K6
AUDIO POWER AMPLIFIER

ASSEMBLY MANUAL

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1. INTRODUCTION

Congratulations! You are about to experience the satisfaction of building and owning one of the finest pieces of audio equipment around. Please read all of the instruction first, carefully, and then return to the beginning and start construction. We strive to provide complete information, but it is advisable to check the A and T Labs WEB site for any additional notes, changes, or hints that may be helpful. If you find errors or omissions or have suggestions for improving these instructions, please give us your feedback. We begin with an overview of how the design works.

2. HOW IT WORKS - CIRCUIT OVERVIEW

Figure 1 shows a block/connectivity diagram of the amplifier. The unit consists of a pair of linear discrete amplifiers and a full-bridge off-line switching power supply to power them. This design approach has several advantages over the conventional heavy line transformer and filter capacitor alternative.

The typical transformer and rectifier/filter power supply needs to employ exceptionally large filter capacitors, since they are charged at the relatively low rate of the power line frequency. While some manufacturers of amplifiers tout this large energy storage as a virtue, it is not in fact a necessity for driving audio loads, and constitutes a destructive threat to the output transistors in the case of abusive loads or short circuits.

The K6 switching power supply runs at 75 KHz, allowing the filter capacitors to be much smaller, providing much less stored energy to dissipate in case of a short circuit. At the same time, the supply is capable of providing over 1 KW of continuous power and 2 KW peak to drive the most demanding audio loads. The inverter may be switched between three different rail voltages, to permit operation at different power levels or for low impedance loads.

2.1 AMPLIFIERS

The power amplifiers are full discrete designs as shown in Figure 2, (except for the bridging inverter and differential input adapter stage). IC2 provides differential input capability, while IC5 acts as an inverter to drive a second channel for bridging.

The normal single ended input is via input blocking capacitor C1 and the R1-R3/C2 input low pass filter network. (This limits the bandwidth to about 160Khz) Complementary differential input stage transistors Q1-Q4 form the first gain stage. Q5 and Q6 along with R15 and R16 provide the next stage of gain, driving the complementary cascode inversion stage, Q10-Q13. Q24 develops the gate bias for the output FETs, and is mounted on the heat sink for thermal tracking. The inverter stage

operates at unity gain, splitting the approximately 8 volts of bias generated by Q24 and applying it to the output transistor gates referenced to the power supply rails. Q24 is mounted on the heat sink to allow the bias to track the output stage temperature. Q14 and Q15 are emitter followers that drive the output transistors Q16-Q23. Finally, the drains of the output transistors are the amplifier output, via relay K1. The output signal also takes two feedback paths, the first via R36 to R31, 32, and 35, setting the output stage voltage gain at about 30x. The second feedback path, R37 to R14 and the input differential amplifier, set the overall amplifier gain at about 29x, with a closed loop bandwidth of about 350Khz. This completes the primary signal path from input to speakers.

In addition to handling the audio signal, several other functions are performed on the amplifier board. The first is automatic servo-nulling of DC input offset voltages, ensuring no DC at the output of the amplifier. This is achieved by IC4, which senses any DC at the output, and injects a compensating current, through R38, into the feedback side of the input differential amplifier.

Next, Q7-Q9 detect any clipping of the amplifier by sensing excessive internal drive signals, such as will occur when the feedback loop becomes non-linear under overload conditions. IC3, C19, and R57 capture any clipping occurrences and light LED1 for a minimum of 1 second.

IC4a and b detect the presence of any DC offset (due to a fault) at the output of the amplifier, and will release relay K1, protecting the speaker. TC1 is a thermal protector, which can also drop out K1, in case of overheating of the amplifier.

Finally, REG1 and REG2 are voltage regulators that keep the supply voltage for the input stages at +/- 30 Volts, while the output stage supply voltage may vary from +/- 41 volts to +/-82 volts, as determined by the switching power supply setting. D11 and D12 regulate the +/- 15 volts for the operational amplifiers IC3 and IC4.

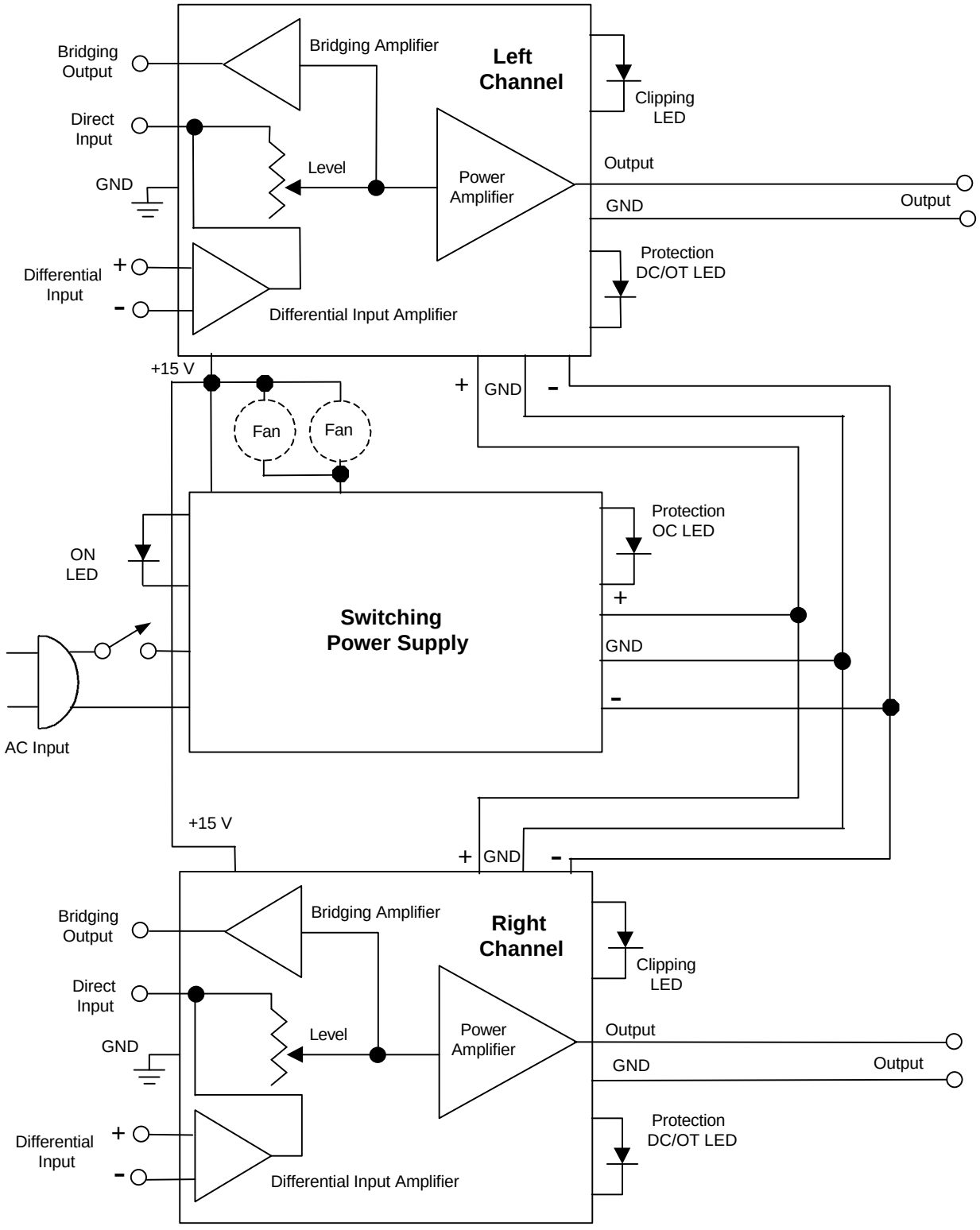


Figure 1 – Block Diagram

2.2 INVERTER POWER SUPPLY

Figure 3 shows the power supply schematic. The inverter power supply is a basic off-line full bridge design, with output current protection and shutdown capability, and three output voltage setting options.

The power line input is filtered and rectified by L3, DB1, and C1/C2. With JMP1 in place, DB1, C1 and C2 form a voltage doubler. Q1-Q4 constitute the bridge, with Q1/Q2 and Q3/Q4 conducting alternately in pairs. They are driven via pulse transformer T2 from pulse width modulator/driver IC1. T4 is the main power transformer, driven by Q1-4, with its output rectified by fast recovery rectifiers D1-D4 and filtered by C17-C20. The positive output is divided by R26 and R27. R27 is in parallel with R32, R33, or nothing. The feedback signal is fed to inverting buffer amplifier IC3a, whose output is summed with a similar divider fed from the negative supply rail. IC3b is an inverting summer whose gain of .42 is set by R37/R36. Diodes D12 and D14 ensure that neither power rail supplies more than approximately half of the 11.9 volt summed input necessary to generate the +5 volt sum output. The result, at pin 7 of IC3 is fed back to the pulse width modulator comparator input pin 2 of IC1, where it is compared with the internal voltage reference applied to pin 1. The feedback path includes a compensation network consisting of IC2b, R25, C24, C25, and R39. Current in the bridge inverter is sensed by current transformer T3, whose output is rectified and filtered by D5-8 and C22. T3 puts out 2 volts for every amp of current. The result is compared to a fixed 2.5 volt reference by IC2a, and if excessive currents are detected, a shutdown signal is sent to IC1 pin 10, and LED1 lights. The shutdown condition is latched via the D11 feedback path, until C26 charges, at which point Q5 will reset the shutdown condition.

To power the inverter control circuits, a small low voltage supply consisting of T1, rectifier DB2, and regulator REG1 generates + 12 volts. Power for the fans, when used, is generated by a separate winding on T4, rectified by D15 and regulated by REG2.

