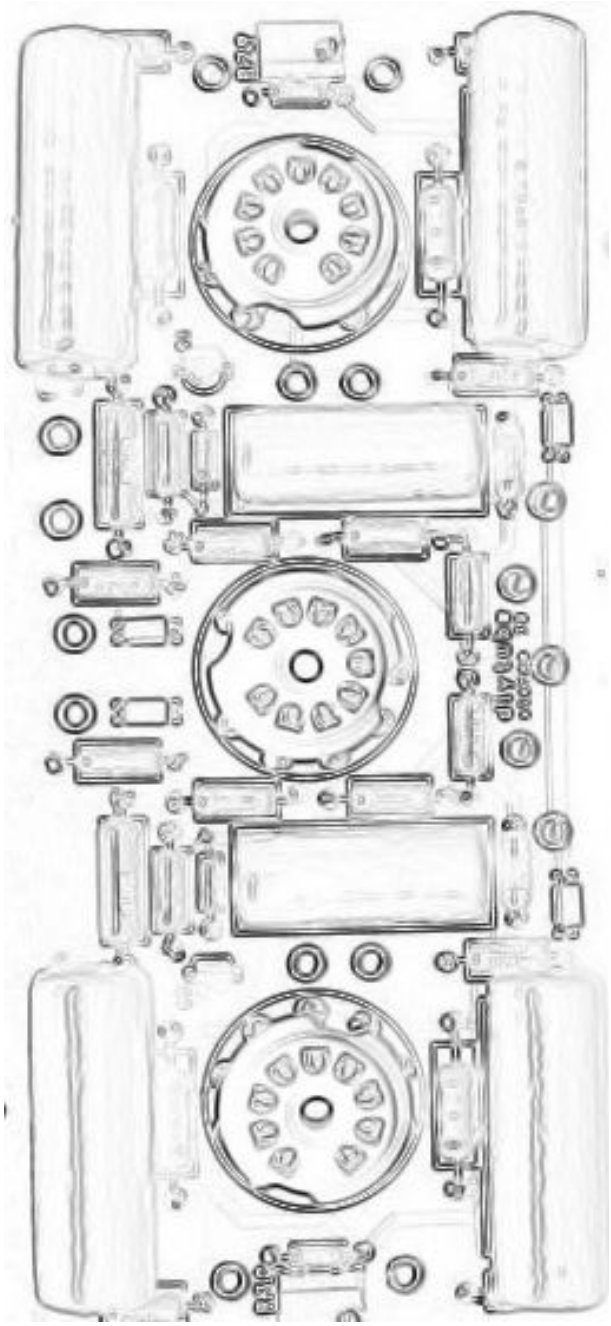
diytube
stereo 70 driver board

INSTRUCTIONS FOR ASSEMBLY AND OPERATION



Price $10.00

Important Note:

The phase is swapped on the diytube ST70 from the orginal design. Be sure to hook up the drive lines (at J1, J2, J22 and J23) per the schematic. They will criss-cross like an 'X' as they hookup to the EL34 socket. This allows the proper phase for negative feedback; otherwise oscillation will occur.

diytube ST70 Driver Assembly Instructions

Stock: The diytube ST70 driver has a dual silkscreen design, which permits mounting of all components – except the tube sockets – on either side. For typical ST70 construction, all the components will be placed on the socket side, also the top side. This side has silkscreen saying "PUT SOCKET ON THIS SIDE".

Custom: For custom chassis, the components could be placed on the underside, identified by the large "diytube' silkscreen. Sockets and ½" board standoffs would be on the top side. The socket holes should be approximately 1" diameter with 2" between centers.

Dims in Mils (origin lower left)

Sockets	*Mounting Holes*
3250, 1625	*1250, 125*
1250, 1625	*5250, 125*
5250, 1625	*1250, 3125*
	5250, 3125

1) On the top side of the board, where it says "PUT SOCKET ON THIS SIDE", insert 9-pin PC socket. Fully insert the socket and solder pins 1, 5 & 8. Using a 9-pin tube (junkbox variety is handy), test all three sockets for ease of insertion. Also straighten the sockets at this point to where it is symmetrical and pleasing to the eye. Then solder the rest of the socket legs.

2) Stuff board with all through-hole resistors. Cross-reference the part with the parts list and check off the resistor once it is placed. Bend the leads of the resistor so that the part identifier markings are clearly visible. Once inserted, fold the leads back to hold the part in place. You can easily stuff the board before soldering them in place, which permits easy correction for misplaced components.

3) Solder all the stuffed resistors. Then gently pull back the excess lead straight out from the board with pair of small pliers. With a pair of cutters, trim close to the board, but do not cut into the solder joint itself.

4) Carefully remove the current sources from the static packaging. Be sure to align the part with the TO-92 silkscreen at Q1 and Q2. The silkscreen is flipped depending on the side you use, but notice how pin 1 always goes in the same location, the square pad. Solder carefully and trim excess. Tip: You can touch your iron to the ground at J9 first to lower chance of ESD damage.

5) Stuff and solder the four silver mica capacitors. Try to have the part identifier facing out so that it can easily be read and so the board will be symmetrical. Also, leave some space (at least .050") between the part and board for a good solder joint. These can be subbed with alternate manufacturers, but the values are fairly critical in the stock ST70.

