

Aperiodic Activity:

## 7. Inharmonic/aperiodic activity

(Scale: 0 to 5, 0= not present to 5= extreme)

### Articulation - Lisa's Descriptions of Sensation

#### Speech:

Articulation: neutral  
Inharmonic activity: 4

#### Classical:

Articulation: "fish face"  
low larynx  
velum arched

#### Pop:

Articulation: smile  
neutral larynx  
breathy  
tongue forward

Inharmonic activity: O1=1  
O11=2  
O21=2  
O31=1  
O44=2

Inharmonic activity: P1=3  
P12=3  
P22=4  
P33=2  
P39=4

#### Legit:

Articulation: smile  
larynx neutral  
tongue forward

#### Country:

Articulation: puckered lips  
high larynx  
tongue forward  
narrow pharynx  
nasal

Inharmonic activity: L1=3  
L2=3  
L12=2  
L22=3  
L34=2  
L35=3

Inharmonic activity: C1=2  
C11=2  
C21=4  
C31=2  
C37=1

Belt: molar mouth  
lips firm  
wide larynx  
wide mouth

#### Jazz:

Articulation: puckered lips  
low larynx  
low tongue  
breathy

Inharmonic activity: B1=4  
B11=2  
B21=1  
B31=4  
B40=2  
B41=1  
B45=1

Inharmonic activity: J1=3  
J11=2  
J21=3  
J33=4 - on entrance notes  
J33=2 - on me  
J38=1

#### R&B:

Articulation: "water in the mouth"  
"molar mouth"  
wide flat tongue  
low larynx or neutral larynx

Inharmonic activity: 4

Auditory Analysis:

8. Auditory Analysis

Legend:

Phonation type: MV(modal voice), HV (harsh voice), WV(whispery voice), CV(creaky voice), BV (breathy voice)

Larynx: RL = raised larynx, LL = lowered larynx

Qualifiers: sl. = slight, vd = ventricular folds, contr. = constriction, pharyn. = pharyngealized  
~~contraction~~

Sample	Phonation Type	Vowel/ Voice	Pharynx	Larynx	Pitch
B1	MV	i	no	neutral	mid
B11	MV	i	no	sl. RL	high
B21	sl. HV	i	sl. vd. trill	sl. RL	extra high
B31	sl. WV ~ sl. sl. HV	jē, æē	sl. constr.	sl. RL	extra high
B40	MV ~ sl. WV	2V̄	sl. sl. constr.	sl. RL	mid
B41	MV ~ sl. BV	V̄	no	sl. RL ~ sl. LL	mid
B45	MV	V	no	neutral	mid
C1	MV	i	no	neutral ~	mid 205
C11	sl. HV	i i	sl. constr. ~ no	sl. RL ~ neutral ~	high 290
C21	sl. HV ~ MV	e	sl. constr.	neutral ~	extra high 418
C31	MV ~ sl. WV ~ MV	i j̄ i	sl. constr. ~ no	sl. RL	low 205
C37	MV	2V̄	no	neutral ~ sl. LL	mid 231
J1	sl. BV	i	no	sl. LL	low
J11	sl. BV	i	no	sl. LL	high
J21	sl. HWV	j	no	sl. LL	extra high
J33	sl. BV	~ sl. V̄	no	sl. LL	low
J38	MV staccato	V̄	no	neutral	mid
L1	sl. WV	r j̄	no	neutral	low
L12	sl. WV ~ sl. sl. WCV	i i	sl. pharyn.	sl. RL	mid
L2	sl. WV ~ MV	i i i	no	sl. LL	low
L22	MV ~ sl. HCV	i	sl. pharyn.	sl. RL	high
L34	sl. BV	V	no	sl. LL	mid
L35	sl. BV	V	no	sl. LL ~ 2LL	mid
O1	MV ~ sl. HV	j̄ j̄	no ~ sl. pharyn.	sl. RL	low
O11	MV ~ sl. BV	i	~ sl. constr.	sl. LL	low
O21	MV	i	no	sl. LL	mid
O31	sl. WV	j̄ ~ j̄	no	sl. LL	high
O44	MV ~ sl. BV	V	sl. constr.	sl. LL	mid
pop1	MV ~ sl. WV	i	2 pharyn.	neutral	low
pop12	sl. WCV ~ MV	j̄ i	sl. pharyn.	sl. RL	mid
pop22	sl. HWV ~ MV	j̄ i	sl. pharyn. ~ no	sl. RL	high
pop33	MV ~ sl. HCV	V ~ V̄	no ~ sl. constr.	neutral	mid
pop39	sl. BV	V̄	no	neutral	high
R1	2WV (sl. HV)	i	sl. constr.	sl. LL	low
R11	2WV	i	sl. pharyn.	neutral	mid
R21	sl. WV ~ MV	e e	sl. pharyn.	sl. RL	high
R31	2BV ~ sl. BV	V	no	2LL ~ sl. LL	low
R37	sl. BV	V̄	no	sl. LL	low
spk36	sl. WV	i æ a e ɤ ʉ	no	sl. LL	low
spk7	sl. WV	i æ g e u	no	sl. LL	low

**DFT observations (from graphic and numerical results):**

**Pop:**

Generally:

Good Fo tracking  
F2 F3 closer together than speech  
Energy at approx. 7600Hz

P01: Fo tracking, F2 F3 closer together than speech, energy at 6606Hz and 7650-7740Hz

P12: Fo tracking

P22: Fo tracking, F2 F3 closer together than speech, energy at 7578 Hz that is not in speech sample

P33: Fo tracking, F2 F3 closer together than speech, energy at 7704Hz that is closer to speech formant

P39: Fo tracking, F2 F3 closer together than speech, energy at 7434 Hz that is not in speech sample

**Country:**

Generally:

Variable

C01: Fo tracking a bit off, P2 has more energy than pop but less than speech, F2 F3 wider apart than speech, energy at 6534Hz and 7452Hz; formant energy 9162 Hz a little higher than speech

C11: fair Fo tracking – high pitch, F2 and F3 wide (F2 low and F3 low)

C21: good Fo tracking, F2 F3 close, energy at 6912 Hz that is not in speech sample

C31: good Fo tracking, F2 F3 wide, F4 a little higher than speech, energy between 6390Hz and 7542 Hz

C37: good Fo tracking, F2 F3 closer together than speech

**Jazz:**

Generally:

Good Fo tracking  
F2 lower than speech  
F3 and F4 close  
upper harmonics weak

**R&B:**

Generally:

Good Fo tracking, F2 ( 3 out of 4) low  
Low energy in upper harmonics  
Aperiodic energy (between the harmonics)

**Classical:**

Generally:

Good Fo tracking  
Very low F2  
Upper harmonics the weakest of all qualities

**Legit:**

Generally:

Good Fo tracking  
F2, F3 are close to speech formants (2500 – 2700) (one sample 3300 high?)  
Upper energy apparent between 6000 – 9000 Hz

6084, 7560, 8496  
6210, 7128, 7812, 8820  
6102, 7326, 8838  
6498 – 8838  
6400 – 7300

**Belt:**

Generally:

Good Fo tracking  
High energy 2500 Hz – 3500 Hz and again 7500 Hz – 10000 Hz

Predicted female formant locations for a uniform vocal tract:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
	600Hz	1800Hz	3000Hz	4200Hz	5400Hz	6600Hz	7800Hz	9000Hz	10200Hz	11400Hz

Average formant frequencies for the vowel [i] Peterson and Barney (1952)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
	310Hz	2790Hz	3310Hz							

Lisa's speech formant locations for the vowel [i]

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
LPC in Hz	316	2683	3246	5339	6247	7417	8215	9104		
DFT in Hz	198-378	2556-2736	3114-3294	5400-5490	6120-6318	6930-7200	8100-8280	8892-9072		

### DFT Numerical Results: Upper Harmonics Energy

Harmonics in Hz nearest a formant

Energy in % of fundamental (P1)

Associated Energy: Location in Hz (Energy in % of fundamental (P1))

None: Energy below 1% of fundamental (P1)

### Speech Quality:

Spk7

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6318		8280	8892		
Energy					1.1		2.4	1.1		

**Pop Quality:**

P1

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic						6605		8892	9324	
Energy						5.6		.8	1.9	

P12: none

P21:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6246	7578	8478	8910	9360	
Energy					1.1	1.8	2.6	1.4	1.2	

P33:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic							8092			
Energy							1.9			

P39:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic						7434		8942		
Energy						1.1		1.2		

**Country:**

C1

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6534	7452	8280	9162		
Energy					2.8	1.8	1.3	1.5		

C11: none

C21:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic						6912	7830	8748		
Energy						4.2	2.3	3.9		

C31:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6390	7542	7992	9360		
Energy					3.3	3.3	1.8	1.4		
Associated Energy					6624(2.3) 6858(1.3)	7054(1.0) 7308(1.6)	7542(3.3)	8892(1.0) 9126(1.2)		

C37: none

**Jazz:**

J1

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6966	7866	8370	8982		
Energy					2.7	2.8	1.2	1.2		
Associated Energy					6066(2.9)					

J11: none

J21: none

J33b and J33b2: none

J38b and J38b2: none

**R&B:**

R1: none

R11: none

R21:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6480	6948	7866			
Energy					1.1	1.1	1.3			

R31b: none

R37b: none

**Classical:**

O1: none

O11: none

O21: none

O31: none

O44b: none

**Legit:**

L1:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6084	7560	8496	8712		
Energy					1.4	1.2	1.7	1.2		
Associated Energy						7650(1.1)	8280(1.6)			

L2:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6210	7128	8262	8820		
Energy					4.8	4.6	1.0	1.9		
Associated Energy					6892(2.6)	7272(2.2) 7812(2.0)		8586(1.5)		

L12:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6102	7326		8838		
Energy					1.7	1.3		1.5		
Associated Energy					6408(1.2) 6714(1.1)	7020(1.1)	7650(1.0)			

L22:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6498	7452	8370	8838		
Energy					1.2	1.5	3.7	1.2		
Associated Energy						6984(1.4)				

L34b: none

L35b:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6462	7398				
Energy					1.1	1.7				

L35b2:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic						7488				
Energy						1.4				

**Belt:**

**B1:**

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6354	7254	8388			
Energy					3.0	3.5	2.1			
Associated Energy					6120(1.9) 6588(1.5)	6804(1.3) 7038(2.0)				

**B11:**

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic							8496			
Energy							(1.0)			

**B2: none**

**B31:**

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic							8424	8892		13104
Energy							1.0	1.5		1.0
Associated Energy										

**B40a**

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic							8514			
Energy							(1.2)			

## B40b

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic							8172			
Energy							1.6			
Associated Energy							8424(1.2)			

## B40c

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic						6930	7560	8622		
Energy						3.0	4.2	4.3		
Associated Energy						6606(1.4)	7308(1.9)	8298(1.9)		
							7956(1.5)	8856(2.5)		

## B41

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic						7146		8568		
Energy						1.0		1.2		

## B45

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Harmonic					6408	7164		8748		
Energy					1.0	1.0		1.2		
Associated Energy					6138(1.1)					



## List of Samples

### Speech

Spk 7: Heed Had Hawed Hayed Who'd  
Trimmed Spk7: ee

### Belt Quality

B1 [i] vowel low pitch B3  
B11 [i] vowel medium pitch E4  
B21 [i] vowel Medium high pitch B4  
B31 [i] [ae] [e] vowels Medium high pitch B4 retake  
B40 running sample "Starting here starting now everythings coming up roses"  
B40a "here"  
B40b "every"  
B41 running sample "There are guys just meant for some kissing and I mean to kiss me a few"  
B41b "mean"  
B45 running sample "There are guys just meant for some kissing and I mean to kiss me a few" higher in pitch  
B45b "mean"

### Country

C1 [i] vowel low pitch B4  
C11 [i] vowel medium pitch E4  
C21 [i] vowel Medium high pitch B5  
C31 [i] vowel Medium high pitch B5 retake  
C37 running sample "Home home on the range where the deer and the buh..antelope play"  
C37b "deer"

### Classical Quality

O1 [i] vowel low pitch B4  
O11 [i] vowel low pitch B4 retake with more chest sound  
O21 [i] vowel medium pitch E4  
O31 [i] vowel Medium high pitch B5  
O44 running sample "You make the listening shores rebound"  
O44b trimmed "rebound"

## Jazz

- J1 [i] vowel low pitch B4
- J11 [i] vowel medium pitch E4
- J21 [i] vowel Medium high pitch B5
- J33 running sample "Got the moon above me and no one to love me"
- J33b "me"
- J33b2 "me"
- J38 running sample "I've got daisies in green pastures. I got my man who could ask for anything more"
- J38b "daisies"
- J38b2 "green"

## Legit

- L1 [i] vowel low pitch B4
- L2 [i] vowel low pitch B4
- L12 [i] vowel medium pitch E4
- L22 [i] vowel Medium high pitch B5
- L34 running sample "with the songs they have sung for a thousand years"
- L34b "years"
- L35 running sample "do a deer a female deer, re a drop of golden sun"
- L35b "deer"
- L35b2 "deer"

## Pop

- P1 [i] vowel low pitch B4
- P12 [i] vowel medium pitch E4
- P22 [i] vowel Medium high pitch B5
- P33 running sample "So get up and get away to McDonalds we do it all for you"
- P33b "we"
- P39 running sample "or ask the grinning bobcat why he grinned"
- P39b "he"

## R&amp;B

- R1 [i] vowel low pitch B4
- R11 [i] vowel medium pitch E4
- R21 [i] vowel Medium high pitch B5
- R31 running sample "Amazing grace how sweet"
- R31b "sweet"
- R37 running sample "You can reach me by trainway"
- R37b "reach"



- LPC Data
- Ran series of box plots to find outliers
  - Outliers in F1 – pitch B4
  - Outliers
    - o LF7 – 8847.66
    - o BF3 – 2273.44 should be BF2
    - o BF4 – 2800.78 should be BF3
    - o BF6 – 4722.65
    - o C – 7028 and 7163 different formants

P = Pop; C = Country; J = Jazz; R = Rhythm and Blues; O = Classical; L = Legit; B = Belt

Scatter Plots: L=lower than speech, E=equal to speech, H= higher than speech, 2 = very

	<b>F2</b>	<b>F3</b>	<b>F4</b>	<b>F5</b>	<b>F6</b>	<b>F7</b>	<b>F8</b>
<b>P</b>	E	E	L	E	E-H	H	E
<b>C</b>	E	H	L	E	E	H	E
<b>J</b>	E	L	L	L	E	L	L
<b>R</b>	L	E	L	E	E	-	E
<b>O</b>	L	E	L	E	L	E	E
<b>L</b>	E	E	L	E	E	H	H
<b>B</b>	L	2L	2L	2L	L	2L	L

Dot Plots: L=lower than speech, E=equal to speech, H= higher than speech (MN = mean; MD = median) sl = slight

	<b>F2</b>		<b>F3</b>		<b>F4</b>		<b>F5</b>		<b>F6</b>		<b>F7</b>		<b>F8</b>	
	<b>MN</b>	<b>MD</b>	<b>MN</b>	<b>MD</b>	<b>MN</b>	<b>MD</b>	<b>MN</b>	<b>MD</b>	<b>MN</b>	<b>MD</b>	<b>MN</b>	<b>MD</b>	<b>MN</b>	<b>MD</b>
<b>P</b>	H	E	H	E	?	L	?	E	H	slH	H	H	E	L
<b>C</b>	E	E	H	H	?	L	H	E	H	L	H	H		
<b>J</b>	E	E	E	L	E	E	?	?	E	slL	E	L		
<b>R</b>	L	L	E	E	?	?	?	?	H	H	?	?		
<b>O</b>	L	L	H	E	?	H	E	H	?	?	E	L		
<b>L</b>	H	E	H	E	?	?	H	E	H	slH	H	H		
<b>B</b>	L	L	E	E	?	?	H	E	H	slH	H	?		

Summed Energy in Q1 and Q2

	0-2500 (Q1)	2500-5000 (Q2)
<b>O</b>	H	L
<b>B</b>	H	H
<b>R</b>	H	L
<b>S</b>	H	L
<b>P</b>	Variable	Variable
<b>J</b>	H	L
<b>L</b>	L	H
<b>C</b>	Variable	variable

LPC DATA

ROW	SPK.F1	SPK.F2	SPK.F3	SPK.F4	SPK.F5	SPK.F6	SPK.F7
1	316.41	2682.97	3246.15	5338.95	6246.5	7417.4	8214.6

ROW	SPK.F8	P.F1	P.F2	P.F3	P.F4	P.F5	P.F6
1	9104.49	257.81	2695.31	3269.50	*	6492.1	7593.75
2		304.69	*	3071.36	*		*
3		445.31	*	3128.90	4464.8		*
4		304.68	2882.90	*			8179.60
5		351.56	2671.50	3117.20			7312.48

ROW	P.F7	P.F8	C.F1	C.F2	C.F3	C.F4	C.F5
1	*	9328.15	269.55	2484.40	3480.47	3960.90	6433.48
2	*	8859.35	316.41	2765.50	*	*	5472.65
3	8648.2	*	468.75	2906.20	3609.37	5079.45	7028.00
4	*	*	246.09	2454.00	3328.15	4102.15	6350.00
5	8542.6	8895.50	257.81	2542.96		4371.10	5999.00

ROW	C.F6	C.F7	C.F8	J.F1	J.F2	J.F3	J.F4	J.F5
1	7523.40	*	9162	234.37	2430.0	2941.50	3855.6	6070.31
2	7456.00	*	9129	468.75	←*	2824.25	3750.0	4722.00
3	7475.15	8765.65	*	269.53	2612.0	*		
4	7429.75	8588.00		269.53	2531.8			
5	7163.50	8226.55						

ROW	J.F6	J.F7	J.F8	R.F1	R.F2	R.F3	R.F4	R.F5
1	7007.8	8027.3	*	234.38	2010.00	3035.15	3961	*
2	*	8016.0	8521	468.75	2132.85	2777.50	*	*
3	7270.0		8450	398.00	2354.00	3035.15		*
4				292.97	2109.00	3175.80		6520

ROW	R.F6	R.F7	R.F8	O.F1	O.F2	O.F3	O.F4	O.F5
1	7417.4	*	*	1148.44	2296.88	3421.88	*	*
2	7668.0	*	9000	234.38	2214.84	3064.00	3867.20	5880
3	*			316.41	2107.00	*	4031.25	*
4	7640.7			468.75	1863.27	2789.08	3726.57	5680
5				410.15	2454.00	3411.33		6230

ROW	O.F6	O.F7	O.F8	L.F1	L.F2	L.F3	L.F4
1	*	8050.78	9199.21	257.81	2484.38	3282.60	*
2	*	8050.80		257.82	2554.68	3375.00	4253.91
3	*	*		304.68	2718.75	3395.00	4101.56
4	6710	*		468.75	2542.98	3152.34	*
5		8403.50		257.81	2484.38	3199.22	3902.24
6				339.84	2671.80	3171.00	*
7				351.56	2542.97	3046.86	3890.00

ROW	L.F5	L.F6	L.F7	L.F8	B.F1	B.F2	B.F3
1	5961.11	*	8378.85	*	269.53	*	2460.95
2	6375.00	7242.18	8109.38	*	316.41	*	2496.10
3	6363.28	7628.90	8847.66	*	457.03	*	2273.44
4	6585.92	*	8414.05	9796.85	468.75	1839.85	2355.47
5	6034.75	7252.75	8296.88	*	468.75	1839.85	2355.47
6	6500.00	7523.45	8519.60	*	339.85	1992.19	2683.60
7	6539.05	7558.60	8472.65	*	363.28	2250.00	2847.66
8				*	292.97	2296.88	*
9				*	316.41	*	2355.47

ROW	B.F4	B.F5	B.F6	B.F7	B.F8
1	3210.94	3878.91	6023.45	7125.00	8307.20
2	3105.50	*	*	*	*
3	2800.78	3585.94	*	7617.50	8620.00
4	3117.19	3621.00	6970.00	8285.00	*
5	3140.62	3700.00	*	8330.00	8823.00
6	*	3597.65	4722.65	LE 8037*06	*
7	*	3667.97	6867.19	7511.72	8660.20
8	*	3773.44	6380.00	7253.91	8847.65
9	*	3750.00		7355.00	8937.00

### LPC Analyses

- gain was adjusted prior to analysis to equalize all samples.

For one representative running samples of each style:

Sample Number	Fo Energy	F2 Energy	Ring Energy	Upper Partial Energy
Spk7	X	X	X	√
P33	√	X	√	√
C37	1/2√	X	X	√
J33	√	X	X	X
R37	√	X	X	√
O44	√	X	X	X
L34	√	√	X	X
B40	X	√	√	1/2√

Mean results for all samples

Numerical values were entered (1=Yes and 2=No). Mean values taken and rounded to nearest integer to give X=2 and √=1

Sample Category	Fo Energy	F2 Energy	Ring Energy	Upper Partial Energy
Speech	X	X	X	X
Pop	√	X	X	X
Country	√(B)	X	X(B)	√(B)
Jazz	√	X	X	X(B)
R&B	√	X	X	X
Opera	√	X	X	X
Legit	√	X(B)	X	X(B)
Belt	X	√	√	X

Thresholds:

For First Formant

F1 X (Quantized Amplitude from 0 to 500)  
 F1 √ (Quantized Amplitude from 500 to infinity)

For Second Formant (0 < F2 < 3000 Hz) and Ring (3000 - 4000 Hz)

F2 and Ring X (Quantized Amplitude from 0 to 30)  
 F2 and Ring √ (Quantized Amplitude from 30 to infinity)

For Upper Partial (above 5000 Hz)

Upper Partial X (no partials with Quantized Amplitude above 7)  
 Upper Partial √ (any partial(s) with Quantized Amplitude above 7)

(B) after a √ or X means that the mean value was between 1.4 and 1.6 therefore was considered borderline.

Data for LPC energy

DATA for 2500pt LPC.  
1 = yes. 2 = No

ROW	Fo-S	F2-S	Ring-S	UP-S	Fo-P	F2-P	Ring-P	UP-P	Fo-C	F2-C
1	2	2	2	2	2	2	2	1	2	2
2					1	2	2	2	1	2
3					1	1	2	1	1	2
4					1	2	1	2	2	2
5					1	2	2	2	1	1

ROW	Ring-C	UP-C	Fo-J	F2-J	Ring-J	UP-J	Fo-R	F2-R	Ring-R	UP-R
1	1	1	2	2	2	1	1	2	2	2
2	2	2	1	2	1	1	1	2	2	2
3	2	1	1	2	2	2	2	1	2	2
4	1	1	1	2	2	2	1	2	2	2
5	2	2					1	2	2	2

ROW	Fo-O	F2-O	Ring-O	UP-O	Fo-L	F2-L	Ring-L	UP-L	Fo-B	F2-B
1	1	2	2	2	2	2	2	1	2	1
2	1	2	2	2	2	2	2	1	1	1
3	1	2	1	2	1	2	2	2	1	1
4	1	2	2	2	1	2	2	1	1	1
5					1	1	1	2	2	1
6					1	1	2	2	2	1
7					1	1	1	2	2	1
8									2	1
9									2	1

ROW	Ring-B	UP-B
1	2	2
2	1	1
3	1	2
4	2	2
5	1	2
6	1	2
7	1	1
8	1	2
9	1	

2 →

Energy thresholds.

F<sub>0</sub> 0-500 = NO  
500-∞ = YES

F<sub>2</sub> 0-30 = NO  
30-∞ = YES

Ring between 3000-4000 Hz  
0-30 = NO  
30-∞ = YES

Upper Partial 5000 Hz - 25000 Hz  
energy in any upper partial  
6-7 = NO  
0-10 = YES

Stats for LPC energy data:

STATS FOR 2500pt LPC

	N	MEAN	MEDIAN	TRMEAN	STDEV	SEMEAN
Fo-S	1	2.0000	2.0000	2.0000	*	*
F2-S	1	2.0000	2.0000	2.0000	*	*
Ring-S	1	2.0000	2.0000	2.0000	*	*
UP-S	1	2.0000	2.0000	2.0000	*	*
Fo-P	5	1.200	1.000	1.200	0.447	0.200
F2-P	5	1.800	2.000	1.800	0.447	0.200
Ring-P	5	1.800	2.000	1.800	0.447	0.200
UP-P	5	1.600	2.000	1.600	0.548	0.245
Fo-C	5	1.400	1.000	1.400	0.548	0.245
F2-C	5	1.800	2.000	1.800	0.447	0.200
Ring-C	5	1.600	2.000	1.600	0.548	0.245
UP-C	5	1.400	1.000	1.400	0.548	0.245
Fo-J	4	1.250	1.000	1.250	0.500	0.250
F2-J	4	2.0000	2.0000	2.0000	0.0000	0.0000
Ring-J	4	1.750	2.000	1.750	0.500	0.250
UP-J	4	1.500	1.500	1.500	0.577	0.289
Fo-R	5	1.200	1.000	1.200	0.447	0.200
F2-R	5	1.800	2.000	1.800	0.447	0.200
Ring-R	5	2.0000	2.0000	2.0000	0.0000	0.0000
UP-R	5	2.0000	2.0000	2.0000	0.0000	0.0000
Fo-O	4	1.0000	1.0000	1.0000	0.0000	0.0000
F2-O	4	2.0000	2.0000	2.0000	0.0000	0.0000
Ring-O	4	1.750	2.000	1.750	0.500	0.250
UP-O	4	2.0000	2.0000	2.0000	0.0000	0.0000
Fo-L	7	1.286	1.000	1.286	0.488	0.184
F2-L	7	1.571	2.000	1.571	0.535	0.202
Ring-L	7	1.714	2.000	1.714	0.488	0.184
UP-L	7	1.571	2.000	1.571	0.535	0.202
Fo-B	9	1.667	2.000	1.667	0.500	0.167
F2-B	9	1.0000	1.0000	1.0000	0.0000	0.0000
Ring-B	9	1.222	1.000	1.222	0.441	0.147
UP-B	9	1.778	2.000	1.778	0.441	0.147

	MIN	MAX	Q1	Q3
Fo-S	2.0000	2.0000	*	*
F2-S	2.0000	2.0000	*	*
Ring-S	2.0000	2.0000	*	*
UP-S	2.0000	2.0000	*	*
Fo-P	1.000	2.000	1.000	1.500
F2-P	1.000	2.000	1.500	2.000
Ring-P	1.000	2.000	1.500	2.000
UP-P	1.000	2.000	1.000	2.000
Fo-C	1.000	2.000	1.000	2.000
F2-C	1.000	2.000	1.500	2.000
Ring-C	1.000	2.000	1.000	2.000
UP-C	1.000	2.000	1.000	2.000
Fo-J	1.000	2.000	1.000	1.750
F2-J	2.0000	2.0000	2.0000	2.0000
Ring-J	1.000	2.000	1.250	2.000
UP-J	1.000	2.000	1.000	2.000
Fo-R	1.000	2.000	1.000	1.500
F2-R	1.000	2.000	1.500	2.000
Ring-R	2.0000	2.0000	2.0000	2.0000
UP-R	2.0000	2.0000	2.0000	2.0000
Fo-O	1.0000	1.0000	1.0000	1.0000
F2-O	2.0000	2.0000	2.0000	2.0000
Ring-O	1.000	2.000	1.250	2.000
UP-O	2.0000	2.0000	2.0000	2.0000
Fo-L	1.000	2.000	1.000	2.000

F2-L	1.000	2.000	1.000	2.000
Ring-L	1.000	2.000	1.000	2.000
UP-L	1.000	2.000	1.000	2.000
Fo-B	1.000	2.000	1.000	2.000
F2-B	1.0000	1.0000	1.0000	1.0000
Ring-B	1.000	2.000	1.000	1.500
UP-B	1.000	2.000	1.500	2.000

LPC results in graphic form

For all LPC F vs F graphs

SPK = Speech

P = Pop

C = Country

J = Jazz

R = R&B

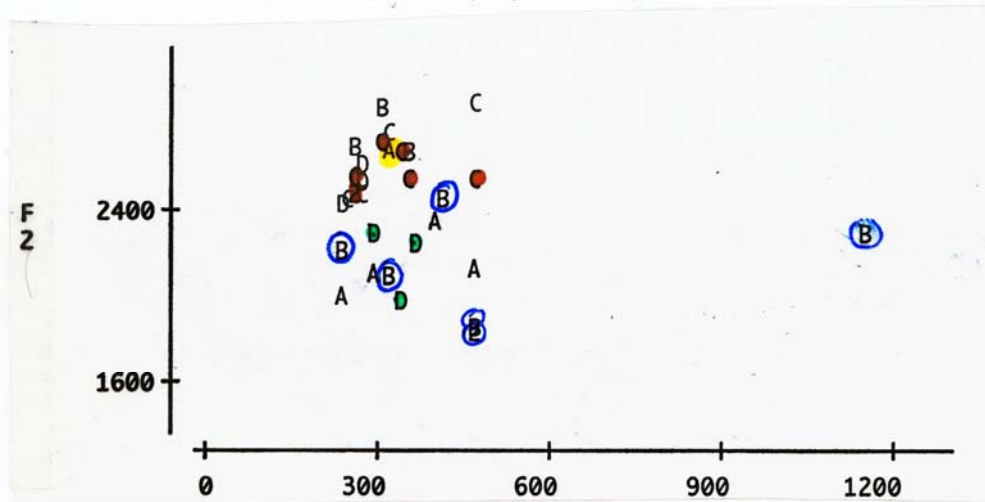
O = Classical

L = Legit

B = Belt

F2 vs F1 for Speech, Pop, Country and Jazz

R and B, Opera, Legit and Belt singing styles



N\* = 3

A=SPK.F2

B=P.F2

vs.SP.K.F1

vs.P.F1

C=C.F2

D=J.F2

F1

vs.C.F1

vs.J.F1

N\* = 7

A=R.F2

B=O.F2

vs.R.F1

vs.O.F1

C=L.F2

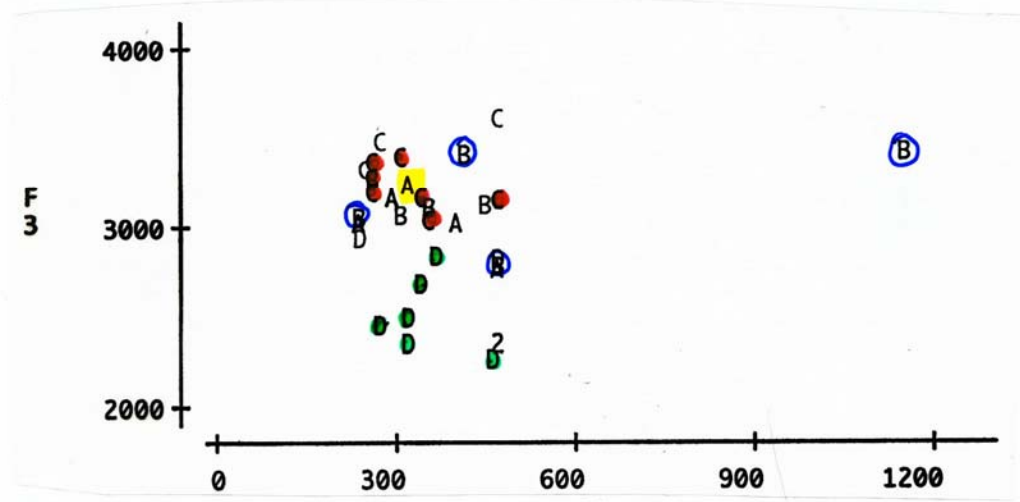
D=B.F2

F1

vs.L.F1

vs.B.F1

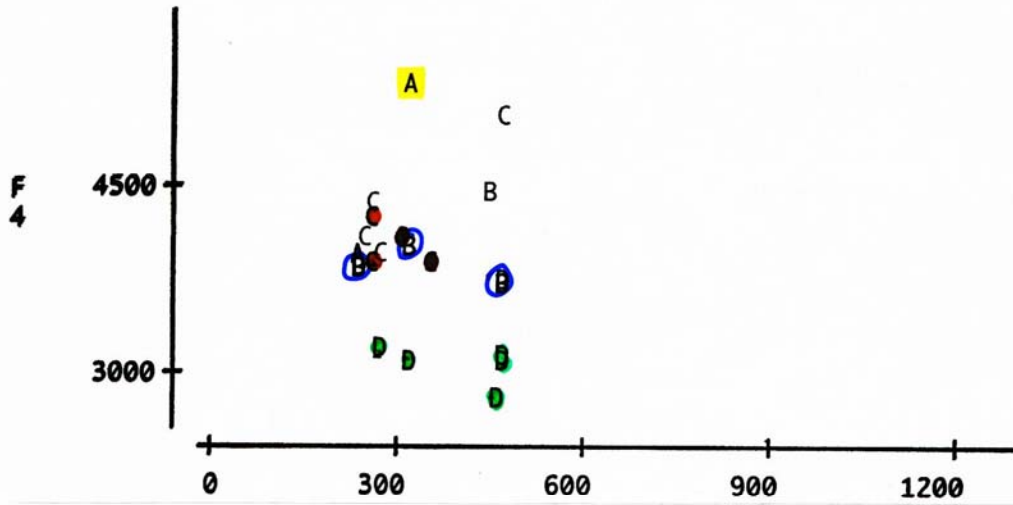
F3 vs F1 for Speech, Pop, Country and Jazz  
 R&B, Opera, Legit and Belt singing styles



N\* = 5  
 A=SPK.F3 vs.SPK.F1 C=C.F3 vs.C.F1  
 B=P.F3 vs.P.F1 D=J.F3 vs.J.F1

N\* = 5  
 A=R.F3 vs.R.F1 C=L.F3 vs.L.F1  
 B=O.F3 vs.O.F1 D=B.F3 vs.B.F1

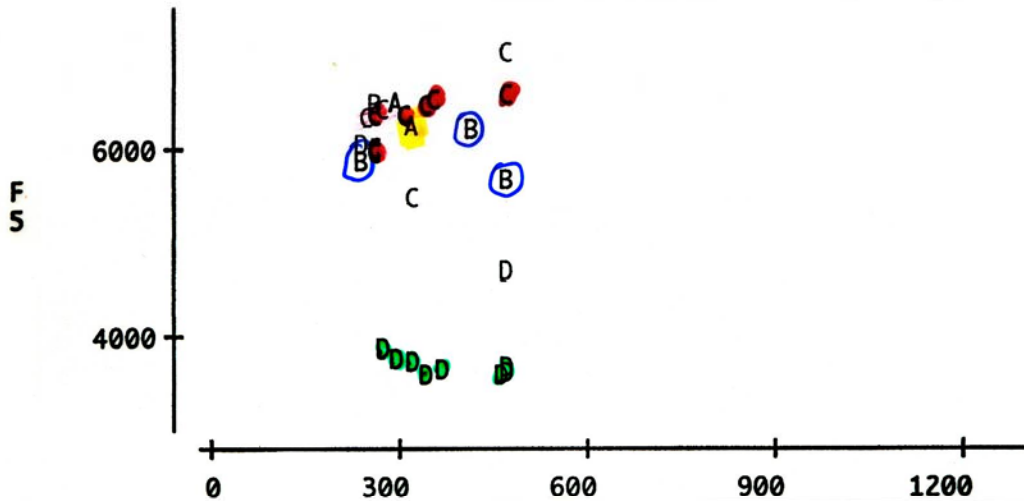
F4 vs F1 for Speech, Pop, Country and Jazz  
 R&B, Opera, Legit and Belt singing styles



N\* = 7  
 A=SPK.F4 vs.SPK.F1 C=C.F4 vs.C.F1  
 B=P.F4 vs.P.F1 D=J.F4 vs.J.F1

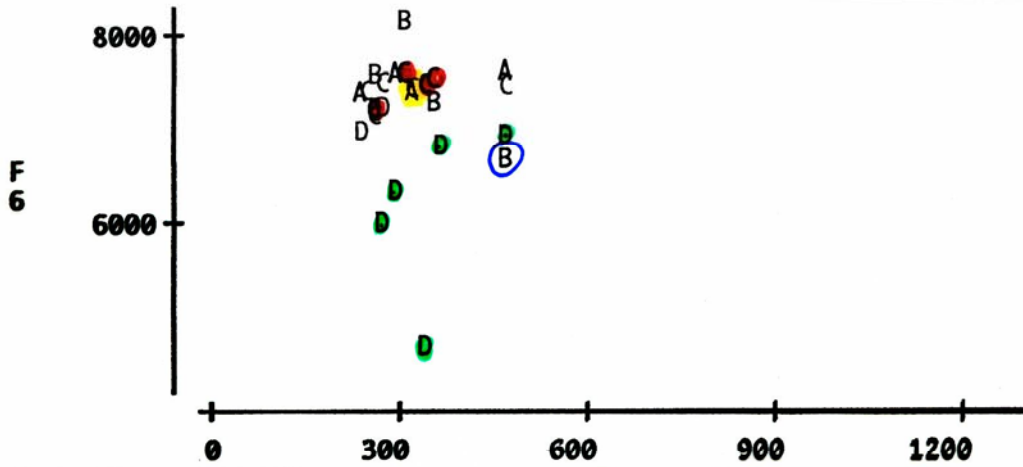
N\* = 15  
 A=R.F4 vs.R.F1 L.F4 vs.L.F1  
 B=O.F4 vs.O.F1 D=B.F4 vs.B.F1

F5 vs F1 for Speech, Pop, Country and Jazz  
 R&B, Opera, Legit and Belt singing styles



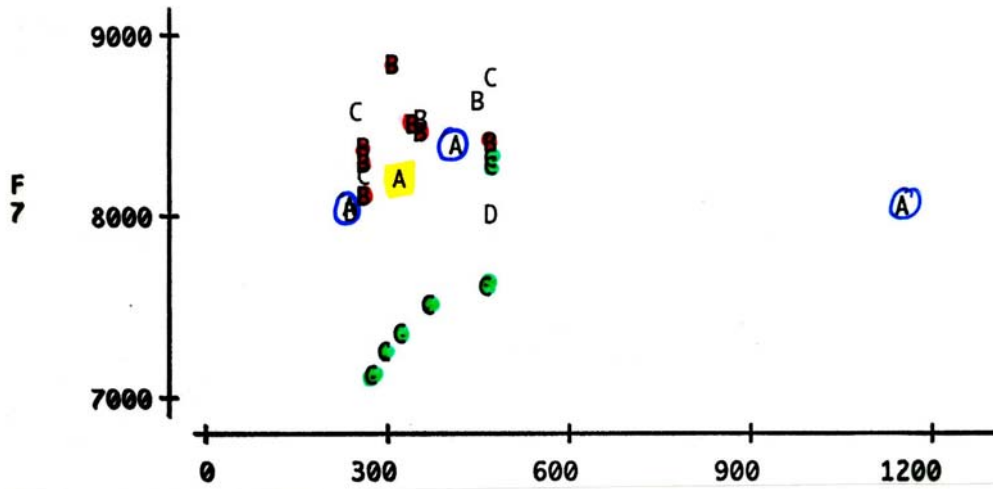
N* = 6				F1
A=SPK.F5	vs.SPK.F1	C=C.F5		vs.C.F1
B=P.F5	vs.P.F1	D=J.F5		vs.J.F1
N* = 9				
A=R.F5	vs.R.F1	C=L.F5		vs.L.F1
B=O.F5	vs.O.F1	D=B.F5		vs.B.F1

F6 vs F1 for Speech, Pop, Country and Jazz  
 R&B, Opera, Legit and Belt singing styles



N* = 4			F1
A=SPK.F6	vs.SPK.F1	C=C.F6	vs.C.F1
B=P.F6	vs.P.F1	D=J.F6	vs.J.F1
N* = 14			
A=R.F6	vs.R.F1	C=L.F6	vs.L.F1
B=O.F6	vs.O.F1	D=B.F6	vs.B.F1

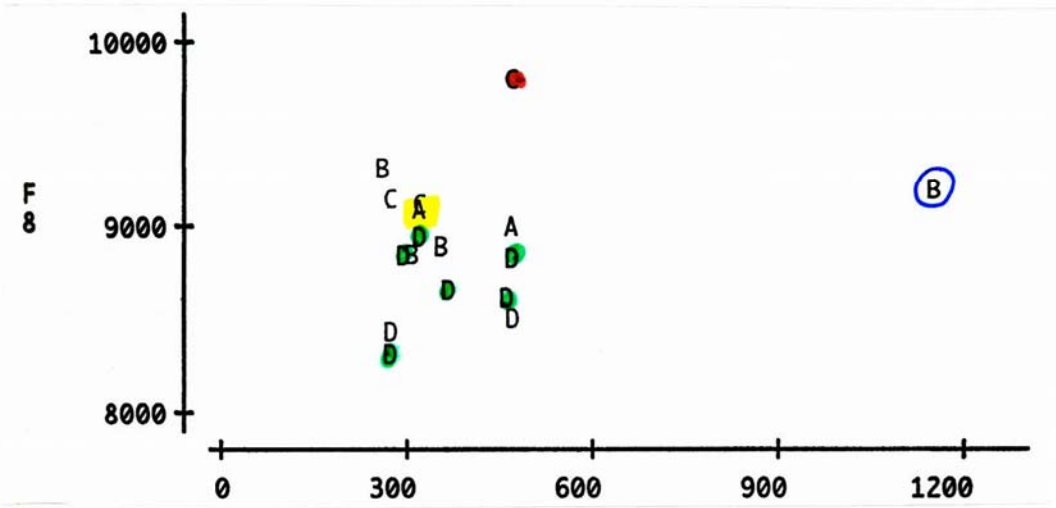
F7 vs F1 for Speech, Pop, Country and Jazz  
 R&B, Opera, Legit and Belt singing styles



N\* = 7  
 A=SPK.F7 vs.SPK.F1 C=C.F7 vs.C.F1  
 B=P.F7 vs.P.F1 D=J.F7 vs.J.F1

N\* = 6  
 A=O.F7 vs.O.F1 B=L.F7 vs.L.F1 C=B.F7 vs.B.F1  
 (no F7 R&B.)

F8 vs F1 for Speech, Pop, Country and Jazz  
 R&B, Opera, Legit and Belt singing styles

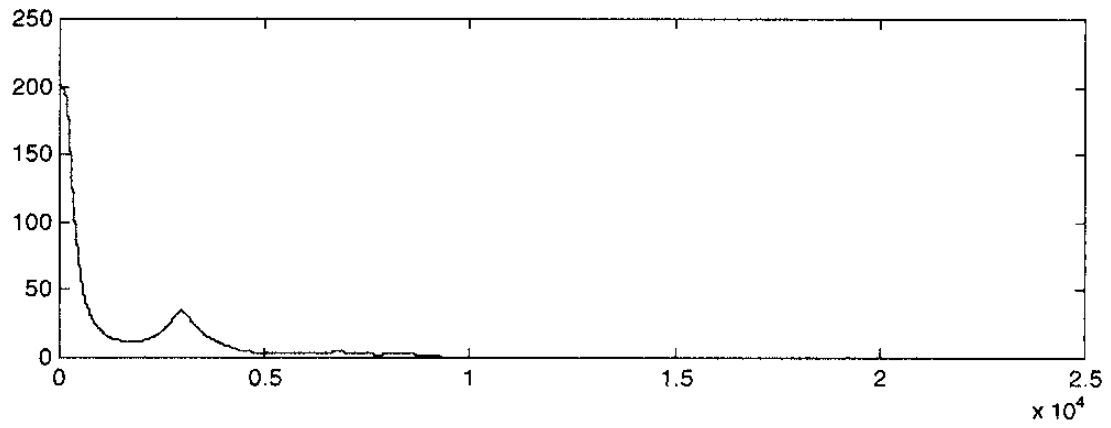


N\* = 7  
 A=SPK.F8 vs.SPK.F1 C=C.F8 vs.C.F1  
 B=P.F8 vs.P.F1 D=J.F8 vs.J.F1

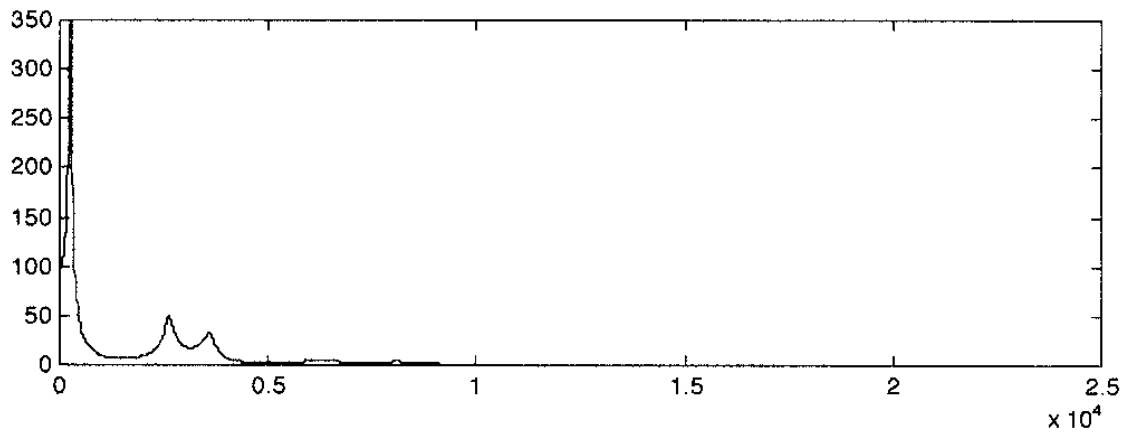
N\* = 19  
 A=R.F8 vs.R.F1 C=L.F8 vs.L.F1  
 B=O.F8 vs.O.F1 D=B.F8 vs.B.F1

# Order Number Decision for LPC analysis

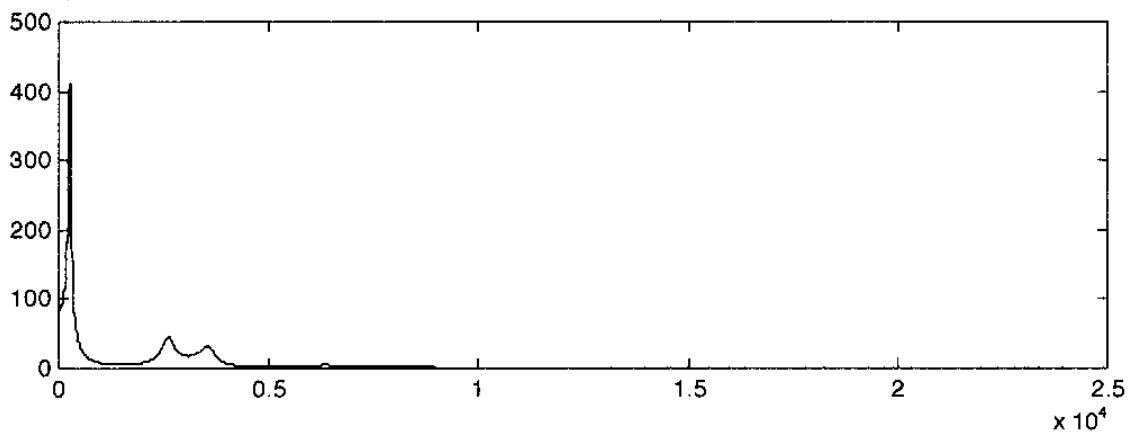
Order 20



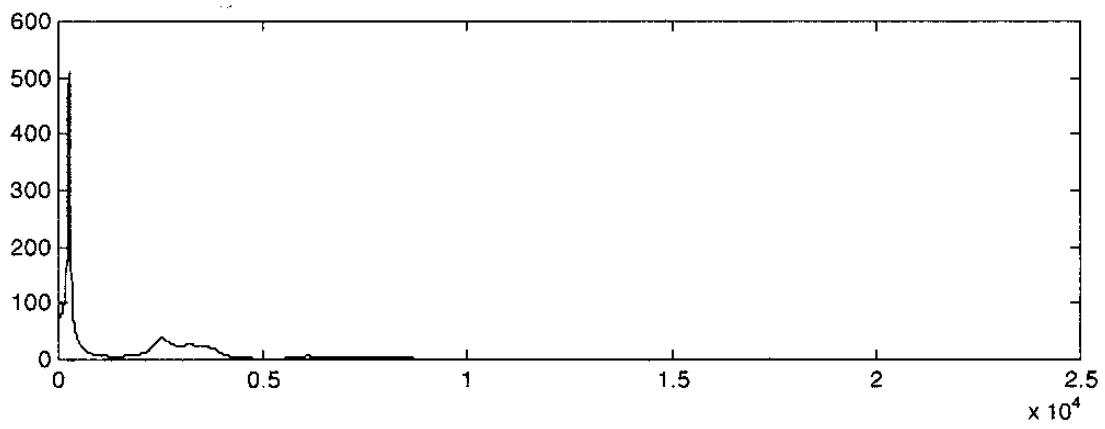
Order 25



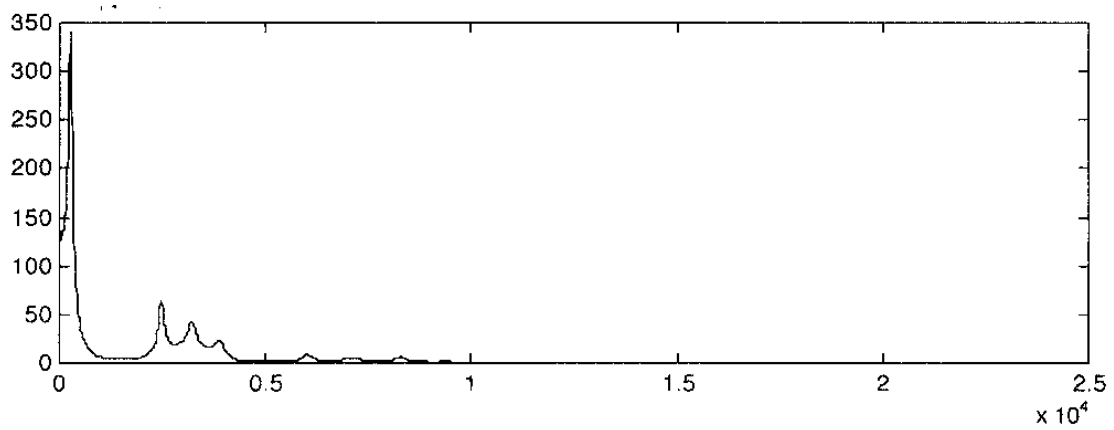
Order 30



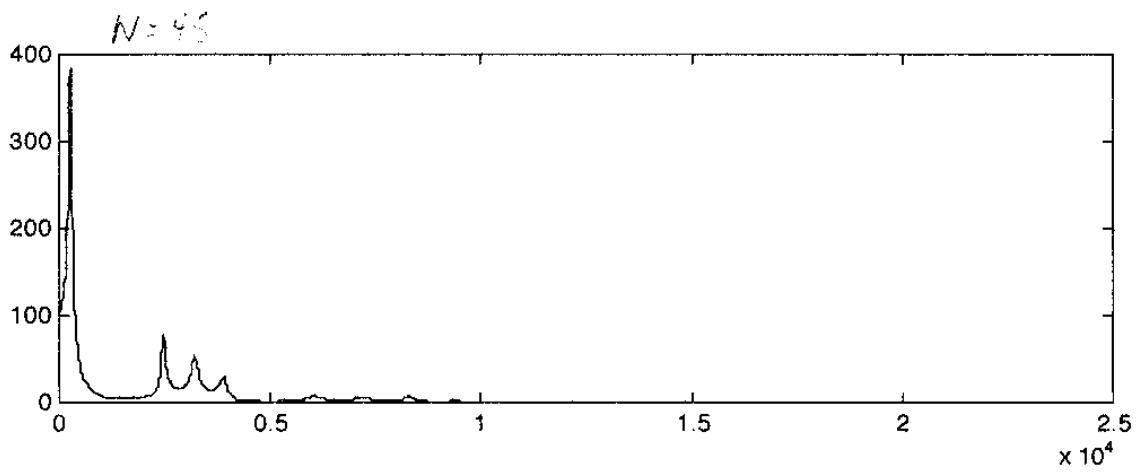
Order 35



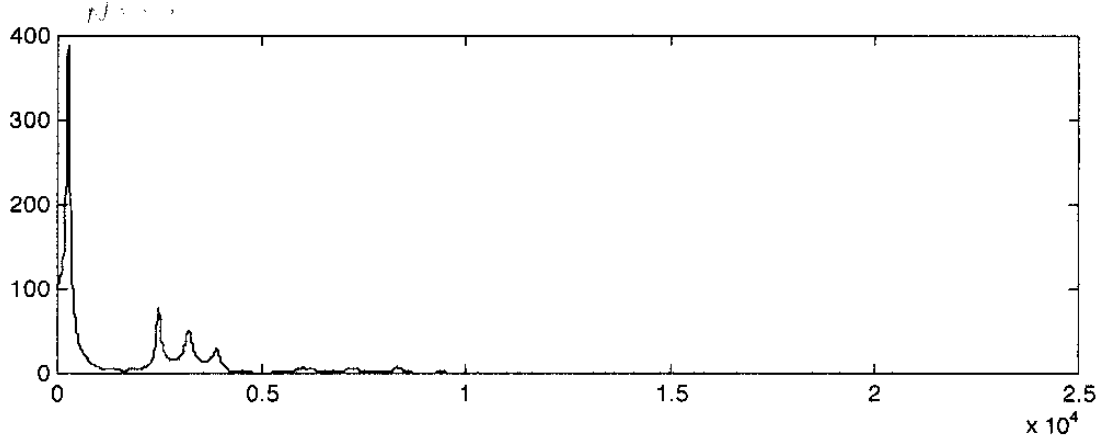
Order 40



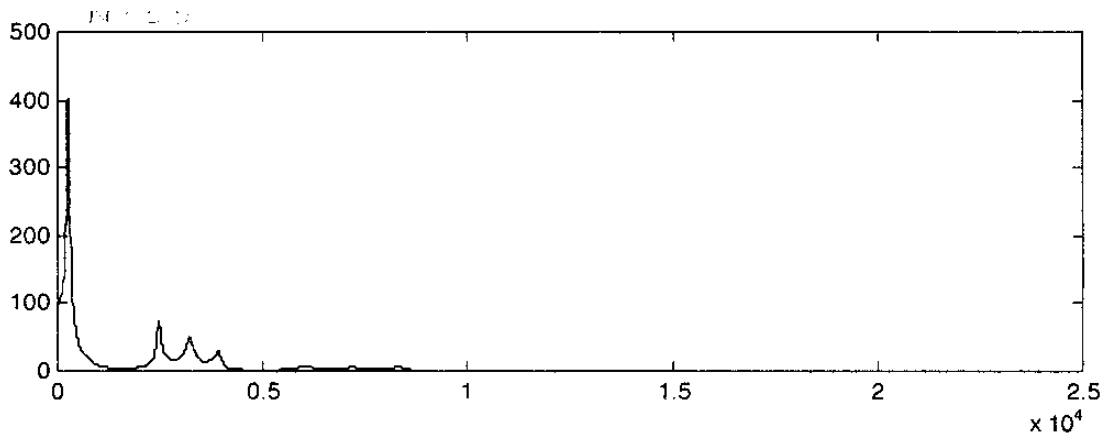
Order 45



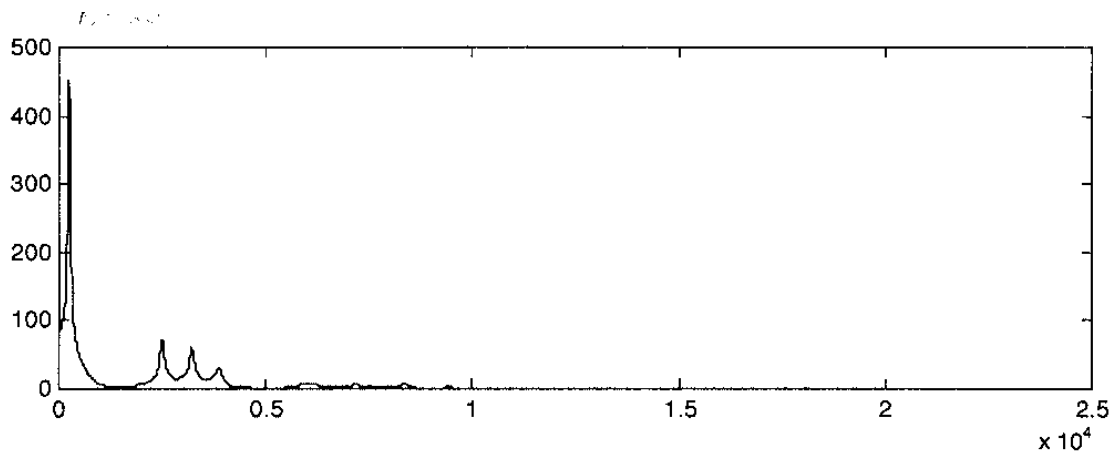
Order 50



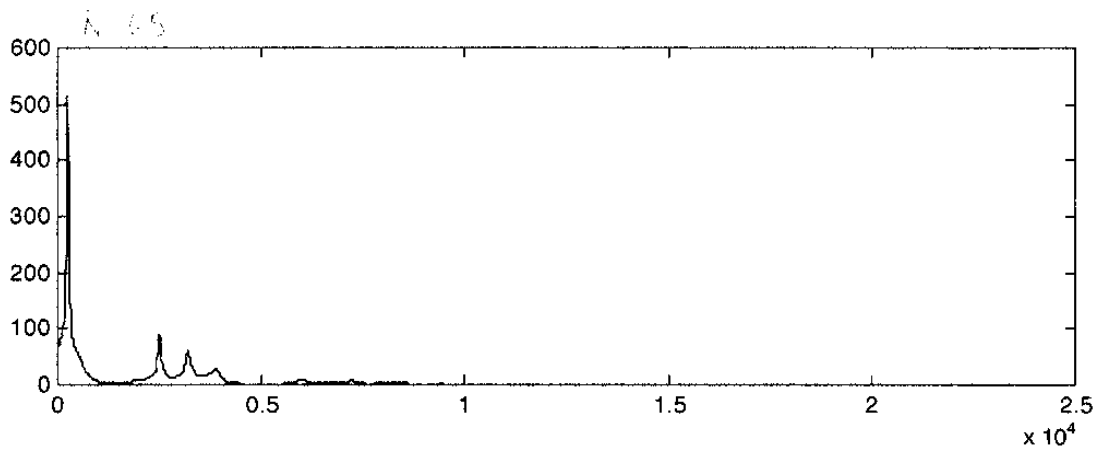
Order 55



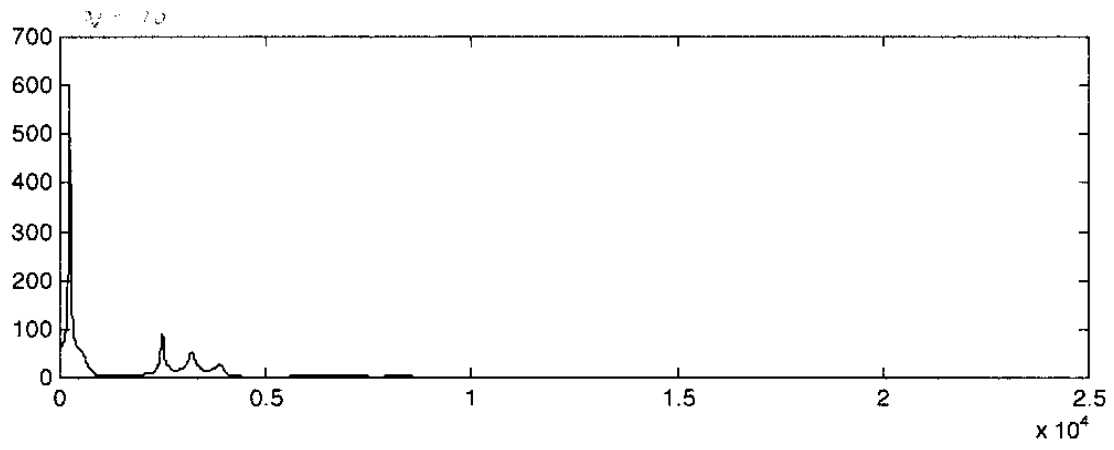
Order 60



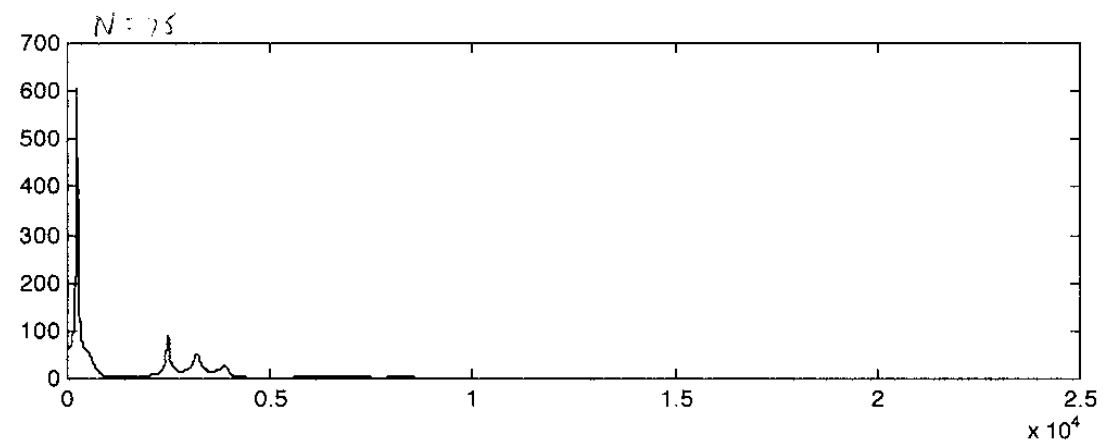
Order 65



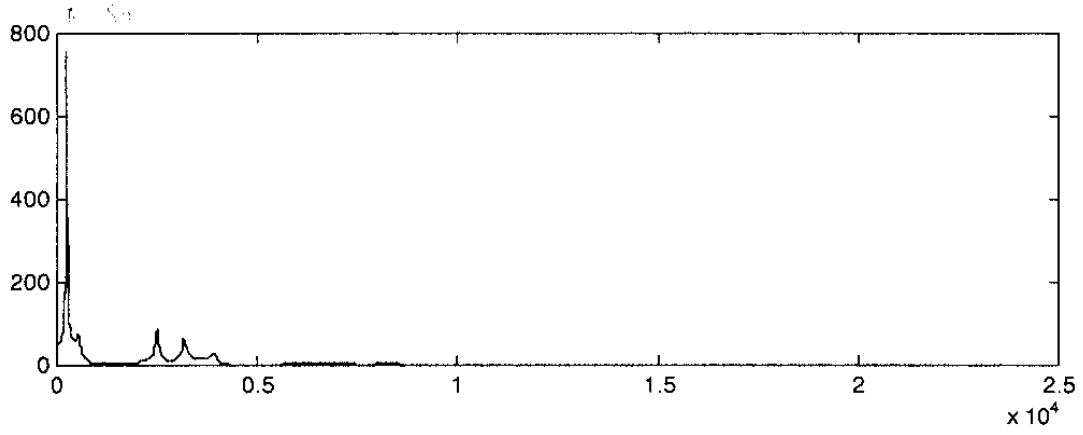
Order 70



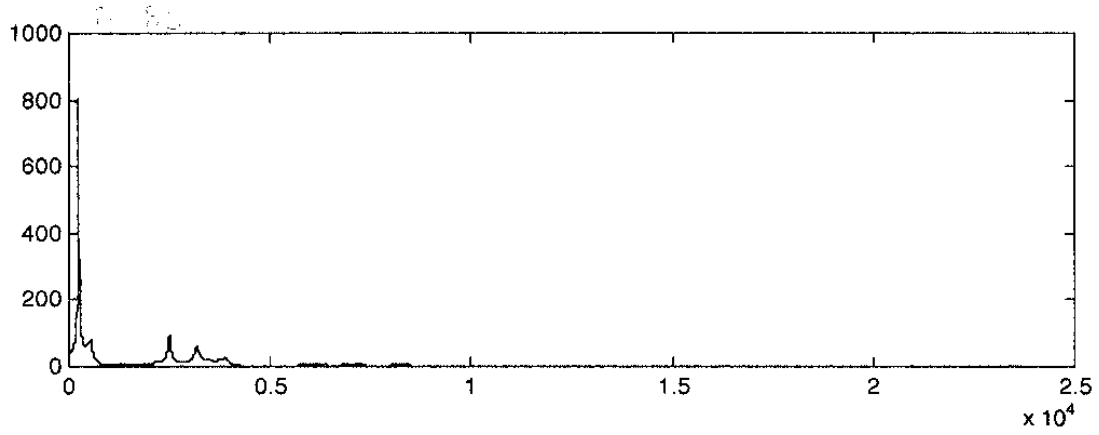
Order 75



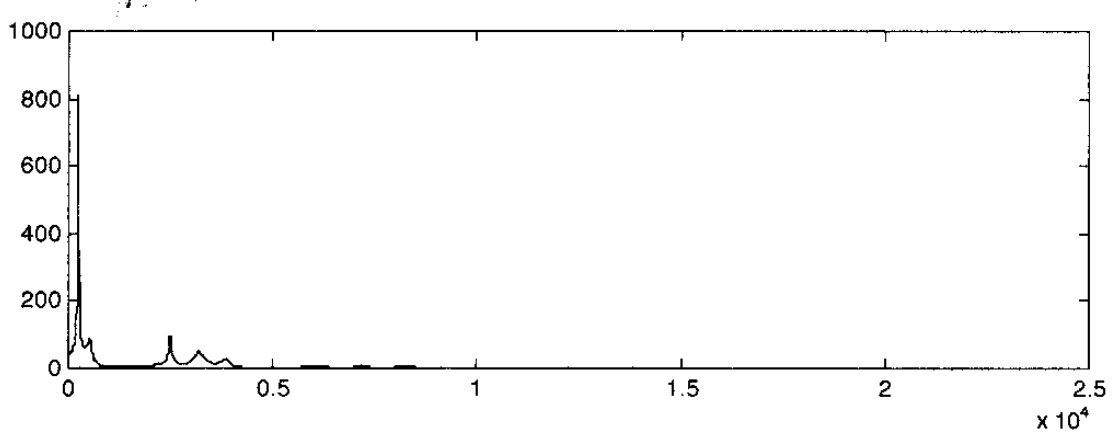
Order 80



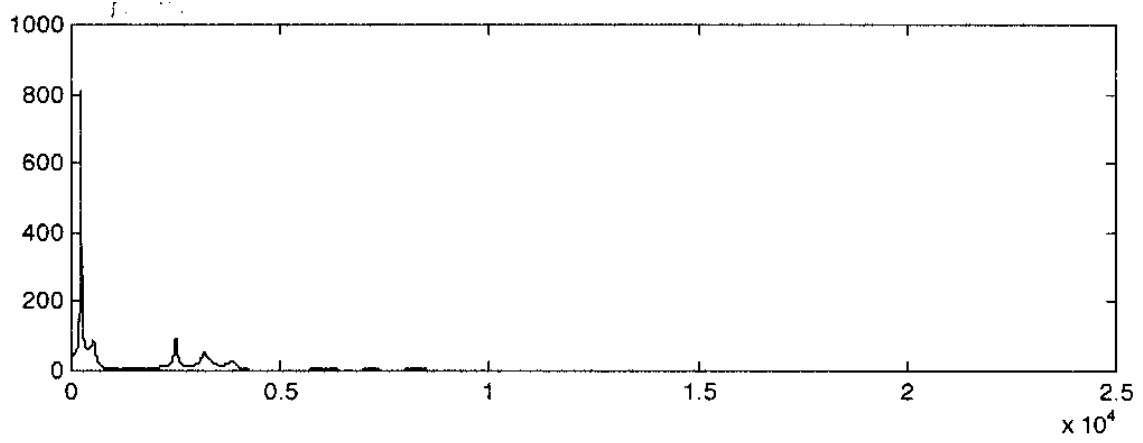
Order 85



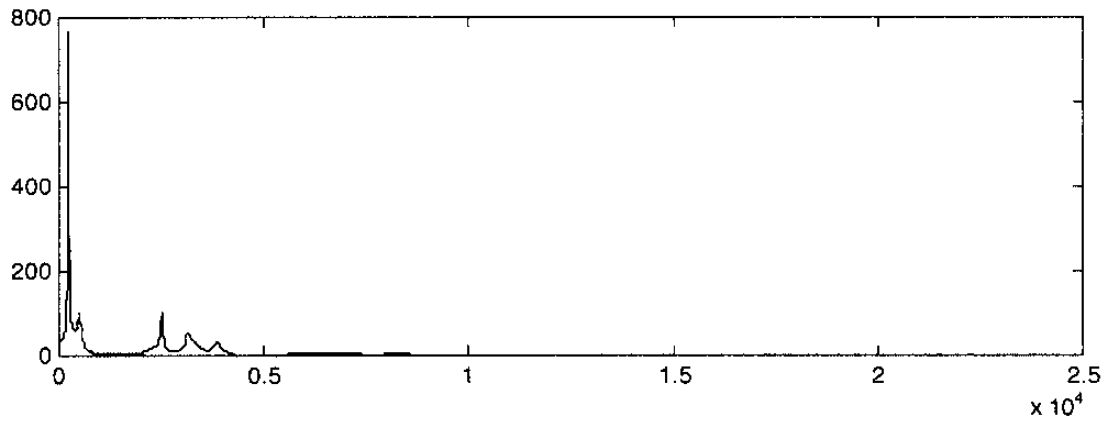
Order 90



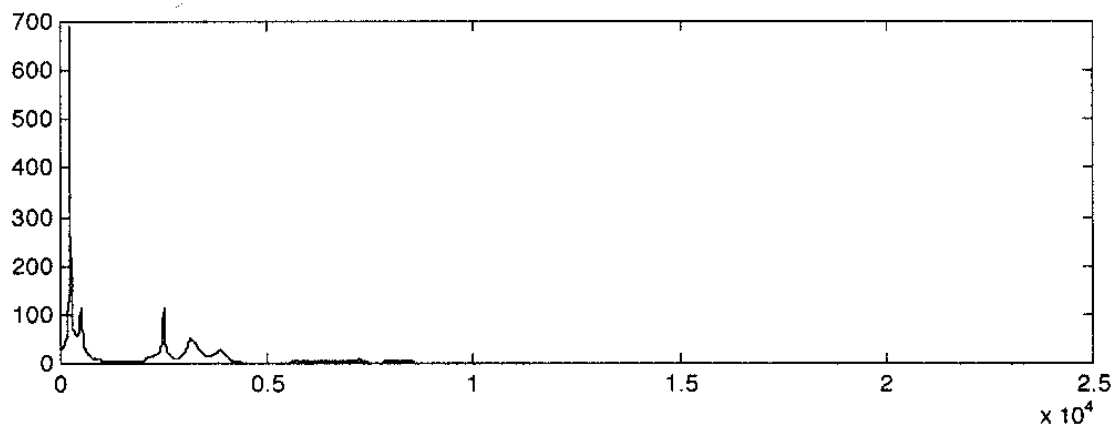
Order 95



Order 100



Order 105



## LPC Statistical Data

STATS FOR LPC

	N	N*	MEAN	MEDIAN	TRMEAN	STDEV	SEMEAN
SPK.F1	1	0	316.41	316.41	316.41	*	*
SPK.F2	1	0	2683.0	2683.0	2683.0	*	*
SPK.F3	1	0	3246.1	3246.1	3246.1	*	*
SPK.F4	1	0	5339.0	5339.0	5339.0	*	*
SPK.F5	1	0	6246.5	6246.5	6246.5	*	*
SPK.F6	1	0	7417.4	7417.4	7417.4	*	*
SPK.F7	1	0	8214.6	8214.6	8214.6	*	*
SPK.F8	1	0	9104.5	9104.5	9104.5	*	*
P.F1	5	0	332.8	304.7	332.8	71.1	31.8
P.F2	3	2	2749.9	2695.3	2749.9	115.8	66.9
P.F3	4	1	3146.7	3123.0	3146.7	85.5	42.8
P.F4	1	2	4464.8	4464.8	4464.8	*	*
P.F5	1	0	6492.1	6492.1	6492.1	*	*
P.F6	3	2	7695	7594	7695	442	255
P.F7	2	3	8595.4	8595.4	8595.4	74.7	52.8
P.F8	3	2	9028	8896	9028	261	151
C.F1	5	0	311.7	269.5	311.7	91.8	41.0
C.F2	5	0	2630.6	2543.0	2630.6	196.5	87.9
C.F3	3	1	3472.7	3480.5	3472.7	140.8	81.3
C.F4	4	1	4378	4237	4378	497	249
C.F5	5	0	6257	6350	6257	574	257
C.F6	5	0	7409.6	7456.0	7409.6	141.7	63.4
C.F7	3	2	8527	8588	8527	275	159
C.F8	2	1	9145.5	9145.5	9145.5	23.3	16.5
J.F1	4	0	310.5	269.5	310.5	106.8	53.4
J.F2	3	1	2524.6	2531.8	2524.6	91.2	52.7
J.F3	2	1	2882.9	2882.9	2882.9	82.9	58.6
J.F4	2	0	3802.8	3802.8	3802.8	74.7	52.8
J.F5	2	0	5396	5396	5396	953	674
J.F6	2	1	7139	7139	7139	185	131
J.F7	2	0	8021.6	8021.6	8021.6	8.0	5.6
J.F8	2	1	8485.5	8485.5	8485.5	50.2	35.5
R.F1	4	0	348.5	345.5	348.5	104.9	52.5
R.F2	4	0	2151.5	2120.9	2151.5	145.1	72.6
R.F3	4	0	3005.9	3035.1	3005.9	166.1	83.0
R.F4	1	1	3961.0	3961.0	3961.0	*	*
R.F5	1	3	6520.0	6520.0	6520.0	*	*
R.F6	3	1	7575.4	7640.7	7575.4	137.5	79.4
R.F7	0	2	*	*	*	*	*
R.F8	1	1	9000.0	9000.0	9000.0	*	*
O.F1	5	0	516	410	516	365	163
O.F2	5	0	2187.2	2214.8	2187.2	221.0	98.8
O.F3	4	1	3172	3238	3172	304	152
O.F4	3	1	3875.0	3867.2	3875.0	152.5	88.0
O.F5	3	2	5930	5880	5930	278	161
O.F6	1	3	6710.0	6710.0	6710.0	*	*
O.F7	3	2	8168	8051	8168	204	118
O.F8	1	0	9199.2	9199.2	9199.2	*	*
L.F1	7	0	319.8	304.7	319.8	76.8	29.0
L.F2	7	0	2571.4	2543.0	2571.4	90.2	34.1
L.F3	7	0	3231.7	3199.2	3231.7	125.8	47.6
L.F4	4	3	4036.9	4001.9	4036.9	174.2	87.1
L.F5	7	0	6337.0	6375.0	6337.0	246.4	93.1
L.F6	5	2	7441.2	7523.5	7441.2	180.9	80.9
L.F7	7	0	8434.2	8414.0	8434.2	226.4	85.6
L.F8	1	8	9796.8	9796.8	9796.8	*	*
B.F1	9	0	365.9	339.9	365.9	78.8	26.3
B.F2	5	4	2043.8	1992.2	2043.8	219.3	98.1

LPC Statistical Data

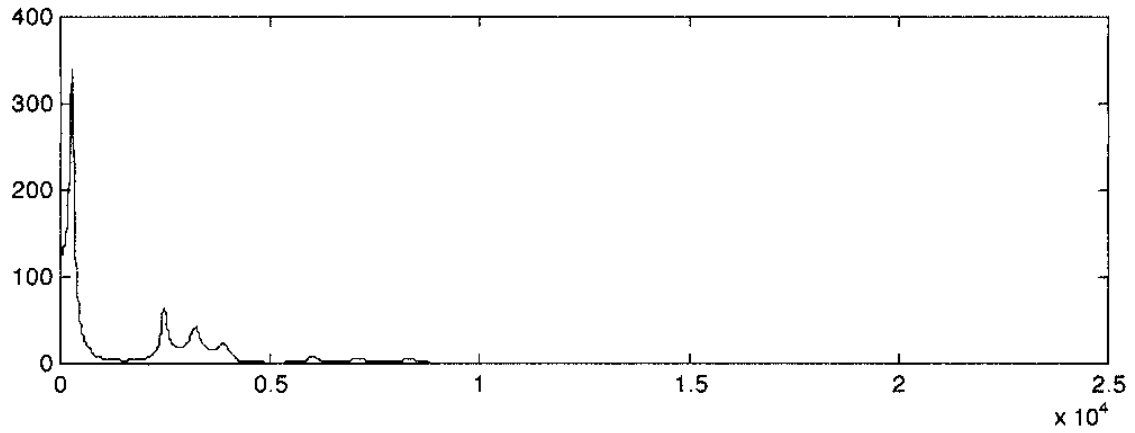
B. F3	8	1	2478.5	2408.2	2478.5	195.1	69.0
B. F4	5	4	3075.0	3117.2	3075.0	158.7	71.0
B. F5	8	1	3696.9	3684.0	3696.9	100.4	35.5
B. F6	5	3	6193	6380	6193	906	405
B. F7	7	2	7640	7512	7640	484	183
B. F8	6	3	8699.2	8741.6	8699.2	226.0	92.3
	MIN	MAX	Q1	Q3			
SPK. F1	316.41	316.41	*	*			
SPK. F2	2683.0	2683.0	*	*			
SPK. F3	3246.1	3246.1	*	*			
SPK. F4	5339.0	5339.0	*	*			
SPK. F5	6246.5	6246.5	*	*			
SPK. F6	7417.4	7417.4	*	*			
SPK. F7	8214.6	8214.6	*	*			
SPK. F8	9104.5	9104.5	*	*			
P. F1	257.8	445.3	281.2	398.4			
P. F2	2671.5	2882.9	2671.5	2882.9			
P. F3	3071.4	3269.5	3082.8	3234.4			
P. F4	4464.8	4464.8	*	*			
P. F5	6492.1	6492.1	*	*			
P. F6	7312	8180	7312	8180			
P. F7	8542.6	8648.2	*	*			
P. F8	8859	9328	8859	9328			
C. F1	246.1	468.8	251.9	392.6			
C. F2	2454.0	2906.2	2469.2	2835.9			
C. F3	3328.1	3609.4	3328.1	3609.4			
C. F4	3961	5079	3996	4902			
C. F5	5473	7028	5736	6731			
C. F6	7163.5	7523.4	7296.6	7499.3			
C. F7	8227	8766	8227	8766			
C. F8	9129.0	9162.0	*	*			
J. F1	234.4	468.8	243.2	418.9			
J. F2	2430.0	2612.0	2430.0	2612.0			
J. F3	2824.3	2941.5	*	*			
J. F4	3750.0	3855.6	*	*			
J. F5	4722	6070	*	*			
J. F6	7008	7270	*	*			
J. F7	8016.0	8027.3	*	*			
J. F8	8450.0	8521.0	*	*			
R. F1	234.4	468.8	249.0	451.1			
R. F2	2010.0	2354.0	2034.8	2298.7			
R. F3	2777.5	3175.8	2841.9	3140.6			
R. F4	3961.0	3961.0	*	*			
R. F5	6520.0	6520.0	*	*			
R. F6	7417.4	7668.0	7417.4	7668.0			
R. F7	*	*	*	*			
R. F8	9000.0	9000.0	*	*			
O. F1	234	1148	275	809			
O. F2	1863.3	2454.0	1985.1	2375.4			
O. F3	2789	3422	2858	3419			
O. F4	3726.6	4031.2	3726.6	4031.2			
O. F5	5680	6230	5680	6230			
O. F6	6710.0	6710.0	*	*			
O. F7	8051	8403	8051	8403			
O. F8	9199.2	9199.2	*	*			
L. F1	257.8	468.8	257.8	351.6			
L. F2	2484.4	2718.7	2484.4	2671.8			
L. F3	3046.9	3395.0	3152.3	3375.0			
L. F4	3890.0	4253.9	3893.1	4215.8			

## LPC Statistical Data

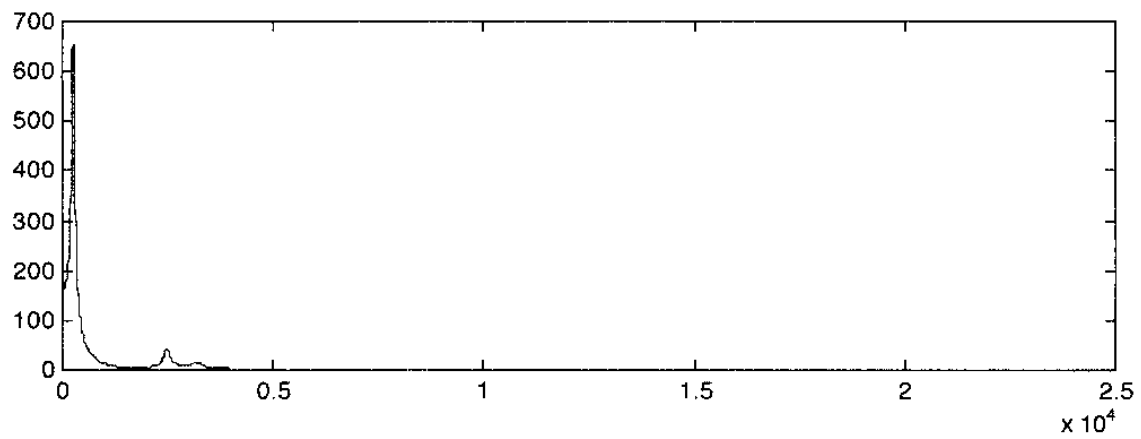
L.F5	5961.1	6585.9	6034.8	6539.0
L.F6	7242.2	7628.9	7247.5	7593.8
L.F7	8109.4	8847.7	8296.9	8519.6
L.F8	9796.8	9796.8	*	*
B.F1	269.5	468.8	304.7	462.9
B.F2	1839.8	2296.9	1839.8	2273.4
B.F3	2273.4	2847.7	2355.5	2636.7
B.F4	2800.8	3210.9	2953.1	3175.8
B.F5	3585.9	3878.9	3603.5	3767.6
B.F6	4723	6970	5373	6919
B.F7	7125	8330	7254	8285
B.F8	8307.2	8937.0	8541.8	8870.0

### LPC Windowing decision

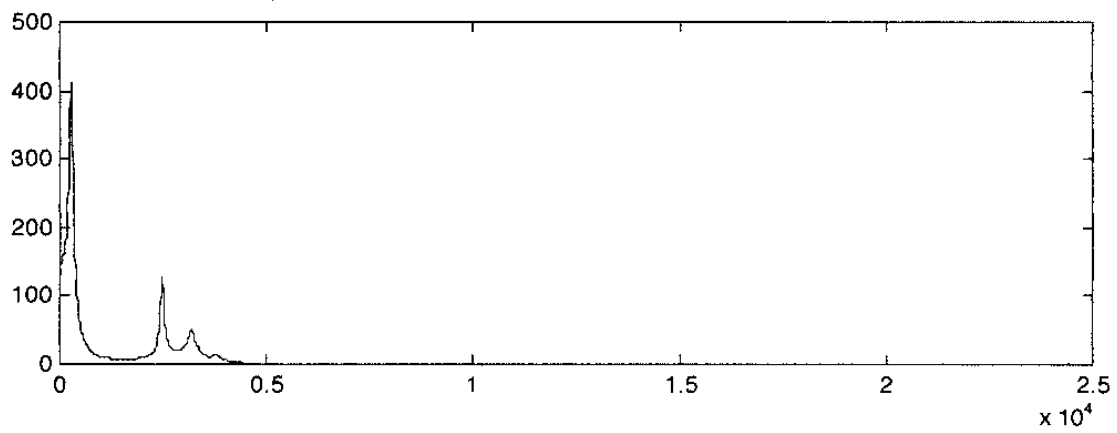
N=50 Rectangular window, no preemphasis



N=50 Blackman window, no preemphasis



N=50 Blackman window, preemphasis .9



Decisions: Don't use Blackman window  
Preemphasis only for visual examination  
Record formant placements  
Energy levels taken signal without preemphasis