3. CONSTRUCTION

The amplifier was designed to minimize the need for point-to-point wiring by including many interconnect features on the printed circuit. Several features, such as bridging capability, are also optional. Variable board populations associated with these will be pointed out during construction. The options are summarized in the following table:

Option	Choices	Description/comments
Power supply input voltage	110v or 240v (section 4.1)	For operation in different countries
Bridging	Equipped or unequipped (section 3.1)	This option allows the two channels to be operated as one amplifier, producing at least twice the power of a single channel. The option is enabled by populating the additional components on the boards. It may then be switched on or off.
Differential input	Equipped or unequipped (section 3.1)	Provides balanced differential input capability
Amplifier operating voltage	+/- 41v, +/- 58v, +/-82v (section 6)	+/- 41v is intended for use with very low impedance speakers to limit amplifier power dissipation. +/- 58v may be set to limit 8 ohm power output to about 130W/channel, or for typical operation with 4 ohm speakers. +/- 82v provides the maximum output power, 350W/channel into 8 ohms
Number of output transistors	Nominally 8 per channel. Optionally may be equipped with 10 per channel (section 4.3)	Most applications operate with plenty of margin with 8 output transistors. For the most demanding and severe environments, an additional two can be installed
Mechanical Assembly	5 ¼" high natural convection case, 3 ½" x 19" forced convection case (section 5)	The natural convection configuration may be desirable for home applications where the noise of a fan is unacceptable. The 3 ½" unit with fans may be best suited for sound re-enforcement or home theatre applications.

Before beginning, refer to and review the soldering techniques and suggestions and static electricity management information sheets. These are very important and must be followed to ensure the highest quality results.

Following is a list of tools required to complete this project:

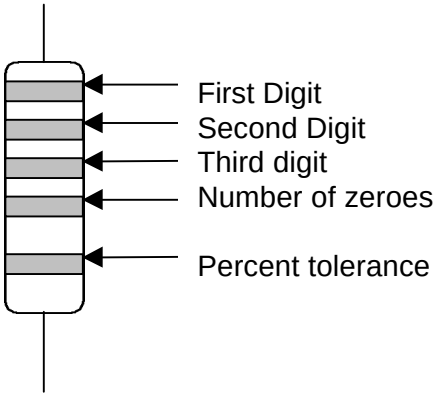
- Soldering iron
- Needle nose pliers
- Diagonal cutters
- Small Phillips and flat blade screw drivers
- Small Allen wrenches
- Digital voltmeter with milliamp range and ohmmeter capability
- (0ptional) Oscilloscope and signal generator

3.1 AMPLIFIER BOARDS

If you are building a stereo unit, the steps in this section will need to be repeated. You may wish to build the two channels in parallel for efficiency of effort.

Begin by installing all resistors, capacitors, and diodes in their appropriate places. (See parts placement Figure 4.) Check values of resistors as you proceed, and take care to orient diodes and electrolytic capacitors properly. Decide if you will want to include the bridging and differential input options. **If so, parts required for bridging are marked with a * , parts for differential input are marked with ** , and parts for the extra output transistor option are marked with *** in the checklists.**

Resistor coding guide - Resistors are identified by color stripes and can be decoded as follows:



Code:
0 – Black
1 – Brown
2 – Red
3 – Orange
4 – Yellow
5 – Green
6 – Blue
7 – Violet
8 – Grey
9 – White

Example: 46.5K, 1/4W, 1% - Yellow-Blue-Yellow-Red (space) Brown

It's always a good idea to check the value of each resistor with an ohmmeter before installing!

3.1.1 Resistors:

Note: All 1% resistors have a brown last stripe

✓	✓	Part	Value	Identity	✓	✓	Part	Value	Identity
		R1	46.4K	Yel-blu-yel-red			R41**	46.4K	Yel-blu-yel-red
		R2	2.05K	Red-blk-grn-brn			R42**	402	Yel-blk-red-blk
		R3	2.05K	Red-blk-grn-brn			R43	10K Pot	**Mount later!**
		R4	100	Brn-blk-blk-blk			R44	825K	Grey-red-grn-or
		R5	100	Brn-blk-blk-blk			R45	1K	Brn-blk-blk-brn
		R6	10K	Brn-blk-blk-red			R46	5.11K	Grn-brn-brn-brn
		R7	10K	Brn-blk-blk-red			R47	1K	Brn-blk-blk-brn
		R8	100	Brn-blk-blk-blk			R48	5.11K	Grn-brn-brn-brn
		R9	100	Brn-blk-blk-blk			R49	1K	Brn-blk-blk-brn
		R10	10K	Brn-blk-blk-red			R50	1K	Brn-blk-blk-brn
		R11	10K	Brn-blk-blk-red			R51	825K	Grey-red-grn-or
		R12	33.2	Or-or-red-gold			R52	1K	Brn-blk-blk-brn
		R13	33.2	Or-or-red-gold			R53	510, 1W	Grn-brn-blk
		R14	162	Brn-blu-red-blk			R54	510, 1W	Grn-brn-blk
		R15	1K	Brn-blk-blk-brn			R55	10K	Brn-blk-blk-red
		R16	1K	Brn-blk-blk-brn			R56	1K	Brn-blk-blk-brn
		R17	402	Yel-blk-red-blk			R57	825K	Grey-red-grn-or
		R18	10K pot	~ 3/8” rectangle			R58	15K	Brn-grn-blk-red
		R19	5.11K	Grn-brn-brn-brn			R59	15K	Brn-grn-blk-red
		R20	1K	Brn-blk-blk-brn			R60	2.05K	Red-blk-grn-brn
		R21	1K	Brn-blk-blk-brn			R61	200	Red-blk-blk-blk
		R22	5.11K	Grn-brn-brn-brn			R62	200	Red-blk-blk-blk
		R23	1K	Brn-blk-blk-brn			R63	200	Red-blk-blk-blk
		R24	20K	Red-blk-blk-red			R64	200	Red-blk-blk-blk
		R25	330, 3W	See Note 1			R65	200	Red-blk-blk-blk
		R26	100	Brn-blk-blk-blk			R66	200	Red-blk-blk-blk
		R27	330, 3W	See note 1			R67	200	Red-blk-blk-blk
		R28	100	Brn-blk-blk-blk			R68	200	Red-blk-blk-blk
		R29	1K	Brn-blk-blk-brn			R69	1.21K	Brn-red-brn-brn
		R30	681	Blu-grey-brn-brn			R70	27.4K	Red-viol-yel-red

	R31	681	Blu-grey-brn-brn	R71	1.21K	Brn-blk-brn-brn
	R32	1K	Brn-blk-blk-brn	R72	27.4K	Red-viol-yel-red
	R33	2K, 5W	See note 1	R73 *	46.4K	Yel-blu-yel-red
	R34	2K, 5W	See note 1	R74 *	46.4K	Yel-blu-yel-red
	R35	50	Grn-blk-blk-gold	R75**	46.4K	Yel-blu-yel-red
	R36	1.5K, 2W		R76**	46.4K	Yel-blu-yel-red
	R37	5.1K, 1/2W	Grn-brn-brn-brn	R77**	46.4K	Yel-blu-yel-red
	R38	10K	Brn-blk-blk-red	R78 *	5.11K	Grn-brn-brn-brn
	R39	825K	Grey-red-grn-or	R79 ***	200	Red-blk-blk-blk
	R40	825K	Grey-red-grn-or	R80 ***	200	Red-blk-blk-blk

Note 1: Mount R25, 27, 33, and 34 ¼" off the board for better airflow/heat dissipation.
* Parts required for bridging option
** Parts required for differential input
*** Parts required for extra output transistor option

3.1.2 Capacitors:

✓	✓	Part	Value	✓	✓	Part	Value	✓	✓	Part	Value
		C1	10uf 50V			C9	.22uf			C17	10uf 35v
		C2	150pf			C10	10uf 35v			C18	1500pf
		C3	100uf 50v			C11	10uf 35v			C19	1uf 35v
		C4	100uf 50v			C12	.1uf 100v			C20*	82pf
		C5	.1uf, 100v			C13	100uf 100v			C21*	.01UF
		C6	150pf			C14	.1uf 100v			C22*	.01UF
		C7	82pf			C15	100uf 100v			C23**	82pf
		C8	.22uf			C16	10uf 35v			C24**	82pf

* Parts required for bridging option
** Parts required for differential input

3.1.3 Diodes:

✓	✓	Part	Type	✓	✓	Part	Type	✓	✓	Part	Type
		D1	1N4148			D6	1N4742A			D11	1N4742A
		D2	1N4148			D7	1N4744A			D12	1N4002
		D3	1N4728A			D8	1N4744A			D13	1N4002
		D4	1N4728A			D9	1N4740A			D14	1N4002
		D5	1N4742A			D10	1N4742A			D15	1N4742A

Next, install small signal transistors and ICs. Adjust R18 to its approximate middle position. Note: Q24 will be installed later, in section 4.3.

3.1.4 Transistors and ICs

✓	✓	Part	Type	✓	✓	Part	Type	✓	✓	Part	Type
		Q1	MPSA06			Q9	MPSA06			IC1	LM334Z
		Q2	MPSA06			Q10	MPSA06			IC2	LM334Z
		Q3	MPSA56			Q11	MPSA06			IC3	LM339AN
		Q4	MPSA56			Q12	MPSA56			IC4	LF411CN
		Q5	MPSA56			Q13	MPSA56			IC5 *	LF357N
		Q6	MPSA06			Q14	MPSA06			IC6 **	LF357N
		Q7	MPSA56			Q15	MPSA56			IC7	LM358
		Q8	MPSA06			Q25	VN0610LL				

* Parts required for bridging option
** Parts required for differential input

Install the fuse clips and terminal blocks. The amplifier boards are designed to mount the input jacks, level set potentiometer, and indicator LEDs on either end of the board, depending on the unit physical configuration. See section 5 and figures 6,7,9, and 10, and determine your planned configuration. Then mount these components accordingly, as follows:

1) Depending on which channel you are building, install the RCA input jack and the level set potentiometer R43 at the appropriate end of the board (back for 3 ½" unit, right end, with the power components at the back of the board, for the 5 ¼" unit).
2) The clipping and protection indicator LEDs go on the opposite end from the input jacks of the board (front for the 3 ½" unit), or on the end of wires to be remoted (about 8") on the front panel for the 5 ¼" unit.

If you have populated the bridging option, the board with R73,74 C20,21,22, and IC5 will be the "input" board for the drive signal), with the switch SW1 and LED 3 on the other. The cathodes of all the LEDs (the direction the arrow in the symbol points) is the longer lead. For differential input capability, include the 1/4" jacks on the appropriate ends of the boards, along with the twisted pair shielded cable from the jack to the center of the board. If you do not need differential input, omit coax #2, the twisted pair, IC6 and the components associated with it (R41,42,75,76,77, C23-24).

Last, install coax #1 and the relay K1. The temperature sensor, regulators, and thermal sensing FET will be left off until heat sink installation, and the output transistors (Q16-23) will be mounted after preliminary testing is completed.

