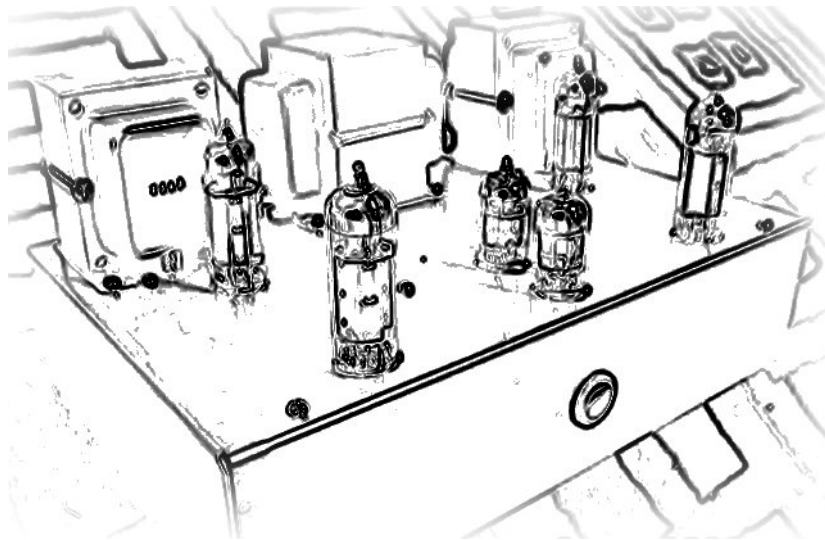


**diytube**  
stereo 35 power amplifier

# **INSTRUCTIONS FOR ASSEMBLY OPERATION**



**Price \$10.00**

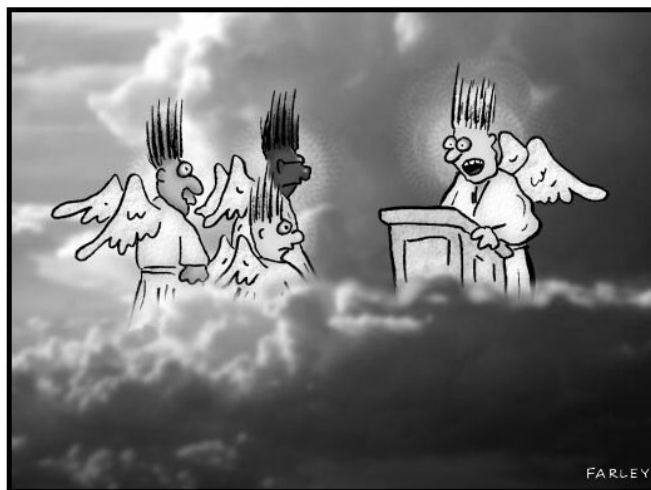
### *Disclaimer*

Under no circumstances does diytube assume liability or responsibility for injury or damages sustained in the assembly, test or operation of this kit or for damages to any other equipment connected to it. As this is a partial kit, proper assembly is buyer's responsibility. diytube reserves the right to make design changes or improvements without the obligation to revise prior versions. All specifications are subject to change without notice.

- WARNING: Lethal voltages (greater than 400VDC) are present in this project.
- Use a Variac or isolation transformer while working on and testing the unit.
- Use a rubber mat to stand on while working on and testing the unit.
- Keep one hand in your back pocket if probing voltages with a DMM.
- Wrap a small piece of electrical tape around the test lead probe shaft to expose just the tip.
- Do not connect or disconnect wires to the terminal blocks when unit is powered or plugged in.
- Lethal voltages exist in the capacitors even after unit is powered down, so wait at least one hour to after unplugging to allow charge to dissipate.

### *Warranty Information*

All goods purchased from diytube have a thirty (30) day warranty from the date of purchase against defects.



"Welcome to the first meeting of guys who thought they could fix old television sets."