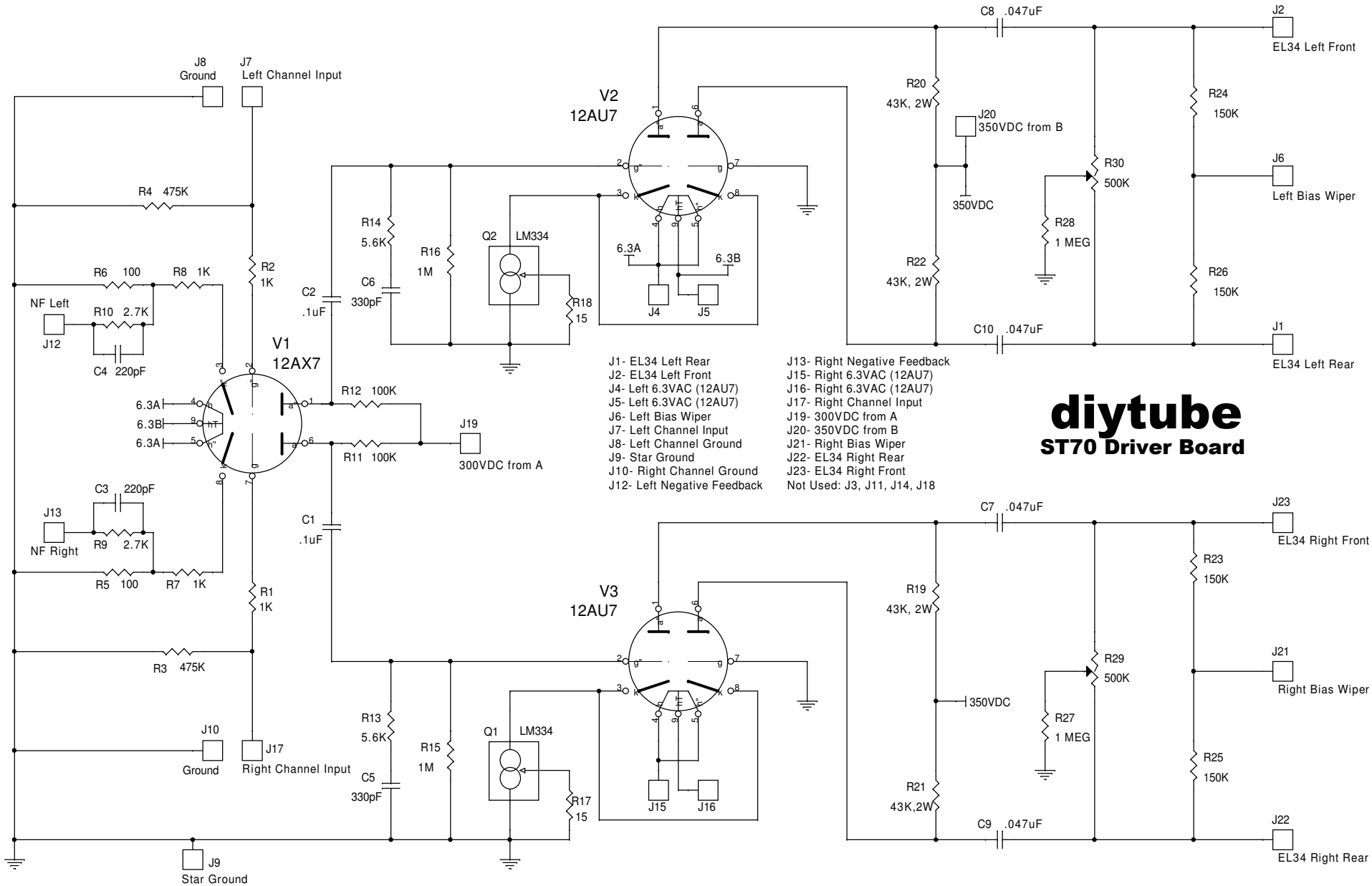
6) When stuffing your six coupling caps, you will probably need to use pliers to re-bend the leads for optimal placing. Just be careful to not damage the meniscus of the capacitor. Once again, the values have been determined through much testing and should not be changed. 400V rated capacitors are OK for use on a stock ST70 with 5AR4.

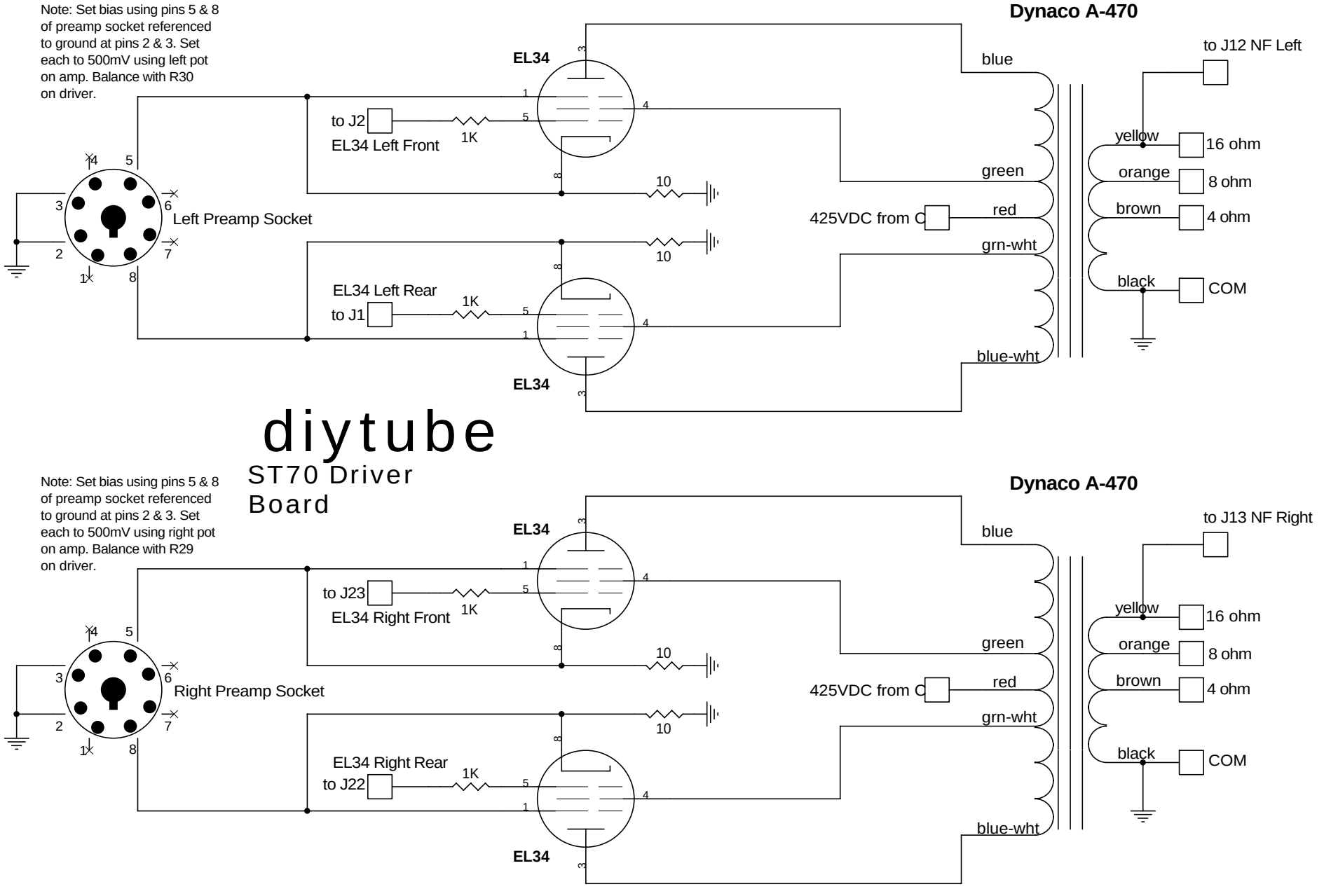
TIP
If using Auricaps, mount with the black lead towards the center of the board on C7 thru C10. For C1 & C2 mount with the black lead on the pad nearest pins 1 and 9 on V1 respectively.