From DFT numerical results

### Vowel Formant Energy

SPK:10%

Pop: 7,1,7,4,2 mean = 4.2%

Country: 6,6,13,9,6 mean = 8.0%

Jazz: 8,9,2,2 mean = 5.3%

R&B: 2,4,23,4,1 mean = 7%

Classical: 2,2,10,4 mean = 4.5%

Legit: 3,7,2,7,15,11,16 mean = 8.7%

Belt: 18,16,32,31,38,32,25,14,24 mean 25.6%

### Singers Formant Energy Clustering of F3-F5

SPK: F3(7%), SF(3%), F4(2%), F5(2%)

Pop: Mean F3(6.4%), SF(2.2%), F4(.6%), F5(.6%)  
F3(6,1,17,6,2), SF(2,1,5,2,1), F4(1,0,0,1,1), F5(2,0,0,0,1)

Country: Mean F3(6.8%), SF(7.8%), F4(5.8%), F5(1%)  
F3(4,7,12,9,2), SF(12,6,5,15,1), F4(6,1,1,15,6), F5(1,2,0,1,1)

Jazz: Mean F3(2.3%), SF(3.0%), F4(1.3%), F5(.3%)  
F3(3,4,1,1), SF(6,5,1,0), F4(3,1,1,0), F5(1,0,0,0)

R&B: Mean F3(7.6%), SF(3.2%), F4(1.4%), F5(.4%)  
F3(2,1,26,4,5), SF(1,0,11,3,1), F4(2,2,1,1,1), F5(1,0,0,0,1)

Classical: Mean F3(3.5%), SF(2.3%), F4(.8%), F5(.3%)  
F3(1,0,9,4), SF(2,0,6,1), F4(0,1,2,0), F5(0,0,1,0)

Legit: Mean F3(6%), SF(2.6%), F4(1.7%), F5(.9%)  
F3(4,2,7,9,7,6,7), SF(1,2,4,0,5,3,3), F4(0,1,5,2,2,1,1), F5(1,1,1,0,1,1,1)

Belt: Mean F3(16.2%), SF(15.8%), F4(7.1%), F5(.8%)  
F3(16,12,23,10,20,14,24,11,16), SF(5,10,9,4,36,17,20,11,30),  
F4(1,5,4,0,30,3,3,16,2), F5(1,0,0,0,1,1,1,1,2)

Spectrogram Data Visual Analysis:  
 S = strong, M = medium, W = weak, V = variable

**RAW DATA FOR FUNDAMENTAL STRENGTH**

<b>SAMPLE NUMBER</b>	<b>FUNDAMENTA L</b>	<b>2nd PARTIAL</b>
SPK7	S	S
P1 (B3)	S	S
P12 (E4)	S	M
P22 (B4)	S	M
P33 (McDonald's Theme)	Variable	Variable
P33(we)	S	M
P39 (Colors of the Wind)	Variable	Variable
P39(he)	S	W
C1 (B3)	S	S
C11 (E4)	S	W
C21 (B4)	S	M
C31 (B3 retake)	S	M
C37 (Home on the Range)	Variable	Variable
C37 (deer)	S	W
J1 (B3)	S	M
J11 (E4)	S	W
J21 (B4)	S	M
J33 (Loverman)	Variable	Variable
J33(me)	S	W
J38 (I've Got Rhythm)	Variable	Variable
J38 (daisies)	S	M-W
J38 (green)	S	M
R1 (B3)	S	W
R11 (E4)	S	W
R21 (B4)	S	S
R31 (Amazing Grace)	S	S-W
R31 (sweet)	S	W
R37 (You can reach me)	S	M-W

R37(reach)	S	W
O1 (B3)	M	M
O11 (B3 retake)	S	M
O21 (E4)	S	W
O31 (B4)	S	W
O44 (Sound the Trumpet)	S	Variable
O44 (rebound)	S	S
L1 (B3)	M	W
L2 (B3 retake)	M	W
L12 (E4)	S	W
L22 (B4)	S	M
L34 (Sound of Music)	Variable	Variable
L34 (years)	S	W
L35 (Do a deer)	S	Variable
L35(deer)	S	W
B1 (B3)	S	S
B11 (E4)	S	W
B21 (B4)	S	W
B31 (B4 retake)	S	W
B40 (Everything's coming up roses)	Variable	Variable
B40(here)	W	W-S
B40(honey)	S	S
B40(every)	M	S-W
B41 (Guys just meant..)	M-W	Variable
B41(Mean)	M	W
B45(Guys just meant.. higher pitch)	W-M	Variable
B45 (Mean)	M	M



# DFT and DFT/LPC Overlay P1 vs P2 analysis

*DFT and DFT/LPC Overlay P1 vs P2 analysis*

## Comparison of relative energy in P2 in % of P1

Sample	Pitch (Hz)	Energy	Tracking (LPC/DFT overlay)
SPK	198	76.25	Poor
		mean=76%	
P1	252	41.549	Exact
P12	324	4.259	Exact
P22	468	6.652	extremely slight + misalignment
P33	324	4.760	Exact
P39	378	3.358	extremely slight + misalignment
		mean=12%	
C1	234	31.010	slight + misalignment
C11	342	4.049	slight - misalignment
C21	486	20.832	slight - misalignment
C31	252	34.182	exact
C37	252	15.074	exact
		mean=21%	
J1	234	30.544	exact
J21	486	5.525	extremely slight - misalignment
J33(1)	288	7.858	extremely slight - misalignment
J33(2)	288	6.133	extremely slight - misalignment
		mean=13%	
R1	252	9.076	extremely slight - misalignment
R11	342	2.563	extremely slight - misalignment
R21	486	22.338	extremely slight - misalignment
R31	432	7.070	slight - misalignment
R37	306	5.204	extremely slight - misalignment
		mean=9%	
O1		discarded	
O11	234	19.836	exact
O21	324	3.678	extremely slight - misalignment
O31	468	6.427	extremely slight - misalignment
O44	432	5.744	extremely slight - misalignment
		mean=9%	
L1	234	29.175	exact
L2	252	20.362	exact
L12	324	7.237	extremely slight - misalignment
L22	486	8.276	extremely slight - misalignment
L34	432	5.212	extremely slight - misalignment
L35(1)	342	5.475	extremely slight - misalignment
L35(2)	360	5.073	extremely slight - misalignment
		mean=12%	
B1	252	38.286	extremely slight + misalignment
B11	324	17.101	extremely slight - misalignment
B21	468	7.818	extremely slight - misalignment
B31	486	5.955	extremely slight - misalignment
B40(1)	324	25.669	extremely slight + misalignment
B40(2)	288	50.740	extremely slight + misalignment
B40(3)	342	31.109	extremely slight + misalignment
B41	252	33.773	slight + misalignment
B45	288	30.744	slight + misalignment
		mean=27%	

Predicted female formant locations for a uniform vocal tract:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
	600Hz	1800Hz	3000Hz	4200Hz	5400Hz	6600Hz	7800Hz	9000Hz	10200Hz	11400Hz

Average formant frequencies for the vowel [i] Peterson and Barney (1952)

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
	310Hz	2790Hz	3310Hz							

Lisa's speech formant locations for the vowel [i]

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
LPC in Hz	316	2683	3246	5339	6247	7417	8215	9104		
DFT in Hz	198-378	2556-2736	3114-3294	5400-5490	6120-6318	6930-7200	8100-8280	8892-9072		

SPSS Output - ANOVA  
 Total Variance Components

	N	N*	MEAN	MEDIAN	TRMEAN	STDEV	SEMEAN
S-F1	2	0	2.000	2.000	2.000	0.707	0.500
S-F2	2	0	16.500	16.500	16.500	0.707	0.500
S-F3	2	0	19.500	19.500	19.500	0.707	0.500
S-F4	1	0	26.000	26.000	26.000	*	*
S-F5	1	0	32.000	32.000	32.000	*	*
S-F6	1	0	37.000	37.000	37.000	*	*
S-F7	1	0	44.000	44.000	44.000	*	*
S-F8	1	0	49.000	49.000	49.000	*	*
P-F1	5	0	2.600	3.000	2.600	0.548	0.245
P-F2	5	0	15.700	16.000	15.700	0.671	0.300
P-F3	3	2	19.000	19.000	19.000	0.000	0.000
P-F4	1	4	22.000	22.000	22.000	*	*
P-F5	5	0	26.800	27.000	26.800	0.837	0.374
P-F6	5	0	40.600	40.000	40.600	1.342	0.600
P-F7	4	1	46.000	46.000	46.000	0.000	0.000
P-F8	5	0	52.200	53.000	52.200	1.643	0.735
C-F1	5	0	2.300	2.000	2.300	0.447	0.200
C-F2	5	0	15.000	15.000	15.000	1.225	0.548
C-F3	4	1	19.250	19.500	19.250	0.957	0.479
C-F4	5	0	23.200	23.000	23.200	1.304	0.583
C-F5	2	3	26.500	26.500	26.500	0.707	0.500
C-F6	3	2	32.000	32.000	32.000	1.000	0.577
C-F7	4	1	38.37	38.00	38.37	2.29	1.14
C-F8	4	1	43.500	43.500	43.500	0.577	0.289
C-F9	5	0	50.800	50.000	50.800	1.095	0.490
J-F1	6	0	2.167	2.000	2.167	0.408	0.167
J-F2	6	0	15.083	15.000	15.083	0.801	0.327
J-F3	6	0	18.250	18.000	18.250	0.612	0.250
J-F4	6	0	22.500	22.500	22.500	0.548	0.224
J-F5	6	0	28.000	28.000	28.000	0.000	0.000
J-F6	2	4	32.500	32.500	32.500	0.707	0.500
J-F7	6	0	38.667	39.500	38.667	1.751	0.715
J-F8	4	2	43.75	43.50	43.75	2.06	1.03
J-F9	5	1	48.600	48.000	48.600	1.342	0.600
R-F1	5	0	2.200	2.000	2.200	0.447	0.200
R-F2	5	0	14.400	14.000	14.400	0.548	0.245
R-F3	5	0	18.400	18.000	18.400	0.548	0.245
R-F4	2	3	23.000	23.000	23.000	0.000	0.000
R-F5	3	2	27.000	27.000	27.000	1.000	0.577
R-F6	3	2	34.333	35.000	34.333	1.155	0.667
R-F7	5	0	42.200	42.000	42.200	0.447	0.200
R-F8	3	2	45.000	45.000	45.000	1.000	0.577
R-F9	3	2	48.333	48.000	48.333	0.577	0.333
O-F1	4	0	2.875	2.500	2.875	1.181	0.591
O-F2	4	0	12.375	12.250	12.375	1.601	0.800
O-F3	4	0	17.250	17.000	17.250	1.500	0.750
O-F4	3	1	23.333	23.000	23.333	0.577	0.333
O-F5	2	2	30.00	30.00	30.00	2.83	2.00
O-F6	3	1	36.333	36.000	36.333	1.528	0.882
O-F7	4	0	40.500	40.500	40.500	0.577	0.289
O-F8	4	0	48.000	48.000	48.000	0.000	0.000
L-F1	6	0	2.583	2.750	2.583	0.492	0.201
L-F2	6	0	15.333	15.000	15.333	0.516	0.211
L-F3	5	1	18.900	19.000	18.900	0.894	0.400
L-F4	5	1	22.600	23.000	22.600	0.548	0.245
L-F5	3	3	26.000	26.000	26.000	0.000	0.000
L-F6	4	2	33.250	33.500	33.250	0.957	0.479
L-F7	4	2	38.000	38.000	38.000	0.816	0.408

L-F8	3	3	42.00	43.00	42.00	1.73	1.00
L-F9	4	2	45.250	45.500	45.250	0.957	0.479
B-F1	9	0	2.667	3.000	2.667	0.433	0.144
B-F2	9	0	14.389	14.000	14.389	0.601	0.200
B-F3	9	0	18.111	18.000	18.111	1.054	0.351
B-F4	8	1	23.250	23.000	23.250	0.707	0.250
B-F5	6	3	31.750	32.000	31.750	1.994	0.814
B-F6	1	7	36.000	36.000	36.000	*	*
B-F7	7	2	38.643	39.000	38.643	0.852	0.322
B-F8	9	0	43.778	44.000	43.778	1.093	0.364

	MIN	MAX	Q1	Q3
S-F1	1.500	2.500	*	*
S-F2	16.000	17.000	*	*
S-F3	19.000	20.000	*	*
S-F4	26.000	26.000	*	*
S-F5	32.000	32.000	*	*
S-F6	37.000	37.000	*	*
S-F7	44.000	44.000	*	*
S-F8	49.000	49.000	*	*
P-F1	2.000	3.000	2.000	3.000
P-F2	14.500	16.000	15.250	16.000
P-F3	19.000	19.000	19.000	19.000
P-F4	22.000	22.000	*	*
P-F5	26.000	28.000	26.000	27.500
P-F6	40.000	43.000	40.000	41.500
P-F7	46.000	46.000	46.000	46.000
P-F8	50.000	54.000	50.500	53.500
C-F1	2.000	3.000	2.000	2.750
C-F2	13.000	16.000	14.000	16.000
C-F3	18.000	20.000	18.250	20.000
C-F4	22.000	25.000	22.000	24.500
C-F5	26.000	27.000	*	*
C-F6	31.000	33.000	31.000	33.000
C-F7	36.00	41.50	36.50	40.62
C-F8	43.000	44.000	43.000	44.000
C-F9	50.000	52.000	50.000	52.000
J-F1	2.000	3.000	2.000	2.250
J-F2	14.000	16.000	14.375	16.000
J-F3	17.500	19.000	17.875	19.000
J-F4	22.000	23.000	22.000	23.000
J-F5	28.000	28.000	28.000	28.000
J-F6	32.000	33.000	*	*
J-F7	36.000	40.000	36.750	40.000
J-F8	42.00	46.00	42.00	45.75
J-F9	47.000	50.000	47.500	50.000
R-F1	2.000	3.000	2.000	2.500
R-F2	14.000	15.000	14.000	15.000
R-F3	18.000	19.000	18.000	19.000
R-F4	23.000	23.000	*	*
R-F5	26.000	28.000	26.000	28.000
R-F6	33.000	35.000	33.000	35.000
R-F7	42.000	43.000	42.000	42.500
R-F8	44.000	46.000	44.000	46.000
R-F9	48.000	49.000	48.000	49.000
O-F1	2.000	4.500	2.000	4.125
O-F2	11.000	14.000	11.000	13.875
O-F3	16.000	19.000	16.000	18.750
O-F4	23.000	24.000	23.000	24.000
O-F5	28.00	32.00	*	*

O-F6	35.000	38.000	35.000	38.000
O-F7	40.000	41.000	40.000	41.000
O-F8	48.000	48.000	48.000	48.000
L-F1	2.000	3.000	2.000	3.000
L-F2	15.000	16.000	15.000	16.000
L-F3	18.000	20.000	18.000	19.750
L-F4	22.000	23.000	22.000	23.000
L-F5	26.000	26.000	26.000	26.000
L-F6	32.000	34.000	32.250	34.000
L-F7	37.000	39.000	37.250	38.750
L-F8	40.00	43.00	40.00	43.00
L-F9	44.000	46.000	44.250	46.000
B-F1	2.000	3.000	2.250	3.000
B-F2	14.000	15.500	14.000	15.000
B-F3	17.000	20.000	17.000	19.000
B-F4	22.000	24.000	23.000	24.000
B-F5	29.000	34.500	29.750	33.375
B-F6	36.000	36.000	*	*
B-F7	37.500	40.000	38.000	39.000
B-F8	42.000	45.000	43.000	
45.000				

### Raw Data for Formant Placements

(numerical values indicate the measurement in mm on the spectrogram from the x-axis)  
(1mm=176Hz)

#### Speech

SPK7	1.5- 2.5						16- 17	19-	20				26				32			37					44			49			53	69	73	85	
------	-------------	--	--	--	--	--	-----------	-----	----	--	--	--	----	--	--	--	----	--	--	----	--	--	--	--	----	--	--	----	--	--	----	----	----	----	--

#### Pop

P1	1.5- 2.5						16	19				26							40					46			51			55	73	78	84	
P12	2.0						16					26							40					46			53				72			
P22	3.0						16					27							40					46			53	68	75				100	106
P33	2.0- 4.0						14.5						28						40					46			54				70	76		110
P39	3.0						16	19			22		27												43			50				73		102

#### Country

C1	2-3						16			20		25							38					43					50			54	79			
C11	2.0						15			20		24								38					44				50	53	55		80			
C21	2.0						13	-	-	19		23							33					41.5				52	55	75	85					
C31	3.0						16				22		27						32					44				52				85	110			
C37	2.0						15			18		22		26				31					36				43				50			73		102

#### Jazz

J1	2.0						16	18			23							36					42			48	50	53		77							
J11	2.0						16	18			23														40			46			52						
J21	3.0						14			18		22							39					47	-	-	53				76						
J33	2.0						14.5	17.5			22							33					37			42			48	-	52						
J38	2.0						15	-		19		22													40				50				70				
J38	2.0						15	-		19		23													40			45			50				70		

#### R&B

R1	2.0						14			18		23							35					42-	45						55	60	72	82		
R11	2.0						15			19				27						35					42	44		48				54	60	65	71	
R21	3.0						14			19															42		46	49		53			74	81	100	



**Raw Data for Formant Placements**  
(numerical values indicate the measurement in mm on the spectrogram from the x-axis)  
(1mm=176Hz)

R31	2.0					15		18				26					43			48		52		71	
R37	2.0					14		18		23							42						55	72	
																						58			
																						66			

**Opera**

O11	2.0					14		18		24				32		36		41			48		54	75	
O21	2.0					13.5		19									38	41			48		68	73	
O31	3.0					11		16		23				35				40			48	-	53	72	
O44	3.0- 6.0					11		16		23		28						40	-	-	48	-	54	72	

**Legit**

L1	2.0					16		20	22	26				34		38		44			48	50	53	73	
L2	2.0					16	19.5		23	26				34		38			46			53	68	73	
L12	3.0					15	-	-	23	26						39		45			51		69	73	83
L22	3.0					15	-	18	-	23			33				-	43	-	-	-	52	68	74	
L34	3.0					15	-	18	-	22			32		37			43			51	-		72	
L35	2.5					15	-	19									40		46			50		74	

**Belt**

B1	1.5- 2.5					15.5		19		24				33		37.5		43			50		55	70	92
																							75	111	
B11	2.0					15		18		24				34.5		39		44			50			76	82
B21	3.0					15	-	-	20				32			38		42			50		55	70	84
																							76	100	
B31	3.0					14	-	19		24			32					45			50		56	70	
																							77		
B40a	2.0- 4.0					14	17		23			30			36	39		45			50		55	70	
B40b	2.0- 4.0					14		18	23									45			50	53		70	80
																							75	93	
B40c	2.0- 4.0					14	17		22							38		43			51			70	
																							75		
B41	2.0- 3.0					14		18	23								40	43			50		55	75	

**Raw Data for Formant Placements**

(numerical values indicate the measurement in mm on the spectrogram from the x-axis)  
(1mm=176Hz)

B45	2.0- 3.0				14	17			23			29				39			44				53				
-----	-------------	--	--	--	----	----	--	--	----	--	--	----	--	--	--	----	--	--	----	--	--	--	----	--	--	--	--

Formants translated from Spectrogram measurements into Hz

**Formant Placements in Hz**  
*\* = samples used in running = ample analysis*

**Speech**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
SPK7	352	2904	3432	none	4576	5632	6512	7744	8624	9328	12848

**Pop**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
Pop1	352	2816	3344		4576		7040	8096	8976	9680	12848
Pop12	352	2816			4576		7040	8096	9328		12672
Pop22	528	2816			4752		7040	8096	9328	11968	13200
Pop33	528	2552	3344		4928		7040	8096	9504		12320
Pop39	528	2816	3344	3872	4752		7568		8800		12848

**Country**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
C1	440	2816	3520		4400		6688	7568	8800	9504	13904
C11	352	2640	3520		4224		6688	7744	8800	9328- 9680	14080
C21	352	2288 to	3344	4048		5808	7304		9152	9680	13200
C31	528	2816		3872	4752	5632		7744	9152		
C37	352	2640	3168	3872	4576	5456	6336	7568	8800		12848

**Jazz**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
J1	352	2816	3168	4048	4928		6336	7392	8448	9328	13552
J11	352	2816	3168	4048	4928			7040	8096	9152	
J21	528	2464	3168	3872	4928		6864		8272	9152	13376
J33	352	2552	3080	3872	4928	5808	6512	7392	8448	9152	
J38b	352	2640	3344	3872	4928			7040		8800	12320
J38c	352	2640	3344	4048	4928	5632		7040	7920	8800	12320

**R&B**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
R1	352	2464	3168	4048	4928	6160	7392	7920		9680	12672
R11	352	2640	3344		4752	6160	7392	7744	8448	9504	12496
R21	528	2464	3344				7392	8096	8624	9328	13024
R31	352	2640	3168		4576	5808	7568		8448	9152	12496
R37	352	2464	3168	4048			7392			9680	12672

**Classical**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
O11	352	2464	3168	4224	5632	6336	7216	8448		9504	13200
O21	352	2376	3344			6688	7216	8448		9504	12848
O31	528	1936	2816	4048		6160	7040	8448		9328	12672
O44	792	1936	2816	4048	4928		7040	8448		9504	12672

**Legit**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
L1	352	2816	3520	3872	4576	5984	6688	7744	8976	9328	12848
L2	352	2816	3432	4048	4576	5984	6688	8096		9328	12848
L12	528	2640-	-	4048	4576		6864	7920	8976		12848
L22	528	2640-	3168	4048		5808		7568		9504	13024
L34	528	2640	3168	3872		5632	6512	7568	8976		12672
L35	440	2640	3344				7040	8096	8800		13024

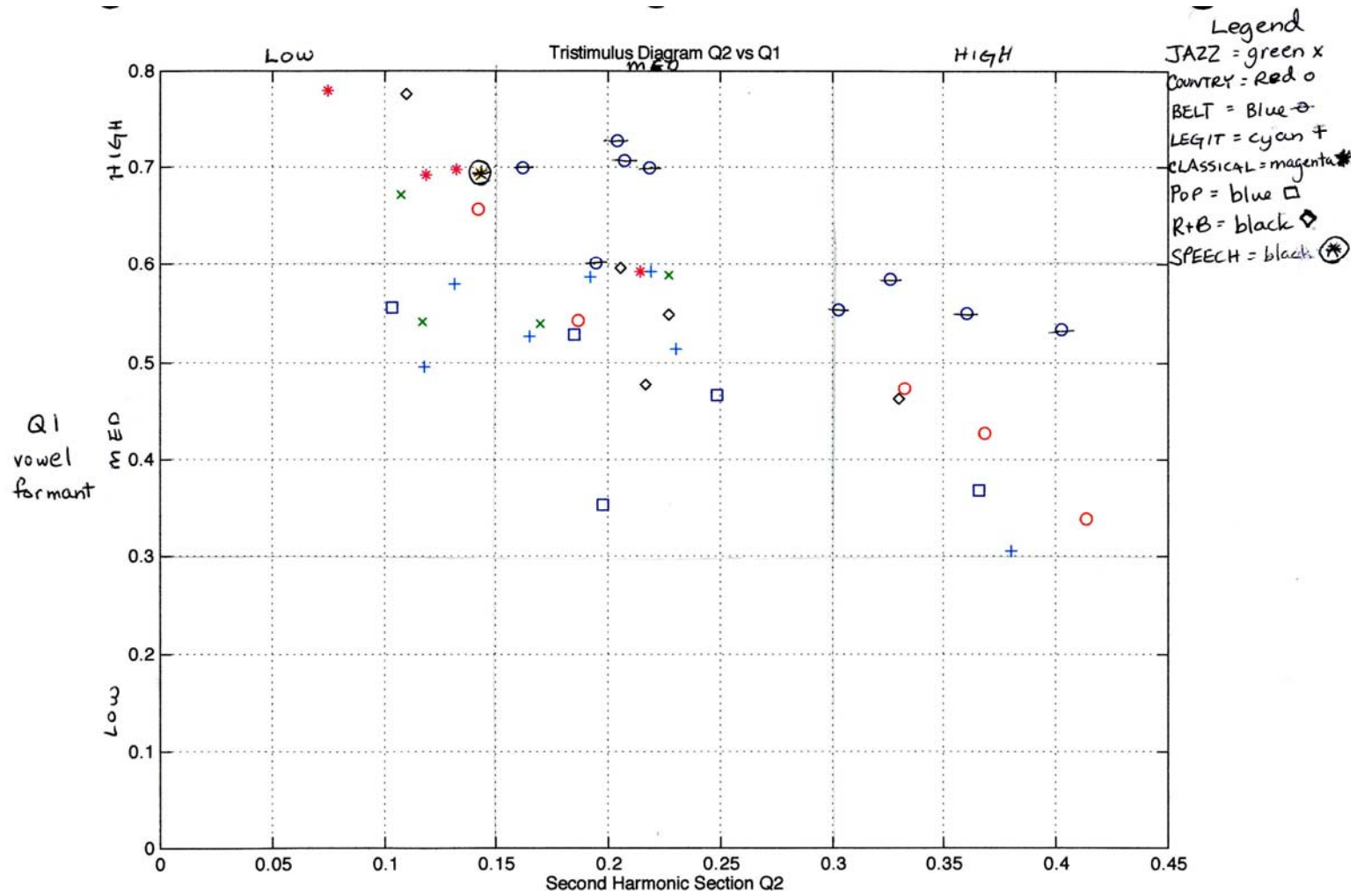
**Belt**

Sample	F1	F2	F3	SF	F4	F5	F6	F7	F8	F9	F10
B1	352	2728	3344	4224		5808	6600	7568	8800	9680	12320
B11	352	2640	3168	4224		6072	6864	7744	8800		13376
B21	528	2640	3520			5632	6688	7392	8800	9680	12320
B31	528	2464	3344	4224		5632		7920	8800	9856	12320
B40b	528	2464	2992	4048		5280		7920	8800	9680	12320
B40c	528	2464	3168	4048				7920	8800	9328	12320
B40d	528	2464	2992	3872			6688	7568	8976		12320
B41	440	2464	3168	4048			7040	7568	8800	9680	13200
B45	440	2464	2992	4048		5104	6864	7744		9328	



**AVERAGE FORMANT PLACEMENTS FOR THE VOWEL [i] IN HERTZ**

Formant	SPK	POP	COUNTRY	JAZZ	R&B	CLASSICAL	LEGIT	BELT
F1	352	510	440	352	352	405	405	475
F2	2904	2816	2640	2745.6	2464	2376	2640 -	2517
F3	3432	3344	3520	3220.8	3256	3168	-	3168
SF	absent	weak	3872	3960(weak)	inconsistent	weak	-	
F4	absent	4664	4488	4928(weak)	4752	4048	- 4048	4048
F5	5632	absent	weak	weak	weak	inconsistent	5986 (weak)	5597
F6	6512	7040	6336	weak	inconsistent	7146	6741 (weak)	6794
F7	7744	8096	7656	7128(weak)	7392-	bands merge	7832	7656
F8	8624	9152	8800	8800	8448	8448	8448 -	8800
F9	9328	9328	9504		9504	9504	- 9328	9680
F10	12848	12672	13200- 14960	12320	12584	12672	12892	12320Hz- 13200Hz
above F10		17600- 19360		13376	14256			



$$Q1 = \sum_{0-3000\text{Hz}} - F_0$$

$$Q2 = \sum_{3000-5000\text{Hz}} - F_0$$

Tristimulus observations:

Low Q2: High Q1 = 3 Classical, 1 Country, 1 Spk, 1 Jazz, 1 R&B

Low Q2: Medium Q1 = 2 Legit, 1 Jazz, 1 Pop

Low Q2: Low Q1 = none

Medium Q2: High Q1 = 5 Belt

Medium Q2: Medium Q1 = 4 Legit, 1 Classical, 2 Jazz, 3 R&B, 2 Pop, 1 Country

Medium Q2: Low Q1 = none

High Q2: High Q1 = none

High Q2: Medium Q1 = 4 Belt, 3 Country, 1 R&B, 1 Pop, 1 Legit

High Q2: Low Q1 = none

Generalizations by voice quality:

Classical: 3/4 High vowel formant and 3/4 low singer's formant

Legit: 6/7 Medium vowel formant and 2/4 low 2/4 medium singer's formant

Belt: 4/9 Medium 5/9 high vowel formant and 5/9 medium 4/9 high singer's formant

Country: 4/4 Medium vowel formant and 3/4 high singer's formant

R&B: 3/5 medium vowel formant and 3/5 medium singer's formant

Pop: 4/4 medium vowel formant and and variable singer's formant

Jazz: 3/4 medium vowel formant and 4/4 low-medium singer's formant

Belt

## Comparison of Singers Formant Placements and associated energy

Spectrogram results:            non = no singers formant  
    SF (22) = singers formant 22 mm from x-axis

LPC:DFT results:            [formant placement in Hz from LPC data] : [closest harmonic in Hz from DFT data]  
    [energy level of closest harmonic in % of P1]

non = no formant registered in LPC : no harmonic with energy over 1% of P1

"Suspected areas of formant activity: 316Hz, 2683Hz, 3246Hz, 3500Hz, 4390Hz, 5339Hz"

Sample	SPG SF	LPC:DFT F2 (Hz)	LPC:DFT F3 (Hz)	LPC:DFT F4 (Hz)	LPC:DFT F5 (Hz)	LPC:DFT F6 (Hz)
SPK7	non	2683:2736 10%	3246:3294 7%	non:3978 2%	non:4392 2%	5339:5490 2%
P1	non	2730:2736 7%	3246:3204 6%	non:3438 2%	non:4338 1%	non:5472 2%
P12	non	non:2466 1%	3363:3366 1%	non:3590 1%	non:non	non:non
P22	non	non:2682 7%	3129:3132 17%	non:3582 5%	4465:non	non:non
P33	non	2721:2898 4%	3222:3222 6%	non:3564 2%	non:4500 1%	non:non
P39	SF(22)	2671:2502 2%	3117:3150 2%	non:3906 1%	non:4626 1%	non:5328 1%

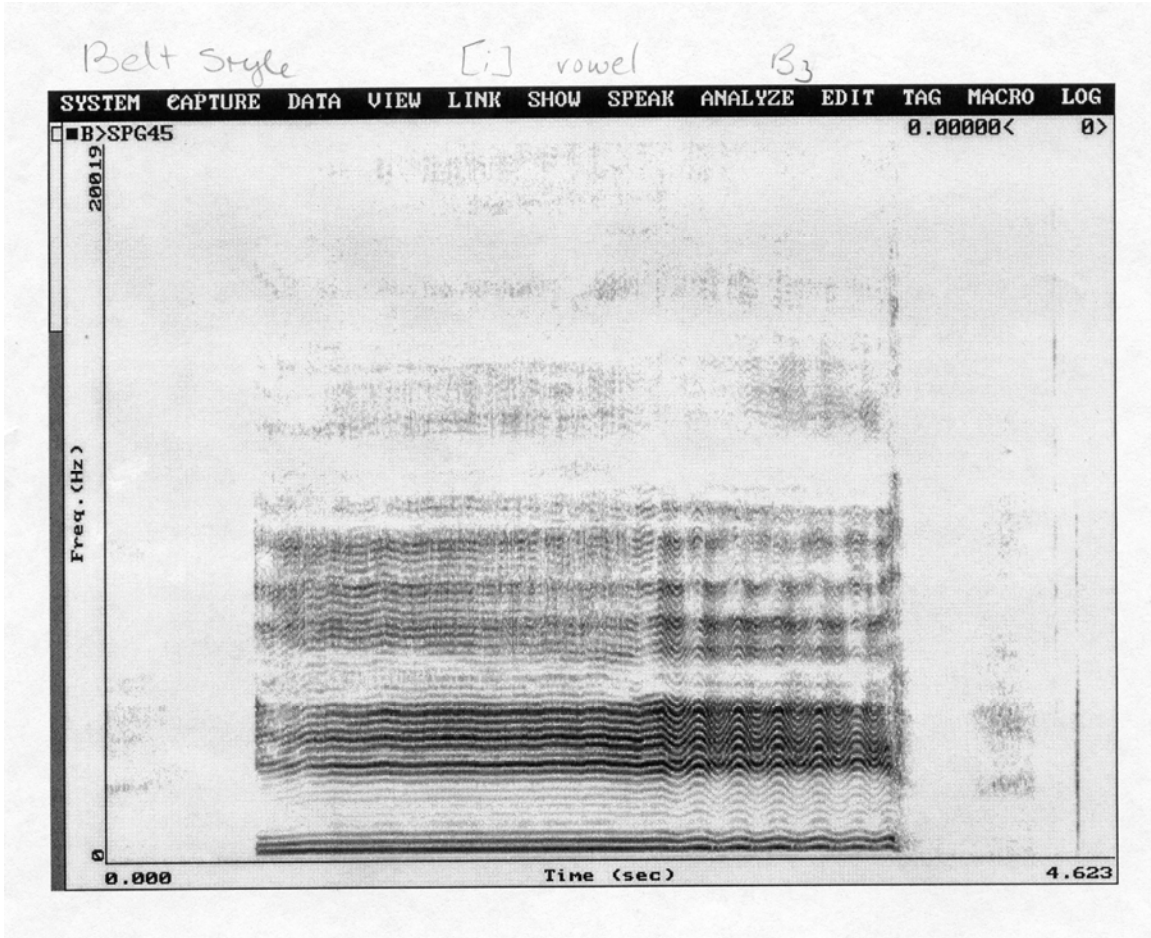
C1	non	2554:2628 6%	non:3294 4%	3516:3510 12%	4042:3942 6%	non:5670 1%
C11	non	2883:2862 6%	3316:3168 7%	non:3492 6%	non:4428 1%	non:5382 2%
C21	SF(23)	2801:2772 13%	3363:3240 12%	non:3708 5%	4757:4698 1%	non:non
C31	SF(22)	2590:2520 9%	3375:3204 9%	non:3438 15%	4160:4122 15%	non:5490 1%
C37	SF(22)	2531:2520 6%	non:2952 2%	non:3726 1%	4383:4464 2%	non:non
J1	SF(23)	2918:2484 8%	non:3600 3%	3783:3834 6%	4617:4500 3%	non:5400 1%
J11	SF(23)	damaged				
J21	SF(22)	2824:2844 9%	non:3312 4%	3750:3780 5%	4722:4734 1%	non:non
J33a	SF(22)	2624:2394 2%	non:3186 1%	non:3438 1%	non:4230 1%	non:non
J33b	SF(22)	2520:2502 2%	non:3060 1%	non:non	non:non	non:non
J38a&b	"SF(22,23)"not analysed					
R1	SF(23)	1993:2106 2%	3022:3024 2%	non:3726 1%	4019:3960 2%	5788:5580 1%

R11	non	2296:2286 4%	3023:3096 1%	non:non 2%	4429:4554	non:non
R21	non	2097:1872 23%	2734:2790 26%	non:3258 11%	non:4194 1%	non:non
R31	non	2310:2502 4%	2968:2916 4%	3714:3744 3%	non:4590 1%	non:non
R37	SF(23)	2263:2340 1% (3% energy at 1170 ?)	3132:3168 5%	non:3744 1%	non:4320 1%	non:4896 1%
O11	SF(24)	2214:2178 2%	3064:3042 1%	3867:3924 2%	non:non	5880:non
O21	non	2107:2160 2%	non:non	non:non	4031:3996 1%	non:non
O31	SF(23)	1793:1872 10%	2742:2818 9%	3703:3690 6%	non:4230 2%	non:5634 1%
O44	SF(23)	1979:2088 4%	2894:2934 4%	non:3762 1%	non:non	non:non
L1	SF(22)	2473:2628 3%	3270:3276 4%	non:3492 1%	non:non 1%	non:5868
L2	SF(23)	2555:2538 7%	3375:3222 2%	non:3690 2%	4254:4608 1%	non:5760 1%
L12	SF(23)	2719:2466 2%	3395:3366 7%	non:3978 4%	4102:4284 5%	non:5796 1%

L22	SF(23)	2566:2340 7%	3070:2808 9%	non:non	4007:4194 2%	non:
L34	SF(22)	2496:2538 15%	3246:2952 7%	3773:3798 5%	non:4230 2%	non:5490 1%
L35(1)	non	2625:2610 11%	3152:3204 6%	non:3546 3%	non:4500 1%	non:non
L35(2)	non	2520:2538 16%	3035:3096 7%	non:3618 3%	non:4392 1%	non:5796 1%
B1	SF(24)	2461:2502 18%	3199:3186 16%	non:3870 5%	non:4536 1%	non:5220 1%
B11	SF(24)	2484:2538 16%	3105:2844 12%	non:3148 10%	non:3474 5%	non:non
B21	non	2262:2268 32%	2753:2718 23%	3597:3636 9%	non:4086 4%	non:non
B31	SF(24)	1840:1890 19%	3117:3294 10%	3621:3762 4%	non:non	non:non
		2356:2358 31%				
B40a	SF(23)	1839:1962 8%	P8-10 also high 17-20%	3700:3600 36%	non:3852 30%	non:5095 1%
		2356:2286 38%	3140:3294 20%			
B40b	SF(23)	1992:1998	2684:2556	3597:3672	4722:4808	non:5382

		32%	14%	17%	3%	1%
B40c	SF(22)	2238:2268 25%	2753:2664 24%	3656:3654 20%	non:4662 3%	non:5796 1%
B41	SF(23)	2297:2358 14%	non:2862 11%	non:3564 11%	3773:3762 16%	non:4698 1%
B45	SF(23)	2285:2412 24%	non:2664 16%	3716:3726 30%	non:4788 2%	non:5580 2%

B1: Spectrogram



Peak	Freq	Energy	Notes
1	(269.53, 341.66)		H1 not tracking
2	(2460.95, 64.42)		H10-H11
3	(3210.94, 43.24)		H14
4	(3878.91, 24.32)		H17
5	(6023.45, 8.42)		H26-27
6	(7125.00, 5.59)		H31-32
7	(8307.20, 6.02)		H36-37

Sample 801 (10,000 - 18,000)

Sampling Rate 48,000

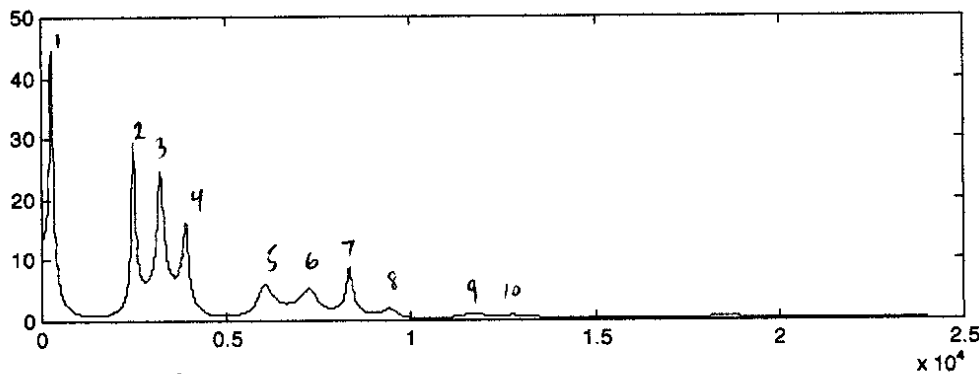
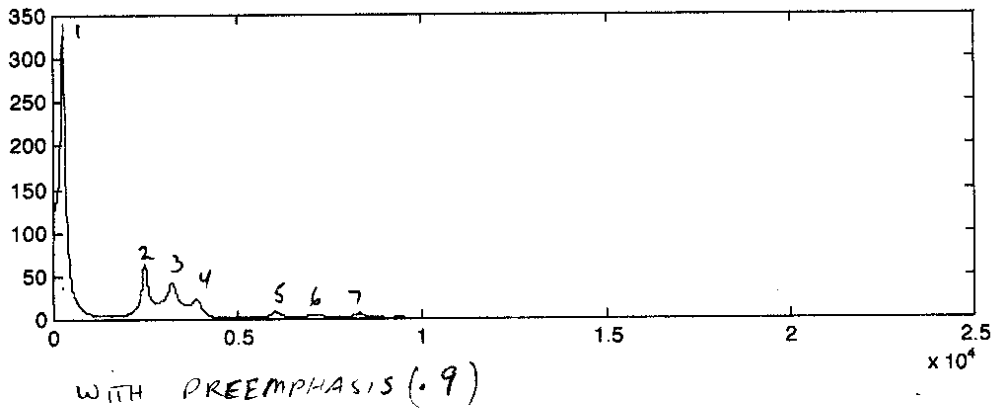
LPC - 8000 pt

Response - 2048pt

order=50

2 roots for each peak + DC + radiation

$F_0 = 227.89$



1	(257.81)
2	(2472.65)
3	(3210.94)
4	(3890.62)
5	(6023.45)
6	(7224)
7	(8332.03)

(257.81, 262.26)

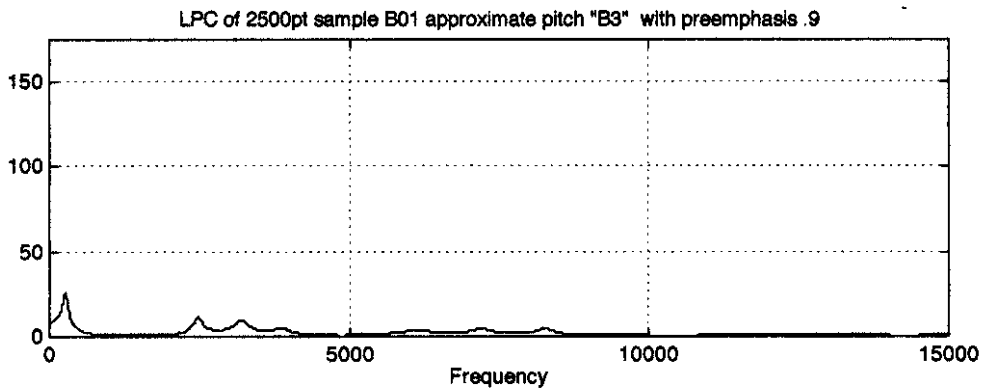
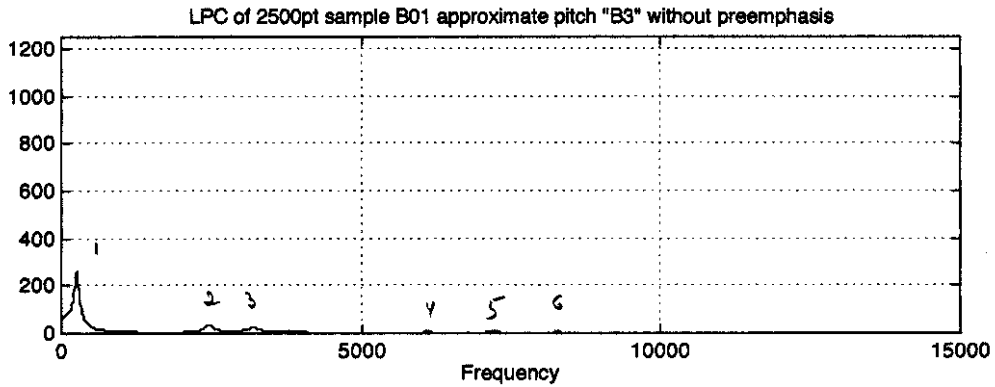
(2460.94, 35.33)

(3199.22, 22.55)

! (6117.19, 4.31)

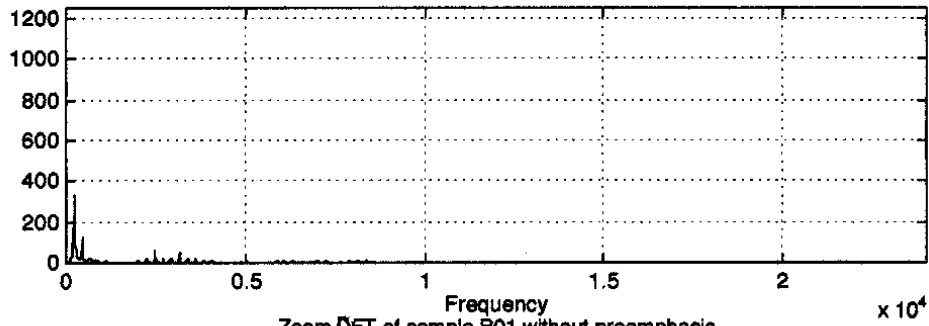
(7207.20, 4.97)

(8285.16, 4.57)

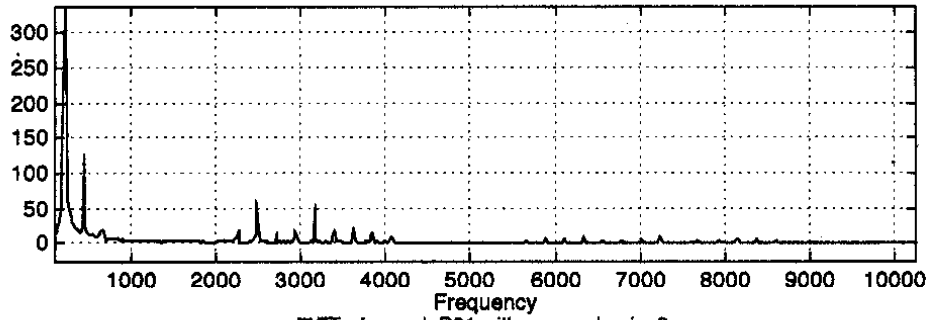


B3

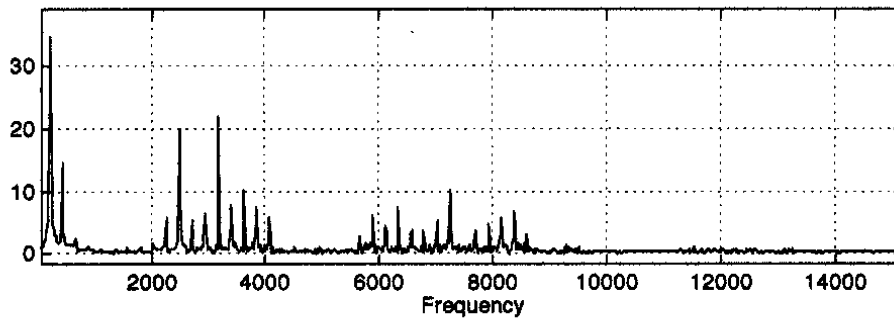
DFT of sample B01 without preemphasis



Zoom DFT of sample B01 without preemphasis



DFT of sample B01 with preemphasis .9



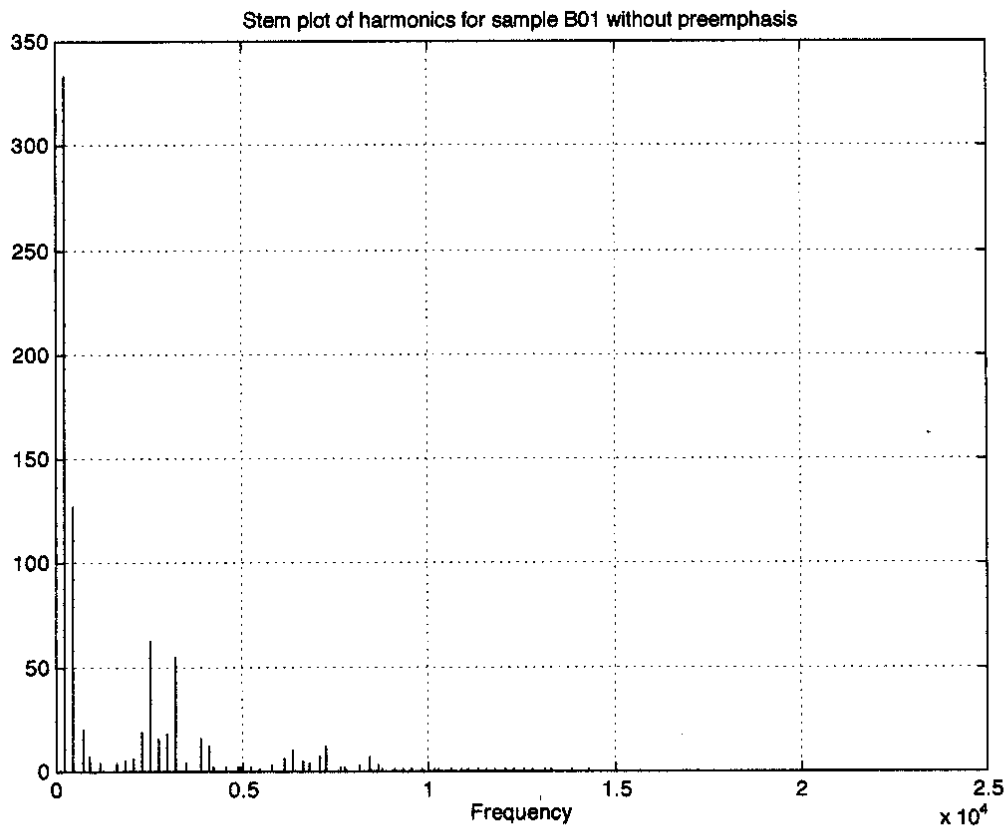
B4

DFT Numerical Results for B1

ROW	Freq	Amp	% Amp
1	252	333.568	100.000
2	468	127.709	38.286
3	702	20.340	6.098
4	918	7.051	2.114
5	1188	4.376	1.312
6	1602	4.032	1.209
7	1836	4.736	1.420
8	2052	5.645	1.692
9	2286	18.772	5.627
10	2502	62.417	18.712
11	2736	16.013	4.801
12	2952	17.857	5.353
13	3186	54.889	16.455
14	3492	4.046	1.213
15	3870	15.472	4.638
16	4086	11.769	3.528
17	4212	1.609	0.482
18	4536	2.023	0.606
19	4878	1.525	0.457
20	4950	1.813	0.544
21	5220	1.730	0.519
22	5454	1.381	0.414
23	5778	2.716	0.814
24	6120	6.348	1.903
25	6354	9.925	2.975
26	6588	4.952	1.484
27	6804	4.400	1.319
28	7038	6.690	2.005
29	7254	11.592	3.475
30	7596	1.679	0.503
31	7722	2.267	0.680
32	8154	3.236	0.970
33	8388	7.065	2.118
34	8622	3.015	0.904
35	8730	0.937	0.281
36	9072	0.921	0.276
37	9306	1.491	0.447
38	9522	0.887	0.266
39	9792	0.597	0.179
40	10152	0.621	0.186
41	10242	0.593	0.178
42	10602	0.513	0.154
43	10872	0.534	0.160
44	11070	0.516	0.155
45	11322	0.658	0.197
46	11556	1.137	0.341
47	11790	0.821	0.246
48	12042	0.617	0.185
49	12276	0.676	0.203
50	12546	0.646	0.194
51	12780	0.539	0.162
52	13140	0.602	0.181
53	13266	0.582	0.175
54	13608	0.466	0.140
55	13824	0.536	0.161
56	14040	0.466	0.140
57	14274	0.516	0.155
58	14616	0.451	0.135

B5

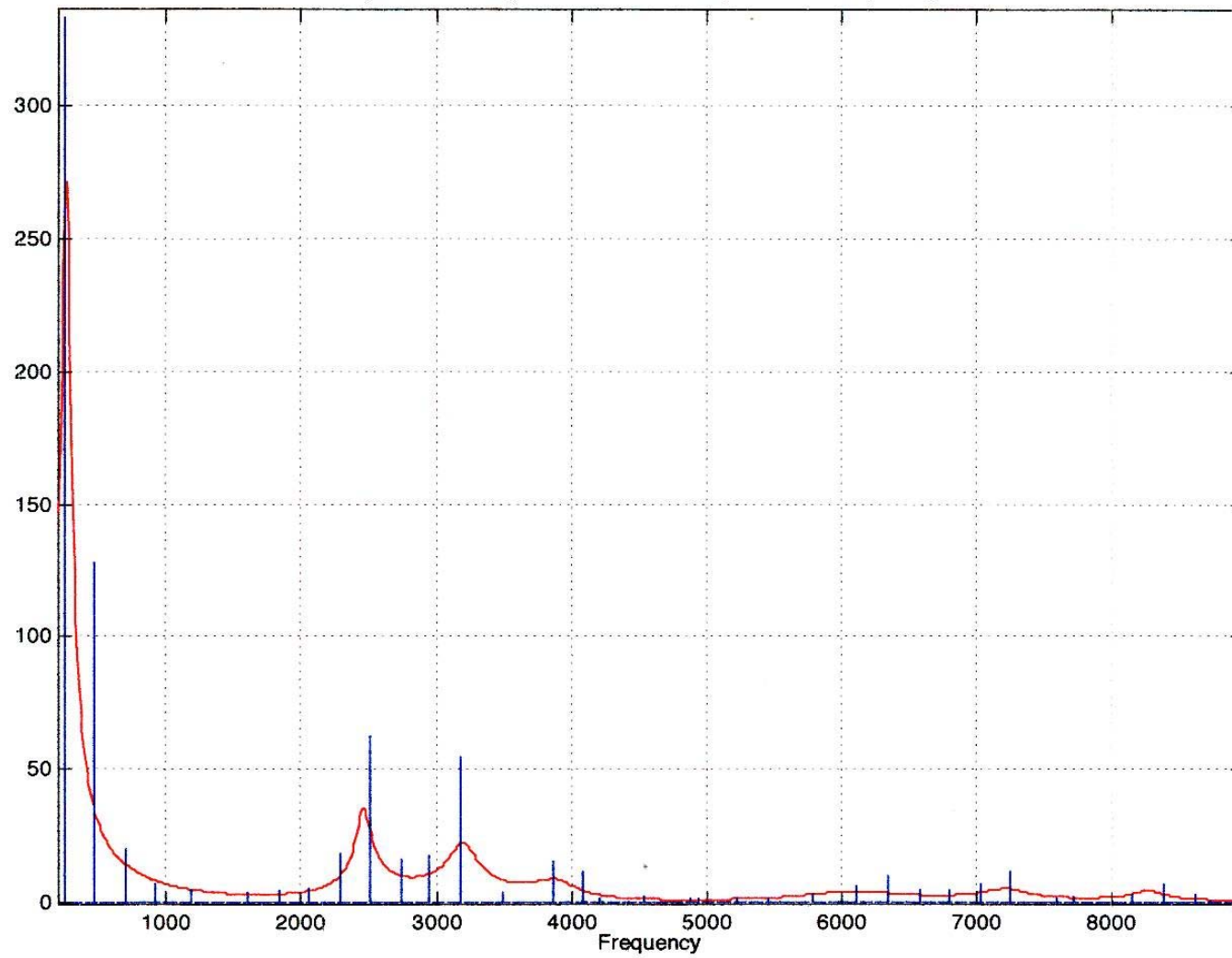
59	14886	0.457	0.137
60	15120	0.476	0.143
61	15318	0.488	0.146
62	15534	0.439	0.131
63	15840	0.406	0.122
64	16200	0.438	0.131
65	16290	0.468	0.140
66	16542	0.447	0.134
67	16974	0.430	0.129
68	17118	0.390	0.117
69	17442	0.397	0.119
70	17676	0.381	0.114
71	17946	0.365	0.109
72	18216	0.400	0.120
73	18324	0.474	0.142
74	18666	0.496	0.149
75	18900	0.418	0.125
76	19152	0.380	0.114
77	19476	0.432	0.129
78	19710	0.382	0.114
79	19890	0.375	0.112
80	20214	0.352	0.106
81	20448	0.393	0.118
82	20754	0.358	0.107
83	20988	0.352	0.105
84	21222	0.350	0.105
85	21456	0.349	0.105
86	21744	0.344	0.103
87	21996	0.339	0.102
88	22086	0.336	0.101
89	22356	0.339	0.102
90	22590	0.338	0.101
91	22932	0.327	0.098
92	23184	0.328	0.098
93	23364	0.326	0.098
94	23706	0.325	0.097



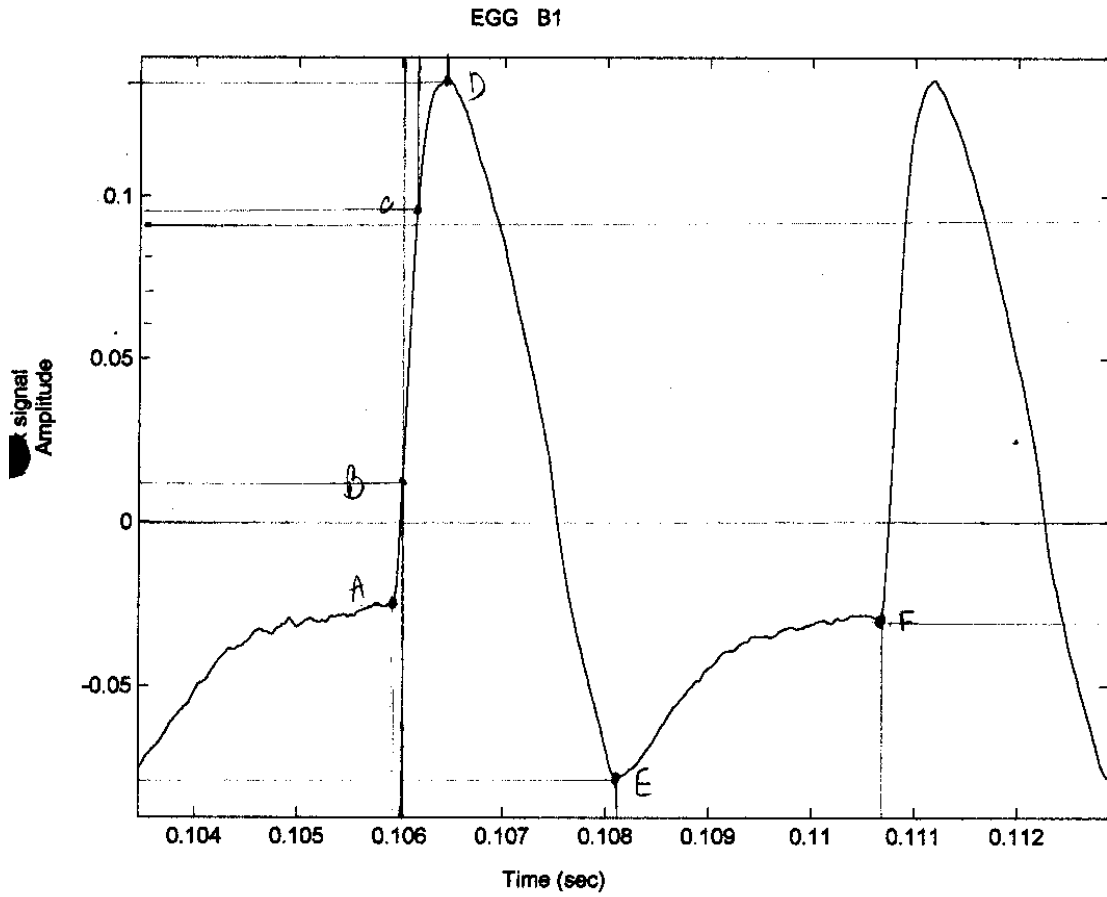
B7

# DFT/LPC Overlay for B01

Stem plot/LPC overlay of harmonics for sample B01 without preemphasis

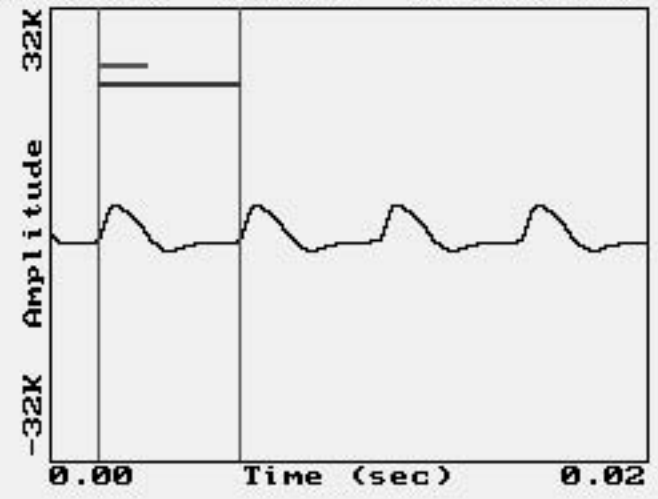
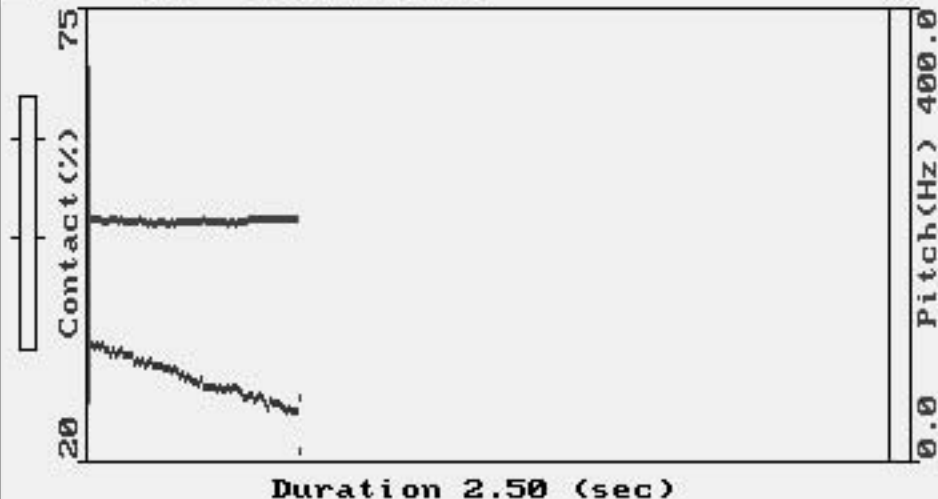


x 17mm = .001  
y 27mm = .05



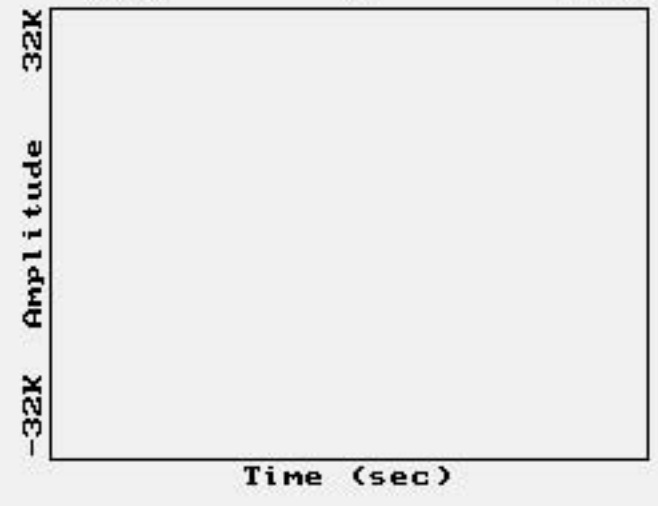
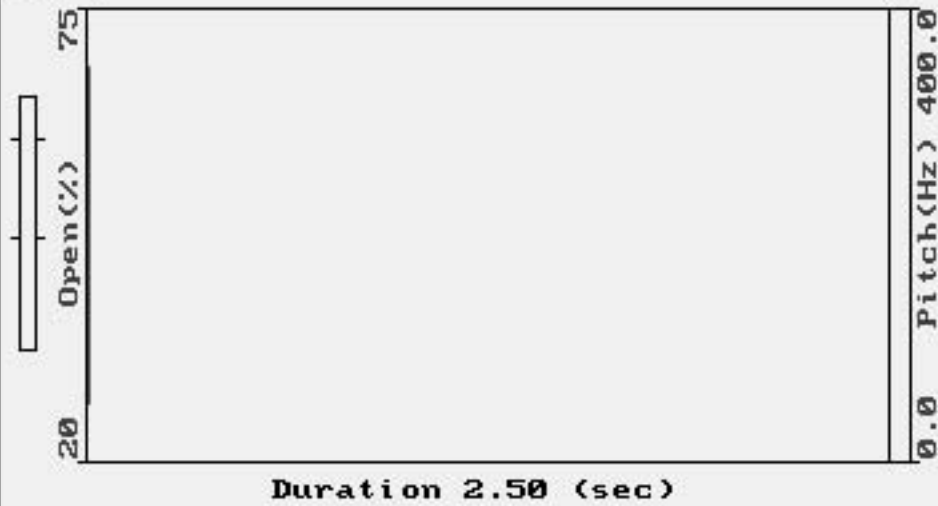
■A> : CH1: B1\_EGGST.NSP

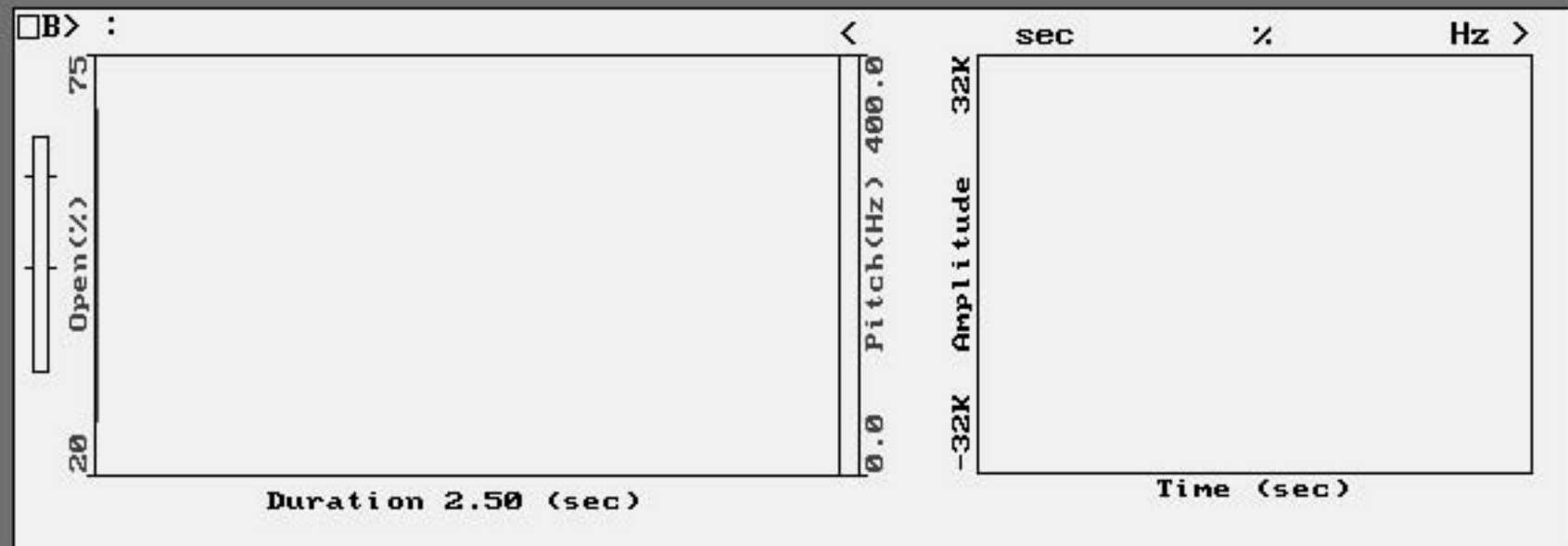
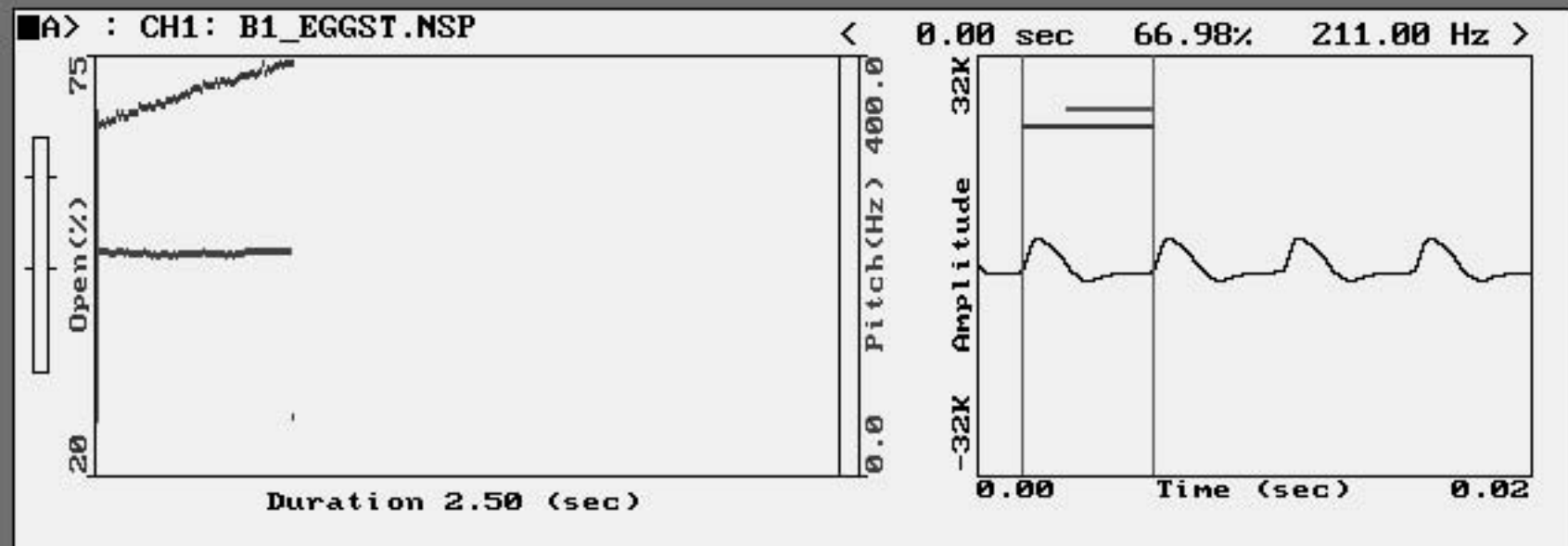
< 0.00 sec 33.01% 211.00 Hz >

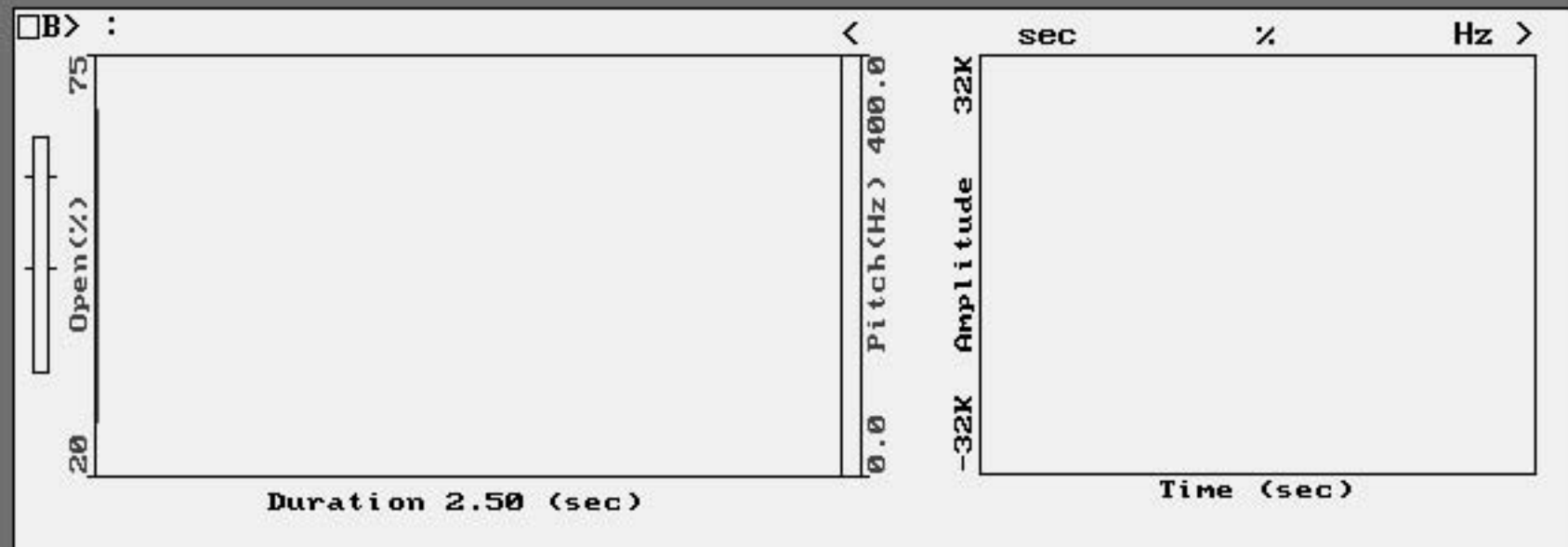
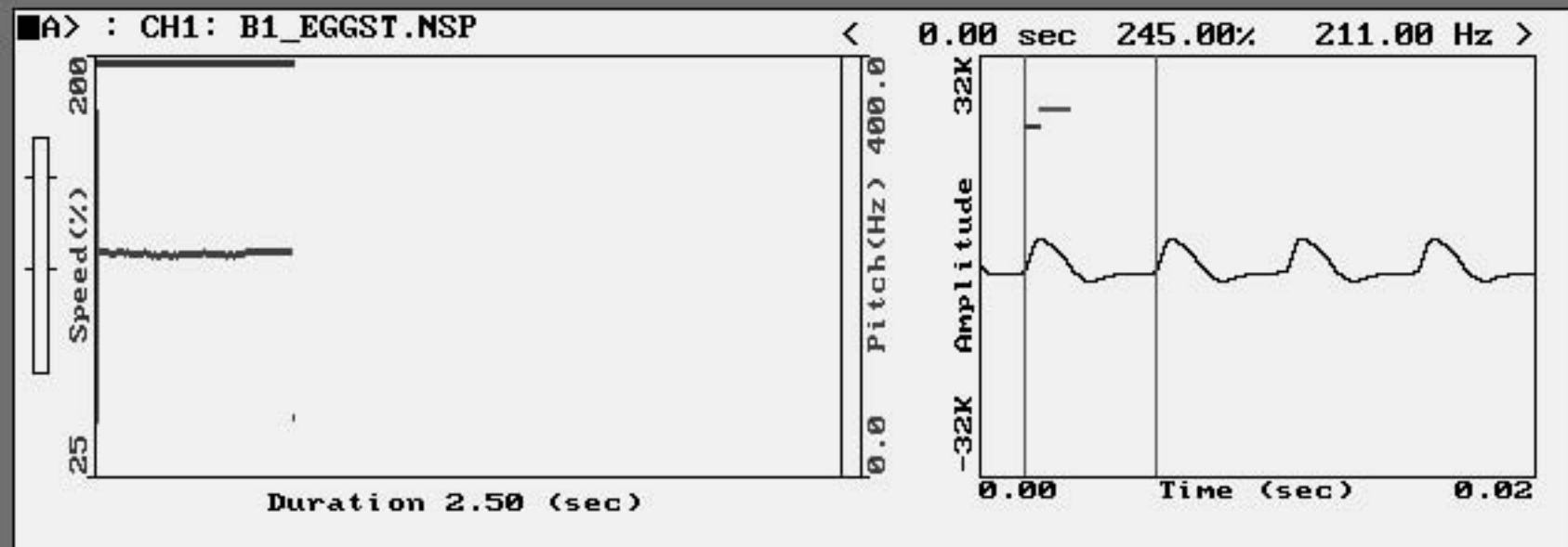


□B> :

< sec % Hz >









B11

$$E_4 \approx 329.63$$

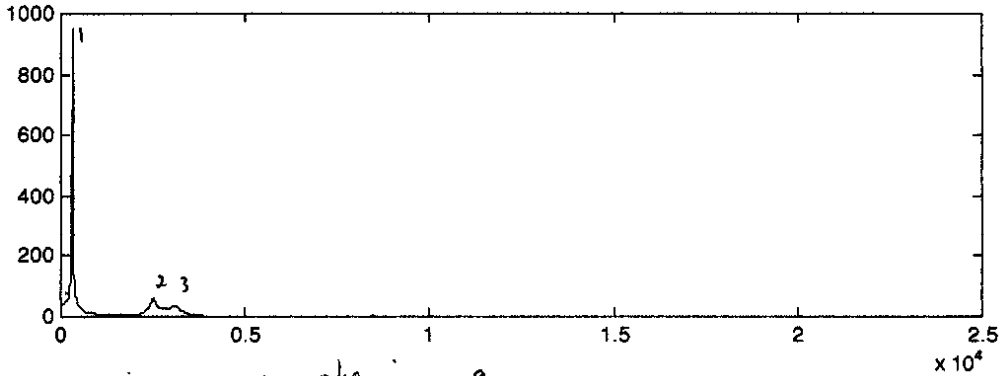
$$F_0 = 313.93 \text{ Hz}$$

$$49 \sqrt{\frac{T}{\dots}} = .003208333$$

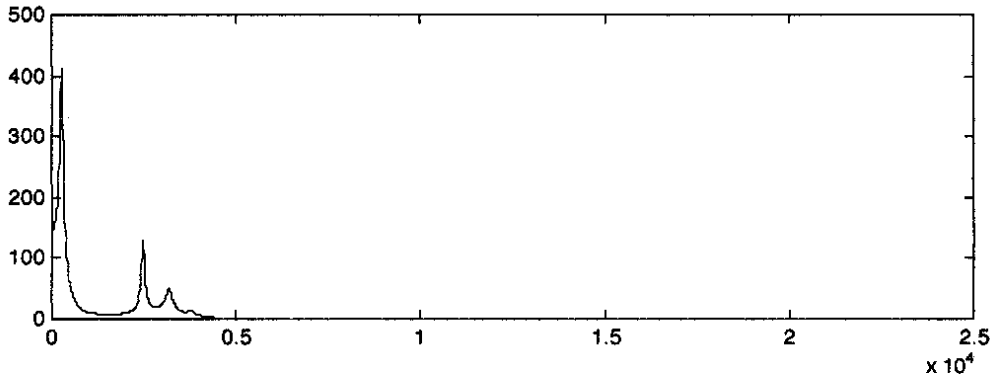
$$\frac{1}{T} = f$$

- 1 (316.41, 950.11) #1
- 2 (2496.10, 60.87) #7-#8
- 3 (3105.50, 33.30) #9-#10

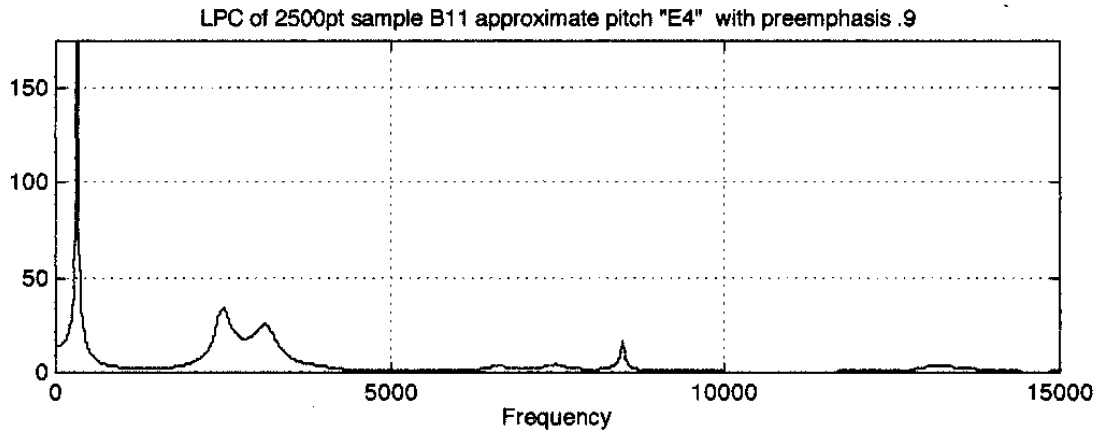
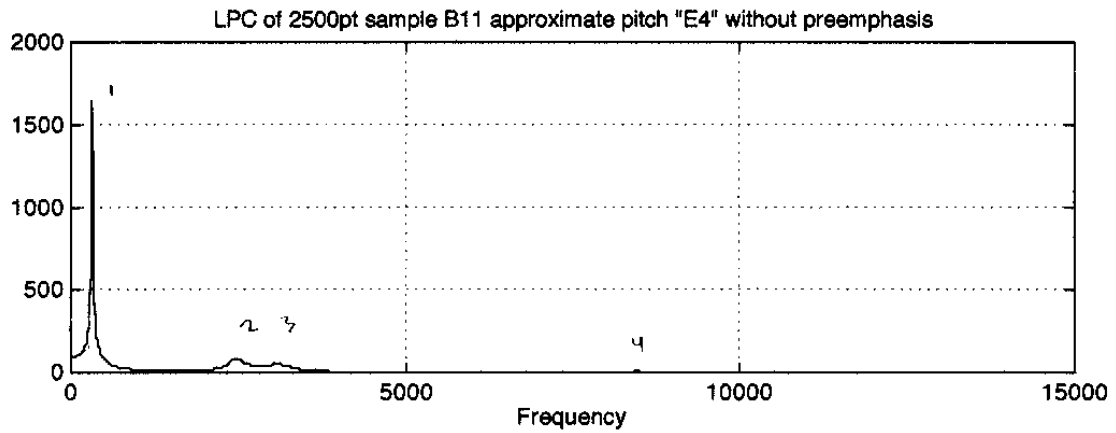
$$N = 50$$



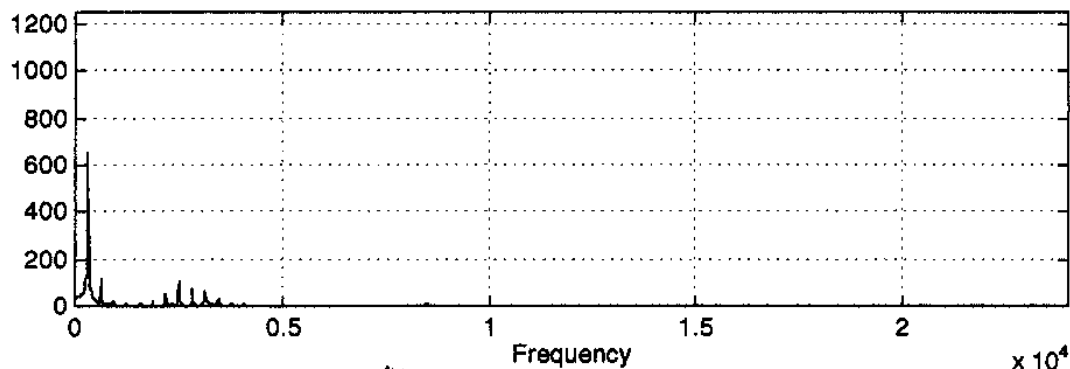
with pre emphasis .9



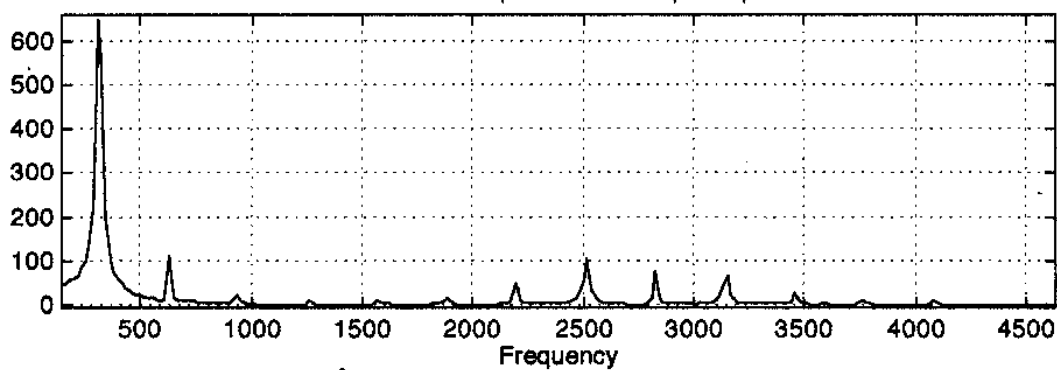
(316.41, 1643.32)  
(2484.38, 84.68)  
(3105.50, 49.87)  
(8472.66, 13.30)