**I strongly suggest you completely read this manual before you turn on your iron or get out the cutting oil.**

### **Preparation**

Before assembly, some preparation needs to be done. Parts must be purchased, a work area needs set up and chassis decisions should be made. The axiom haste makes waste has never been more true. Make sure your chosen transformers and the board will fit comfortably using the chassis of your choice. Please use the bare PCB to make a template, or use the PCB directly on the chassis as shown on the website, for socket holes and mounting holes. *Remember, the non-silk-screened side of the board will be facing up, so use that side for these measurements, in order to eliminate variations in the symmetry of the PCB.* Also, plan where RCA connectors, binding posts, standby & ON/OFF switches and the AC cord will be oriented on the chassis. Small-grid graph paper makes a very handy template. Physically lay out the parts in a space equal to your chassis to assure everything fits.

### **Overview of the Schematic and Design**

The design closely resembles the Dynaco Stereo 35. The use of one 12DW7 per channel has been replaced by  $\frac{1}{2}$  a 12AX7A and  $\frac{1}{2}$  a 12AU7. The 12AX7A is a voltage amplifier that directly drives the 12AU7, a cathodyne phase splitter. The only other meaningful change is the replacement of a single cathode resistor and capacitor with four individual resistors and capacitors. A larger value resistor in series with a variable resistor parallels the main cathode resistor, providing a range of 360-530 ohms per cathode. This circuit is then in series with a 10 ohm resistor to calculate the current very easily via a test point - set conservatively for 350mV, thus 35mA.

### **Using the Assembly Drawing**

The assembly drawing is a quick reference to what component is where and the numbering scheme for the connectors. It is also a good place to make any notes.

### **Soldering**

This PCB is a double-sided, plated through-hole design on .094" FR4 material with LPI (liquid photo-imagable) solder mask and 2 ounce copper per side. When soldering these components, let the solder flow through the

hole to form a ‘teepee’ on both sides of the board for an optimum connection. Ground plane connections sink a lot of heat from the soldering iron, so take care to do these well- you may have to touch up from the opposite side.

*TIP: PCB Stuffing*

You can use the flat end of the 11-pole connector as a lead bending tool. This works for most of the parts. Do take care to not damage the meniscus of the components. Insert all resistors before soldering, bending the leads down to hold them in place. This allows one to fix any placing errors that might occur very easily. Use a good pair of snips to remove the excess leads.

1. Stuff all fixed value resistors into the PCB.
2. Stuff variable resistors.
3. Stuff R42, the IRCL, and the power resistor, R43.
4. Kink leads on the silver mica capacitors and stuff.
5. Stuff D1 and D2. Mind the orientation of the cathode, which is represented by a stripe on both the silkscreen and the diode’s body.
6. Stuff C3,C4,C7 & C8. Mind the polarity. The board has “+” symbols to show where the positive terminal from the capacitor should be placed. Note that many modern caps have only the “-“ terminal marked, usually with a stripe running down one side.
7. Stuff all the polyprop capacitors.
8. Place and solder all the tube sockets – make sure they are mounted to the non-silk-screened side. Also make sure to use enough solder.
9. Place and solder the terminal blocks. As with the sockets, use enough solder.
10. Stuff the nine filter capacitors. Mind the polarity.
11. Carefully go over your work, looking for:
  - a. any cold solder joints (these will look dull)
  - b. solder splashes and shorts between socket pins
  - c. any connections that solder didn’t flow to the other side (like ground plane connections)
  - d. snip excess leads
  - e. compare your board to photos from the website – a good check for capacitor orientation

### Initial Impedances: When it Doubt, Ohm it Out

These are without connections to the terminal blocks. When connected, those readings that will differ will be in brackets. Different transformers will have different readings – this one is a PA-774.

J1

1. >10M
2. GND
3. >10M

J2

1. >10M
2. >10M
3. GND

J3

1. >10M
2. >10M
3. 34.3K [1 ohm]

J4

1. >10M
2. >10M
3. 34.3K [1 ohm]

J5

1. >10M
2. >10M
3. GND

J6

1. >2M [94]
2. >2M [94]
3. >200K
4. >200K
5. GND
6. GND
7. GND
8. 100 [50]
9. 100 [50]
10. >10M
11. >10M

### Initial Settings: Feedback and Bias

WARNING: Do these adjustments with the unit off and unplugged, as well as having had one hour to bleed voltage from the filter caps.

