ML-2 SERVICE MANUAL

mark levinson

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:

AC Line Voltage	Fuse
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, serveral 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.

PROBLEM	POSSIBLE CAUSE	SOLUTION
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. TO-220 transistor shorted to heatsink.	2. Check by measuring with an ohm meter. Measure TO-220 mounting screw to heatsink with heatsink removed from unit. Refer to dwg. A-13.
	3. TO-220 transistor collector circuit open.	3. Tighten. Refer to dwg. A-13.
	4. TO-220 transistor defective.	4. Replace. Refer to dwg. A-13.
	5. TO-3 transistor shorted to heatsink.	5. Check by measuring with an ohm meter. Measure TO-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 Mother-board.	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.	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. Lead dress and/or lack of shielding of input wiring connecting inputs to Motherboard.	2. Replace unshielded leads with shielded cable. Dress leads away from back panel.
	3. Unused input not shorted or shorting plug defective.	3. Check shorting plug.
	4. Loose screw(s) on filter capacitors.	4. Tighten screws. Refer to dwg. A-1, item #'s 86-97.
	5. Poor connections of "Quick Disconnect" terminals to bridge rectifier or circuit breaker.	5. Check crimp connections on wires.
	6. Poor connection of transformer center tap.	6. Check secondary wiring. Check connection of Red/Yellow transformer wire to Motherboard.
	7. Defective bridge rectifier.	7. Check by substitution. Refer to dwg. A-11.
	8. Defective Relay.	8. Check by substitution. Refer to dwg. A-1, item #125.

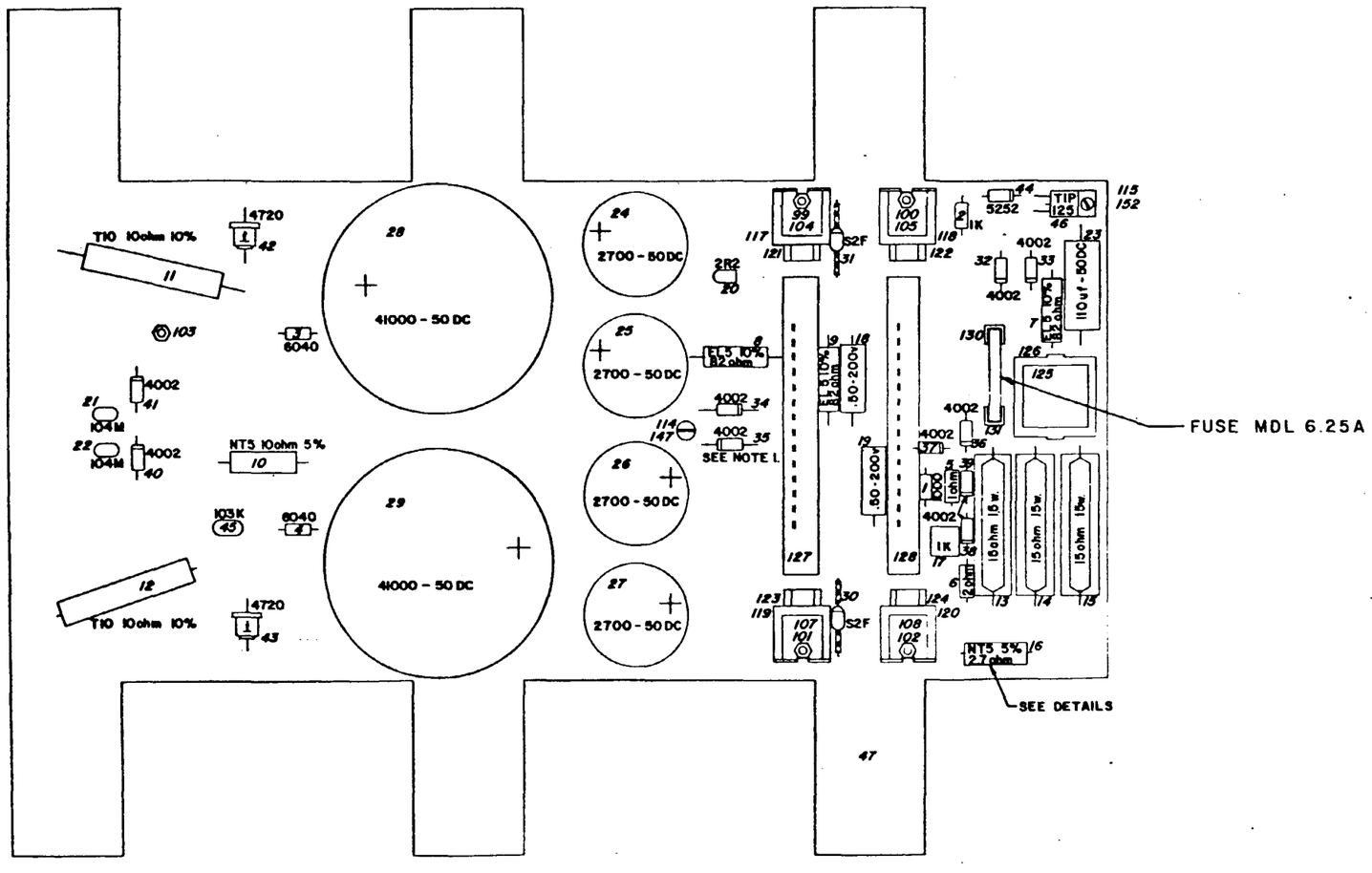
PROBLEM	POSSIBLE CAUSE	SOLUTION
Circuit breaker trips when signal is applied	1. Poor mating of Elco contacts.	1. Check all Elco contacts. Tighten contacts by squeezing fingers together with needlenose pliers to achieve proper preload. Straighten and realign. Refer to dwg. A-14.
	2. Load terminals shorted.	2. Check external connections.
	3. Component lead or P.C. line shorted to heatsink or standoff.	3. Insulate standoff with heat shrink tubing if necessary. (Applies to units with 30-0710-00 heatsink P.C. boards only).
	4. Defective capacitor on regulator P.C. board.	4. Check by substitution of Regulator P.C. Board. For location of capacitor refer to dwg. A-3, item #73.
	5. Loose screw(s) on filter capacitors.	5. Tighten screws. Refer to dwg. A-1, item #'s 86-87.
	6. TO-220 transistor collector circuit open.	6. Tighten refer to dwg. A-13.
	7. Defective TO-220 transistor.	7. Replace. Refer to dwg. A-13.

PROBLEM	POSSIBLE CAUSE	SOLUTION
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 TO-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 TO-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.

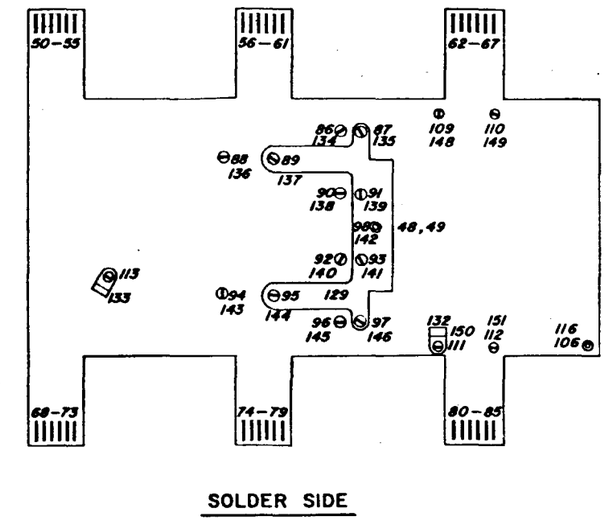
LIST OF DRAWINGS

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
ML-2 Top View		A-10
ML-2 Bottom View		A-11
Chassis Assembly		A-12
Heat Sink Assembly		A-13
Elco Pin Connector Diagram		A-14

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



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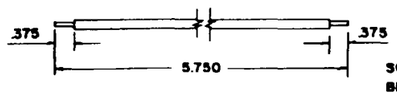
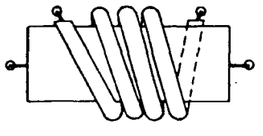


SOLID BUSS WIRE (16 GA.) WITH BLACK SHRINK TUBING.

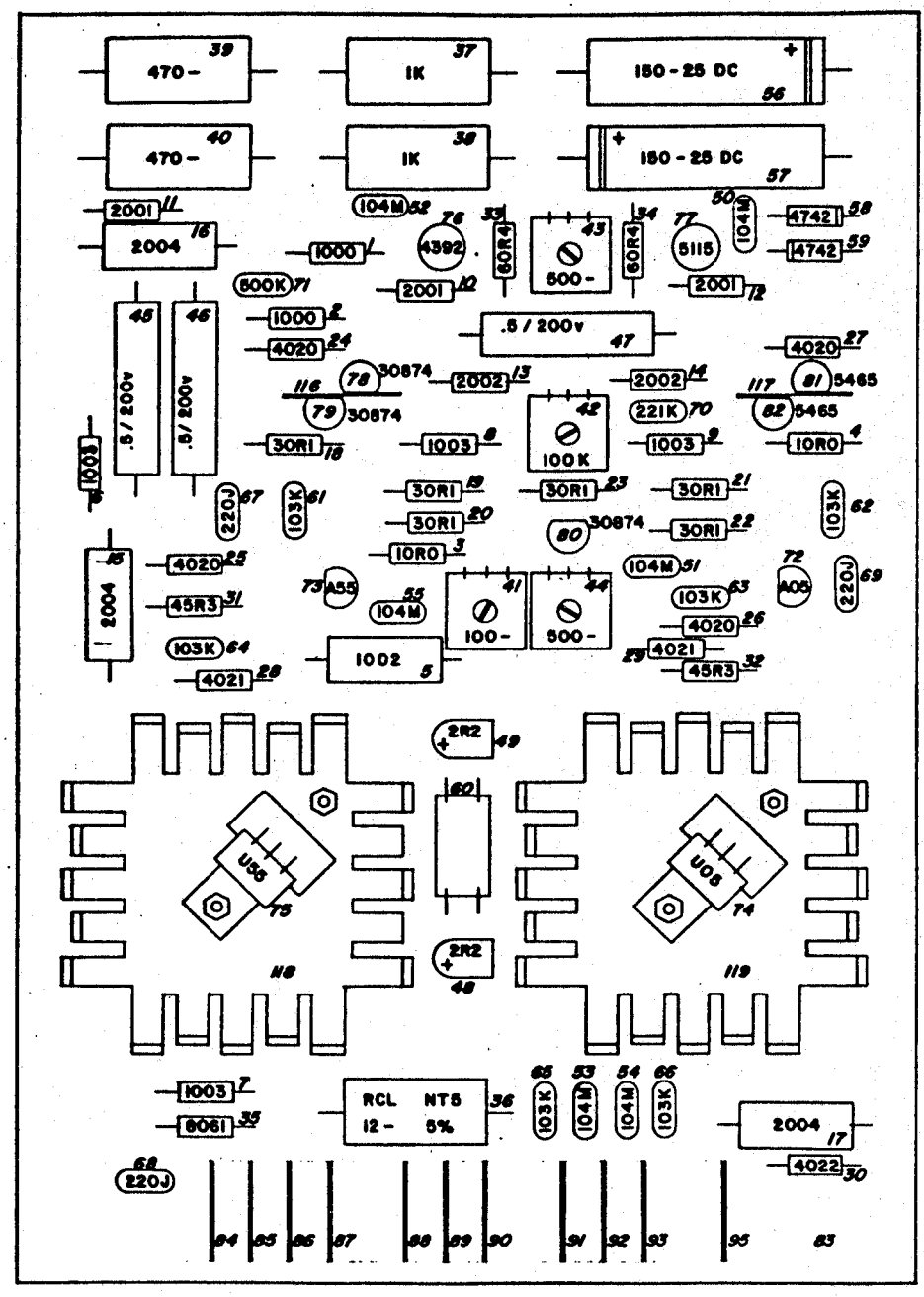


WRAP WIRE AROUND RESISTOR (16) 4 TURNS.

NOTES:

1. CUT DIODE LEADS FLUSH WITH BOTTOM OF BOARD AND SOLDER FROM COMPONENT SIDE OF BOARD.

MOTHERBOARD A-1


470 - 39
1K 37
150 - 25 DC 56
470 - 40
1K 38
150 - 25 DC 57
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2004 16
104M 52
1000 1
4392 76
60R4 33
500 - 43
60R4 34
5115 77
104M 50
4742 58
4742 59
2001 42
2001 12
500K 71
1000 2
4020 24
.5 / 200v 47
4020 27
30874 78
30874 79
2002 13
2002 14
5465 81
5465 82
221K 70
30R1 18
1003 6
100K 42
1003 9
10R0 4
1003 8
.5 / 200v 45
.5 / 200v 46
220J 67
103K 61
30R1 19
30R1 20
30R1 23
30R1 21
30874 80
30R1 22
103K 62
2004 15
4020 25
45R3 31
103K 64
4021 28
1002 5
A55 73
104M 55
100 - 41
500 - 44
104M 51
103K 63
4020 26
4021 29
45R3 32
A05 72
220J 69
2R2 49
2R2 48
U55 75
U05 74
116
117
118
119
1003 7
6061 35
RCL NTS 12 - 5% 36
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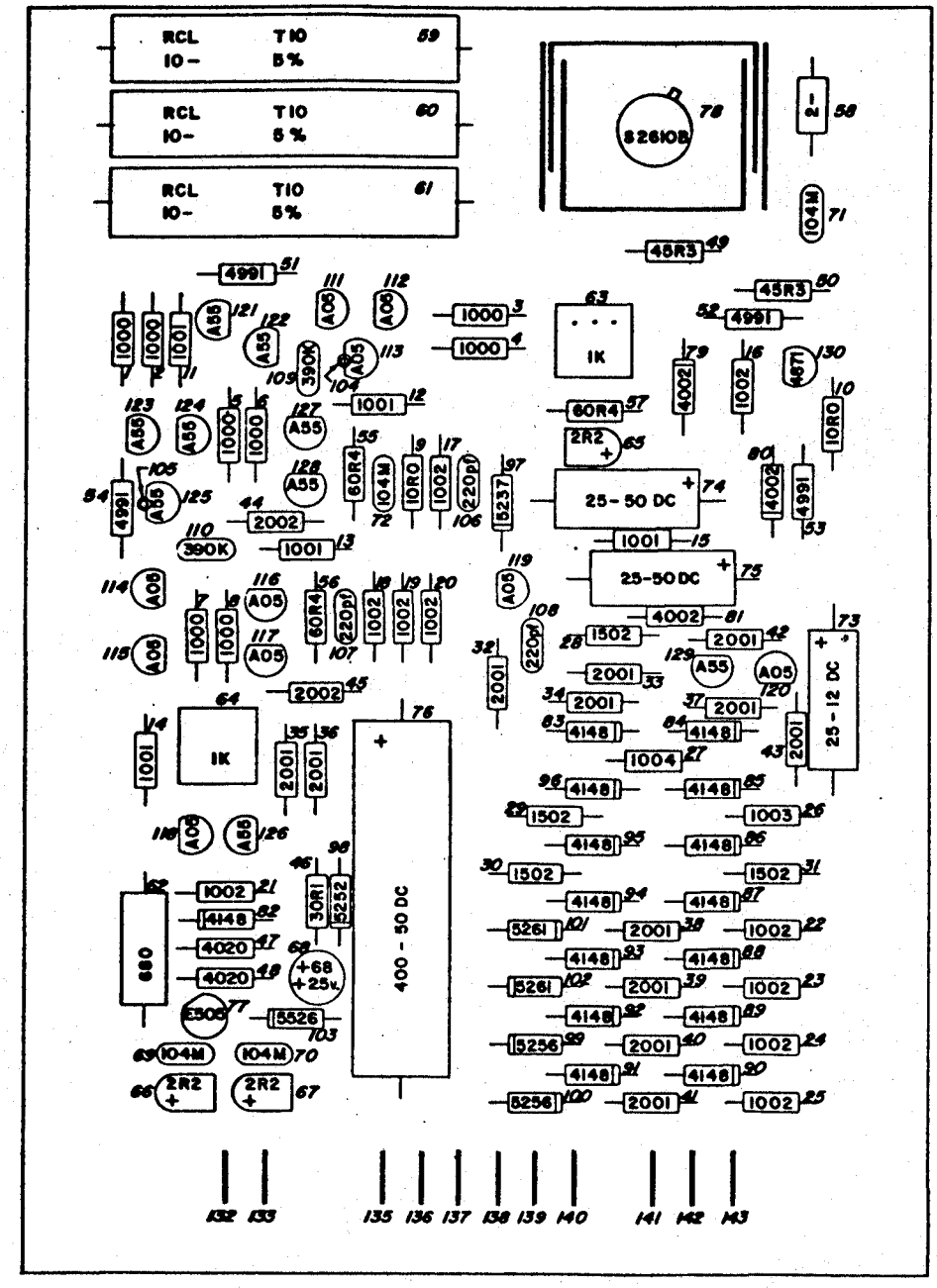
AP-1 A-2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10- 5%
RCL T10 60
10- 5%
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10- 5%
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2- 58
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45R3 50
4991 52
IK 63
1000 3
1000 4
A05 111
A05 112
A55 121
A55 122
A05 113
390K 109
1001 12
A55 123
A55 124
A55 127
A55 128
60R4 55
104M 72
10R0 9
1002 17
220pf 106
5237 97
2R2 65
25-50 DC 74
60R4 57
4002 79
1002 16
4671 130
10R0 10
4002 80
4991 53
4991 54
A05 105
A05 125
2002 44
390K 110
1001 13
1001 15
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A05 119
4002 81
220pf 108
1502 28
2001 42
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2001 33
A55 129
A05 120
2001 34
2001 37
4148 63
4148 64
25-12 DC 73
1004 27
2001 43
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4148 85
1502 29
1003 26
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1502 30
1502 31
4148 94
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2001 38
1002 22
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1002 23
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2001 40
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4148 90
5256 100
2001 41
1002 25
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A05 116
A05 117
A05 115
60R4 56
220pf 107
1002 18
1002 19
1002 20
2002 45
1000 7
1000 8
1001 14
IK 64
2001 35
2001 36
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A05 118
A55 126
880 82
1002 21
4148 82
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4020 48
30R1 46
5232 98
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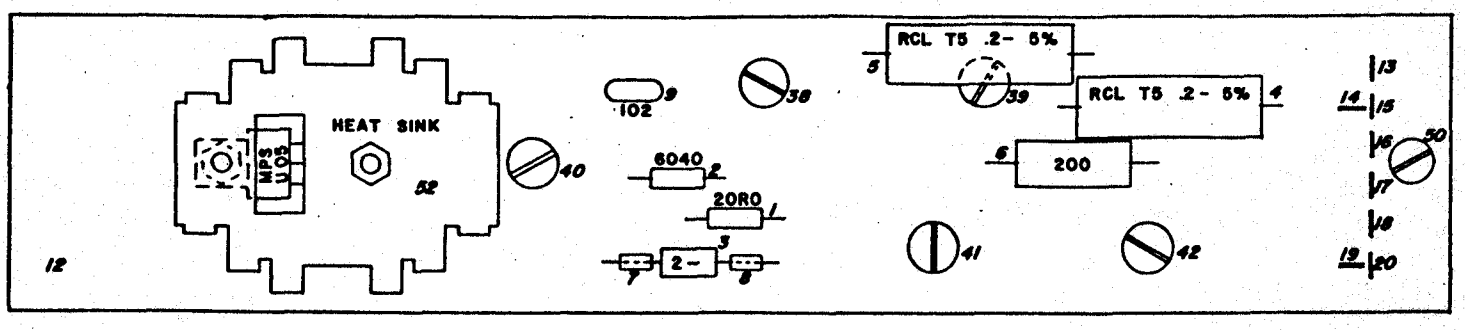
RP-1 A-3



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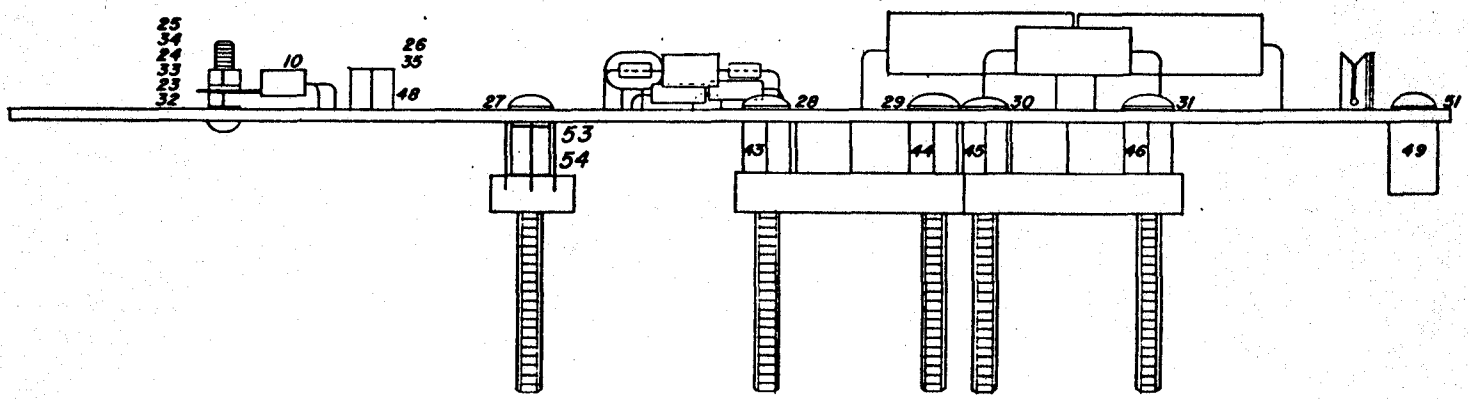

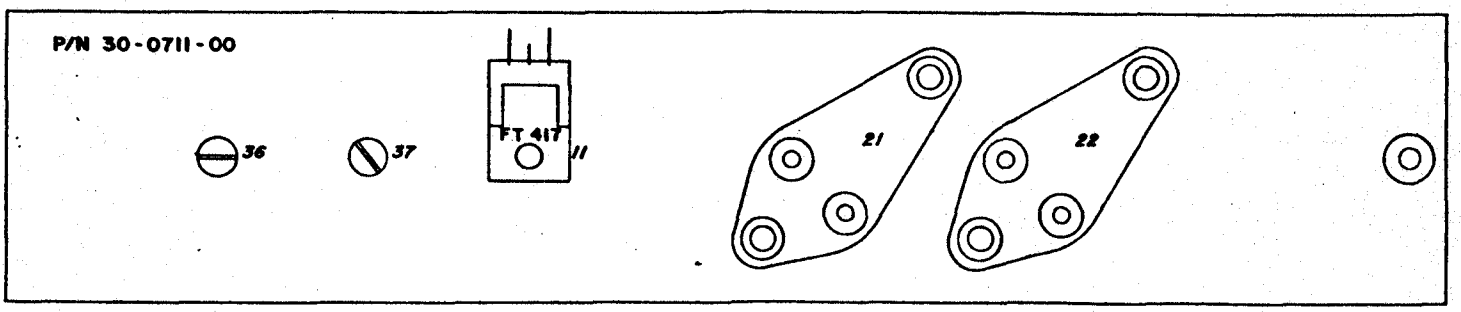

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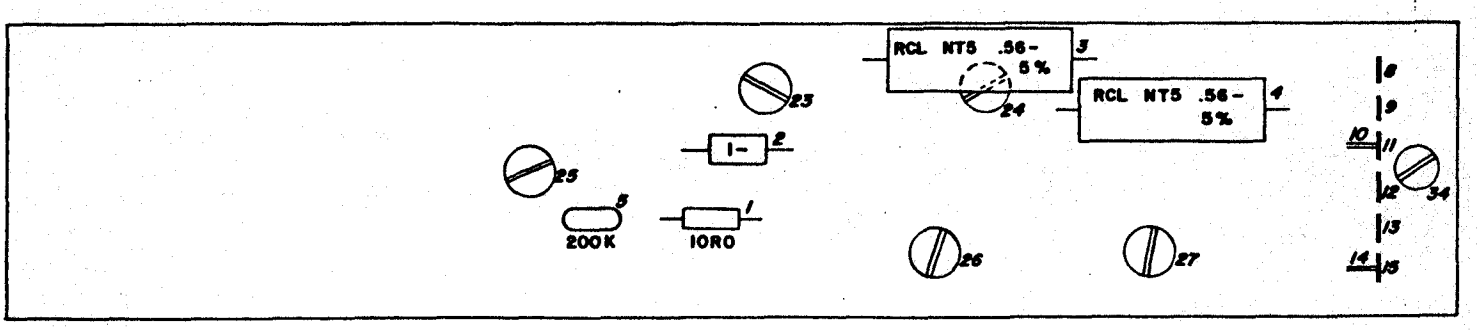

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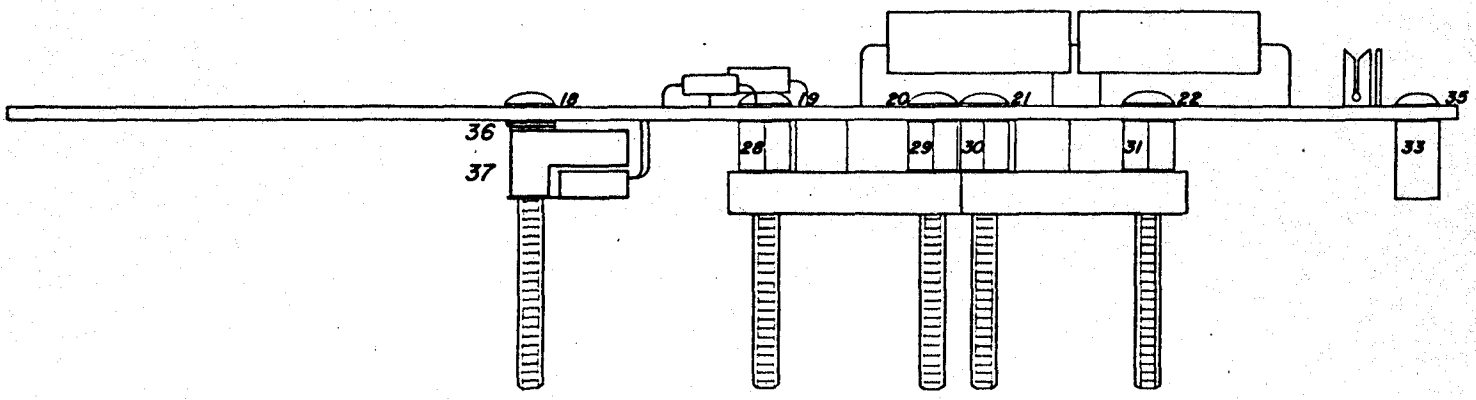

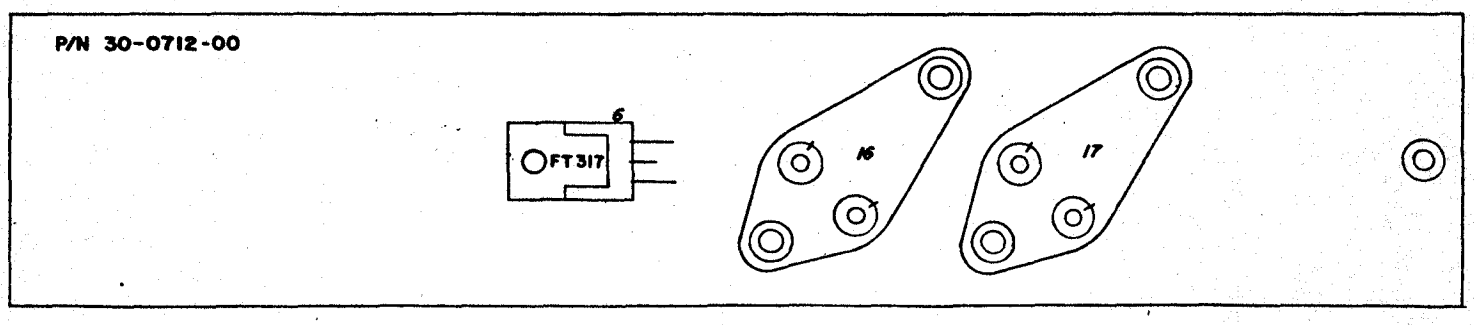

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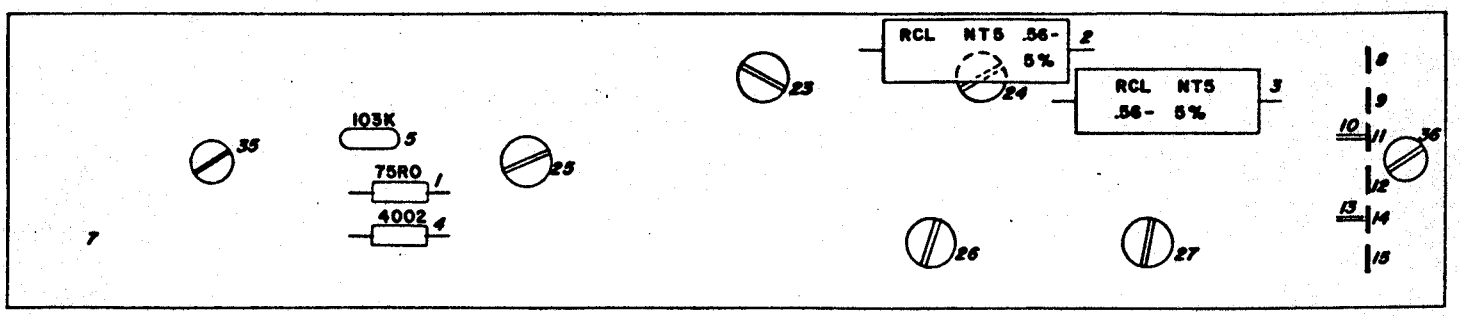

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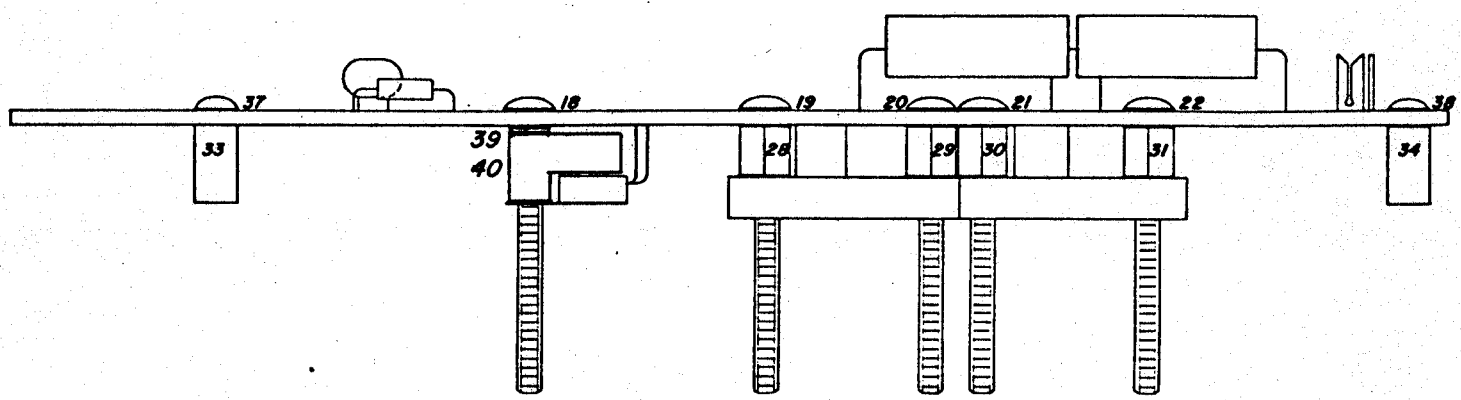

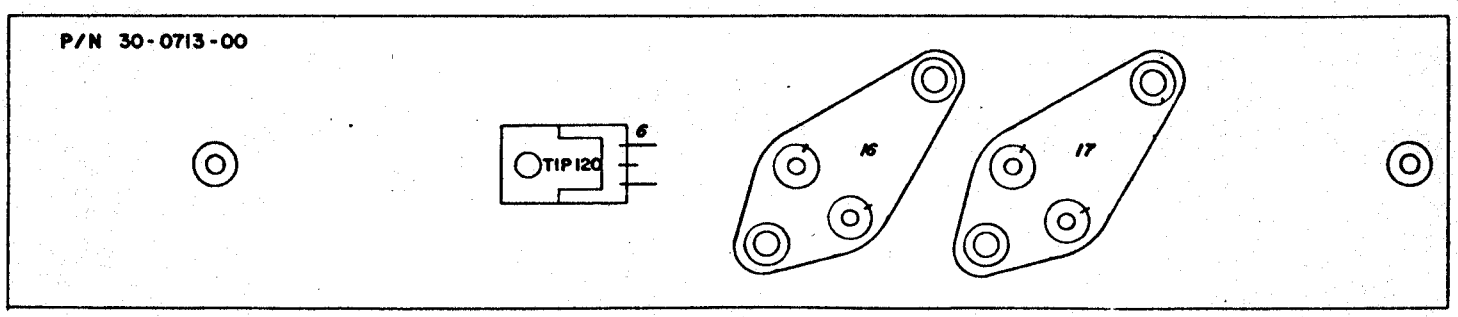

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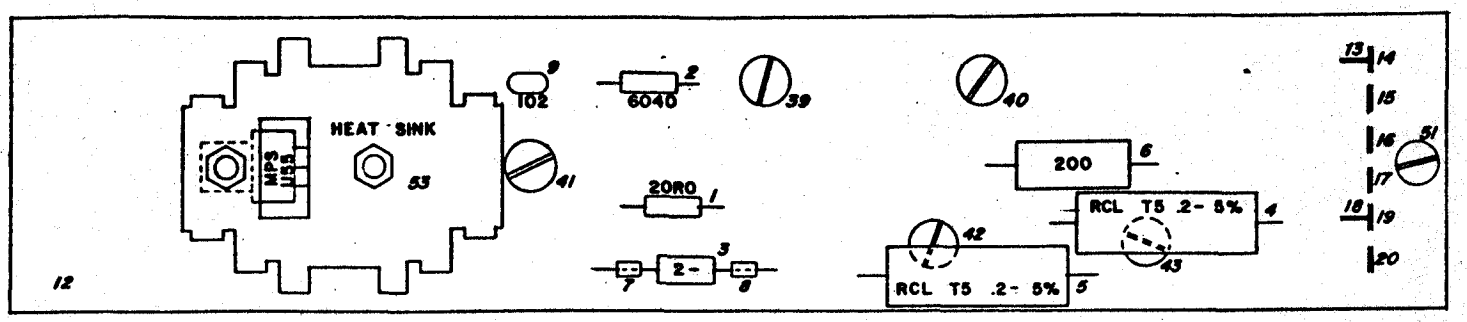

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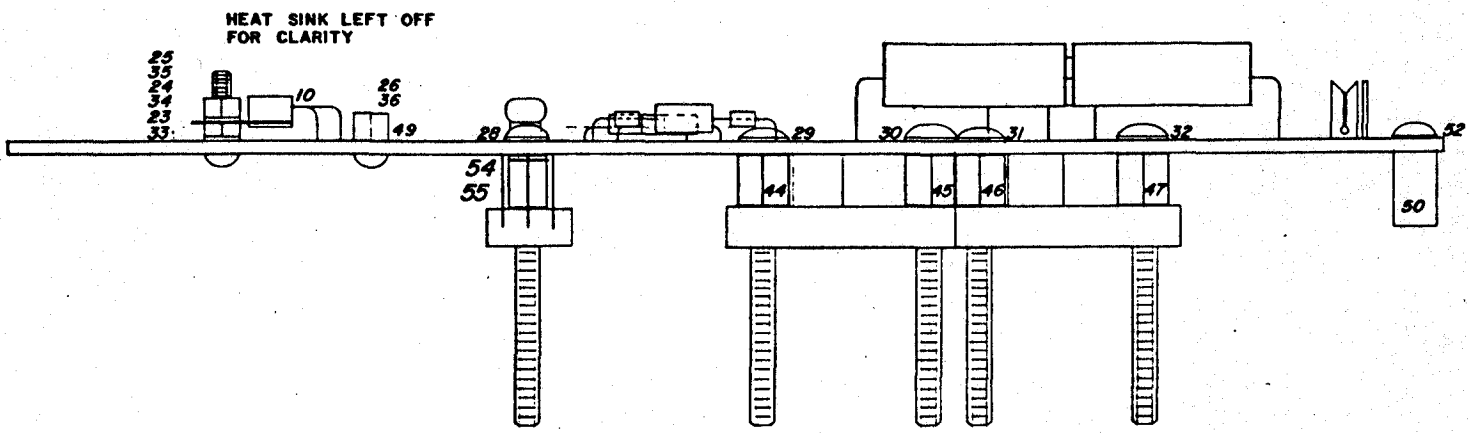

