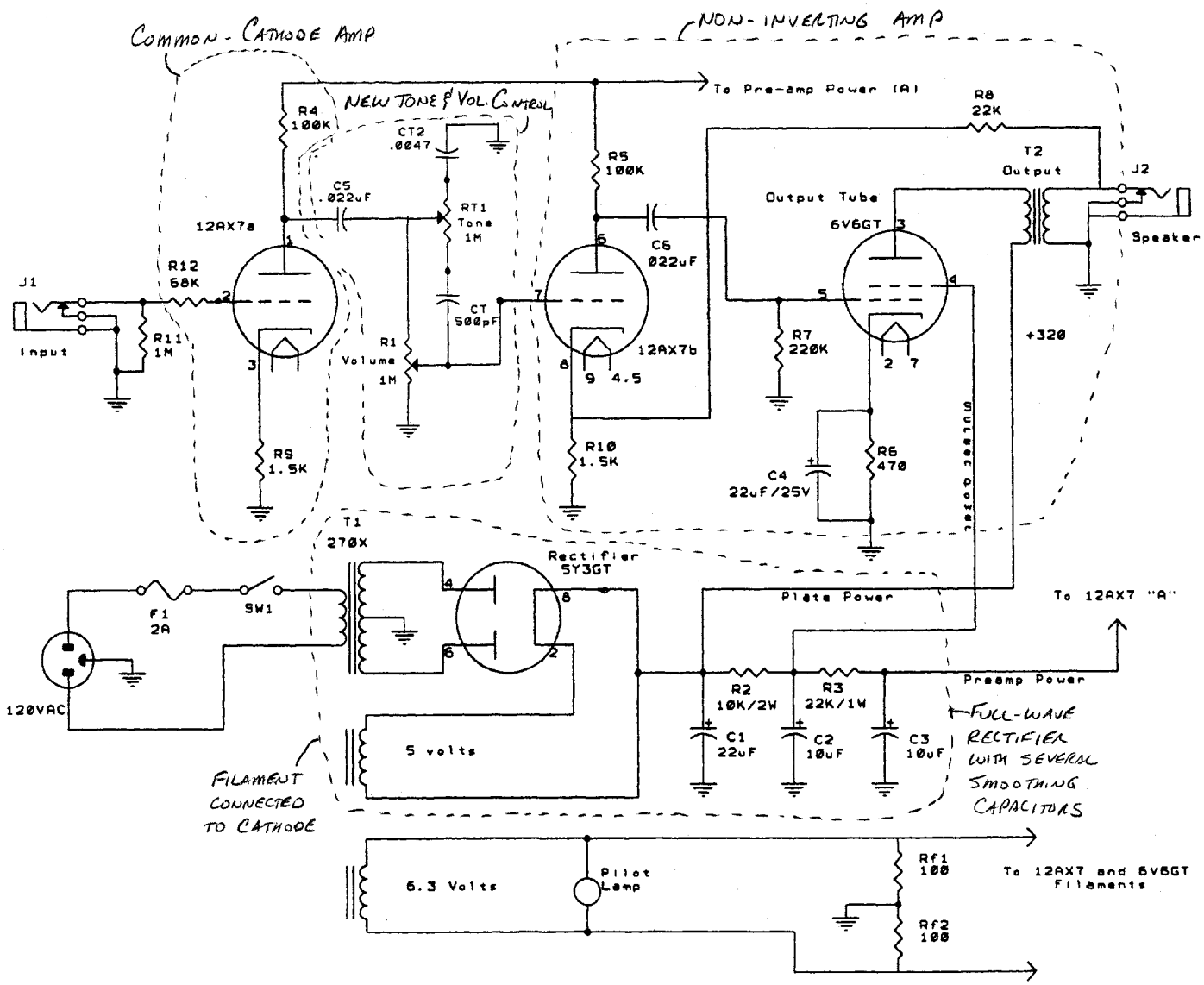
CHAMP HEAD

With Tone Control Option

Fender Princeton 5F2-A

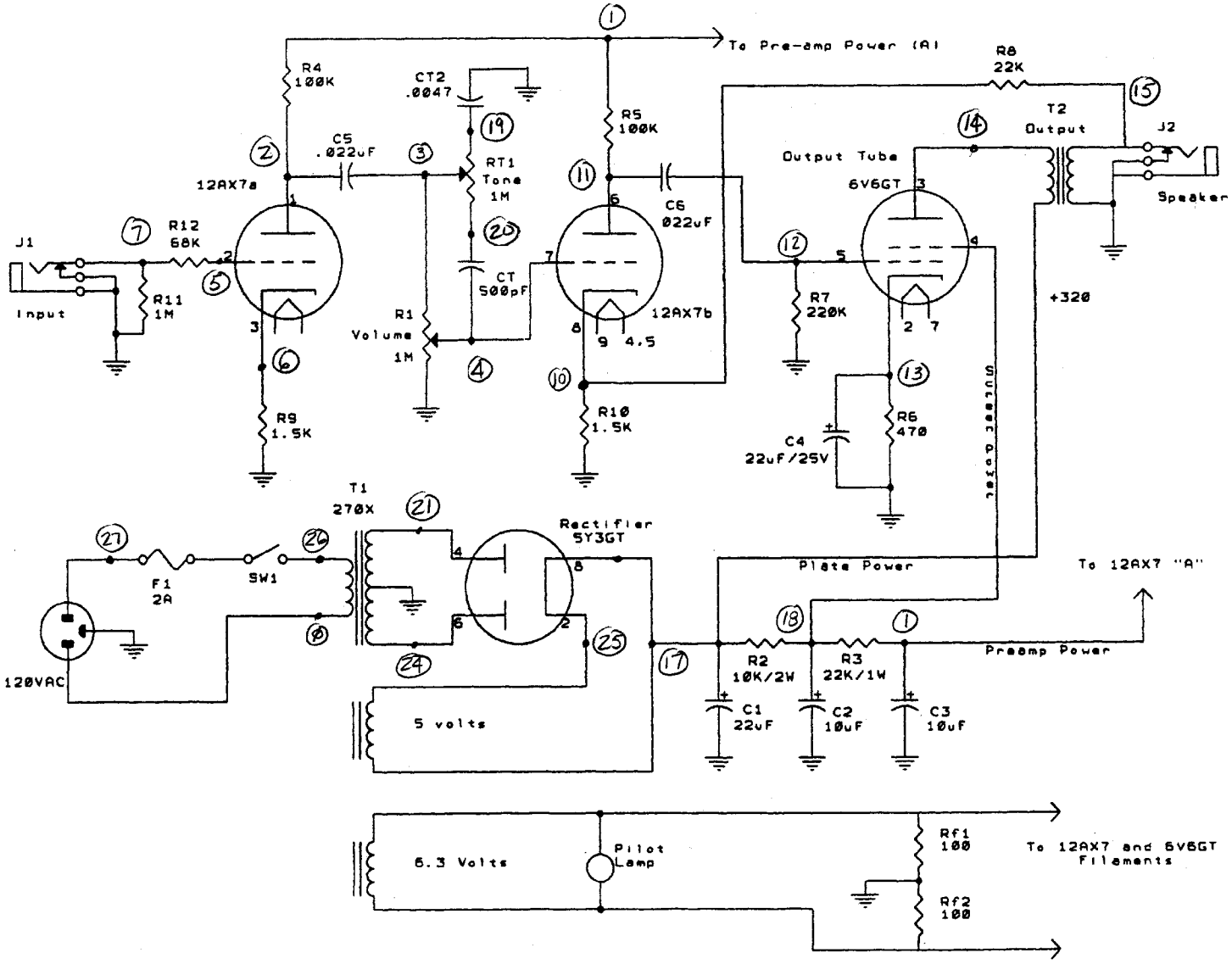


G) PSPICE NODES

CHAMP HEAD

With Tone Control Option

Fender Princeton 5F2-A



```
Fender Princeton
R1a 3 4 .01MEG
R1b 4 0 0.99MEG
RT1a 20 3 0.5MEG
RT1b 3 19 0.5MEG
R2 17 18 10K
R3 18 1 22K
R4 1 2 100K
R5 1 11 100K
R6 13 0 470
R7 12 0 220K
R8 10 15 22K
R9 6 0 1.5K
R10 10 0 1.5K
R11 7 0 1MEG
R12 7 5 68K
C1 17 0 22U
C2 18 0 10U
C3 1 0 10U
C4 13 0 22U
C5 2 3 .022U
C6 11 12 .022U
CT 20 4 500P
CT2 19 0 .0047U
X1 2 5 6 12AX7A
X2 11 4 10 12AX7A
X3 14 18 12 13 6V6GT
X4 21 17 5Y3GT
X5 24 25 5Y3GT
RS 15 15a 0.453
LS 15a 0 8.36143m
LP 14 17a 16.6731
RP 17a 17 703
KXT2 LP LS 0.99
LP1 26 0 0.24
LS1 21 0 1.25
LS2 0 24 1.25
LS3 25 17 0.284M
KXT1 LP1 LS1 LS2 LS3 1
VAC 27 0 SIN (0 162 60)
RAC 27 26 1
Vin 7 0 SIN (0 22m 1K)
Ropen1 1 0 10MEG
Ropen2 25 0 10MEG
Rspeaker 15 0 10
.SUBCKT 5Y3GT A K
GP  A  K  VALUE={2.69E-4*(PWR(V(A,K),1.5)+PWRS(V(A,K),1.5))/2}
:ENDS 5Y3GT
.SUBCKT 12AX7A P G K
E1  2  0  VALUE={45+V(P,K)+95.43*V(G,K)}
R1  2  0  1.0K
Gp  P  K  VALUE={1.147E-6*(PWR(V(2),1.5)+PWRS(V(2),1.5))/2}
Rgk G 1 1.0K
D1 1 K DM
Cgk G  K  1.6P
Cgp G  P  1.7P
Cpk P  K  0.46P
.MODEL DM D
.ENDS 12AX7A
.SUBCKT 6V6GT P S G K
Rgk G 1 1.4K
D1 1 K DM
Esp 2  0  VALUE={V(P,K)+13.49*V(S,K)+130.4*V(G,K)}
E1  3  2  VALUE={5.521E-7*(PWR(V(2),1.5)+PWRS(V(2),1.5))/2}
E2  3  4  VALUE={5.521E-7*PWR(13.49*V(S,K),1.5)*V(P,K)/25}
E3  5  4  VALUE={(1-V(4,2)/ABS(V(4,2)+0.001))/2}
R1  5  0  1.0K
Gk  S  K  VALUE={V(3,2)}
Gp  P  S  VALUE={0.92*(V(3,4)*(1-V(5,4))+V(3,2)*V(5,4))}
Cgk G  K  4.5P
Cgs G  S  4.5P
Cgp G  P  0.7P
Cpk P  K  7.5P
.MODEL DM D
.ENDS 6V6GT
.OPTIONS ITL4=50
.TRAN 2U 9000M 8900M 2U
.FOUR 1K V(7) V(15)
.PROBE
.END
```