1. To set the negative feedback when using the variable resistor, unhook any connection to J3-3 and J4-3 and measure from those points to ground with a DMM. Your exact value is 1.3k less (due to the cathode resistors on V1). For example: 34.3k would be 33k. You may set it at 27k, use oscilloscope for optimum square wave, etc. Ultimately, trust your ears.
2. Turn the bias pots (R19,R22,R25,R29) clock-wise until you measure around 430ohms from pin 7 of V3,V4,V5 and V6 to ground.

## Adjusting Bias

**WARNING:** This is done while the unit is ON and IDLE. Take care and follow proper high voltage safety rules.

1. With an insulated adjustment tool and a DMM (at low voltage setting), adjust bias pots clockwise (up) or counter-clockwise (down) to get the voltage at each TP (i.e. the test point at R19,R22,R25,R29) to be 350mV. This means the cathode current is 35mA. Plate current is about 30mA and the screen is 5mA. Bias all four tubes this way. Check again after a few hours use and readjust if necessary. Check again after one week, then one month.

## Voltages

These are zero-signal, nominal measurements in VDC, unless otherwise noted. They are all referenced to ground.

PIN	V1	V2	V3	V4	V5	V6
1	116	207	-	-	-	-
2	0	116	0	0	0	0
3	780mV	120	13	13	13	13
4	3.1VAC	3.1VAC	3.1VAC	3.1VAC	3.1VAC	3.1VAC
5	3.1VAC	3.1VAC	3.1VAC	3.1VAC	3.1VAC	3.1VAC
6	115	208	-	-	-	-
7	0	114	360	360	360	360
8	780mV	118	-	-	-	-
9	3.1VAC	3.1VAC	364	364	364	364

## Modifications

- If volume controls are desired, use a 100k or better audio taper pot. A linear pot will not work correctly. You can salvage the 250k pot off of your Dynaco SCA-35. Radio Shack has a 100k Alps stereo pot that many people use. Each channel must have its own control, so either a stereo pot or two single pots must be used.

The pot connections will be:

- pin 1 to RCA audio IN
- pin 2 (the wiper) to J1-1 or J1-3 (depending on channel)
- pin 3 to J1-2 (GND)

To determine which pin is which, use a DMM and crank the volume pot fully counter-clockwise (lowest volume setting). Resistance between pins 1 & 2 will be nearly the full range of the pot. Pins 2 & 3 will be very low resistance. Rotating the pot fully clockwise (highest volume setting) will yield opposite results, i.e. pins 1 & 2 will be very low resistance and pins 2 & 3 will be nearly the full range of the pot. If using a stereo pot, follow the same process with pins 4, 5 & 6.

- A 100 ohm 1W resistor (Mouser# 281-100) can be soldered on the underside of the board between pins 1 & 2 on J2,J3,J4 and J5 for triode operation. Do not attach any UL taps to pin 2 on these connector blocks if you do this.
- If you are using a filament supply with a center tap and choose to use the center tap, do not populate R40 and 41. These are for non-CT filament supplies, such as the Dynaco PA-774.
- SW2 can be omitted and the secondary CT wired straight to ground if a standby switch is not desired
- R42, the IRCL, is very important for proper operation of this unit. It is possible to wire a switch in parallel with it in order take it out of the circuit once the unit has warmed up, but this is not recommended- especially for Hammonds, as they are rated at 115VAC. *Note: This will increase the B+ by around 12V and will slightly increase heater voltage. Switch would need to be reset as well.*

Tip: Put a dot in the checkbox if you have the part already as a quick reference when ordering parts. 'X' out the checkbox when you have installed the part on the PCB.