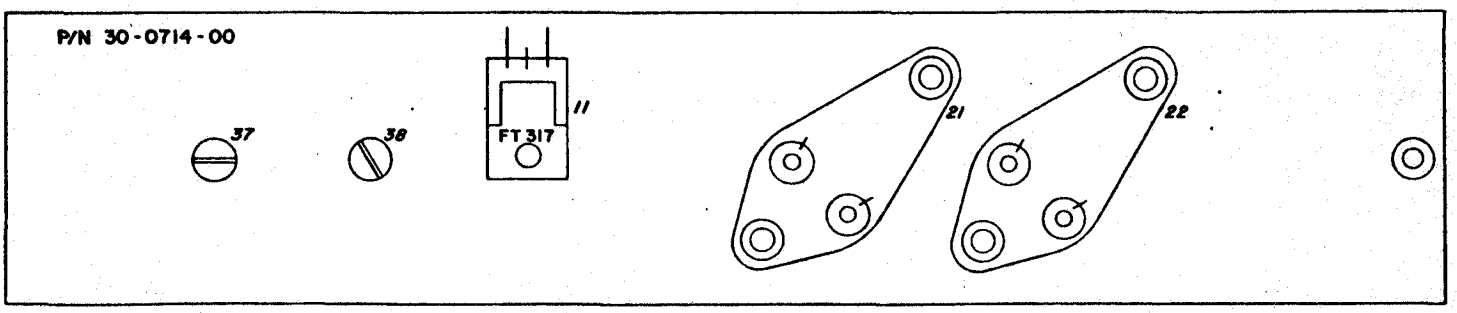

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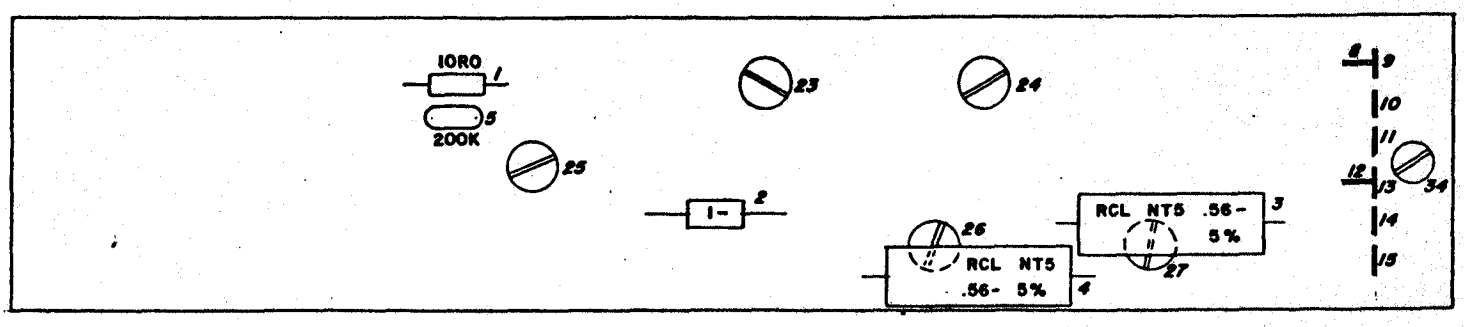

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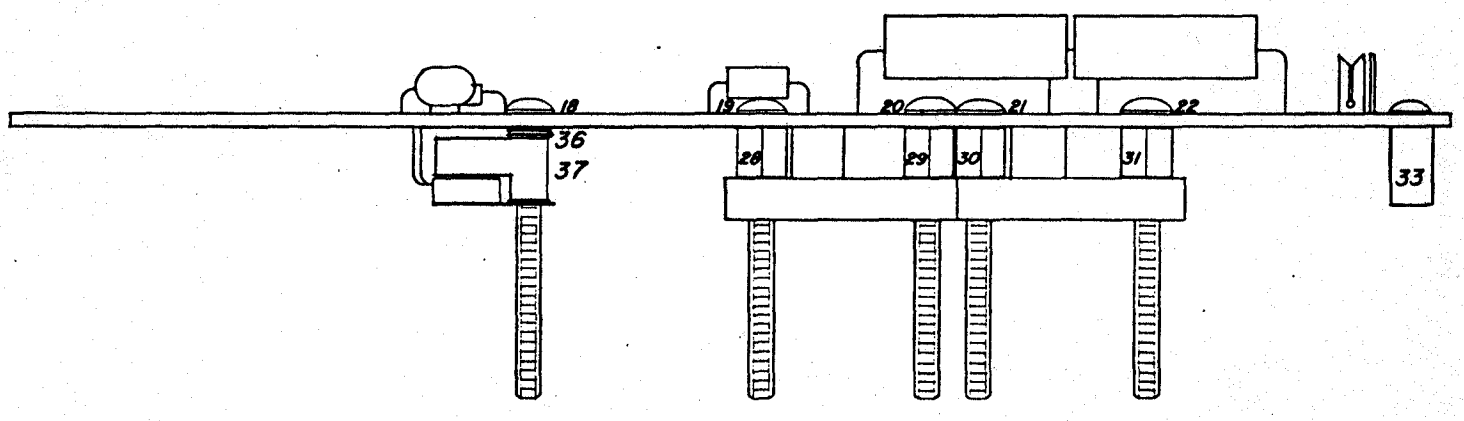

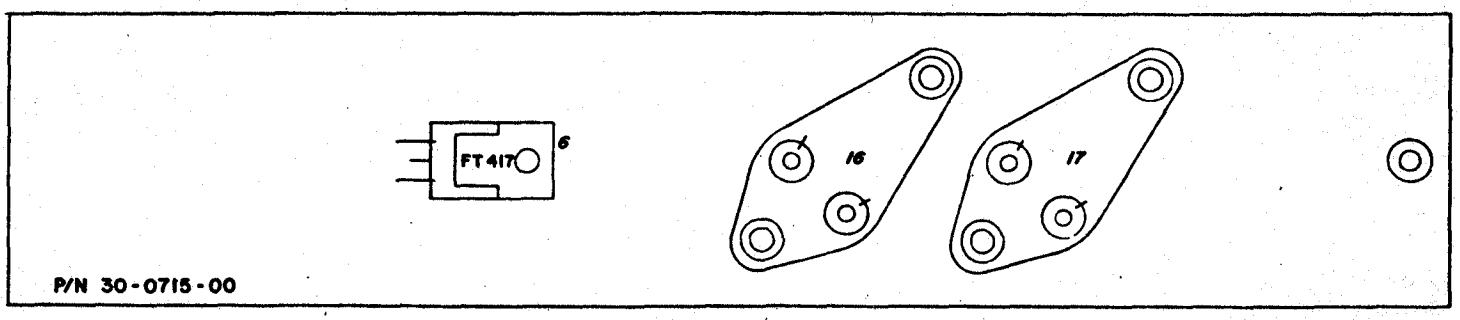

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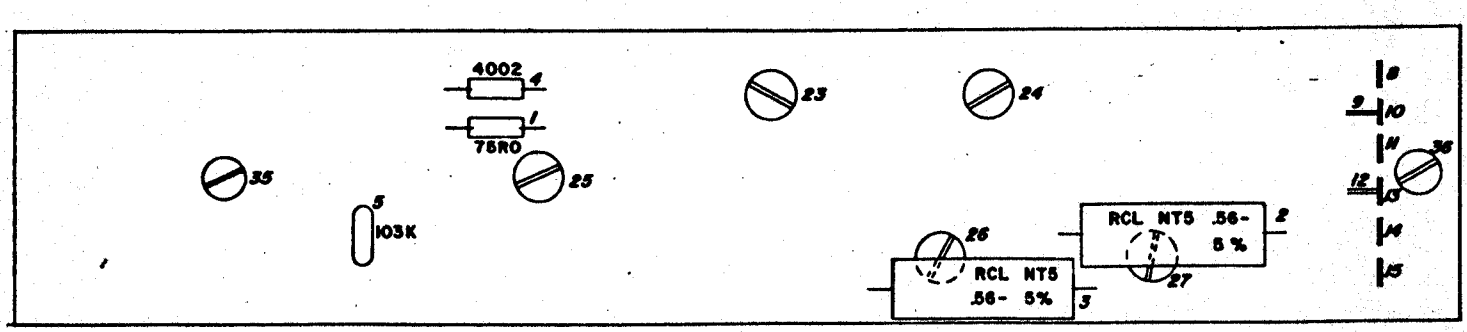
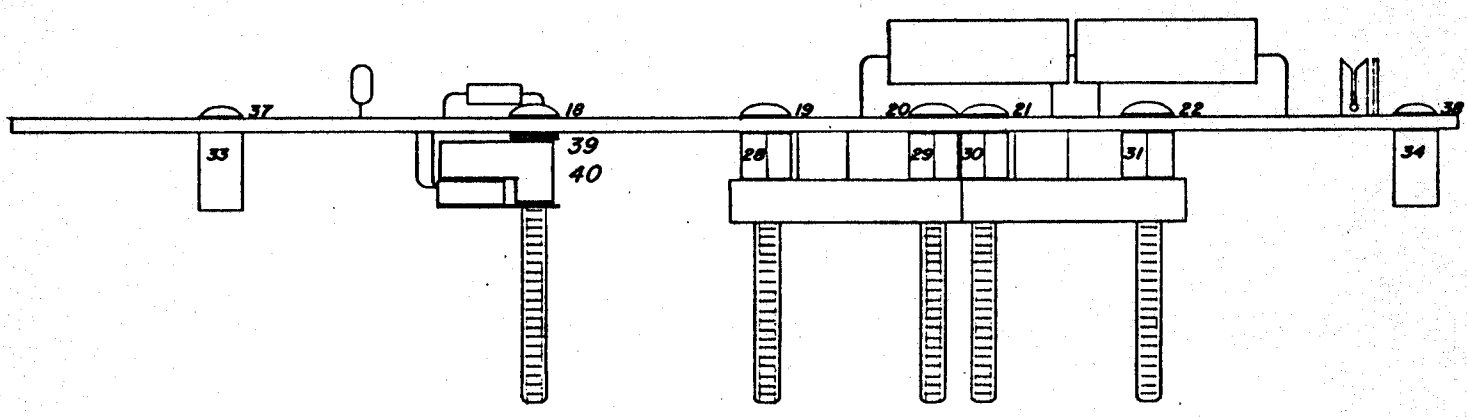
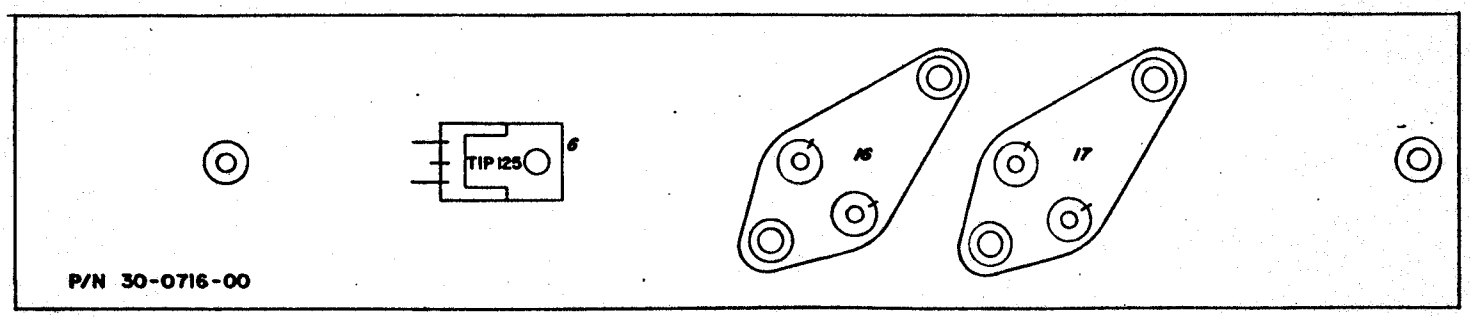


COMPONENT SIDE



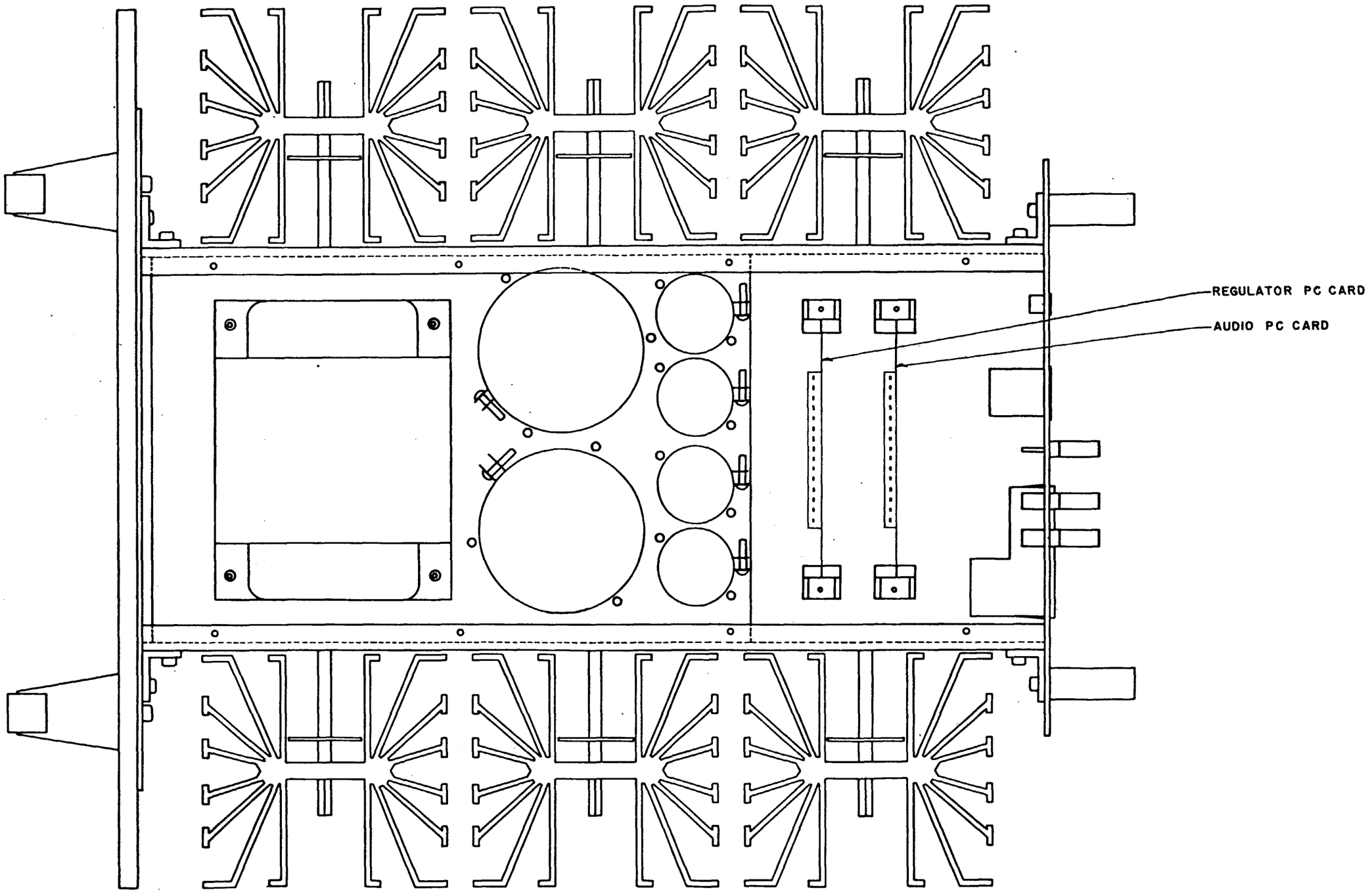


SOLDER SIDE

POS. REG.

POS. DRIVER & OUTPUT

POS. BIAS & OUTPUT



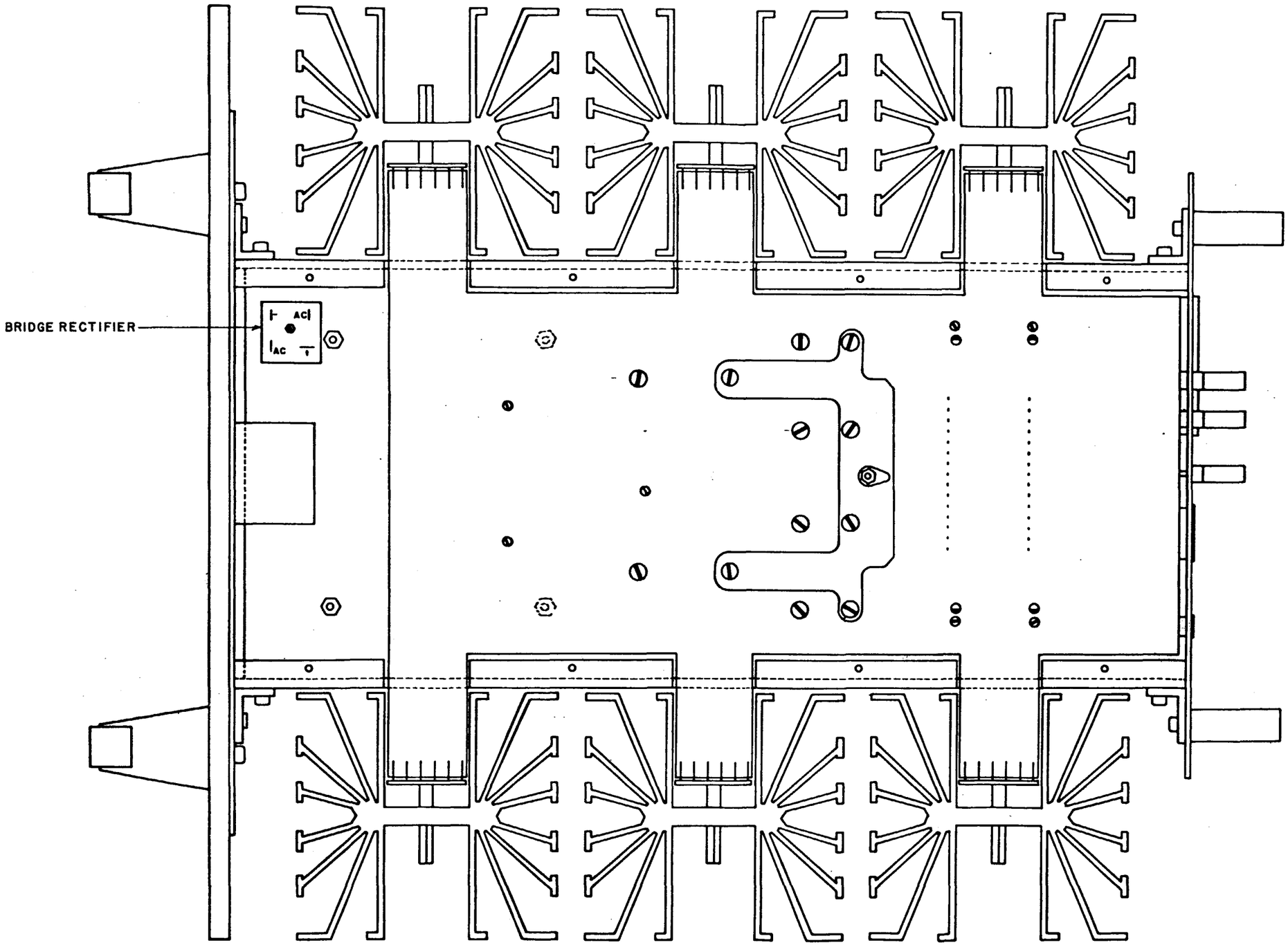
NEG. REG.

NEG. DRIVER & OUTPUT

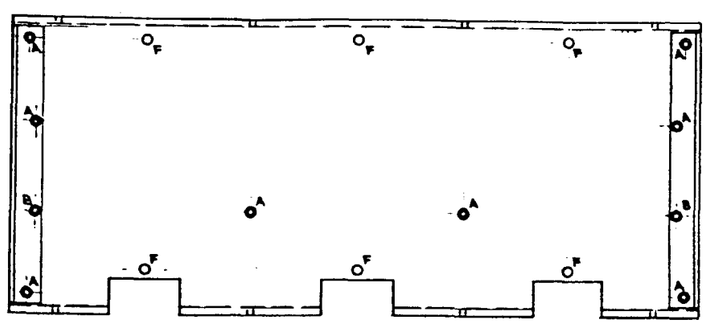
NEG. BIAS & OUTPUT

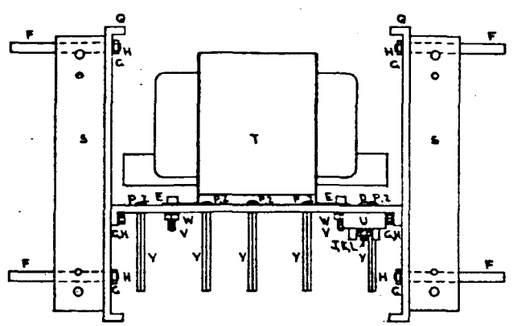
ML-2 TOP VIEW

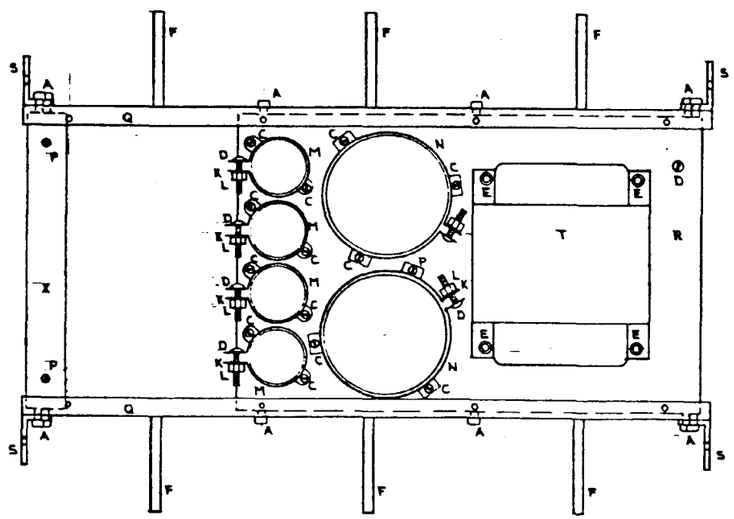
A-10



ML-2 BOTTOM VIEW A-11

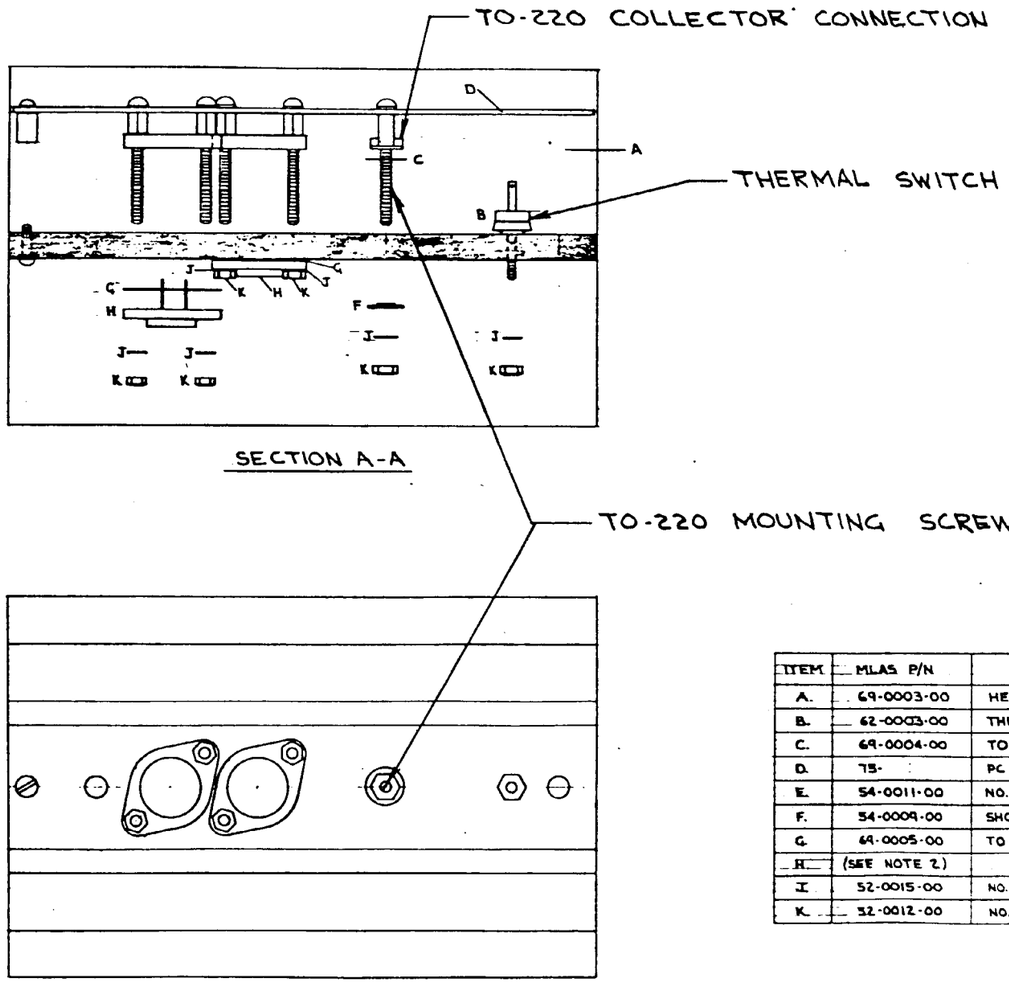




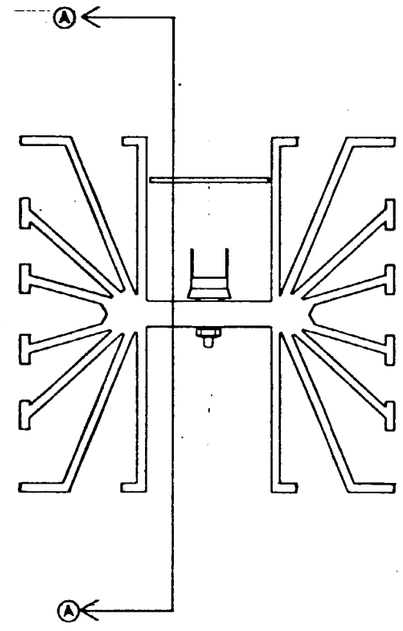


ITEM	MLAS P/N	DESCRIPTION	ITEM	MLAS P/N	DESCRIPTION
A	52-0025-00	#8-32 x 3/8" SHCS, S.S.	N	80-0008-00	CAPACITOR CLAMP
B	52-0026-00	#8-32 x 3/4" SHCS, S.S.	P	52-0021-00	#4-40 x 1/2" BHMS, C.S.
C	52-0018-00	#6-32 x 1/2" BHMS, C.S.	Q	70-0001-00	SIDE PLATE
D	52-0030-00	#6-32 x 7/8" BHMS, C.S.	R	70-0002-00	FALSE BOTTOM
E	52-0028-00	#10-32 x 1/2" 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	#8-32 x 5/16" HEX NUT, S.S.	V	82-0036-00	#10-32 x 11/32" HEX NUT, S.S.
J	82-0033-00	#6 x 3/8" FLAT WASHER, C.S.	W	52-0011-00	#10 ITLW, S.S.
K	82-0015-00	#6 ITLW, C.S.	X	70-0007-00	BRACE
L	52-0012-00	#6-32 x 1/4" 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

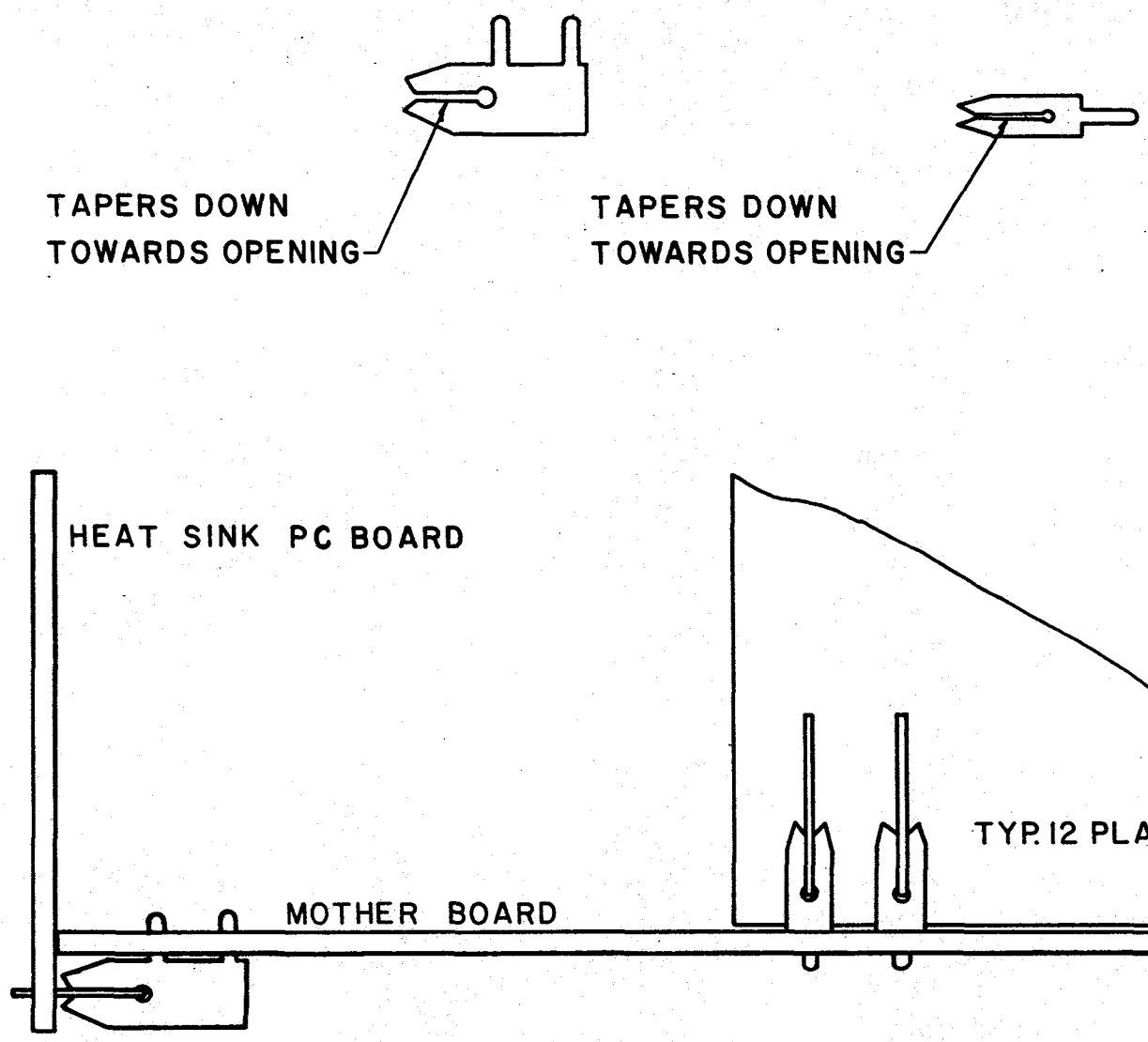


ITEM	MLAS P/N	DESCRIPTION
A.	69-0003-00	HEAT SINK
B.	62-0003-00	THERMAL SWITCH (SEE NOTE 1 & 3)
C.	69-0004-00	TO-220 INSULATOR
D.	75-	PC BOARD ASSEMBLY
E.	54-0011-00	NO. 4-40 x 7/16" NYLON BHMS
F.	54-0009-00	SHOULDER WASHER
G.	69-0005-00	TO-3 INSULATOR
H.	(SEE NOTE 2.)	
I.	52-0015-00	NO. 6 INTERNAL TOOTH LOCKWASHER
K.	52-0012-00	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 20-5886-00 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 A-13



ELCO PIN CONNECTOR DIAGRAM A-14

NOTES:

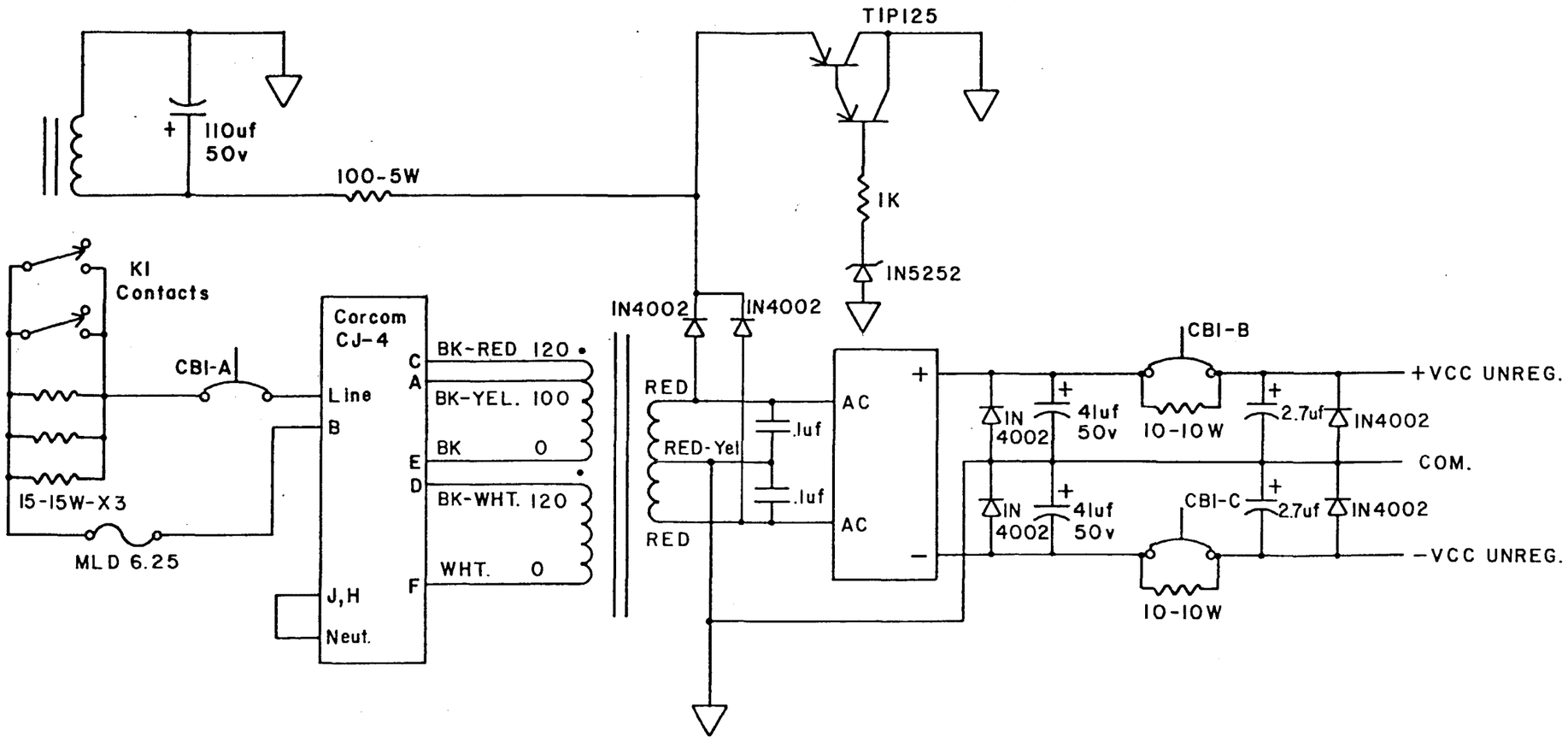
1) ALL RESISTORS ARE IN OHMS UNLESS INDICATED OTHERWISE.

2) ALL RESISTORS ARE RN55D, .25W, 1% UNLESS INDICATED OTHERWISE.

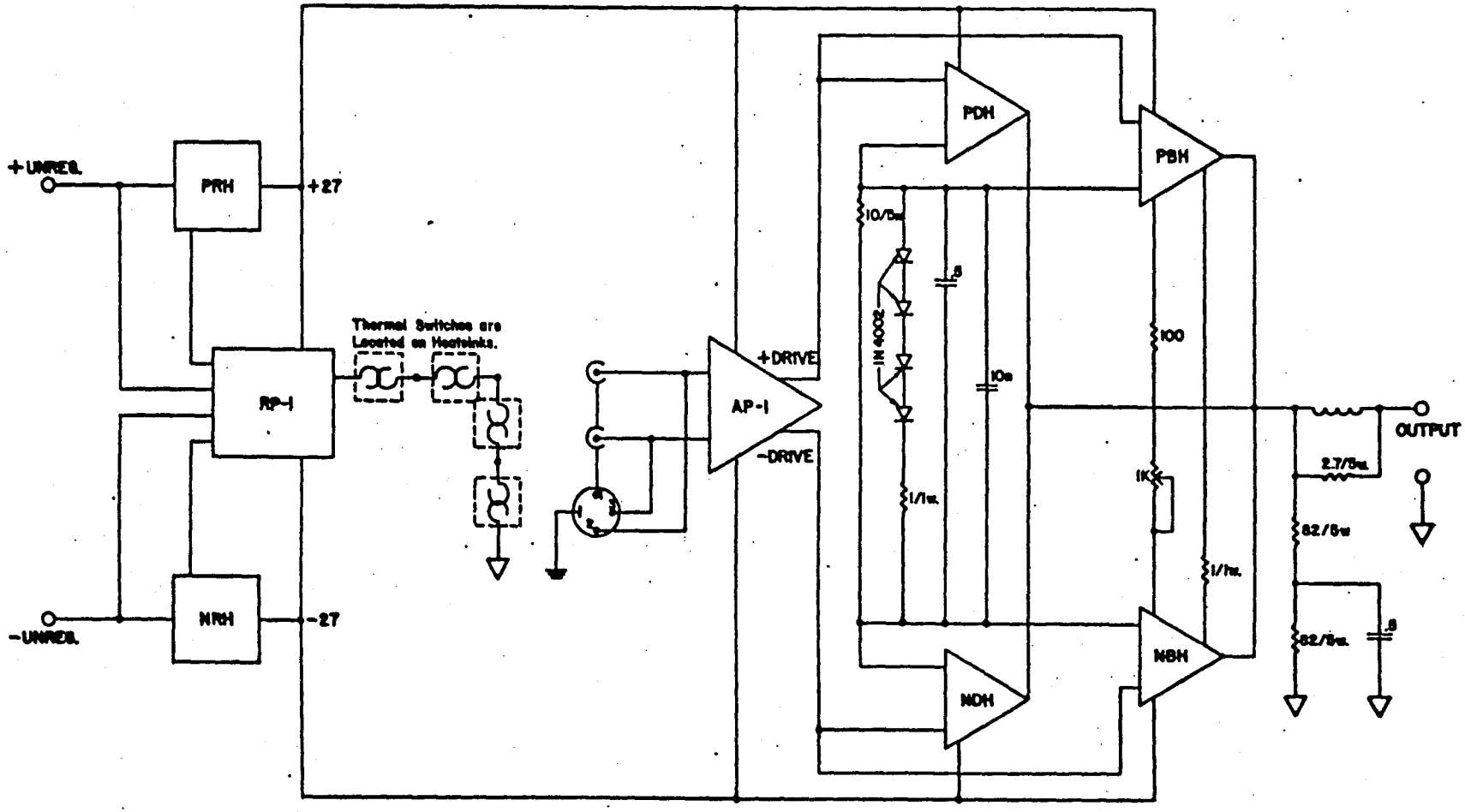
3) $K = 10^3$, $M = 10^6$

4) ALL CAPACITORS ARE IN MICRO-FARADS UNLESS INDICATED OTHERWISE.