3.1.5 Miscellaneous parts

✓	✓	Part	✓	✓	Part	✓	✓	Part
		Fuse clips (4)			LED1			Twisted pair **
		Term. Blocks (5)			LED2			Coax #1

RCA input jack	SW1 *	K1 relay
R43 Level set	LED3 *	Fuse, 6A
¼" input jacks (If used) **	Coax #2 **	

* Parts required for bridging option
** Parts required for differential input

3.2 INVERTER POWER SUPPLY

Much like the amplifiers, begin by installing resistors, capacitors, and diodes, carefully checking values and orientations. (See parts placement Figure 5.)

3.2.1 Resistors:

✓	Part	Value	Identity	✓	Part	Value	Identity
	R1	316	Or-brn-blu-blk		R23	1K	Brn-blk-blk-brn
	R2	7.50K	Viol-grn-blk-brn		R24	100K	Brn-blk-blk-yel
	R3	10K	Brn-blk-blk-red		R25	6.98K	Blu-wht-grey-brn
	R4	4.7, 1/2W	Yel-viol-gold-gold		R26	100K	Brn-blk-blk-yel
	R5	75	Viol-grn-blk-gold		R27	16.9K	Brn-blu-wht-red
	R6	75	Viol-grn-blk-gold		R28	36.5K	Or-blu-grn-red
	R7	75	Viol-grn-blk-gold		R29	15K	Brn-grn-blk-red
	R8	75	Viol-grn-blk-gold		R30	100K	Brn-blk-blk-or
	R9	75	Viol-grn-blk-gold		R31	16.9K	Brn-blu-wht-red
	R10	75	Viol-grn-blk-gold		R32	36.5K	Or-blu-grn-red
	R11	75	Viol-grn-blk-gold		R33	15K	Brn-grn-blk-red
	R12	75	Viol-grn-blk-gold		R34	100K	Brn-blk-blk-or
	R13	50, 25W	See note below		R35	100K	Brn-blk-blk-or
	R14		Not used		R36	100K	Brn-blk-blk-or
	R15		Not used		R37	46.4K	Yel-blu-yel-red
	R16	200, .5W	Red-blk-blk-blk		R38	100K	Brn-blk-blk-or
	R17	3.48K	Or-yel-grey-brn		R39	4.99K	Yel-wht-wht-brn
	R18	1K	Brn-blk-blk-brn		R40	316	Or-brn-blu-blk
	R19	2.05K	Red-blk-grn-brn		R41	1K, .5W	Brn-blk-blk-brn
	R20	10K	Brn-blk-blk-red		R42	1K	Brn-blk-blk-brn
	R21	10K	Brn-blk-blk-red		R43	22K 10W	
	R22	1K	Brn-blk-blk-brn				

Note: R13 is mounted with a pair of short segments of wire soldered to the resistor tabs.

3.2.2 Capacitors:

✓	Part	Value	✓	Part	Value	✓	Part	Value
	C1	2200uf 200V		C10	4700pf		C19	470UF 100V
	C2	2200uf 200V		C11	4700pf		C20	470UF 100V
	C3	1000uf 50V		C12	4700pf		C21	.01UF
	C4	1000uf 50v		C13	4700pf		C22	.22uf
	C5	.001uf		C14	560pf 500V		C23	.01UF
	C6	10uf 50V		C15	Not used		C24	3300PF
	C7	100pf		C16	Not used		C25	.22UF
	C8	.01uf		C17	470UF 100V		C26	1000uf 25v
	C9	10uf 50V		C18	470UF 100V			

3.2.3 Diodes, ICs, Q5, and REG1:

(Power rectifier diodes, power transistors and REG2 are installed later after heat sink installation)

✓	Part	Type	✓	Part	Type	✓	Part	Type
	D5	1N4002		D10	1N4735A		IC1	SG3525
	D6	1N4002		D11	1N4002		IC2	LM358
	D7	1N4002		D12	1N4735A		IC3	LM358
	D8	1N4002		D13	1N4742A		Q5	VN0610LL
	D9	1N4742A		D14	1N4735A		REG1	7812

Install the transformers and current transformer, inductors, ZNR1, TR1, LEDs, bridge rectifiers, and the fuse holders. The current transformer T3 is installed with two turns of insulated 16 gage wire wound through the hole in the transformer and soldered into the large holes adjacent to T3. Also wire the voltage select switch at this time.

This is the time for determining your power supply jumper configuration: For 120v operation, equip jumpers 1, 2, and 3. For 240 v operation, use jumper 4 only.

3.2.4 Transformers and miscellaneous parts

✓	Part	✓	Part	✓	Part	Description	✓	Part	Description
	T1		Fuse clips (6)		L1	350uH		TR1	KC022L-ND
	T2		Term. Blocks(10)		L2	350uH		LED1	Red
	T3		Voltage select Switch		L3	1.8UH x 2		LED2	Green
	T4		Wire for T3		ZNR1	ERZ-V20D431		F2	.25 amp fuse
					F1	15 amp fuse		F3	8 amp fuse
			Jumpers 1-4		BR1	Bridge rectifier		DB2	Bridge rectifier

3.3 HEAT SINKS AND MECHANICAL ASSEMBLY

Both the amplifiers and the inverter are designed to edge mount their power components on the board, with their attachment to the heat sinks via a linear flange or flat mounting scheme. Figures 6 and 7 show the two basic enclosure designs for the 5 ¼" natural convection and 3 ½" fan cooled units, along with their heat sink flange arrangements.

The 3 ½" unit has fans and is the preferred configuration for sound re-enforcement and other heavy duty applications. The 5 ¼" high design is intended for home installations in which the fan noise may be objectionable, and uses natural convection cooling. For this, more heat sink area and vertical fin orientation is necessary, and the unit height is increased to 5 1/4", with the heat sinks across the back. The amplifiers are mounted one above the other, with the power supply at the bottom. For this physical design, it will also be necessary to run wires to the front panel mounted LEDs.

The flanges for both amplifiers and the power supply will be prepared at this time and the power components mounted for the power supply. Use the circuit boards or artwork as drilling templates to locate the transistor mounting holes. The flanges also need to be match-drilled with the heat sinks per the drawings. The lateral positioning of the flanges on the boards for the 5 ¼" unit is approximately centered. The mounting of the flanges to the heat sinks can be accomplished with three holes per flanged, drilled to avoid conflict between parts on the board and the screw driver or Allen wrench that will eventually mount the assembly to the heat sink. Drill holes through the flanges such that they are close to vertically centered on the flange, and fall midway between heat sink fins. The easiest approach is to drill and tap the holes in the heat sink. Alternatively, with careful spacing, nuts may be used. Lateral positioning of the amplifier assemblies is such that the input RCA jacks sit just inside the holes on the right side of the enclosure.

For the 3 ½" unit, the lateral positioning of the amplifier flanges is centered on the board. Lateral mounting of the assembly on the heat sink is chosen to align the front edge of the board with the front of the heat sink, such that the board mounted LEDs can protrude through their respective front panel holes. Vertical positioning of the holes should be such that the holes fall midway between heat sink fins.

Be sure to remove all burs from holes, as they may cut through transistor mounting insulators and cause short circuits, or cause the flanges not to lie perfectly flat against the heat sinks. At this time, prepare the mechanical assembly of heat sink components, drilling the flanges and heat sinks.

Mechanical Assembly

	Prepare mechanical assembly

3.4 POWER SUPPLY FLANGE MOUNTED COMPONENTS

Power supply heat sink mounted components may be mounted at this time. The power transistors and rectifiers mount at the edge of the board, so you will need to align these with your heat sink drilling before soldering to ensure proper alignment. Mount all power components with insulators coated with a liberal layer of heat sink conductive white silicone grease. Tighten well, but do not over tighten – ensure insulators do not deform under pressure. Using an ohm meter, ensure that there are no shorts between transistor cases and the heat sink. Solder the components to the board. This should complete the power supply assembly, including the angle flange.

3.4.1 Power Supply Power Components

✓	Part	Description	✓	Part	Description	✓	Part	Description
	D1	FR805		D4	FR805		Q3	IRFP450
	D2	FR805		Q1	IRFP450		Q4	IRFP450
	D3	FR805		Q2	IRFP450		REG2	7812

4. TESTING

4.1 INVERTER TESTING (Without oscilloscope)

Begin by once again looking over the inverter board for completeness and correctness of parts values and orientation. Also re-check the quality of all solder connections.

Next, install F1 and F2, but leave out F3. Make sure jumpers Jmp1, 2, 3, and 4 are installed properly for the supply voltage of intended use (see section 3.2). Apply input power from a power cord, temporarily connected to the AC input terminals, labeled “N” and “LIVE”. From here on, remember to exercise extreme caution in handling and measuring, since the input portions of the inverter are directly connected to the power line. Also note the rectified line filter capacitors will store a substantial charge for some time after the unit is turned off and pose a serious electrocution or damage threat. It is a good idea to discharge them with a low value resistor before handling the supply.

Measure at the input to F3 with respect to the ground side of C2 and verify the presence of 320 volts. Also, measure the output of REG1 with respect to board ground, and check for +12 volts (+/- .5v). Double check the orientation of T2. Turn off input power and install F3.

For the next test it is advisable to load the output of the inverter lightly, say with a 5K, 10 Watt resistor per rail. Set switch SW2 to the 41 volt position, and apply power. Check for +/- 41 (+/- 2) volts at the inverter output. Switch SW2 to +/- 58 volts and +/- 82 volts (+/- 2), and check for each voltage at the output.

Temporarily connect the shutdown input pin to +12 volts and verify that the output voltages are turned off.

4.2 ALTERNATIVE INVERTER TESTING CHECKLIST (If an oscilloscope is available)

After installing all components, except fuses, check component values and orientations again carefully

Install fuse F2 only and check for the presence of +/- 12 (+/- .5) volts at the output of regulator IC3 (Reg1) and D13 respectively

If an oscilloscope is available, a very useful test that is highly predictive of operational success of the power supply is possible: **(Very Important !!: Be sure your scope is operating ungrounded with respect to the AC power line for these tests!)**
Check the gate drive waveforms at the power transistors (from gate to source) with fuse F2 installed and fuses F1 and F3 left out. This applies +/- 12 volt control voltage without applying rectified line voltage to the power transistors. What you should see is approximately 75Khz, somewhat rounded square waves, with the signals at Q1 and Q2 in phase, and those at Q3 and Q4 in phase, and both pairs 180 degrees out of phase with each other.