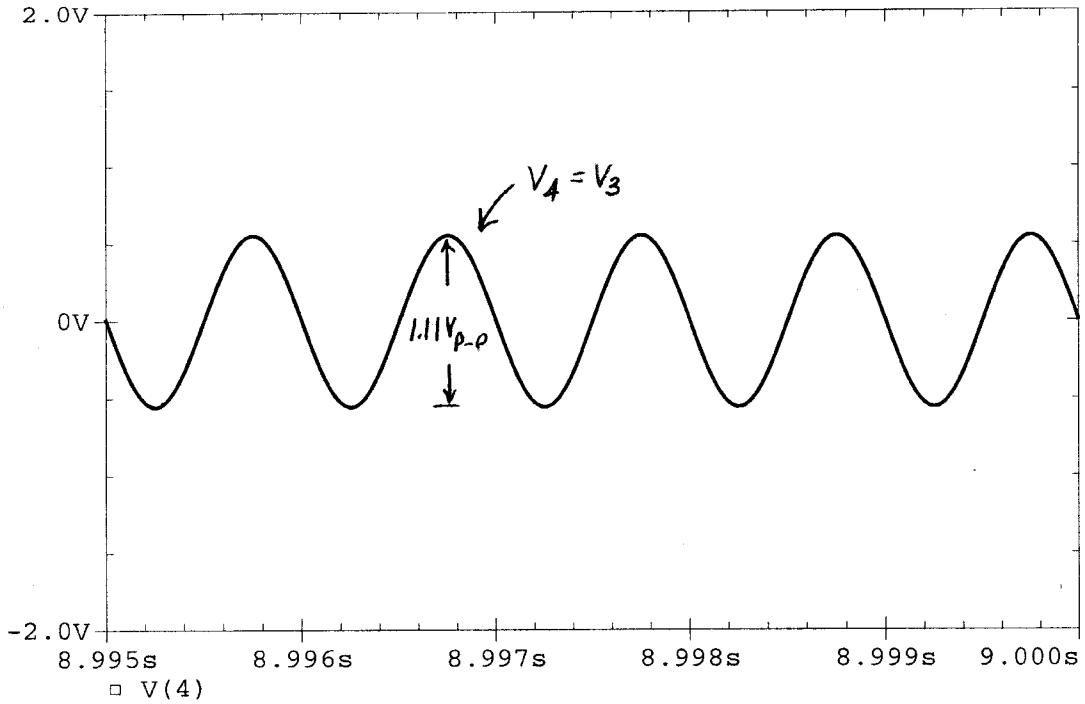
VOLUME MAX
TONE MID

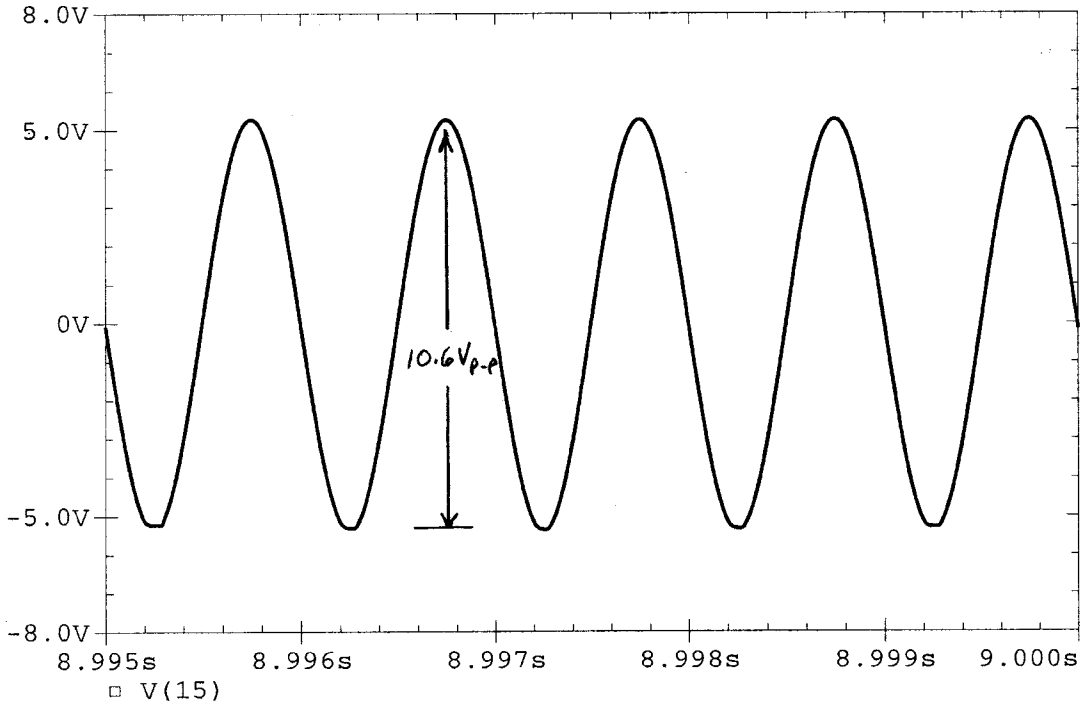
RESISTANCE OF WINDING ADDED

FILAMENT CONNECTED TO CATHODE

– FOR VOLUME MAX, TONE MID, $V_{IN} = 44mV_{p-p}$

Fender Princeton,... Temperature: 27.0,...





$$\frac{V_4}{V_{IN}} = \frac{-1.11}{44m} = -25.22 \quad ; \quad \frac{V_{15}}{V_4} = \frac{10.6}{1.11} = 9.55$$

$$\frac{V_{15}}{V_{IN}} = (-25.22)(9.55) = -241$$

****

Fender Princeton

**** FOURIER ANALYSIS TEMPERATURE = 27.000 DEG C

****

FOURIER COMPONENTS OF TRANSIENT RESPONSE V(7)

DC COMPONENT = 5.474696E-07

HARMONIC NO	FREQUENCY (HZ)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	1.000E+03	2.200E-02	1.000E+00	-2.573E-01	0.000E+00
2	2.000E+03	1.290E-06	5.862E-05	1.214E+02	1.219E+02
3	3.000E+03	1.163E-06	5.287E-05	1.089E+02	1.097E+02
4	4.000E+03	1.132E-06	5.146E-05	1.037E+02	1.047E+02
5	5.000E+03	1.120E-06	5.089E-05	1.008E+02	1.021E+02
6	6.000E+03	1.113E-06	5.060E-05	9.892E+01	1.005E+02
7	7.000E+03	1.109E-06	5.043E-05	9.760E+01	9.940E+01
8	8.000E+03	1.107E-06	5.032E-05	9.663E+01	9.869E+01
9	9.000E+03	1.105E-06	5.025E-05	9.588E+01	9.819E+01

TOTAL HARMONIC DISTORTION = 1.470677E-02 PERCENT

****

Fender Princeton

**** FOURIER ANALYSIS TEMPERATURE = 27.000 DEG C

****

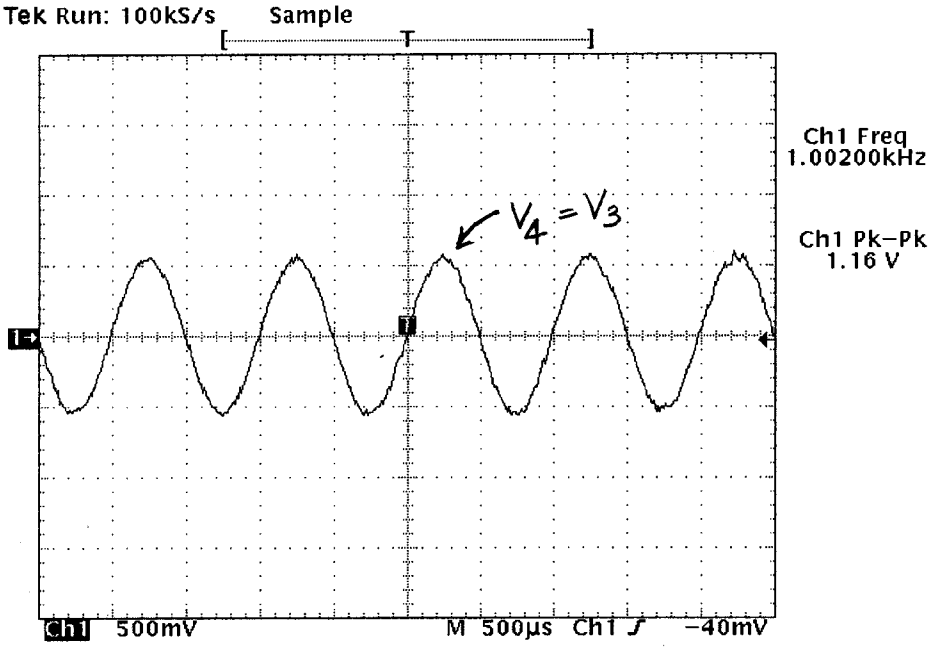
FOURIER COMPONENTS OF TRANSIENT RESPONSE V(15)

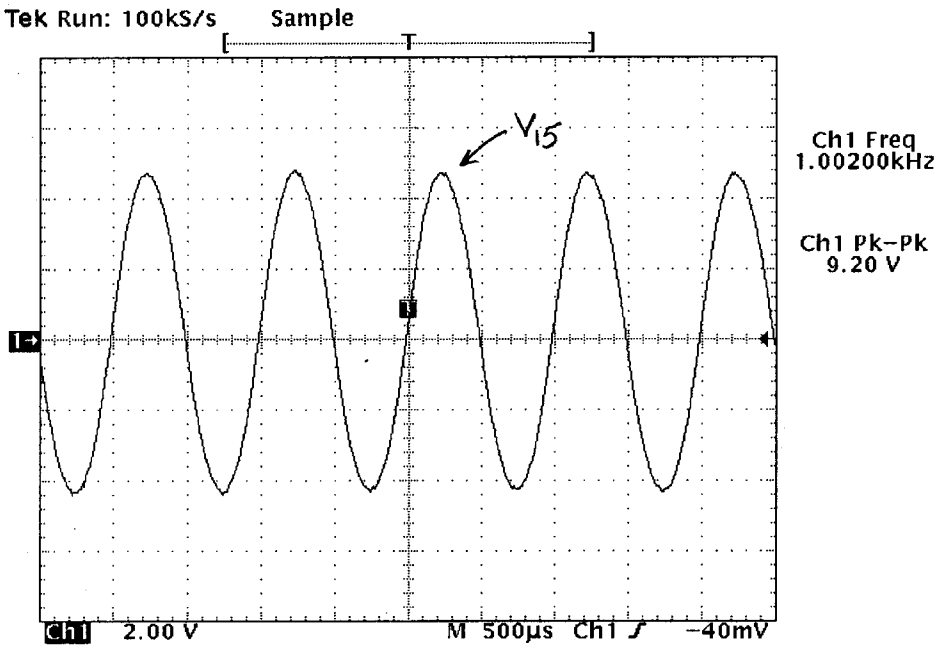
DC COMPONENT = -2.925673E-03

HARMONIC NO	FREQUENCY (HZ)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	1.000E+03	5.325E+00	1.000E+00	-1.786E+02	0.000E+00
2	2.000E+03	3.248E-02	6.099E-03	6.477E+01	4.221E+02
3	3.000E+03	1.300E-02	2.440E-03	1.799E+02	7.158E+02
4	4.000E+03	8.537E-03	1.603E-03	1.070E+02	8.215E+02
5	5.000E+03	7.950E-03	1.493E-03	1.209E+01	9.053E+02
6	6.000E+03	8.087E-03	1.519E-03	-7.713E+01	9.947E+02
7	7.000E+03	7.732E-03	1.452E-03	-1.607E+02	1.090E+03
8	8.000E+03	6.563E-03	1.232E-03	1.132E+02	1.542E+03
9	9.000E+03	5.740E-03	1.078E-03	2.001E+01	1.628E+03