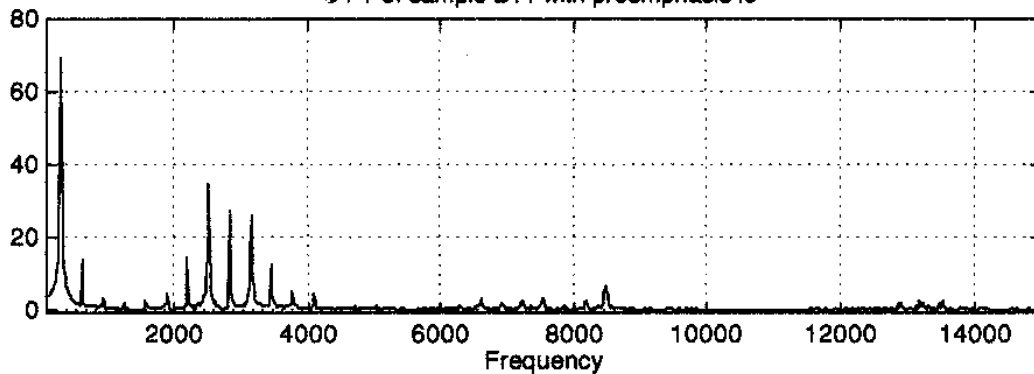
DFT of sample B11 without preemphasis



Zoom DFT of sample B11 without preemphasis



DFT of sample B11 with preemphasis .9



DFT Numerical Results for B12

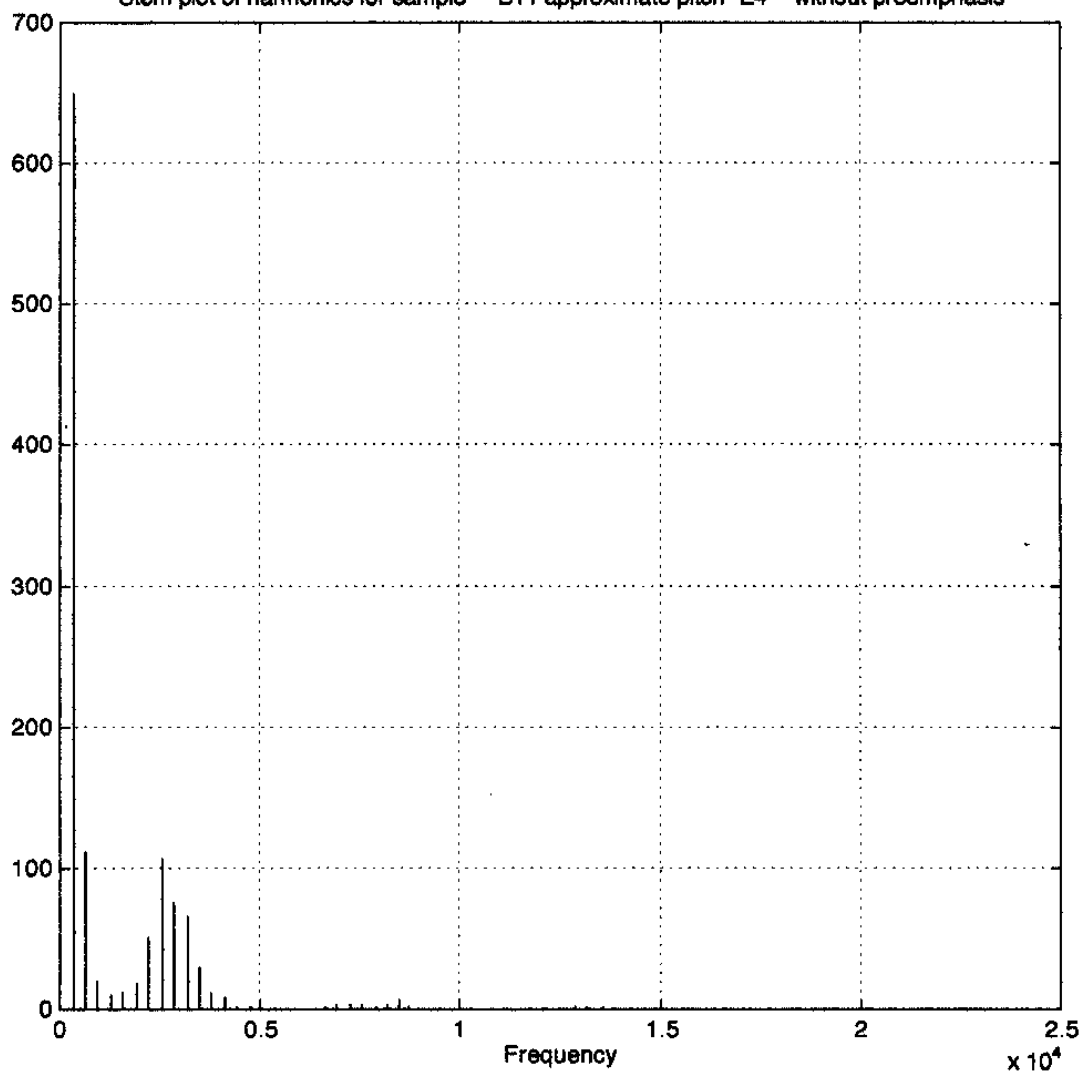
Worksheet saved into file: Minitab.B11  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	324	649.055	100.000 —
2	648	110.997	17.101
3	954	20.349	3.135
4	1278	9.873	1.521
5	1584	10.919	1.682
6	1908	17.421	2.684
7	2214	49.901	7.688
8	2538	105.737	16.291 —
9	2844	74.887	11.538 —
10	3168	65.570	10.102 —
11	3474	29.128	4.488
12	3780	10.691	1.647
13	4104	8.527	1.314
14	4410	1.486	0.229
15	4734	1.574	0.243
16	5094	0.696	0.107
17	5418	0.563	0.087
18	5850	0.608	0.094
19	6282	0.697	0.107
20	6588	1.662	0.256
21	6930	2.510	0.387
22	7254	2.809	0.433
23	7560	3.682	0.567
24	7884	1.042	0.161
25	8190	2.851	0.439
26	8496	6.636	1.022 —
27	8712	0.927	0.143
28	9144	0.436	0.067
29	9432	0.733	0.113
30	9792	0.502	0.077
31	9954	0.267	0.041
32	10404	0.238	0.037
33	10674	0.229	0.035
34	11016	0.253	0.039
35	11466	0.231	0.036
36	11664	0.344	0.053
37	11934	0.403	0.062
38	12276	0.366	0.056
39	12528	0.486	0.075
40	12888	1.614	0.249
41	13194	1.811	0.279
42	13554	1.662	0.256
43	13824	0.583	0.090
44	14130	0.559	0.086
45	14670	0.309	0.048
46	15012	0.241	0.037
47	15138	0.371	0.057
48	15462	0.271	0.042
49	15786	0.438	0.068
50	16092	0.420	0.065
51	16632	0.170	0.026
52	16974	0.195	0.030
53	17172	0.276	0.043
54	17442	0.199	0.031
55	17910	0.154	0.024

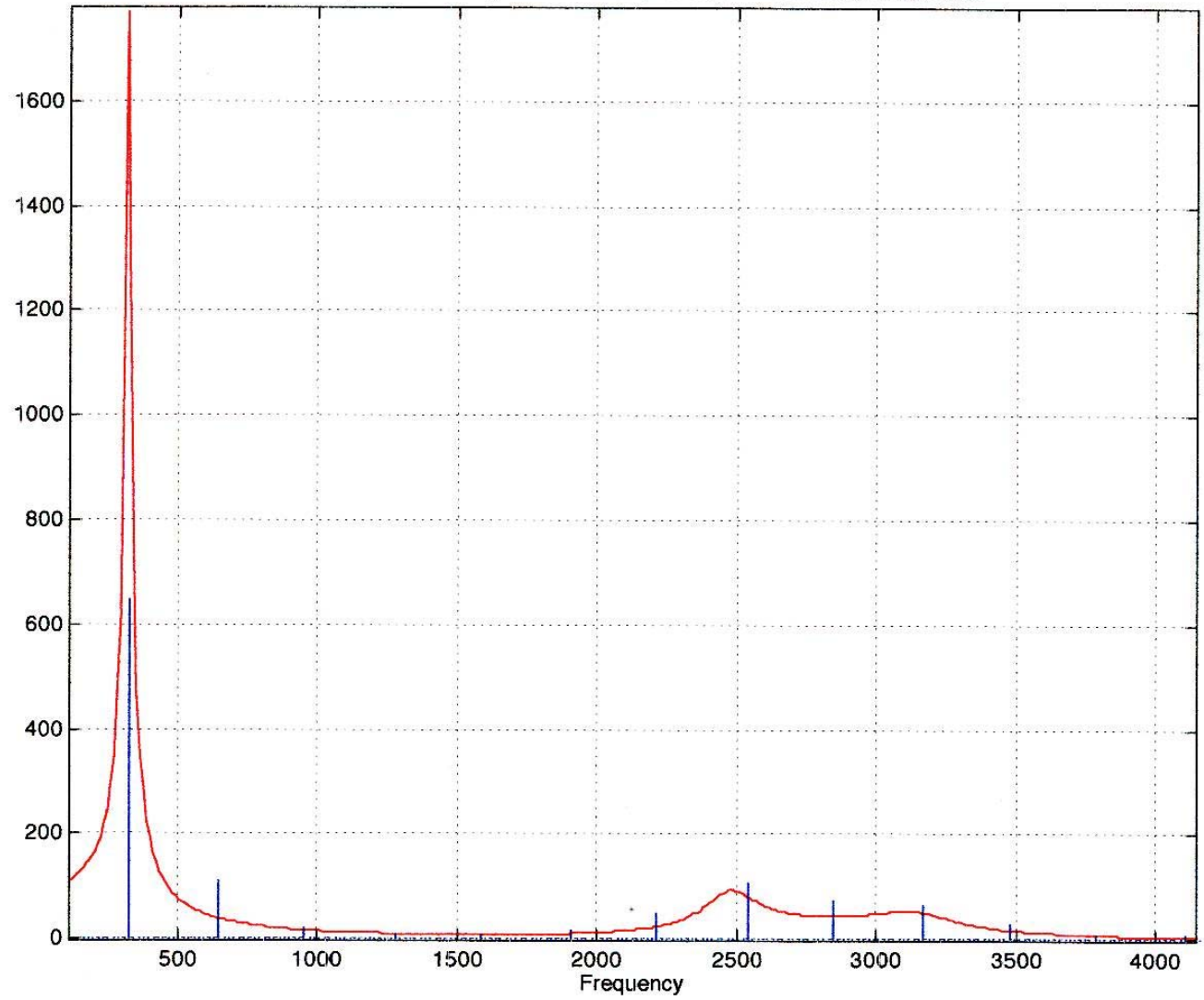
56	18036	0.186	0.029
57	18594	0.266	0.041
58	18720	0.188	0.029
59	18990	0.256	0.039
60	19476	0.171	0.026
61	19692	0.144	0.022
62	20016	0.174	0.027
63	20358	0.145	0.022
64	20808	0.134	0.021
65	21114	0.121	0.019
66	21510	0.114	0.017
67	21744	0.111	0.017
68	22086	0.113	0.017
69	22266	0.104	0.016
70	22716	0.112	0.017
71	23058	0.103	0.016
72	23310	0.107	0.016
73	23706	0.112	0.017
74	18666	0.496	0.076
75	18900	0.418	0.064
76	19152	0.380	0.059
77	19476	0.432	0.067
78	19710	0.382	0.059
79	19890	0.375	0.058
80	20214	0.352	0.054
81	20448	0.393	0.061
82	20754	0.358	0.055
83	20988	0.352	0.054
84	21222	0.350	0.054
85	21456	0.349	0.054
86	21744	0.344	0.053
87	21996	0.339	0.052
88	22086	0.336	0.052
89	22356	0.339	0.052
90	22590	0.338	0.052
91	22932	0.327	0.050
92	23184	0.328	0.051
93	23364	0.326	0.050
94	23706	0.325	0.050
95	22212	0.156	0.024
96	22464	0.149	0.023
97	22770	0.146	0.022
98	22986	0.147	0.023
99	23148	0.160	0.025
100	23454	0.154	0.024
101	23670	0.155	0.024
102	20160	0.179	0.028
103	20430	0.180	0.028
104	20610	0.171	0.026
105	20718	0.158	0.024
106	21042	0.164	0.025
107	21240	0.157	0.024
108	21420	0.141	0.022
109	21564	0.154	0.024
110	21834	0.144	0.022
111	21978	0.138	0.021
112	22104	0.146	0.022
113	22302	0.133	0.021
114	22608	0.144	0.022
115	22824	0.134	0.021

116	22950	0.130	0.020
117	23202	0.139	0.021
118	23418	0.141	0.022
119	23490	0.135	0.021
120	23814	0.133	
0.021			

Stem plot of harmonics for sample B11 approximate pitch "E4" without preemphasis

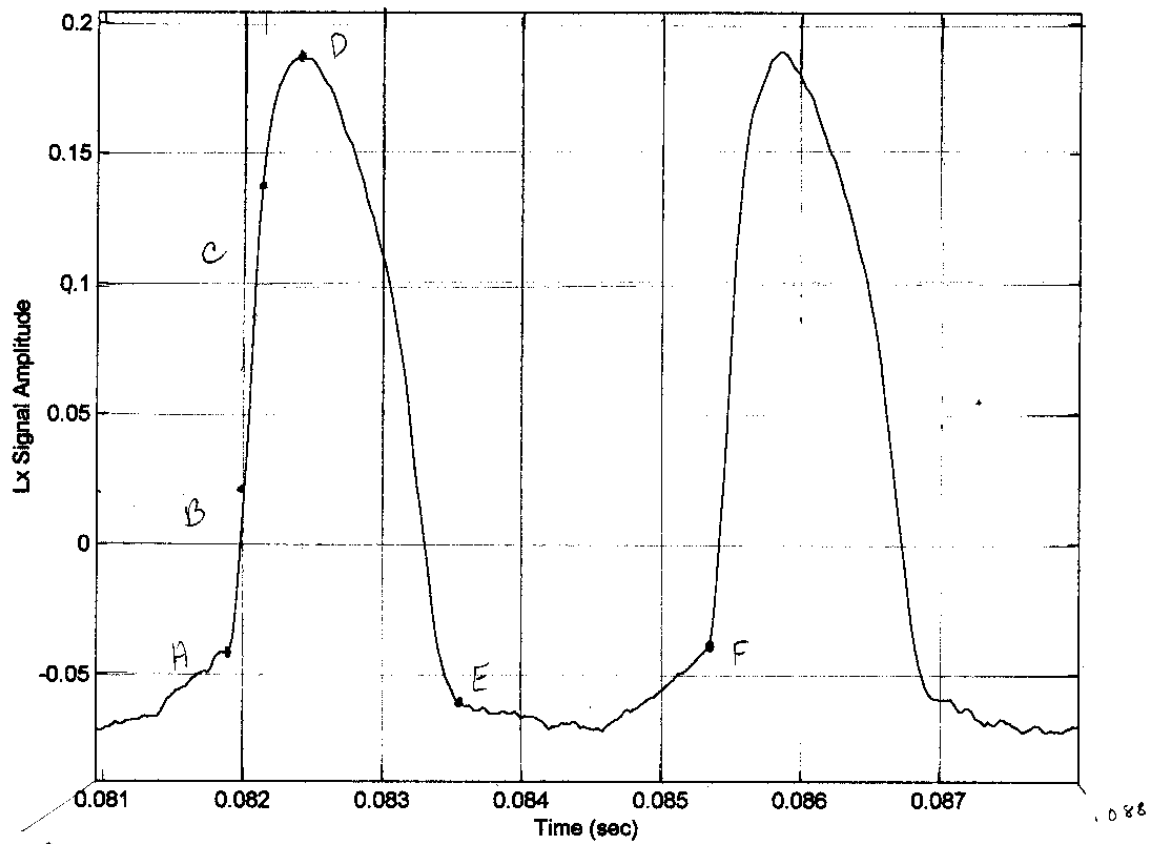


Stem plot/LPC overlay of harmonics for sample B11 without preemphasis



x 22 1/2 mm = .001  
 y 21 mm = .05

EGG B11



8099

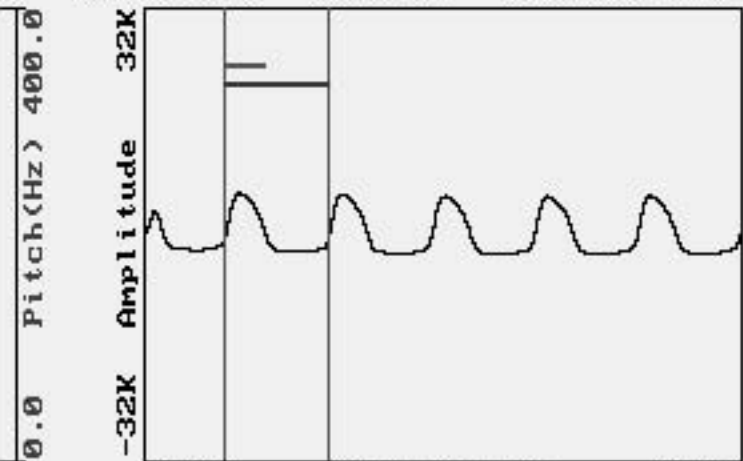
- A (.08189, -.04167)
- B (.082, .01577)
- C (.08213, .13066)
- D (.0824, .18810)
- E (.08353, -.05952)
- F (.08531, -.03810)

**A** > : CH1: B11\_EG~1.NSP

< 0.00 sec 38.96% 286.36 Hz >



Duration 2.50 (sec)



Time (sec) 0.00 0.02

**B** > :

< sec % Hz >



Duration 2.50 (sec)



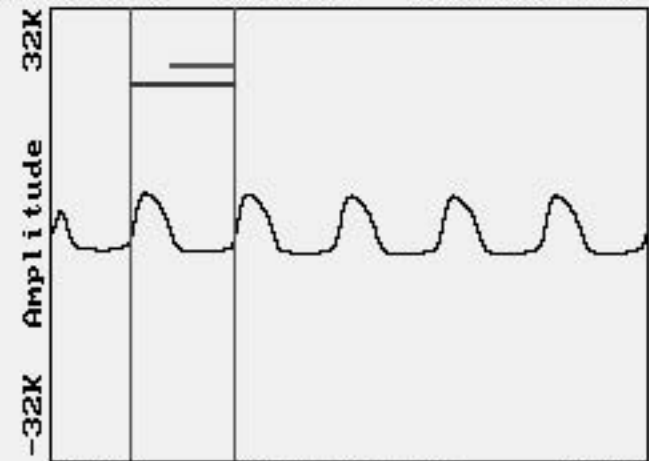
Time (sec)

**A** > : CH1: B11\_EG~1.NSP

< 0.00 sec 61.03% 286.36 Hz >



Duration 2.50 (sec)



**B** > :

< sec % Hz >

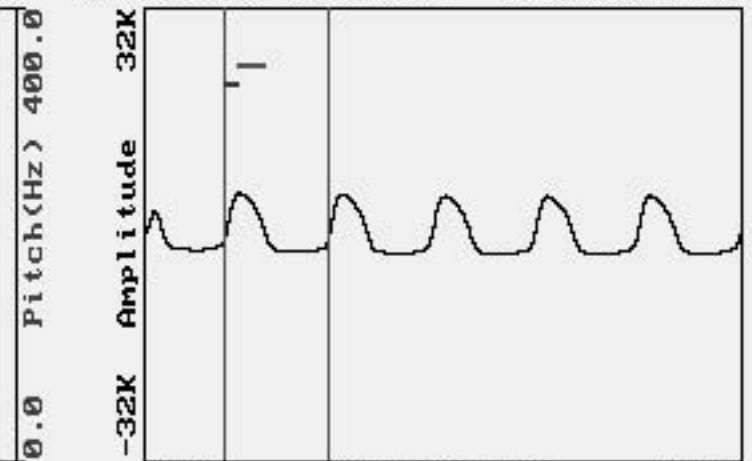


Duration 2.50 (sec)



**A** > : CH1: B11\_EG~1.NSP

< 0.00 sec 200.00% 286.36 Hz >

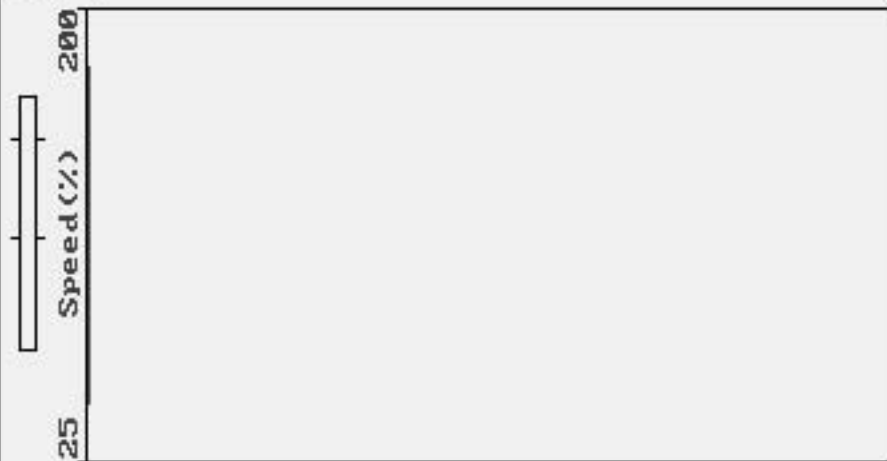


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >

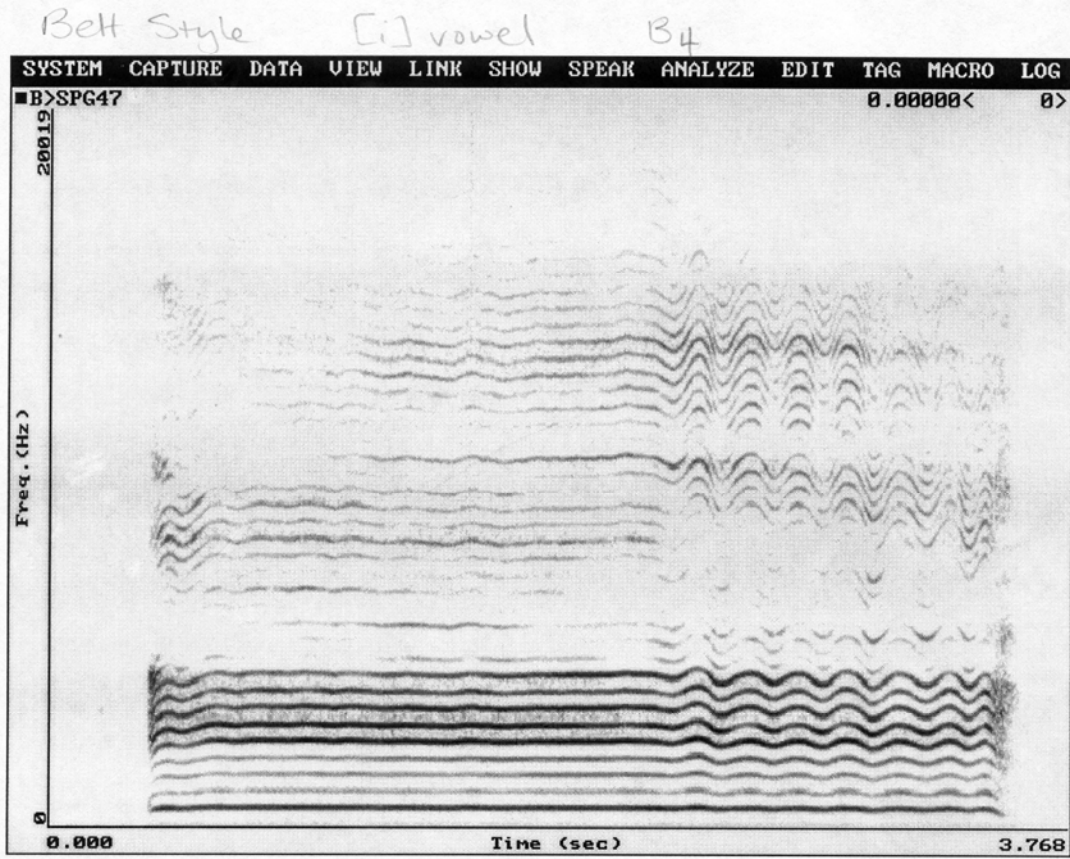


Duration 2.50 (sec)

Pitch(Hz) 400.0

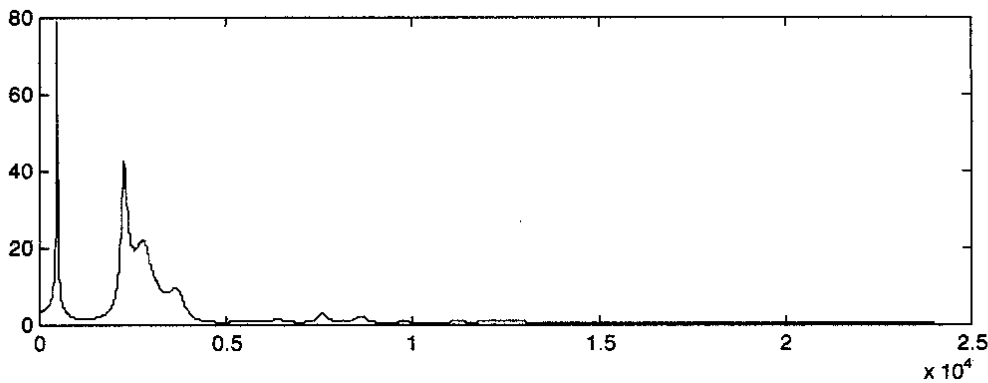
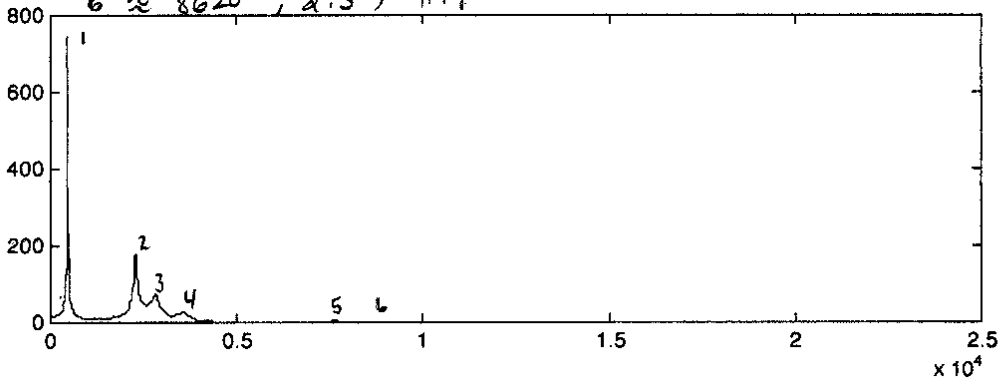
Spectrogram for B21

B21



B21

- Hz      dB      Ass.  $F_0 = 451.53 \text{ Hz}$
- 1 (457.03, 743.33) H1
  - 2 (2273.44, 177.36) H5
  - 3 (2800.78, 74.33) H6-7
  - 4 (3585.94, 25.11) H7-8
  - 5  $\approx$  7617.50, 3.53) H17
  - 6  $\approx$  8620, 2.5) H19



$$F_0 = \frac{11733333 - .037604167}{36 \lambda} = \frac{.079729133 \text{ sec} -}{36}$$

$$T = .0020121698 \text{ sec}$$

$$\frac{1}{T} = 451.53 \text{ Hz}$$

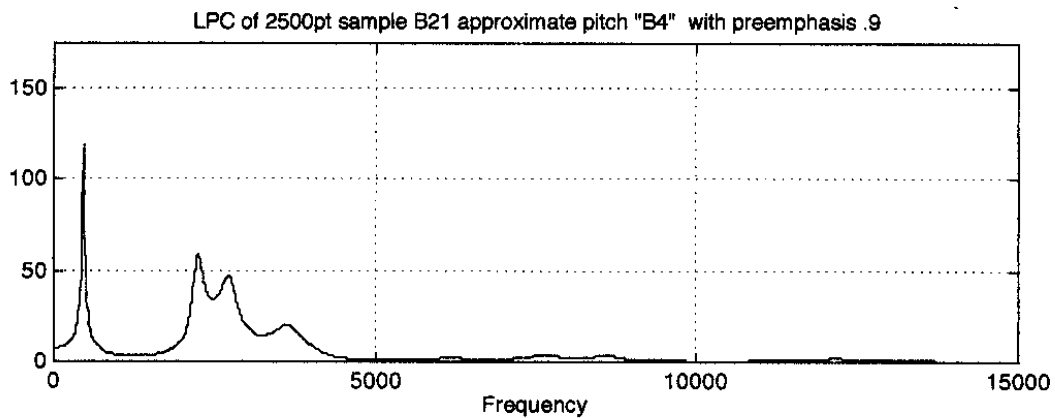
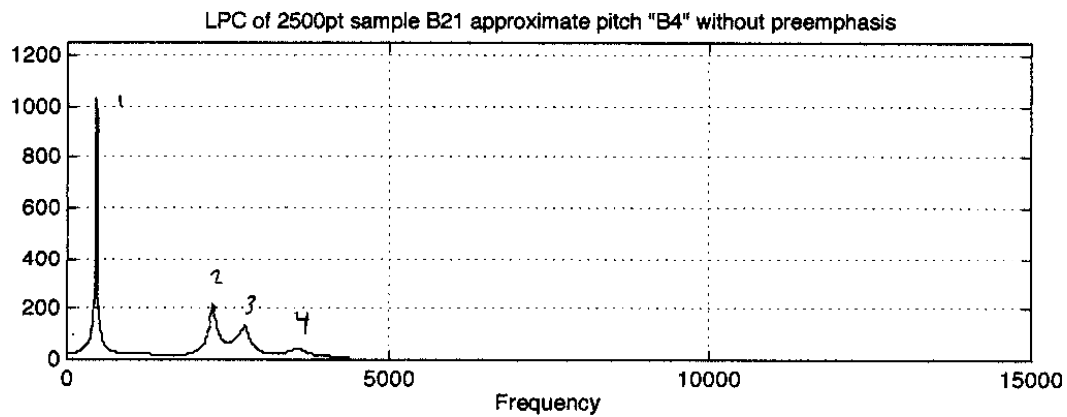
B17

(445.31, 1033.12)

(2261.72, 216.98)

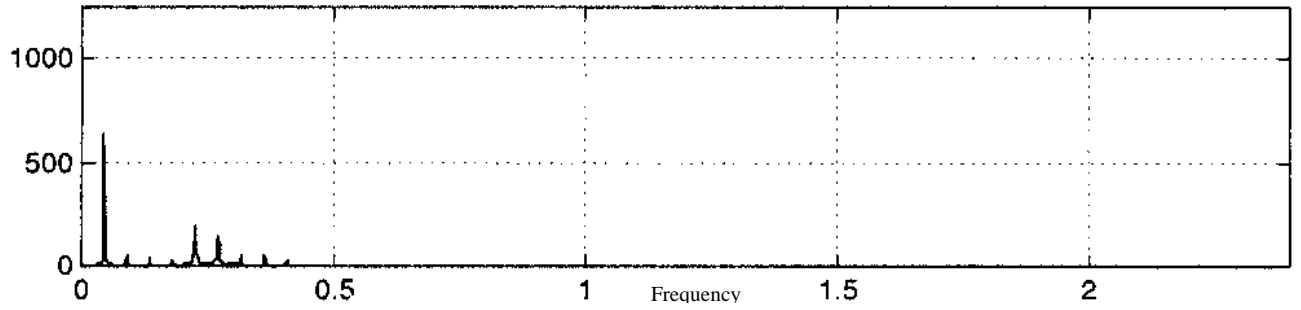
(2753.91, 131.11)

(3597.66, 44.24)



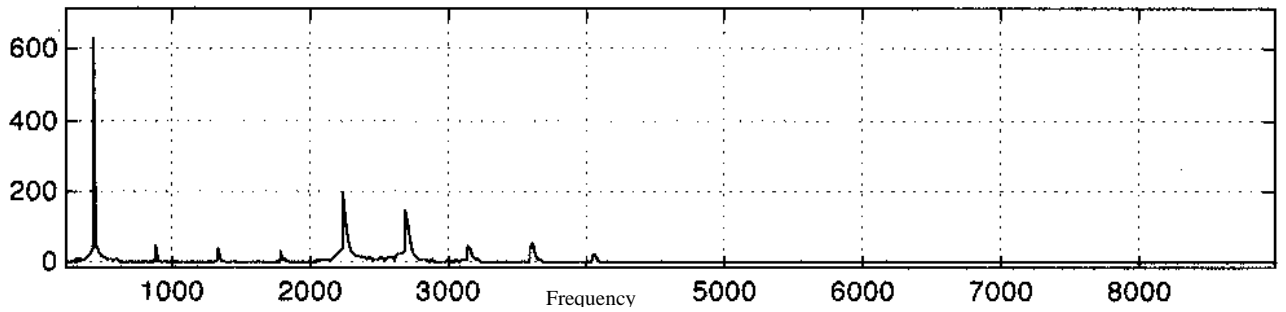
DFT Results for B21 Frequency (Hz) vs Amplitude

sample B21 approximate pitch "B4" without preemphasis

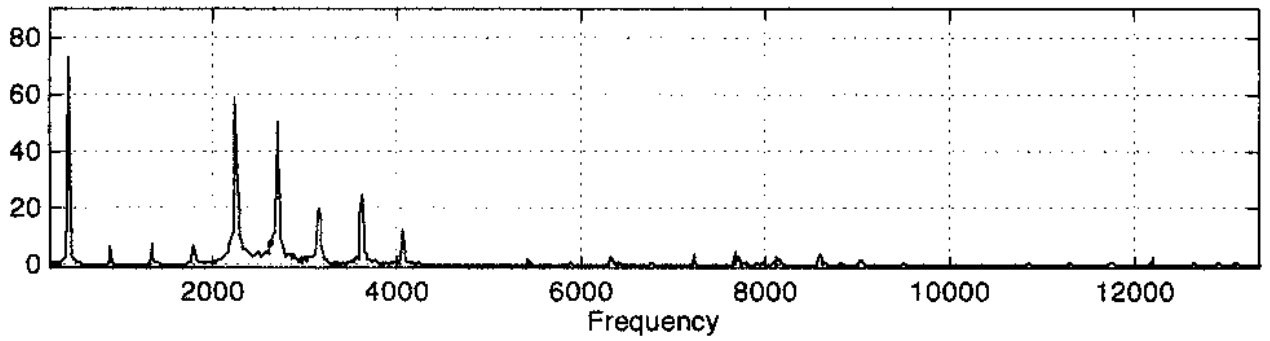


Zoom DFT sample B21 approximate pitch B4 without preemphasis

$\times 10^4$



DFT sample B21 approximate pitch B4 with preemphasis .9



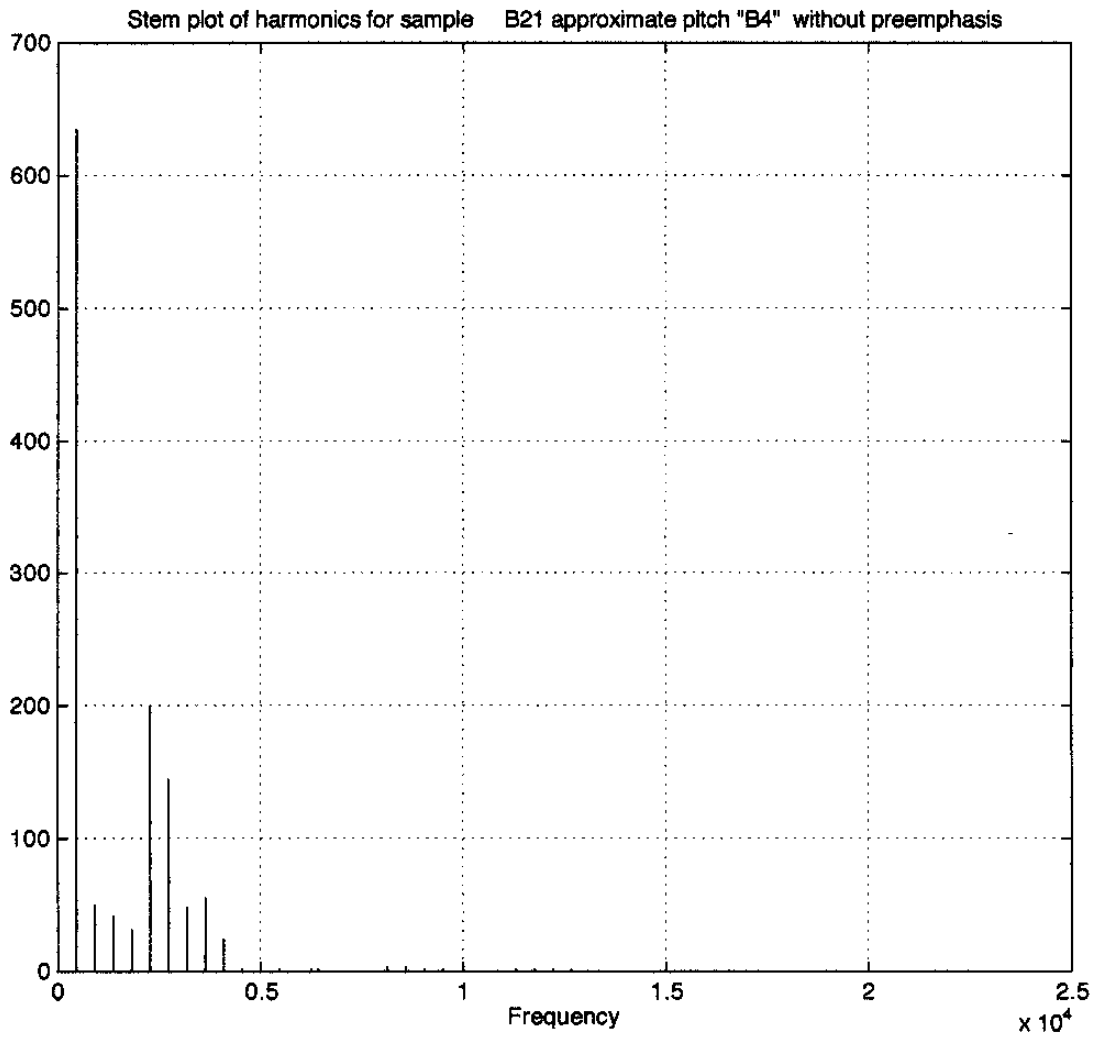
# DFT Numerical Results

Worksheet saved into file: Minitab.B21  
 MTB > Print 'Freq' 'Amp' '% Amp'.

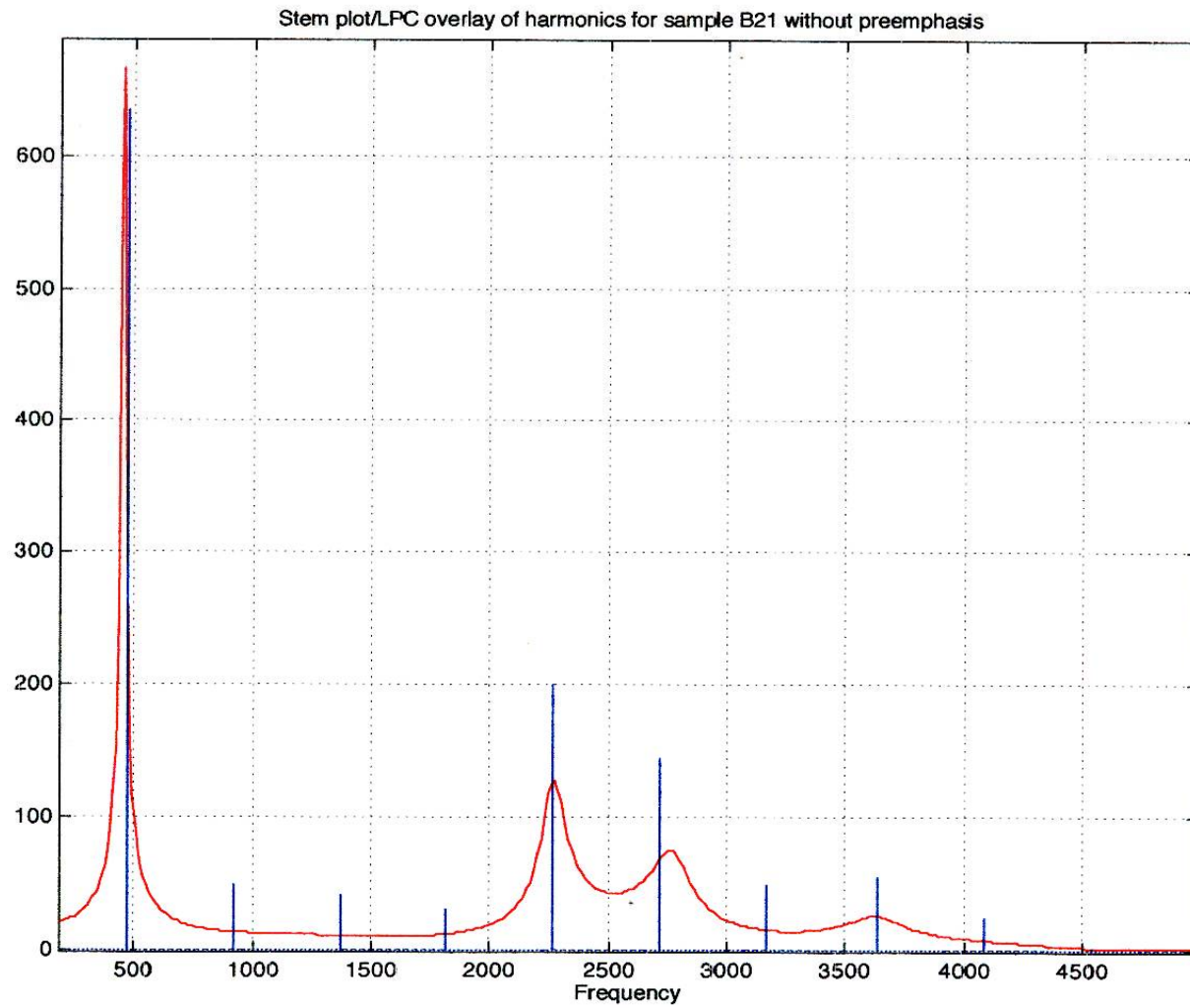
ROW	Freq	Amp	% Amp
1	468	634.609	100.000
2	918	49.613	7.818
3	1368	41.952	6.611
4	1818	30.349	4.782
5	2268	199.943	31.506
6	2718	145.463	22.922
7	3168	48.826	7.694
8	3636	55.429	8.734
9	4086	24.931	3.929
10	4536	1.392	0.219
11	5004	1.124	0.177
12	5436	2.069	0.326
13	6228	1.038	0.163
14	6426	1.528	0.241
15	7146	0.677	0.107
16	7308	0.719	0.113
17	8136	3.911	0.616
18	8586	3.724	0.587
19	9036	2.053	0.323
20	9486	0.868	0.137
21	9972	0.553	0.087
22	10404	0.583	0.092
23	10854	0.857	0.135
24	11304	1.028	0.162
25	11754	1.128	0.178
26	12204	1.956	0.308
27	12654	0.901	0.142
28	13050	0.625	0.098
29	13572	0.496	0.078
30	13986	0.460	0.072
31	14670	0.436	0.069
32	14904	0.397	0.063
33	15354	0.376	0.059
34	15822	0.791	0.125
35	16254	0.319	0.050
36	16794	0.344	0.054
37	17154	0.348	0.055
38	17640	0.284	0.045
39	18378	0.265	0.042
40	18702	0.280	0.044
41	19278	0.262	0.041
42	19728	0.260	0.041
43	20106	0.256	0.040
44	20682	0.251	0.040
45	20952	0.238	0.037
46	21456	0.251	0.040
47	21852	0.247	0.039
48	22410	0.246	0.039
49	22806	0.244	0.038
50	23472	0.236	0.037
51	16632	0.170	0.027
52	16974	0.195	0.031
53	17172	0.276	0.044
54	17442	0.199	0.031
55	17910	0.154	0.024

56	18036	0.186	0.029
57	18594	0.266	0.042
58	18720	0.188	0.030
59	18990	0.256	0.040
60	19476	0.171	0.027
61	19692	0.144	0.023
62	20016	0.174	0.027
63	20358	0.145	0.023
64	20808	0.134	0.021
65	21114	0.121	0.019
66	21510	0.114	0.018
67	21744	0.111	0.017
68	22086	0.113	0.018
69	22266	0.104	0.016
70	22716	0.112	0.018
71	23058	0.103	0.016
72	23310	0.107	0.017
73	23706	0.112	0.018
74	18666	0.496	0.078
75	18900	0.418	0.066
76	19152	0.380	0.060
77	19476	0.432	0.068
78	19710	0.382	0.060
79	19890	0.375	0.059
80	20214	0.352	0.055
81	20448	0.393	0.062
82	20754	0.358	0.056
83	20988	0.352	0.055
84	21222	0.350	0.055
85	21456	0.349	0.055
86	21744	0.344	0.054
87	21996	0.339	0.053
88	22086	0.336	0.053
89	22356	0.339	0.053
90	22590	0.338	0.053
91	22932	0.327	0.052
92	23184	0.328	0.052
93	23364	0.326	0.051
94	23706	0.325	0.051
95	22212	0.156	0.025
96	22464	0.149	0.023
97	22770	0.146	0.023
98	22986	0.147	0.023
99	23148	0.160	0.025
100	23454	0.154	0.024
101	23670	0.155	0.024
102	20160	0.179	0.028
103	20430	0.180	0.028
104	20610	0.171	0.027
105	20718	0.158	0.025
106	21042	0.164	0.026
107	21240	0.157	0.025
108	21420	0.141	0.022
109	21564	0.154	0.024
110	21834	0.144	0.023
111	21978	0.138	0.022
112	22104	0.146	0.023
113	22302	0.133	0.021
114	22608	0.144	0.023
115	22824	0.134	0.021

116	22950	0.130	0.020
117	23202	0.139	0.022
118	23418	0.141	0.022
119	23490	0.135	0.021
120	23814	0.133	0.021



# DFT/LPC Overlay of B21

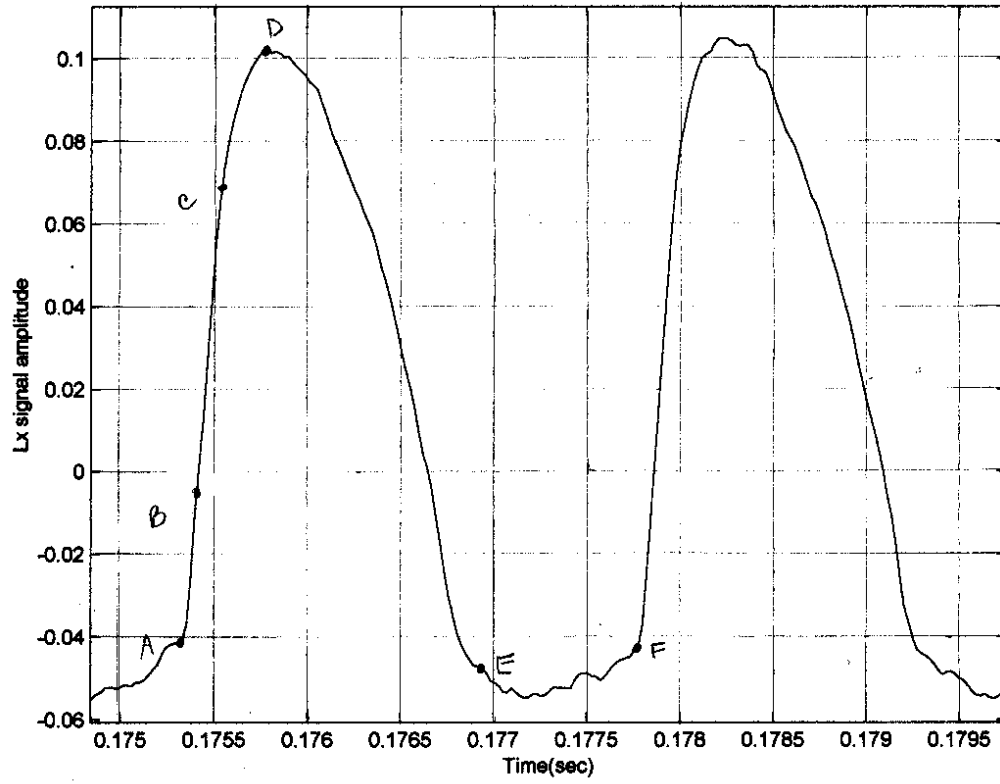


x 16 mm = 1.0005

y 15 mm = 1.02

1 mm = 1.00133

EGG B21

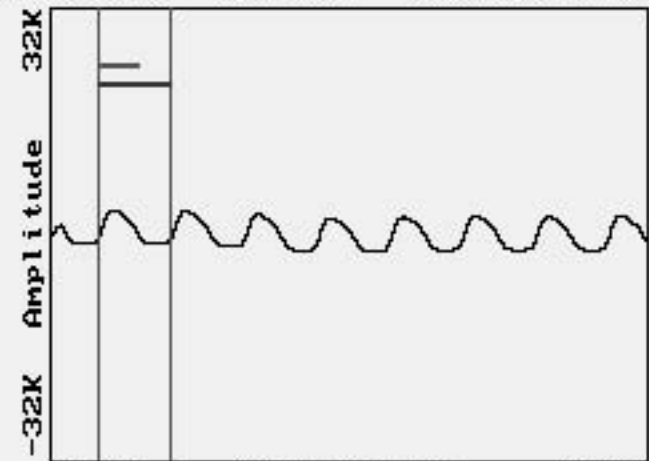


**A** > : CH1: B21\_EG~1.NSP

< 0.00 sec 53.70% 408.33 Hz >



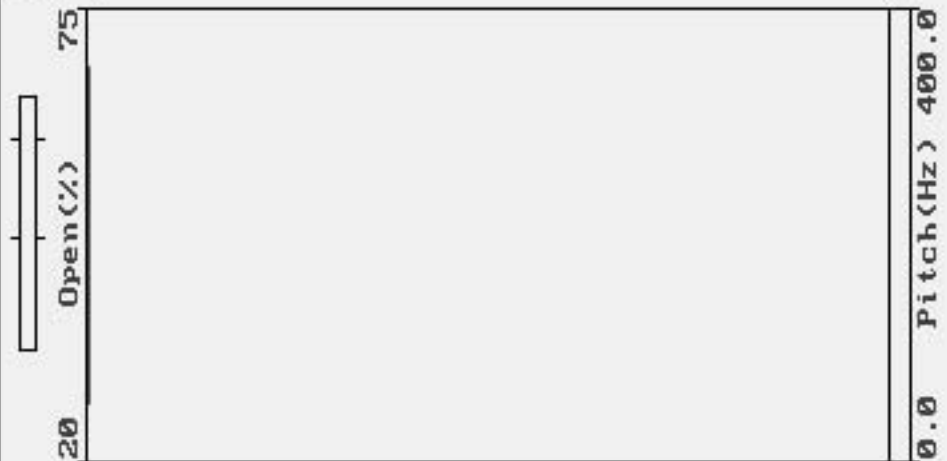
Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

< sec % Hz >



Duration 2.50 (sec)



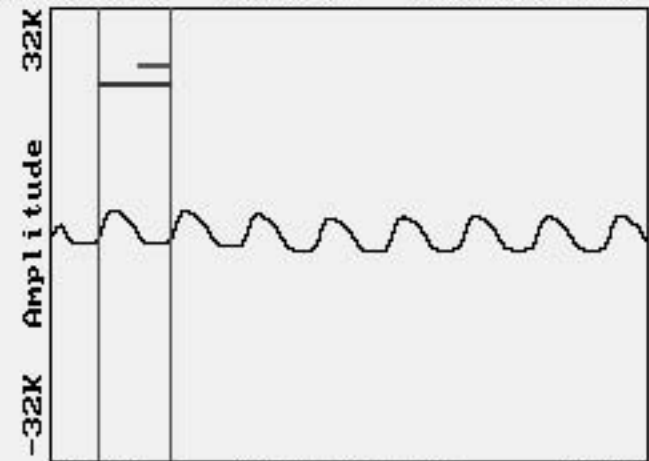
Time (sec)

**A** > : CH1: B21\_EG~1.NSP

< 0.00 sec 46.29% 408.33 Hz >

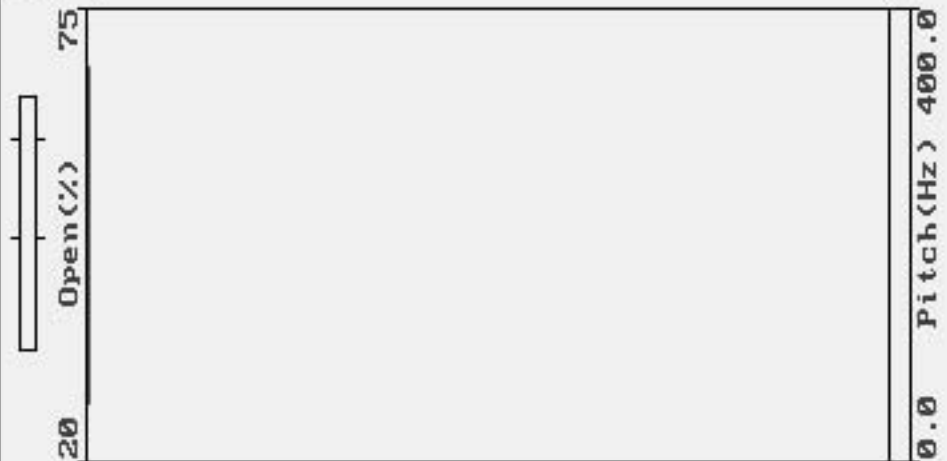


Duration 2.50 (sec)



**B** > :

< sec % Hz >

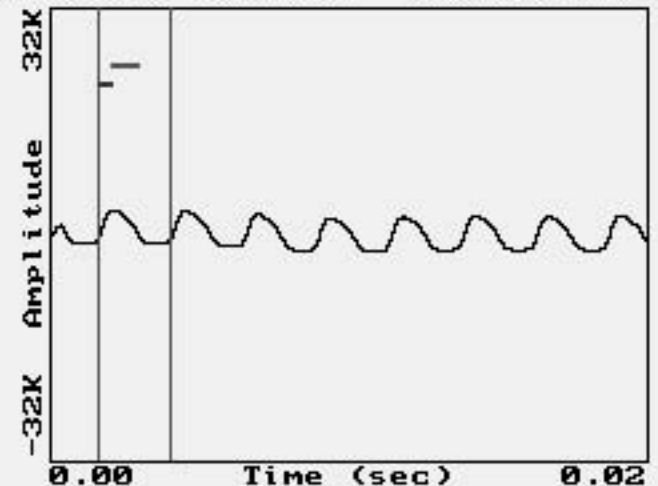


Duration 2.50 (sec)



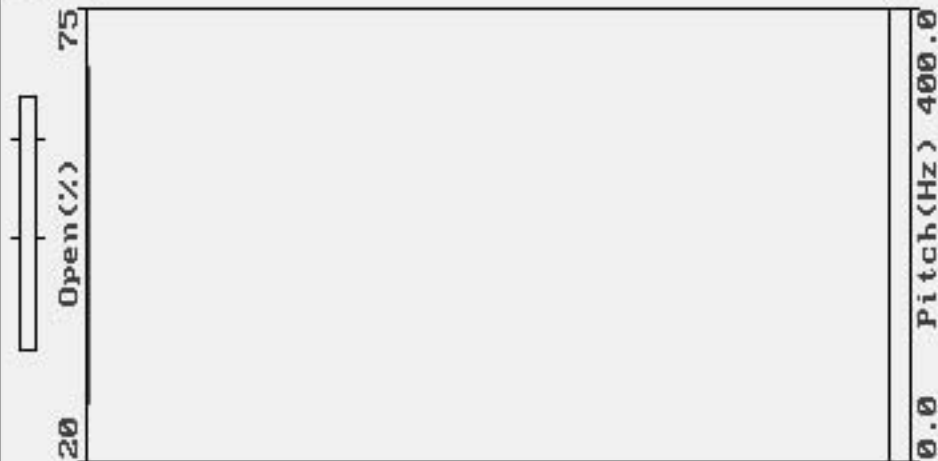
**A** > : CH1: B21\_EG~1.NSP

< 0.00 sec 190.00% 408.33 Hz >



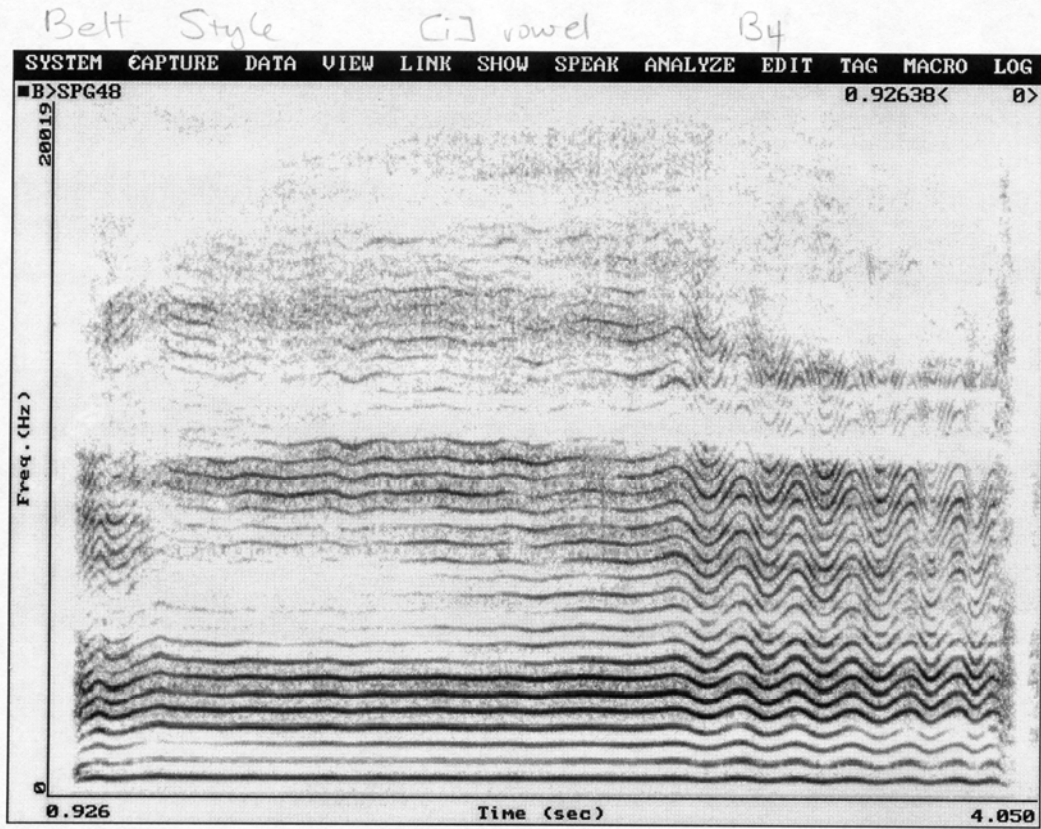
**B** > :

< sec % Hz >



Spectrogram for B31

B31

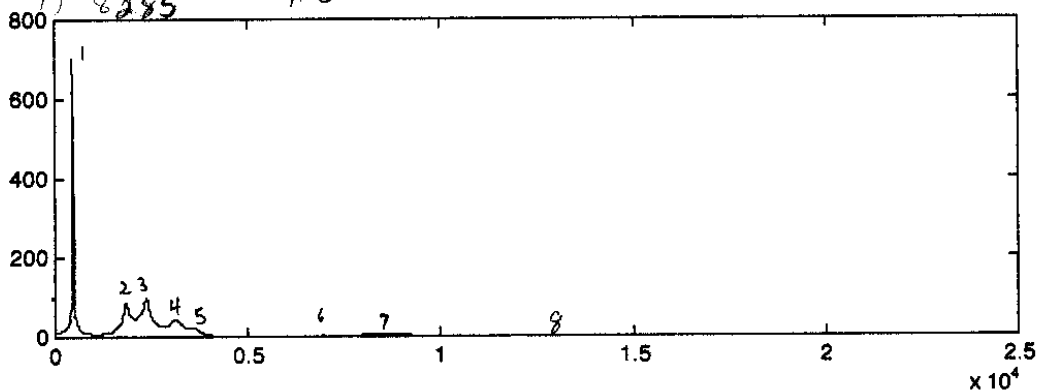


B31

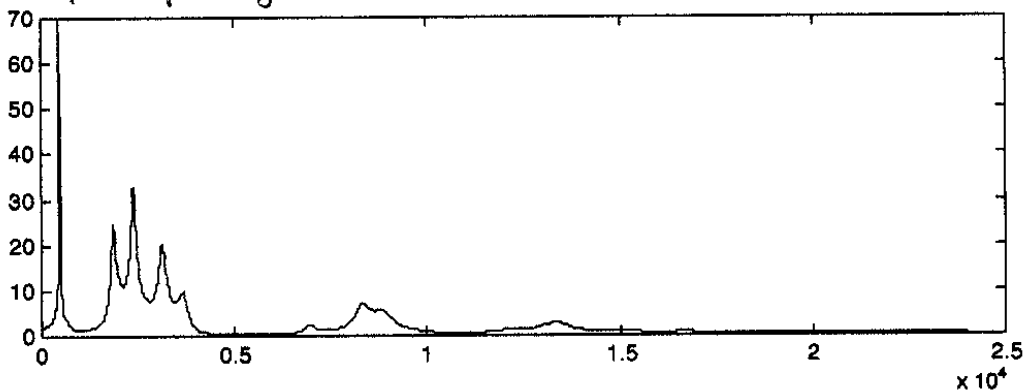
$F_0 = 462.59$

	Freq.	Amp
1)	468.75	702.41
2)	1839.85	84.60
3)	2355.47	96.93
4)	3117.19	45.64
5)	3621	20.15
6)	6970	2.0
7)	8285	7.0

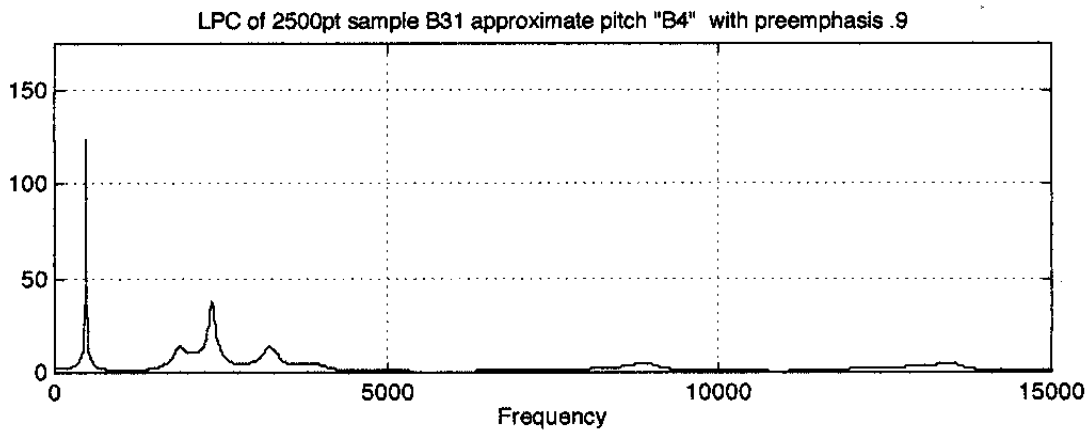
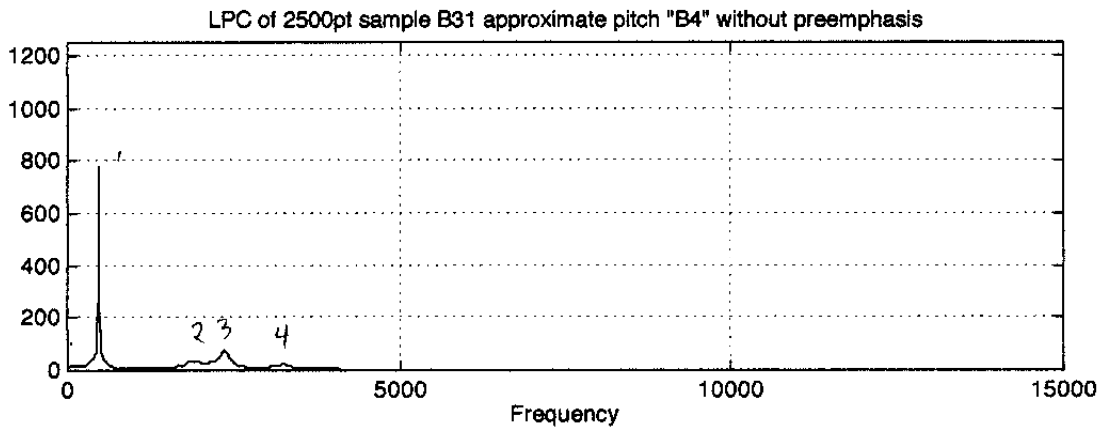
8) 13370 2.0



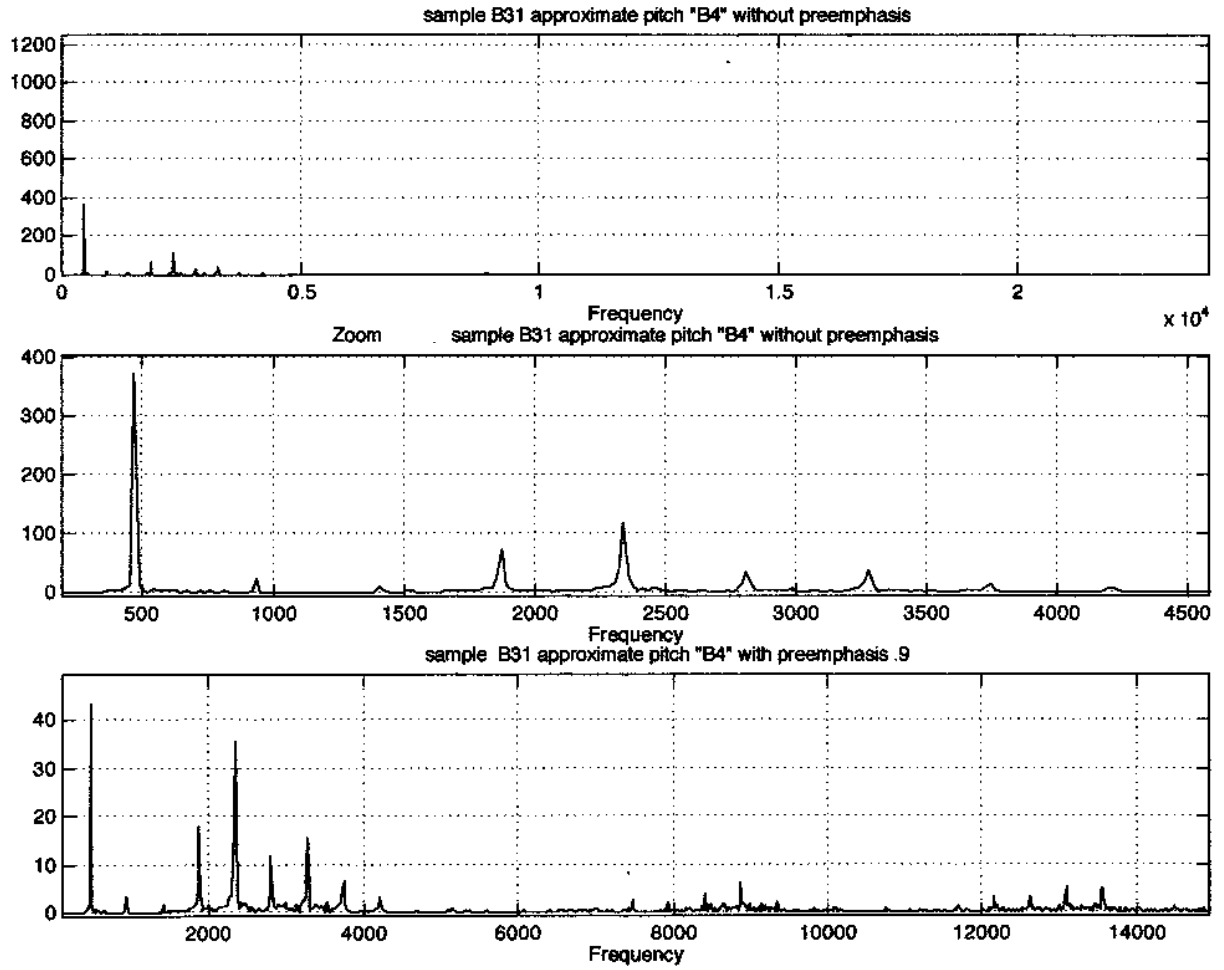
preemphasized  $b = .9$ .



(468.75, 778.93)  
(1898.44, 34.89)  
(2367.19, 76.90)  
(3257.81, 22.35)



# DFT Results

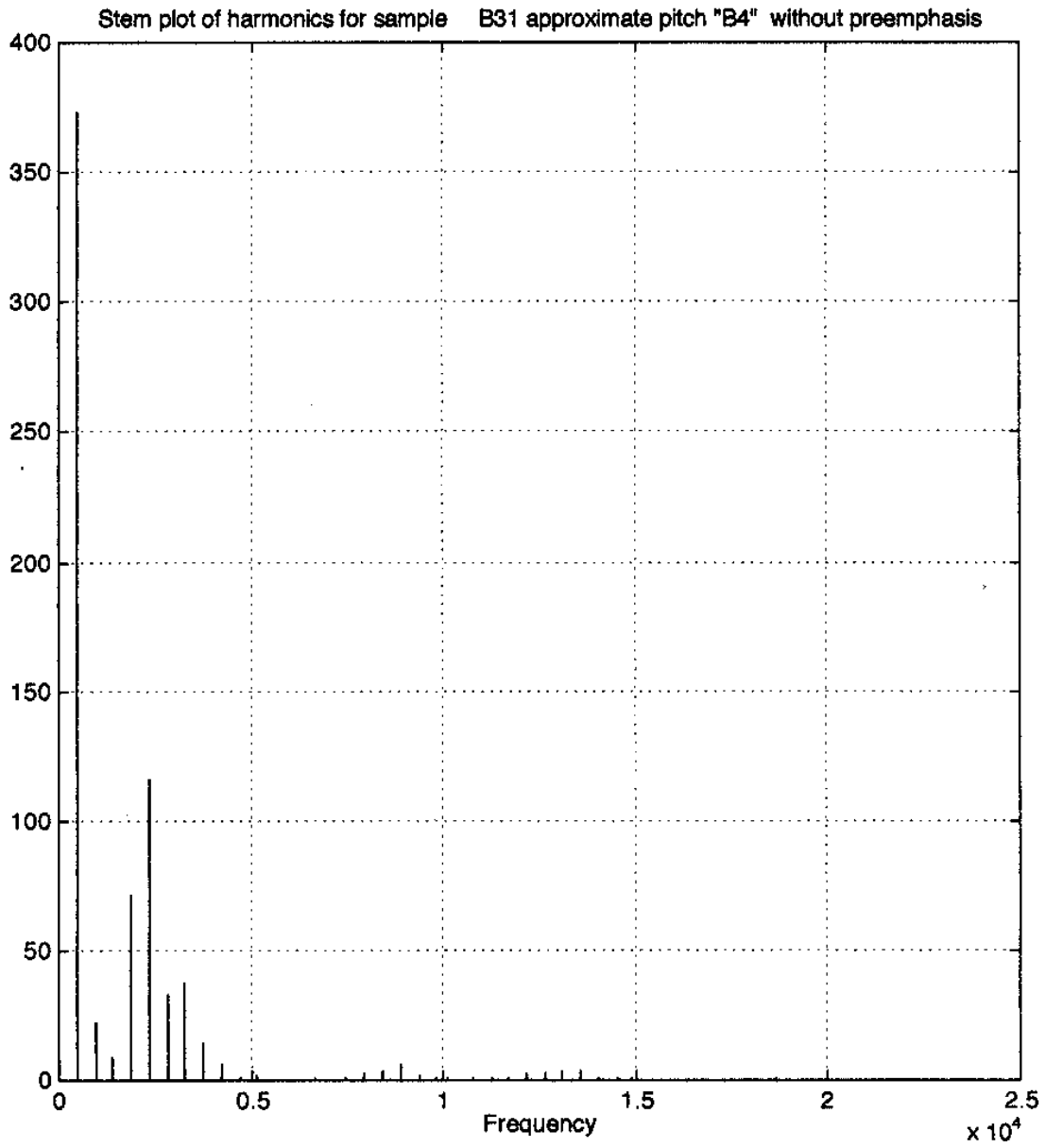


# DFT Numerical Results

ROW	Freq	Amp	% Amp
1	486	373.442	100.000 —
2	954	22.238	5.955
3	1422	8.784	2.352
4	1890	71.677	19.194
5	2358	115.668	30.974 —
6	2826	33.253	8.905
7	3294	37.034	9.917
8	3762	14.136	3.785
9	4230	6.289	1.684
10	4698	0.723	0.194
11	5166	1.405	0.376
12	5958	0.266	0.071
13	6426	0.392	0.105
14	6678	0.802	0.215
15	7452	0.849	0.227
16	7956	2.450	0.656
17	8424	3.758	1.006
18	8892	5.797	1.552 —
19	9360	2.057	0.551
20	9828	0.965	0.258
21	10098	0.905	0.242
22	10764	0.868	0.233
23	11232	0.474	0.127
24	11700	1.095	0.293
25	12168	2.413	0.646
26	12636	2.457	0.658
27	13104	3.864	1.035 —
28	13572	3.466	0.928
29	14040	0.741	0.199
30	14508	0.763	0.204
31	14886	0.542	0.145
32	15462	0.306	0.082
33	16038	0.176	0.047
34	16470	0.102	0.027
35	17172	0.090	0.024
36	17550	0.102	0.027
37	18108	0.195	0.052
38	18324	0.267	0.071
39	18792	0.295	0.079
40	19332	0.129	0.035
41	20106	0.114	0.030
42	20574	0.158	0.042
43	21024	0.097	0.026
44	21510	0.131	0.035
45	21690	0.112	0.030
46	22194	0.060	0.016
47	22824	0.052	0.014
48	23328	0.046	0.012
49	22806	0.244	0.065
50	23472	0.236	0.063
51	16632	0.170	0.046
52	16974	0.195	0.052
53	17172	0.276	0.074
54	17442	0.199	0.053
55	17910	0.154	0.041
56	18036	0.186	0.050
57	18594	0.266	0.071
58	18720	0.188	0.050

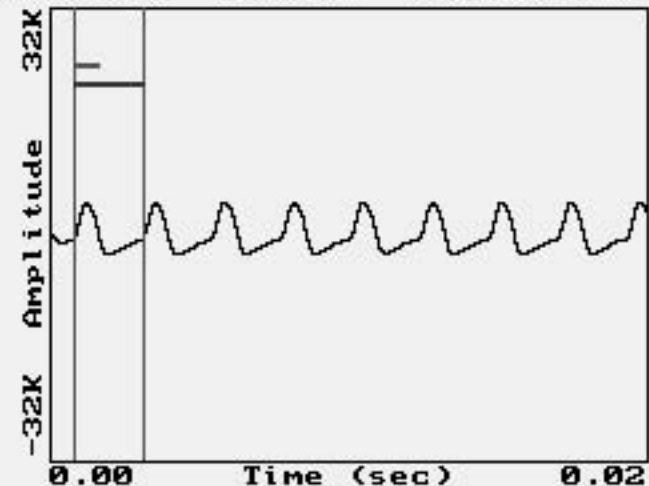
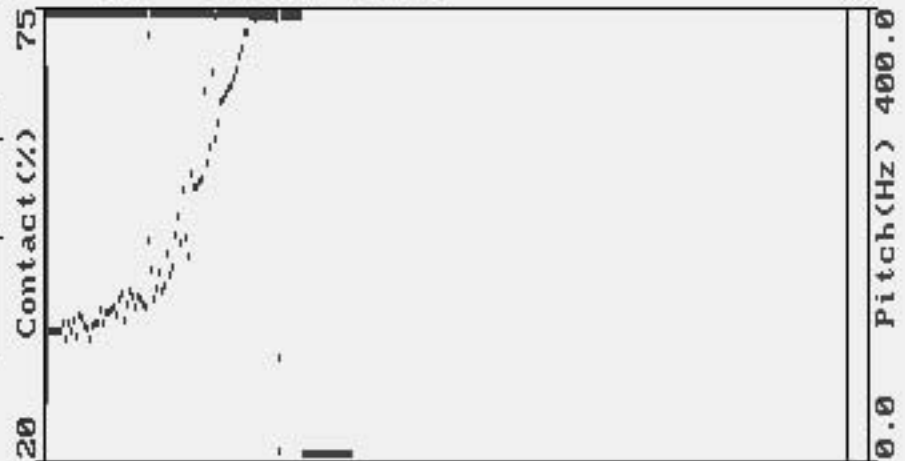
59	18990	0.256	0.069
60	19476	0.171	0.046
61	19692	0.144	0.039
62	20016	0.174	0.047
63	20358	0.145	0.039
64	20808	0.134	0.036
65	21114	0.121	0.032
66	21510	0.114	0.030
67	21744	0.111	0.030
68	22086	0.113	0.030
69	22266	0.104	0.028
70	22716	0.112	0.030
71	23058	0.103	0.028
72	23310	0.107	0.029
73	23706	0.112	0.030
74	18666	0.496	0.133
75	18900	0.418	0.112
76	19152	0.380	0.102
77	19476	0.432	0.116
78	19710	0.382	0.102
79	19890	0.375	0.100
80	20214	0.352	0.094
81	20448	0.393	0.105
82	20754	0.358	0.096
83	20988	0.352	0.094
84	21222	0.350	0.094
85	21456	0.349	0.093
86	21744	0.344	0.092
87	21996	0.339	0.091
88	22086	0.336	0.090
89	22356	0.339	0.091
90	22590	0.338	0.090
91	22932	0.327	0.088
92	23184	0.328	0.088
93	23364	0.326	0.087
94	23706	0.325	0.087
95	22212	0.156	0.042
96	22464	0.149	0.040
97	22770	0.146	0.039
98	22986	0.147	0.039
99	23148	0.160	0.043
100	23454	0.154	0.041
101	23670	0.155	0.042
102	20160	0.179	0.048
103	20430	0.180	0.048
104	20610	0.171	0.046
105	20718	0.158	0.042
106	21042	0.164	0.044
107	21240	0.157	0.042
108	21420	0.141	0.038
109	21564	0.154	0.041
110	21834	0.144	0.039
111	21978	0.138	0.037
112	22104	0.146	0.039
113	22302	0.133	0.036
114	22608	0.144	0.039
115	22824	0.134	0.036
116	22950	0.130	0.035
117	23202	0.139	0.037
118	23418	0.141	0.038

119 23490 0.135 0.036  
120 23814 0.133  
0.036



**A** > : CH1: B31\_EG~1.NSP

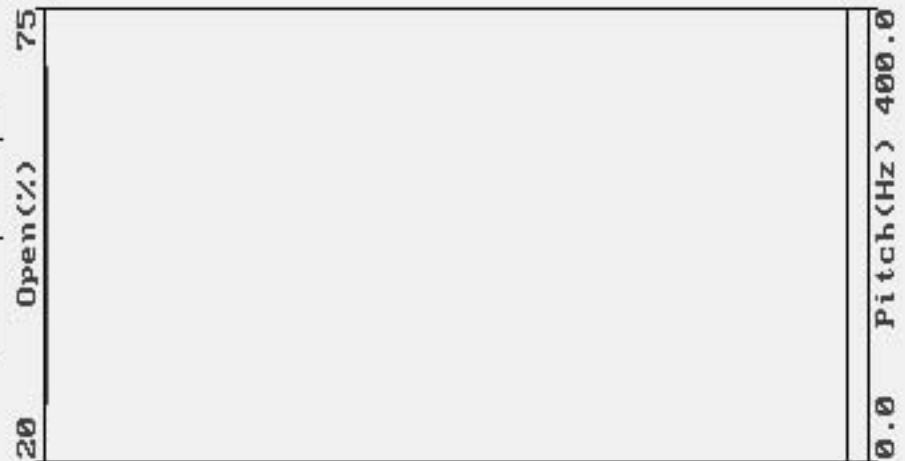
< 0.00 sec 33.98% 428.16 Hz >



Duration 2.50 (sec)

**B** > :

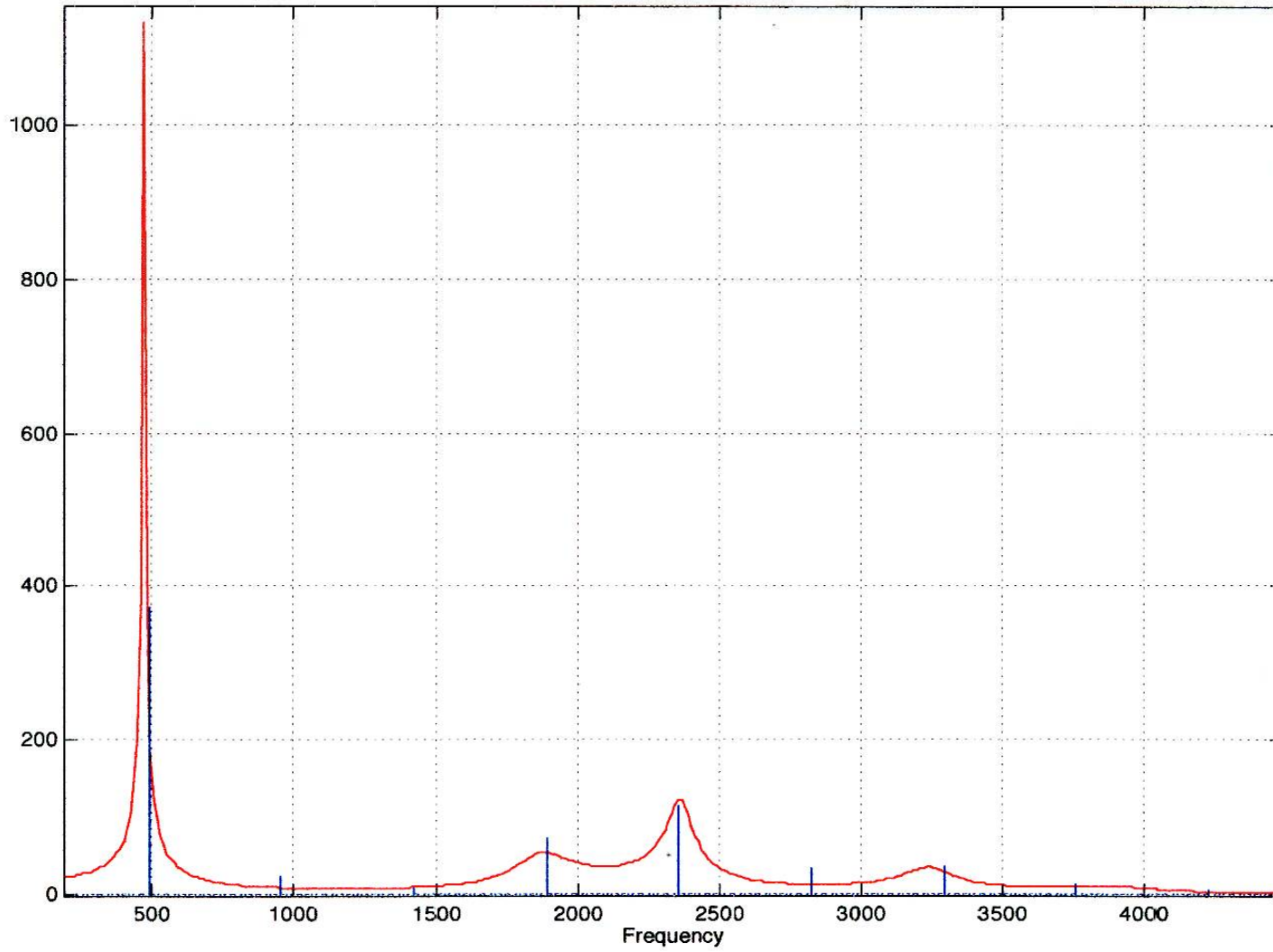
< sec % Hz >



Duration 2.50 (sec)