	QTY	Reference	Part	Mouser Part	Unit Cost
<input type="checkbox"/>	2	R4,R1	47k, 1/2W	273-47K	0.12
<input type="checkbox"/>	6	R2,R5,R13,R14, R15,R16	470k, 1/2W	273-470K	0.12
<input type="checkbox"/>	2	R3,R6	1.3k, 1/2W	273-1.3K	0.12
<input type="checkbox"/>	8	R8,R7,R34,R35 R36,R37,R38,R39	300k, 1/2W	273-300K	0.12
<input type="checkbox"/>	2	R10,R9	27k, 1W	281-27K	0.13
<input type="checkbox"/>	2	R12,R11	33k, 1W	281-33K	0.13
<input type="checkbox"/>	4	R17,R20,R23,R26	560, 1W	281-560	0.13
<input type="checkbox"/>	4	R18,R21,R24,R27	1K, 1/2W	273-1.0K	0.12
<input type="checkbox"/>	4	R46,R47,R48,R49	10 Ohm, 1/4W	271-10	0.09
<input type="checkbox"/>	2	R33,R32	3.3k, 1W	281-3.3K	0.13
<input type="checkbox"/>	2	R41,R40	100, 1W	281-100	0.13
<input type="checkbox"/>	2	R44,R45	150k, 1/2W	273-150K	0.12
<input type="checkbox"/>	4	R19,R22,R25,R29	10K Pot	72-T93YB-10K	1.20
<input type="checkbox"/>	2	R30,R31	100K Pot	72-T93YB-100K	1.20
<input type="checkbox"/>	1	R42	IRCL	527-CL90	2.35
<input type="checkbox"/>	1	R43	50 Ohm, 10W	280-CR10-50	0.39
<input type="checkbox"/>	2	C21,C20	27pF	5982-15-500V27	0.55
<input type="checkbox"/>	2	C22,C23	33pF	5982-15-500V33	0.55
<input type="checkbox"/>	2	C24,C25	20pF	5982-15-500V20	0.53
<input type="checkbox"/>	2	C18,C19	0.1uF	1431-2104K	0.53
<input type="checkbox"/>	2	C26,C27	0.22uF	5989-250V.22	0.31
<input type="checkbox"/>	2	D1,D2	UF4007 Diode	625-UF4007	0.25
<input type="checkbox"/>	4	C3,C4,C7,C8	470uF	140-XRL35V470	0.21
<input type="checkbox"/>	4	C1,C2,C5,C6	0.1uF, 600V	75-715P600V0.1	1.22
<input type="checkbox"/>	5	J1,J2,J3,J4,J5	3pin Term Block	In Stock	0.00
<input type="checkbox"/>	1	J6	11pin Term Block	In Stock	0.00
<input type="checkbox"/>	8	C9,C10,C11,C12, C13,C14,C15,C16	220uF	In Stock	0.00
<input type="checkbox"/>	1	C17	22uF	140-XRL450V22	0.62



	QTY	Reference	Part	Mouser Part	Unit Cost
Note: Change the last letter of the part number, 'G', to a 'Y' or 'R' for a yellow or red neon indicator on the power switch. Default is green.					
<input type="checkbox"/>	1	SW1	Power Switch	103-R13-112B-02G	1.29
<input type="checkbox"/>	1	SW2	Standby Switch	103-R13-112A-02	0.99
<input type="checkbox"/>	1	F1	Fuse Holder	504-HTB-26M	2.13
<input type="checkbox"/>	1	F1	2A SB Midget Fuse	44FM052	0.13
<input type="checkbox"/>	1		3-Prong AC cord	173-73101	3.12

Note: The filter caps are 1.65" tall, so a two inch high chassis probably won't work (although I will try it out).

<input type="checkbox"/>	1		16X8X3 Chassis	546-1444-28	24.27
<input type="checkbox"/>	1		16X8X3 Bottom	546-1434-26	8.66
or					
<input type="checkbox"/>	1		12X8X3 Chassis	546-1444-24	20.45
<input type="checkbox"/>	1		12X8X3 Bottom	546-1434-22	8.66

Note: Note that these aren't \$30, gold-plated interconnects - if you want that stuff, then go for it. Due to the small quantities of nuts & bolts, you might want to buy these at your local hardware store. The Mouser parts are nickel plated and in boxes of 100.