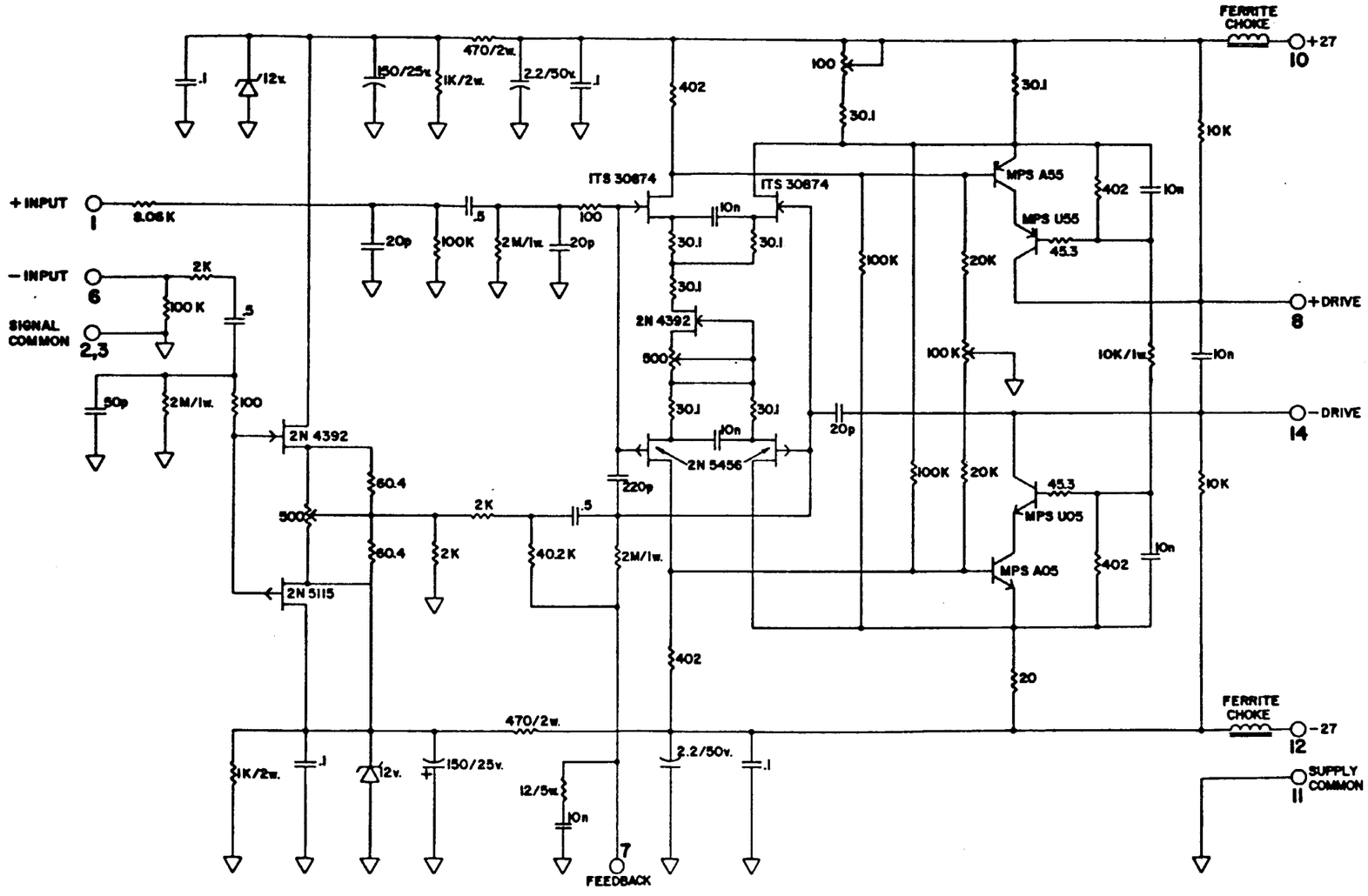
5) $n = 10^{-9}$, $p = 10^{-12}$



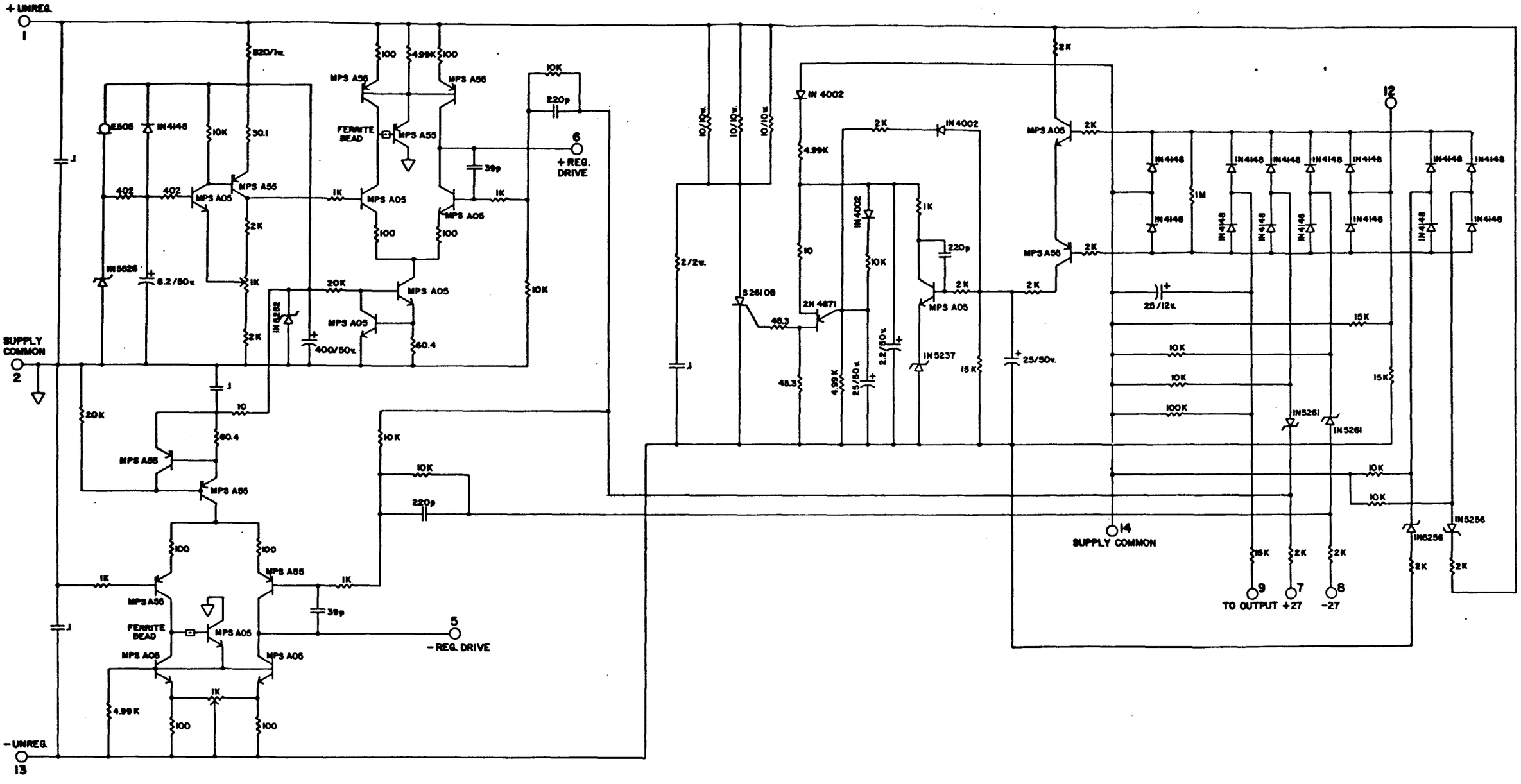
POWER TRANSFORMER WIRING DIAGRAM S - 1



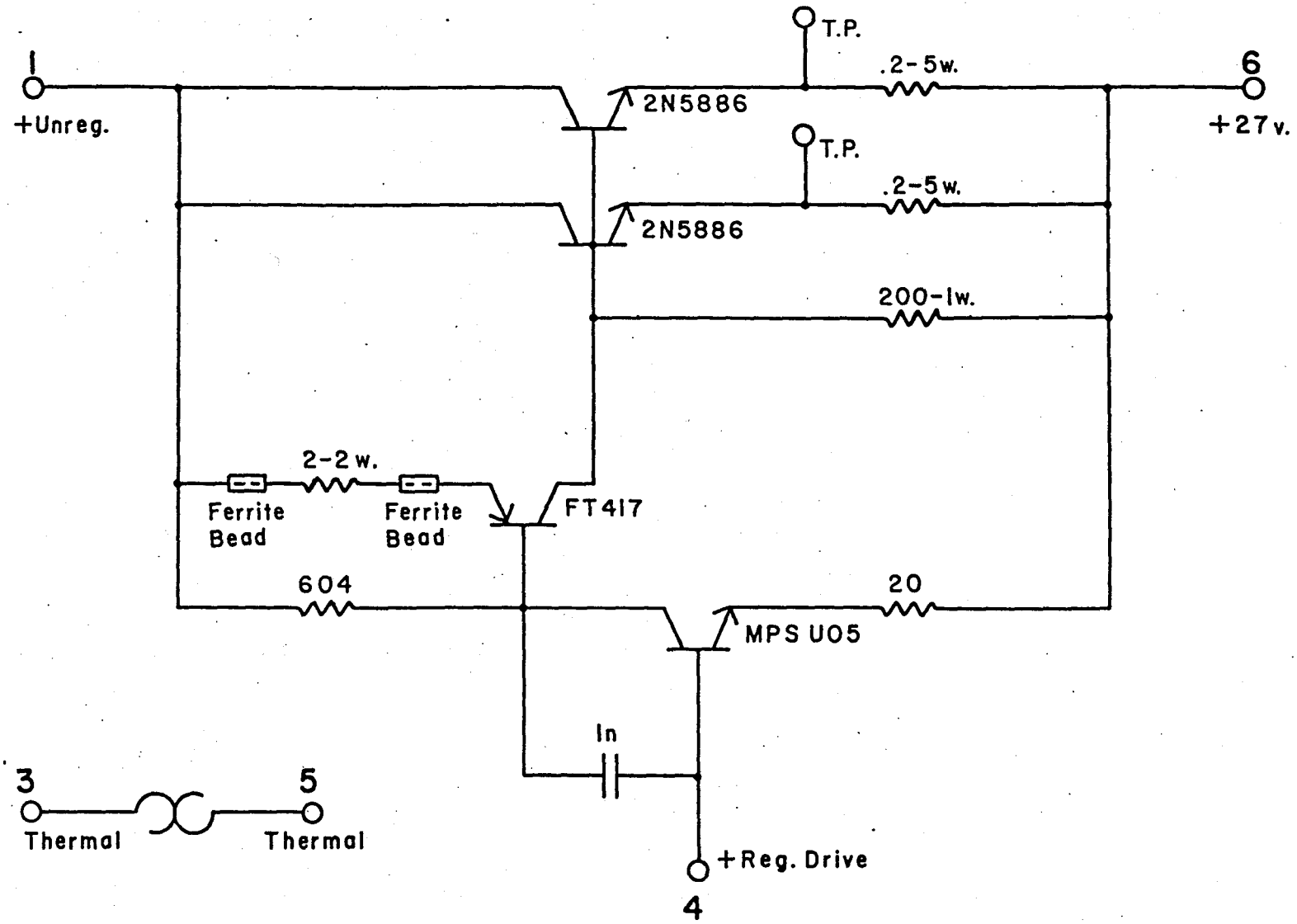
BLOCK DIAGRAM S-2



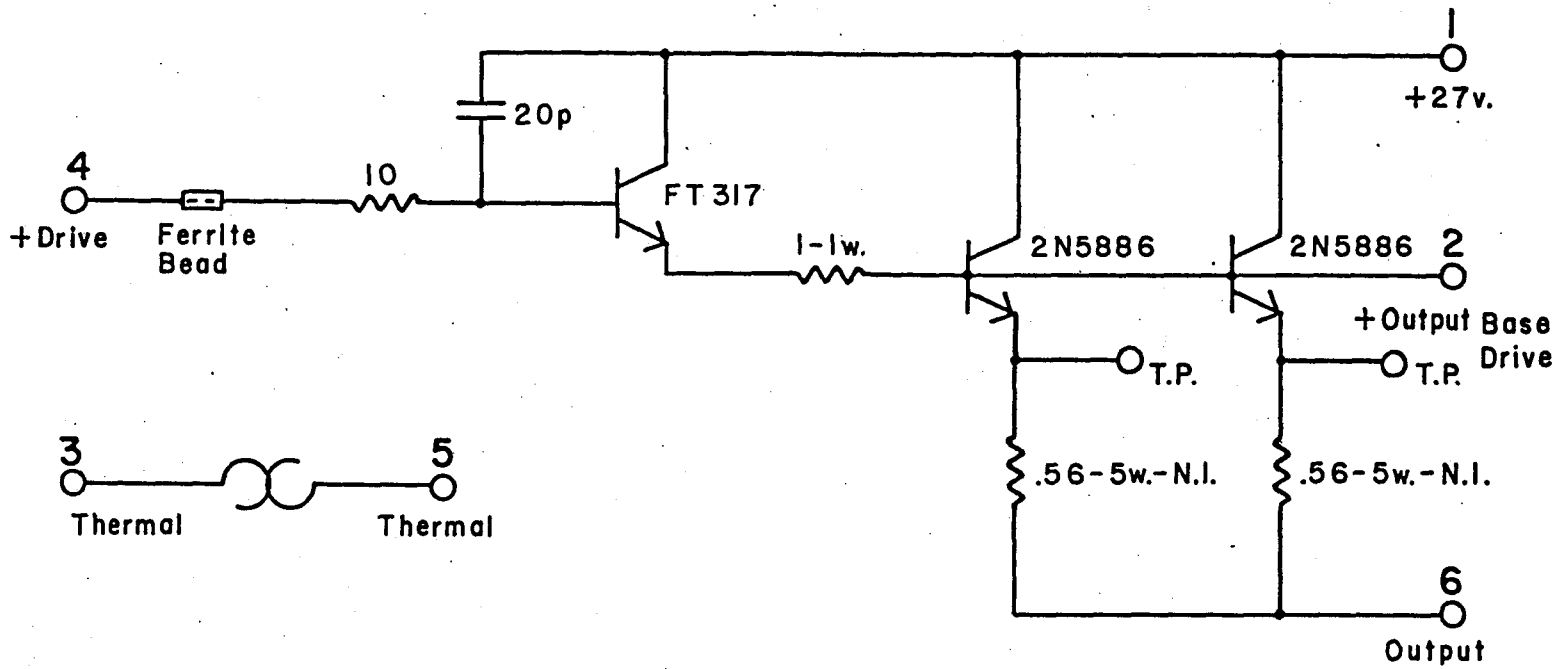
AUDIO CARD S-3



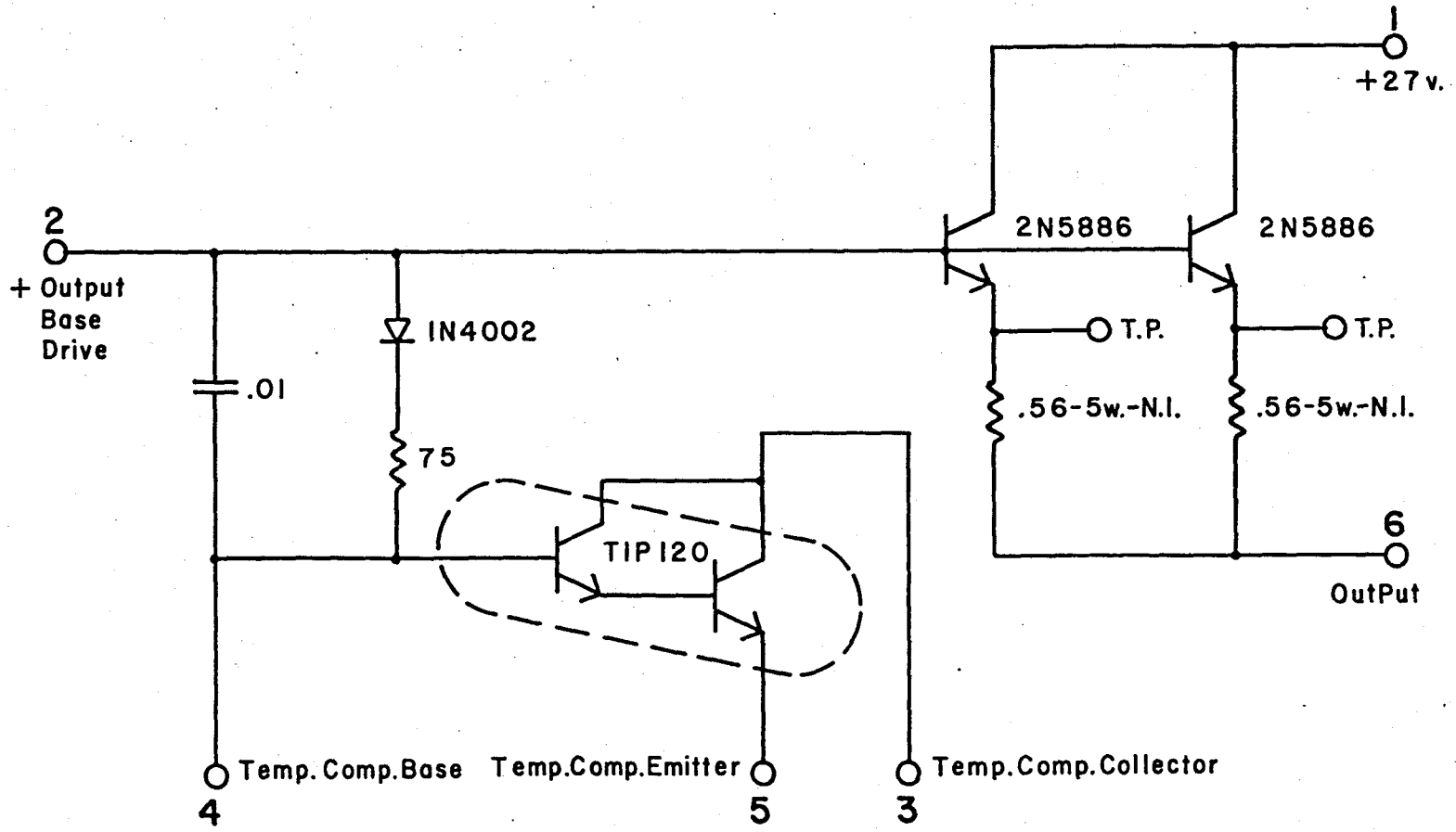
REGULATOR CARD S-4


T.P.
1
+Unreg.
2N5886
.2-5w.
6
+27v.
T.P.
.2-5w.
2N5886
200-1w.
2-2w.
Ferrite Bead
Ferrite Bead
FT417
604
20
MPS U05
In
3
Thermal
5
Thermal
+Reg. Drive
4

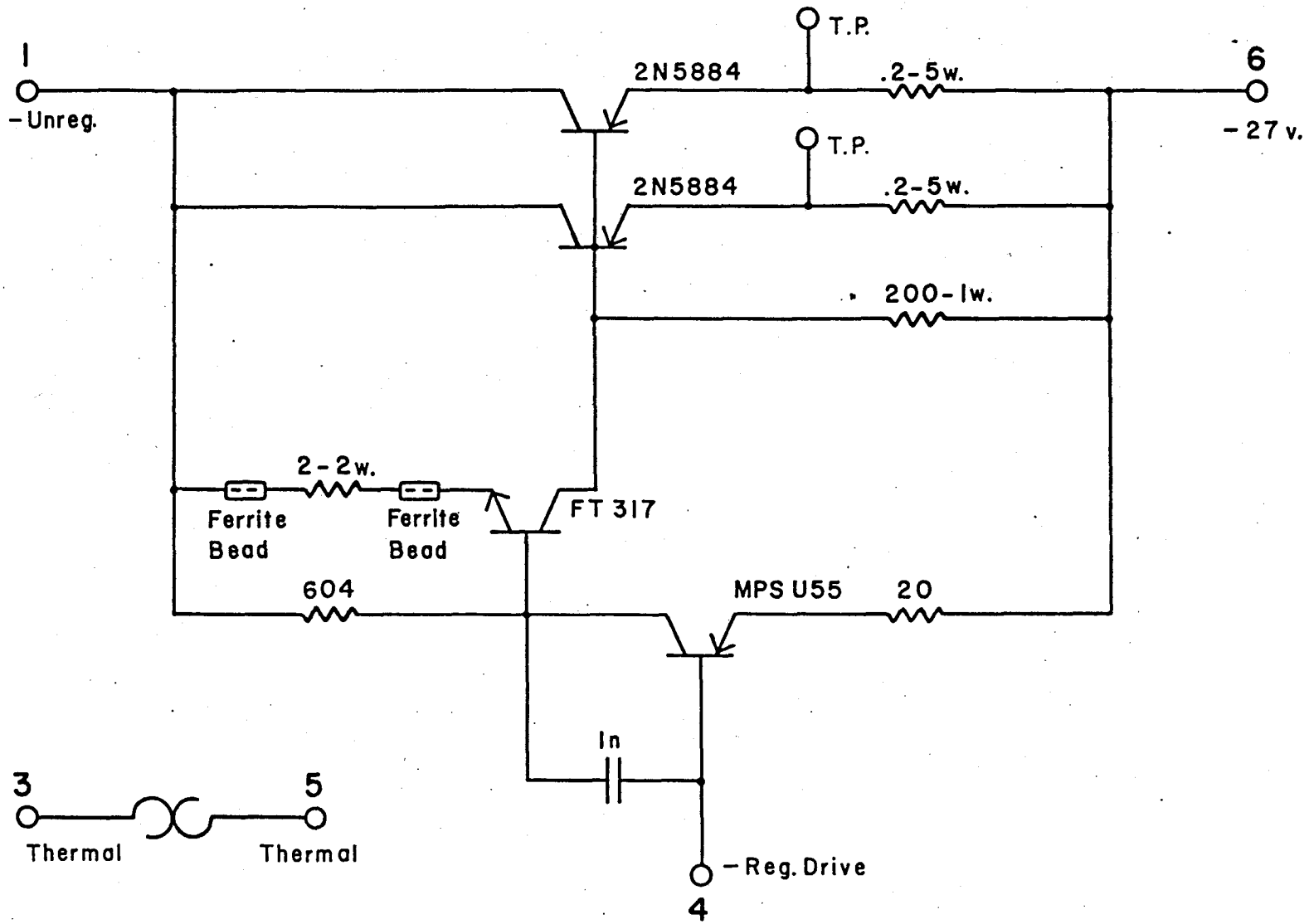
PRP-1 S-5


1
+27v.
20p
4
+Drive
Ferrite
Bead
10
FT 317
1-1w.
2N5886
2N5886
2
+Output Base
Drive
T.P.
T.P.
3
Thermal
5
Thermal
.56-5w.-N.I.
.56-5w.-N.I.
6
Output

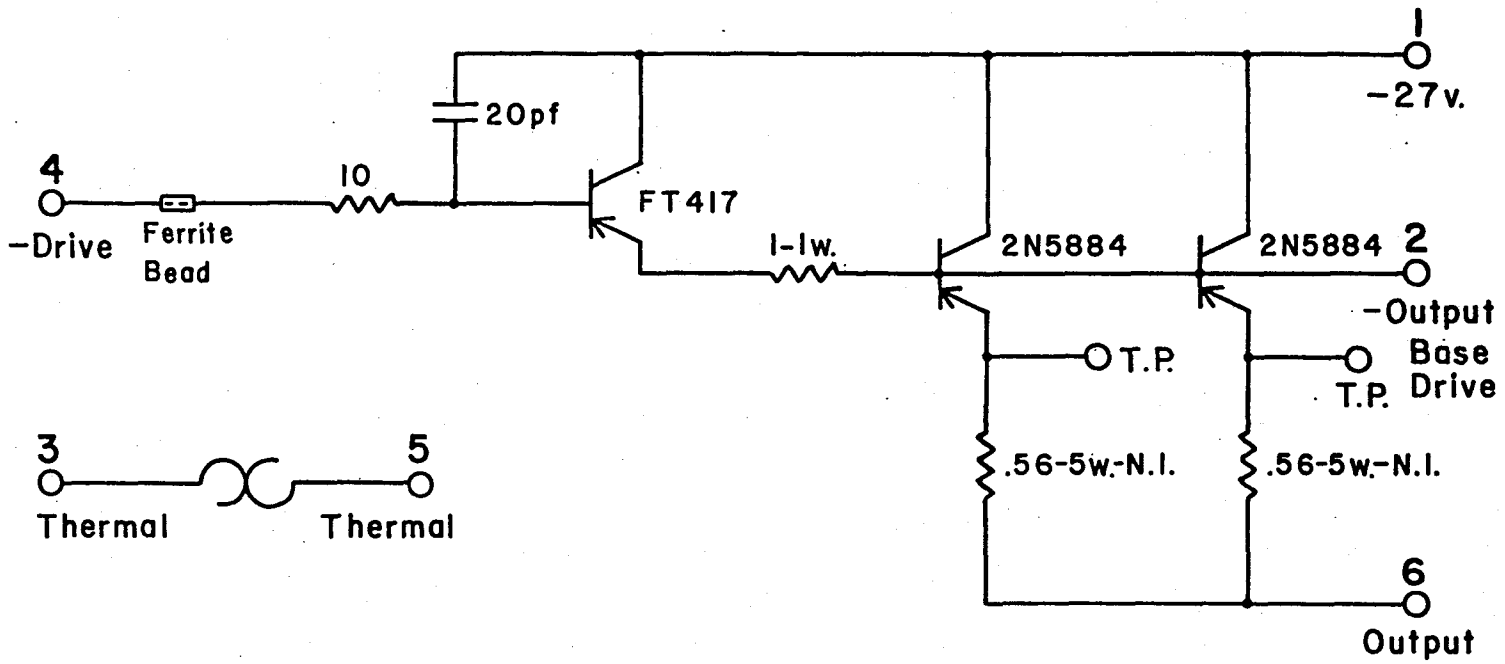
PDP-1 S-6


1
+27v.
2
+ Output
Base
Drive
2N5886
2N5886
IN4002
T.P.
T.P.
.01
.56-5w.-N.I.
.56-5w.-N.I.
75
6
TIP120
OutPut
Temp. Comp. Base
Temp.Comp.Emitter
Temp.Comp.Collector
4
5
3

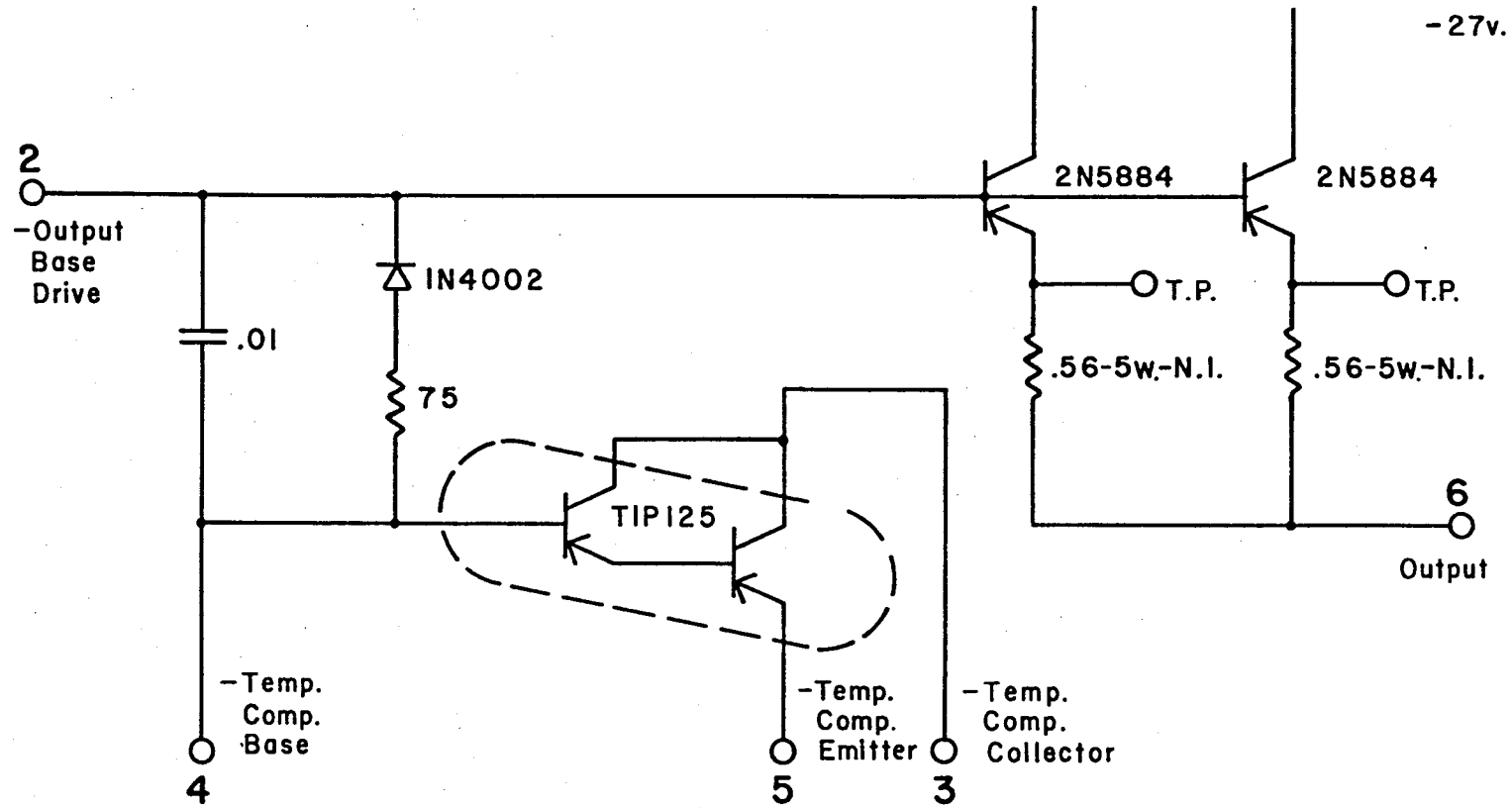
PBP-1 S-7


1
-Unreg.
T.P.
2N5884
.2-5w.
6
-27 v.
T.P.
2N5884
.2-5w.
200-1w.
2-2w.
Ferrite Bead
Ferrite Bead
FT 317
604
MPS U55
20
In
3
Thermal
5
Thermal
-Reg. Drive
4

NRP-1 S-8


1
-27v.
20pf
4
-Drive
Ferrite
Bead
10
FT417
1-1w.
2N5884
2N5884
2
-Output
T.P.
T.P.
Base
Drive
3
Thermal
5
Thermal
.56-5w.-N.I.
.56-5w.-N.I.
6
Output

NDP-1 S-9


-27v.
2
-Output
Base
Drive
IN4002
.01
75
2N5884
2N5884
T.P.
T.P.
.56-5w.-N.I.
.56-5w.-N.I.
TIP125
6
Output
-Temp.
Comp.
Base
4
-Temp.
Comp.
Emitter
5
-Temp.
Comp.
Collector
3

NBP-1 S-10

mark levinson audio systems inc.

55 circular avenue hamden connecticut 06514 u.s.a.

telephone (203) 281-6333

your ref.
our ref.
date November 14, 1977

100 K TRIMPOT ADJUSTMENT

1. Before applying power, set pot in middle of rotation.
2. Apply power.
3. Using D.C. Voltmeter, adjust pot for 0 VDC $\pm$ 50 mV at speaker output.
4. This completes the adjustment.

ML-2 FRONT PLATE REPLACEMENT

A. BEFORE PROCEEDING, DISCONNECT ALL CABLES FROM ML-2.

I. Removal of left and right front heat sinks:

a. Remove thumb screws which will release transistor covers,

b. remove hex standoffs (3/8" nut driver),

c. remove heat sink by gently pulling away from chassis, keeping heat sink square at all times,

d. place heat sink out of the way so it will not be damaged.

II. Removal of handles and front plate:

a. Handles and front plate are released from the chassis by removing four (4) hex bolts located behind the front plate.

CAUTION: Each handle consists of three (3) parts. These parts will detach from each other when hex bolts are removed. (EXTREME CARE SHOULD BE TAKEN TO KEEP THESE PARTS FROM FALLING AGAINST THE FRONT PLATE.)

b. "Removed" front plate should be packaged as soon as possible to prevent any damage.

III. Reassembly:

a. To reassemble with the new face plate, simply reverse removal procedure (II).

IV. Installation of heat sink:

a. Key pin must fit into key way ("slot") in motherboard,

b. align heat sink connectors so they lock securely into motherboard connectors while making sure steel studs pass through holes in heat sink,

c. replace hex standoffs. Tighten standoffs alternately (top and bottom) so that heat sink will secure evenly.

mark levinson audio systems ltd.

mailing address: p.o. box 6183
hamden connecticut 06517 u.s.a.
shipping address: 131 leeder hill drive bldg 261
hamden connecticut 06517 u.s.a.
telephone (203) 281-6333
telex 96 6405 lvnsnaudo hadn

ML-2 ANTI-BUZZ CIRCUIT REMOVAL (ORIGINAL TYPE)
(Refer to diagram)

1) Disconnect all cables from the amplifier.

2) Remove the top and bottom plate (5/64 hex).

3) Remove wire A from the "line" terminal of the circuit breaker. Disconnect wire B from wire C.

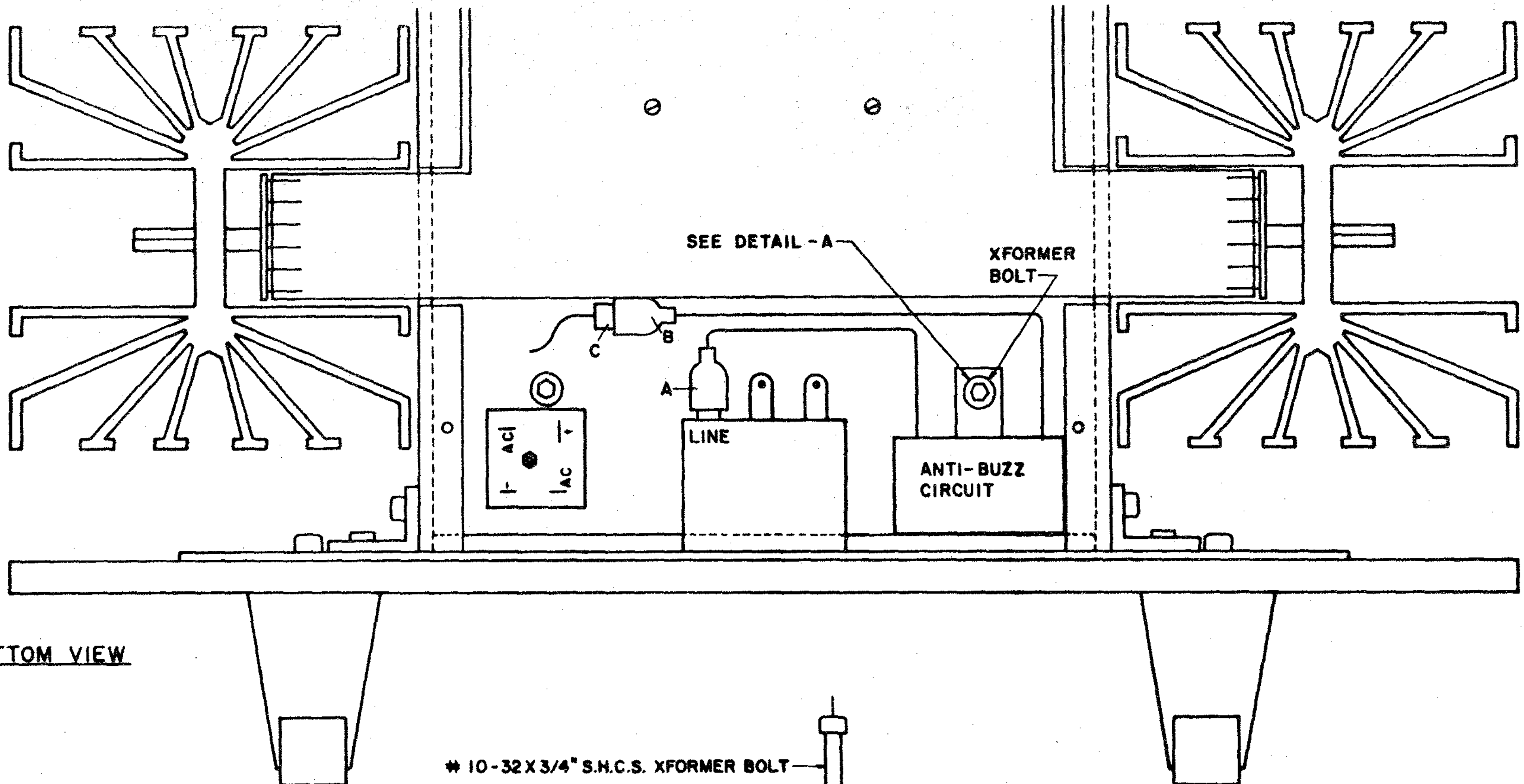
4) Remove lower right hand transformer bolt securing present anti-buzz circuit. Do not reuse this bolt.

5) Remove present anti-buzz circuit.

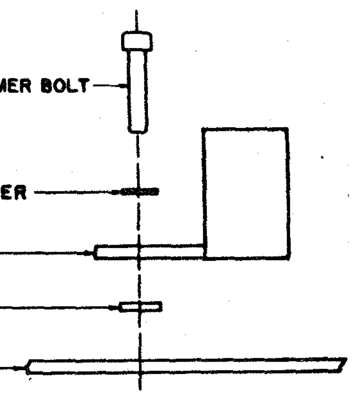
6) Replace transformer bolt with 10-32 x 5/8" bolt supplied, in conjunction with the #10 cad steel lockwasher and brass flat washer.