diytube ST70 Driver Rev B January 25, 2006

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.

Item	QTY	Reference	Part	Mouser Part	Unit Cost
❑	4	R1,R2,R7,R8	1K, 1/4W	71-RN60D-F-1.0K	0.21
❑	2	R3,R4	475K, 1/4W	71-RN60D-F-475K	0.21
❑	2	R5,R6	100, 1/4W	71-RN60D-F-100	0.21
❑	2	R9,R10	2.74K, 1/4W	71-RN60D-F-2.74K	0.21
❑	2	R11,R12	100K, 1/2W	71-RN65D-F-100K	0.32
❑	2	R13,R14	5.62K, 1/4W	71-RN60D-F-5.62K	0.21
❑	4	R15,R16,R27,R28	1M, 1/8W	71-RN55D-F-1M	0.16
❑	2	R17,R18	15, 1/8W	71-RN55D-F-15	0.16
❑	4	R19,R20,R21,R22	43K, 2W	282-43K	0.19
❑	4	R23,R24,R25,R26	150K, 1/4W	71-RN60D-F-150K	0.21
❑	2	R29,R30	500K Pot	72-T93YB-500K	1.20
❑	2	C1,C2	0.1uF,600V	75-715P600V0.1	1.22
❑	2	C3,C4	220pF	5982-15-500V220	0.78
❑	2	C5,C6	330pF	5982-15-500V330	1.05
❑	4	C7,C8,C9,C10	0.047uF,600V	75-715P600V0.047	0.77
❑	2	Q1,Q2	LM334Z	511-LM334Z	0.76
❑	1		Wire Labels	644-PCM-1-33	1.95
❑	1		100' Wire Red TFE	566-83005-100-02	21.12


J8
Ground
J7
Left Channel Input
V2
12AU7
C8 .047uF
J2
EL34 Left Front
R20
43K, 2W
J20
350VDC from B
R24
150K
R4 475K
R14
5.6K
R16
1M
Q2 LM334
R18
15
6.3A
6.3B
J4
J5
R30
500K
J6
Left Bias Wiper
350VDC
R28
1 MEG
R22
43K, 2W
R26
150K
C10 .047uF
J1
EL34 Left Rear
R6 100
R8 1K
R2
1K
NF Left
J12
R10 2.7K
C4 220pF
C2
.1uF
C6
330pF
V1
12AX7
6.3A
6.3B
6.3A
R12 100K
R11 100K
J19
300VDC from A
C3 220pF
J13
NF Right
R9 2.7K
R5 100
R7 1K
C1
.1uF
R1
1K
R3 475K
J1- EL34 Left Rear
J2- EL34 Left Front
J4- Left 6.3VAC (12AU7)
J5- Left 6.3VAC (12AU7)
J6- Left Bias Wiper
J7- Left Channel Input
J8- Left Channel Ground
J9- Star Ground
J10- Right Channel Ground
J12- Left Negative Feedback
J13- Right Negative Feedback
J15- Right 6.3VAC (12AU7)
J16- Right 6.3VAC (12AU7)
J17- Right Channel Input
J19- 300VDC from A
J20- 350VDC from B
J21- Right Bias Wiper
J22- EL34 Right Rear
J23- EL34 Right Front
Not Used: J3, J11, J14, J18
diytube
ST70 Driver Board
C7 .047uF
J23
EL34 Right Front
R23
150K
V3
12AU7
R19
43K, 2W
R29
500K
J21
Right Bias Wiper
R13
5.6K
R15
1M
Q1 LM334
R17
15
J15
J16
350VDC
R27
1 MEG
R21
43K,2W
R25
150K
C9 .047uF
J22
EL34 Right Rear
J10
Ground
J17
Right Channel Input
C5
330pF
J9
Star Ground


