

**Model PA-118/119
Power Amplifier
Operation and Installation**

**Revision 2, effective
S/N 118-180 and up
S/N 119-180 and up**

 **Labworks Inc.**

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If any difficulty is encountered in implementing the instructions in this manual contact the Customer Service Department, Labworks Inc., Costa Mesa, California at (714) 549-1981. Please give the equipment model number, the serial number, the conditions of use, and a description of the problem.

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SECTION 1

INTRODUCTION

1.1 General Description

The Labworks 118/119 series linear power amplifiers are high quality, air cooled, solid state audio amplifiers primarily intended for use with electro-pneumatic acoustic transducers and small vibration (shaker) systems. Although these amplifiers have been designed to directly drive low impedance loads typical of vibration transducers, they can be used in any application requiring continuous duty high quality audio power (see specifications). All the amplifiers have over temperature, over current and secondary breakdown protection. Peak voltage and RMS current bar graph meters along with a resetable external interlock are available as an optional package.

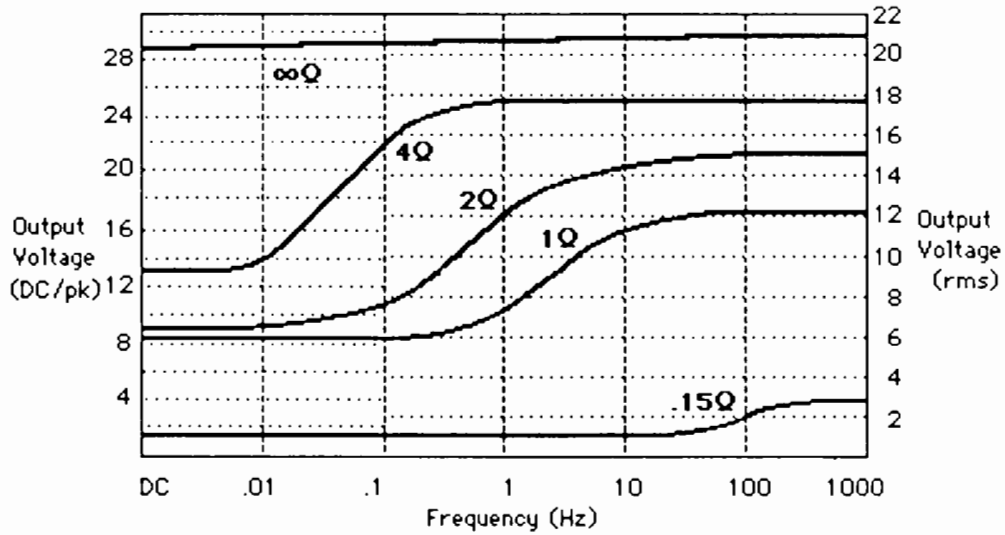
The amplifiers are designed for standard 19 inch rack mounted installation (approximately 3.5 inches tall) and require 115/230 V, 48 to 62 HZ power (see specifications). Both DC and AC coupled inputs are provided.

1.2 Technical Specifications

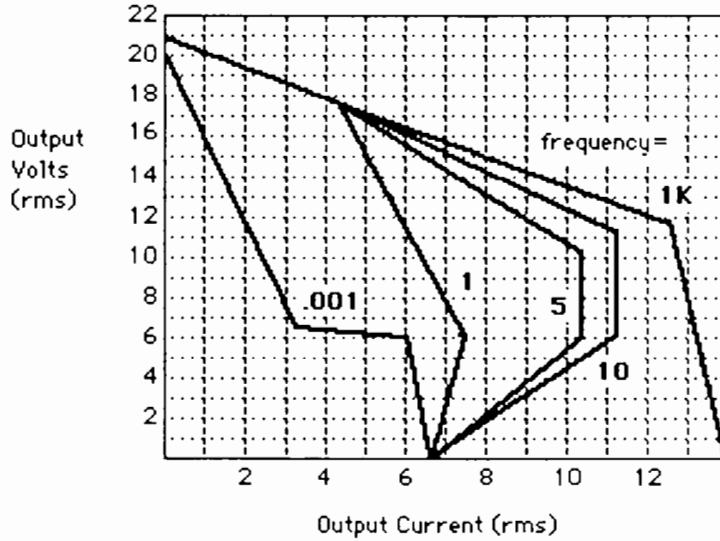
<u>Specification</u>	<u>PA-119</u>	<u>PA-118</u>
Output Voltage (continuous)		
100 HZ to 20 KHz		
open circuit	16.0 Vrms	21.0 Vrms
4 Ω load	14.5	17.5
2 Ω	12.3	15.0
1 Ω	5.5	12.3
DC to .01 Hz		
open circuit	22.5 Vdc/pk	28.0 Vdc/pk
4 Ω load	13.0	13.3
2 Ω	5.5	8.7
1 Ω	2.5	6.5
.01 to 100 Hz	see Figure 1-2	see Figure 1-1
Random Voltage output		
2.5 sigma peak volts		
open circuit	9.2 Vrms	12.0 Vrms
4 Ω load	8.8	11.0
2 Ω	7.6	9.8
1 Ω	3.8	8.4
3.0 sigma peak volts		
open circuit	7.6 Vrms	10.0 Vrms
4 Ω load	7.3	9.3
2 Ω	6.3	8.7
1 Ω	3.2	7.6