If the appropriate signals are not found, backtrack to IC1, verifying the square wave output and proper installation of T2.

Next, install F1 and verify the presence of 320 (+/- 5%) volts at the input to fuse F3.

Install fuse F3 and check for proper output voltage (as set by the S2 switch setting) at the output terminals. This may be a little bit high if no load is applied.

Apply a resistive load to the output, (for example 5K, 5 Watt) and check that the voltage stays at the value expected for the particular S2 switch setting. Calculate the load according to V=IR or P=(V*V)/R, and choose loads that are within the power range of the supply, and that can dissipate the power without burning up!

That should do it! If you get to this point successfully, then your power supply should have no trouble running the amplifiers!

If you have trouble with these last tests, for example if the shutdown LED operates (which will typically be in the form of a pulsating cycle with the LED operating, and

noticeable heavy AC power line load, as evidenced by flickering lights), check for short circuits in the output portions of the power supply. This could include, for example, output capacitors shorted or installed backwards, or rectifiers shorted to the heat sink.

4.3 AMPLIFIER TESTING

The amplifiers will first be tested without the output transistors installed. Begin again by carefully checking that all components are present, the correct value or type, and properly oriented. A little bit of patience and scrupulous inspection at this point can go a long way in avoiding smoke, loss of expensive parts, and endless troubleshooting and heartache later!

At this time, install the heat sink adapter L-bracket, drilled and prepared previously, with the temperature sensor TC1, (Our kits come with one over temp. cutout per channel. Mount it on the forward end of the board where the LEDs are, opposite the input jacks. See figures 9 and 10). Install temperature sense FET Q24, and regulators REG1 and REG2. Use transistor insulators, heat sink grease, and do not over tighten.

4.3.1 Amplifier Miscellaneous Power Parts

✓	✓	Part	Description	✓	✓	Part	Description
		REG1	LM317T			TC1	67F080
		REG2	LM337T			Q24	IRF510

Install 1/2 amp fuses for F1 and F2, and temporarily connect the power supply to an amplifier board, making sure all power polarities are correct. These tests can be accomplished by carefully laying the modules out on the bench. Be sure they are all on insulating surfaces! For these tests you may wish to use the current limiting capabilities of the power supply for extra protection. This can be achieved by placing a jumper on the power supply board between the junction of R17 and R18, and the junction of D5 and D9. Apply power and check for the +/- 15 volt supplies on the board and the +/- 30 volts at the input stages. Do all probing very carefully, as a slip with a probe can easily result in a damaging short circuit!

Very carefully measure the voltages across D7 and D8. They should each be in the range of 3 to 5 volts. Adjust R18 until they are each less than or equal to 3.5 volts. If you have a signal generator and oscilloscope, an additional valuable test is to apply a very low level signal, say 5-10 millivolts at 1Khz, and check for drive signals at the emitters of Q14 and Q15. Since the amplifier is open loop at this point, the drive signals will easily overload, and look like square waves, about 12 volts p-p or less, as limited by D7 and D8.

If all is well, you may now mount and solder the output transistors. They must be matched, and a circuit for matching them is shown in figure 8. (Transistors supplied in our kits are matched) Mount the transistors on the heat sink angle bracket with mica washers and liberal silicon grease, and check for absence of shorts between transistors and the heat sink, then solder to the amp board. For home use and 8 ohm operation, four output transistors per rail is sufficient. However, if you plan to operate in bridging mode, or at high power with low impedance loads, include the additional transistor per rail, for a total of five per rail.

4.3.2 Amplifier Power Transistors

✓	✓	Part	Description	✓	✓	Part	Description
		Q16	IRFP9240			Q20	IRFP240
		Q17	IRFP9240			Q21	IRFP240
		Q18	IRFP9240			Q22	IRFP240
		Q19	IRFP9240			Q23	IRFP240

Set the power supply in the +/-58 volt mode. Apply power with a 1 amp fuse installed for F1, and a milliameter in place of F2. Adjust R18 for an idle current of about 240 mA. (The bias must be re-set for long term operation at different voltages) Remove the ammeter and install a 1 amp fuse for F2. Check that the output is within a few millivolts of ground. Apply an input signal at a low level, and verify that an amplified output appears.

✓	✓	Description	✓	✓	Description	✓	✓	Description
		Idle current set			Check output DC offset			Signal check

If all is well, replace F1 and F2 with 6 amp fuses, and perform similar tests on the second channel. If you used it, remove the current limiting jumper on the power supply board.

5. FINAL ASSEMBLY

Figure 9 shows details of chassis preparation for the packaging shown in Figure 6 for the 5 ¼" unit. Figure 10 shows details of chassis preparation for the packaging shown in Figure 7 for the 3 ½" unit. Following construction of the basic chassis, it's time to mount switches, connectors, and LEDs, and to install wiring. If you are fabricating your own case, you will need to drill holes for LEDs, inputs, outputs, power cord, etc. in the appropriate places. For the 3 ½" unit this includes proper alignment between the front panel LED holes and the LEDs, as mounted on the amplifier boards.

Following is a checklist for the chassis mounted components:

5.1 Chassis Mounted Components

✓	Description	✓	Description
	4 output terminals		Mount panel LEDs (power supply and 5 ¼" amp clip and overload)
	IEC power input connector		Fans (3 ½" unit)
	Power switch		

Once all boards have been tested, install them along with their heat sinks in the chassis. Use heat sink grease between the L-bracket and the heat sink. The power supply is installed first in both the 3 ½" and 5 ¼" units. Wiring will need to be installed on the power supply before the amplifier boards are installed. Measure, cut, and strip wires to appropriate lengths to reach the corresponding amplifier terminals. Following is a checklist for inter module and other unit wiring:

5.2 Wiring

✓	✓	Description	✓	✓	Description
		IEC AC power connector to power switch			Ground to each amp
		Power switch to power supply			Output from binding post to each amp
		Fans to 12V power on power supply			Output ground from binding post to each amp
		Power supply voltage select switch (switch installation)			Power supply power and shutdown LEDs/wires
		12 volt relay power to each amp			Amp clip and overload LEDs/wires (5 ¼" unit)
		+Vcc to each amp			Bridging coax from input channel to other channel (If used)
		-Vcc to each amp			

Carefully re-check work and perform final testing: Install fuses in power supply and one amplifier. Apply power and check that no DC appears at the amplifier output terminals. Apply a signal and load and check for proper amplifier operation. Test the other channel the same way.

6. OPERATING HINTS

The only special operating instruction pertains to the use of the inverter voltage select switch. In general, lower voltages can be used for two purpose: First, to limit the power available to sensitive loads. Some audiophiles, for example like to limit the available power to near 100 watts into an 8 ohm load. For that kind of operation, choose the 58 volt setting. Second, when driving low impedance speakers, such as 1-4 ohms, the power dissipation in the amplifier may be limited by setting the voltage to 41 volts. In

any case, the current detection built into the power supply will protect the amplifier sections, resulting in momentary shutdowns and an LED indication. The supply will reset itself when the overload is removed. Finally, for maximum performance and power output into 8 ohm loads, use the 82 volt power supply setting (Remember that the bias current must be re-set for each voltage for long term operation. See section 4.3)

Finally, remember the power levels this amplifier is capable of, and be careful with both your speakers and your ears. Happy listening!

