		String Tab. to ON Full Tibias Tab. Theater Brass Tab. Upper Man. Tone Bar	Mid. C, E, & G on Upper Manual	Note: All levels are ±20% MAX.	4.5v ± 0.5v rms. 4.5v ± 0.5v rms. 4.9v ± 0.5v rms.	
		16' Tone/Bar			3.5v rms.	
		5-1/3' "			2.6v rms.	
		8' "			2.8v rms.	
		4' "			2.0v rms.	
		2-2/3' "			2.0v rms.	
		2' "			2.3v rms.	
		1-3/5' "			2.3v rms.	
		1-1/3' "			2.3v rms.	
		1' "			2.5v rms.	

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
(c)		Lower Man. Tone Bar 8' Tone/Bar 4' " 2-2/3' " 2' " 1-3/5' " 1-1/3' " 1' "			2.9v rms. 2.3v rms. 2.0v rms. 2.2v rms. 2.2v rms. 2.1v rms. 2.4v rms.	
5 (a)	<b>Pedal</b> I Pedal Decay Time Across Speaker	Pedal Tab. 8' & String Bass I & II Tab. to "ON" String Bass Tab. to "OFF". String Bass Tab. I to "ON". String Bass Tab. II to "ON"	Pedal Key C of High Note	Pot. VR2 on SB-5(B) Bd.	1.5 sec.  150 msec. ± 15 msec. 400 msec. ± 40 msec. 800 msec. ± 80 msec.	2
(b)	II Pedal Level Across Speaker	Pedal Tone Bar to 8 Pedal Tab. to 8'  Pedal Tone Bar to 8 Pedal Tab. to 8' Mute Tab. to "ON"	Pedal Key C of High Note Pedal Key G Pedal Key C of Low Note Pedal Key C of High Note	Pot. VR1 on SB-5(B)	3.4v rms. 4.5v ± 0.5v rms. 5.4v ± 0.5v rms.  2.3v ± 0.5v rms.	
6 (a)	<b>Extent of Expression Pedal</b> Across Speaker	Full Tibias Tab. to "ON".	Mid. Key C on Up. Man.	Level is at -20dB ~ -24dB when Exp. Pedal MAX to MIN. (Level is 0dB at Exp. Pedal MAX)		
7 (a)	<b>Noise Level</b> Across Speaker	All Tab.s to ON (Except Reverb Tab. & Mute Tab.) All Tone Bars to 8 All Tab.s to OFF All Tone Bars to O (OFF), and Percussion Tab.s to ON	Mid. Key C on Up. Man. & Low. Man.		5 mv rms. MAX.  10 mv rms. MAX.  No noise occurs.	

\*NOTE: During Test Procedure The Following Must Be Maintained Unless Otherwise Stated:  
a. All Control Knobs and Expression Pedal at Maximum.  
b. All Tab.s and All Tone Bars in the Off Position.



Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind.	Fig.
<b>Brilliance &amp; Freq. Response</b>						
8 (a)	Across Speaker	Upper Man. Tone/Bar 4' to 8	Upper Man. Key F of Lowest Note Up. Man. Key F of Highest Note	Point of Brill. Volume Max. MIN. 0dB (Set to Volume Control) -2dB -4dB -13dB -20dB		
<b>Percussion</b>						
9 (a)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow" Next Decay Tab. to "Fast" Third Harmonic Tab. as in step to do Sec. Harm. Tab.	Middle Key C on Upper Manual  Check as same to Second Harmonic.	Pot VR2 on PA-33(B) Board	t; 1500 msec.  t; 90 msec.	3
<b>Repeat</b>						
(b)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow" Repeat Tab. to "ON", and Decay Tab. to "Fast"	Middle Key C on Upper Manual	Reit Volume to "Slow"  Reit to Slow (MIN.) Reit to Fast (MAX.)	t; 500+100 msec.  Reit; 13+3 times/10 sec. Reit; 70+7 msec.	4
<b>Vibrato</b>						
10 (a)	Test Point R-26 on MG-4(B) Bd.	Vibrato I & II Tab. to "ON"  Vibrato I & II Tab. to "OFF" Vibrato I Tab. to "ON" Vibrato II Tab. to "ON"		Pot. VR1 on MG-4(B) Board Pot. VR2 on MG-4(B) Board	t; 152 msec. (6.8Hz) 8v p-p  0v  2v p-p  4v p-p	5 6  7
<b>Reverb</b>						
11 (a)	Test Point R-43 & J4 on PA-56 Board	Low. Man. Tone Bar 8' to 8	Middle Key C on Lower Manual	Pot. VR2 on PA-56 Board	2v p-p	7
(b)	Test Point Reverb Tab. & Ear	Reverb I & II Tab. to "ON"	Mid. Key C E & G on Low. Man.	Pot. VR4 on PA-56 Board	About 70 mv & Decay Time: 2.5-3 sec.	8
(c)	Balance Ear			Pot. VR3 on PA-56 Board	Same Level on Reverb "OFF" from I & II to "ON"	

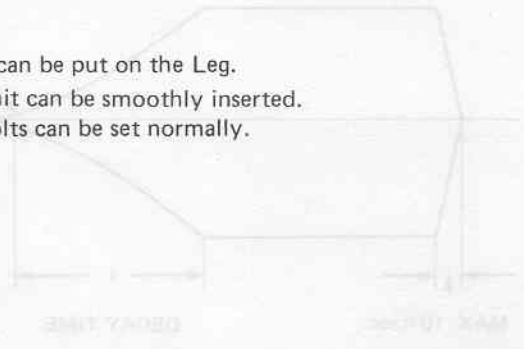
Step	Test & Test Point	Depress Tab. or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
12 (a)	<b>Other Operation</b>					
12 (a)	Leslie Socket; Pin 7, Pon 6, & 1	Leslie ON/OFF to "ON" Leslie Slow/Fast to "Fast" Leslie ON/OFF to "OFF"	Note: That Pin 6 is grounded (to Pin 1) and that Pin 7 is removed from ground (Pin 1). If Tab. is returned to Slow, Pin 7 will be grounded. Pin 6 and Pin 7 are removed from ground (Pin 1).			9
13 (a)	Ear	Ensemble Tab. to "ON" Lower Man. Tone/Bar sets to: 8666444 String Tab. to "ON" Upper Man. Tone/Bar sets to: 008888666 Full Tibias Tab. to "ON" - do -, sets 806808006 Theater Brass Tab. to "ON" - do -, sets 848868666	Note: Same Tone as Tone Bar Setting.    - ditto -  - ditto -			

**14 Test of Mechanism Operation**

- a) Confirm that Tone Bars are easy to operate, and that one Tone Bar doesn't disturb other Tone Bar operation, and that Mark 8 is visible.
- b) Confirm that Keyboards are operational.
- c) Confirm that Expression Pedal is normal to operate and to stop at will.
- d) Confirm that position of Knob Mark is normal.
- e) Confirm that Pedal Keys are normal to operate.
- f) Confirm that Tab.s are normal to operate.

**15 Assembly**

- a) Confirm that Cabinet can be put on the Leg.
- b) Confirm that Pedal Unit can be smoothly inserted.
- c) Confirm that Knob Bolts can be set normally.



Step	Test & Test Point	Adjust	Oscilloscope or Other Indication	Fig.
<b>Main Amplifier</b>				
16 (a)	Preparations Across Ext. Sp. Out	Connection as Fig. 10, 11		10
(b)	Test Point R26 on PW-27(B) Board	Pot. VR1 on PW-27(B) Board Note: Set VR1 to turn left, and turn right, Stop at 10mV Point.	Set 10mV, and about afteral Minute 35mV + 5mV	11
(c)	Across Ext. Sp. Out	Input: 0.3V rms. (1000Hz) . . . . .	Output: 16V Note: Confirm that Output Wave Form is normal or not.	10
(d)	Test Point GND . . . . + Vcc GND . . . . + Vcc		+ 30V ~ + 35V DC - 30V ~ - 35V DC	

FIGURE

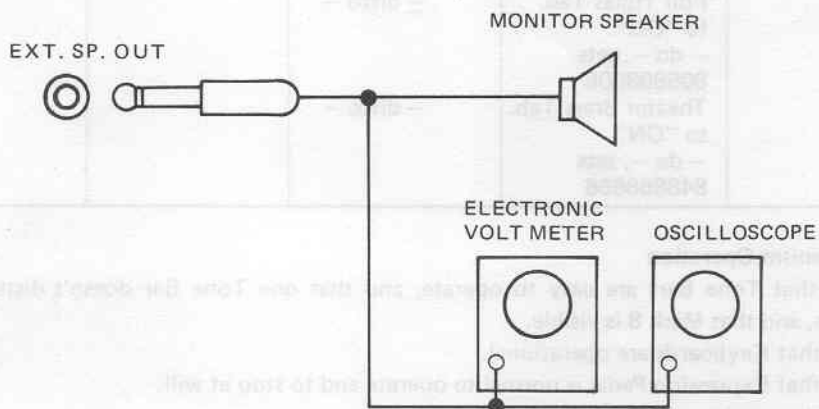


Fig. 1

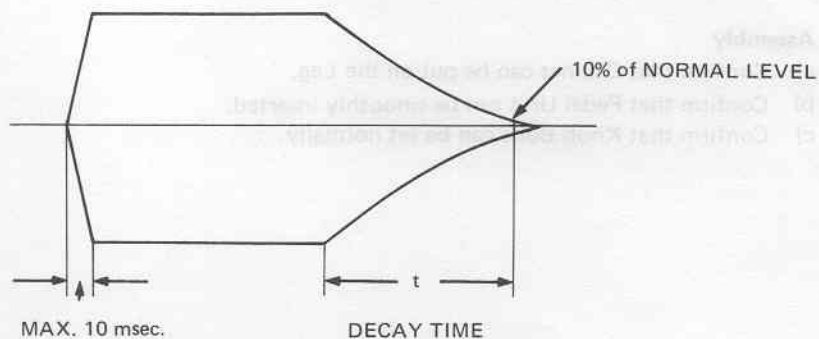


Fig. 2

Fig. 3

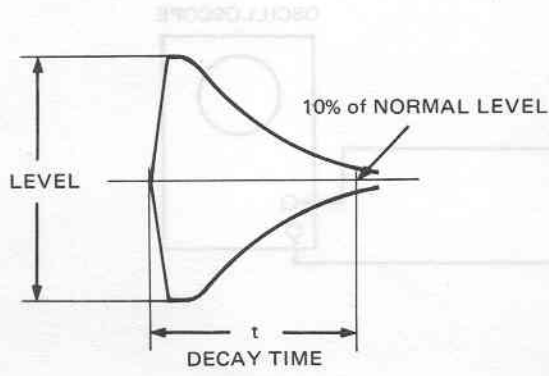


Fig. 4

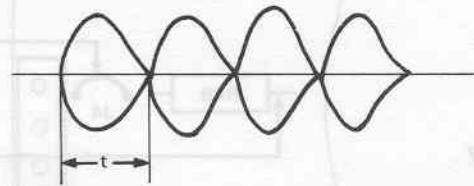


Fig. 5

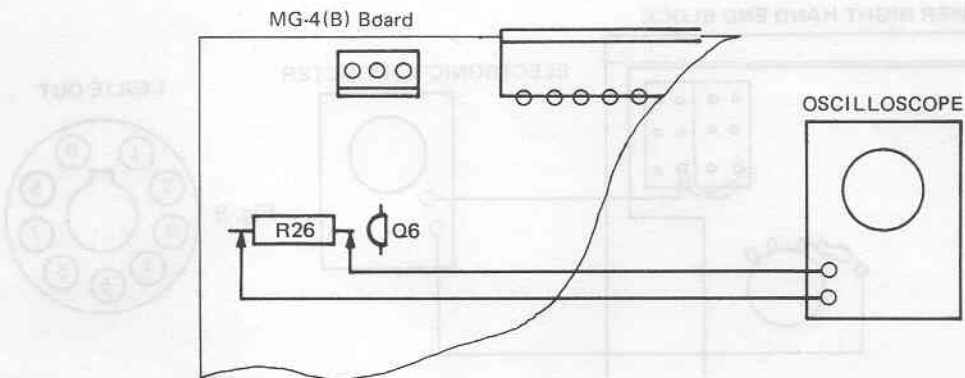


Fig. 6

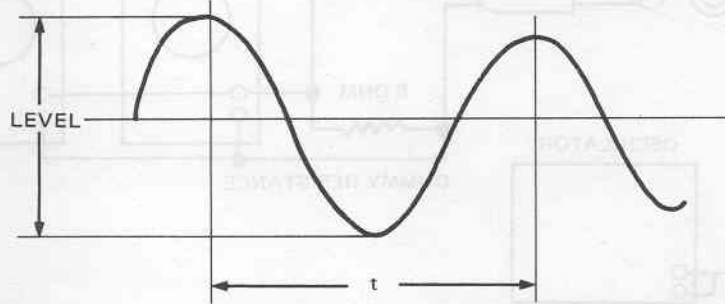


Fig. 7

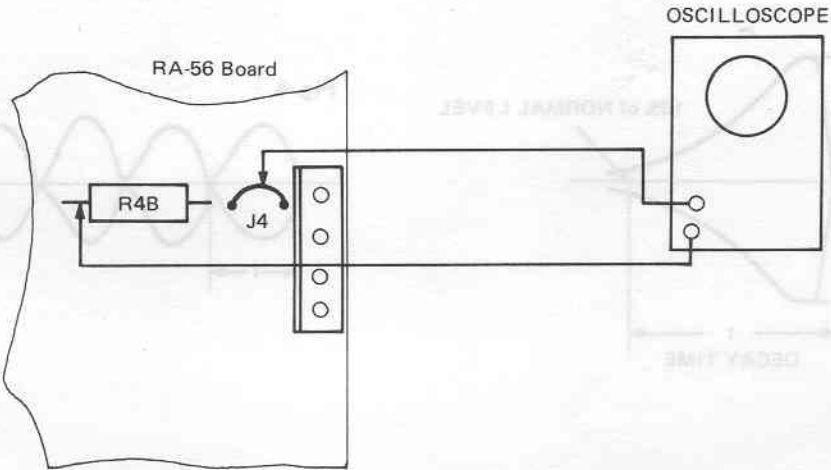


Fig. 8

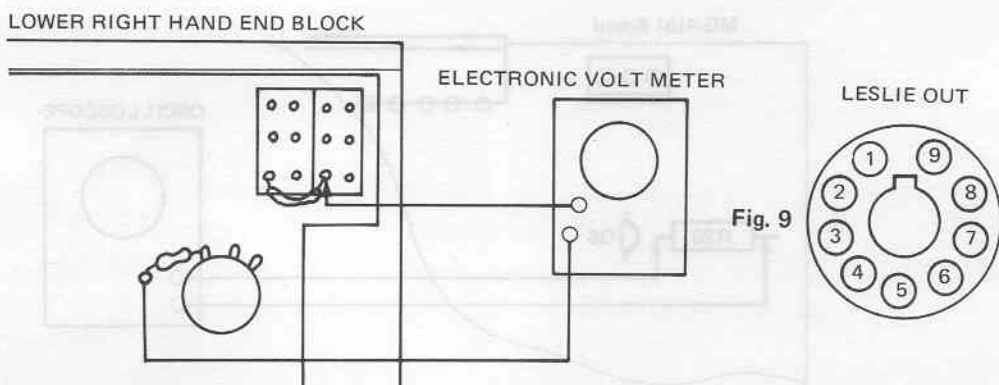


Fig. 10

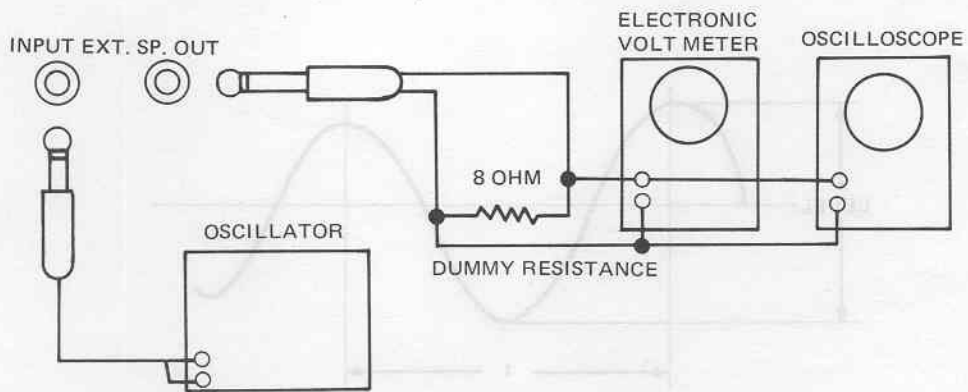
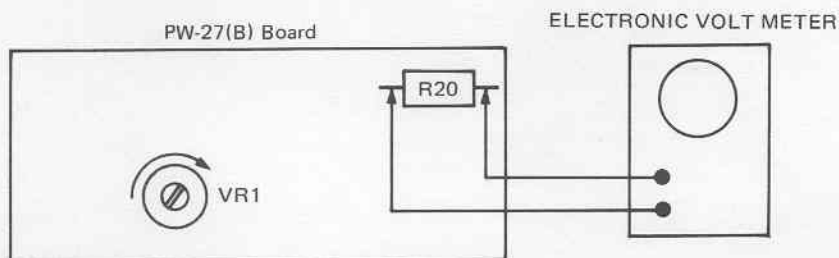
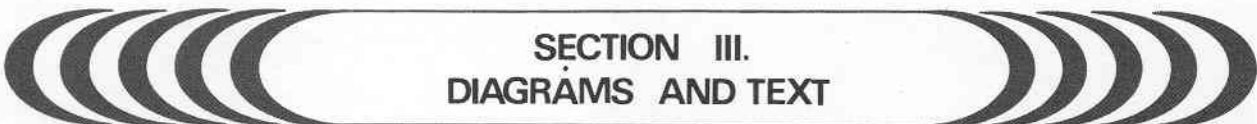


Fig. 11

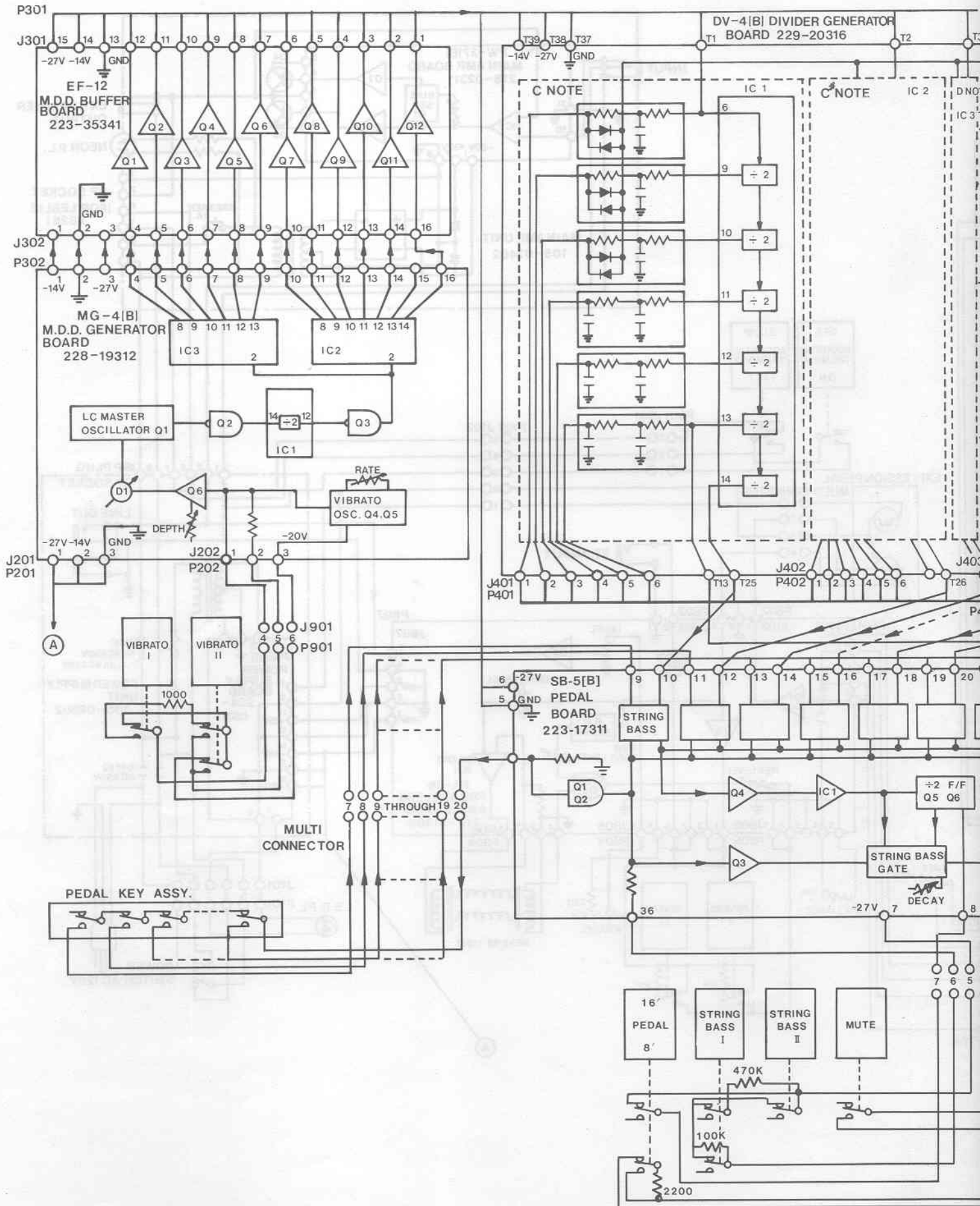




**SECTION III.  
DIAGRAMS AND TEXT**

**3-1 GENERAL**

This section contains schematic diagrams and text to illustrate and provide information necessary to proper organ servicing.





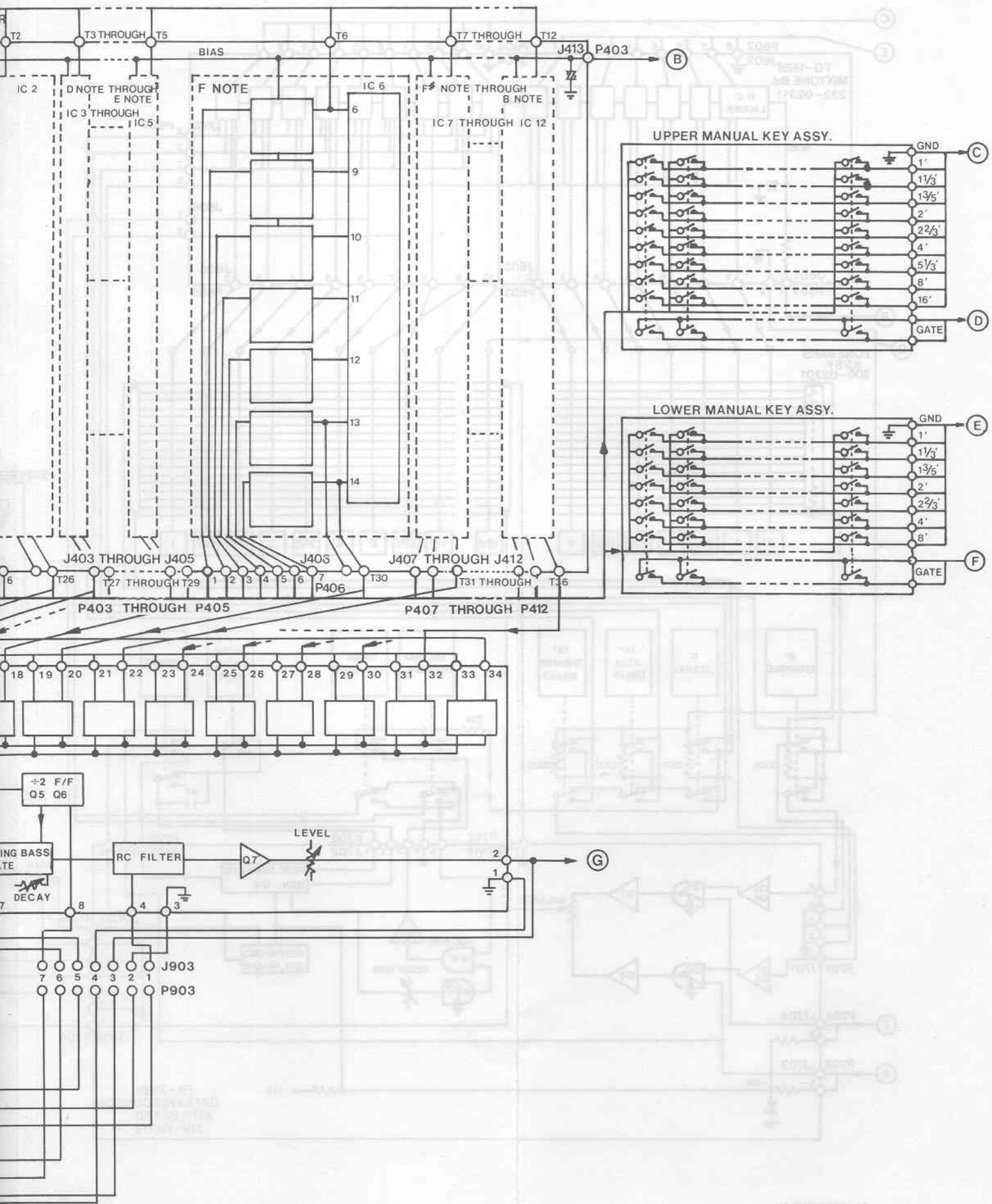


FIGURE 3-1  
LOGIC DIAGRAM (2-1) 3-2

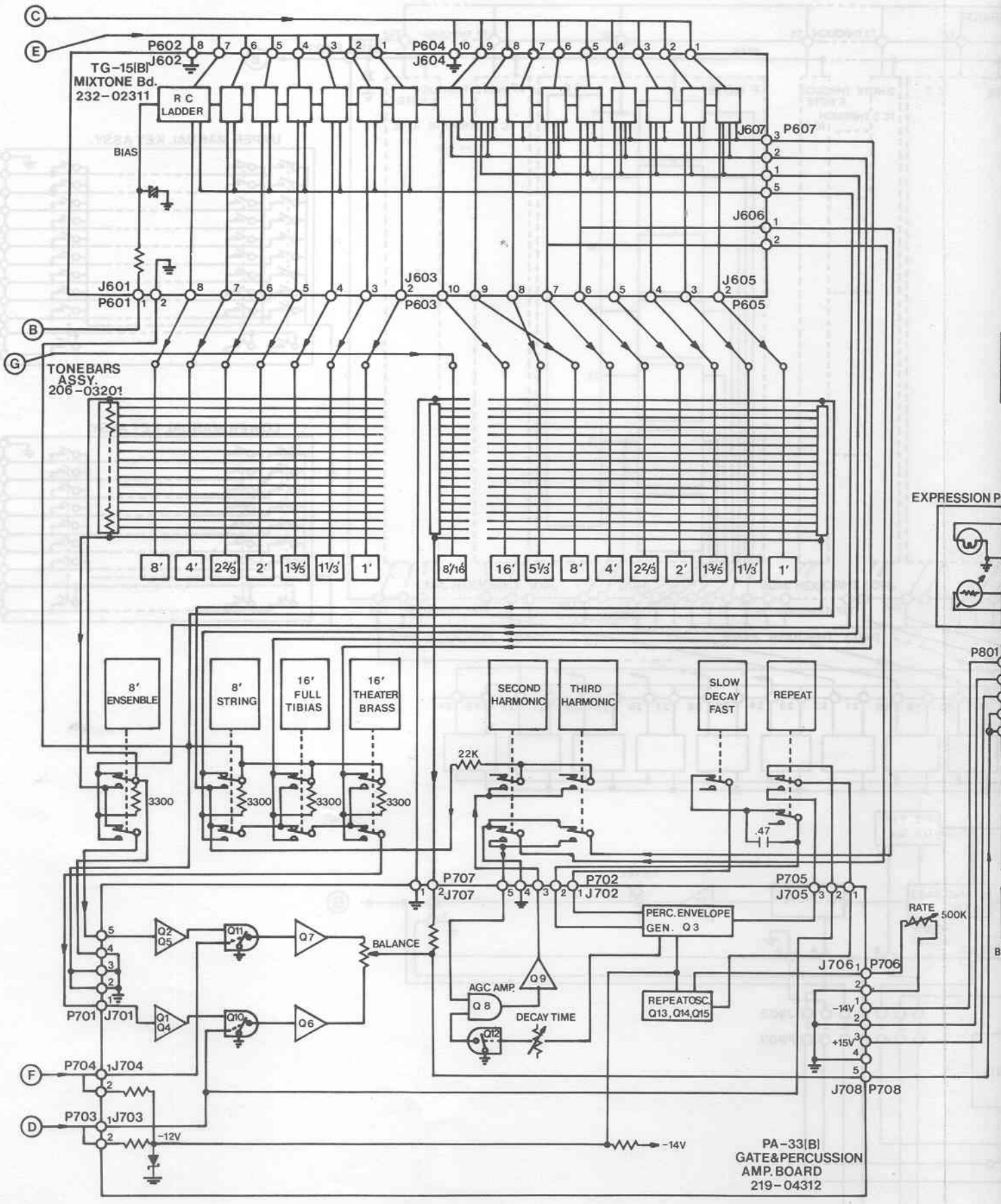
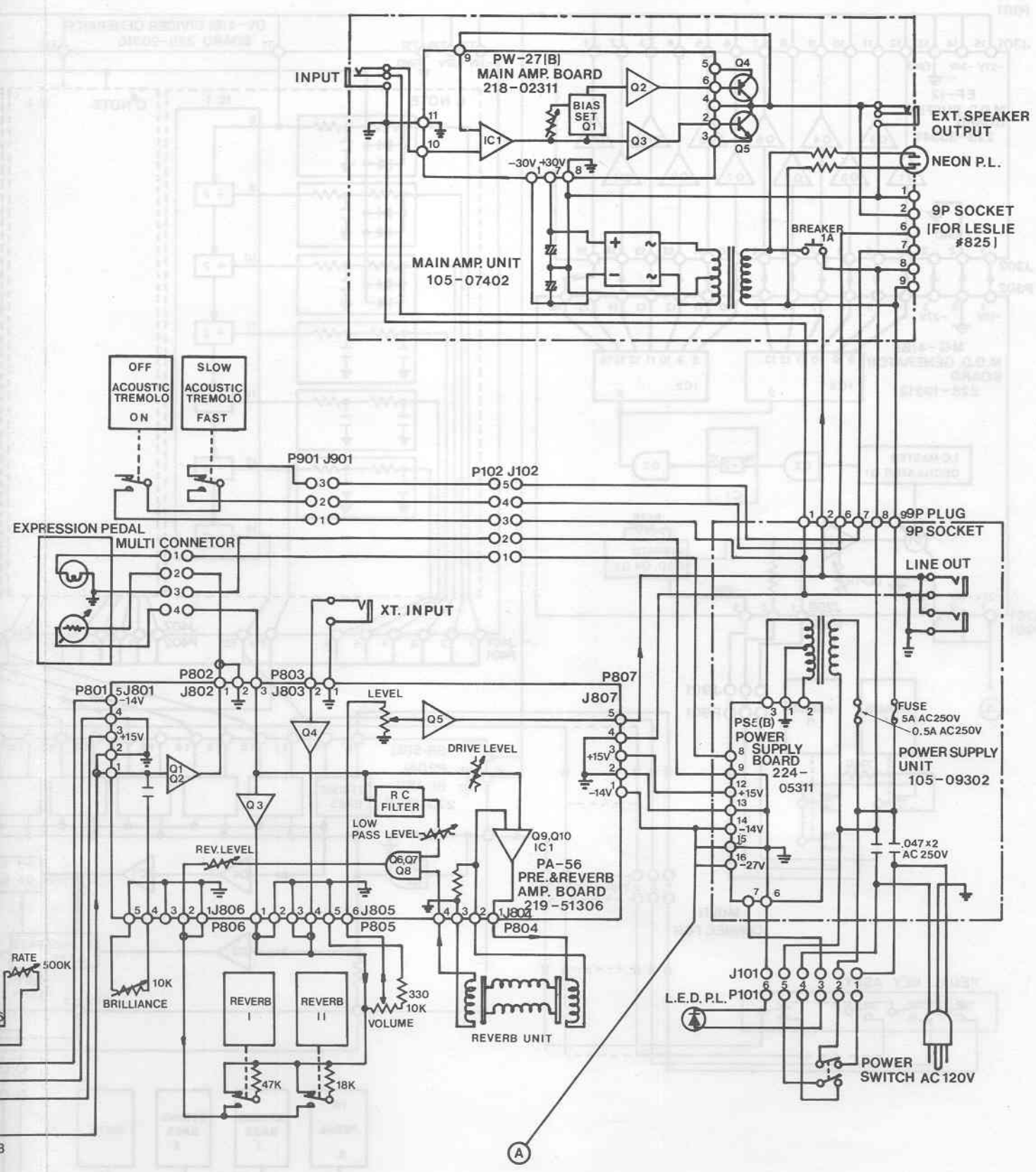


FIGURE 3-2  
LOGIC DIAGRAM (2-2)



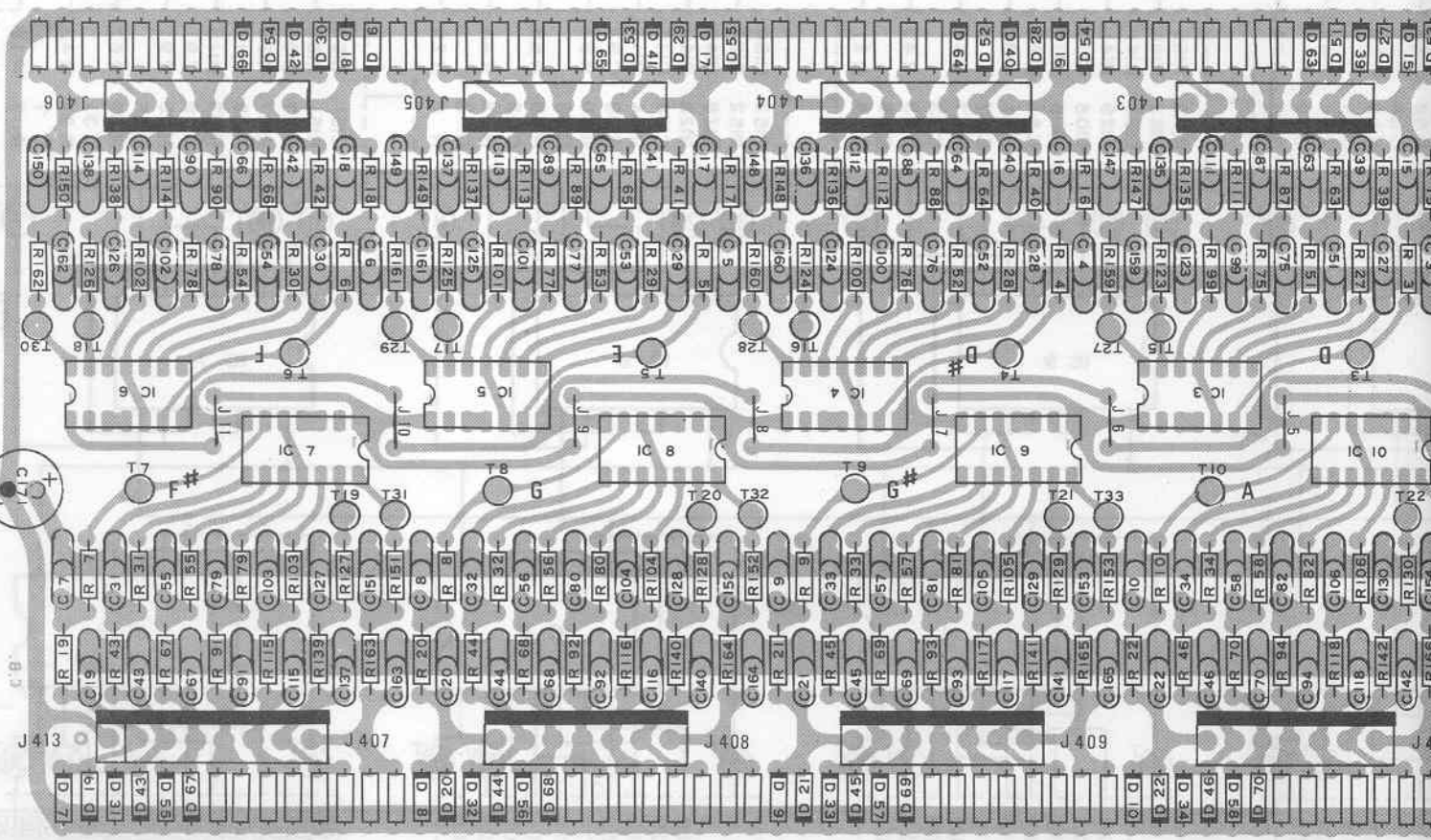
3

(A)

229-20316

DV-4-05A

A-229-20317



### DV-4(B) RC LIST

#### CAPACITORS

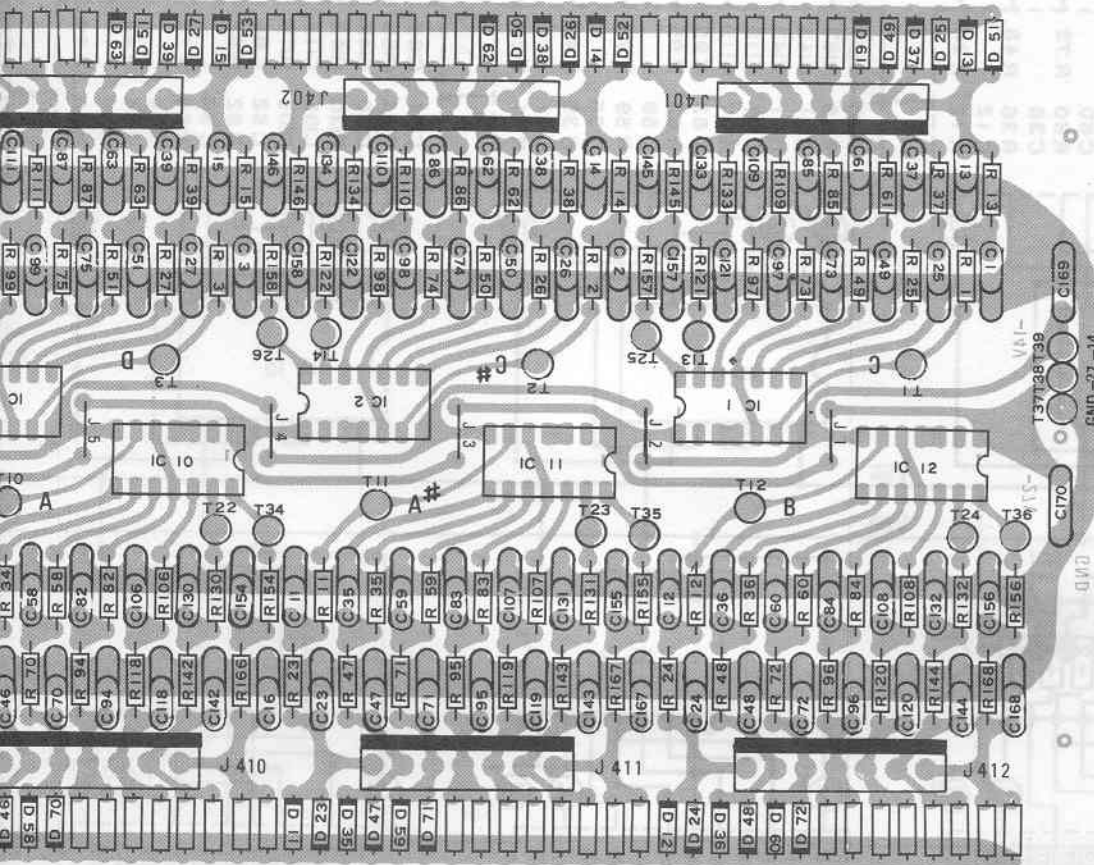
- .01 C95, 96
- .015 C80 thru 84, 39 thru 94
- .022 C10 thru 12, 75 thru 79, 85 thru 88
- .027 C8, 9, 34 thru 36, 73, 74, 108, 119, 120
- .033 C5 thru 7, 31 thru 33, 104 thru 107, 113 thru 118
- .039 C1 thru 4, 29, 30, 101 thru 103, 112
- .047 C25 thru 28, 98 thru 100, 109 thru 111
- .056 C58 thru 60, 97, 130 thru 132, 141 thru 144
- .068 C55 thru 57, 127 thru 129, 137 thru 140
- .082 C53, 54, 124 thru 126, 134 thru 136
- .1 C49 thru 52, 121 thru 123, 133, 150 thru 156, 162 thru 169

#### RESISTORS

- 560 R13 thru 24
- 1000 R37 thru 48, 61 thru 72
- 10K R1 thru 12
- 22K R25 thru 36, 49 thru 60
- 47K R73 thru 84, 86 thru 88, 94, 97 thru 133, 135, 137 thru 141, 143, 144, 151 thru 156, 162, 167, 168
- 56K R85, 89 thru 93, 95, 96, 134, 136, 142, 166
- 68K R165
- 82K R163, 164
- 100K R150

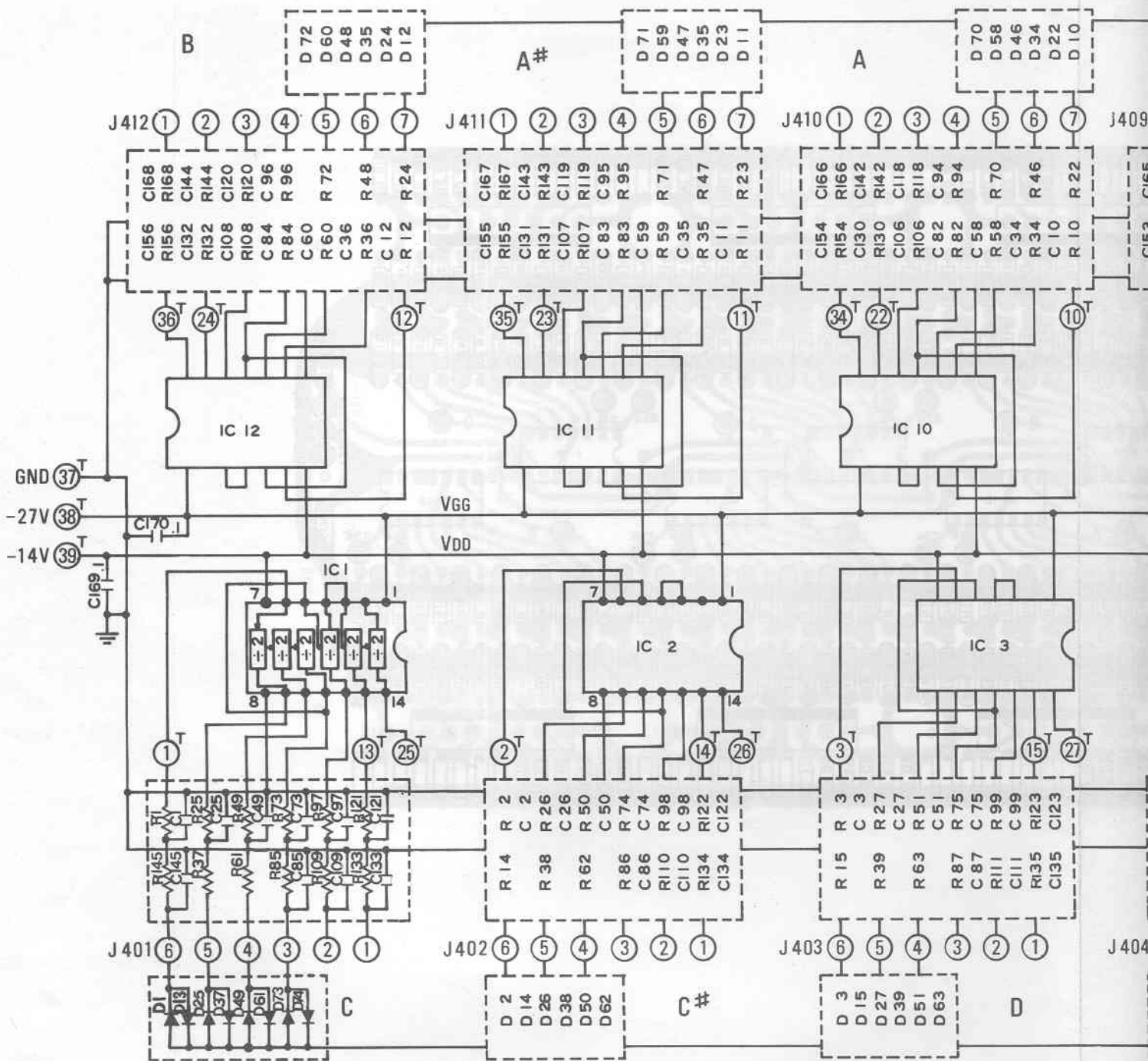
\*NOTES All capacitors are in microfarads,  $\pm 10\%$  50 volts.  
All resistors are in ohms,  $\pm 5\%$ ,  $\frac{1}{4}$  watt.





1. THROUGH-HOLE COMPONENTS ARE TO BE MOUNTED ON THE REVERSE SIDE OF THE BOARD.  
 2. ALL DIMENSIONS ARE IN MILLIMETERS.  
 3. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 4. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 5. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 6. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 7. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 8. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 9. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 10. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.

FIGURE 3-3  
 DV-4B (229-20316)  
 DIVIDER BOARD LAY OUT  
 & R.C. LIST



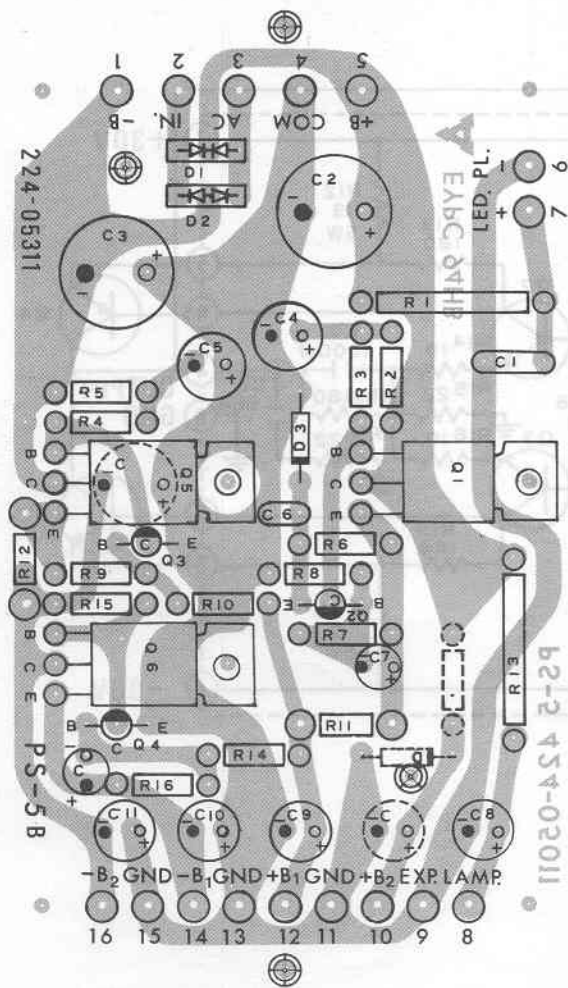
\* NOTES

- 1 D2 THROUGH D74 306-01017 1S2473 or 306-01005 1S1555  
IC1 THROUGH IC12, 319-01007 MM5824
- 2 UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.  
ALL CAPACITORS ARE IN MICROFARADS, AND  
C1 THROUGH C170 ARE USED MYLAR TYPE,  $\pm 10\%$ .
- 3 (1) SYMBOL DENOTES NUMBERS IN TERMINAL.  
(1) SYMBOL DENOTES NUMBERS IN PLUG.
- 4 C NOTE THROUGH E NOTE ARE 6 STAGES, AND  
F NOTE THROUGH B NOTE ARE 7 STAGES.  
CIRCUITS OF EACH NOTE ARE ALL SIMILARLY.

FIGURE 3-4  
DV-4B (229-20316)  
DIVIDER BOARD  
THEORY



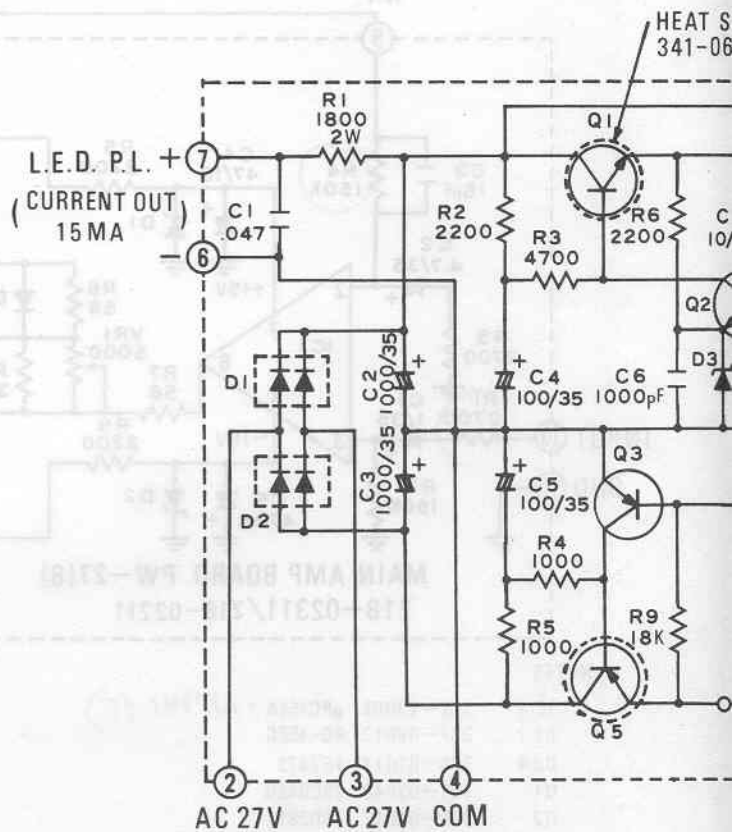




**PS-5(B) 224-05311  
POWER SUPPLY BOARD**

This board provides the power supply regulated circuits for the organ circuits.

