

**ML-2 SERVICE MANUAL**

**mark**  
**evinson**  
AUDIO SYSTEMS, LTD.

## INTRODUCTION

The ML-2 Class A Power Amplifier is the result of two years of design and development by the Mark Levinson Audio Systems staff. The objective was to create a power amplifier to complement the finest music reproduction systems available now and in the future.

The ML-2 does not represent revolutionary new technologies. Rather, it is a refinement of many intrinsically sound concepts which have never before been fully utilized. In that sense, the ML-2 is a classic audio component.

## The ML-2 Class A Power Amplifier - A Brief Description

The advantages of Class A operation have been well known for years. The absence of crossover notch distortion results in a marked improvement in sonic quality. The ML-2 maintains Class A operation over its full output range for load impedances as low as two ohms.

Low distortion is achieved in the ML-2 through the use of complementary push-pull circuitry and small amounts of local feedback. Transient distortion is greatly reduced by the combination of low feedback and group delay, and high slew rate and open-loop bandwidth.

The ML-2 has been designed to drive the complex loads presented by loudspeakers. Its high current capability allows it to deliver more power to a low impedance load than many amplifiers with much higher power ratings.

Both non-inverting (normal) and inverting inputs are provided on the ML-2, adding versatility and broadening the range of applications for the amplifier.

An electromagnetic circuit breaker, which also functions as the power switch, is the heart of the amplifier's protection circuit. Direct or very low frequency voltage appearing at the output terminals or unusually high temperatures will cause the circuit breaker to open before damage can occur to the loudspeaker or the amplifier.

The line voltage selector on the rear panel of the ML-2 allows the amplifier to be operated from AC voltages of 100, 120, 220, or 240 volts. The setting can be changed without affecting the internal wiring.

The ML-2 has been designed and built to be as reliable as possible. It will operate for years without deterioration. Should service be required, however, it is easily accomplished due to the modular construction of the amplifier.

## Installation

Before connecting the ML-2 to a power source, make sure that the line voltage selector is set correctly and that the proper fuse is installed. The line voltage indicator can be viewed through the clear plastic window on the rear panel.

To remove the fuse, first remove the AC cord from the receptacle. Slide the window to the left. Pull the lever inside the fuse compartment.

To change line voltage, the fuse must be removed as above. Pull out the printed circuit board, using a small screwdriver or a similar instrument. Turn the printed circuit board to obtain the correct voltage rating, and reinsert the board. The correct voltage should now be readable. Install the proper fuse and close the compartment.

Use a slow blow,  $\frac{1}{4}$  inch x  $1\frac{1}{4}$  inch fuse as follows:

<u>AC Line Voltage</u>	<u>Fuse</u>
100 volts	5 amp(MDL-5)
120 volts	4 amp(MDL-4)
220 volts	3 amp(MDA-3)
240 volts	2 amp(MDX-2)

## Operating Instructions

The heat sinks on the ML-2 become very warm under normal operating conditions. Although the amplifier is protected from damage due to overheating, careful set-up will avoid tripping of the protection circuit and extend the operating life of the transistors.

Place the ML-2 so that air can circulate freely through the heat sinks. If two or more amplifiers must be stacked vertically, allow at least six inches between amplifiers. If the ML-2 is to be operated in an enclosure, such as a cabinet or a relay rack, adequate ventilation must be provided.

The ML-2 should be placed far enough from the turntable and preamp that the hum field from its power transformer does not inject noise into the system. A distance of three feet is usually sufficient.

A binding post is provided on the rear panel for connections to the chassis. This point is intended for use in those applications where the chassis of two or more components must be connected for hum reduction. It must never be used for loudspeaker connection.

In most systems, it will be necessary to float the preamplifier and auxiliary equipment as well as all but one ML-2 power amplifier from the AC line ground using 3 to 2 pin AC adaptors.

As with all electrical equipment, the ML-2 should be kept out of the reach of children.

## Specifications

The correlation between published specifications and sonic quality is usually very poor. A list of numbers reveals virtually nothing. All technical measurements must be subject to qualitative as well as quantitative interpretation.

Measurements of the ML-2 yield excellent results by any standards. However, only those specifications that apply to the actual operation of the amplifier are included here.

Rated Power: 25 watts minimum continuous sine-wave power into 8 ohms from 20Hz to 20kHz with no more than 0.1% total harmonic distortion.

Input Impedance: 100,000 ohms

Power Requirement: 400 watts nominal, 50-400 Hz

Overall Dimensions: 19 in. Wide X 8.5 in. High X 21.5 in. Deep  
(48.3cm Wide X 21.6cm High X 54.6cm Deep)

Weight: 65 pounds (29.6 kilograms)

Connector Complement: 2 Lemo coaxial connectors

1 3-pin audio connector

5 Binding posts

1 AC receptacle/line voltage selector

### Connections for Normal Operation

Most power amplifier applications require that the amplifier be of the non-inverting type, that is, the output signal is in phase with the input signal. For this type of operation, connect the main output of the preamplifier to the NORMAL input of the ML-2 and use the shorting plug in the INVERTING input.

### Connection for Inverting Operation

In some cases, a phase reversal is required. In other words, the output signal is 180 degrees out of phase with the input signal. One such case might be in a system containing a component, such as a moving coil cartridge preamplifier, which inverts the signal. Using the ML-2 inverting input returns the signal to its original phase condition.

Connect the preamplifier main output to the ML-2 INVERTING input and use the shorting plug in the normal input.

### Bridged Operation

In some cases, the power required to drive a loudspeaker exceeds the capabilities of an ML-2. For load impedances of at least four ohms, two ML-2s can be bridged to quadruple the available power.

One ML-2 should be run in the NORMAL mode, the other in the inverting mode. Both amplifiers must be driven from the same source. Connect the loudspeaker between the + outputs of the amplifiers. In this configuration, neither loudspeaker terminal is connected to common.



### Important Note Concerning Bridged Operation

When operating two ML-2s in the bridged configuration, it is extremely important to avoid ground loops.

Connect the shortest possible length of 14 gauge or larger wire from the output common terminal of one ML-2 to the output common terminal of the other ML-2. Since this wire will carry all of the load current, it should be as heavy as possible. If heavy gauge wire is not available, several lengths of 16 or 18 gauge may be used.

Connect another wire between the chassis grounds of the two amplifiers. This wire should also be as short as possible and of heavy gauge.

<u>PROBLEM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
Circuit breaker trips upon turn on	1. Poor mating of Elco contacts.	1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14.
	2. T0-220 transistor shorted to heatsink.	2. Check by measuring with an ohm meter. Measure T0-220 mounting screw to heatsink with heatsink removed from unit. Refer to dwg. A-13.
	3. T0-220 transistor collector circuit open.	3. Tighten. Refer to dwg. A-13.
	4. T0-220 transistor defective.	4. Replace. Refer to dwg. A-13.
	5. T0-3 transistor shorted to heatsink.	5. Check by measuring with an ohm meter. Measure T0-3 case to heatsink with heatsink removed from unit. Refer to dwg. A-13.
	6. P.C. line or component lead shorting to heatsink or stand-off.	6. Insulate standoff with heat shrink tubing if necessary. (Applies to units with 30-0710-00 heatsink P.C. boards only).
	7. Loose screw(s) on heatsink assembly.	7. Tighten screws. Refer to dwg. A-13.
	8. Loose screw(s) on filter capacitors.	8. Tighten screws. Refer to dwg. A-1, item #'s 86-97.
	9. Defective thermal switch on heatsink.	9. Measure switch with an ohm meter across contacts with heatsink removed from unit. Switch should read less than 1 ohm. Refer to dwg. A-13.
	10. Defective diode on Motherboard.	10. Check with an ohm meter with power cord disconnected. Refer to dwg. A-1, item #'s 30,31,34,35,40,41, 42,43.
	11. Defective bridge rectifier.	11. Check by substitution. Refer to dwg. A-11.
	12. Defective Audio P.C. board.	12. Check by substitution. Refer to dwg. A-10.
	13. Defective Regulator P.C. board.	13. Check by substitution. Refer to dwg. A-10.
	14. Defective Trimpot on Motherboard.	14. Check by substitution. Refer to dwg. A-1 item #17.
	15. Defective Relay.	15. Check by substitution. Refer to dwg. A-1 item #125.

PROBLEM

POSSIBLE CAUSE

SOLUTION

Hum

- |  |  |   |   |   |  |   |   |
|--|--|---|---|---|--|---|---|
| 1. Poor mating of Elco contacts interfacing Audio P.C.B. or Regulator P.C.B. to Motherboard.   | 2. Lead dress and/or lack of shielding of input wiring connecting inputs to Motherboard. | 3. Unused input not shorted or shorting plug defective. | 4. Loose screw(s) on filter capacitors.               | 5. Poor connections of "Quick Disconnect" terminals to bridge rectifier or circuit breaker. | 6. Poor connection of transformer center tap.  | 7. Defective bridge rectifier.                | 8. Defective Relay.                                     |
| 1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14. | 2. Replace unshielded leads with shielded cable. Dress leads away from back panel.       | 3. Check shorting plug.                                 | 4. Tighten screws. Refer to dwg. A-1, item #'s 86-97. | 5. Check crimp connections on wires.  | 6. Check secondary wiring. Check connection of Red/Yellow transformer wire to Motherboard. | 7. Check by substitution. Refer to dwg. A-11. | 8. Check by substitution. Refer to dwg. A-1, item #125. |

PROBLEM

Circuit breaker trips  
when signal is applied

POSSIBLE CAUSE

1. Poor mating of Elco contacts.
2. Load terminals shorted.
3. Component lead or P.C. line shorted to heatsink or stand-off.
4. Defective capacitor on regulator P.C. board.
5. Loose screw(s) on filter capacitors.
6. T0-220 transistor collector circuit open.
7. Defective T0-220 transistor.

SOLUTION

1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14.
2. Check external connections.
3. Insulate standoff with heat shrink tubing if necessary. (Applies to units with 30-0710-00 heatsink P.C. boards only).
4. Check by substitution of Regulator P.C. Board. For location of capacitor refer to dwg. A-3, item #73.
5. Tighten screws. Refer to dwg. A-1, item #'s 86-87.
6. Tighten refer to dwg. A-13.
7. Replace. Refer to dwg. A-13.

<u>PROBLEM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
Noise	1. Poor mating of Elco contacts.	1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14.
	2. Defective trimpot on Audio P.C. Board.	2. Check by substitution of Audio P.C. Board. For location of trimpot refer to dwg. A-2, item #42.
Unit Inoperative	1. Poor mating of Elco contacts.	1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14.
	2. Fuse on Motherboard.	2. Check by substitution. Replace with MDL 6.25A. For location of fuse refer to dwg. A-1.
	3. Defective T0-220 transistor on regulator heatsink.	3. Check by substitution of regulator heatsinks. Refer to dwgs. A-4, item #11, A-7, item #11.
	4. Defective Regulator P.C. Board.	4. Check by substitution. Refer to dwg. A-10.
	5. Defective Audio P.C. Board.	5. Check by substitution. Refer to dwg. A-10.
High Distortion	1. Poor mating of Elco contacts.	1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14.
	2. Defective T0-220 transistor on Audio driver heatsink.	2. Check by substitution of Audio Driver heatsinks. Refer to dwgs. A-5, item #6, A-8, item #6.
	3. Loose screw(s) on filter capacitors.	3. Tighten screws. Refer to dwg. A-1, item #'s 86-97.
	4. Defective Audio P.C. Board.	4. Check by substitution. Refer to dwg. A-10.

LIST OF DRAWINGS

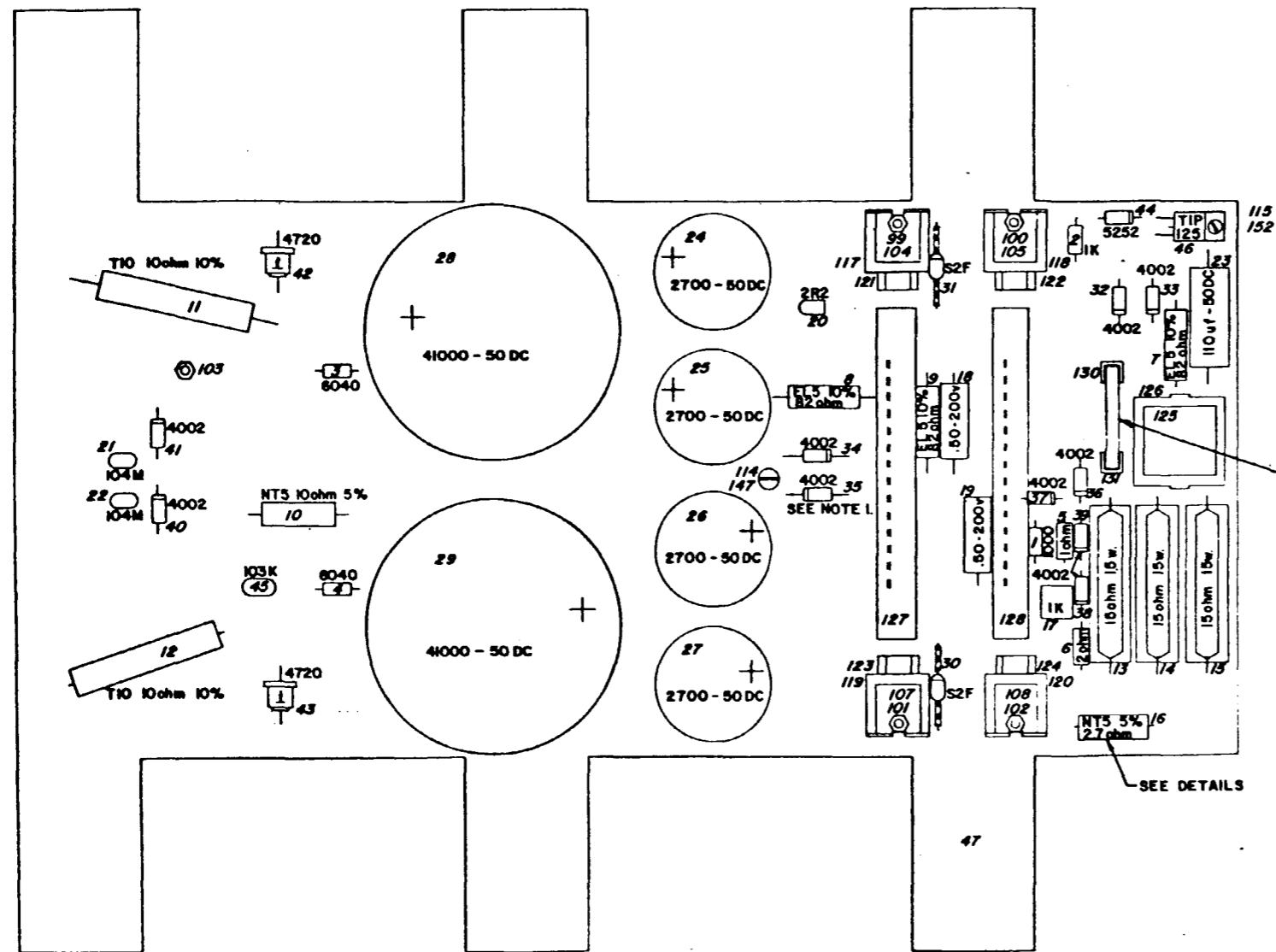
ASSEMBLY DIAGRAMS

DWG. NO.