TOTAL HARMONIC DISTORTION = 7.419020E-01 PERCENT

— ACTUAL AMPLIFIER WITH VOL. MAX, TONE MID, $V_{IN} = 50mV_{p-p}$





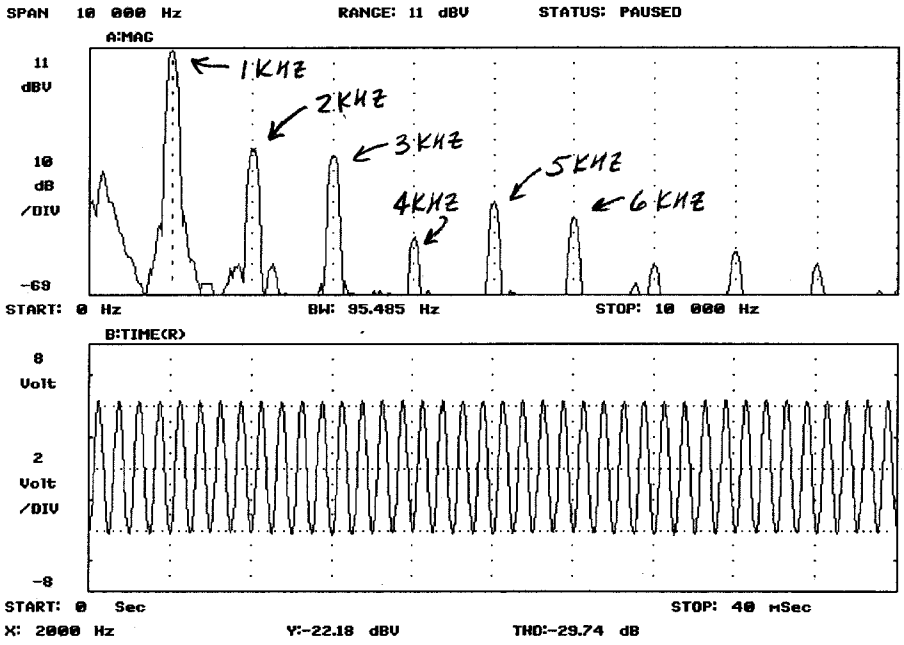
$$\frac{V_4}{V_{IN}} = \frac{-1.16}{50m} = -23.2; \quad \frac{V_{15}}{V_4} = \frac{9.20}{1.16} = 7.93$$

$$\frac{V_{15}}{V_{IN}} = (-23.2)(7.93) = -184$$

- DISTORTION (HP 3561A DYNAMIC SIGNAL ANALYZER)

TOTAL HARMONIC DISTORTION (THD) IS

$$\frac{\text{RMS VALUE OF ALL THE DISTORTION COMPONENTS}}{\text{RMS VALUE OF THE FUNDAMENTAL}} \times 100\%$$