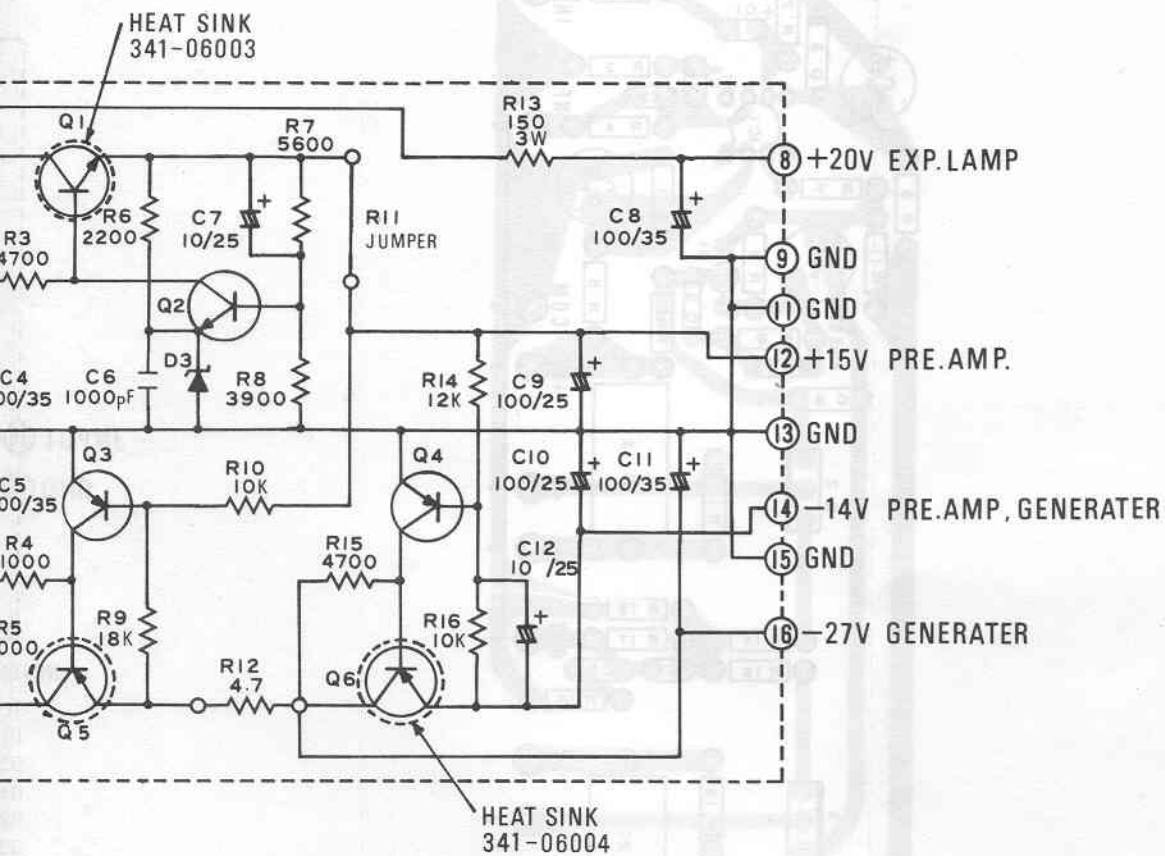
The outputs are unregulated for the LED Pilot light and Expression Pedal light, and the voltage outputs are regulated for the organ circuits. The current is about 15Ma for LED. on terminals 6 and 7, and about 100Ma for the Expression light on terminals 8 and 9. The voltage outputs are +15 volts, on terminal 12, -14 volts on terminal 14, and -27 volts on terminal 16; The output of +15 volts and -14 volts are used for the control and pre-amplifier, and the outputs of -14 volts and -27 volts are used for generators.



**\*NOTES**

- 1 D1 306-01023 1B2C1
- 2 D2 306-01024 1B2Z1
- 3 D3 337-02001 02Z-6.2A
- 4 Q1 305-03027 2SC1226A
- 5 Q2 305-03040 2SC945D
- 6 Q3.4 305-01008 2SA7330
- 7 Q5.6 305 01013 2SA490Y
- 8 UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS. ±5%. 1/4WATT.  
ALL CAPACITORS ARE IN MICROFARADS.
- 9 (1) SYMBOL DENOTES NUMBERS IN TERMINALS.

The regulated voltages are referenced from zener diode D3, its voltage is approximately +6 volts. The +15 volts is decided by resistor R7 and R8, the -14 volts is decided by resistor R14 and R16, and the -27 volts is decided by resistor R9 and R10. The resistor R12 protects the transistor Q5 and Q6 from over load.



1/4WATT.  
LEADS.  
ON TERMINALS.

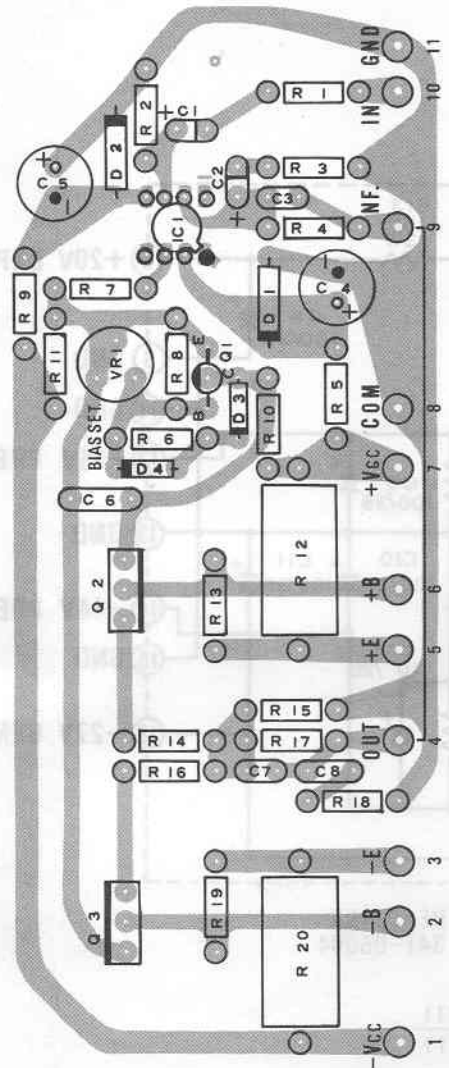
### 30 WATT POWER AMPLIFIER MODULE

The Amplifier is formed by two (2) stages. The first stage is a differential signal amplifier and the second stage is a voltage and power amplifier of the symmetrical push-pull type.

A full bridge amplifier (Operational Amplifier) used for the most accurate bridge the output is D.C. ground by compensating the tip of the output waveform. The circuit uses a symmetrical output section of a transformer to provide a balanced D.C. It is based on a 100/25/100/25 transformer. The bridge is connected to the 100/25 terminals. The output is taken from the 100/25 terminals.

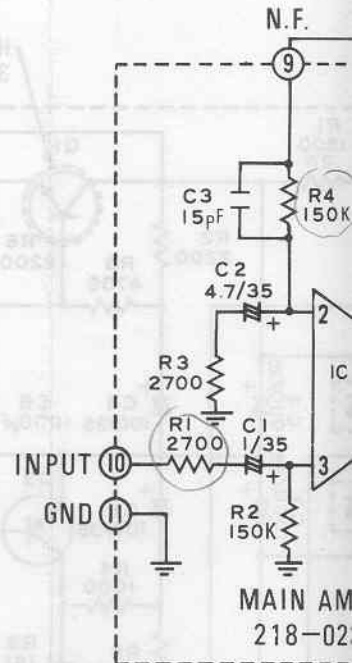
FIGURE 3-9  
PS-5(B) (224-05311)  
POWER SUPPLY BOARD  
LAYOUT & THEORY

Check R  
- R



B 72-MPB  
418-11031

K3510HB



\* NOTES

- 1 IC 1 319-23001  $\mu$ PC
- D1,2 337-06013 RD-
- D3,4 306-01017 1S2
- Q1 305-03040 2SC
- Q2 305-04012 2SD
- Q3 305-02010 2SB
- Q4 305-01009 2SA
- Q5 305-04011 2SD
- 2 RESISTORS (R5, R9, R13, R15, R16, R17, R18, R19)
- 3 UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS ALL CAPACITORS ARE IN MICROFARADS
- 4  $\text{\textcircled{1}}$  SYMBOL DENOTES NUMBER

30 WATT POWER AMPLIFIER MODULE

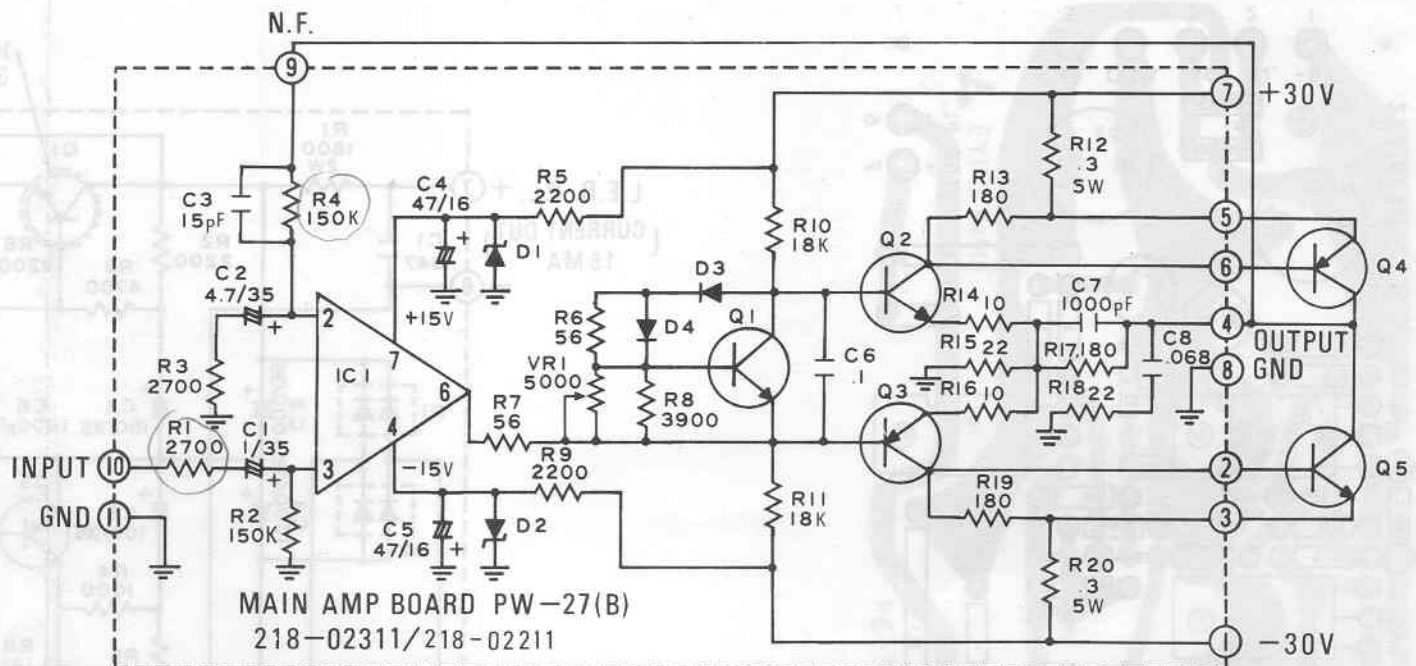
This Amplifier is formed by two (2) stages. The first stage is a differential voltage amplifier, and the second stage is a voltage and power amplifier of the symmetrical inverted darlington type.

A differential amplifier (Operational Amplifier) used for the input circuit keeps the output at D.C. ground by compensating the bias of the output transistors. This circuit makes symmetry-complementary output practical by eliminating the bias problems. I.C. 1 is biased equally to ground with R2 and R4. Since the load is connected to Pin 2 of I.C. 1 through R4, ground potential is achieved at the load.

The I.C. feedback path from the load to Pin 2 of I.C. 1 also presents a convenient way to apply A.C. feedback. The amount of feedback is controlled by R3 and R4 and their ratio determines the overall gain of the amplifier. The very high open loop gain, which permits the large negative feedback, is due to I.C. 1 which operates class A with D.C. to high frequency.

Two diodes, D1 and D2, are connected in series across the output terminals. This is an important feature. In order for the amplifier to operate properly, the voltage drops across the diodes must be taken into account. The voltage drop across the diodes plus the drop across the load must be less than the supply voltage. This current, which flows through the diodes, is approximately equal to the quiescent current. The quiescent current is adjusted by VR1. The counter-clockwise

Check R1 shal var 27KΩ  
 - R4 - - - 150KΩ



MAIN AMP BOARD PW-27(B)  
 218-02311/218-02211

NOTES

- 1 IC 1 319-23001 μPC151A = LM741 (S)
- D1,2 337-06013 RD-15EC
- D3,4 306-01017 1S2473
- Q1 305-03040 2SC9450
- Q2 305-04012 2SD381
- Q3 305-02010 2SB536
- Q4 305-01009 2SA627
- Q5 305-04011 2SD188
- 2 RESISTORS (R5, R9, R13, R15, R17, R19) ARE ±10%, 1/2 WATT.
- 3 UNLESS OTHERWISE SPECIFIED:  
 ALL RESISTORS ARE IN OHMS, ±5%, 1/4 WATT.  
 ALL CAPACITORS ARE IN MICROFARADS.
- 4 ① SYMBOL DENOTES NUMBERS IN TERMINALS

Pin 2 of  
 ply A.C.  
 olled by  
 overall  
 op gain,  
 s due to  
 to high

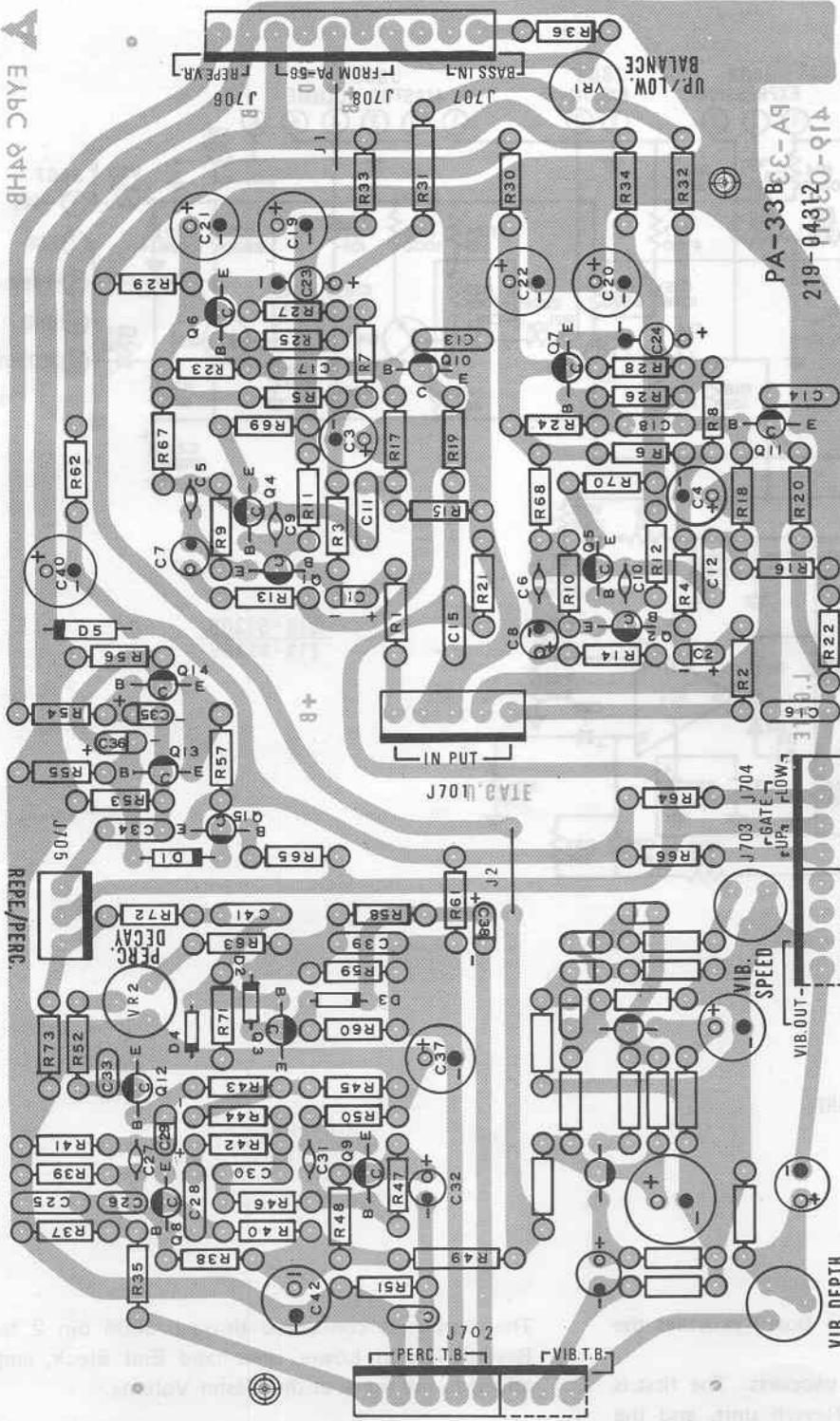
Two diodes, D3, and D4, and transistor Q1 represent part of the load seen by I.C. 1 and perform the important function of biasing the output transistors. In order for Q2 and Q3 to be biased on, the voltage drops across collector to emitter of Q1 must equal the voltage drops across the emitters Q2 and Q3 plus the drops across R14 and R16. The current through the Q1 is determined by R10 and R11, and this current, in turn, determines the voltage drop across the Q1 by VR1. A Q4, Q5 quiescent current of approximately 100Ma is necessary to prevent crossover distortion, then this current determines the voltage drop across R12, or R20, and the voltage is approximately 35 Mv. The quiescent current must be determined by adjusting VR1 to clockwise completely, and then counterclockwise to achieve 100Ma.

Transistors, Q2 and Q4, Q3 and Q5, are Inverted Darlington connected. Q2 and Q4 is like a NPN transistor, Q3 and Q5 is like a PNP transistor.

RC pad R18, and C8 across the load provides high frequency stabilization. C7 is high frequency compensation of second stage amplifier, and C3 is high frequency compensation of overall amplifier.

FIGURE 3-10  
 30W POWER AMP MODULE  
 (218-02311)  
 LAYOUT & THEORY

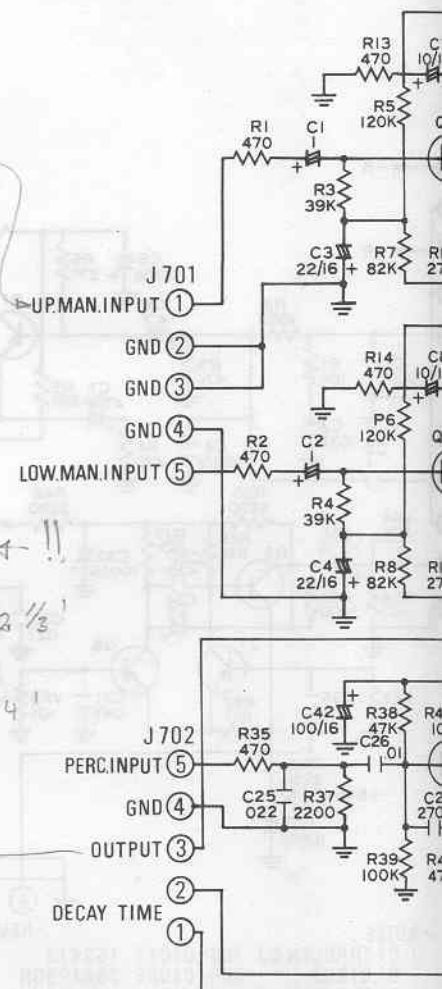




**PA-33(B) 219-04312  
GATE & PERCUSSION AMP. BOARD**

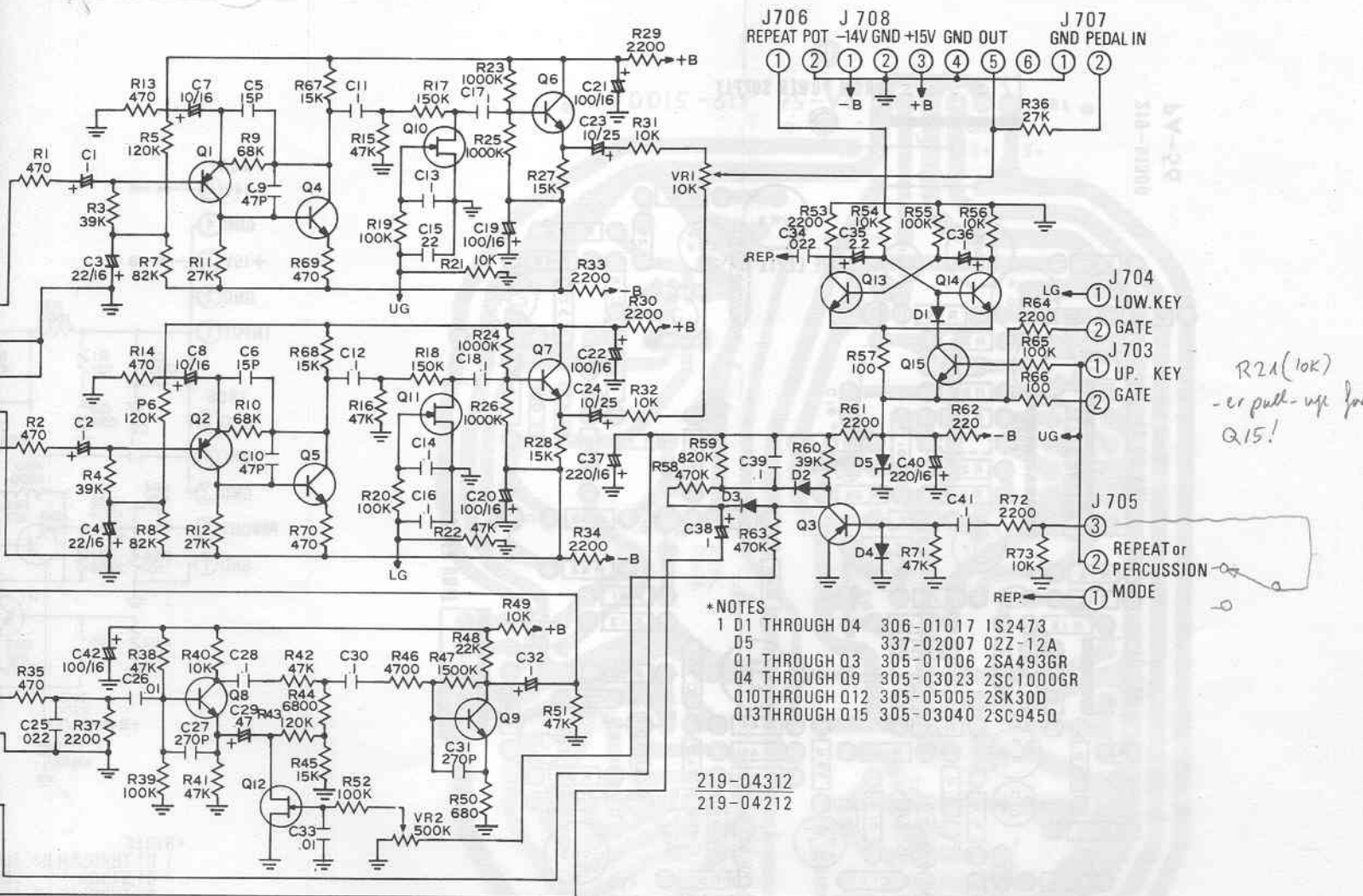
This board will be described in three sections: Section 1 will be the Gate Amplifiers for Upper Manual and Lower Manual, Section 2 will be the Voltage controlled amplifier for Percussion, and Section 3 will be the repeat oscillator for the percussion.

1. The signals is applied to J701 from Presets Tabs in Lower left-hand End Block. The signal of Upper Manual, (included Percussion), comes pin 1 of J701, and the signal of Lower Manual comes pin 5 of J701. These signals are amplified by Q1, and Q4, or Q2 and Q5, and these amplified signals are normally grounded by Q10 or Q11, and then if Manual Keys will be downed, through J703 or J704, the negative D.C. voltage is connected to UG point or LG point, and Q10 or Q11 is turned off. The signals



- \* NOTES  
 2 UNLESS OTHERWISE SPECIFIED:  
 ALL RESISTORS ARE IN OHMS ±5%  
 ALL CAPACITORS ARE IN MICROFARADS  
 USED TANTALUM.  
 3 ① SYMBOL DENOTES NUMBERS IN

appear th  
 emitter fo  
 are balan  
 through J  
 2. The se  
 Percussion  
 from Perc  
 and pin 5  
 The signa  
 controlled  
 amplified s  
 and to inp  
 The envel  
 Q3, Its d  
 through J  
 and pin 2  
 and if pin  
 decay tim  
 percussion



OTHERWISE SPECIFIED:  
 RESISTORS ARE IN OHMS, ±5%, 1/4WATT.  
 CAPACITORS ARE IN MICROFARADS; AND 1μF THROUGH 4.7μF ARE ALUM.  
 "L" DENOTES NUMBERS IN PLUG.

FIGURE 3-5  
 PA-33(B) (219-04312)  
 GATE & PERCUSSION AMP  
 BOARD LAYOUT & THEORY

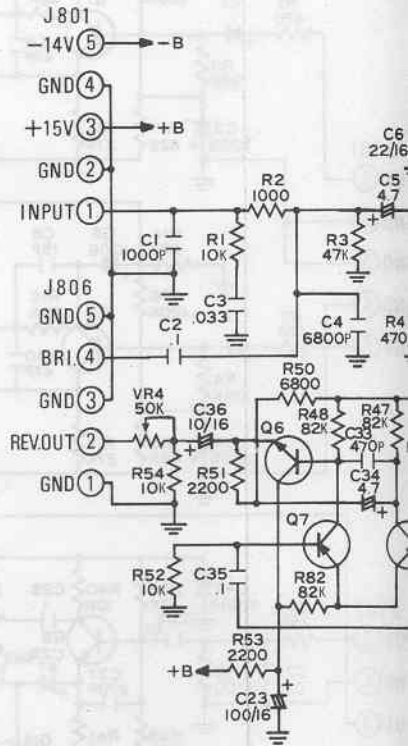
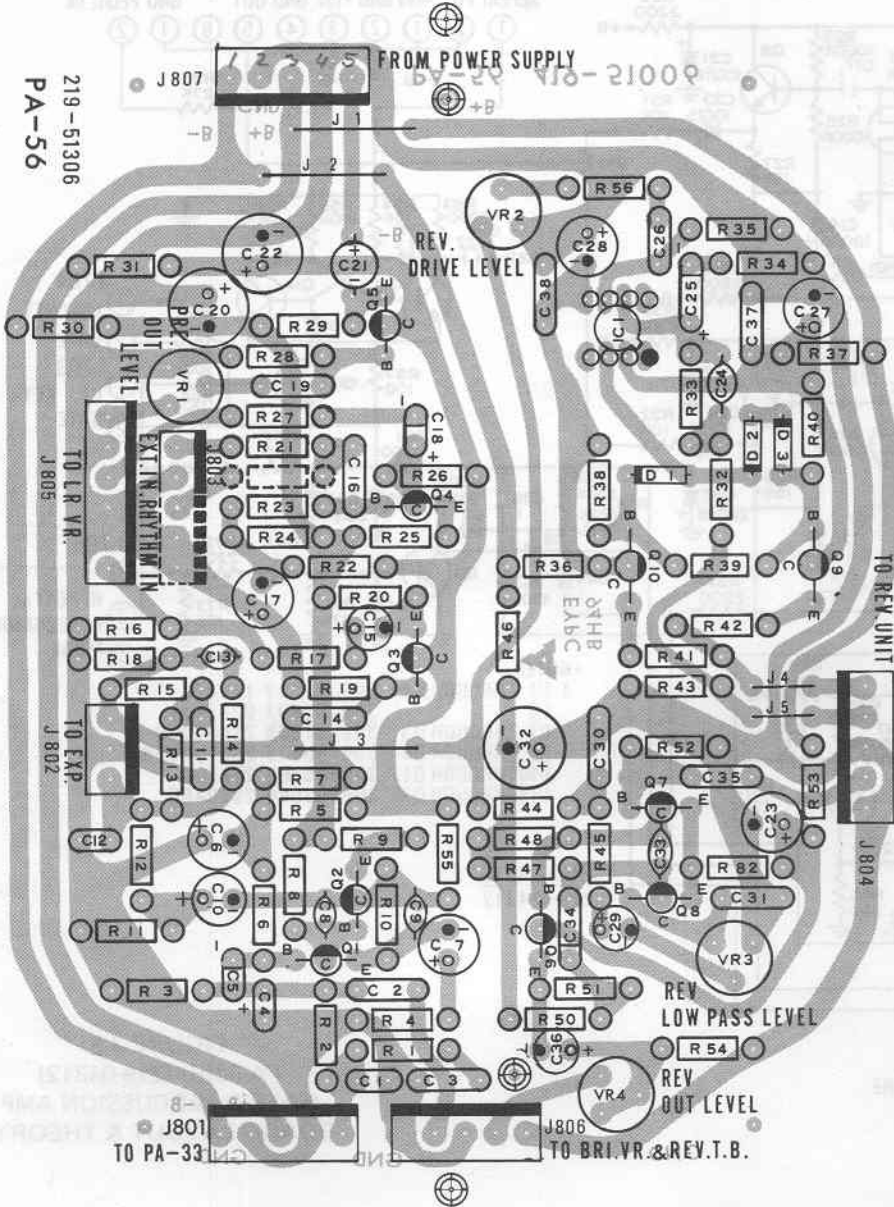
appear through Q6 or Q7 which is used as an emitter follower. The signals gated and amplified are balanced by VR1, and added Pedal signal through J707, and exit at J708 pin 5.

2. The second section of this board provides the Percussion signals. These signals are applied to J702 from Percussion Tabs in Lower left-hand End Block, and pin 5 is the input and pin 3 is the output. The signal is amplified by Q8, which gain is controlled by Q12. Q9 is buffer amplifier, and these amplified signal provide to add the Tone Bars signals, and to input the upper manual input in J701. The envelope of percussion signals is generated by Q3, Its decay time is controlled by Decay Tab through J702 pin 1 and pin 2 is switched; If pin 1 and pin 2 will be connected, the decay time is slow, and if pin 1 and pin 2 will be not connected, the decay time is fast. VR2 controls the off point of percussion signals.

If an upper manual key is depressed, the negative D.C. voltage is connected to J705 through Repeat Tab, and this voltage triggers Q3. Q3 is turned on, and charges up C38 or C39. This charging controls the envelope of percussion.

3. The third section of this board provides the repeat oscillator. The oscillator used is the self running multi vibrator type, Q15 is normally off, and the oscillator is stopped. If upper manual key is depressed, the negative D.C. voltage is connected to the base of Q15 through J703, and Q15 is turned on, and the oscillator runs. This output of osc. is connected J705 pin 3 through the Repeat Tab in Lower left-hand End Block. This output pulse triggers the transistor Q3, and then the percussion signals is repeated automatically. The repeat rate of this oscillator is controlled by Repeat Rate Pot, In Lower right-hand End Block through J706 in 1 and pin 2.

219-51306  
PA-56



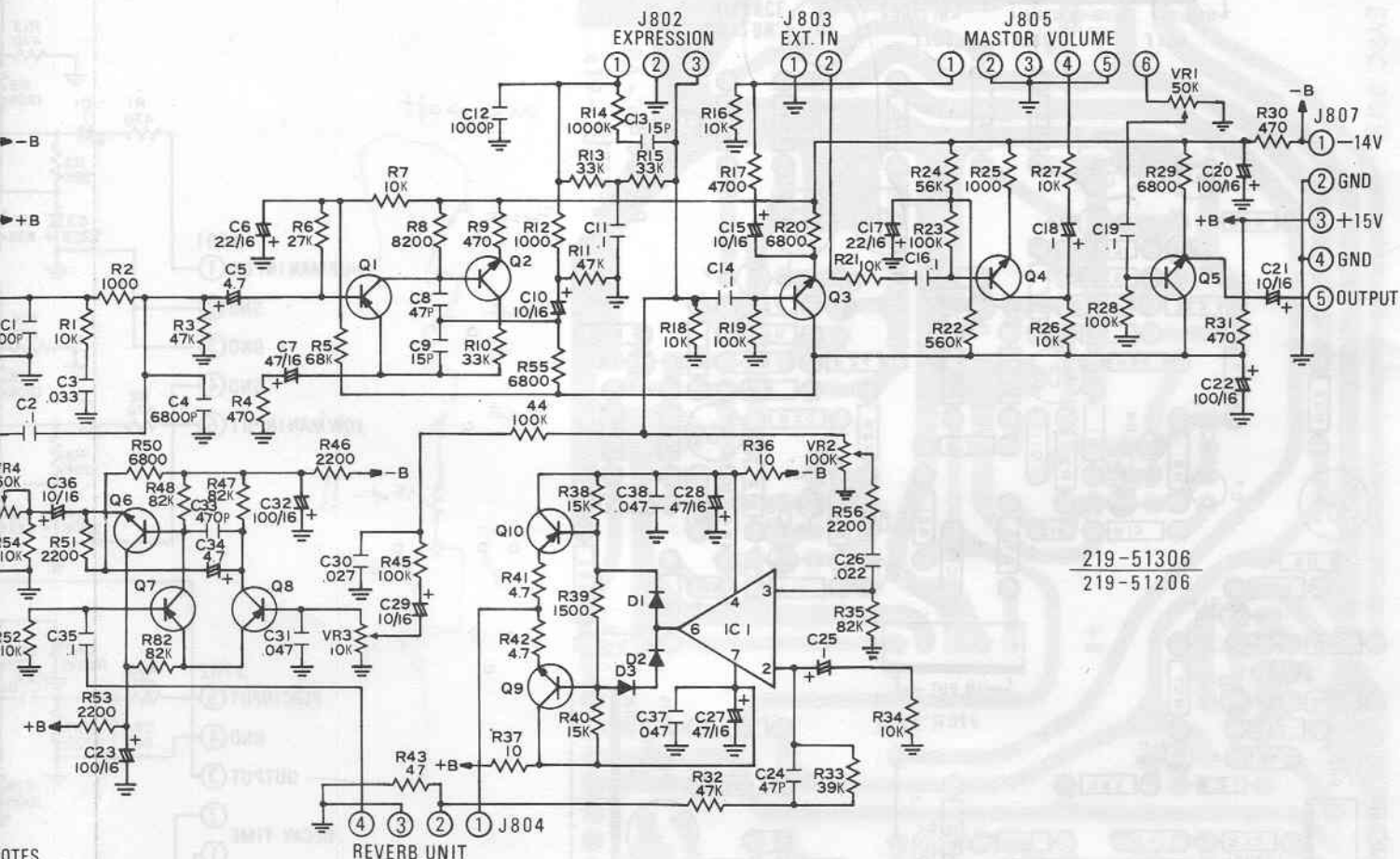
- \* NOTES
- 1 D1 THROUGH D3 306-01017
  - Q1, Q7 & Q8 305-01006
  - Q2 THROUGH Q6 305-03023
  - Q9 305-03041
  - Q10 305-01014
  - IC1 319-23001
  - 2 UNLESS OTHERWISE SPECIFIED  
ALL RESISTORS ARE IN OHMS  
ALL CAPACITORS ARE IN MICROFARADS  
USED TANTALUM.
  - 3 Ⓢ SYMBOL DENOTES NUMERICAL VALUE

**PA-56 219-51306  
PREAMP & REVERB AMPLIFIER BOARD**

This board will be described in two sections: Section 1 will be the Pre Amplifier for the Expression and the Output of The Main Amplifier and Line. Section 2 will be the Reverb Amplifier.

1. The signals from PA-33(B) and the power supply to PA-33(B) are connected to J801. This signal is amplified by transistors Q1 and Q2, and connected to Expression Pedal through J802, and the volume of this signal is controlled by Exp. Pedal. This signal through transistor Q3 is added to Ext. Input signal amplified by Q4 on Master Volume in Lower right-hand End Block, and the signal is output through Q5, its level set by VR1. The Brilliance Pot. is connected to J806 pin 4, The Brilliance Pot. is located on Lower right-hand End Block.





219-51306  
219-51206

- NOTES
- D1 THROUGH D3 306-01017 1S2473
  - Q1, Q7 & Q8 305-01006 2SA4936R
  - Q2 THROUGH Q6 305-03023 2SC1000GR
  - Q9 305-03041 2SC509Y
  - Q10 305-01014 2SA509Y
  - IC1 319-23001  $\mu$ PC151A
- UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.  
ALL CAPACITORS ARE IN MICROFARADS, AND  $1\mu F$  THROUGH  $4.7\mu F$  ARE USED TANTALUM.
- ① SYMBOL DENOTES NUMBERS IN PLUG.

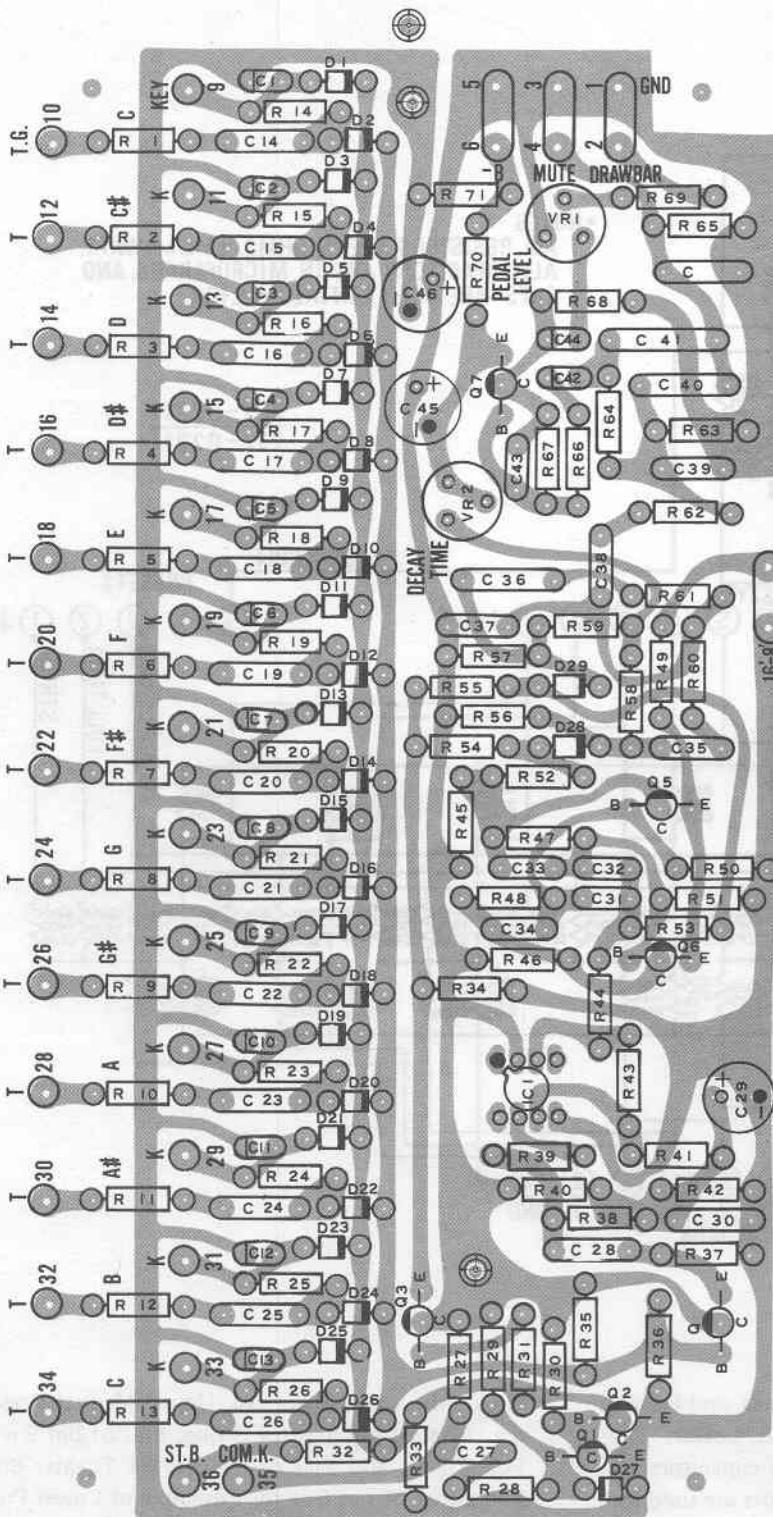
2. The second section of this board provides the reverberation signal.

This section is formed from twoparts: The first is the amplifier drive for the Reverb unit, and the second is the amplifier to pickup the Reverb unit. The drive amplifier Feeds the current drive type I.C. 1, Q9, and Q10. That level setting is controlled by VR2. The Resistor R43 provides feedback current. The pickup amplifier is formed by the differential amplifier Q6 through Q8. The low frequency passed filter is formed by R44, R45, VR3, C30, and C31 And this level is controlled by VR3. The output level is controlled by VR4. The Reverb Unit is connected through J804.

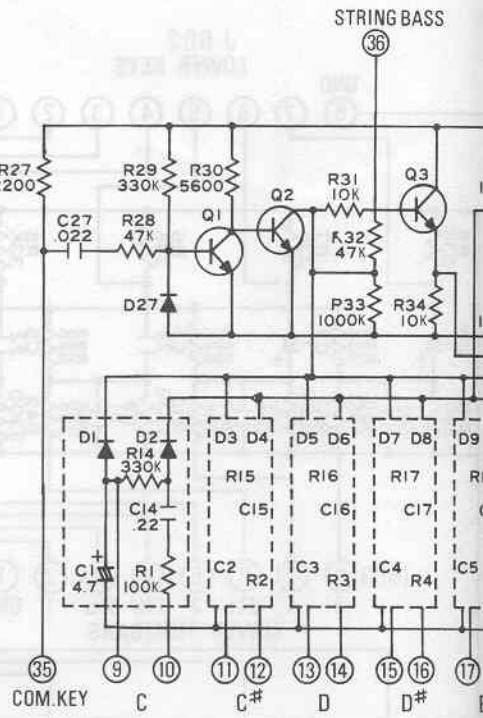
The output is connected through J806 pin 2 to Reverb Tab in Lower right-hand End Block, and added to the signal at the Master Volume.

The connector J805 is for Master Volume, and The connector J807 is for the output and the power supply connections.

FIGURE 3-6  
PA-56 (219-51306)  
PRE. & REVERB AMP BOARD  
LAYOUT & THEORY



EYBC 04HB  
2B-B5-B5  
453-01821-027



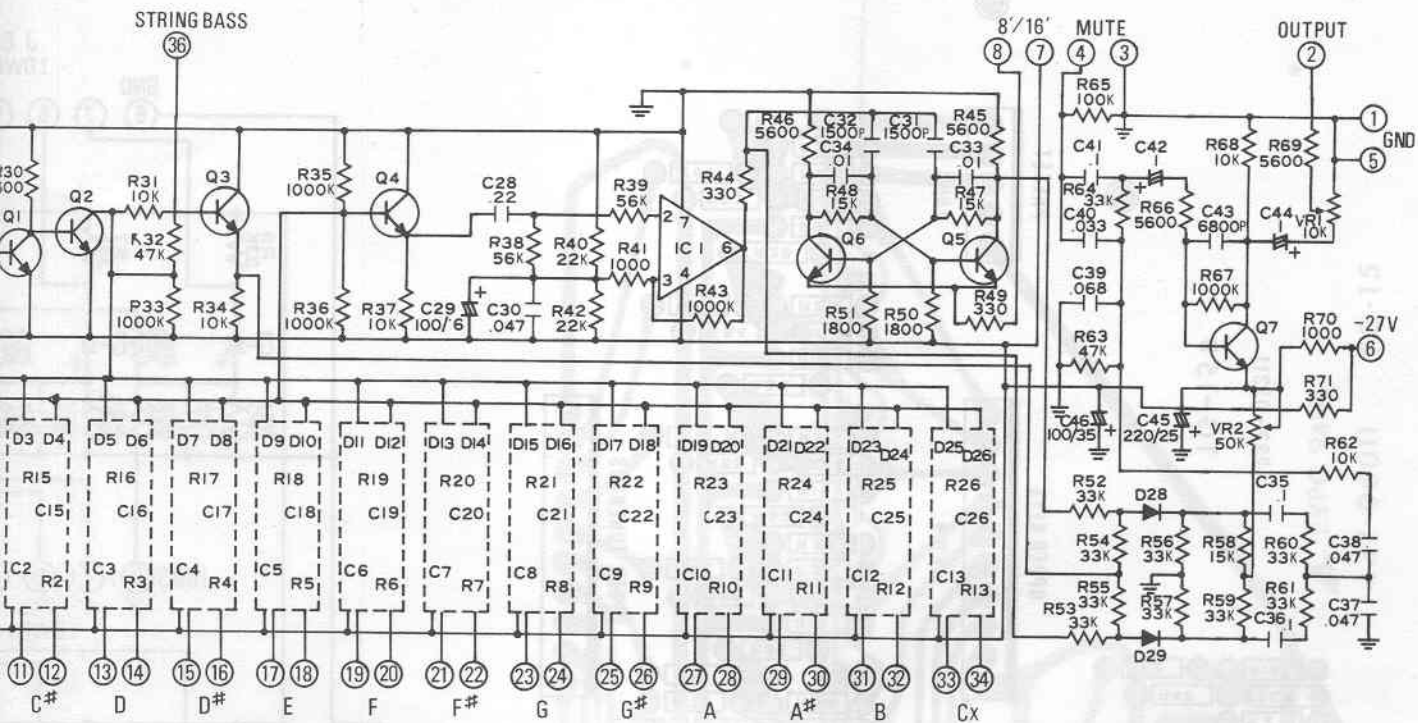
- \* NOTES
- D1 THROUGH D29 306-01017 1S2473  
Q1 THROUGH Q6 305-03002 2SC8280 or  
Q7 305-03023 2SC1000G  
IC1 319-23001  $\mu$ PC151A
  - UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS,  $\pm 5\%, 1/4W$   
ALL CAPACITORS ARE IN MICROFARADS:  $\mu$
  - Ⓢ SYMBOL DENOTES NUMBERS IN TERM  
Ⓢ SYMBOL DENOTES SAME CIRCUIT.

SB-5(B) 223-17  
PEDAL BOARD

This board provides...  
Signals with sus...

The clocks from...  
input on terminal...  
T22, T24, T26...  
Keys are connecte...  
T15, T17, T19,...  
and T35. The...  
This Pedal Key...  
Select, and 1 c...

This section is...  
other notes are...  
the terminal T...  
and the capacit...  
R27. The curr...  
Q1 and Q2...  
capabilities of...  
and D25, before...  
This envelope...  
D1 and R33 or...  
Bass Tabs in L...  
the-envelope of



D29 306-01017 1S2473  
 Q6 305-03002 2SC8280 OR 305-03040 2SC9450  
 305-03023 2SC1000GR  
 319-23001  $\mu$ PC151A  
 OTHERWISE SPECIFIED:  
 RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.  
 CAPACITORS ARE IN MICROFARADS; AND  $1\mu$ F THROUGH  $4.7\mu$ F ARE USED TANTALUM,  $\pm 10\%$ .  
 L DENOTES NUMBERS IN TERMINALS.  
 L DENOTES SAME CIRCUIT.

### SB-5(B) 223-17311 PEDAL BOARD

This board provides the 13 Pedal (Bass) Notes Signals with sustain (String Bass) or without Sustain.

The clocks from DV-4(B) Generator Board are input on terminals T10, T12, T14, T16, T18, T20, T22, T24, T26, T28, T30, T32, and T34. The Pedal Keys are connected on the terminals T9, T11, T13, T15, T17, T19, T21, T23, T25, T27, T29, T31, T33, and T35. The terminal T35 is for common key. This Pedal Keyer assembly is wired with High Note Select, and 1 contact of key connected to common.

This section is illustrated by only one note, the other notes are all as same. If Pedal key is depressed, the terminal T9 is connected to the common T35, and the capacitor C1 is charged up through resistor R27. The current through R27 switches transistors Q1 and Q2 to turned on, and discharges all capabilities of capacitors through diode, D1, D3, — and D25, before the capacitor C1 will be charged up. This envelope of the discharging capacitors through D1 and R33 or R33 and R31 added through String Bass Tabs in Lower right-hand End Block provides the envelope of the sustain.

The clock is gated by D2, and amplified by Q4 and I.C. 1, and this signal is divided by flip-flop of Q5 and Q6; But if the T7 and T8 are not connected through Pedal Tab 8'/16', the flip-flop is not operated. These amplified and divided signals are gated on D28 and D29 by the D.C. voltages amplified by Q3. The decay time of the Sustain envelope is controlled by VR2.

Next, those gated signals are amplified by Q7, filtered, and output to Pedal Tone Bar on Terminal T2, and its output level is controlled by VR1.