<input type="checkbox"/>	1		RCA Red Jack	161-0251	0.87
<input type="checkbox"/>	1		RCA Black Jack	161-0252	0.87
<input type="checkbox"/>	4		Binding Posts	530-111-0102-1	1.54
<input type="checkbox"/>	2		Binding Posts	530-111-0103-1	1.54
<input type="checkbox"/>	8		Standoffs 1/4X1/2	534-1451C	0.45
<input type="checkbox"/>	6		Bushings	561-MP6258	0.14
<input type="checkbox"/>	1 box (need 16)		6-32x1/4 screws	5721-632-1/4	1.77
<input type="checkbox"/>	1 box (need 8)		#6 lock washers	5721-LWI-6	1.57
<input type="checkbox"/>	1 box (need 12)		10-32x3/8 screws	5721-1032-3/8	2.95
<input type="checkbox"/>	1 box (need 12)		#10 flat washers	538-MW-404C	2.00
<input type="checkbox"/>	1 box (need 12)		#10 lock washers	5721-LWI-10	1.82
<input type="checkbox"/>	1 box (need 12)		10-32 hex nuts	5721-1032	2.56

QTY	Reference	Part	Part#	Unit Cost
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Note: I'm assuming this is the area people will improvise most, and with parts they have on hand. I highly recommend parting out a Dynaco SCA-35 as these are the same transformers found the in the highly regarded Dynaco ST-35.

<input type="checkbox"/>	1	V1	12AX7A/ECC83	
<input type="checkbox"/>	1	V2	12AU7A	
<input type="checkbox"/>	4	V3,V4,V5,V6	6BQ5/EL84/7189/6p14p	
<input type="checkbox"/>	6	V1-V6	9pin PCB Ceramic Socket (13/16" tail diameter)	

<input type="checkbox"/>	1	T1	Dynaco PA-774 Power Transformer	
or				

<input type="checkbox"/>	1	T1	Hammond 272HX Power Transformer	
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Note: A pair of dropping resistors (.1 ohm, 2W - Mouser# 72-RWM410-R1-5) can be run in series with the heater windings if heater voltage is too high.