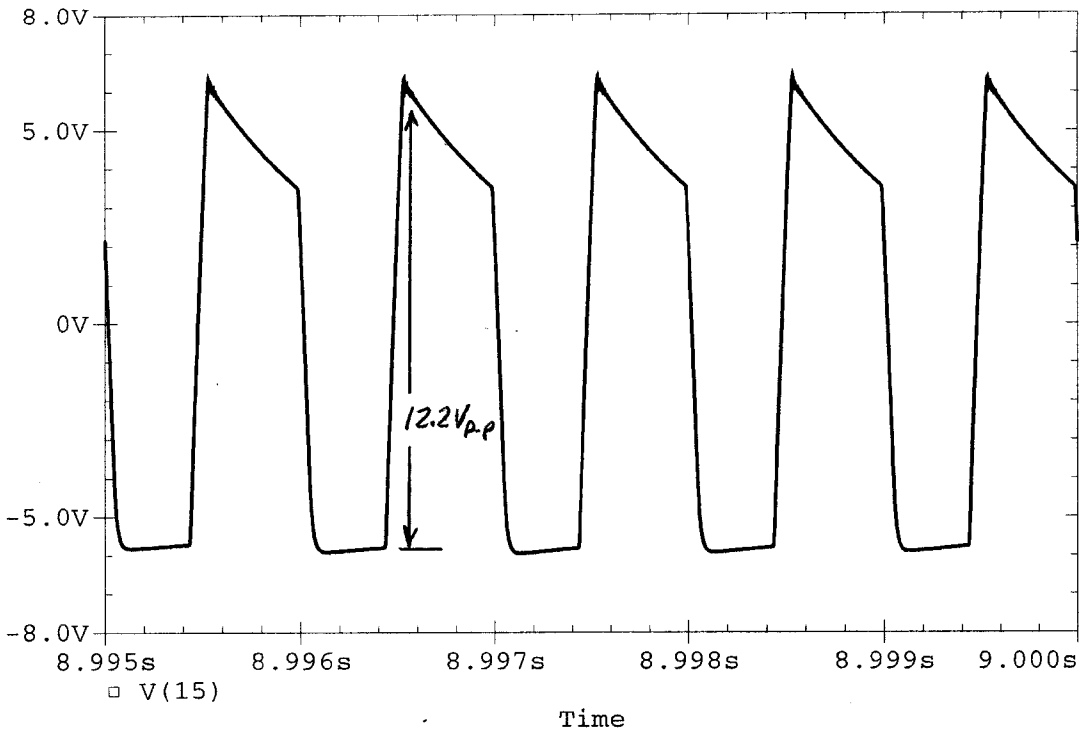
CONVERTING

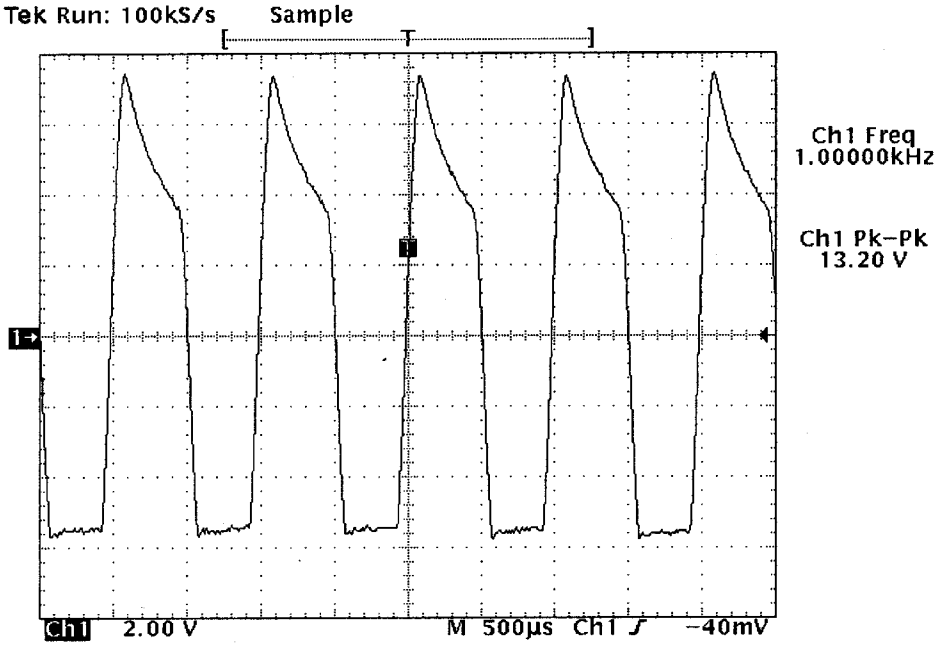
$$THD = 10^{\frac{-29.74}{20}} \times 100\% = 3.25\%$$

H) Overdriving the Amp (V_{IN} = 200 mV_{p-p})

Fender Princeton

Temperature: 27.0





****

Fender Princeton

**** FOURIER ANALYSIS TEMPERATURE = 27.000 DEG C

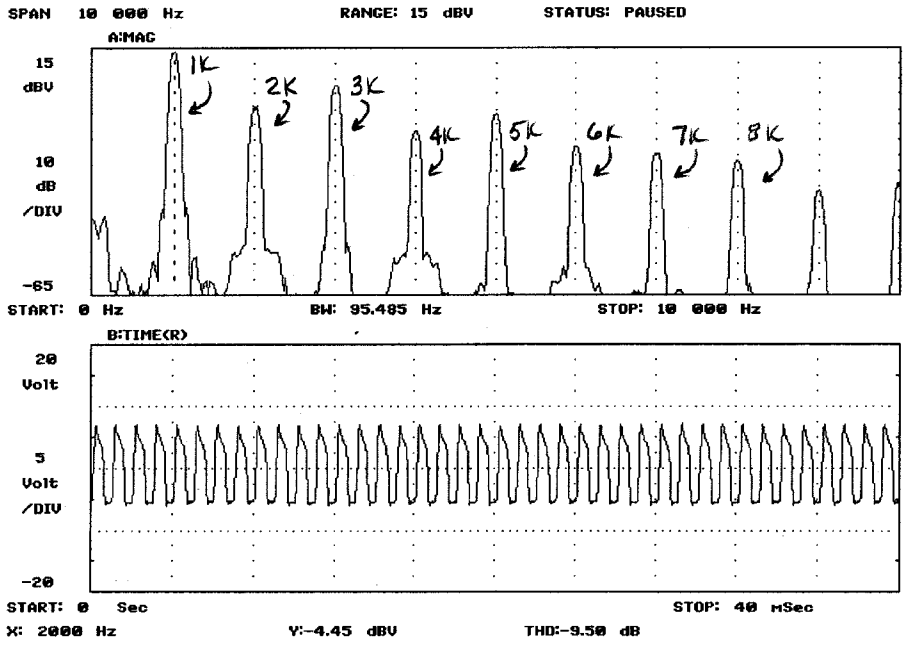
****

FOURIER COMPONENTS OF TRANSIENT RESPONSE V(15)

DC COMPONENT = 1.544828E-03

HARMONIC NO	FREQUENCY (HZ)	FOURIER COMPONENT	NORMALIZED COMPONENT	PHASE (DEG)	NORMALIZED PHASE (DEG)
1	1.000E+03	6.654E+00	1.000E+00	-1.750E+02	0.000E+00
2	2.000E+03	1.072E+00	1.612E-01	6.569E+01	4.157E+02
3	3.000E+03	1.850E+00	2.780E-01	-1.795E+02	3.455E+02
4	4.000E+03	7.929E-01	1.192E-01	7.486E+01	7.749E+02
5	5.000E+03	7.398E-01	1.112E-01	1.789E+02	1.054E+03
6	6.000E+03	5.404E-01	8.121E-02	7.912E+01	1.129E+03
7	7.000E+03	2.649E-01	3.981E-02	1.749E+02	1.400E+03
8	8.000E+03	3.087E-01	4.639E-02	8.349E+01	1.484E+03
9	9.000E+03	6.950E-02	1.044E-02	1.444E+02	1.720E+03