FIGURE 3-7  
 SB-5(B) (223-17311)  
 PEDAL BOARD  
 LAYOUT & THEORY

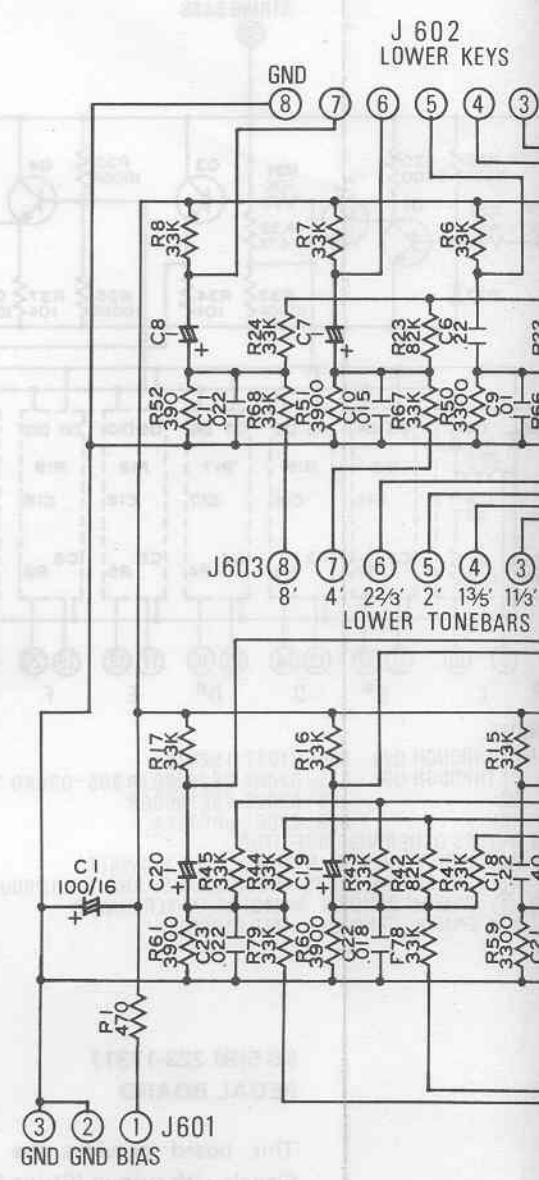
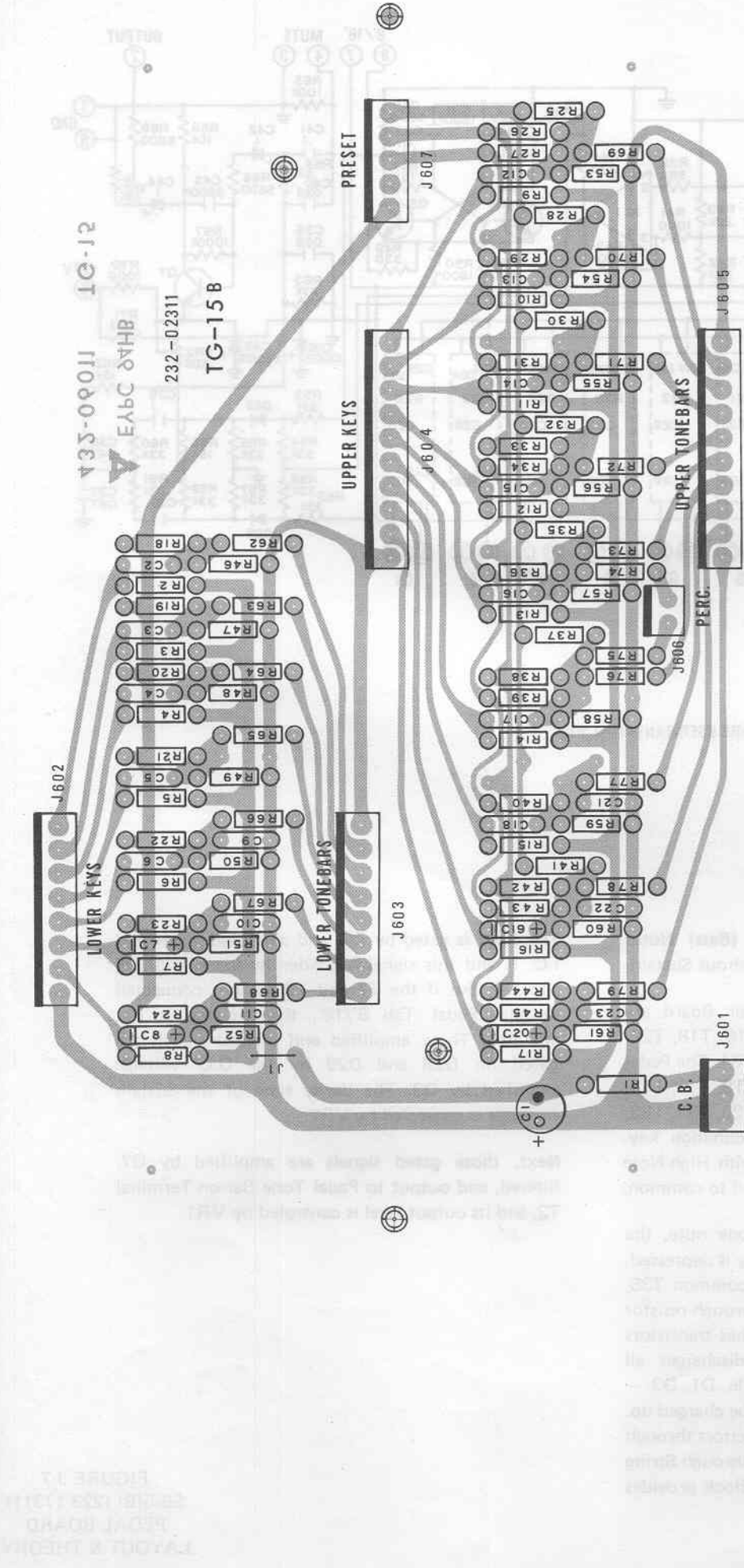
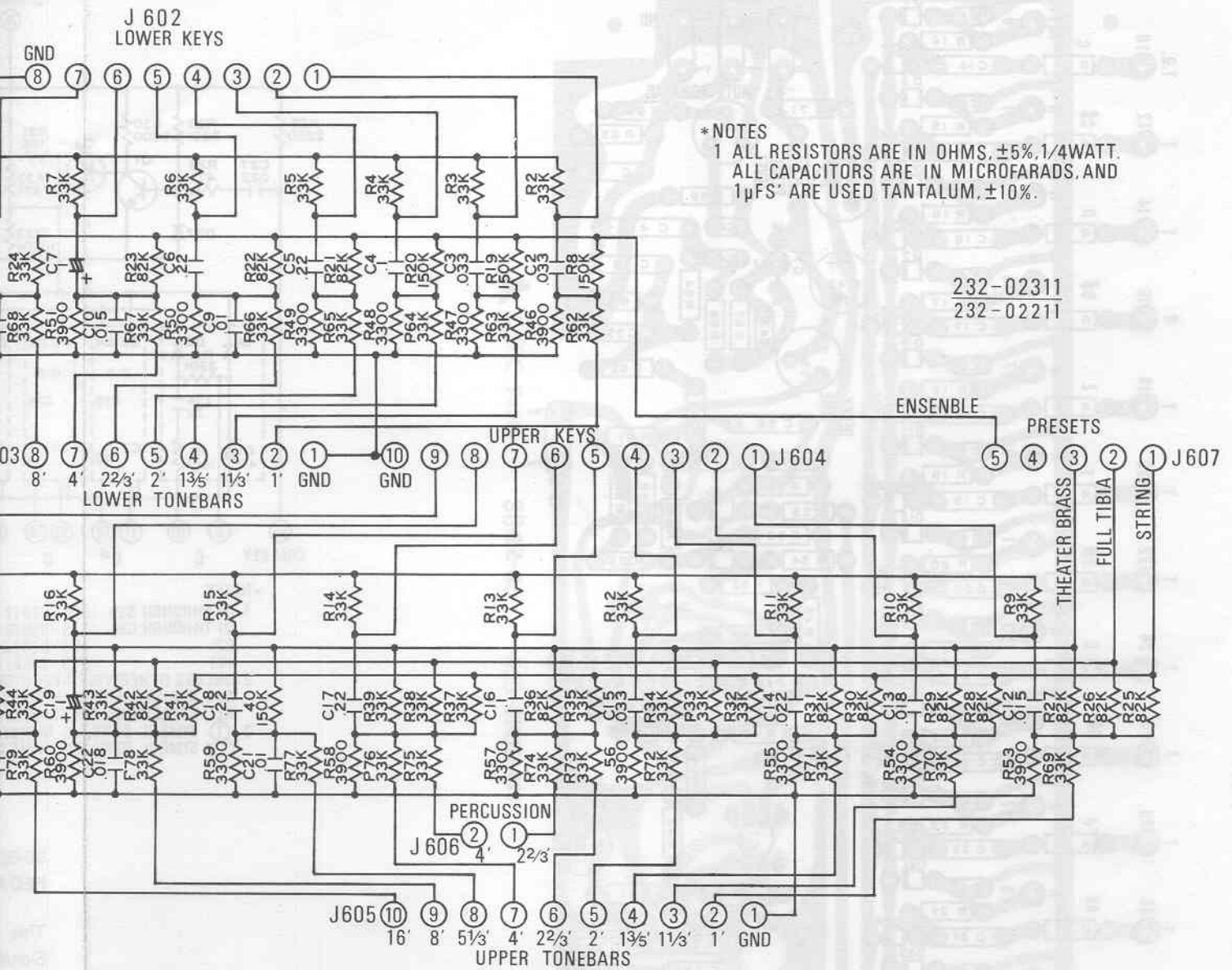


FIGURE 12  
REAR BOARD  
LAYOUT & THEORY

The section is illustrated by only one wire. The other wire is connected to the common tone bar. The current through R22, R23, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159, R160, R161, R162, R163, R164, R165, R166, R167, R168, R169, R170, R171, R172, R173, R174, R175, R176, R177, R178, R179, R180, R181, R182, R183, R184, R185, R186, R187, R188, R189, R190, R191, R192, R193, R194, R195, R196, R197, R198, R199, R200, R201, R202, R203, R204, R205, R206, R207, R208, R209, R210, R211, R212, R213, R214, R215, R216, R217, R218, R219, R220, R221, R222, R223, R224, R225, R226, R227, R228, R229, R230, R231, R232, R233, R234, R235, R236, R237, R238, R239, R240, R241, R242, R243, R244, R245, R246, R247, R248, R249, R250, R251, R252, R253, R254, R255, R256, R257, R258, R259, R260, R261, R262, R263, R264, R265, R266, R267, R268, R269, R270, R271, R272, R273, R274, R275, R276, R277, R278, R279, R280, R281, R282, R283, R284, R285, R286, R287, R288, R289, R290, R291, R292, R293, R294, R295, R296, R297, R298, R299, R300, R301, R302, R303, R304, R305, R306, R307, R308, R309, R310, R311, R312, R313, R314, R315, R316, R317, R318, R319, R320, R321, R322, R323, R324, R325, R326, R327, R328, R329, R330, R331, R332, R333, R334, R335, R336, R337, R338, R339, R340, R341, R342, R343, R344, R345, R346, R347, R348, R349, R350, R351, R352, R353, R354, R355, R356, R357, R358, R359, R360, R361, R362, R363, R364, R365, R366, R367, R368, R369, R370, R371, R372, R373, R374, R375, R376, R377, R378, R379, R380, R381, R382, R383, R384, R385, R386, R387, R388, R389, R390, R391, R392, R393, R394, R395, R396, R397, R398, R399, R400, R401, R402, R403, R404, R405, R406, R407, R408, R409, R410, R411, R412, R413, R414, R415, R416, R417, R418, R419, R420, R421, R422, R423, R424, R425, R426, R427, R428, R429, R430, R431, R432, R433, R434, R435, R436, R437, R438, R439, R440, R441, R442, R443, R444, R445, R446, R447, R448, R449, R450, R451, R452, R453, R454, R455, R456, R457, R458, R459, R460, R461, R462, R463, R464, R465, R466, R467, R468, R469, R470, R471, R472, R473, R474, R475, R476, R477, R478, R479, R480, R481, R482, R483, R484, R485, R486, R487, R488, R489, R490, R491, R492, R493, R494, R495, R496, R497, R498, R499, R500, R501, R502, R503, R504, R505, R506, R507, R508, R509, R510, R511, R512, R513, R514, R515, R516, R517, R518, R519, R520, R521, R522, R523, R524, R525, R526, R527, R528, R529, R530, R531, R532, R533, R534, R535, R536, R537, R538, R539, R540, R541, R542, R543, R544, R545, R546, R547, R548, R549, R550, R551, R552, R553, R554, R555, R556, R557, R558, R559, R560, R561, R562, R563, R564, R565, R566, R567, R568, R569, R570, R571, R572, R573, R574, R575, R576, R577, R578, R579, R580, R581, R582, R583, R584, R585, R586, R587, R588, R589, R590, R591, R592, R593, R594, R595, R596, R597, R598, R599, R600, R601, R602, R603, R604, R605, R606, R607, R608, R609, R610, R611, R612, R613, R614, R615, R616, R617, R618, R619, R620, R621, R622, R623, R624, R625, R626, R627, R628, R629, R630, R631, R632, R633, R634, R635, R636, R637, R638, R639, R640, R641, R642, R643, R644, R645, R646, R647, R648, R649, R650, R651, R652, R653, R654, R655, R656, R657, R658, R659, R660, R661, R662, R663, R664, R665, R666, R667, R668, R669, R670, R671, R672, R673, R674, R675, R676, R677, R678, R679, R680, R681, R682, R683, R684, R685, R686, R687, R688, R689, R690, R691, R692, R693, R694, R695, R696, R697, R698, R699, R700, R701, R702, R703, R704, R705, R706, R707, R708, R709, R710, R711, R712, R713, R714, R715, R716, R717, R718, R719, R720, R721, R722, R723, R724, R725, R726, R727, R728, R729, R730, R731, R732, R733, R734, R735, R736, R737, R738, R739, R740, R741, R742, R743, R744, R745, R746, R747, R748, R749, R750, R751, R752, R753, R754, R755, R756, R757, R758, R759, R760, R761, R762, R763, R764, R765, R766, R767, R768, R769, R770, R771, R772, R773, R774, R775, R776, R777, R778, R779, R780, R781, R782, R783, R784, R785, R786, R787, R788, R789, R790, R791, R792, R793, R794, R795, R796, R797, R798, R799, R800, R801, R802, R803, R804, R805, R806, R807, R808, R809, R810, R811, R812, R813, R814, R815, R816, R817, R818, R819, R820, R821, R822, R823, R824, R825, R826, R827, R828, R829, R830, R831, R832, R833, R834, R835, R836, R837, R838, R839, R840, R841, R842, R843, R844, R845, R846, R847, R848, R849, R850, R851, R852, R853, R854, R855, R856, R857, R858, R859, R860, R861, R862, R863, R864, R865, R866, R867, R868, R869, R870, R871, R872, R873, R874, R875, R876, R877, R878, R879, R880, R881, R882, R883, R884, R885, R886, R887, R888, R889, R890, R891, R892, R893, R894, R895, R896, R897, R898, R899, R900, R901, R902, R903, R904, R905, R906, R907, R908, R909, R910, R911, R912, R913, R914, R915, R916, R917, R918, R919, R920, R921, R922, R923, R924, R925, R926, R927, R928, R929, R930, R931, R932, R933, R934, R935, R936, R937, R938, R939, R940, R941, R942, R943, R944, R945, R946, R947, R948, R949, R950, R951, R952, R953, R954, R955, R956, R957, R958, R959, R960, R961, R962, R963, R964, R965, R966, R967, R968, R969, R970, R971, R972, R973, R974, R975, R976, R977, R978, R979, R980, R981, R982, R983, R984, R985, R986, R987, R988, R989, R990, R991, R992, R993, R994, R995, R996, R997, R998, R999, R1000.





**TG-15(B) 232-02311  
MIXTONE BOARD**

This board provides the Tone Bars tones, and Presets Tones of each Manuals, upper and Lower. The circuits make up an RC ladder: The capacitors are used for D.C. bias cut, and the resistors are used for the signals added.

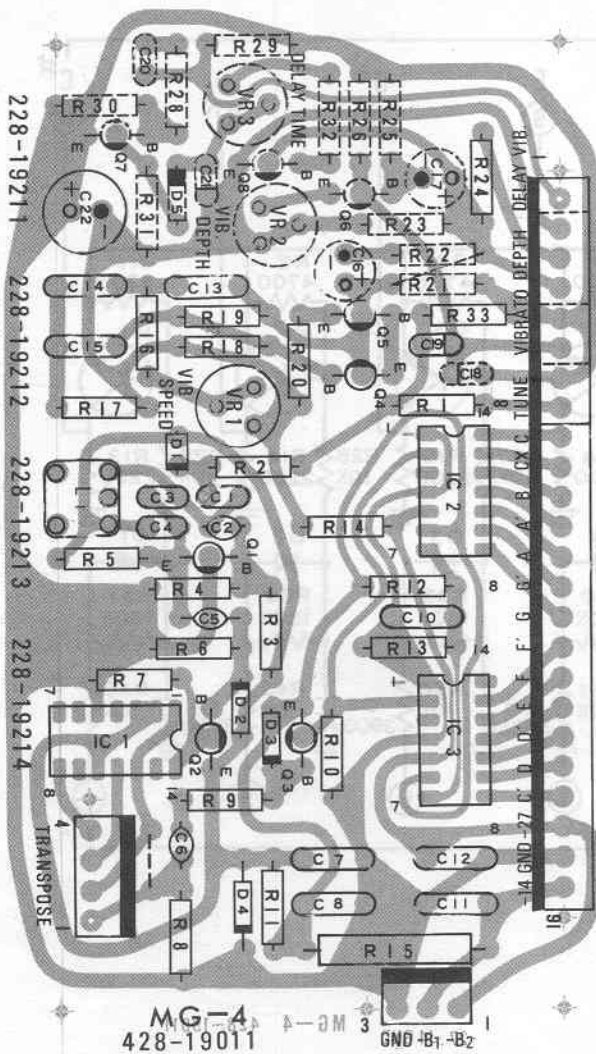
The signal inputs are to J602 and J604, through each manual; J602 is for Lower Manual, and J604 is for upper Manual.

The output signals leave on J603, J605, J606, and J607: J603 is used for Lower Tone Bars, J605 is used for Upper Tone Bars, J606 is used for Percussion, and J607 is used for Presets Tones.

Pin 1 thru pin 3 are for Upper Manual Presets, the signal of pin 1 is for String, that of pin 2 is for Full Tibias, and that of pin 3 is for Theater Brass. The signal of pin 5 is for Ensemble of Lower Preset. The signal of J606 pin 1 is for Third Harmonic, and that of J606 pin 2 is for Second Harmonic.

J601 is fed a negative D.C. voltage from DV-4(B) Divider Generator. This voltage is used for the bias, and the voltage is about -7 volts D.C.

FIGURE 3-8  
TG-15(B) (232-02311)  
MIXTONE BOARD  
LAYOUT & THEORY



### MDD GENERATOR-TWO PACKAGE SYSTEM VIBRATOABLE

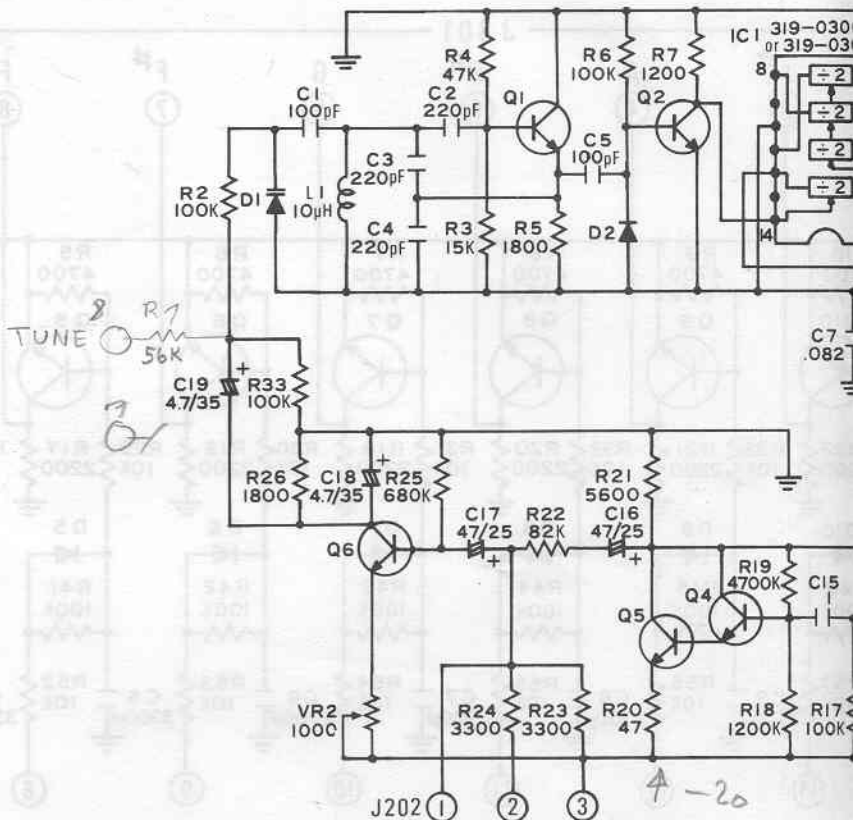
#### LC Oscillator With Vibrato

Assembly MG-4(B) includes a vibrato oscillator, vibrato circuitry, and a high frequency LC oscillator used to drive the MDD generator.

The vibrato oscillator is a phase shift type, comprised of C13, C14, C15, R16, R17, R18, R19, R20, R21, VR1, Q4, and Q5. VR1 is used to adjust the oscillator's frequency. The vibrato signal is coupled through C16, R22, and C17 to the base of transistor Q6, where it is amplified. (Its width being controlled by VR2.)

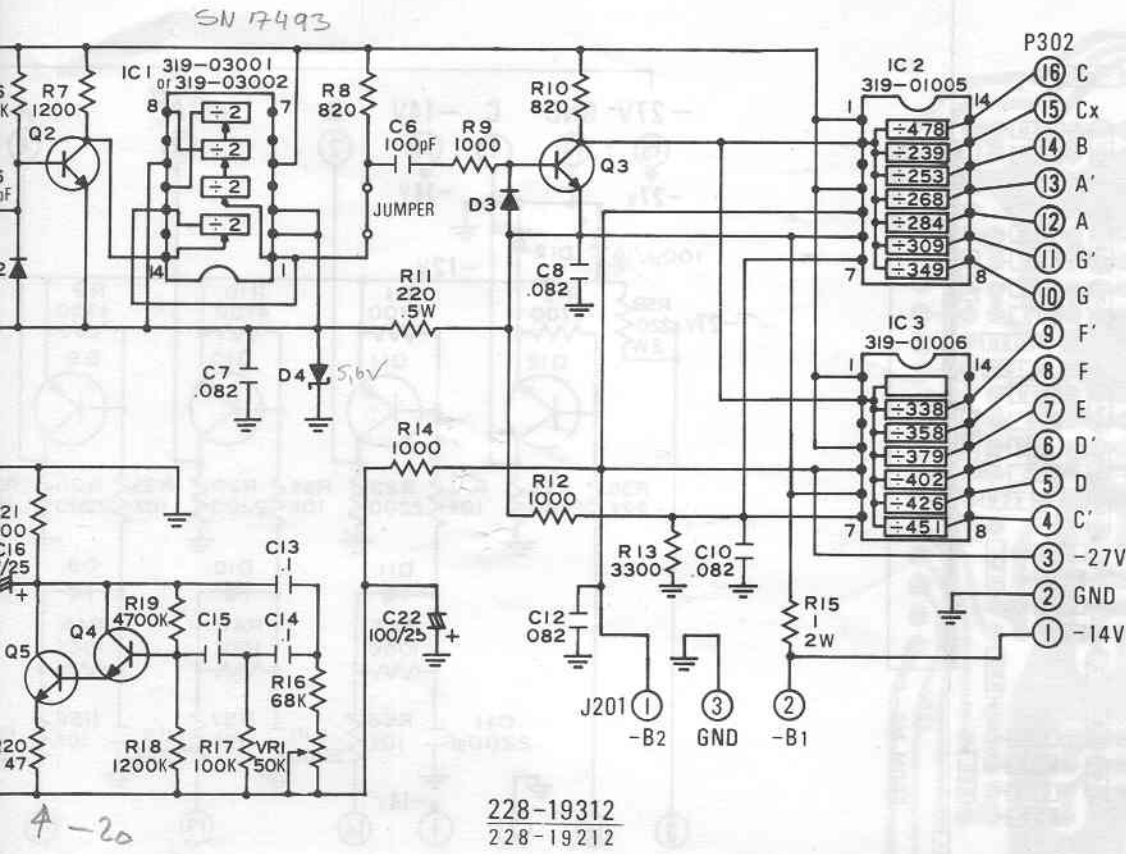
Vibrato may be turned off by connecting J202-1 to -20V (J202-3), and may be reduced for "Vibrato I or Vibrato II" by connecting R24 through J202-2 to -20V. To achieve a better sine wave the vibrato signals is filtered by C18 and is then coupled to the LC oscillator circuitry by C19.

The LC oscillator is comprised of L, D1, C1, C2, C3, C4, R3, R4, R5, and Q1, and is a Colpitts type. D3, a varicap diode, is used to vary the oscillator's frequency for vibrato and tuning control; As the voltage at the junction of R2, C1, an D1 becomes more negative, the capacitance of the varicap diode increases, and the oscillator frequency decreases. Since the cathode of the varicap is normally (with no vibrato) at ground potential and the anode is held at -5.6V by D4 and R1, the capacitance of the varicap remains constant, and stability of the oscillator is maintained. Capacitor C1 is used to isolate the D.C. bias on the varicap from the tank circuit. L1, with C3, C4, C1 and the varicap diode oscillator at 4.0048 MHz. R4 and R5 supply a bias voltage for Q1. The oscillator signal is coupled through C5 to buffer amplifier Q2 which drives I.C. 1.



- \*NOTES
- 1 D1 306-05001 1S2206
  - D2,D3 306-01017 1S2473
  - D4 337-06014 RD-5.6EB
  - Q1 305-03014 2SC373
  - Q2 THROUGH Q6 305-03040 2SC945Q
  - 2 UNLESS OTHERWISE SPECIFIED:
  - ALL RESISTORS ARE IN OHMS ±5% 1/4WATT.
  - ALL CAPACITORS ARE IN MICROFARADS.
  - 3 ① SYMBOL DENOTES NUMBERS IN PLUG.

MDD Gene  
I.C. 1, a si  
input signa  
the MDD  
driven by  
this I.C. is  
by C7.  
I.C. 2 and  
I.C. 2 gen  
"Cx" and  
I.C. 3 doe  
buffer Q3  
signal for t



IC 2 = MM5832 N (B)  
 IC 3 = MM5833 N

S2206  
 S2473  
 D-5.6EB  
 SC373  
 SC9450  
 5% .1/4WATT  
 FARADS  
 S IN PLUG

**MDD Generator**

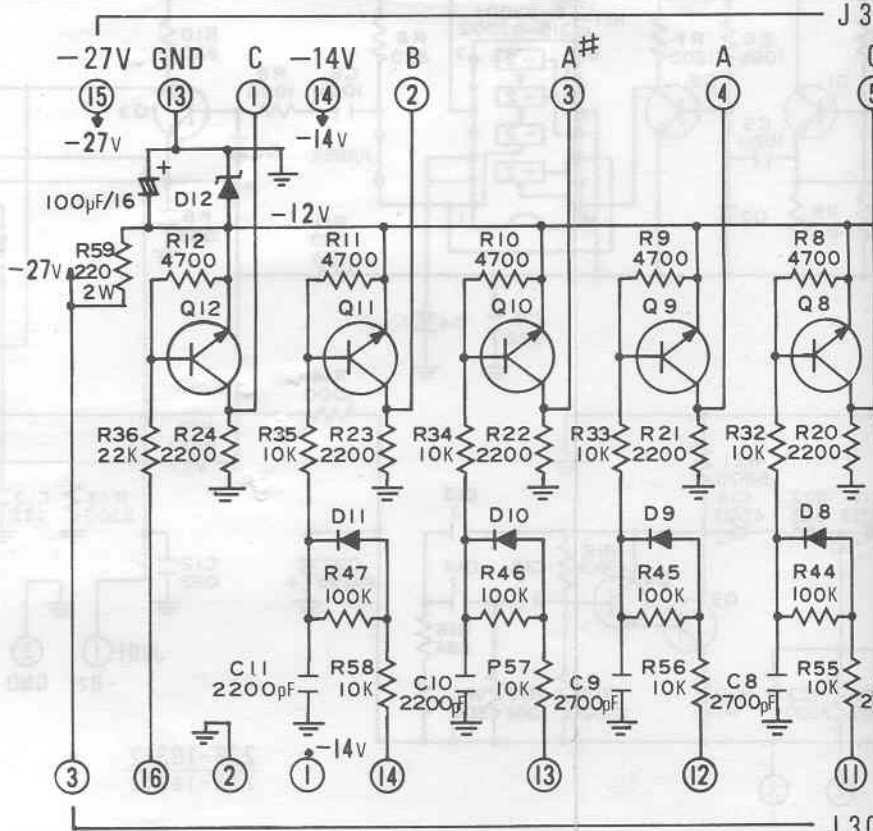
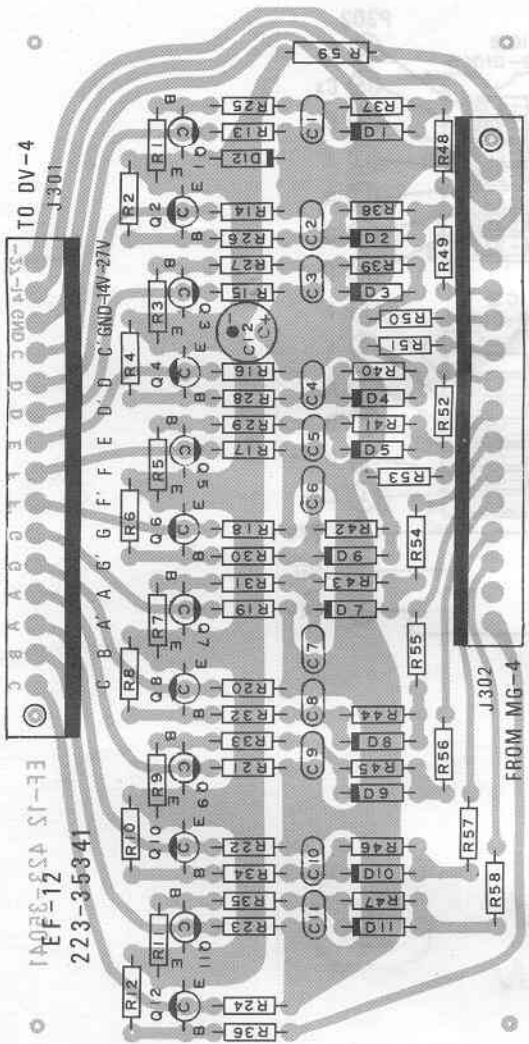
I.C. 1, a signal divider: It is used to insure a square input signal with a 50 per cent duty cycle to drive the MDD I.C. packages. This divider (I.C. 1) may be driven by the vibratoable oscillator. The -5V for this I.C. is generated by D4 and R11 and bypassed by C7.

I.C. 2 and I.C. 3 are the two frequency generators: I.C. 2 generates frequencies of Note "G" through "Cx" and "C".

I.C. 3 does Note "C" through "F". I.C. 1 drives buffer Q3, supplying an 11V 2.00024 MHz clock signal for the MDD packages.

Three power supplies, -11V, -14V, and -27V, are required for the operation of the two MDD packages. The -14V and -27V are supplied from the organ power supply - PS-5(B)-. R12 and R13 form a voltage divider between ground and -14V to generate the -11V supply. Each of the three supplies is protected from static discharge by a capacitor (C8, 10, 11, 12).

FIGURE 3-11  
 MDD GENERATOR-TWO PACKAGE  
 (228-19312)  
 LAYOUT & THEORY



- \* NOTES**
- 1 D1 THROUGH D11 306-01017 1S2473  
D12 337-02005 02Z-12A
  - Q1 THROUGH Q12 305-03040 2SC9450
  - 2 UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS. ±5%. 1/4WATT.
  - 3 Ⓛ SYMBOL DENOTES PIN NUMBERS IN PLUG.

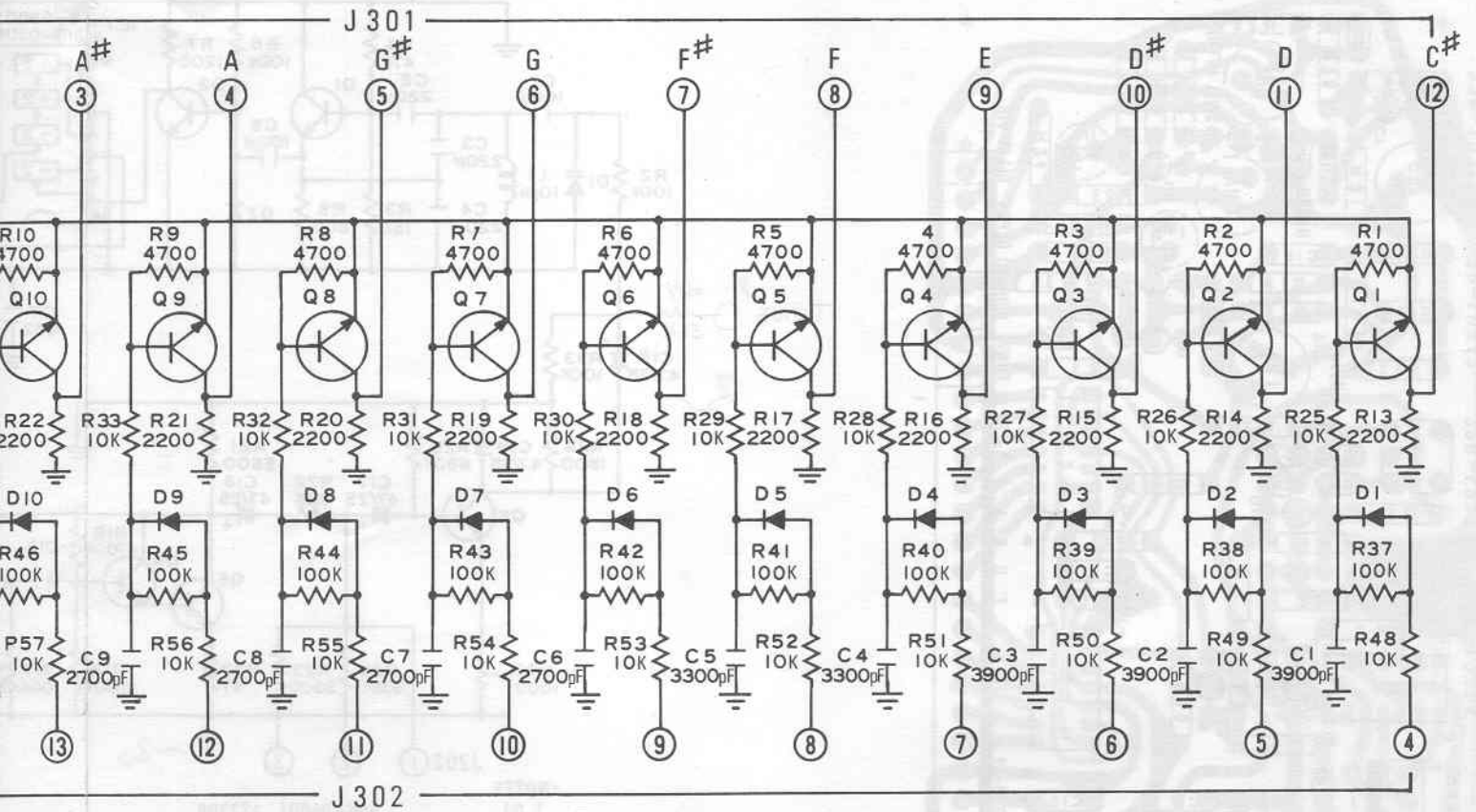
**EF-12 223-3534 MDD BUFFER BOARD**

This board is a MDD Buffer Board, on a single board format, approximately 2.5" x 3.5".

There are 12 input channels, each formed by a transistor (Q1 through Q12) and a diode (D1 through D12) connected in a common emitter configuration. The input signal is applied to the base of the transistor through a 100K resistor (R1 through R12). The output signal is taken from the collector of the transistor through a 2200 ohm resistor (R13 through R24). The diode is connected in series with the output signal to provide a voltage drop of approximately 0.7V. The output signal is then applied to the input of the next stage through a 2200 ohm resistor (R25 through R36). The board is powered by a -27V supply through a 220 ohm resistor (R37) and a 100µF capacitor (C1). The -14V and -12V supplies are also shown.

FIGURE 1  
MDD BUFFER BOARD  
LAYOUT & THEORY





S2473  
2Z-12A  
SC9450

5%, 1/4WATT.  
NUMBERS IN PLUG.

223-35341  
223-35241

**EF-12 223-35341  
MDD BUFFER BOARD**

This board provides the clocks to drive the DV-4 Board, on which wave forms are squared and approximately 50% duty cycle.

There are 12 transistors located on this board, which are Q1 through Q12. The inputs of these transistors are connected through RC filters, but the input of Q12 is connected through resistor only, to the connector J302. These inputs from the MDD Generator Board enter on J302 pin 4 through pin 16, but pin 15 is not used. These input wave forms are not 50% duty cycle, those are 30%-70% duty cycle, but "C" Note, pin 16, is 50% duty cycle. These inputs are fed to RC time delay circuits.

These time delay circuits provide the charge up without time delay, and the discharge down with time delay, and these signals are fed to buffer transistors, which operate inverters. These output wave forms are approximately 50% duty cycle. The output of "C" Note is inverted only.

These outputs come on J301 pin 1 through pin 12, and these signal voltages are approximately 12 volts negative going in amplitude.

The connector J302 is connected to the connector P302 of MG-4 MDD Generator Board, and the connector J301 is connected to T1 through T12, T37, T38, and T39 of DV-4 Divider Generator Board.

**FIGURE 3-12  
MDD BUFFER BOARD  
(223-35341)  
LAYOUT & THEORY**

## SECTION IV PARTS LIST

18050K FRONT VIEW	4- 2
TOP SECTION OF ORGAN FRONT VIEW	4- 3
TOP SECTION OF ORGAN BOTTOM VIEW	4- 3
TOP SECTION OF ORGAN BACK VIEW	4- 4
LEG ASSEMBLY	4- 4
LOWER SECTION OF ORGAN FRONT VIEW	4- 5
LOWER SECTION OF ORGAN INSIDE VIEW	4- 5
TOP SECTION OF ORGAN INSIDE VIEW OF TOP UP	4- 6
TONE BAR ASSEMBLY	4- 6
TOP SECTION OF ORGAN INSIDE VIEW OF UPPER MANUAL ASSEMBLY UP	4- 7
POWER SWITCH VIEW	4- 7
END BLOCK ASSEMBLY TOP VIEW (LOWER RIGHT)	4- 8
END BLOCK ASSEMBLY TOP VIEW (LOWER LEFT)	4- 8
END BLOCK ASSEMBLY BOTTOM VIEW (LOWER RIGHT)	4- 9
END BLOCK ASSEMBLY BOTTOM VIEW (LOWER LEFT)	4- 9
POWER SUPPLY UNIT TOP VIEW	4-10
POWER SUPPLY UNIT BOTTOM VIEW	4-10
30W MAIN AMPLIFIER	4-11
MANUAL ASSEMBLY	4-12
<b>PARTS LIST (PWB)</b>	
MDD BUFFER BD. EF-12	4-13
MDD GENERATOR MG-4E	4-13
DIVIDER GENERATOR DV-4B	4-13
PEDAL BOARD SB-5B	4-13
MIX TONE BOARD TG-15B	4-14
GATE AND PERCUSSION AMP PA-33B	4-14
POWER SUPPLY BOARD PS-5B	4-14
PREAMP AND REVERB AMP PA-56	4-14
MAIN AMPLIFIER PW-27B	4-14

SECTION IV  
List

MUSIC PANEL ASSY  
ML-2 (234-15201)

STUD  
401-05101

TOP PANEL  
402-07111

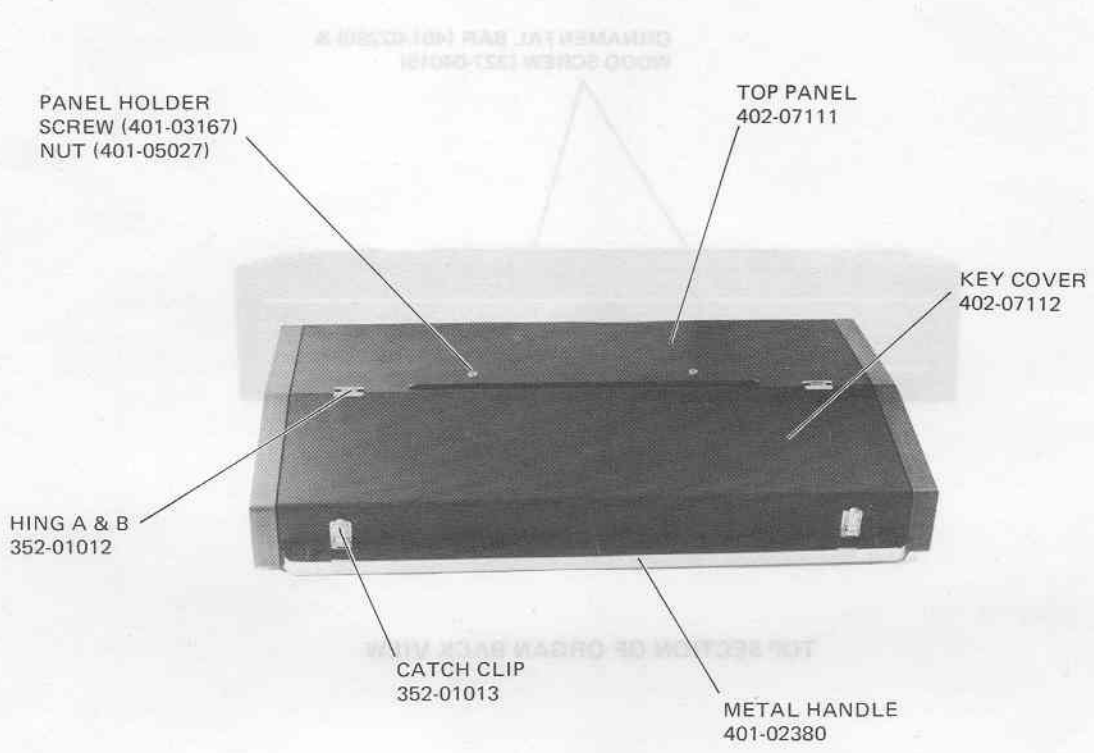
POWER SWITCH  
301-08006

PIPE LEGS ASSY

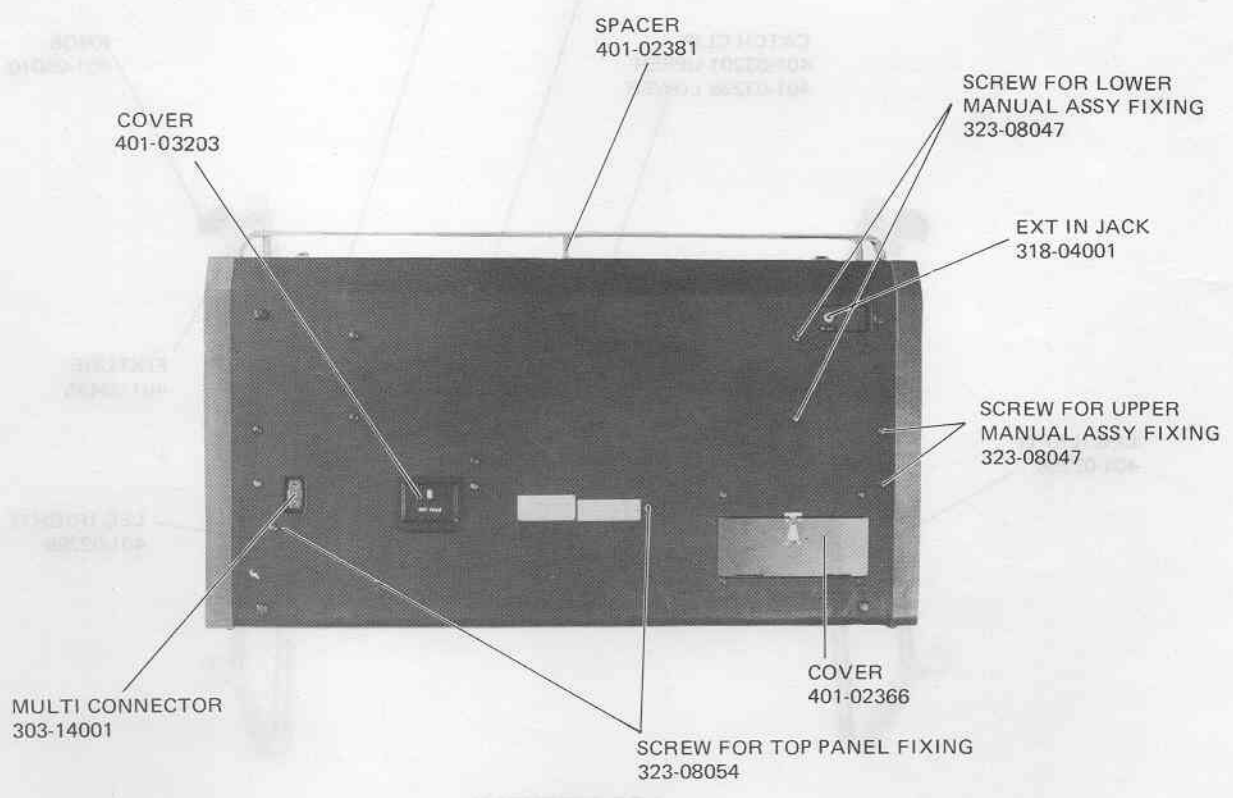
LOWER SECTION ASSY  
105-09209

18050K FRONT VIEW



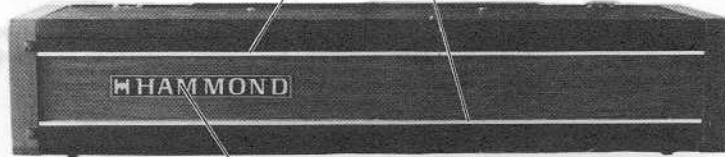


**TOP SECTION OF ORGAN FRONT VIEW**



**TOP SECTION OF ORGAN BOTTOM VIEW**

ORNAMENTAL BAR (401-02290) &  
WOOD SCREW (327-04015)



BADGE & (401-02383) & WOOD SCREW (326-08008)