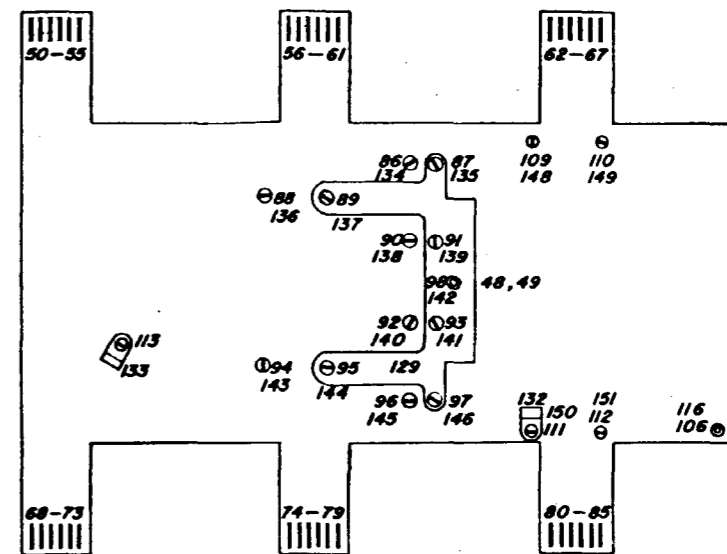
Motherboard		A-1
Audio Card	AP-1	A-2
Regulator Card	RP-1	A-3
Pos. Regulator H.S.	PRP-1	A-4
Pos. Audio Output & Driver H.S.	PDP-1	A-5
Pos. Audio Output & Bias Regulator H.S.	PBP-1	A-6
Neg. Regulator H.S.	NRP-1	A-7
Neg. Audio Output & Driver H.S.	NDP-1	A-8
Neg. Audio Output & Bias Regulator H.S.	NBP-1	A-9
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SCHEMATICS

Power Transformer Wiring Diagram		S-1
Block Diagram		S-2
Audio Card	AP-1	S-3
Regulator Card	RP-1	S-4
Pos. Regulator H.S.	PRP-1	S-5
Pos. Audio Output & Driver H.S.	PDP-1	S-6
Pos. Audio Output & Bias Regulator H.S.	PBP-1	S-7
Neg. Regulator H.S.	NRP-1	S-8
Neg. Audio Output & Driver H.S.	NDP-1	S-9
Neg. Audio Output & Bias Regulator H.S.	NBP-1	S-10

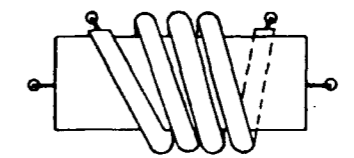
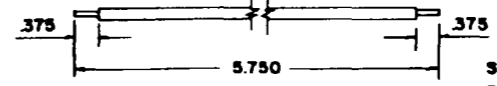


COMPONENT SIDE



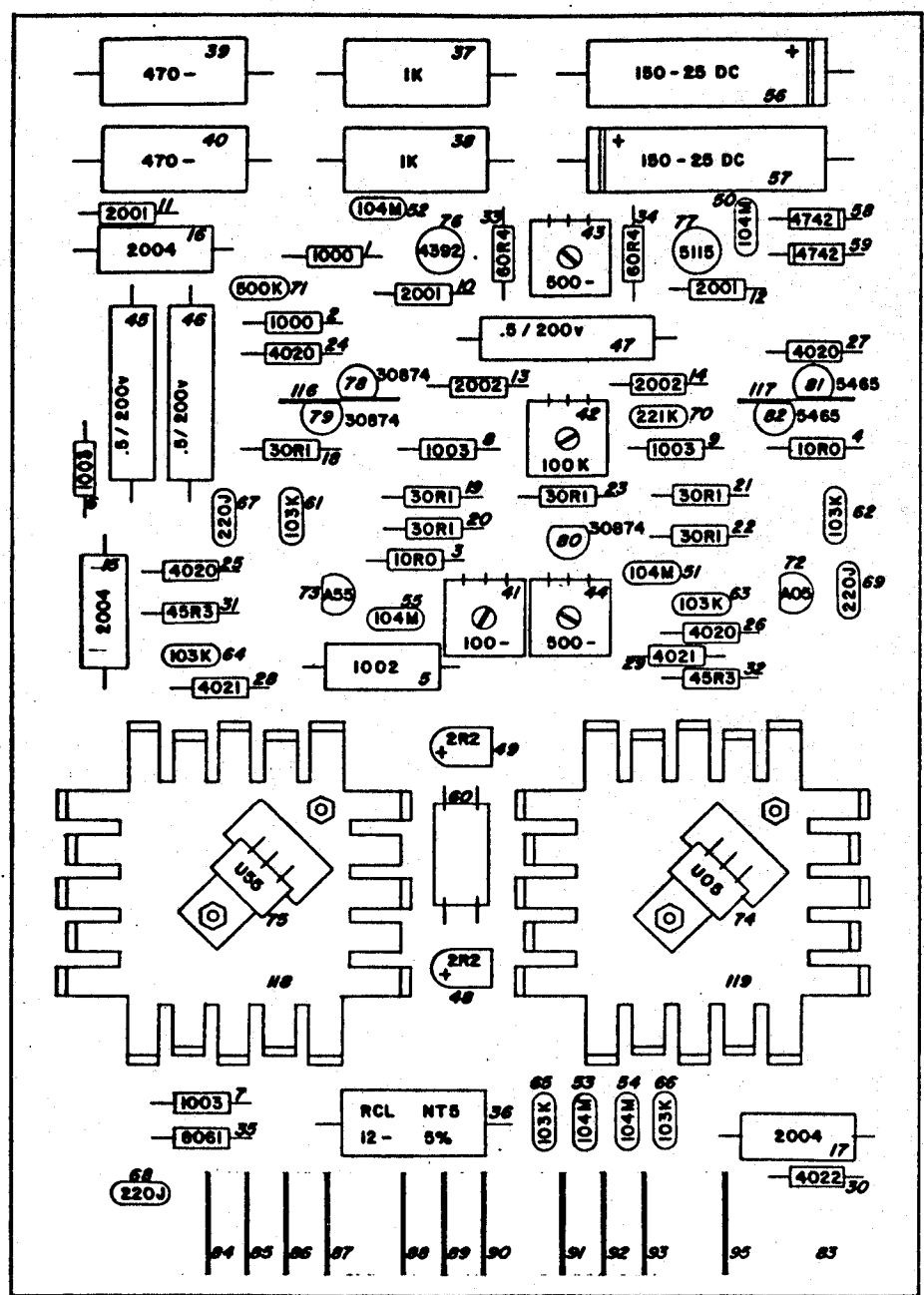
SOLDER SIDE

FUSE MDL 6.25A

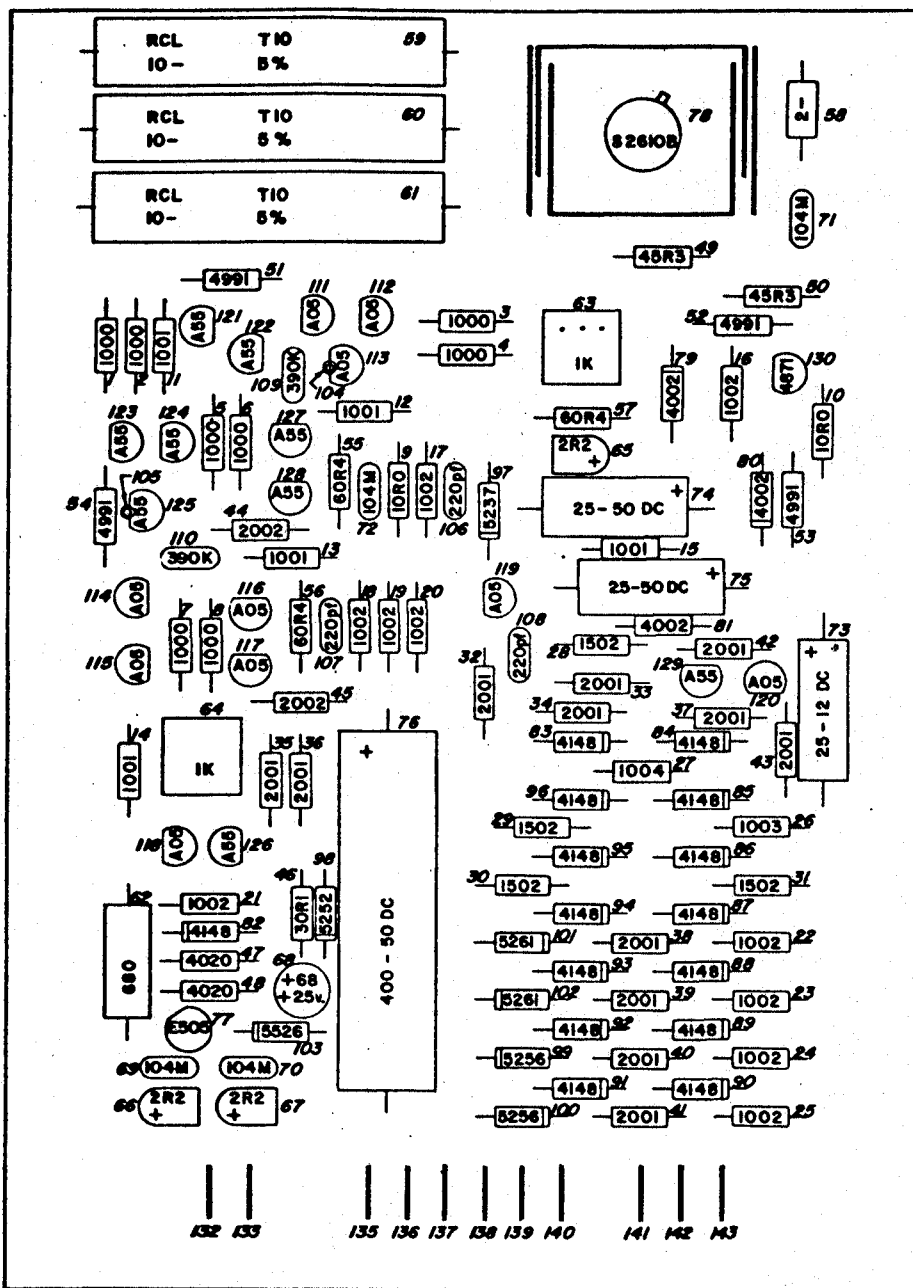


NOTES:  
 I. CUT DIODE LEADS FLUSH WITH BOTTOM OF BOARD AND SOLDER FROM COMPONENT SIDE OF BOARD.

MOTHERBOARD A-1

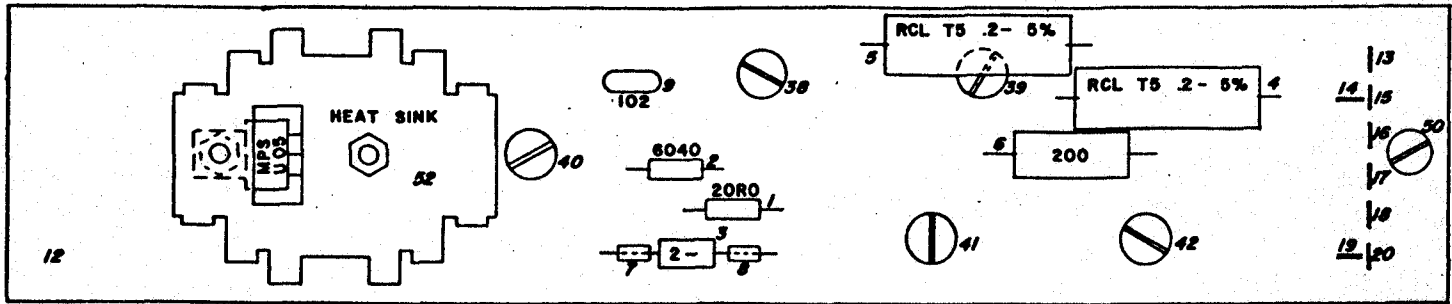




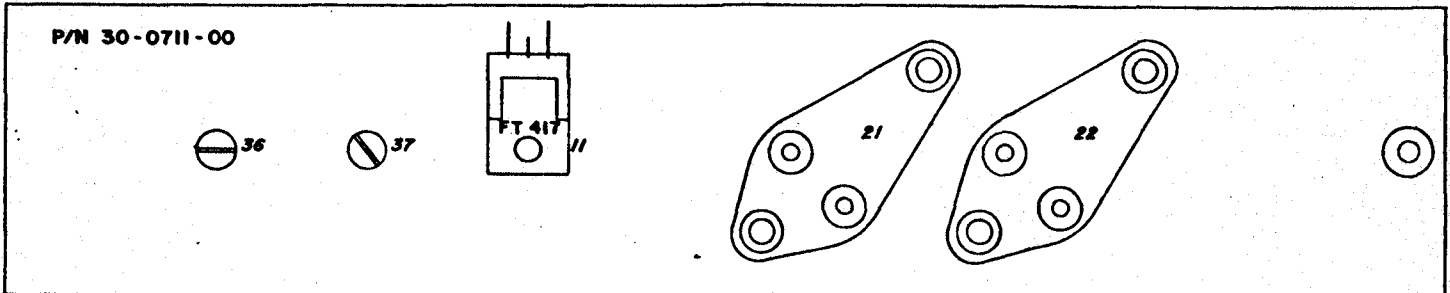
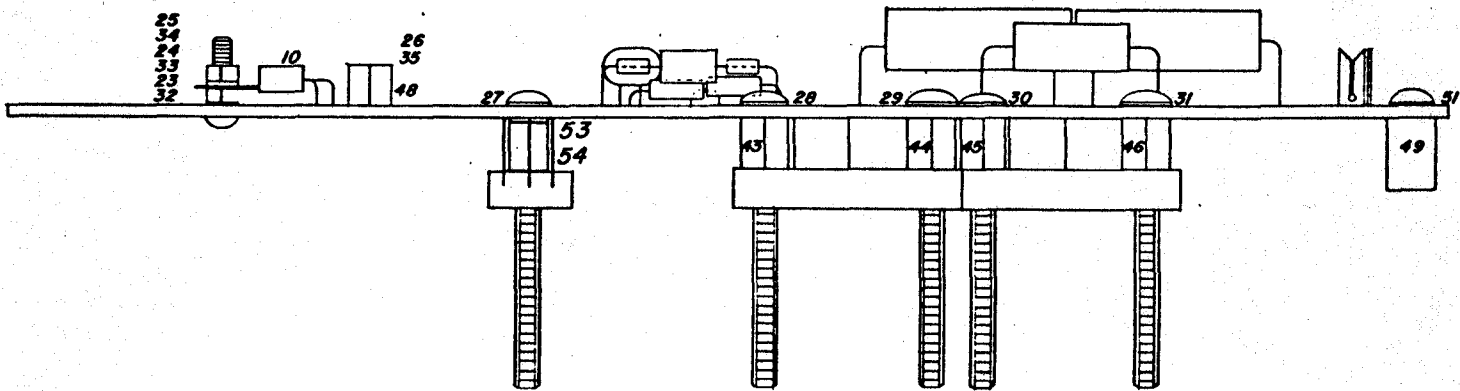