MARK LEVINSON AUDIO SYSTEMS

TECHNICAL SERVICES
March 19, 1982



BOTTOM VIEW



DETAIL - A

mark levinson audio systems, ltd

55 circular avenue hamden connecticut 06514 u.s.a.

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±1/2°

DR. A. Edwards DATE 12-9-81
CH. DATE
SCALE

ISSUE | REVISION | DATE

MATERIAL

USED IN ML-2

NAME Anti - Buzz Circuit Retro Fit

SHEET OF

A B C D E R

NO.

MEMO

TO : Myer
Sid
Dave
Paul
Judd
Sandy

FROM: Phil

DATE: March 16, 1982

RE : Buzz Circuits

Due to complaints raised by Harman U.K. about transformer buzz, we must change the buzz circuits to alleviate their problems and avoid any further problems in other European countries.

We must stop building the current ML-3, ML-9, and ML-2 buzz circuits. All completed and in-process buzz circuits should be put only in 120V units. ML-3 and ML-9 buzz circuits should be built with the 10,000uf caps in place of the 4700uf caps for use in amps of voltages other than 120V. (ML-9 buzz circuit will be on SL-2 pc bd. as soon as we start using Swiss bds. in all units.) ML-2 buzz circuits will have four 10,000uf caps instead of two. A sample of this will be released to Production shortly.

Amplifiers in the cage with old buzz circuits should be shipped as is, with the exception of Harman U.K. If we get an order from them, the amplifiers shipped must have new style buzz circuits.

Please do not overbuild these new type buzz circuits until we've had enough time to receive any further field reaction. Build only what you need for the production schedule.

An ECN for these subassemblies will follow shortly. If you have any questions or comments, please contact Tom or myself.

PM/srw

ENGINEERING CHANGE NOTICE

ENG 31682 T1

UNIT: ML-3, ML-9

PRIORITY: P3

START DATE: 3/16/82

STOP DATE: —

SUB-ASSY: 75-1910-00-00-00 – ML-3 ANTI-BUZZ
75 1909-00-00-00 – ML-9 ANTI BUZZ

ENG

DUE TO CONTINUED TRANSFORMER BUZZ IN U.K. AND OTHER ASIAN AND EUROPEAN COUNTRIES, WE MUST INCREASE THE CAPACITANCE OF THE BUZZ CIRCUITS

PROD

ON ML-9 AND ML-3 ANTI BUZZ CIRCUIT P.C.B.O., DELETE TWO PCS. OF 4700 uf/16V CAPS (14-0472-00-EC-00). REPLACE WITH TWO PCS. OF 10,000 uf/16V CAPS (14-0103-00-EC-00). OBSERVE SAME POLARITY AND SAME PLACEMENT OF ELECTRICAL TAPE.

Q A

—

PURCH

ON SA# 75-1910-00-00-00, DELETE 2pcs. OF QUAN 2, 14-0472-00-EC-00
ADD 2pcs. 14-0103-00-EC-00.

ON SA# 75-1909-00-00-00, DELETE 2pcs. OF QUAN 2, 14-0472-00-EC-00
ADD 2pcs. 14-0103-00-EC-00

INV

See PURCH.

COMPUTER

SEE PURCH.

ACKNOWLEDGEMENT

INVENTORY	PURCHASING	COMPUTER	PRODUCTION

MFG. COORDIN.	ACCOUNTING	TECH. SERVICES	ENGINEERING
			P. Meyer

Q.A.

MEMO

TO: Manufacturing

FROM: Sid Chatterjee

DATE: January 26, 1982

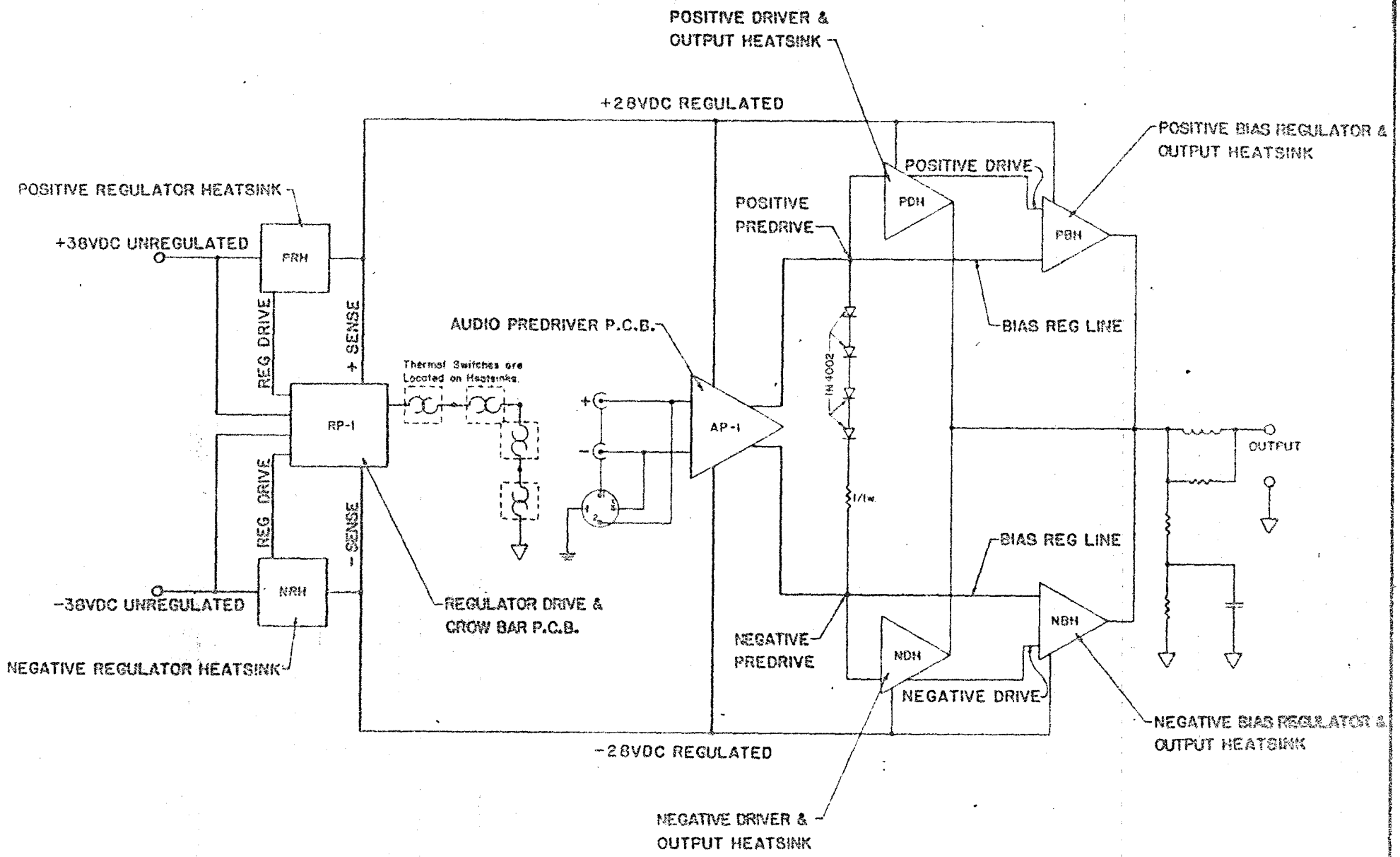
RE: Buzz Circuits

Presently we are building two types of anti-buzz circuits. First type uses 4,700uF capacitors; second type uses 10,000uF capacitors. In the near future, we will stop using the 4,700uF and build anti-buzz with only the 10,000uF capacitors.

It should be noted:
a) ML-2 can only use the 10,000uF
b) ML-3 and ML-9
    1) 100VAC units can only use the 10,000uF
    2) all other voltages can use up our present supply of 4,700uf capacitors.

Since it is nearly impossible to tell which capacitor is used inside of the potted shell, I suggest:
a) all 4,700uF units use 16 ga. black PVC insulated wire
b) all 10,000uF units use 16 ga. white PVC insulated wire

I hope that this will simplify the confusing situation.



ML-2 BLOCK DIAGRAM

ML-2

CHASSIS WIRING

1. Square chassis.

   a. Insure fitting of Top & Bottom Plate.
      1. Bolt down both plates, then tighten sides.
      2. Remove plates.

2. Brackets flush with sides.

3. Install bracket with spacer post on aluminum cap. side.

4. Make sure capacitors will fit into centered clamps.

5. Transformer Inspection:

   a. Tighten bolts.
   b. Check wires for damage.
   c. Check for body damage, straighten corners if necessary.

6. Motherboard

   a. Inspect completely, and clean if necessary.

7. Inspect Audio card and Reg. and Pro. Card. Note pins! Clean cards.

8. Adjust card guides and install cards.

9. Install Transformer:

   a. Large group of transformer wire on bridge side.
   b. Twisted 3 wire on opposite side.
   c. Square transformer and bolt down.
      1. Lockwasher on top and bottom.

10. Turn chassis over and locktight transformer nuts and clamp nuts, and corner bracket.

11. Install Motherboard. (22½")

    a. Add white wire and blue wire to transformer wrap and tie wrap.
    b. Orange stripe and two red wires go around post.
        1. Orange striped wire in small hole - middle motherboard.
        2. Red twisted wires in both small center back holes.
        3. Solder all 3 wires.
    c. No pinched wire.
    d. Neatly tie wrap and push wrap down along side.
    e. Motherboard should slide into clamps easily.
        * Make sure no wires are in the way.
    f. If motherboard won't slide down, readjust the clamps.

12. Line up spacer posts with holes.

13. 440 screw into posts with lockwasher.
    * DO NOT overtighten.*

14. ~~Turn chassis over and~~ add green ground wire.

15. ~~Tie wrap yellow and blue wires; tie remainder of yellow wire and blue wire into transformer wrap.~~ *

16. Tie wrap red and green wires (~~Must go over post bracket.~~)

17. ~~#22 twisted wires must approach holes from front.~~

18. Connect rear panel (See diagram.) Inspect for damage.
    *Make sure that black, ~~green~~ red, white wires are neat ~~and tightly twisted~~.

19. Install handles. Inspect handles.

20. Install Front Panel.

    a. Inspect ON/OFF switch.
        1. Should switch on and off fairly easily.
        2. Inspect lettering.
    b. Connect breaker and bridge.

21. Final Inpection

mark levinson audio systems ltd.

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hamden connecticut 06517 u.s.a.
shipping address: 131 leeder hill drive bldg 261
hamden connecticut 06517 u.s.a.
telephone (203) 281-6333
telex 96 6405 lvnsnaudo hadn

ML-2 CIRCUIT BREAKER REPLACEMENT

1) Remove all electrical cables from amplifier.

2) Place amplifier on front handles.

3) Remove covers from forward-most heat sink assemblies (left and right) (thumb screws).

4) Remove forward heat sink assemblies (left and right) 3/8" hex standoff). Pull heat sink away from chassis to remove.

5) Remove eight 5/32" hex cap screws holding frontplate and handles to amplifier chassis.

6) Lift chassis vertically leaving frontplate and handles behind.

7) Place amplifier in a comfortable position for circuit breaker replacement.

   CAUTION: Do not place amplifier down on false front or circuit breaker will be crushed.

8) Remove circuit breaker from chassis by loosening the two screws holding it to the false front.

9) Disconnect wires, ONE AT A TIME, from defective circuit breaker and connect to the new circuit breaker.

   CAUTION: Do not alter wire locations. Miswiring circuit breaker may cause destruction of the amplifier.

10) Mount new circuit breaker and tighten screws.

11) Bolt frontplate and handles to chassis.

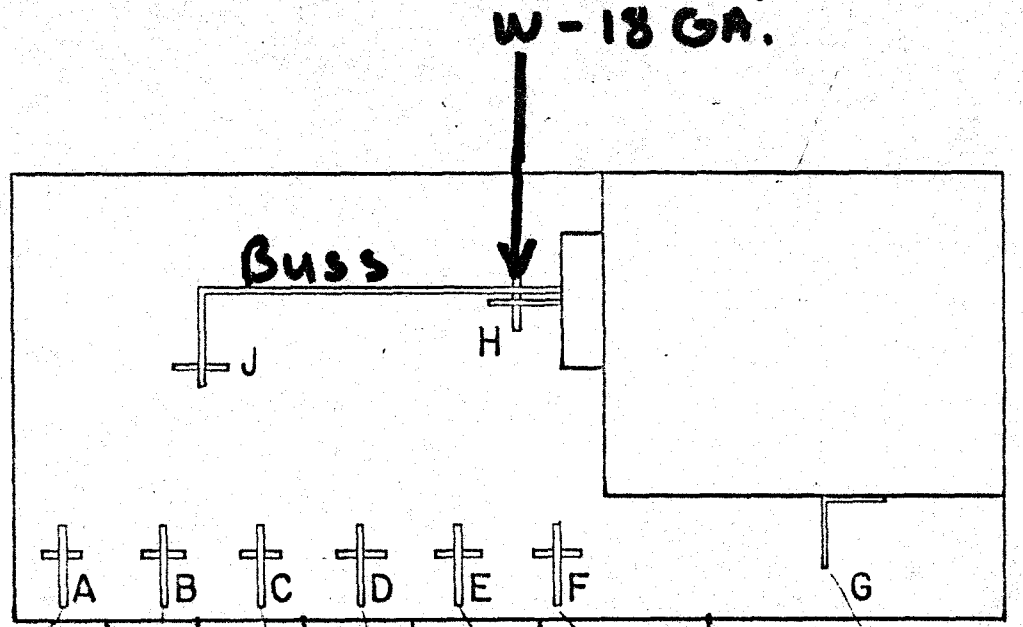
12) Install forward heat sinks (left and right) being sure that gold contacts mate properly.

13) Replace heat sink bolts and snug. Do not over tighten.

14) Replace heat sink covers.

PLEASE FORWARD QUESTIONS TO MARK LEVINSON AUDIO SYSTEMS, LTD., TECHNICAL SERVICES.

ML-2 CORCOM WIRING



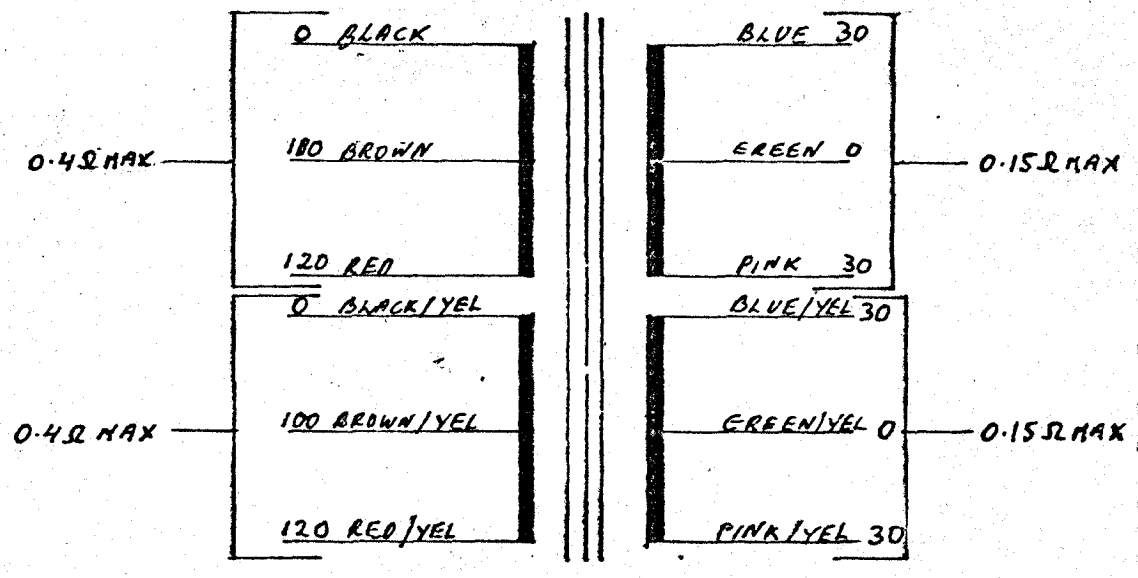
	A	B	C	D	E	F	G
E-CORE	Y BLK	Y	R BLK	BLK W	BLK	W	16GA BUSS TO BINDING POST & SWITCHCRAFT
AVEL LINDBERG TOROIDAL	BR	Y	R	R Y	BLK	BLK Y	

SHEET / OF / SHEETS		
PT.No. COD 822		
ISSUE		
No.	REF.	DATE
1		
2		
3		
4		
5		
6		
7		

A

VC 24/0·2 WIRES 20" LONG.

0-32 UNF



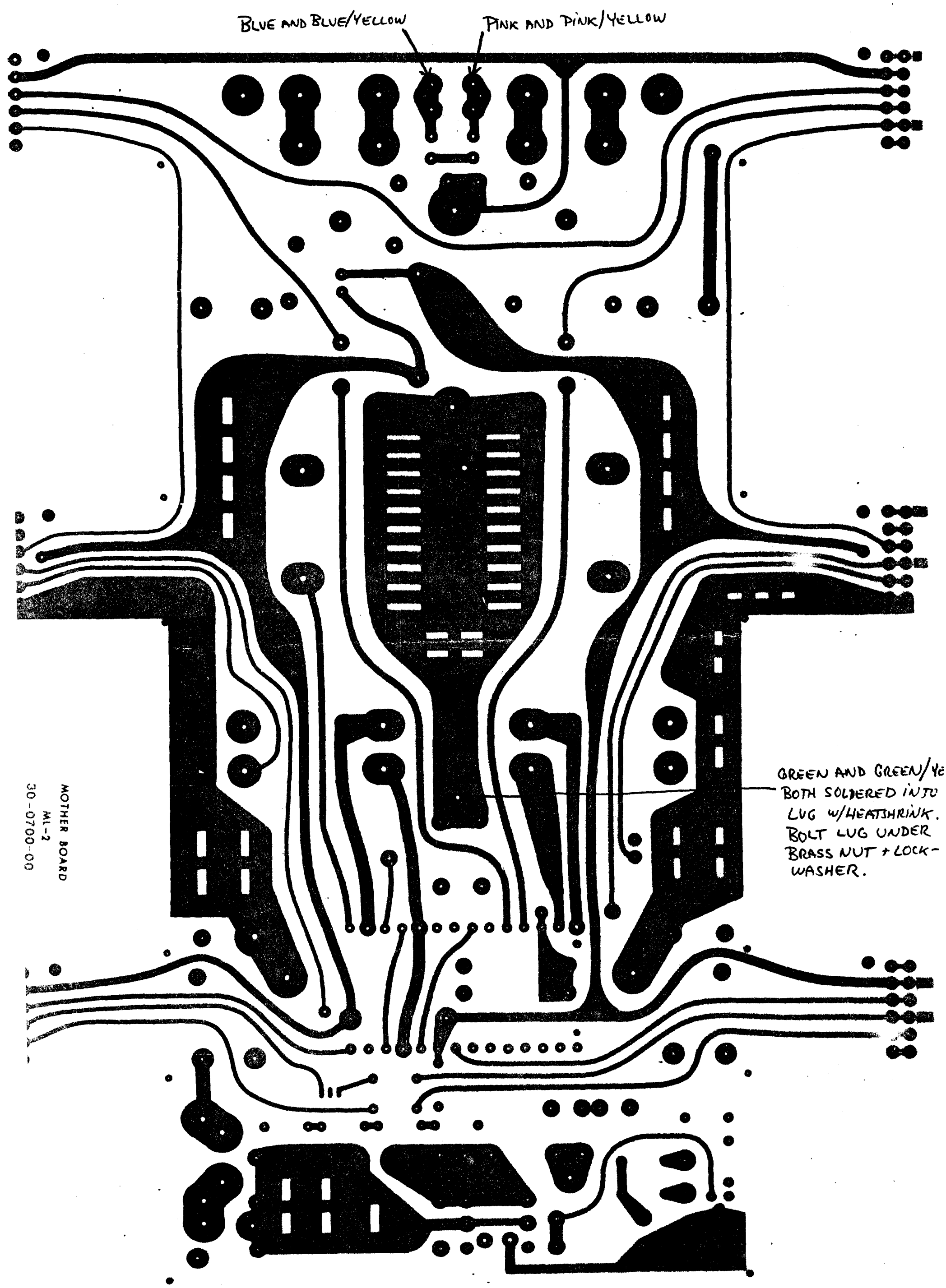
Electrical
1) Imag at 240v 60Hz 30mA nom.
2) Flash Test Primary to Secondary 2Kv AC 60Hz 1 min.
3) Insulation 10 Meg ohm at 500v DC at 25°C.
4) Rated at 120v rms at 8 amp rms. Temperature rise at 25°C ambient 35°C. (i.e. Surface 60°C).
5) Transformer wound for minimum stray magnetic field.

AVEL LINDBERG LIMITED South Ockendon Essex			DRAWN P.W.J	DATE 11-5-78
DIMENSIONS IN:- M M	FINISH		CHECKED	
3RD ANGLE PROJECTION	MATERIAL	NAME	METHODS	
METRIC DIMENSIONS FRACTIONAL DIMENSIONS ± 1/64" DECIMAL DIMENSIONS ± .005" SPECIAL LIMITS AS STATED		SPEC.	MFR. APP. R. Daniels 12.5.78	
		SIZE		
SCREW THREAD DIMENSIONS. BRITISH STD. AFTER PLATING.	DESCRIPTION 1200 WATT POWER TRANSFORMER 40/3488		PART No. COD 822	
SCALE 1:2 HALF FULL SIZE			SHEET 1 OF 1	

HARDWARE FOR TOROIDAL TRANSFORMER MOUNTING IN ML-2

4pcs.	52-0029-00-50-00	10-32 x 5/8" SHCS
4pcs.	52-0011-00-LW-00	#10 ITLW
4pcs.	52-0037-00-WO-00	BRASS FLAT WASHER
1pc.	47-3180-10-HS-00	HEATSHRINK BLACK 1"
1pc.	50-0600-00-HE-00	RING TERMINAL

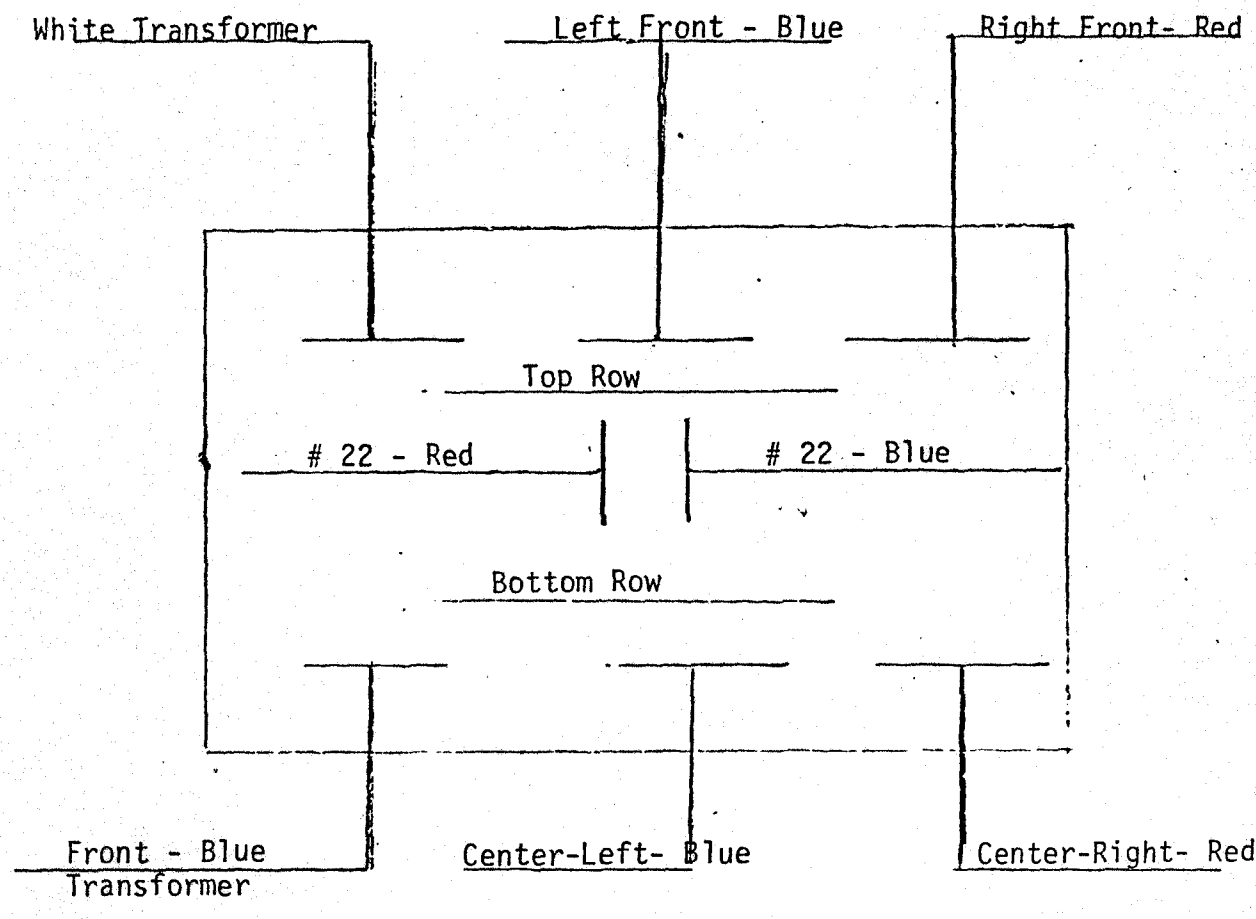
TOROIDAL TRANSFORMER SECONDARY WIRING - ML-2 MOTHERBOARD, TOP VIEW



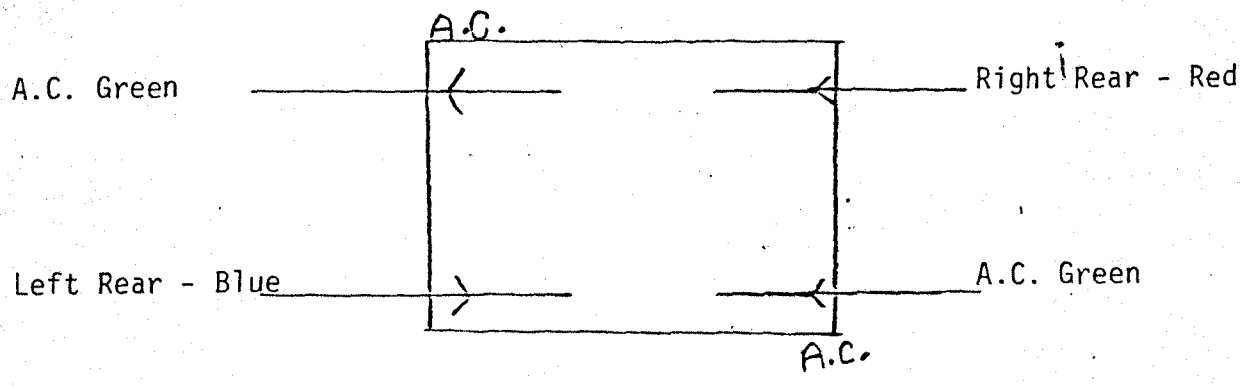
9/23/77 ME.

FRONT PANEL

BREAKER

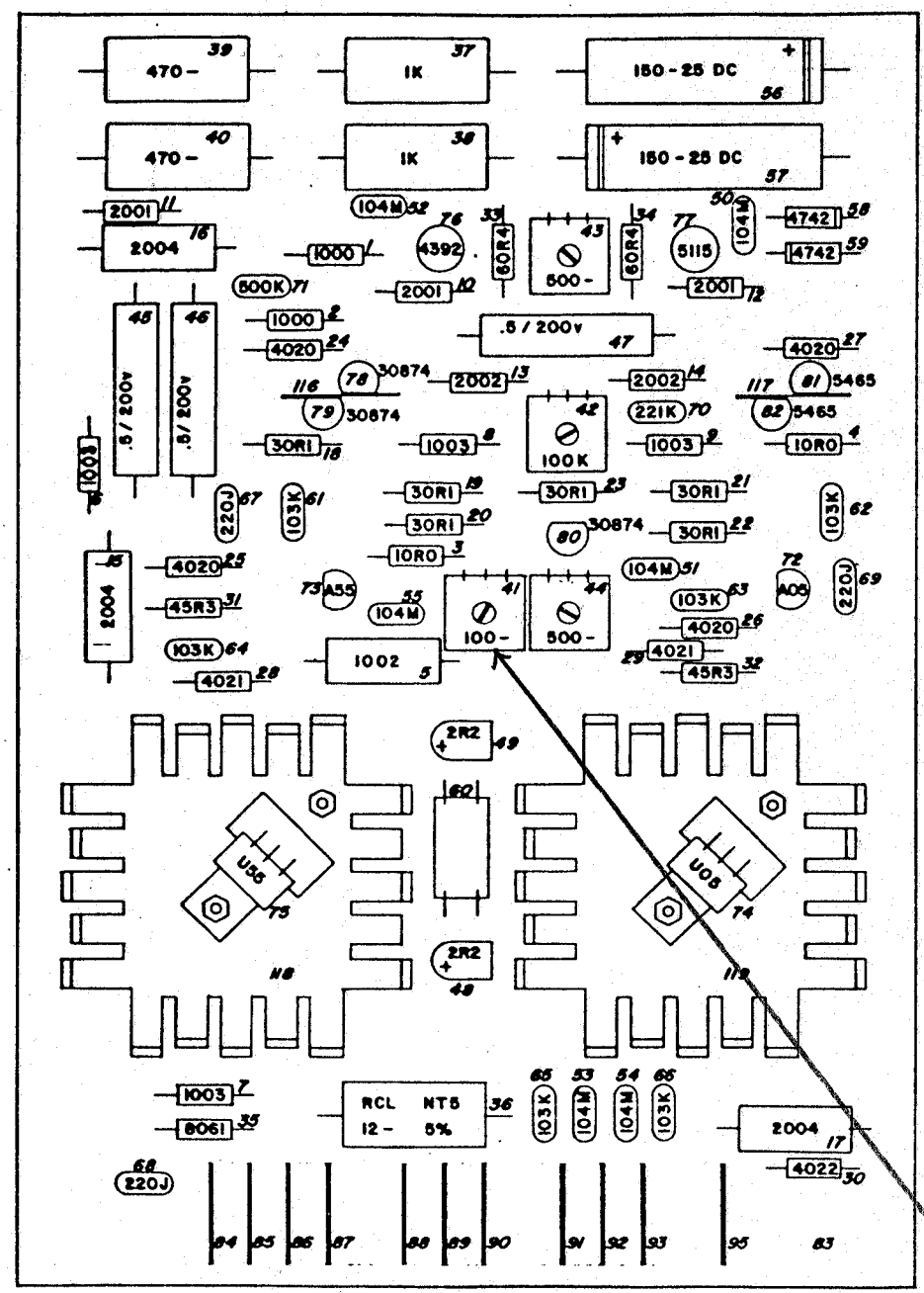


BRIDGE



IM Balance (Noninverting input)

8Ω load
1000Hz Sinewave input
20 watts output

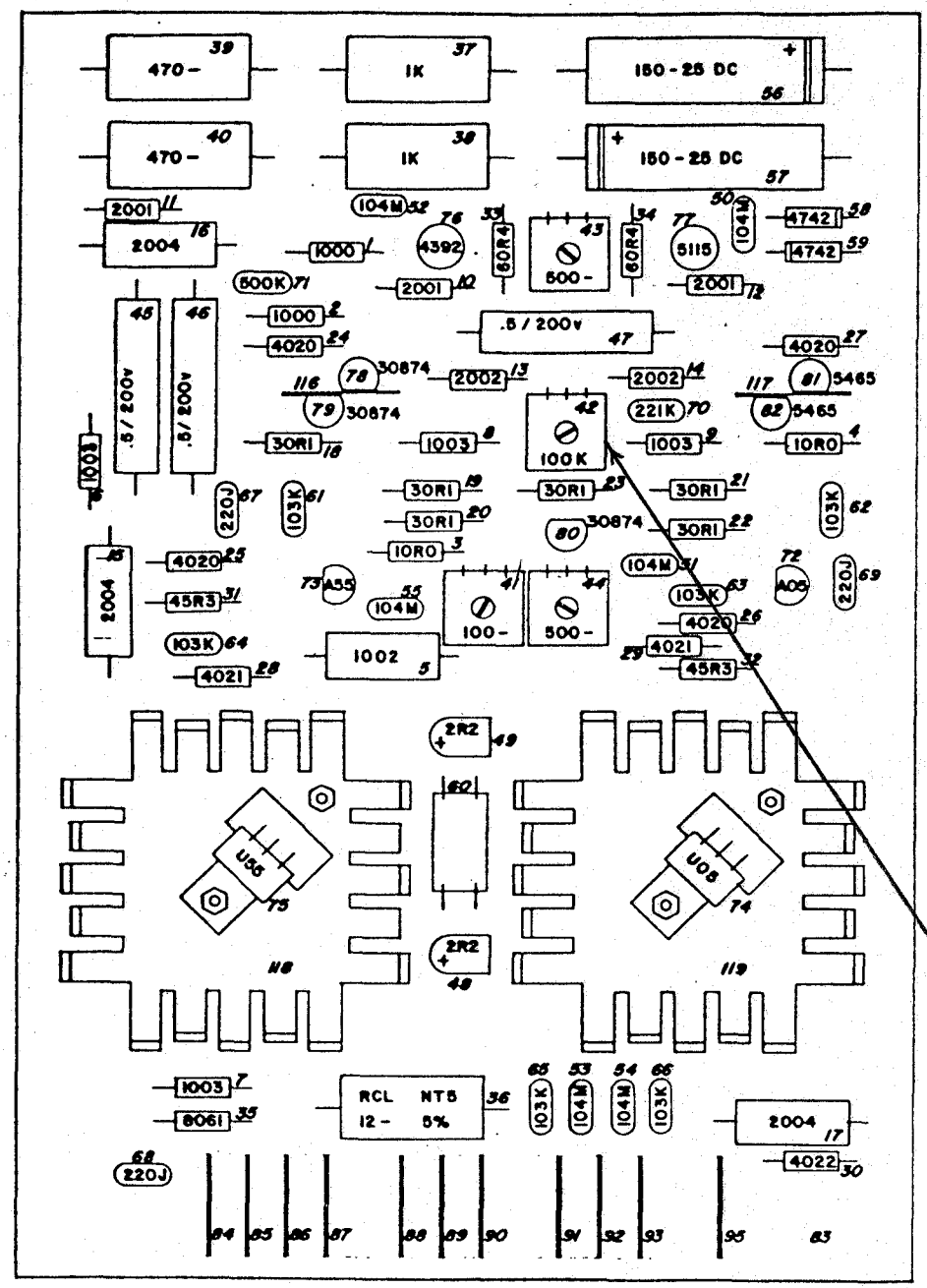


Adjust for minimum distortion

AP-1 A-2

DC offset Adjustment

Measure Across Output terminals

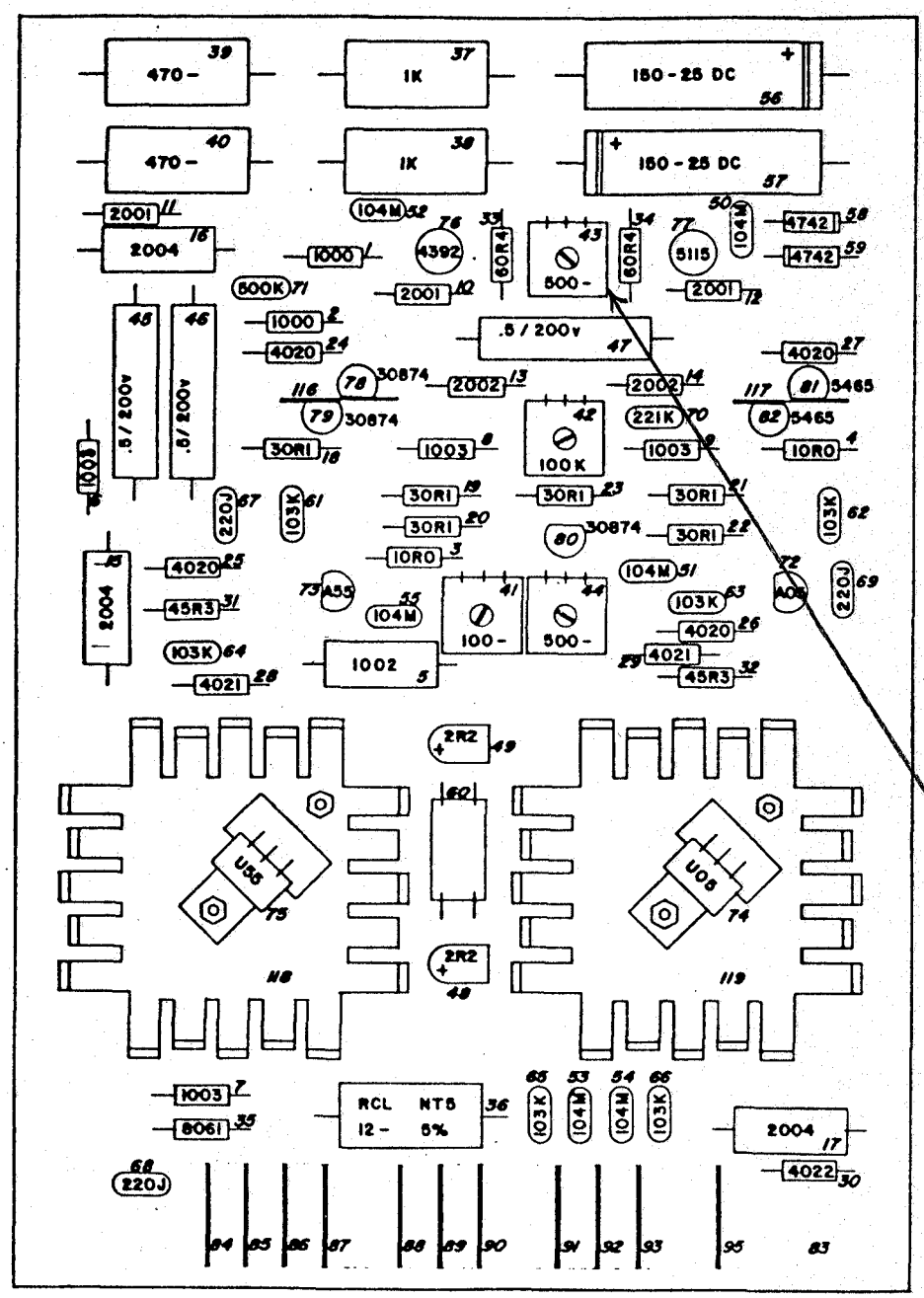


Adjust for 0V ± 10mV

AP-1 A-2

IM Balance (inverting input)