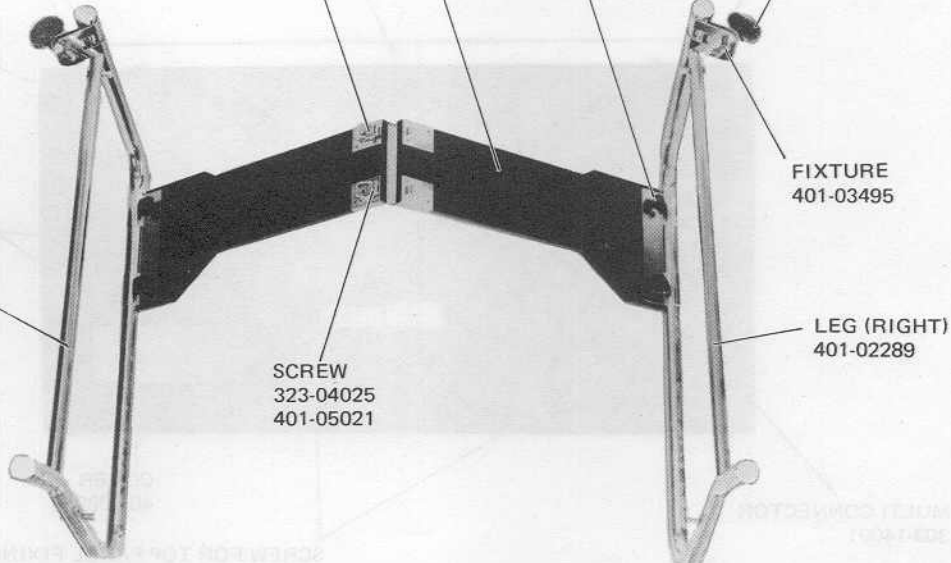
TOP SECTION OF ORGAN BACK VIEW

PLATE  
401-03216 RIGHT  
401-03217 LEFT

KNOB  
349-02001 BOLT  
401-05009 NUT

CATCH CLIP  
401-03201 UPPER  
401-03238 LOWER

KNOB  
401-05010



LEG (LEFT)  
401-02288

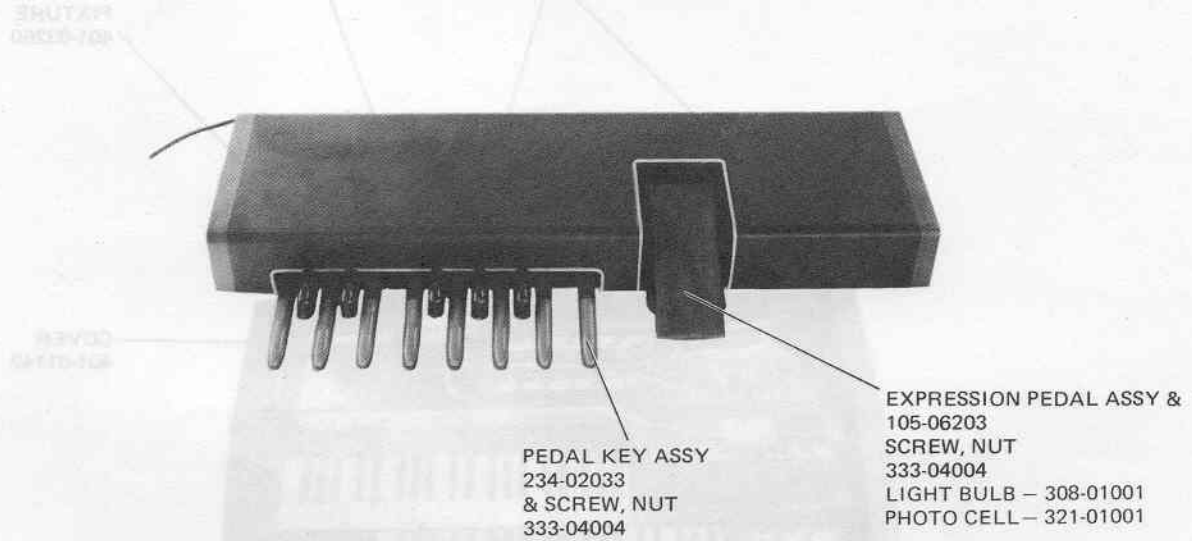
SCREW  
323-04025  
401-05021

FIXTURE  
401-03495

LEG (RIGHT)  
401-02289

LEG ASSEMBLY

**LOWER SECTION OF ORGAN FRONT VIEW**



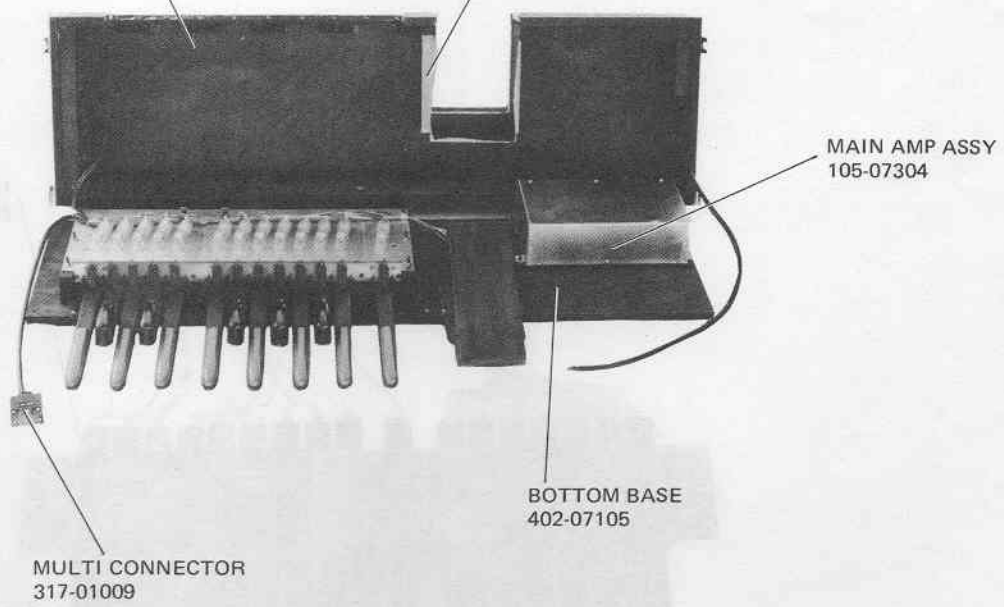
LOWER SECTION TOP COVER  
402-07106

PEDAL KEY ASSY  
234-02033  
& SCREW, NUT  
333-04004

EXPRESSION PEDAL ASSY &  
105-06203  
SCREW, NUT  
333-04004  
LIGHT BULB - 308-01001  
PHOTO CELL - 321-01001

COVER  
402-02045

**LOWER SECTION OF ORGAN INSIDE VIEW**

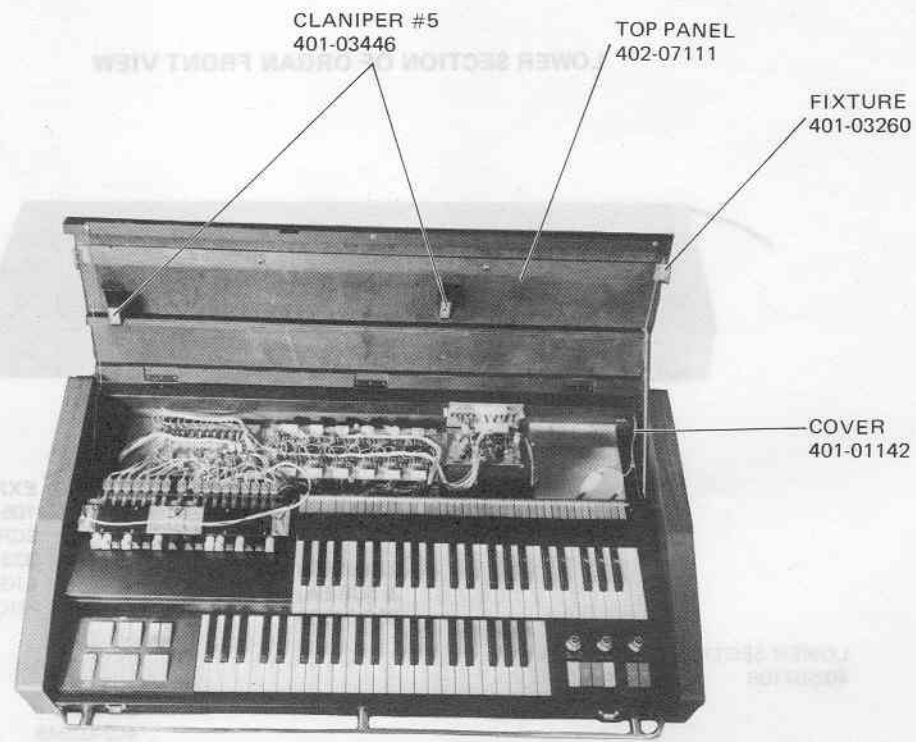


MAIN AMP ASSY  
105-07304

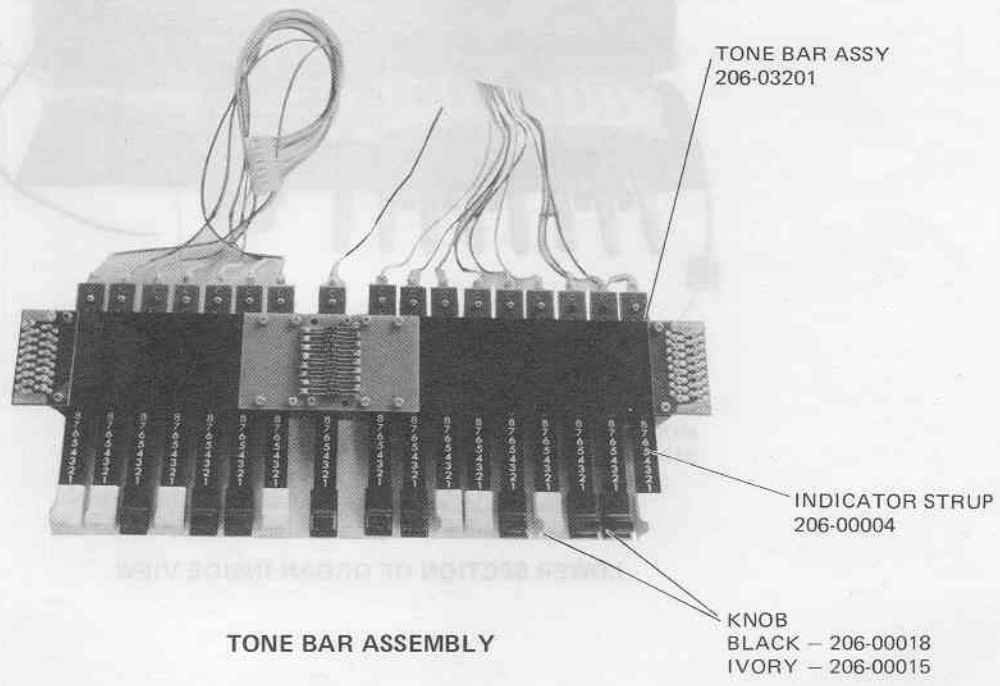
BOTTOM BASE  
402-07105

MULTI CONNECTOR  
317-01009

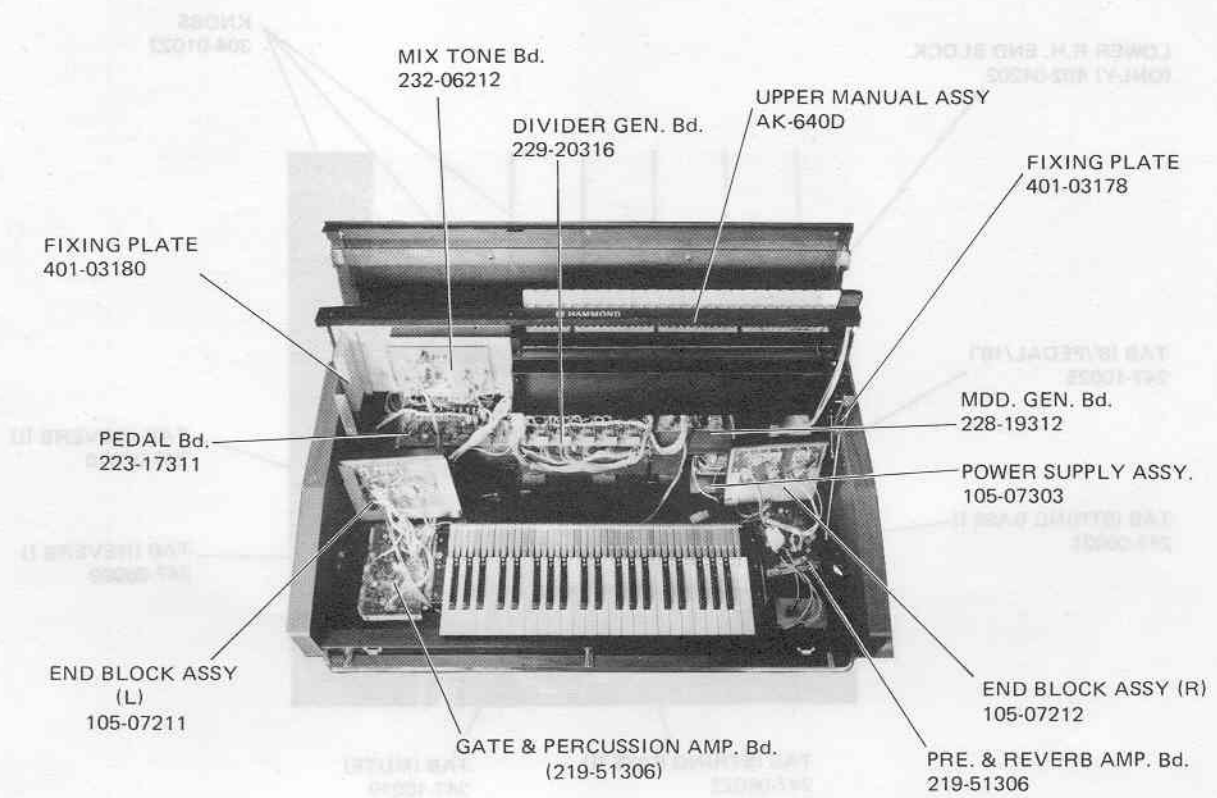




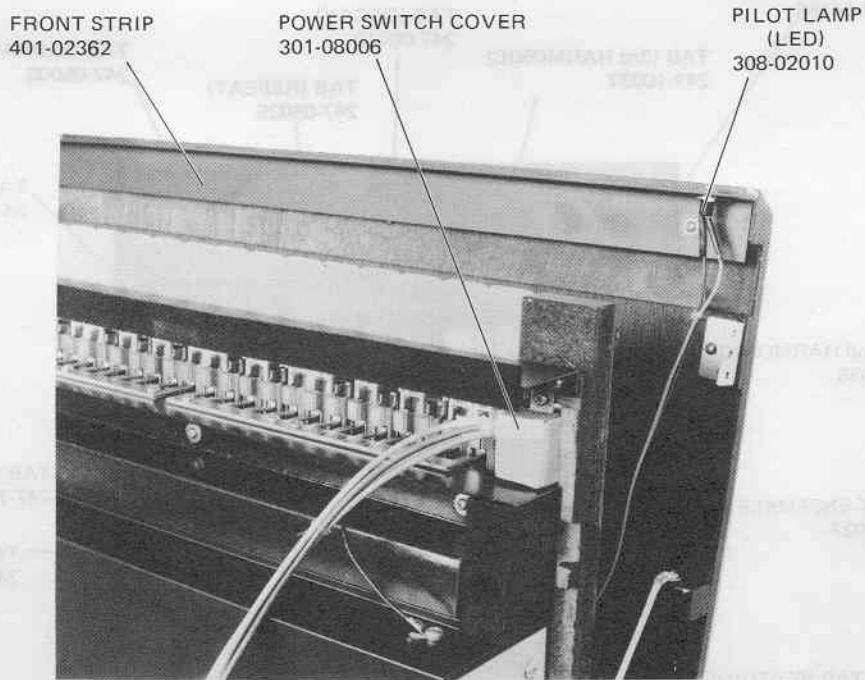
INTERIOR FORM OF ORGAN INSIDE VIEW OF TOP UP



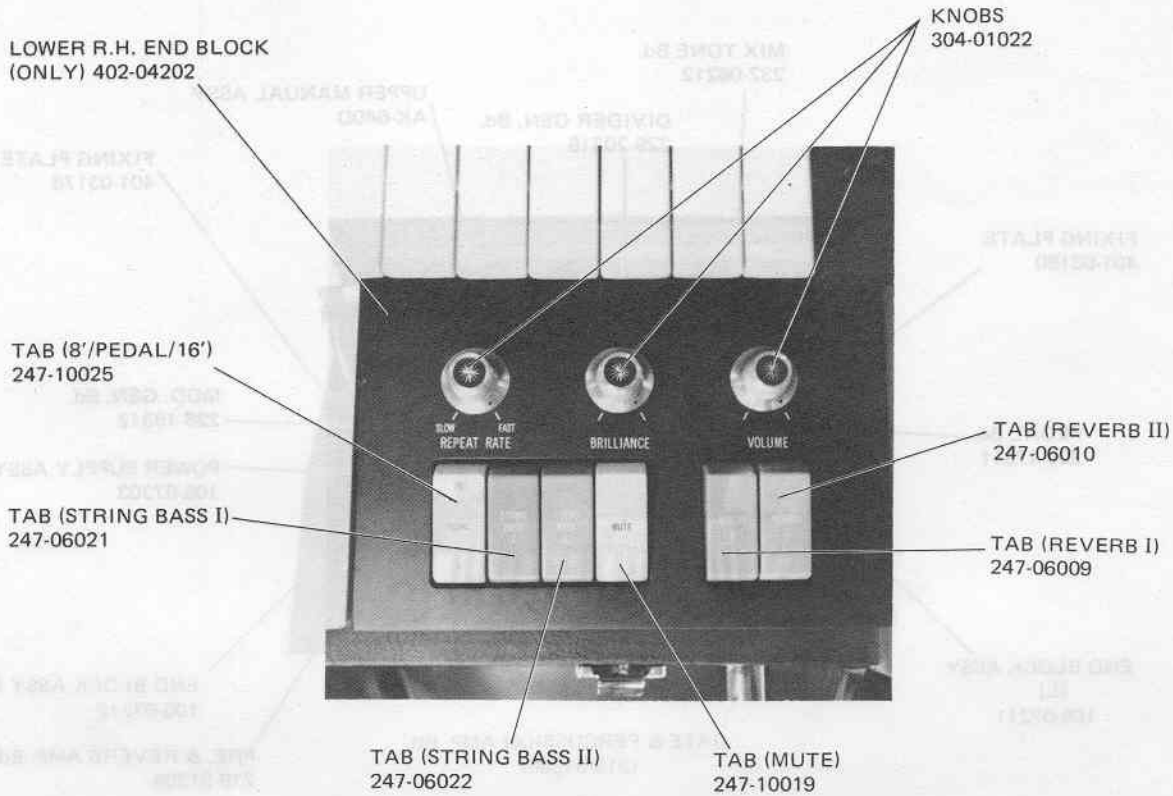
TONE BAR ASSEMBLY



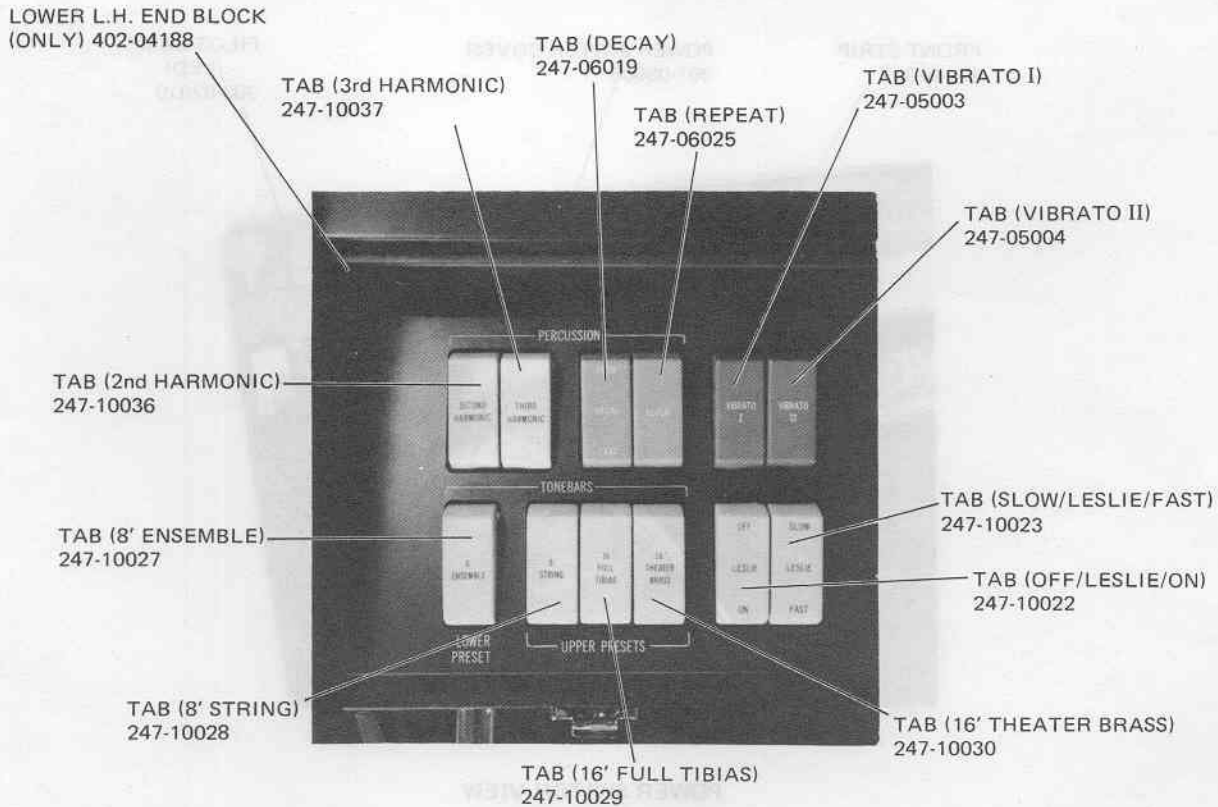
INSIDE VIEW OF UPPER MANUAL ASSEMBLY UP



POWER SWITCH VIEW

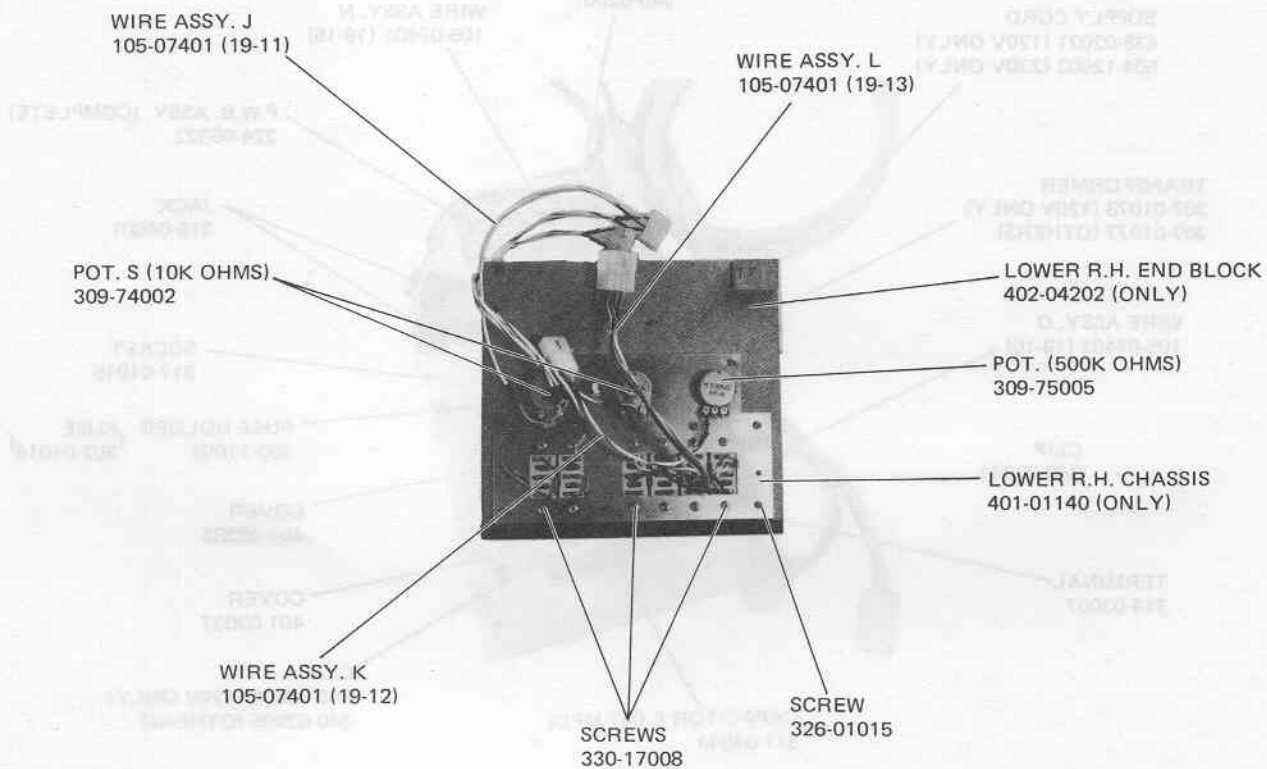


LOWER RIGHT-HAND END BLOCK ASSEMBLY – TOP VIEW (COMPLETE)

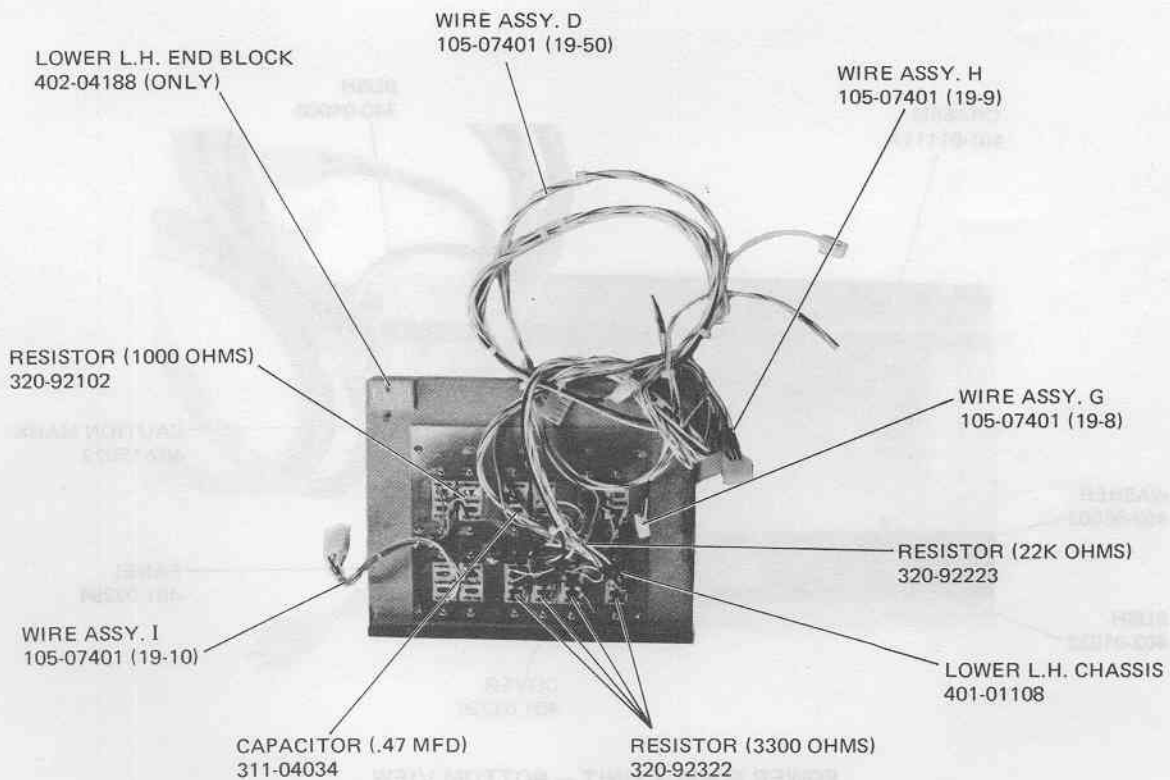


LOWER LEFT-HAND END BLOCK ASSEMBLY – TOP VIEW (COMPLETE)

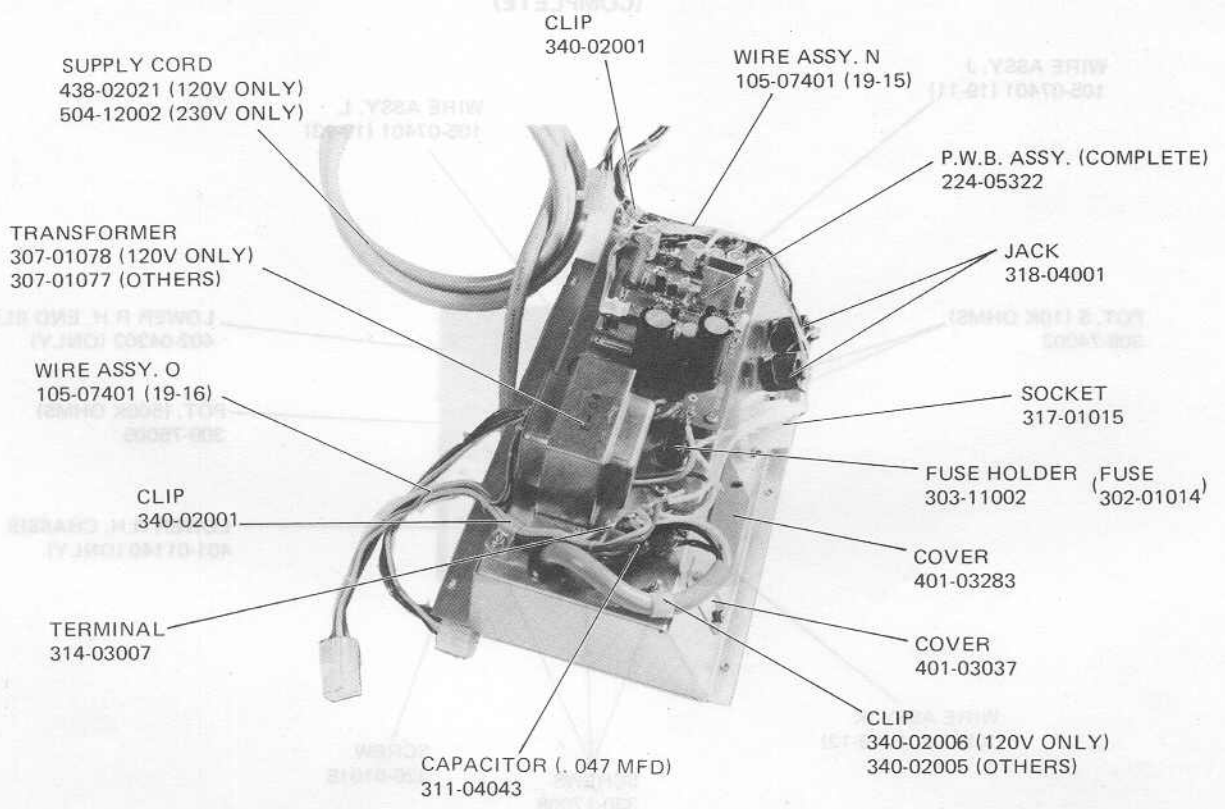
**LOWER RIGHT-HAND END BLOCK ASSEMBLY – BOTTOM VIEW  
(COMPLETE)**



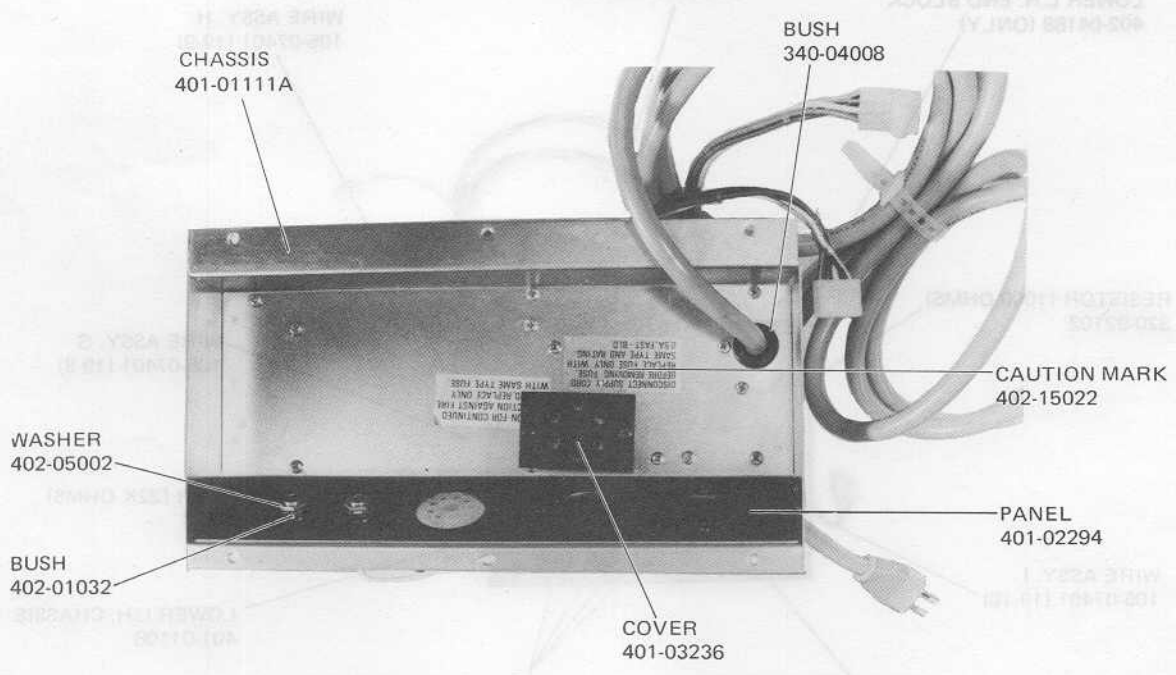
**LOWER LEFT-HAND END BLOCK ASSEMBLY – BOTTOM VIEW  
(COMPLETE)**



LOWER RIGHT-HAND END BLOCK ASSEMBLY - BOTTOM VIEW  
(COMPLETE)

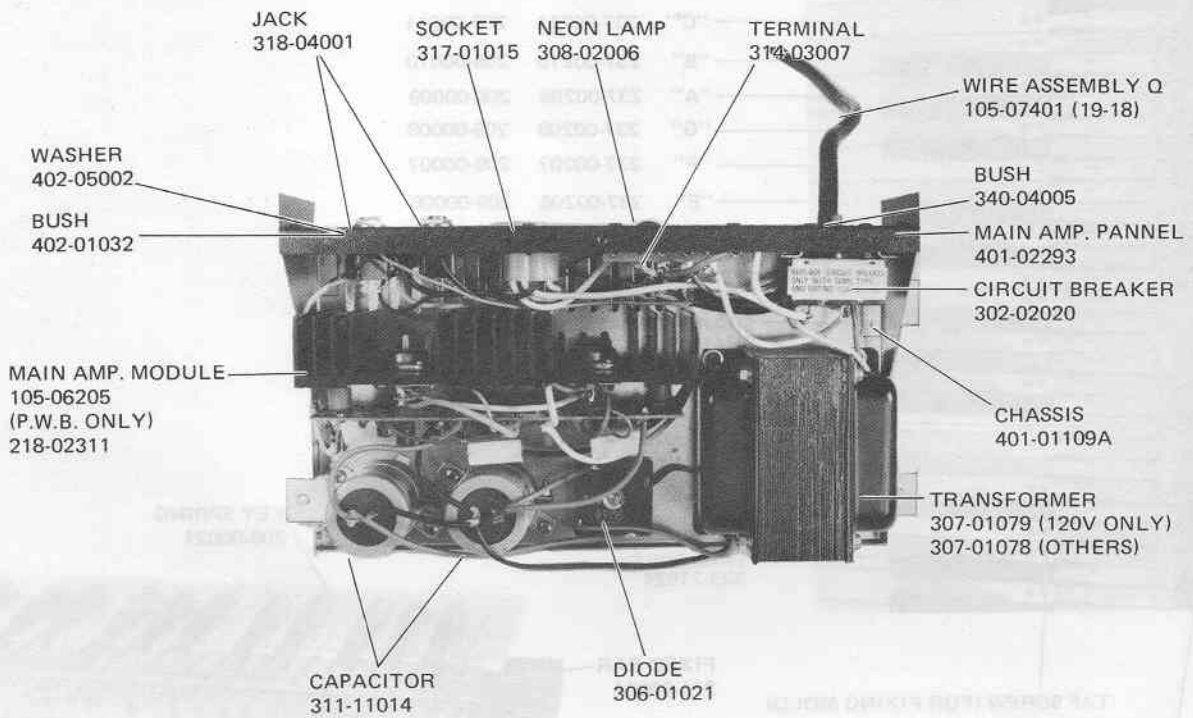


POWER SUPPLY UNIT - TOP VIEW  
105-07303

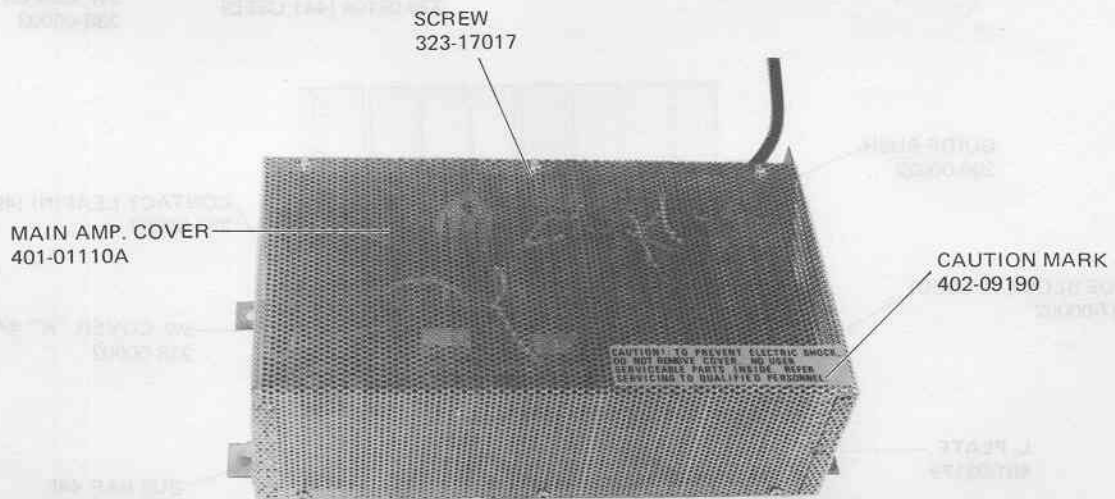


POWER SUPPLY UNIT - BOTTOM VIEW





**30 WATT MAIN AMPLIFIER -- (COMPLETE)**  
105-07304



NATURAL KEY ASSEMBLY 237-00602-6

KEY ONLY

"C"	237-00211	209-00011
"B"	237-00210	209-00010
"A"	237-00209	209-00009
"G"	237-00208	209-00008
"F"	237-00207	209-00007
"E"	237-00206	209-00006
"D"	237-00205	209-00005
"C"	237-00212	209-00004

SHARP KEY ASSEMBLY 237-00213  
SHARP KEY 209-00013

KEY CHANNEL  
237-00019

TRIM SCREW  
323-21024

FIXED BAR  
211-00004

LOCK SPRING  
209-00047

KEY SPRING  
209-00021

RESISTOR 100KOHm  
320-06104 (441 USED)

Z. PLATE

SW, COVER "B" #4  
238-00003

TAP SCREW (FOR FIXING MOLD)

SW, COVER "C" #4  
238-00004

GUIDE BUSH  
209-00022

SIDE BLOCK (2 USED)  
237-00002

L, PLATE  
401-03179

CONTACT LEAF(N) (490 USED)  
237-00007

SW, COVER "A" #4  
238-00002

BUS BAR 44P  
238-00007

POLYURETHANE  
COATED WIRE  
504-17002

CONTACT LEAF(P) (49 USED)  
237-00008

FIGURE 2. MANUAL ASSEMBLY  
UPPER MANUAL (AK-640D)  
LOWER MANUAL (AK-648D)

**MDD Buffer Board -EF-12- 223-35341**

Diode, Zener 12V

Diode

**MDD GENERATOR Board -MG-4(B)- 228-19312**

Diode

Diode, Varicap

Diode, Zener 5.6V

Coil 10  $\mu$ H

Transistor, NPN

Transistor, NPN

Integrated Circuit

Integrated Circuit

Integrated Circuit

IC Socket 14P

Socket Assembly

Pot Trim 1000 Ohms

Pot Trim 50K

**Divider Generator Board -DV-4(B)- 229-20316**

Diode

Integrated Circuit

IC Socket 14P

**Pedal Board -SB-5(B)- 223-17311**

Diode

Transistor, NPN

Transistor, NPN

Integrated Circuit

**Mix. Tone Board -TG-15(B)- 232-02311****Gate & Percussion Amp. Board -PA-33(B)- 219-04312**

Diode

Diode, Zener 12V

Transistor, PNP

Transistor, NPN

Transistor, NPN

Transistor, FET

Wafer Assembly

Wafer Assembly

Wafer Assembly

Wafer Assembly

D-12

D-1 Through 11

D-2, 3,

D-1

D-4

L-1

Q-1

Q-2, 3, 4, 5, 6,

IC-1

IC-2

IC-3

P-302

VR-2

VR-1

D-1 Through 72

IC-1 Through 12

D-1 Through 29

Q-1 Through 6

Q-7

IC-1

D-1, 2, 3, 4,

D-5

Q-1, 2, 3

Q-4, 5, 6, 7, 8, 9,

Q-13, 14, 15

Q-10, 11, 12

J-705

J703(704)

J701, 702

J708(707)

337-02005

306-01017

306-01017

306-05001

337-06014

322-01028

305-03014

305-03040

319-03001

319-01005

319-01006

303-13005

317-03068

336-01003

336-01009

306-01017

319-01007

303-13005

306-01017

305-03040

305-03023

319-23001

306-01017

337-02007

305-01006

305-03023

305-03040

305-05005

317-03053

317-03054

317-03055

317-03060

**Power Supply Board -PS-5(B)- 224-05311**

Diode	D-1
Diode	D-1 Through 11
Diode, Zener 6V	
Transistor, PNP	
Transistor, PNP	Q-3, 4
Transistor, NPN	Q-5, 6
Transistor, NPN	Q-2
Transistor, NPN	Q-1
Heat Sink	(Q-1)
Heat Sink	(Q-6)
Screw	
Nut	
Fiber Tube	

D-1	306-01023
D-2	306-01024
D-3	337-02001
Q-3, 4	305-01008
Q-5, 6	305-01013
Q-2	305-03040
Q-1	305-03027
(Q-1)	341-06003
(Q-6)	341-06004
	323-17019
	323-04003
	505-03023

**Pre. & Reverb Amp. Board -PA-56- 219-51306**

Transistor, PNP	
Transistor, NPN	
Transistor, PNP	
Transistor, NPN	
Integrated Circuit	
Pot Trim	10K
Pot Trim	100K
Pot Trim	50K

Q-1, 7, 8	305-01006
Q-2 Through 6	305-03023
Q-10	305-01014
Q-9	305-03041
IC-1	319-23001
VR-3	336-01006
VR-2	336-01010
VR-1	336-01009

**Main Amplifier Board -PW-27(B)- 218-02311**

Diode	D-1 Through 20
Diode, Zener 15V	D-1 Through 6
Transistor, PNP	Q-1
Transistor, NPN	Q-1
Transistor, NPN	
Integrated Circuit	
Pot Trim	5K

D-3, 4	306-01017
D-1, 2	337-06013
Q-3	305-02010
Q-1	305-03040
Q-2	305-04012
IC-1	319-23001
VR-1	336-01005

# NEW X-5 BASS SYSTEM

## PEDALS & BASS TO LOWER MANUAL

### INTRODUCTION

The new X-5 Bass System supplies bass tones for 13 pedals at both 16' and 8' pitches, as well as bass tones for twenty lower manual keys. Figure 1 shows the relative ranges of bass tones employed by the lower manual and pedals. In manual bass the system operates in a low select manner because of the action of 3 priority-encoder ICs. In pedal bass mode the system operates high select because of the wiring of the pedal assembly.

The heart of the X-5 Bass System is the Bass Generator Board (223-35386). This board contains 10 basic sections. These sections are:

- 1) A diode ladder matrix
- 2) A priority encoder stage
- 3) An inverter NOR gate stage
- 4) A latch stage
- 5) A channel data selector stage (Multiplexer)
- 6) A divider stage
- 7) Octave select gates
- 8) Envelope gates
- 9) A Mute filter
- 10) An amplifier stage

These

Ten stages interact to provide all the features that are associated with bass on the X-5. Figure 2 in the back of this booklet demonstrates how these basic stages fit together in a functional block diagram.

Notice in Figure 2 that the keying inputs from the pedals or lower manual are applied to J503, J504, and J505 and the diode matrix. The selected keying inputs are logic 1 (ground) levels which are received by the matrix and are sent to the appropriate data (D1-D7) inputs of the priority encoder stage (ICs 1, 2 and 3).

The priority encoder ICs encode the highest priority input (D7-D0) to a 3 bit binary code. This code is released at the Q2, Q1, and Q0 outputs. The encoders also release inhibit/enable information at their Gs outputs. This inhibit/enable

information is used to disable or enable the data selector ICs later on in the keying process.

Both the note select code and the inhibit/enable code are sent to the inverter stages of IC7 and transistors Q1-Q2 respectively. The NOR gates within IC 7 invert the note select data, and transistors Q1 and Q2 invert the inhibit/enable information.

Following inversion, the two codes travel to the latch stage. Latching is accomplished by ICs 8, 9, 10, and 11 which are quad NAND gates wired as flip-flops. The latches receive the data from the inverters, re-invert the information, memorize the information, and then apply the information to the note select (A, B, C) and disable (D) inputs of the data selector ICs 4, 5 and 6.

The combination of note select and inhibit data at ICs 4, 5, and 6, allows a specific bass frequency (from J501, J502, or J503) to pass through the appropriate data selector IC and reach the Z output buss. The selected signal enters a buffer stage and flows to the divider stage of IC15.

Figure 2 demonstrates that IC15, a dual D flip-flop generates the low bass, and medium bass frequencies. The output signal from the data selector ICs clocks IC15 and also feeds IC12 as the high bass signal. The high bass, medium bass, and low bass signals then enter IC12, the bass select gates.

The combinations of inputs at the bass select gates from the key down data buss (S), the bass select data buss (R), and the 16'/8' stop determine which combination of bass frequencies pass through the bass select gates of IC12 and enter the envelope gates of IC14.

During times of manual or pedal down, the key down data buss applies an input to the D section of IC14. The NAND gate activates transistor Q4, and Q4, in turn, sends a gating pulse to the 3 envelope NAND gates of IC14 A, B, and C. The result of this operation is the gating of the appropriate bass tones through the envelope gates to the RC mute filter. If String Bass is selected,

the envelope generator continues to function after the key or pedal is released and a sustain effect occurs.

At the RC mute filter transistors Q8 and Q9 normally permit maximum bass signal to reach amplifier Q10. When the mute tab is activated, transistors Q9 and Q10 conduct and shunt a portion of the bass signal away from Q10. The result of the mute operation is a significant drop in volume of the bass tones.

The output signal of the mute filter feeds amplifier Q10, travels through the bass level adjust potentiometer, and leaves the Bass Generator Board at J507 pin 1. After leaving the Bass Generator Board, the bass signal travels to the organ preamp where it mixes with signals from other systems of the organ.

### GENERATION OF BASS TONES (EXAMPLES)

As stated previously, the Bass Generator Board contains 10 basic sections. These sections interact to produce all base tones required by the organ. The operation of the Board, however, is not consistent over the entire pedal and manual frequency ranges. The board can operate in five different modes, and the selected pedal or lower manual keys in the 16' or 8' settings determine the appropriate mode. The following list defines the conditions which set the Bass Generator Board for the various modes of operation:

**Mode #1:** The pressing of a pedal 1-5 (low C through E) when the bass stop is set for 16'.

**Mode #2:** The pressing of a pedal 6-13 (F through high C) when the bass stop is set for 16'.

**Mode #3:** The pressing of a pedal 1-5 when the bass stop is set for 8'.

**Mode #4:** The pressing of a pedal 6-13 when the bass stop is set for 8'.

**Mode #5:** The pressing of a lower manual key 1-20 when the



bass to lower coupler is "ON".

In each of these modes the "String Bass" and the "Mute" features can be used.

The following descriptions are step by step circuit analyses of the Bass Generator Board for the 5 different modes of operation. Refer to Figures 3, 4, and 5.

#### EXAMPLE #1 - MODE #1

Assuming that pedal #2 (C#) is depressed and the bass tab is set for 16', the following operation occurs:

The activation pedal #2 (C#), transfers a logic 1 (ground potential) to J503 pin 2 of the Bass Generator Board. This logic 1 (grd) passes through the matrix diode D6 and reaches the D7 input of priority encoder IC2 at pin 4. The logic 1 (grd) at J503 pin 2 also changes the bass select data buss (R) and the keydown data buss (S) from a logic 0 (-14V) to logic 1 (grd).

With a logic 1 (grd) applied to the D7 input of IC2, the E0 output (pin 15) of IC2 falls from a logic 1 (grd) to a logic 0 (-14V). This transition disables IC1. Also, at this time, the Gs output of IC2 rises from a logic 0 (-14V) to a logic 1 (grd). The Gs output is supplied to the input of transistor Q1. Finally with a logic 1 (grd) applied to the D7 input, IC2 releases the note select code of (1, 1, 1) from its Q2, Q1 and Q0 outputs. These outputs exist on pins 6, 7, and 9 respectively.

After the Gs output of IC2 is inverted to a logic 0 (-14V) by transistor Q1, the signal works with the inverted Gs output of IC3 (logic 1 at transistor Q2's output) to form the 2-bit inhibit/enable code.

The 2-bit code activates two latches with ICs 9 and 10. The logic 0 (-14V) at the output of transistor Q1 combines with the logic 1 (grd) of the keydown data buss (S) at NAND gate IC10D; the logic 0 (-14V) also travels to the input pin 6 of IC9A - one half of a latch consisting of IC9A and IC9B. The logic 1 (grd) and logic 0 (-14V) inputs to IC10D force a logic 1 output at pin 11 of IC10D.

Now, with a logic 0 (-14V) applied to pin 1 of IC9A and a logic 1 applied to pin 6 of IC9B, the latch forces a logic 0 (-14V) to pin 4 of IC9B. This logic 0 (-14V) travels to the disable input (D1 pin 15) of data selector IC5. With logic 0 (-14V) maintained at the D1 input of the IC5, the chip becomes enabled and, therefore, available for operation. The logic 0 (-14V) at IC9B pin 4 is also applied to IC11A pin 2. At IC11A, the logic 0 (-14V) combines with the output of IC10B pin 4. To determine the output level of IC10B pin 4, we must follow the Gs output of IC3.

Because priority encoder IC2 receives no logic 1 (grd) D inputs with the C# pedal depressed, its Gs output must maintain a logic 0 (-14V) level. Transistor Q2 inverts this logic 0 (-14V) into a logic 1 (grd) and applies that level to pin 9 of IC10C and pin 6 of IC10B.

The logic 1 (grd) output of Q2 then combines with the logic 1 (grd) of the keydown buss at IC10C. As a result, the NAND gate output pin 10 falls to a logic 0 (-14V) which is transferred to pin 1 of IC10A. Now, because the input pin 6 of IC10B is held to logic 1 (grd), and the input pin 1 of IC10A is held to logic 0 (-14V), the latch forces a logic 1 (grd) at IC10A pin 3.

The logic 1 (grd) at IC10A pin 3 travels to the disable (D2) input of data selector IC4 pin 15. This disables IC4. Also, the logic 1 (grd) at pin 3 of IC10A combines with logic 0 (-14V) from pin 4 of IC9A at IC11A. The logic 1 (grd) and logic 0 (-14V) inputs of IC11A force a logic 1 (grd) at pin 3 of IC11A, and this level reaches the disable (D0) input of IC6, disabling IC6.

Thus far, we have examined how the Gs outputs of ICs 2 and 3 have formed a 2-bit inhibit/enable code that has enabled IC5 and has inhibited IC4 and IC6 when the pedal is depressed. In order for IC4 to release the appropriate bass frequency, the chip must receive a 3-bit note select code at its A, B, and C inputs. Therefore, we must return to the Q2, Q1 and Q0 outputs of IC2.

Earlier, we stated that with the D7 input of IC2 held to a logic 1 (grd), the

chip's Q2, Q1 and Q0 outputs were all logic 1 (grd) levels. These levels are sent directly to the inverting NOR gates of IC7. IC7's A, B, and C sections invert the Q2, Q1 and Q0 outputs of IC2 to logic 0 (-14V) levels. These levels are then applied to the latches of ICs 8 and 9, and to NAND gate IC11.

The inverted Q2 output leaves pin 6 of IC7A as a logic 0 (-14V). This level is transferred to pin 13 of IC11D as well as to pin 13 at IC9D. At IC11D the logic 1 (grd) of the keydown data buss combines with the logic 0 (-14V) to force the NAND gate to release a logic 1 (grd) to pin 8 of IC9C. Now, with IC9C and IC9D receiving logic 1 (grd) and logic 0 (-14V) inputs respectively, the pin 11 output of latch IC9C/9D goes to a high logic 1 (grd) level. This level is applied to the "C" data line of the data selectors ICs 4, 5, and 6.

The inverted Q1 output leaves pin 9 of IC7B as a logic 0 (-14V). Also from pin 9 the low level travels to pin 5 of IC11B as well as to pin 1 of IC8A. At IC11B the logic 0 (-14V) from IC7 pin 9 becomes "NANDED" with the logic 1 (grd) of the keydown data buss. The NAND process yields a logic 1 (grd) at pin 6 of IC8B. The combination of logic 1 (grd) at pin 6 of IC8B and the logic 0 at pin 1 of IC8A makes flip-flop IC8B/8A provide a logic 1 (grd) to the "B" data line of data selectors.