RP-1

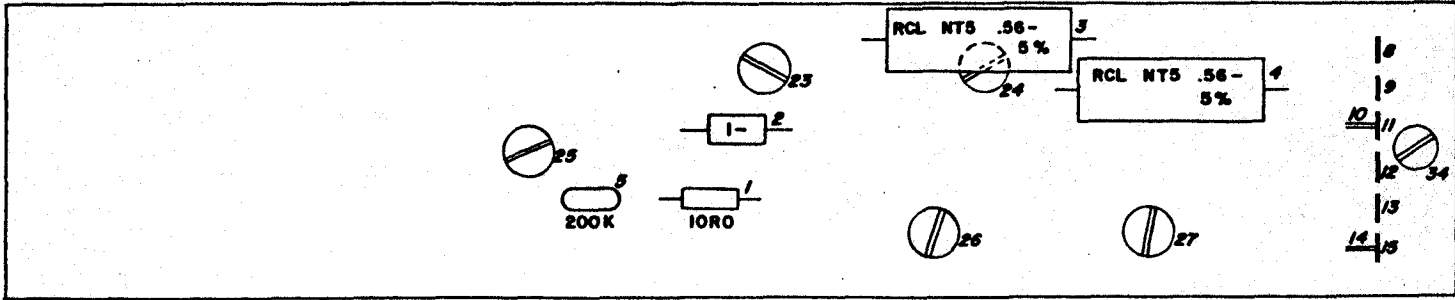
A-3



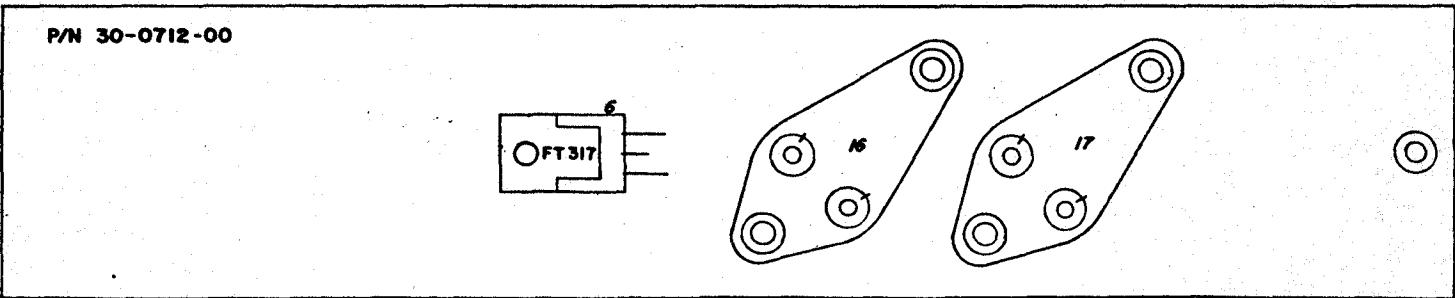
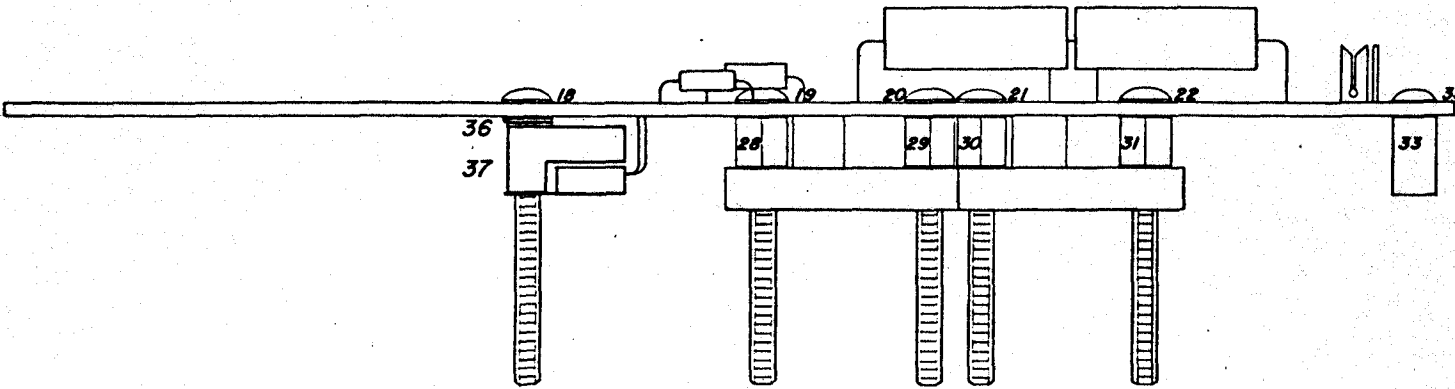
COMPONENT SIDE



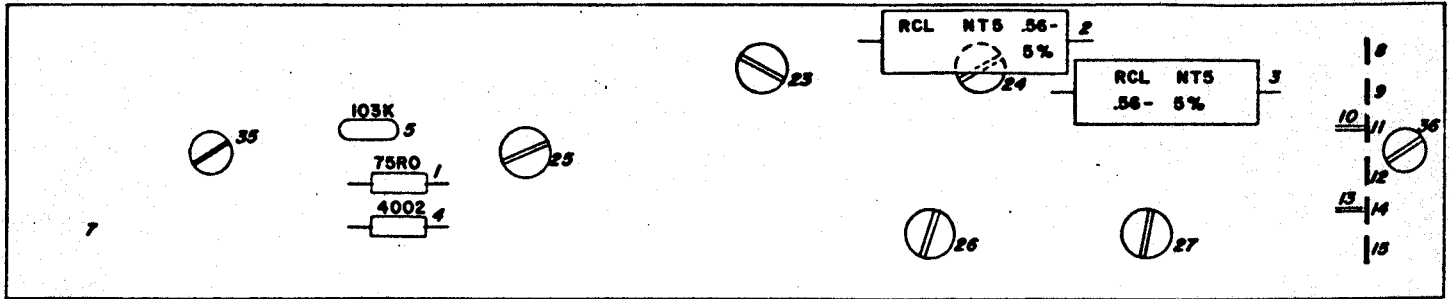
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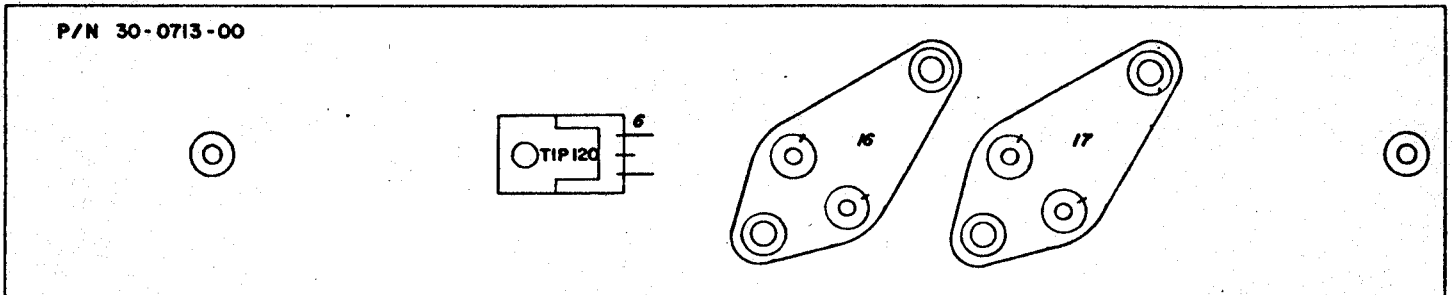
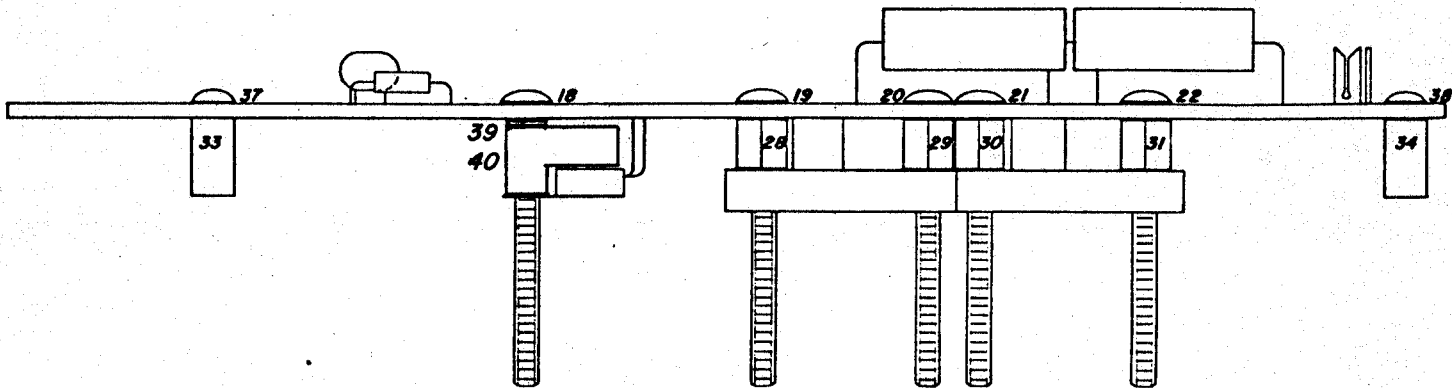
COMPONENT SIDE



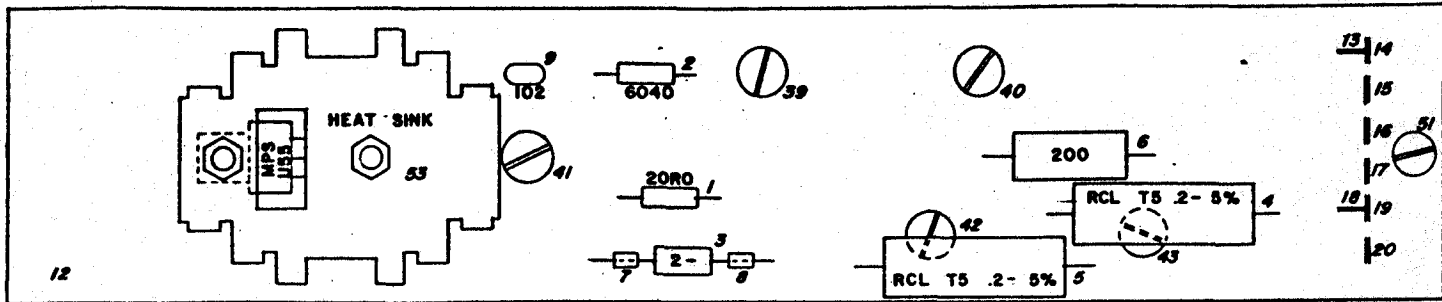
SOLDER SIDE



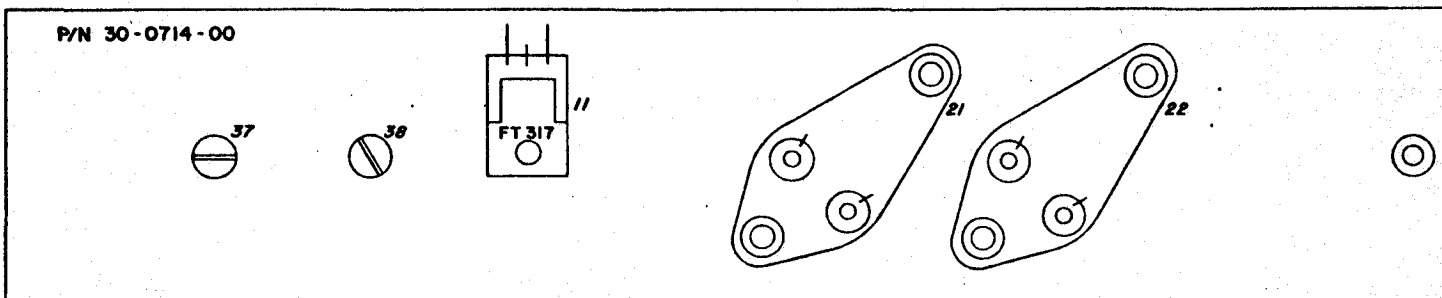
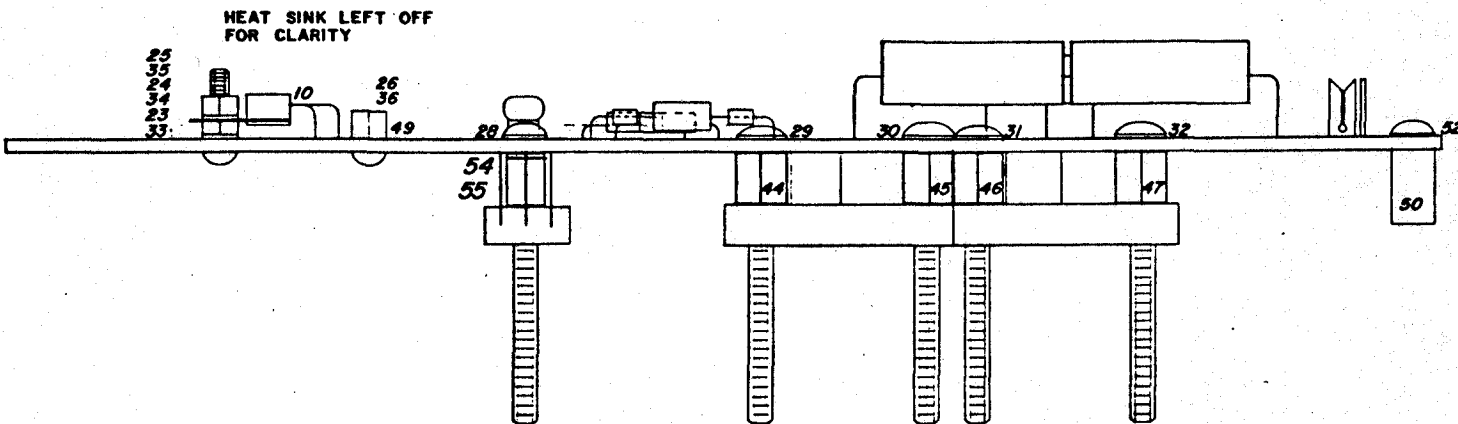
COMPONENT SIDE