8Ω load
1000Hz Sinewave input
20watts output

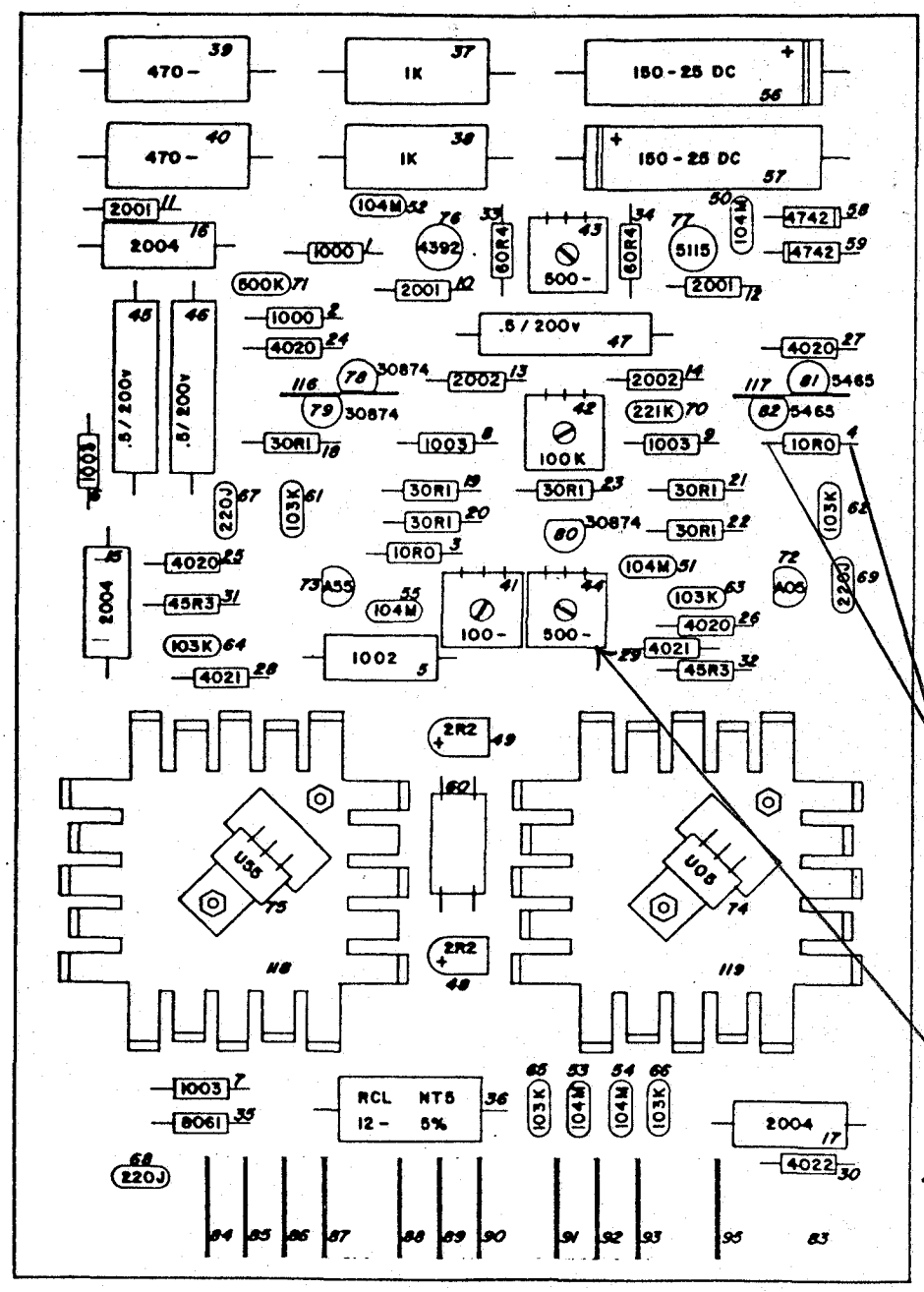


Adjust for minimun distortion

AP-1 A-2

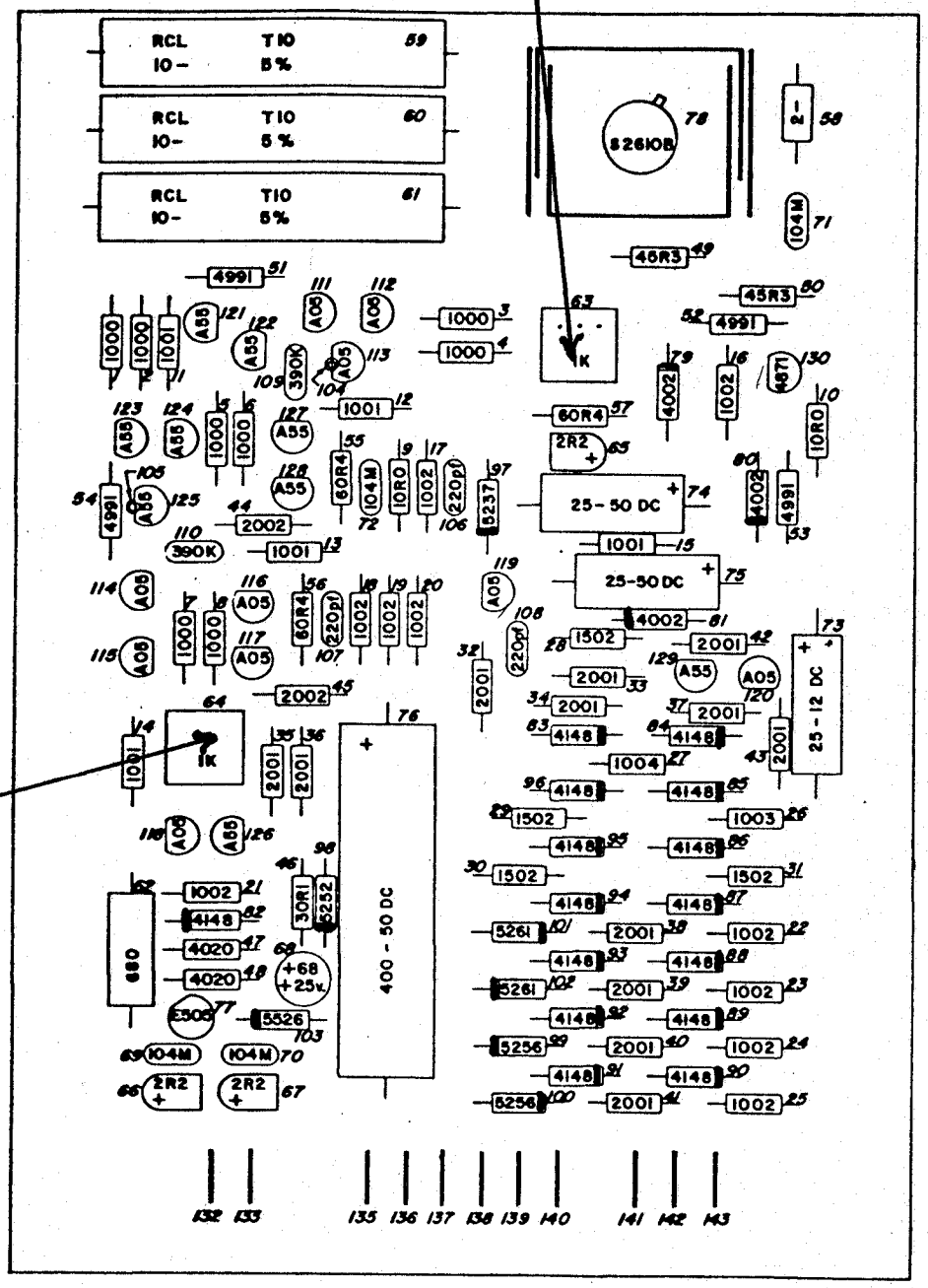
Card Current Adjustment

(All Adjustments made simultaneously)



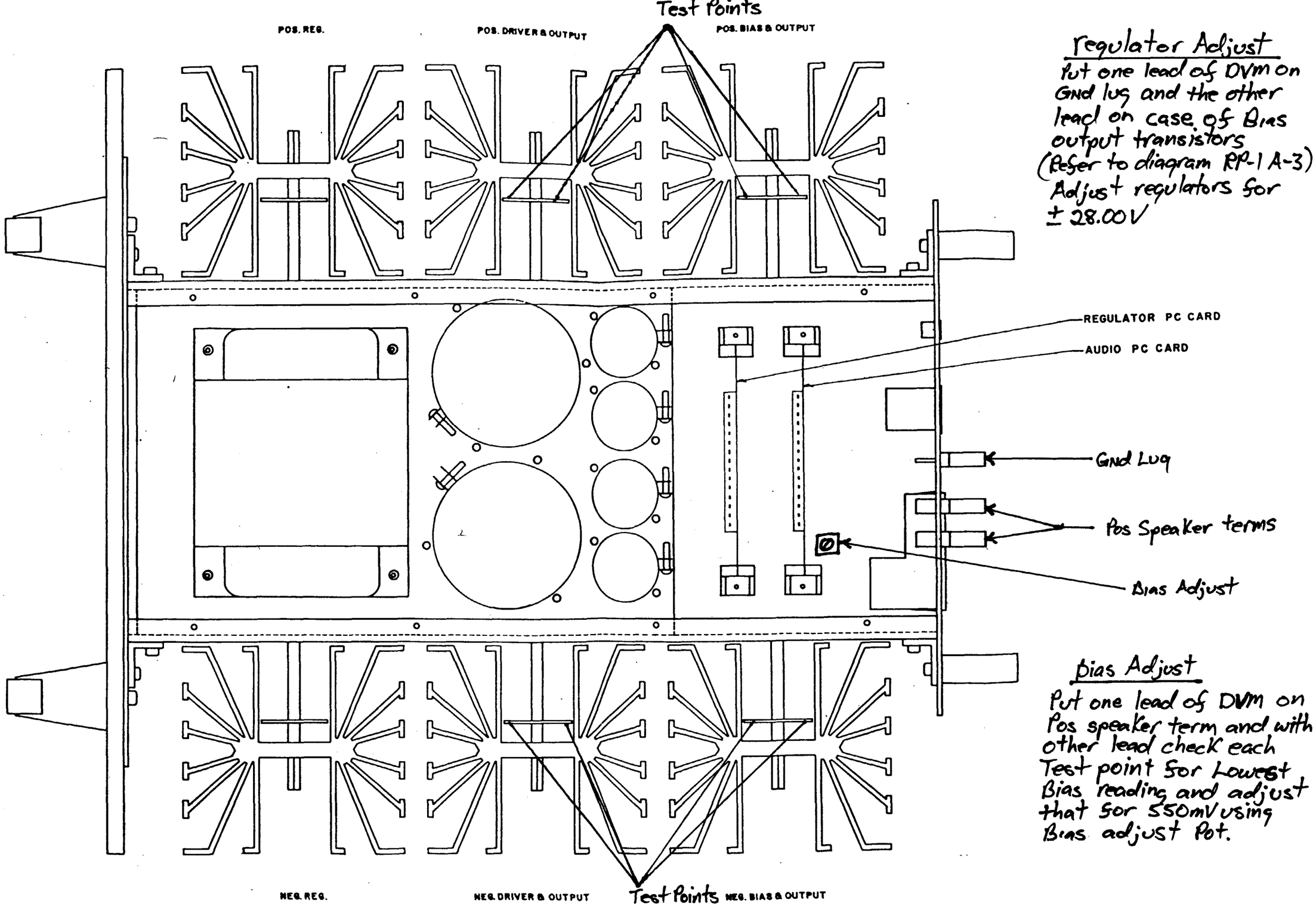
AP-1 A-2

Neg reg Adjust



Pos reg Adjust

RP-1 A-3



Regulator Adjust

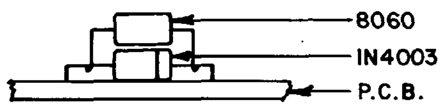
Put one lead of DVM on GND lug and the other lead on case of Bias output transistors (Refer to diagram RP-1 A-3) Adjust regulators for ± 28.00V

Bias Adjust

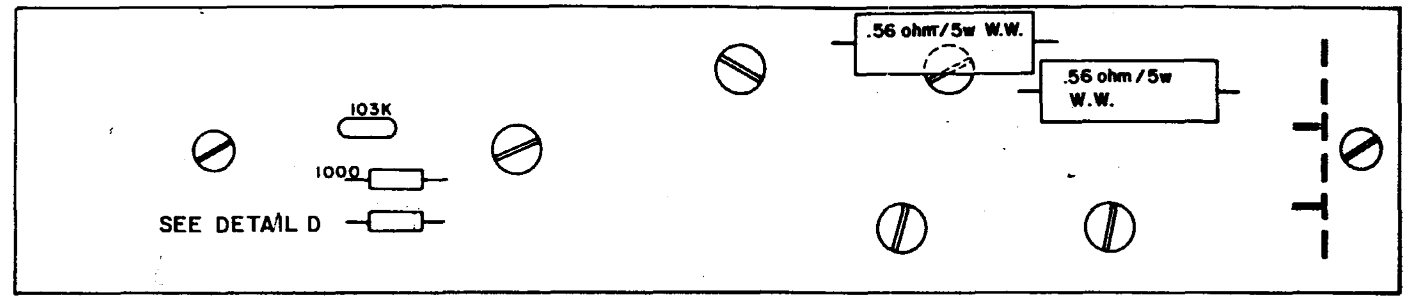
Put one lead of DVM on Pos speaker term and with other lead check each Test point for Lowest Bias reading and adjust that for 550mV using Bias adjust Pot.

ML-2 TOP VIEW

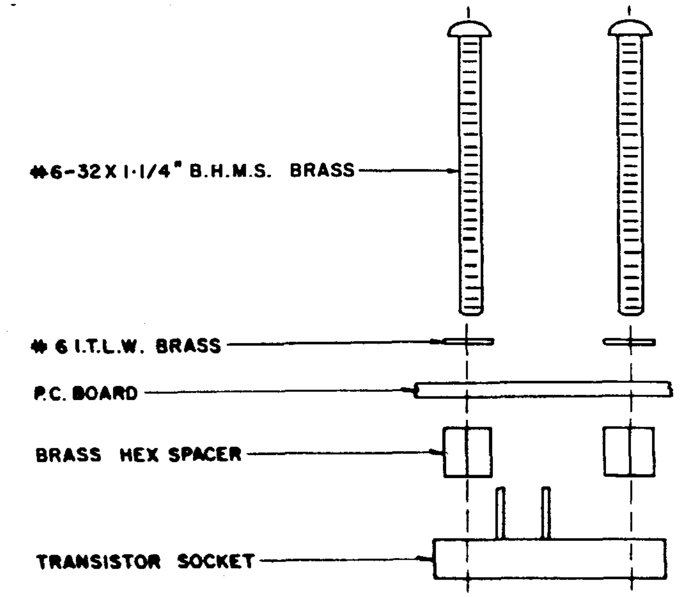
A-10



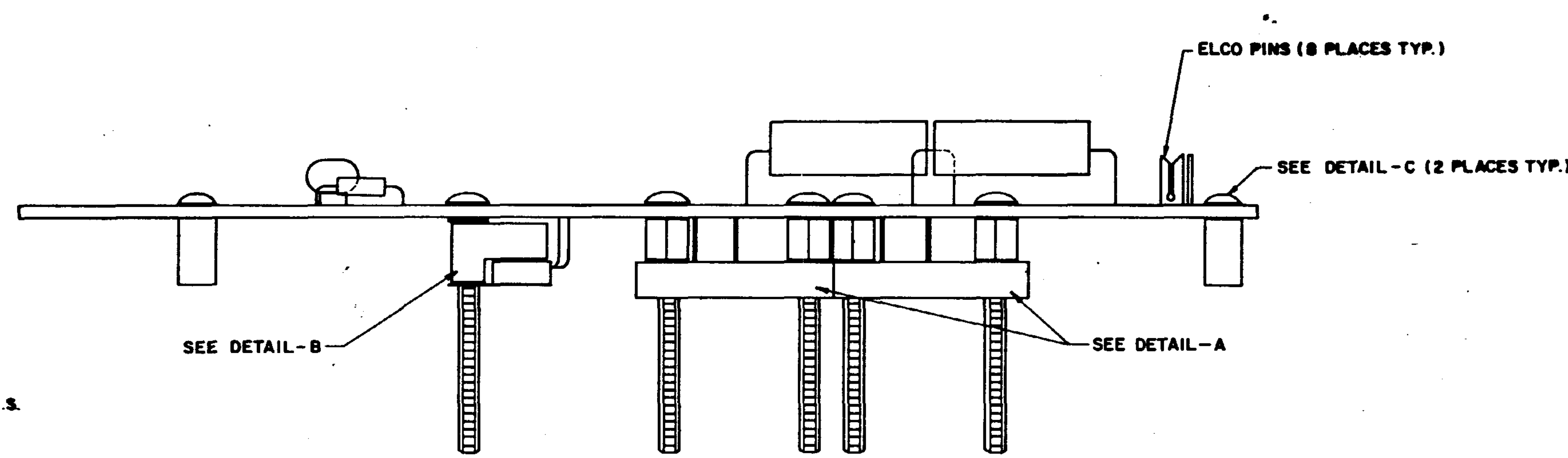
DETAIL D

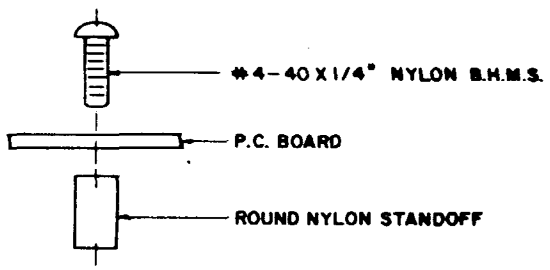


COMPONENT SIDE

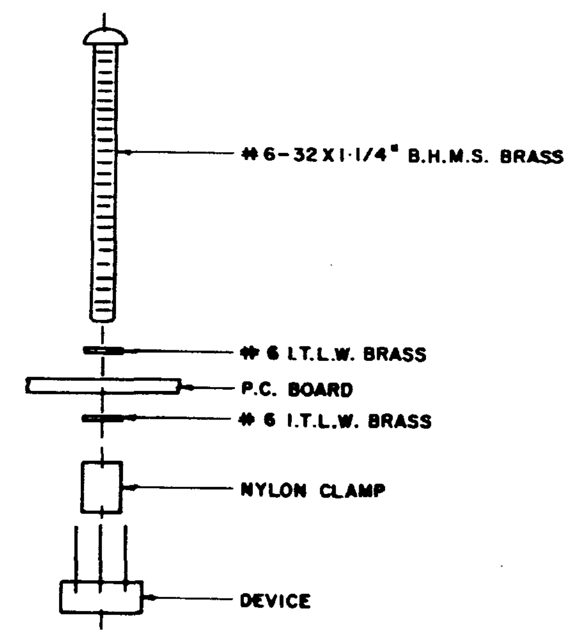


DETAIL - A

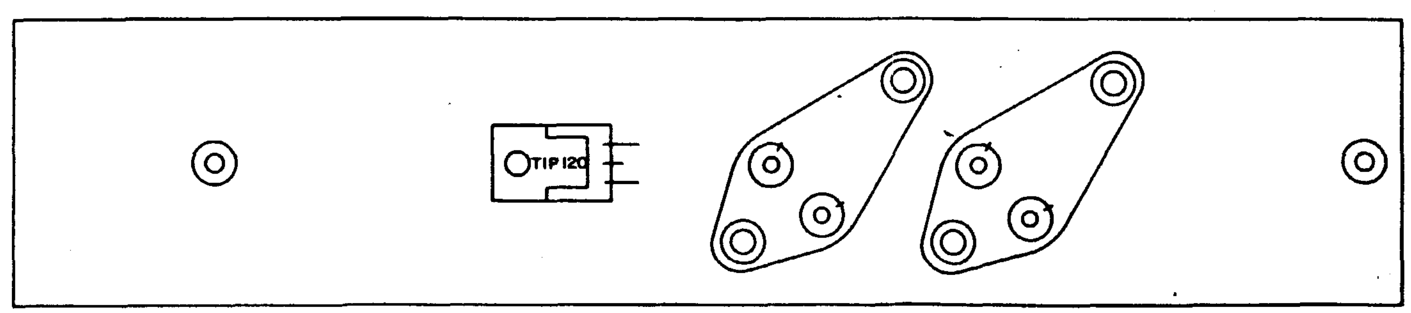




DETAIL - C



DETAIL - B



SOLDER SIDE

NOTE:

1. ALL CAPACITORS ARE IN CODE UNLESS OTHERWISE SPECIFIED.
2. ALL RESISTORS ARE RN55, & ARE IN CODE UNLESS OTHERWISE SPECIFIED.
3. INSTALL MOUNTING PADS ON ALL STANDING COMPONENTS.

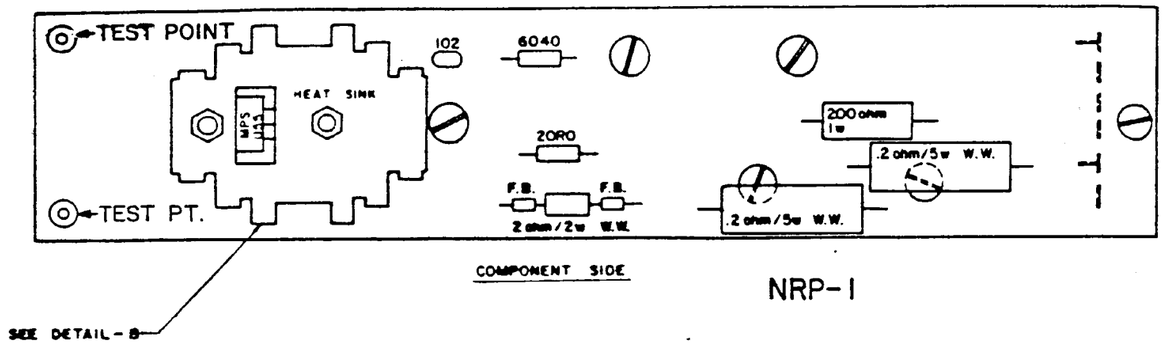
ISSUE	REVISION	DATE
C	ECN 0032	2-29
B	Change 40.2 ohm to 100 ohm	4-23
A	Change 75 ohm to 40.2 ohm	9-29

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±1°

DR. S.G. DATE 11-29-77
CH. DATE
SCALE

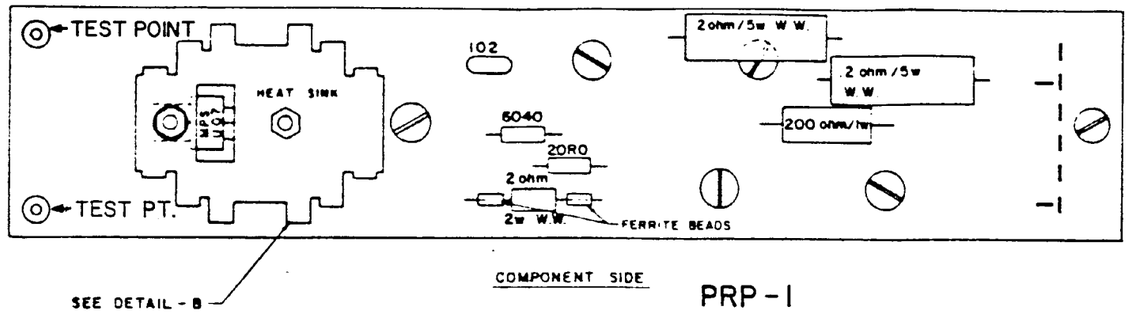
MADRIGAL audio laboratories, inc

MATERIAL
USED IN: ML - 2
NAME: PBP - 1
SHEET OF
A ✓ B ✓ C 83 D E F
NO. 75-1713-01-00-00



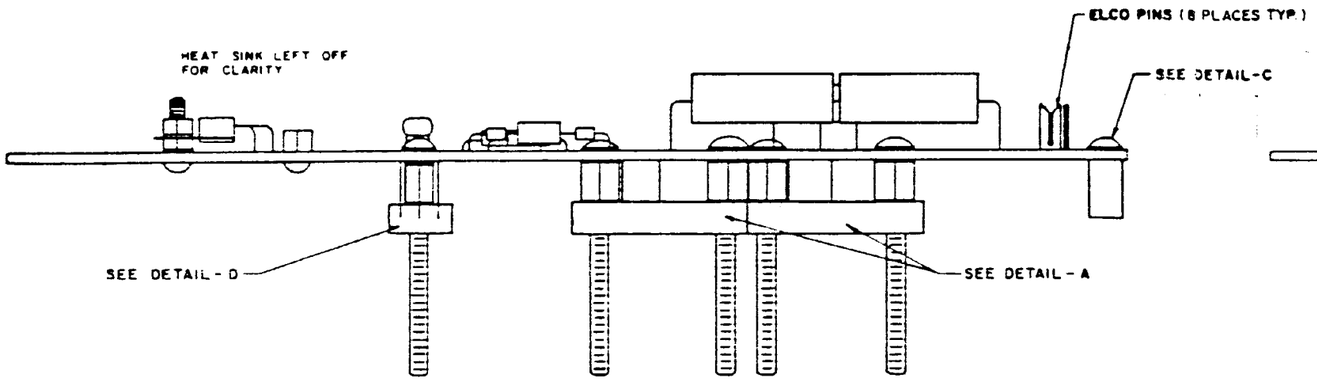
COMPONENT SIDE

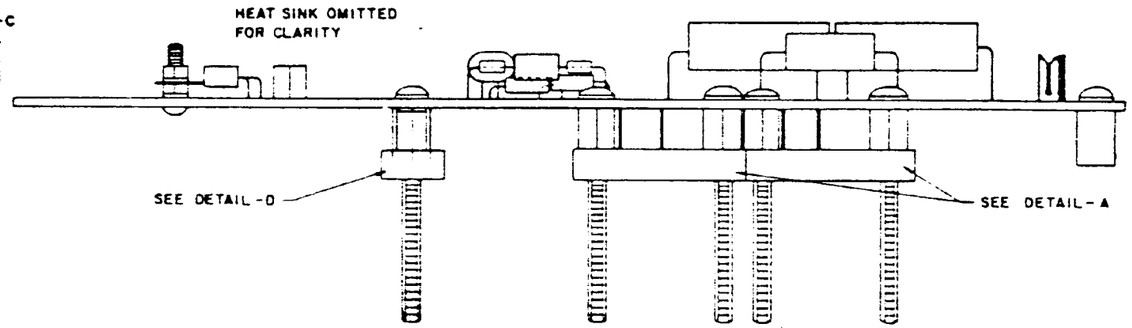
NRP-1

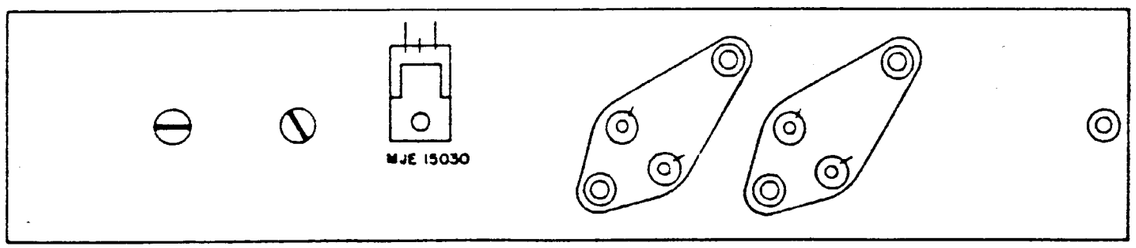


COMPONENT SIDE

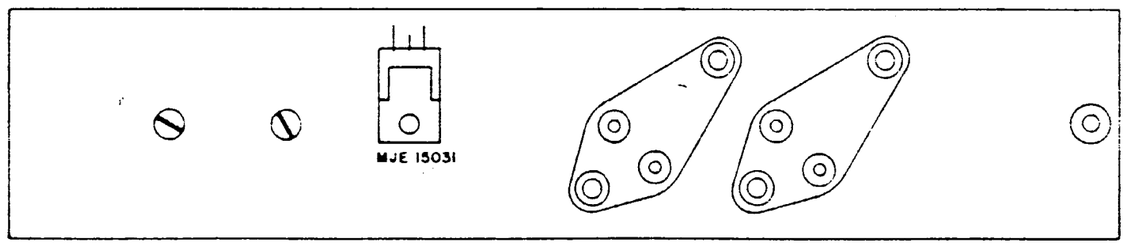
PRP-1







SOLDER SIDE



SOLDER SIDE

DRAWING Nº 1

NOTE
1. ALL CAPACITORS ARE IN CODE UNLESS OTHERWISE SPECIFIED
2. ALL RESISTORS ARE RN55, B ARE IN CODE UNLESS OTHERWISE SPECIFIED
3. INSTALL MOUNTING PADS ON ALL STANDING COMPONENTS.

ISSUE	REVISION	DATE
	ORIGINAL IF RED Property of Madrigal Audio Laboratories Inc.	

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±1/2°

DR. D.M. DATE 4-29-86
CH. DATE
SCALE

MADRIGAL audio laboratories, inc.
2081 south main street middletown connecticut 06457 u.s.a.

MATERIAL

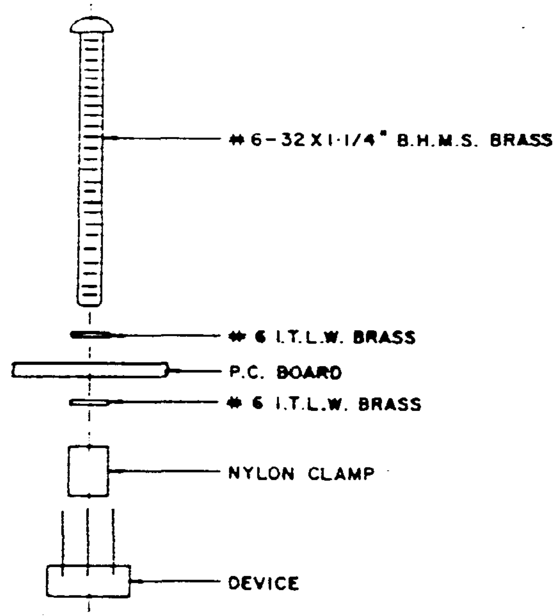
SHEET OF

A	B	C	D	E	R

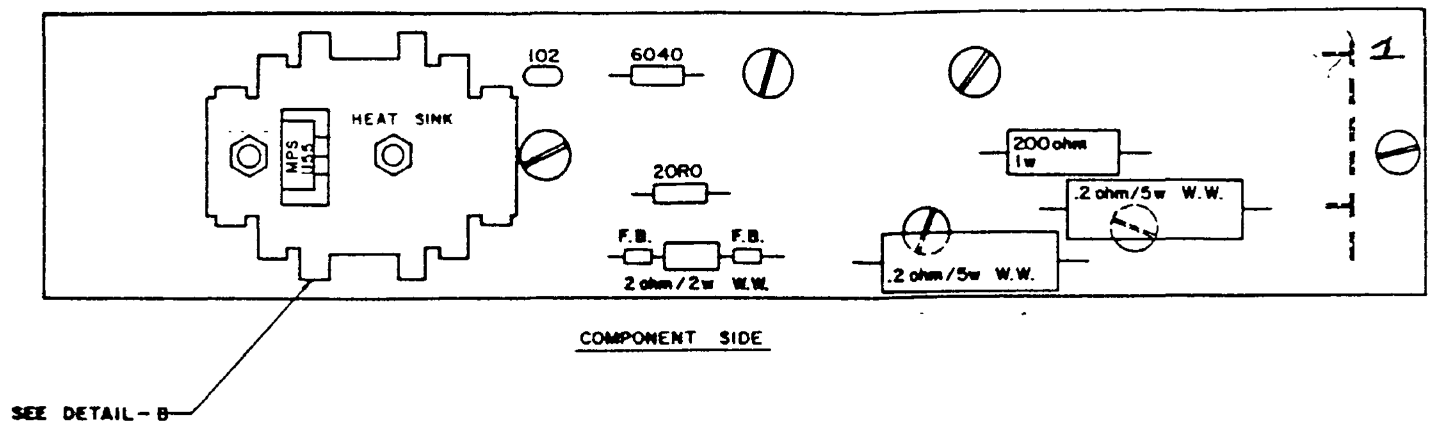
USED IN
ML-2

NAME
PRP-1 / NRP-1

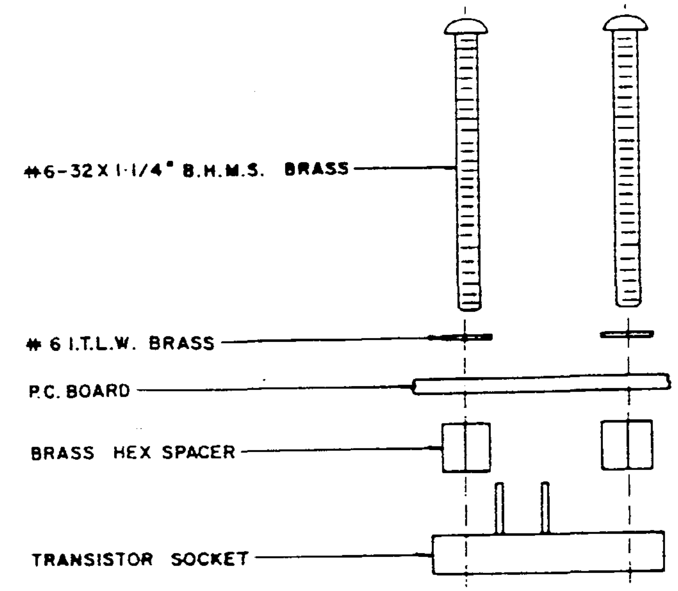
NO.
75-1711-01-00-00
75-1714-01-00-00



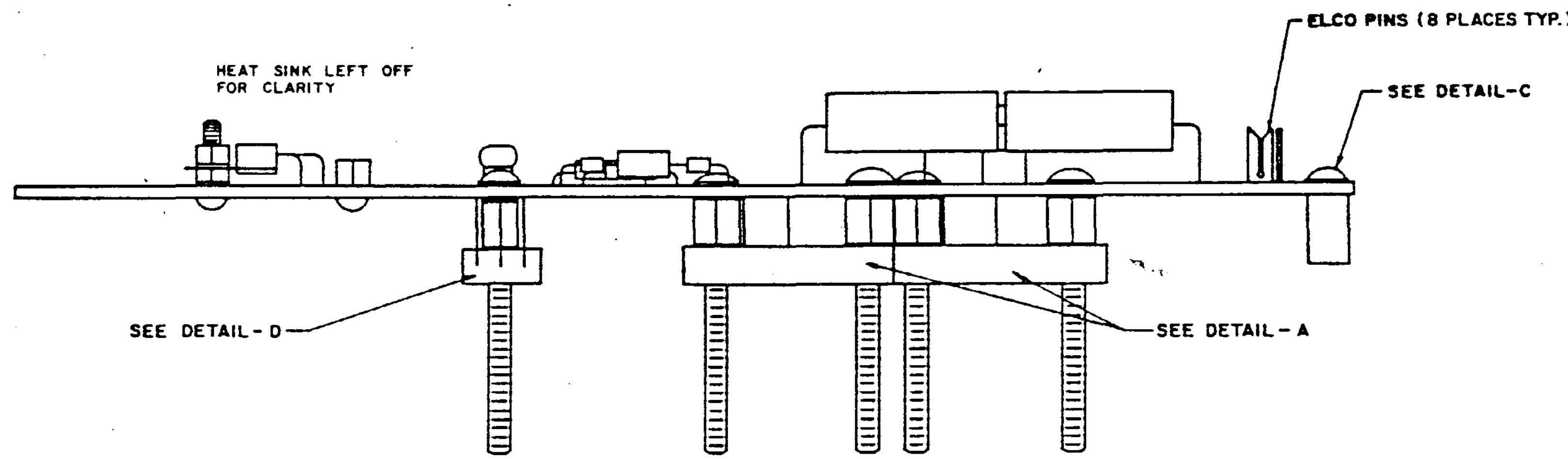
DETAIL - D

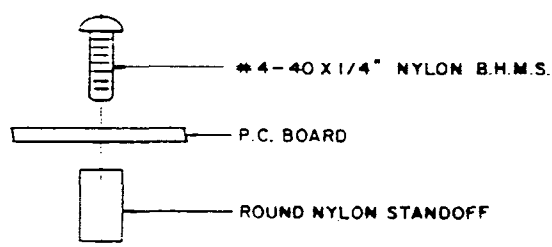


COMPONENT SIDE

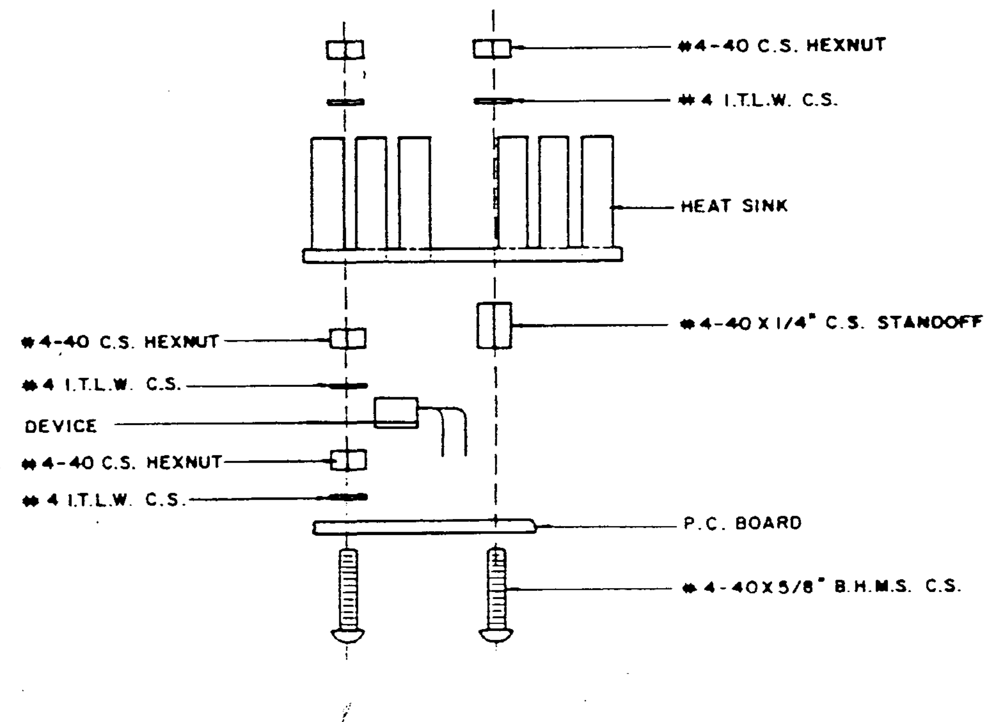


DETAIL - A

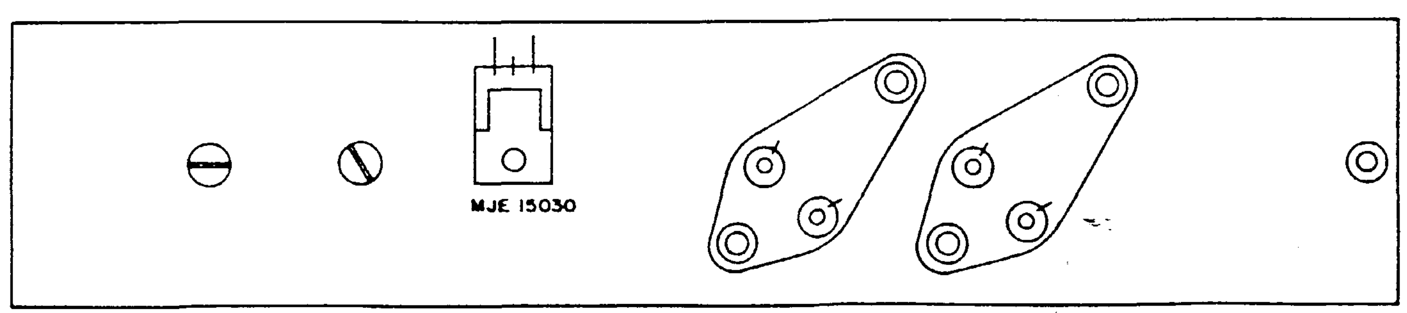




DETAIL - C



DETAIL - B



SOLDER SIDE

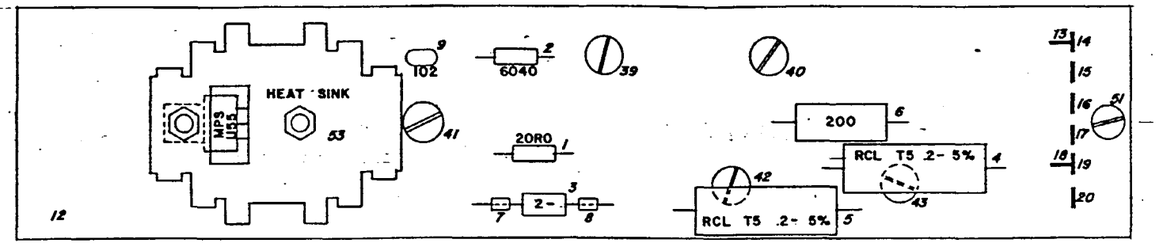
NOTE:
1 ALL CAPACITORS ARE IN CODE UNLESS OTHERWISE SPECIFIED.
2 ALL RESISTORS ARE RN55, & ARE IN CODE UNLESS OTHERWISE SPECIFIED.
3 INSTALL MOUNTING PADS ON ALL STANDING COMPONENTS.