Finally, the logic 0 (-14V) Q0 output of IC7C pin 10 travels to pin 9 of IC11C and to pin 13 of IC8D. IC11C NANDS the logic 1 (grd) of the keydown buss and the logic 0 (-14V) output of IC7C. This holds pin 8 of IC8C to logic 1 (grd). Consequently, the flip-flop IC8C/8A places a logic 1 (grd) level on the "A" data line of the data selectors.

At this time data selectors ICs 4, 5, and 6 receive logic 1's (grd) at their A, B, and C inputs. These inputs will be maintained by the flip-flops even after pedal #2 is released (to allow the sustain in String Bass). Only IC5 responds to the code at its A, B, and C inputs because IC4 and 6 are disabled by the logic 1 (grd) levels at their D inputs. The result of this process is the transferring the C# bass signal from the X7 data input of IC5 to the Z signal output of

1. The signal is available on the Z line because the Z output pins of disabled ICs 4 and 6 are at high impedances.

The C# square wave released by the data selector is inverted by NAND gate IC12C. This inverted signal travels to pin 12 of IC12D as well as to pin 11 of IC15. IC15 divides the C# bass signal by 2 twice. The resultant signal from the first stage of division leaves IC15 at pin 13 and enters NAND gate IC12A at pin 2; the signal from the second stage leaves IC15 at pin 1 and enters IC12 at pin 6.

At this time the highest C# frequency (high bass) is available at IC12D, the second highest C# frequency (medium bass) is available at IC12A, and the lowest C# frequency (low bass) is available at IC12B. The NAND gates of IC14, however, will not pass the low, medium or high bass signals unless pins 5, 1, and 13 receive logic 1 (grd) levels. To determine if these inputs exist, we must examine the operation of octave select circuitry IC13 and transistors Q5 and Q6.

Because the C# pedal is within the group of pedals 1 through 5, both the keydown data buss (S) and the bass select data buss (R) are held at logic 1's (grd) during pedal down. IC13D NANDS these two logic 1's (grd) levels. This forces a logic 0 (-14V) at pin 11 of IC13D. IC13C then NANDS the logic 0 (-14V) from IC13D with the logic 1 (grd) from the keydown buss producing a logic 1 (grd) output at IC13C pin 10. Now the logic 0 (-14V) from IC13 pin 11 and the logic 1 (grd) from IC13 pin 10 force flip-flop IC13A/13B to produce a logic 1 (grd) at pin 3 and a logic 0 (-14V) at pin 4. The output from pin 3 is applied to transistors Q5 and Q6, and the output from pin 4 is applied to IC12D.

With the 16'/8' tab set for the 16' mode (normal), J506 pin 2 of the Bass Generator Board receives -14VDC (logic 0). This potential is inverted by transistor Q6. Thus, both the inputs of Q6 and IC13A hold IC12A pin 1 to a logic 1 (grd) level. (Refer to schematic of Bass Generator Board).

Also, because the 16'/8' tab is set for 16', J506 pin 1 receives no input from the 16'/8' tab. Therefore, transistor Q5 becomes self biased and produces a logic 1 (grd) at its collector. This logic 1 (grd) is applied to pin 5 of IC12D.

Because both IC12B pin 5 and IC12A pin 1 are held to logic 1 (grd) levels, IC12B and IC12A pass the inverted low bass and medium bass C# signals to the envelope gates of IC14A pin 2 and IC14B pin 5 respectively. IC12D cannot pass the high bass C# frequency to IC14C because IC13B is holding pin 13 of IC12D to a logic 0 (-14V) level.

NAND gates IC14A and 14B cannot pass the low and medium bass frequencies until envelope generator Q4 sends logic 1 (grd) gating pulse to their input pins 1 and 6. The generation of the logic 1 (grd) gating pulse begins at the keydown data buss (S). When any pedal is depressed, a logic 1 (grd) appears at the keydown buss which is felt at pins 12 and 13 of NAND gate IC14D. IC14D inverts the logic 1 (grd) to a logic 0 (-14V) and sends this level from pin 11 to the base of transistor Q3 (refer to schematic of Bass Generator Board).

Transistor Q3 turns on with the application of -14V on its base. As Q3 conducts, it immediately charges capacitor C3 and forces transistor Q4 into conduction as well. With transistor Q4 conducting, a load is applied to resistor R11 which forces the junction of R11 and R12 to rise from -14V to -7V. The -7V is reduced by three 560K resistors before being applied to pins 1 and 6 of IC14 sections A and B. Thus, pins 2 and 6 feel logic 1 (grd) potential as long as the pedal remains depressed. As a result, IC14A and 14B pass the low and medium bass tones into the RC mute filters.

When the pedal is released with String Bass "OFF", transistor Q3 shuts off and capacitor C3 discharges quickly through the parallel combination R9 and R10. With String Bass 1 "ON", the capacitor discharges through the parallel combination of R9 and R10 in series with a 180K resistance. Finally, with String Bass II "ON", the capacitor discharges through the parallel combination of R9 and R10 in series with an

820K resistance.

The availability of these various discharge time constants allows control over the conduction time of transistor Q4, which in turn, controls the passing of bass tones through the envelope gates of IC14.

As the low and medium bass tones leave IC14, they become filtered by an RC network before reaching the bass of amplifier Q10. With the mute switch in the off position, transistors Q8 and Q9 receive no forward bias from J506 pin 4, and they allow maximum signal to transfer from the filter to the bass of Q10. When mute is selected, the transistors receive -14V from pin 4; they conduct and shunt a portion of the signals away from transistor Q10.

#### EXAMPLE #2 - MODE #2

Assuming that pedal #8 (G) is depressed and the 16'/8' stop is set for 16', the following operation occurs:

Note selection at the data selector ICs occurs in the same manner as example #1 except:

- priority encoder IC3 receives the logic 1 (grd) keying input at its D5 pin 4.
- data selector IC4 receives a 1, 0, 1 code at its A, B, and C inputs while ICs 5 and 6 are inhibited. As a result IC4 passes the low G clock from its X5 input to the Z output buss.

IC12C receives the low G square wave from the Z line and sends it to the divider IC15 to form the low and medium octaves of G. Consequently, the low bass is available at pin 6 of IC12B, the medium bass G is available at pin 2 of IC12A, and the high bass G is available at pin 12 of IC12D. The NAND gates of IC12, however, cannot pass the three signals until they receive octave select inputs at pins 5, 1, and 13 from the octave select circuitry of IC13, Q5 and Q6.

Because pedal #8 is within the 6-13 group of pedals, the depression of pedal



#8 forces a logic 1 (grd) at the keydown data buss (S) and a logic 0 (-14V) at bass select data buss (R). This combination yields a logic 1 (grd) at the pin 11 output of IC13D. The logic 1 (grd) at pin 11 is sent to pin 1 of IC13A and pin 9 of IC13C. IC13C NANDS the logic 1 (grd) from IC13D and the logic 1 (grd) from the keydown buss to produce a logic 0 (-14V) at its output pin 10. Now with pin 1 of IC13A at logic 1 (grd) and pin 6 of IC13B at logic 0 (-14V) flip-flop IC13A/13B produces a logic 1 (grd) at its pin 4 and pin 0 (-14V) at its pin 3.

The two outputs of the flip-flop combine with the inputs of the 16'/8' tab to allow the medium bass G frequency and the high bass G frequency to pass through IC12A and IC12D to enter the envelope gates of IC14B and IC14C. IC12D directly receives the logic 1 (grd) gating input at pin 13 from IC13B. IC12A receives a logic 1 (grd) at its gating input (pin 1) from conducting transistor Q6. IC12B is inhibited because the logic 0 (-14V) from pin 3 of IC13A overrides the logic 1 (grd) from transistor Q5. (Refer to schematic of the Bass Generator Board).

After the medium and high bass signals reach the envelope NAND gates of IC14, the signals undergo the same process that was explained in example #1.

#### EXAMPLE #3 - MODE #3

Assuming that pedal #2 is depressed and the 16'/8' stop is set for 8' the following operation occurs:

The note selection process of the C# bass tone from data selector IC5 is accomplished in exactly the same manner as that described in example #1. Likewise, the C# low, medium, and high bass tones are made available at IC12 at its respective B, A, and D selections. But, with the 16'/8' tab set for the 8' mode, the octave select gates of IC13, transistor Q5, and transistor Q6 enable the medium and high bass gates IC12 and IC12D and disable the low bass gate IC12B.

Because both the keydown data buss (S) and the bass select data buss (R) are held to logic 1 (grd) levels with pedal #2

depressed, flip-flop IC13A/13B provides a logic 0 (-14V) at its pin 4 output and a logic 1 (grd) at its pin 3 output. Even though transistor Q6 is shut off in 8' mode, the logic 1 (grd) output of IC13A maintains pin 1 of IC12A at ground potential. This enables the medium bass gate. (Refer to board schematic).

Transistor Q5 maintains cutoff potential in 8' mode. The transistor's high collector/emitter resistance develops a logic 0 (-14V) level and applies this level to pin 5 of IC12B. The logic 0 (-14V) at pin 5 disables the low bass gate.

After the medium and high bass signals leave the IC12, they enter the envelope gates of IC14 and follow the normal path through the RC mute filter and transistor Q10.

#### EXAMPLE #4 - MODE #4

Assuming that pedal #8 is depressed and the 16'/8' stop is set for 8' the following operation occurs:

The G low, medium and high bass tones are applied to the bass select gates of IC12B, A, and D in the normal manner. Because pedal #8 is depressed the keydown data buss (S) goes to logic 1 (grd) and the bass select data buss goes to a logic 0 (-14V). These levels force pin 3 of IC13A to fall to the logic 0 (-14V) level and pin 4 of IC13B to rise to the logic 1 (grd) level.

Because the 16'/8' tab is set for 8', the outputs of the IC13A/13B flip-flop combine with the "floating" and logic 1 (grd) potentials at J506 pins 2 and 1 respectively and force pins 5 and 1 of IC12B and IC12A to logic 0 (-14V) levels. This action allows only the high bass gate of IC12D to become active and pass a signal to the envelope gates.

#### EXAMPLE #5 - MODE #5

Assuming the bass to lower tab is set for the "ON" position and lower manual key #20 (C) is depressed, the following action occurs:

With the bass to lower tab on, ground is removed from the pedal assembly and applied to a buss bar in the lower manual assembly. This rearrangement of ground disables the pedals and enables the first 20 lower manual keys for bass keying.

When the lower manual keys 1-20 are depressed in bass mode, J505, J504 and J503 receive logic 1 (grd) keying inputs. These keying inputs travel through the diode matrix and key the priority encoder ICs. Lower manual key #20, for instance, places a logic 1 (grd) at the D4 input of IC1. The note select process from this encoder stage to the data selector stage operates in the same manner as that of the pedal mode.

With lower manual key #20 depressed the high C bass frequency at the X4 input of IC6 is released at the Z output line. This frequency travels through IC12C reaches IC12 pin 12 as the high bass signal, and clocks IC15 to form the medium and low bass signals at IC12A pin 2 and IC12B pin 6.

As in the pedal modes, IC12 does not pass any signals to the envelope gates of IC14 until the bass select circuitry (IC13, Q5, and Q6) releases logic 1 (grd) levels to the gating inputs of IC12 pins 5, 1, or 13.

Also with lower manual key #20 activated, the keydown data buss rises to logic 1 (grd) level and the bass select buss (R) remains at logic 0 (-14V). This combination of inputs at NAND gate IC13D forces flip-flop IC13A/13B to hold a logic 0 (-14V) level at its pin 3 output and a logic 1 (grd) level at its pin 4 output. The pin 3 output of logic 0 (-14V) holds IC12B in a disabled mode and the pin 4 output holds IC12D operational.

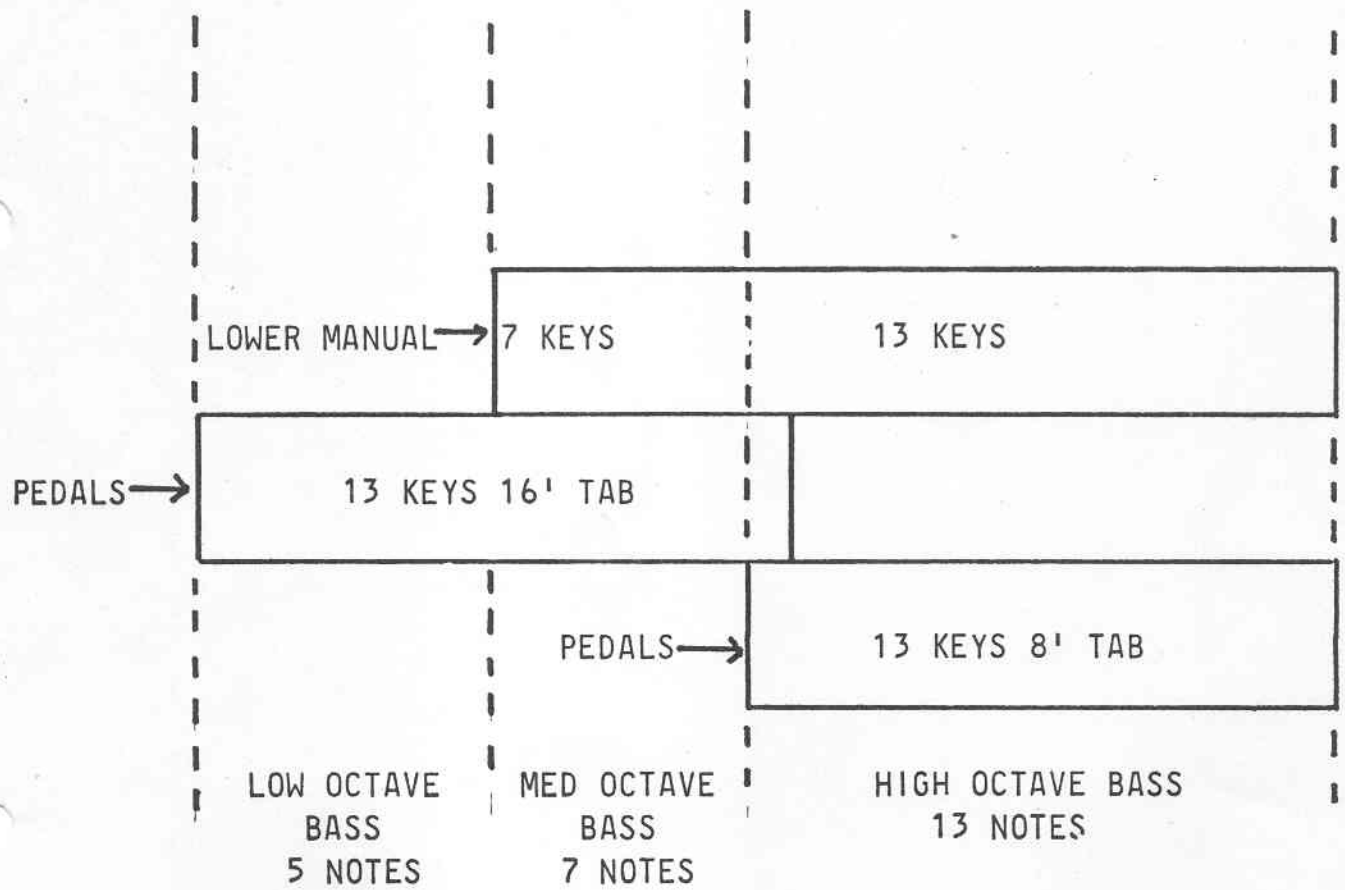
Also, because the bass to lower tab is actuated, transistor Q6 receives -14V at its base input. This potential turns Q6 on which allows pin 1 of IC12A to maintain a logic 1 (grd) level. Consequently IC12A passes the medium bass signal gate.

The result of holding lower manual key #20 down when the bass to lower coupler is on is the passing of the

medium and high bass C tones from the bass select gates of IC12 to the envelope gates of IC14. At this point the system processes the signal in the normal fashion.

NOTE: All 20 lower manual keys utilize only the medium and high bass outputs of IC12A and IC12D.

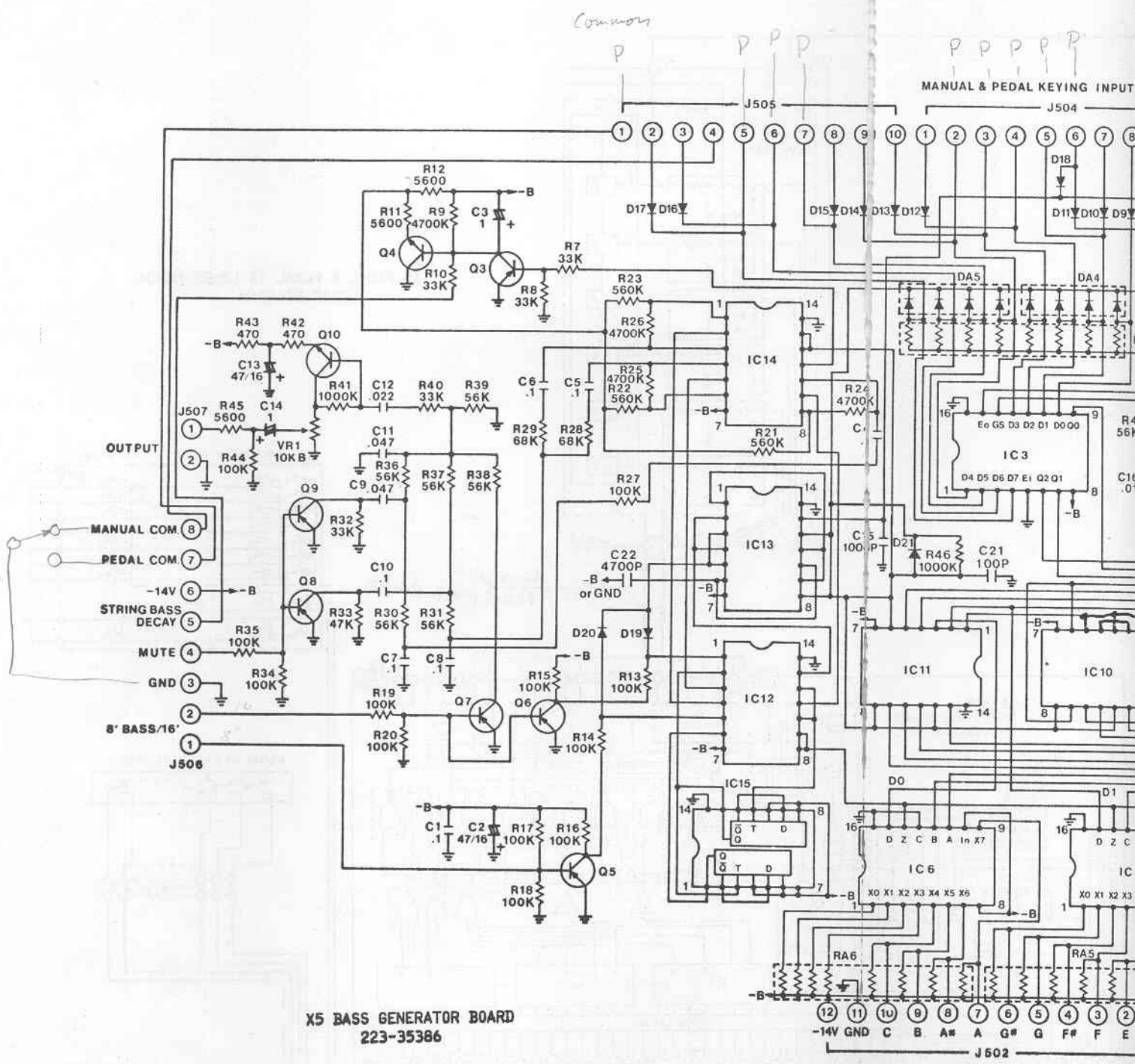
NOTE: All 20 lower manual keys utilize only the medium and high bass outputs of IC12A and IC12D.



X5 BASS RANGE

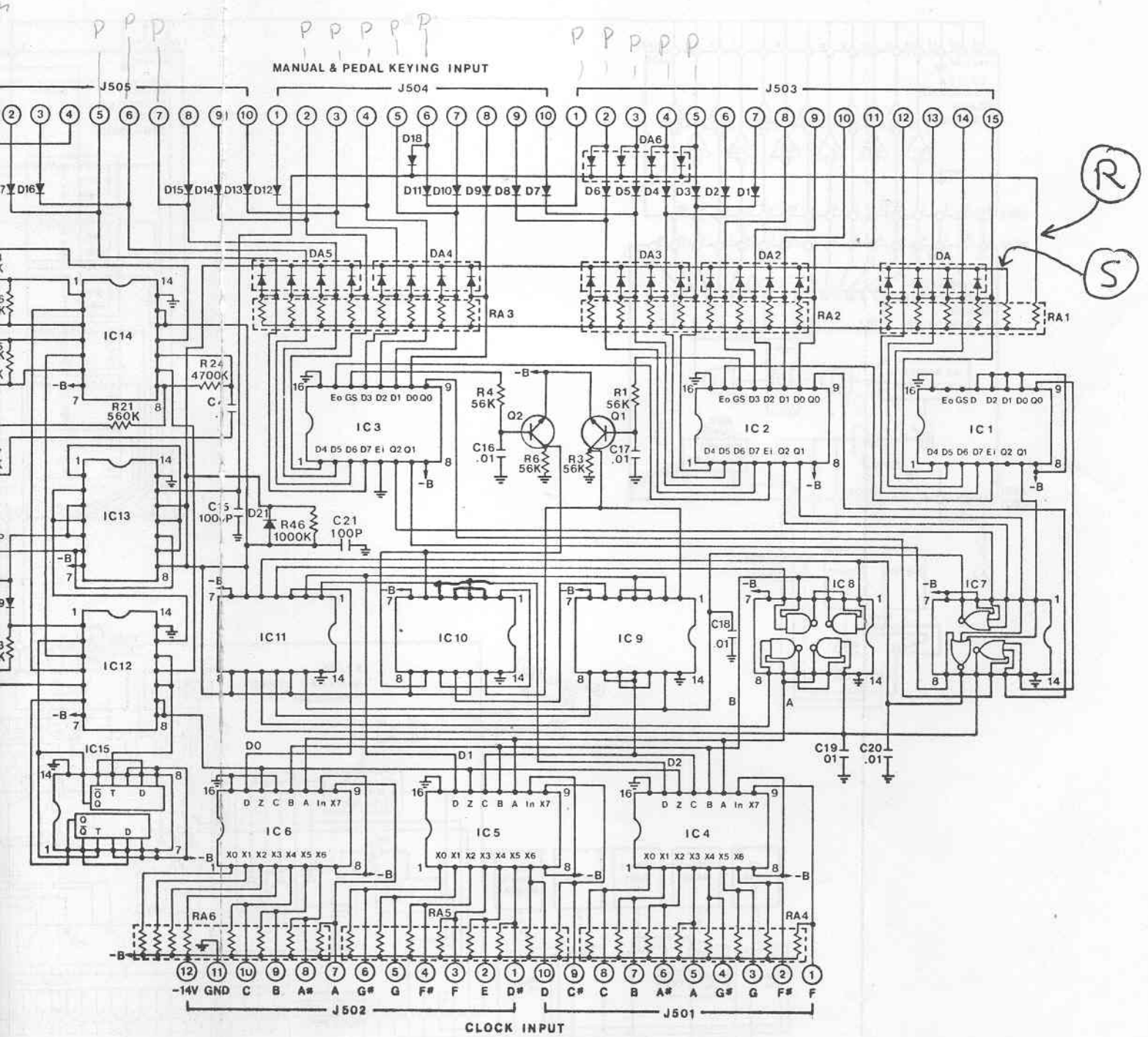
Figure 1





X5 BASS GENERATOR BOARD  
223-35386

(12) (11) (10) (9) (8) (7) (6) (5) (4) (3) (2)  
 -14V GND C B A# A G# G F# F E  
 J502  
 CLO



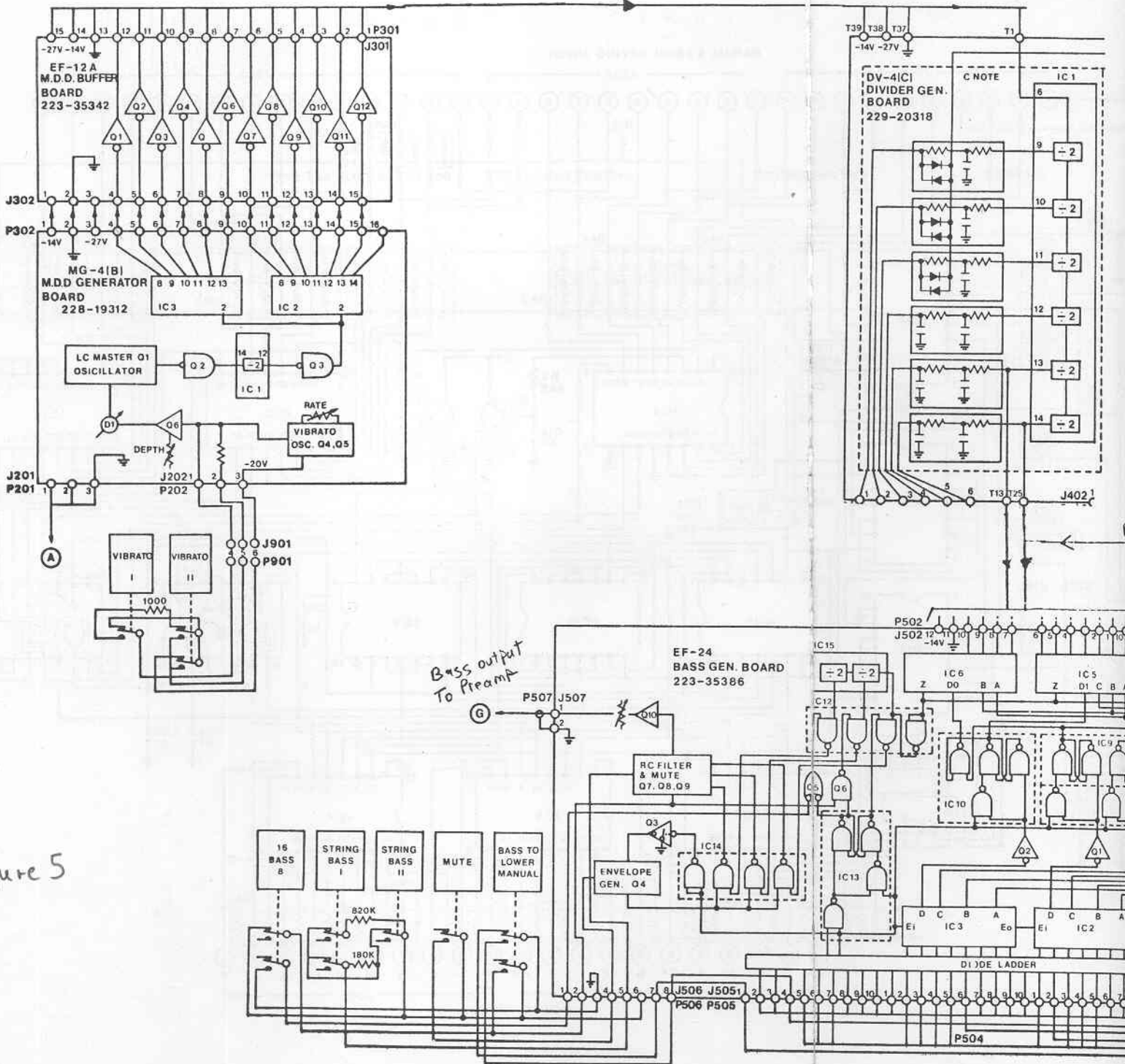
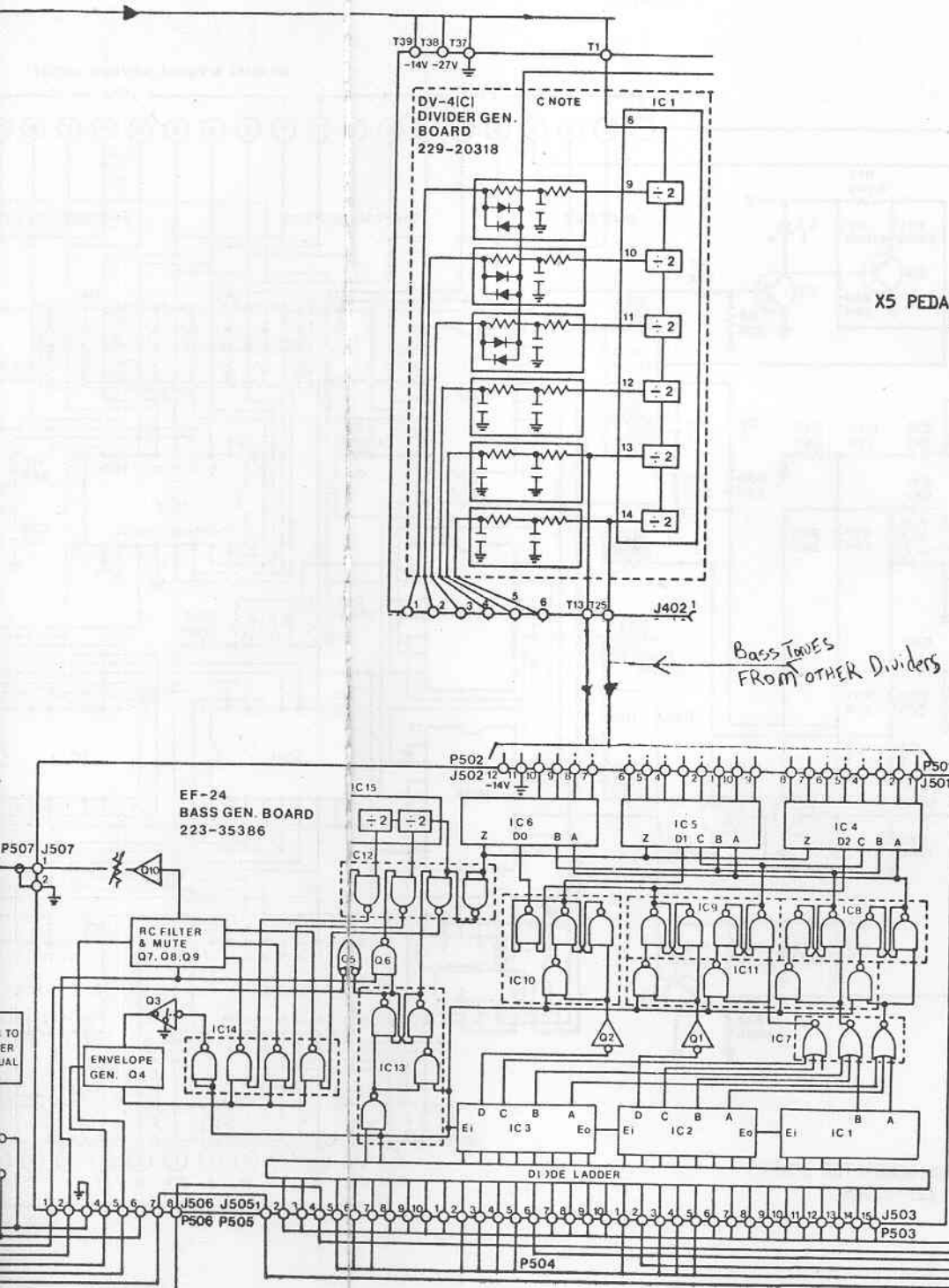
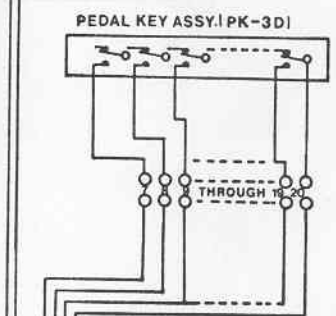
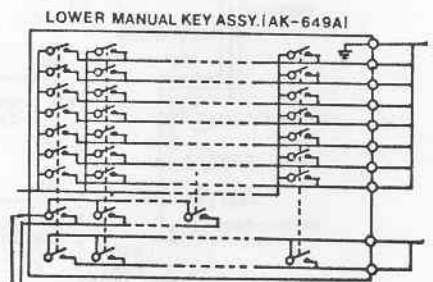


Figure 5



X5 PEDAL & PEDAL TO LOWER MANUAL LOGIC DIAGRAM



*Bass Lines From Other Dividers*

X5 BASS GENERATOR BOARD  
FUNCTIONAL BLOCK DIAGRAM FOR PEDALS AND PEDALS TO

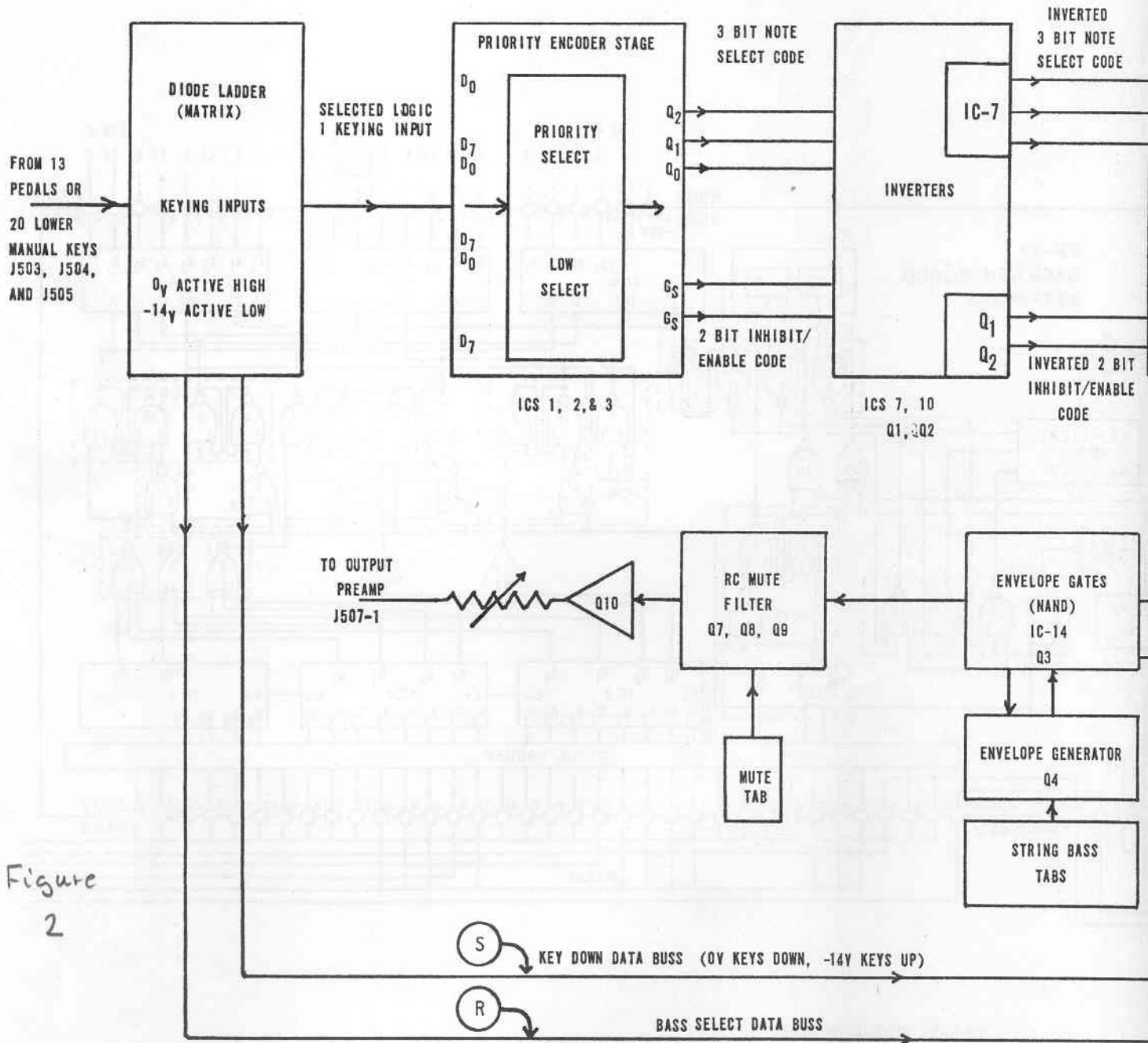
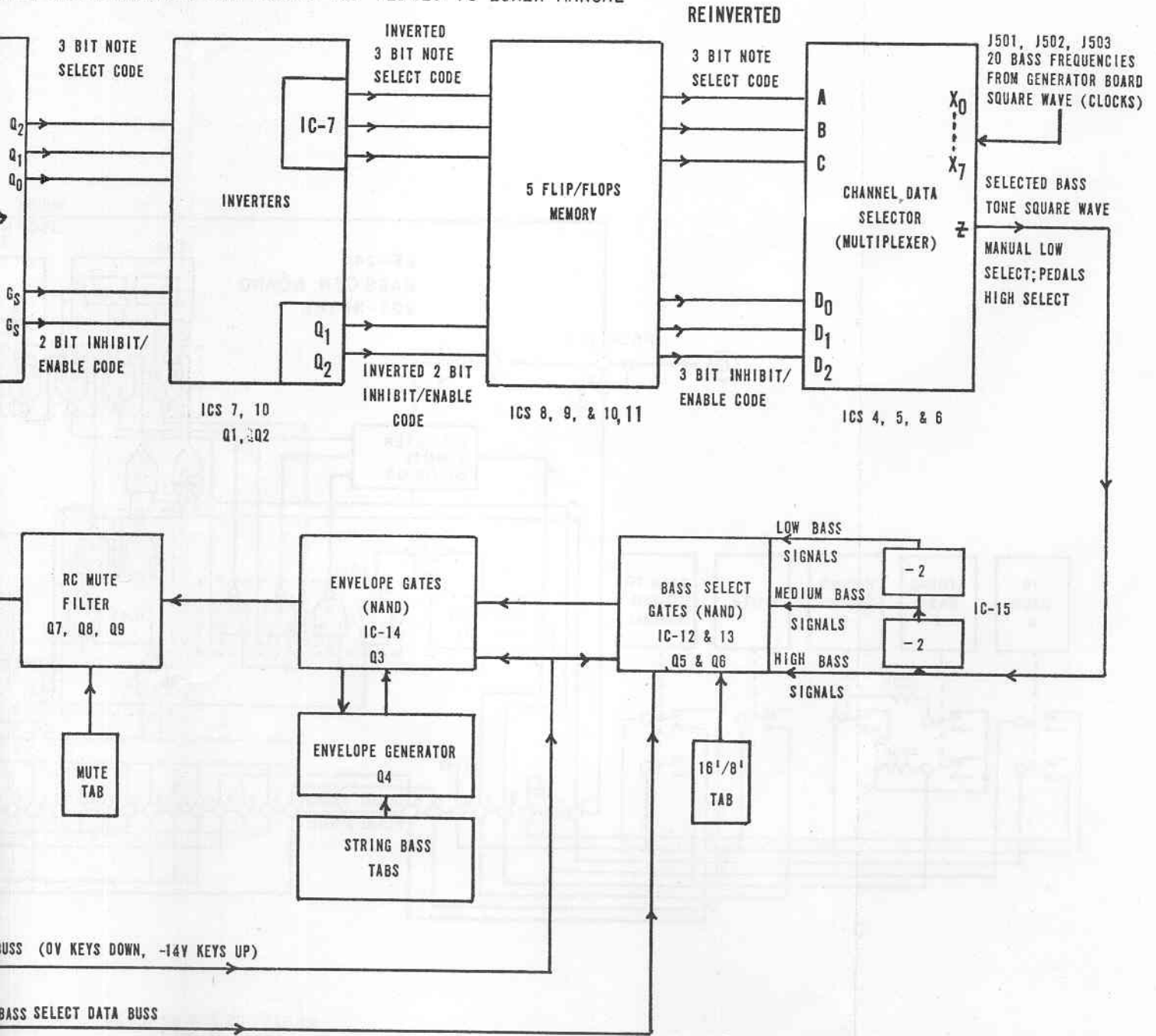


Figure  
2



# X5 BASS GENERATOR BOARD

## FUNCTIONAL BLOCK DIAGRAM FOR PEDALS AND PEDALS TO LOWER MANUAL



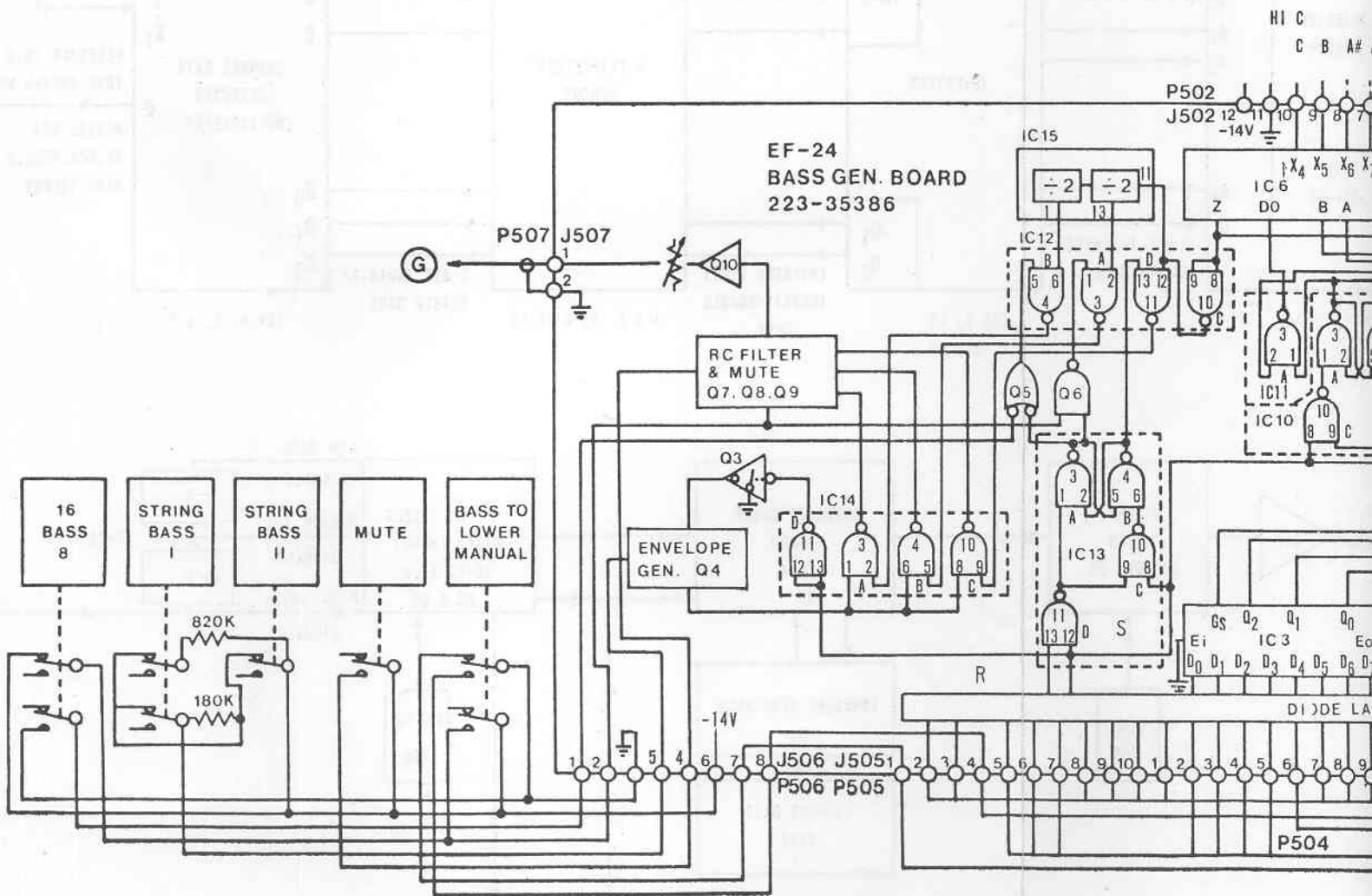
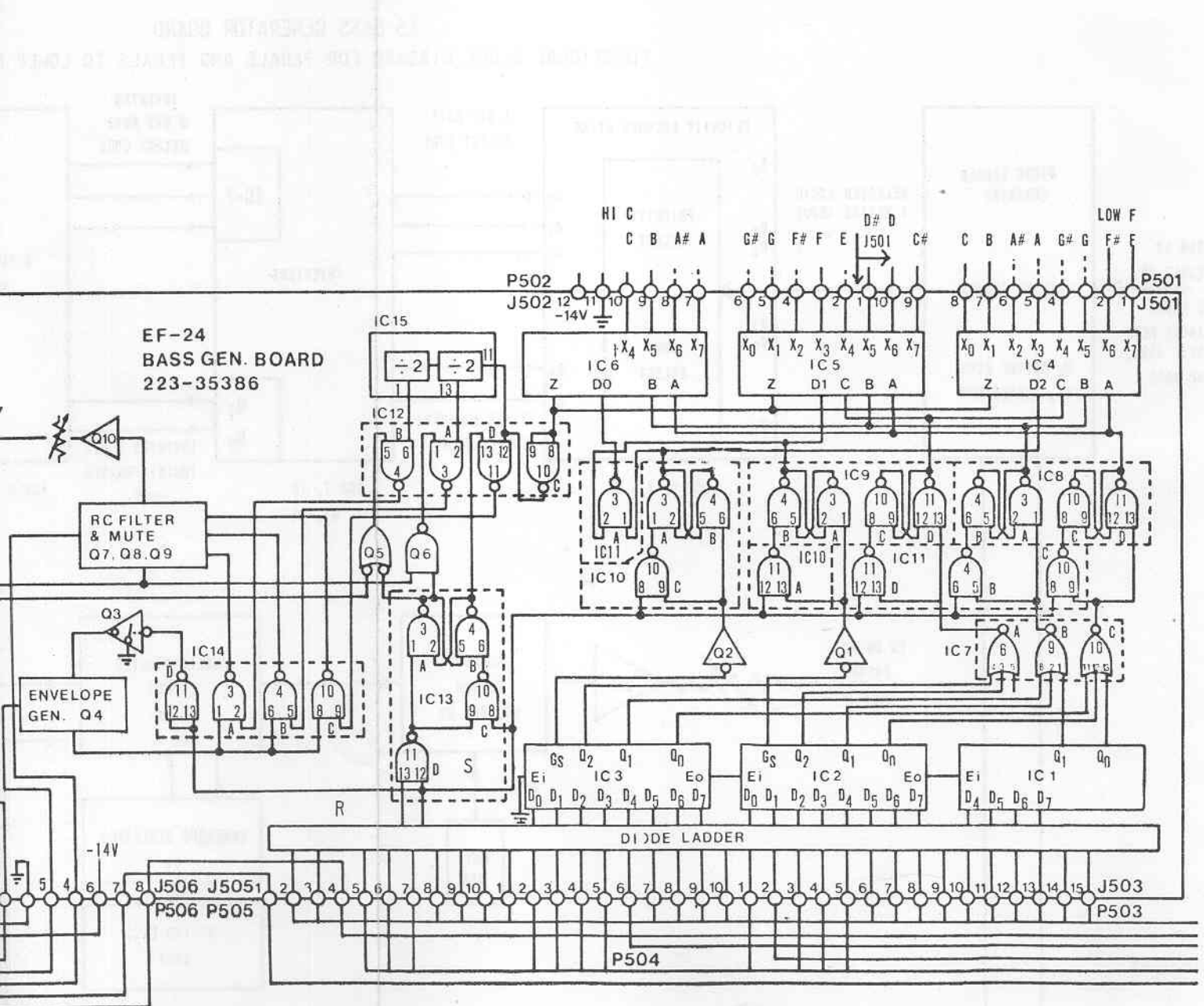
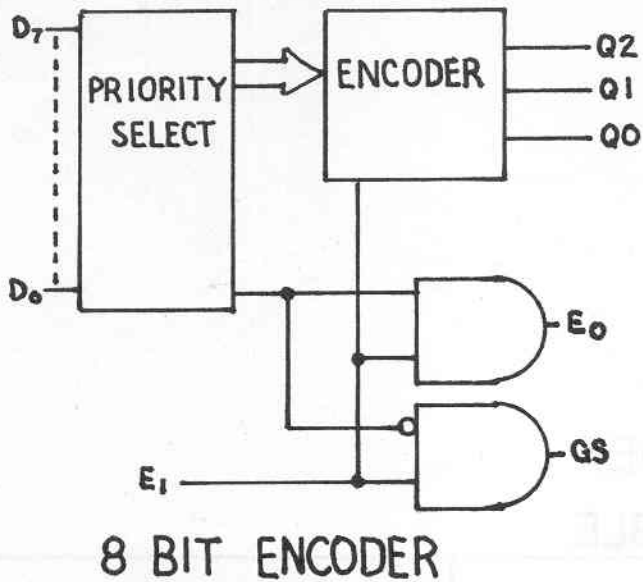


Figure 3

X5 BASS GENERATOR BOARD  
LOGIC DIAGRAM



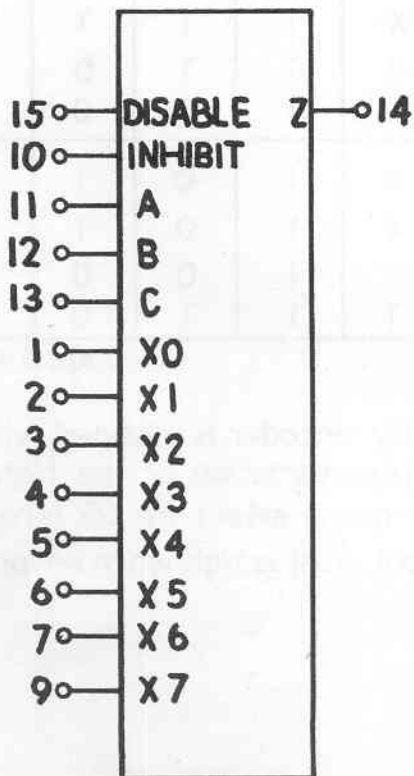
X5 BASS GENERATOR BOARD  
LOGIC DIAGRAM



HAMMOND PART NUMBER J 319-009001

MOTOROLA NUMBER MC 14532 CP

RCA NUMBER CD 4532 E



HAMMOND PART NUMBER J 319-010001

MOTOROLA NUMBER MC 14512 CP

$V_{DD}$  = PIN 16  
 $V_{SS}$  = PIN 8  
**DATA SELECTOR**

Figure 6

## 8-BIT ENCODER TRUTH TABLE

INPUT									OUTPUT				
E <sub>1</sub>	D7	D6	D5	D4	D3	D2	D1	D0	GS	Q2	Q1	Q0	E <sub>0</sub>
0	X	X	X	X	X	X	X	X	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	1
1	1	X	X	X	X	X	X	X	1	1	1	1	0
1	0	1	X	X	X	X	X	X	1	1	1	0	0
1	0	0	1	X	X	X	X	X	1	1	0	1	0
1	0	0	0	1	X	X	X	X	1	1	0	0	0
1	0	0	0	0	1	X	X	X	1	0	1	1	0
1	0	0	0	0	0	1	X	X	1	0	1	0	0
1	0	0	0	0	0	0	1	X	1	0	0	1	0
1	0	0	0	0	0	0	0	1	1	1	0	0	0

X = Don't Care

Logic 1 = High

Logic 0 = Low

D7 is the highest priority and D0 is the lowest. The priority encoder is inhibited when the chip-enable input E<sub>1</sub> is low. When E<sub>1</sub> is high, the binary representation of the highest priority input appears on output lines Q2-Q0, and the group select line GS is high to indicate that priority inputs are present. The enable-out (E<sub>0</sub>) is high when no priority inputs are present.