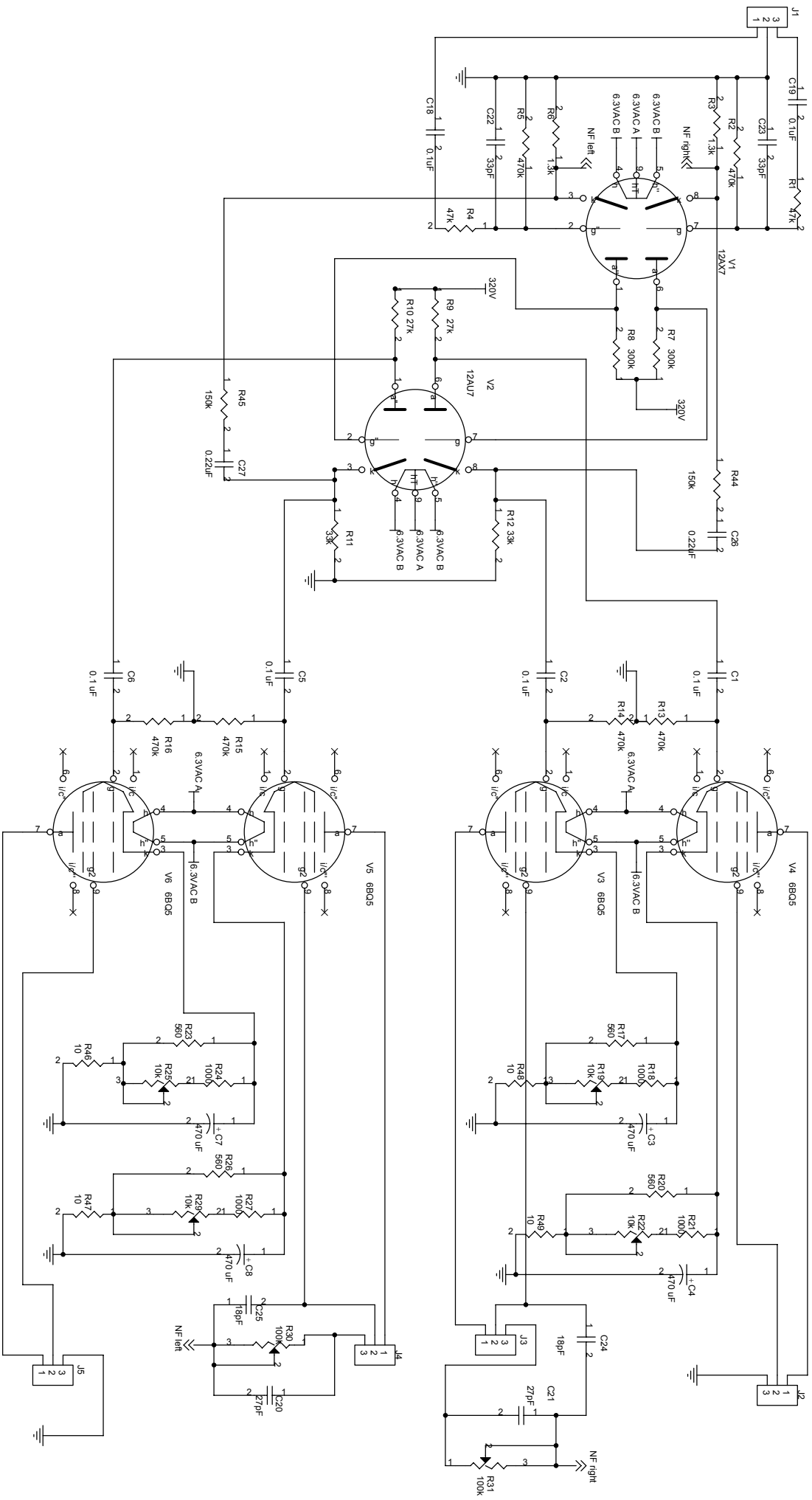
<input type="checkbox"/>	2	T2,T3	Dynaco Z-565 Output Transformer	
or				