mark levinson audio systems ltd

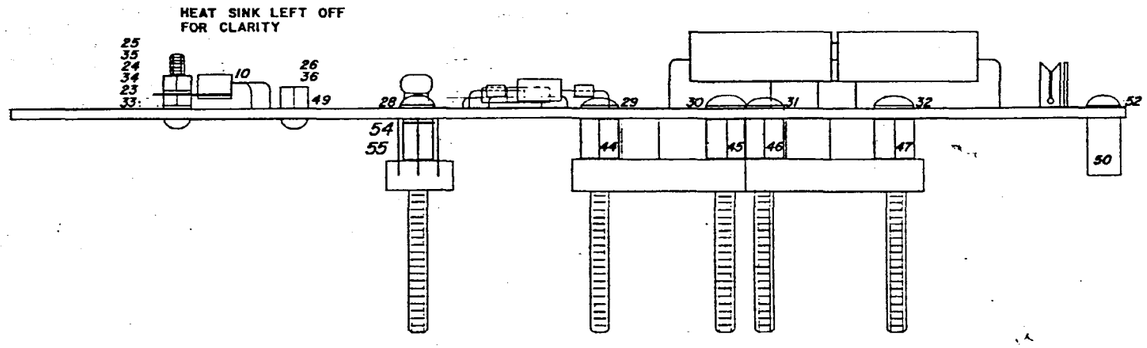
ML-2

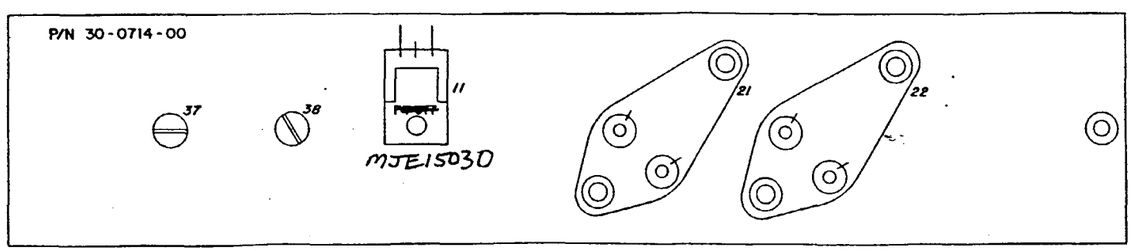
NRP-1

75-1714-01-00-00



COMPONENT SIDE

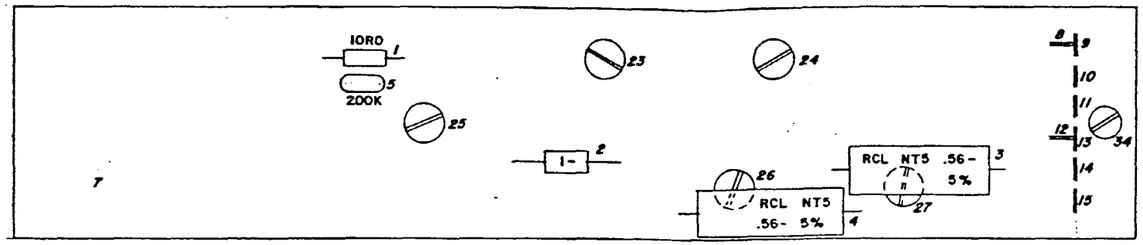




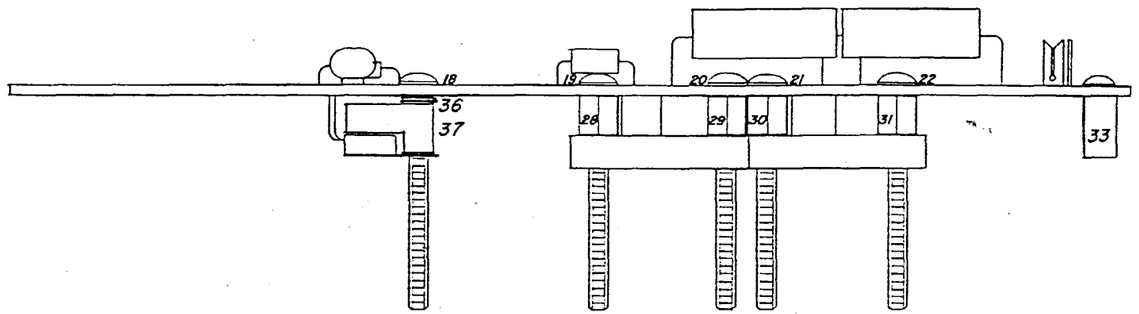
SOLDER SIDE

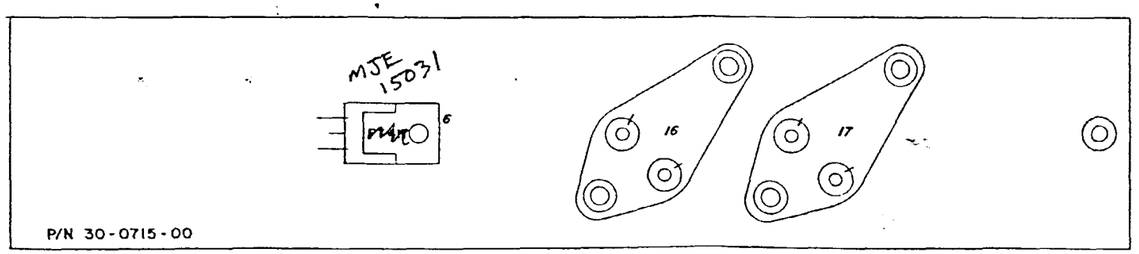
NRP-1 A-7

		TOLERANCES UNLESS SPECIFIED	mark levinson audio systems, ltd		
		FRACTION ±			
		DECIMAL ±	MATERIAL	SHEET	OF
		ANGLE ±°		1	
		DR. S.C. DATE 11-29-77	USED IN ML-2		
		CH. DATE		NO.	
ISSUE	REVISION	DATE	SCALE	NAME NRP-1	94-0714-15



COMPONENT SIDE

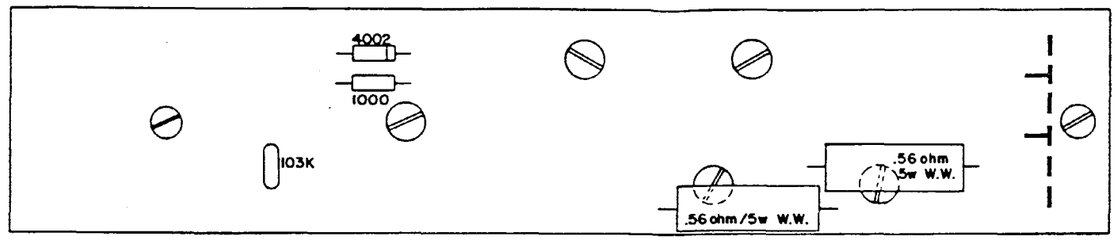




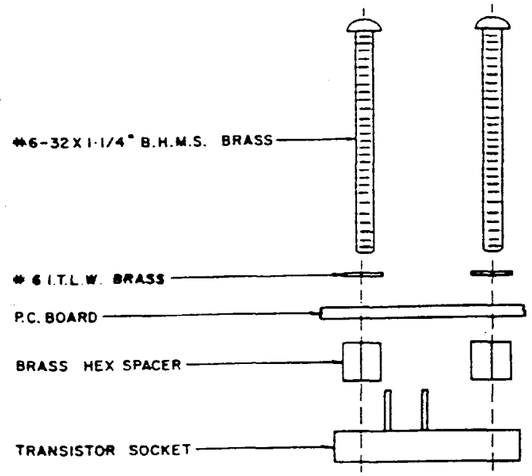
SOLDER SIDE

NDP-1 A-8

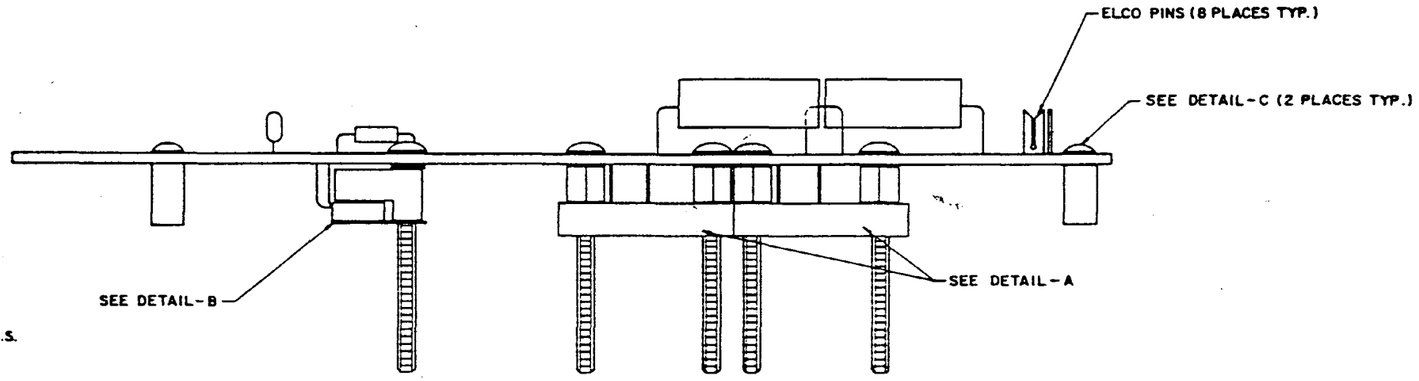
			TOLERANCES UNLESS SPECIFIED	mark levinson audio systems, ltd		
			FRACTION ±.016		SHEET	SIZE
			DECIMAL ±.005	MATERIAL		B
			ANGLE ±1°			
			DR B.C. DATE 11-29-77	USED ON ML-2		
			CH. DATE			
ISSUE	REVISION	DATE	SCALE	NAME NDP-1	NO 94-0715-15	

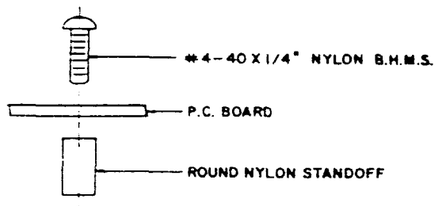


COMPONENT SIDE

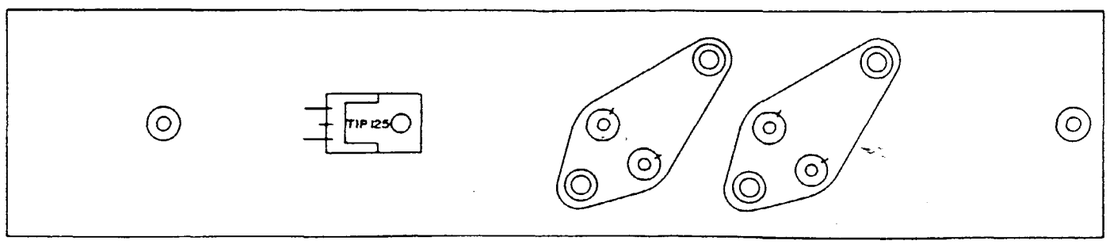


DETAIL - A

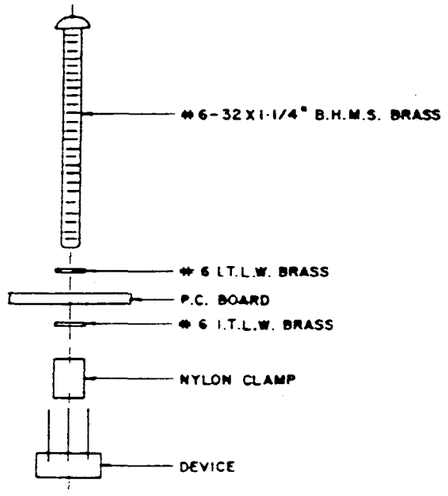




DETAIL - C



SOLDER SIDE



DETAIL - B

NOTE:
1 ALL CAPACITORS ARE IN CODE UNLESS OTHERWISE SPECIFIED.
2 ALL RESISTORS ARE RN55, B ARE IN CODE UNLESS OTHERWISE SPECIFIED.
3 INSTALL MOUNTING PADS ON ALL STANDING COMPONENTS.

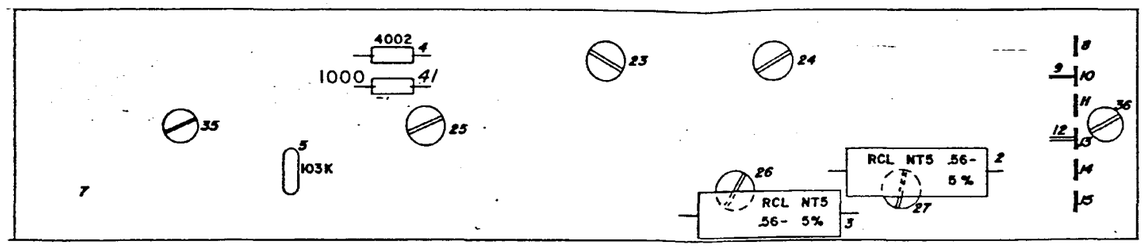
B	Change 40.2 ohms to 100 ohm 4.23	B.C.	11.24.77
A	Change 75 ohms to 40.2 ohms 9-29		

mark levinson audio systems ltd

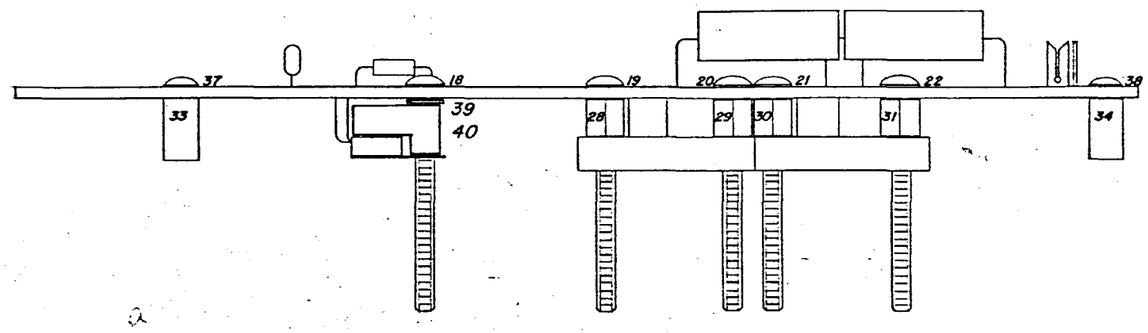
ML-2

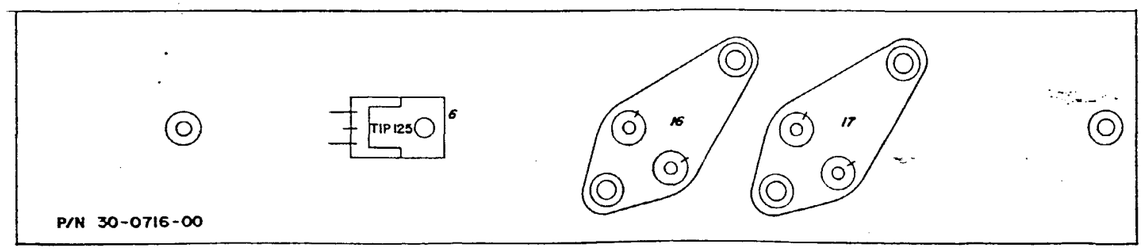
NBP-1

75-1716 01-00-00



COMPONENT SIDE

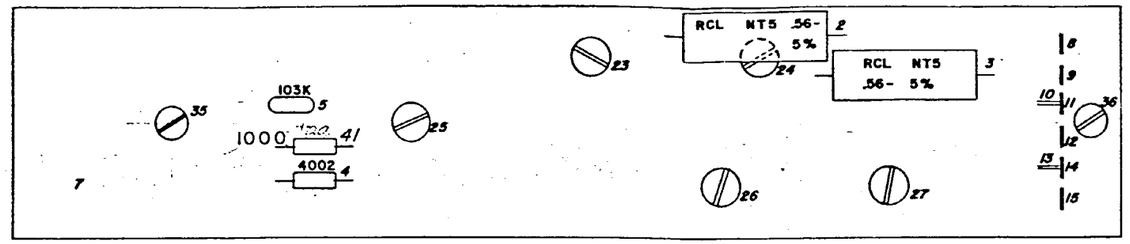




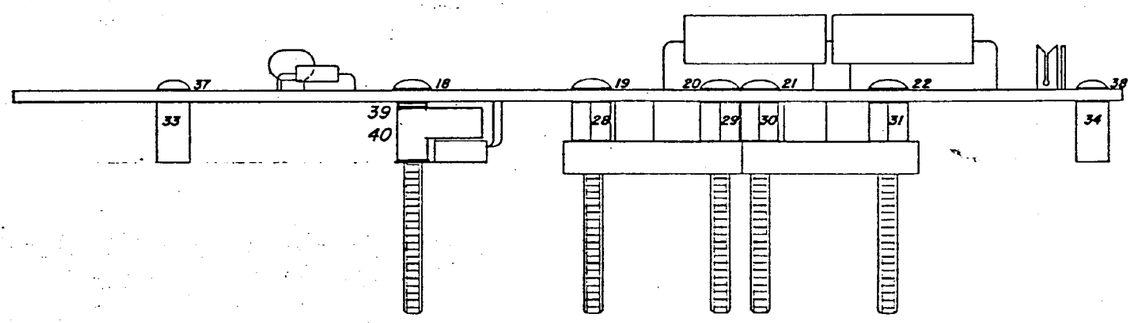
SOLDER SIDE

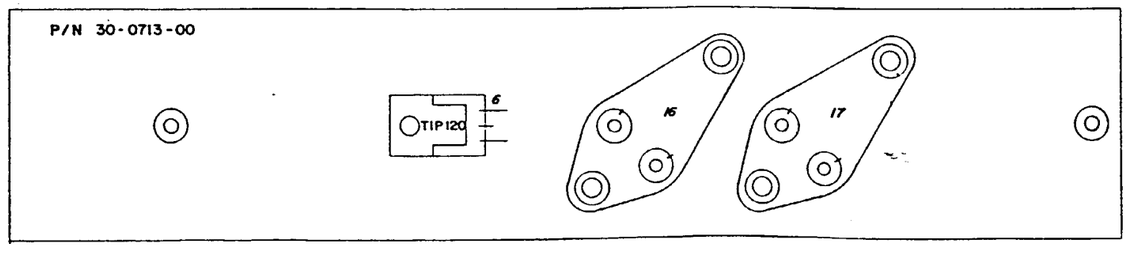
NBP-1 A-9

			TOLERANCES UNLESS SPECIFIED	mark levinson audio systems, ltd		
			FRACTION ± .010			
			DECIMAL ± .005	MATERIAL	SHEET	SIZE
			ANGLE ± 1°			A
			BY B.G.	DATE 11-29-77	USED IN ML-2	
A	Change resistor 929		BY	DATE		NO. 94-0716-15
ISSUE	REVISION	DATE	SCALE		NAME NBP-1	



COMPONENT SIDE

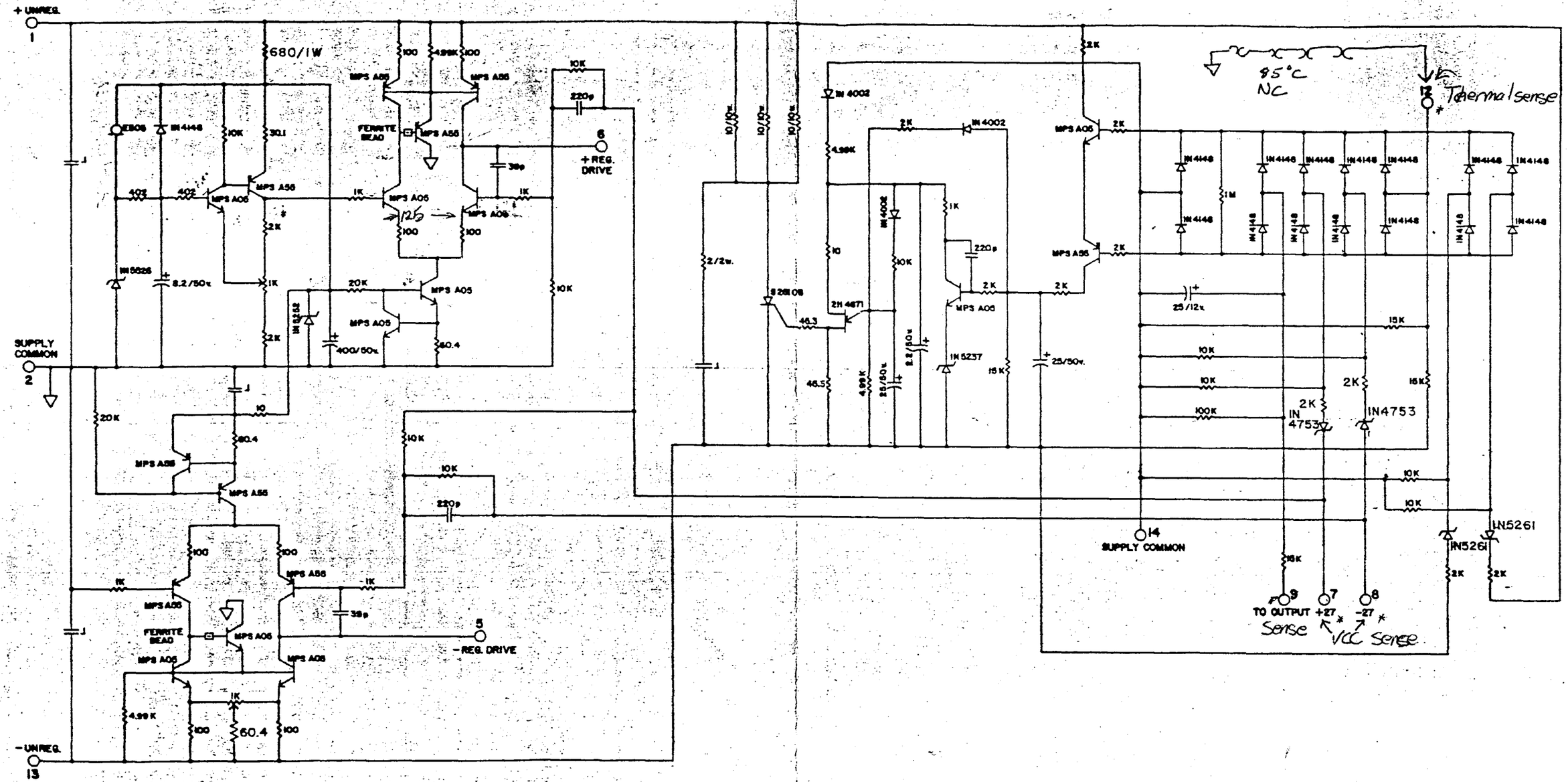




SOLDER SIDE

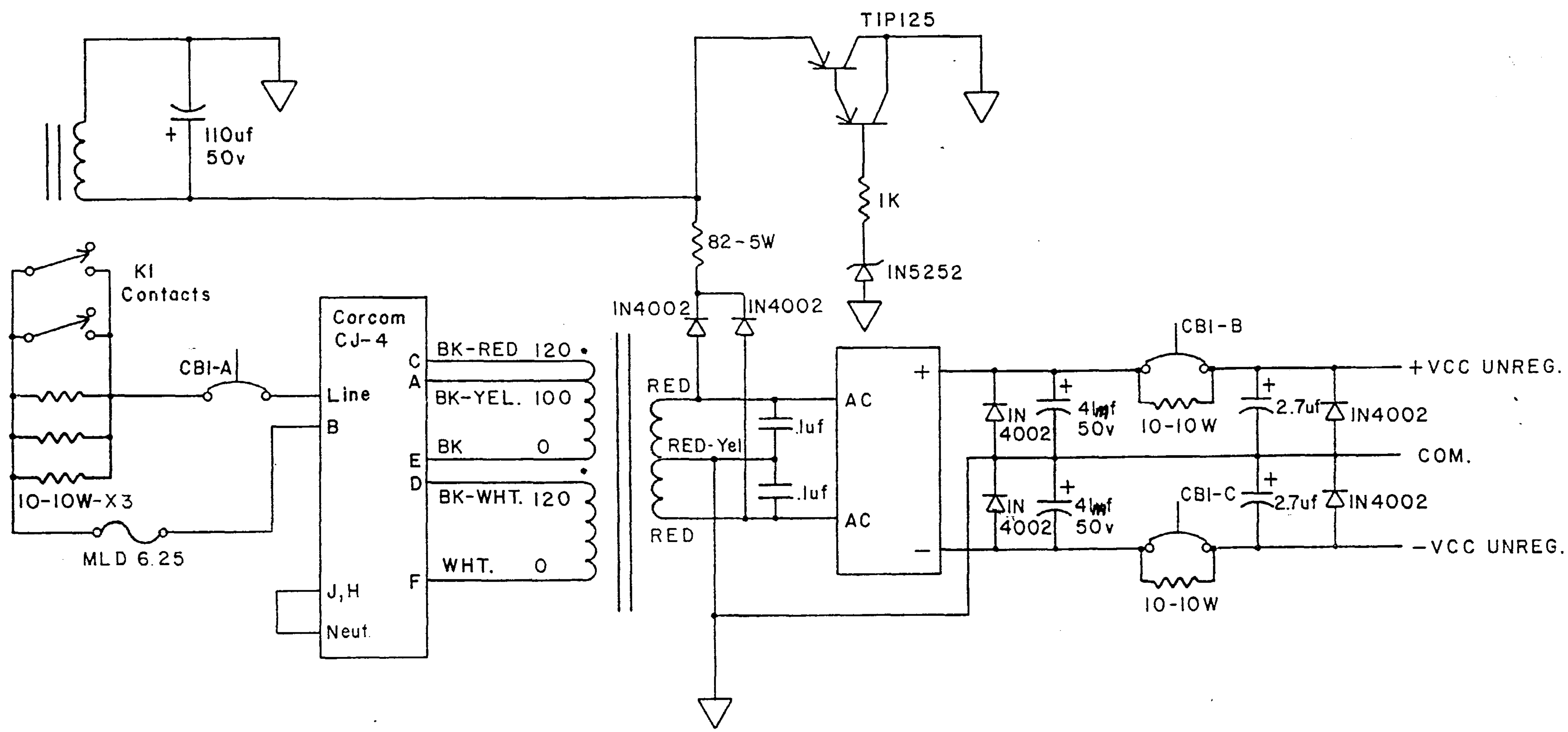
PBP-1 A-6

			TOLERANCES UNLESS SPECIFIED	mark evinson audio systems ltd		
			FRACTION ±.010		SHEET	QTY
			DECIMAL ±.005	MATERIAL	1	
			ANGLE ±1°			
			DR. S.G. DATE 11-29-77	USED IN ML-2		
A	ECN Change		CH. DATE		NO 94-0713-15	
ISSUE	REVISION	DATE	SCALE	NAME PBP-1		



REGULATOR CARD S-4

				mark levinson audio systems, ltd	
				MATERIAL	SHEET
A	8.30			USED ON ML-2	



POWER TRANSFORMER WIRING DIAGRAM S-1

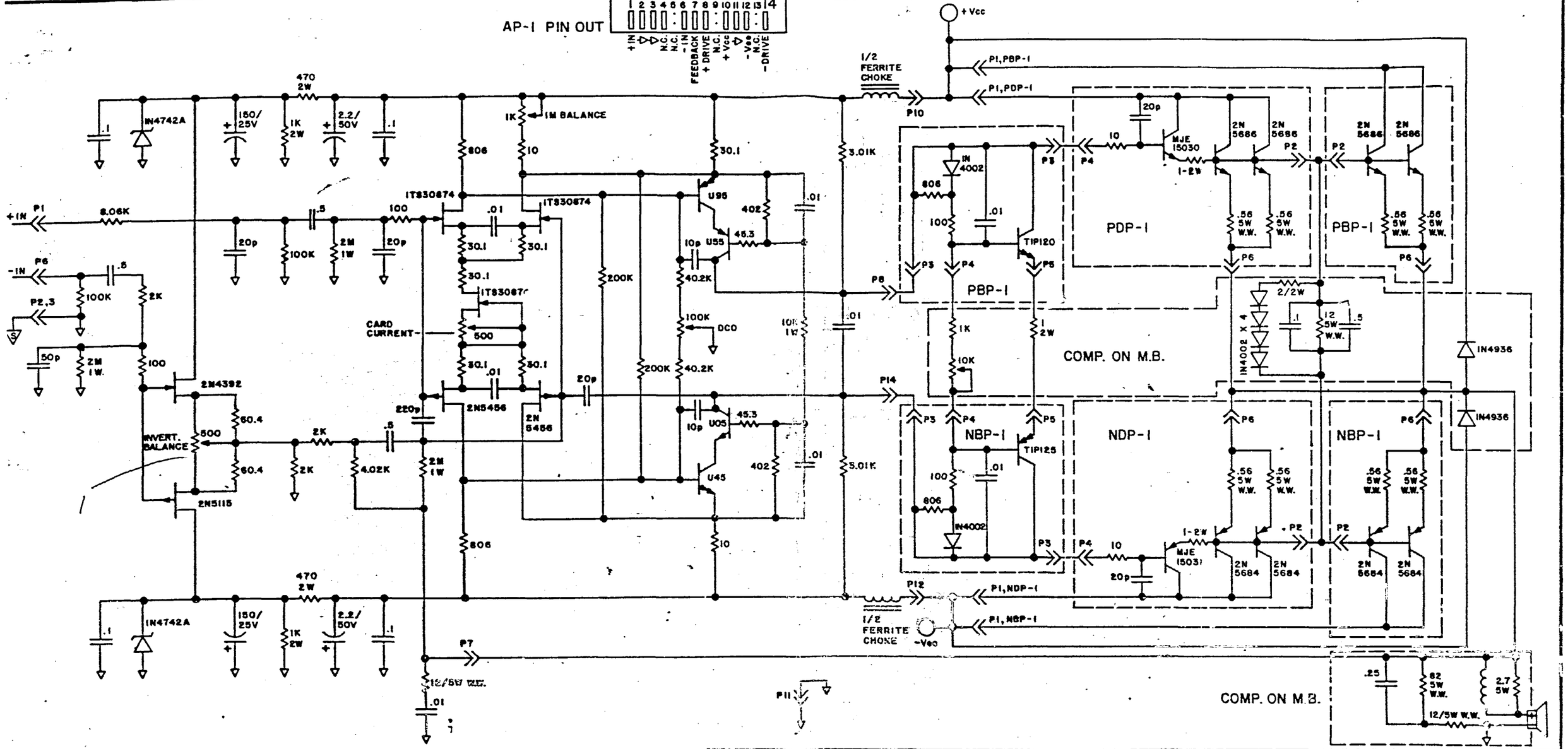
ISSUE	REVISION	DATE	TOLERANCES UNLESS SPECIFIED FRACTION ±.010 DECIMAL ±.005 ANGLE ±1° DR. DATE CH. DATE SCALE

audio systems.ltd

55 circular avenue hamden connecticut 06514 u.s.a.

MATERIAL	SHEET	OF
USED IN ML-2.	A B C D E R	
NAME	NO.	

AP-1 PIN OUT



COMP. ON M.B.

NOTE:

1. ALL RESISTORS ARE RN55,.125W MIL.,1%,& ARE IN OHMS OR IN CODE UNLESS INDICATED OTHERWISE.
2. ALL CAPACITORS ARE IN MICROFARADS OR IN CODE UNLESS INDICATED OTHERWISE.
3. $K=10^{3}$, $M=10^{6}$.
4. $m=10^{-3}$, $\mu=10^{-6}$, $n=10^{-9}$, $p=10^{-12}$.

ORIGINAL IF RED
Property of
Madrigal Audio Laboratories Inc.

ISSUE	REVISION	DATE

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±1/2°

DR. DM. DATE 4-28-86
CH. DATE

SCALE

MADRIGAL audio laboratories, inc.
2081 south main st. of middletown connecticut 06457 u.s.a.