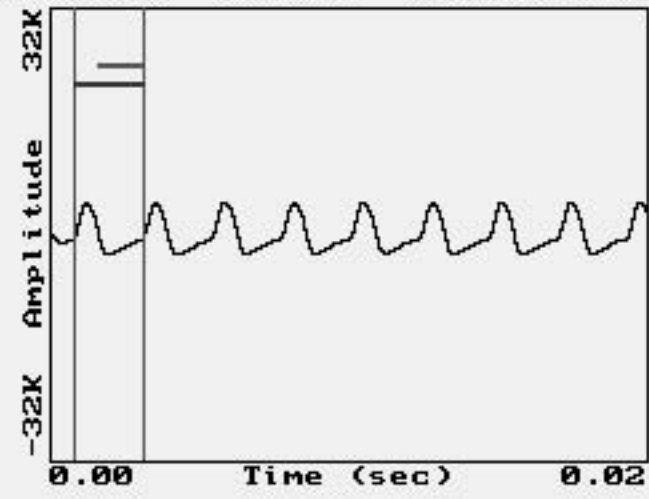
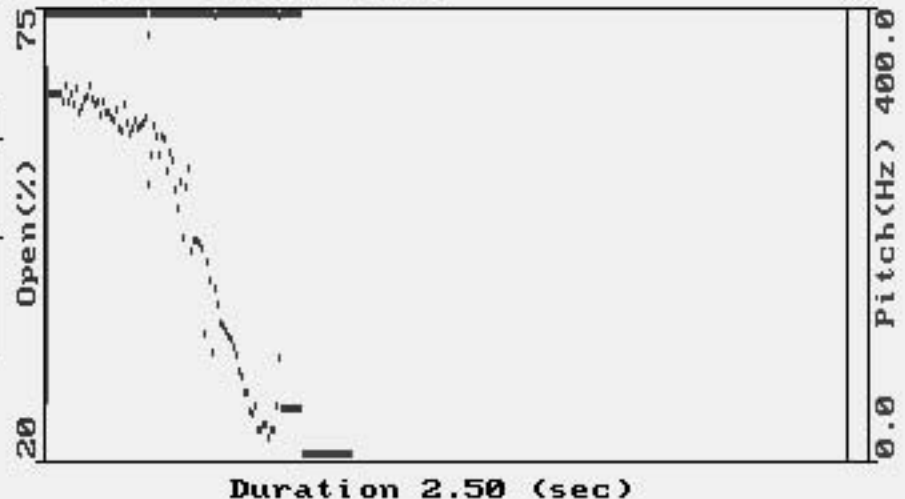
# DFT/LPC Overlay

Stem plot/LPC overlay of harmonics for sample B31 without preemphasis



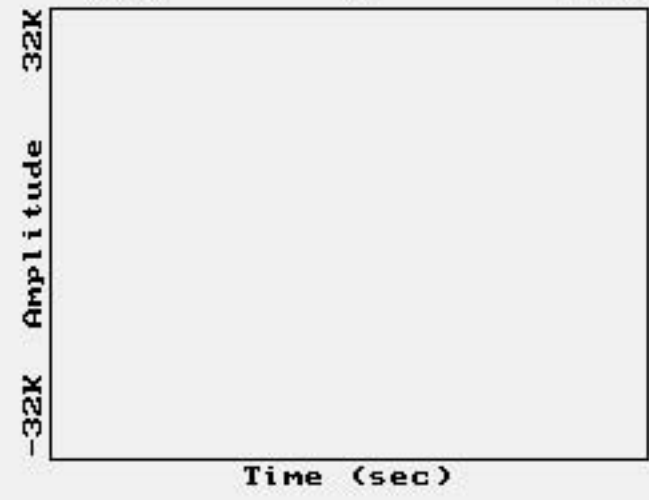
■A> : CH1: B31\_EG~1.NSP

< 0.00 sec 66.01% 428.16 Hz >



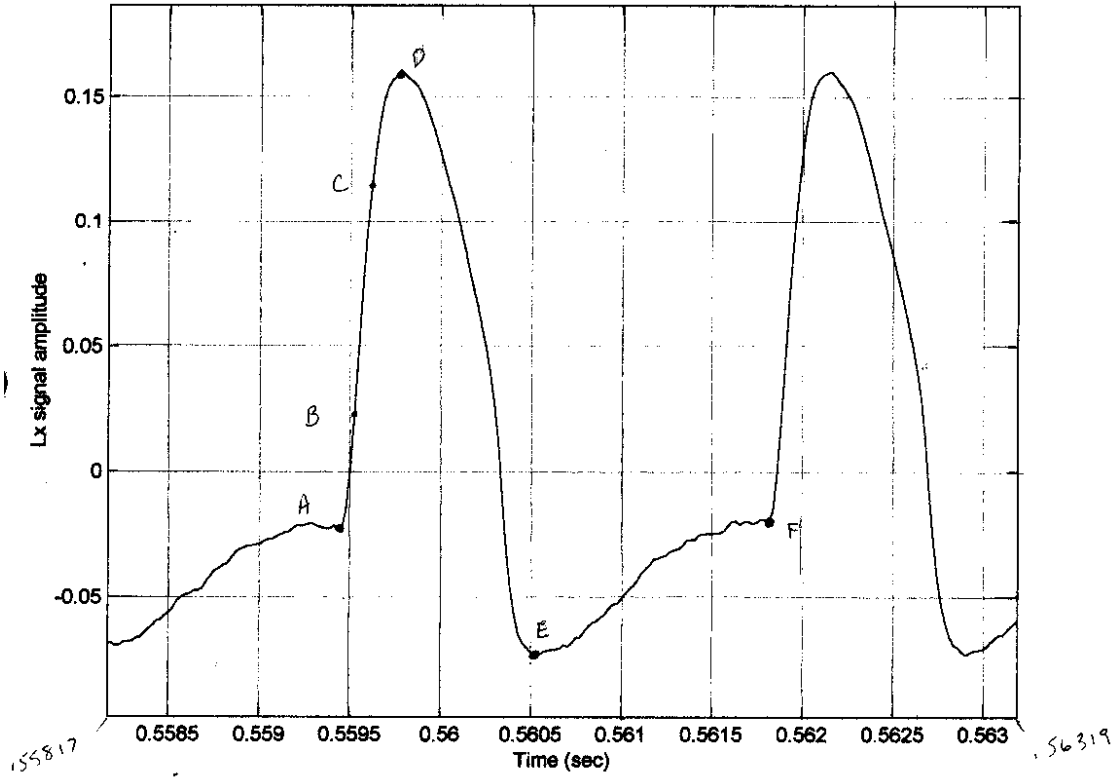
□B> :

< sec % Hz >



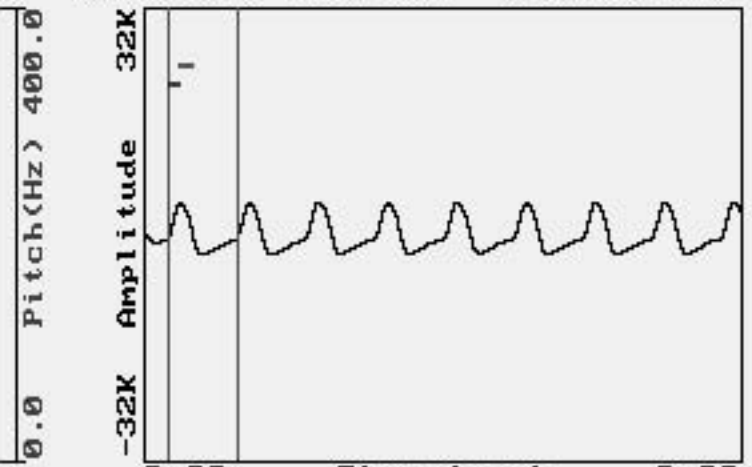
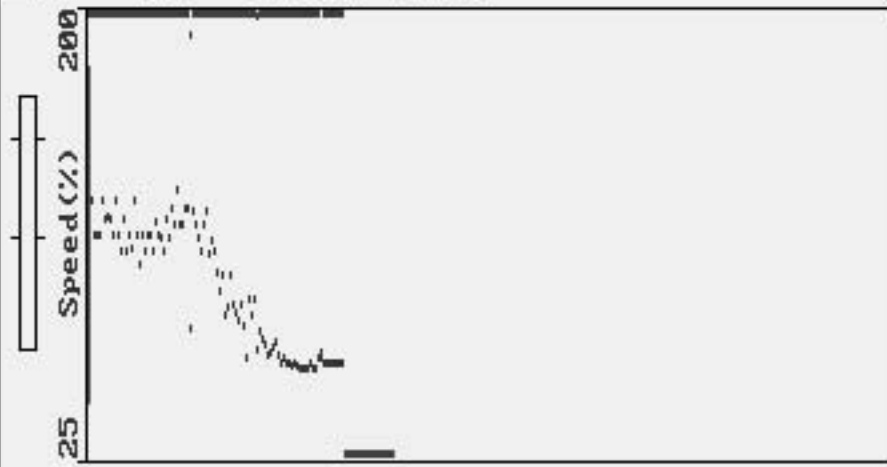
X 16 mm = .0005  
Y 22 mm = .05      .00227 =

EGG B31



**A** > : CH1: B31\_EG~1.NSP

< 0.00 sec 118.75% 428.16 Hz >

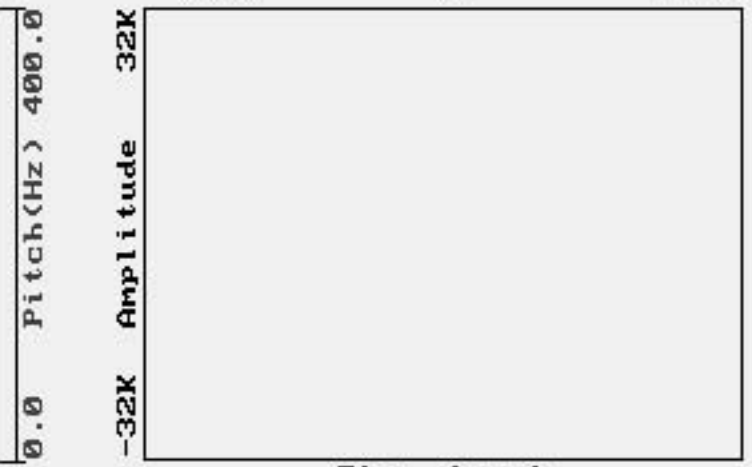


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >



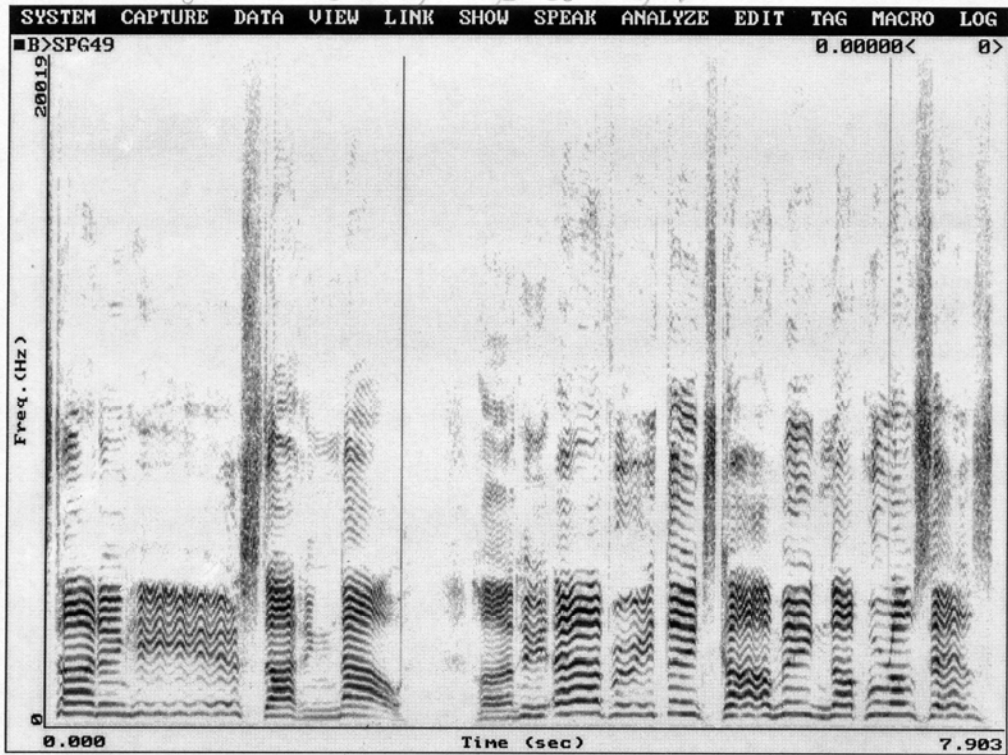
Duration 2.50 (sec)

Pitch(Hz) 400.0

Spectrogram for B40a entire running sample

B40 a  
entire

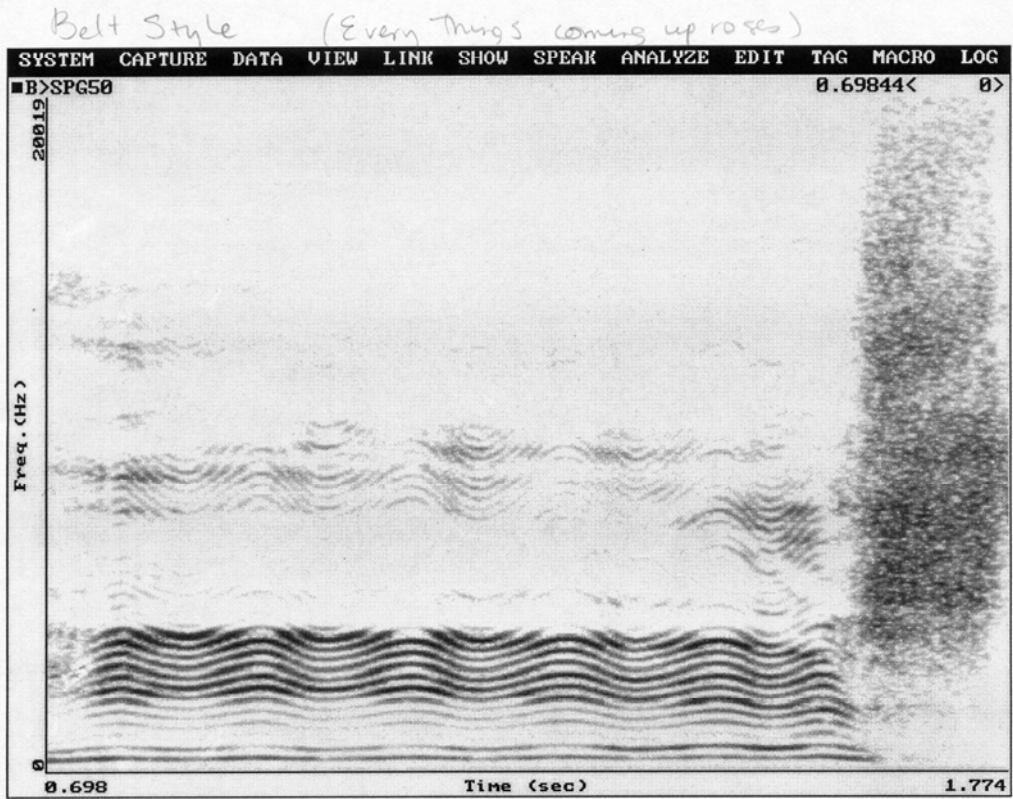
Belt Style (Everything's Coming up Roses)



starting here starting how honey every thing coming up roses

Spectrogram B40b "here"

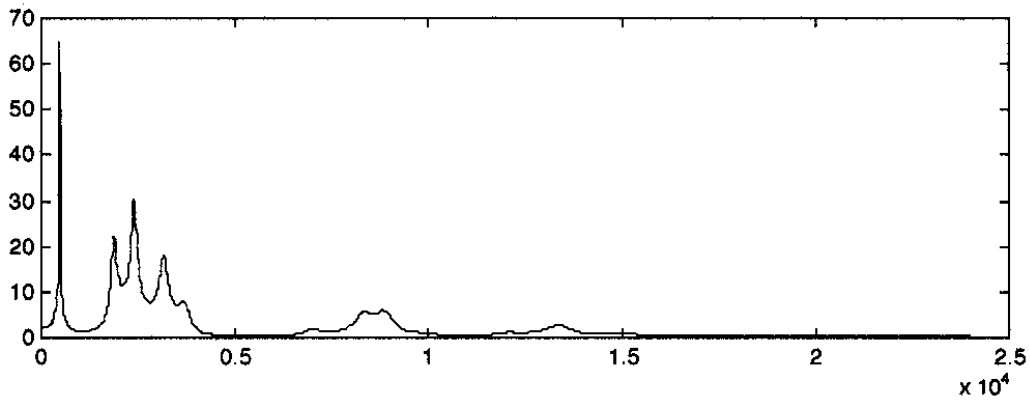
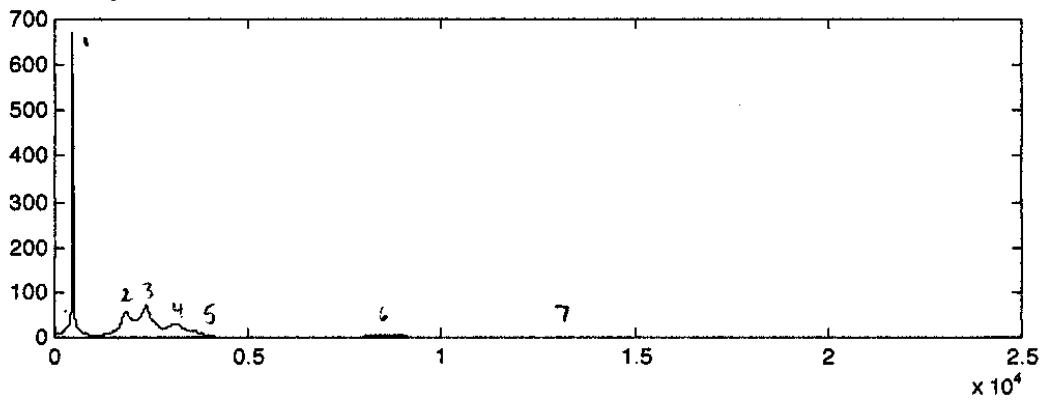
B40 b



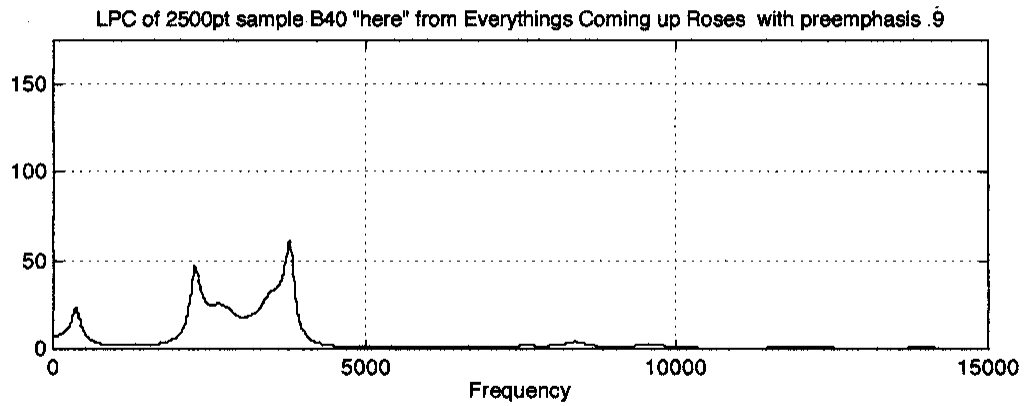
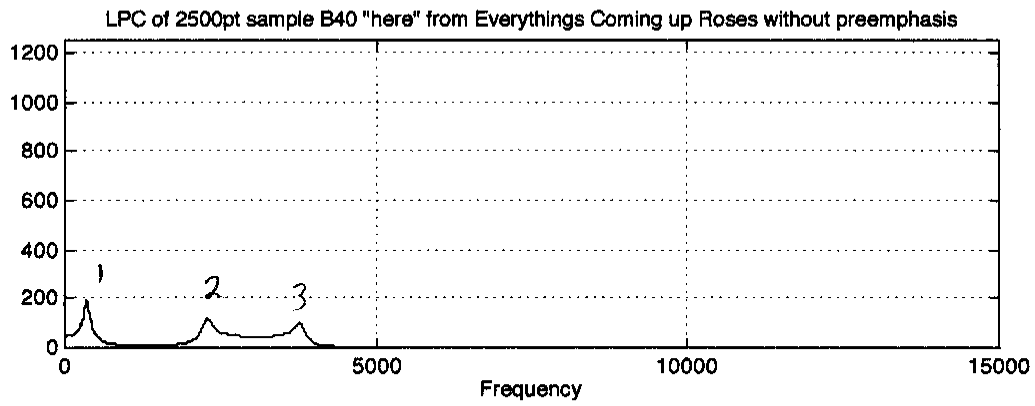
here

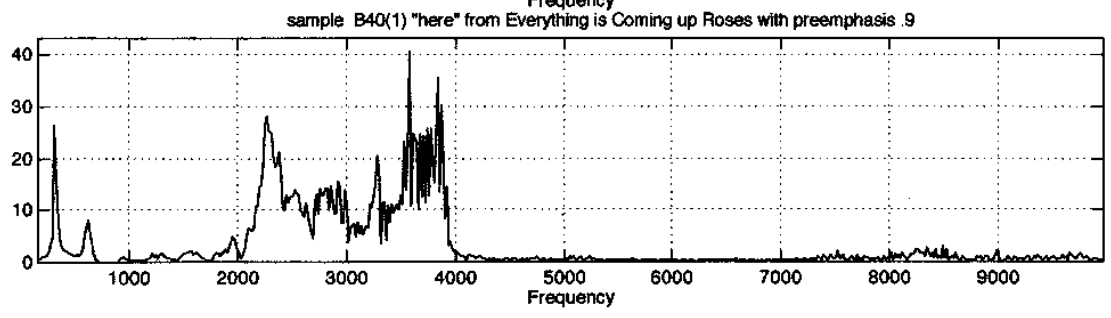
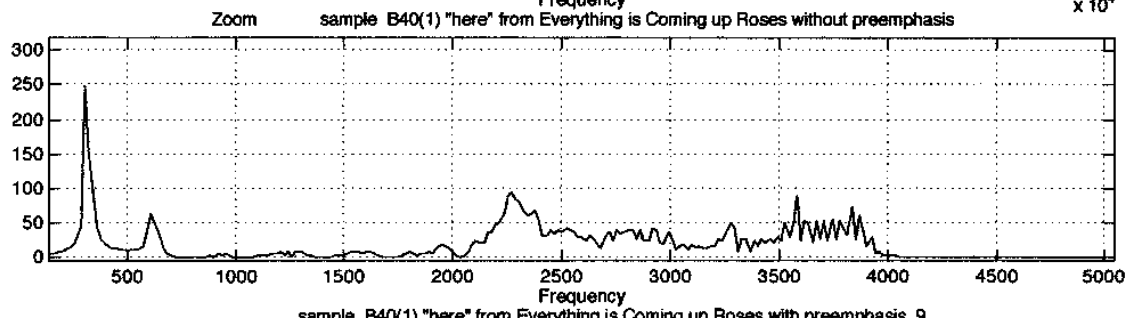
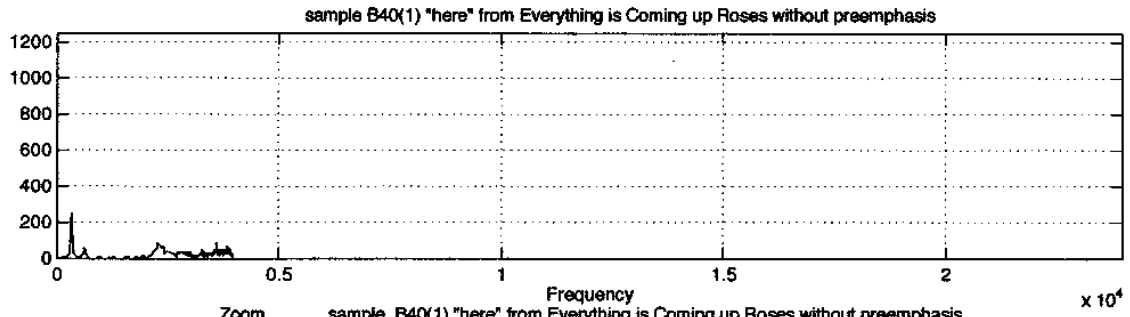
LPC B40

	Freq.	Amp.	B40 (1)	$F_0 = 464.48$
1)	468.75	670.20		
2)	1839.85	58.84		
3)	2355.47	69.19		
4)	3143.62	30.64		
5)	~3700	~12		
6)	8330	4.6		
7)	8823	4.5		
8)	13350	2.0		



(351.56, 191.16)  
(2285.16, 119.95)  
(3773.44, 98.50)





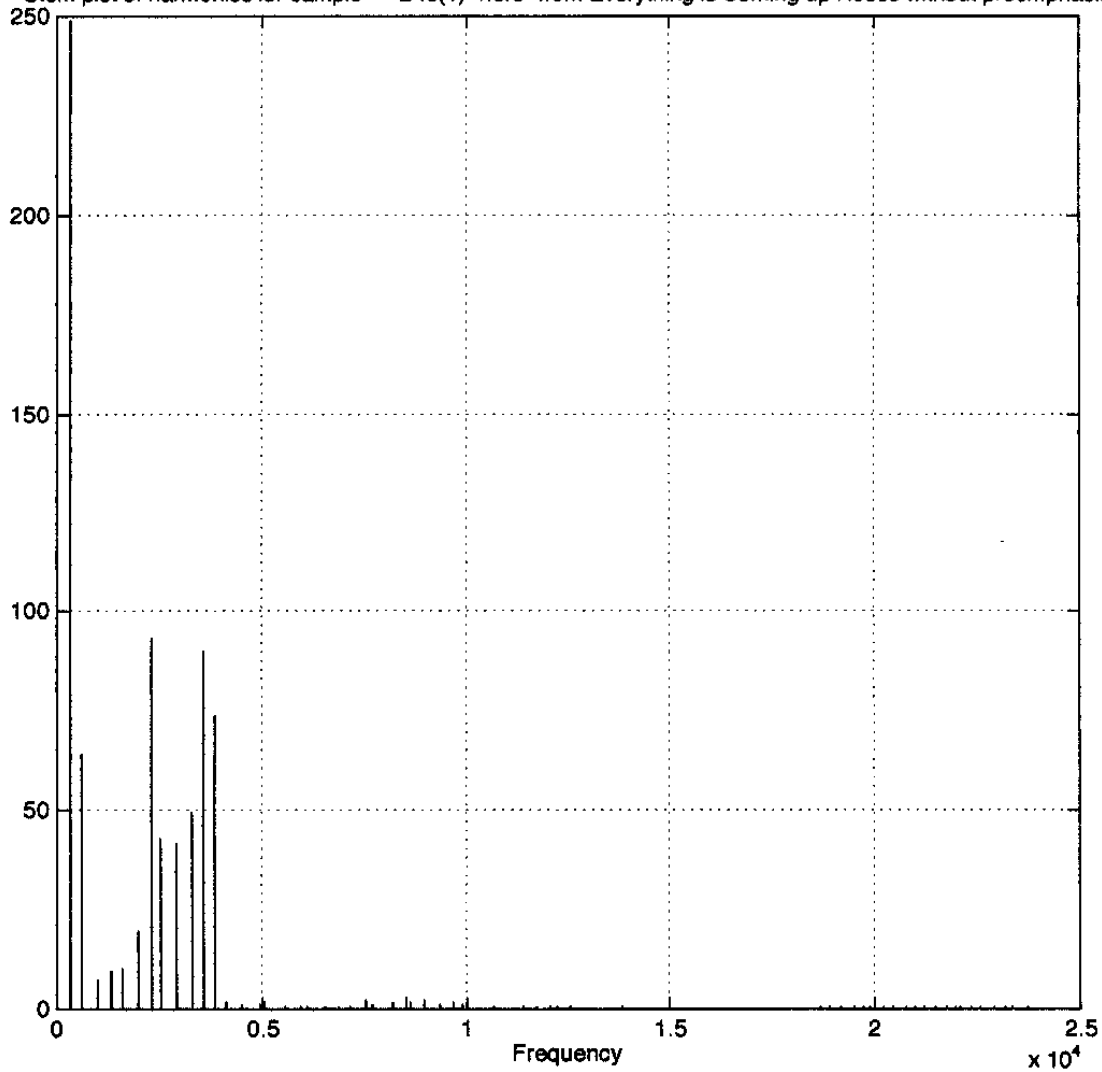
DFT Numerical Results for B40b

ROW	Freq	Amp	% Amp
1	324	248.987	100.000
2	630	63.912	25.669
3	972	7.223	2.901
4	1314	9.698	3.895
5	1584	9.901	3.976
6	1962	19.538	7.847
7	2286	93.640	37.608
8	2538	42.902	17.231
9	2934	41.944	16.846
10	3294	49.628	19.932
11	3600	90.349	36.286
12	3852	73.590	29.556
13	4140	1.885	0.757
14	4500	1.017	0.409
15	4968	1.124	0.451
16	5076	1.481	0.595
17	5562	0.553	0.222
18	5922	0.364	0.146
19	6102	0.445	0.179
20	6552	0.486	0.195
21	6858	0.441	0.177
22	7164	0.680	0.273
23	7542	2.000	0.803
24	7722	1.356	0.545
25	8226	1.691	0.679
26	8514	2.972	1.193
27	8622	1.689	0.678
28	9000	2.287	0.919
29	9378	1.204	0.484
30	9684	1.703	0.684
31	9918	0.909	0.365
32	10350	0.279	0.112
33	10674	0.293	0.118
34	10944	0.168	0.067
35	11412	0.311	0.125
36	11718	0.427	0.171
37	12042	0.638	0.256
38	12204	0.694	0.279
39	12528	0.368	0.148
40	13086	0.139	0.056
41	13338	0.221	0.089
42	13716	0.249	0.100
43	13824	0.470	0.189
44	14184	0.254	0.102
45	14454	0.188	0.076
46	14976	0.141	0.056
47	15120	0.233	0.094
48	15678	0.152	0.061
49	15768	0.181	0.073
50	16308	0.144	0.058
51	16578	0.134	0.054
52	16848	0.112	0.045
53	17172	0.124	0.050
54	17424	0.137	0.055
55	17910	0.126	0.051
56	18180	0.110	0.044
57	18342	0.128	0.051

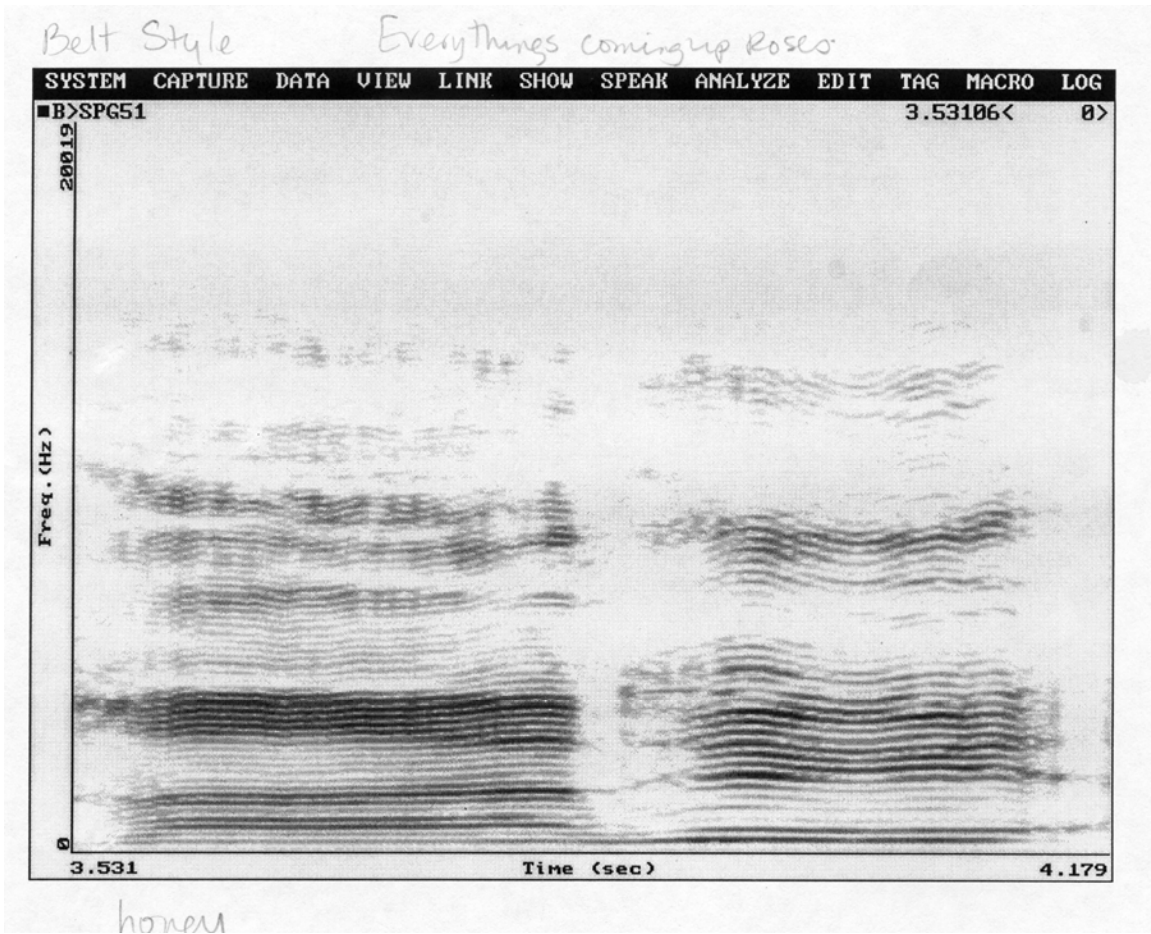
58	18810	0.134	0.054
59	19188	0.115	0.046
60	19404	0.113	0.045
61	19782	0.123	0.049
62	19980	0.113	0.045
63	20520	0.117	0.047
64	20682	0.106	0.043
65	21168	0.116	0.047
66	21474	0.100	0.040
67	21690	0.105	0.042
68	22122	0.114	0.046
69	22230	0.130	0.052
70	22608	0.100	0.040
71	23130	0.099	0.040
72	23454	0.115	0.046
73	23724	0.106	0.043
74	18666	0.496	0.199
75	18900	0.418	0.168
76	19152	0.380	0.153
77	19476	0.432	0.173
78	19710	0.382	0.153
79	19890	0.375	0.151
80	20214	0.352	0.141
81	20448	0.393	0.158
82	20754	0.358	0.144
83	20988	0.352	0.141
84	21222	0.350	0.140
85	21456	0.349	0.140
86	21744	0.344	0.138
87	21996	0.339	0.136
88	22086	0.336	0.135
89	22356	0.339	0.136
90	22590	0.338	0.136
91	22932	0.327	0.131
92	23184	0.328	0.132
93	23364	0.326	0.131
94	23706	0.325	0.131
95	22212	0.156	0.063
96	22464	0.149	0.060
97	22770	0.146	0.059
98	22986	0.147	0.059
99	23148	0.160	0.064
100	23454	0.154	0.062
101	23670	0.155	0.062
102	20160	0.179	0.072
103	20430	0.180	0.072
104	20610	0.171	0.069
105	20718	0.158	0.063
106	21042	0.164	0.066
107	21240	0.157	0.063
108	21420	0.141	0.057
109	21564	0.154	0.062
110	21834	0.144	0.058
111	21978	0.138	0.056
112	22104	0.146	0.058
113	22302	0.133	0.053
114	22608	0.144	0.058
115	22824	0.134	0.054
116	22950	0.130	0.052
117	23202	0.139	0.056

118	23418	0.141	0.057
119	23490	0.135	0.054
120	23814	0.133	0.054

Stem plot of harmonics for sample B40(1) "here" from Everything is Coming up Roses without preemphasis



Spectrogram of B40c "honey"

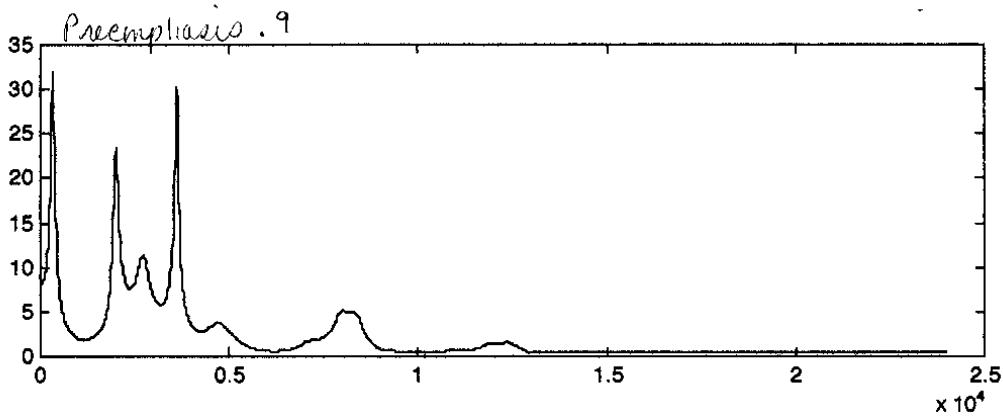
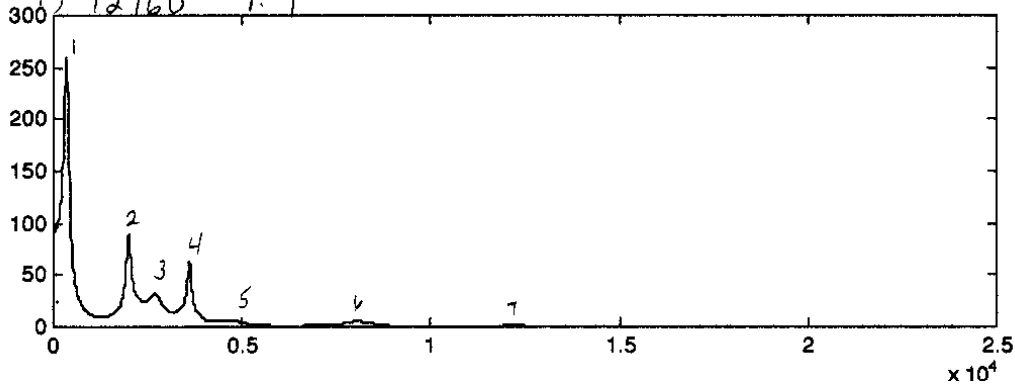


LPC for B40c "honey"

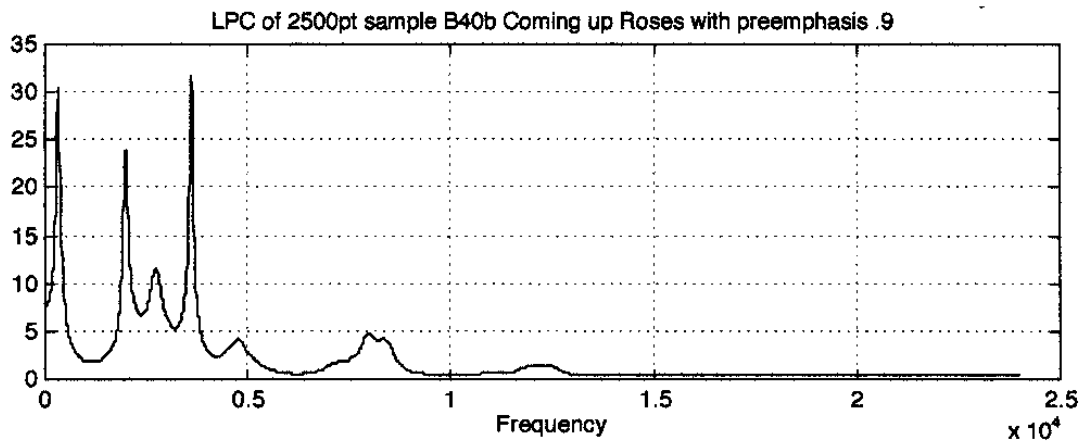
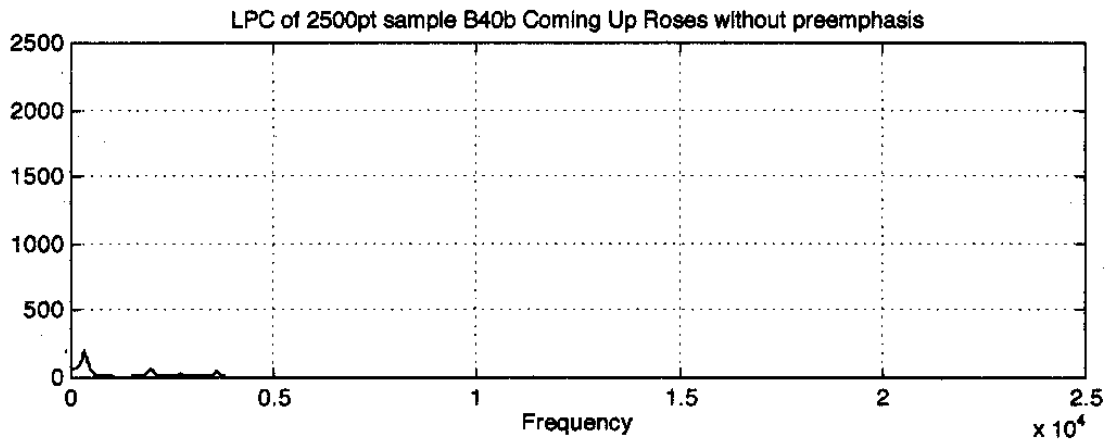
B40(2)

$F_0$  274 Hz

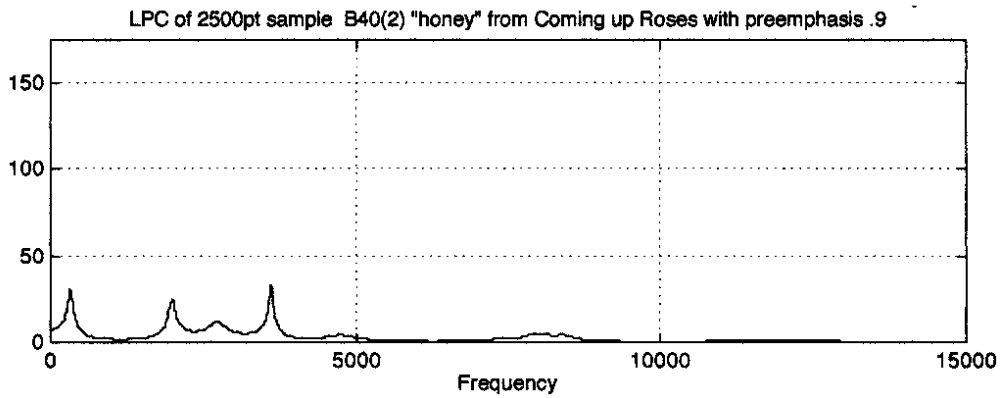
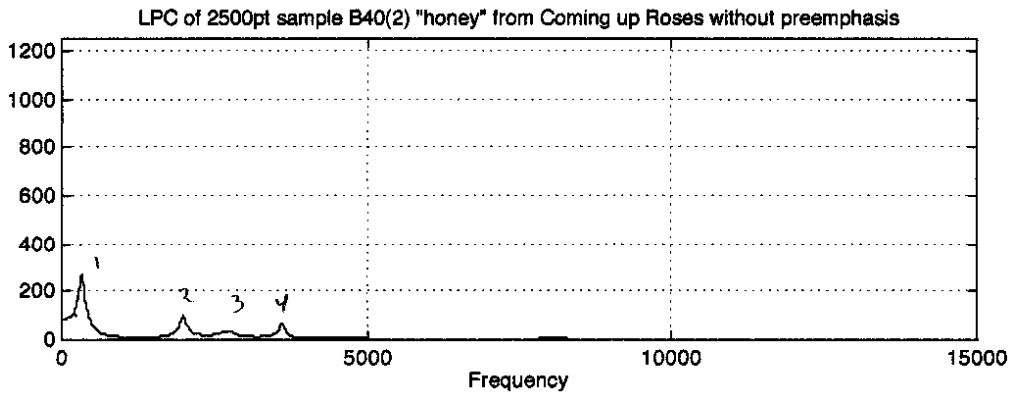
	F	dB
1)	339.85	260.18
2)	1992.19	88.60
3)	2683.60	32.78
4)	3597.65	63.06
5)	4722.65	6.24 ?
6)	8039.06	5.32
7)	12160	1.1



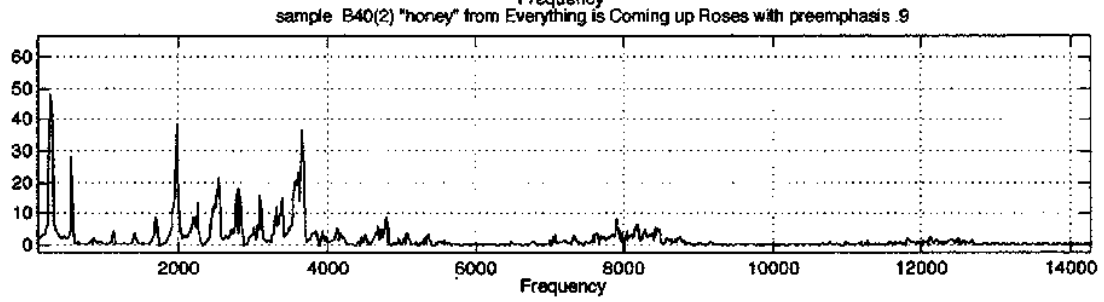
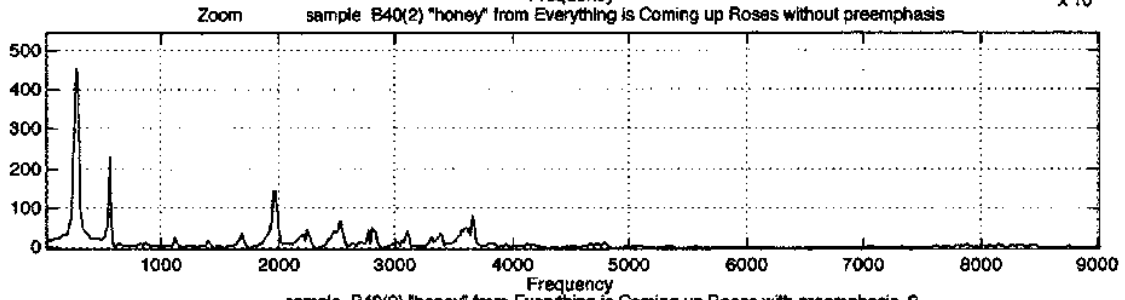
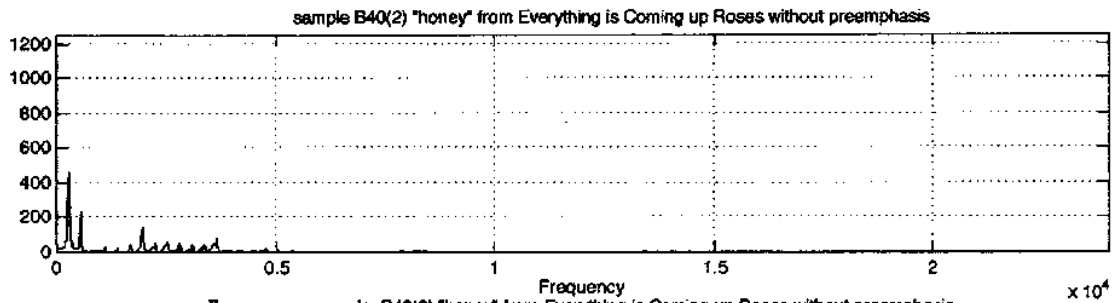
points 100 - 3000 = 2999 pts  
 for  $F_0$  looked at  $.0063541667 - .075625 = .069270834/19$   
 $T = .003645833$   
 $F = 1/T = 274 \text{ Hz}$



(328.13, 268.23)  
(1980.47, 97.30)  
(2718.75, 34.56)  
(3609.37, 70.76)



# DFT of B40c "honey"



DFT Numerical Results for B40c "honey"

Worksheet saved into file: Minitab.B40(2)  
 MTB > Print 'Freq' 'Amp' '% Amp'.

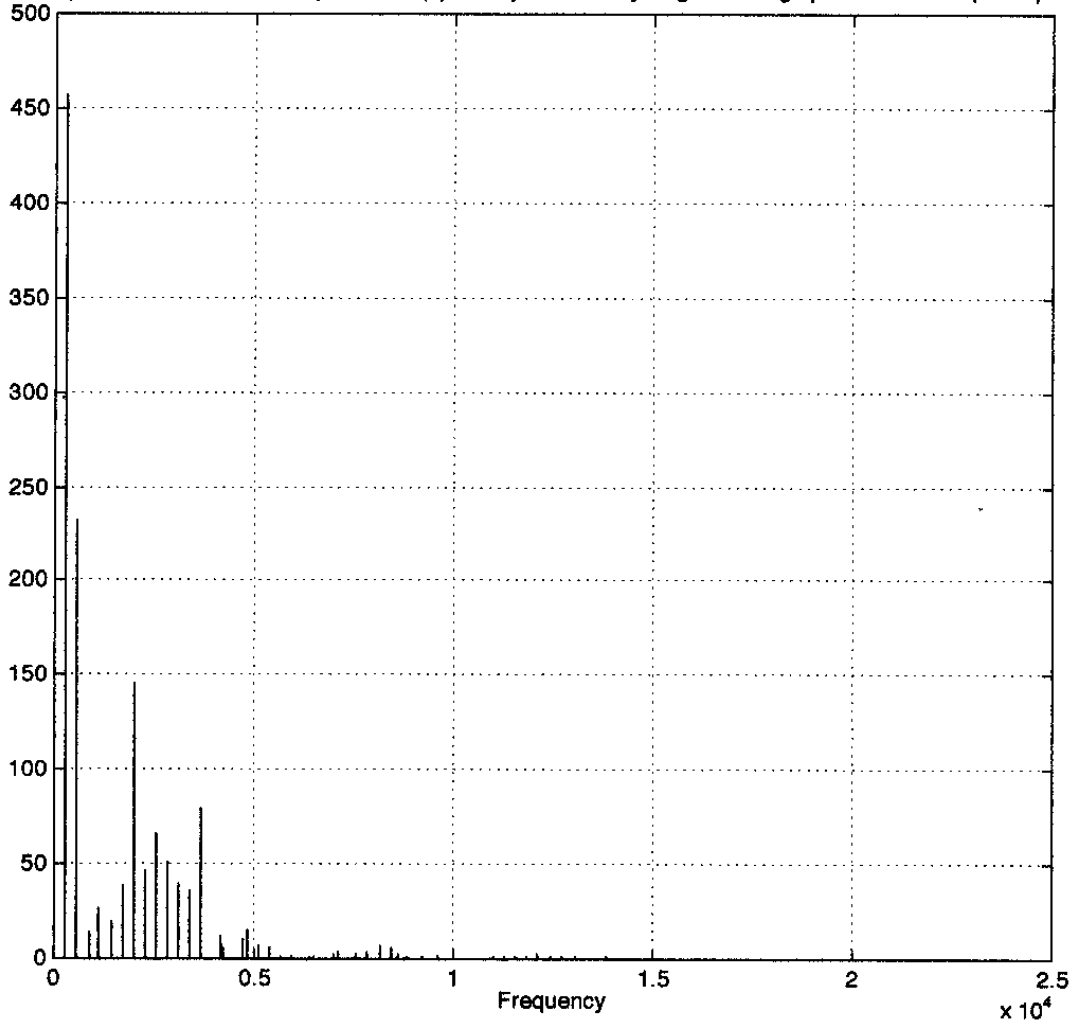
ROW	Freq	Amp	% Amp
1	288	456.306	100.000
2	576	231.532	50.740
3	882	14.458	3.169
4	1134	26.805	5.874
5	1422	19.959	4.374
6	1710	38.138	8.358
7	1998	145.266	31.835
8	2268	46.299	10.147
9	2556	66.089	14.484
10	2826	50.743	11.120
11	3114	39.827	8.728
12	3402	36.300	7.955
13	3672	79.781	17.484
14	4140	11.314	2.479
15	4230	5.863	1.285
16	4698	10.891	2.387
17	4806	15.370	3.368
18	5094	6.427	1.408
19	5382	5.286	1.158
20	5670	1.702	0.373
21	5958	0.851	0.186
22	6372	1.112	0.244
23	6516	1.167	0.256
24	7020	2.203	0.483
25	7092	3.866	0.847
26	7578	2.105	0.461
27	7848	3.884	0.851
28	8172	7.357	1.612
29	8424	5.616	1.231
30	8604	2.552	0.559
31	8820	1.616	0.354
32	9198	0.959	0.210
33	9594	0.807	0.177
34	9702	0.548	0.120
35	10152	0.521	0.114
36	10368	0.582	0.127
37	10710	0.546	0.120
38	10998	0.766	0.168
39	11286	1.265	0.277
40	11574	0.920	0.202
41	11826	1.591	0.349
42	12132	2.119	0.464
43	12438	1.269	0.278
44	12708	1.479	0.324
45	13050	0.618	0.135
46	13158	0.406	0.089
47	13500	0.336	0.074
48	13860	0.634	0.139
49	14058	0.478	0.105
50	14346	0.405	0.089
51	14796	0.359	0.079
52	14904	0.288	0.063
53	15336	0.316	0.069
54	15570	0.322	0.071
55	15858	0.295	0.065

56	16020	0.266	0.058
57	16308	0.285	0.063
58	16650	0.277	0.061
59	16956	0.303	0.066
60	17244	0.299	0.066
61	17676	0.335	0.073
62	17928	0.285	0.062
63	18108	0.285	0.063
64	18522	0.267	0.058
65	18828	0.319	0.070
66	18954	0.292	0.064
67	19404	0.263	0.058
68	19530	0.259	0.057
69	19854	0.248	0.054
70	20142	0.243	0.053
71	20394	0.256	0.056
72	20718	0.236	0.052
73	20934	0.239	0.052
74	21276	0.232	0.051
75	21690	0.242	0.053
76	21924	0.229	0.050
77	22104	0.240	0.053
78	22428	0.228	0.050
79	22788	0.235	0.052
80	22950	0.231	0.051
81	23274	0.231	0.051
82	23580	0.230	0.050
83	20988	0.352	0.077
84	21222	0.350	0.077
85	21456	0.349	0.076
86	21744	0.344	0.075
87	21996	0.339	0.074
88	22086	0.336	0.074
89	22356	0.339	0.074
90	22590	0.338	0.074
91	22932	0.327	0.072
92	23184	0.328	0.072
93	23364	0.326	0.072
94	23706	0.325	0.071
95	22212	0.156	0.034
96	22464	0.149	0.033
97	22770	0.146	0.032
98	22986	0.147	0.032
99	23148	0.160	0.035
100	23454	0.154	0.034
101	23670	0.155	0.034
102	20160	0.179	0.039
103	20430	0.180	0.039
104	20610	0.171	0.037
105	20718	0.158	0.035
106	21042	0.164	0.036
107	21240	0.157	0.034
108	21420	0.141	0.031
109	21564	0.154	0.034
110	21834	0.144	0.032
111	21978	0.138	0.030
112	22104	0.146	0.032
113	22302	0.133	0.029
114	22608	0.144	0.032
115	22824	0.134	0.029

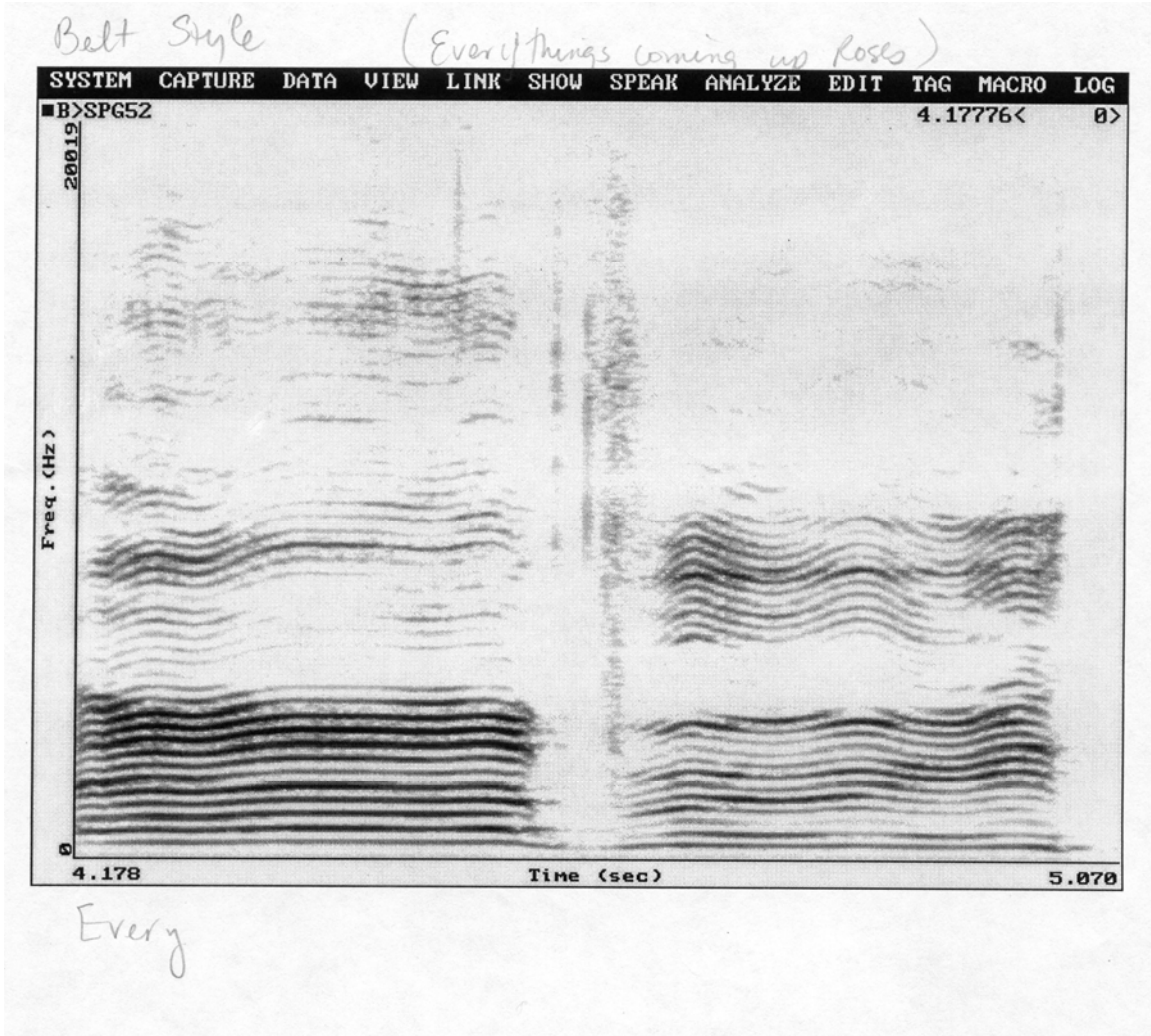
116	22950	0.130	0.028
117	23202	0.139	0.030
118	23418	0.141	0.031
119	23490	0.135	0.029
120	23814	0.133	

0.029

Stem plot of harmonics for sample B40(2) "honey" from Everything is Coming up Roses without preemphasis



Spectrogram B40d

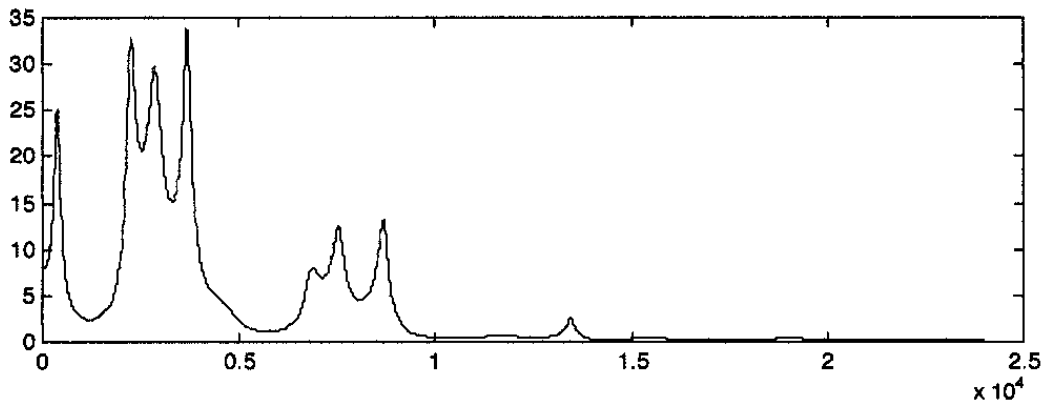
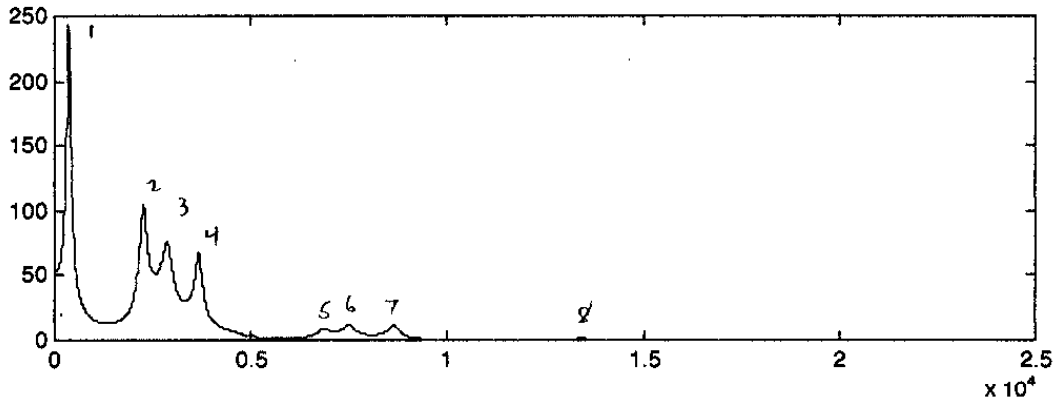


LPC

	$F_{ng}$	.dB.
1)	363.28	243.50
2)	2250	104.74
3)	2847.66	75.58
4)	3667.97	67.80
5)	6867.19	8.57
6)	7511.72	12.23
7)	8660.2	11.17
8)	13453	1.68

B40(3)

$F_0 = 323 \text{ Hz}$



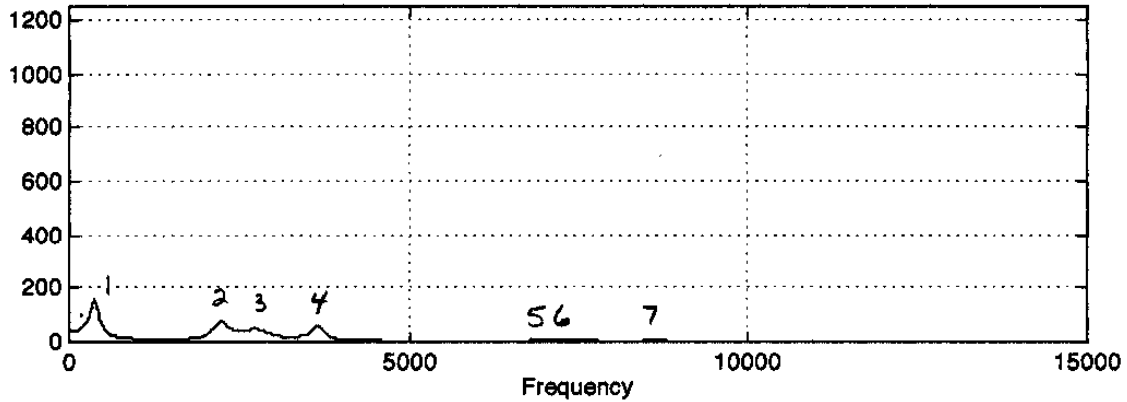
$$100 - 3000 \text{ pt} = 2899 \text{ pt}$$

$$.0555625 - .0029375 = .052625 / 17 = T \quad 1/T$$

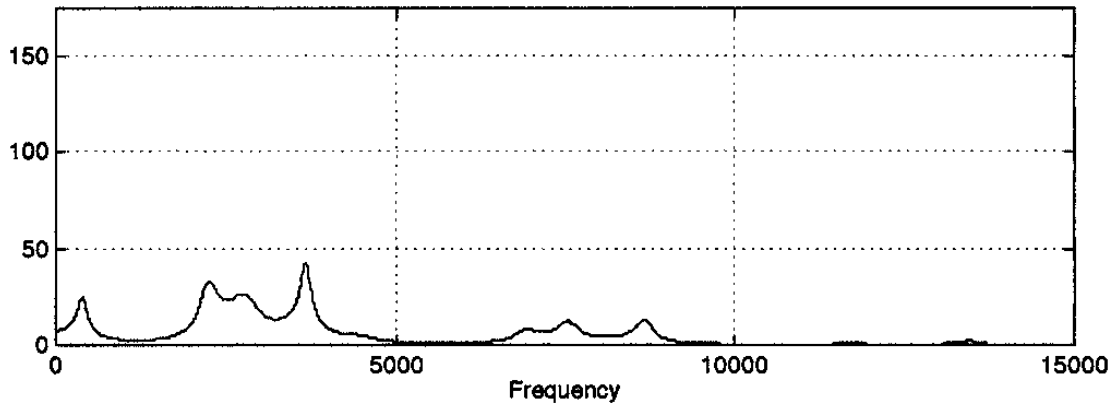
$$= 323 \text{ Hz}$$

(375.00, 156.46)  
 (2238.28, 75.21)  
 (2753.91, 47.49)  
 (3656.25, 58.39)  
 (6936.50, 5.85)  
 (7535.50, 8.33)  
 (8660.15, 7.85)

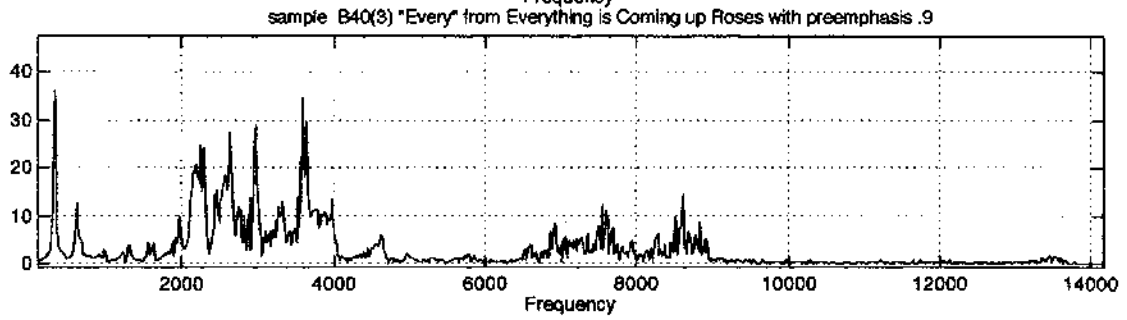
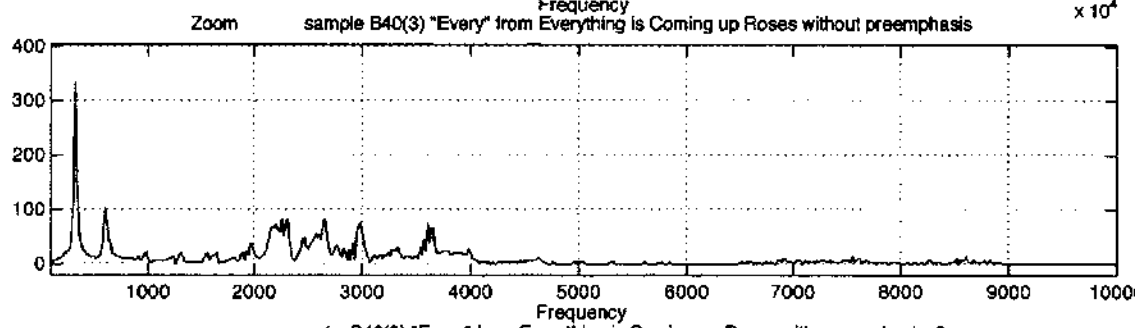
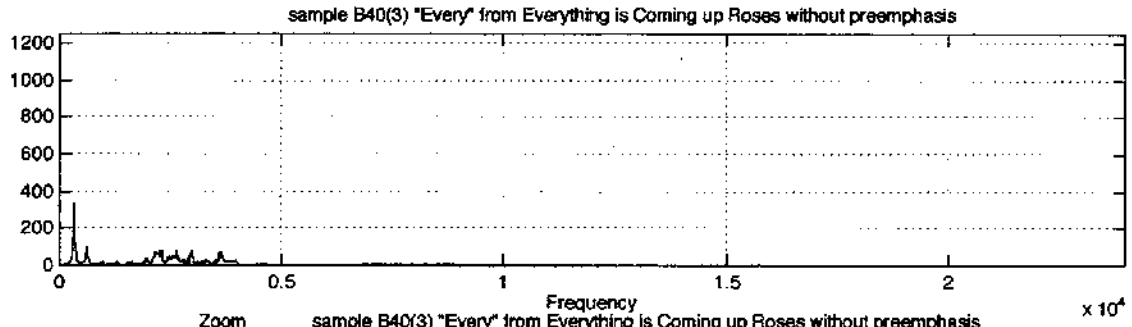
LPC of 2500pt sample B40(3) "Every" from Coming up Roses without preemphasis



LPC of 2500pt sample B40(3) "Every" from Coming up Roses with preemphasis .9



# DFT Analysis



DFT Numerical Results for B40d

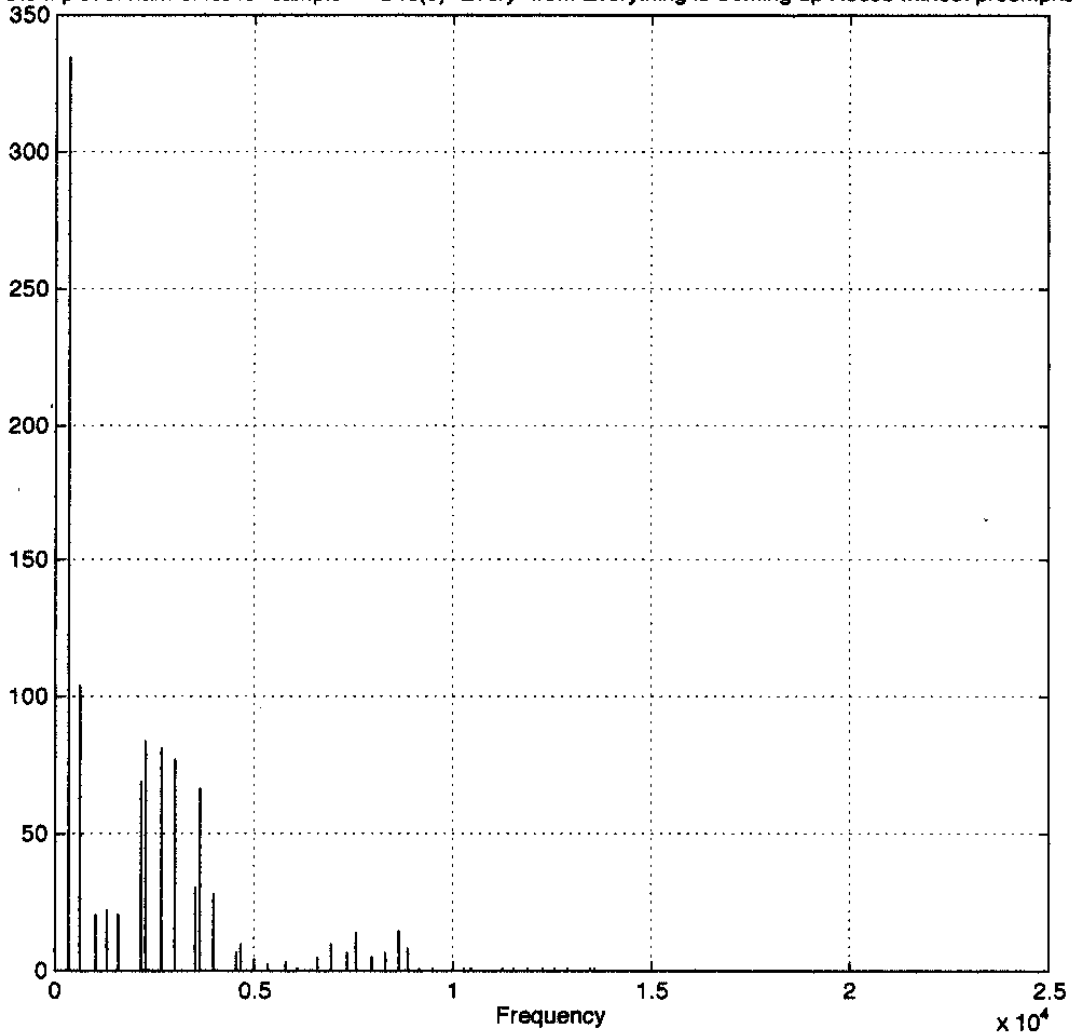
Worksheet saved into file: Minitab.B40(3)  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	342	334.662	100.000
2	630	104.110	31.109
3	1008	20.485	6.121
4	1332	22.442	6.706
5	1584	20.518	6.131
6	2178	68.653	20.514
7	2268	83.446	24.934
8	2664	81.322	24.300
9	2988	77.433	23.138
10	3546	30.739	9.185
11	3654	66.184	19.776
12	3996	27.526	8.225
13	4572	6.680	1.996
14	4662	9.908	2.961
15	5004	3.773	1.127
16	5346	2.067	0.618
17	5796	3.434	1.026
18	6084	1.148	0.343
19	6606	4.677	1.398
20	6930	10.163	3.037
21	7308	6.346	1.896
22	7560	14.026	4.191
23	7956	5.124	1.531
24	8298	6.495	1.941
25	8622	14.385	4.299
26	8856	8.221	2.456
27	9126	1.092	0.326
28	9504	0.810	0.242
29	9990	0.658	0.197
30	10296	0.746	0.223
31	10476	0.413	0.123
32	11016	0.342	0.102
33	11232	0.747	0.223
34	11556	0.639	0.191
35	11898	0.618	0.185
36	12294	0.432	0.129
37	12564	0.411	0.123
38	12888	0.458	0.137
39	13464	0.897	0.268
40	13572	0.943	0.282
41	13986	0.326	0.097
42	14256	0.216	0.065
43	14580	0.241	0.072
44	15156	0.319	0.095
45	15354	0.298	0.089
46	15804	0.309	0.092
47	16038	0.253	0.076
48	16344	0.222	0.066
49	16776	0.159	0.048
50	17118	0.232	0.069
51	17550	0.183	0.055
52	17784	0.185	0.055
53	18108	0.181	0.054
54	18540	0.225	0.067
55	18774	0.311	0.093

56	19134	0.293	0.088
57	19548	0.209	0.062
58	19872	0.253	0.075
59	20070	0.200	0.060
60	20412	0.157	0.047
61	20736	0.152	0.046
62	21132	0.134	0.040
63	21654	0.141	0.042
64	21780	0.141	0.042
65	22122	0.133	0.040
66	22518	0.131	0.039
67	22806	0.148	0.044
68	23130	0.131	0.039
69	23634	0.132	0.040
70	20142	0.243	0.073
71	20394	0.256	0.077
72	20718	0.236	0.070
73	20934	0.239	0.071
74	21276	0.232	0.069
75	21690	0.242	0.072
76	21924	0.229	0.068
77	22104	0.240	0.072
78	22428	0.228	0.068
79	22788	0.235	0.070
80	22950	0.231	0.069
81	23274	0.231	0.069
82	23580	0.230	0.069
83	20988	0.352	0.105
84	21222	0.350	0.105
85	21456	0.349	0.104
86	21744	0.344	0.103
87	21996	0.339	0.101
88	22086	0.336	0.100
89	22356	0.339	0.101
90	22590	0.338	0.101
91	22932	0.327	0.098
92	23184	0.328	0.098
93	23364	0.326	0.098
94	23706	0.325	0.097
95	22212	0.156	0.047
96	22464	0.149	0.044
97	22770	0.146	0.044
98	22986	0.147	0.044
99	23148	0.160	0.048
100	23454	0.154	0.046
101	23670	0.155	0.046
102	20160	0.179	0.053
103	20430	0.180	0.054
104	20610	0.171	0.051
105	20718	0.158	0.047
106	21042	0.164	0.049
107	21240	0.157	0.047
108	21420	0.141	0.042
109	21564	0.154	0.046
110	21834	0.144	0.043
111	21978	0.138	0.041
112	22104	0.146	0.043
113	22302	0.133	0.040
114	22608	0.144	0.043
115	22824	0.134	0.040

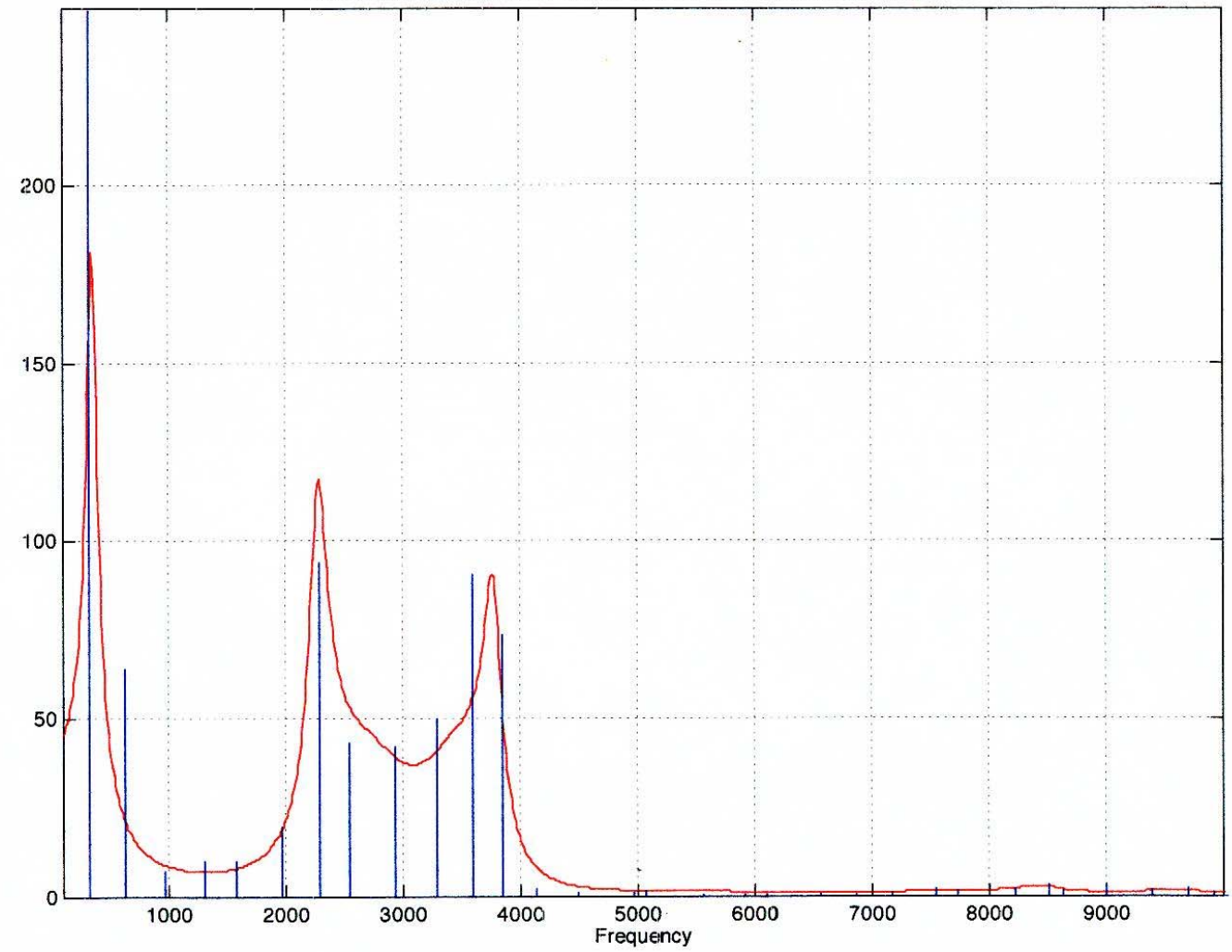
116	22950	0.130	0.039
117	23202	0.139	0.042
118	23418	0.141	0.042
119	23490	0.135	0.040
120	23814	0.133	0.040

Stem plot of harmonics for sample B40(3) "Every" from Everything is Coming up Roses without preemphasis