Note: Set bias using pins 5 & 8 of preamp socket referenced to ground at pins 2 & 3. Set each to 500mV using left pot on amp. Balance with R30 on driver.
Dynaco A-470
to J12 NF Left
EL34
blue
to J2
EL34 Left Front
1K
10
green
Left Preamp Socket
425VDC from C
red
grn-wht
EL34 Left Rear
to J1
1K
10
blue-wht
EL34
yellow
16 ohm
orange
8 ohm
brown
4 ohm
black
COM
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ST70 Driver Board
Note: Set bias using pins 5 & 8 of preamp socket referenced to ground at pins 2 & 3. Set each to 500mV using right pot on amp. Balance with R29 on driver.
Dynaco A-470
to J13 NF Right
EL34
blue
to J23
EL34 Right Front
1K
10
green
Right Preamp Socket
425VDC from C
red
grn-wht
EL34 Right Rear
to J22
1K
10
blue-wht
EL34
yellow
16 ohm
orange
8 ohm
brown
4 ohm
black
COM

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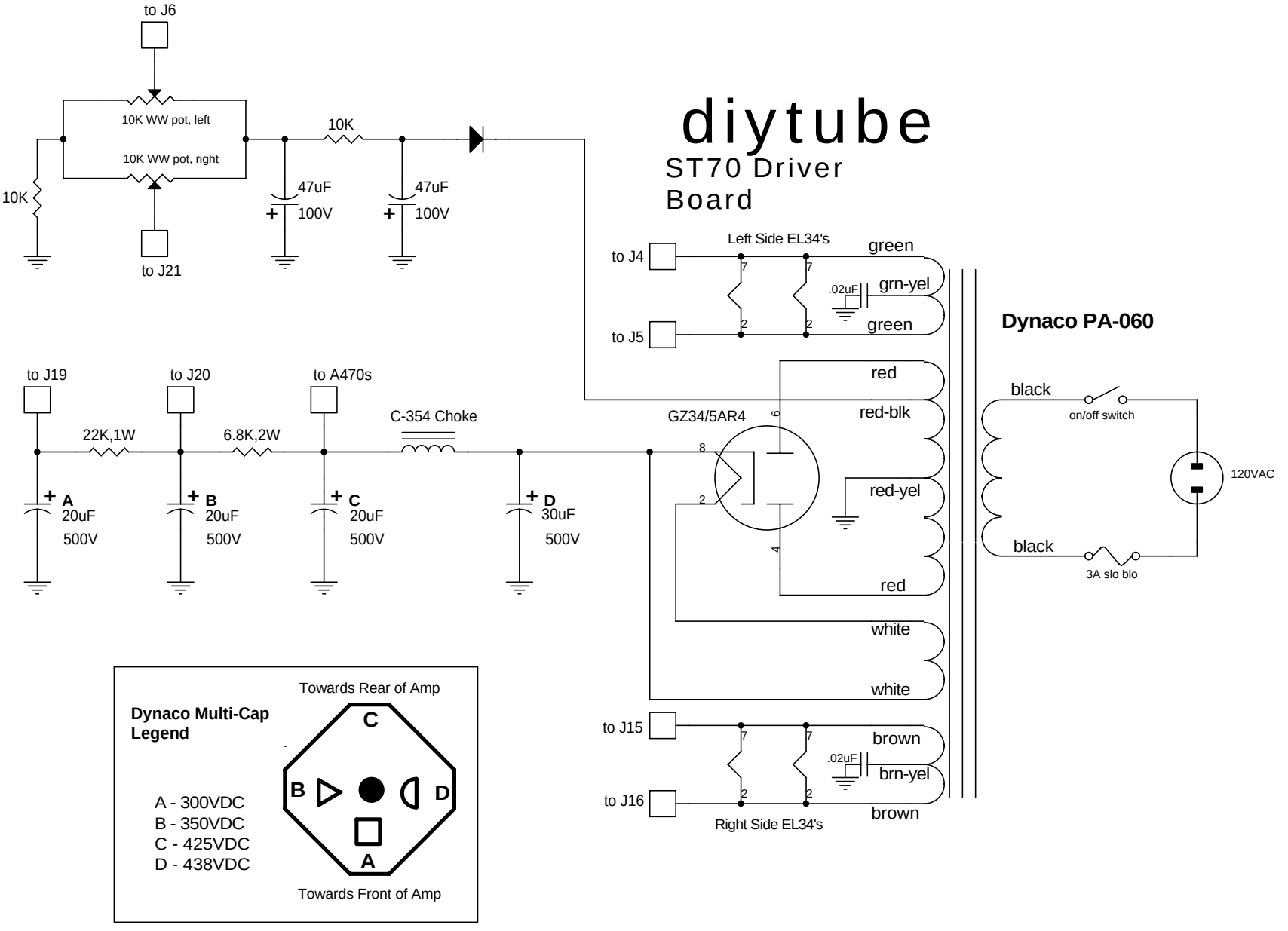
ST70 Driver Board



Dynaco Multi-Cap Legend

A - 300VDC
B - 350VDC
C - 425VDC
D - 438VDC

Biasing Instructions:

Note: Always use test loads on your speaker terminals, e.g. two 8 ohm power resistors. Be sure to have the RCA inputs loaded or shorted.

The first steps make sure your bias supply is working, is semi-balanced, and won't cause a melt down on first power up. Maintenance biasing can go directly to step #5.

1) Remove your 5AR4 and power the amp. The bias voltage will appear immediately at J6 and J21 on the diytube PCB. Adjust the wire-wound pots on the ST70 chassis so that these voltages go as negative as possible (eg -55VDC), but adjust to have the voltage the same on both test points. You can use the preamp socket pins 2 or 3 as your DMM ground.

2) Turn the unit off. Replace your 5AR4 rectifier. Turn on unit.

3) Because adjusting one side usually changes the bias on the other side, you will now start ping-ponging between the sides adjusting the wire wound pot and measuring one of the bias points on that side unit you near 400mV.