Maximum continuous dissipation		
Ambient Temp = 40°C	50 W	100 W
50	25	50
60	0	0
Frequency response (DC coupled input)		
DC to 10 KHz	- .6 dB	- .6 dB
" 20 KHz	-2.5	-2.5
" 30 KHz	-4.5	-4.5
AC coupling @ 1.0 Hz	-0.5	-0.5
Harmonic distortion (10V, DC-10K)	<.5% @ 2Ω	<.5% @ 1Ω
Signal/Noise ratio (ref 10V out)	80 dB	80 dB
Input impedance		
DC coupled	6.5 KΩ min	6.5 KΩ min
AC coupled	47 uF in series with 6.5 KΩ min	
DC offset	6 mV max	6 mV max
Voltage Gain	47 (34dB) max	47 (34dB) max
Voltage regulation (30Hz/10Vrms)	.5 dB (∞-2Ω load)	.5 dB (∞-1Ω load)
Front panel controls	Power switch, Gain adjustment	
Front panel indicator	Internal DC power indicator	
Cooling	nat. convection	2 sp fan
noise level: low/high speed	n/a	<45dB/<55dB
(switches @ apx 1/2 diss.)		
Self protection	Over current, over temperature & secondary breakdown	
Line protection	Magnetic type front panel circuit bkr.	
Input power	225 VA max	450 VA max
voltage	115/230 V	115/230 V
frequency	48 to 62 Hz	48 to 62 Hz
Dimensions	3.5" H x 19" W x 13" D	
Weight	15 lbs	20 lbs

PA-118 Low Frequency Output Capability



PA-118 Output Capability



PA-118 Frequency Response

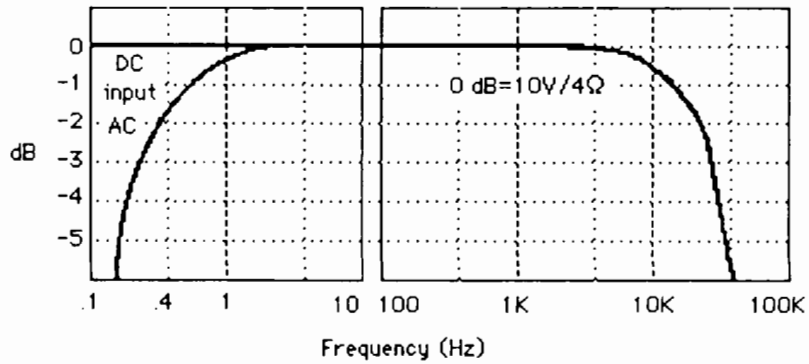


Figure 1-1
PA-118 Output Capabilities

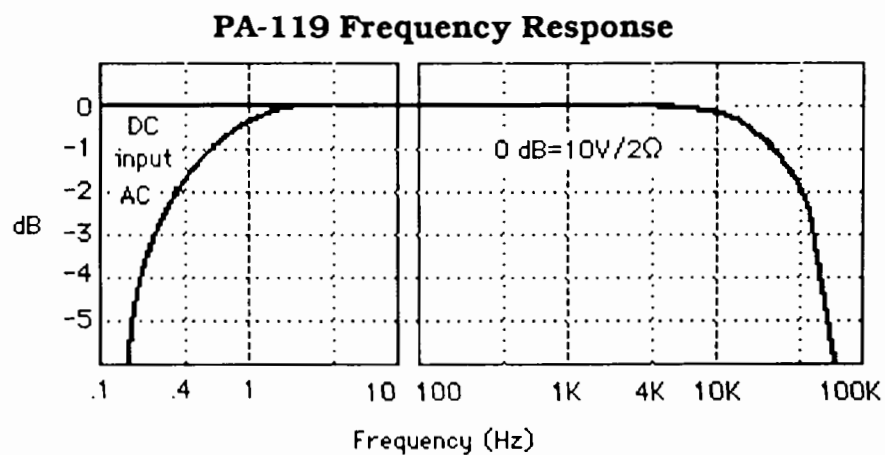
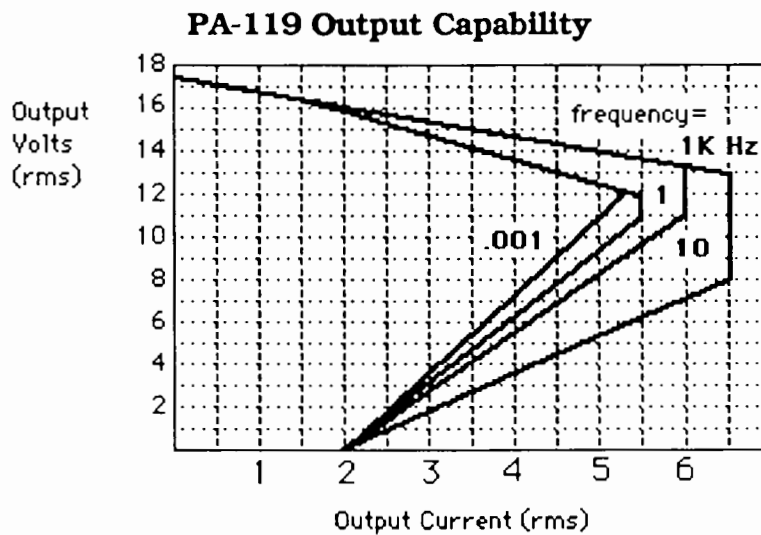
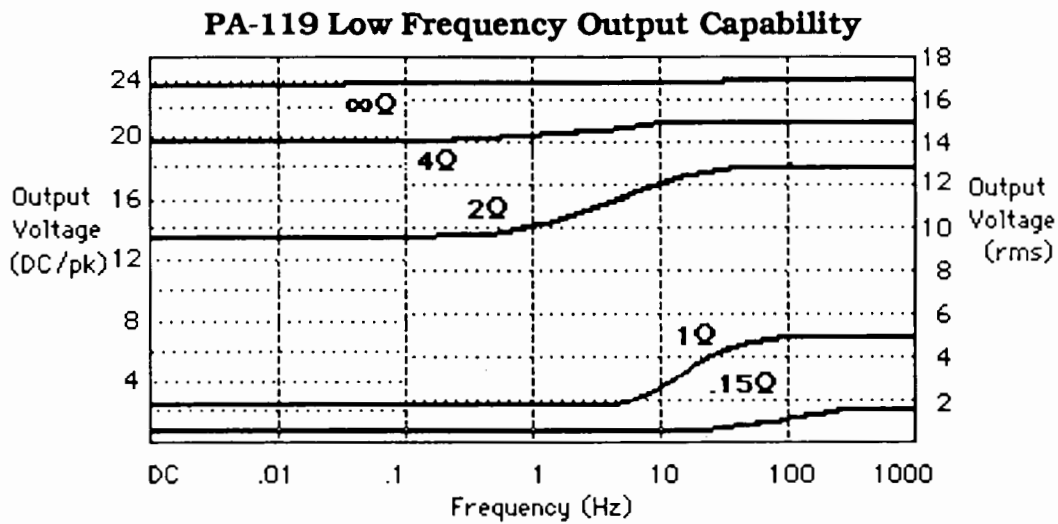