SOLDER SIDE



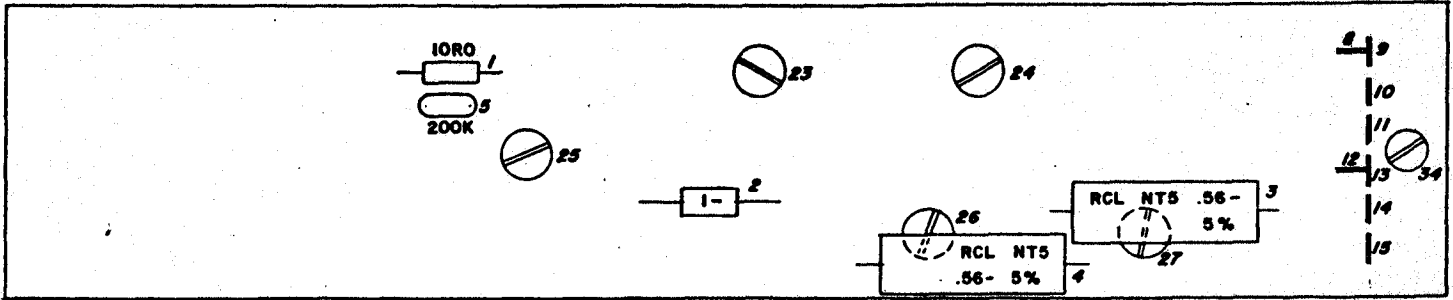
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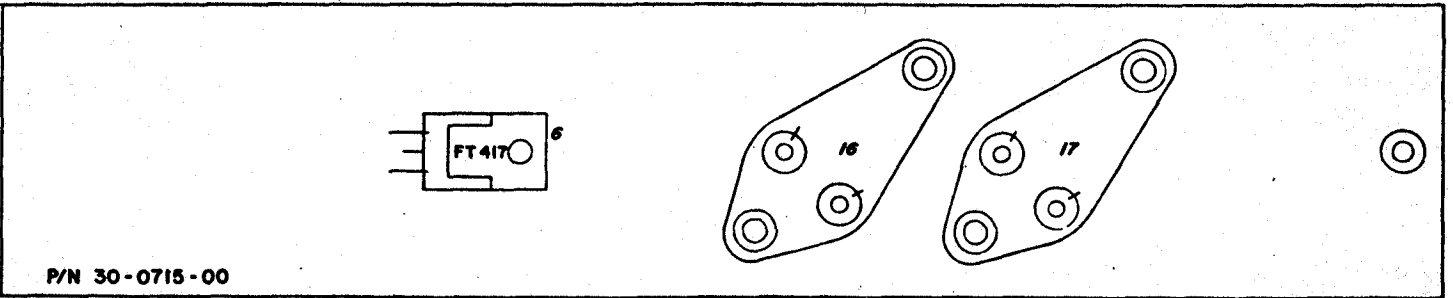
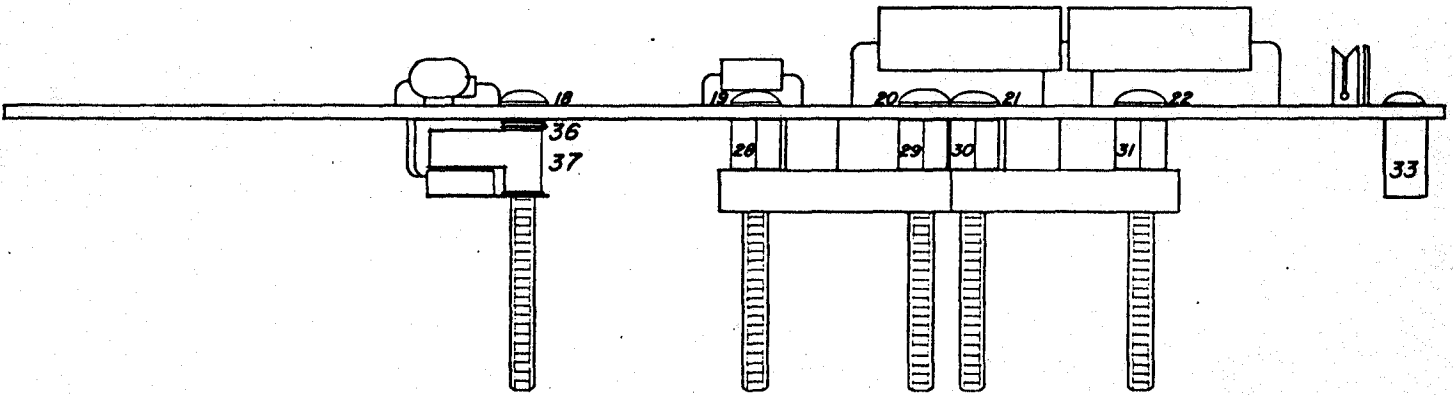
SOLDER SIDE

**NRP-1**

**A-7**



COMPONENT SIDE

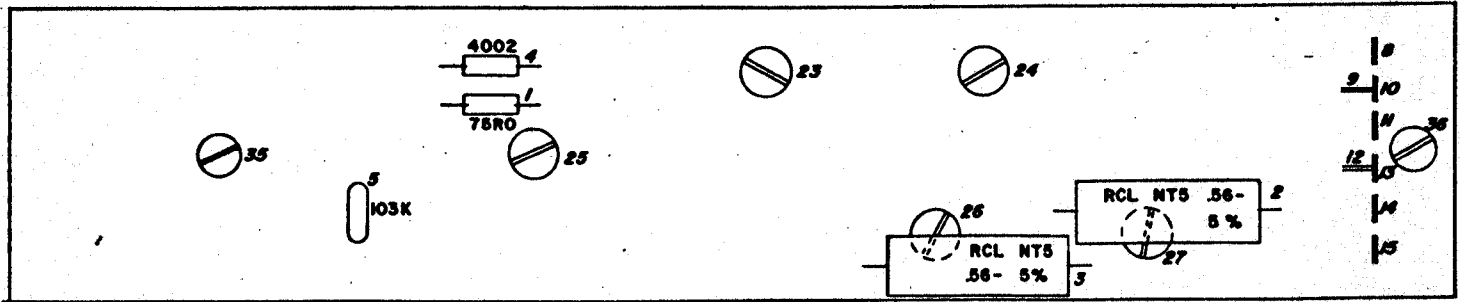


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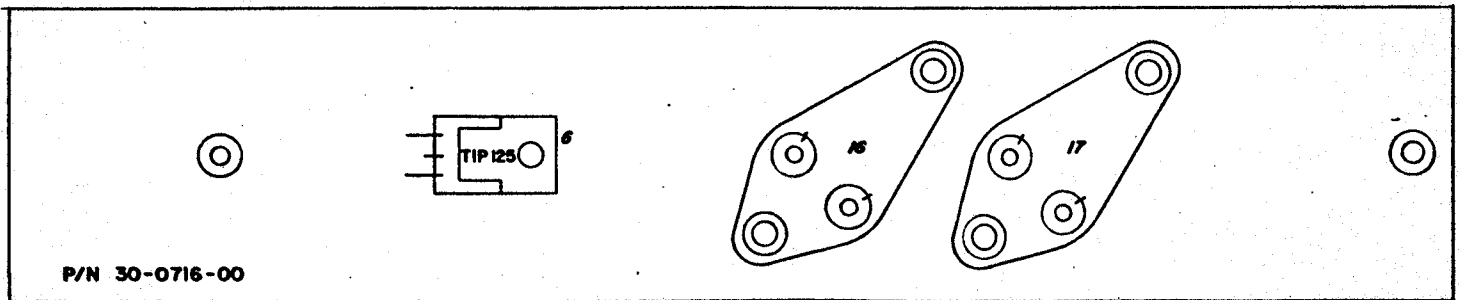
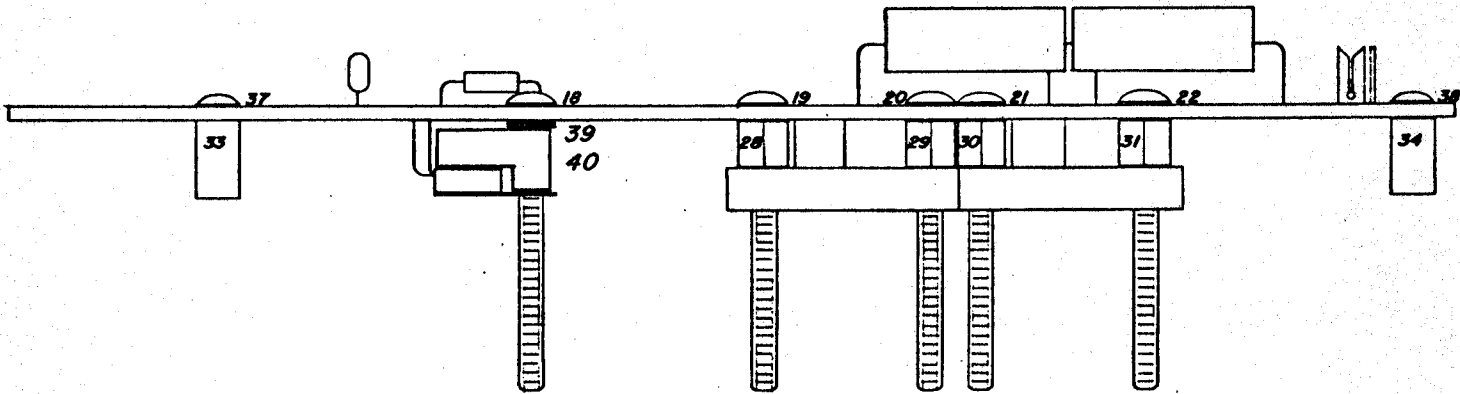
SOLDER SIDE

**NDP-1**

**A-8**



COMPONENT SIDE



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SOLDER SIDE

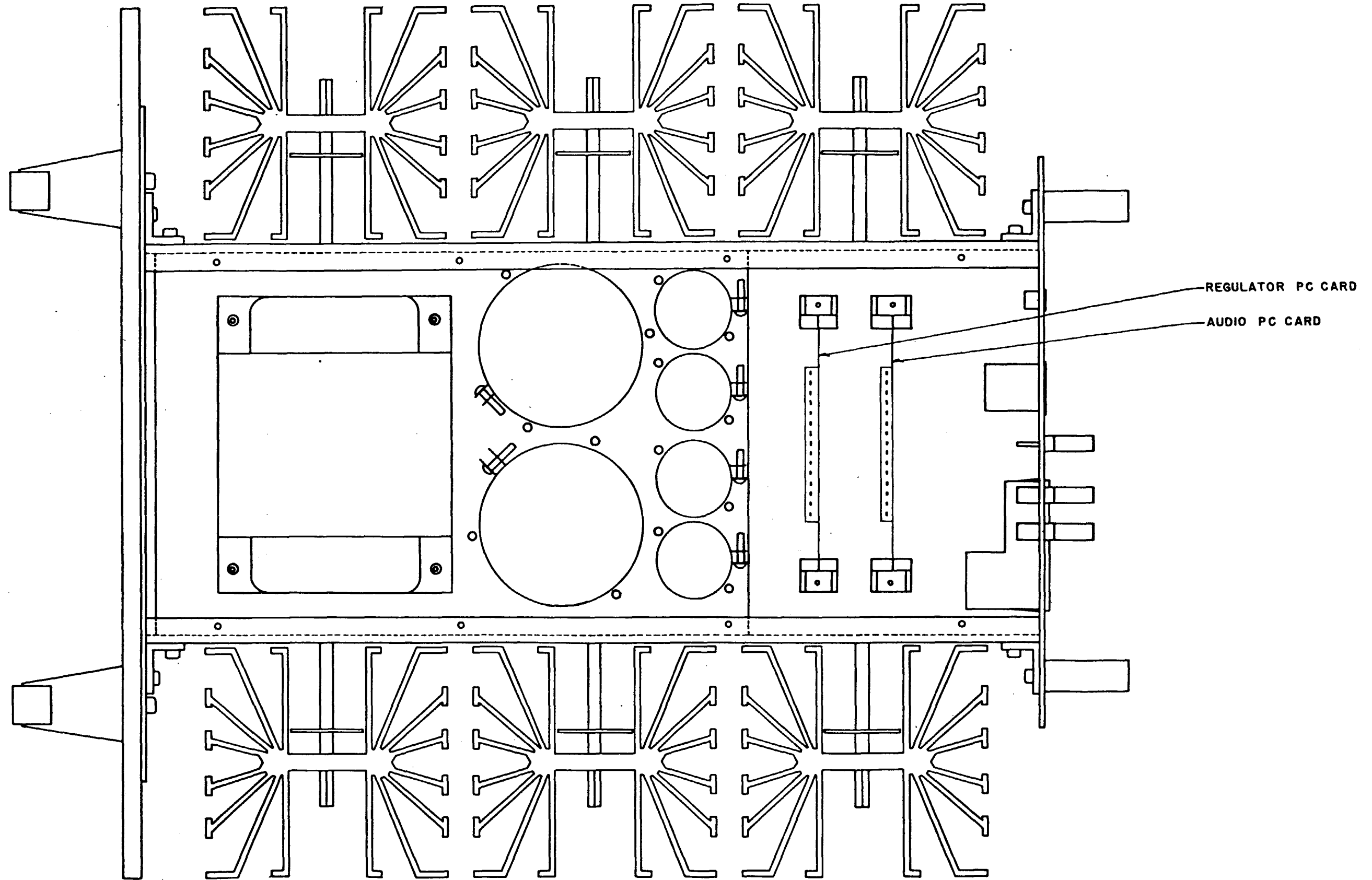
**NBP-1**

**A-9**

POS. REG.