4) Now that you are around 400mV on all the tubes, stick your DMM probes in pins 5 & 8 of the preamp socket. You are measuring the small voltage difference between the biasing of the EL34 pair. Now adjust the respective balance pot (R29 or R30, depending on which side you are adjusting) until the voltage you read is zero or near zero difference. You might end up changing the scale of your DMM to the 300mV region. Do on both sides.

5) Now repeat step #3, but adjust to 500mV (500mV drop across the 10 ohm resistor is 50mA idle current) using the Dynaco wire-wound pots.

6) Now repeat step #4 for push pull perfection.

VOLTAGE CHART

- **DC measurements (unless noted)**
  - **Shorted input, no signal**
  - **All measurements +/-5%**

V1	**12AX7**
PIN#	
1	190V
2	0V
3	1.2V
4	6.3VAC ←|
5	6.3VAC ←|
6	190V |
7	0V |
8	1.2V |
9	6.3VAC ←|

V2,V3	**12AU7**
PIN#	
1	245V
2	0V
3	13V
4	6.3VAC ←|
5	6.3VAC ←|
6	245V |
7	0V |
8	13V |
9	6.3VAC ←|

V4-V7	**EL34**
PIN#	
1	500mV
2	6.3VAC ←|
3	418V |
4	421V |
5	-35V |
6	-35V |
7	6.3VAC ←|
8	500mV

V8	**GZ34/5AR4**
PIN#	
1	0V
2	438V
3	0V
4	366VAC
5	0V
6	366VAC
7	0V
8	438V

J1	-35V
J2	-35V
J4	6.3VAC ←|
J5	6.3VAC ←|
J6	-37V
J7	0V
J8	0V
J9	0V
J10	0V
J12	0V

J13	0V
J15	6.3VAC ←|
J16	6.3VAC ←|
J17	0V
J19	300V
J20	350V
J21	-37V
J22	-35V
J23	-35V
Not Used:	J3,J11,J14 & J18

MultiCap Lugs

A	300V
B	350V
C	425V
D	438V

RESISTANCE CHART

- **Take measurements when unit is OFF and power supply caps are drained**
- **[ ] bracketed numbers are in-circuit values**
- **Consider readings >10 meg to be open**
- **All measurements +/-5%**

V1	**12AX7**
PIN#	
1	open
2	475K
3	1.1K
4	open
5	open
6	open
7	475K
8	1.1K
9	open

V2,V3	**12AU7**
PIN#	
1	open
2	475K
3	open
4	open
5	open
6	open
7	less than 1 ohm
8	open
9	open

V4-V7	**EL34**
PIN#	
1	10 ohms
2	open
3	xxx
4	xxx
5	xxx
6	xxx
7	open
8	10 ohms

V8	**GZ34/5AR4**
PIN#	
1	open
2	xxx
3	open
4	xxx
5	open
6	xxx
7	open
8	xxx

J1	1.2 meg
J2	1.2 meg
J4	open
J5	open
J6	1.2 meg [14K]
J7	475K
J8	less than 1 ohm
J9	less than 1 ohm
J10	less than 1 ohm
J12	2.84K [1 ohm]

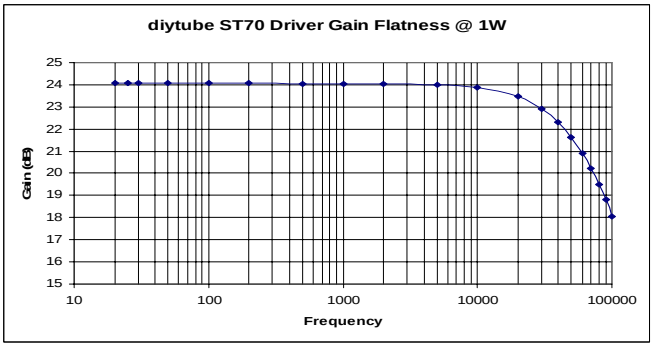
J13	2.84K [1 ohm]
J15	open
J16	open
J17	475K
J19	open
J20	open
J21	1.2 meg [14K]
J22	1.2 meg
J23	1.2 meg
Not Used:	J3,J11,J14 & J18