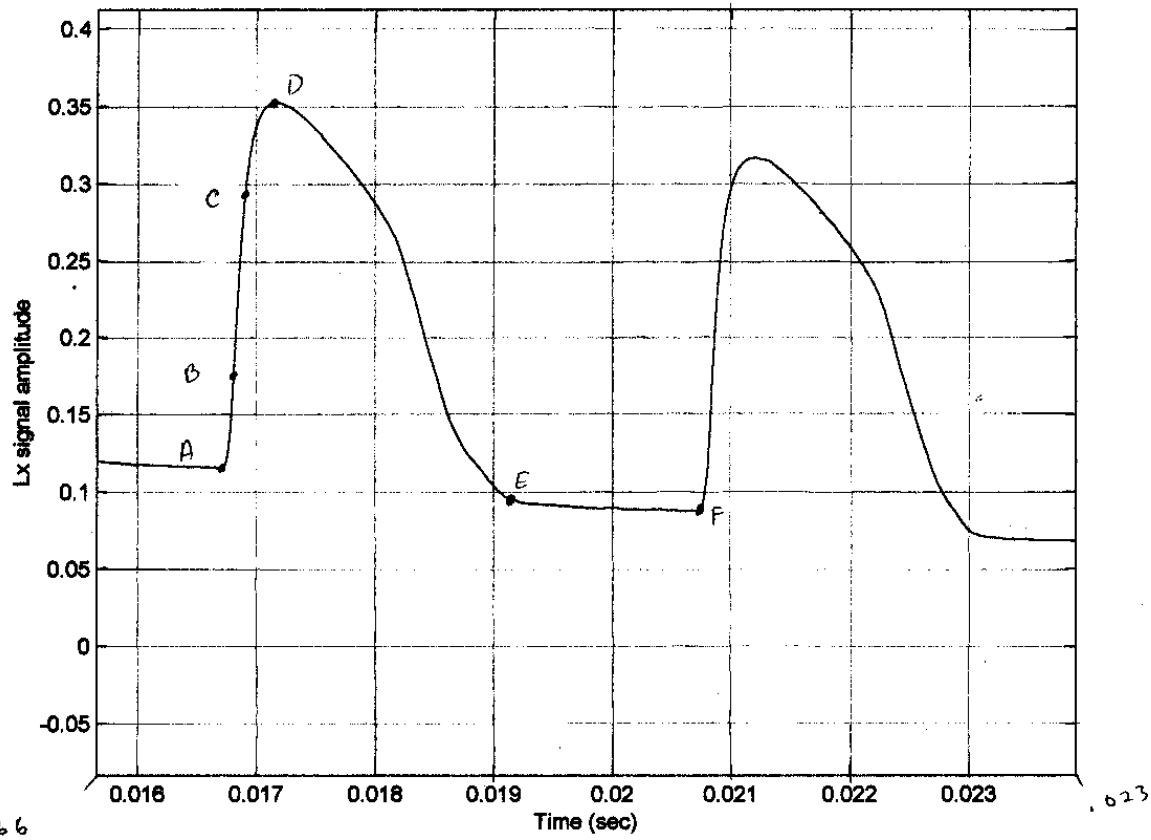
# DFT/LPC Overlay for B40b

Stem plot/LPC overlay of harmonics for sample B40(1) without preemphasis



X 19 mm = .001  
Y 12.5 mm = .05

EGG B40  $\beta$



66

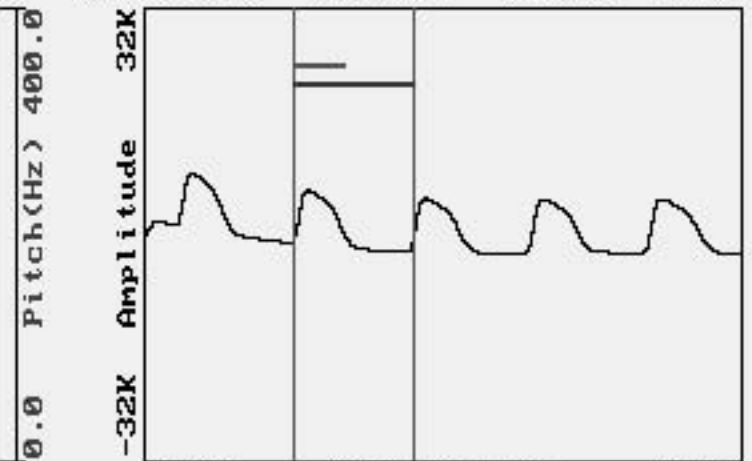
023

**A** > : CH1: B40A\_E~1.NSP

< 0.00 sec 41.47% 250.57 Hz >



Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

< sec % Hz >



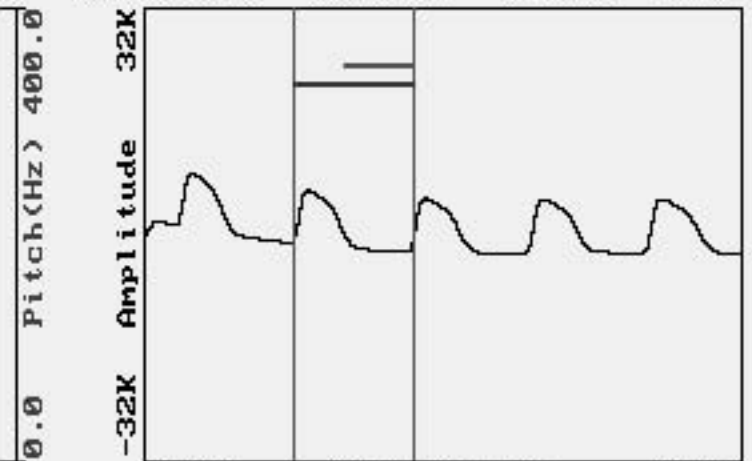
Duration 2.50 (sec)



Time (sec)

**A** > : CH1: B40A\_E~1.NSP

< 0.00 sec 58.52% 250.57 Hz >

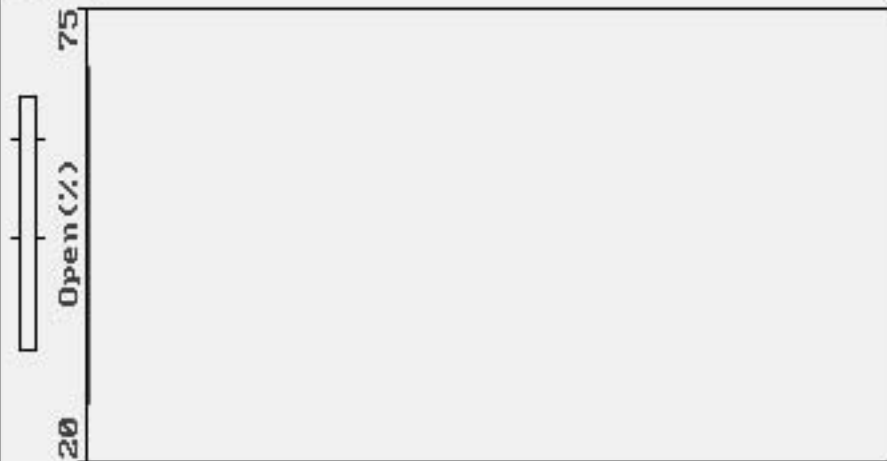


Duration 2.50 (sec)

0.00 Time (sec) 0.02

**B** > :

< sec % Hz >

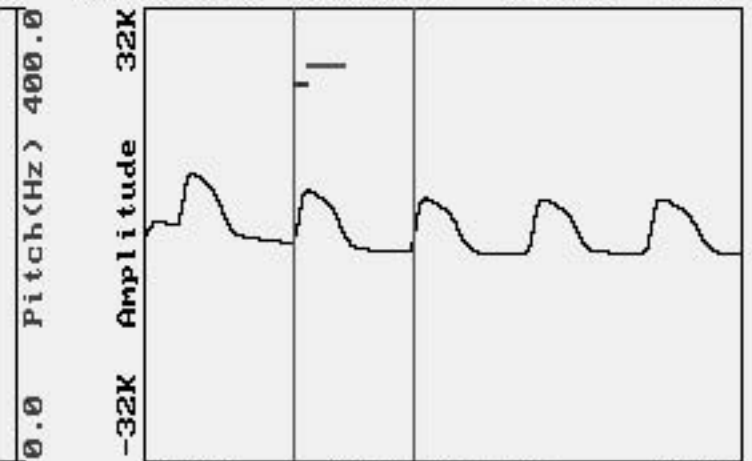


Duration 2.50 (sec)

Time (sec)

■A> : CH1: B40A\_E~1.NSP

< 0.00 sec 284.21% 250.57 Hz >

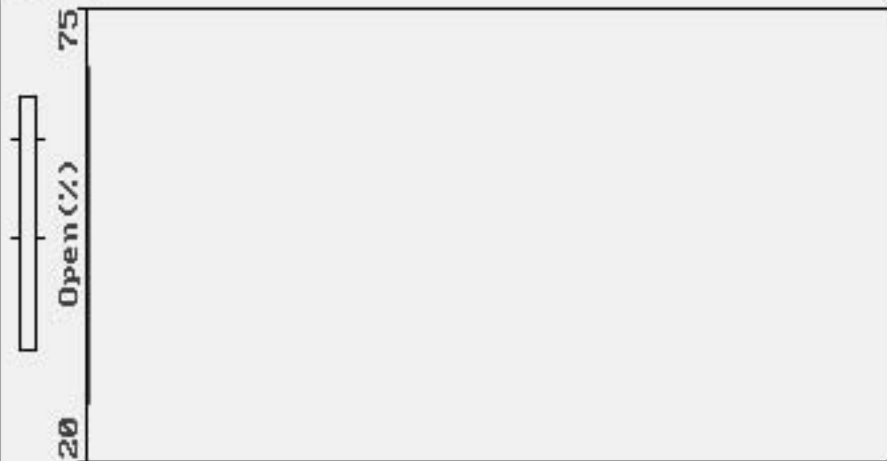


Pitch(Hz) 400.0

Duration 2.50 (sec)

□B> :

< sec % Hz >

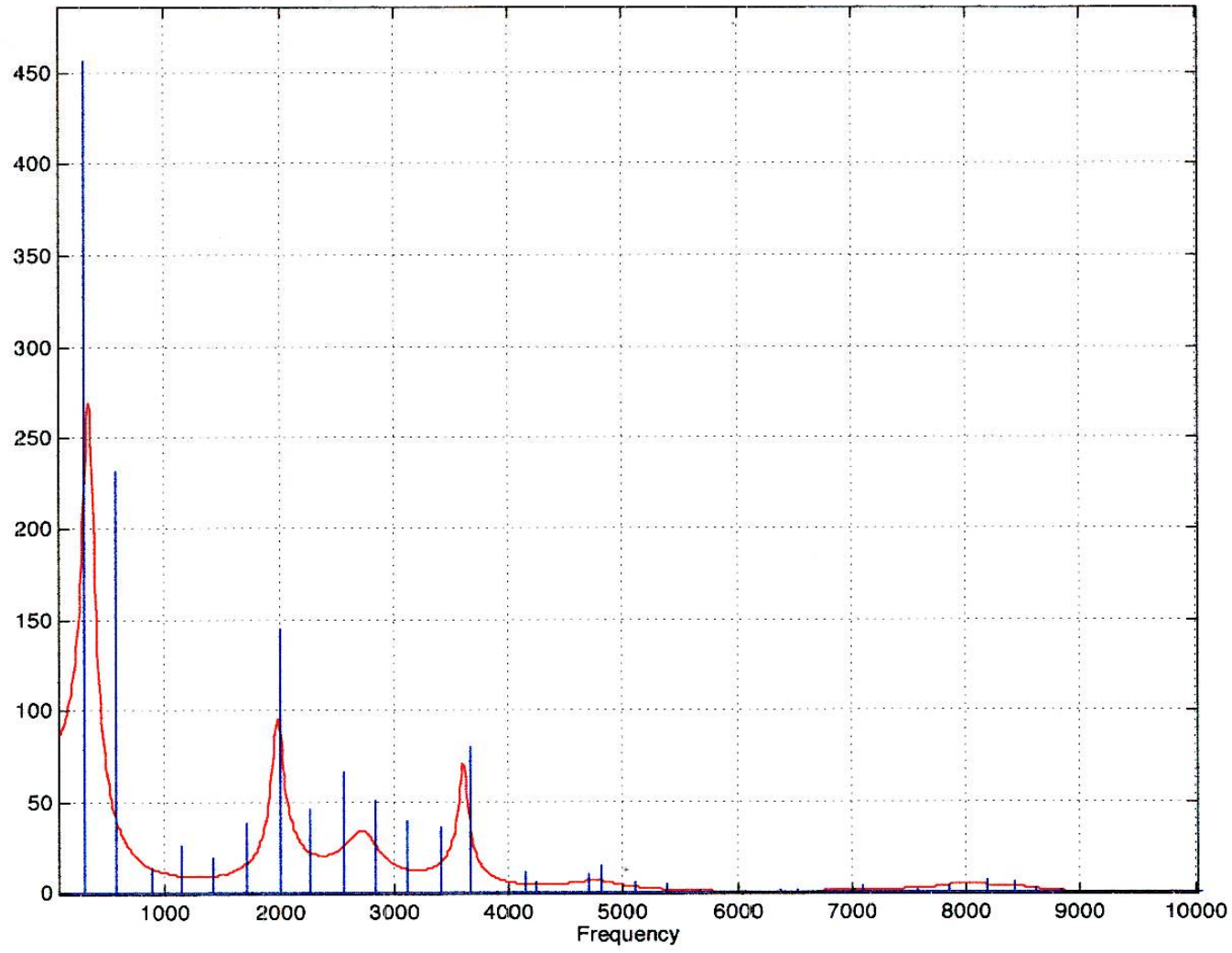


Pitch(Hz) 400.0

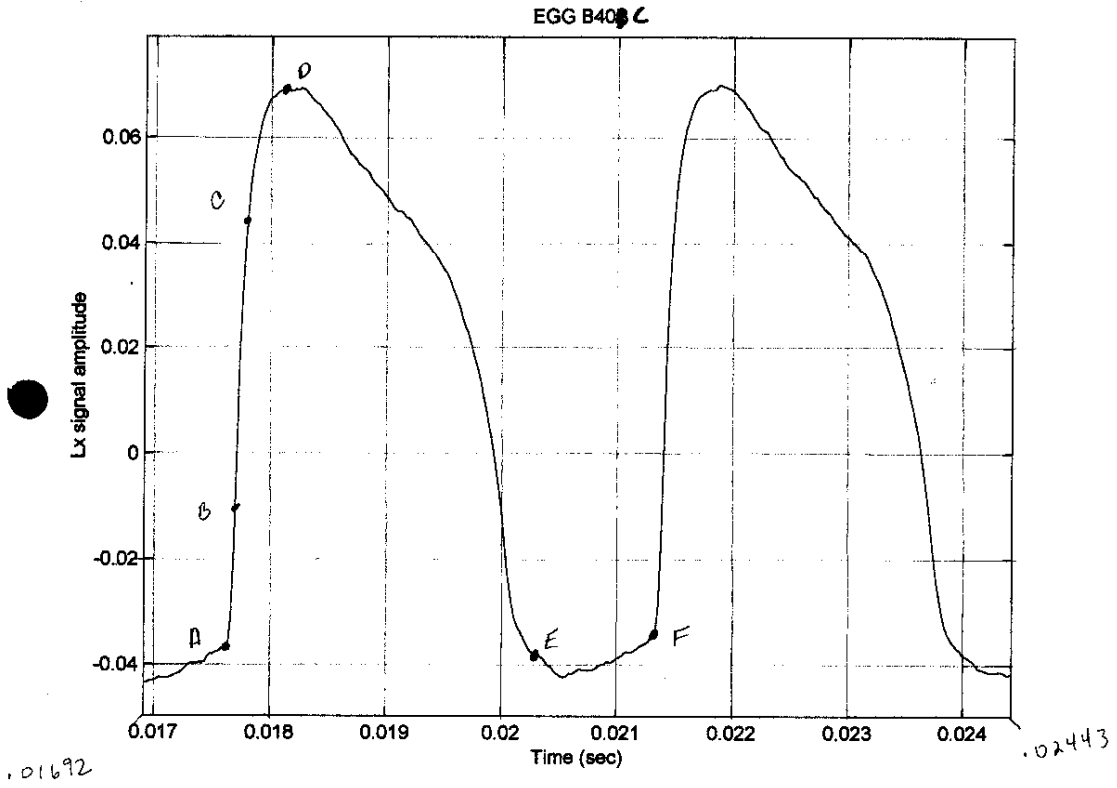
Duration 2.50 (sec)

# DFT/LPC Overlay for B40c

Stem plot/LPC overlay of harmonics for sample B40(2) without preemphasis



X 21 mm = .001  
Y 19.5 mm = .02 .001 = 1.

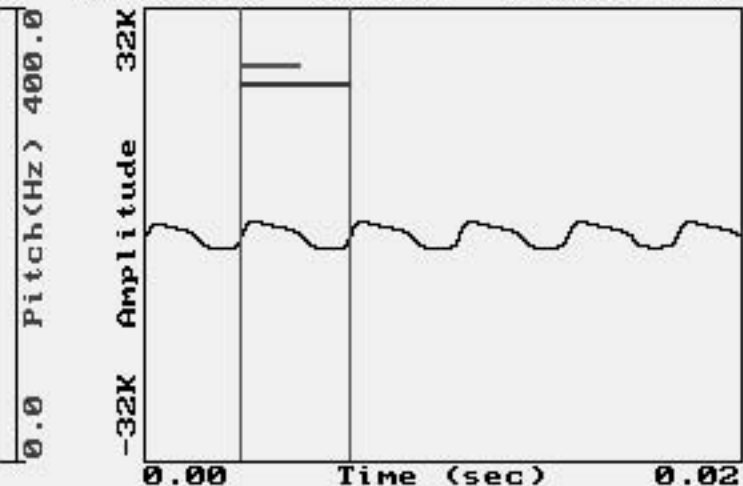


■A> : CH1: B40B\_E~1.NSP

< 0.00 sec 54.65% 273.91 Hz >

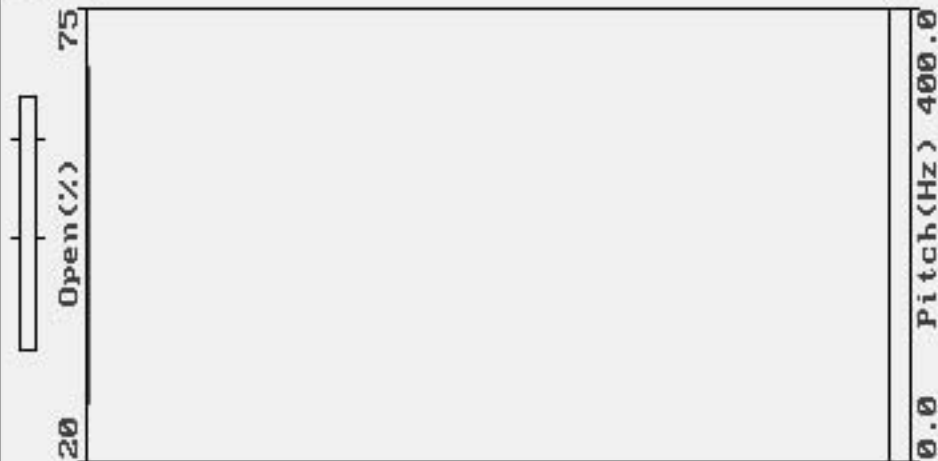


Duration 2.50 (sec)



□B> :

< sec % Hz >

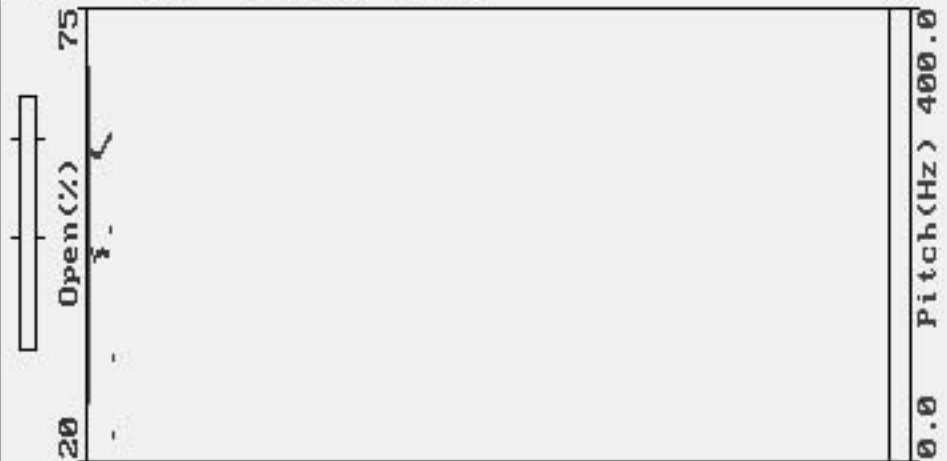


Duration 2.50 (sec)

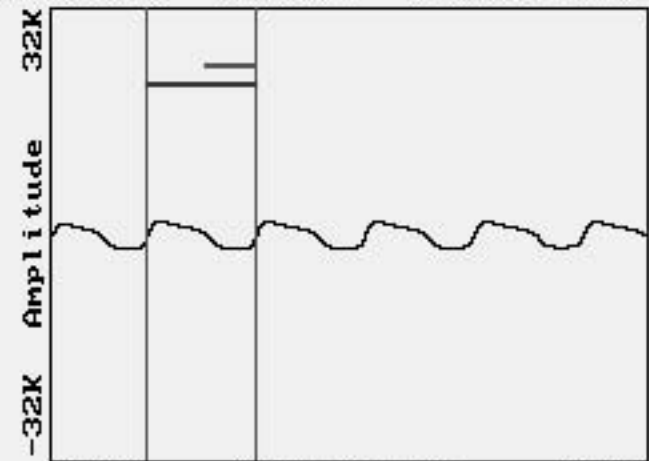


■A> : CH1: B40B\_E~1.NSP

< 0.00 sec 45.34% 273.91 Hz >



Duration 2.50 (sec)



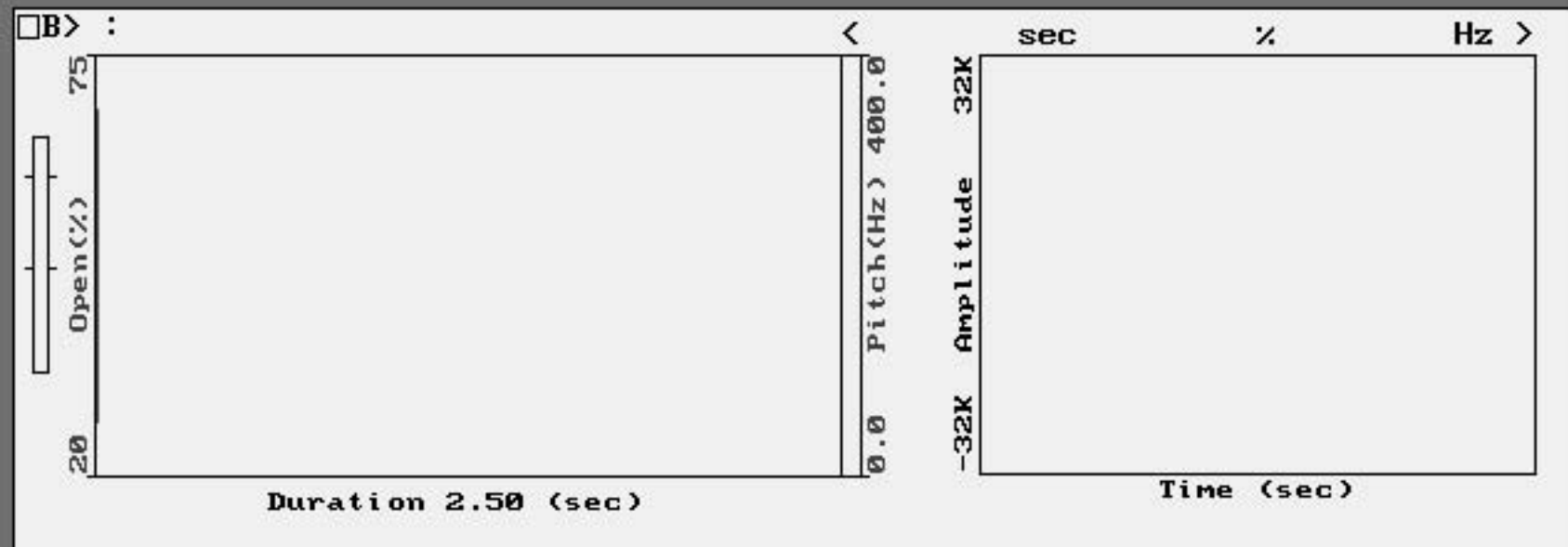
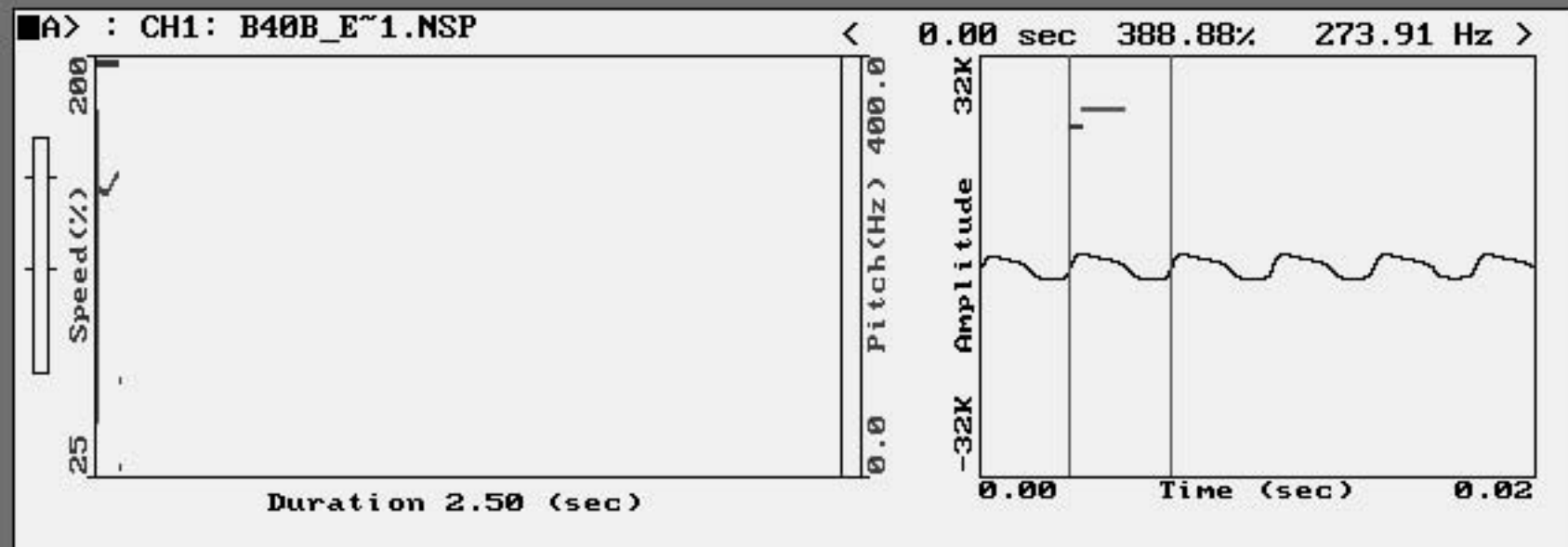
□B> :

< sec % Hz >



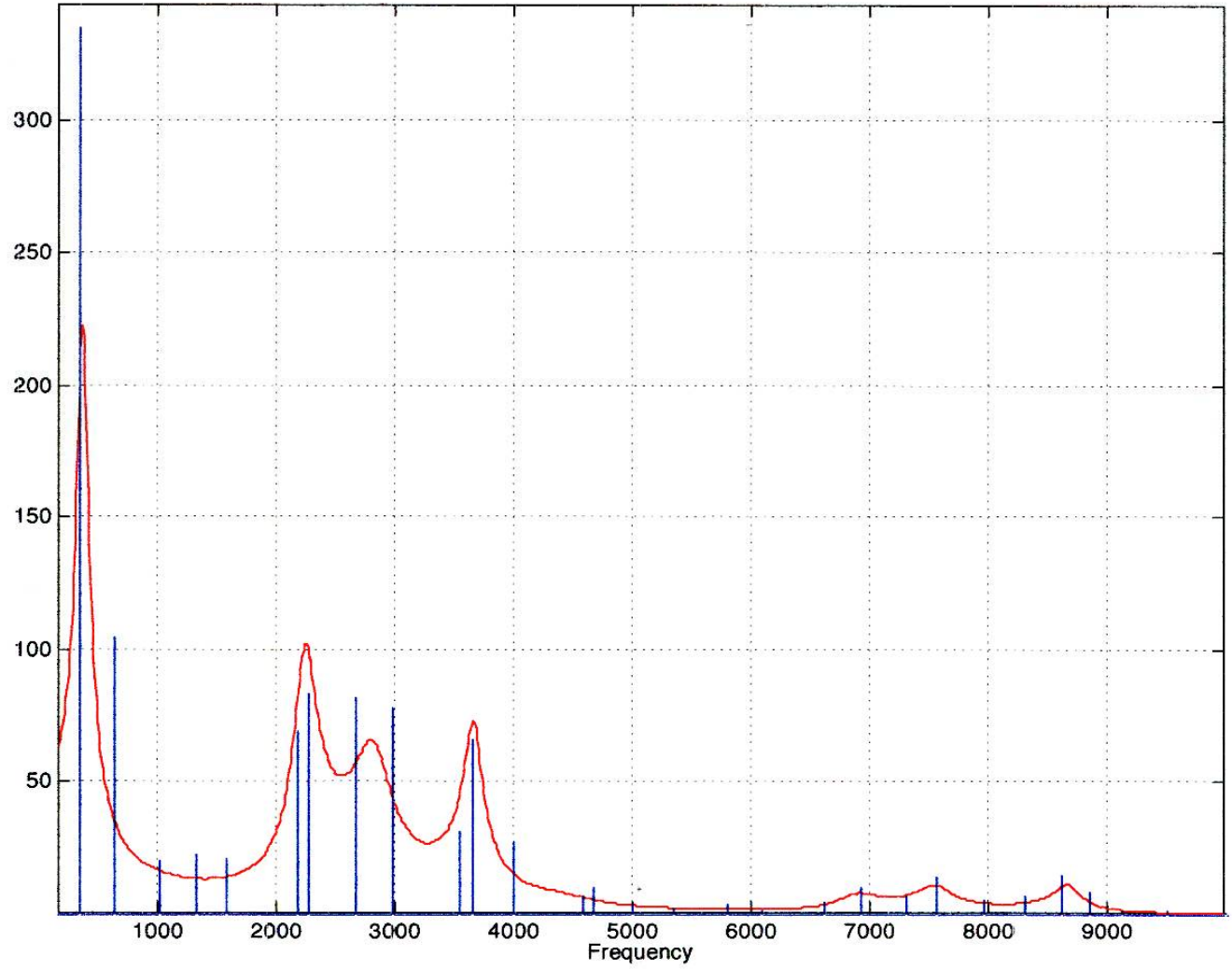
Duration 2.50 (sec)





# DFT/LPC Overlay B40d

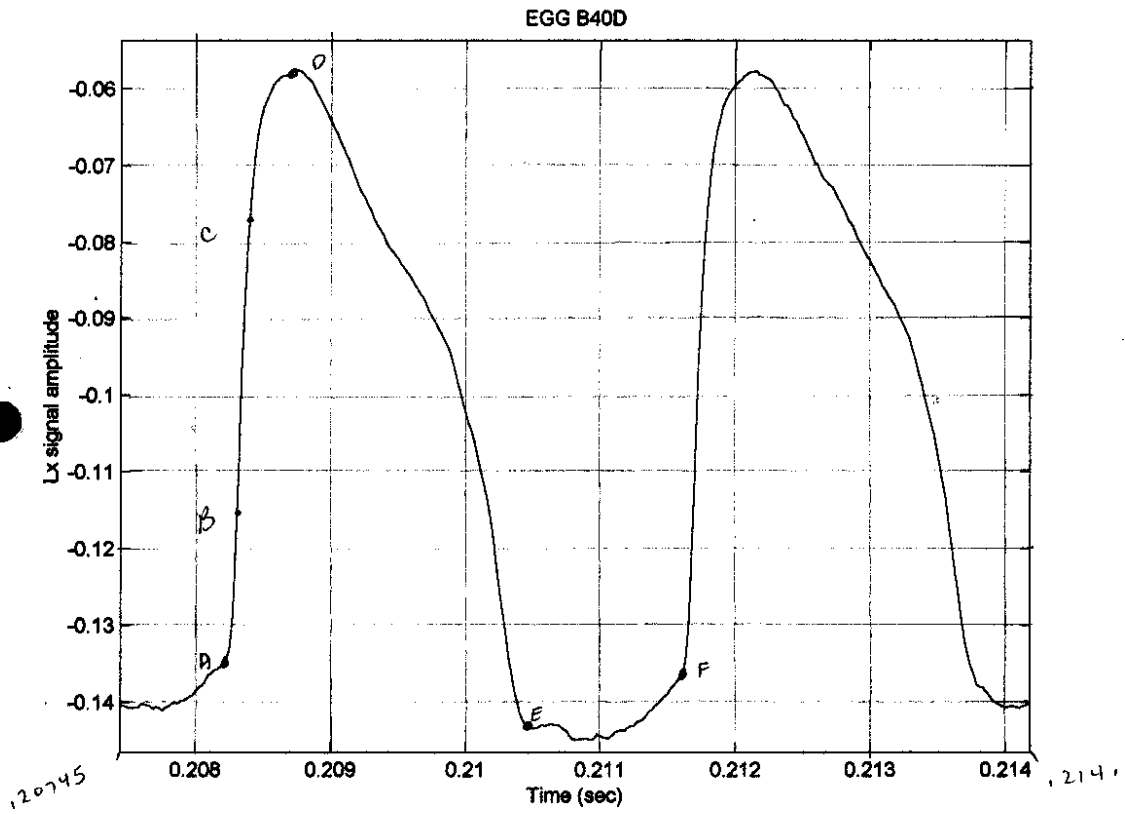
Stem plot/LPC overlay of harmonics for sample B40(3) without preemphasis



$$\lambda \Rightarrow 23.5 \text{ m} = .001$$

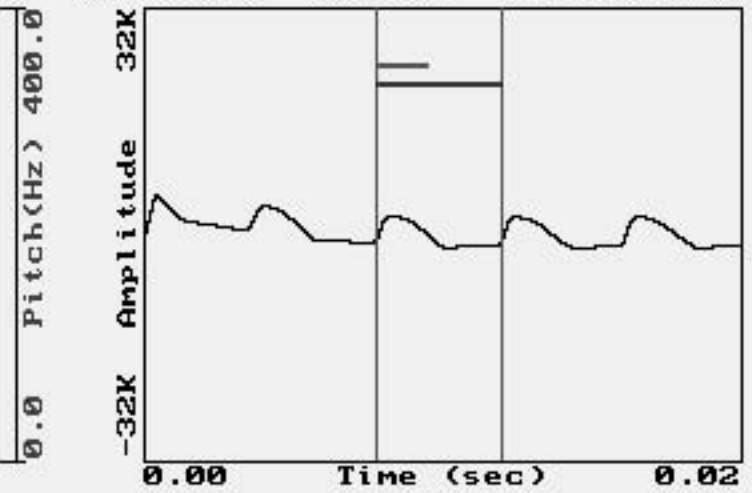
$$f \Rightarrow 13 \text{ m} = .01$$

$$(4) 1 \text{ m} = .00077$$



**A** > : CH1: B40D\_E~1.NSP

< 0.00 sec 39.78% 237.10 Hz >

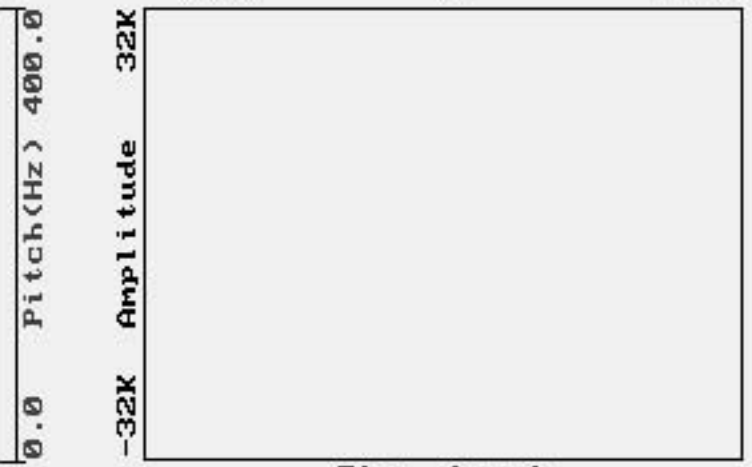


Duration 2.50 (sec)

0.00 Pitch(Hz) 400.0

**B** > :

< sec % Hz >

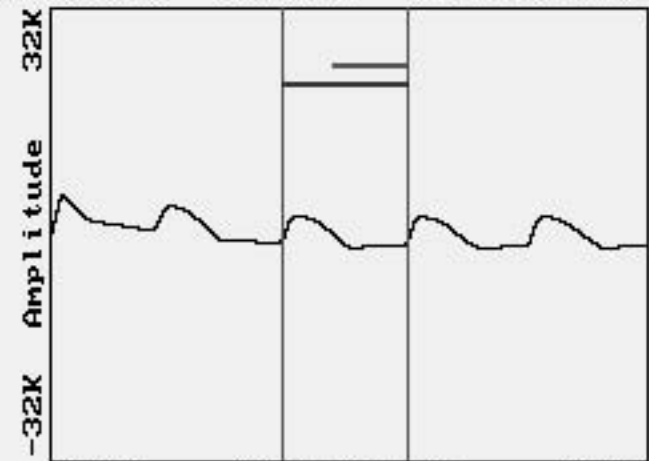
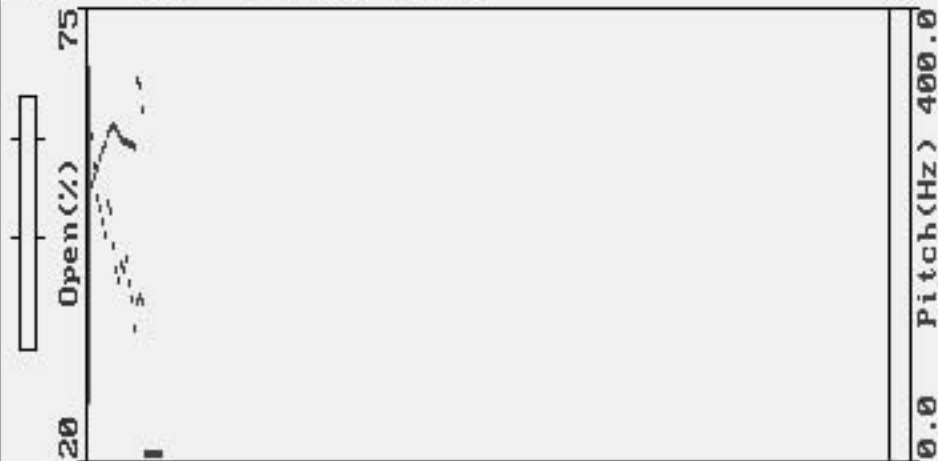


Duration 2.50 (sec)

0.00 Pitch(Hz) 400.0

**A** > : CH1: B40D\_E~1.NSP

< 0.00 sec 60.21% 237.10 Hz >



Duration 2.50 (sec)

0.00 Time (sec) 0.02

**B** > :

< sec % Hz >

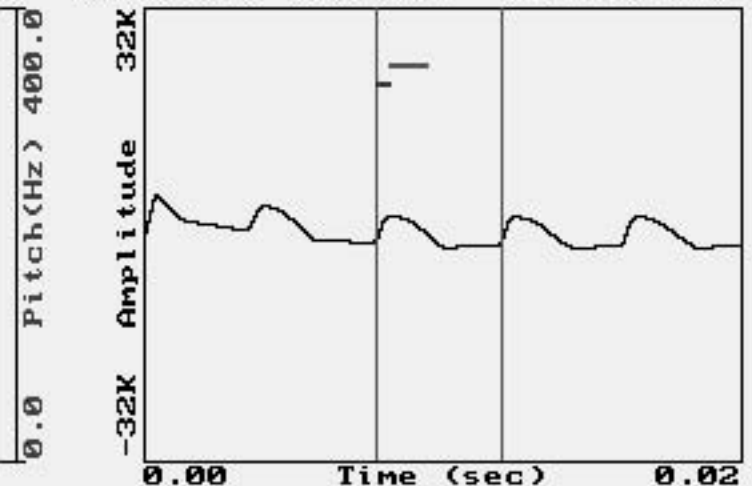
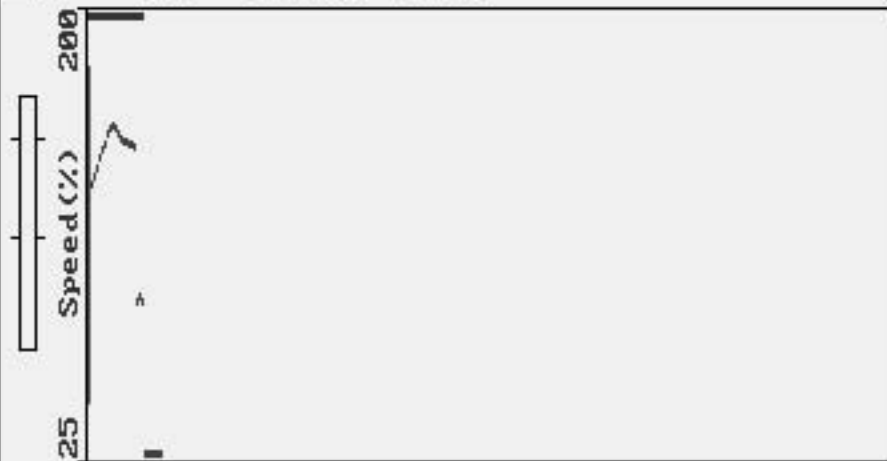


Duration 2.50 (sec)

Time (sec)

**A** > : CH1: B40D\_E~1.NSP

< 0.00 sec 289.47% 237.10 Hz >

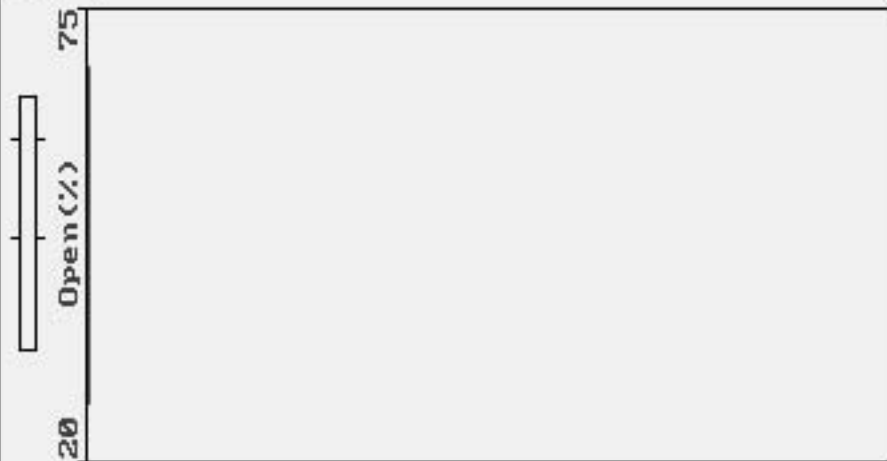


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

**B** > :

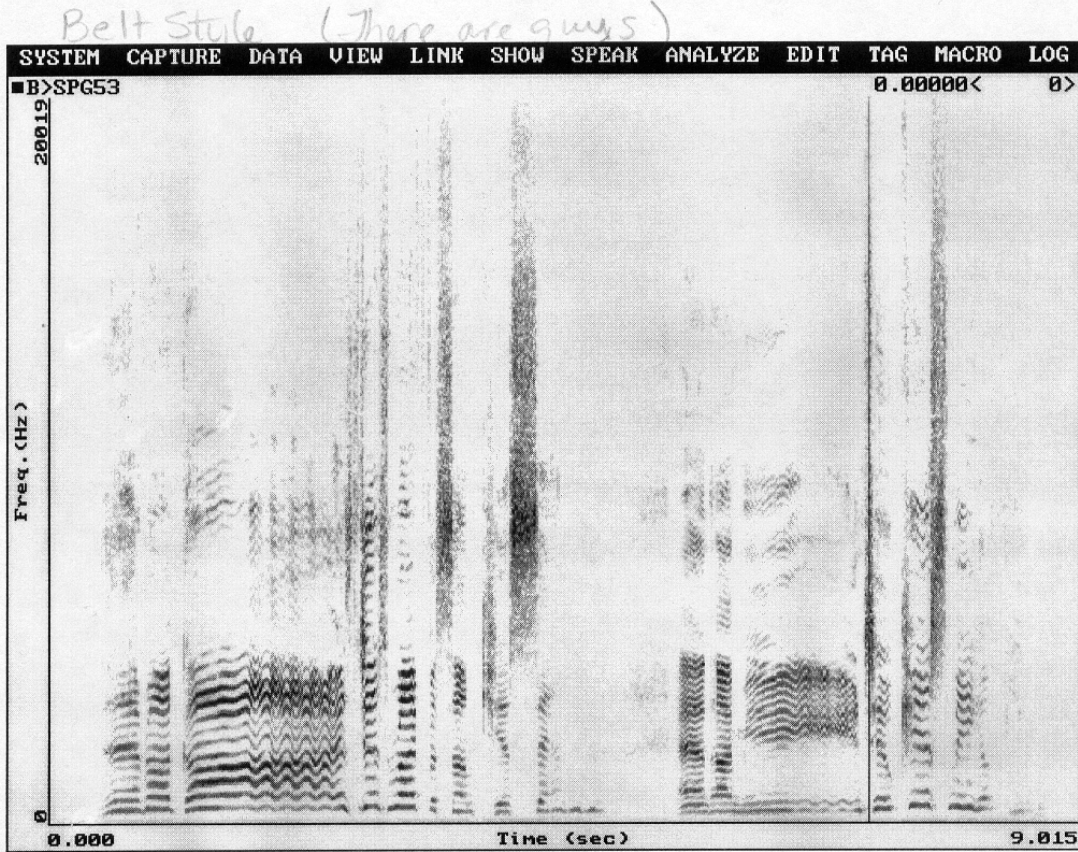
< sec % Hz >



Duration 2.50 (sec)

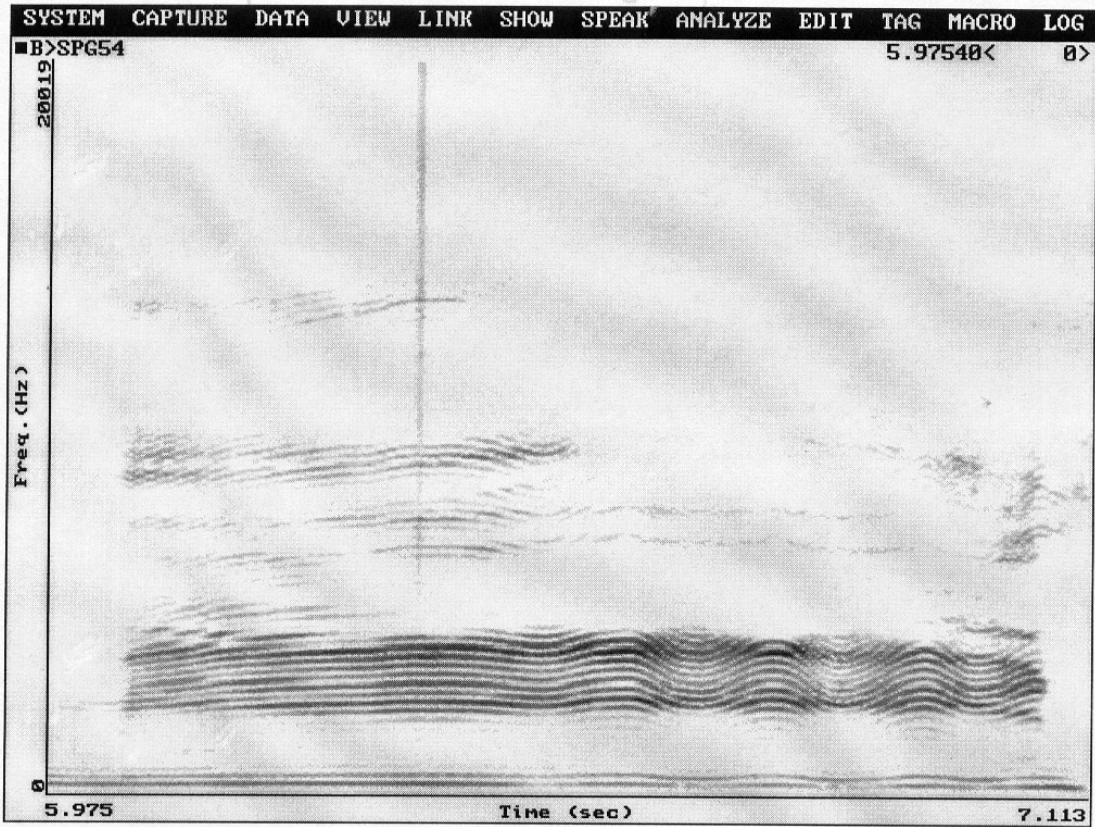
0.0 Pitch(Hz) 400.0

Spectrograms for B41



There are guys, just meant for some kissing And I mean to kiss me a few

Belt Style (There are guys)



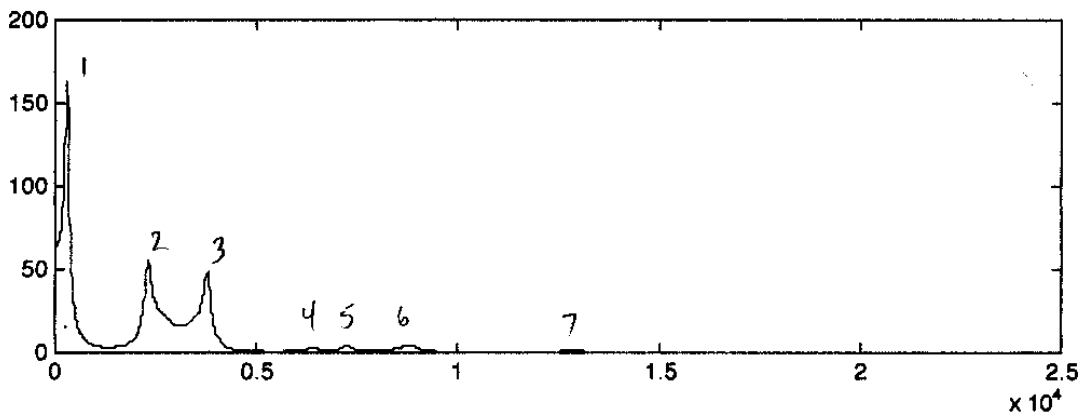
mean

F	dB
1) 292.97	163.32
2) 2296.88	54.97
3) 3773.44	49.14
4) 6380	2.64
5) 7253.91	4.21
6) 8847.65	4.20
7) 12820	1.1

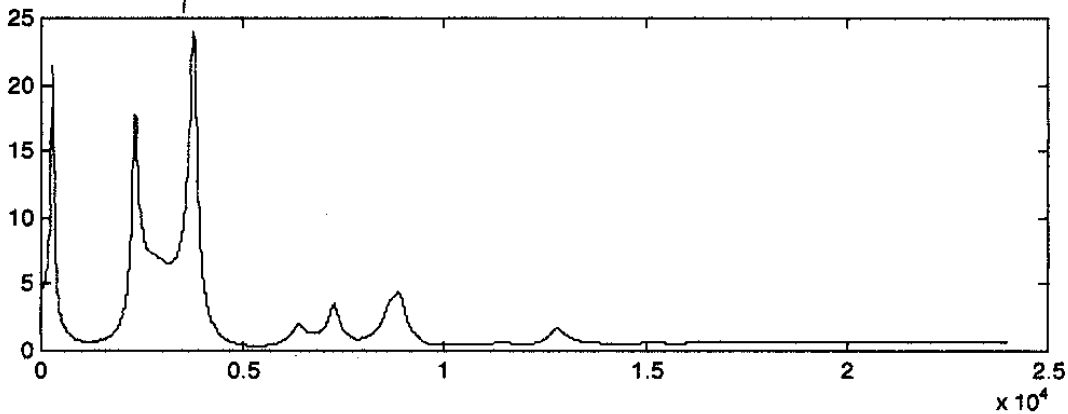
B41

$F_0$  238 Hz

$N = 50$



$P_{\text{remp}} = .9$

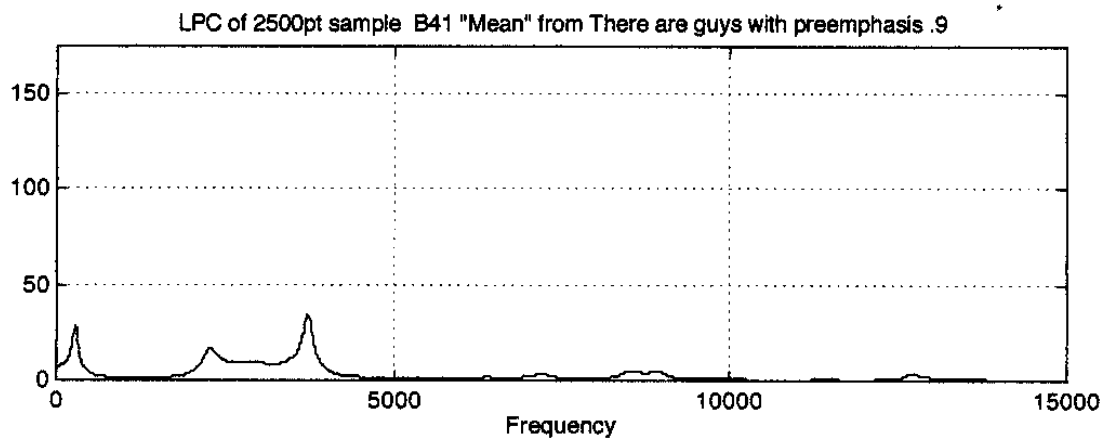
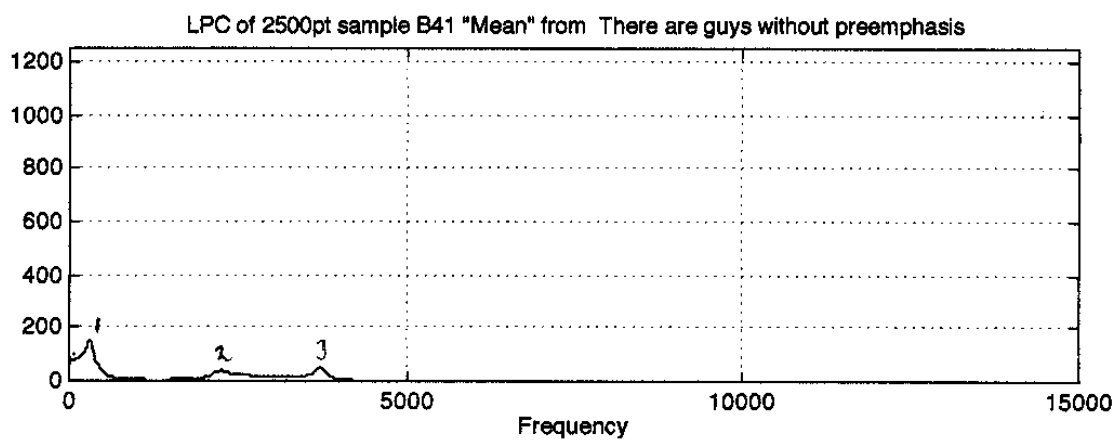


$$\begin{aligned}
 .1554375 - .008125 &= .1473125 / 35 = .004208929 \\
 &= T \quad 1/T = F \\
 &= 238
 \end{aligned}$$

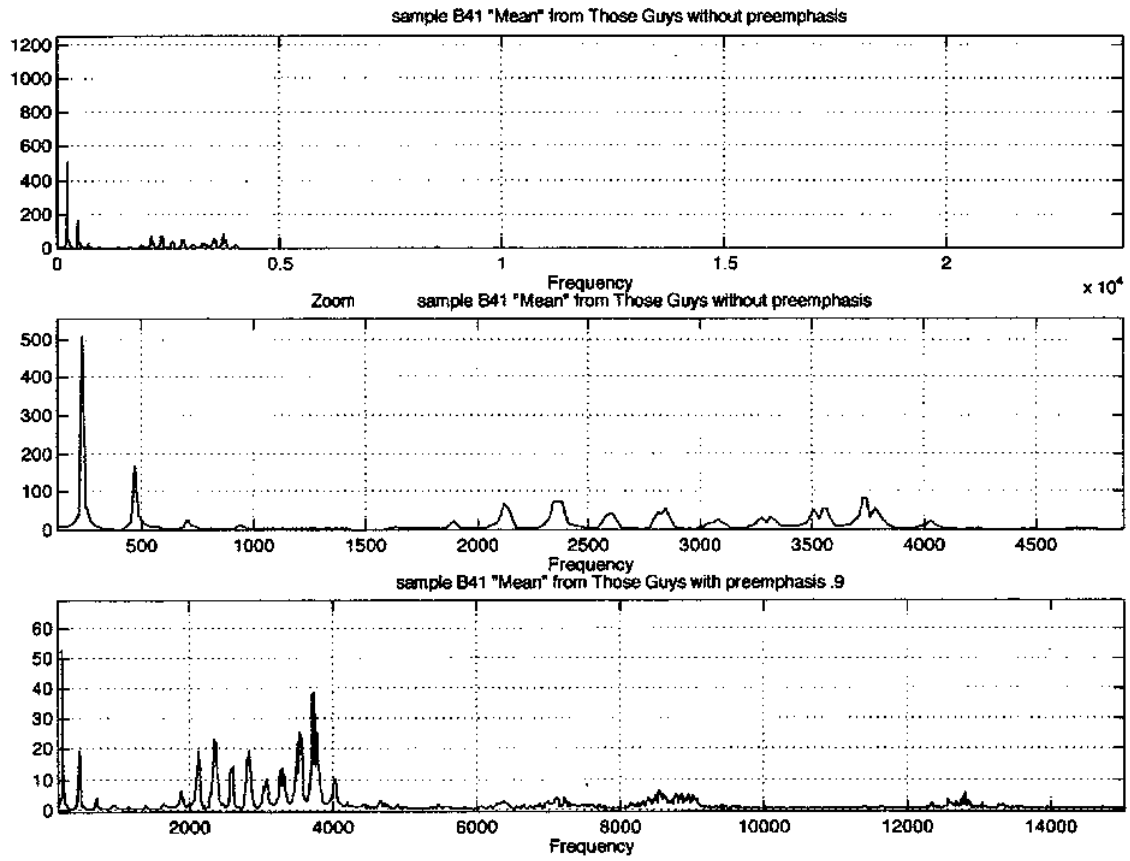
( 304.69, 153.52 )

( 2261.72, 38.17 )

( 3726.56, 53.35 )



# DFT of B41

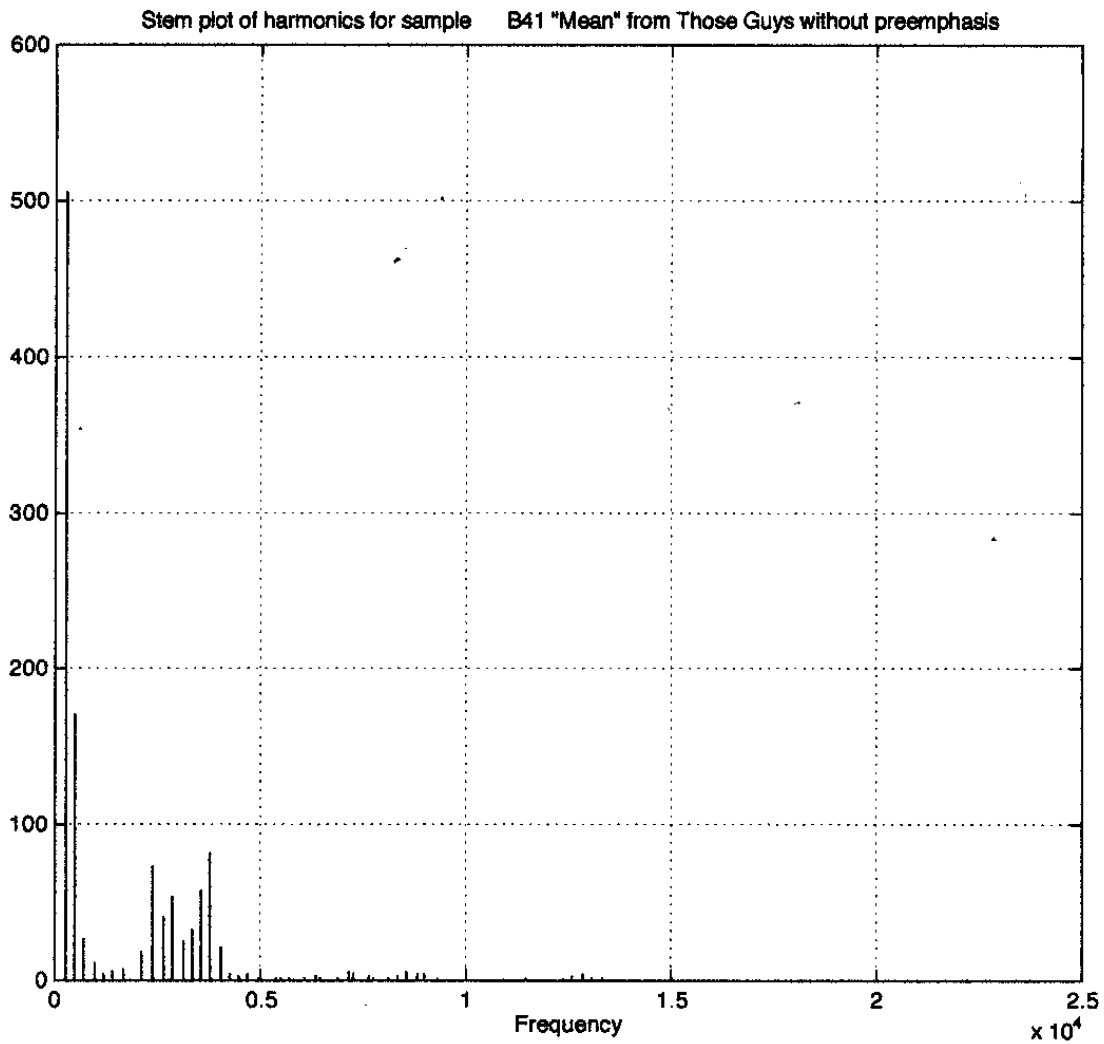


Worksheet saved into file: Minitab.B41  
MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	252	505.330	100.000 —
2	486	170.667	33.773
3	720	27.045	5.352
4	954	11.596	2.295
5	1170	4.489	0.888
6	1422	6.268	1.240
7	1674	6.658	1.318
8	2106	18.944	3.749
9	2358	72.995	14.445 —
10	2610	40.911	8.096
11	2862	53.546	10.596 —
12	3096	25.519	5.050
13	3330	32.164	6.365
14	3564	57.419	11.363 —
15	3762	81.828	16.193 —
16	4050	21.097	4.175
17	4230	4.011	0.794
18	4464	2.333	0.462
19	4698	3.913	0.774
20	4968	1.070	0.212
21	5382	0.719	0.142
22	5490	1.796	0.355
23	5724	0.745	0.147
24	6084	1.442	0.285
25	6318	3.312	0.655
26	6462	1.543	0.305
27	6894	1.809	0.358
28	7146	5.109	1.011 —
29	7254	4.029	0.797
30	7614	2.239	0.443
31	7722	1.096	0.217
32	8100	1.239	0.245
33	8334	2.950	0.584
34	8568	5.935	1.175 —
35	8802	4.581	0.906
36	8982	4.359	0.863
37	9324	0.960	0.190
38	9522	0.439	0.087
39	9918	0.204	0.040
40	10062	0.338	0.067
41	10278	0.362	0.072
42	10548	0.113	0.022
43	10782	0.168	0.033
44	11088	0.164	0.032
45	11430	0.707	0.140
46	11664	0.457	0.090
47	11916	0.246	0.049
48	12186	0.184	0.036
49	12366	1.335	0.264
50	12600	2.256	0.447
51	12834	3.529	0.698
52	13068	1.163	0.230
53	13338	1.085	0.215
54	13590	0.448	0.089
55	13788	0.249	0.049

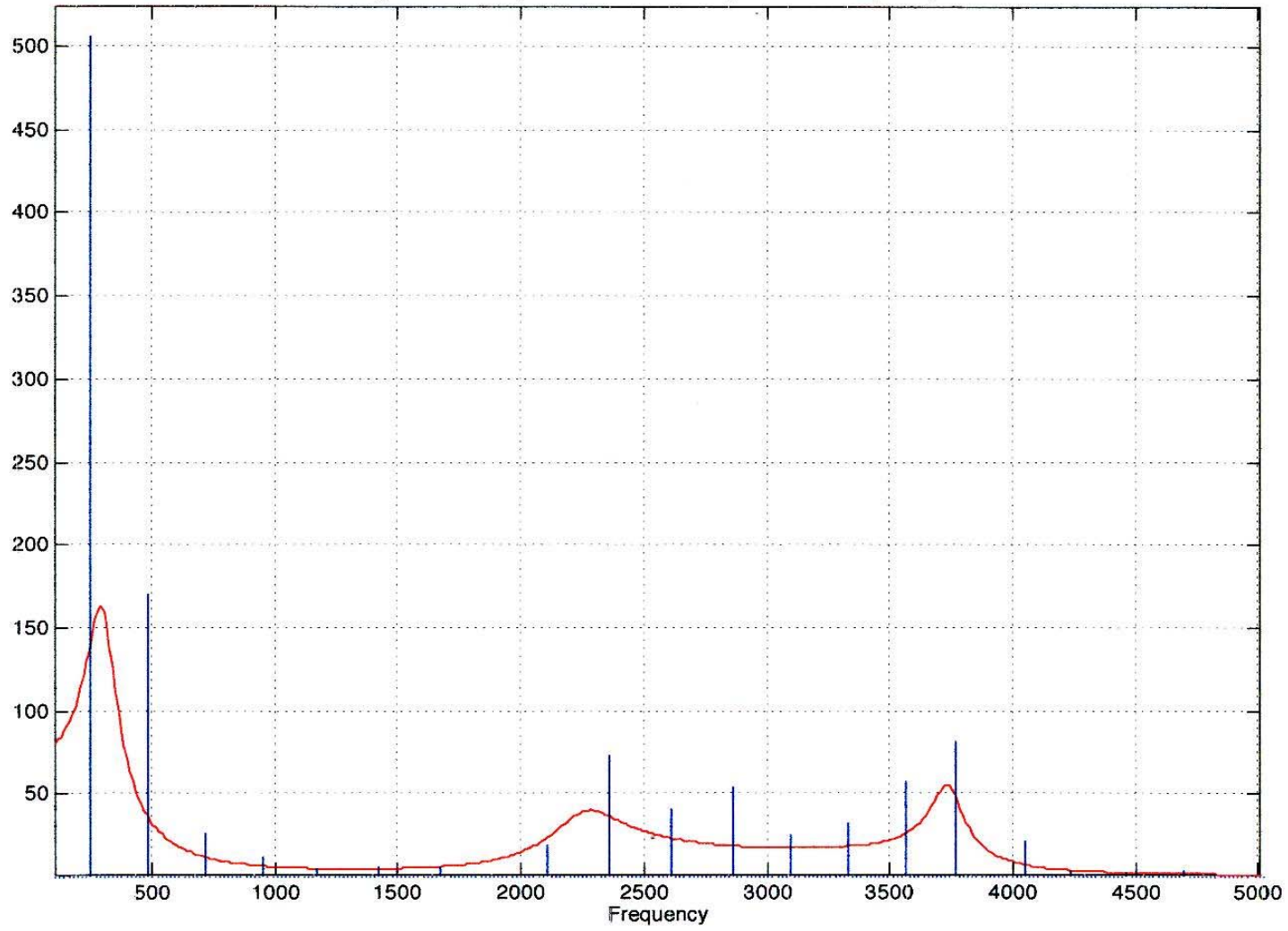
56	14202	0.247	0.049
57	14346	0.129	0.026
58	14562	0.302	0.060
59	14796	0.224	0.044
60	15210	0.114	0.023
61	15390	0.105	0.021
62	15696	0.088	0.017
63	15840	0.093	0.018
64	16200	0.111	0.022
65	16398	0.089	0.018
66	16542	0.128	0.025
67	16884	0.096	0.019
68	17172	0.161	0.032
69	17316	0.153	0.030
70	17550	0.140	0.028
71	17964	0.144	0.029
72	18162	0.127	0.025
73	18450	0.157	0.031
74	18684	0.120	0.024
75	18918	0.079	0.016
76	19098	0.129	0.026
77	19476	0.079	0.016
78	19602	0.074	0.015
79	19836	0.099	0.020
80	20070	0.074	0.015
81	20322	0.091	0.018
82	20664	0.077	0.015
83	20826	0.092	0.018
84	21258	0.069	0.014
85	21510	0.083	0.016
86	21654	0.073	0.014
87	21870	0.063	0.013
88	22194	0.071	0.014
89	22356	0.061	0.012
90	22644	0.064	0.013
91	22842	0.062	0.012
92	23220	0.065	0.013
93	23400	0.061	0.012
94	23742	0.072	0.014
95	22212	0.156	0.031
96	22464	0.149	0.029
97	22770	0.146	0.029
98	22986	0.147	0.029
99	23148	0.160	0.032
100	23454	0.154	0.031
101	23670	0.155	0.031
102	20160	0.179	0.035
103	20430	0.180	0.036
104	20610	0.171	0.034
105	20718	0.158	0.031
106	21042	0.164	0.033
107	21240	0.157	0.031
108	21420	0.141	0.028
109	21564	0.154	0.031
110	21834	0.144	0.028
111	21978	0.138	0.027
112	22104	0.146	0.029
113	22302	0.133	0.026
114	22608	0.144	0.029
115	22824	0.134	0.026

116	22950	0.130	0.026
117	23202	0.139	0.028
118	23418	0.141	0.028
119	23490	0.135	0.027
120	23814	0.133	0.026



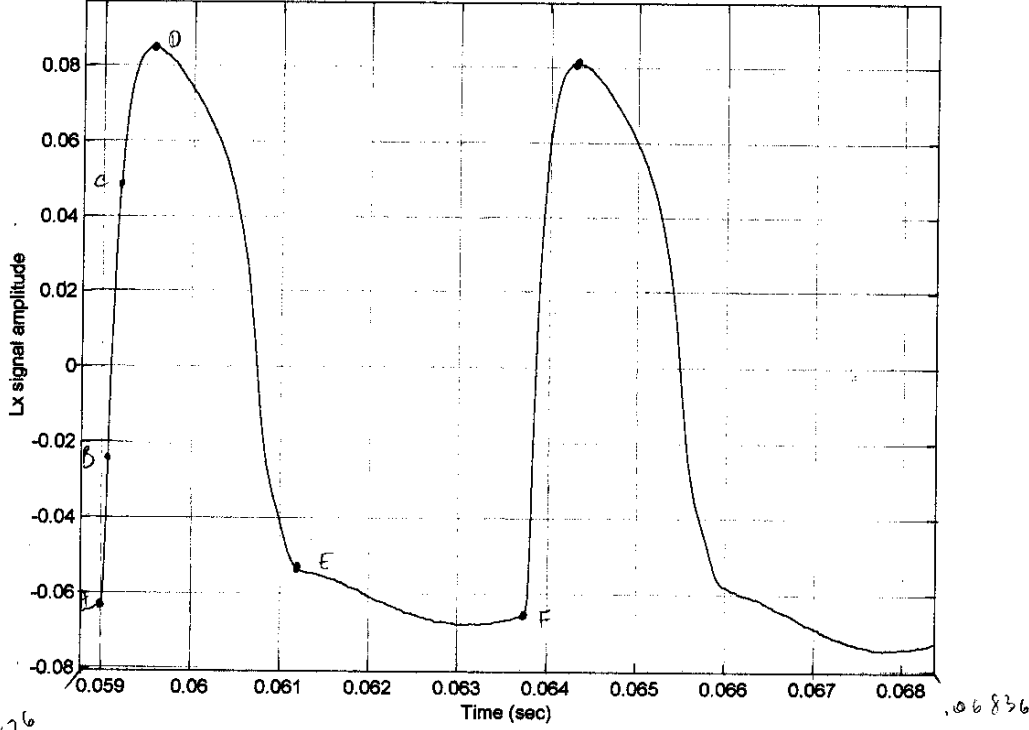
# DFT/LPC Overlay of B41

Stem plot/LPC overlay of harmonics for sample B41 without preemphasis



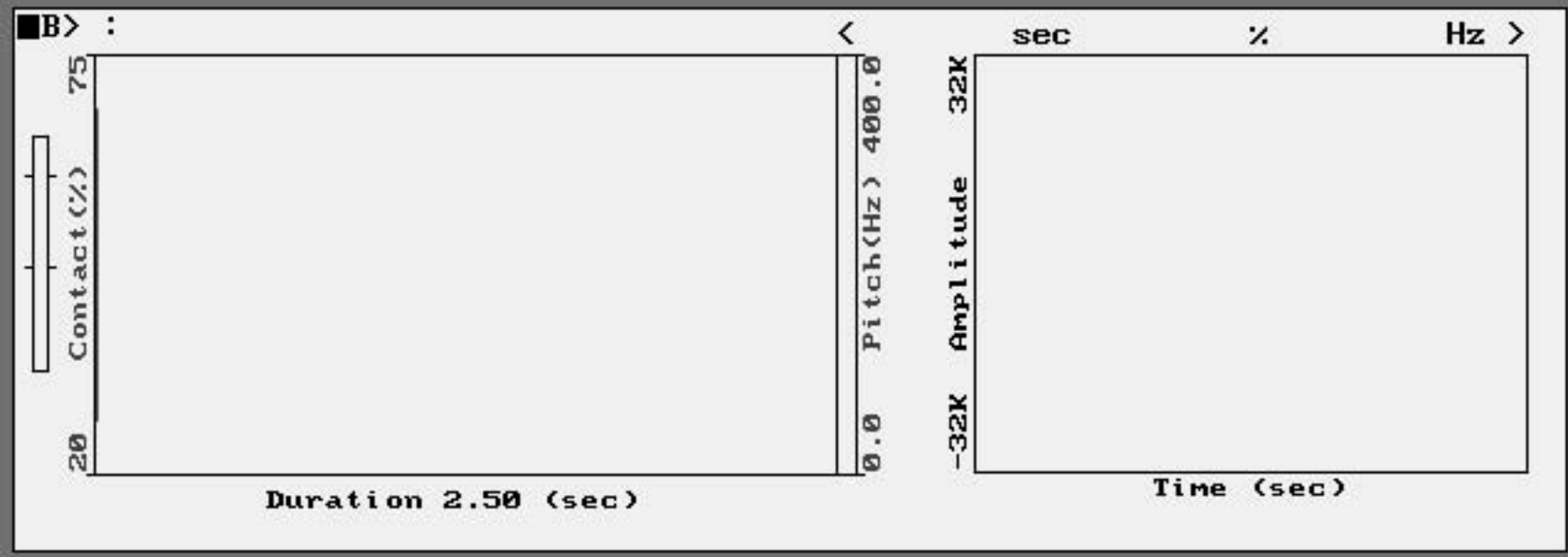
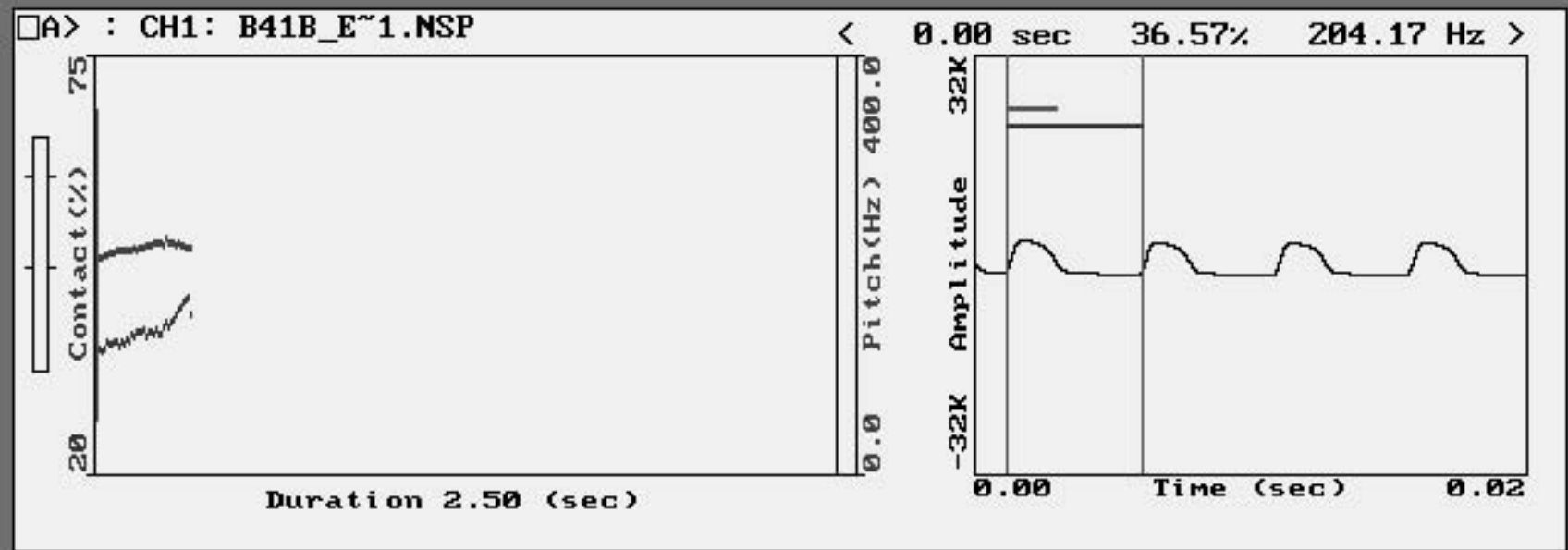
$x \rightarrow 16.5 \text{ mm} = .001 \quad .0000606$   
 $\quad \quad \quad \quad \quad \quad \quad \quad \quad = 1 \text{ mm}$   
 $y \rightarrow 14 \text{ mm} = .02 \quad .0014285$   
 $\quad \quad \quad \quad \quad \quad \quad \quad \quad = 1 \text{ mm}$

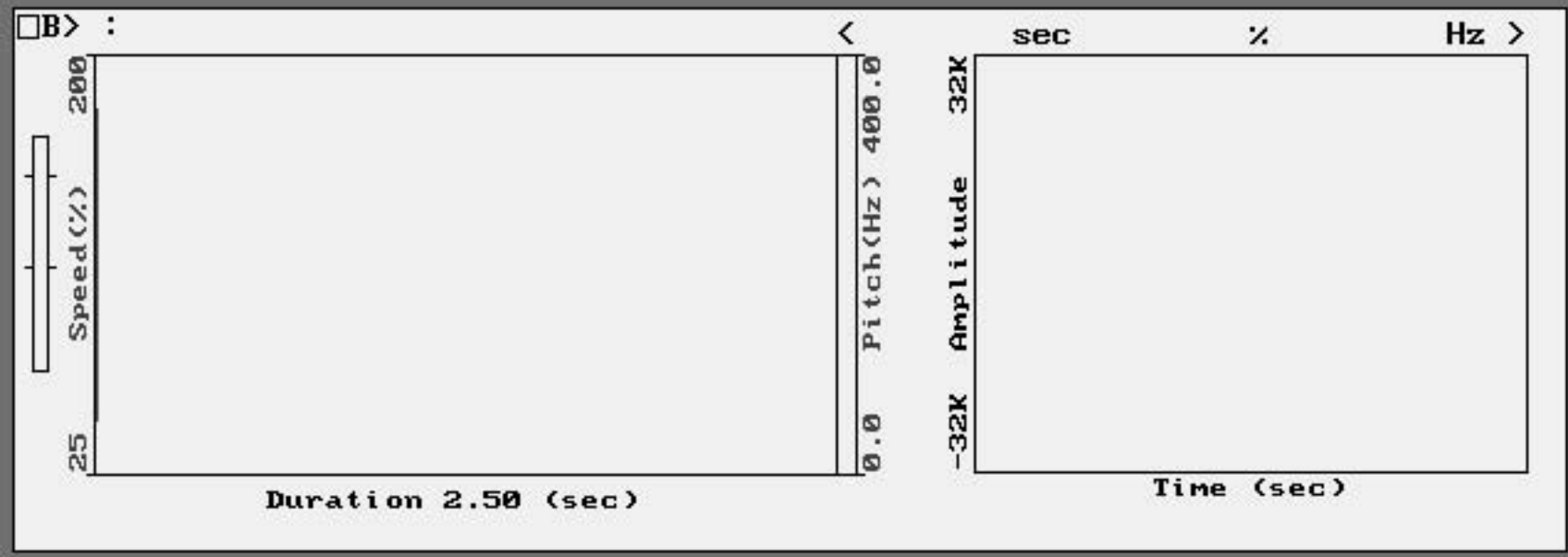
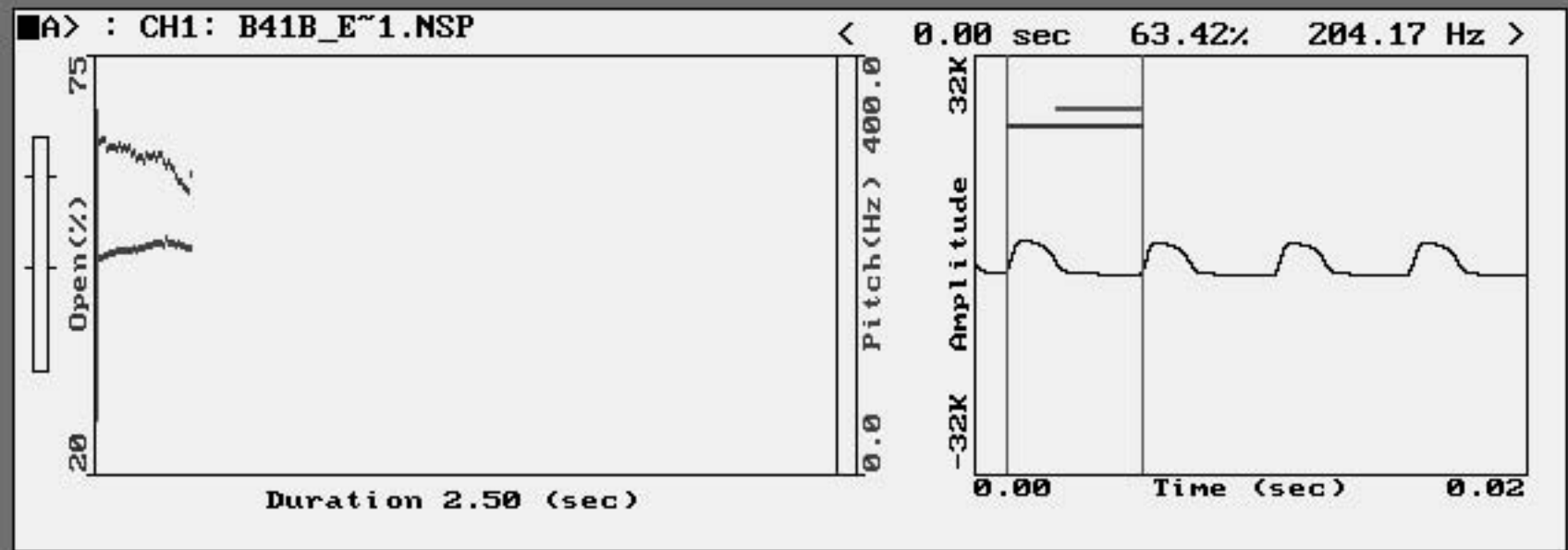
EGG B41B