POS. DRIVER & OUTPUT

POS. BIAS & OUTPUT



REGULATOR PC CARD

AUDIO PC CARD

NEG. REG.

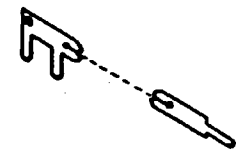
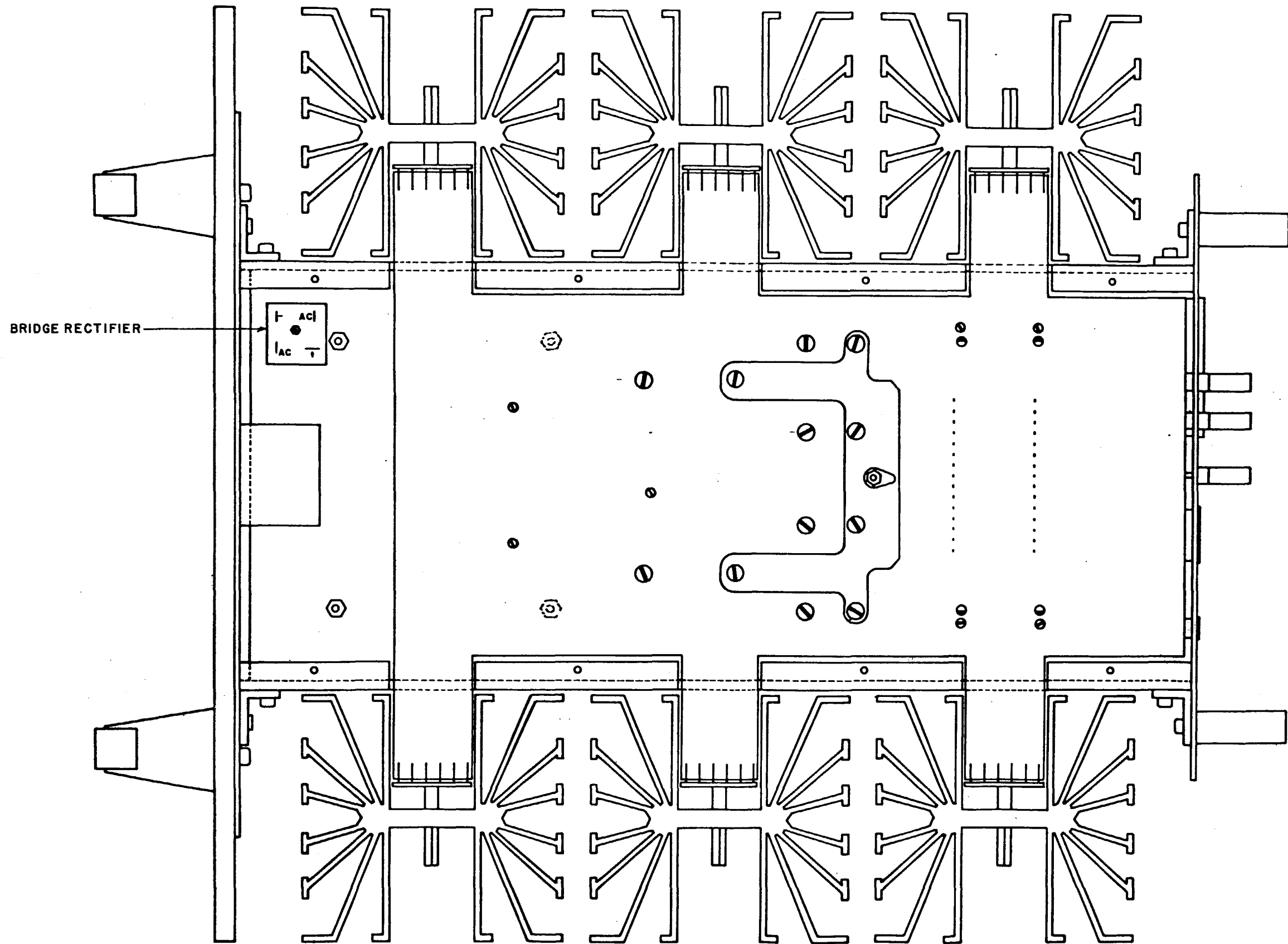
NEG. DRIVER & OUTPUT

NEG. BIAS & OUTPUT

**ML-2 TOP VIEW**

**A-10**

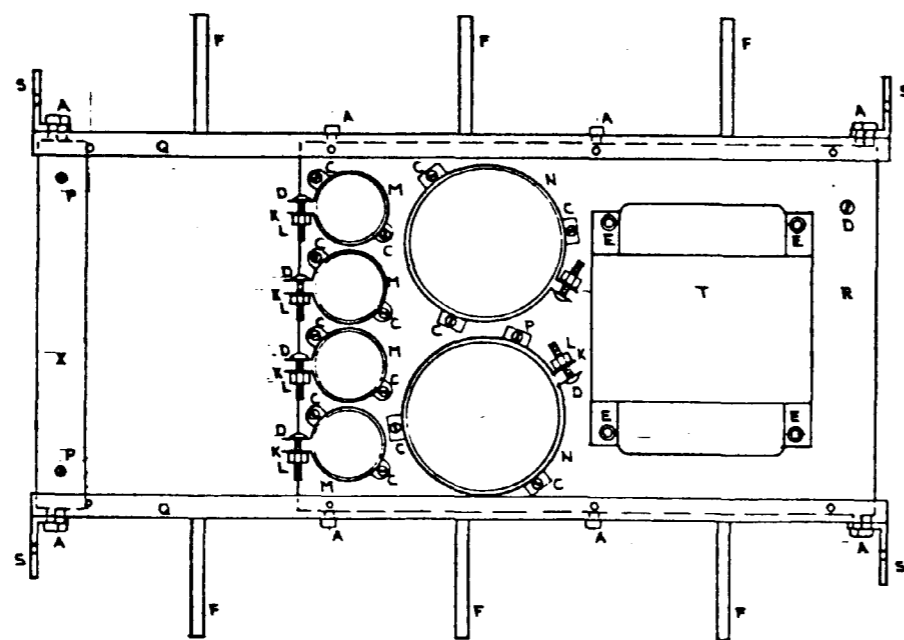
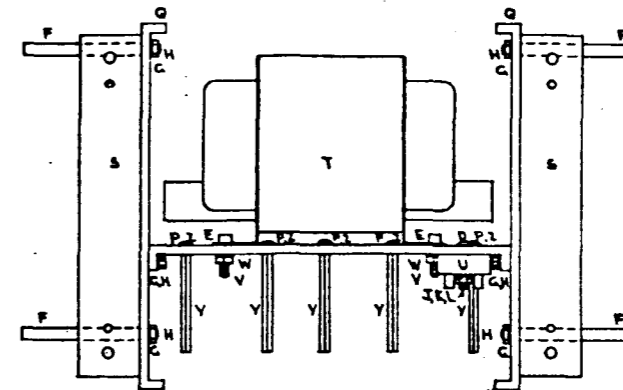
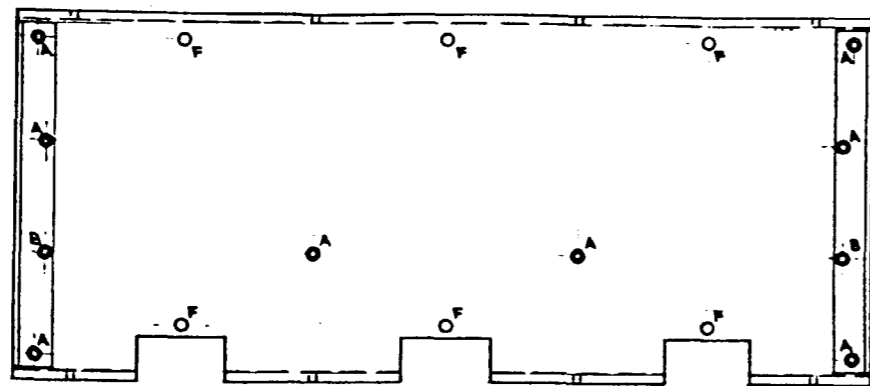




TYP. PIN CONNECTORS

**ML-2 BOTTOM VIEW**

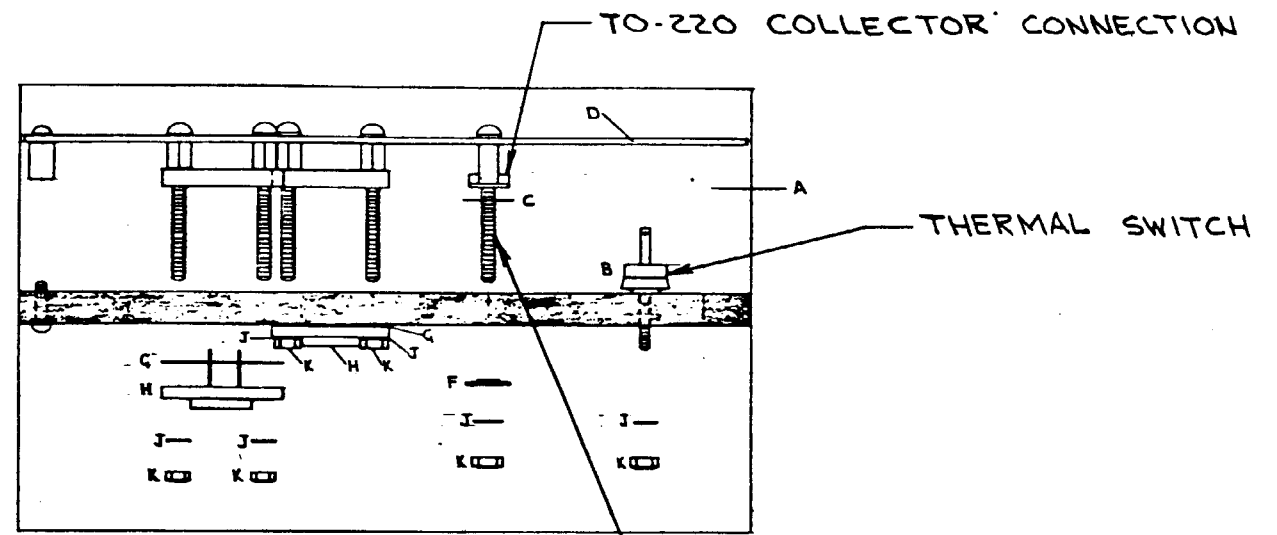
**A-11**



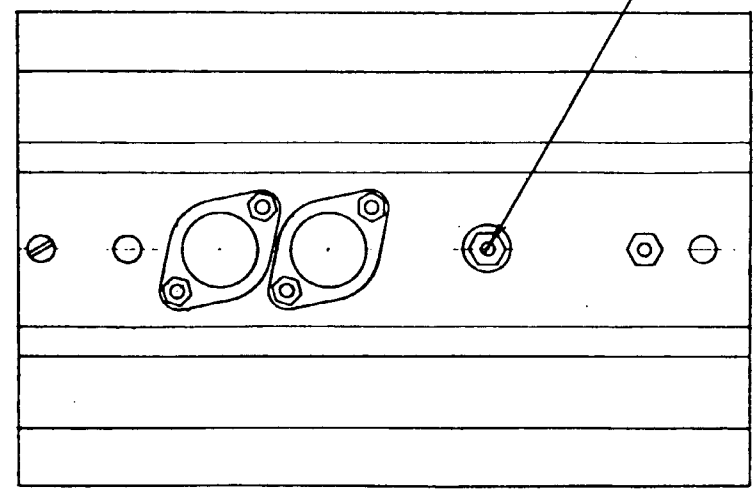
ITEM	MLAS P/N	DESCRIPTION	ITEM	MLAS P/N	DESCRIPTION
A	52-0025-00	#8-32x <sup>3</sup> / <sub>8</sub> " SHCS, S.S.	N	50-0008-00	CAPACITOR CLAMP
B	52-0026-00	#8-32x <sup>7</sup> / <sub>4</sub> " SHCS, S.S.	P	52-0021-00	#4-40x <sup>1</sup> / <sub>2</sub> " BHMS, C.S.
C	52-0018-00	#6-32x <sup>1</sup> / <sub>2</sub> " BHMS, C.S.	Q	70-0001-00	SIDE PLATE
D	52-0030-00	#6-32x <sup>7</sup> / <sub>8</sub> " BHMS, C.S.	R	70-0002-00	FALSE BOTTOM
E	52-0028-00	#10-32x <sup>1</sup> / <sub>2</sub> " SHCS, S.S.	S	70-0008-00	BRACKET
F	53-0002-00	ROUND SPACER	T	16-0280-00	TRANSFORMER
G	52-0010-00	#8 ITLW, C.S.	U	17-0001-00	BRIDGE RECTIFIER
H	52-0008-00	#8-32x <sup>3</sup> / <sub>16</sub> " HEX NUT, S.S.	V	52-0036-00	#10-32x <sup>1</sup> / <sub>2</sub> " HEX NUT, S.S.
J	52-0033-00	#6x <sup>3</sup> / <sub>8</sub> " FLAT WASHER, C.S.	W	52-0011-00	#10 ITLW, S.S.
K	52-0015-00	#6 ITLW, C.S.	X	70-0007-00	BRACE
L	52-0012-00	#6-32x <sup>1</sup> / <sub>4</sub> " HEX NUT, C.S.	Y	53-0004-00	HEX SPACER
M	50-0009-00	CAPACITOR CLAMP	Z	52-0017-00	#4 ITLW, C.S.