Figure 7



# 8-CHANNEL DATA SELECTOR

4512

## TRUTH TABLE

C	B	A	INHIBIT	DISABLE	Z
0	0	0	0	0	X0
0	0	1	0	0	X1
0	1	0	0	0	X2
0	1	1	0	0	X3
1	0	0	0	0	X4
1	0	1	0	0	X5
1	1	0	0	0	X6
1	1	1	0	0	X7
$\emptyset$	$\emptyset$	$\emptyset$	1	0	0
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	1	High Impedance

Figure 8

## X-5 PRIORITY SELECT INPUTS

L/M KEY	#	Note	Connector	IC	Pin
	# 1	F	J505-2	IC3	pin 4
	# 2	F#	J505-3	IC3	pin 3
	# 3	G	J505-7	IC3	pin 2
	# 4	G#	J505-9	IC3	pin 1
	# 5	A	J505-10	IC3	pin 13
	# 6	A#	J504-1	IC3	pin 12
	# 7	B	J504-5	IC3	pin 11
	# 8	C	J504-8	IC3	pin 10
	# 9	C#	J504-9	IC2	pin 4
	#10	D	J504-10	IC2	pin 3
	#11	D#	J503-6	IC2	pin 2
	#12	E	J503-7	IC2	pin 1
	#13	F	J503-8	IC2	pin 12
	#14	F#	J503-9	IC2	pin 11
	#15	G	J503-10	IC2	pin 10
	#16	G#	J503-11	IC2	pin 9
	#17	A	J503-12	IC1	pin 4
	#18	A#	J503-13	IC1	pin 3
	#19	B	J503-14	IC1	pin 2
	#20	C	J503-15	IC1	pin 1

PEDAL KEY	#	Note	Connector	IC	Pin
	# 1	C	J503-1	IC3	pin 10
	# 2	C#	J503-2	IC2	pin 4
	# 3	D	J503-3	IC2	pin 3
	# 4	D#	J503-4	IC2	pin 2
	# 5	E	J503-5	IC2	pin 1
	# 6	F	J505-5	IC3	pin 4
	# 7	F#	J505-6	IC3	pin 3
	# 8	G	J505-7	IC3	pin 2
	# 9	G#	J504-2	IC3	pin 1
	#10	A	J504-3	IC3	pin 13
	#11	A#	J504-4	IC3	pin 12
	#12	B	J504-5	IC3	pin 11
	#13	C	J503-1	IC3	pin 10

*Her  
zu  
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galt!*

*Something  
wotten!*

Figure 9



# NIHON HAMMOND SERVICE NEWS

NIHON HAMMOND, LTD. · SERVICE DEPARTMENT

2-30, 2-chome, Shinkitajima, Suminoe-ku, Osaka, Japan 〒 559

Volume 1 Number 1

SEPTEMBER 1977

## NEW X-5 CHANGES

Eight new pages for the NEW X-5 (18150K) Appendix HO-I296A are enclosed. These pages should be inserted into your NEW X-5 (18150K) Appendix in place of the pages that are there now. Three of the pages, 3-8A·3-9A (ADD-1), 3-8A·3-9 $\bar{A}$  (ADD-2) and 3-8A·3-9A (ADD-3), concern changes in the M.D.D. Generator Board and the M.D.D. Buffer Board. Five of the pages, 3-13A (ADD-1), 3-15A (ADD-1), 3-16A (ADD-1), 4-7A (ADD-1) and 4-7A (ADD-2), concern changes in the Power Supply Unit and the Main Amp. Assy.

## TWO NEW SERVICE SHEETS

Service information for two models is enclosed. A complete manual, H000-006023 JR for 123JMR and H000-006041 JR for 124JMR.

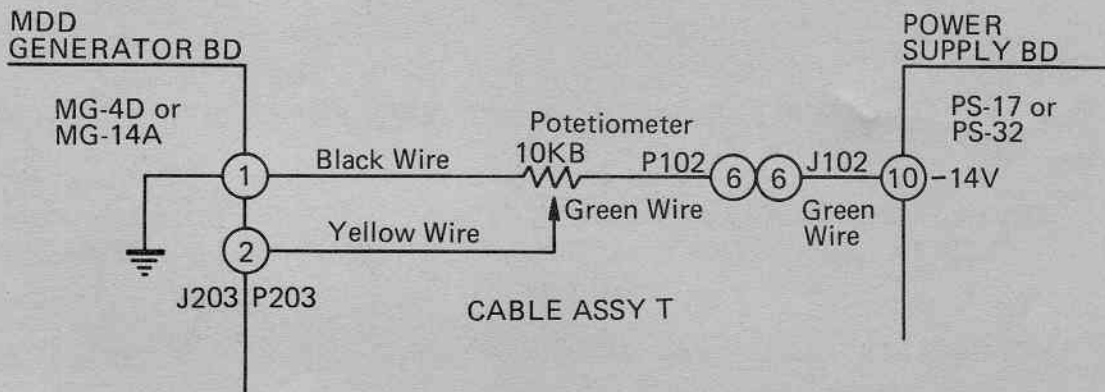
**SUBJECT: MISPRINTED NEW X-5 (18150K) SERVICE MANUAL**

**CORRECTION:** Refer to schematic (NOTES 1.) of 228-19312 M.D.D. Generator Board on Page 3-8A in NEW X-5 (18150K) service manual HO-1296A.

<b>WRONG:</b>	Q1	305-03014	2SC373
	Q2 THROUGH Q6	305-03040	2SC945Q
<b>RIGHT:</b>	Q1 THROUGH Q3	305-03063	2SC1675L or K
	Q4 THROUGH Q6	305-03040	2SC945Q

**SUBJECT: ADD PITCH CONTROL IN 220V & 240V AREA**  
(Serial No. 572263 Up)

See detail as follows.



**CAUTION:** MG-4D is added pin-terminal 2P (J203) to MG-4B.

<b>PARTS:</b>	Pin Terminal 2P (J203)	317-03081	5028-2A
	Cable Assy T	105-03421	
	Connector 2P (P203)	317-03001	2139-2
	Connector Pin (for P203)	317-03009	2478-TL
	Connector Pin (for P102)	314-07001	1380-TL
	Potentiometer 10KB	309-17002	EVC-BOA-S15
	Blind #2	401-02418	
	Bracket	401-03497	
	Potentiometer Knob	304-02047	FT-20S

**SUBJECT: ADD NEW TYPE M.D.D. GENERATOR BOARD IS USED 1-CHIP LSI (S-50240)** Except 120V Area

Refer to Appendix Page 3-8A-3-9A (ADD-1), 3-8A-3-9A (ADD-2) and 3-8A-3-9A (ADD-3).

SEPTEMBER 1977

MODEL NEW X-5 (18150K)

**SUBJECT: ADD NEW TYPE POWER SUPPLY UNIT & MAIN AMP ASSY**  
Refer to appendix Pages 3-13A (ADD-1), 3-15A (ADD-), 3-16A (ADD-1),  
4-7A (ADD-1) and 4-7A (ADD-2).

**SUBJECT: CIRCUIT CHANGES ON NEW TYPE MAIN AMP ASSY IN 220V & 240V AREA**

**CORRECTION:** Changes Value of Fuses F1 and F2 (1AT) to 1.6 AT on the 224-15211  
PS-34 Fuse Board in the New Type Main Amp Assy. (Serial No. 572263 Up)

**SUBJECT: CIRCUIT CHANGES ON NEW TYPE POWER SUPPLY UNIT IN 220V &  
240V AREA**

**CORRECTION:** Changes value of Fuses F1 and F2 (0.63A) to 315 mAT on the 224-15206  
PS-33 Fuse Board in the New Type Power Supply Unit (Serial No. 578268  
Up and No.580591 Down)

**CORRECTION:** Changes value of Fuses F1 and F2 (315 mAT) to 400 mAT on the 224-  
15206 PS-33 Fuse Board in the New Type Power Supply Unit  
(Serial No. 580592 Up)

**SUBJECT: BASS GENERATOR P.W.B. (EF-24) 223-35286 REVISION**  
For output level up. (Serial No. 02200 Up)

**CORRECTION:** Refer to schematic of 223-35386 Bass Generator Board on Page 3-7A in  
NEW X-5 service manual HO-1296A.

Change value of resistor R11 (5600) to 4700.

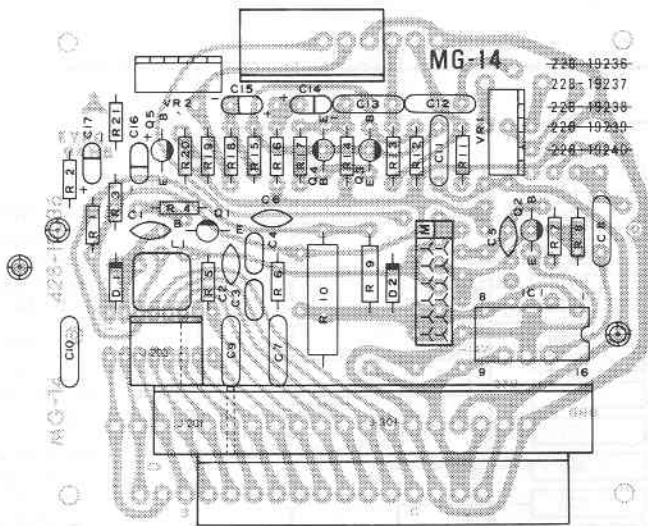


**DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE POWER SUPPLY UNIT**  
**DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE MAIN AMP. ASSY**

◀ 100V & 120V AREA ▶			
PRESENTED SERVICE MANUAL (OLD TYPE)		ADD (NEW TYPE)	
POWER SUPPLY UNIT	105-09201 (100V) 105-09292 (120V)	POWER SUPPLY UNIT	105-09225 (100V) 105-09226 (120V)
<p>(a) SOCKET 9P (1412-B) (c) FUSE BD (PS-23A)</p> <p>POWER SUPPLY (PS-17) BD 224-14216</p> <p>JACK 318-04001 (SG-7615) TRANSFORMER 307-01077 (E-06) 100V 307-01078 (E-06UL) 120V</p> <p>(b) POWER SUPPLY CORD</p> <p align="center"><b>TOP VIEW</b></p>		<p>(a) AC POWER CABLE (TO MAIN AMP) (a) DIN SOCKET 5P (c) FUSE BD</p> <p>POWER SUPPLY (PS-17) BD 224-14216</p> <p>JACK 318-04001 (SG-7615) TRANSFORMER 307-01077 (E-06) 100V 307-01078 (E-07UL) 120V</p> <p>(a) AC SOCKET 3P</p> <p align="center"><b>TOP VIEW</b></p>	
<p>NOTE:</p> <p>(a) Socket 9P 317-01015 (1412-B)</p> <p>(b) Power Supply Cord 438-08001 100V only Power Supply Cord 438-02021 120V only</p> <p>(C) Fuse Board Assy 224-14241 (PS-23A)</p>		<p>NOTE:</p> <p>(a) DIN Socket 5P 303-14001 AC Socket 3P 303-09005 (CM-3) AC Power Cable 439-01008 (to Main Amp.)</p> <p>(b) Power Supply Cord 439-02002 100V only Power Supply Cord 439-01004 120V only</p> <p>(C) Fuse Board Assy 224-14241 (PS-23A) 120V Fuse Board Assy 224-14243 (PS-23C) 100V</p> <p>CHANGE: SERIAL NO. 589442 Up (100V AREA) SERIAL NO. 585539 Up (120V AREA)</p>	
MAIN AMP. ASSY	105-09205 (100V) 105-09206 (120V)	MAIN AMP. ASSY	105-09229 (100V) 105-09230 (120V)
<p>JACK 318-04001 (SG-7615)</p> <p>(b) CIRCUIT BREAKER 1A NEON LAMP 308-02006 (P-5595)</p> <p>(a) CABLE ASSY Q SOCKET 9P 317-01015 (1412-B)</p> <p align="center"><b>FRONT VIEW</b></p>		<p>(b) CIRCUIT BREAKER 1A NEON LAMP 308-02006 (P-5595) SOCKET 9P 317-01015 (1412-B)</p> <p>(a) DIN SOCKET 5P (a) AC SOCKET 3P (CM-3) JACK 318-04001 (SG-7615)</p> <p align="center"><b>FRONT VIEW</b></p>	
<p>NOTE:</p> <p>(a) Cable Assy Q 105-07415</p> <p>(b) Circuit Breaker 1A 302-02020 (MB-1)</p>		<p>NOTE:</p> <p>(a) DIN Socket 5P 303-14001 AC Socket 3P 303-09005 (CM-3) DIN Cord 440-01002</p> <p>(b) Circuit Breaker 1A 302-02004 (NW-1S) CSA only Circuit Breaker 1A 302-02020 (MB-1) UL &amp; 100V only</p> <p>CHANGE: SERIAL NO. 589442 Up (100V AREA) SERIAL NO. 585539 Up (120V AREA)</p>	

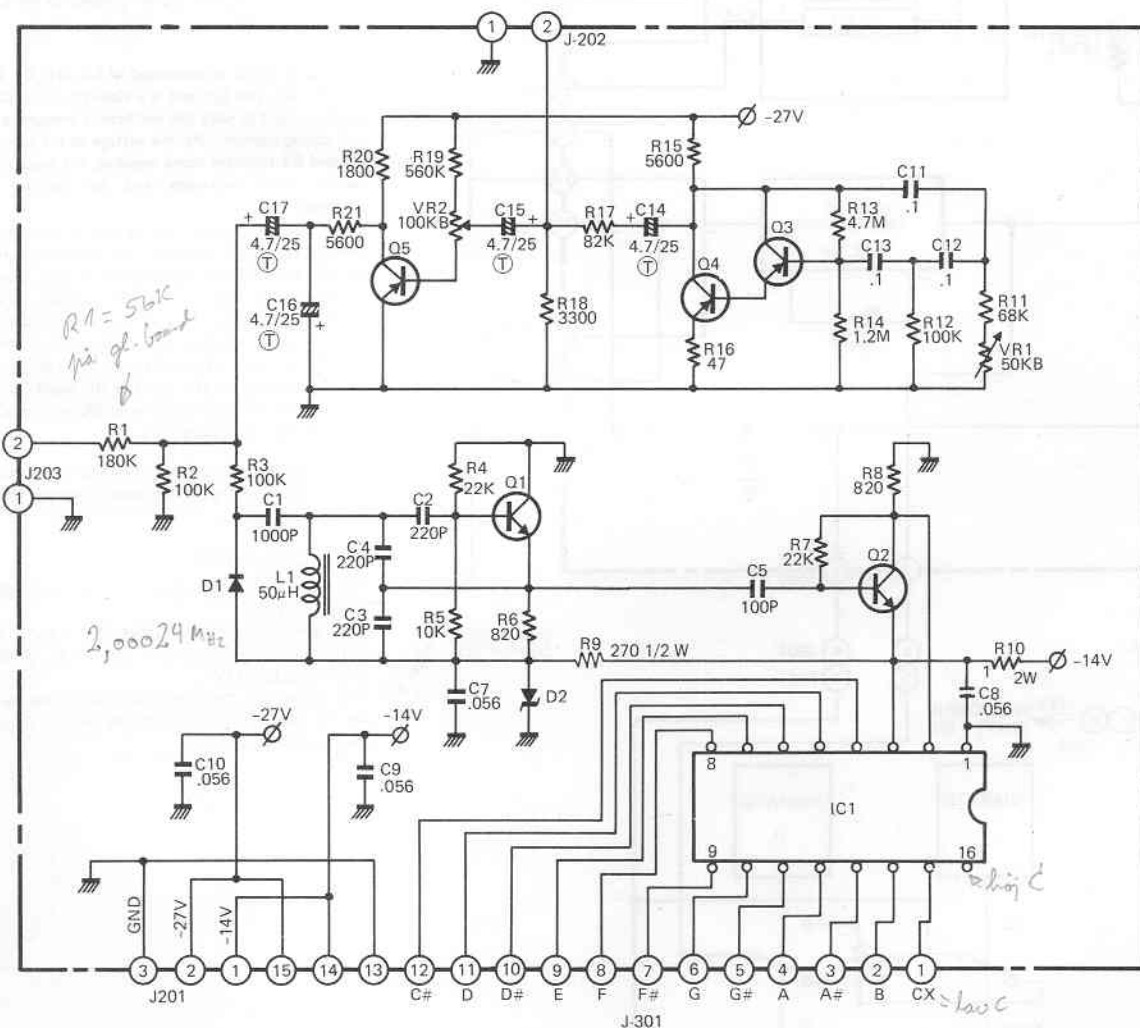
**DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE POWER SUPPLY UNIT**  
**DIFFERENCE BETWEEN NEW TYPE AND OLD TYPE MAIN AMP. ASSY**

≪ 220V & 240V AREA ≫																																																	
PRESENTED SERVICE MANUAL (OLD TYPE)	ADD (NEW TYPE)																																																
POWER SUPPLY UNIT 105-09204 (230V)	POWER SUPPLY UNIT 105-09227 (220V) 105-09228 (240V)																																																
<p>(d) SOCKET 9P (1412-B) (b) FUSE BD (PS-23B)</p> <p>(a) POWER SUPPLY BD (PS-17) (c) TRANSFORMER (E-06)</p> <p>JACK (SG-7615) 318-04001 (e) POWER SUPPLY CORD</p> <p align="center"><b>TOP VIEW</b></p>	<p>(d) AC Power Cable (TO MAIN AMP) (b) FUSE BD (PS-33)</p> <p>(d) DIN SOCKET 5P (d) AC SOCKET 3P (CM-3)</p> <p>(a) POWER SUPPLY BD (PS-32) (c) TRANSFORMER</p> <p>JACK (SG-7615) 318-04001</p> <p align="center"><b>TOP VIEW</b></p>																																																
<p>NOTE:</p> <table border="0"> <tr> <td>(a) Power Supply PWB Assy</td> <td>224-14216</td> <td>(PS-17)</td> </tr> <tr> <td>(b) Fuse Boad Assy</td> <td>224-14242</td> <td>(PS-23B)</td> </tr> <tr> <td>(c) Transformer (230V)</td> <td>307-01077</td> <td>(E-06)</td> </tr> <tr> <td>(d) Socket 9P</td> <td>317-01015</td> <td>(1412-B)</td> </tr> <tr> <td colspan="3"> </td> </tr> <tr> <td>(e) Power Supply Cord Plug</td> <td>504-12002</td> <td>(230V)</td> </tr> <tr> <td></td> <td>316-03001</td> <td>(230V)</td> </tr> </table>	(a) Power Supply PWB Assy	224-14216	(PS-17)	(b) Fuse Boad Assy	224-14242	(PS-23B)	(c) Transformer (230V)	307-01077	(E-06)	(d) Socket 9P	317-01015	(1412-B)				(e) Power Supply Cord Plug	504-12002	(230V)		316-03001	(230V)	<p>NOTE:</p> <table border="0"> <tr> <td>(a) Power Supply PWB Assy</td> <td>224-15201</td> <td>(PS-32)</td> </tr> <tr> <td>(b) Fuse Boad Assy</td> <td>224-15206</td> <td>(PS-33)</td> </tr> <tr> <td>(c) Transformer (220 ~ 240V)</td> <td>307-01103</td> <td></td> </tr> <tr> <td>(d) DIN Socket 5P</td> <td>303-14001</td> <td></td> </tr> <tr> <td>AC Socket 3P</td> <td>303-09005</td> <td>(CM-3)</td> </tr> <tr> <td>AC Power Cable</td> <td>439-01011 (to Main Amp.)</td> <td>240V only</td> </tr> <tr> <td>AC Power Cable</td> <td>439-01009 (to Main Amp.)</td> <td>220V only</td> </tr> <tr> <td>(e) Power Supply Cord</td> <td>439-01006</td> <td>220V only</td> </tr> <tr> <td>Power Supply Cord</td> <td>439-01005</td> <td>240V only</td> </tr> </table> <p>CHANGE: SERIAL NO. 01800 Up</p>	(a) Power Supply PWB Assy	224-15201	(PS-32)	(b) Fuse Boad Assy	224-15206	(PS-33)	(c) Transformer (220 ~ 240V)	307-01103		(d) DIN Socket 5P	303-14001		AC Socket 3P	303-09005	(CM-3)	AC Power Cable	439-01011 (to Main Amp.)	240V only	AC Power Cable	439-01009 (to Main Amp.)	220V only	(e) Power Supply Cord	439-01006	220V only	Power Supply Cord	439-01005	240V only
(a) Power Supply PWB Assy	224-14216	(PS-17)																																															
(b) Fuse Boad Assy	224-14242	(PS-23B)																																															
(c) Transformer (230V)	307-01077	(E-06)																																															
(d) Socket 9P	317-01015	(1412-B)																																															
(e) Power Supply Cord Plug	504-12002	(230V)																																															
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Power Supply Cord	439-01005	240V only																																															
MAIN AMP. ASSY 105-09207 (230V)	MAIN AMP. ASSY 105-09231 (220V) 105-09232 (240V)																																																
<p>(b) CIRCUIT BREAKER 1A (MB-1) JACK 318-04001 (SG-7615)</p> <p>SOCKET 9P 317-01015 (1412-B)</p> <p>NEON LAMP 318-02006 (P-5595)</p> <p>(a) CABLE ASSY Q</p> <p align="center"><b>FRONT VIEW</b></p>	<p>NEON LAMP 308-02006 (P-5595)</p> <p>(a) DIN SOCKET 5P JACK 318-04001 (SG-7615)</p> <p>(b) FUSE BD (PS-34)</p> <p>(a) AC SOCKET 3P (CM-3) SOCKET 9P 317-01015 (1412-B)</p> <p align="center"><b>FRONT VIEW</b></p>																																																
<p>NOTE:</p> <table border="0"> <tr> <td>(a) Cable Assy Q</td> <td>105-07415</td> <td></td> </tr> <tr> <td colspan="3"> </td> </tr> <tr> <td>(b) Circuit Breaker 1A</td> <td>302-02004</td> <td>(NW-1S)</td> </tr> <tr> <td>(c) Transformer (230V)</td> <td>307-01068</td> <td>(E-05)</td> </tr> </table>	(a) Cable Assy Q	105-07415					(b) Circuit Breaker 1A	302-02004	(NW-1S)	(c) Transformer (230V)	307-01068	(E-05)	<p>NOTE:</p> <table border="0"> <tr> <td>(a) DIN Socket 5P</td> <td>303-14001</td> <td></td> </tr> <tr> <td>AC Socket 3P</td> <td>303-09005</td> <td>(CM-3)</td> </tr> <tr> <td>DIN Cord</td> <td>440-01002</td> <td></td> </tr> <tr> <td>(b) Fuse Boad Assy</td> <td>224-15211</td> <td>(PS-34)</td> </tr> <tr> <td>(c) Transformer (220V ~ 240V)</td> <td>307-01104</td> <td></td> </tr> </table> <p>CHANGE: SERIAL NO. 01800 Up</p>	(a) DIN Socket 5P	303-14001		AC Socket 3P	303-09005	(CM-3)	DIN Cord	440-01002		(b) Fuse Boad Assy	224-15211	(PS-34)	(c) Transformer (220V ~ 240V)	307-01104																						
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(c) Transformer (220V ~ 240V)	307-01104																																																



Component on  
print requiring  
is vendor info hold  
hit him and then!

This pcb layout  
is very faulty!



NOTES:

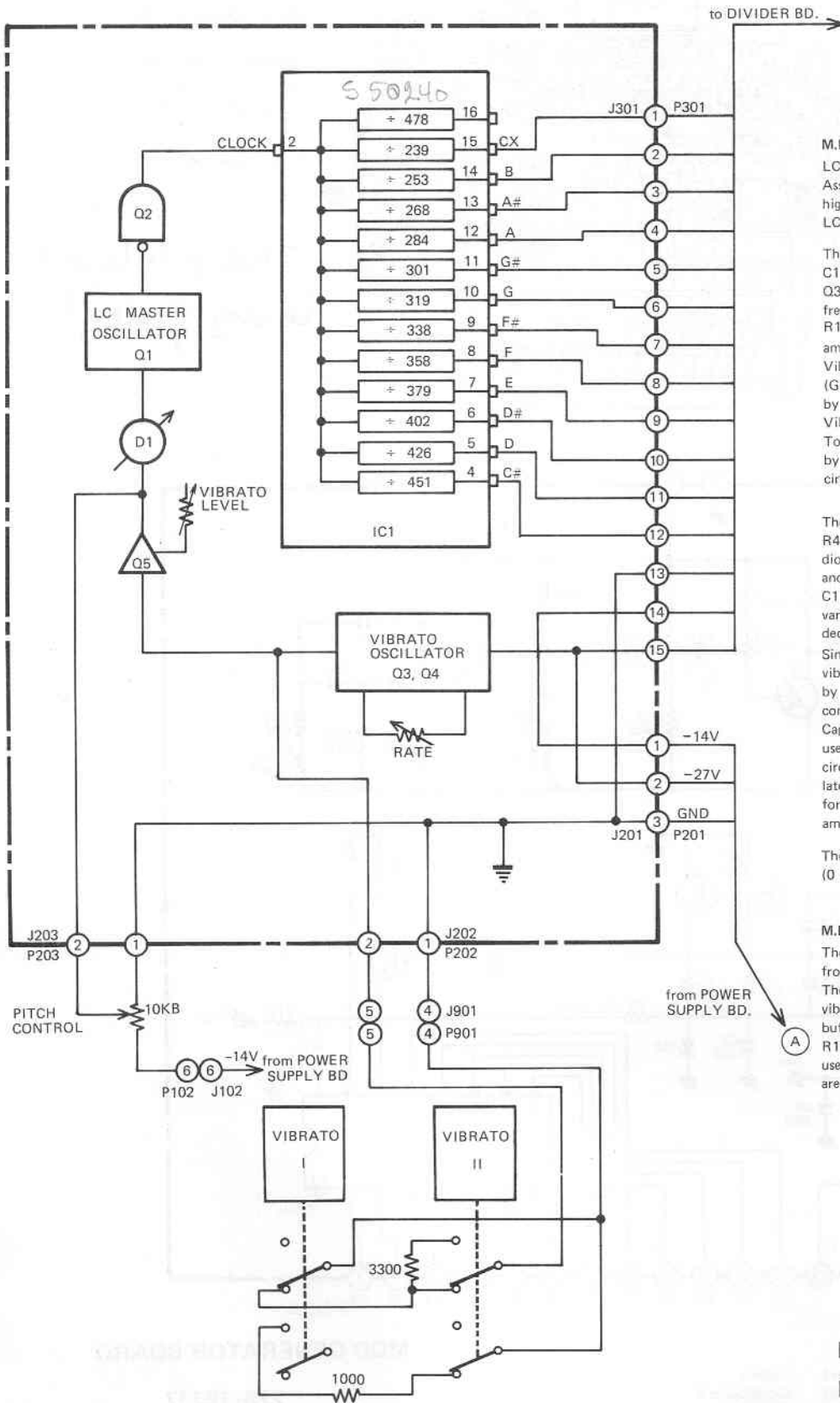
- |            |           |                            |
|------------|-----------|----------------------------|
| 1. IC1     | 319-01014 | S-50240                    |
| Q1, Q2     | 305-03063 | 2SC1675L or K              |
| Q3 thru Q5 | 305-01008 | 2SA733Q                    |
| D1         | 306-05002 | ITT-310                    |
| D2         | 337-06022 | RD-10EB                    |
| C2, C3     | 311-19003 | THERMAL COMPENSATOR CAPAC. |
| C4         | 311-05005 | POLYSTYRENE FILM CAPAC.    |
2. UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.  
ALL CAPACITORS ARE IN MICROFARADS.
3. ① SYMBOL DENOTES NUMBERS IN TERMINALS.  
Ⓣ SYMBOL DENOTES TANTALUM CAPAC.

MDD GENERATOR BOARD

MG-14 228-19337  
228-19237

FIGURE 3-7-3-8 (ADD-1)  
MDD GENERATOR BOARD  
MG-14A (228-19337)  
SCHEMATIC DIAGRAM AND LAYOUT

3-8A-3-9A (ADD-1)



### M.D.D. GENERATOR BOARD

LC Oscillator with vibrato.  
 Assembly 228-19237 includes a vibrato oscillator, and a high frequency.  
 LC oscillator is used to drive the M.D.D. generator.

The vibrato oscillator is a phase shift type comprised of C11, C12, C13, R11, R12, R13, R14, R15, R16, VR1, Q3 and Q4. Pot VR1 is used to adjust the oscillator's frequency. The vibrato signal is coupled through C14, R17 and C15 to the base of transistor Q5, where it is amplified (its width being controlled by VR2).

Vibrato may be turned off by connecting J202-2 to J202-1 (GND), and may be reduced for "Vibrato I or Vibrato II" by connecting J202-2 through switch (Vibrato I and Vibrato II) to J202-1.

To achieve a better sine wave the vibrato signals is filtered by R21 and C16, and is then coupled to the LC oscillator circuitry by C17.

The LC oscillator is comprised of L1, D1, C1, C2, C3, C4, R4, R5, R6, and Q1, and is a Colpitts type. D1, a varicap diode, is used to vary the oscillator's frequency for vibrato and tuning control: As the voltage at the junction of R3, C1 and D1 becomes more negative, the capacitance of the varicap diode, increases, and the oscillator frequency decreases.

Since the cathode of the varicap is normally (with no vibrato) at ground potential and the anode is held at -10V by D2 and R9, the capacitance of the varicap remains constant, and stability of the oscillator is maintained. Capacitor C1 is not part of the tank capacitance, but is used to isolate the D.C. bias on the varicap from the tank circuit. L1, with C3 and C4, and the varicap diode oscillate at 2.00024 M Hz. R4 and R5 supply a bias voltage for Q1. The oscillator signal is couple through C5 to buffer amplifier Q2 which drives IC1.

The tuning is controlled at J203-2 from the varying voltage (0 to -14V) on the tuning potentiometer (10 K ohms).

### M.D.D. GENERATOR

The top octave note is made from the clock signal, coming from Q2, by IC1.

They are supplied the negative D.C. voltage as that the vibrato oscillator is supplied -27V, L.C. oscillator -10V, buffer amp IC1 -14V.

R10 is used for the high frequency by-pass by making to use the inductance of wire-wound resistor, and C7, C8, C9, are also for by-pass.

MDD GENERATOR BD  
 MG-14A 228-19237

FIGURE 3-7-3-8 (ADD-2)  
 MG-14A (228-19231)  
 BLOCK DIAGRAM OF M.D.D. GENERATOR BOARD  
 AND THEORY  
 3-8A-3-9A (ADD-2)

# CONVERSION PROCEDURE

## [from EF-12A & MG-4D (MG-4B) to MG-14A]

1. Change the Tab. Switch (Vibrato I, II) Circuit in the Lower L. H. End Block Assy. See (FIGURE 3)
2. Take off the blue wires from P901-6 to wire end (Soldered to Vibrato tab. switch) and from J901-6 to P202-3.
3. Locate P201 plug. Remove the wires from Pin 1 (-27V DC) and Pin 2 (-14V DC). And insert Pin 1 (with blue wire) into P201-2, Pin 2 (with green wire) into P201-1.
4. Connect P201, P202, P203 and P301 Plugs to MG-14A.

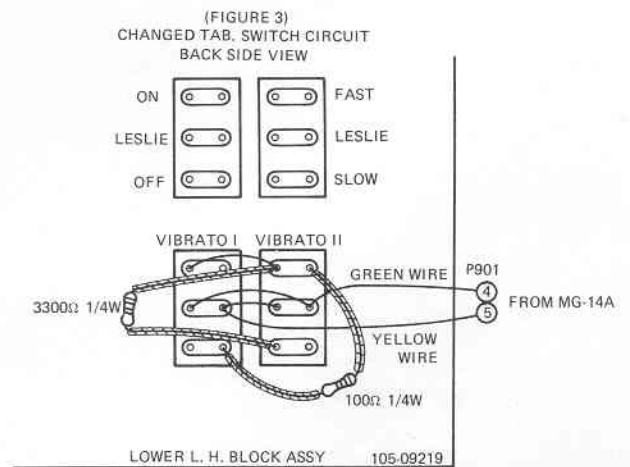
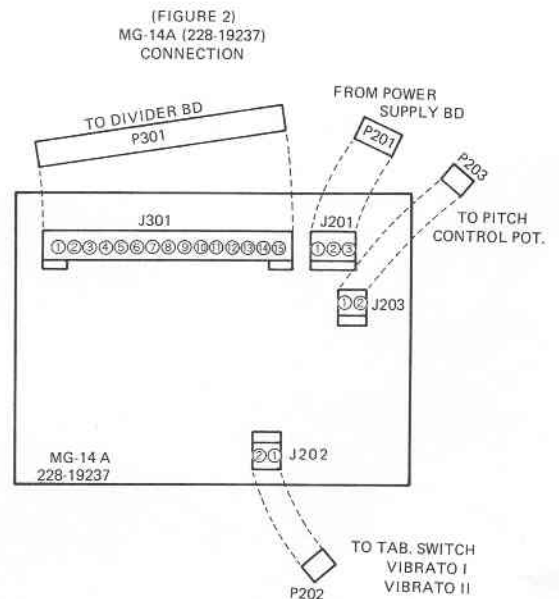
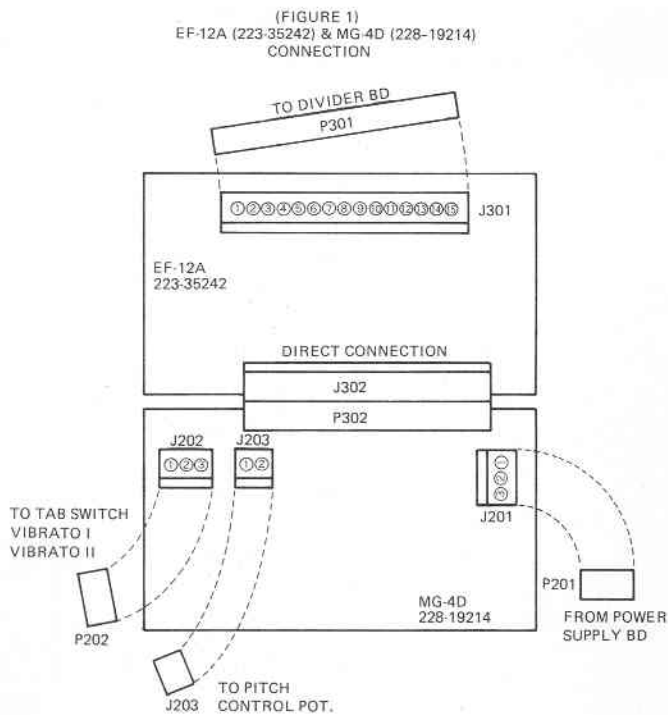
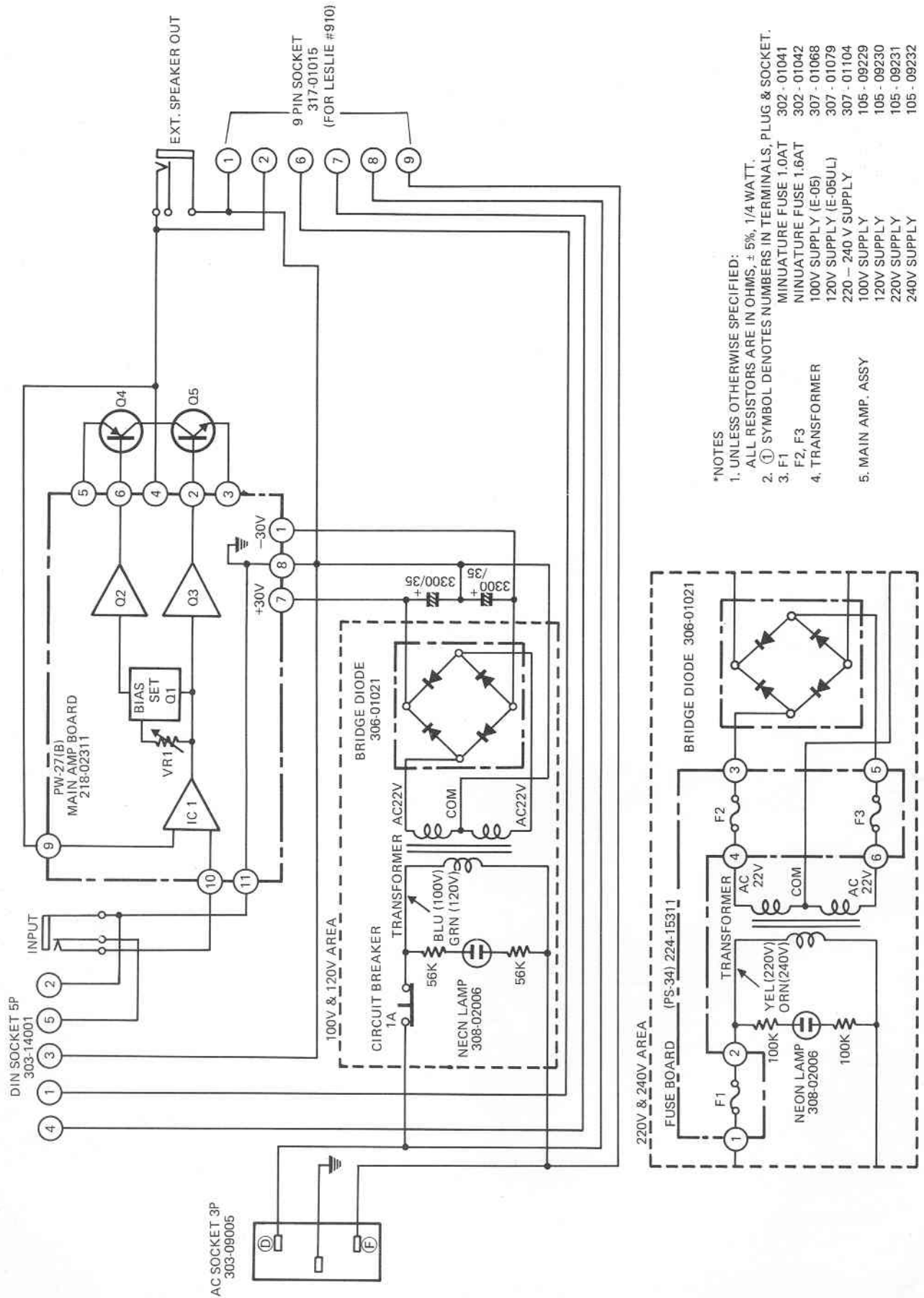


FIGURE 3-7-3-8 (ADD-3)  
M.D.D. GENERATOR BOARD  
MG-14A (228-19337)  
CONVERSION PROCEDURE

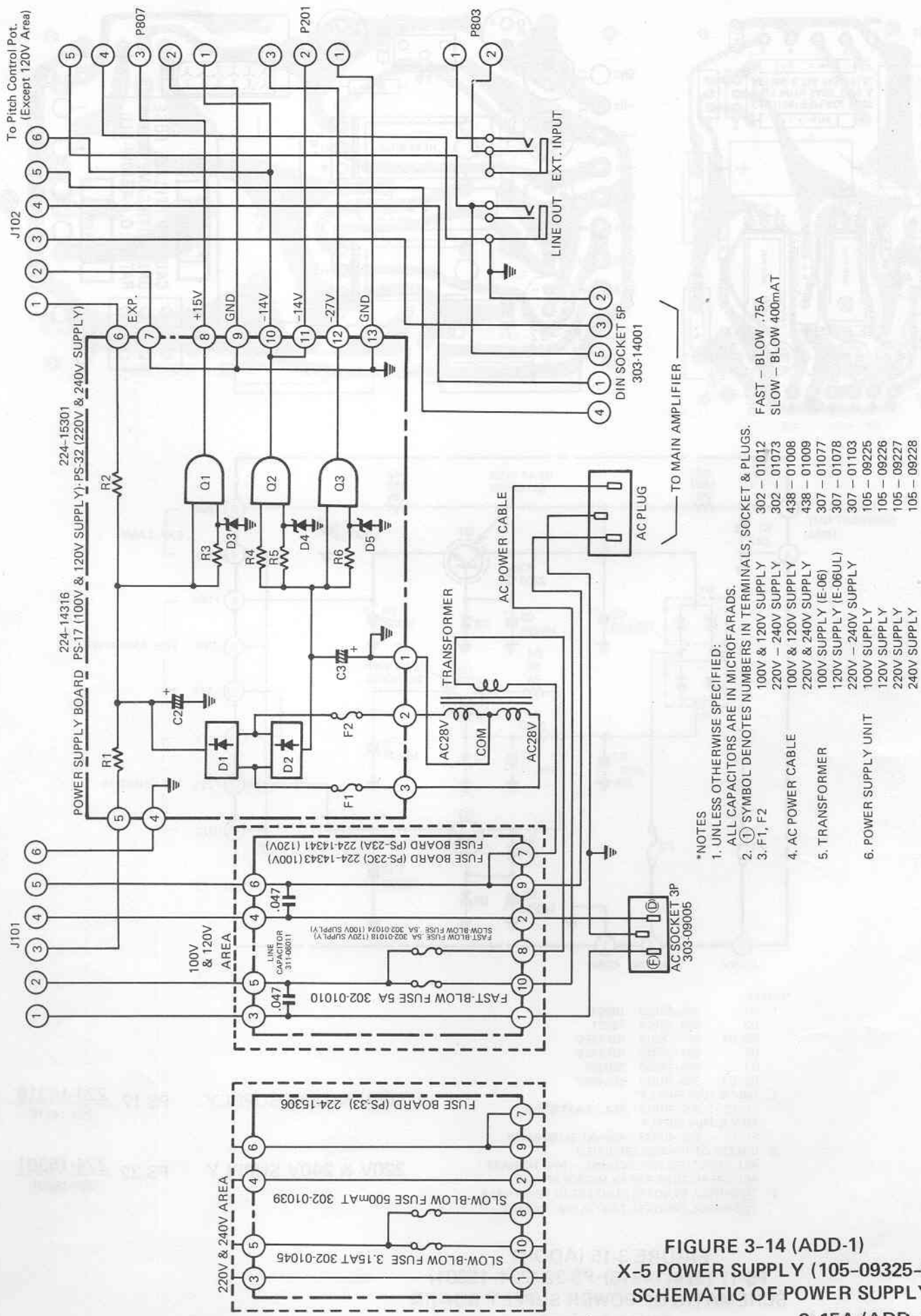
3-8A · 3-9A (ADD-3)





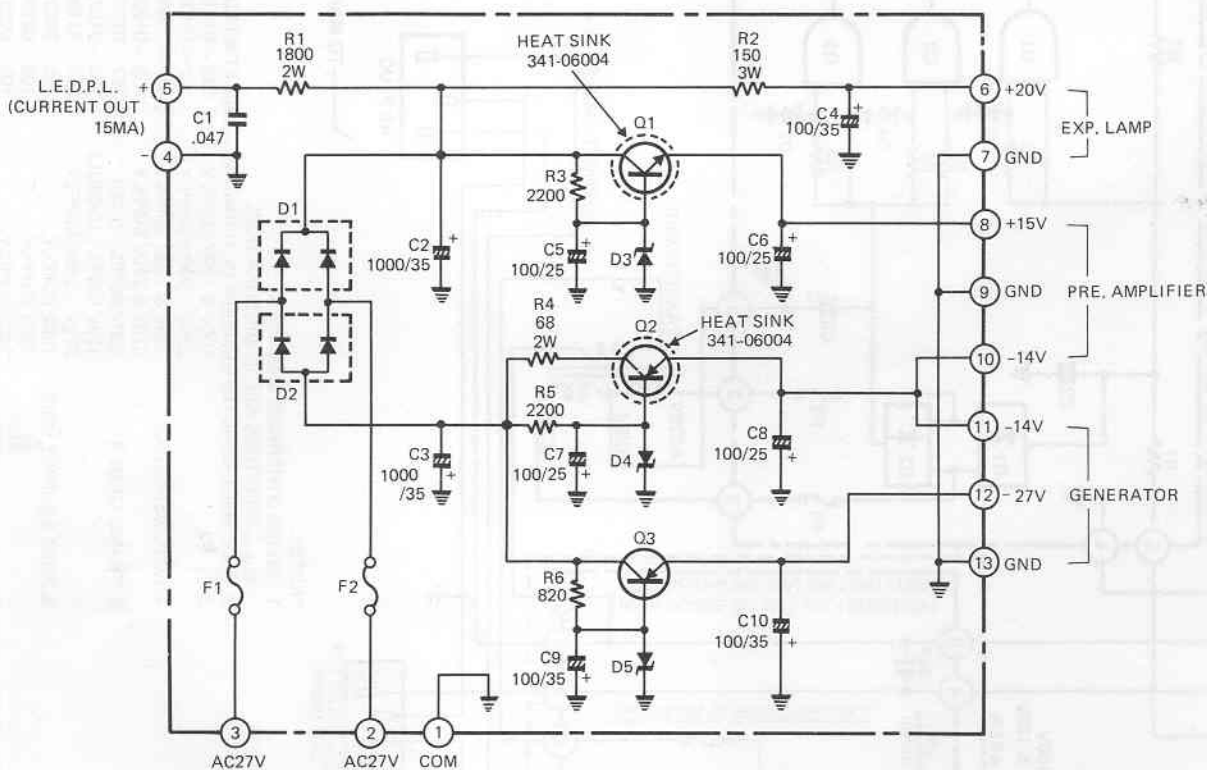
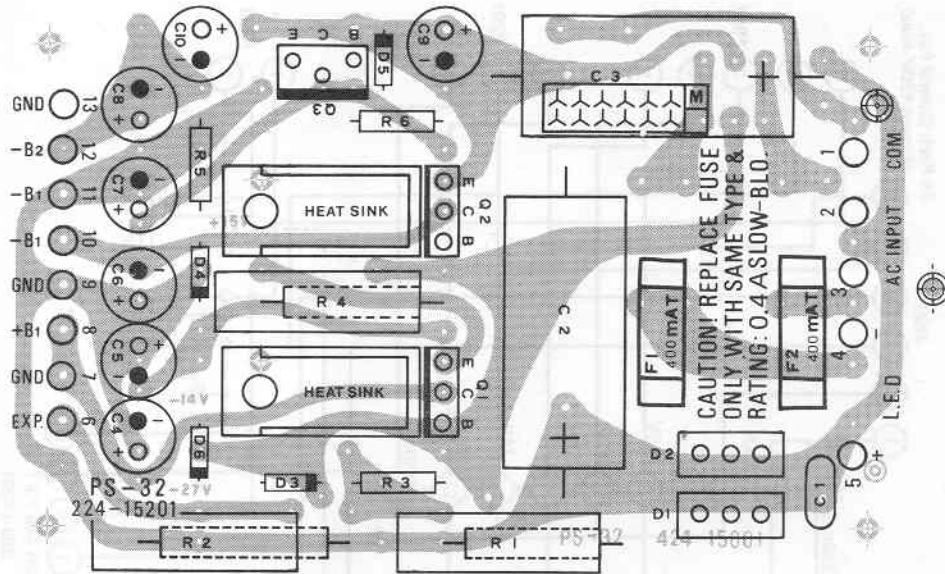
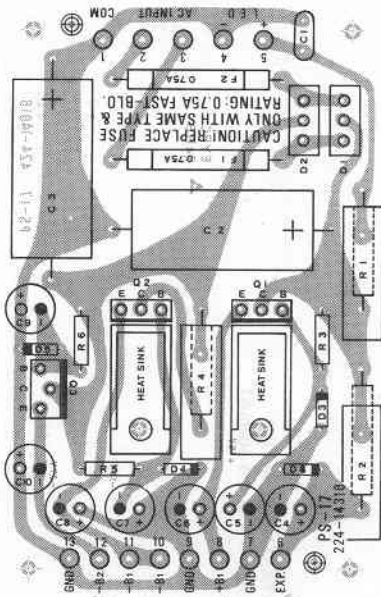
- \*NOTES
1. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.
  2. ① SYMBOL DENOTES NUMBERS IN TERMINALS, PLUG & SOCKET.
  3. F1 MINUATURE FUSE 1.0AT
  - F2, F3 MINUATURE FUSE 1.6AT
  4. TRANSFORMER
  5. MAIN AMP. ASSY
- 302 - 01041  
 302 - 01042  
 307 - 01068  
 307 - 01079  
 307 - 01104  
 105 - 09229  
 105 - 09230  
 105 - 09231  
 105 - 09232

FIGURE 3-12 (ADD-1)  
 X-5 MAIN AMPLIFIER (105-09329-32)  
 SCHEMATIC OF MAIN AMPLIFIER UNIT 3-13A (ADD-1)



- \*NOTES
1. UNLESS OTHERWISE SPECIFIED: ALL CAPACITORS ARE IN MICROFARADS.
  2. (1) SYMBOL DENOTES NUMBERS IN TERMINALS, SOCKET & PLUGS.
  3. F1, F2
  4. AC POWER CABLE
  5. TRANSFORMER
  6. POWER SUPPLY UNIT
- |                      |             |
|----------------------|-------------|
| 100V & 120V SUPPLY   | 302 - 01012 |
| 220V - 240V SUPPLY   | 302 - 01073 |
| 100V & 120V SUPPLY   | 438 - 01008 |
| 220V & 240V SUPPLY   | 438 - 01009 |
| 100V SUPPLY (E-06)   | 307 - 01077 |
| 120V SUPPLY (E-06UL) | 307 - 01078 |
| 220V - 240V SUPPLY   | 307 - 01103 |
| 100V SUPPLY          | 105 - 09225 |
| 120V SUPPLY          | 105 - 09226 |
| 220V SUPPLY          | 105 - 09227 |
| 240V SUPPLY          | 105 - 09228 |
- FAST - BLOW .75A  
SLOW - BLOW 400mA

FIGURE 3-14 (ADD-1)  
X-5 POWER SUPPLY (105-09325-8)  
SCHEMATIC OF POWER SUPPLY  
3-15A (ADD-1)



\*NOTES

1. D1 306-01023 1B2C1  
 D2 306-01024 1B2Z1  
 D3, D4 337-06013 RD-15EC  
 D5 337-06015 RD-27EB  
 Q1 305-04005 2SD234  
 Q2, Q3 305-01013 2SA490Y
2. 100V & 120V SUPPLY  
 F1, F2 302-01012 .75A FAST-BLOW  
 220V & 240V SUPPLY  
 F1, F2 302-01073 400mAT SLOW-BLOW
3. UNLESS OTHERWISE SPECIFIED  
 ALL RESISTORS ARE IN OHMS, ± 10%, 1/2 WATT.  
 ALL CAPACITORS ARE IN MICROFARADS.
4. Ⓛ SYMBOL DENOTES NUMBERS IN TERMINALS.  
 Ⓢ SYMBOL DENOTES TANTALUME CAPAC.