0.5876

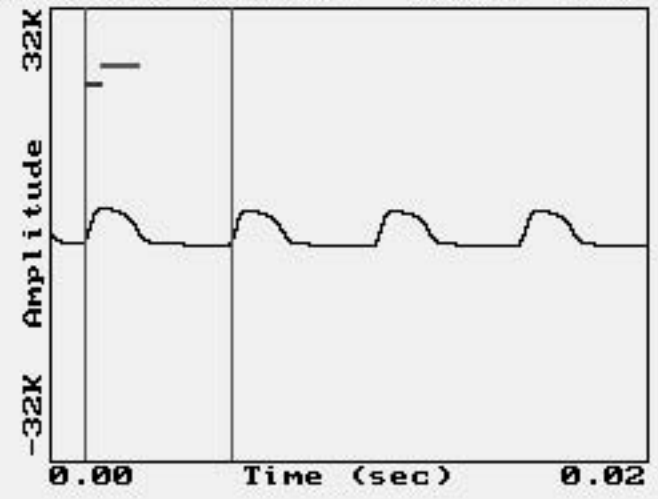
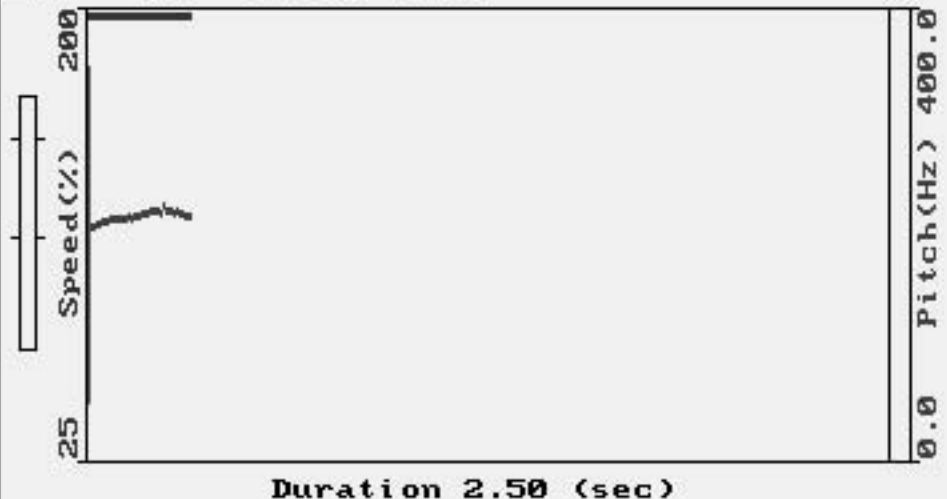
0.6836





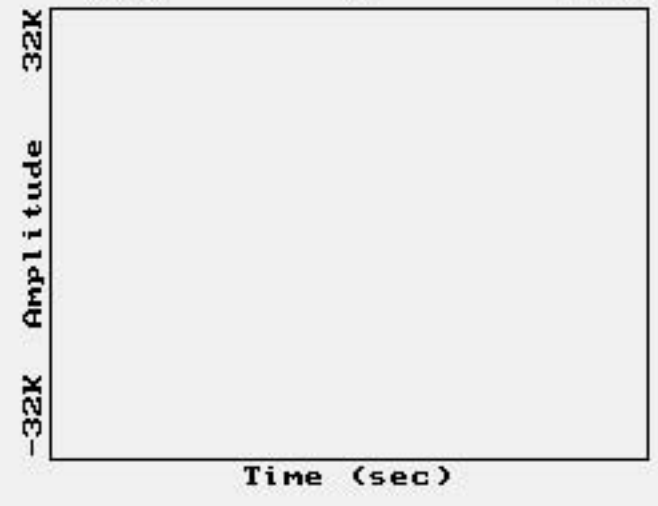
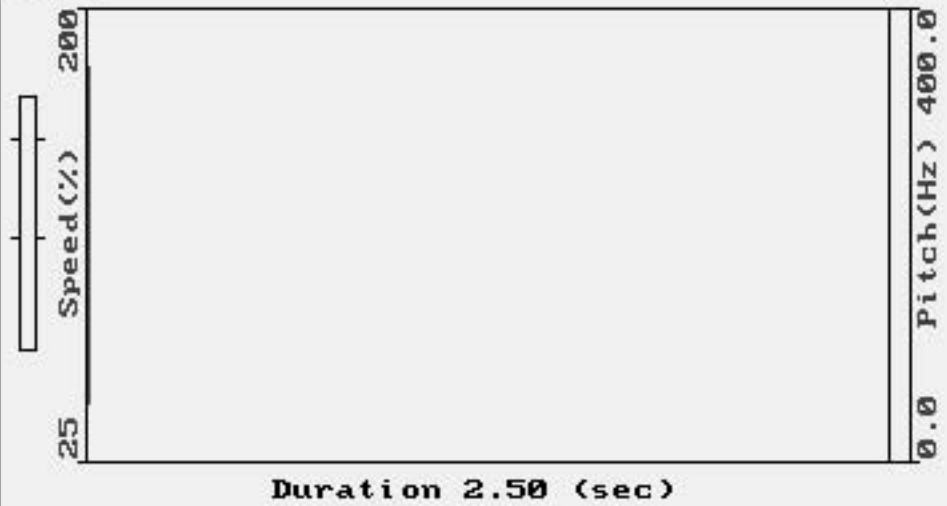
**A** > : CH1: B41B\_E~1.NSP

< 0.00 sec 243.47% 204.17 Hz >

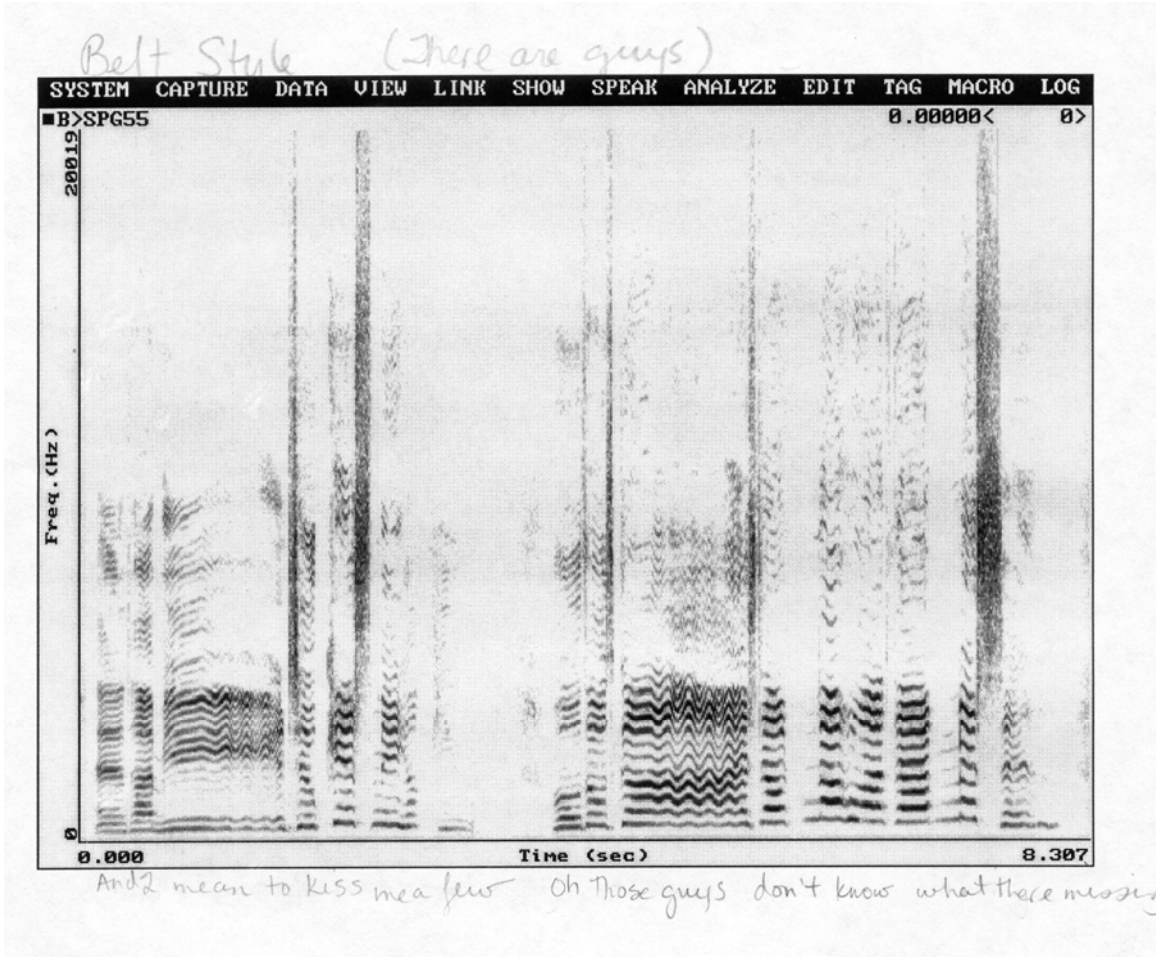


**B** > :

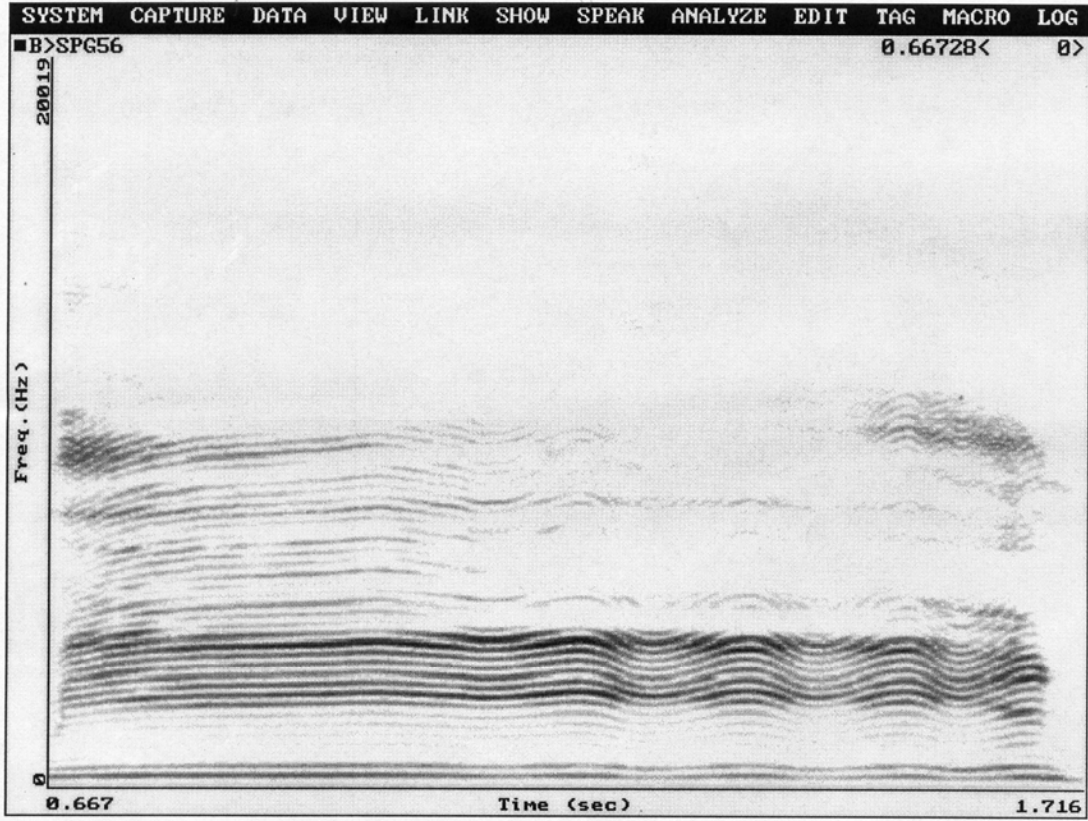
< sec % Hz >



Spectrograms of B45



Belt style (Oh those guys)

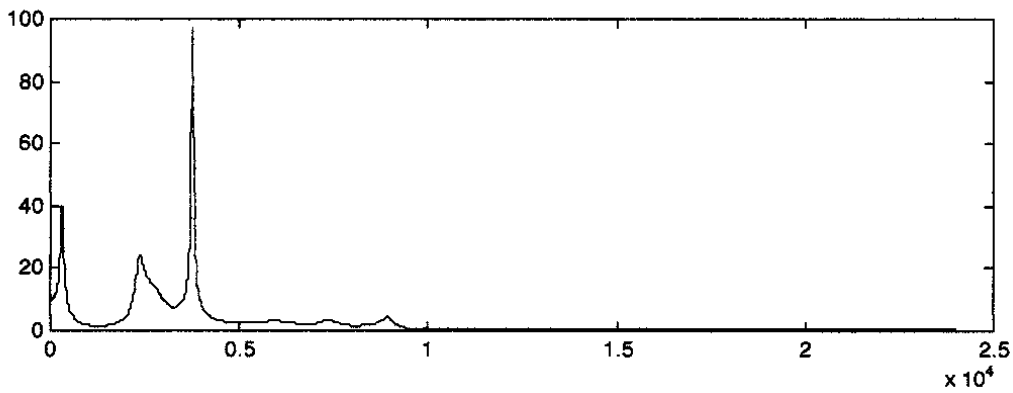
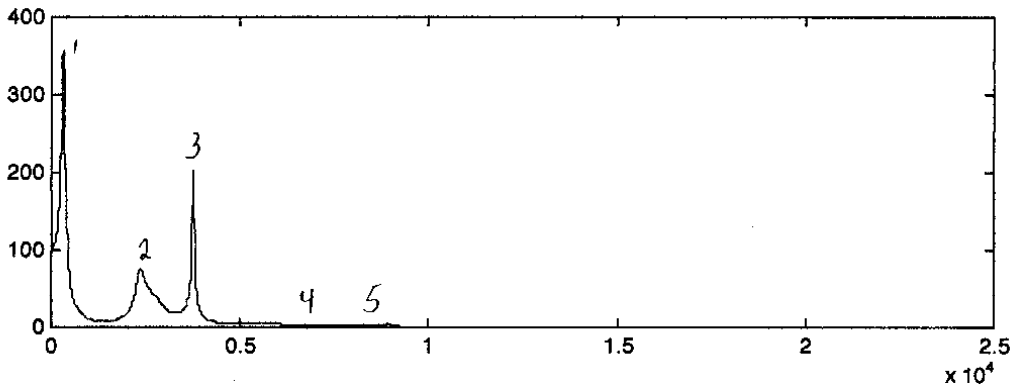


mean.

	F	dB
1)	316.41	357.13
2)	2355.47	76.30
3)	3750	201.39
4)	7355	3.9
5)	8937	4.22

B45

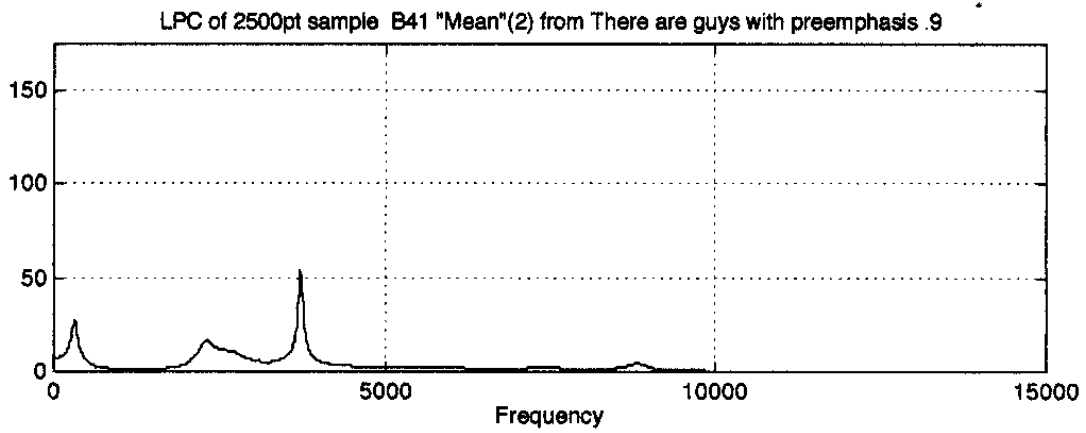
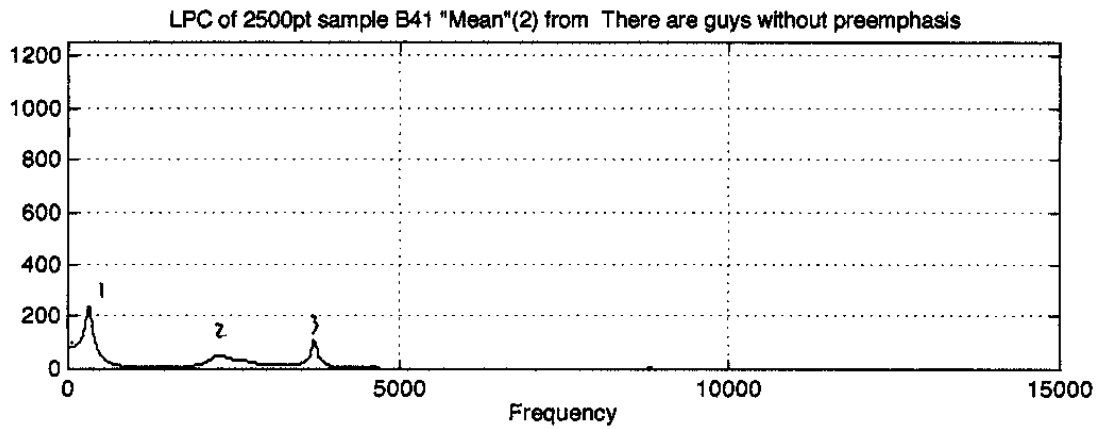
$$F_0 = 270 \text{ Hz}$$



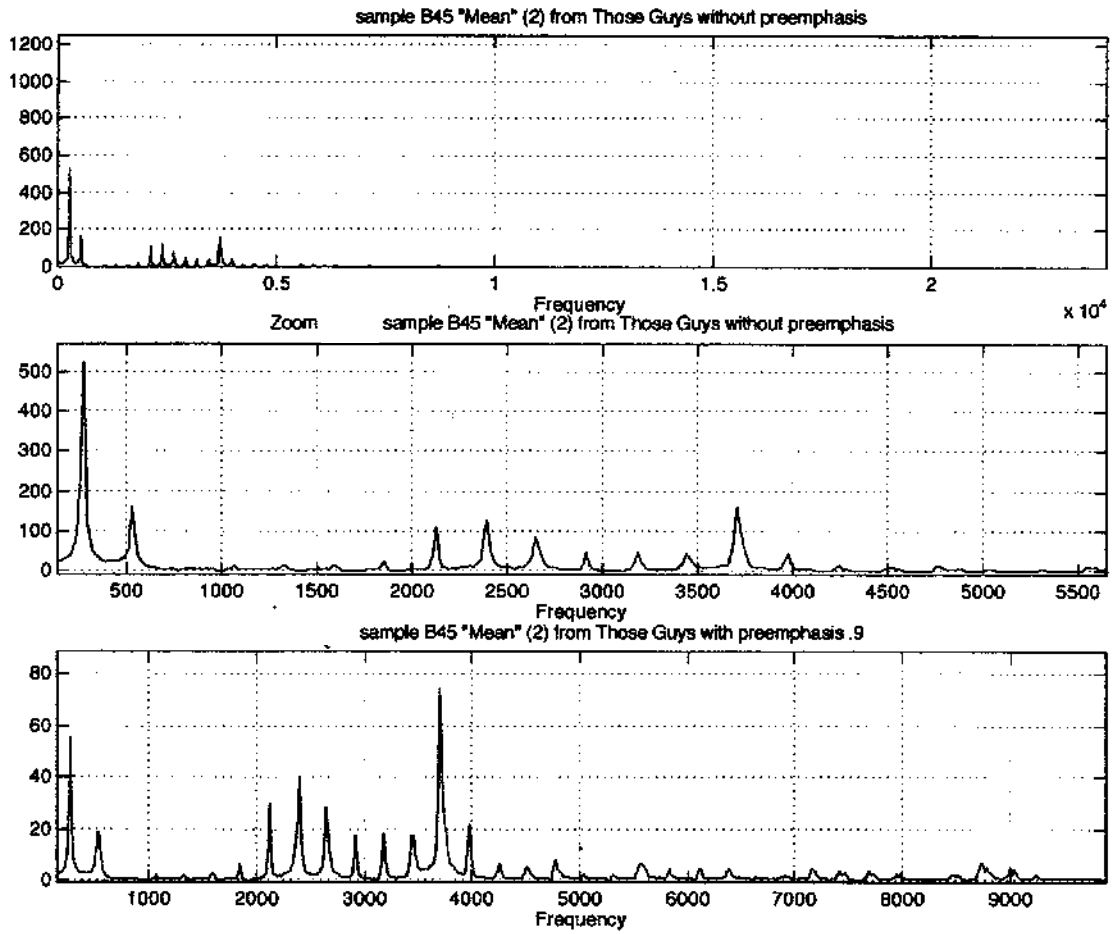
$$.15679167 - .02708333 = .12970834 / 35 = T$$

$$1/4 = F \quad F = 270 \text{ Hz}$$

(328.12; 235.02)  
(2285.16, 53.73)  
(3715.85, 112.18)



# DFT Results for B45



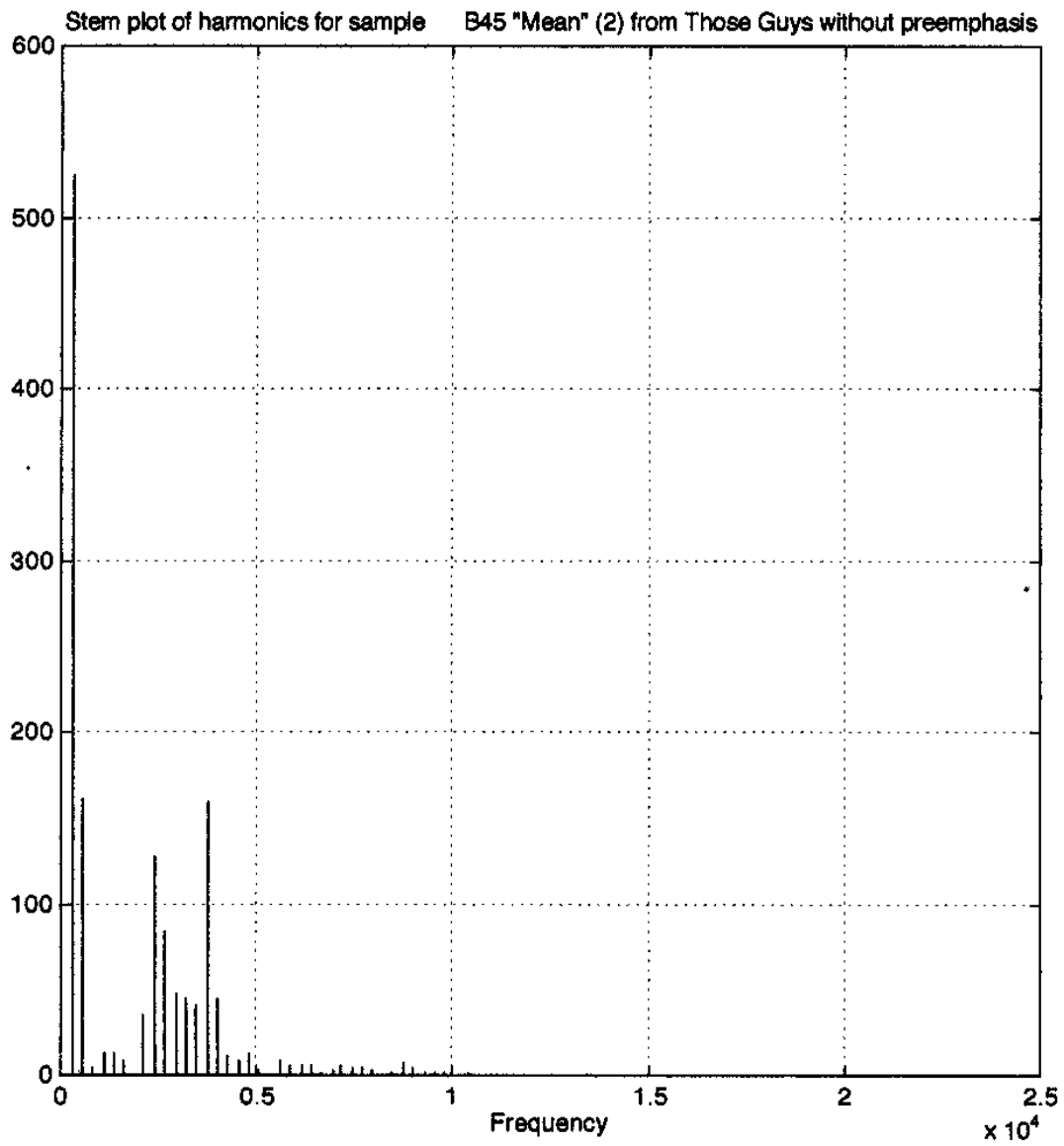
DFT Numerical Results

Worksheet saved into file: Minitab.B45  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	288	523.940	100.000
2	540	161.083	30.744
3	810	4.119	0.786
4	1080	12.429	2.372
5	1350	12.910	2.464
6	1620	8.940	1.706
7	2124	35.101	6.699
8	2412	127.032	24.245
9	2664	84.351	16.099
10	2934	47.248	9.018
11	3204	45.350	8.656
12	3456	40.170	7.667
13	3726	158.754	-30.300
14	3996	44.176	8.431
15	4266	11.581	2.210
16	4536	8.877	1.694
17	4788	13.085	2.497
18	5076	2.313	0.441
19	5580	8.862	1.691
20	5850	5.834	1.113
21	6138	5.704	1.089
22	6408	5.886	1.123
23	6642	1.320	0.252
24	6930	2.272	0.434
25	7164	5.293	1.010
26	7434	4.341	0.829
27	7704	3.877	0.740
28	7956	3.121	0.596
29	8460	1.817	0.347
30	8748	6.742	1.287
31	9018	4.667	0.891
32	9270	1.879	0.359
33	9540	0.737	0.141
34	9810	0.825	0.157
35	10116	0.410	0.078
36	10386	0.790	0.151
37	10584	0.401	0.077
38	10926	0.307	0.059
39	11322	0.355	0.068
40	11430	0.356	0.068
41	11718	0.565	0.108
42	12204	0.424	0.081
43	12474	0.372	0.071
44	12726	0.309	0.059
45	12996	0.312	0.059
46	13320	0.484	0.092
47	13590	0.272	0.052
48	13788	0.468	0.089
49	14112	0.413	0.079
50	14418	0.285	0.054
51	14652	0.264	0.050
52	15048	0.269	0.051
53	15282	0.234	0.045
54	15498	0.260	0.050
55	15858	0.252	0.048

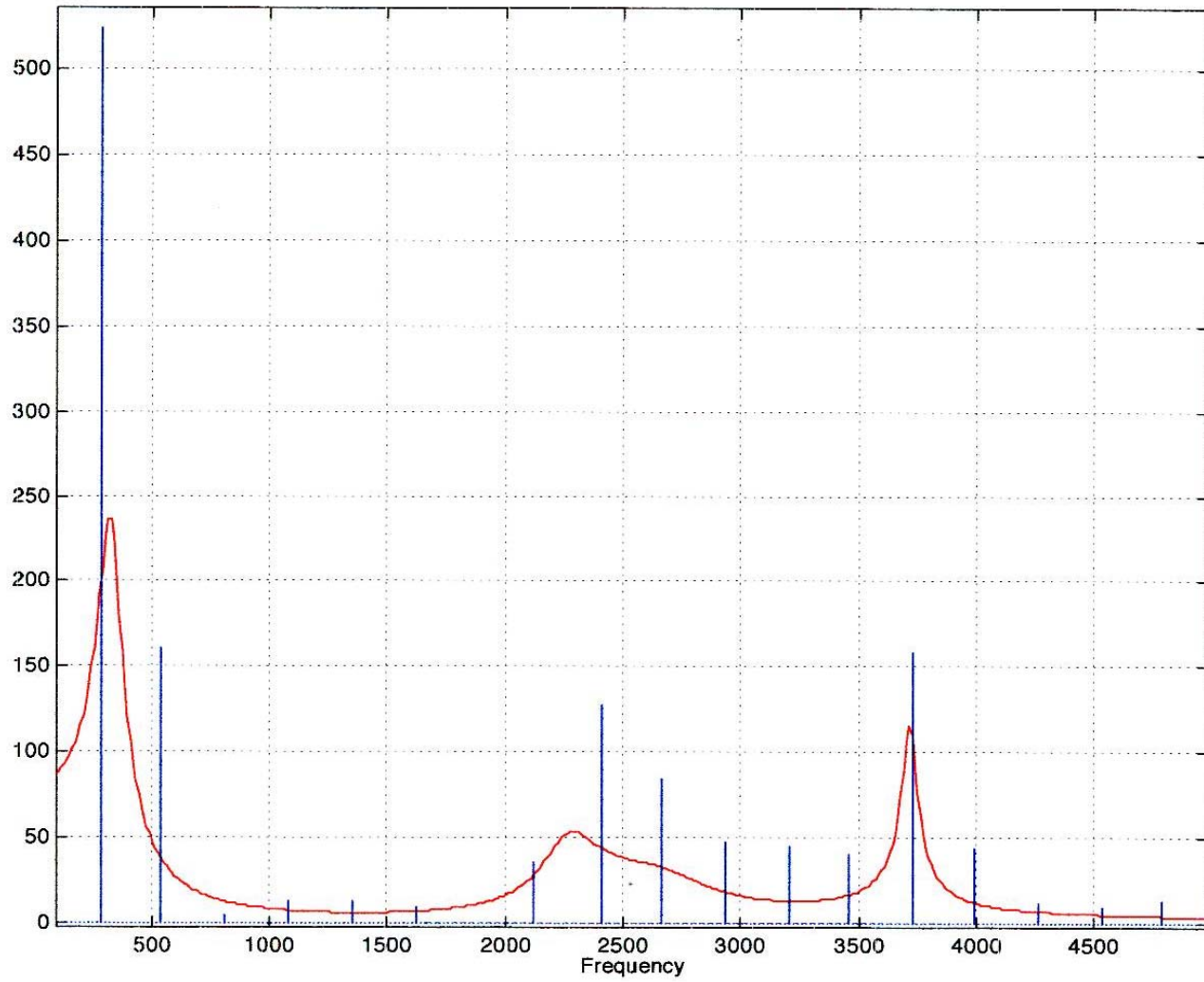
56	16200	0.233	0.045
57	16308	0.224	0.043
58	16812	0.265	0.051
59	16938	0.232	0.044
60	17172	0.212	0.040
61	17514	0.236	0.045
62	17856	0.214	0.041
63	18198	0.211	0.040
64	18540	0.249	0.047
65	18720	0.211	0.040
66	19062	0.199	0.038
67	19278	0.221	0.042
68	19566	0.194	0.037
69	19854	0.218	0.042
70	20088	0.205	0.039
71	20484	0.202	0.039
72	20826	0.199	0.038
73	21060	0.206	0.039
74	21402	0.210	0.040
75	21582	0.193	0.037
76	21978	0.199	0.038
77	22266	0.180	0.034
78	22554	0.187	0.036
79	22662	0.188	0.036
80	23004	0.208	0.040
81	23238	0.197	0.038
82	23634	0.184	0.035
83	20826	0.092	0.018
84	21258	0.069	0.013
85	21510	0.083	0.016
86	21654	0.073	0.014
87	21870	0.063	0.012
88	22194	0.071	0.014
89	22356	0.061	0.012
90	22644	0.064	0.012
91	22842	0.062	0.012
92	23220	0.065	0.012
93	23400	0.061	0.012
94	23742	0.072	0.014
95	22212	0.156	0.030
96	22464	0.149	0.028
97	22770	0.146	0.028
98	22986	0.147	0.028
99	23148	0.160	0.031
100	23454	0.154	0.029
101	23670	0.155	0.030
102	20160	0.179	0.034
103	20430	0.180	0.034
104	20610	0.171	0.033
105	20718	0.158	0.030
106	21042	0.164	0.031
107	21240	0.157	0.030
108	21420	0.141	0.027
109	21564	0.154	0.029
110	21834	0.144	0.027
111	21978	0.138	0.026
112	22104	0.146	0.028
113	22302	0.133	0.025
114	22608	0.144	0.028
115	22824	0.134	0.026

116	22950	0.130	0.025
117	23202	0.139	0.027
118	23418	0.141	0.027
119	23490	0.135	0.026
120	23814	0.133	0.025

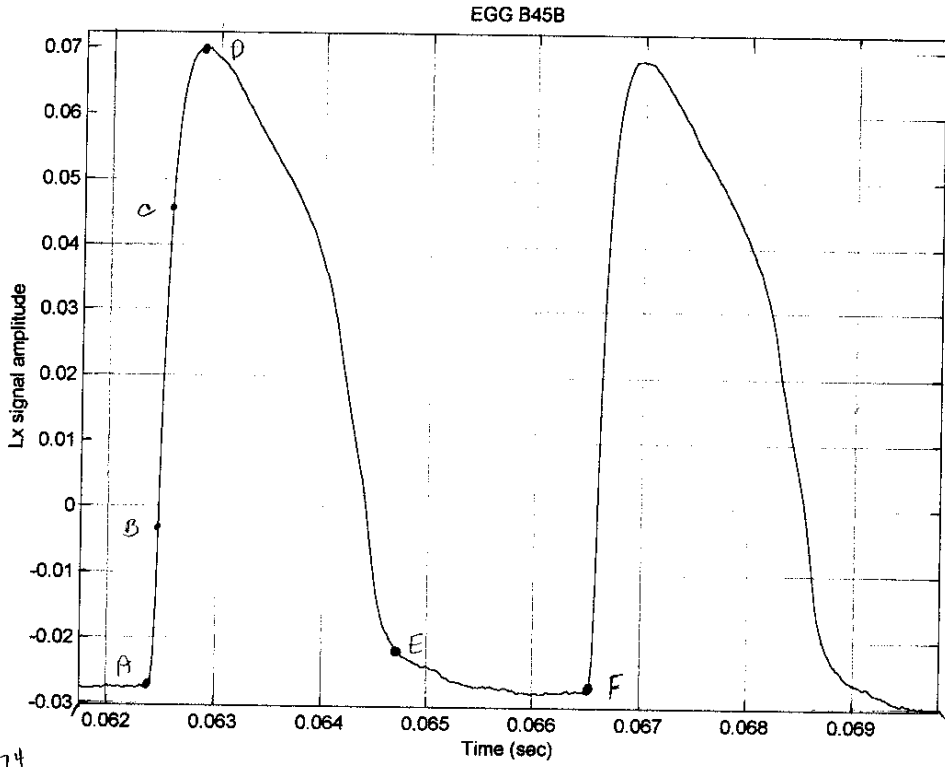


# DFT/LPC Overlay of B45

Stem plot/LPC overlay of harmonics for sample B45 without preemphasis

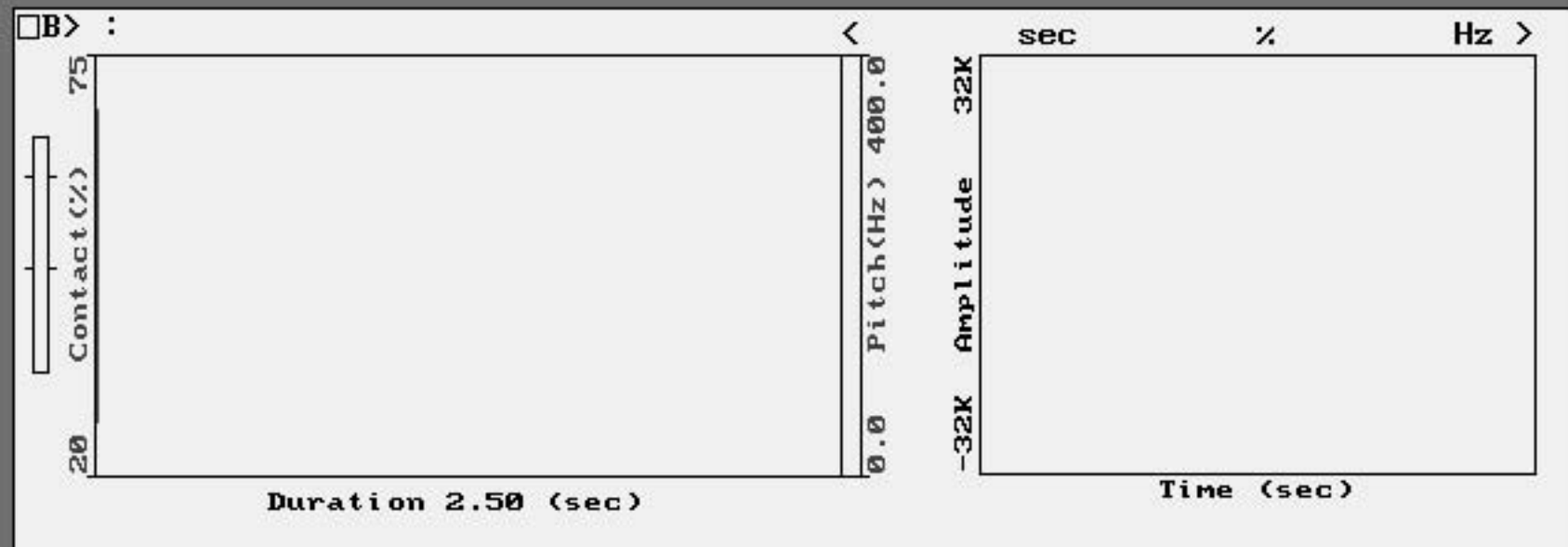
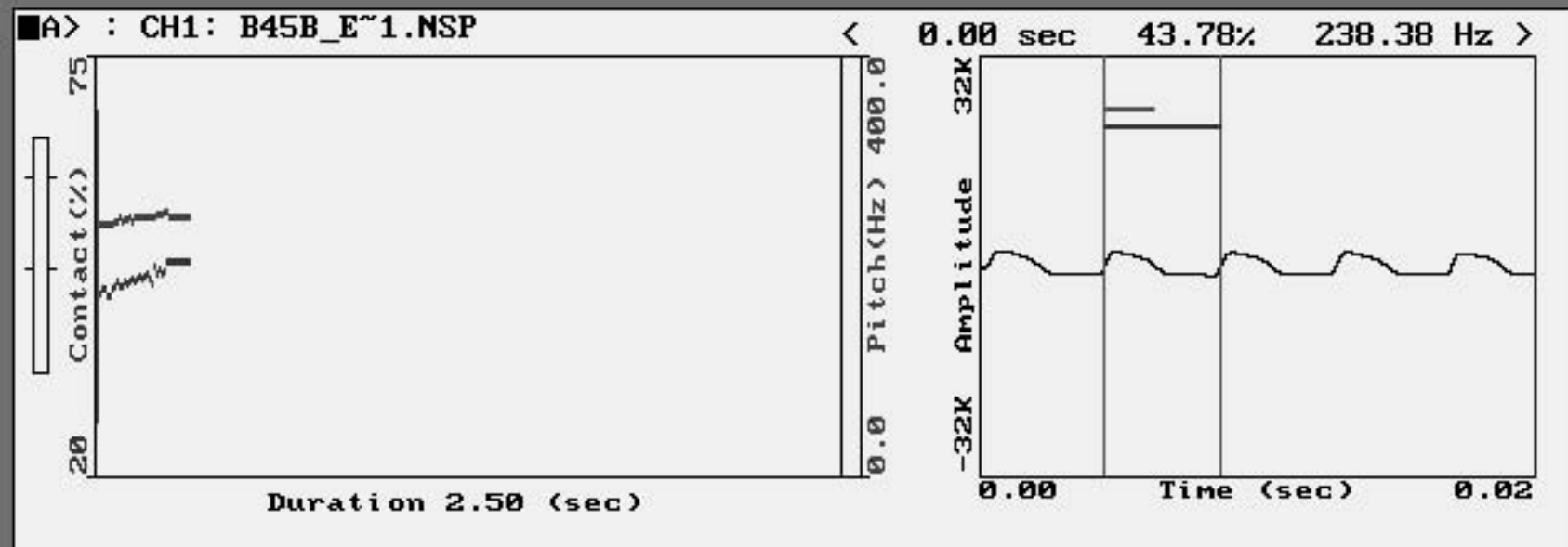


$x \Rightarrow 19.5 \text{ mm} = .001$   
 $d \Rightarrow 12 \text{ mm} = .01$   
 $r = 7 \text{ mm} = .000072$   
 $\omega = 27 \text{ rad} = .000132$



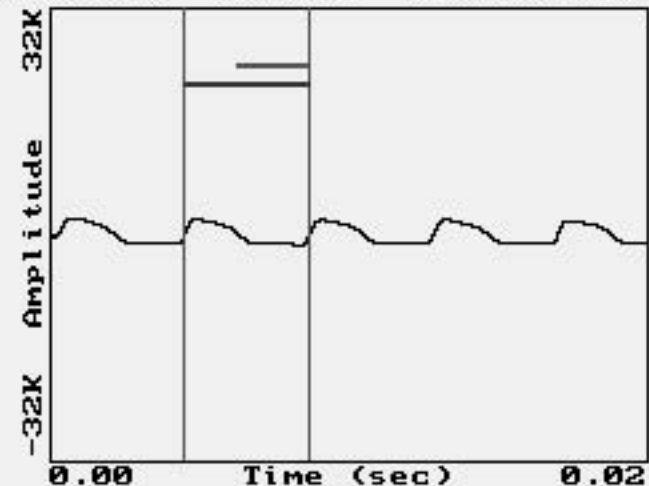
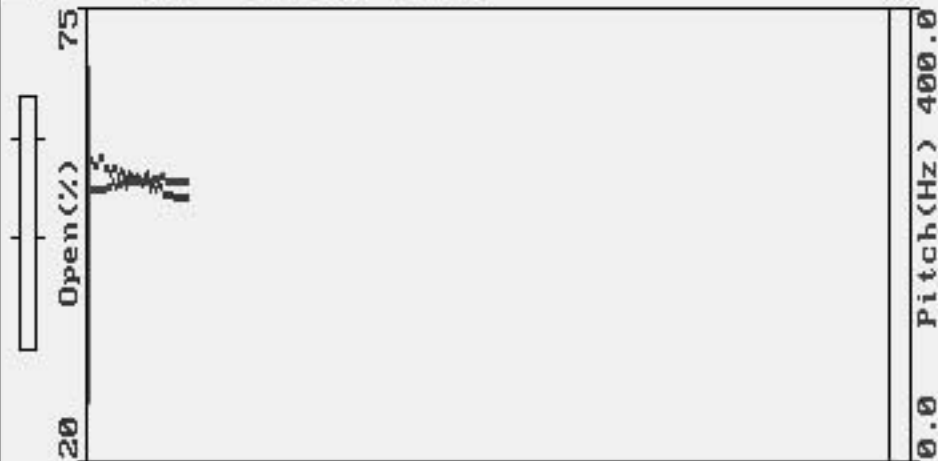
.06174

.06982



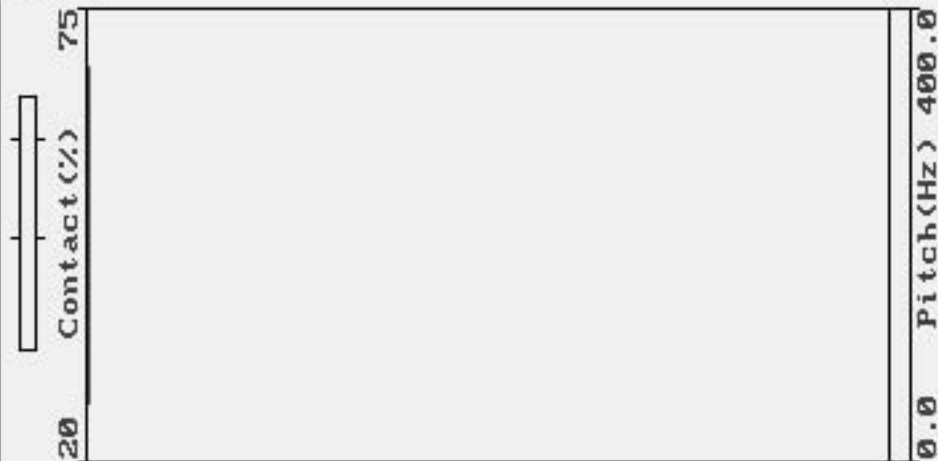
**A** > : CH1: B45B\_E~1.NSP

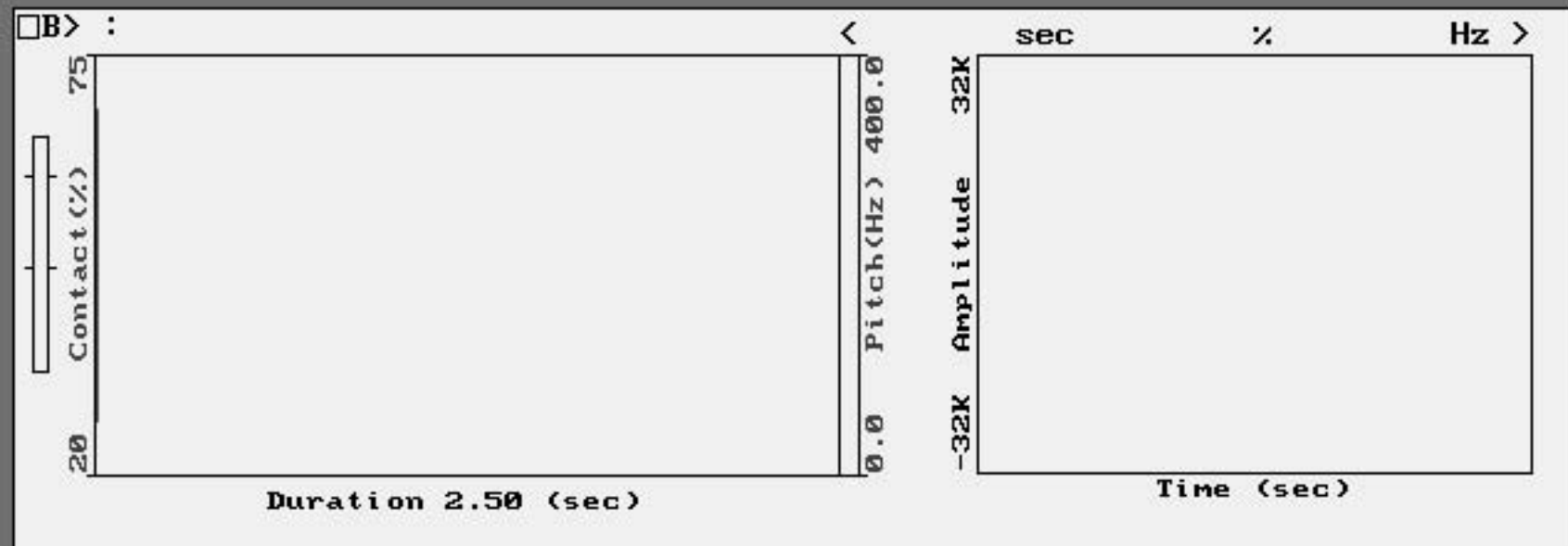
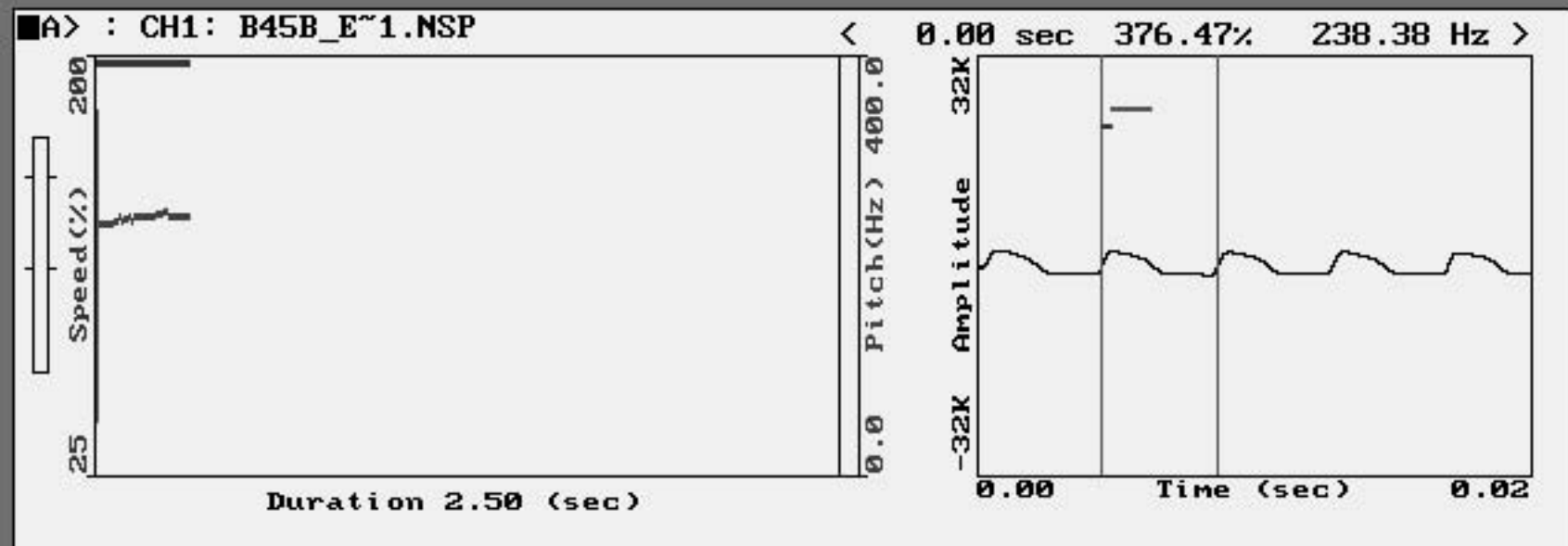
< 0.00 sec 56.21% 238.38 Hz >



**B** > :

< sec % Hz >

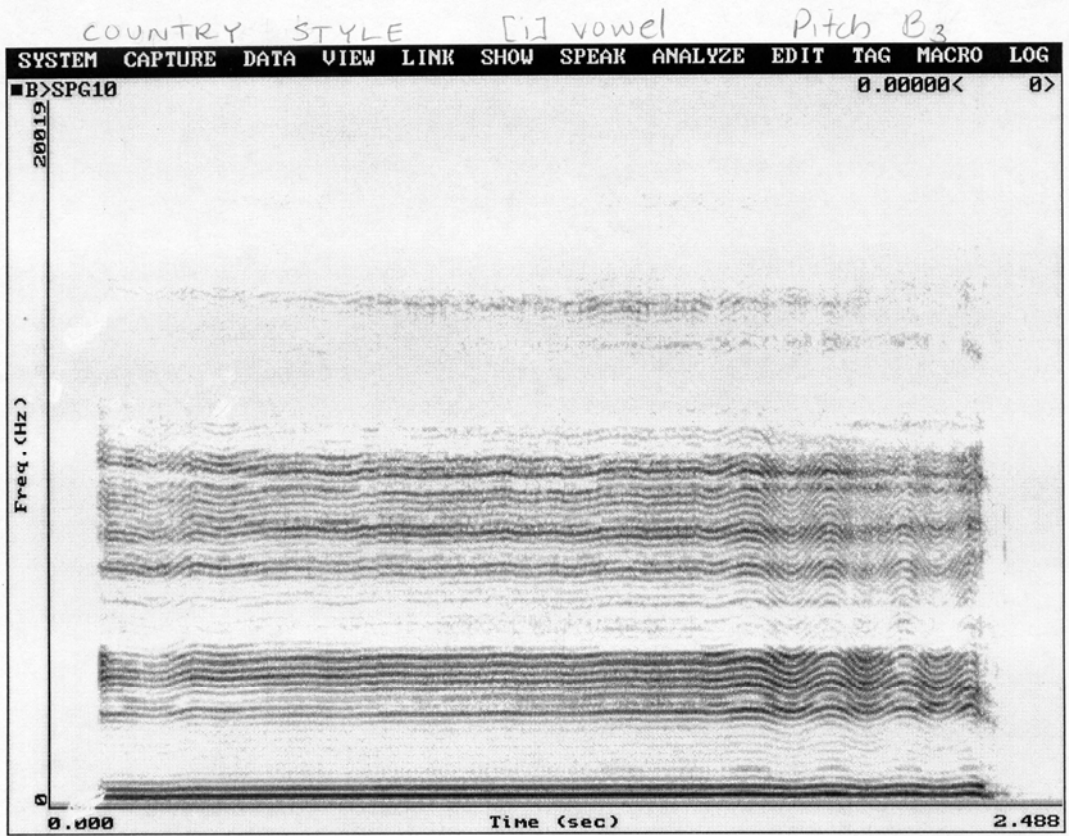




Sample #	B1	B11	B21	B31	B40b
Description	Belt B3	Belt E4	Belt B4	Belt B4 (retake)	Belt "here"
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.67	0.35	0.46	0.99	0.08
Start time	0	0	0	0	0
End time	0.67	0.35	0.46	0.99	0.08
Silence	0	0	0.05	0.26	0
Active	0.68	0.37	0.43	0.74	0.08
Data Points	29440	15648	20224	43520	3408
Range	6354 (13 Bits)	7098 (13 Bits)	4893 (13bits)	7226 (13bits)	3417 (12 Bits)
PITCH (Hz)					
Mean	209.09	287.11	410.22	424.56	267.96
Pitch Range	163.38	322.04	35.06	422.94	207.02
Minimum	49.66	45.46	397.29	61.67	86.98
Maximum	213.04	367.5	432.35	484.61	294
Std Deviation	13.62	25.92	3.65	38.93	42.05
Avg. Jitter %	101.00	2.52	0.49	7.47	3.78
CONTACT(1:6)%					
Mean	28.85	40.88	54.17	48.36	55.94
Range	27.42	49.55	21.5	75.49	26.1
Minimum	6.07	7.1	43.92	11.32	52
Maximum	33.49	56.65	65.42	86.81	78.1
Std Deviation	3.23	4.4	5.65	14.75	5.16
CONTACT(Tif)	33.01	38.96%	53.70%	33.98%	54.65%
SPEED(3:2)%					
Mean	238.41	193.12	201.12	94.85	364.2
Range	206.49	144.03	111.54	81.08	405.14
Minimum	186.36	78.18	165.38	48.33	12.5
Maximum	392.85	222.21	276.92	129.41	417.64
Std Deviation	17.57	14.82	11.96	23.84	82.94
SPEED(Tif)	245.00	200%	190%	118.75%	388,88%
OPEN(4:6)%					
Mean	71.13	59.1	45.82	51.62	44.04
Range	27.41	49.55	21.49	75.49	26.11
Minimum	66.50	43.33	34.57	13.18	21.89
Maximum	93.91	92.88	56.06	88.67	48
Std Deviation	3.23	4.4	5.65	14.75	5.16
OPEN(Tif)	66.98	61.03%	46.29%	66.01%	45.34%

B40c	B40d	B41b	B45b
Belt "honey"	Belt "every"	Belt "mean"	Belt "mean"
44100	44100	44100	44100
0.12	0.26	0.33	0.33
0	0	0	0
0.12	0.26	0.33	0.33
0.01	0.11	0	0.07
0.12	0.17	0.34	0.27
5328	11648	14336	14336
8978 (14bits)	5891 (13 Bits)	3909 (12 Bits)	2452 (12 Bits)
255.43	265.8	212.28	245.29
286.63	160.59	173.06	12.19
238.37	137.38	51.94	238.37
525	297.97	225	250.56
52.02	43.47	20.01	3.36
0.9	1.88	1.74	0.27
44.95	51.68	37.84	45.56
41.53	32.06	32.12	4.88
39.41	32.71	11.07	43.16
80.94	64.77	43.19	48.04
7.12	8.15	3.77	1.31
41.47%	39.78%	36.57%	43.78%
320.53	371.52	307.68	380.95
69.12	160.09	187.43	100.66
284.21	277.41	234.78	336.84
353.33	437.5	422.21	437.5
16.79	35.54	49.44	23.75
284.21%	289.47%	243.47%	376.47%
55.03	48.3	62.14	54.42
41.53	32.06	32.12	4.88
19.04	35.22	56.79	51.95
60.57	67.28	88.91	56.83
7.12	8.15	3.77	1.31
58.52%	60.21%	63.42%	56.21%

Spectrogram of C01



1) 269.55, 255.32

C1

$F_0 = 221 \text{ Hz}$

2) 2484.4, 17.46

3) 3480.47, 40.88

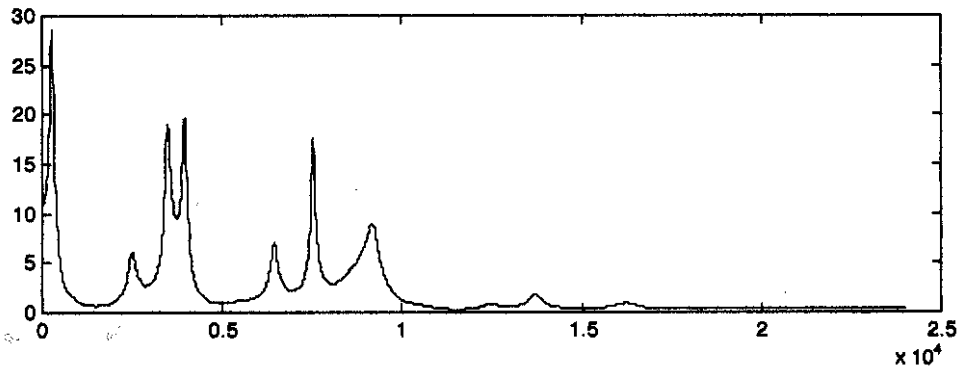
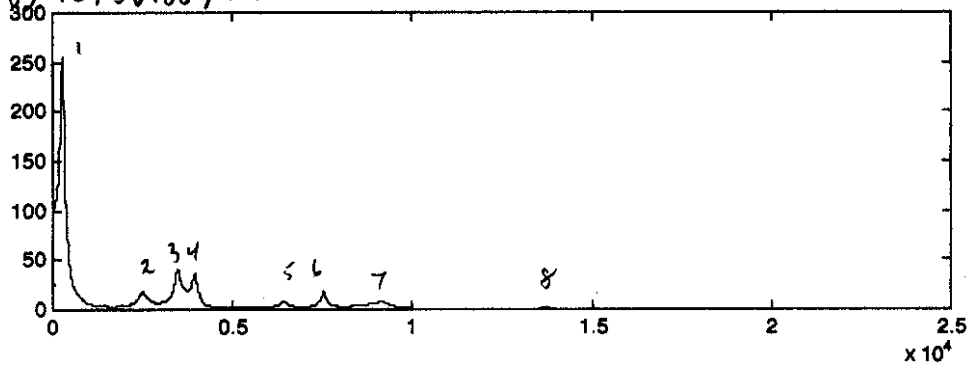
4) 3960.90, 37.40

5) 6433.48, 8.41

6) 7523.40, 17.95

7) 9162.00, 7.70

8) 13730.00, 1.22

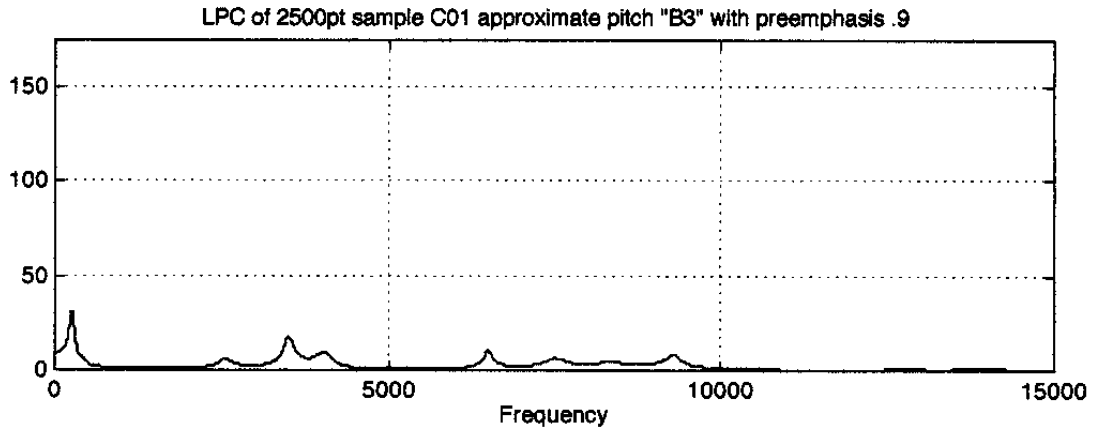
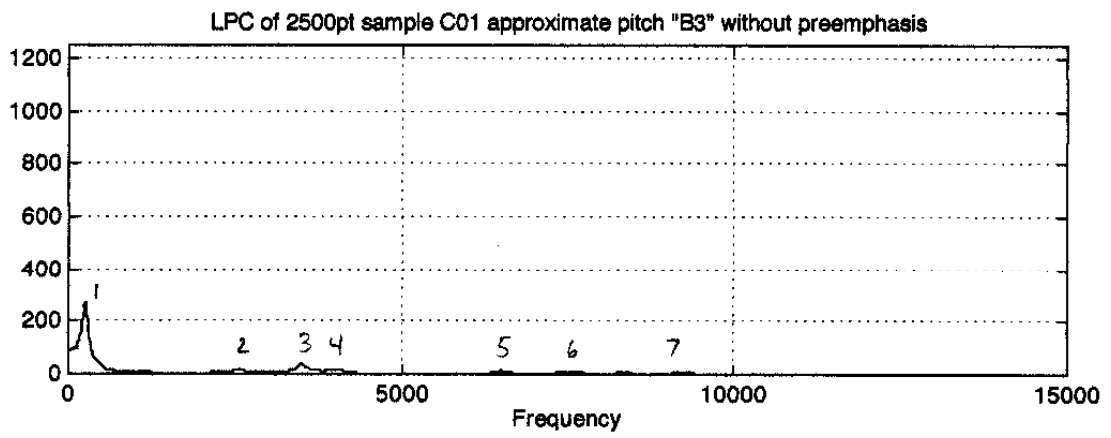


$$.15202083 - 0.0118025 = .140207 / 31$$

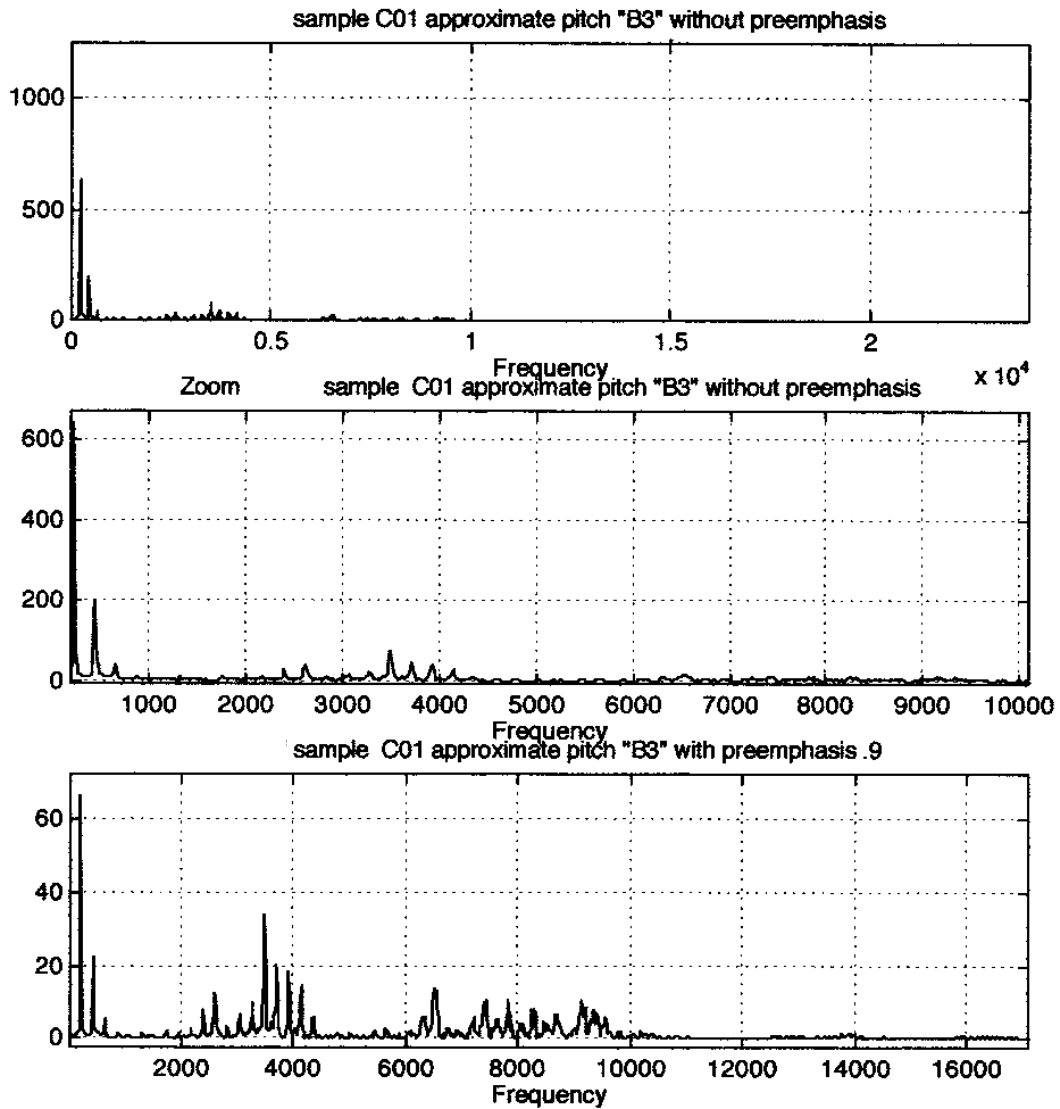
.004522806

221.1016568

- (257.81, 269.72)
- (2554.69, 16.88)
- (3515.61, 38.62)
- (4042.96, 17.88)
- (6503.91, 13.62)
- (7511.74, 7.14)
- (9281.25, 7.45)



DFT of C01



# DFT Numerical Results

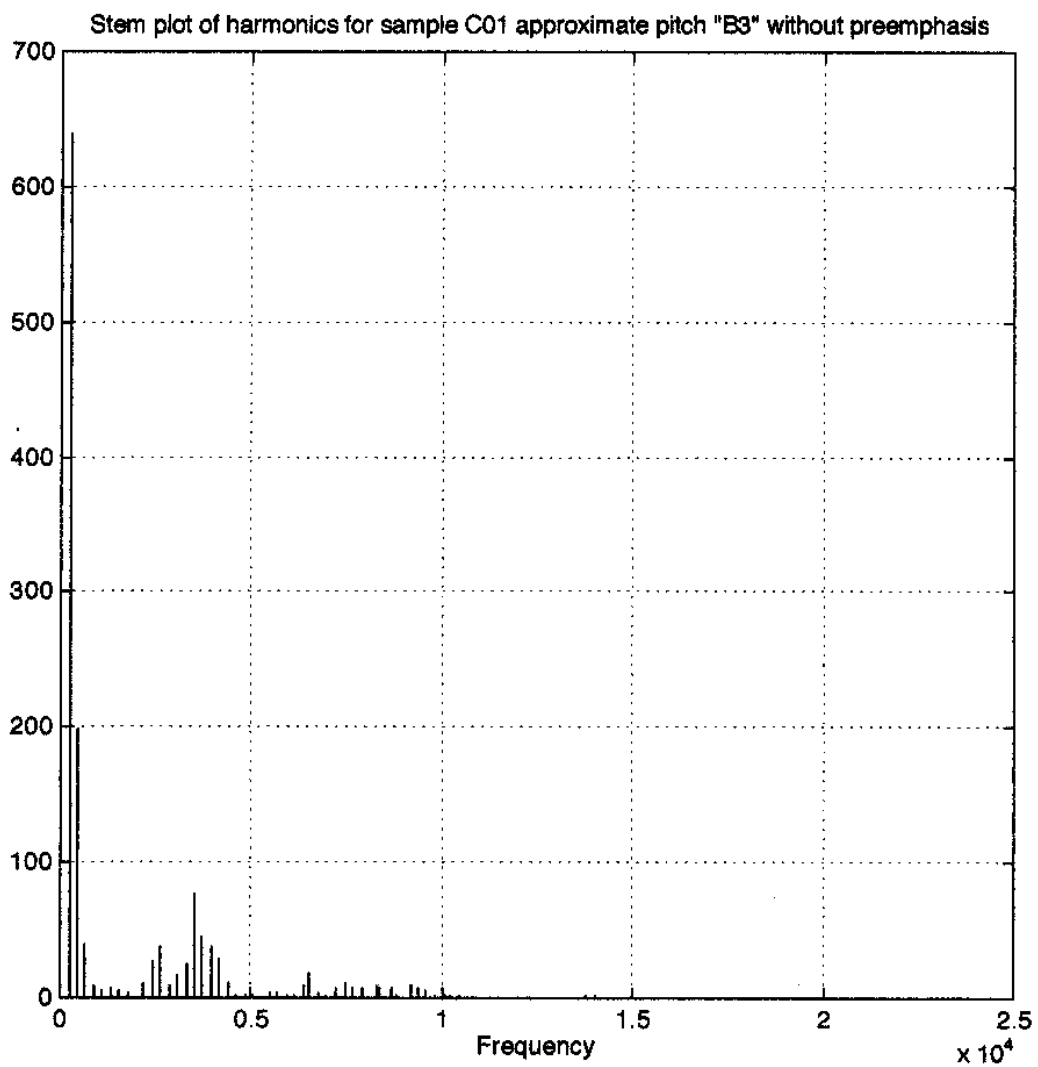
Worksheet saved into file: Minitab.C01  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp	
1	234	639.688	100.000	
2	450	198.364	31.010	← fair tracking
3	666	39.955	6.246	
4	900	9.288	1.452	
5	1098	5.416	0.847	
6	1332	7.119	1.113	
7	1548	4.577	0.715	
8	1782	2.729	0.427	
9	2196	9.940	1.554	
10	2412	26.151	4.088	
11	2628	37.110	5.801	← F2
12	2844	8.388	1.311	
13	3078	16.572	2.591	
14	3294	24.484	3.827	
15	3510	77.059	12.046	← F3
16	3726	44.495	6.956	↑ SF
17	3942	37.485	5.860	↑
18	4158	28.435	4.445	↑
19	4374	11.607	1.814	
20	4608	2.099	0.328	
21	4824	2.605	0.407	
22	5058	1.551	0.243	
23	5472	2.897	0.453	
24	5670	3.633	0.568	
25	5922	1.648	0.258	
26	6102	2.461	0.385	
27	6354	8.366	1.308	
28	6534	17.648	2.759	← not in speech
29	6750	3.568	0.558	
30	6966	2.629	0.411	
31	7236	7.189	1.124	
32	7452	11.436	1.788	← not in speech
33	7668	6.544	1.023	
34	7884	7.254	1.134	
35	8280	8.177	1.278	← same as speech
36	8334	6.365	0.995	
37	8694	6.427	1.005	
38	8802	1.399	0.219	
39	9162	9.816	1.535	← a little lower in speech
40	9360	7.351	1.149	
41	9576	5.855	0.915	
42	9846	1.596	0.250	
43	10080	1.306	0.204	
44	10224	1.696	0.265	
45	10440	1.482	0.232	
46	10854	0.645	0.101	
47	10908	0.579	0.091	
48	11160	0.243	0.038	
49	11520	0.153	0.024	
50	11754	0.137	0.021	
51	11970	0.308	0.048	
52	12078	0.182	0.029	
53	12492	0.355	0.055	
54	12708	0.893	0.140	
55	12924	0.594	0.093	

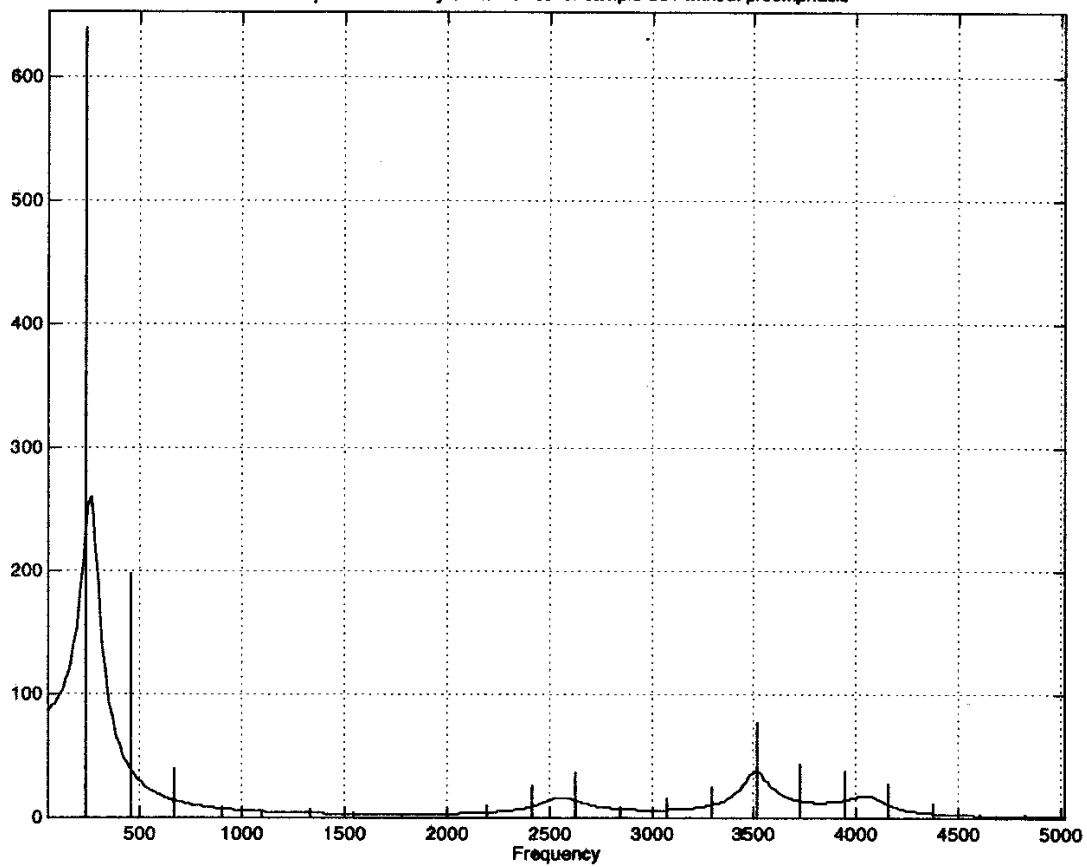
F2 would  
 than speech  
 F3 higher  
 wider apart

56	13140	0.522	0.082
57	13374	0.362	0.057
58	13572	0.617	0.096
59	13806	1.142	0.179
60	14022	1.349	0.211
61	14184	0.369	0.058
62	14544	0.434	0.068
63	14652	0.234	0.037
64	14904	0.252	0.039
65	15228	0.109	0.017
66	15480	0.196	0.031
67	15768	0.308	0.048
68	15984	0.649	0.102
69	16110	0.449	0.070
70	16308	0.416	0.065
71	16560	0.323	0.051
72	16902	0.329	0.051
73	16992	0.201	0.031
74	17298	0.143	0.022
75	17496	0.127	0.020
76	17838	0.122	0.019
77	18108	0.116	0.018
78	18162	0.141	0.022
79	18558	0.133	0.021
80	18756	0.107	0.017
81	18954	0.117	0.018
82	19278	0.117	0.018
83	19404	0.127	0.020
84	19674	0.098	0.015
85	19854	0.107	0.017
86	20142	0.105	0.016
87	20358	0.100	0.016
88	20520	0.136	0.021
89	20826	0.117	0.018
90	21042	0.139	0.022
91	21312	0.085	0.013
92	21564	0.094	0.015
93	21672	0.126	0.020
94	22014	0.141	0.022
95	22248	0.108	0.017
96	22464	0.092	0.014
97	22752	0.096	0.015
98	22914	0.089	0.014
99	23184	0.082	0.013
100	23454	0.078	0.012
101	23634	0.083	0.013
102	20160	0.179	0.028
103	20430	0.180	0.028
104	20610	0.171	0.027
105	20718	0.158	0.025
106	21042	0.164	0.026
107	21240	0.157	0.025
108	21420	0.141	0.022
109	21564	0.154	0.024
110	21834	0.144	0.022
111	21978	0.138	0.022
112	22104	0.146	0.023
113	22302	0.133	0.021
114	22608	0.144	0.023
115	22824	0.134	0.021

116	22950	0.130	0.020
117	23202	0.139	0.022
118	23418	0.141	0.022
119	23490	0.135	0.021
120	23814	0.133	0.021



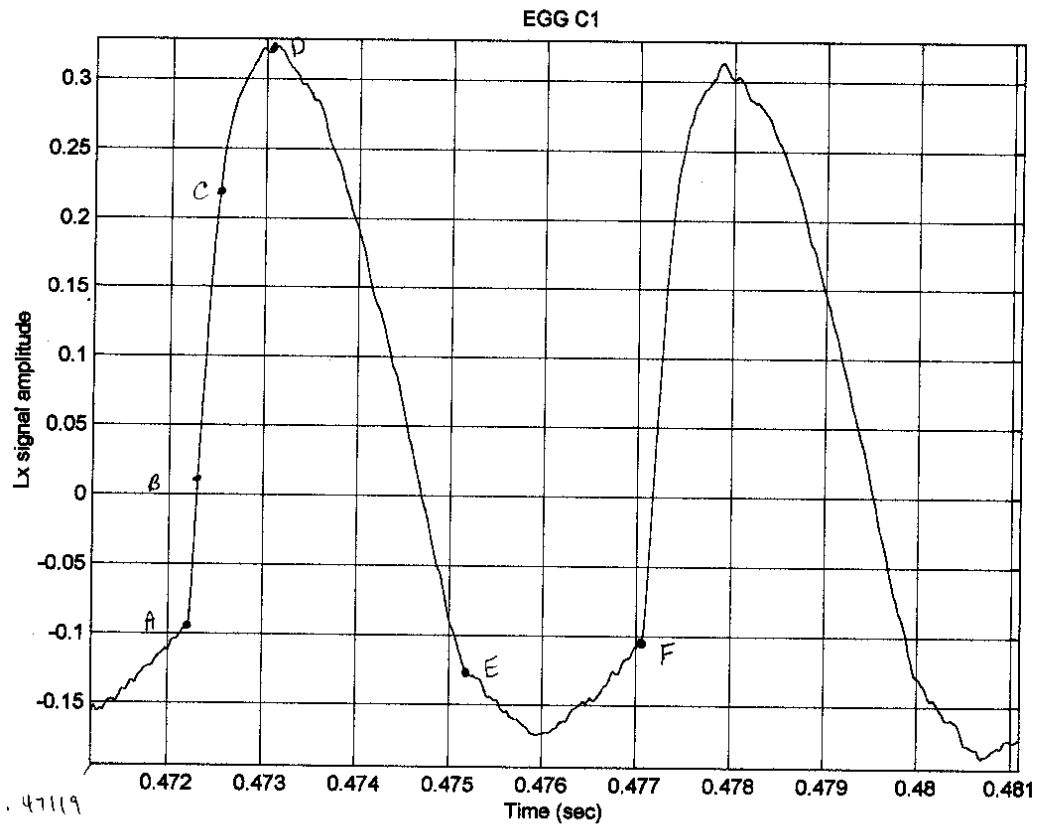
Stem plot/LPC overlay of harmonics for sample C01 without preemphasis



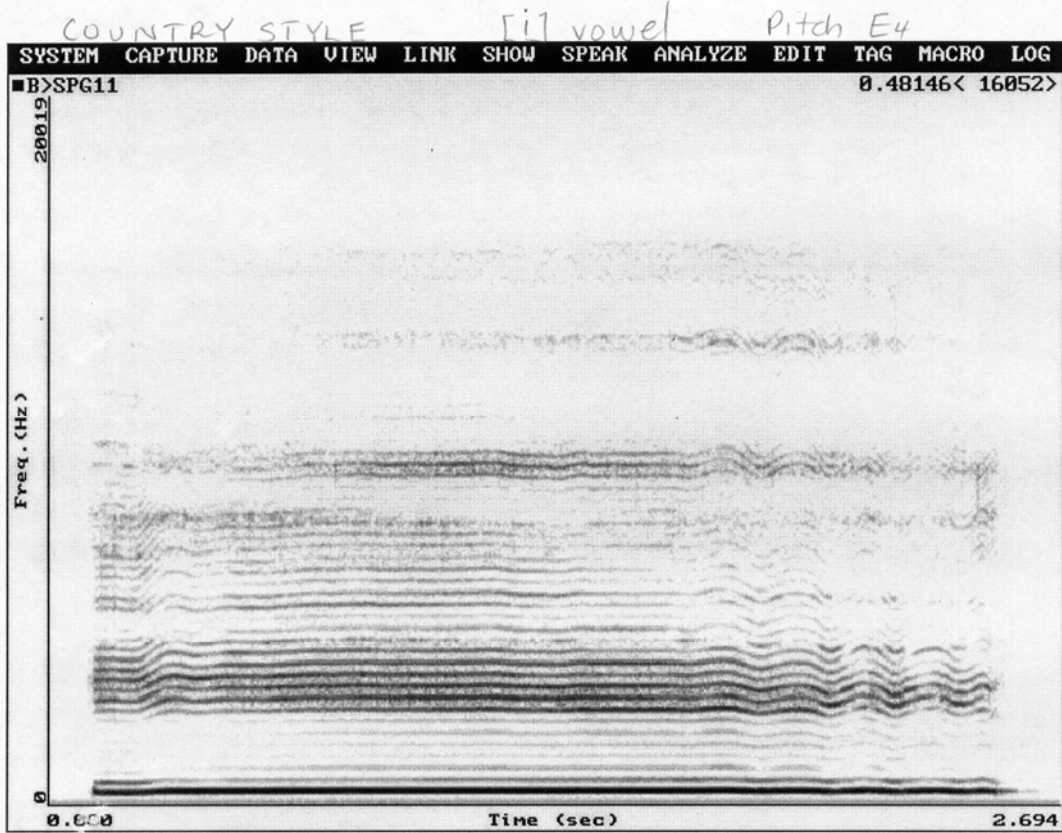
$v \Rightarrow 16mm = .001$

$u \Rightarrow 12mm = .06$

$\eta \Rightarrow 1mm = .0041666$



Spectrogram of C11



1) 316.41, 2722.20 C11

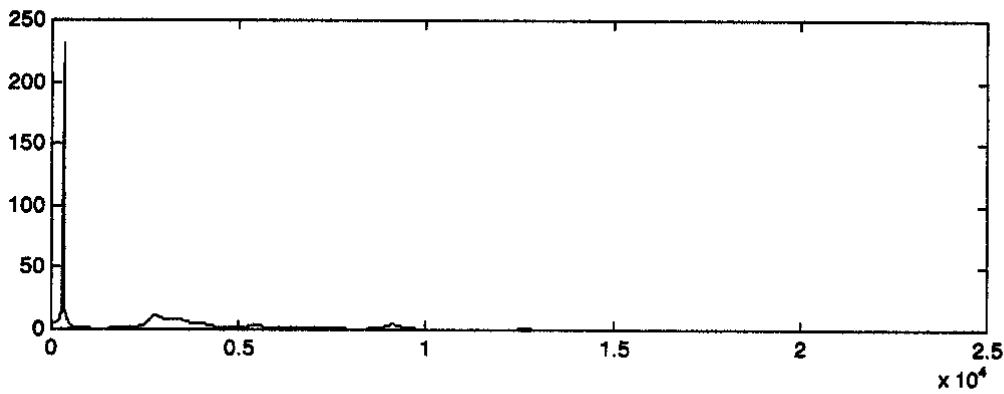
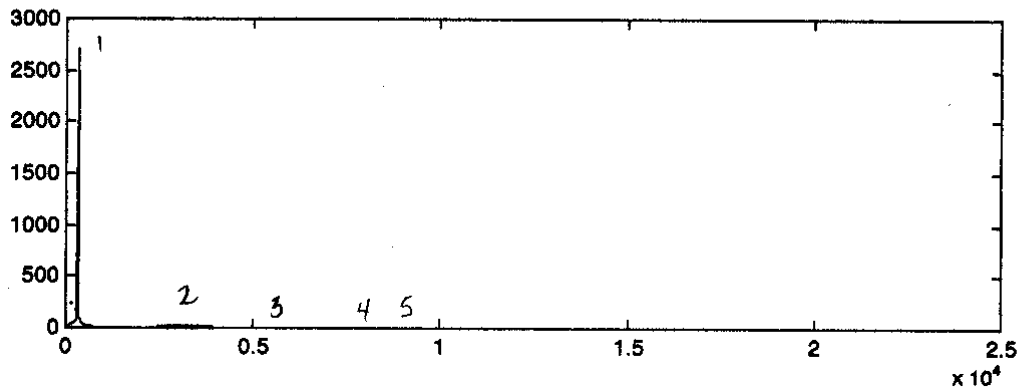
$$F_0 = 317 \text{ Hz}$$