Figure 1-2
PA-119 Output Capabilities

1.3 Meter Option Specifications (both amplifiers)

Type	(2) 19 seg horizontal bar graphs	
Scale		
Voltage	0-16 V peak	0-16 V peak
Current	0-6 A rms	0-12 A rms
Resolution		
Peak voltage	5% of full scale	
True rms current	5% of full scale	
Accuracy (voltage & current)	±5% absolute	
Interlock circuit		
Type	+2 to +15V= fault, N.O. or N.C. sw.	
Response time	3 ms. max	
Action	Output drives to ground	
Reset	Gain pot full down	
Indicator	Flashing front panel light	

*Specifications subject to change. Consult factory for critical applications.



SECTION 2 **OPERATION**

The Labworks series 118/119 power amplifiers have been designed for easy operation via front panel controls. Input and output (as well as optional external interlock) connections are found on the rear panel. Internal over-temperature, over-current, and secondary breakdown protection assure continuous operation at full rated power without concern for damage to the amplifier.

2.1 Front Panel Features

Power Switch	Magnetic type circuit breaker for line protection and power on/off.
Gain Potentiometer	Amplifier gain adjustment and reset (full down detent position) for optional interlock.
Bar Graph Display	Power indicator (all models) Optional display includes the following: 19 segment peak voltage indicator*; 19 segment rms current indicator*; Interlock indicator (flashes when tripped).

*The Output peak voltage bar graph indicates the peak voltage applied to the connected load and will indicate voltage clipping limits and output signal level. It can also be useful in detecting output open circuit problems. The Output rms current level graph indicates the amount of current being delivered to the load and can be used to prevent overdriving and subsequent damage to connected loads.

2.2 Rear Panel Features

Power Line Connector	115/230 Volts, 48 to 62 Hz
Input	two BNC connectors for either AC (>1 Hz) or DC coupled input, .5 Vrms min for full output, 6K Ω min. input impedance (47 uF series with AC input).
Interlock	(optional) screw terminal, +5 to +15 V @ 1 mA causes output clamp to ground. -5 to -15 V causes external interlock reset (caution: external reset is independent of gain pot).
Load Output & Return	#6 Screw terminal connections for connection of load.
Signal Ground	#6 Screw terminal common to input connector shells and interlock ground reference.

Chassis Ground	#6 Screw terminal common to chassis and power line connector ground lug.
+15 V	#6 Screw terminal, 15 V dc behind 20K Ω for use with switches in external interlock circuitry.

2.3 Normal Power Up Procedure

- 2.3.1 Turn the gain down to the detent **Reset** position. When the interlock package is installed, the reset detent will clear any prior interlock fault and restore the amplifier to the operational mode. If an external interlock is unsatisfied, the amplifier will immediately fault or refault upon turning the gain control clockwise out of the detent position.
- 2.3.2 Move the front panel circuit breaker to the **On** position (power indicator LED will light) and insure that the optional external interlock is satisfied.
- 2.3.3 Make any necessary adjustments to control instrumentation (servos, oscillators, etc.) to which the amplifier is connected.
- 2.3.4 Provide the amplifier input signal and slowly turn the amplifier **Gain** up (clockwise) to the desired open loop level or until sufficient closed loop gain has been provided for the system servo.

2.4 Normal Power Down Procedure

- 2.4.1 Reduce any external servo or controller signal to the amplifier to zero.
- 2.4.2 Turn the amplifier **Gain** control fully counter-clockwise to reduce the amplifier output to zero.
- 2.4.3 Allow the fan on the pa-118 to cool to its idling speed (approx 1-2 minutes) if not already at its slow speed.
- 2.4.4 Switch the power to **Off** and wait 30-60 seconds for internal power dissipation before disconnecting any amplifier wiring.

SECTION 3 INSTALLATION AND CALIBRATION

3.1 Power Requirements

The PA-118/119 amplifiers are designed to be installed in a standard 19" rack panel arrangement and unless specifically ordered and labeled otherwise, require **115 VAC 50/60 Hz** power for which a power cord is provided. The unit may be converted for 230 VAC 50/60 Hz operation by disconnecting the unit, removing the top cover, and resoldering the power transformer input connections for 230 VAC using the information found on the amplifier schematic provided for this purpose. The power cord supplied can then be modified or replaced as desired.