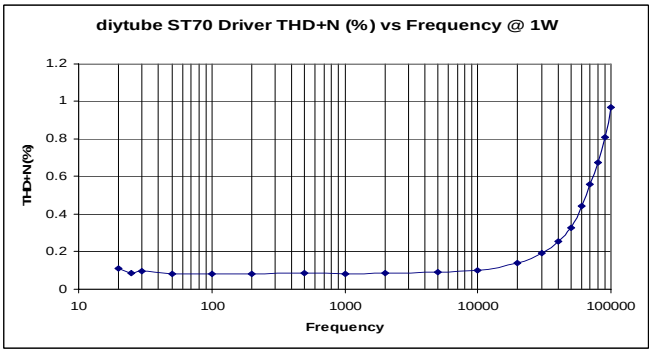
MultiCap Lugs

A	xxx
B	xxx
C	xxx
D	xxx

Test & Measurement Data

20Hz	2.881V	+24.06dB	.111%THD+N	1.04W @ 8ohm
25Hz	2.881V	+24.06dB	.089%THD+N	1.04W @ 8ohm
30Hz	2.88V	+24.06dB	.098%THD+N	1.04W @ 8ohm
50Hz	2.879V	+24.06dB	.084%THD+N	1.04W @ 8ohm
100Hz	2.879V	+24.06dB	.08%THD+N	1.04W @ 8ohm
200Hz	2.88V	+24.06dB	.081%THD+N	1.04W @ 8ohm
500Hz	2.877V	+24.05dB	.088%THD+N	1.04W @ 8ohm
1kHz	2.878V	+24.05dB	.084%THD+N	1.04W @ 8ohm
2kHz	2.877V	+24.05dB	.089%THD+N	1.03W @ 8ohm
5kHz	2.862V	+24.00dB	.091%THD+N	1.02W @ 8ohm
10kHz	2.825V	+23.89dB	.101%THD+N	.997W @ 8ohm
20kHz	2.692V	+23.47dB	.138%THD+N	.906W @ 8ohm
30kHz	2.525V	+22.92dB	.195%THD+N	.796W @ 8ohm
40kHz	2.355V	+22.29dB	.254%THD+N	.694W @ 8ohm
50kHz	2.19V	+21.63dB	.326%THD+N	.6W @ 8ohm
60kHz	2.034V	+20.92dB	.443%THD+N	.518W @ 8ohm
70kHz	1.88V	+20.21dB	.558%THD+N	.442W @ 8ohm
80kHz	1.739V	+19.51dB	.673%THD+N	.379W @ 8ohm
90kHz	1.621V	+18.81dB	.809%THD+N	.329W @ 8ohm
100kHz	1.491V	+18.06dB	.967%THD+N	.278W @ 8ohm

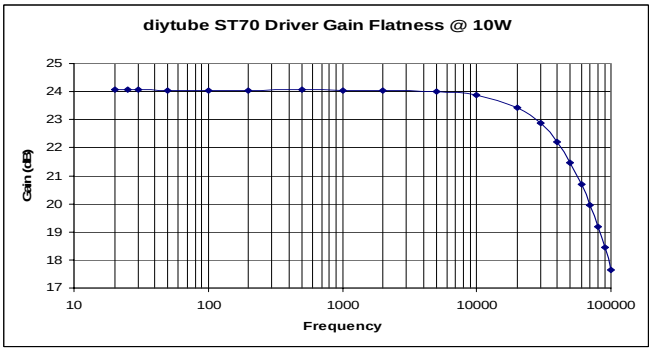


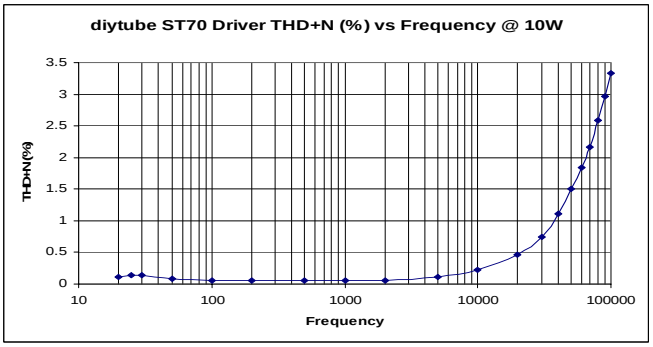


diytube ST70 driver closed loop 1W output

- 180mVrms input

20Hz	9.V	+24.07dB	.111%THD+N	10.15W @ 8ohm
25Hz	8.99V	+24.07dB	.145%THD+N	10.13W @ 8ohm
30Hz	9.V	+24.07dB	.145%THD+N	10.13W @ 8ohm
50Hz	8.97V	+24.05dB	.084%THD+N	10.06W @ 8ohm
100Hz	8.97V	+24.05dB	.059%THD+N	10.08W @ 8ohm
200Hz	8.97V	+24.05dB	.053%THD+N	10.06W @ 8ohm
500Hz	8.98V	+24.06dB	.052%THD+N	10.08W @ 8ohm
1kHz	8.97V	+24.05dB	.053%THD+N	10.04W @ 8ohm
2kHz	8.96V	+24.04dB	.063%THD+N	10.04W @ 8ohm
5kHz	8.93V	+24.01dB	.111%THD+N	9.946W @ 8ohm
10kHz	8.8V	+23.88dB	.229%THD+N	9.658W @ 8ohm
20kHz	8.37V	+23.44dB	.467%THD+N	8.736W @ 8ohm
30kHz	7.84V	+22.87dB	.748%THD+N	7.664W @ 8ohm
40kHz	7.31V	+22.22dB	1.109%THD+N	6.661W @ 8ohm
50kHz	6.71V	+21.48dB	1.505%THD+N	5.611W @ 8ohm
60kHz	6.17V	+20.70dB	1.847%THD+N	4.759W @ 8ohm
70kHz	5.67V	+19.94dB	2.162%THD+N	4.004W @ 8ohm
80kHz	5.21V	+19.17dB	2.588%THD+N	3.393W @ 8ohm
90kHz	4.81V	+18.43dB	2.959%THD+N	2.88W @ 8ohm
100kHz	4.41V	+17.63dB	3.333%THD+N	2.42W @ 8ohm



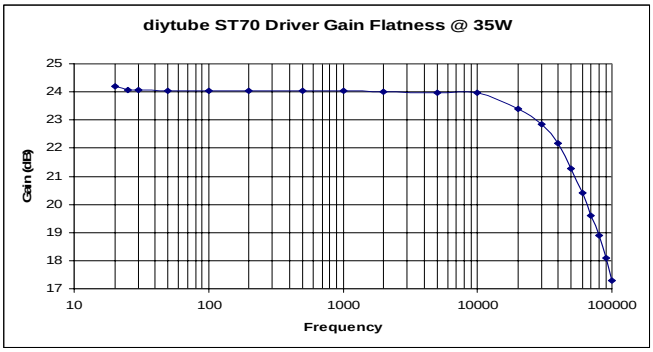


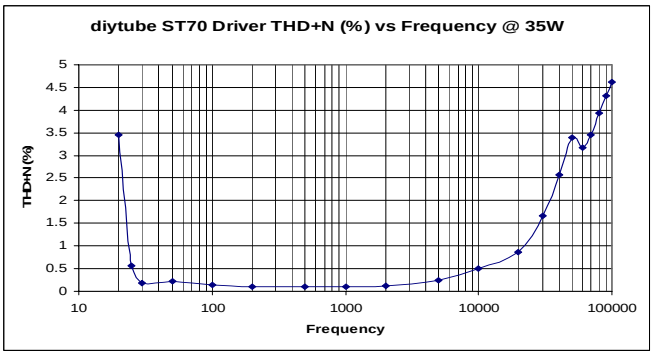
diytube ST70 driver closed loop 10W output