2) 2765.50, 27.30

3) 5472.65, 5.10

4) 7456.00, 2.58

5) 9129.00, 4.06



$$.15179167 - .0035833333 = .148208337 / 47$$

$$= .003153369$$

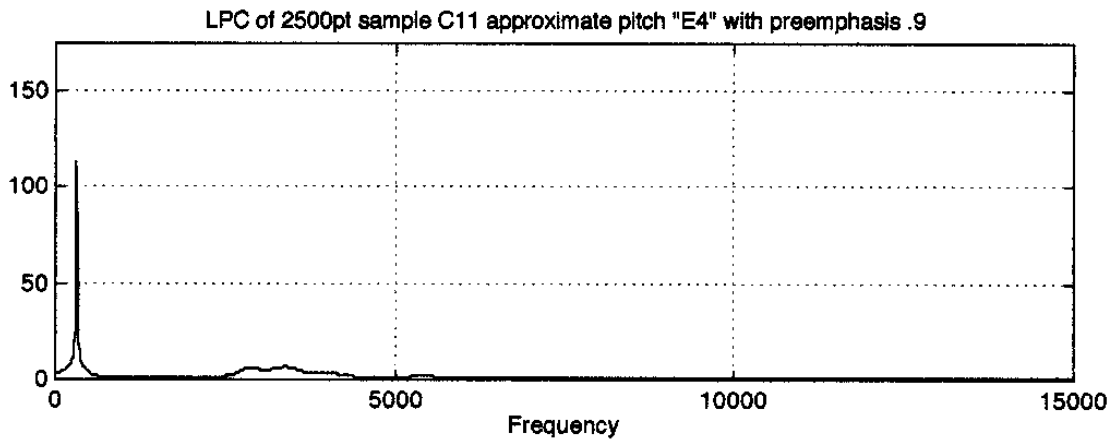
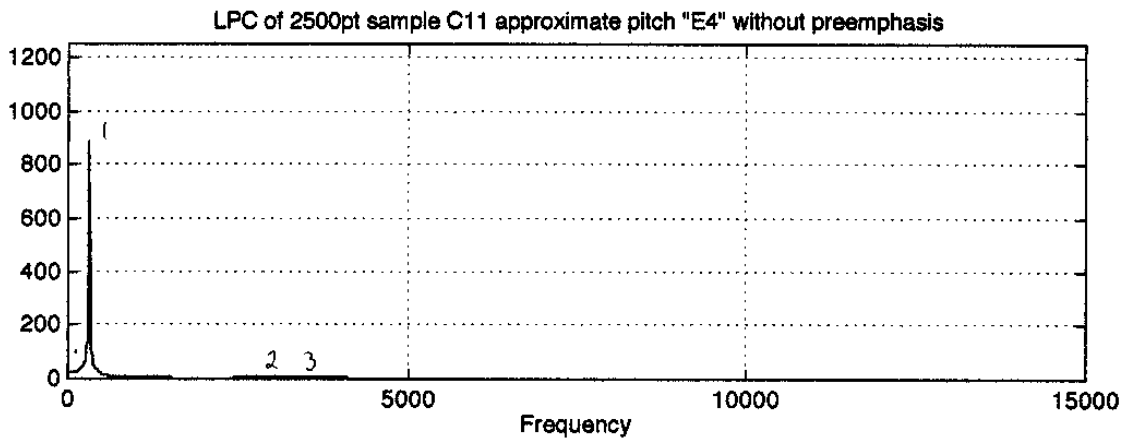
(10000 - 18000)

$$317.1211617$$

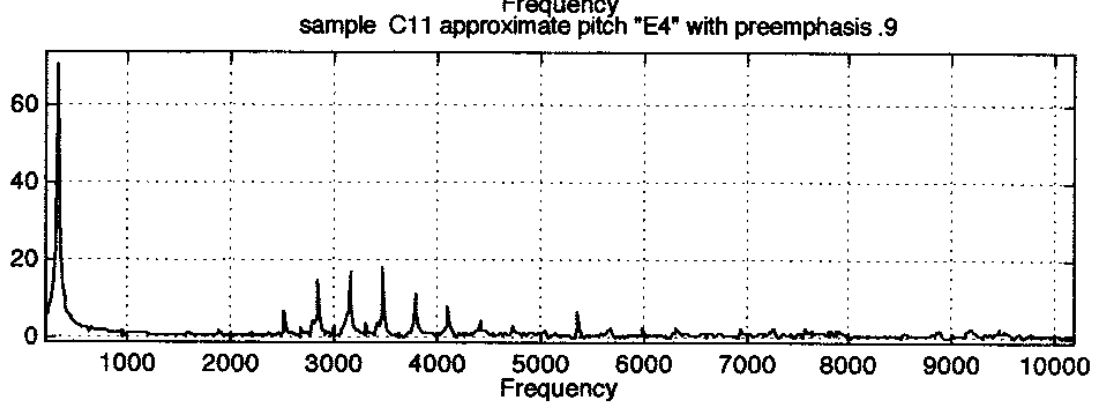
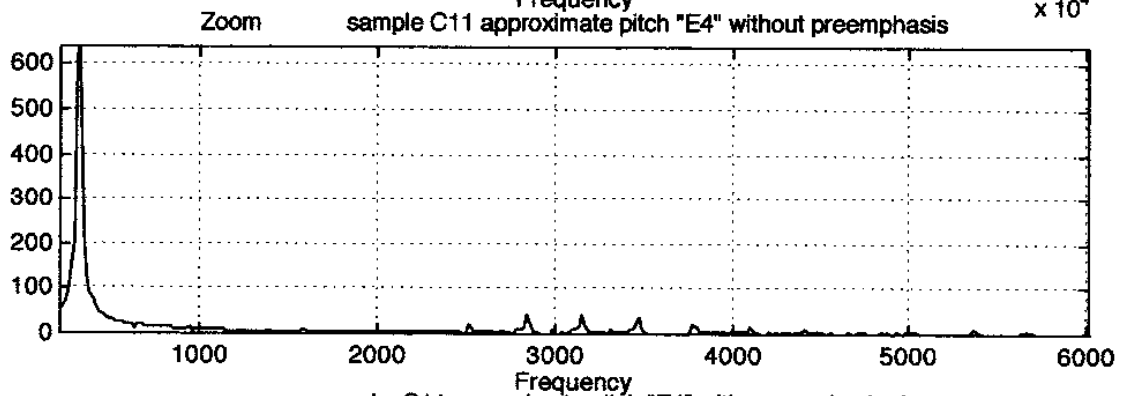
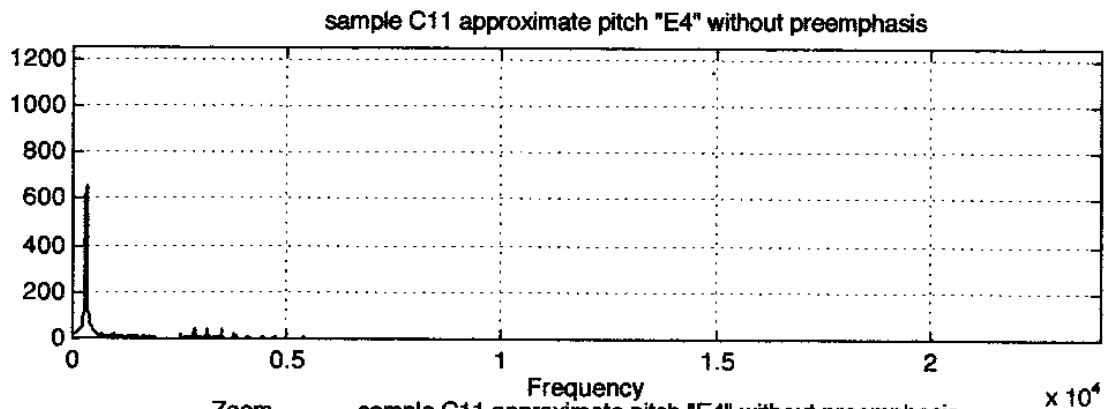
(316.41, 888.48)

(2882.81, 11.00)

(3316.41, 10.91)



DFT of C11



# DFT Numerical Results

Worksheet saved into file: Minitab.C11  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	342	654.845	100.000
2	558	26.512	4.049
3	954	16.341	2.495
4	1242	7.436	1.136
5	1602	8.437	1.288
6	1926	5.576	0.851
7	2376	5.104	0.779
8	2862	41.547	6.345
9	3168	42.886	6.549
10	3492	40.188	6.137
11	3798	23.776	3.631
12	4122	14.824	2.264
13	4428	8.363	1.277
14	4752	5.357	0.818
15	5058	3.166	0.483
16	5382	11.154	1.703
17	5688	4.127	0.630
18	6048	1.772	0.271
19	6408	2.403	0.367
20	6966	3.322	0.507
21	7290	3.262	0.498
22	7596	3.149	0.481
23	7848	2.606	0.398
24	8118	1.319	0.201
25	8568	1.503	0.230
26	8874	2.056	0.314
27	9198	2.520	0.385
28	9468	2.765	0.422
29	9792	1.462	0.223
30	10278	1.106	0.169
31	10602	1.220	0.186
32	11052	1.105	0.169
33	11250	1.010	0.154
34	11520	0.930	0.142
35	11970	0.891	0.136
36	12438	1.028	0.157
37	12690	1.052	0.161
38	12960	1.039	0.159
39	13464	0.807	0.123
40	13554	0.875	0.134
41	13896	0.806	0.123
42	14310	0.832	0.127
43	14760	0.927	0.142
44	15084	0.793	0.121
45	15336	0.752	0.115
46	15696	0.714	0.109
47	15948	0.775	0.118
48	16362	0.733	0.112
49	16794	0.719	0.110
50	17028	0.692	0.106
51	17496	0.670	0.102
52	17658	0.671	0.102
53	18252	0.666	0.102
54	18522	0.637	0.097
55	18864	0.650	0.099

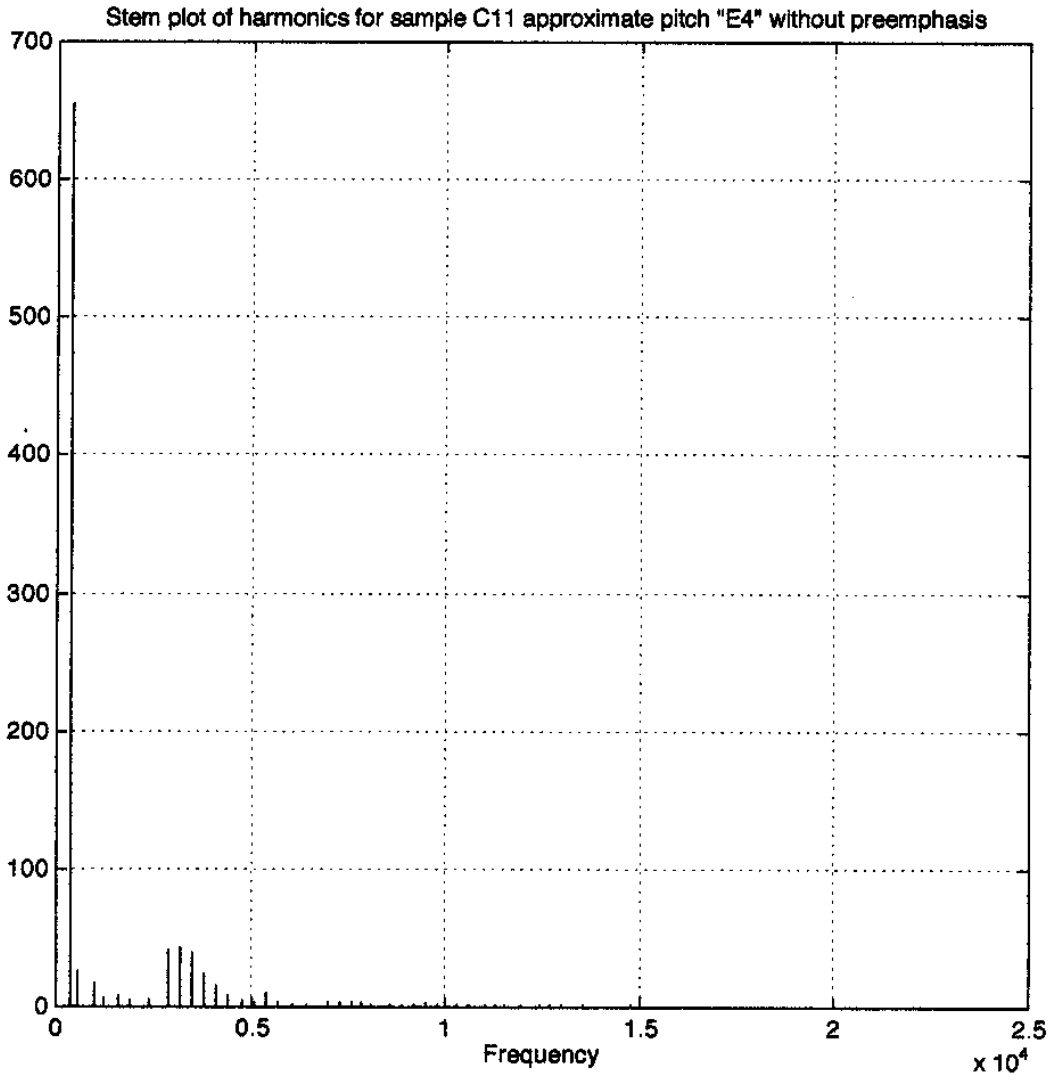
*← form tracking - higher pitch*

*← F2  
← F1  
- SF*

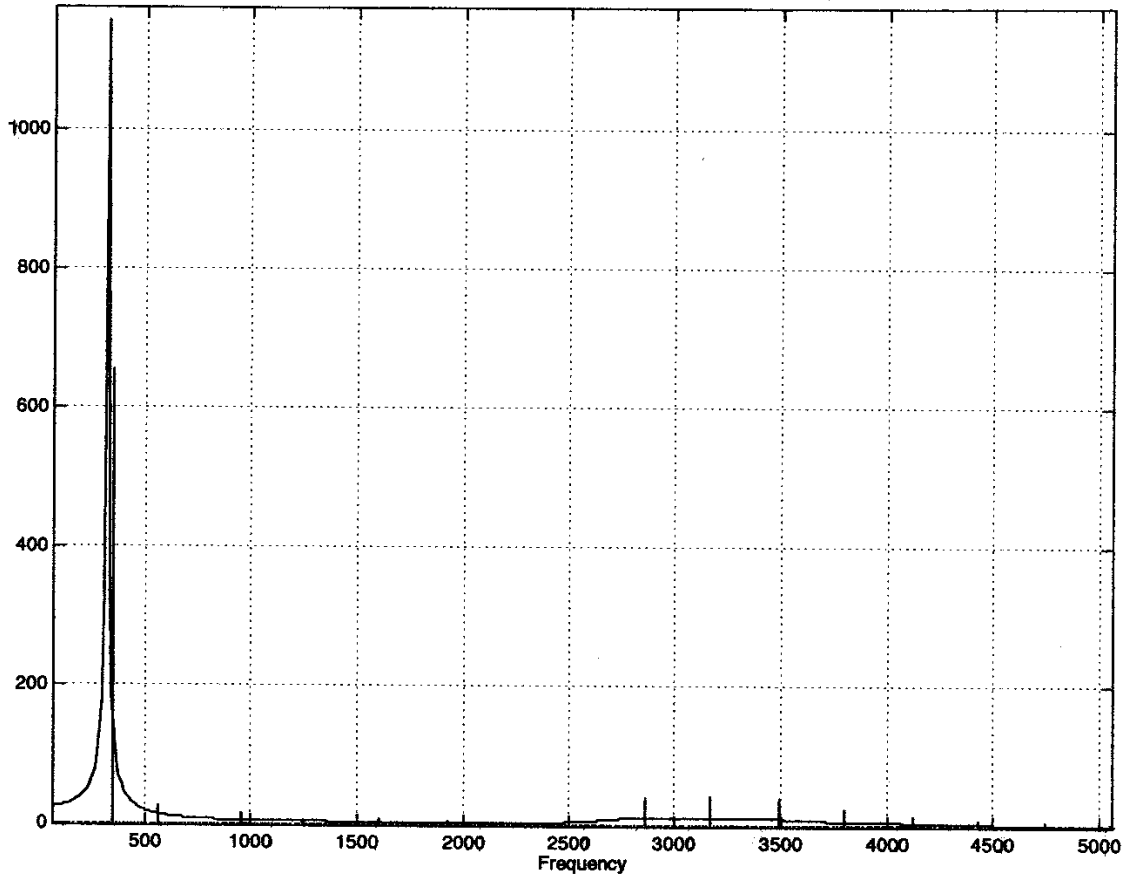
*← near speech formant*

56	19188	0.645	0.099
57	19584	0.651	0.099
58	19944	0.621	0.095
59	20052	0.625	0.096
60	20466	0.615	0.094
61	20916	0.605	0.092
62	21168	0.622	0.095
63	21582	0.617	0.094
64	21906	0.606	0.093
65	22104	0.608	0.093
66	22662	0.601	0.092
67	22806	0.597	0.091
68	23328	0.593	0.091
69	23580	0.592	0.090
70	16308	0.416	0.064
71	16560	0.323	0.049
72	16902	0.329	0.050
73	16992	0.201	0.031
74	17298	0.143	0.022
75	17496	0.127	0.019
76	17838	0.122	0.019
77	18108	0.116	0.018
78	18162	0.141	0.022
79	18558	0.133	0.020
80	18756	0.107	0.016
81	18954	0.117	0.018
82	19278	0.117	0.018
83	19404	0.127	0.019
84	19674	0.098	0.015
85	19854	0.107	0.016
86	20142	0.105	0.016
87	20358	0.100	0.015
88	20520	0.136	0.021
89	20826	0.117	0.018
90	21042	0.139	0.021
91	21312	0.085	0.013
92	21564	0.094	0.014
93	21672	0.126	0.019
94	22014	0.141	0.021
95	22248	0.108	0.016
96	22464	0.092	0.014
97	22752	0.096	0.015
98	22914	0.089	0.014
99	23184	0.082	0.012
100	23454	0.078	0.012
101	23634	0.083	0.013
102	20160	0.179	0.027
103	20430	0.180	0.027
104	20610	0.171	0.026
105	20718	0.158	0.024
106	21042	0.164	0.025
107	21240	0.157	0.024
108	21420	0.141	0.022
109	21564	0.154	0.024
110	21834	0.144	0.022
111	21978	0.138	0.021
112	22104	0.146	0.022
113	22302	0.133	0.020
114	22608	0.144	0.022
115	22824	0.134	0.020

116	22950	0.130	0.020
117	23202	0.139	0.021
118	23418	0.141	0.022
119	23490	0.135	0.021
120	23814	0.133	0.020



Stem plot/LPC overlay of harmonics for sample C11 without preemphasis

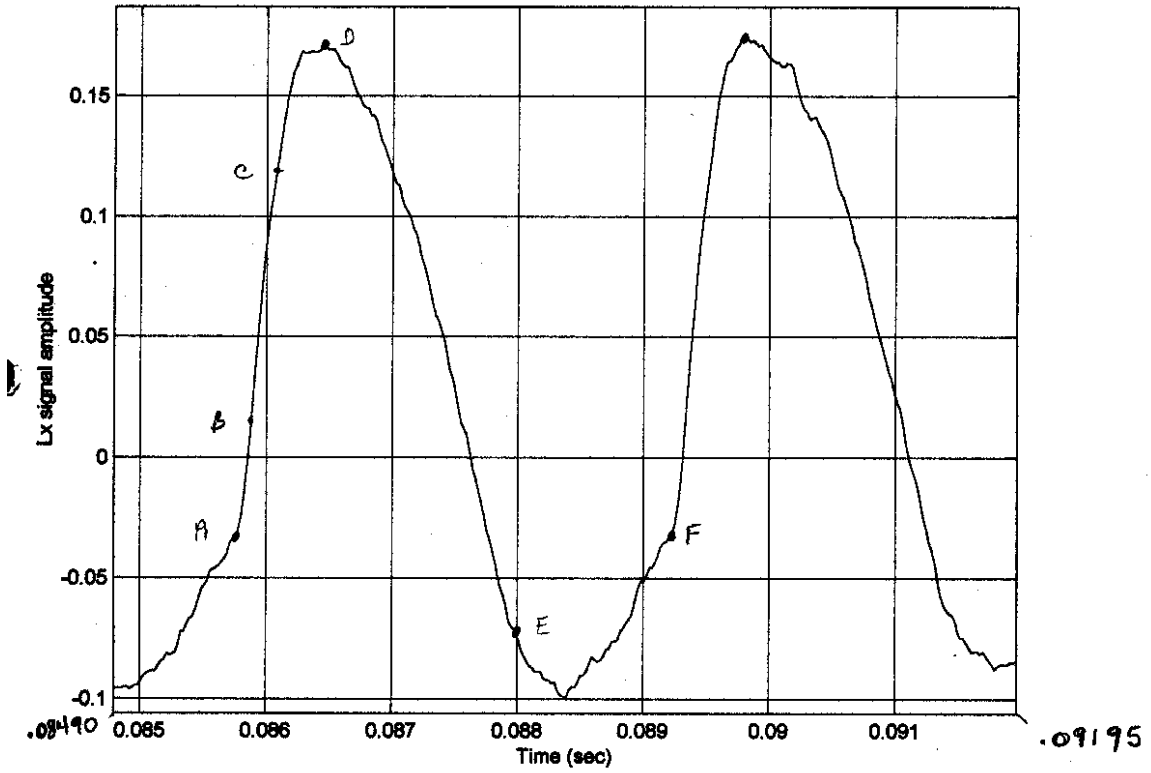


$x \Rightarrow 22 \text{ mm} = .001$

$y \Rightarrow 21 \text{ mm} = .05$

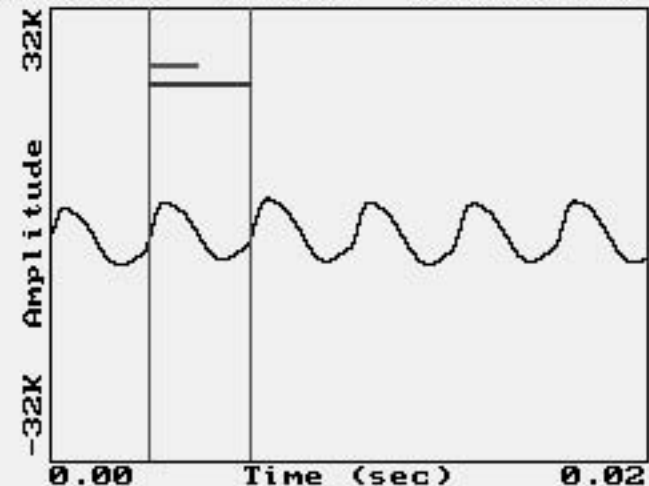
$y \Rightarrow 1 \text{ mm} = .0023609$

EGG C11



**A** > : CH1: C11\_EG~1.NSP

< 0.00 sec 47.33% 294.00 Hz >



Duration 2.50 (sec)

0.00 Pitch(Hz) 400.0

**B** > :

< sec % Hz >

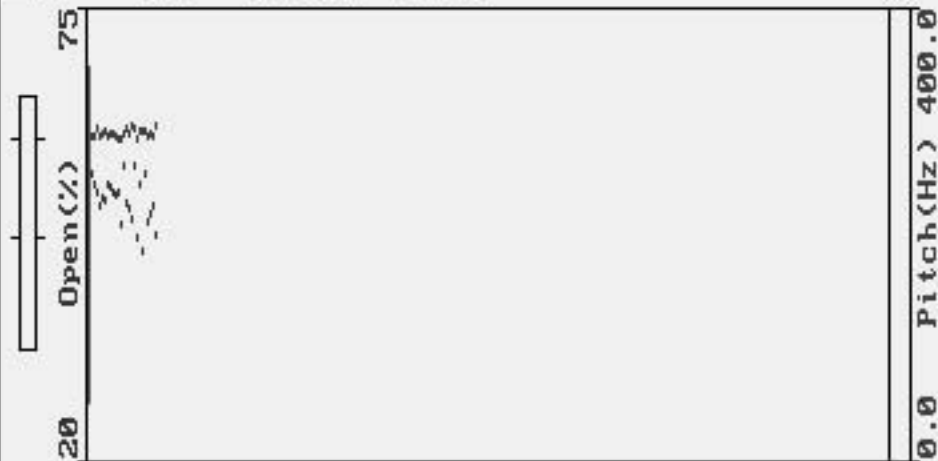


Duration 2.50 (sec)

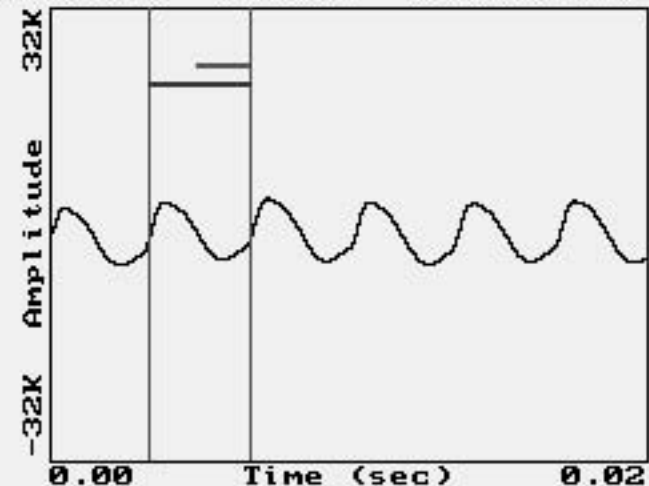
0.00 Pitch(Hz) 400.0

**A** > : CH1: C11\_EG~1.NSP

< 0.00 sec 52.66% 294.00 Hz >

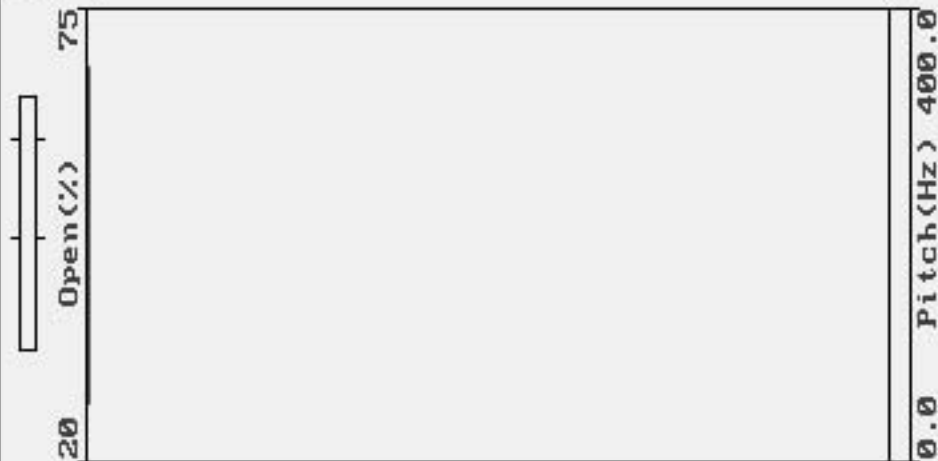


Duration 2.50 (sec)



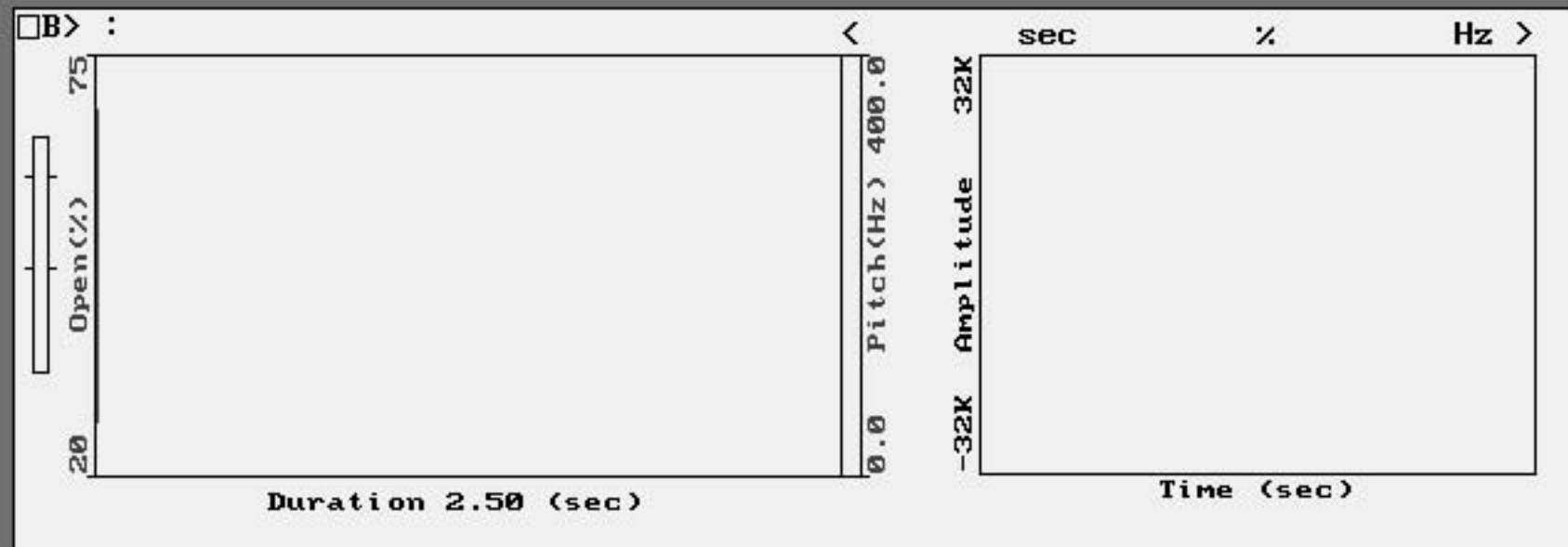
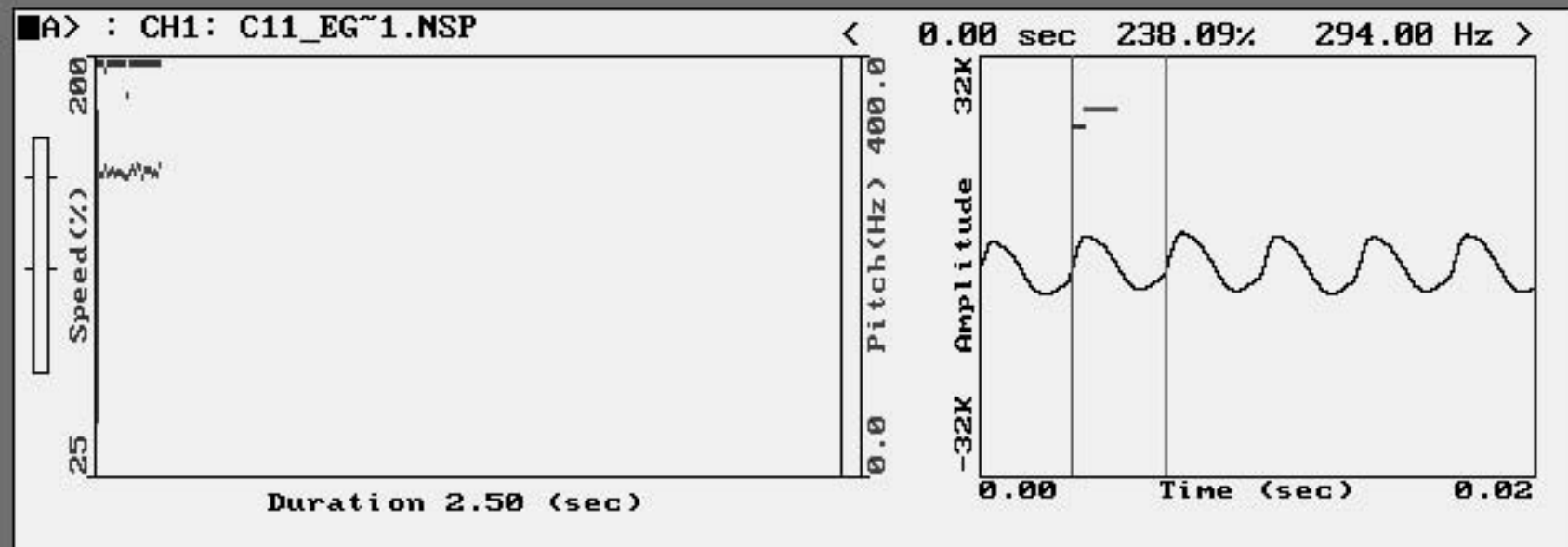
**B** > :

< sec % Hz >



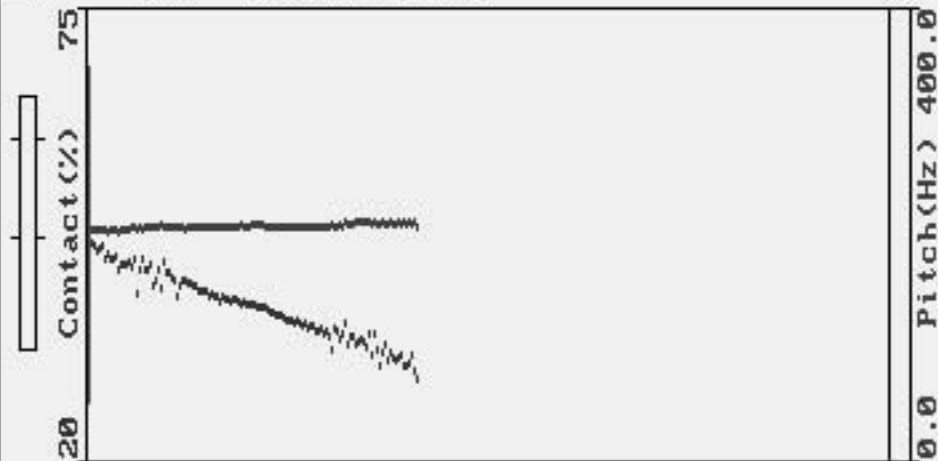
Duration 2.50 (sec)



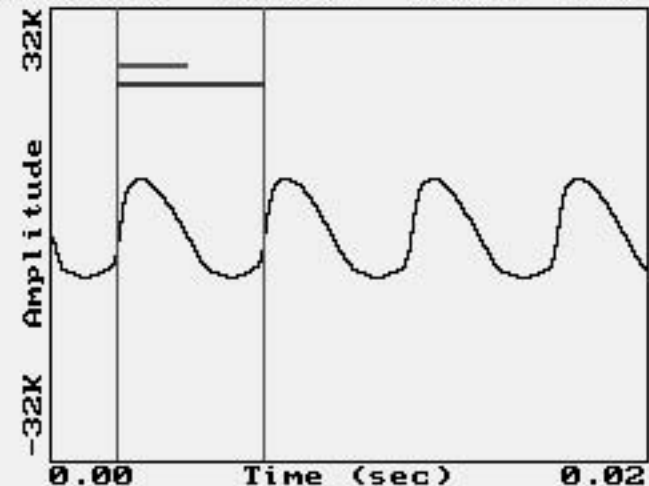


■A> : CH1: C1\_EGGST.NSP

< 0.00 sec 46.29% 204.17 Hz >

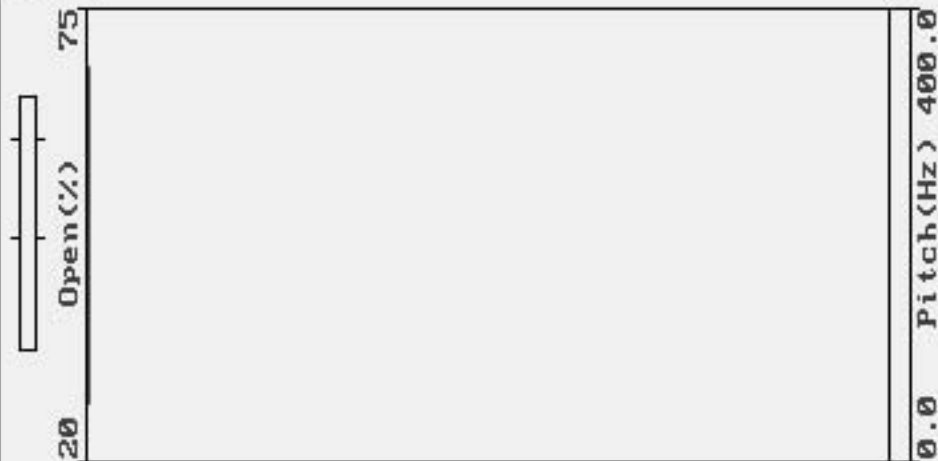


Duration 2.50 (sec)



□B> :

< sec % Hz >

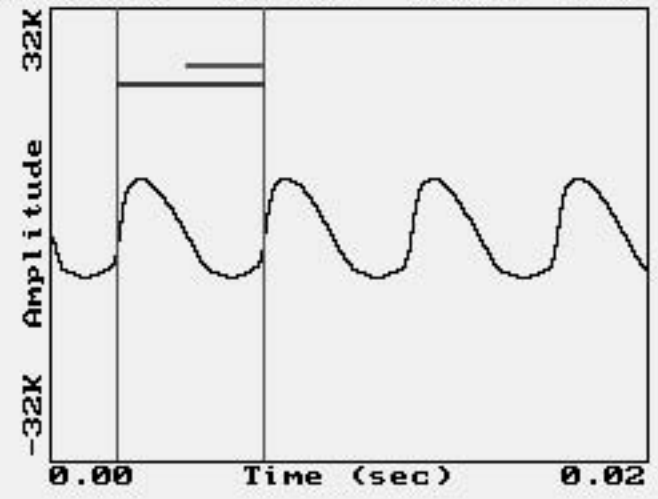
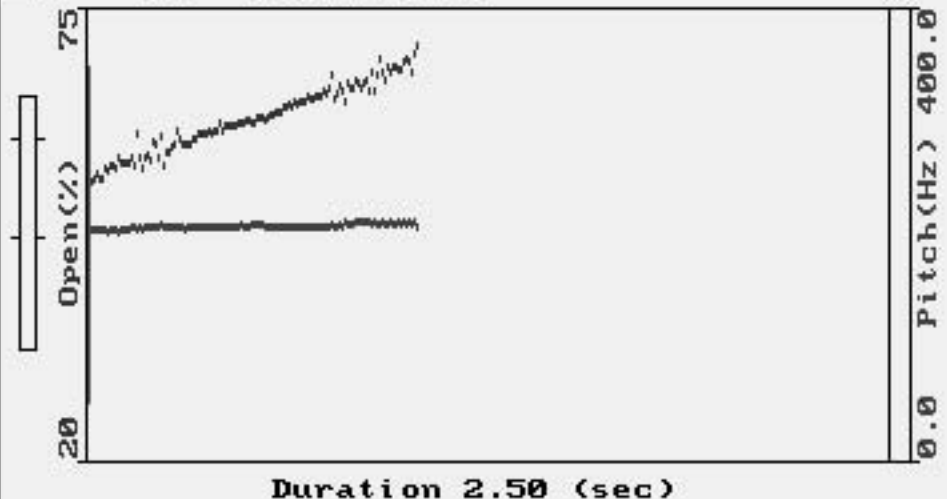


Duration 2.50 (sec)



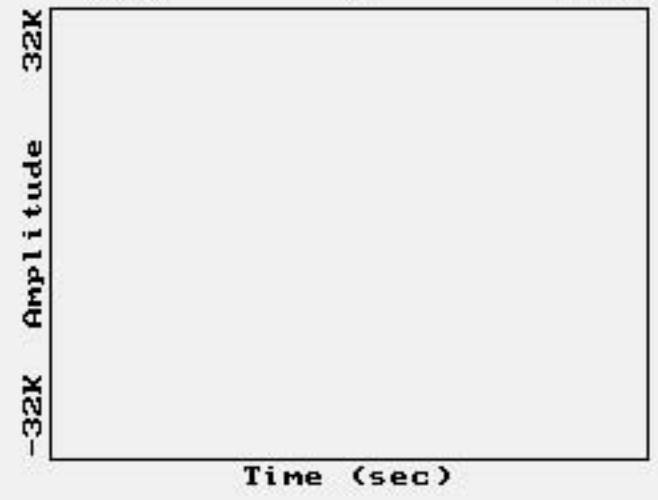
**A** > : CH1: C1\_EGGST.NSP

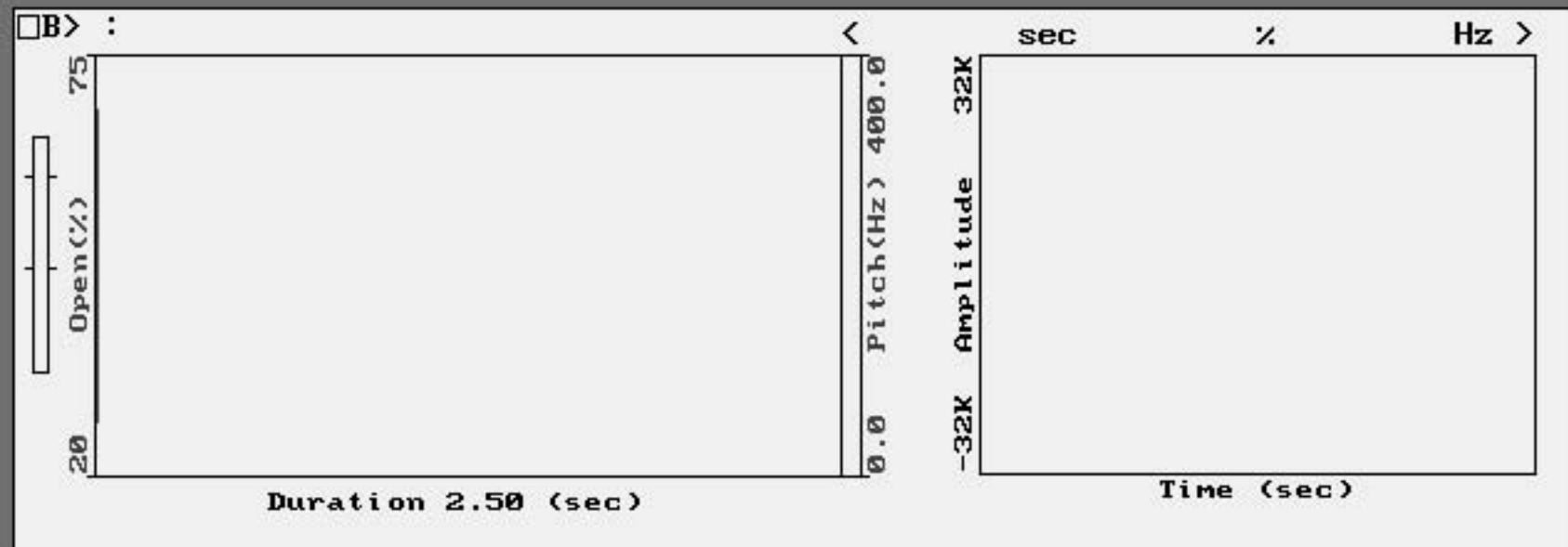
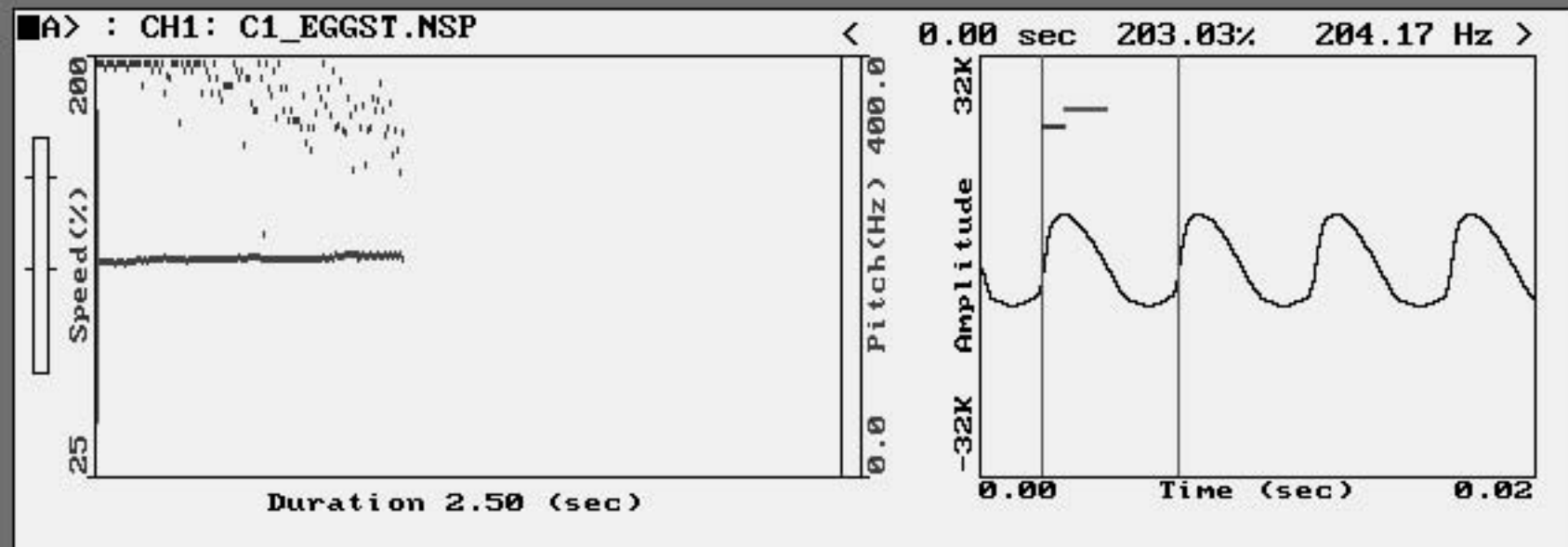
< 0.00 sec 53.70% 204.17 Hz >



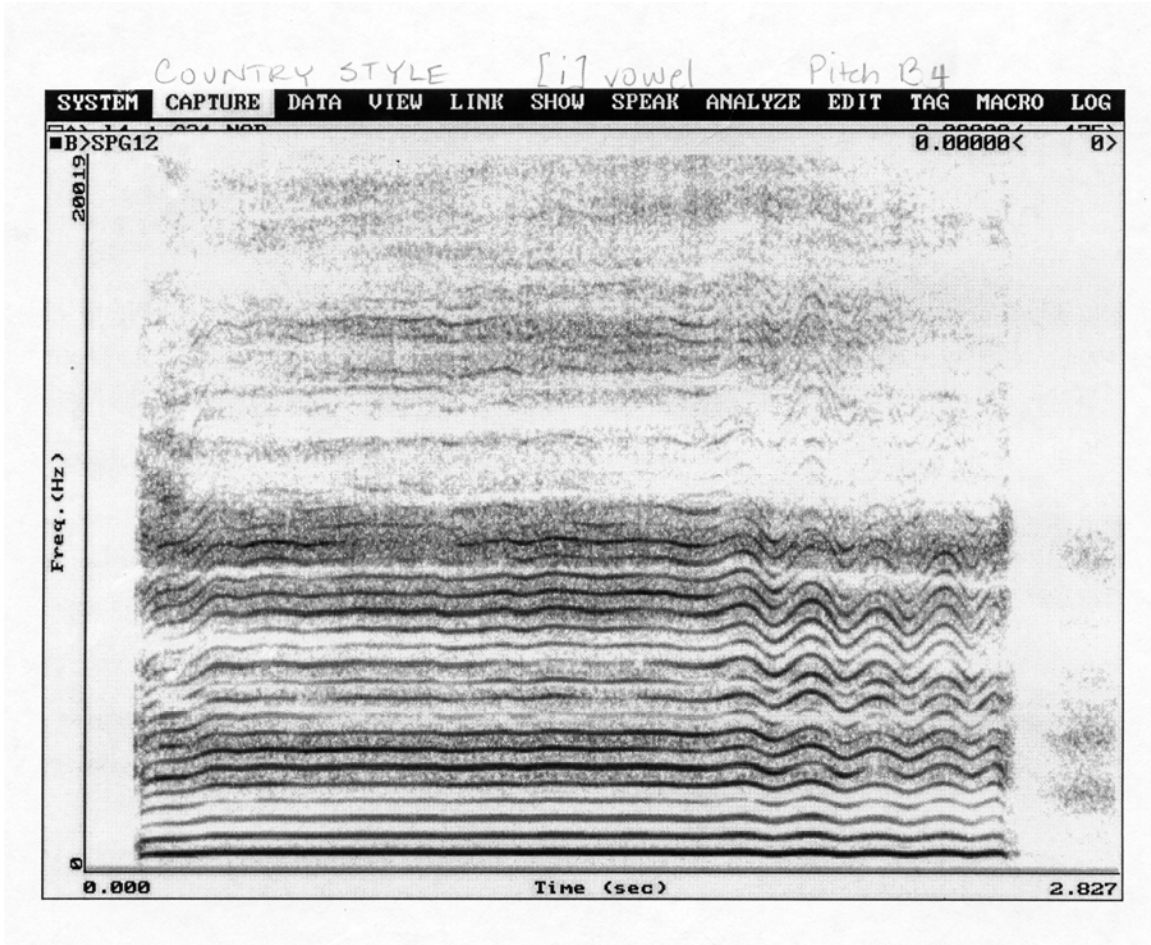
**B** > :

< sec % Hz >



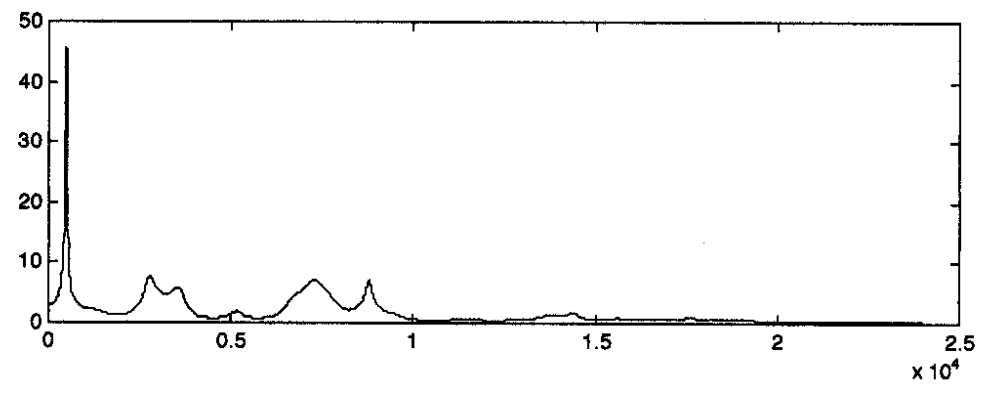
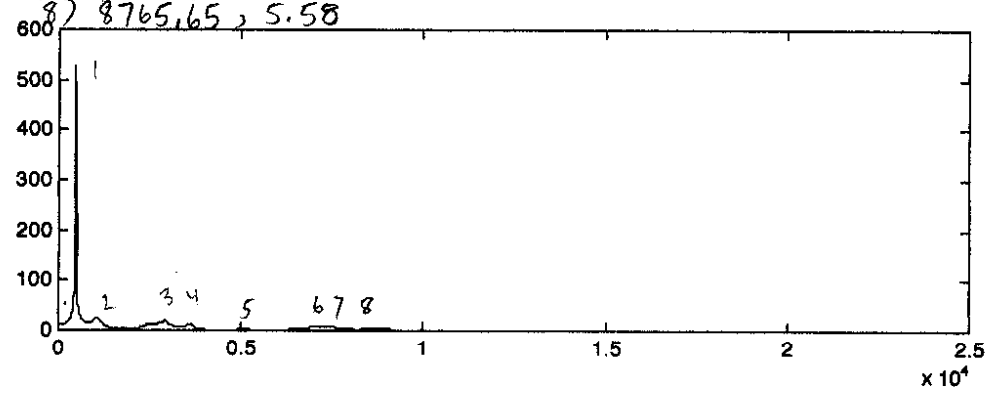


Spectrogram of C21



- 1) 468.75, 528.05      C21
- 2) 1054.76, 23.31
- 3) 2906.2, 18.25
- 4) 3609.37, 13.24
- 5) 5079.45, 2.76
- 6) 7028.00, 6.8
- 7) 7475.15
- 8) 8765.65, 5.58

$F_0 = 462 \text{ Hz}$

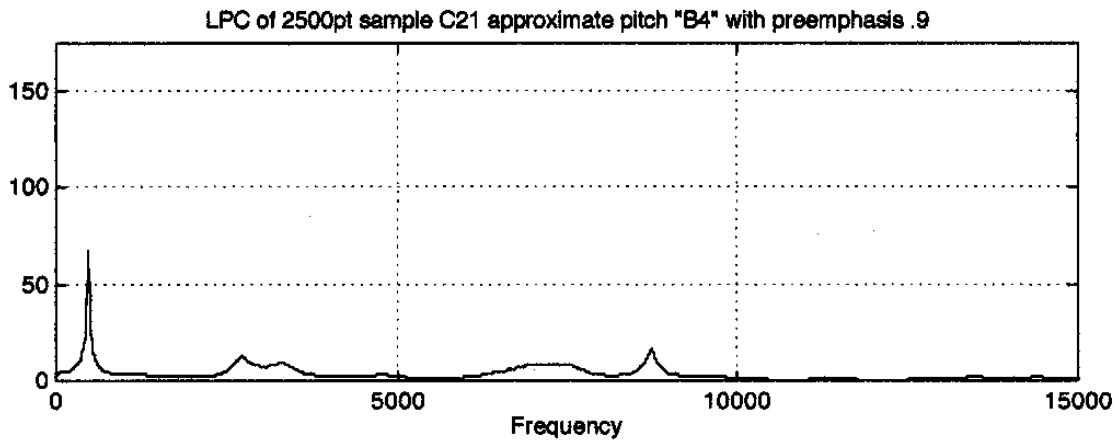
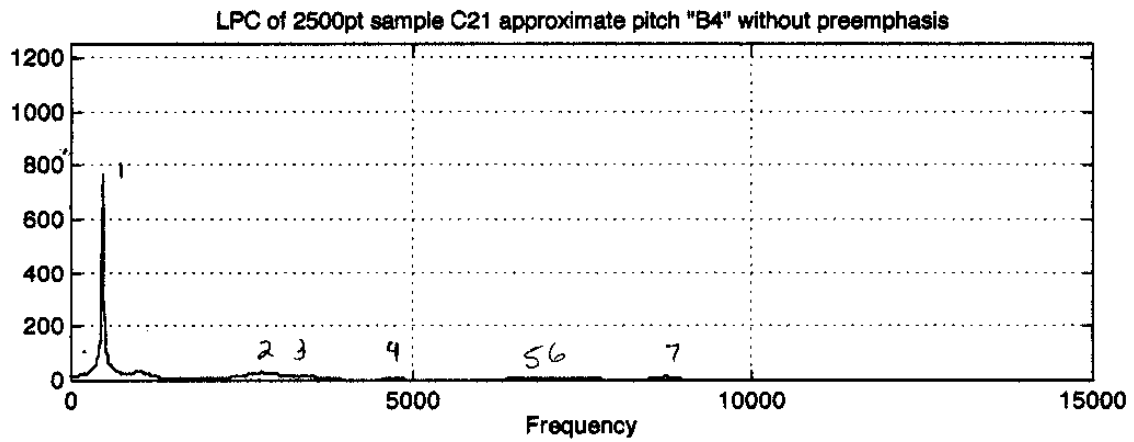


$.15079167 - .007875 = .14291667/66$

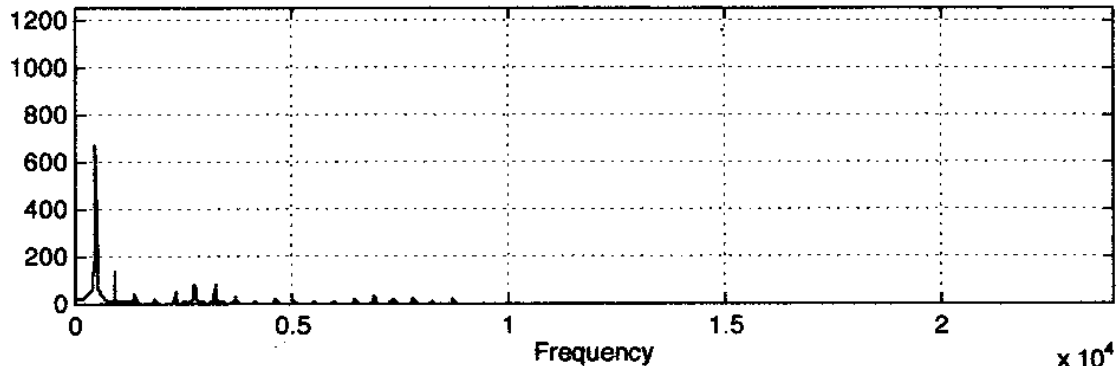
$.002165404$

$461.8075694$

(457.03, 769.27)  
(2860.78, 29.59)  
(3363.28, 17.06)  
(4757.80, 5.79)  
(6902.35, 9.69)  
(7453.98, 10.29)  
(8730.47, 13.61)



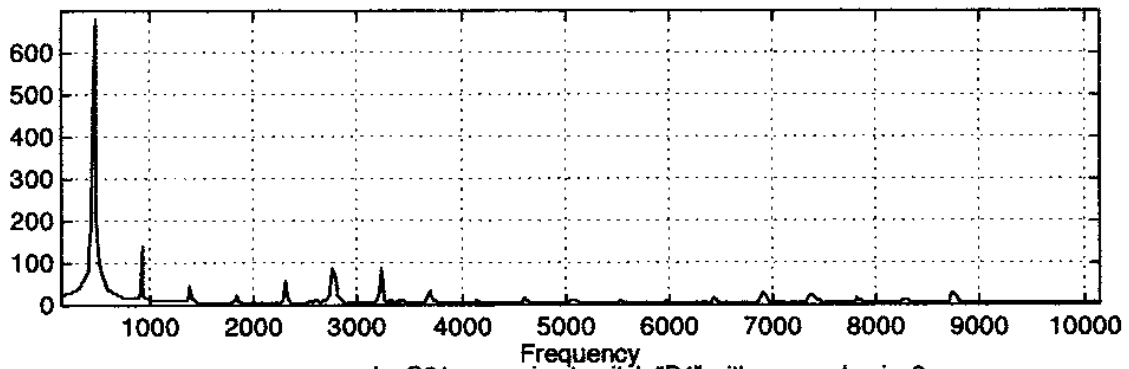
sample C21 approximate pitch "B4" without preemphasis



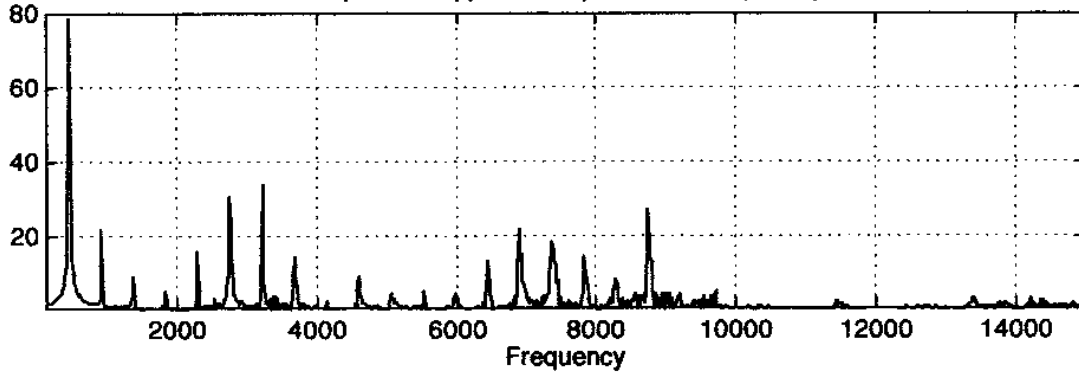
Zoom

sample C21 approximate pitch "B4" without preemphasis

x 10<sup>4</sup>



sample C21 approximate pitch "B4" with preemphasis .9



## DFT Numerical Results

Worksheet saved into file: Minitab.C21  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	486	677.518	100.000
2	936	141.144	20.832
3	1404	46.247	6.826
4	1854	23.179	3.421
5	2322	54.840	8.094
6	2772	86.144	12.715
7	3240	82.722	12.210
8	3708	32.280	4.764
9	4500	1.838	0.271
10	4698	3.768	0.556
11	5526	3.004	0.443
12	5994	6.977	1.030
13	6462	17.397	2.568
14	6912	27.062	3.994
15	7380	20.790	3.069
16	7830	15.809	2.333
17	8298	8.476	1.251
18	8748	26.147	3.859
19	9054	4.685	0.692
20	9720	4.647	0.686
21	10188	1.504	0.222
22	10584	0.913	0.135
23	11196	0.908	0.134
24	11502	1.470	0.217
25	12276	0.408	0.060
26	12708	1.160	0.171
27	13230	0.820	0.121
28	13428	2.739	0.404
29	14220	2.182	0.322
30	14400	2.090	0.308
31	14922	1.106	0.163
32	15660	0.646	0.095
33	16218	0.910	0.134
34	16380	0.706	0.104
35	17010	0.637	0.094
36	17550	0.912	0.135
37	17802	0.794	0.117
38	18630	0.778	0.115
39	18918	0.595	0.088
40	19584	0.454	0.067
41	19782	0.366	0.054
42	20358	0.281	0.042
43	21024	0.294	0.043
44	21312	0.283	0.042
45	22050	0.261	0.039
46	22230	0.269	0.040
47	22734	0.252	0.037
48	23148	0.249	0.037
49	16794	0.719	0.106
50	17028	0.692	0.102
51	17496	0.670	0.099
52	17658	0.671	0.099
53	18252	0.666	0.098
54	18522	0.637	0.094
55	18864	0.650	0.096

- good tracking

← F2 close  
 ← F3

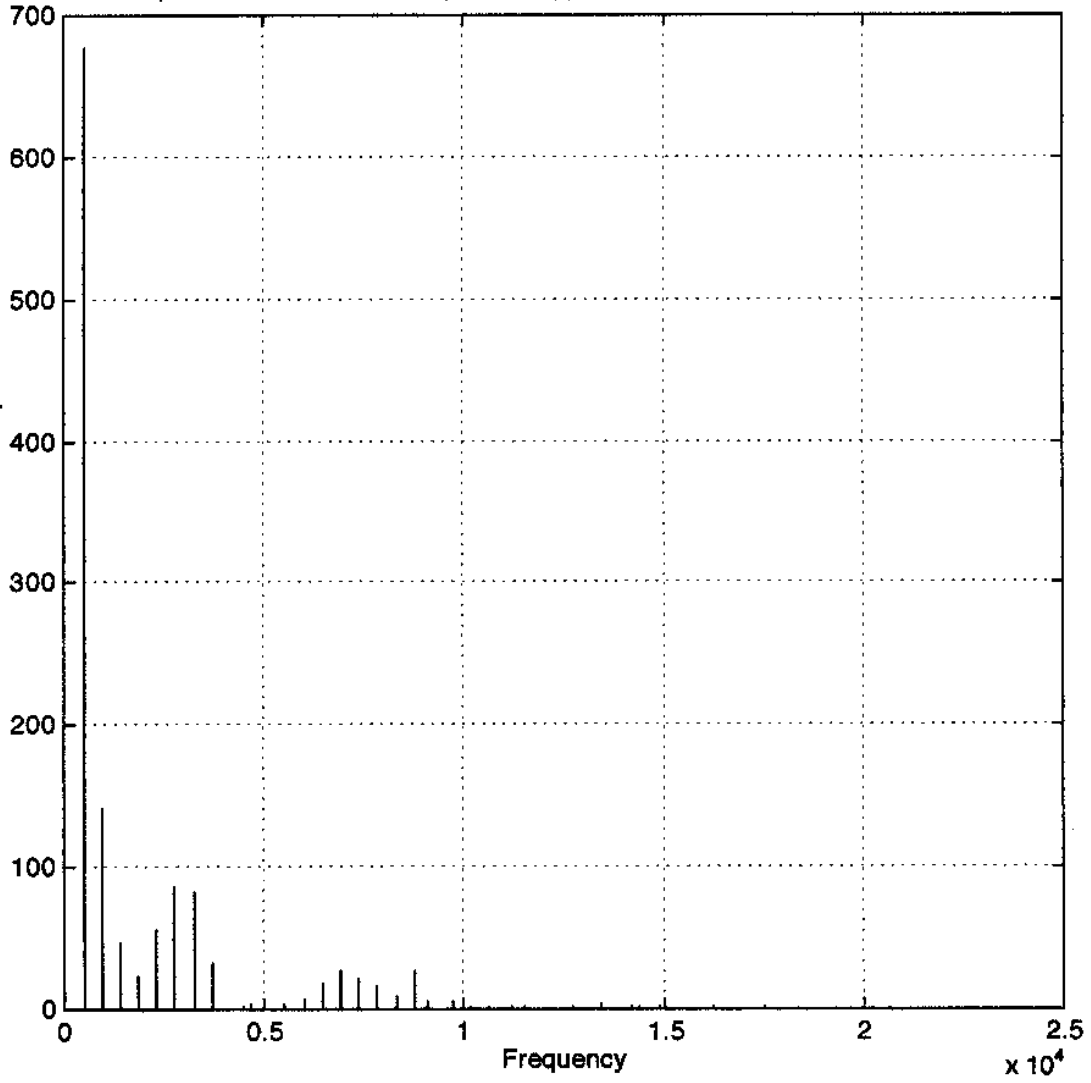
← not in speech

← near speech format

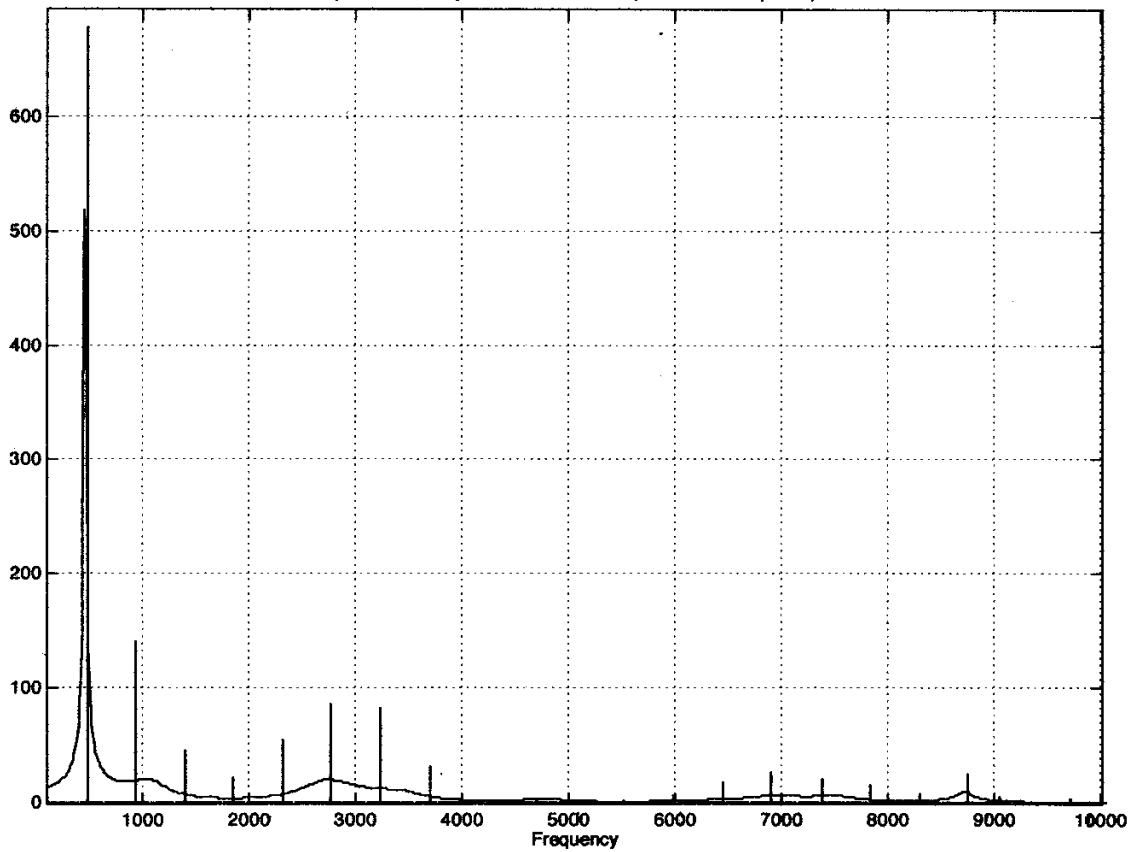
56	19188	0.645	0.095
57	19584	0.651	0.096
58	19944	0.621	0.092
59	20052	0.625	0.092
60	20466	0.615	0.091
61	20916	0.605	0.089
62	21168	0.622	0.092
63	21582	0.617	0.091
64	21906	0.606	0.089
65	22104	0.608	0.090
66	22662	0.601	0.089
67	22806	0.597	0.088
68	23328	0.593	0.088
69	23580	0.592	0.087
70	16308	0.416	0.061
71	16560	0.323	0.048
72	16902	0.329	0.049
73	16992	0.201	0.030
74	17298	0.143	0.021
75	17496	0.127	0.019
76	17838	0.122	0.018
77	18108	0.116	0.017
78	18162	0.141	0.021
79	18558	0.133	0.020
80	18756	0.107	0.016
81	18954	0.117	0.017
82	19278	0.117	0.017
83	19404	0.127	0.019
84	19674	0.098	0.014
85	19854	0.107	0.016
86	20142	0.105	0.016
87	20358	0.100	0.015
88	20520	0.136	0.020
89	20826	0.117	0.017
90	21042	0.139	0.020
91	21312	0.085	0.013
92	21564	0.094	0.014
93	21672	0.126	0.019
94	22014	0.141	0.021
95	22248	0.108	0.016
96	22464	0.092	0.014
97	22752	0.096	0.014
98	22914	0.089	0.013
99	23184	0.082	0.012
100	23454	0.078	0.011
101	23634	0.083	0.012
102	20160	0.179	0.026
103	20430	0.180	0.027
104	20610	0.171	0.025
105	20718	0.158	0.023
106	21042	0.164	0.024
107	21240	0.157	0.023
108	21420	0.141	0.021
109	21564	0.154	0.023
110	21834	0.144	0.021
111	21978	0.138	0.020
112	22104	0.146	0.021
113	22302	0.133	0.020
114	22608	0.144	0.021
115	22824	0.134	0.020

116	22950	0.130	0.019
117	23202	0.139	0.021
118	23418	0.141	0.021
119	23490	0.135	0.020
120	23814	0.133	0.020

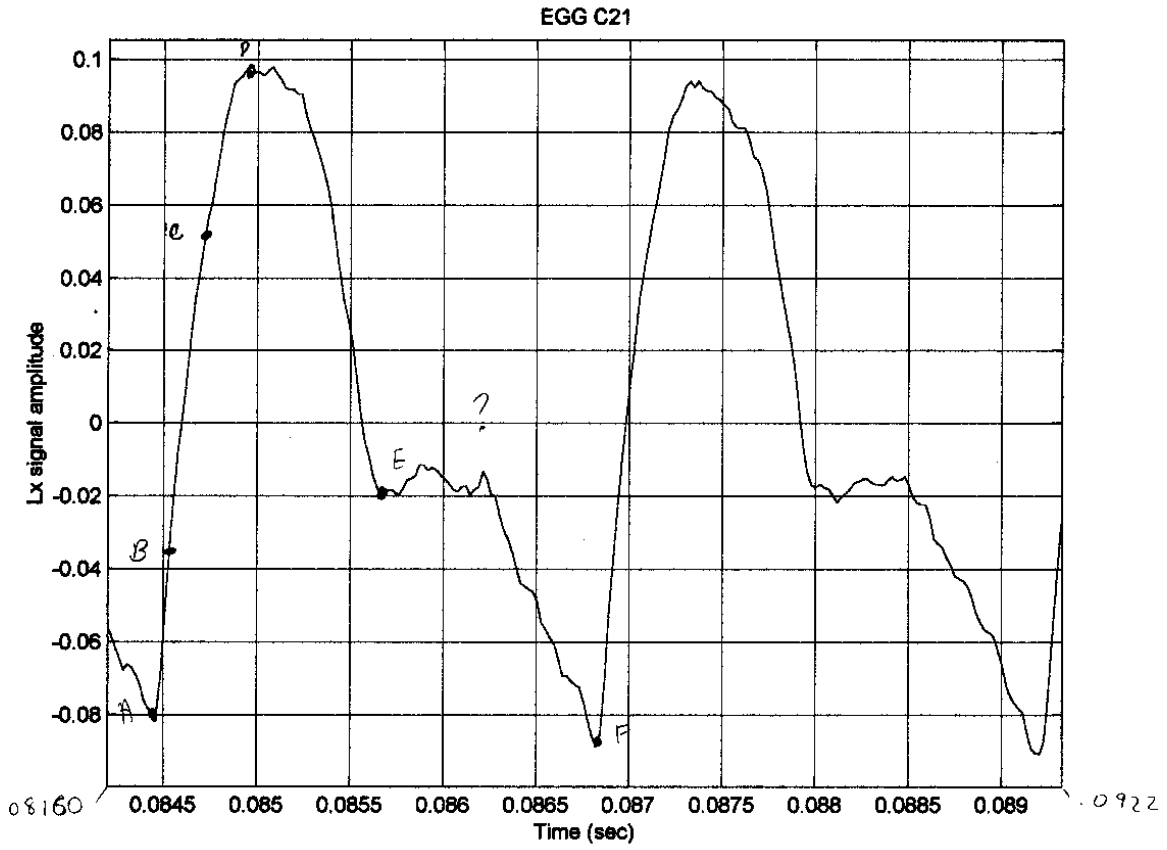
Stem plot of harmonics for sample C21 approximate pitch "B4" without preemphasis



Stem plot/LPC overlay of harmonics for sample C21 without preemphasis



$x \Rightarrow 15\frac{1}{2} \text{ mm} = .0005$   
 $y \Rightarrow 12 \text{ mm} = .02$   
 $y \Rightarrow 1 \text{ mm} = .0016666$

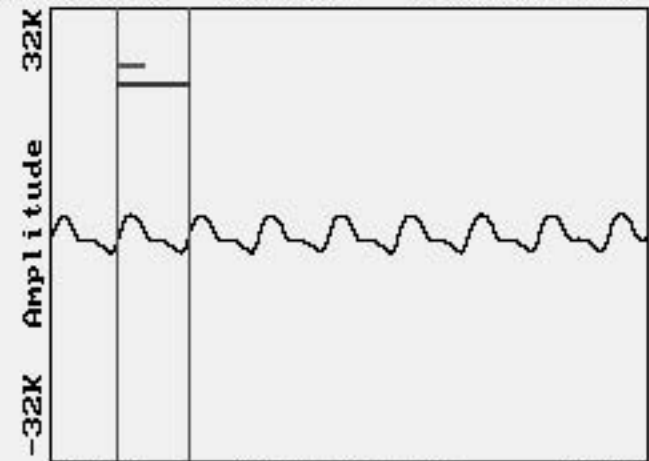


**A** > : CH1: C21\_EG~1.NSP

< 0.00 sec 38.46% 424.04 Hz >



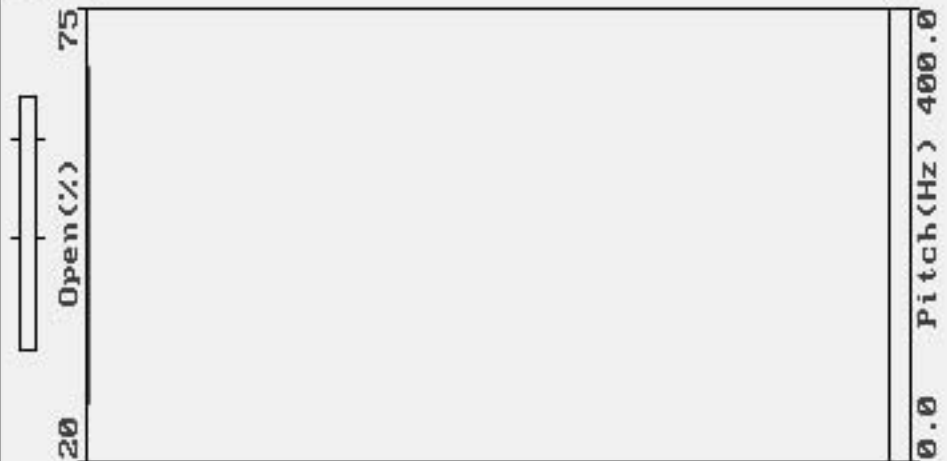
Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

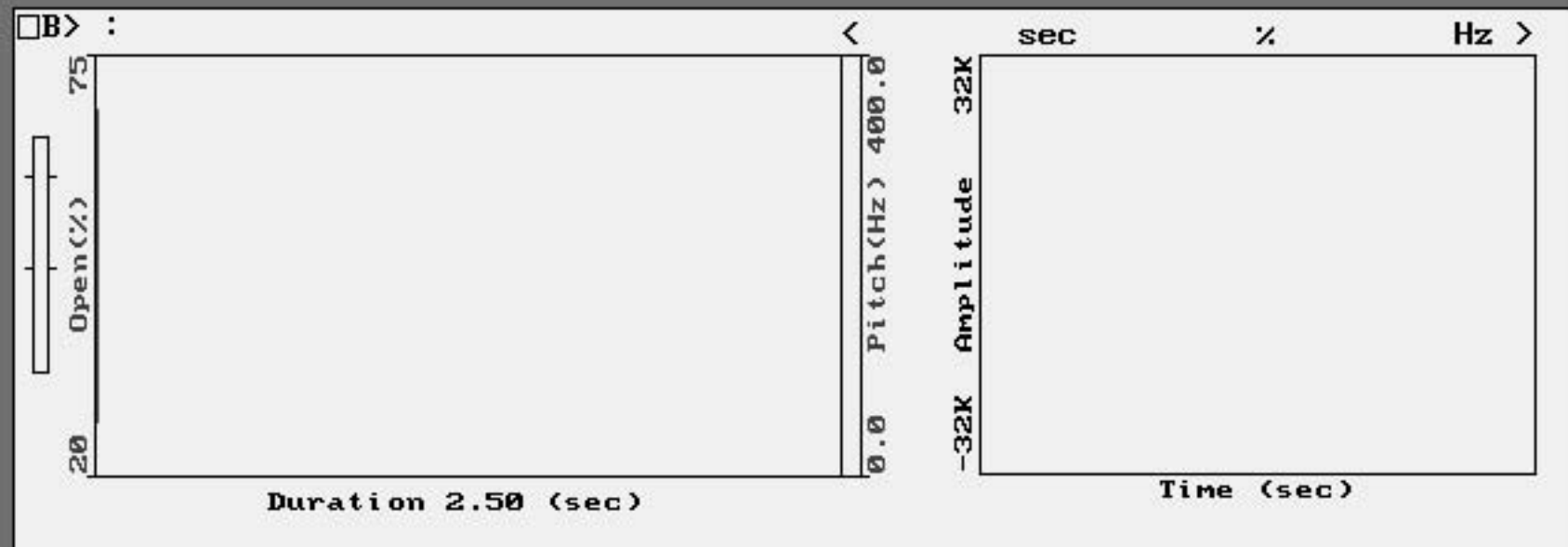
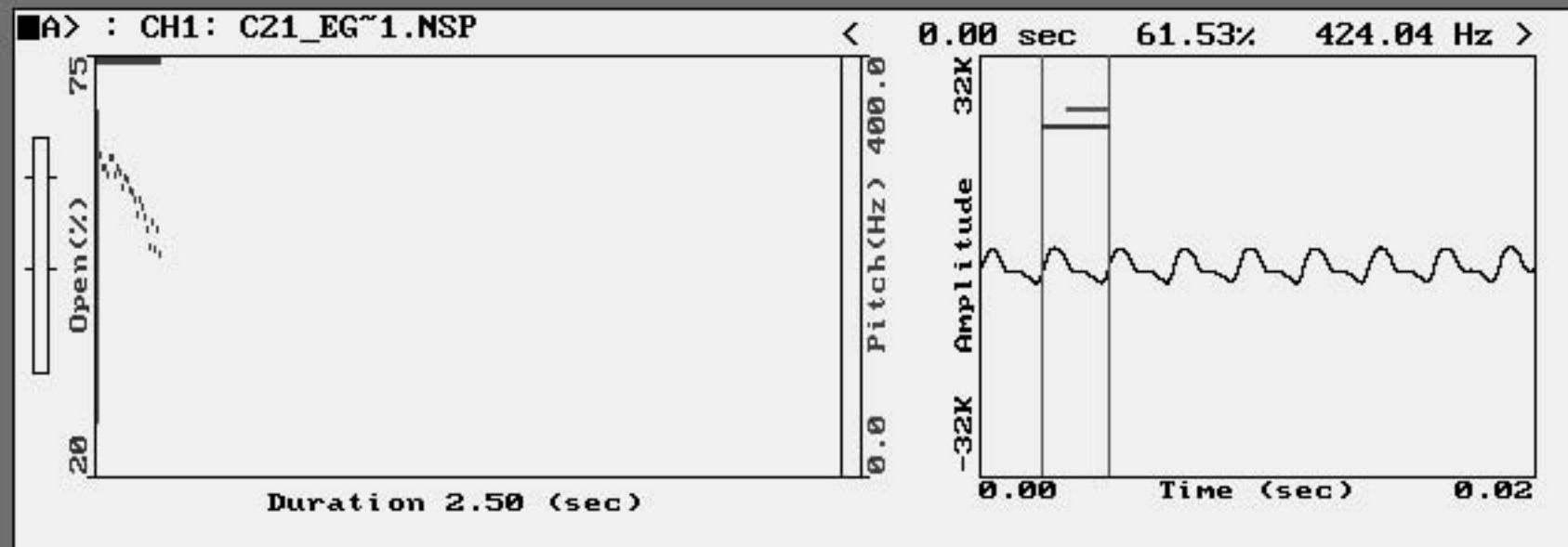
< sec % Hz >