Note: A three conductor grounded power cord has been supplied with this unit. To insure proper grounding of the cabinet use only power cords of this type.

3.2 Location Considerations

The amplifier should be located in the instrumentation rack so that the controls and indicators are easily accessible and visible to the operator. Adequate space (a minimum of 6 inches) front and rear is required, as well as a ventilated cabinet, to facilitate necessary air cooling. Locations with ambient temperatures above 40° C are not acceptable since the maximum continuous dissipation of the amplifier will be greatly reduced (see specifications). Extremely dusty or humid locations should be avoided or internal cooling surfaces may become fouled and will not function properly unless frequently cleaned. The amplifier should not be operated with either of its covers removed. Removal of the amplifier bottom cover (after line power removal) allows access to the heat sink cooling fins for cleaning by a suitable vacuum or other cleaner.

WARNING: Lethal voltages are present within the cabinet.

3.3 Offset Voltage Calibration Procedure

- 3.3.1 Remove the power cord from amplifier and then remove top cover.
- 3.3.2 Disconnect all external loads to the **Output** and **Return** terminals.
- 3.3.3 Reconnect the power line and switch the **Power** on with the front panel **Gain** fully counter-clockwise.
- 3.3.4 Observe the power indicator and allow 5 minutes minimum for the amplifier to warm up and stabilize.
- 3.3.5 Connect a DC Voltmeter capable of measuring 1 mV accurately (preferably a dual polarity meter) to the **Output** and **Return** terminals of the amplifier.

- 3.3.6 Using a trim pot adjustment screwdriver, adjust **R5** (located at the top edge of the front panel pc board) for less than 2.0 mVdc at the output.
- 3.3.7 Switch **Power** off, remove the power cord and replace the amplifier top cover.

3.4 Meter/Interlock Option Calibration

- 3.4.1 Remove the power cord from amplifier and then remove the amplifier top cover.
- 3.4.2 Connect a 1.0 Ω , 2% or better, 150 Watt resistor (2.0 Ω , 75 Watts for the pa-119) to the **Output** and **Return** terminals.
- 3.4.3 Connect a sine signal source to the **AC Input** BNC connector.
- 3.4.4 Reconnect the power line and switch the **Power** on with the front panel **Gain** fully counter-clockwise.
- 3.4.5 Observe the power indicator and allow 5 minutes minimum for the amplifier to warm up and stabilize.
- 3.4.6 Apply an approximate 1.0 Vrms sine signal at 50 - 100 Hz to the amplifier **AC Input** from the signal source.
- 3.4.7 With a rms calibrated AC volt meter also connected to the amplifier **Output** and **Return** terminals, adjust the front panel **Gain** control to give an output voltage of 8.5 Vac.
- 3.4.8 Trim voltage graph reading by adjusting trim pot **R37** (located near the left edge of the front panel pc board) to just barely light the bargraph segment below the 12 volts pk indicator.
- 3.4.9 Reduce the **Gain** control to zero and connect the AC voltmeter directly across the terminals of the 1.0 Ω (2.0 Ω for pa-119) load.
- 3.4.10 Adjust the front panel **Gain** control to give a 9.0 VAC reading across the load resistor.
- 3.4.11 Trim the current graph by adjusting trim pot **R41** (located near the middle of the front panel pc board) to barely light the segment above the 9 amp (4.5 amp on the pa-119) rms indicator.
- 3.4.12 Reduce the **Gain** control to fully counter-clockwise and switch **Power** off.
- 3.4.13 Wait a minimum of 2 minutes for the power supply capacitors to discharge after disconnecting the line power cord.
- 3.4.14 Disconnect the load resistor and replace the top cover.

3.5 Interlock Function

The interlock function may be tested by jumping between the **+15V** and the **Interlock** terminals with the **Gain** pot up and a signal applied to the input to give a voltage indication on the front panel graph (no load is required). If the interlock is functional, the interlock light will flash and the output voltage will reduce to zero.



SECTION 4
DOCUMENTATION

4.1 Documentation

All documentation needed to support this product are included on the following pages.