TOTAL HARMONIC DISTORTION = 3.745293E+01 PERCENT



$$THD = 10^{\frac{-9.5}{20}} \times 100\% = 33.5\%$$

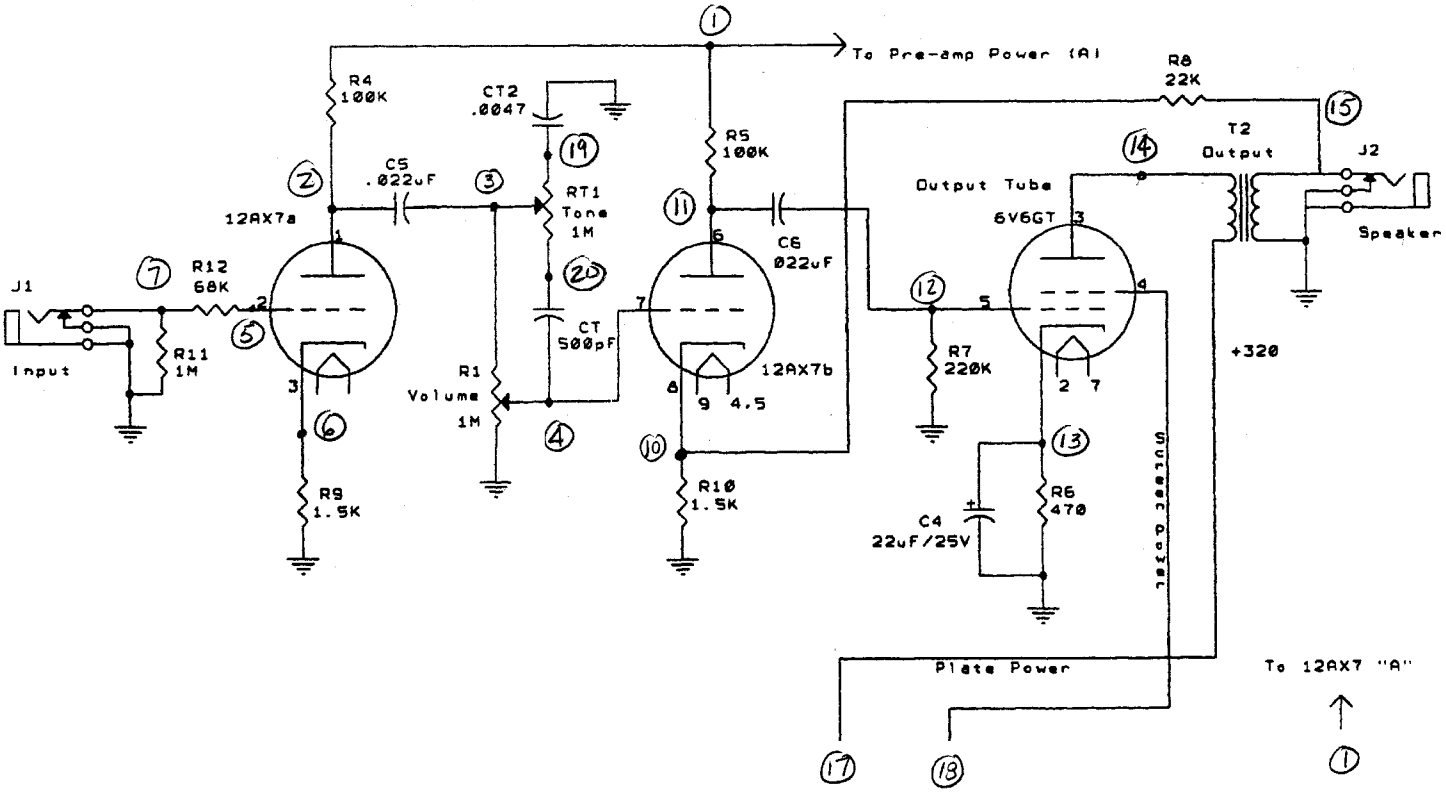
I) AC Analysis

- To do a Bode Plot (magnitude and phase of the gain versus frequency), we need to replace the "full-wave rectifier with several smoothing capacitors" power supply with their DC values.