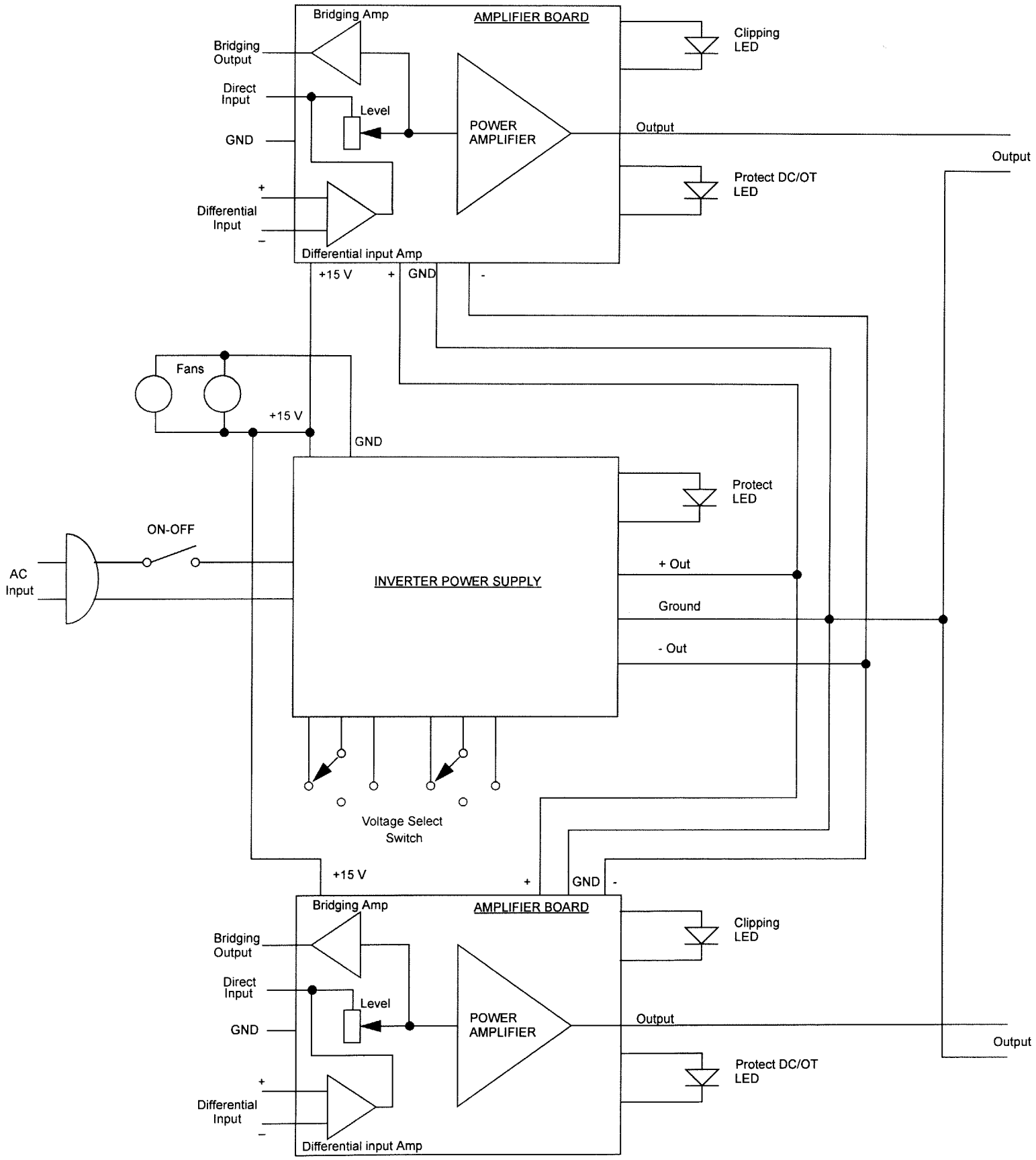


Figure 1: Block Diagram

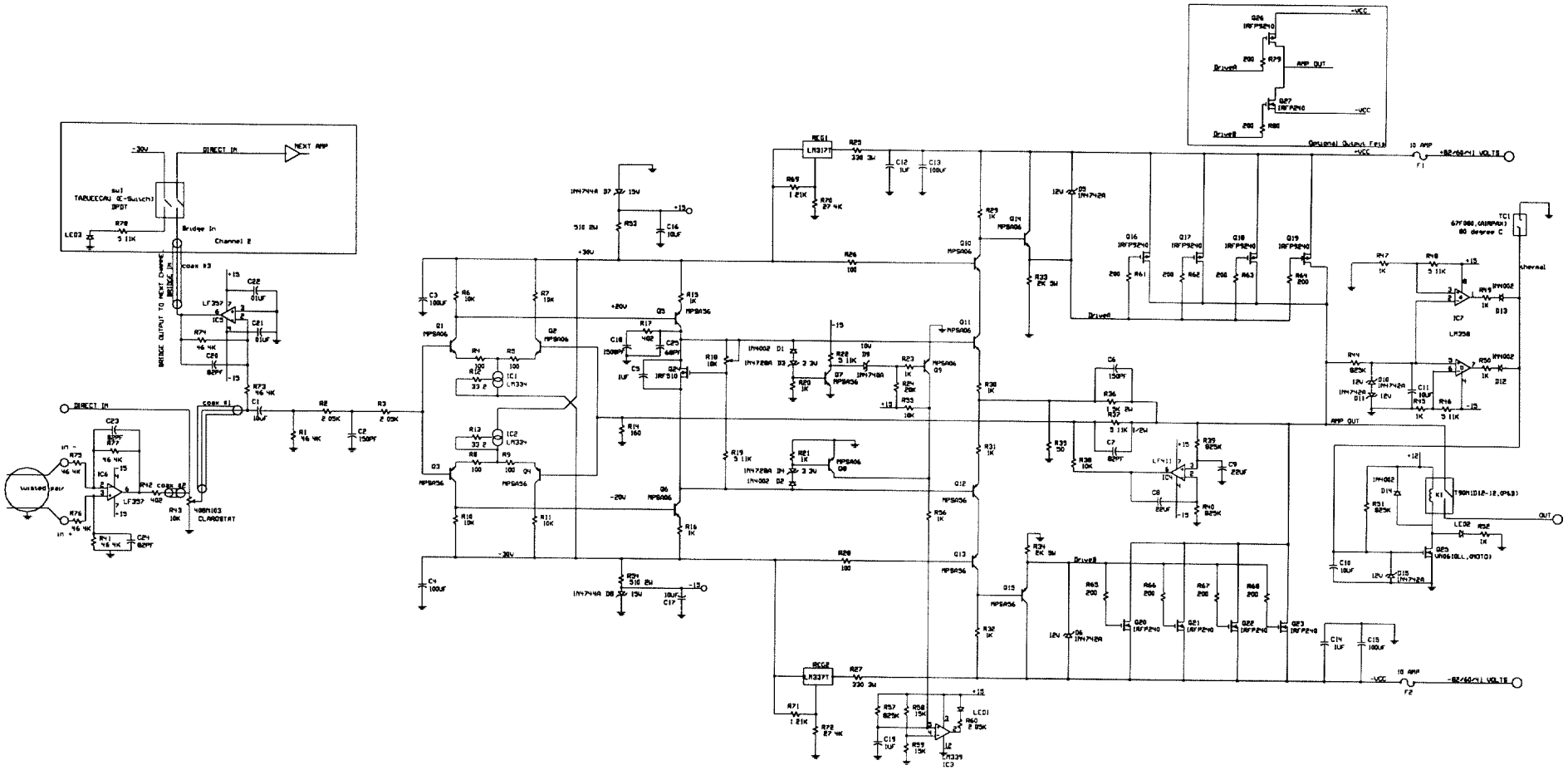


Figure 2

K6 - 700 Watt Power Amp

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SHEET 1 OF 1

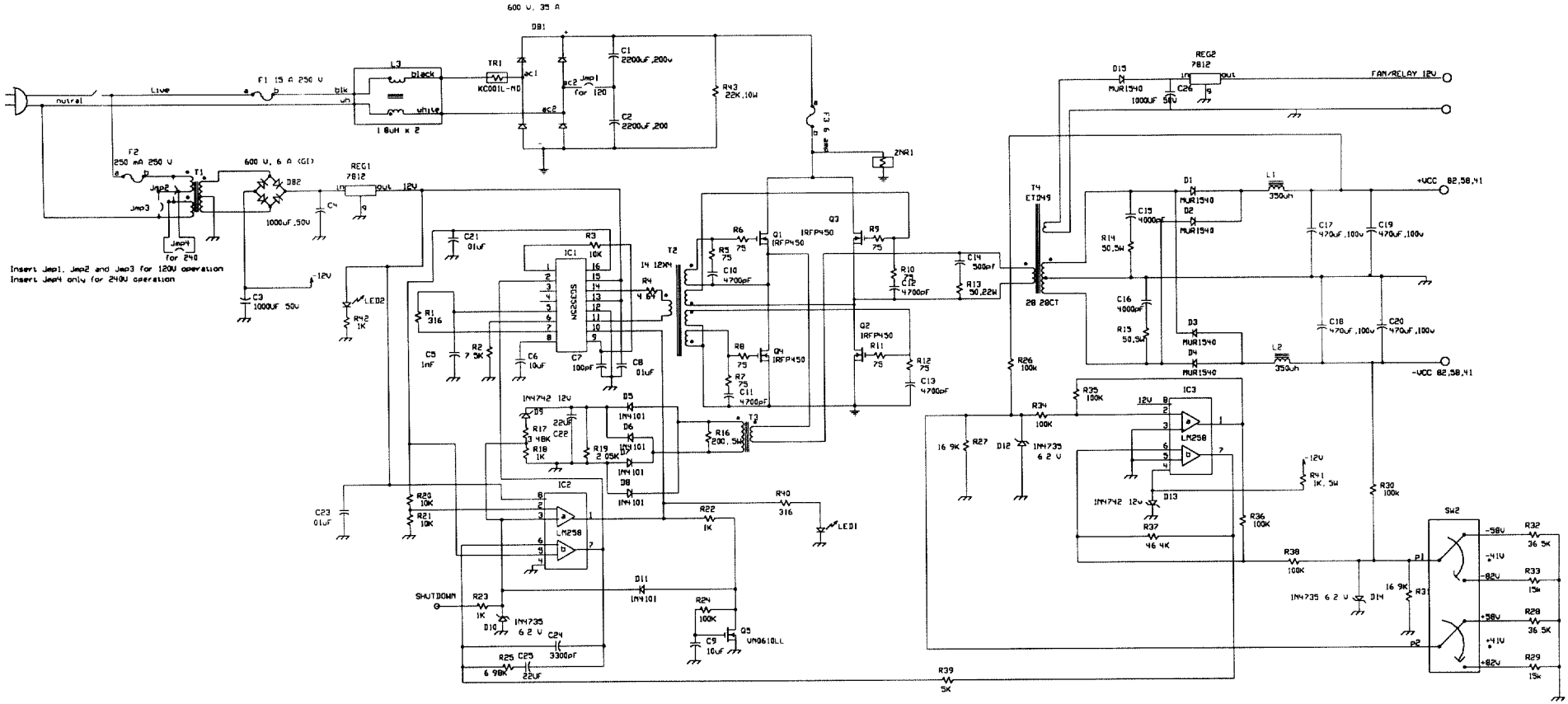

Figure 3

K6 - Switching Power Supply	
	REVISION 2 0
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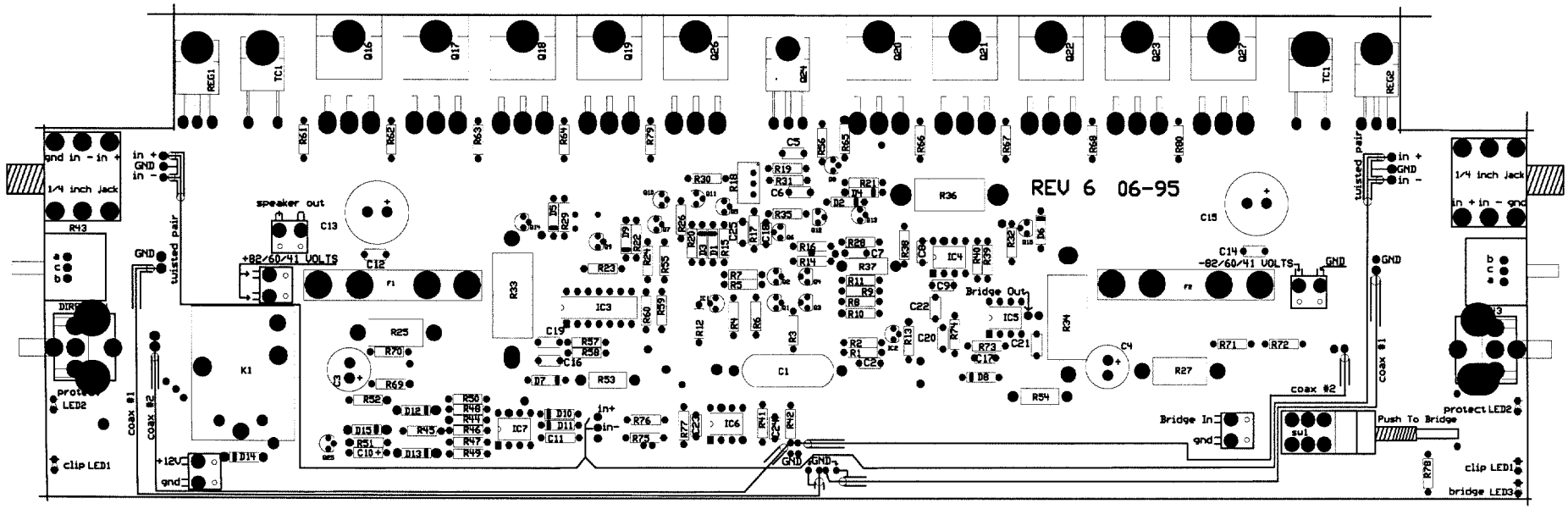