PA-119-1M Bill of Material

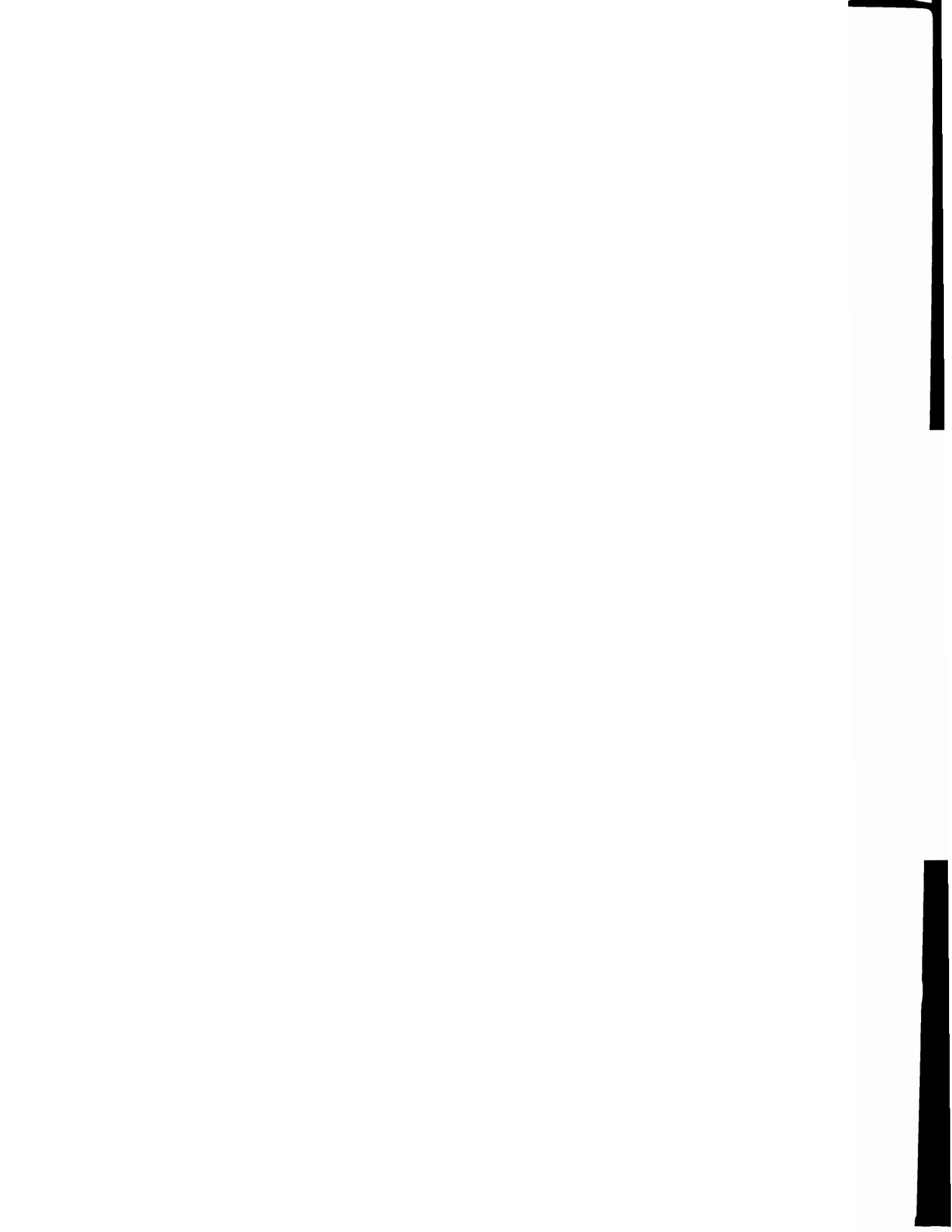
	A	B	C	D	E	F	G	H	I	J	K	L	M
6	PA-119-1M Power Amplifier w/Meter Interlock											5/19/97	
7	Rev N sn:243 cg'd C13, 14 &R59, S1												
8	Description						Qty.	Ref. Desig.				Part #	
9													
10	Complete Assy PA-119-1M Power Amplifier						001-					119000	
11	Final Test												
12	Front Panel						001-					118004	
13	Front Panel Overlay						001-					118011-3	
14	Moulding Strip						002-					108006	
15	Adhesive Tape						003'					655-00001	
16	Shell						001-					118002	
17	Silkscreen, Shell						001-					118010	
18	Cover						002-					108005	
19	Power Cord, 3 Conductor, 115 Vac						001-					135-00001	
20	Line Input Receptacle, Panel Mount						001-					250-00004	
21	Connector, Insulated BNC						002-					250-00005	
22	Tubing, High Temp Insulated Teflon						0.2'					381-00001	
23	Full Wave Bridge, 25 Amp, 100V						001-	D10-13					290-00003
24	Capacitor, 10uF, 20%, 100V, axial						002-	C10,11					161-NJ100
25	Capacitor, 47uF, 20%, 50V, non-polarized						001-	C12					166-CG470
26	Capacitor, 33K uF, +80/-20%, 35V min						002-	C13,14					161-HR273
27	Bracket, Cap Mtg, 2" Dia x 3 Screw						002-					221-00001	
28	Resistor, 5.1Ω, 1/4W, 5%						002-	R56,57					571-B51.A
29	Resistor, 100K, 1/4W, 5%						001-	R58					571-B10.4
30	PC Board, Heat Sink						002-					118013	
31	Heat Sink						001-					118008	
32	Heat Sink Mount						002-					118003-1	
33	Power OP-AMP, LM12CLK						002-	U11,12					392-00008
34	Current Limiter, 2.5Ω@25°C, 8A						001-					577-00001	
35	Terminal Block, 6 position, solder type						001-					662-00008	
36	Terminal Strip, 6 Lug						001-					662-00009	
37	Transformer, 41 VCT, 2.9 Amp						001-	X5					119001
38	Pot/Switch 10K ,Panel Mt w/SPDT Detent						001-	R59,S1					572-D0103
39	Knob, Knurled Aluminum, .95" Dia						001-					371-00002	
40	Circuit Breaker, 3 A Magnetic Type						001-	S2					630-00002
41	Screw, 4-40 X 3/8, P.H. Phil., B.O.						002-					331-FUB03	
42	Screw, 4-40 X 1/4, P.H. Phil., B.O.						014-					331-FUB02	
43	Screw, 6-32 X 1/4, P.H. Phil., S.S.						004-					331-HUS02	
44	Screw, 6-32 X 3/8, P.H. Phil., B.O.						006-					331-HUB03	
45	Screw, 6-32 X 1/2, P.H. Phil., S.S.						005-					331-HUS04	
46	Screw, 6-32 X 5/8, P.H. Phil., S.S.						004-					331-HUS05	
47	Screw, 6-32 X 3/4, P.H. Phil., B.O.						001-					331-HUB06	