CHAMP HEAD

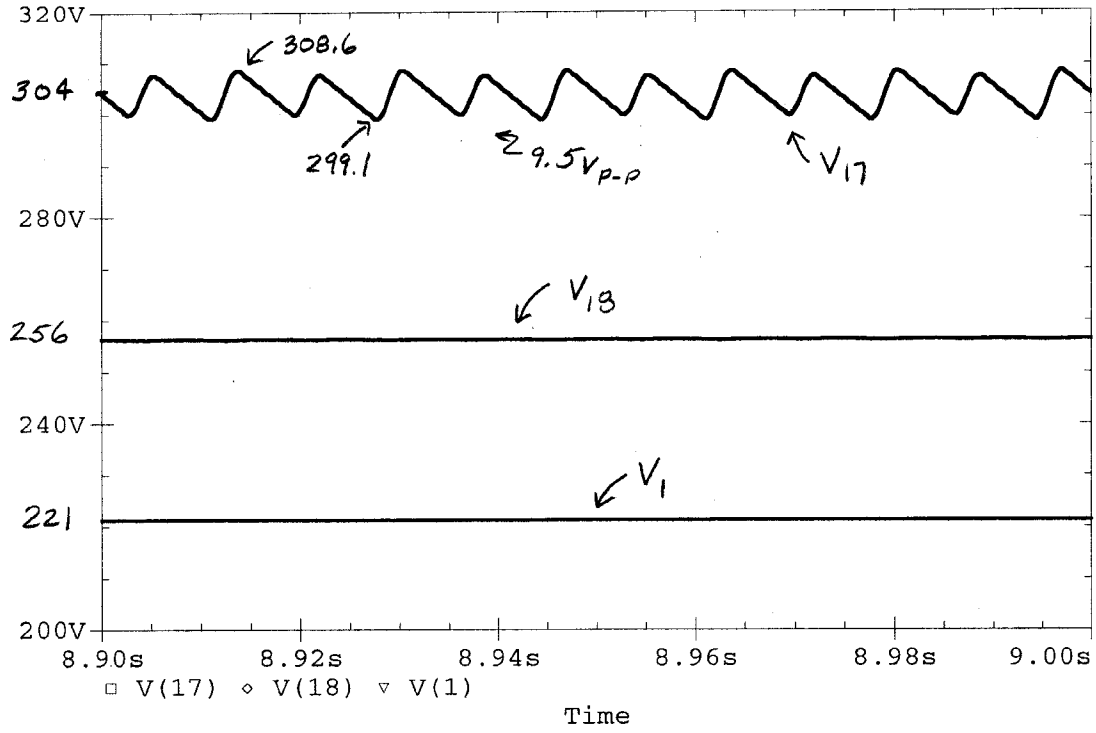
With Tone Control Option

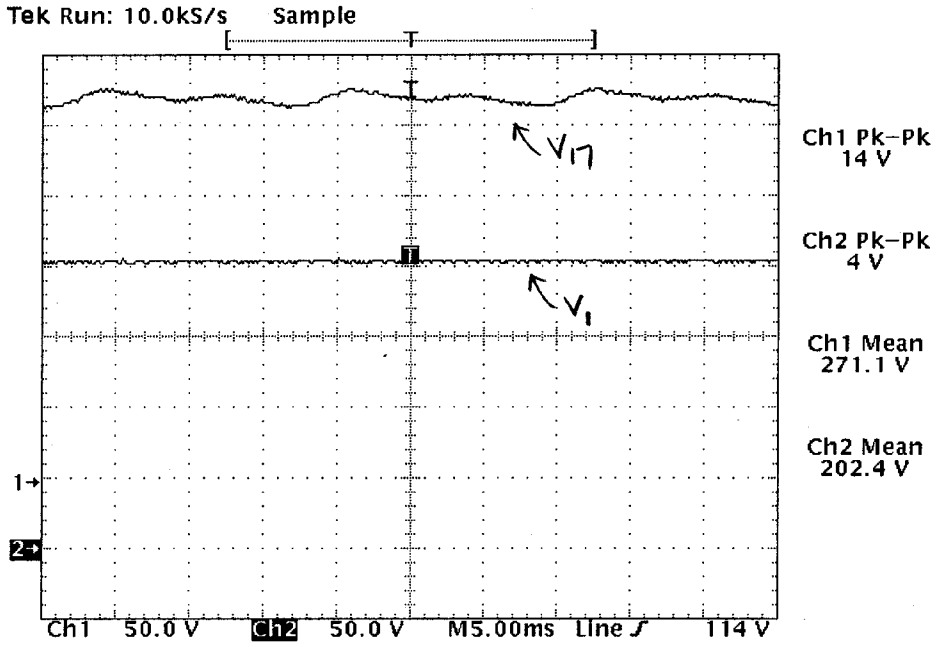
Fender Princeton 5F2-A



Fender Princeton

Temperature: 27.0



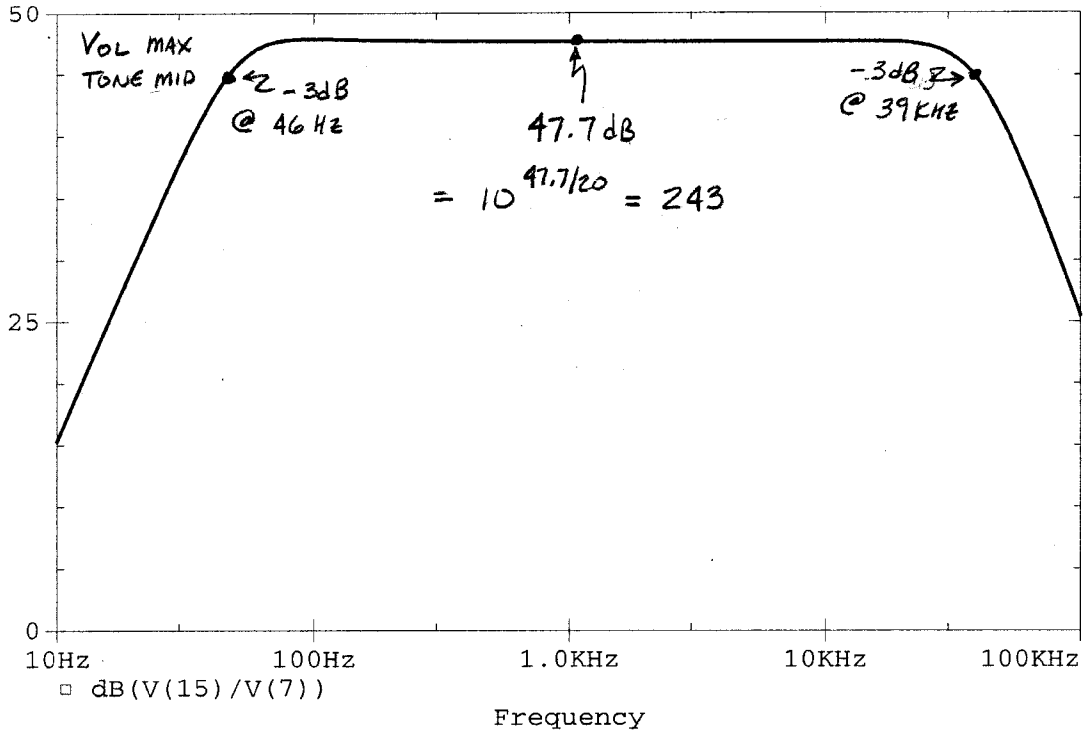


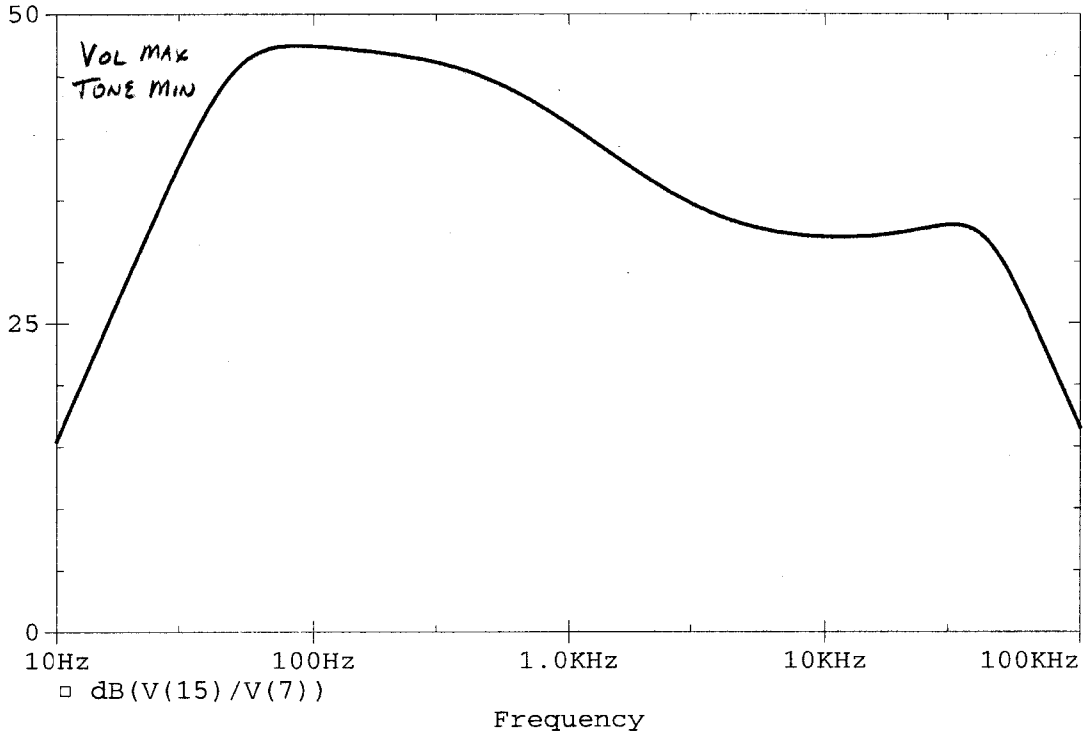
– PSPICE FILE FOR AC ANALYSIS

```
Fender Princeton
R1a 3 4 .01MEG          } VOL. MAX
R1b 4 0 0.99MEG
RT1a 20 3 0.5MEG        } TONE MID
RT1b 3 19 0.5MEG
R4 1 2 100K
R5 1 11 100K
R6 13 0 470
R7 12 0 220K
R8 10 15 22K
R9 6 0 1.5K
R10 10 0 1.5K
R11 7 0 1MEG
R12 7 5 68K
C4 13 0 22U
C5 2 3 .022U
C6 11 12 .022U
CT 20 4 500P
CT2 19 0 .0047U
X1 2 5 6 12AX7A
X2 11 4 10 12AX7A
X3 14 18 12 13 6V6GT
RS 15 15a 0.453
LS 15a 0 8.36143m
LP 14 17a 16.6731
RP 17a 17 703
KXT2 LP LS 0.99
Vin 7 0 AC 1 SIN (0 22m 1K)
Rspeaker 15 0 10