- 560mVrms input

Test & Measurement Data

20Hz	17.31V	+24.21dB	3.444%THD+N	37.45W @ 8ohm
25Hz	17.06V	+24.08dB	.568%THD+N	36.3W @ 8ohm
30Hz	17.V	+24.06dB	.174%THD+N	36.17W @ 8ohm
50Hz	16.94V	+24.04dB	.223%THD+N	35.83W @ 8ohm
100Hz	16.94V	+24.04dB	.134%THD+N	35.87W @ 8ohm
200Hz	16.94V	+24.04dB	.099%THD+N	35.83W @ 8ohm
500Hz	16.96V	+24.04dB	.092%THD+N	35.96W @ 8ohm
1kHz	16.92V	+24.03dB	.094%THD+N	35.79W @ 8ohm
2kHz	16.9V	+24.02dB	.12%THD+N	35.7W @ 8ohm
5kHz	16.84V	+23.98dB	.24%THD+N	35.45W @ 8ohm
10kHz	16.58V	+23.84dB	.5%THD+N	34.36W @ 8ohm
20kHz	15.76V	+23.40dB	.872%THD+N	31.01W @ 8ohm
30kHz	14.79V	+22.84dB	1.667%THD+N	27.27W @ 8ohm
40kHz	13.75V	+22.18dB	2.57%THD+N	23.63W @ 8ohm
50kHz	12.4V	+21.26dB	3.4%THD+N	19.22W @ 8ohm
60kHz	11.28V	+20.41dB	3.177%THD+N	15.93W @ 8ohm
70kHz	10.33V	+19.60dB	3.445%THD+N	13.52W @ 8ohm
80kHz	9.54V	+18.88dB	3.932%THD+N	11.4W @ 8ohm
90kHz	8.77V	+18.10dB	4.31%THD+N	9.658W @ 8ohm
100kHz	8.03V	+17.29dB	4.617%THD+N	8.1W @ 8ohm

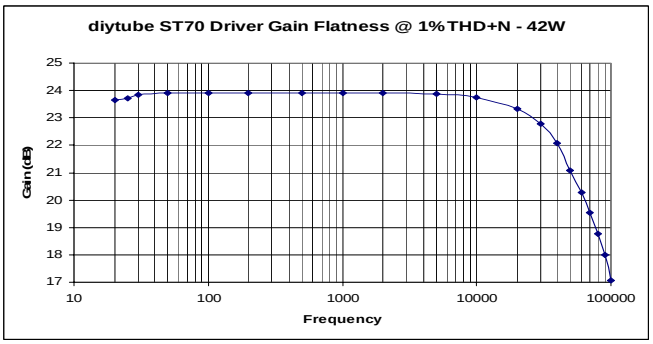


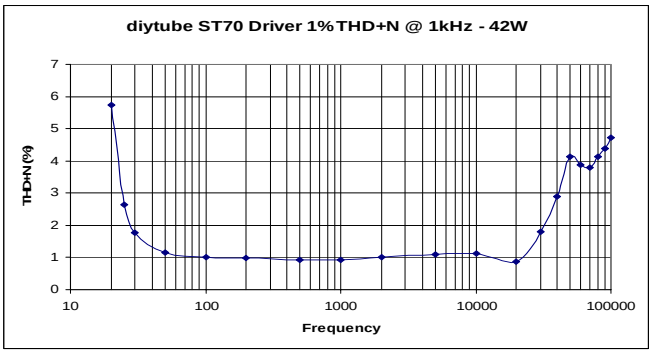


diytube ST70 driver closed loop 35W output

- 1.06Vrms input

20Hz	17.85V	+23.66dB	5.744%THD+N	39.96W @ 8ohm
25Hz	18.V	+23.73dB	2.64%THD+N	40.77W @ 8ohm
30Hz	18.24V	+23.85dB	1.784%THD+N	41.68W @ 8ohm
50Hz	18.37V	+23.91dB	1.164%THD+N	42.04W @ 8ohm
100Hz	18.38V	+23.92dB	1.022%THD+N	42.18W @ 8ohm
200Hz	18.38V	+23.92dB	.976%THD+N	42.23W @ 8ohm
500Hz	18.35V	+23.90dB	.937%THD+N	42.14W @ 8ohm
1kHz	18.39V	+23.92dB	.922%THD+N	42.23W @ 8ohm
2kHz	18.36V	+23.91dB	.999%THD+N	42.14W @ 8ohm
5kHz	18.28V	+23.87dB	1.088%THD+N	41.72W @ 8ohm
10kHz	18.04V	+23.75dB	1.117%THD+N	40.64W @ 8ohm
20kHz	17.21V	+23.34dB	.871%THD+N	36.94W @ 8ohm
30kHz	16.18V	+22.79dB	1.797%THD+N	32.64W @ 8ohm
40kHz	14.93V	+22.08dB	2.902%THD+N	27.79W @ 8ohm
50kHz	13.32V	+21.07dB	4.14%THD+N	22.01W @ 8ohm
60kHz	12.23V	+20.28dB	3.868%THD+N	18.7W @ 8ohm
70kHz	11.27V	+19.54dB	3.795%THD+N	15.9W @ 8ohm
80kHz	10.36V	+18.77dB	4.131%THD+N	13.47W @ 8ohm
90kHz	9.5V	+17.98dB	4.389%THD+N	11.33W @ 8ohm
100kHz	8.62V	+17.08dB	4.726%THD+N	9.267W @ 8ohm