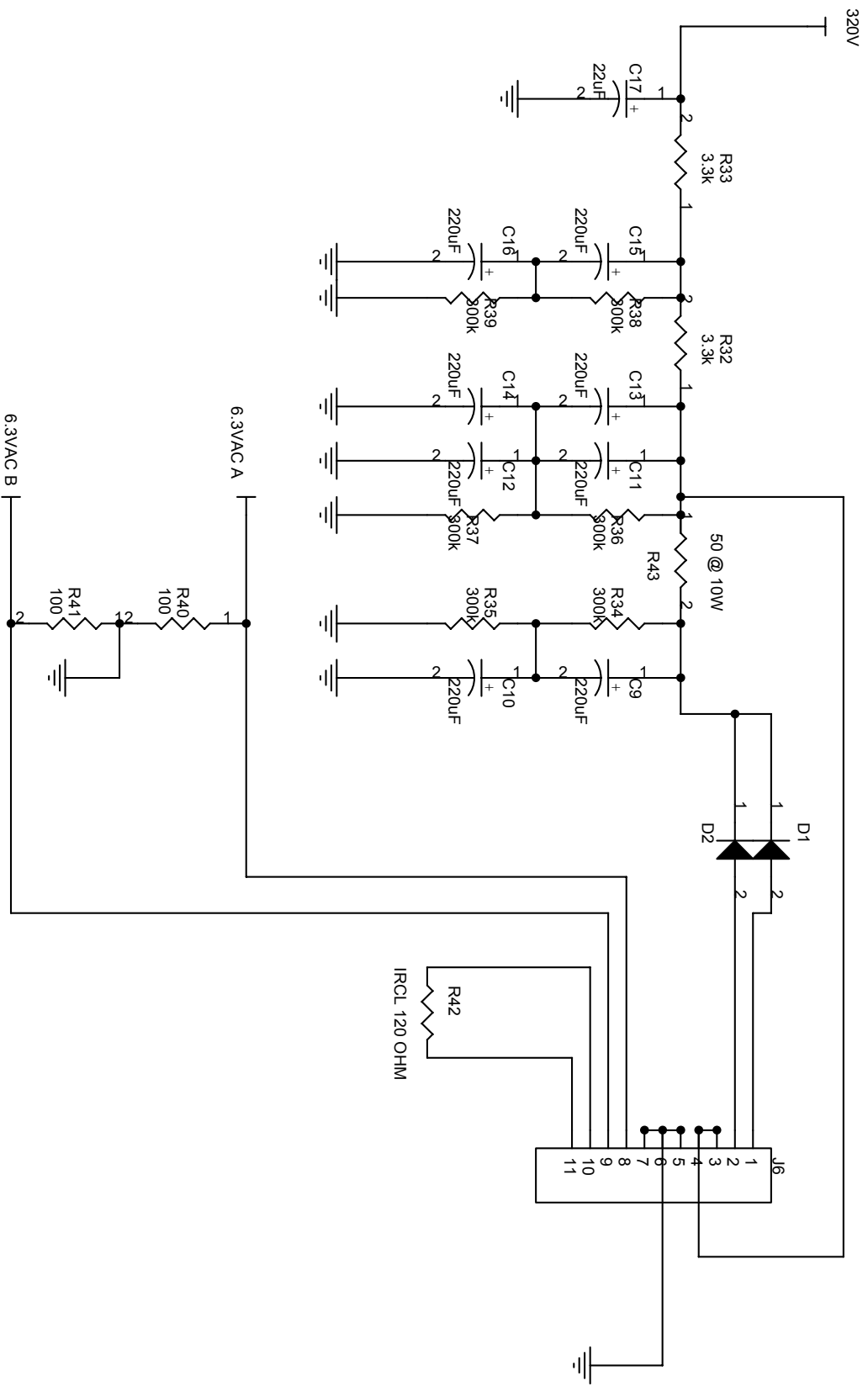
<input type="checkbox"/>	2	T2,T3	Hammond 1650F Output Transformer	
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Note: Hammond 1650E (8k) and 1620 (6.6k) have been used as well.

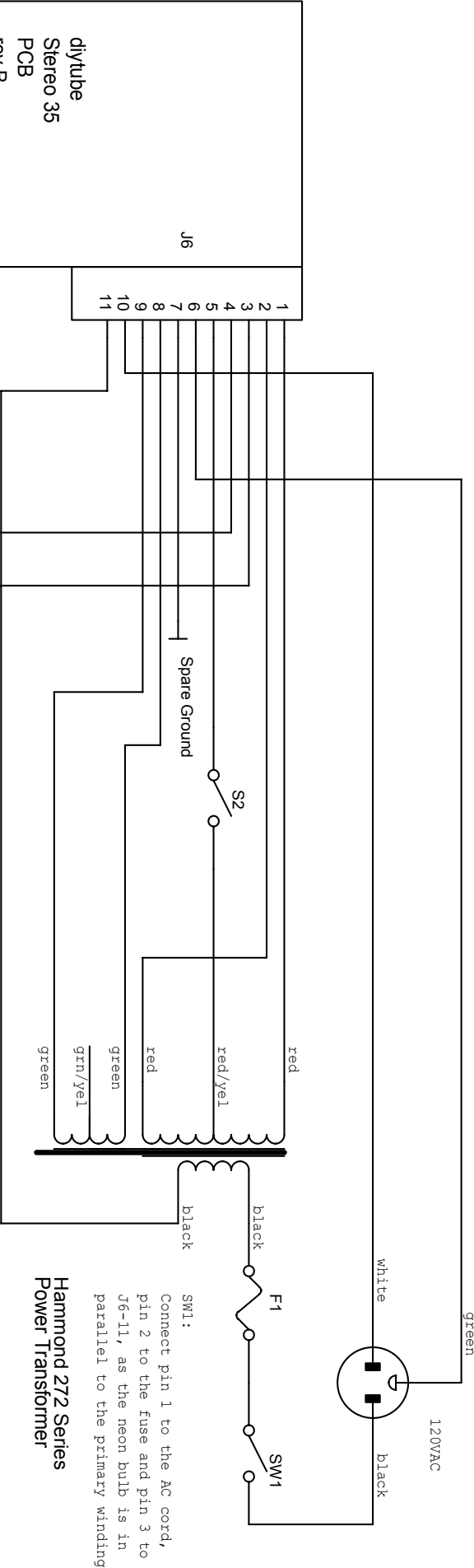
Triode Electronics -- aka Uncle Ned <http://www.triodeelectronics.com/>  
 Angela Instruments -- <http://www.angela.com/>  
 Antique Electronics -- <http://www.tubesandmore.com/>  
 Handmade Electronics -- <http://www.hndme.com/>