Vdc1 17 0 304           } AVE VALUE
Vdc2 18 0 256
Vdc3 1 0 221
.SUBCKT 12AX7A P G K
E1  2  0  VALUE={45+V(P,K)+95.43*V(G,K)}
R1  2  0  1.0K
Gp  P  K  VALUE={1.147E-6*(PWR(V(2),1.5)+PWRS(V(2),1.5))/2}
Rgk G 1 1.0K
D1 1 K DM
Cgk G  K  1.6P
Cgp G  P  1.7P
Cpk P  K  0.46P
.MODEL DM D
.ENDS 12AX7A
.SUBCKT 6V6GT P S G K
Rgk G 1 1.4K
D1 1 K DM
Esp 2  0  VALUE={V(P,K)+13.49*V(S,K)+130.4*V(G,K)}
E1  3  2  VALUE={5.521E-7*(PWR(V(2),1.5)+PWRS(V(2),1.5))/2}
E2  3  4  VALUE={5.521E-7*PWR(13.49*V(S,K),1.5)*V(P,K)/25}
E3  5  4  VALUE={(1-V(4,2)/ABS(V(4,2)+0.001))/2}
R1  5  0  1.0K
Gk  S  K  VALUE={V(3,2)}
Gp  P  S  VALUE={0.92*(V(3,4)*(1-V(5,4))+V(3,2)*V(5,4))}
Cgk G  K  4.5P
Cgs G  S  4.5P
Cgp G  P  0.7P
Cpk P  K  7.5P
.MODEL DM D
.ENDS 6V6GT
.OPTIONS ITL4=50
.AC DEC 500 10 100k
.PROBE
.END
```