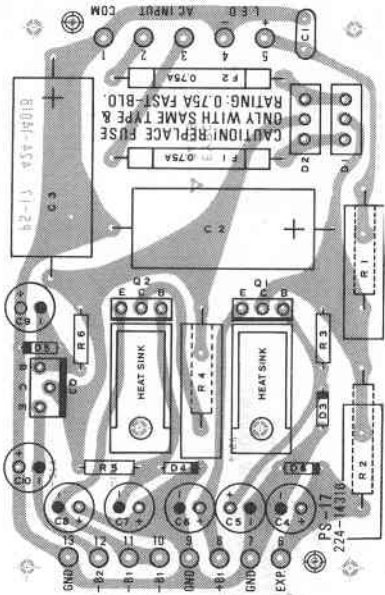
100V & 120V SUPPLY

PS-17 224-14316  
224-14216

220V & 240V SUPPLY

PS-32 224-15301  
224-15201

FIGURE 3-15 (ADD-1)  
 PS-17 (224-14316) • PS-32 (224-15301)  
 SCHEMATIC OF POWER SUPPLY BOARD  
 AND LAYOUT



CAUTION: REPLACE FUSE  
 ONLY WITH SAME TYPE &  
 RATING: 0.75A FAST-BLO.



PS-17  
 224-14316

27 14 15 23

APPENDIX

LIST OF ILLUSTRATIONS

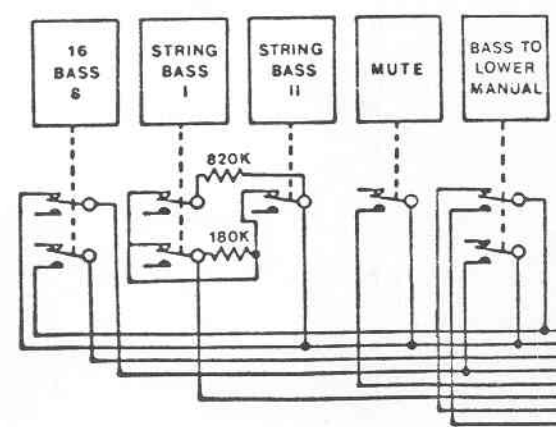
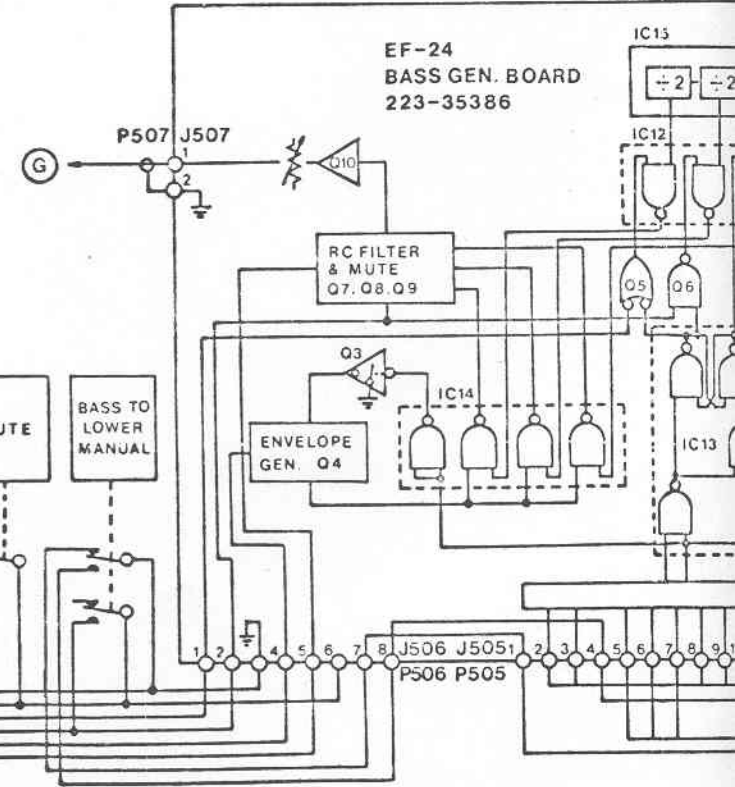
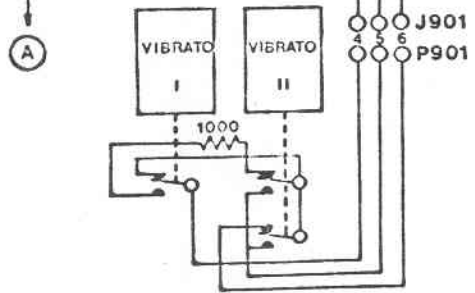
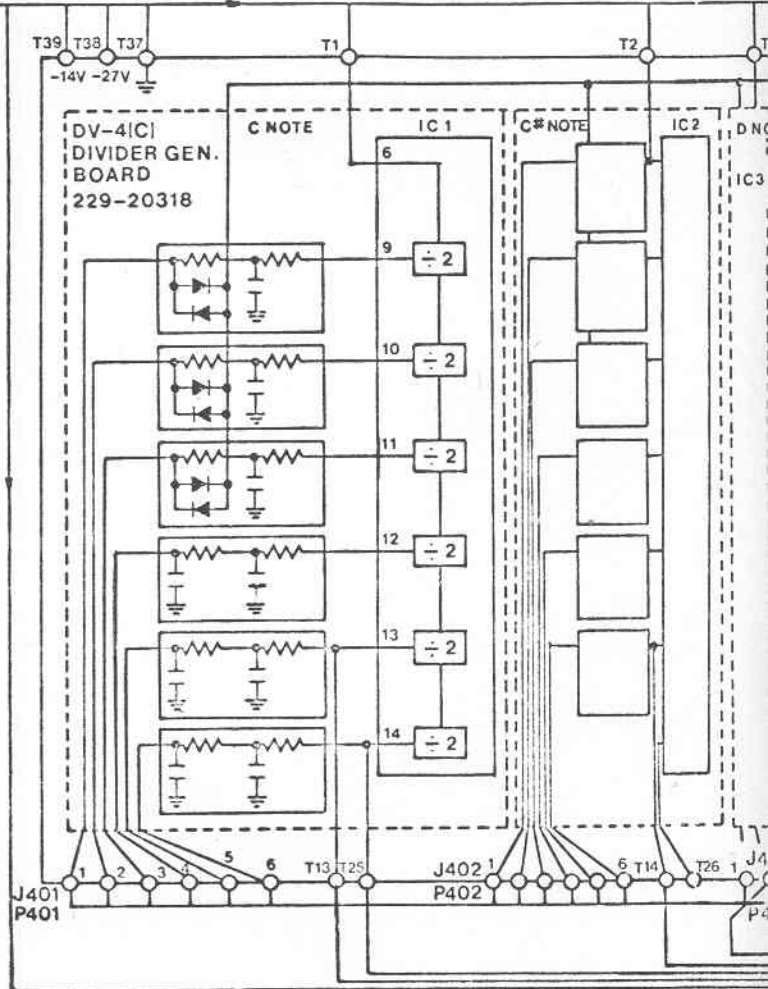
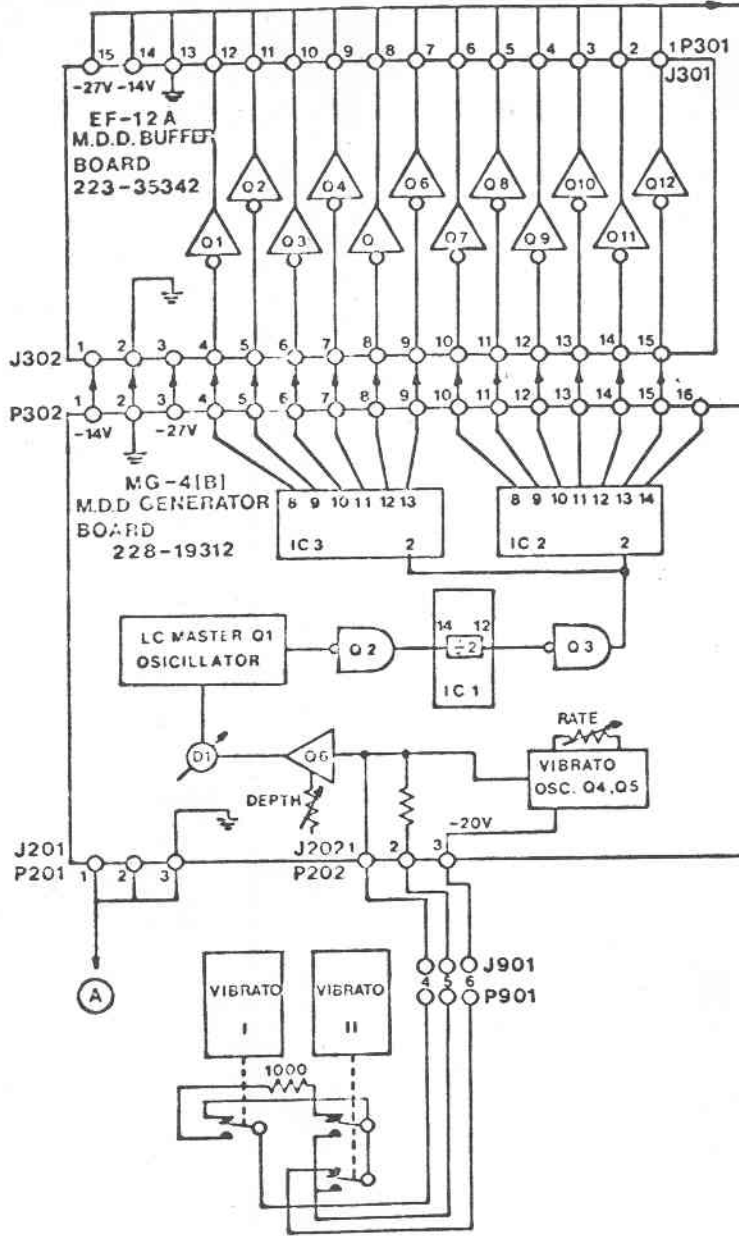
X-5

	<u>PAGE</u>
LOGIC DIAGRAM NO. 1 ..... (105-09301) .....	A- 2
LOGIC DIAGRAM NO. 2 ..... (105-09301) .....	A- 3
DIVIDER GENERATOR BOARD DV-4(C) ..... (229-20318) .....	A- 4
BASS GENERATOR BOARD EF-24 ..... (223-35386) .....	A- 5
POWER SUPPLY UNIT ..... (105-09302) .....	A- 6
POWER SUPPLY BOARD PS-17 ..... (224-14216) .....	A- 7
M.D.D. GENERATOR BOARD MG-4(B) ..... (228-19212) .....	A- 8
SET UP PROCEDURE .....	A- 9
PARTS LIST .....	A-17

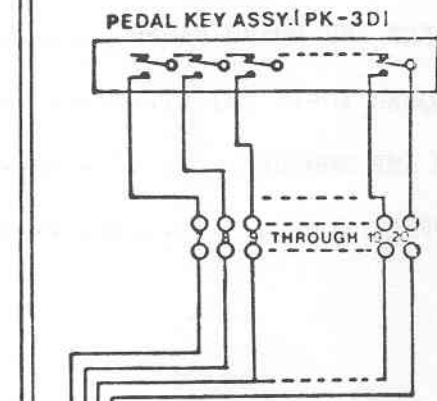
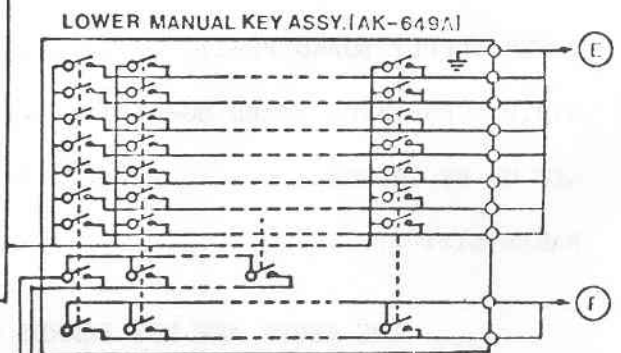
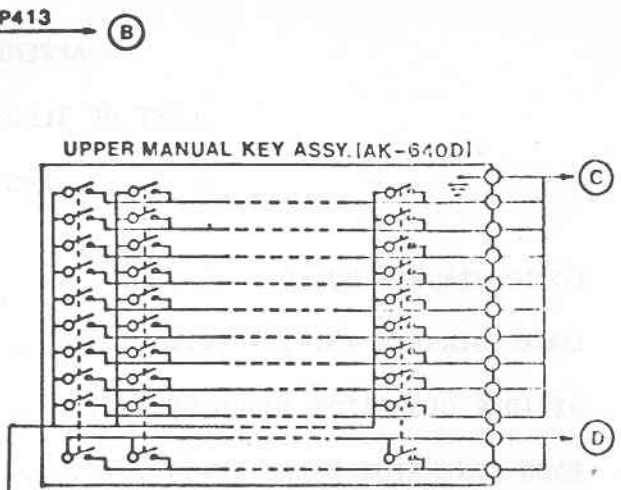
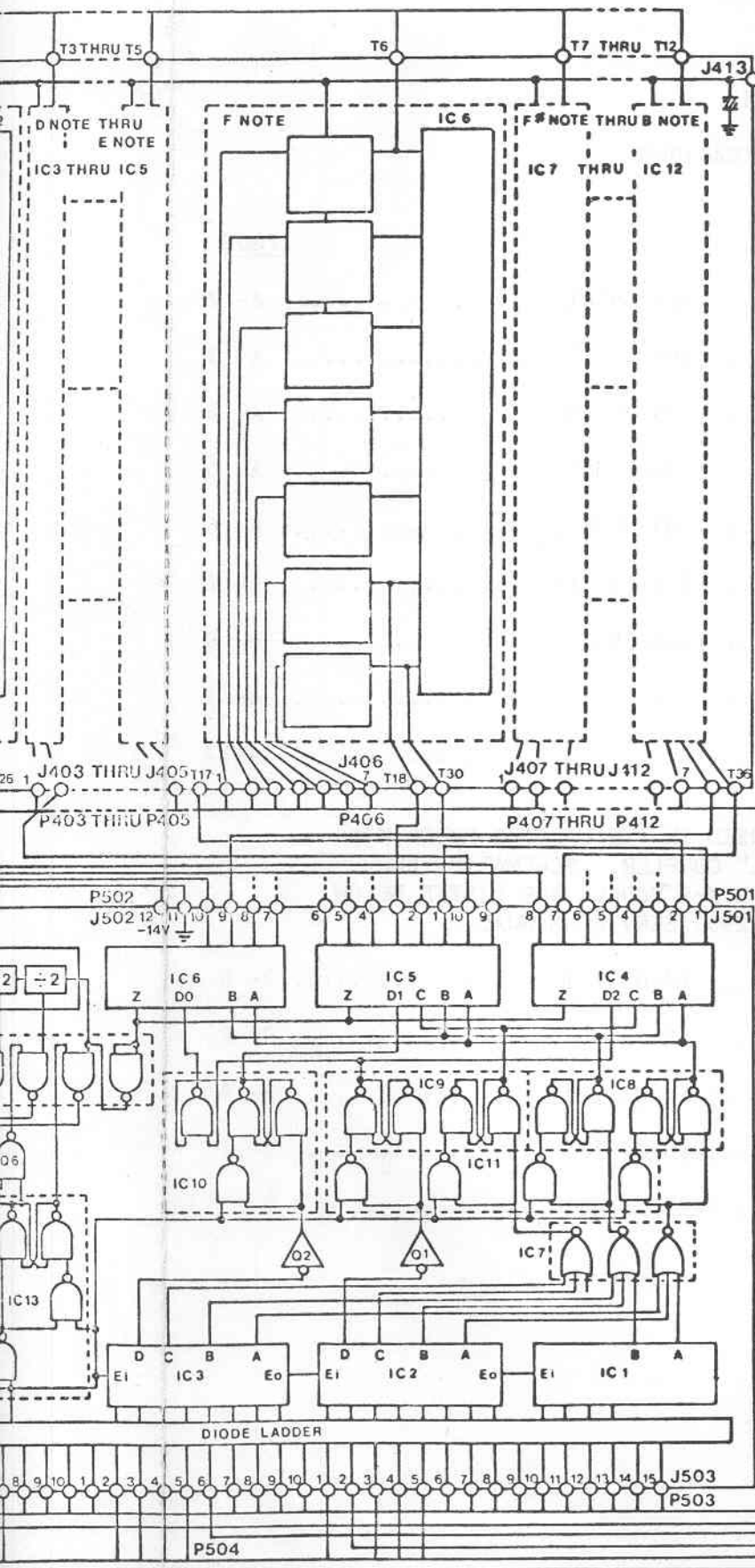
THE ABOVE ARE NEW BOARDS USED IN THE UPDATED MODEL X-5 WITH "BASS TO LOWER MANUAL" COUPLER. SCHEMATICS FOR THOSE BOARDS COMMON TO BOTH X-5 MODELS ARE LISTED BELOW. SEE THE EXISTING X-5 (H0-1296) SERVICE MANUAL.

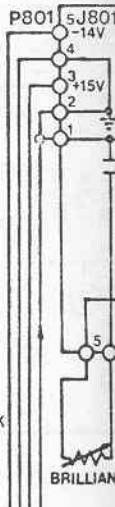
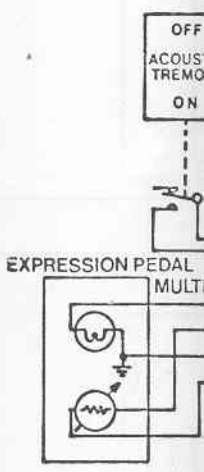
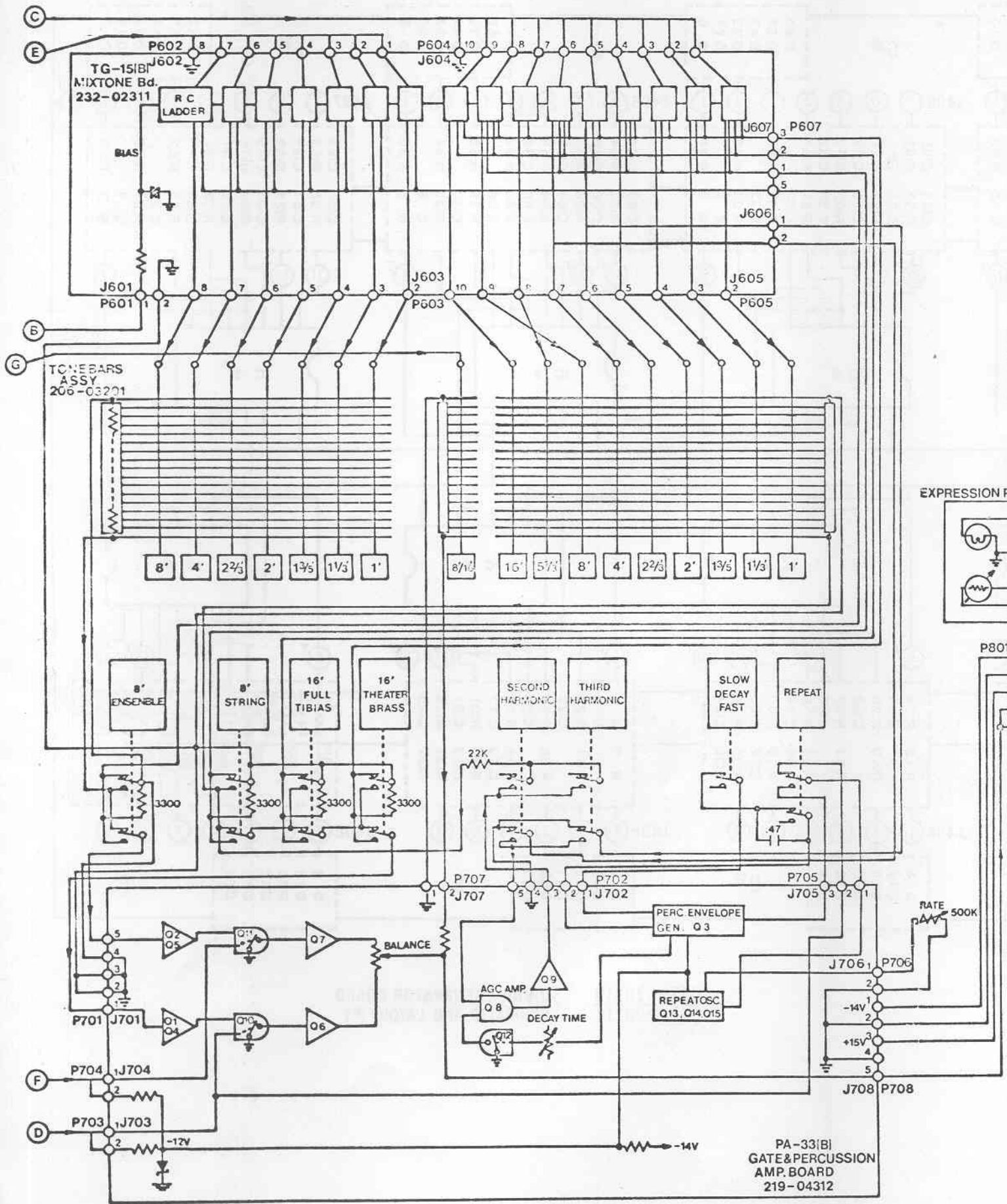
GATE & PERCUSSION AMP. BOARD PA-33 .... (219-04312) .....	3- 6
PRE & REVERB AMP BOARD PA-56 ..... (219-51306) .....	3- 7
MIXTONE BOARD TG-15 (B) ..... (232-02311) .....	3- 9
30W POWER AMP MODULE ..... (218-02311) .....	3-11
M.D.D. BUFFER BOARD ..... (223-35341) .....	3-13

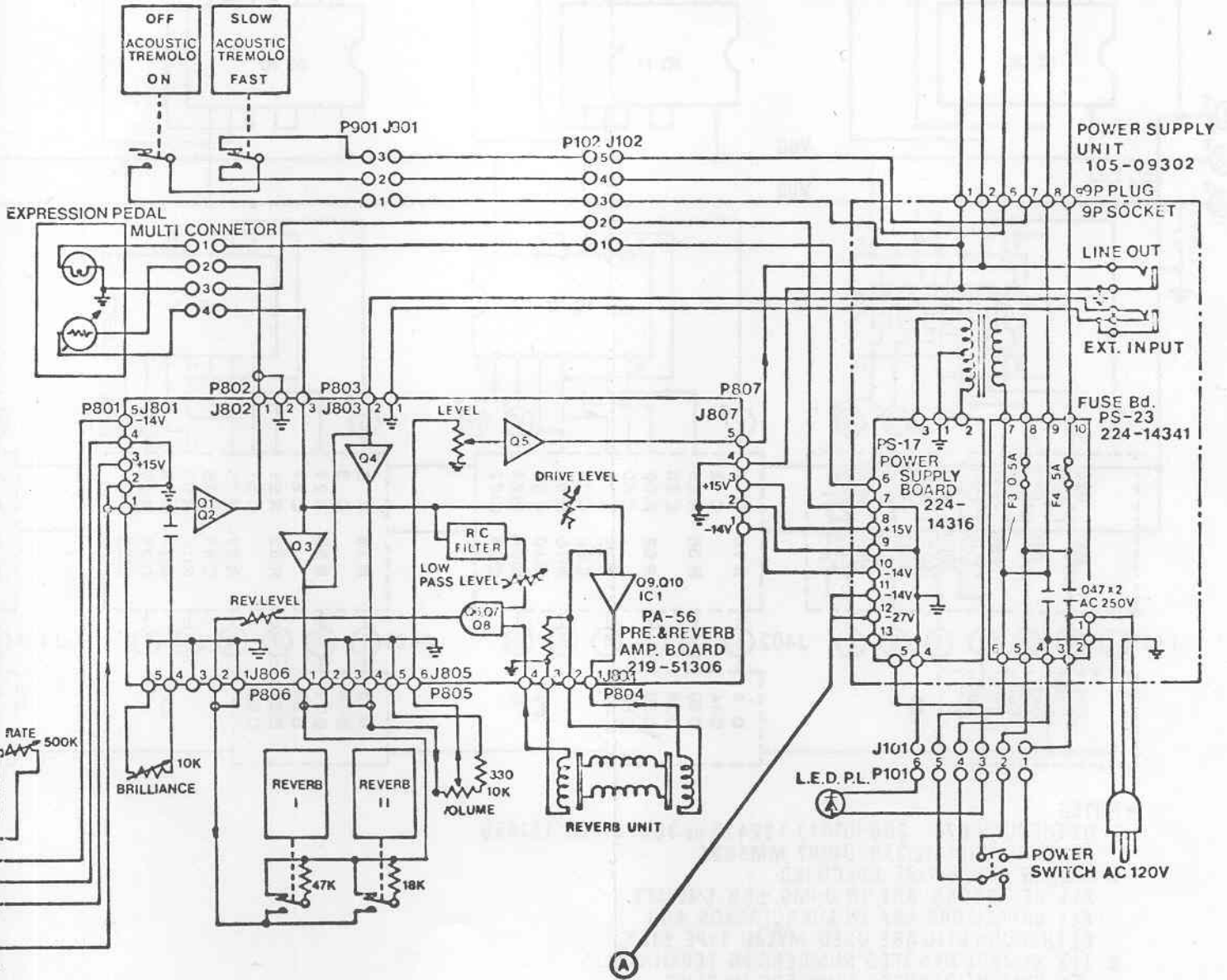
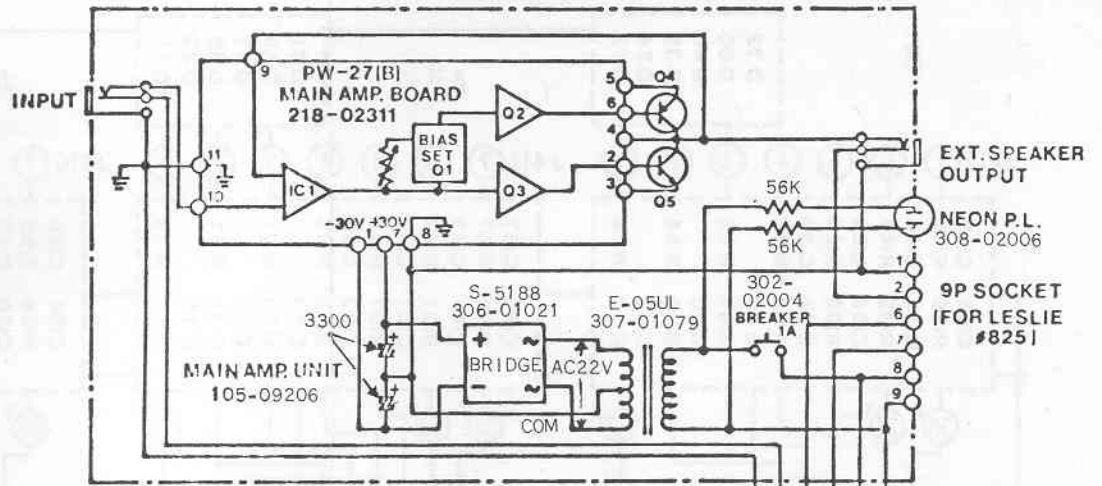




LOGIC DIAGRAM NO. 1  
105-09301

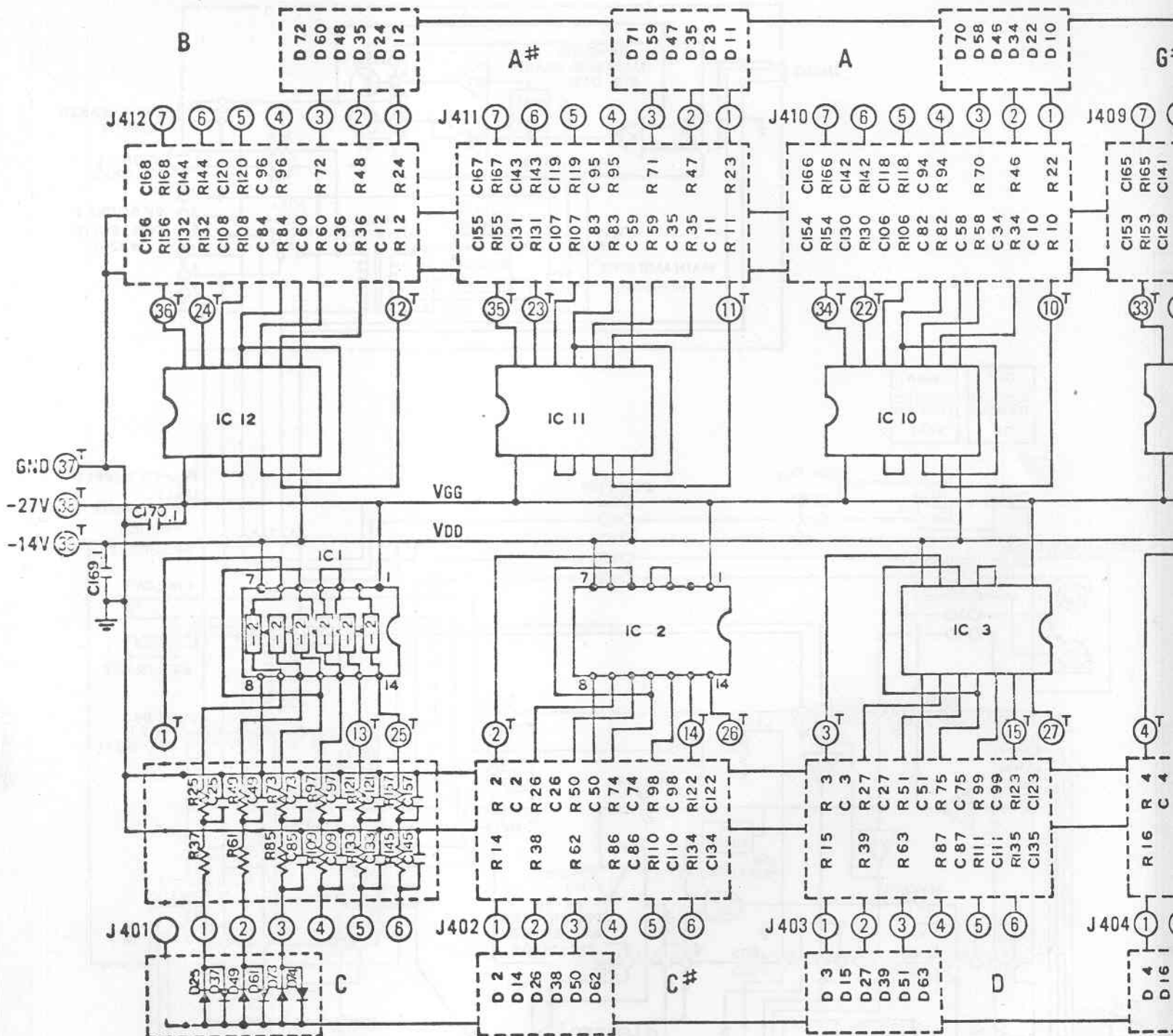






LOGIC DIAGRAM NO. 2  
 105-09301



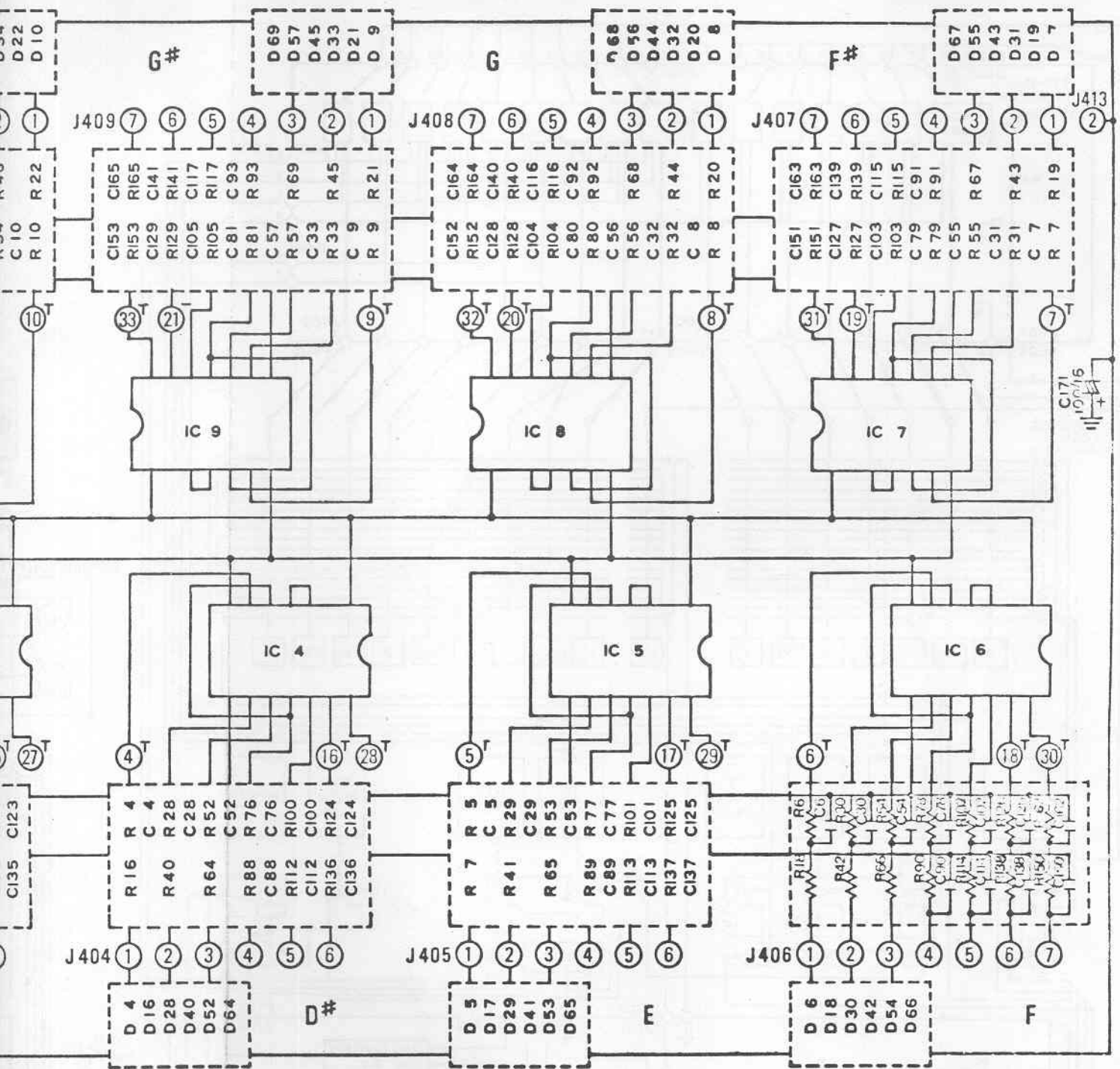


**\* NOTES**

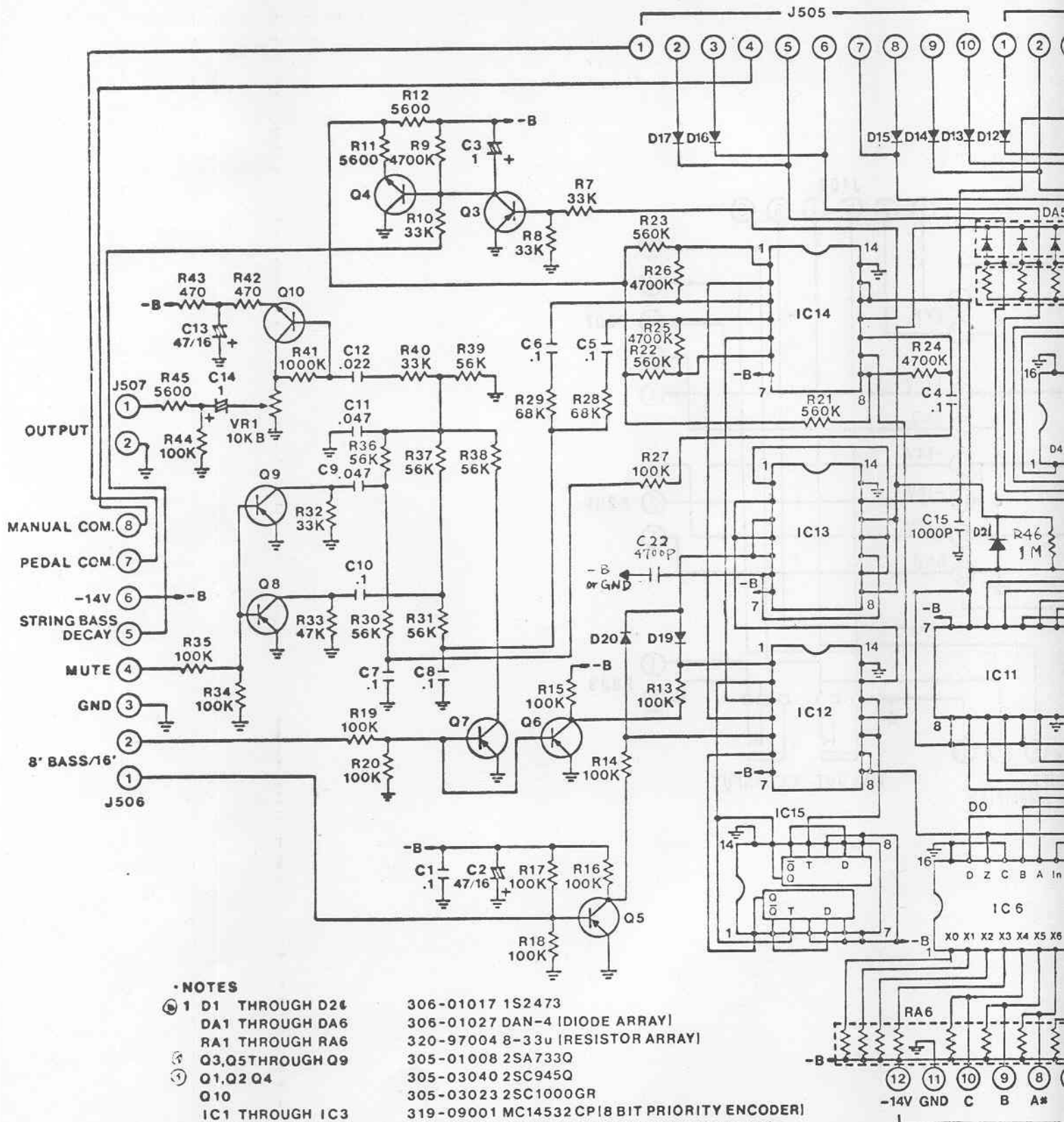
- 1 D2 THROUGH D74 306-01017 1S2473 or 306-01005 1S1555  
IC1 THROUGH IC12, 319-01007 MM5824
- 2 UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4WATT.  
ALL CAPACITORS ARE IN MICROFARADS, AND  
C1 THROUGH C170 ARE USED MYLAR TYPE,  $\pm 10\%$ .
- 3 (1) SYMBOL DENOTES NUMBERS IN TERMINAL.  
(1) SYMBOL DENOTES NUMBERS IN PLUG.
- 4 C NOTE THROUGH E NOTE ARE 6STAGES, AND  
F NOTE THROUGH B NOTE ARE 7STAGES.  
CURCUIITS OF EACH NOTES ARE ALL SIMILARLY.

DIVIDER GENERATOR BOARD  
DV-4(C) 229-20318



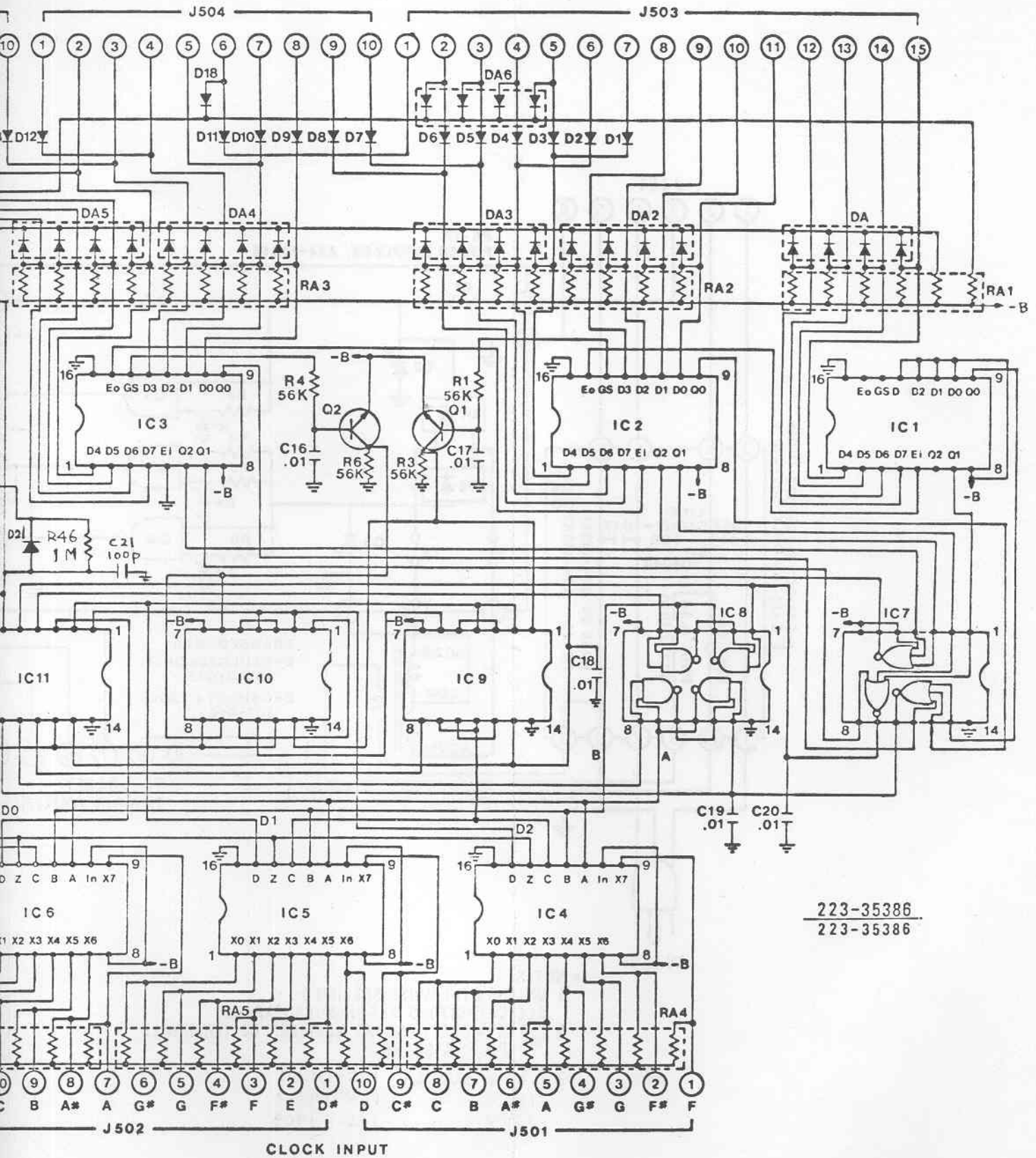


229-20318 DIVIDER GENERATOR BOARD  
 229-20218 SCHEMATIC AND LAYOUT #1



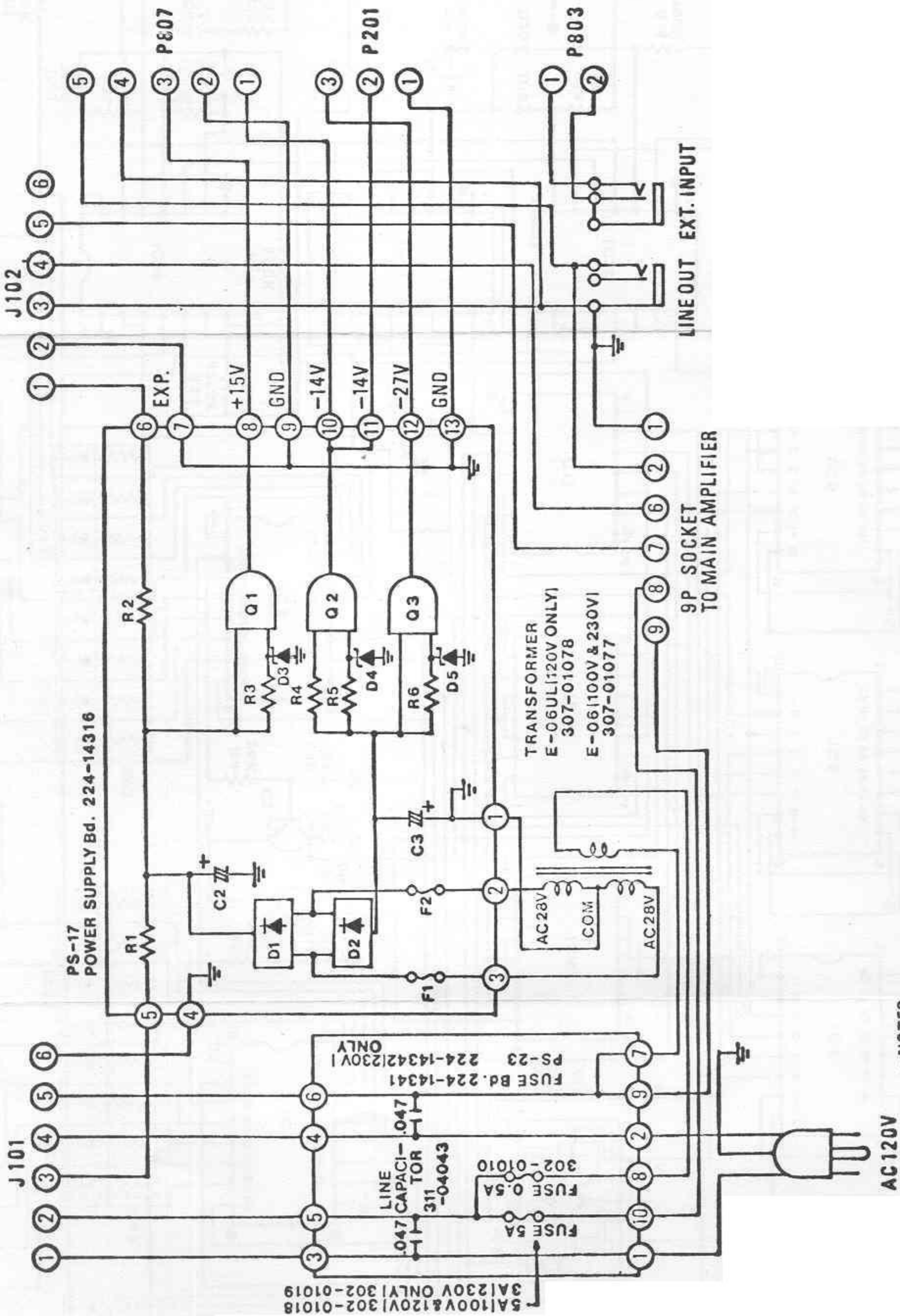
- NOTES**
- ① D1 THROUGH D24 306-01017 1S2473
  - DA1 THROUGH DA6 306-01027 DAN-4 (DIODE ARRAY)
  - RA1 THROUGH RA6 320-97004 8-33 $\mu$  (RESISTOR ARRAY)
  - ② Q3, Q5 THROUGH Q9 305-01008 2SA733Q
  - Q1, Q2, Q4 305-03040 2SC945Q
  - Q10 305-03023 2SC1000GR
  - IC1 THROUGH IC3 319-09001 MC14532 CP (8 BIT PRIORITY ENCODER)
  - IC4 THROUGH IC6 319-10001 MC14512 CP (8 Ch. DATA SELECTOR)
  - IC7 319-06007 MC14025 CP (TRIPLE NOR GATE)
  - IC8 THROUGH IC14 319-06006 MC14011 CP (QUAD NAND GATE)
  - IC15 319-03004 MC14013 CP (DUAL D FLIP FLOP)
- 2 UNLESS OTHERWISE SPECIFIED:  
 ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.  
 ALL CAPACITORS ARE IN MICROFARADS.  
 C3 AND C14 ARE USED WITH TANTALUM,  $\pm 10\%$ .
- ① SYMBOL DENOTES NUMBERS IN PLUG.