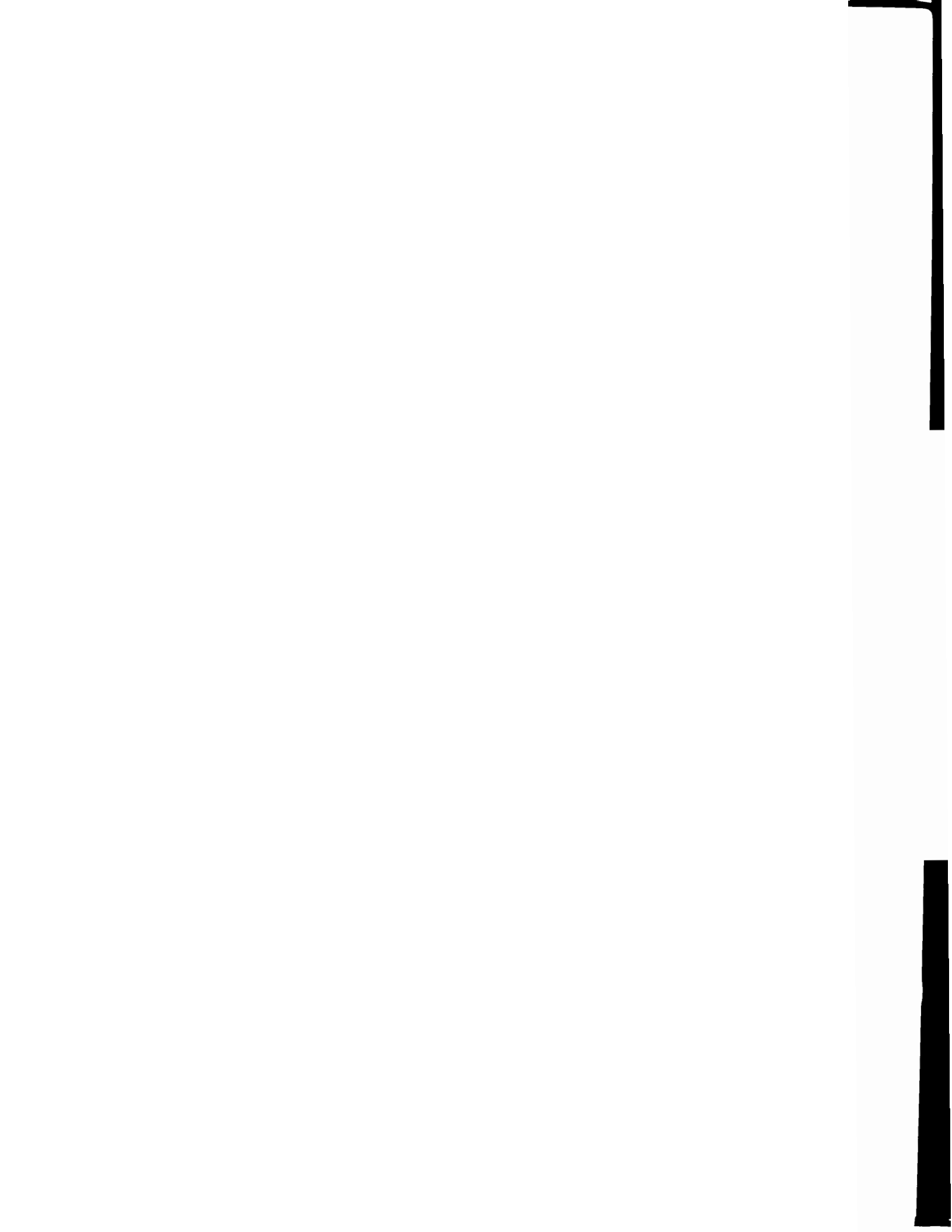
PA-119-1M Bill of Material

	A	B	C	D	E	F	G	H	I	J	K	L	M
48						Screw, 6-32 X 3/4, P.H. Phil., S.S.	001-						331-HUS06
49						Screw, 10-32 X 1/4, P.H. Phil., S.S.	004-						331-NUS02
50						Screw, 10-32 X 3/8, Flat Hd. Phil., B.O.	004-						331-NTB03
51						Nut, #4-40, Hex, S.S.	004-						333-FAS00
52						Nut, #6-32, Hex, S.S.	021-						333-HAS00
53						Nut, #10-32, Hex, S.S.	008-						333-NAS00
54						Stand-off, 6-32 X 5/8, Hex	004-			PCB			461-00005
55						Disconnect Lug, Female, 12-10 AWG	004-						660-00001
56						Ring Lug, #10, 16-14 AWG	009-						660-00005
57						Wire, Hookup, 12 AWG, strd'd, Black	2.0'						131-0BP12
58						Wire, Hookup, 12 AWG, strd'd, Red	1.4'						131-0RP12
59						Wire, Hookup, 12 AWG, strd'd, White	1.4'						131-0WP12
60						Wire, Hookup, 12 AWG, strd'd, Yellow	1.4'						131-0YP12
61						Wire, Hookup, 18 AWG, strd'd, Green/Yellow	0.3'						131-0FP18
62						Wire, Hookup, 18 AWG, strd'd, Red	1.0'						131-0RP18
63						Wire, Hookup, 18 AWG, strd'd, White	1.3'						131-0WP18
64						Wire, Hookup, 18 AWG, strd'd, Yellow	1.1'						131-0YP18
65						Wire, Hookup, 18 AWG, strd'd, Lt. Blue	2.0'						131-0HP18
66						Wire, Hookup, 18 AWG, strd'd, Brown	1.2'						131-0AP18
67						Wire, Hookup, 26 AWG, strd'd, Yellow	0.4'						131-0YP26
68						Wire, Hookup, 26 AWG, strd'd, Blue	0.4'						131-0CP26
69						Wire, Hookup, 26 AWG, strd'd, White	0.4'						131-0WP26
70						Wire, Hookup, 26 AWG, strd'd, Grey	0.4'						131-0DP26
71						Wire, Hookup, 26 AWG, strd'd, Black	0.4'						131-0BP26
72						Coaxial, 1 Cond, 26 AWG, 75Ω, .1"OD, Blk	1.3'						130-00001
73						Zip Cord, 2 Cond., 22 AWG	2.6'						134-00013
74						Heat Shrink Tubing 1/16 Dia	0.5'			R56,57 (ref)			380-00003
75						Cable Tie	006-						462-00005
76						Bumper, 5/16" H X .5" D, Black	001-						129-00001
77						Printed Circuit Board Assy, Front Panel	001-						118016
78						Printed Circuit Board, Front Panel	001-						118007
79						Display, 10 Segment Bar Graph	004-			X1,2,3,4			311-00001
80						Socket, 20 Pin, Wirewrap, .4 wide Max	004-			X1,2,3,4			460-00013
81						Hash Choke, 4.0uH, 8A Heavy Duty	001-			L1			231-00001
82						Relay, SPST 14 Pin DIP	001-			RLY1			561-00003
83						IC, AD563A A/D Converter	001-			U4			391-00002
84						IC, Quad Op Amp, 084	001-			U3			392-00004