Figure 4

K6 - 700 Watt Power Amp	SHEET COMPONENT PLACEMENT
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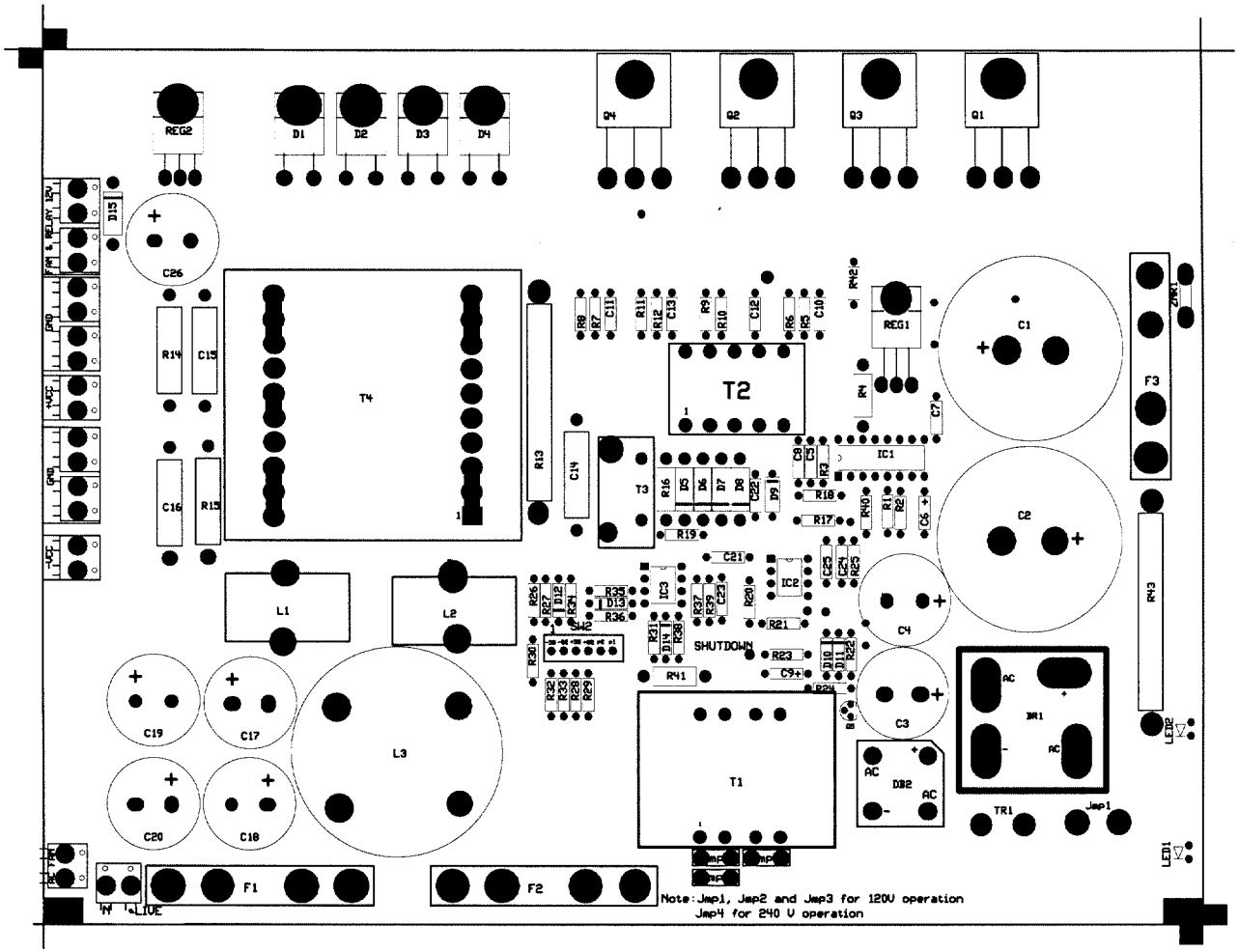

Figure 5

K6 - Switching Power Supply	SHEET COMPONENT PLACEMENT
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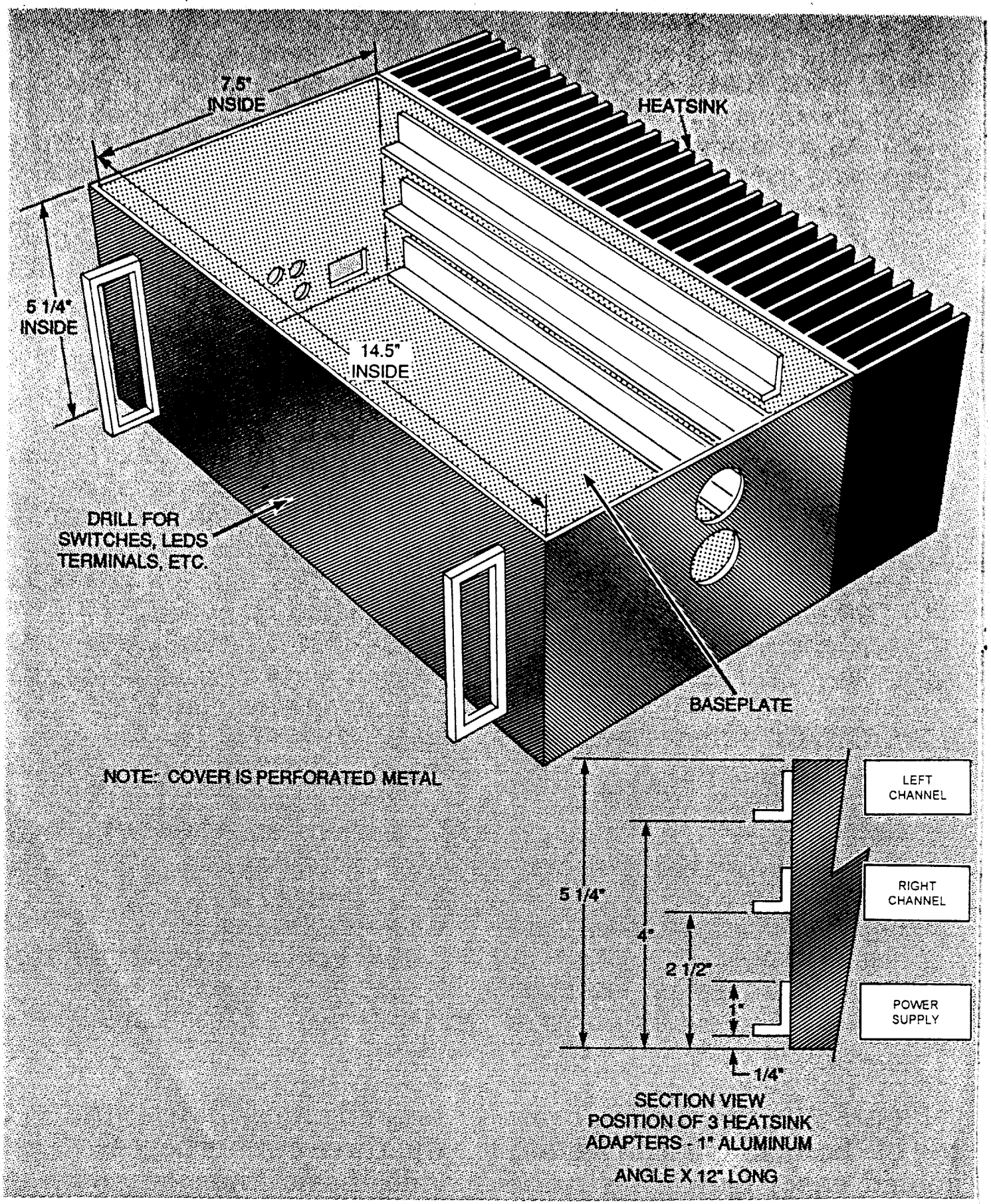
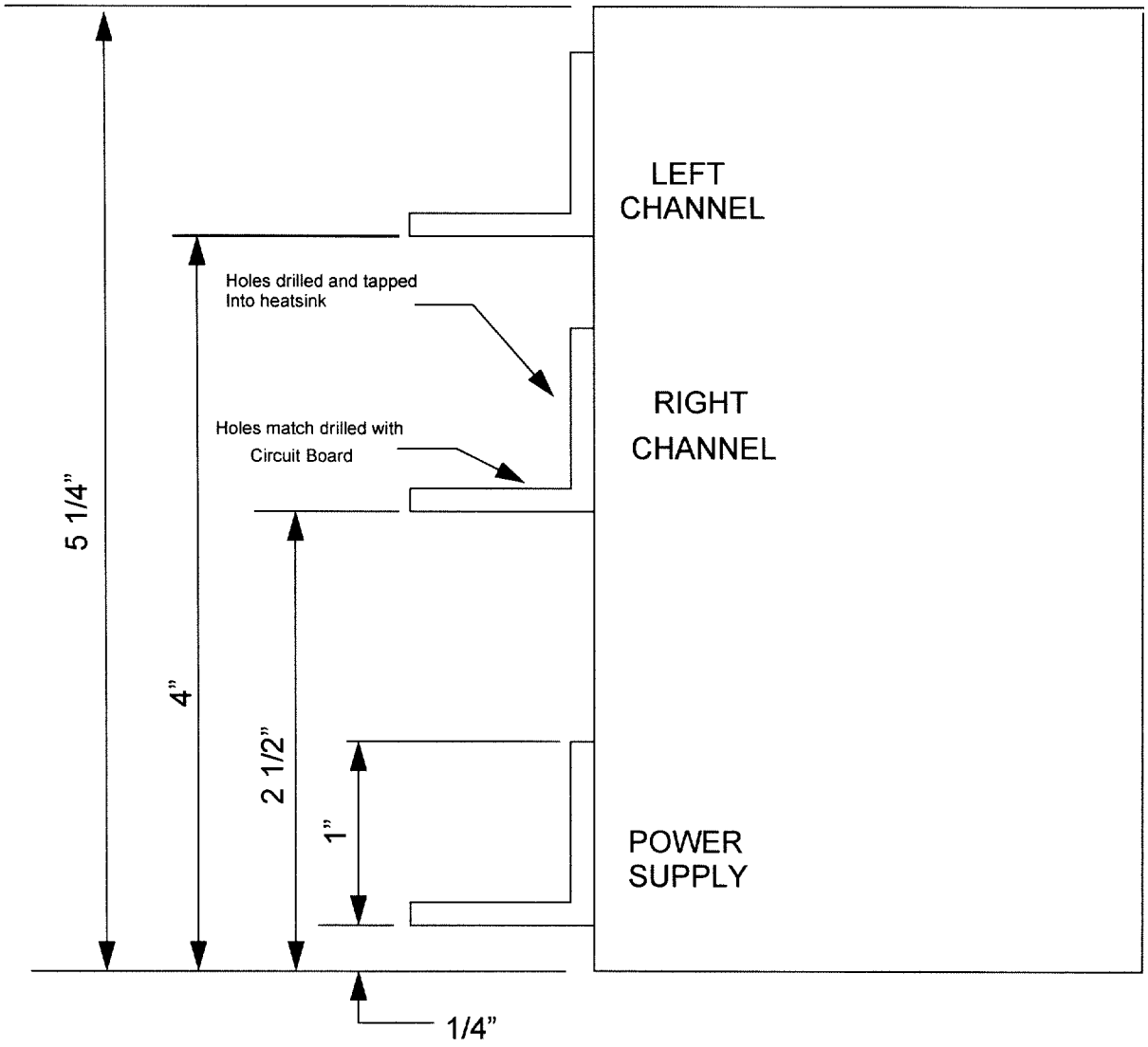