<i>Triode Electronics</i>	<i>Angela Instruments</i>	<i>Antique Electronics</i>	<i>Handmade Electronics</i>
Reissue PA774 \$59.95	Hammond 272HX \$58.00	Hammond 272HX \$70.30	Hammond 272HX \$70.30
Mangequest Z565 \$99.00	Hammond 1650F \$47.00	Hammond 1650F \$55.22	Hammond 1650F \$61.36
9pin Ceramic PC \$1.95	Hammond 1444-24 \$19.00	9pin Ceramic PC \$2.50	9pin Ceramic PC \$1.95
Sovtek EL84 quad \$23.90	Hammond 1434-22 \$7.25	EI EL84 quad \$31.80	Hammond 1444-24 \$20.45
12AX7 \$5.95		12AX7 \$6.95	Hammond 1434-22 \$8.66
12AU7 \$6.95		12AU7 \$4.75	







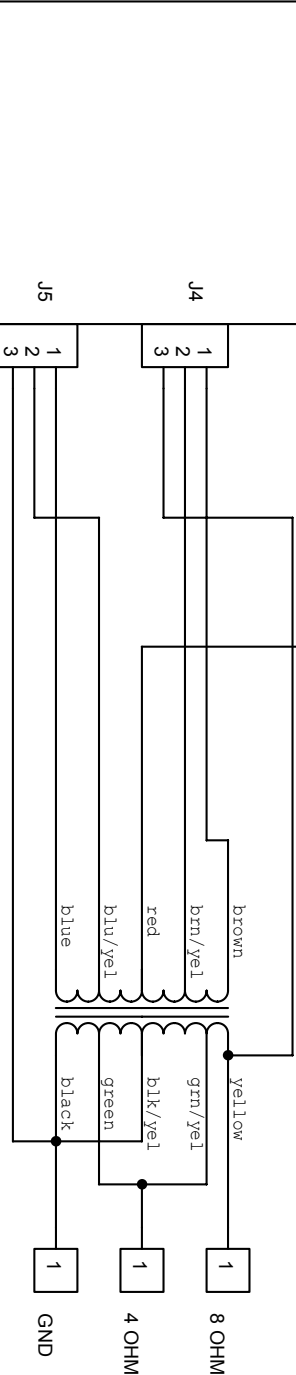


Hammond 272 Series  
Power Transformer

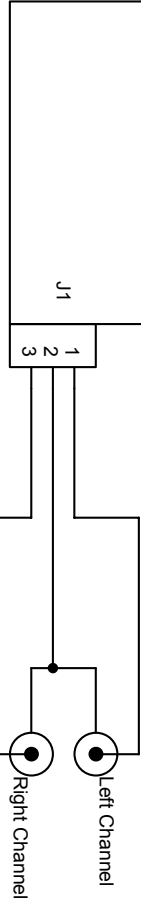
-I suggest using R40 & R41 instead of the heater CT. If you decide to use this CT, then do not populate R40 & R41.  
-5VCT taps are not used  
-Two resistors may be used in series with heater connections to J6-8 & J6-9 to lower high heater voltage (.1 ohm, 2W, Mouse# 72-RMW410-R1-5)

Hammond Style  
Right Output Transformer

Just think green/yellow to green, and black/yellow to black.



Hammond Style  
Left Output Transformer



# Logical Layout of the diyTube Stereo 35 with Hammond Transformers