85						IC, LM3914 Display Driver	004-			U5,6,7,8			392-00005
86						IC, Op Amp, 082	001-			U2			392-00006
87						IC, Op Amp, OP-27EP	001-			U1			392-00007
88						Heat Sink, TO-220	001-			U9			375-00003
89						Voltage Regulator, 7815, +15 Volts	001-			U9			396-00003

PA-119-1M Bill of Material

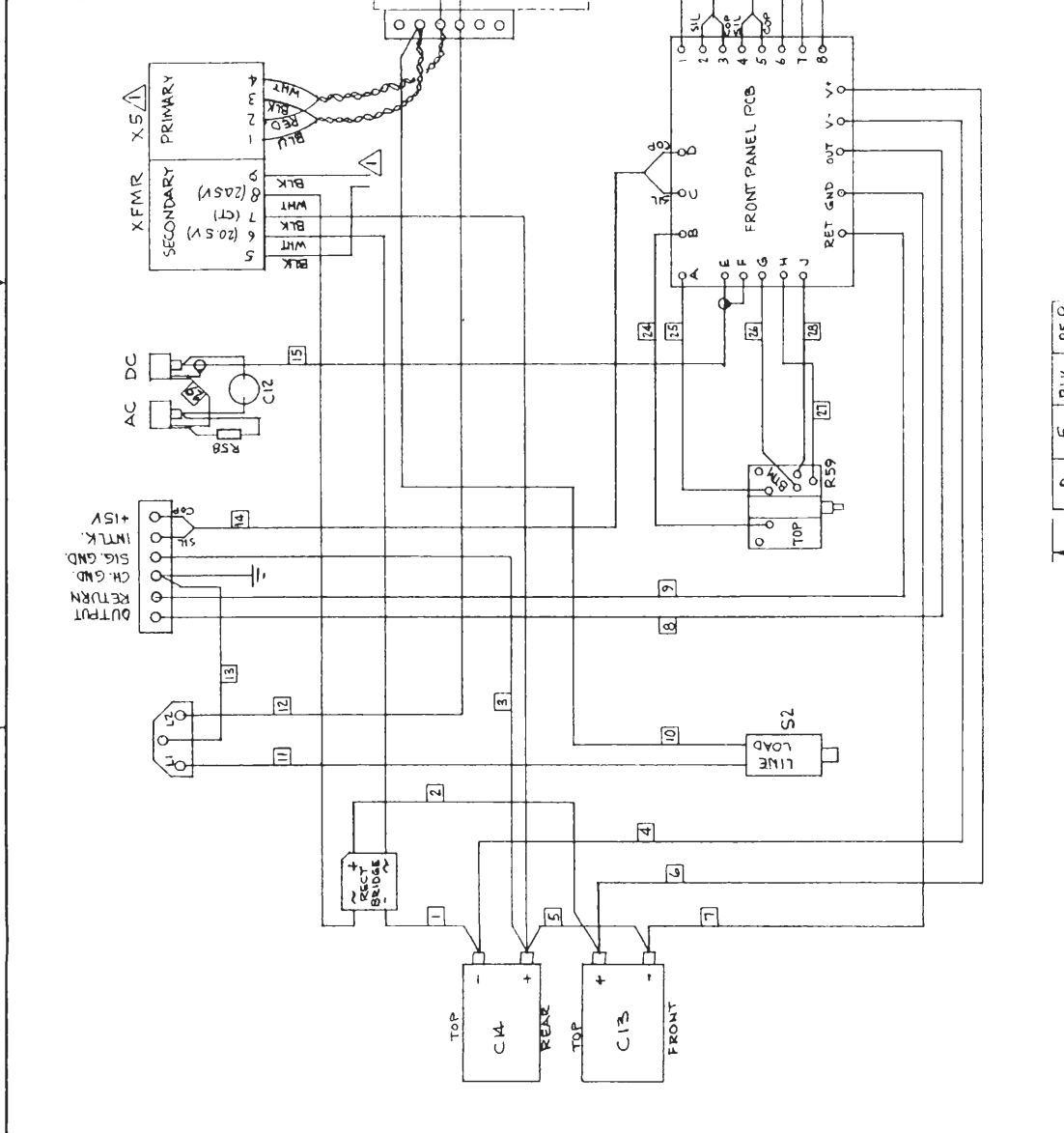
	A	B	C	D	E	F	G	H	I	J	K	L	M
90						Voltage Regulator, 7915, -15 Volts					001-	U10	396-00004
91						JFET, 2N4391, TO-39					001-	Q1	702-00006
92						Diode, 1N914					005-	D1,3,5-7	291-00001
93						Diode, 1N4001					001-	D4	291-00002
94						Diode, 1N5402, 3 Amp, 200V					002-	D8,9	291-00003
95						Ziener Diode, 1N5231, 5.1V, .5 W					001-	D2	293-0A051
96						Potentiometer, Trim, 20K Ω , Horiz.					002-	R5,23	575-D0203
97						Potentiometer, Trim, 1K Ω , Horiz.					001-	R21	575-D0102
98						Capacitor, .1uF, 20%, 50V					002-	C4,5	160-AB104
99						Capacitor, 470 pF, 10%, 25V					002-	C6,7	160-AJ471
100						Capacitor, 4.7uF, 20%, 20 V min					002-	C8,9	161-AG47A
101						Capacitor, 10uF, 20%, 20 V min					003-	C1-3	161-AF100
102						Resistor, 1/4W, 5% Carbon Film							
103						15 Ω					001-	R3	571-B15.0
104						200 Ω					001-	R31	571-B20.1
105						510 Ω					001-	R35	571-B51.1
106						1K					005-	R17,26,32,45,46	571-B10.2
107						2K					003-	R8,36,38	571-B20.2
108						3K					001-	R33	571-B30.2
109						5.1K					005-	R1,2,7,37,42	571-B51.2
110						10K					005-	R9,12-14,41	571-B10.3
111						20K					001-	R52	571-B20.3
112						33K					001-	R11	571-B33.3
113						51K					001-	R6	571-B51.3
114						62K					001-	R16	571-B62.3
115						100K					003-	R10,15,25	571-B10.4
116						200K					002-	R4,28	571-B20.4
117						Resistor, 1/4W, 1% Metal Film							
118						4.99K					001-	R18	571-N4991
119						10K					004-	R19,20,22,24	571-N1002
120						Resistor, 1/8W, .1% Metal Film							
121						1.74K					002-	R43,44	571-H1741
122						5.05K					002-	R49,51	571-H5051
123						Resistor, 2.7 Ω , 5%, 1W					001-	R47	571-D27.A
124						Resistor, 39 Ω , 5%, 2W					001-	R34	571-E39.0
125						Resistor, 0.1 Ω , 2%, 5W					002-	R48,50	573-00014
126						Resistor, .03 Ω , 5%, 5W					001-	R27	573-00005
127						Box, Shipping					001-		481-00005
128						Insert, Foam Corners (set of 4)					001-		482-00004
129						Bag, Plastic					001-		480-00003
130						Manual, Operator's					001-		119003