MATERIAL

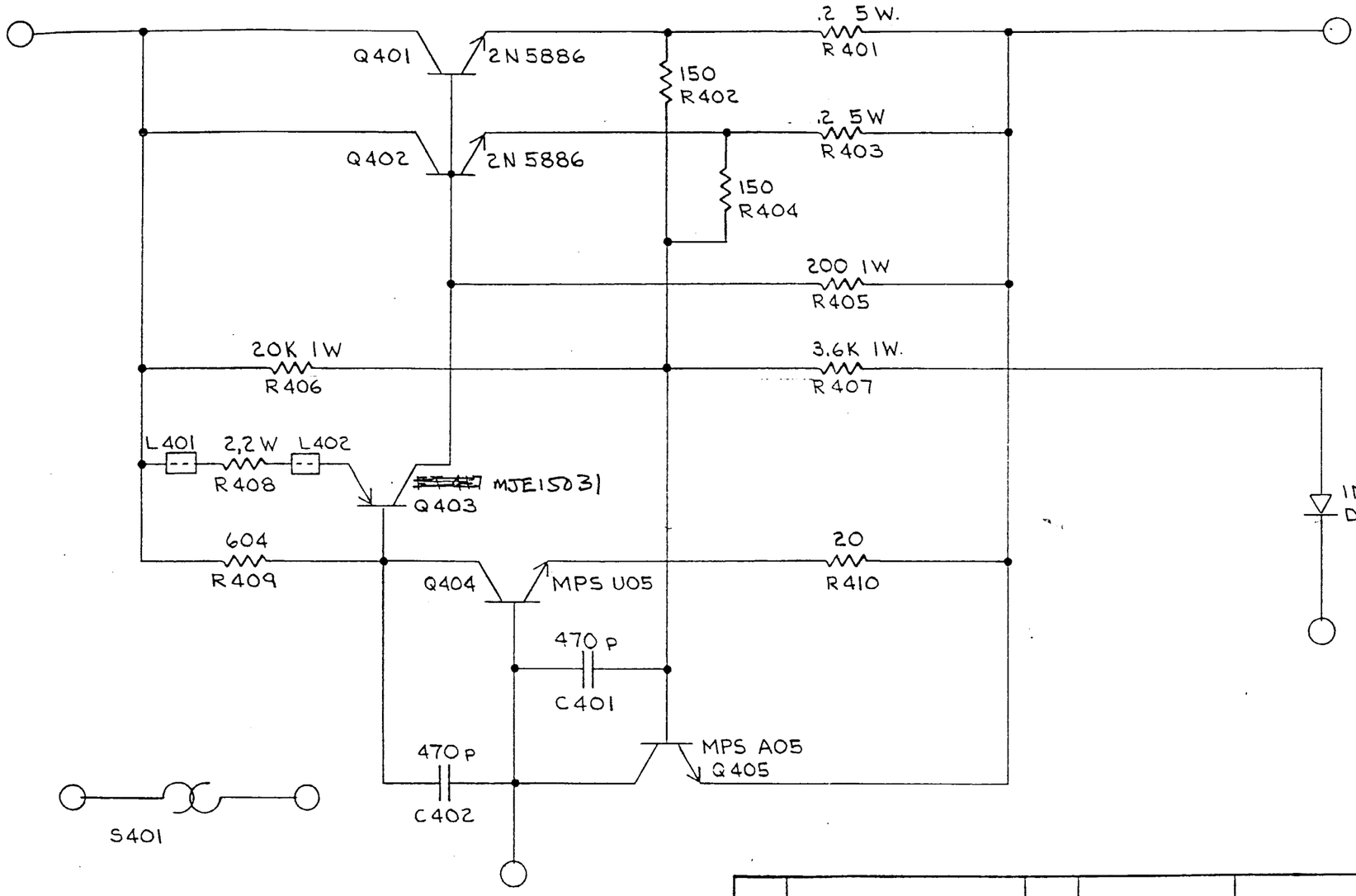
USED IN ML-2

NAME AP-1, Bias & Driver circuit

SHEET OF

A B C D E R

NO. S 75-1701-03-00-00



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 MICROFARADS UNLESS INDICATED OTHERWISE.
5. $n = 10^{-9}$, $p = 10^{-12}$

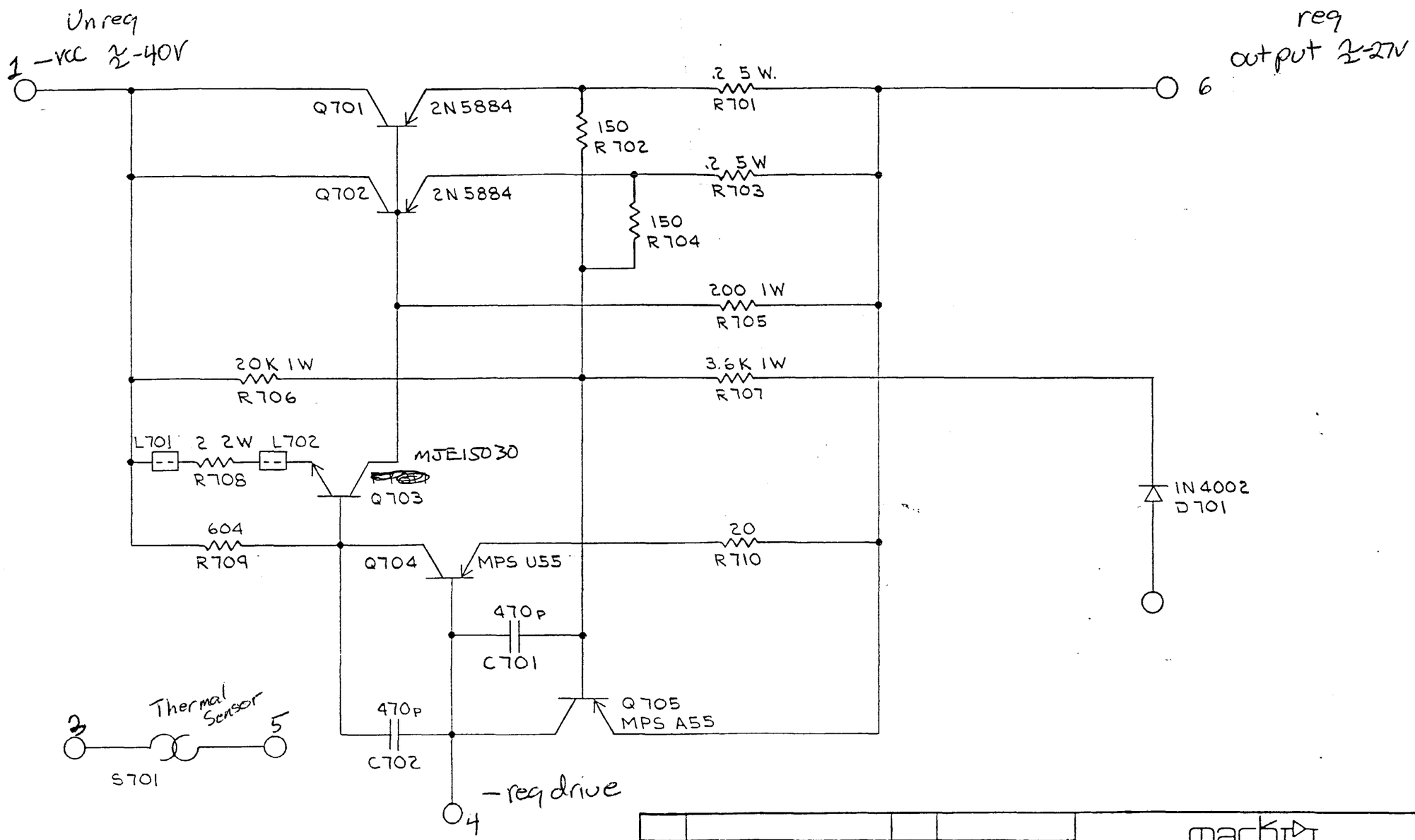
ISSUE	REVISION	DATE

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±½°

DR. S.G. DATE 7-5-77
CH. DATE
SCALE

mark levinson audio systems, ltd
55 circular avenue hamden connecticut 06514 usa

MATERIAL
SHEET OF
A B C D E R
USED IN ML-2
NAME + REGULATOR HEAT SINK BOARD
NO. 34-0009-00



NOTES:

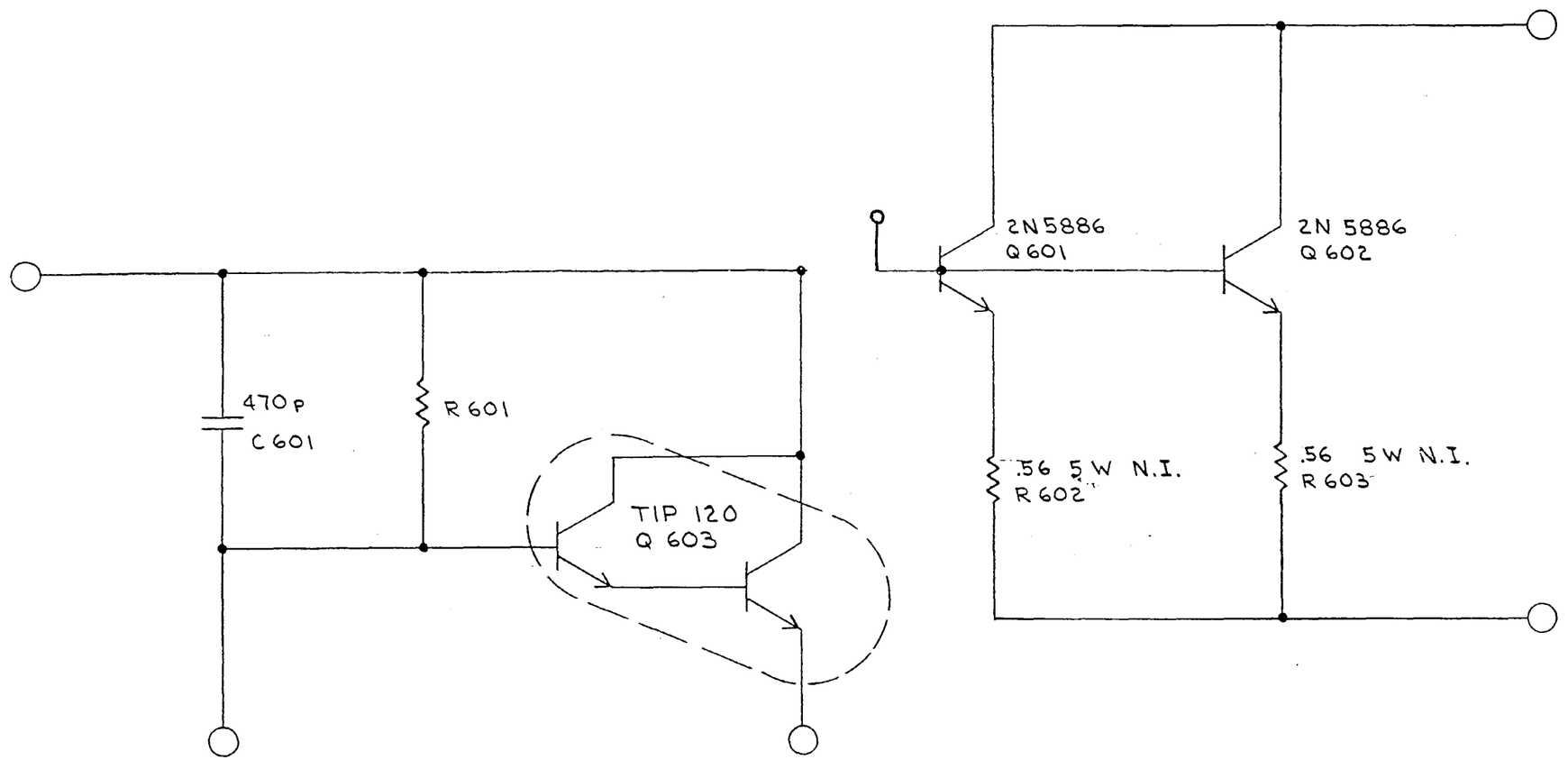
1. ALL RESISTORS ARE IN OHMS UNLESS INDICATED OTHERWISE.
2. ALL RESISTORS ARE RN55D, .25 W, 1% UNLESS INDICATED OTHERWISE.
3. $K = 10^3$, $M = 10^6$
4. ALL CAPACITORS ARE IN MICROFARADS UNLESS INDICATED OTHERWISE.
5. $n = 10^{-9}$, $p = 10^{-12}$

ISSUE	REVISION	DATE	SCALE
			TOLERANCES UNLESS SPECIFIED
			FRACTION ±.010
			DECIMAL ±.005
			ANGLE ±½°
			DR. S.G. DATE 7-5-77
			CH. DATE

mark levinson audio systems, ltd

55 circular avenue hamden connecticut 06514 usa

MATERIAL		SHEET		OF			
		A	B	C	D	E	R
USED IN	ML-2						
NAME	- REGULATOR HEAT SINK BOARD	NO.	94-0010-00				



NOTES:

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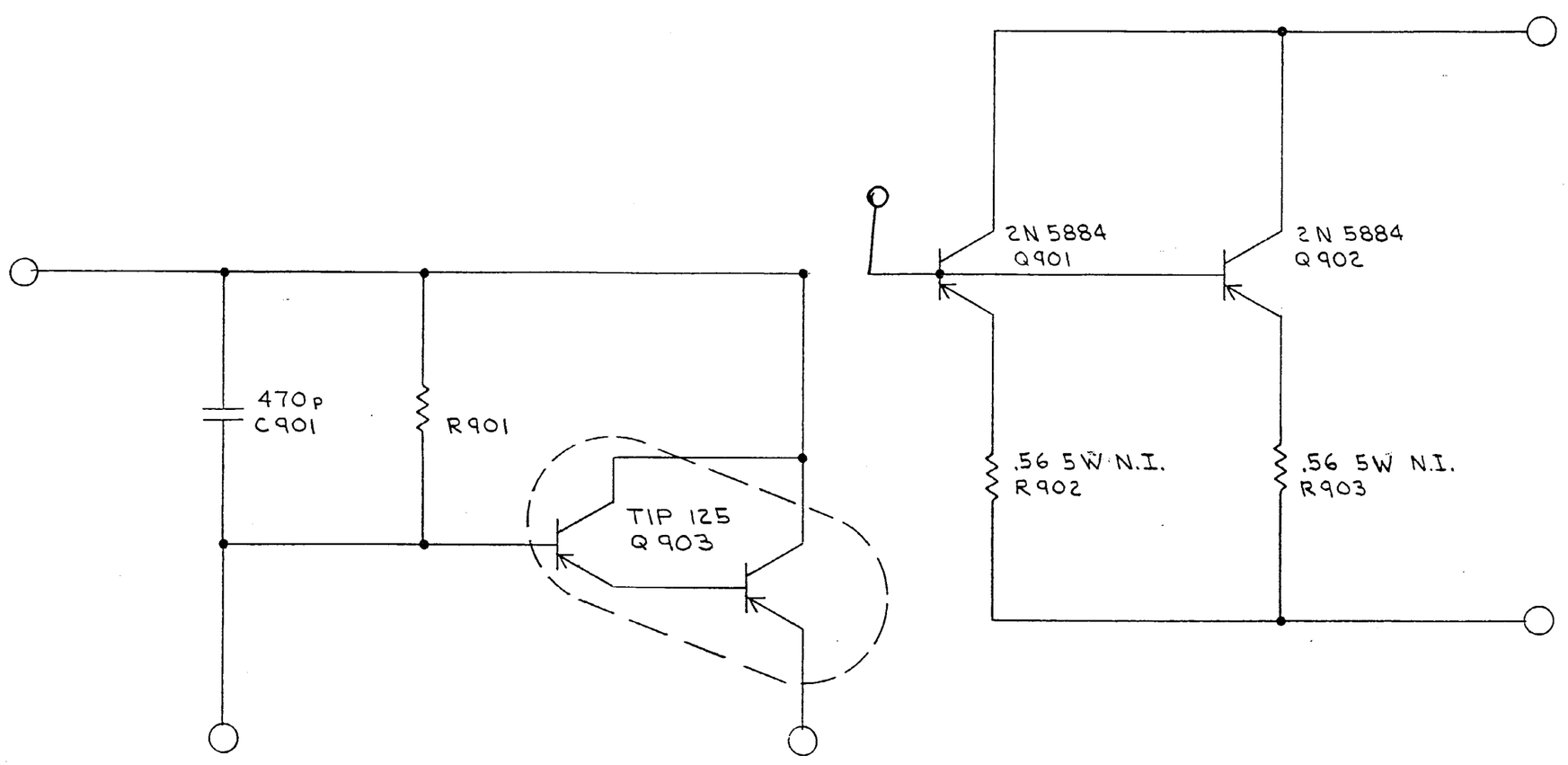
3. $K = 10^3$, $M = 10^6$
4. ALL CAPACITORS ARE IN MICROFARADS UNLESS INDICATED OTHERWISE.
5. $n = 10^{-9}$, $p = 10^{-12}$

ISSUE	REVISION	DATE	SCALE
			TOLERANCES UNLESS SPECIFIED
			FRACTION ±.010
			DECIMAL ±.005
			ANGLE ±½°
			DR. S.G. DATE 7-6-77
			CH. DATE

mark levinson audio systems, ltd

55 circular avenue hamden connecticut 06514 u.s.a

MATERIAL		SHEET	OF				
USED IN ML-2		A	B	C	D	E	R
NAME + AUDIO OUTPUT & BIAS REG. H.S. BOARD	NO. 94-0011-00						



NOTES :

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

ISSUE	REVISION	DATE	SCALE

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±½°

DR. S.G. DATE 7-5-77
CH. DATE

mark levinson audio systems, ltd
55 circular avenue hamden connecticut 06514 usa

MATERIAL

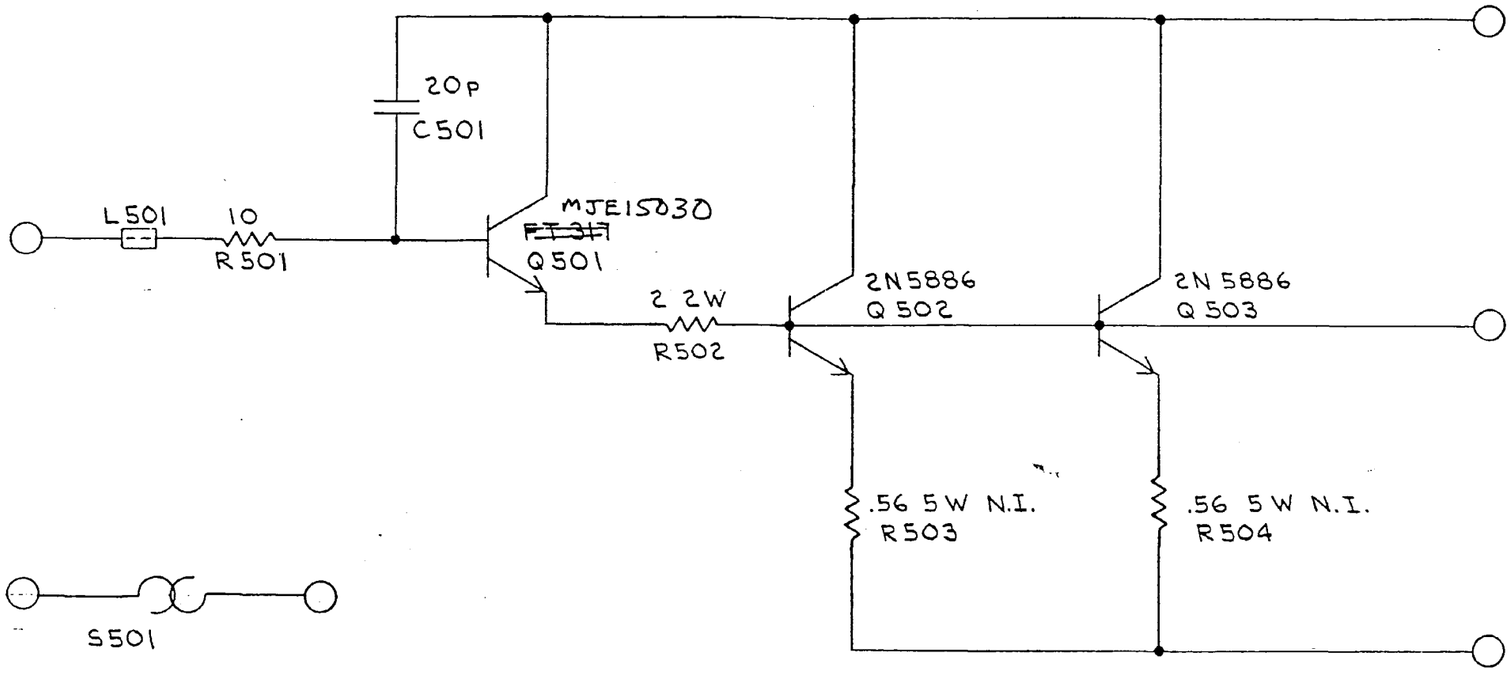
SHEET OF

A B C D E R

USED IN ML-2

NAME – AUDIO OUTPUT & BIAS REG. H.S. BOARD

NO. 94-0012-00



NOTES:

1. ALL RESISTORS ARE IN OHMS UNLESS INDICATED OTHERWISE.
2. ALL RESISTORS ARE RN55 D, .25 W, 1% UNLESS INDICATED OTHERWISE.
3. K = 10^3, M = 10^6
4. ALL CAPACITORS ARE IN MICROFARADS UNLESS INDICATED OTHERWISE.
5. n = 10^{-9}, p = 10^{-12}

ISSUE	REVISION	DATE	SCALE
			TOLERANCES UNLESS SPECIFIED FRACTION ±.010 DECIMAL ±.005 ANGLE ±½°
			DR. S.G. DATE 7-6-77
			CH. DATE

mark levinson audio systems, ltd

55 circular avenue hamden connecticut 06514 u.s.a

MATERIAL

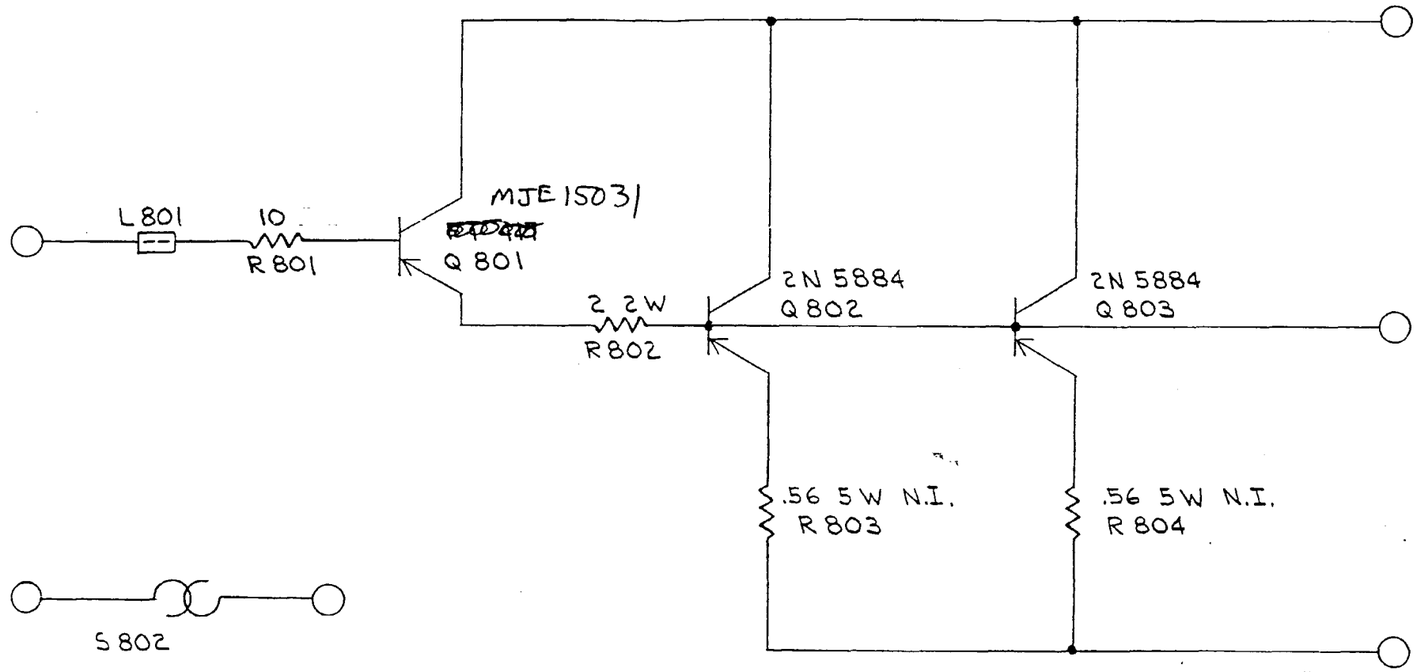
SHEET OF

USED IN ML-2

A B C D E R

NAME + AUDIO OUTPUT & DRIVER H.S. BOARD

NO. 94-0013-00



NOTES:

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

ISSUE	REVISION	DATE

TOLERANCES UNLESS SPECIFIED
FRACTION ±.010
DECIMAL ±.005
ANGLE ±½°

DR.	DATE
S.G.	7-6-77
CH.	DATE

SCALE

mark levinson audio systems, ltd
55 circular avenue hamden connecticut 06514 usa

MATERIAL

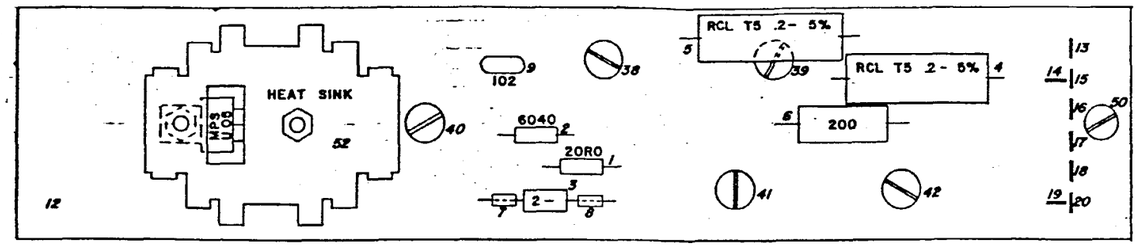
SHEET OF

A	B	C	D	E	R

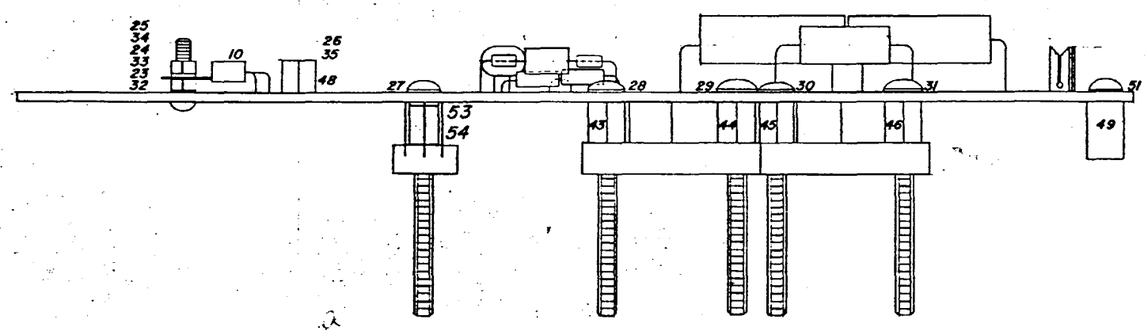
USED IN
ML-2

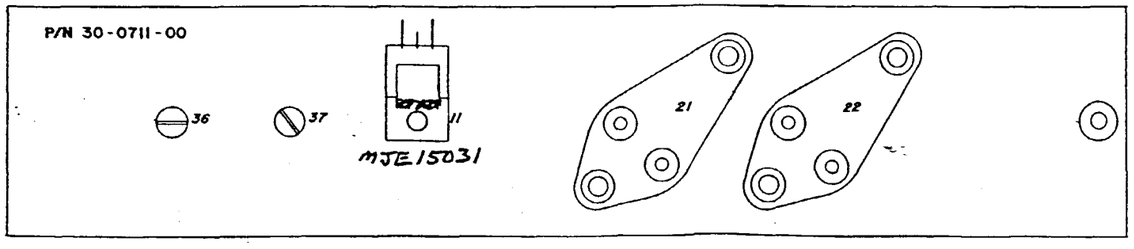
NAME – AUDIO OUTPUT & DRIVER H.S. BOARD

NO.
94-0014-00



COMPONENT SIDE

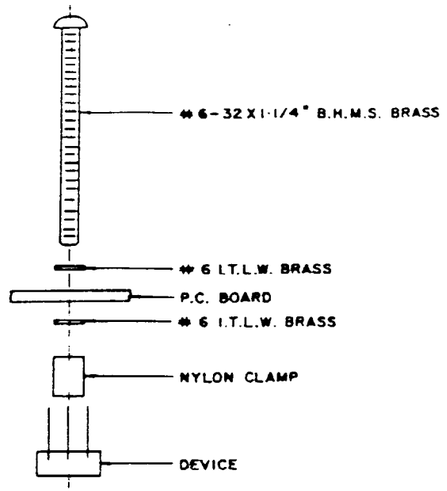




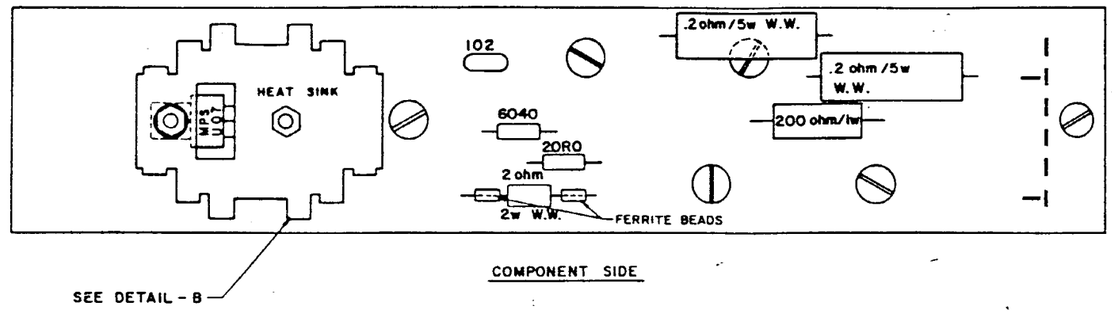
SOLDER SIDE

PRP-1 A-4

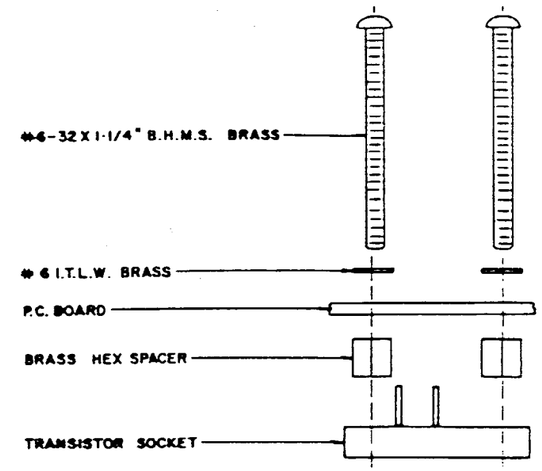
				TOLERANCES UNLESS SPECIFIED FRACTION ±.016 DECIMAL ±.005 ANGLE ±1°	mark levinson audio systems, ltd		
					MATERIAL	SHEET	OF
				DR. S.C. DATE 11-28-77	USED ON ML-2		
				CH. DATE	NAME PRP-1	NO. 94-0711-15	
ISSUE	REVISION	DATE	SCALE				



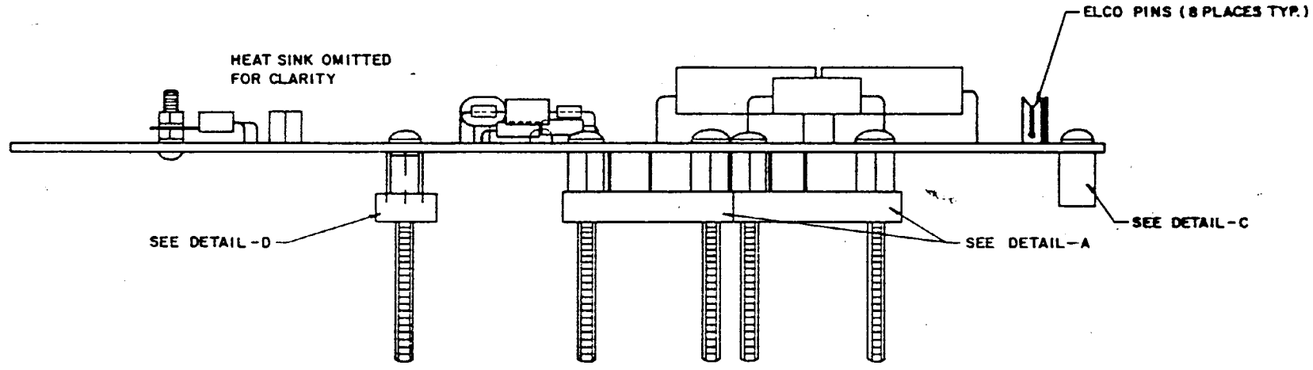
DETAIL - D

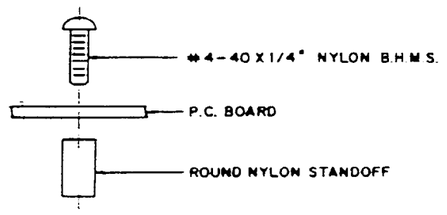


COMPONENT SIDE

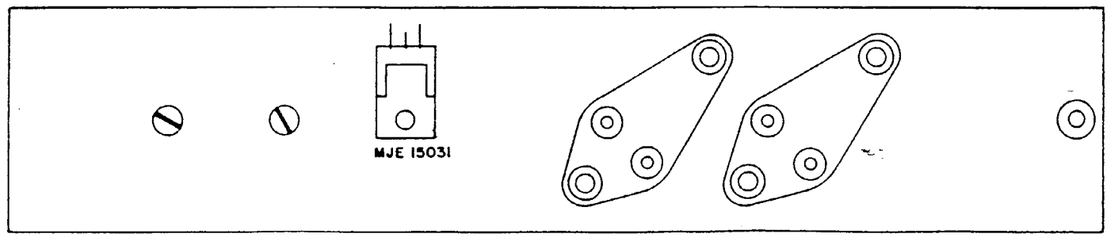


DETAIL - A

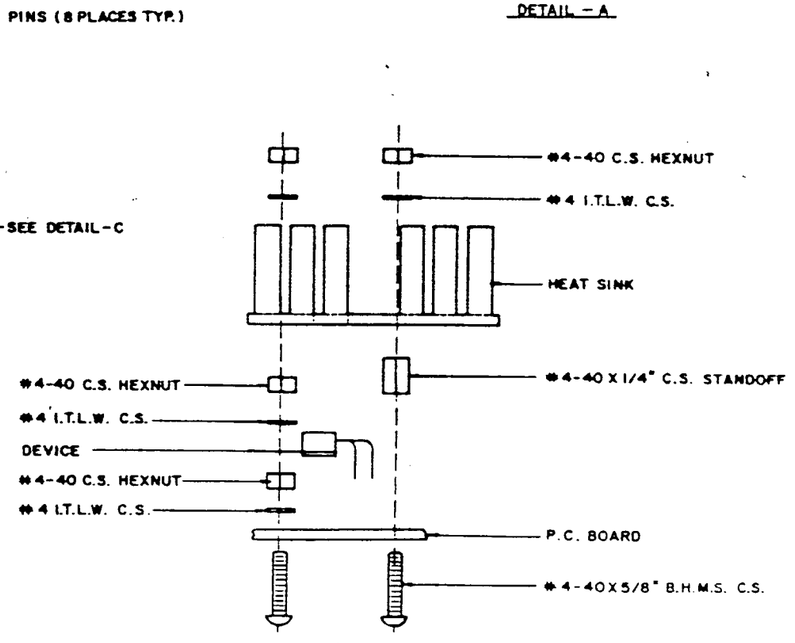




DETAIL - C



SOLDER SIDE



DETAIL - B

NOTE:
1 ALL CAPACITORS ARE IN CODE UNLESS OTHERWISE SPECIFIED.
2 ALL RESISTORS ARE RN55, 8 ARE IN CODE UNLESS OTHERWISE SPECIFIED.
3 INSTALL MOUNTING PADS ON ALL STANDING COMPONENTS.

mark levinson AUDIO SYSTEMS LTD

ML-2

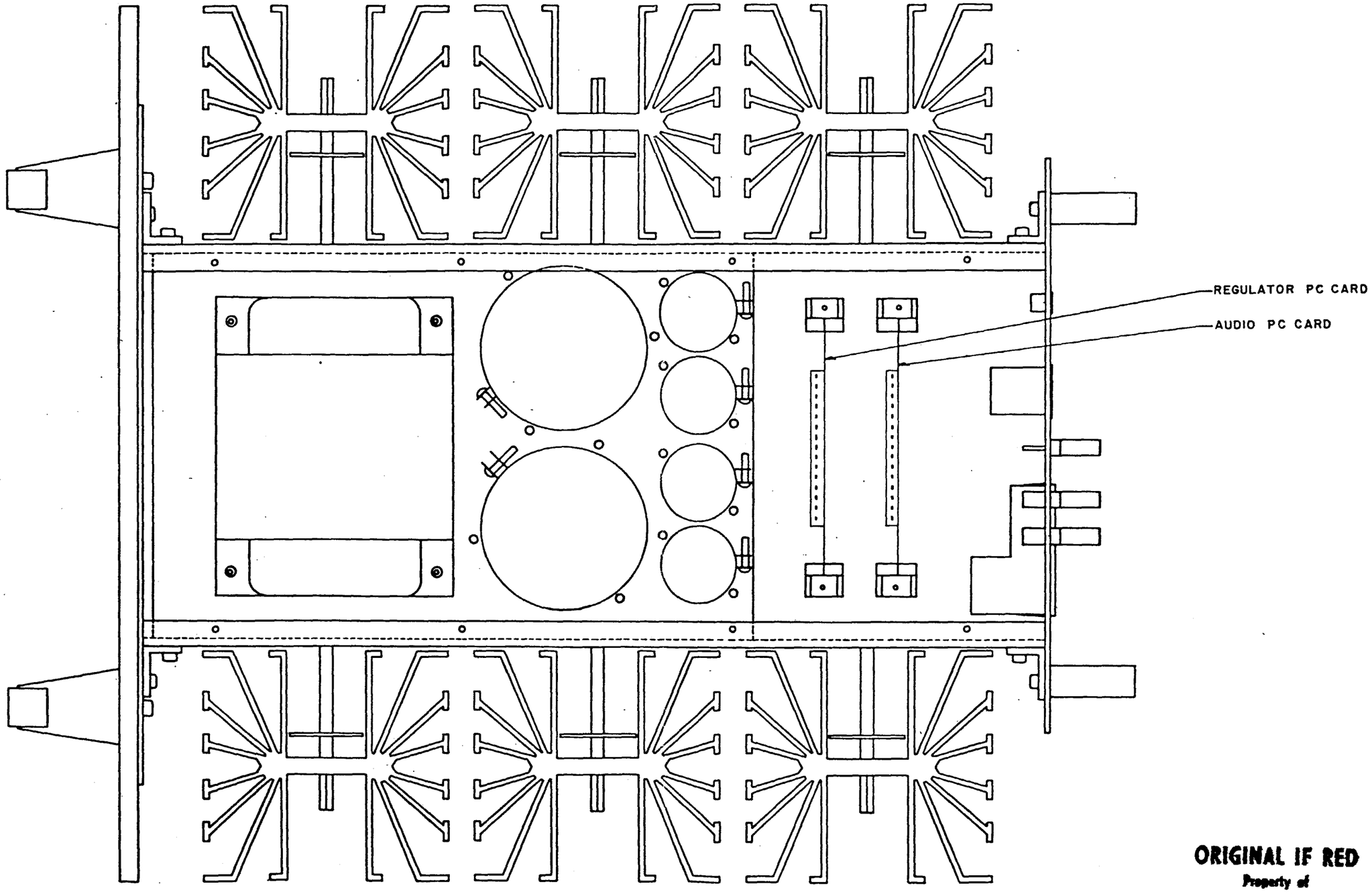
PRP-1

75 171 01 00 00

POS. REG.