## CHASSIS ASSEMBLY

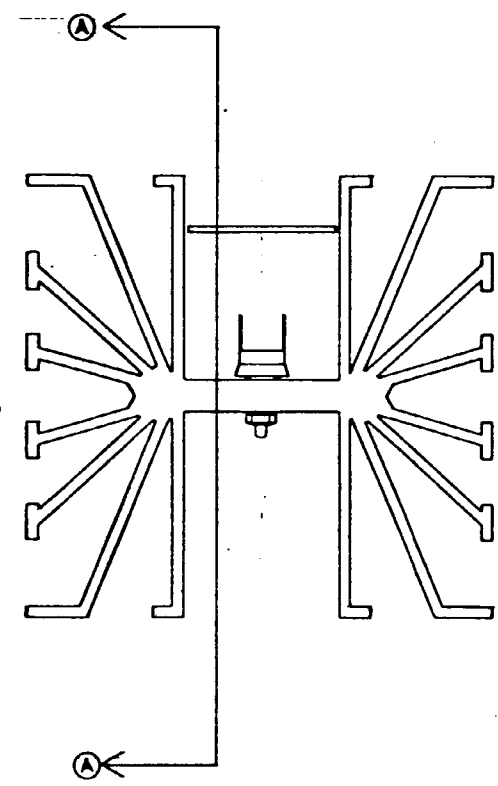
A-12



SECTION A-A



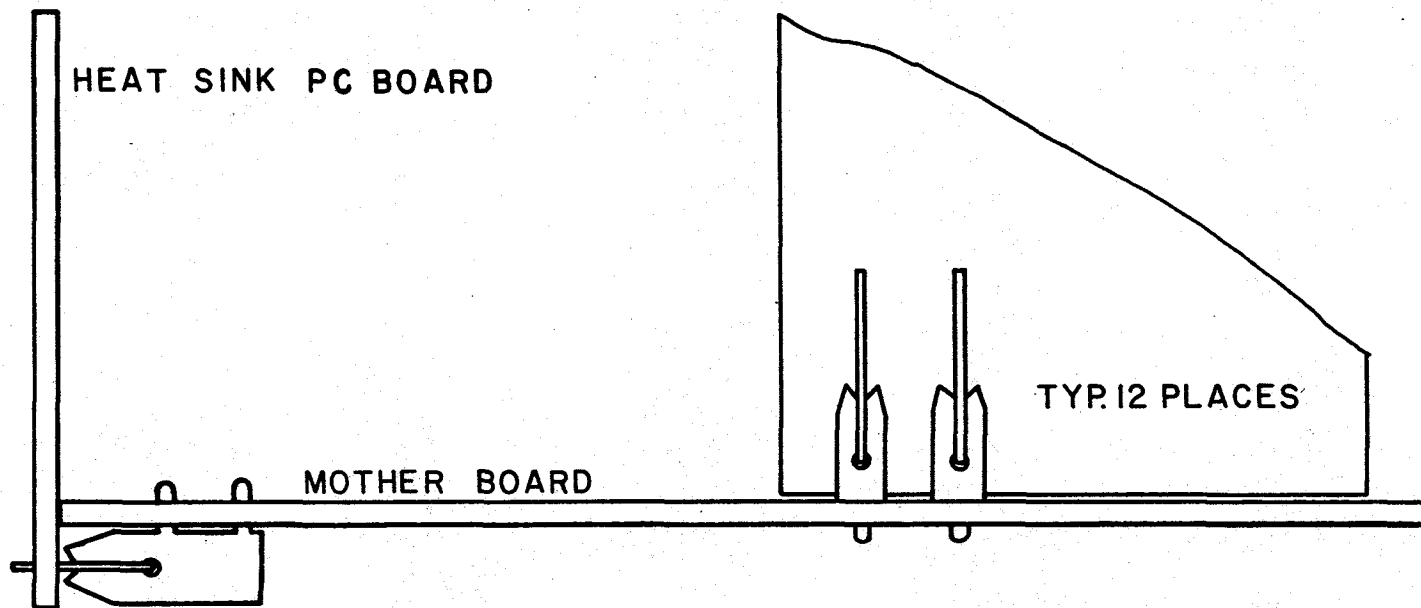
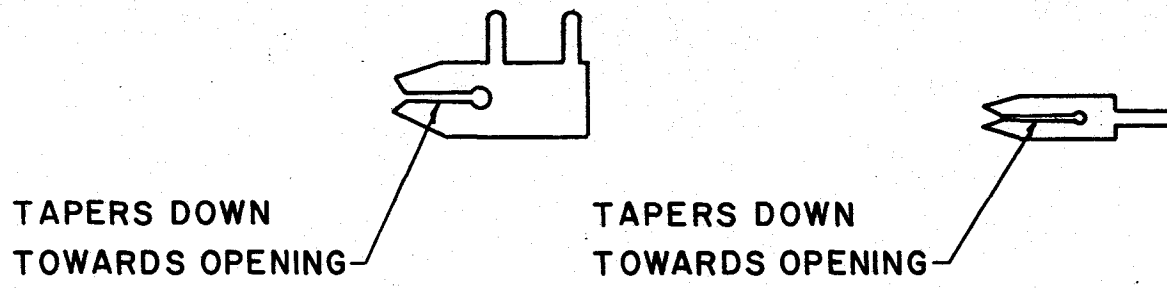
TO-220 MOUNTING SCREW



ITEM	MLAS P/N	DESCRIPTION
A.	69-0003-00	HEAT SINK
B.	62-0003-00	THERMAL SWITCH (SEE NOTE 1/3)
C.	69-0004-00	TO-220 INSULATOR
D.	75-	PC BOARD ASSEMBLY
E.	54-0011-00	NO. 4-40 x 7/16" NYLON BHMS
F.	54-0009-00	SHOULDER WASHER
G.	69-0005-00	TO-3 INSULATOR
H.	(SEE NOTE 2)	
I.	52-0015-00	NO. 6 INTERNAL TOOTH LOCKWASHER
K.	32-0012-00	NO. 6-32 x 1/4" HEX NUT

- NOTES:
1. FASTEN THERMAL SWITCH TO HEAT SINK AS FIRST STEP.
  2. USE 20-5884-00 FOR NRH-1, NDH-1, NBH-1 ASSEMBLIES. USE 20-5884-00 FOR PRH-1, PDH-1, PBH-1 ASSEMBLIES.
  3. OMIT ON NBH-1, PBH-1 ASSEMBLIES.
  4. TIGHTEN ALL HEX NUTS TO 8 OZ.-IN., AND APPLY LOC-TITE.
  5. SOLDER THERMAL SWITCH TERMINALS TO PC BOARD AFTER BOARD IS FASTENED TO HEAT SINK.

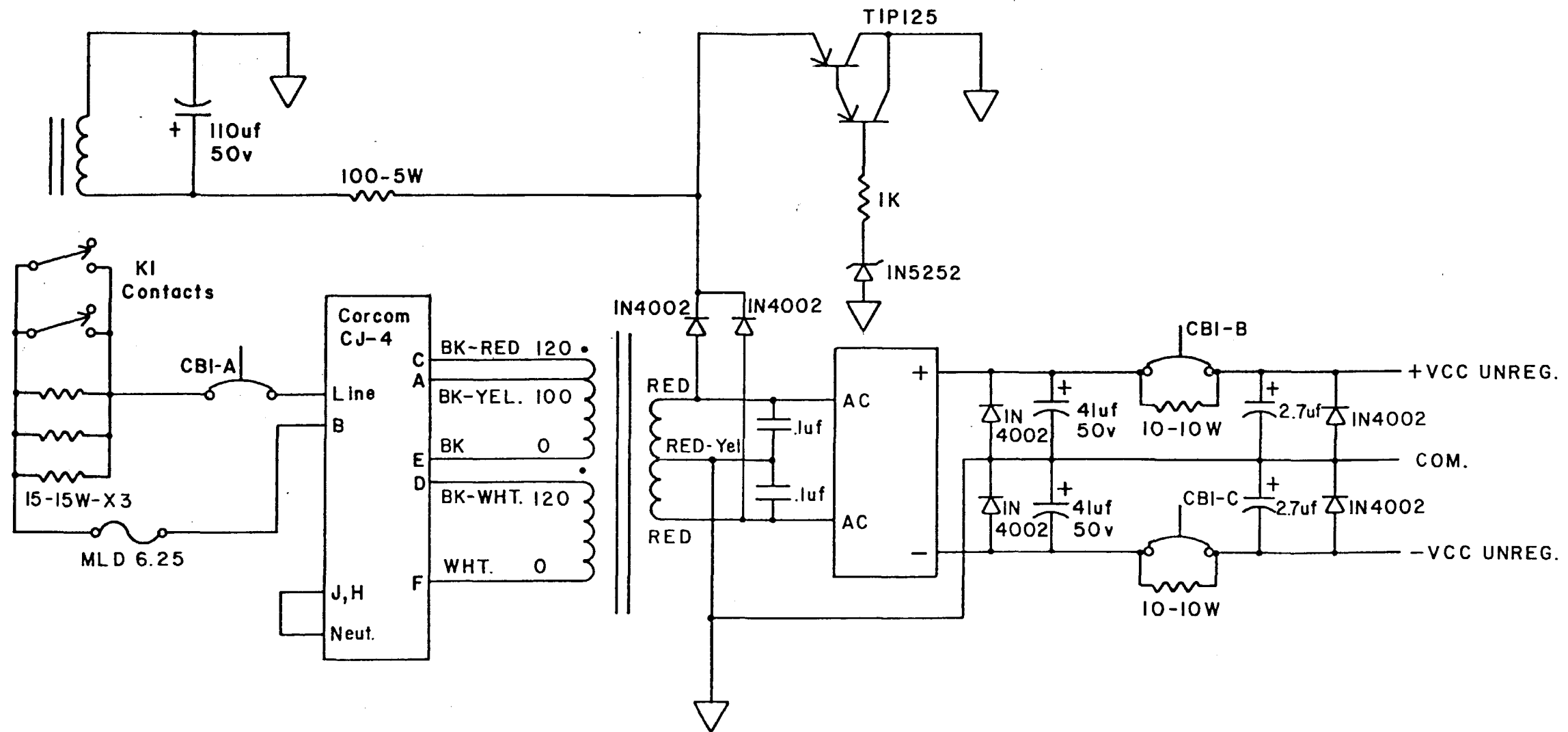
# HEAT SINK ASSEMBLY



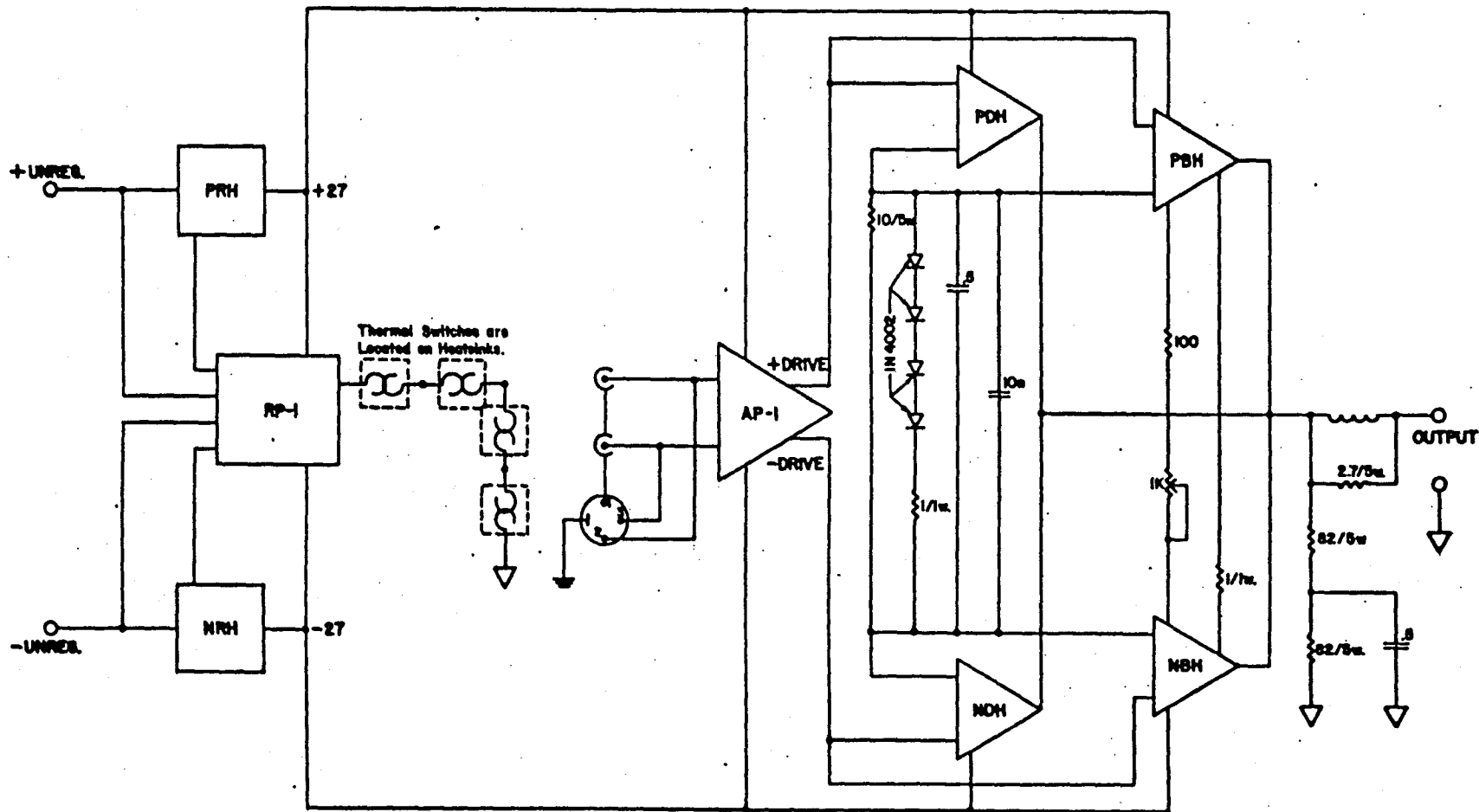
**ELCO PIN CONNECTOR DIAGRAM**

NOTES:

- 1) ALL RESISTORS ARE IN OHMS  
UNLESS INDICATED OTHERWISE.
- 2) ALL RESISTORS ARE RN55D,  
.25W, 1% UNLESS INDICATED  
OTHERWISE.
- 3)  $K=10^3$  ,  $M=10^6$
- 4) ALL CAPACITORS ARE IN MICRO-  
FARADS UNLESS INDICATED  
OTHERWISE.
- 5)  $n=10^{-9}$  ,  $p=10^{-12}$