MANUAL & PEDAL KEYING INPUT



223-35386  
223-35386

BASS GENERATOR BOARD  
EF-24 223-35386

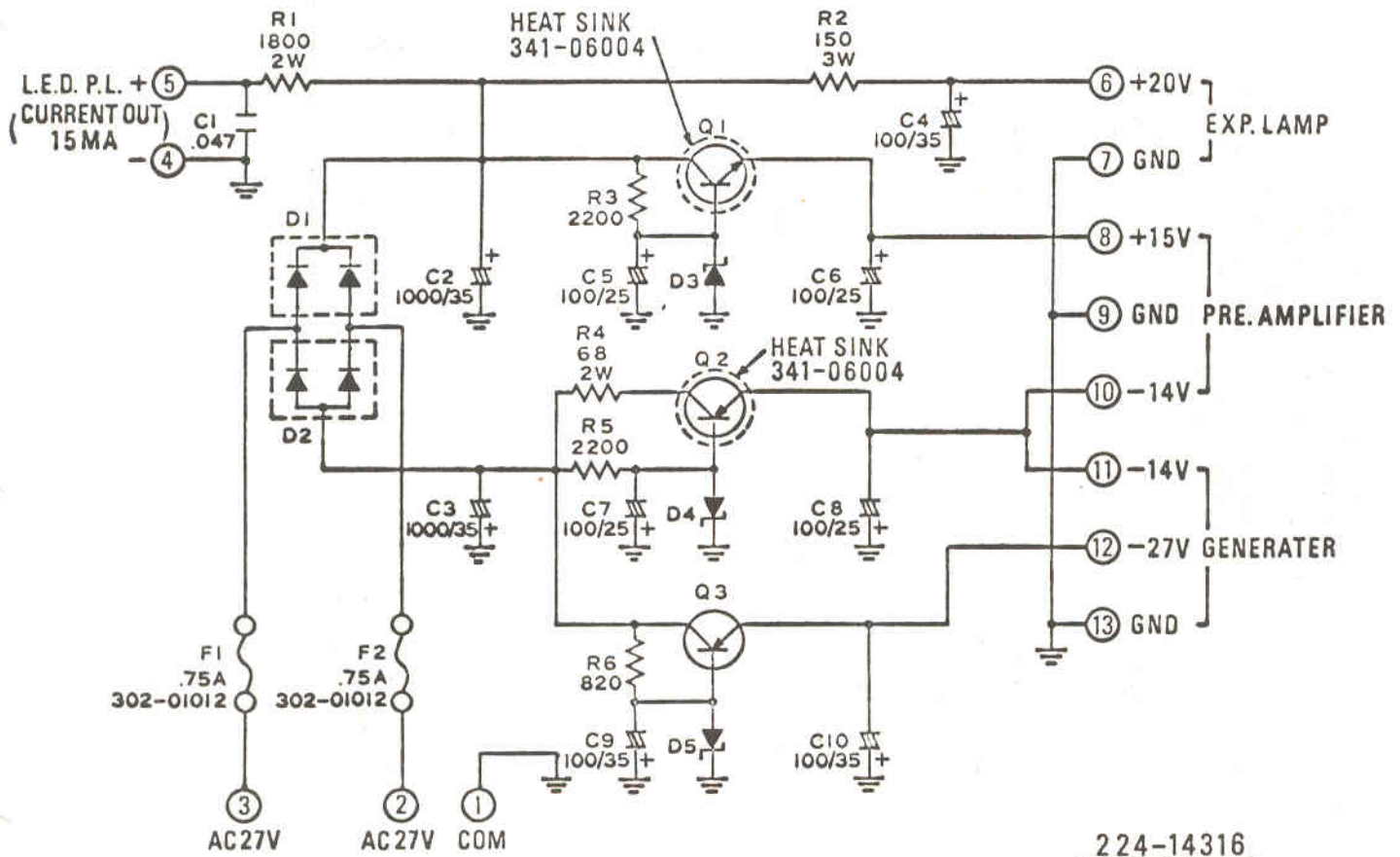


Power Supply Unit  
105-09302

- NOTES
- 1 UNLESS OTHERWISE SPECIFIED:  
ALL CAPACITORS ARE IN MICROFARADS.
  - 2 (1) SYMBOL DENOTES NUMBERS IN TERMINALS,  
PLUGS & SOCKET.

3	100 V SUPPLY	105-09201
	120 V "	105-09202
	230 V "	105-09204





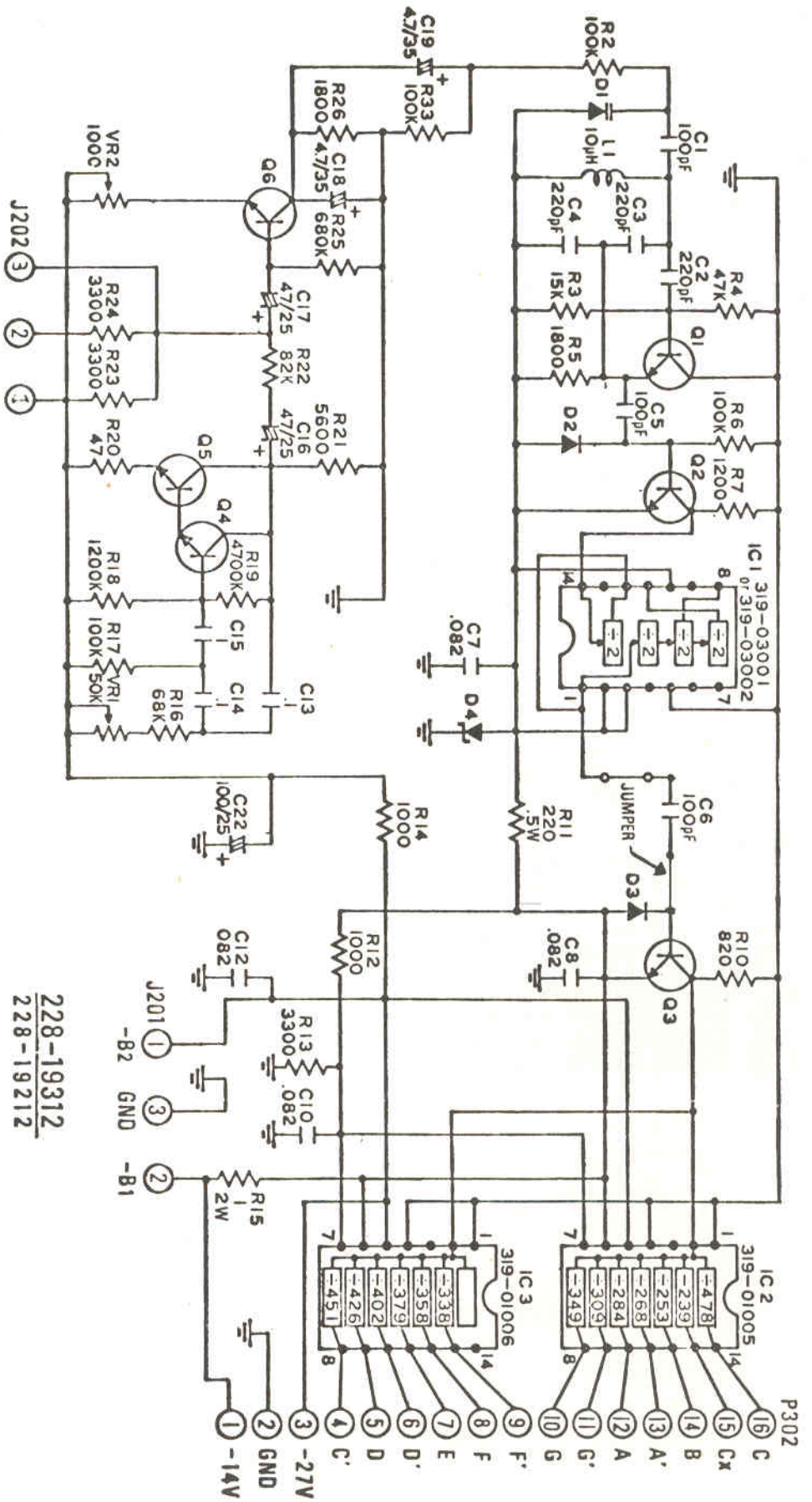
224-14316  
224-14216

• NOTES

- |   |       |           |         |                                |
|---|-------|-----------|---------|--------------------------------|
| 1 | D1    | 306-01023 | 1B2C1   | <del>D8-337-06017-RD20EB</del> |
|   | D2    | 306-01024 | 1B2Z1   |                                |
|   | D3,D4 | 337-06013 | RD15EC  |                                |
|   | D5    | 337-06015 | RD27EB  |                                |
|   | Q1    | 305-04005 | 2SD234  |                                |
|   | Q2,Q3 | 305-01013 | 2SA490Y |                                |
- 2 UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS, ±10%, 1/2 WATT.  
ALL CAPACITORS ARE IN MICROFARADS.
- 3 ① SYMBOL DENOTS NUMBERS IN TERMINALS.

POWER SUPPLY BOARD  
PS-17 224-14216





•NOTES

- 1 D1 306-05001 1S2206
  - 2 D2,D3 306-01017 1S2473
  - 3 D4 337-06014 RD-5.6EB
  - 4 Q1 305-03014 2SC9373-②
  - 5 Q2 THROUGH Q6 305-03040 2SC9450 ②
- ② UNLESS OTHERWISE SPECIFIED:  
 ALL RESISTORS ARE IN OHMS, ±5%, 1/4WATT.  
 ALL CAPACITORS ARE IN MICROFARADS.  
 ③ ① SYMBOL DENOTES NUMBERS IN PLUG.

② Q1 THROUGH Q3 305-03063 2SC1675

228-19312  
 228-19212

**TEST AND ADJUSTMENT PROCEDURES**  
X-5 (18150)

**WITH BASS TO LOWER MANUAL COUPLER**

Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
	<b>Preperations</b>					
1 (a)	Connect Pedal Connector, Main Amp. Connector					1
(b)	Connect Ext. Sp. Out. of Main Amp. as Fig. 1 And Power Switch is to "ON".					
(c)	All Tab.s are to "OFF". All Control Knobs are to "MAX.".					
	<b>Power Supply</b>					
2 (a)	Indicator Light			Note: Confirm Light "ON".		
(b)	Terminals on PS-17 Board			TERM. 12 (BLU) -25 TO -27.5V TERM. 10 (GRN) -13 TO -15V TERM. 8 (ORN) +14 TO +15.5V TERM. 7 (BRN) +18 TO +21V Note: Confirm AC Line and GND are "OPEN".		
	<b>Tune &amp; Scale</b>					
3 (a)	Across Speaker	Upper Man. Tone/Bar 8' to 8	Middle Key A on Up. Man.	Coil L1 on MG-4(B) Bd. Note: 3dB MIN. (two keys next to) Except Scale Repeated.	440 Hz	
(b)		All Foot & All Sounds	All Keys			
	<b>Output Level</b>					
4 (a)	Across Speaker	Up. Man. 8' Tone/Bar to 8 Low. Man. 8' Tone/Bar to 8	Middle Key C on Upper & Lower Man.	Pot. VR1 on PA-33(B) Bd.	Conform Upper Man. & Lower Man. is same level.	
(b)		Ensemble Tab. to "ON".  String Tab. to ON Full Tibias Tab. Theater Brass Tab.	Mid. C, E, & G on Lower Manual  Mid. C, E, & G on Upper Manual	Pot. VR1 on PA-56 Bd.	1.2v rms. 1.5v $\pm$ 0.3v rms. 1.5v $\pm$ 0.3v rms. 1.8v $\pm$ 0.4v rms.	
(c)		Upper Man. Tone Bar 16' Tone/Bar 5-1/3' " 8' " 4' " 2-2/3' " 2' " 1-3/5' " 1-1/3' " 1' "		Note: All levels are $\pm$ 20% MAX.	1.4v rms. 0.9v rms. 1.9v rms. 1.0v rms. 0.75v rms. 0.75v rms. 0.75v rms. 0.75v rms. 0.8v rms.	

STEP	TEST & TEST POINT	DEPRESS TAB, OR EXTEND TONE BAR	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER IND.	FIG.
(c)		Lower Man. Tone Bar 8'Tone/Bar 4'Tone/Bar 2-2/3'Tone/Bar 2'Tone/Bar 1-3/5'Tone/Bar 1-1/3'Tone/Bar 1'Tone/Bar			1.0v rms. 0.9v rms. 0.75v rms. 0.75v rms. 0.75v rms. 0.75v rms. 0.8v rms.	
5(a)	<u>Bass</u> 1 Bass Level across Speaker	Bass ToneBar to 8 Bass Tab. to 8'  Bass ToneBar to 8 Bass Tab to 8' Mute Tab to "ON"	Pedal Key C of high note Pedal Key G Pedal Key C of Low Note Pedal Key C of High Note	Pot. VR1 on EF-24	1.0v rms. 1.4v±0.5v rms. 1.8v±0.5v rms.  0.92v±0.5v rms.	
(b)	II Bass Decay Time across Speaker	String Bass Tab to "OFF" String Bass Tab I to "ON" String Bass Tab II to "ON" String Bass Tab I & II to "ON"	Pedal Key C of High Note	NOTE: All decay Time are +15% MAX	150 msec. 400 msec. 800 msec. 1500 msec.	
(c)	Manual Bass Across Speaker	Bass to lower Tab to "ON"	Lower Man. Key lowest F to C of 20 notes.	NOTE: 1. String Bass Tab & Mute Tab are achieved except Bass tab. 2. Manual Bass note is Low Note Select, and 16'only.		
6(a)	<u>Extent of Expression Pedal</u> Across Speaker	Full Tibias Tab to "ON"	Mid. Key C. on Up. Man.	Level is at -20dB ~ -24dB When Exp. Pedal MAX to MIN. (Level is 0dB at Exp. Pedal MAX.)		
7(a)	<u>Noise Level</u> Across Speaker	All tabs to "ON" (Except Reverb Tab & Mute Tab.) All ToneBar to 8 All Tabs to "OFF" All ToneBar to 0 (OFF), and Percussion Tabs to "ON"	Mid. Key C. on Up. Man. & Low. Man.		2mv rms MAX.  4 mv rms. MAX. No. noise occurs	

NOTE: During Test Procedure the following must be maintained unless otherwise stated.

- a. All Control Knobs & Expression Pedal at Maximum.
- b. All Tabs and all Tone Bars in the off position.



Step	Test & Test Point	Depress Tab, or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
	<b>Brilliance &amp; Freq. Response</b>					
8 (a)	Across Speaker	Upper Man. Tone/Bar 4' to 8	Upper Man. Key F of Lowest Note Up. Man. Key F of Highest Note	Point of Brill. Volume Max. MIN. 0dB (Set to Volume Control) - 2dB - 4dB - 13dB - 20dB		
	<b>Percussion</b>					
9 (a)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow" Next Decay Tab. to "Fast" Third Harmonic Tab. as in step to do Sec. Harm. Tab.	Middle Key C on Upper Manual  Check as same to Second Harmonic.	Pot VR2 on PA-33(B) Board	t; 1500 msec.  t; 90 msec.	3
	<b>Repeat</b>					
(b)	Across Speaker	Second Harmonic Tab. to "ON" Decay Tab. to "Slow" Repeat Tab. to "ON", and Decay Tab. to "Fast"	Middle Key C on Upper Manual	Reit Volume to "Slow"  Reit to Slow (MIN.) Reit to Fast (MAX.)	t; 500+100 msec.  Reit; 13+3 times/10 sec. Reit; 70+7 msec.	4
	<b>Vibrato</b>					
10 (a)	Test Point R-26 on MG-4(B) Bd.	Vibrato I & II Tab. to "ON"  Vibrato I & II Tab. to "OFF" Vibrato I Tab. to "ON" Vibrato II Tab. to "ON"		Pot. VR1 on MG-4(B) Board Pot. VR2 on MG-4(B) Board	t; 152 msec. (6.8Hz) 8v p-p  0v  2v p-p  4v p-p	5 6  7
	<b>Reverb</b>					
11 (a)	Test Point R-43 & J4 on PA-56 Board	Low. Man. Tone Bar 8' to 8	Middle Key C on Lower Manual	Pot. VR2 on PA-56 Board	2v p-p	7
(b)	Test Point Reverb Tab. & Ear	Reverb I & II Tab. to "ON"	Mid. Key C E & G on Low. Man.	Pot. VR4 on PA-56 Board	About 70 mv & Decay Time: 2.5-3 sec.	8
(c)	Balance Ear			Pot. VR3 on PA-56 Board	Same Level on Reverb "OFF" from I & II to "ON"	

Step	Test & Test Point	Depress Tab. or Extend Tone Bar	Play Keys	Adjust	Oscilloscope or Other Ind	Fig.
12 (a)	<b>Other Operation</b>					
12 (a)	Leslie Socket; Pin 7, Pin 6, & 1	Leslie ON/OFF to "ON" Leslie Slow/Fast to "Fast" Leslie ON/OFF to "OFF"	Note: That Pin 6 is grounded (to Pin 1) and that Pin 7 is removed from ground (Pin 1). If Tab. is returned to Slow, Pin 7 will be grounded. Pin 6 and Pin 7 are removed from ground (Pin 1).			9
13 (a)	Ear	Ensemble Tab. to "ON" Lower Man. Tone/Bar sets to: 8666444 String Tab. to "ON" Upper Man. Tone/Bar sets to: 008888666 Full Tibias Tab. to "ON" - do -, sets 806808006 Theater Brass Tab. to "ON" - do -, sets 848868666	Note: Same Tone as Tone Bar Setting.  Same Tone as Tone Bar Setting.  - ditto -  - ditto -			

#### 14 Test of Mechanism Operation

- Confirm that Tone Bars are easy to operate, and that one Tone Bar doesn't disturb other Tone Bar operation, and that Mark 8 is visible.
- Confirm that Keyboards are operational.
- Confirm that Expression Pedal is normal to operate and to stop at will.
- Confirm that position of Knob Mark is normal.
- Confirm that Pedal Keys are normal to operate.
- Confirm that Tabs are normal to operate.

#### 15 Assembly

- Confirm that Cabinet can be put on the Leg.
- Confirm that Pedal Unit can be smoothly inserted.
- Confirm that Knob Bolts can be set normally.



Step	Test & Test Point	Adjust	Oscilloscope or Other Indication	Fig.
16 (a)	<b>Main Amplifier</b> Preparations Across Ext. Sp. Out	Connection as Fig. 10, 11		10
(b)	Test Point R26 on PW-27(B) Board	Pot. VR1 on PW-27(B) Board Note: Set VR1 to turn left, and turn right, Stop at 10mV Point.	Set 10mV, and about afteral Minute 35mV + 5mV	11
(c)	Across Ext. Sp. Out	Input: 0.3V rms. (1000Hz) . . . . . Output: 16V	Note: Confirm that Output Wave Form is normal or not.	10
(d)	Test Point GND . . . . + Vcc GND . . . . + Vcc		+ 30V ~ + 35V DC - 30V ~ - 35V DC	

FIGURE

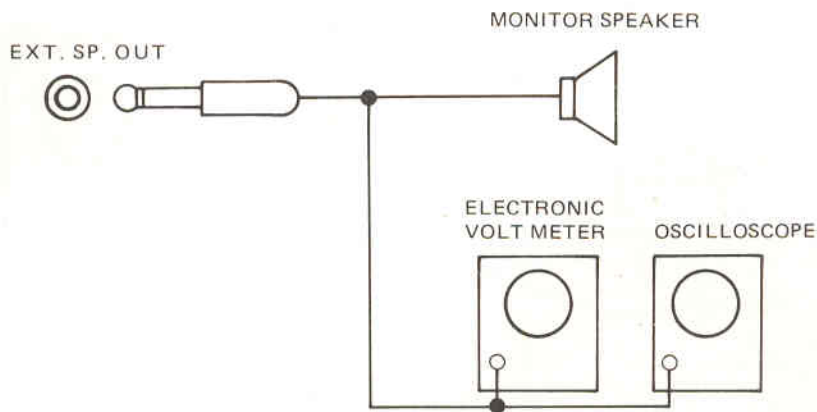


Fig. 1

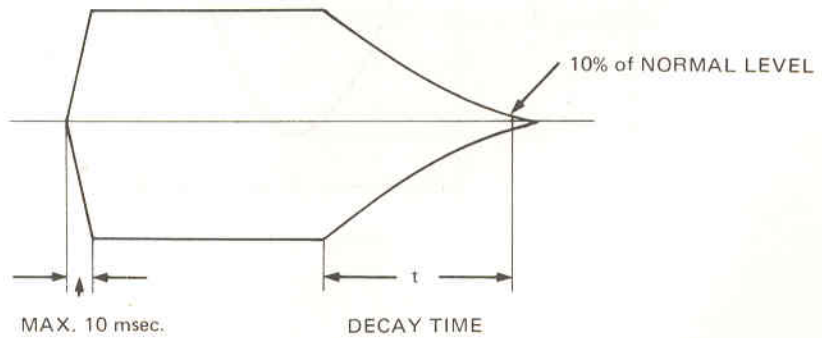


Fig. 2

Fig. 3

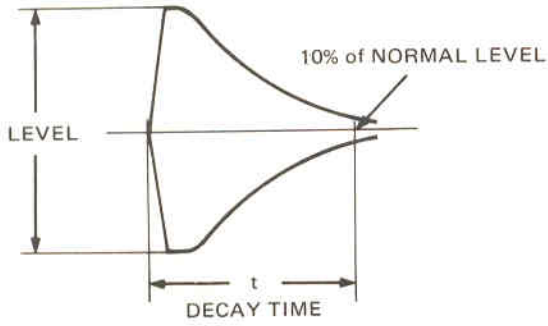


Fig. 4

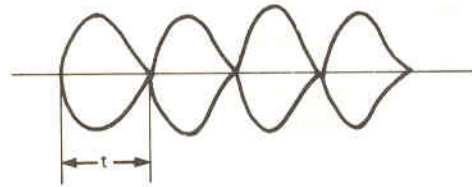


Fig. 5

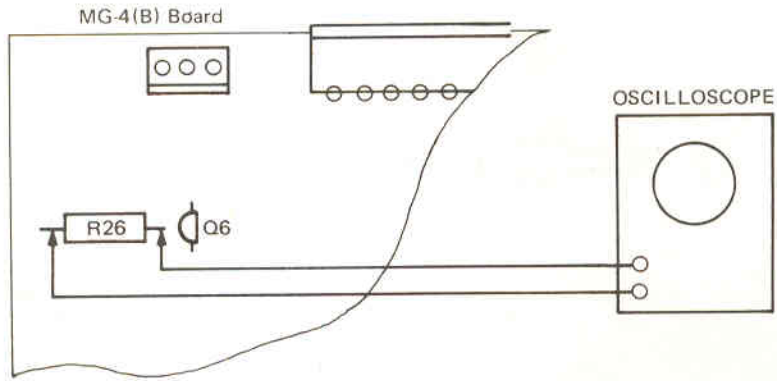


Fig. 6

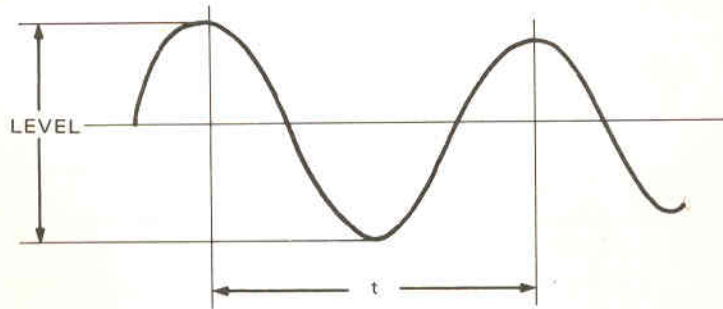


Fig. 7

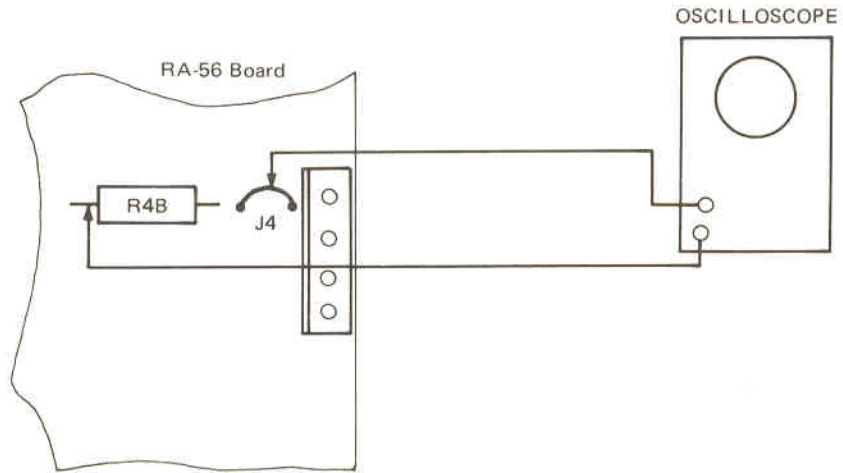


Fig. 8

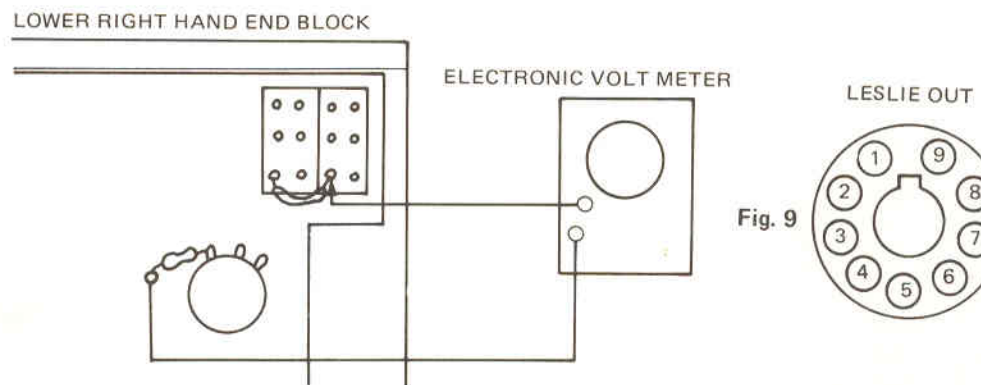


Fig. 10

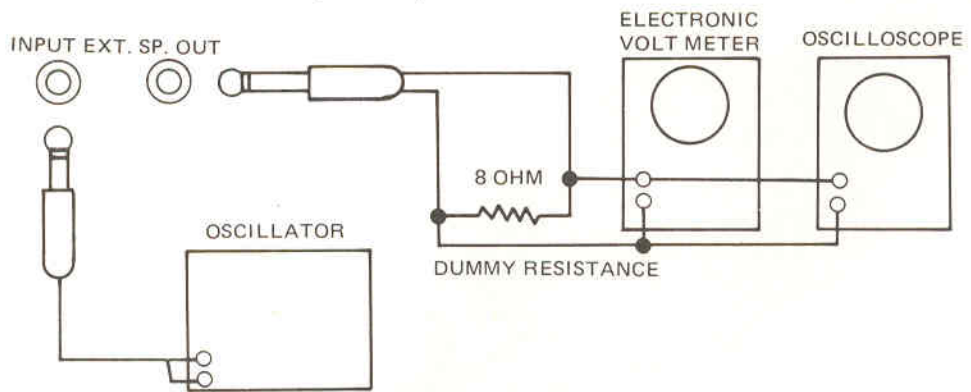
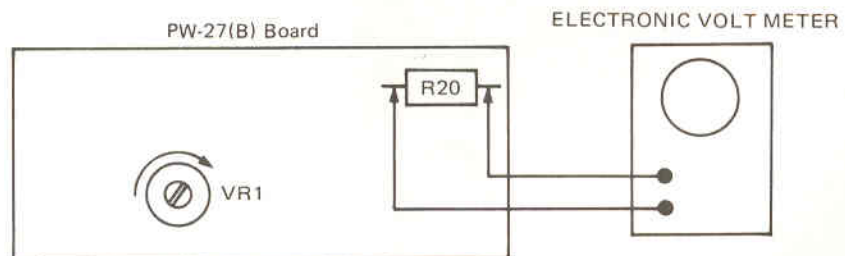


Fig. 11



## PARTS LIST

X-5 (18150K)  
(WITH PEDAL COUPLER)

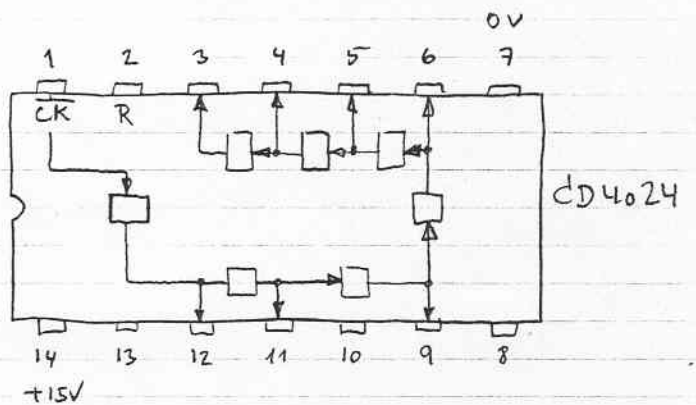
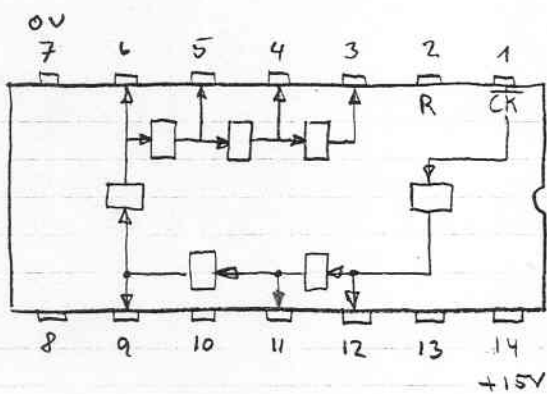
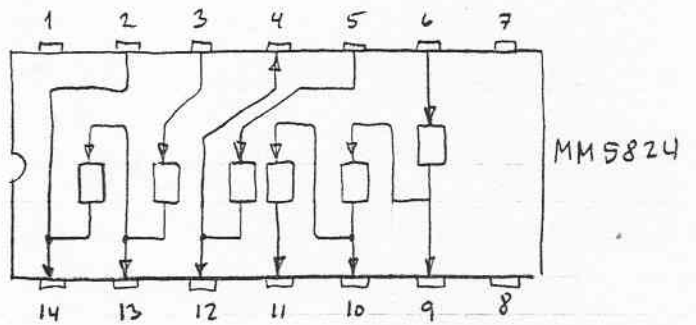
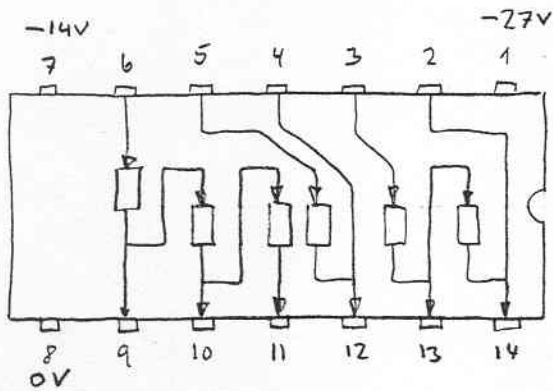
<u>MDD BUFFER BOARD (EF-12A)</u>		223-35342
TRANSISTOR		
Q1 thru Q12	2SC945Q	305-03040
DIODE		
D1 THRU D11	1S2473	306-01017
D12 (12 Volt Zener)	022-12A	337-02005
<u>MDD GENERATOR BOARD (MG-4B)</u>		228-19212
IC-1		319-03001 or 319-03002
IC-2		319-01005
IC-3		319-01006
TRANSISTOR		
Q1 THRU Q3	2SC1675	305-03063
Q4 THRU Q6	2SC945Q	305-03040
DIODE		
D1	1S2206	306-05001
D2, D3	1S2473	306-01017
D4 (5.6V Zener)	RD-5.6 EB	337-06014
<u>DIVIDER GENERATOR BOARD (DV 4-C)</u>		229-20218
IC-1 THRU 12	MM5824	319-01007
DIODE		
D2 THRU D 74	1S2473 or 1S1555	306-01017 306-01005
<u>BASS GENERATOR BOARD (EF-24)</u>		223-35386
IC-1 THRU IC-3	MC14532 CP(8 Bit Priority Endcoder)	319-09001
IC-4 THRU IC-6	MC14512 CP(8 CH. Data Selector)	319-10001
IC-7	MC14025 CP(Triple Nor Gate)	319-06007
IC-8 THRU IC-14	MC14011 CP(Quad Nand Gate)	319-06006
IC-15	MC14013 CP(Dual D Flip Flop)	319-03004
TRANSISTOR		
Q1, Q2,Q4	2SC945Q	305-03040
Q3,Q5 THRU Q9	2SA733Q	305-01008
Q10	2SC1000GR	305-03023
DIODE		
D1 THRU D21	1S2473	306-01017
DA-1 THRU DA-6 (DIODE ARRAY)	DAN-4	306-01027
RA-1 THRU RA-6 (RESISTOR ARRAY)	8-33u	320-97004
<u>LOWER MANUAL ASSEMBLY</u>		AK-649A
<u>PEDAL KEY ASSEMBLY</u>		PK-3D

<u>MAIN AMP UNIT</u>		105-07402
Circuit Breaker	1 amp.	302-02004
Transformer		307-01079
Bridge Diode Pak	S-5188)	306-01021
<u>MAIN AMP BOARD</u>		PW 27B 218-02211
IC-1	NPC151A	319-23001
TRANSISTOR		
Q1	2SC945Q	305-03040
Q2	2SD381	305-04012
Q3	2SB536	305-02010
Q4	2SA627	305-01009
Q5	2SD188	305-04011
DIODE		
D1, D2 (15v Zener)	RD15EC	337-06013
D3, D4	1S2473	306-01017
<u>PRE AND REVERB AMP BOARD (PA-56)</u>		219-51206
IC-1	MPC151A	319-23001
TRANSISTOR		
Q1, Q7, Q8	2SA493GR	305-01006
Q2 THRU Q6	2SC1000GR	305-03023
Q9	2SC509Y	305-03041
Q10	2SA509Y	305-01014
DIODE		
D1 THRU D3	1S2473	306-01017
<u>POWER SUPPLY UNIT</u>		105-09302
Power Transformer	120V E-06u1	307-01078
Power Transformer	100V & 230v E-06	307-01077
Fuse Board	100v, 120v, PS-23	224-14341
Fuse Board	230v	224-14342
Fuse	100v & 120v 5A	302-01018
Fuse	230v 3A	302-01019
<u>POWER SUPPLY BOARD PS-17</u>		224-14216
TRANSISTOR		
Q1	2SD234	305-04005
Q2, Q3	2SA490Y	305-01013
DIODE		
D1	1B2C1	306-01023
D2	1B2Z1	306-01024
D3, D4 (15v Zener)	RD15EC	337-06013
D5 (27v Zener)	RD27EB	337-06015



Top View

Bottom View



MM5824 kann ersetzt werden mit CD4024, doch ist die pin kompatibel.

CD 4024 pin :

Auf MM 5824 pin :

- 1 Clock in
- 2 Reset
- 3 Clock ÷ 128
- 4 Clock ÷ 64
- 5 Clock ÷ 32
- 6 Clock ÷ 16
- 7 0V
- 8 N.C.
- 9 Clock ÷ 8
- 10 N.C.
- 11 Clock ÷ 4
- 12 Clock ÷ 2
- 13 N.C.
- 14 +14V

- 6
- 7
- 14 (& 2)
- 13
- 12 (& 4)
- 7 = -14V
- 11
- 10
- 9
- 8 = 0V



Bus  
bars.

1"

(1)

33K R9

.015 C12

82K

82K

82K

33K

3K9 R53

1 1/3"

(2)

33K R10

.018 C13

82K

82K

33K

3K3 R54

1 3/5"

(3)

33K R11

.022 C14

82K

82K

33K

2"

(4)

33K R12

.033 C15

33K

33K

33K

33K

3K9 R56

2 3/5"

(5)

33K R13

.01 C16

33K R35

82K R36

33K R37

3K3 R57

4"

(6)

33K R14

.022 C17

33K R37

33K R38

33K R39

33K R76

3K9 R58

33K R74

J606

2 2/3' perc.

(5)

5 1/3"

(7)

33K R15

.022 C18

33K R40

33K R41

3K3 R59

33K R75

4' perc

(6)

8"

(8)

33K R16

1u C19

33K R41

22K R42

33K R43

3K9 R60

18u C22

33K R78

16"

(9)

33K R17

1u C20

33K R44

33K R45

33K R79

3K9 R61

22u C23

(3)

(2)

(1)

J601

Bias (-7.5V)

J607

(1) Strings

(2) Full Tilia

(3) Theatre Brass

(2) 1" Drawbar

J605

Drawbars

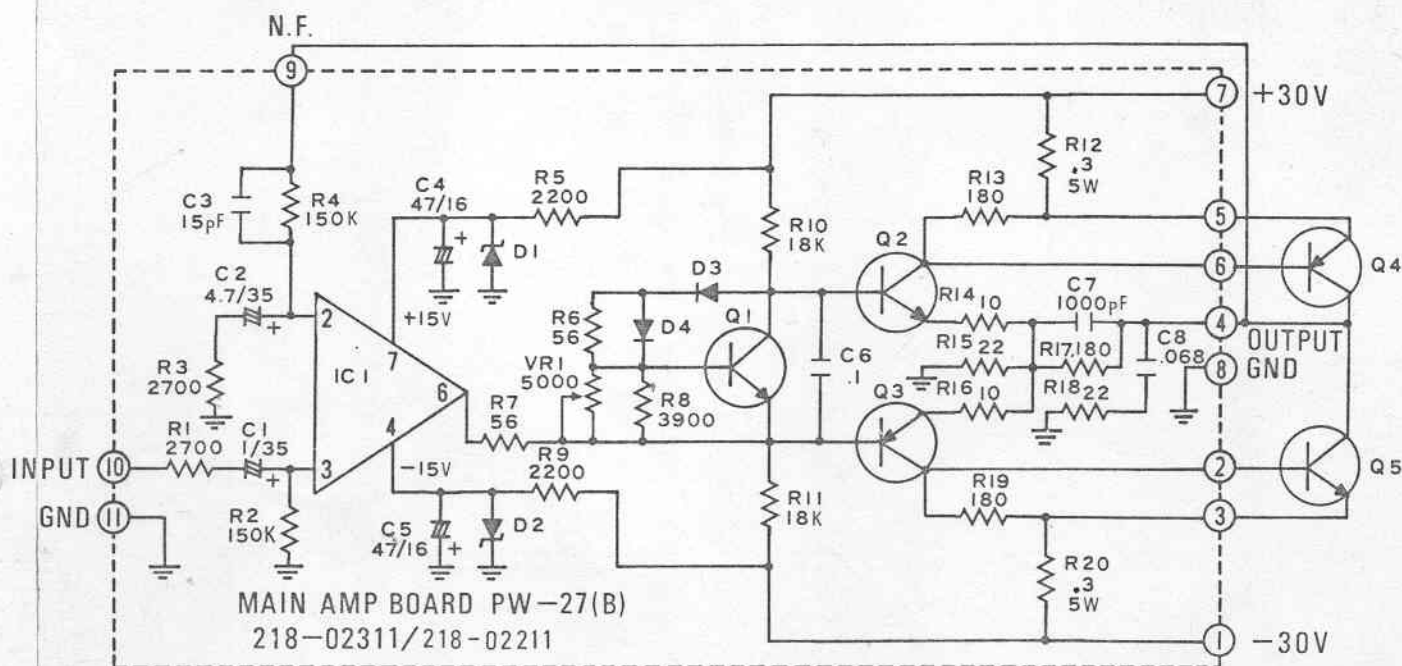
Strings

Full Tilia

Theatre Brass

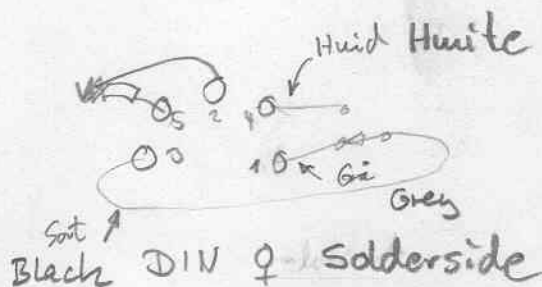
(1) J701

Check  $R_1$  must be  $2K\Omega$   
 $R_4$  ———  $150K\Omega$   
 $A_v = 56,599$



• NOTES

- 1 IC 1 319-23001  $\mu$ PC151A *n 7415*
- D1,2 337-06013 RD-15EC
- D3,4 306-01017 1S2473
- Q1 305-03040 2SC945Q
- Q2 305-04012 2SD381
- Q3 305-02010 2SB536
- Q4 305-01009 2SA627
- Q5 305-04011 2SD188
- 2 RESISTORS (R5, R9, R13, R15, R17, R19) ARE  $\pm 10\%$ , 1/2 WATT.
- 3 UNLESS OTHERWISE SPECIFIED:  
 ALL RESISTORS ARE IN OHMS,  $\pm 5\%$ , 1/4 WATT.  
 ALL CAPACITORS ARE IN MICROFARADS.
- 4  $\textcircled{1}$  SYMBOL DENOTES NUMBERS IN TERMINALS



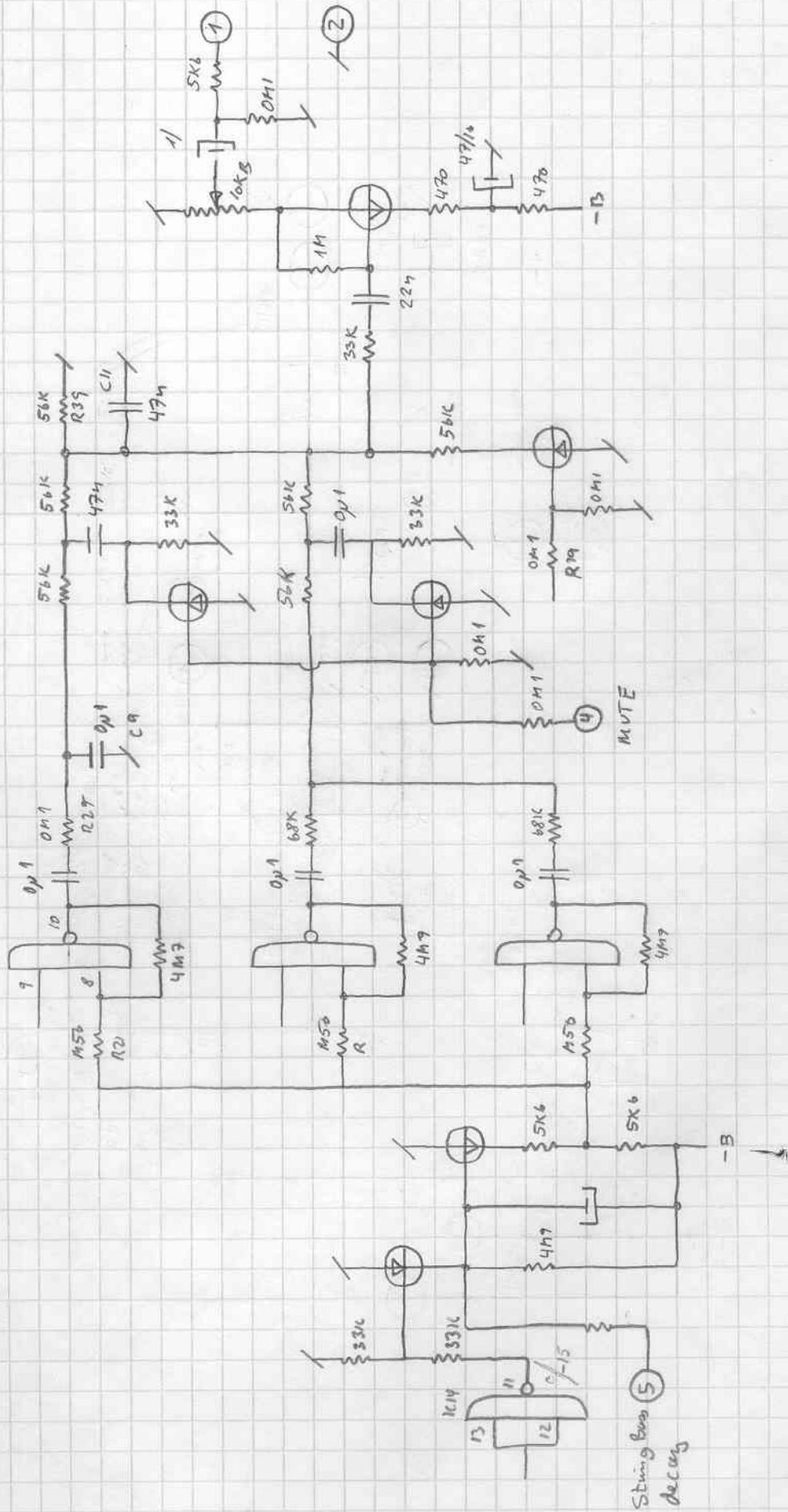
Two diodes, D3, and D4, and transistor Q1 represent part of the load seen by I.C. 1 and perform the important function of biasing the output transistors. In order for Q2 and Q3 to be biased on, the voltage drops across collector to emitter of Q1 must equal the voltage drops across the emitters Q2 and Q3 plus the drops across R14 and R16. The current through the Q1 is determined by R10 and R11, and this current, in turn, determines the voltage drop across the Q1 by VR1. A Q4, Q5 quiescent current of approximately 100Ma is necessary to prevent crossover distortion, then this current determines the voltage drop across R12, or R20, and the voltage is approximately 35 Mv. The quiescent current must be determined by adjusting VR1 to clockwise completely, and then counterclockwise to achieve 100Ma.

Transistors, Q2 and Q4, Q3 and Q5, are Inverted Darlington connected. Q2 and Q4 is like a NPN transistor, Q3 and Q5 is like a PNP transistor.

RC pad R18, and C8 across the load provides high frequency stabilization. C7 is high frequency compensation of second stage amplifier, and C3 is high frequency compensation of overall amplifier.

FIGURE 3-10  
 30W POWER AMP MODULE  
 (218-02311)  
 LAYOUT & THEORY

8' voice covers 2 octaves  
 16' voice can be added.



Hammond New X-5  
 Bass tone output

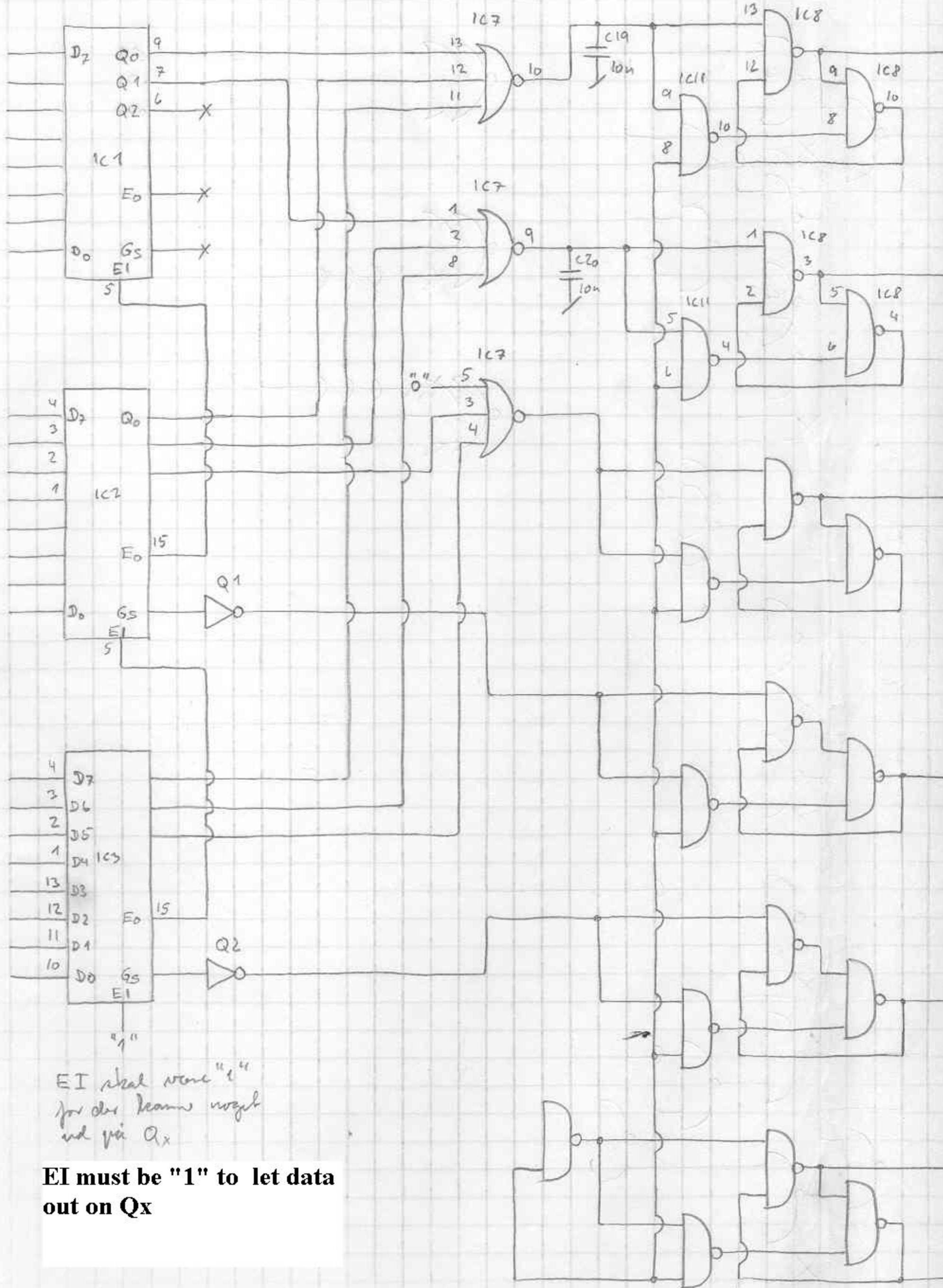


Highest input number is let through.

Höchste Input Nr. kommt raus,

C<sup>+</sup> 503-2  
 D 503-2  
 D<sup>#</sup> 503-4  
 E 503-5  
 F 505-5

F<sup>#</sup> 505-6  
 G 505-7  
 G<sup>#</sup> 504-2  
 A 504-3  
 A<sup>#</sup> 504-4  
 B 504-5  
 C 503-1



EI skal være "1"  
 for det kommer noget  
 ud på Q<sub>x</sub>

EI must be "1" to let data out on Q<sub>x</sub>