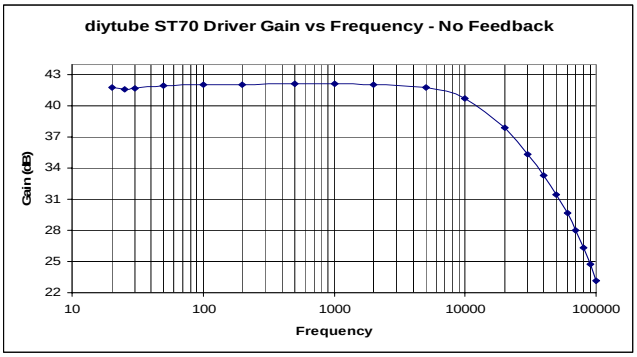


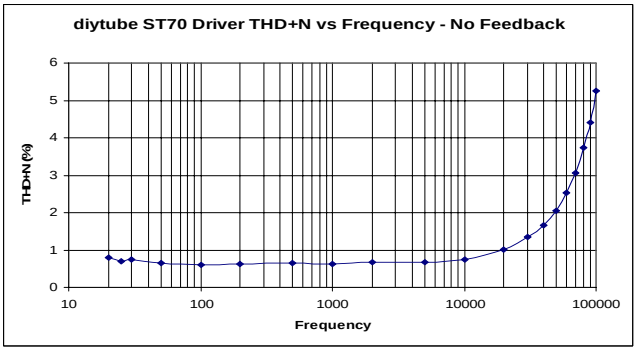
diytube ST70 driver closed loop 1%THD at 1kHz

- 1.165Vrms input

Test & Measurement Data

20Hz	2.446V	+41.75dB	.787%THD+N	.682W @ 8ohm
25Hz	2.398V	+41.58dB	.699%THD+N	.721W @ 8ohm
30Hz	2.439V	+41.72dB	.744%THD+N	.744W @ 8ohm
50Hz	2.507V	+41.96dB	.658%THD+N	.784W @ 8ohm
100Hz	2.538V	+42.07dB	.598%THD+N	.804W @ 8ohm
200Hz	2.547V	+42.10dB	.615%THD+N	.812W @ 8ohm
500Hz	2.553V	+42.12dB	.649%THD+N	.812W @ 8ohm
1kHz	2.553V	+42.12dB	.631%THD+N	.814W @ 8ohm
2kHz	2.542V	+42.08dB	.663%THD+N	.807W @ 8ohm
5kHz	2.448V	+41.76dB	.665%THD+N	.749W @ 8ohm
10kHz	2.178V	+40.74dB	.737%THD+N	.592W @ 8ohm
20kHz	1.583V	+37.97dB	1.017%THD+N	.312W @ 8ohm
30kHz	1.173V	+35.37dB	1.349%THD+N	.172W @ 8ohm
40kHz	.926V	+33.31dB	1.668%THD+N	.107W @ 8ohm
50kHz	.75V	+31.48dB	2.057%THD+N	.07W @ 8ohm
60kHz	.611V	+29.70dB	2.524%THD+N	.047W @ 8ohm
70kHz	.503V	+28.01dB	3.07%THD+N	.032W @ 8ohm
80kHz	.415V	+26.34dB	3.74%THD+N	.022W @ 8ohm
90kHz	.354V	+24.74dB	4.41%THD+N	.016W @ 8ohm
100kHz	.294V	+23.13dB	5.25%THD+N	.011W @ 8ohm





diytube ST70 driver open loop 20mV input

- 20mVrms input

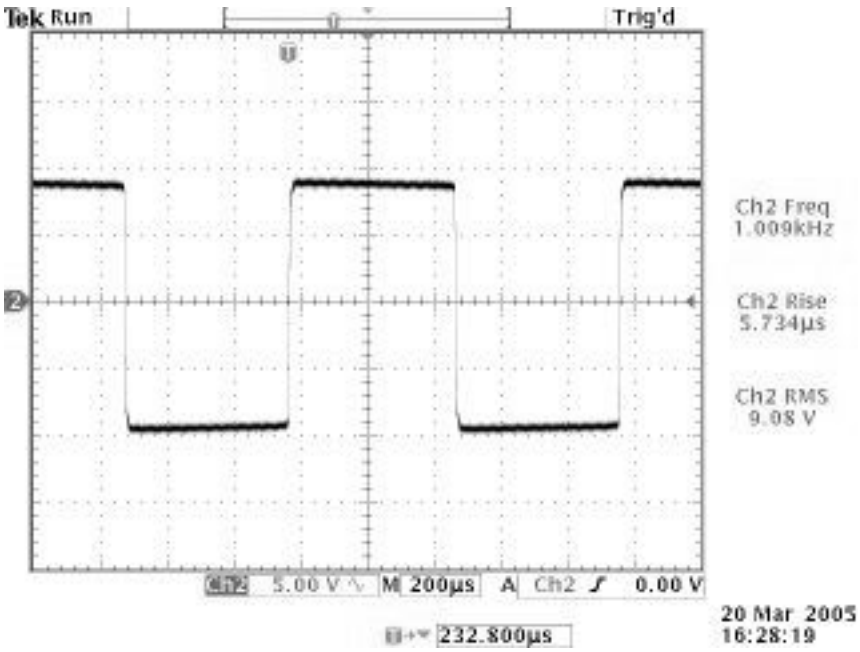
03/25/05

Tests were conducted using:

- Hewlett-Packard 8903B Audio Analyzer
- diytube Audio Acq v1.0 software
- Hewlett Packard 3455A Voltmeter
- Tektronix TDS3012B DPO
- BK Precision 5390 .025% DMM
- No-name garbage signal generator

Test & Measurement Data

1 kHz Square Wave at 10W Output



10 kHz Square Wave at 10W Output