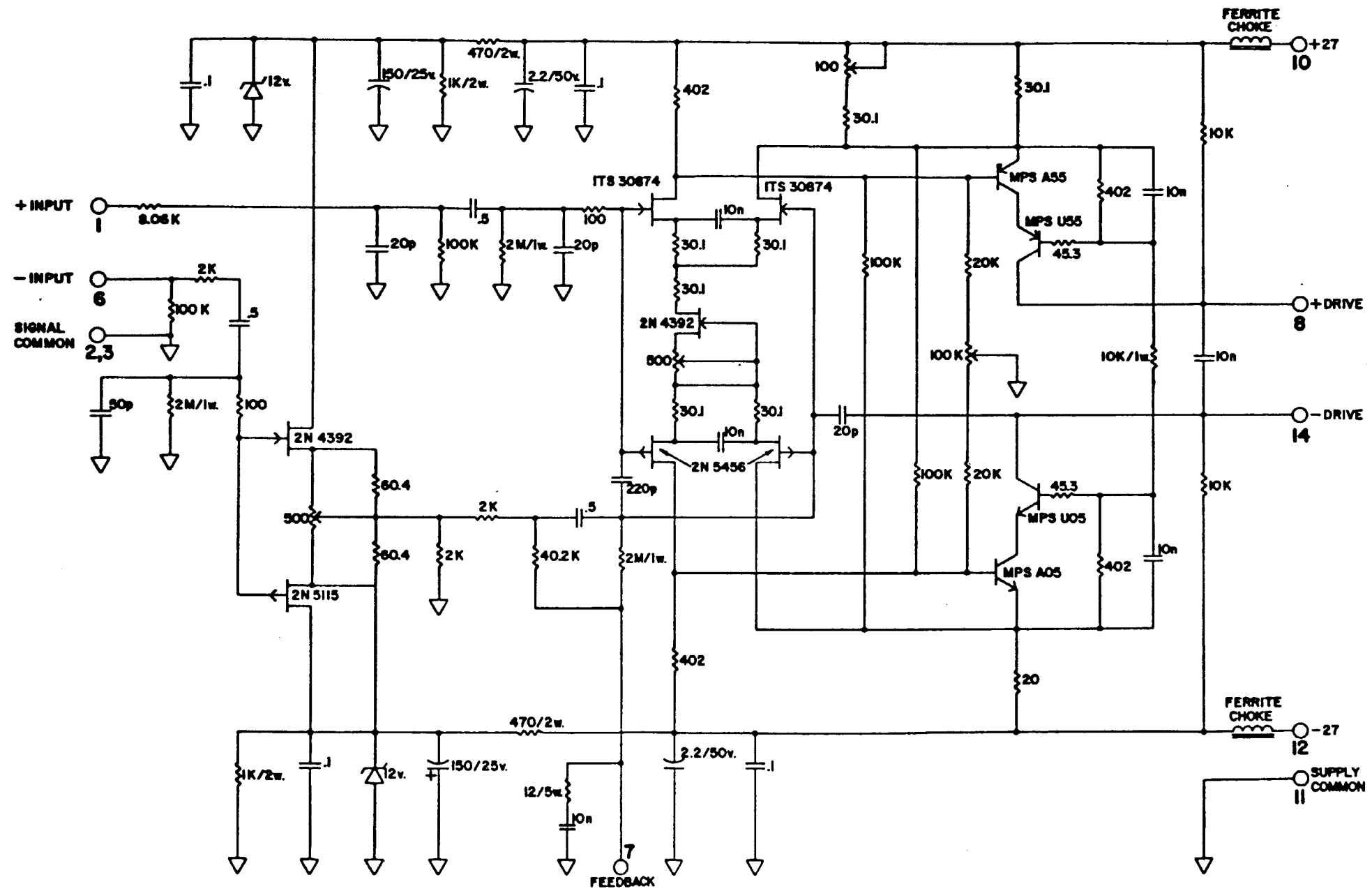


**POWER TRANSFORMER WIRING DIAGRAM**



**BLOCK DIAGRAM**

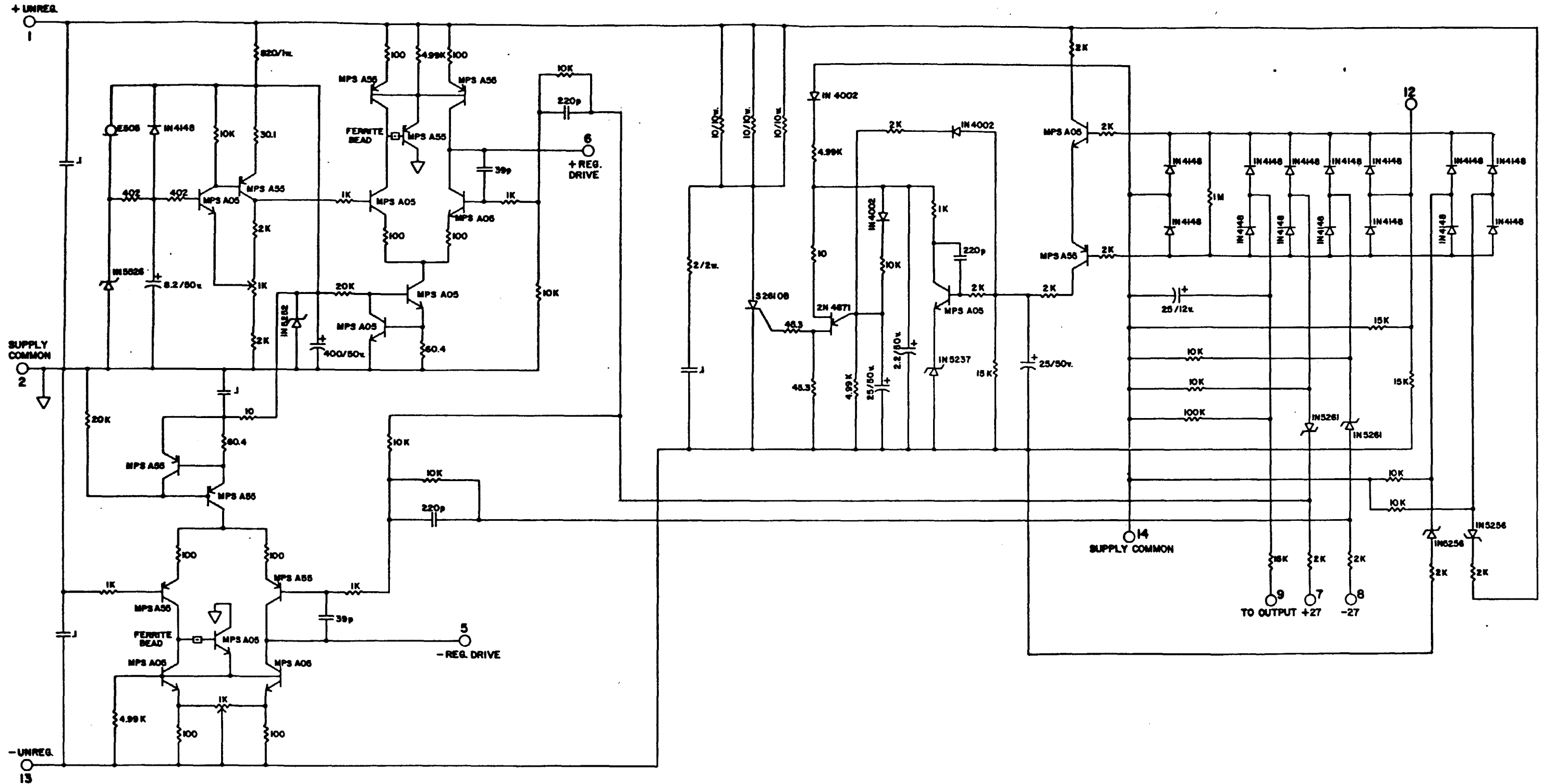
**S-2**

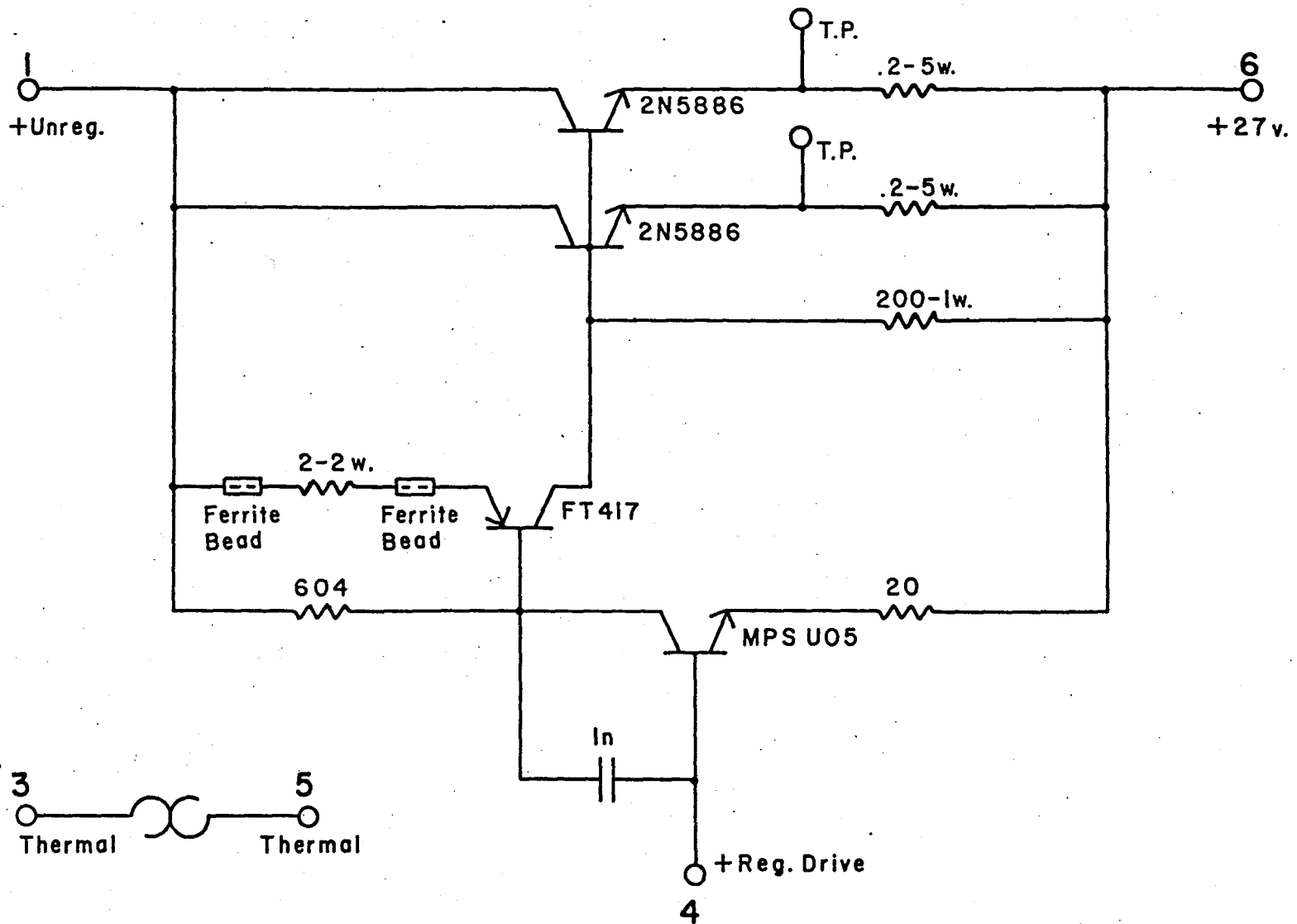


AUDIO CARD

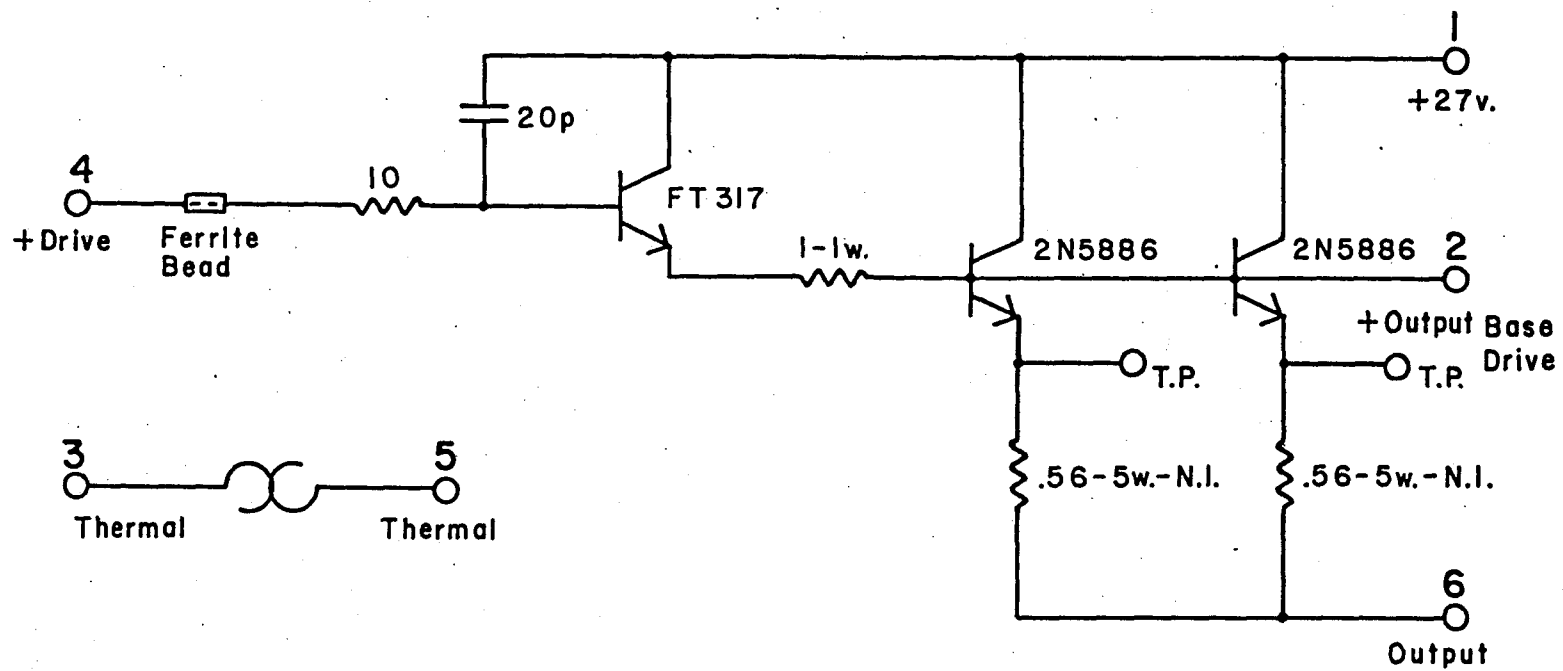
S - 3