7.5"
INSIDE
HEATSINK
5 1/4"
INSIDE
14.5"
INSIDE
DRILL FOR
SWITCHES, LEDS
TERMINALS, ETC.
BASEPLATE
NOTE: COVER IS PERFORATED METAL
LEFT
CHANNEL
RIGHT
CHANNEL
POWER
SUPPLY
5 1/4"
4"
2 1/2"
1"
1/4"
SECTION VIEW
POSITION OF 3 HEATSINK
ADAPTERS - 1" ALUMINUM
ANGLE X 12" LONG

Figure 6

FIGURE 6a: HEATSINK AND ANGLE BRACKET DRAWING
FOR NATURAL CONVECTION UNIT



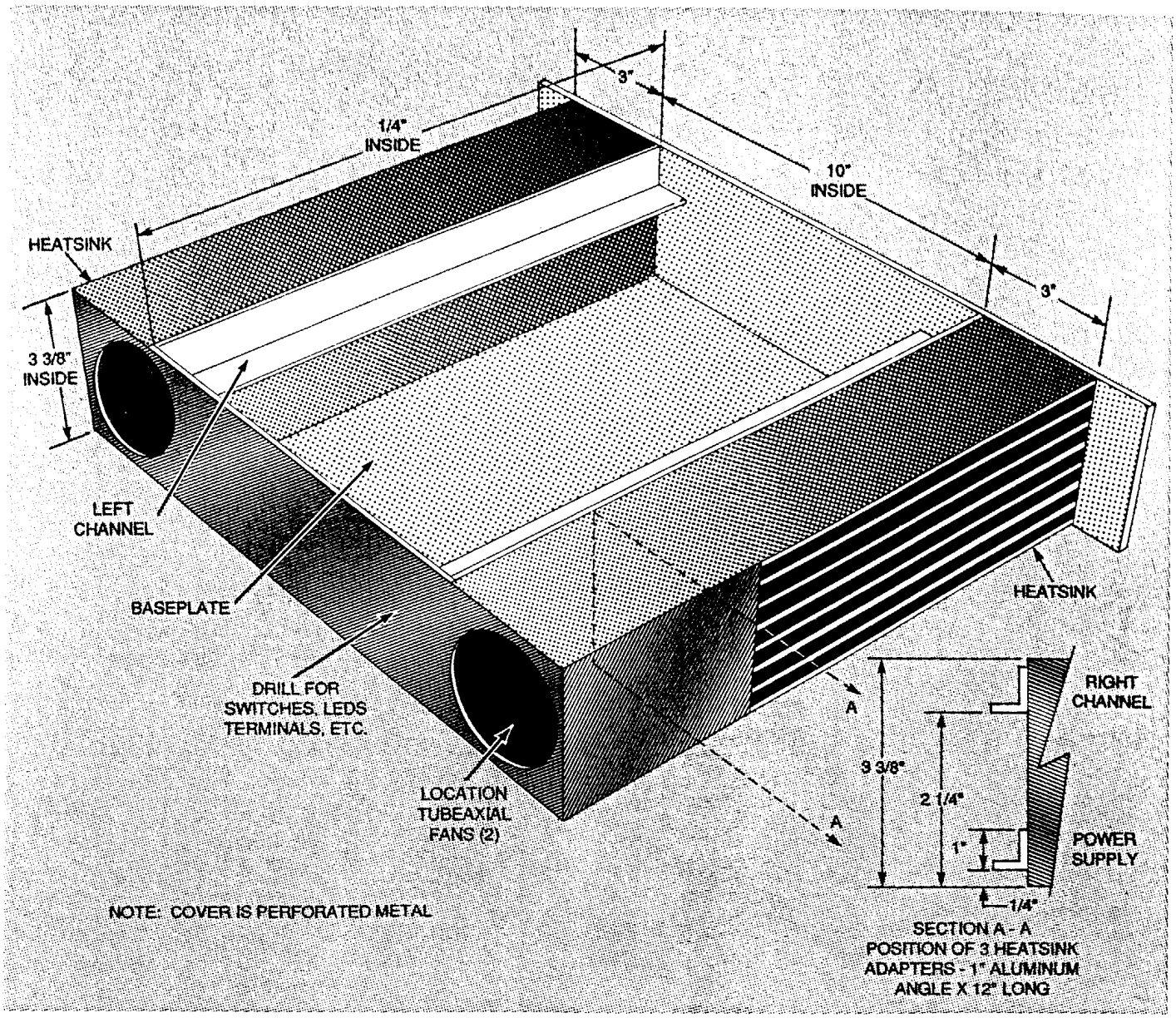
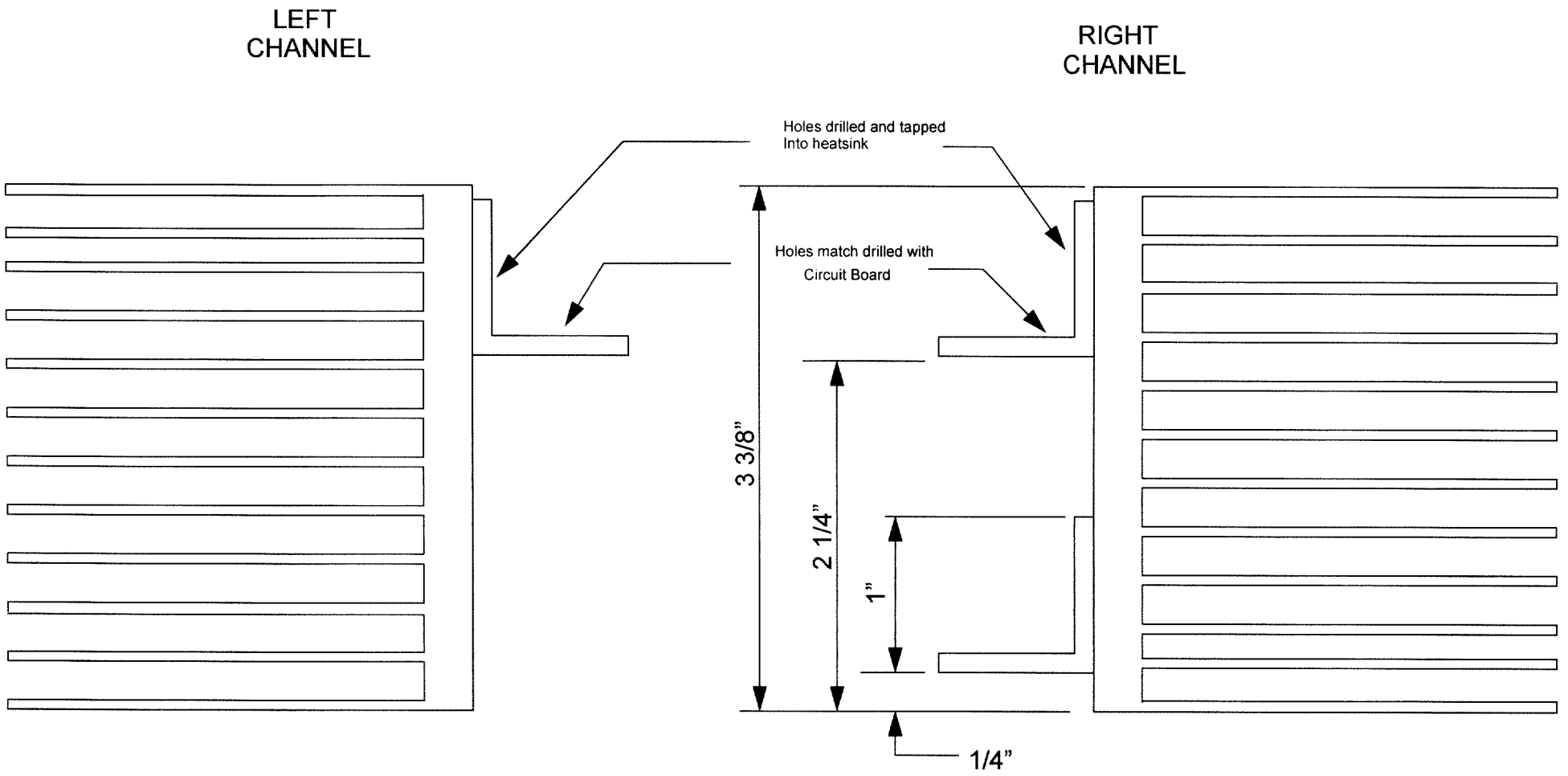