1 2 3 4

ZONE	LTR	DESCRIPTION	DATE	APPROVED
A	21GA	21P WAS 16GA	5/27/99	BH
B		CHNGD XFMR WIRE COLORS	11/4/02	BH



WIRE #	LENGTH	AWG	COLOR	END 1	END 2
29	1	20	PAS WIRE		
28	4.5	26	BLK	STP	STP
27	4.5	26	GRAY	STP	STP
26	4.5	26	WHT	STP	STP
25	4.5	26	BLU	STP	STP
24	4.5	26	YEL	STP	STP
23	6.5	22	SILVER	STP	STP
22	10	22	COPPER	STP	STP
21	9.5	18	WHT	STP	STP
20	5.5	18	RED	STP	STP
19	4.5	18	WHT	STP	STP
18	7.5	18	YEL	STP	STP
17	5	18	RED	STP	STP
16	5	18	YEL	STP	STP
15	15.5	COAX	WHT	STP	STP
14	15	22	COPPER	STP	STP
13	4	18	GRN/YEL	STP	STP
12	12	18	BLU	STP	STP
11	14	18	BRN	STP	STP
10	12	18	BLU	STP	STP
9	13.5	12	BLK	STP	STP
8	16.5	12	WHT	STP	STP
7	6.5	12	BLK	10R	STP
6	7.5	12	RED	10R	STP
5	3.5	12	BLK	10R	STP
4	9.5	12	YEL	10R	STP
3	6.5	12	BLK	10R	STP
2	9.5	12	RED	10R	STP
1	7	12	YEL	10R	STP

COMPLETE ASSY & WIRING DIAGRAM

DATE: 01/20/99
 DRAWN: B. NIXON
 CHECKED: [Signature]

APPROVALS: [Signature]

SIZE: C
 SCALE: NONE

DRAWING NO: 119004
 REV: B

DO NOT SCALE DRAWING

NOTES:
 1 TRANSFORMER WIRING SHOWN IS FOR 115V PRIMARY & 47V (CT) SECONDARY. INSULATE (2) PUSH ON LUGS ON RED SECONDARY WIRES W/HEAT SHRINK TUBING & TIE BACK

TRANSFORMER WIRES:

WIRE #	LENGTH	COLOR	END
9	5	BLK	.25P
8	5	WHT	.25P
7	5	BLK	10R
6	5	WHT	.25P
5	5	BLK	.25P
4	8	WHT	STP
3	8	BLK	STP
2	8	RED	STP
1	8	BLU	STP

1 2 3 4