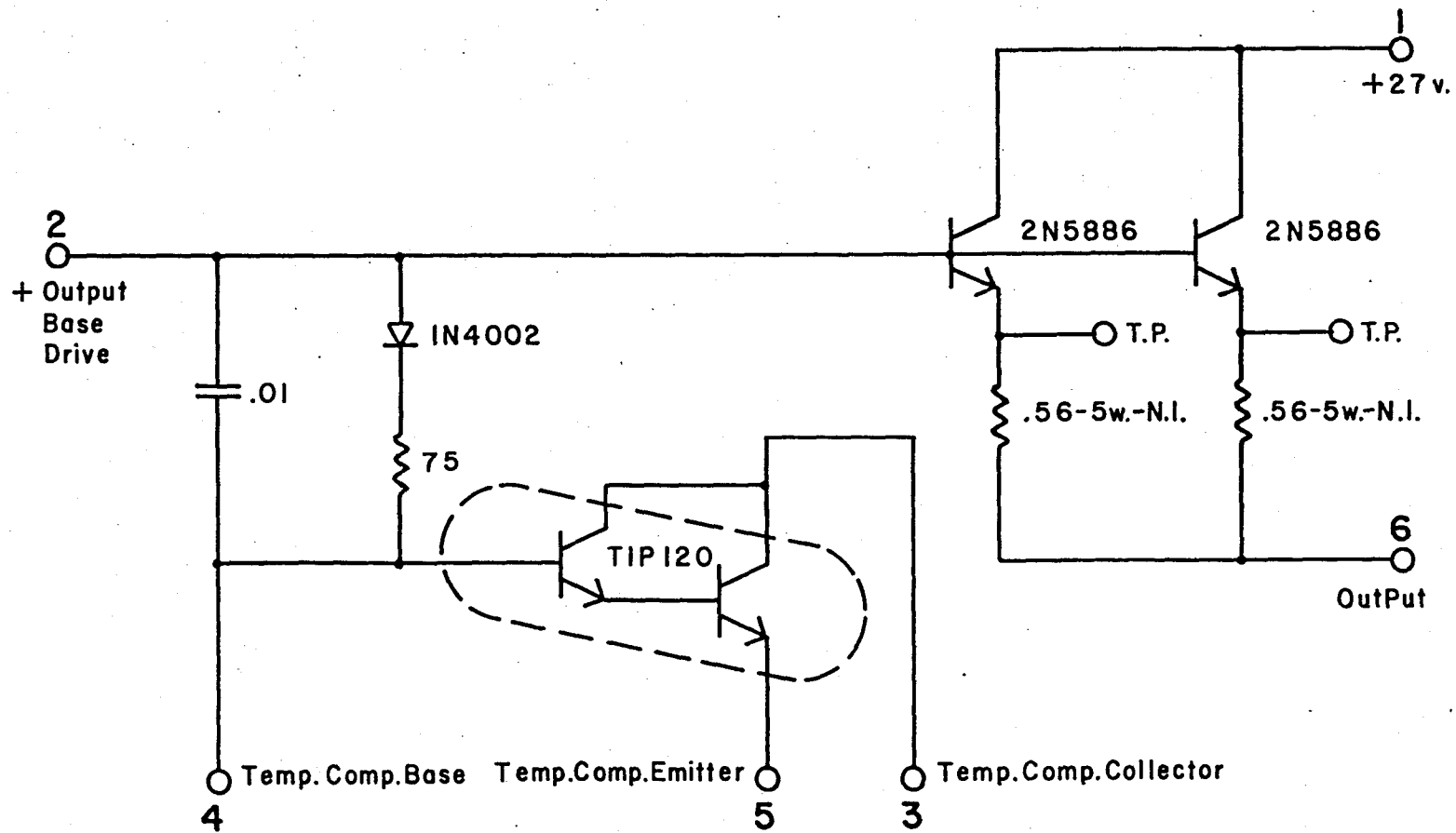




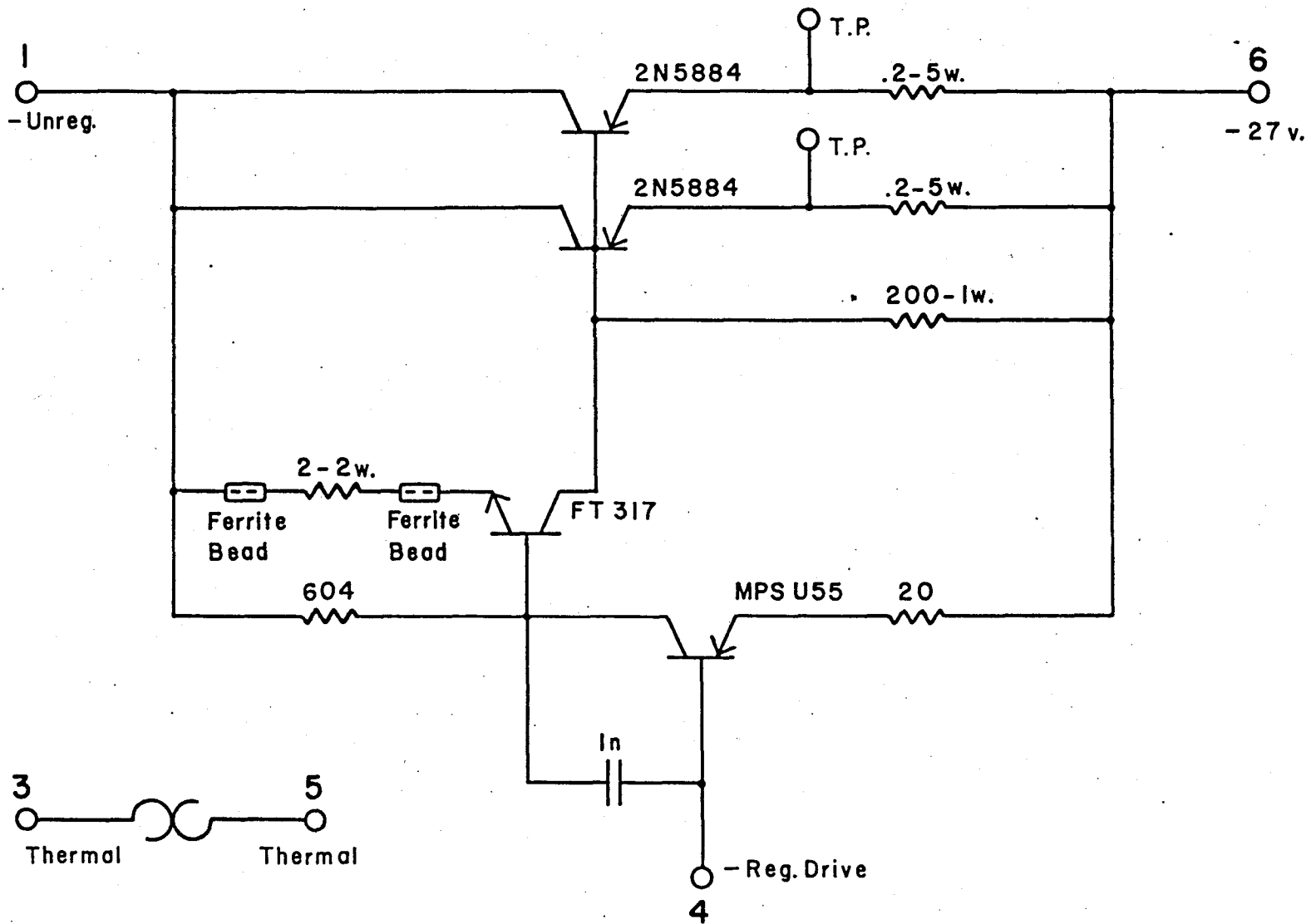
**PRP-1 S-5**



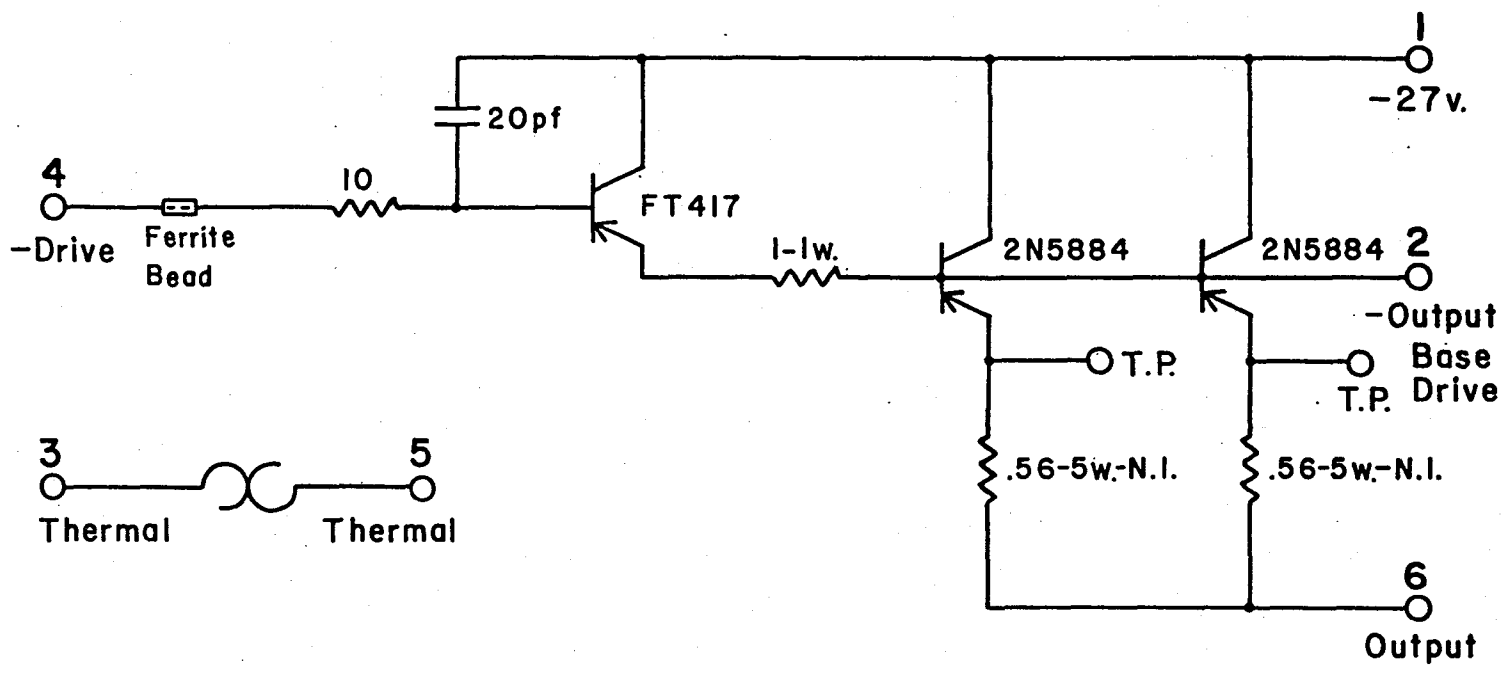
PDP-1 S-6



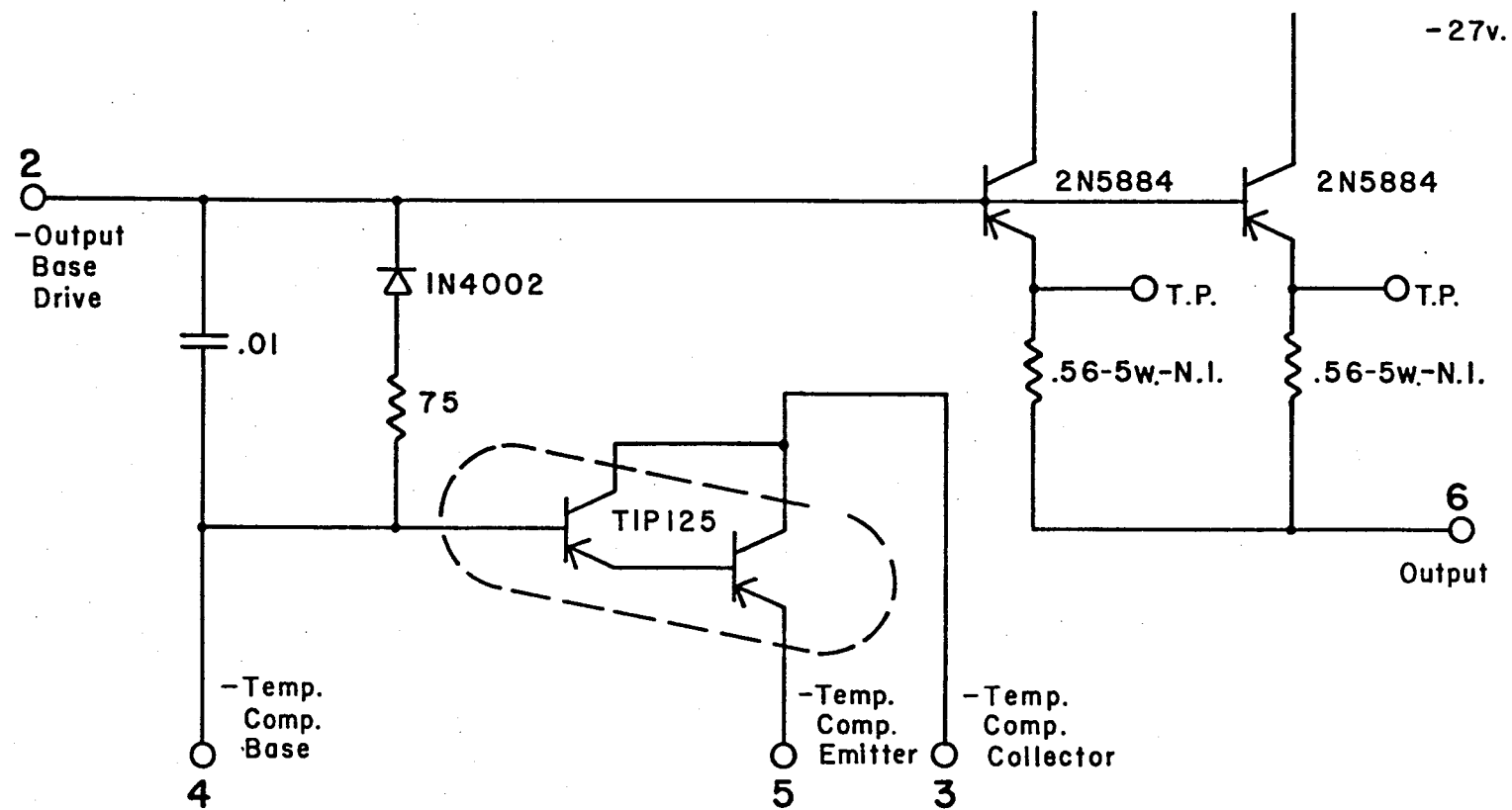
PBP-1 S-7



**NRP-1 S-8**



NDP-1 S-9



**NBP-1 S-10**