3"
1/4"
INSIDE
10"
INSIDE
HEATSINK
3"
3 3/8"
INSIDE
LEFT
CHANNEL
BASEPLATE
HEATSINK
DRILL FOR
SWITCHES, LEDS
TERMINALS, ETC.
LOCATION
TUBEAXIAL
FANS (2)
NOTE: COVER IS PERFORATED METAL
A
A
RIGHT
CHANNEL
3 3/8"
2 1/4"
1"
POWER
SUPPLY
1/4"
SECTION A - A
POSITION OF 3 HEATSINK
ADAPTERS - 1" ALUMINUM
ANGLE X 12" LONG

Figure 7

Figure 7a: HEATSINK AND ANGLE BRACKET DRAWING
FOR 3 1/2" FORCED AIR UNIT



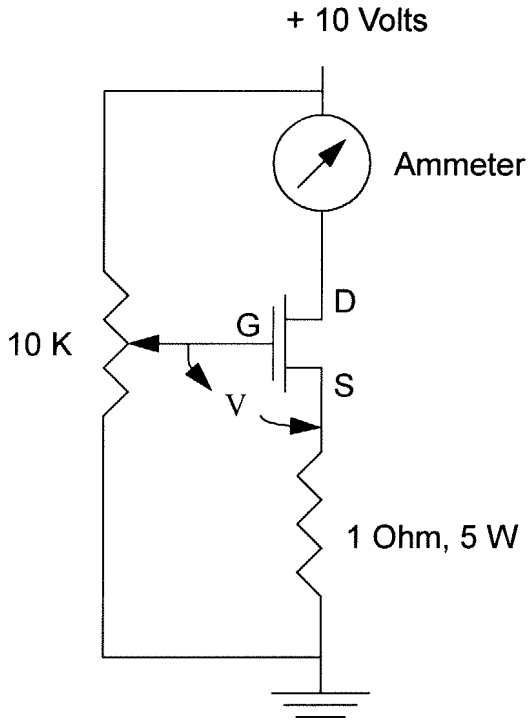
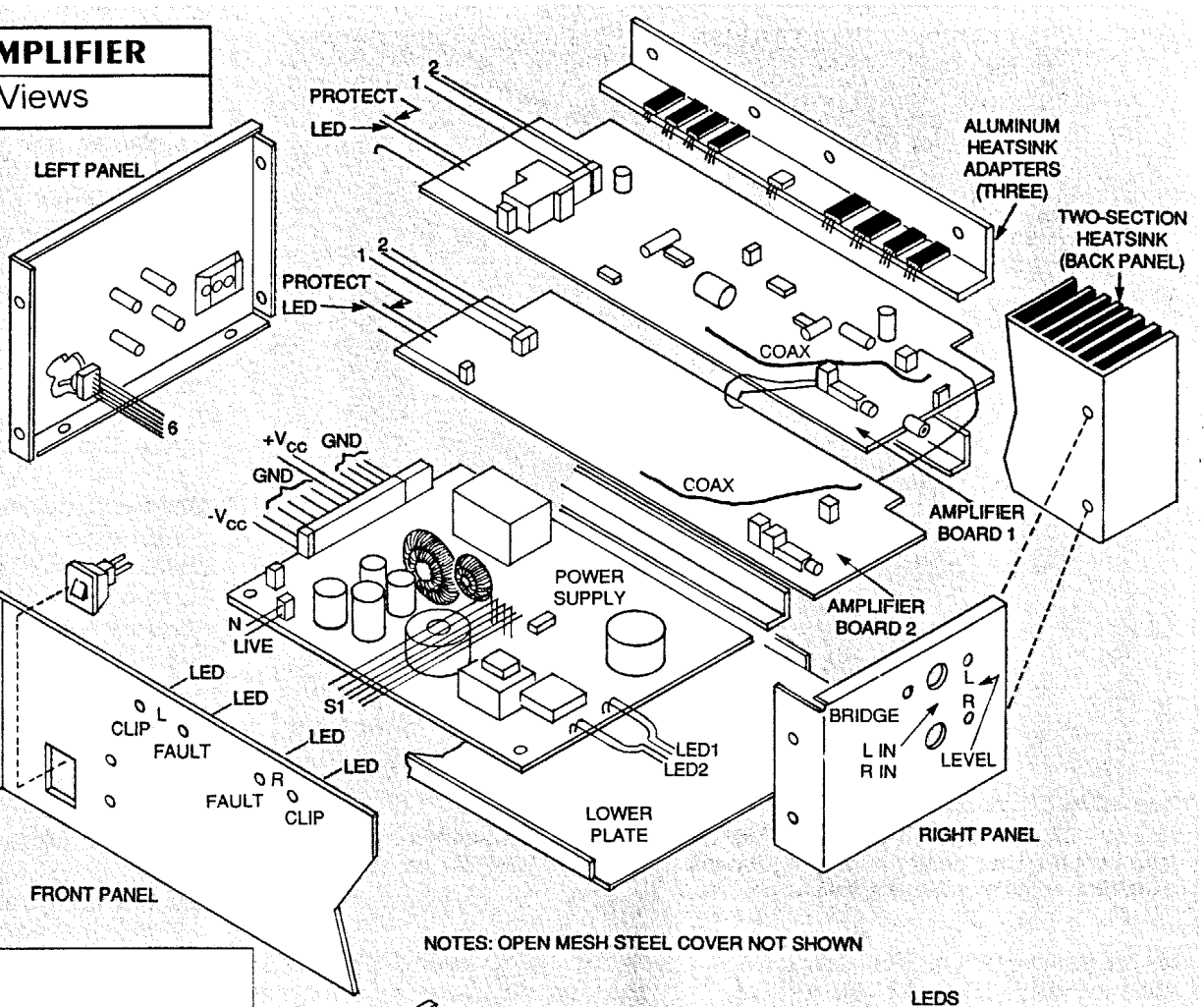


Figure 8 : Transistor matching circuit

Set 10 K pot for about .5 to 1.0 Amps drain current.
Then, plug in transistors and measure gate
voltage "V" or drain current. Transistors are matched in groups
with gate voltage or drain current spreads no greater than 10%

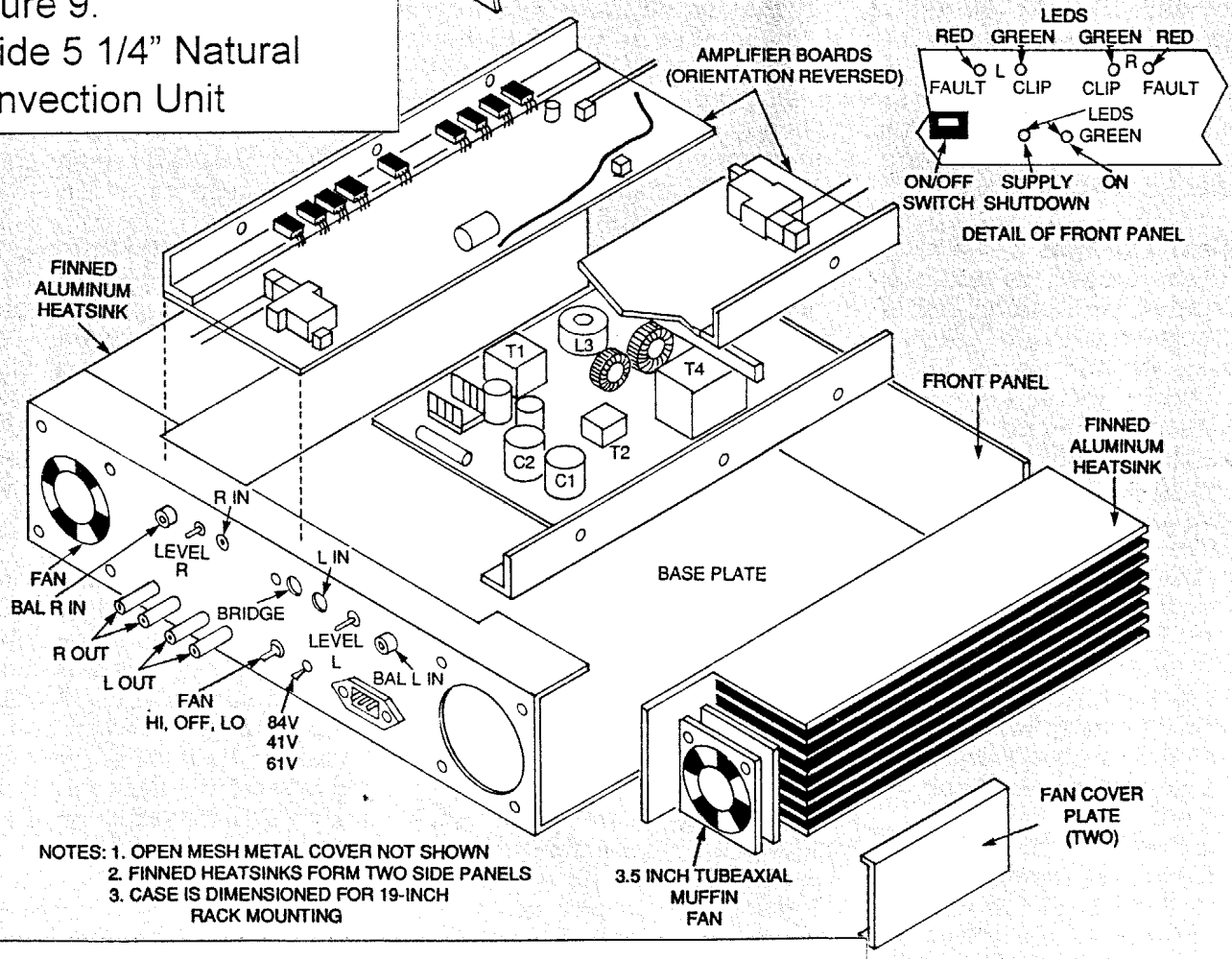
AUDIO AMPLIFIER

Inside Views



NOTES: OPEN MESH STEEL COVER NOT SHOWN

Figure 9:
Inside 5 1/4" Natural Convection Unit



NOTES: 1. OPEN MESH METAL COVER NOT SHOWN
2. FINNED HEATSINKS FORM TWO SIDE PANELS
3. CASE IS DIMENSIONED FOR 19-INCH RACK MOUNTING

Figure 10: Inside 3 1/2" Forced Air Unit