POS. DRIVER & OUTPUT

POS. BIAS & OUTPUT



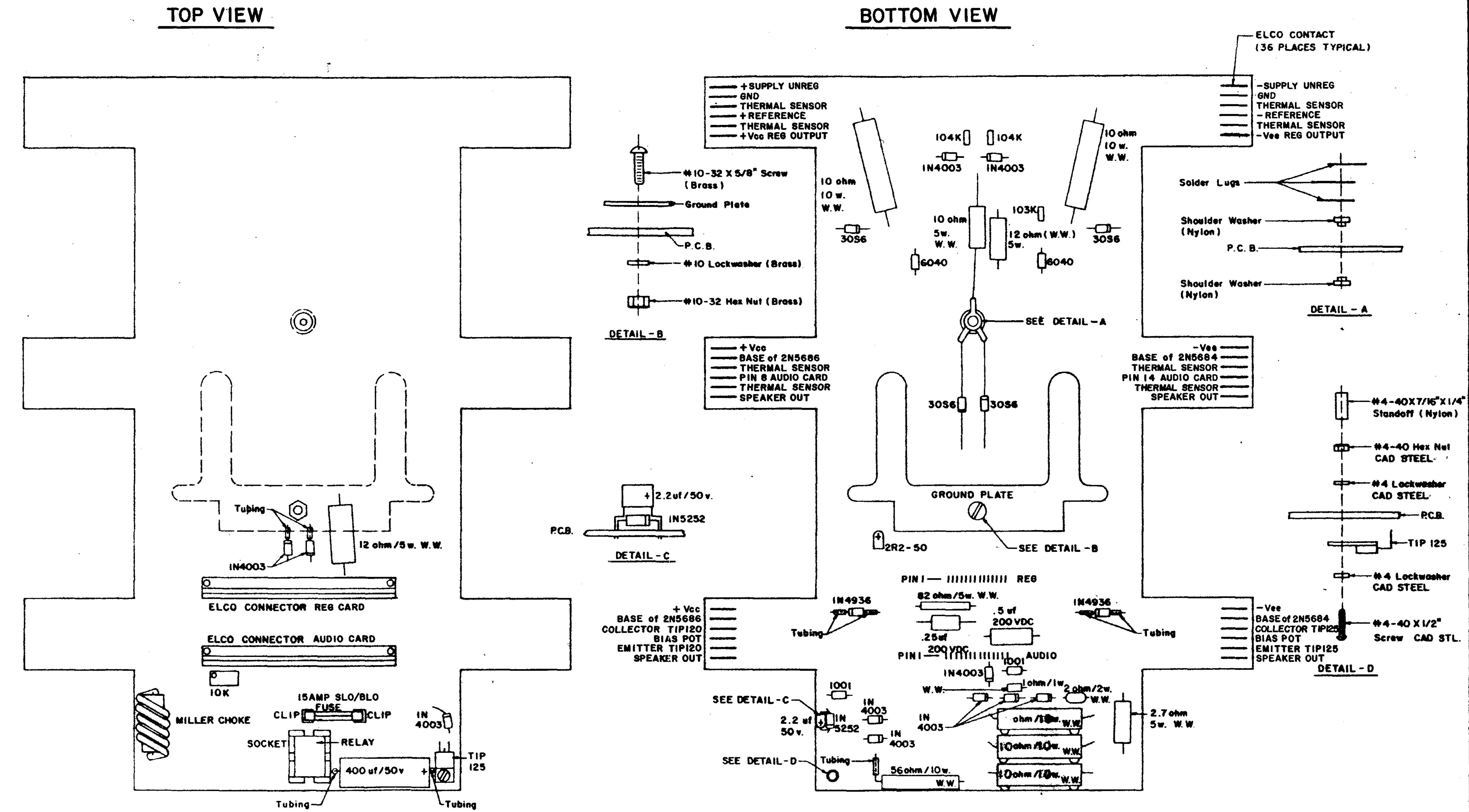
NEG. REG.

NEG. DRIVER & OUTPUT

NEG. BIAS & OUTPUT

ML-2 TOP VIEW

A-10



AUDIO CARD PIN OUT

1 + IN
2 GND
3 GND
4 N.C.
5 N.C.
6 - IN
7 FEEDBACK
8 +DRIVE
9 N.C.
10 +Vcc
11 GND
12 -Vee
13 N.C.
14 -DRIVE

REG CARD PIN OUT

1 + UNREG
2 GND
3 N.C.
4 N.C.
5 -REG DRIVE
6 +REG DRIVE
7 +Vcc FAULT SENSE
8 -Vee FAULT SENSE
9 OUTPUT FAULT SENSE
10 N.C.
11 N.C.
12 THERMAL FAULT SENSE
13 -UNREG
14 -FAULT SENSE

NOTE:

1 ALL RESISTORS ARE RN55 & ARE CODED.
2 ALL CAPACITORS ARE CODED UNLESS OTHERWISE SPECIFIED.
3 ALL STANDING COMPONENTS ARE TO BE INSTALLED WITH MOUNTING PADS UNLESS SHOWN OTHERWISE.

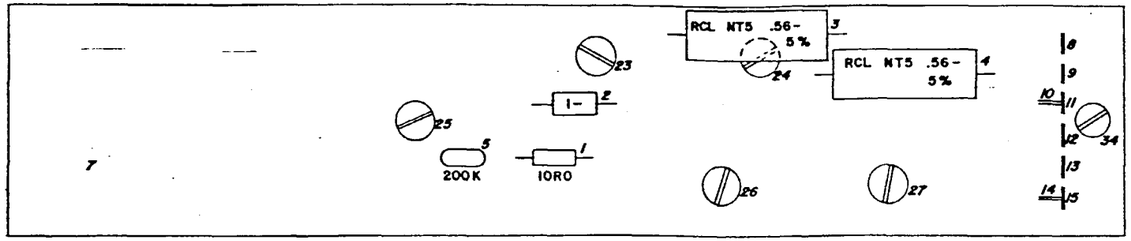
MADRIGAL audio laboratories, inc.

USED IN: ML-2

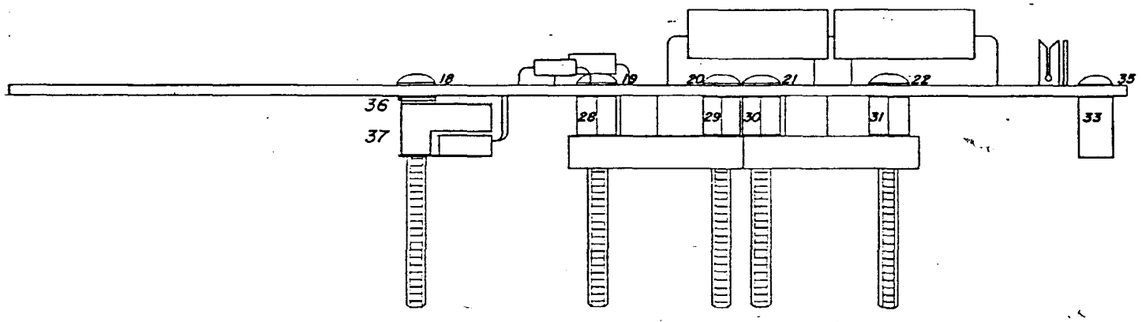
DATE: 6/10/81; 7/1/81

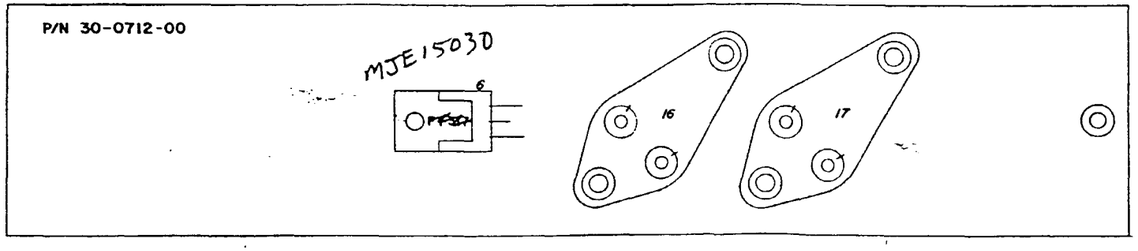
NAME: MOTHERBOARD

NO. 75 1702 01 00 00



COMPONENT SIDE

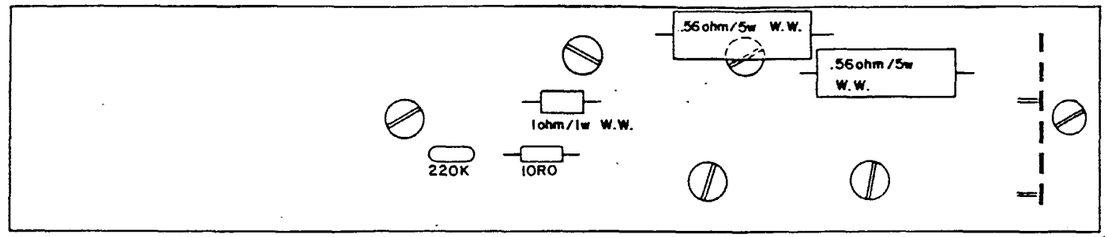




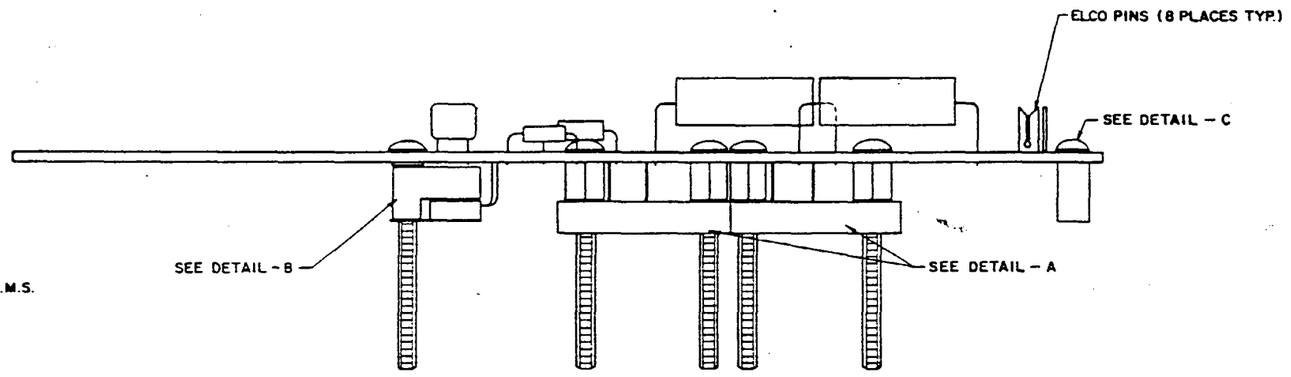
SOLDER SIDE

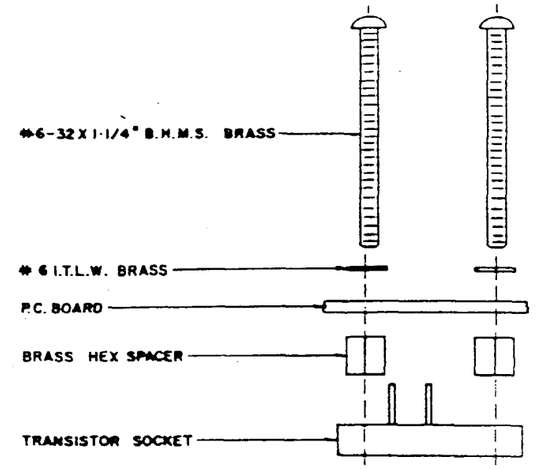
PDP-1 A-5

			TOLERANCES UNLESS SPECIFIED	mark evinson audio systems, ltd	
			FRACTION ±.010		
			DECIMAL ±.005		
			ANGLE ±1°	MATERIAL	SHEET
			DR. B.C. 11-16-77	USED IN ML-2	
			CH. DATE	NAME PDP-1	NO. 94-0712-15
ISSUE	REVISION	DATE	SCALE		

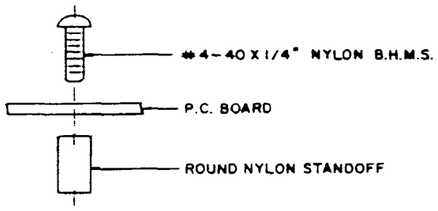


COMPONENT SIDE

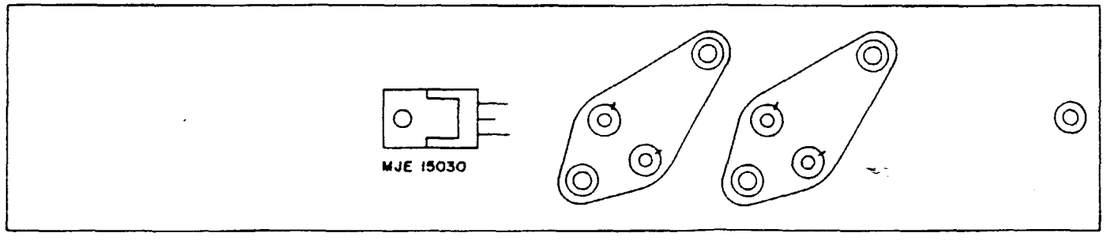




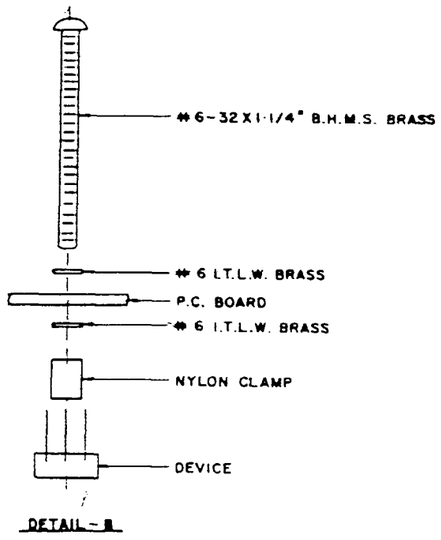
DETAIL - A



DETAIL - C



SOLDER SIDE



DETAIL - B

NOTE:
1 ALL CAPACITORS ARE IN CODE UNLESS OTHERWISE SPECIFIED.
2 ALL RESISTORS ARE RN55, & ARE IN CODE UNLESS OTHERWISE SPECIFIED.
3 INSTALL MOUNTING PADS ON ALL STANDING COMPONENTS.

mark levinson audio systems ltd

5 6 31 2877 ML-2

PDP-1

75.1712.01.00.00

Typical ML-2 specifications:

supply rails set ±28.00 ~ 28.25 VDC
output idle current set ≈ 4 Amps

@ 8Ω load w/ 1KHZ clip at 17V = 36W

THD @ 25W with 20KHZ
inverting or non-inverting mode 0.07%

IMD @ 25W SMPTE method
inverting or non-inverting mode 0.035%

@ 4Ω load w/ 1 KHZ clip at 17V = 72W

THD @ ~~25~~ 50W with 20KHZ
inverting or non-inverting mode 0.095%

IMD @ 50W SMPTE method
inverting or non-inverting mode 0.045%

@ 2Ω load w/ 1KHZ clip at 16.5V = 136W
class A operation w/ 2Ω load 10V = 50W

THD @ 100W with 20KHZ
inverting or non-inverting mode 0.25%

THD @ 50W with 20KHZ
inverting or non-inverting 0.10%

IMD @ 100W SMPTE method
inverting or non-inverting mode 0.30%

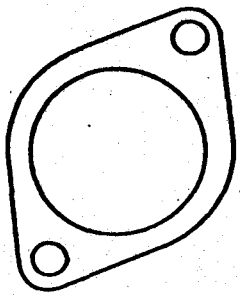
IMD @ 50W SMPTE method
inverting or non-inverting mode 0.04%

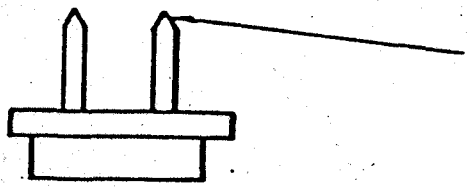
power supply: line regulation better than 1%
load regulation better than 0.15%

ML-2 TRANSISTOR REPLACEMENT

When 2N5684 and 2N5686 transistors are supplied, it will be necessary to trim the leads (as shown in diagram below) and to enlarge the socket openings in the heatsink.

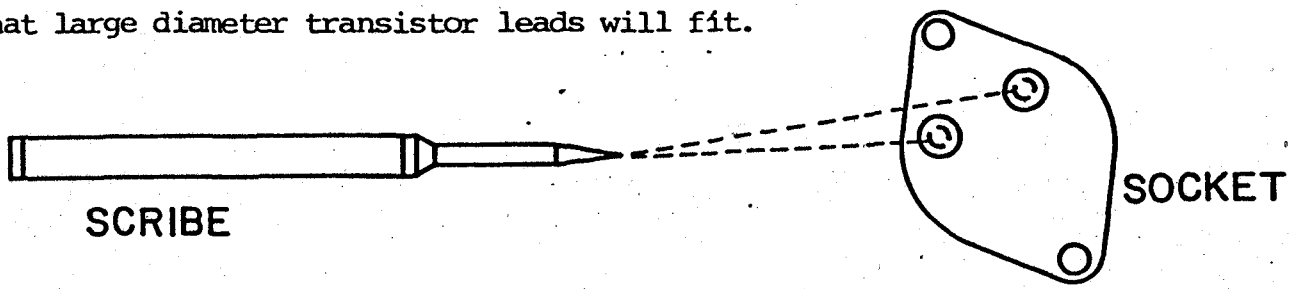
(TO3) Power Transistor





Snipping the leads with a diagonal cutter will create a bevel on the end of the lead.

Using scribe like tool, spread transistor socket contacts so that large diameter transistor leads will fit.



Replace insulators and then mount replacement transistors. Before tightening transistor nuts, tighten all screws from printed circuit side of heatsink. Now snug transistor nuts. Over tightening transistors will destroy insulators. Check all other nuts on outer side of heatsink.

ML-2 RELIABILITY TEST

1) Adjust the variac for 115V.

2) Adjust the DC supplies for + & - 32V and idle current for 4A (.56V). Use + & - 27V and 5A (.7V) for Ecore type. (See diagrm 1)

3) Defeat the crowbar circuit, (see diagram 1) and bypass two .5uf capacitors as shown in diagram 2.

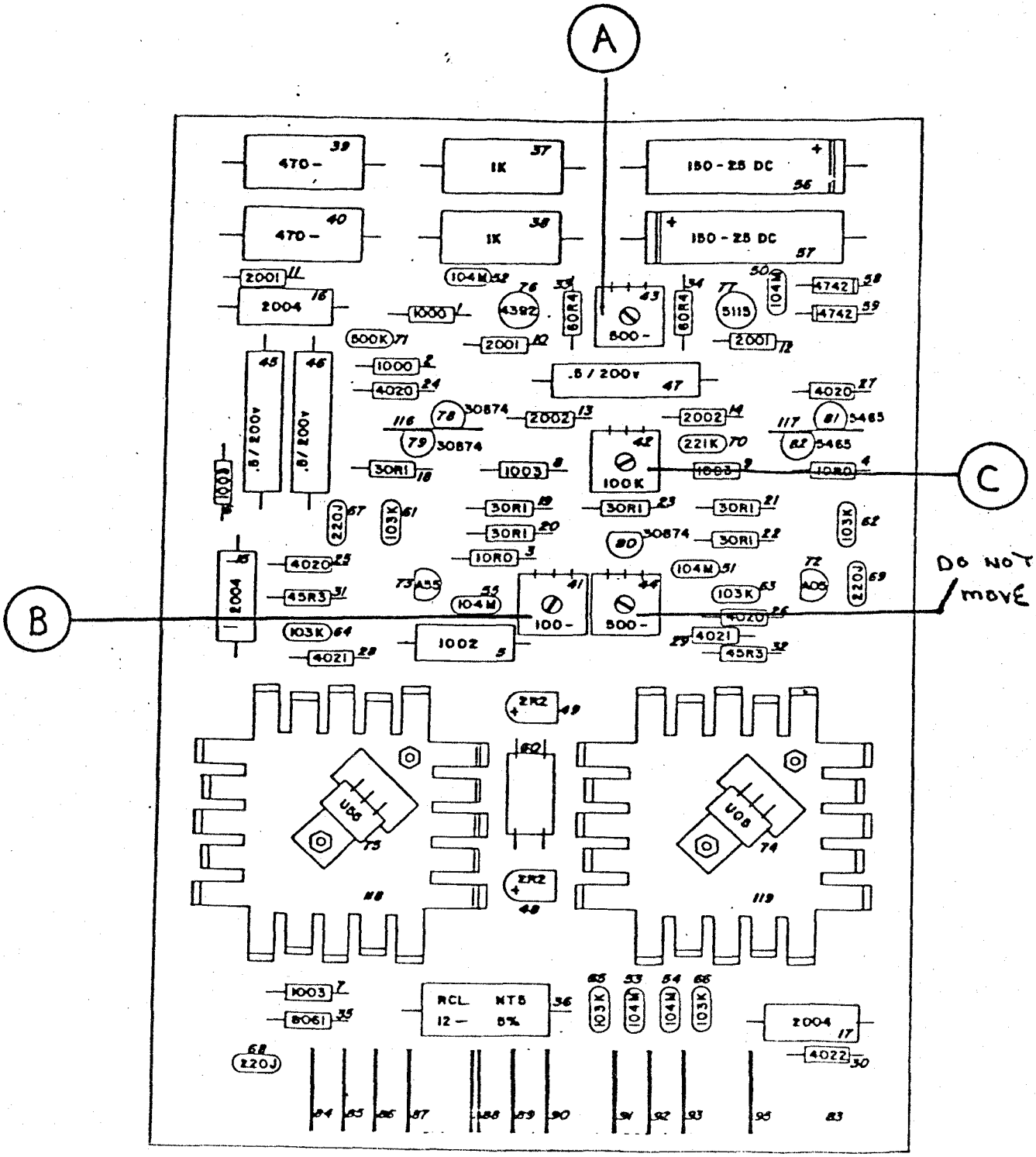
4) Adjust the inverting distortion control for minimum DC at the output. (See diagrm 2).

5) Connect the noninverting input to a square wave generator, set for .5Hz. Increase the generator level until the AC watt meter begins to fluxuate (approximately + & - 20V output). Run for 30 minutes minimum then readjust the generator for .3Hz and run for 5 minutes.

6) Readjust the generator for 20kHz. Connect 4uF polycarbonate capacitor to the output. The circuit breaker will trip. Repeat 5 to 10 times.

ML-2 Predriver Adjustment

1) Place card on extender and insert into the amplifier.
2) Apply power to amplifier and allow to heat for about 30 minutes.
3) Set trimpot A for center of rotation.
4) Adjust trimpot B for minimum IMD (less than .1% @ 14 V).
5) Adjust trimpot C for minimum D.C. offset (+- 25mv).
6) Check IMD; readjust if necessary.
7) Check D.C. offset; readjust if necessary.
8) Remove extender card and insert predriver directly into the amplifier.



MARK LEVINSON AUDIO SYSTEMS, LTD.
TECHNICAL SERVICES 8/14/80

ML-2 REBUILD INSTRUCTIONS SC 11/07/85 REV.C

RA No._____ SN:_____ Date Rcvd._____

1.) All units should have Motorola bridge rectifier P/N 17-9905-00-BR-00.

2.) All circuit breaker and bridge rectifier crimp connections should be of the new type.

3.) Motherboard fuse should be 8A slo-blo P/N 62-0012-00-FO-00.

4.) All driver turn-off resistor should be 33 OHM/5W wirewound P/N 06-3300-80-00-00 when MJE 15030/31 drivers are used.

5.) Replace or tighten speaker binding post Red - P/N 65-0102-00-BP-00, Black - P/N 65-0103-00-BP-00.

6.) Add bias modification - 05-8060-00-RN-55, 17-4003-00-DO-00.

7.) Add surge delay timing - 12-0225-50-TC-00, 17-4003-00-DO-00.

8.) Motherboard should have buss wire added to the plated thru holes, as per ECN 0005.

9.) Driver and bias heat sinks should be rebuilt using current Motorola matched outputs with new insulators. However, to-66 drivers - 2N6466/68 - do not have to be changed.

____ 20-5030-01-00-00 - Driver NPN
____ 20-5031-01-00-00 - Driver PNP
____ 20-5684-01-00-00 - Output PNP
____ 20-5686-01-00-00 - Output NPN
____ 69-0004-00-IN-00 - Insulator TO-220
____ 69-9030-00-00-00 - Insulator TO-3
____ 70-0018-70-00 - Heat sink, as needed

10.) Elmwood sensors, TO-3 sockets and other parts on the heatsink PCB should be installed and soldered to present day workmanship standards.

11.) All heatsinks should have TO-3 insulators changed to P/N 69-9030-00-00-00.

12.) All screws and nuts used on the chassis, faceplate, handles, heatsink stand offs, etc. should be retightened.

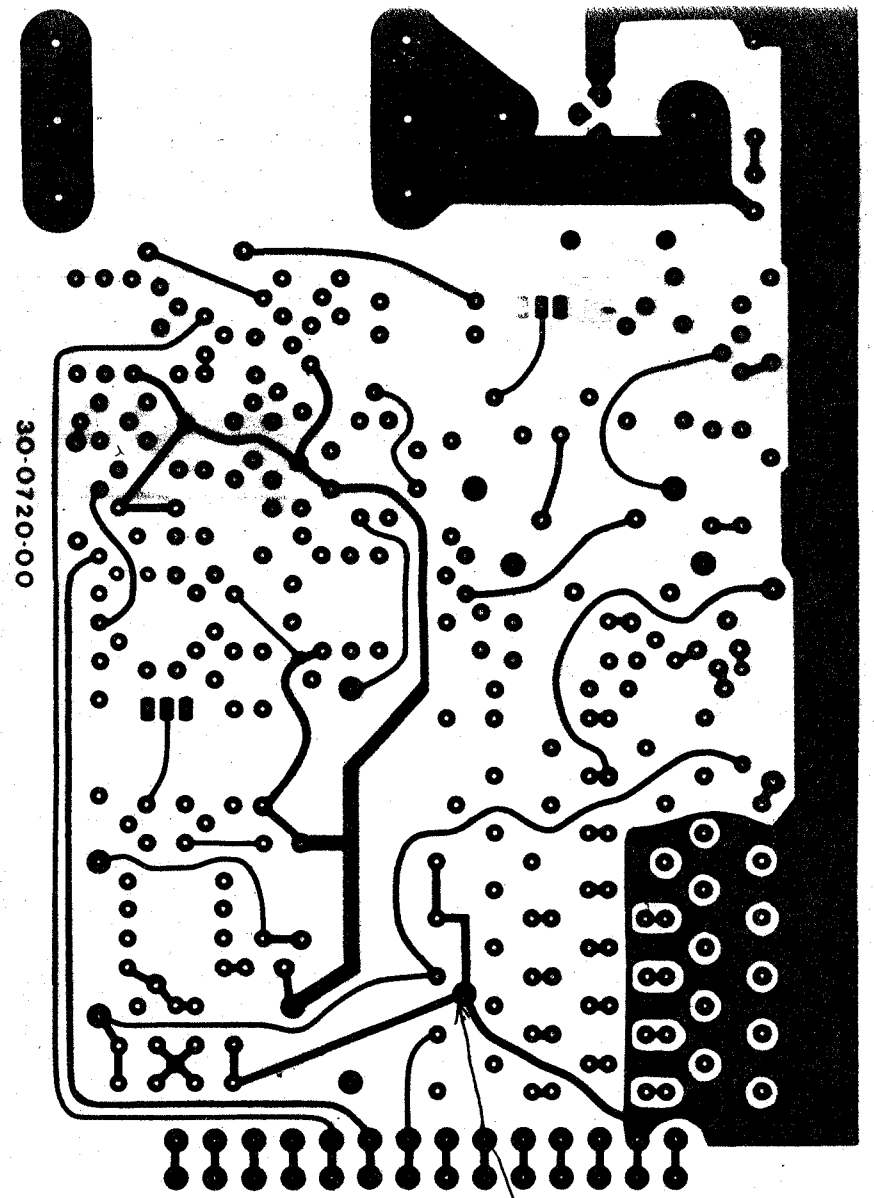
13.) Transformer bolts should be retightened wherever possible.

14.) Install new rubber feet pads onto all six heatsinks - (24) 85-2184-00-00-00.

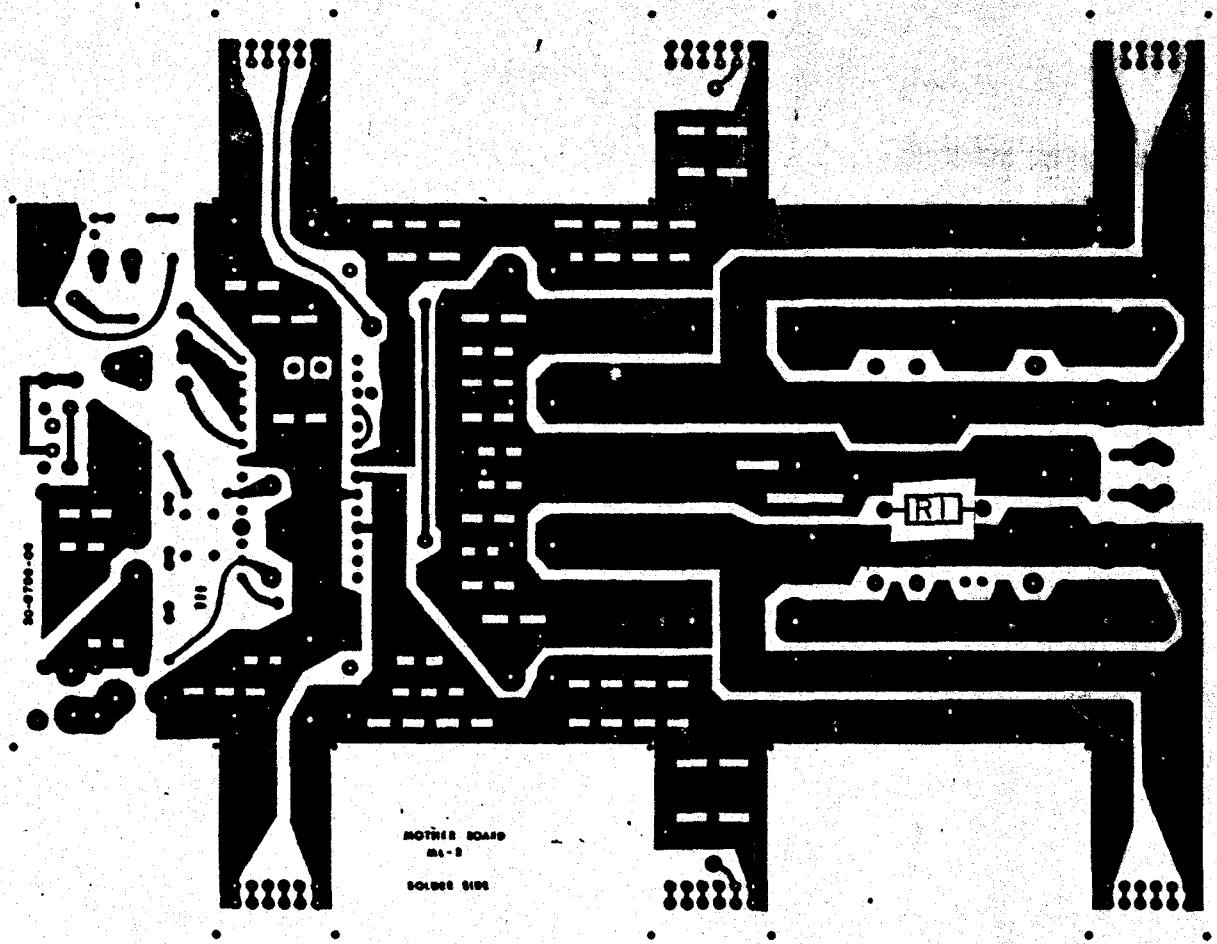
15.) Re-install all six heatsinks, observing for proper alignment of the Elco connectors and proper torque of the hex standoffs.

Check Reverse Side for Additional Information.

Return this sheet with the RA paperwork.



Check clad with your IRon for hole under the clad.



R1 SHOULD BE CHANGED TO 30 ohms or 33 ohm / 5W WHEN DRIVER TRANSISTORS MJE15030/MJE15031 MATCHED PAIR IS USED.

FRONT OF AMP.

ISSUE	REVISION	DATE

ORIGINAL IF RED

Property of

Madrigal Audio Laboratories Inc.

TOLERANCES UNLESS SPECIFIED

FRACTION ±.010

DECIMAL ±.005

ANGLE ±1/2°

DR. J.M. DATE 4-28-86

CH. DATE

SCALE

MADRIGAL audio laboratories, inc.

2081 south main street middletown connecticut 06457 u.s.a.

MATERIAL

USED IN ML-2

NAME RESISTOR REPLACEMENT

SHEET OF

A B C D E R

NO. 75-1701-03-00-00

N28752

ML-2 POWER AMPLIFIER

OWNER'S MANUAL

mark levinson®

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 this 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 refined linearization techniques.

The ML-2 is designed to drive complex loads, such as those presented by loudspeakers. Its high current capability allows it to deliver more power to low impedance loads than many amplifiers with much higher power ratings.

Both noninverting (normal) and inverting inputs are provided on the ML-2, adding versatility and broadening the range of application.

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

PROTECTION:

The ML-2's ON-OFF switch is actually a three pole electromagnetic circuit breaker. The circuit breaker in conjunction with the internal "crowbar" circuit constantly monitors the following areas for improper operation:

1. Mains current.
2. Current level of the positive power supply.
3. Current level of the negative power supply.
4. Voltage level of the positive unregulated power supply.
5. Voltage level of the negative unregulated power supply.
6. Voltage level of the positive regulated power supply.
7. Voltage level of the negative regulated power supply.
8. Amplifier temperature.
9. D.C. offset level.
10. Extreme low frequency at the output (accidental misuse).

This system offers excellent protection for the amplifier and the load (speaker).

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

INSTALLATION

FOR YOUR PROTECTION

We strongly advise that your entire stereo system be disconnected from the AC mains before connecting or disconnecting ANY cables. Furthermore, equipment should NEVER be uncovered or disassembled by any person(s) other than factory authorized service personnel.

Products are sometimes manufactured with user operated internal adjustments. Be sure to consult your owner's manual before attempting said adjustments. As always, keep electrical equipment out of reach of children.

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 prevent 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 so that its power transformer does not inject hum 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 connector 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.

*Although the ML-2 does not comply with true rack mount standards, most racks can be modified to facilitate the installation.

MAINS CONNECTION

We recommend that the AC mains outlet be capable of delivering (minimum): 5A @ 117V, 6A @ 100V, and 3A @ 220V, per ML-2.

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

To change the line voltage setting, remove the AC cord from the receptacle. Slide the window to the left. Pull out the printed circuit board, using a small screw driver 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 through the window. The fuse may be removed for easy access.

FUSES:

External fuse: 6¼ Amp slow blow; located at rear of amplifier.
Internal fuse: 15 Amp slow blow; located on motherboard behind audio predriver card.

CONNECTIONS FOR NORMAL OPERATION

Most power amplifier applications require that the amplifier be of the noninverting type, which means 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 (white) input of the ML-2 and **use the shorting plug in the INVERTING (red) 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 in the inverting mode will return the signal to its original phase condition.

To accomplish this, connect the preamplifier main output to the INVERTING input of the ML-2 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 the 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 + (red) outputs of the amplifiers. For proper phasing (noninverting) connect + (red) speaker terminal to noninverted amp. In this configuration neither loudspeaker terminal is connected to common. **Shorting plugs must be used in the unused inputs.**

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 ground of the two amplifiers. This wire should also be as short as possible and of heavy gauge.

For optimum performance we recommend **Mark Levinson Audio Systems HF10C** speaker cable.

SERVICE

RETURN AUTHORIZATION

In the event that a unit must be returned to the factory for service, return authorization must be obtained from the Mark Levinson Audio Systems, Ltd. Technical Services Department.

The unit must be properly packaged, preferably in its original packing material, and marked with the proper return authorization number on the outer carton for easy identification.

Mark Levinson Audio Systems, Ltd. reserves the right to repackage any unit for shipment at the owner's expense.

The Technical Services Department is designed to solve technical problems with maximum efficiency. It is extremely important that information regarding a problem be explicit and complete. This helps us to locate and repair a defect with maximum expediency.

The philosophy of the Technical Services Department is based on the realization that our customers have made a substantial investment in order to obtain exceptional quality. It is the intent of the Technical Services Department to provide service commensurate with the investment.

LIMITED FIVE YEAR WARRANTY

The ML-2 Class A Power Amplifier is warranted by Mark Levinson Audio Systems, Ltd. to the original purchaser to be free from defects in material and workmanship under normal use for a period of five (5) years from the date of purchase. During the warranty period, and upon proof of purchase, any power amplifier exhibiting defects in materials and/or workmanship will be repaired or replaced, at our option, without charge for either parts or labor, at our factory. The warranty will not apply to any power amplifier that has been misused, abused or altered.

Any power amplifier not performing satisfactorily may be returned to the factory for evaluation. Return authorization must first be obtained by either calling or writing the factory prior to shipping the power amplifier. The factory will pay for return shipping charges only in the event that the power amplifier is found to be defective as above mentioned.

THERE IS NO OTHER EXPRESS WARRANTY ON THIS POWER AMPLIFIER. NEITHER THIS WARRANTY NOR ANY OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS, SHALL EXTEND BEYOND THE WARRANTY PERIOD. NO RESPONSIBILITY IS ASSUMED FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS AND OTHER STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THAT THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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, 50-400Hz
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 Camac coaxial connectors 1 3-pin audio connector (XLR) 5 binding posts 1 AC receptacle/line voltage selector

August 1, 1977
Revised October 1, 1980

P.O. BOX 6183 • HAMDEN, CONNECTICUT 06517 • U.S.A.