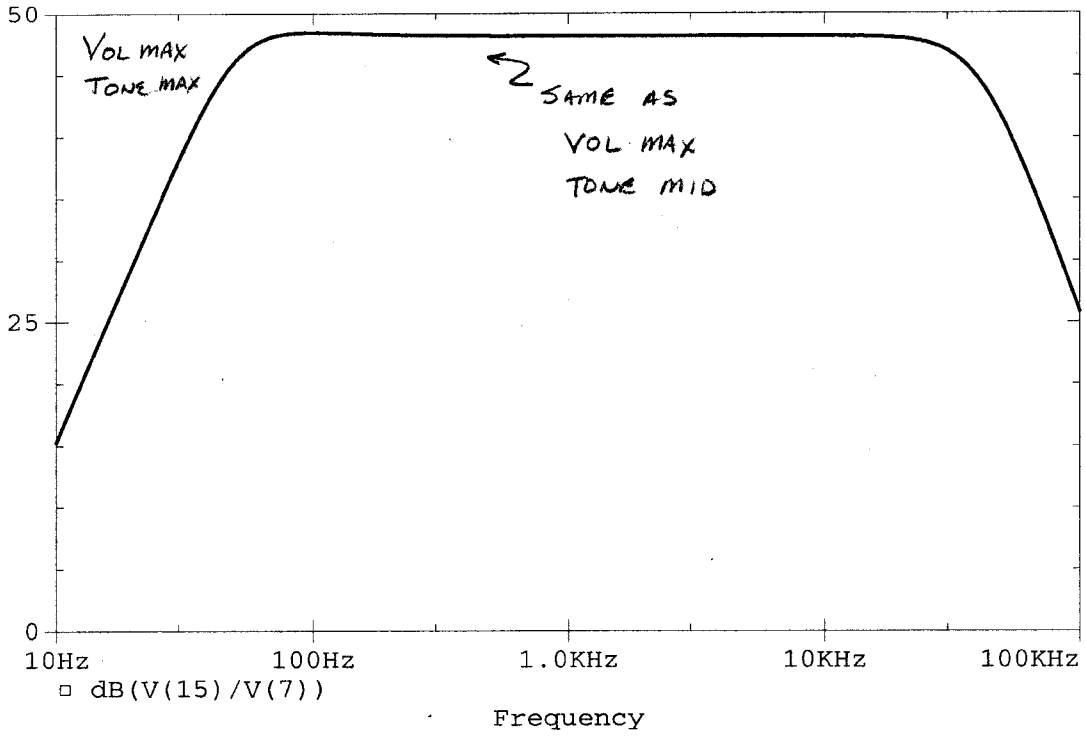
Fender Princeton,...

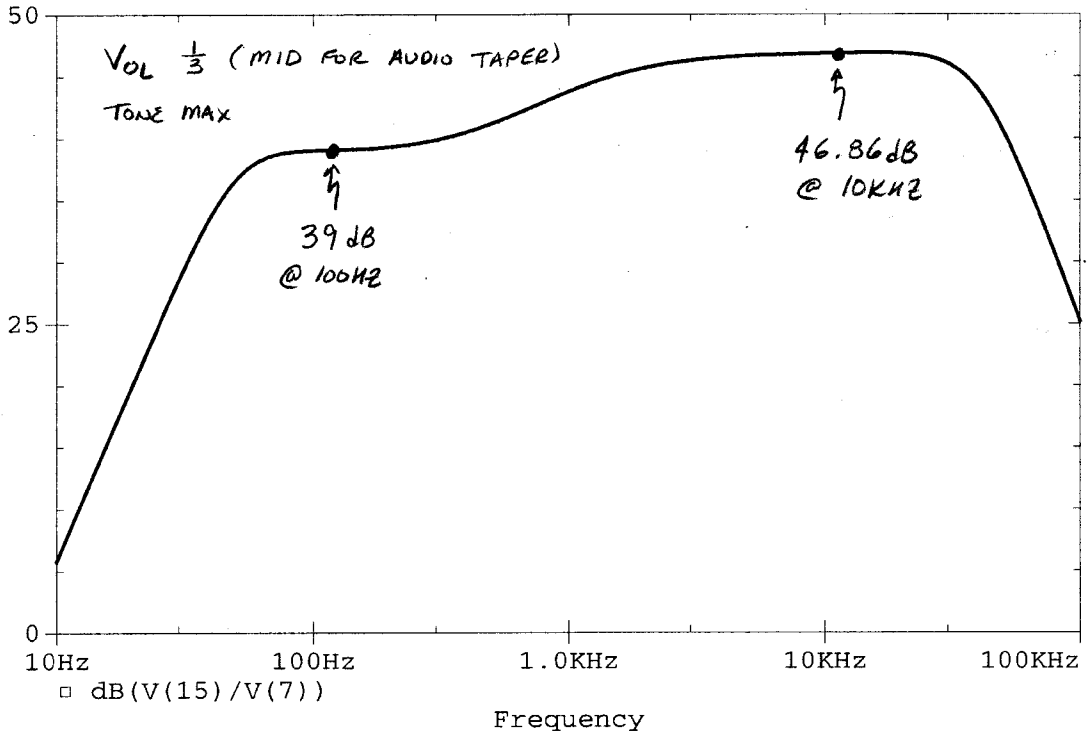
Temperature: 27.0,...





Fender Princeton,... Temperature: 27.0,...

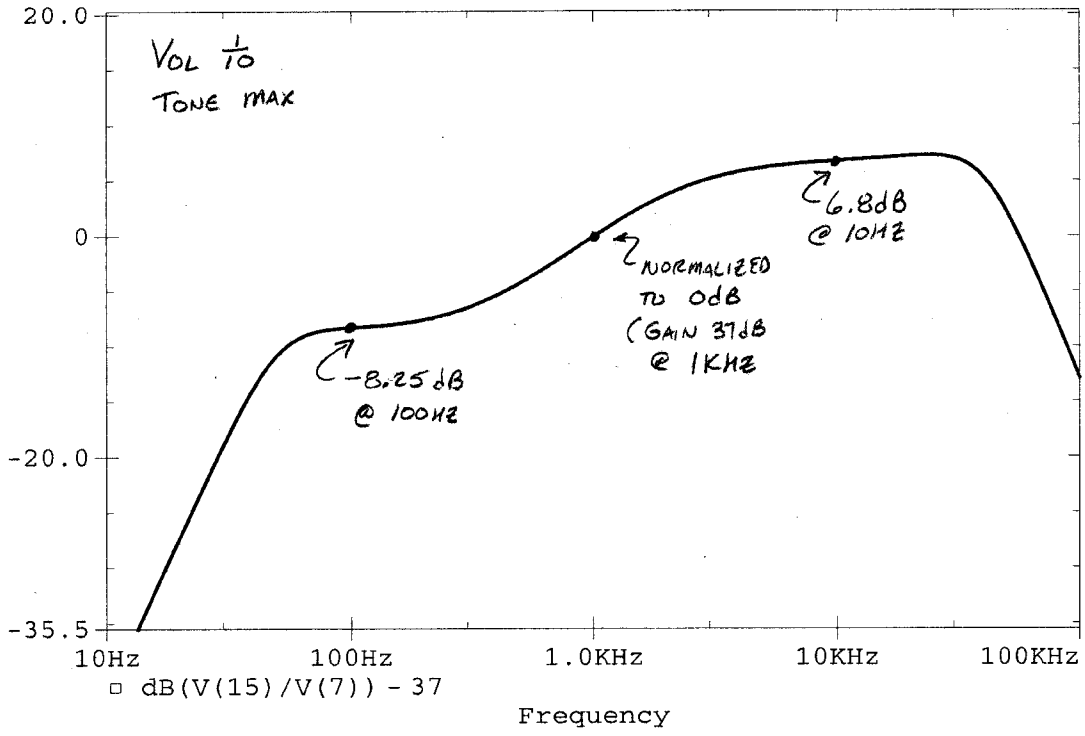




– Comparison with measured

Fender Princeton

Temperature: 27.0



– Using an HP8903B Audio Analyzer