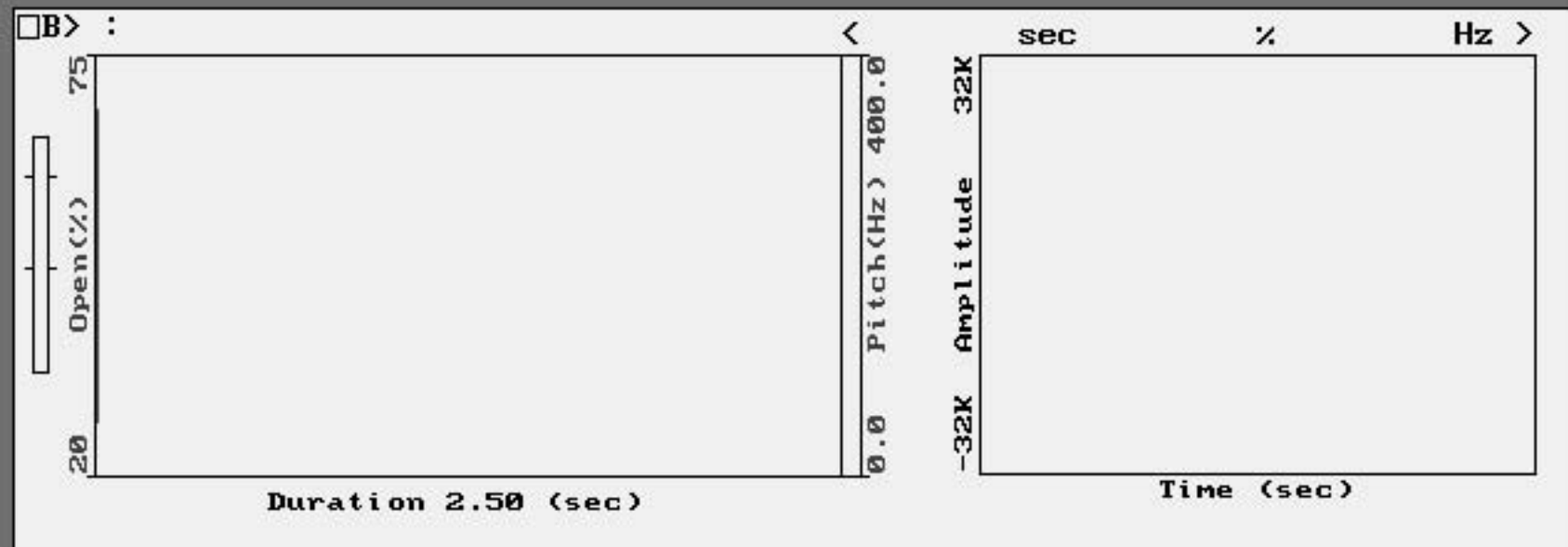
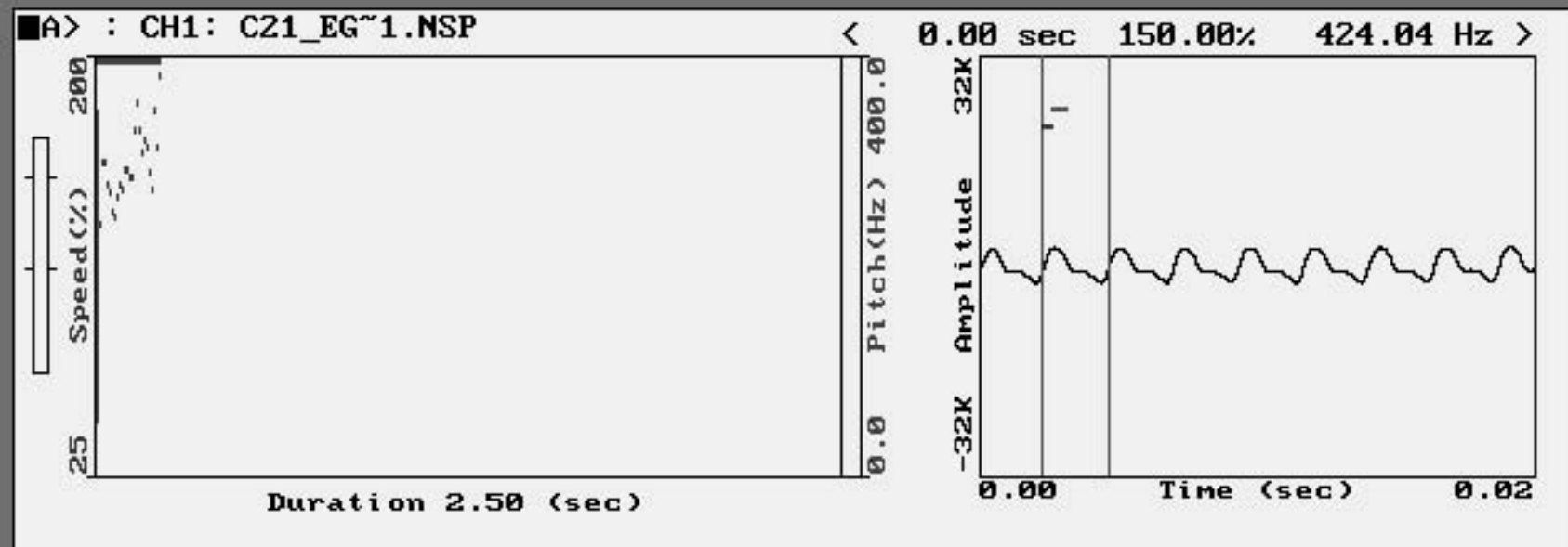


Duration 2.50 (sec)

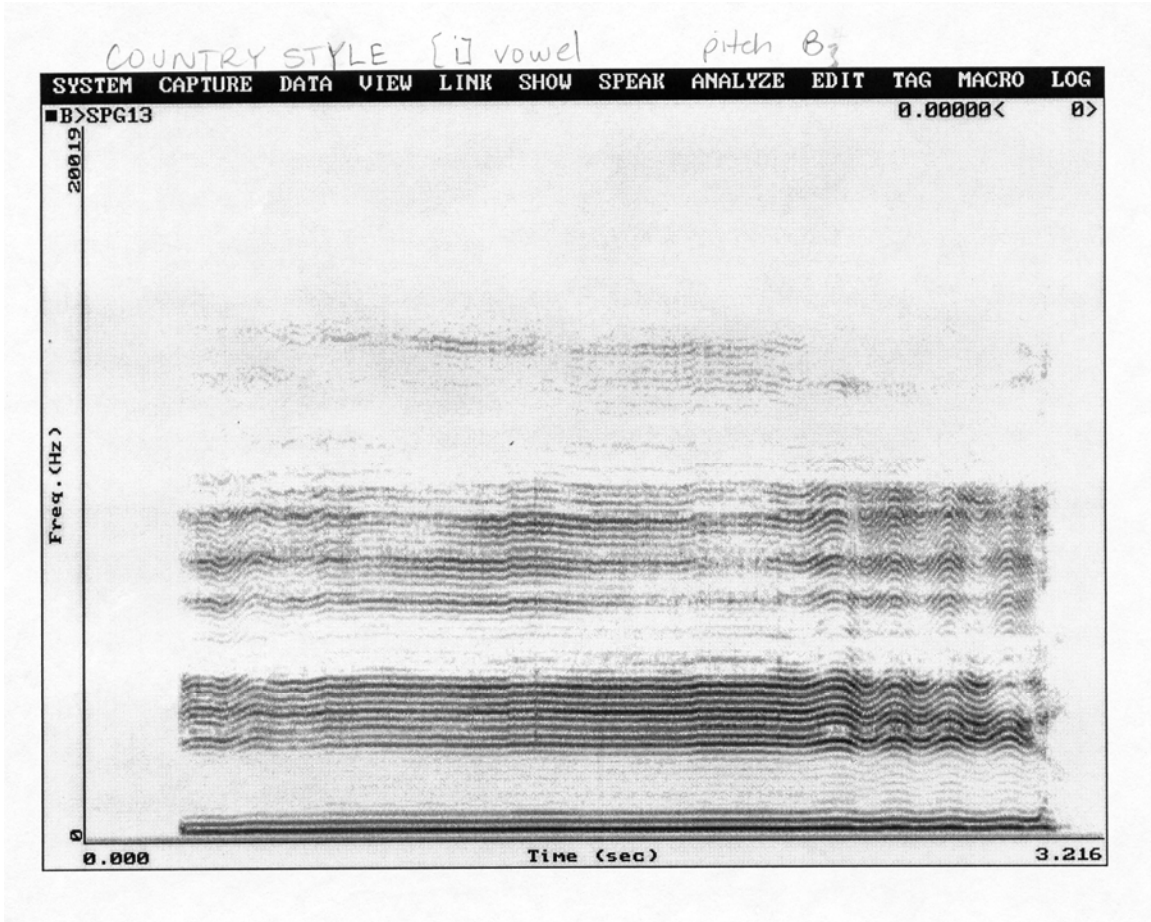


Time (sec)





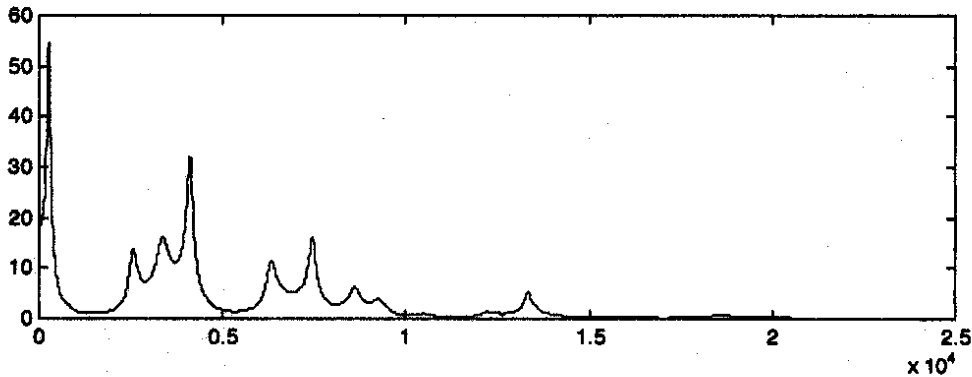
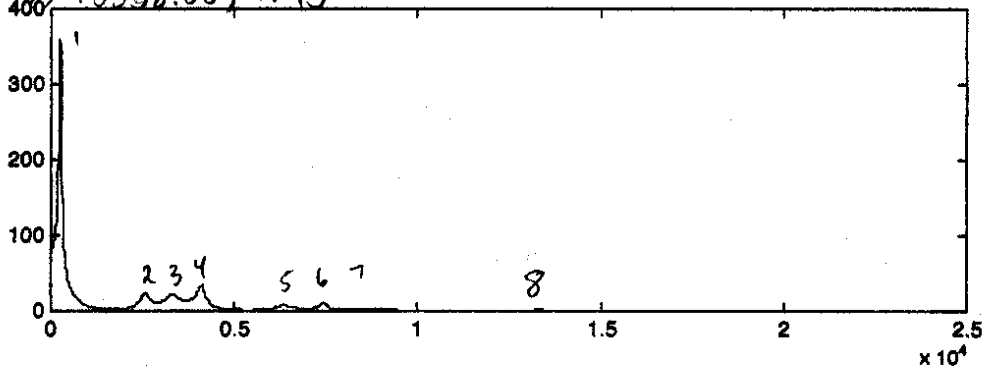
Spectrogram of C31



- 1) 246.09, .360.70
- 2) 2454, 25.48
- 3) 3328.15, 22.03
- 4) 4102.15, 34.6
- 5) 6350.00, 8.15
- 6) 7429.75, 10.68
- 7) 8588.00, 3.3
- 8) 13358.00, 1.95

C31

$F_0 = 228 \text{ Hz}$



$$.14466667 - .0086041667 = .136062504 / 31$$

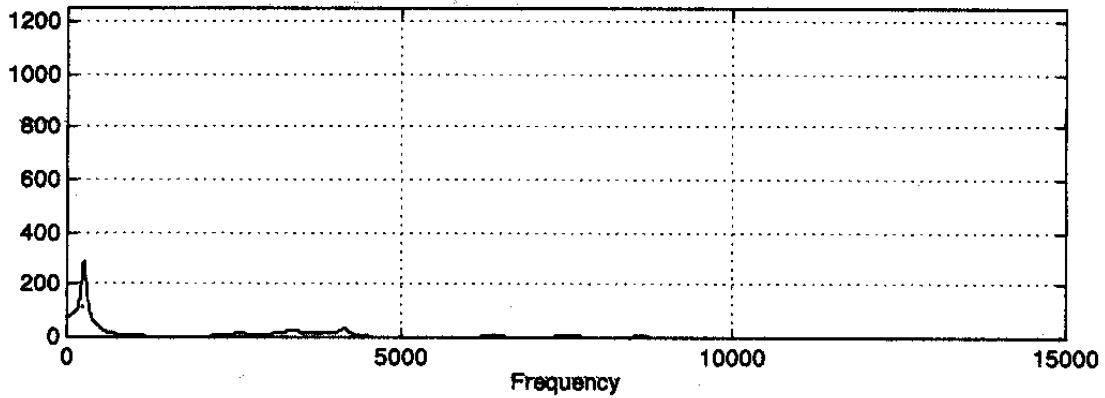
$$= .004389113$$

$$= 227.8364655$$

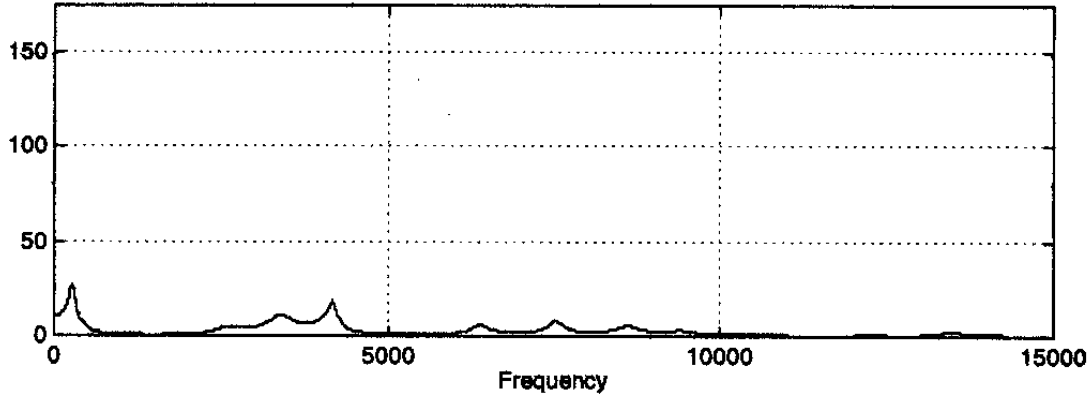
(10000-16000)

(257.81, 291.33)  
(2589.86, 14.7)  
(3375.05, 25.9)  
(4160.16, 32.46)  
(6386.68, 6.88)  
(7546.88, 8.50)  
(8624.73, 5.51)

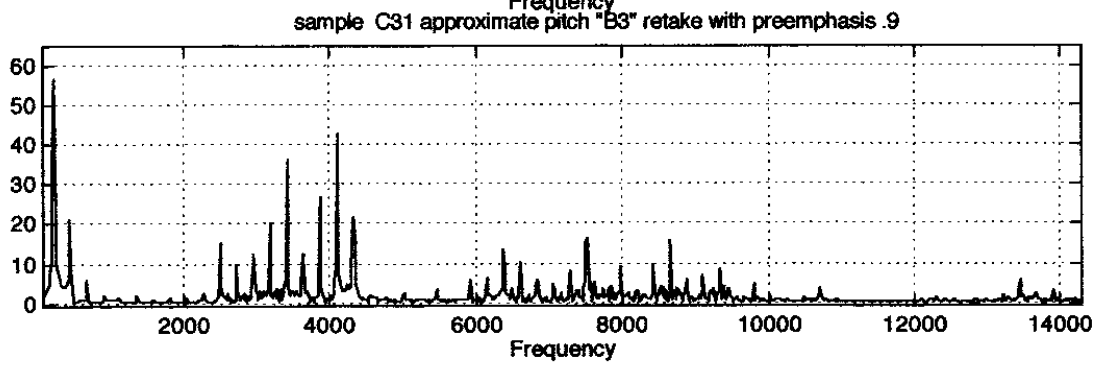
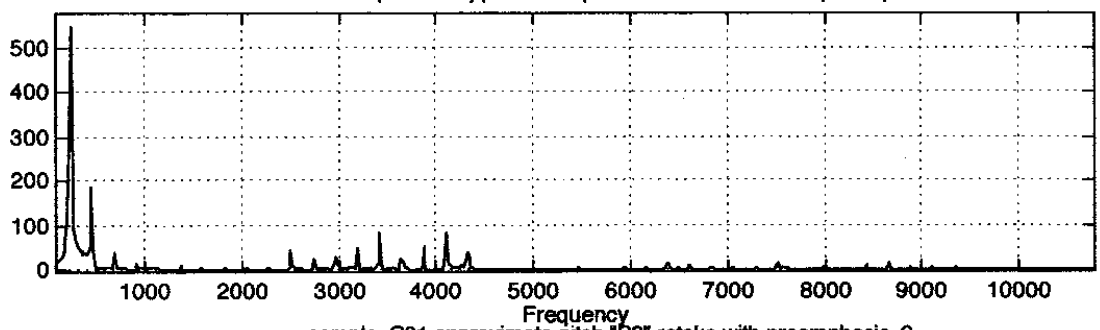
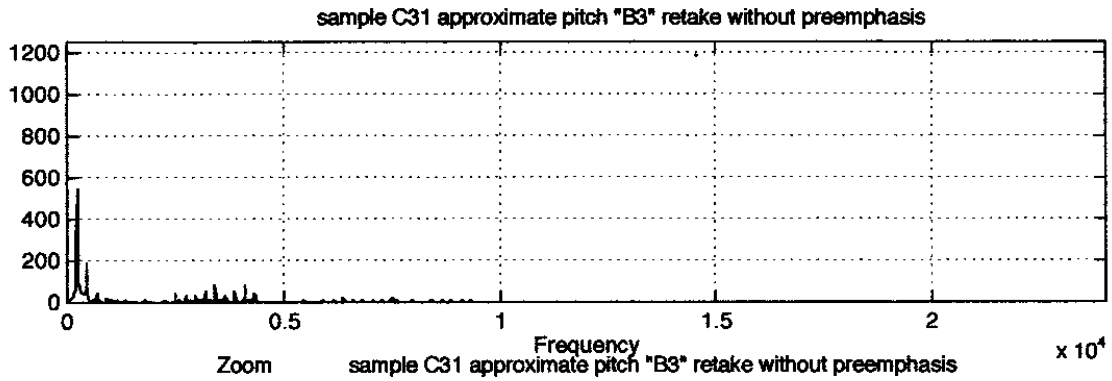
LPC of 2500pt sample C31 approximate pitch "B3" (retake) without preemphasis



LPC of 2500pt sample C31 approximate pitch "B3" (retake) with preemphasis .9



DFT of C31



# DFT Numerical Results

Worksheet saved into file: Minitab.C31  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	252	547.097	100.000
2	468	187.005	34.181
3	702	42.836	7.830
4	936	16.619	3.038
5	1242	4.353	0.796
6	1602	5.146	0.941
7	1836	7.614	1.392
8	2070	5.034	0.920
9	2286	9.425	1.723
10	2520	46.745	8.544
11	2754	28.597	5.227
12	2988	33.162	6.062
13	3204	50.738	9.274
14	3438	83.449	15.253
15	3708	6.471	1.183
16	4122	83.682	15.296
17	4338	40.649	7.430
18	4590	3.553	0.649
19	4788	2.701	0.494
20	5040	3.988	0.729
21	5202	1.689	0.309
22	5490	5.462	0.998
23	5724	1.864	0.341
24	6138	2.368	0.433
25	6390	17.886	3.269
26	6624	12.815	2.342
27	6858	7.011	1.282
28	7074	5.521	1.009
29	7308	9.022	1.649
30	7542	18.324	3.349
31	7866	4.599	0.841
32	7992	9.612	1.757
33	8226	3.332	0.609
34	8550	4.434	0.811
35	8892	5.589	1.022
36	9126	6.437	1.176
37	9360	7.702	1.408
38	9486	1.446	0.264
39	9810	4.198	0.767
40	10044	1.904	0.348
41	10260	0.796	0.145
42	10494	1.500	0.274
43	10746	1.153	0.211
44	10998	0.459	0.084
45	11430	0.453	0.083
46	11538	0.488	0.089
47	11934	0.474	0.087
48	12096	1.039	0.190
49	12312	1.345	0.246
50	12654	0.576	0.105
51	12852	0.650	0.119
52	13014	0.680	0.124
53	13446	2.375	0.434
54	13680	1.905	0.348
55	13914	2.107	0.385

*good tracking*

*← F2*

*← F3*

*← a little higher in Speed - (4392 Hz) SF?*

*← F4*

*not such high energy Speed.*

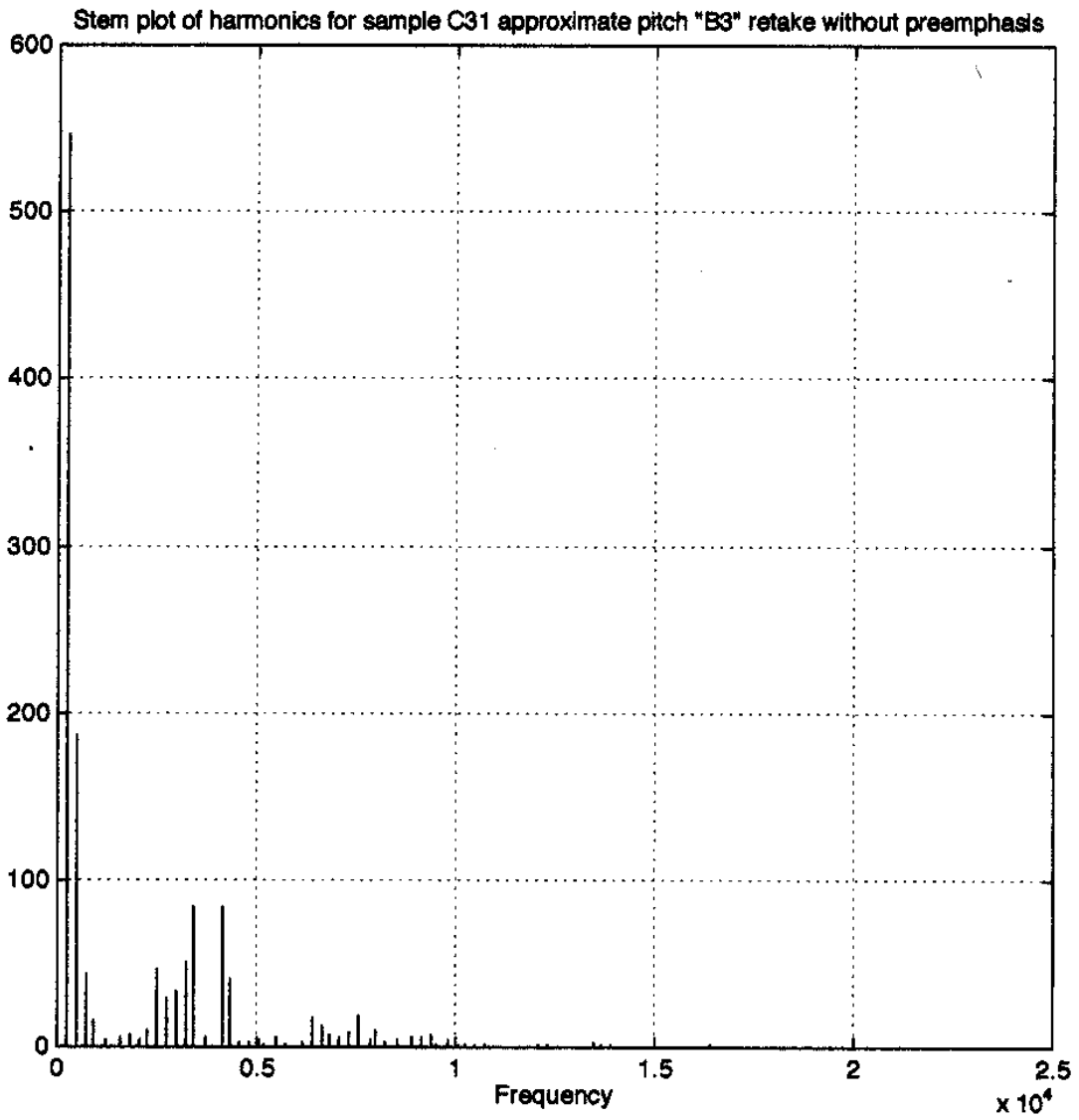
*←*



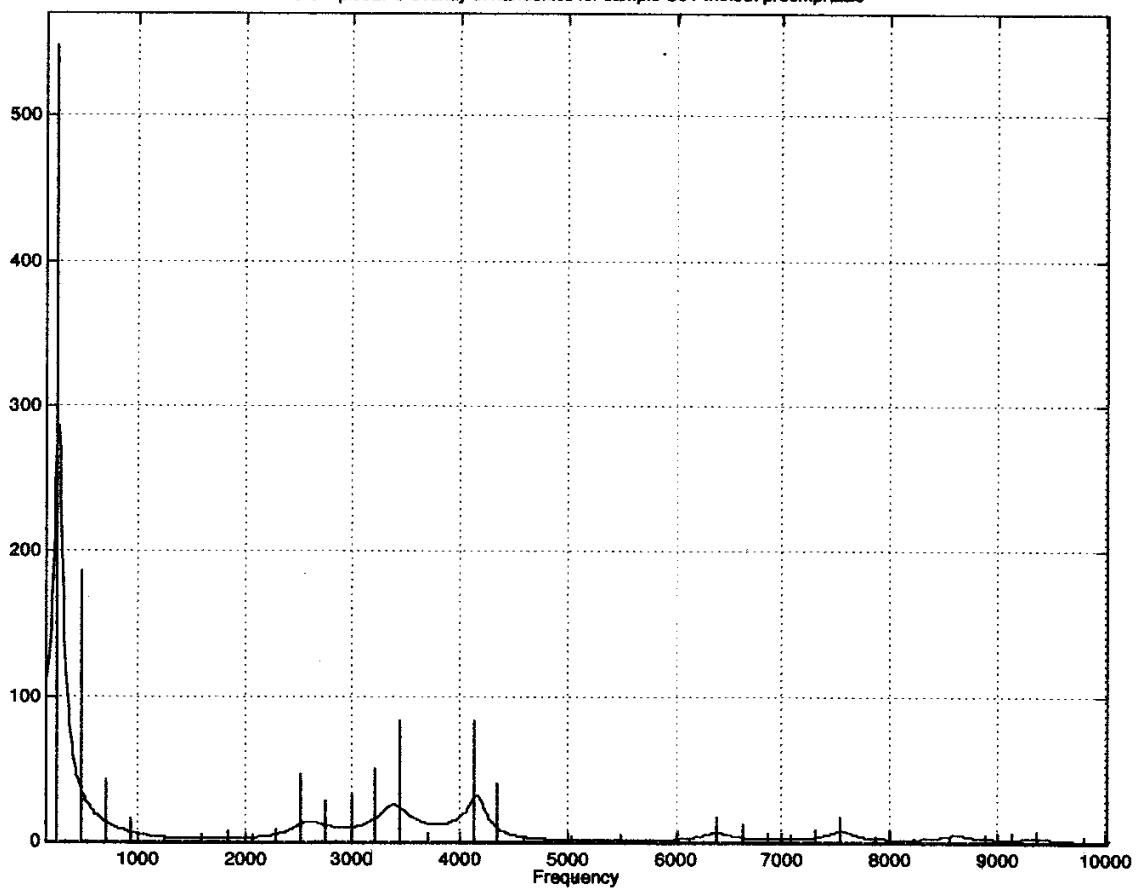
56	14202	0.704	0.129
57	14436	0.458	0.084
58	14598	0.601	0.110
59	14814	0.585	0.107
60	15048	0.487	0.089
61	15462	0.412	0.075
62	15714	0.416	0.076
63	15966	0.607	0.111
64	16182	0.638	0.117
65	16416	0.790	0.144
66	16560	0.392	0.072
67	16848	0.391	0.071
68	17100	0.451	0.082
69	17388	0.383	0.070
70	17550	0.377	0.069
71	17802	0.432	0.079
72	18108	0.419	0.077
73	18342	0.549	0.100
74	18738	0.566	0.104
75	18918	0.553	0.101
76	19152	0.521	0.095
77	19368	0.488	0.089
78	19620	0.447	0.082
79	19944	0.352	0.064
80	20160	0.379	0.069
81	20412	0.383	0.070
82	20628	0.375	0.069
83	20934	0.361	0.066
84	21096	0.347	0.064
85	21474	0.354	0.065
86	21618	0.356	0.065
87	21996	0.345	0.063
88	22230	0.337	0.062
89	22482	0.338	0.062
90	22680	0.346	0.063
91	22896	0.340	0.062
92	23274	0.336	0.061
93	23418	0.335	0.061
94	23616	0.332	0.061
95	22248	0.108	0.020
96	22464	0.092	0.017
97	22752	0.096	0.018
98	22914	0.089	0.016
99	23184	0.082	0.015
100	23454	0.078	0.014
101	23634	0.083	0.015
102	20160	0.179	0.033
103	20430	0.180	0.033
104	20610	0.171	0.031
105	20718	0.158	0.029
106	21042	0.164	0.030
107	21240	0.157	0.029
108	21420	0.141	0.026
109	21564	0.154	0.028
110	21834	0.144	0.026
111	21978	0.138	0.025
112	22104	0.146	0.027
113	22302	0.133	0.024
114	22608	0.144	0.026
115	22824	0.134	0.024

116	22950	0.130	0.024
117	23202	0.139	0.025
118	23418	0.141	0.026
119	23490	0.135	0.025
120	23814	0.133	

0.024



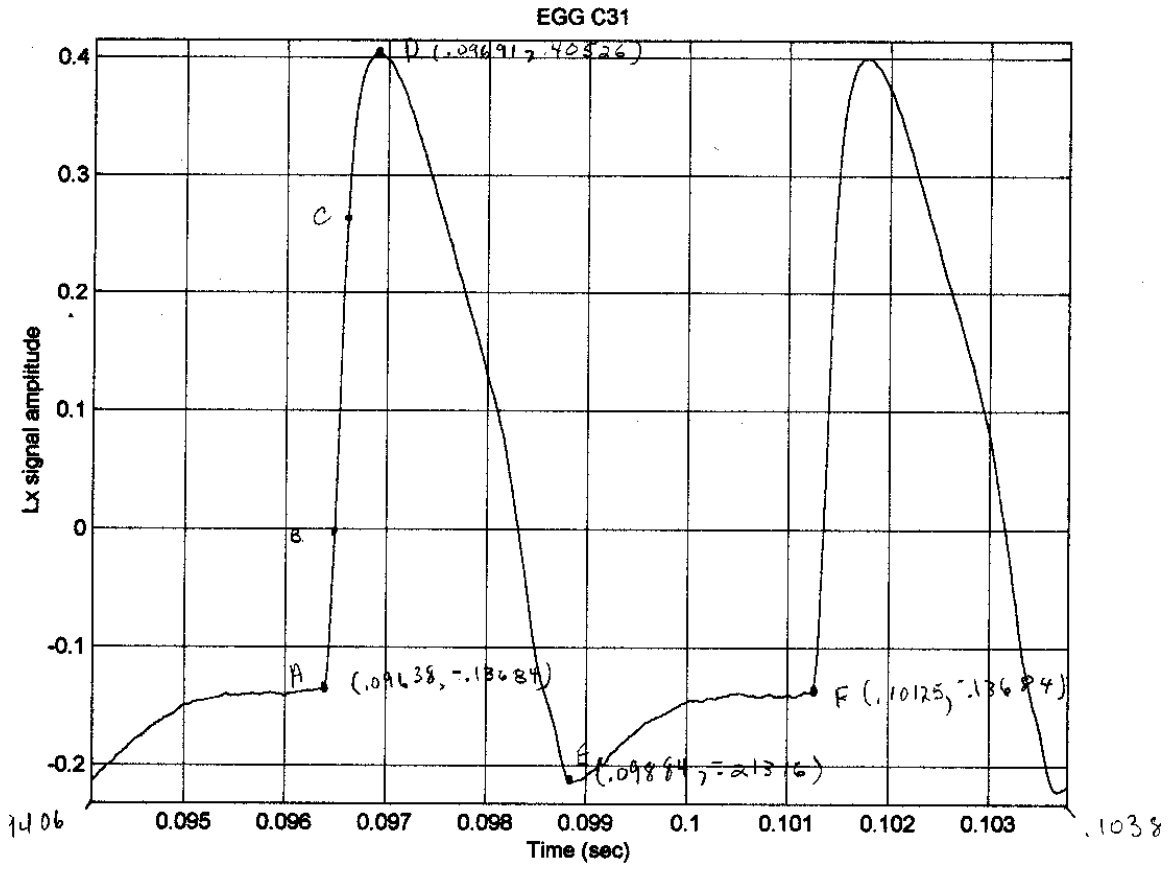
Stem plot/LPC overlay of harmonics for sample C31 without preemphasis



$x \Rightarrow 16\text{mm} = .001$

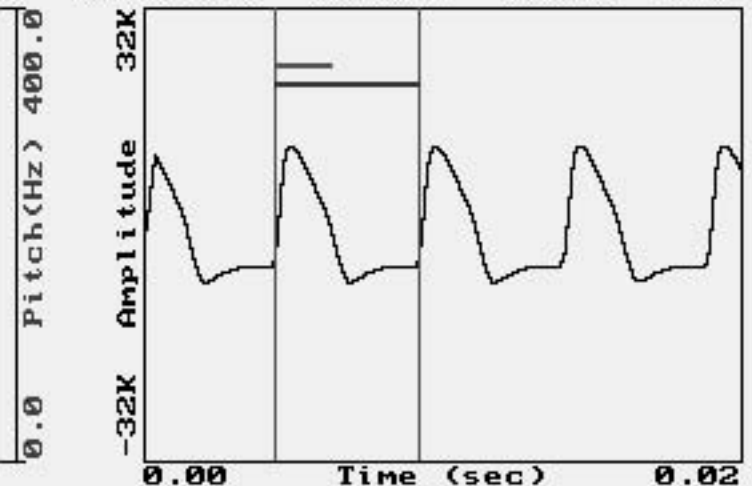
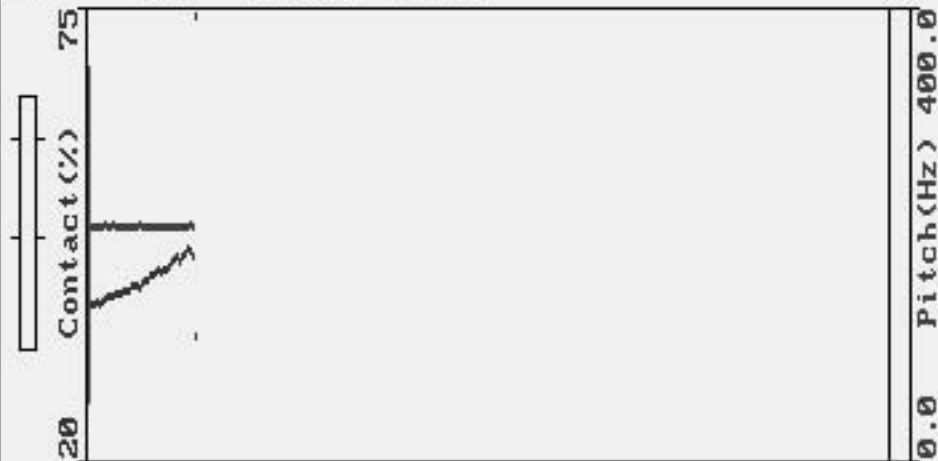
$y \Rightarrow 19\text{mm} = .1$

$y \Rightarrow 1\text{mm} = .0052631$



**A** > : CH1: C31\_EG~1.NSP

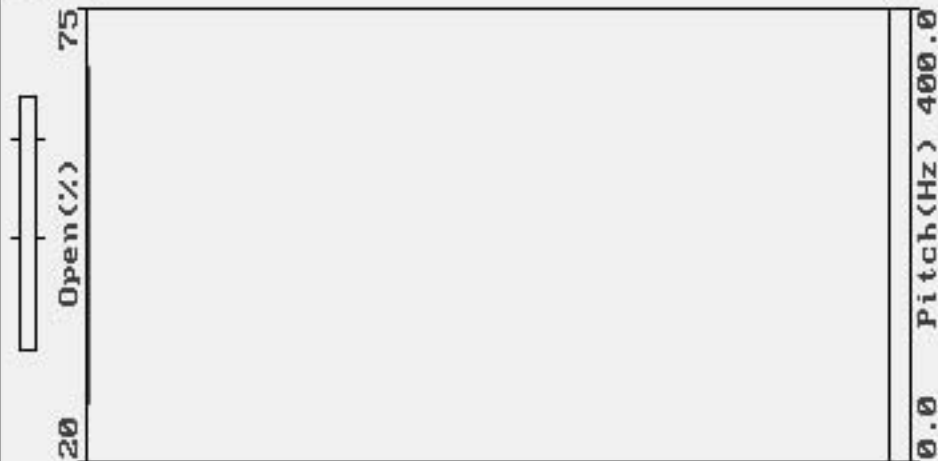
< 0.00 sec 38.31% 206.07 Hz >



Duration 2.50 (sec)

**B** > :

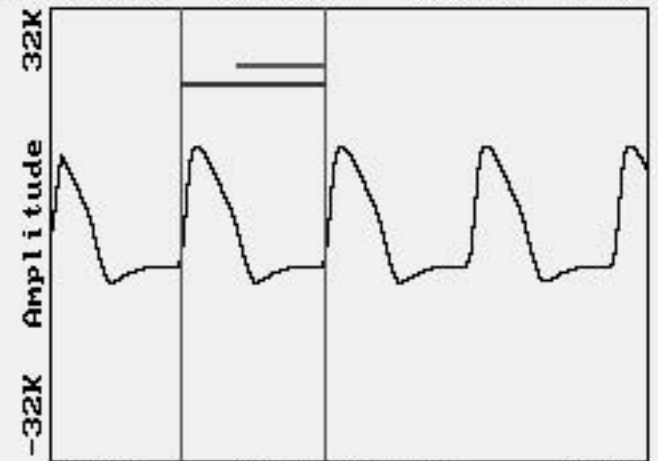
< sec % Hz >



Duration 2.50 (sec)

**A** > : CH1: C31\_EG~1.NSP

< 0.00 sec 61.68% 206.07 Hz >



Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >

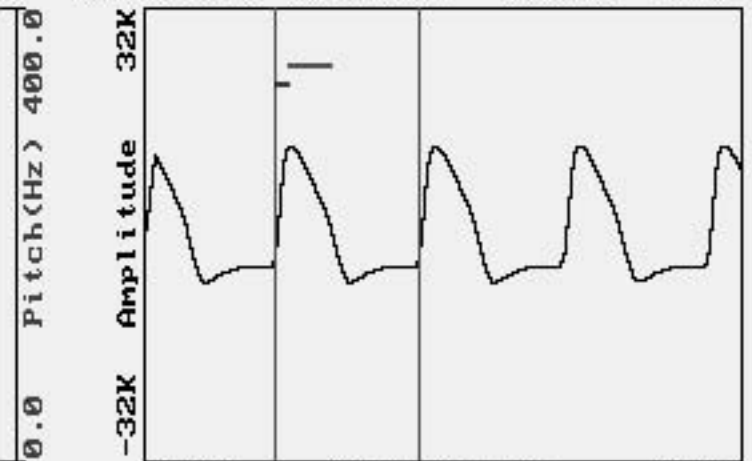


Duration 2.50 (sec)

Pitch(Hz) 400.0

**A** > : CH1: C31\_EG~1.NSP

< 0.00 sec 310.00% 206.07 Hz >

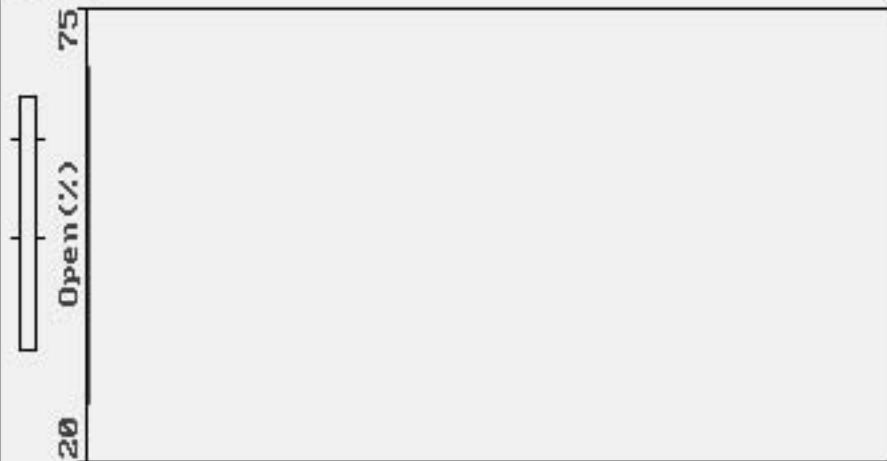


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

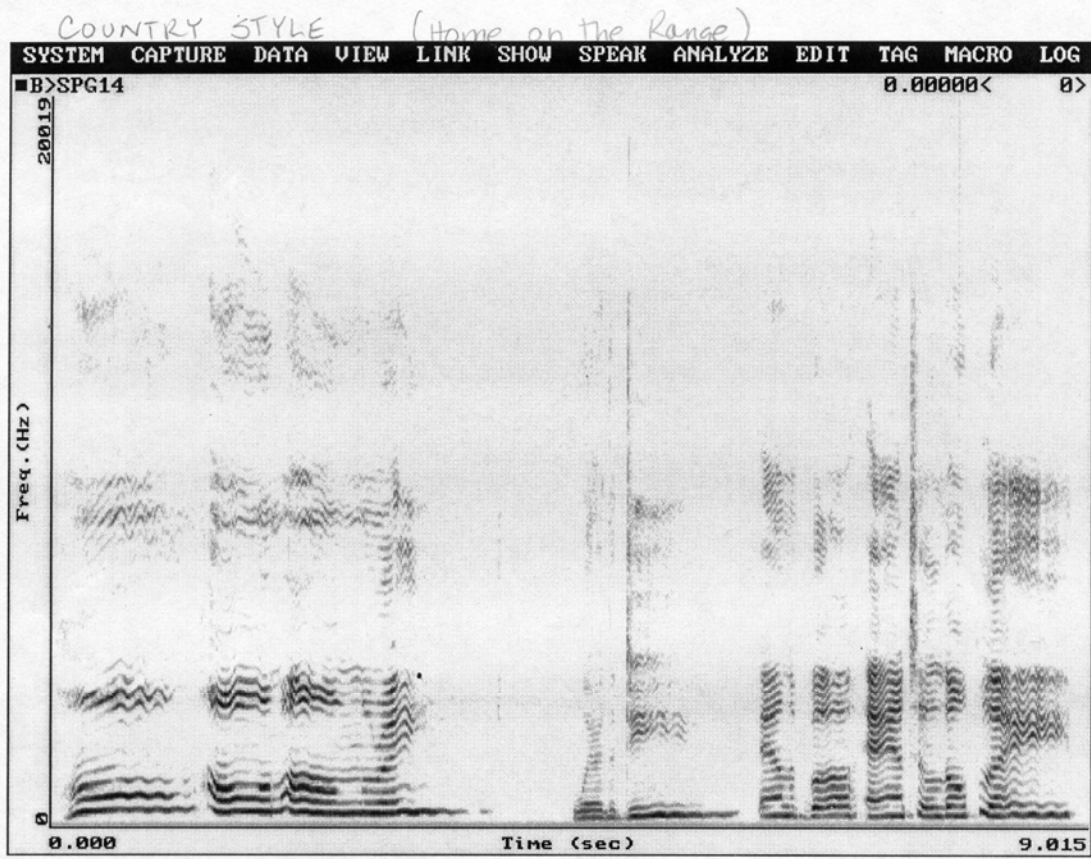
< sec % Hz >



Duration 2.50 (sec)

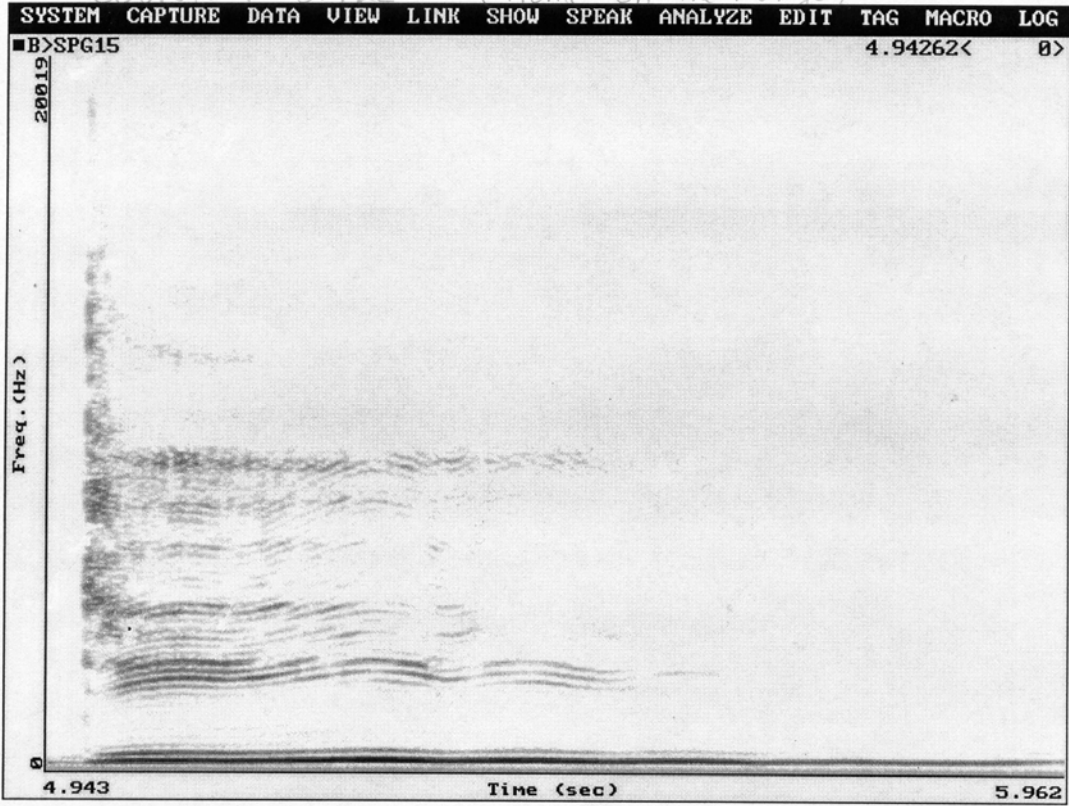
Pitch(Hz) 400.0

Spectrograms of C37b



Home home on the range where the deer and the antelope play

COUNTRY STYLE (Home on the Range)

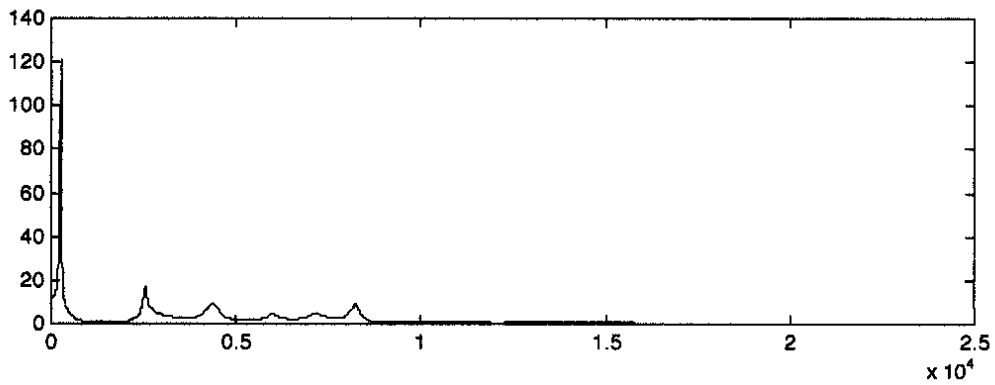
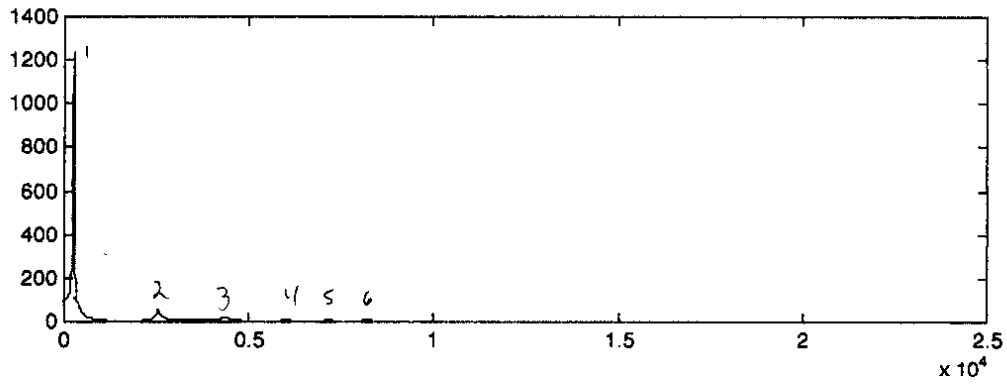


deer

- 1) 257.81, 1238.00
- 2) 2542.96, 53.5
- 3) 4371.10, 16.60
- 4) 5999.00, 6.07
- 5) 7163.50, 5.13
- 6) 8226.55, 9.74

C37

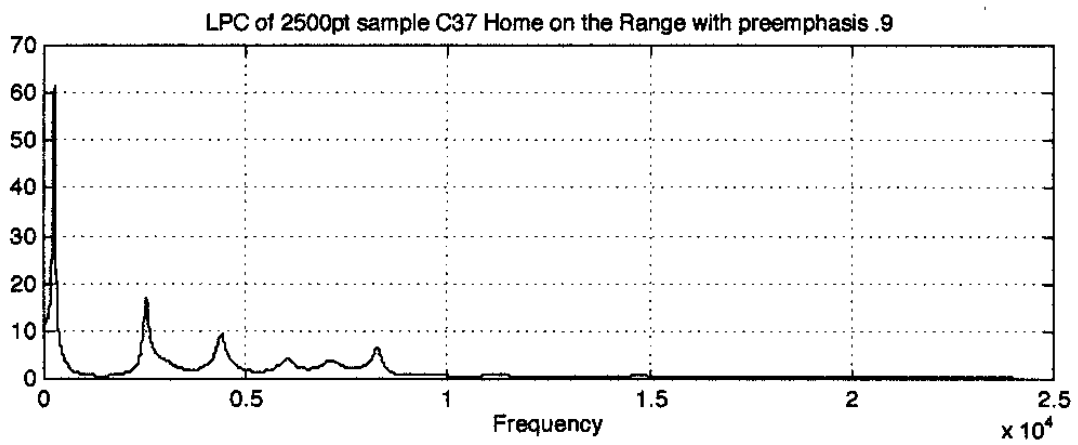
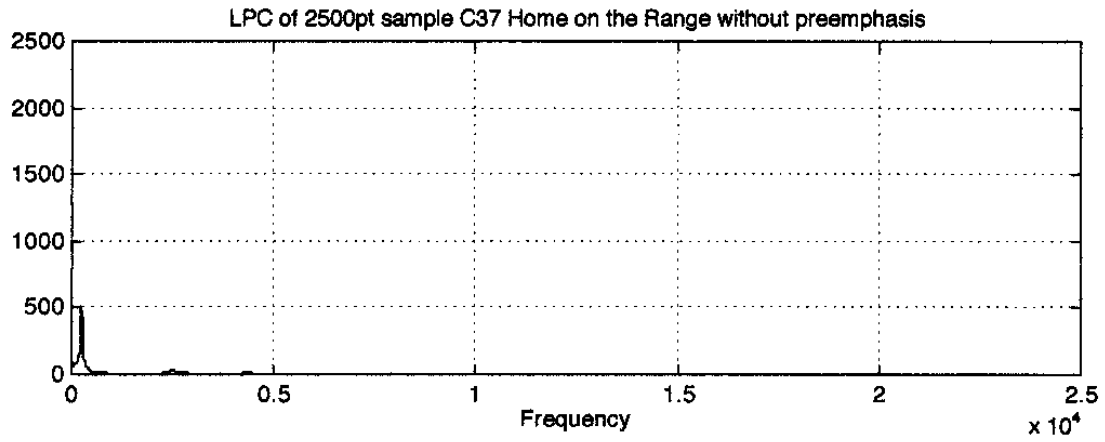
$$F_0 = 242 \text{ Hz}$$



$$.09341667 - .0025625 = .090854167 / 22$$

$$= .004129735$$

$$= 242.1462958$$

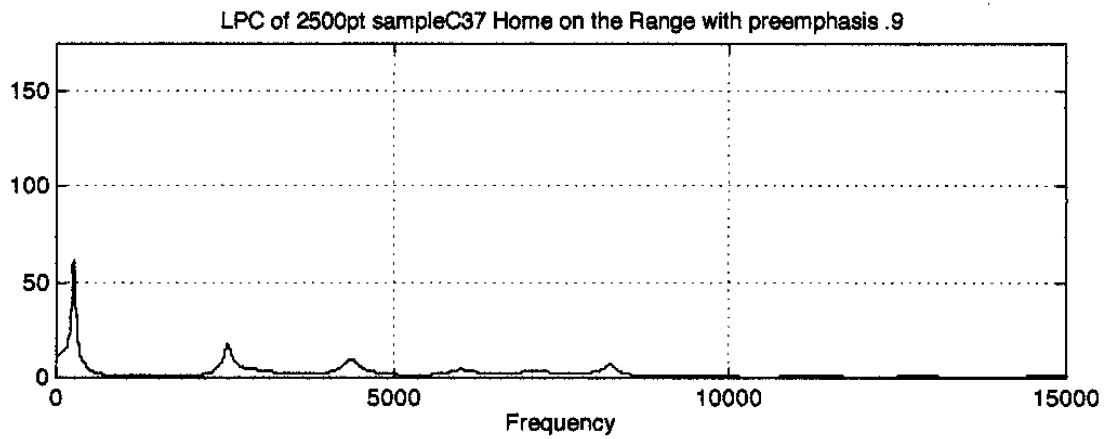
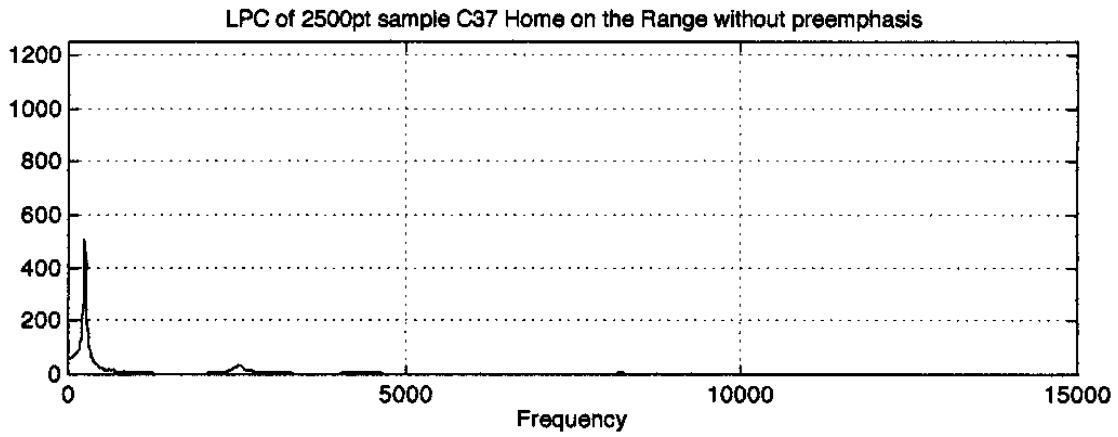


C37 est. wav

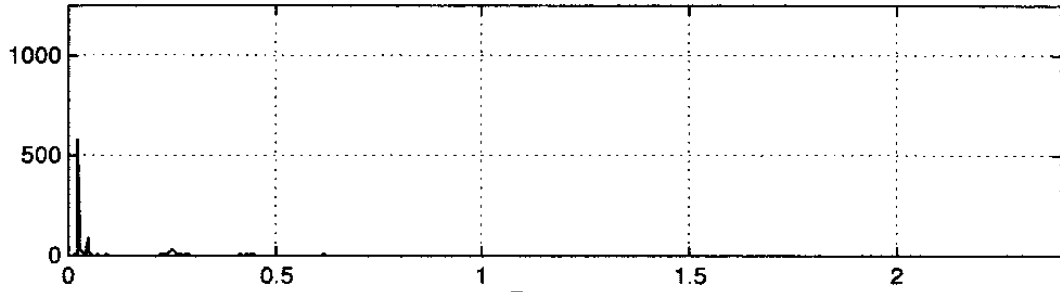
F1(246, 503)

F2(2531, 34)

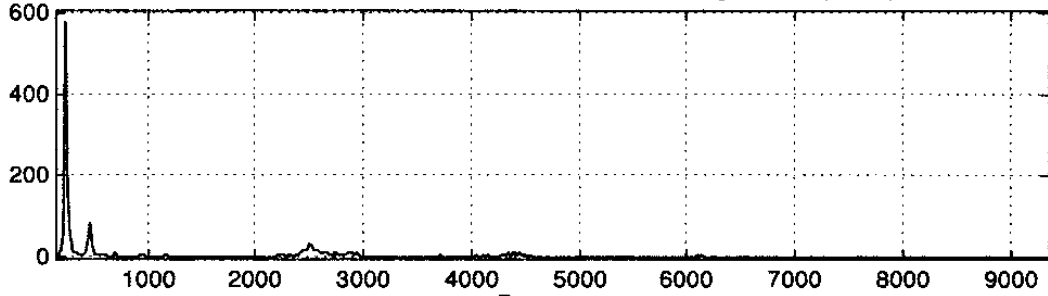
F3(4383, 12)



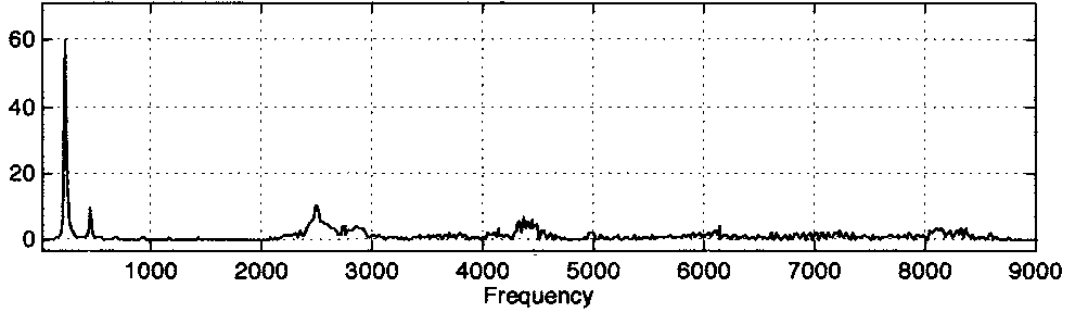
sample C37 "deer" from Home on the Range without preemphasis



Zoom sample C37 "deer" from Home on the Range without preemphasis  $\times 10^4$



sample C37 "deer" from Home on the Range with preemphasis .9



Worksheet saved into file: Minitab.C31  
MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	252	575.041	100.000
2	486	86.679	15.074
3	720	10.947	1.904
4	972	8.144	1.416
5	1170	4.644	0.808
6	1458	3.716	0.646
7	1854	3.380	0.588
8	2106	3.517	0.612
9	2340	8.081	1.405
10	2520	32.200	5.600
11	2682	11.590	2.015
12	2952	10.204	1.775
13	3186	3.855	0.670
14	3456	3.348	0.582
15	3726	4.800	0.835
16	4122	4.830	0.840
17	4356	9.992	1.738
18	4464	11.080	1.927
19	4698	1.602	0.279
20	4986	3.147	0.547
21	5382	2.238	0.389
22	5616	1.694	0.295
23	5868	2.125	0.370
24	6120	4.237	0.737
25	6228	2.422	0.421
26	6624	2.507	0.436
27	6858	2.807	0.488
28	7074	2.913	0.507
29	7254	3.875	0.674
30	7542	2.331	0.405
31	7884	2.423	0.421
32	8118	3.989	0.694
33	8388	4.126	0.718
34	8604	1.922	0.334
35	8766	0.552	0.096
36	9000	0.265	0.046
37	9360	0.433	0.075
38	9486	0.794	0.138
39	9738	0.565	0.098
40	10026	0.266	0.046
41	10386	0.204	0.036
42	10494	0.128	0.022
43	10890	0.289	0.050
44	11178	0.688	0.120
45	11412	0.691	0.120
46	11556	0.275	0.048
47	11790	0.322	0.056
48	12024	0.194	0.034
49	12258	0.125	0.022
50	12654	0.275	0.048
51	12852	0.352	0.061
52	13122	0.175	0.030
53	13410	0.294	0.051
54	13644	0.403	0.070
55	13842	0.169	0.029

← good tracking

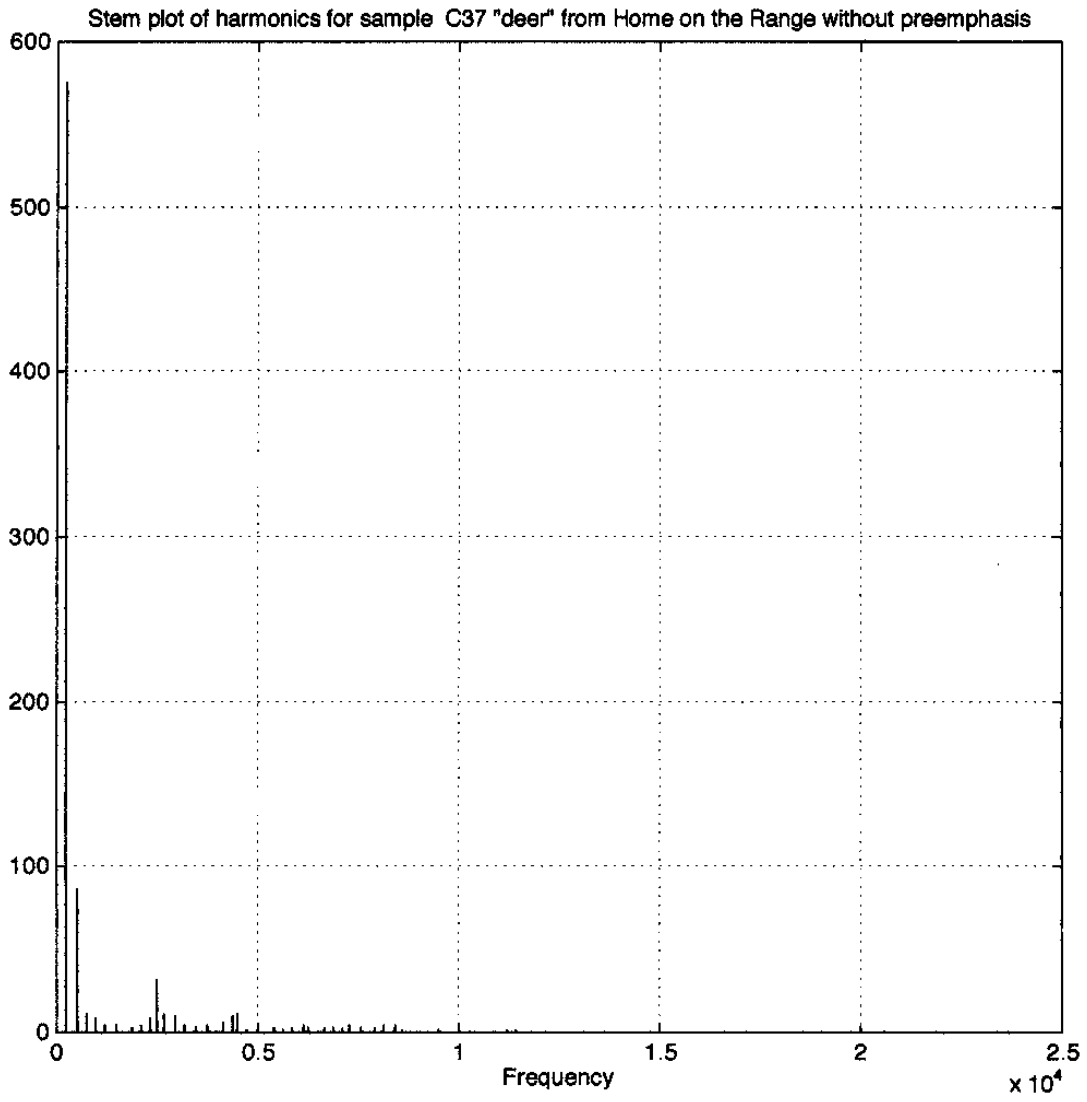
← maybe 12 F3 elevated

← near special format

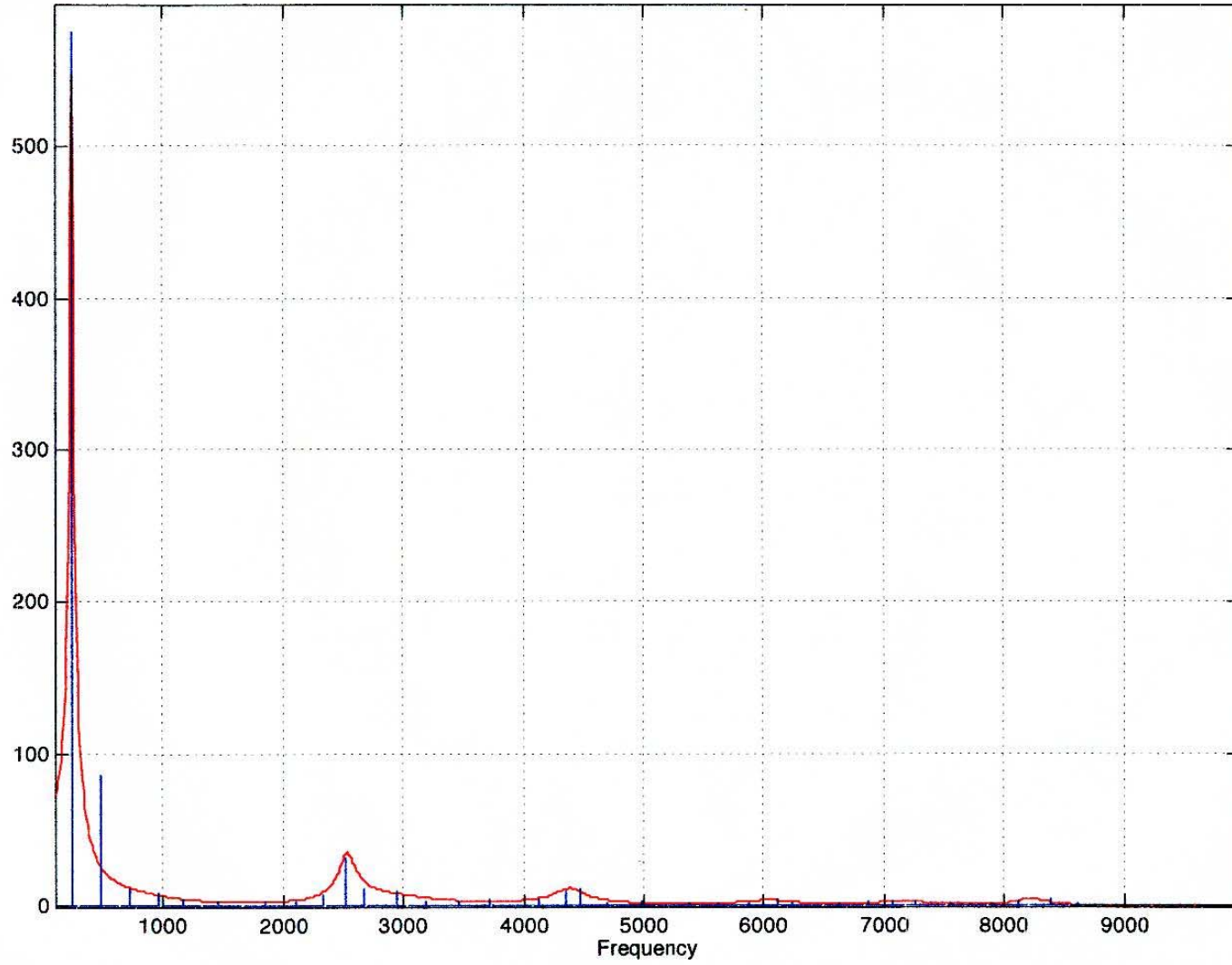
56	14166	0.235	0.041
57	14418	0.185	0.032
58	14598	0.153	0.027
59	14868	0.310	0.054
60	15102	0.269	0.047
61	15318	0.141	0.024
62	15642	0.140	0.024
63	15858	0.115	0.020
64	16128	0.136	0.024
65	16362	0.113	0.020
66	16722	0.111	0.019
67	16848	0.172	0.030
68	17118	0.128	0.022
69	17334	0.107	0.019
70	17586	0.146	0.025
71	17838	0.107	0.019
72	18054	0.102	0.018
73	18396	0.095	0.016
74	18720	0.125	0.022
75	18846	0.119	0.021
76	19116	0.091	0.016
77	19314	0.126	0.022
78	19584	0.150	0.026
79	19854	0.107	0.019
80	20250	0.098	0.017
81	20322	0.100	0.017
82	20718	0.094	0.016
83	20844	0.112	0.019
84	21114	0.097	0.017
85	21384	0.090	0.016
86	21654	0.107	0.019
87	21978	0.116	0.020
88	22176	0.109	0.019
89	22446	0.097	0.017
90	22644	0.102	0.018
91	22914	0.098	0.017
92	23112	0.104	0.018
93	23454	0.097	0.017
94	23778	0.091	0.016
95	22248	0.108	0.019
96	22464	0.092	0.016
97	22752	0.096	0.017
98	22914	0.089	0.015
99	23184	0.082	0.014
100	23454	0.078	0.013
101	23634	0.083	0.014
102	20160	0.179	0.031
103	20430	0.180	0.031
104	20610	0.171	0.030
105	20718	0.158	0.027
106	21042	0.164	0.029
107	21240	0.157	0.027
108	21420	0.141	0.025
109	21564	0.154	0.027
110	21834	0.144	0.025
111	21978	0.138	0.024
112	22104	0.146	0.025
113	22302	0.133	0.023
114	22608	0.144	0.025
115	22824	0.134	0.023

116	22950	0.130	0.023
117	23202	0.139	0.024
118	23418	0.141	0.025
119	23490	0.135	0.023
120	23814	0.133	

0.023



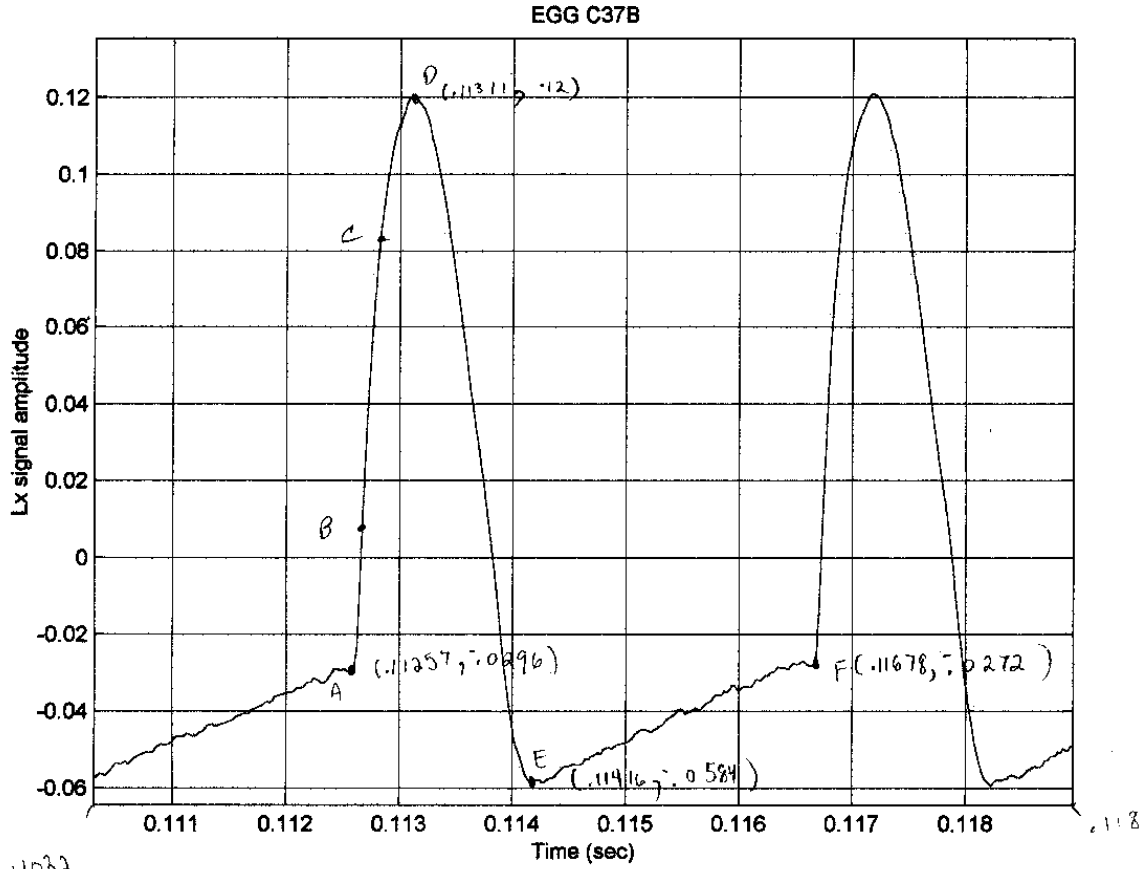
Stem plot/LPC overlay of harmonics for sample C37 without preemphasis



$x \Rightarrow 18.5\text{mm} = .001$

$y \Rightarrow 12.5\text{mm} = .02$

$u \Rightarrow 1\text{mm} = .0016$



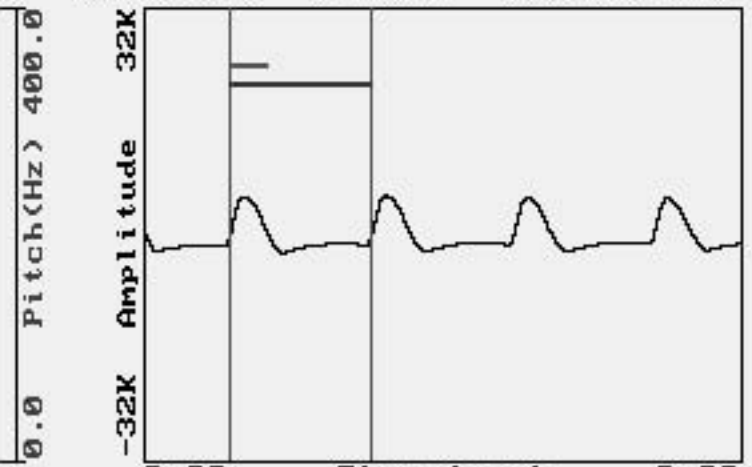
.11032

■A> : CH1: C37B\_E~1.NSP

< 0.00 sec 27.01% 209.00 Hz >



Duration 2.50 (sec)



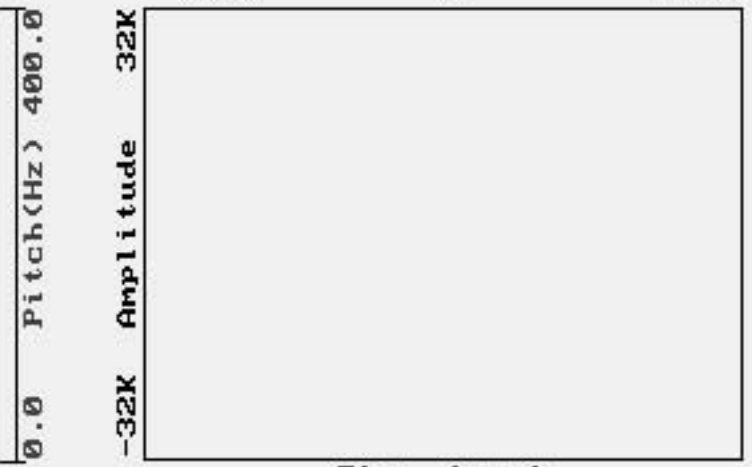
0.00 Pitch(Hz) 400.0

□B> :

< sec % Hz >



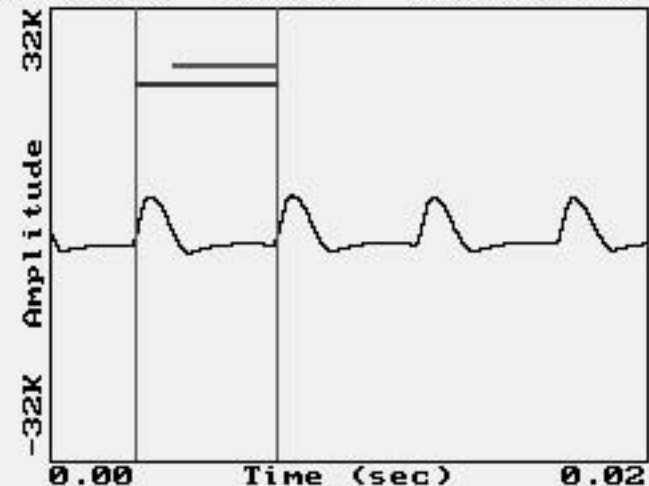
Duration 2.50 (sec)



Time (sec)

**A** > : CH1: C37B\_E~1.NSP

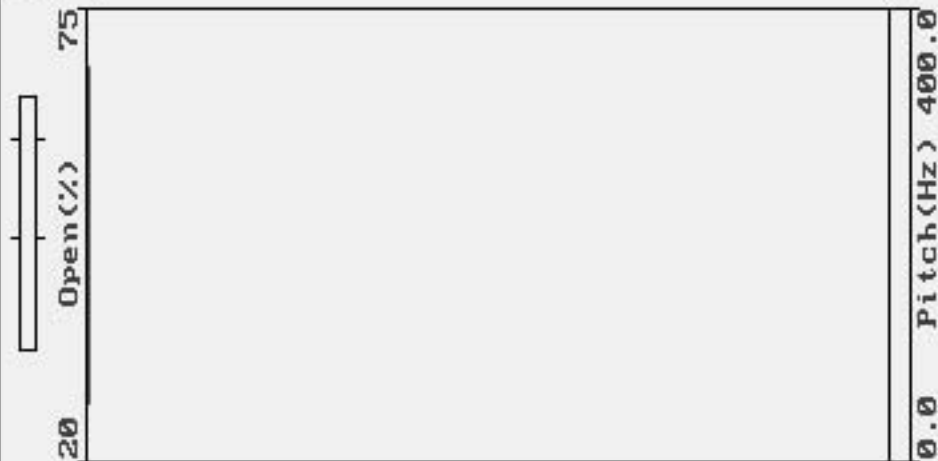
< 0.00 sec 72.98% 209.00 Hz >



Duration 2.50 (sec)

**B** > :

< sec % Hz >

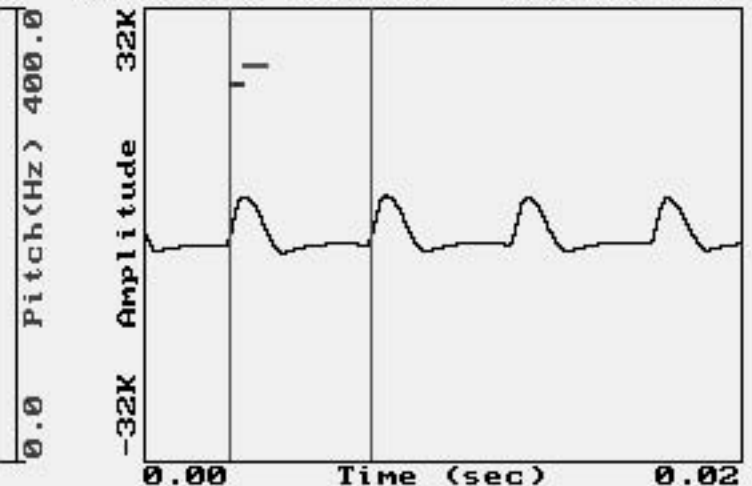
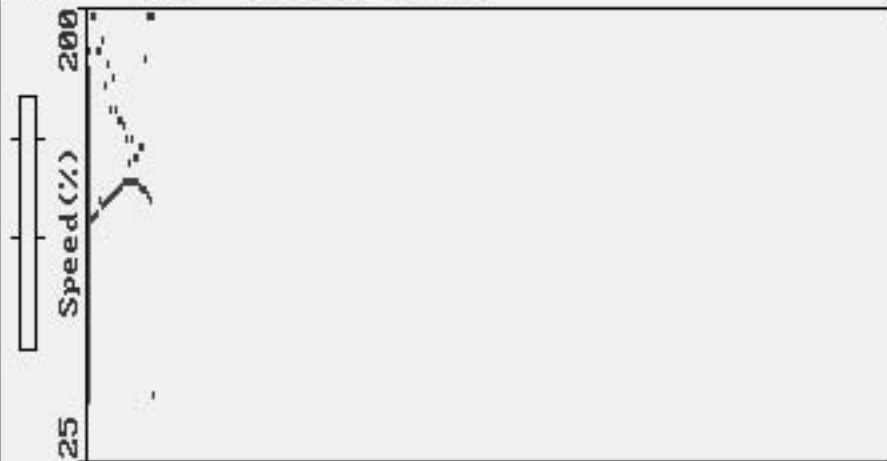


Duration 2.50 (sec)

Time (sec)

**A** > : CH1: C37B\_E~1.NSP

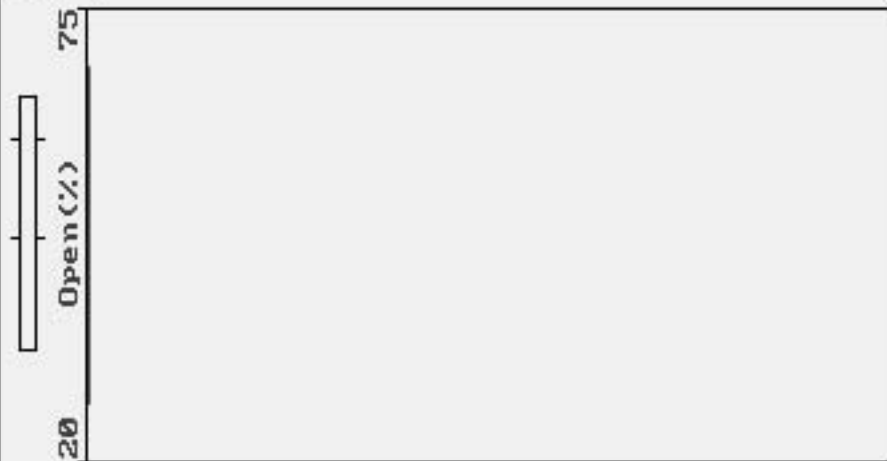
< 0.00 sec 185.00% 209.00 Hz >



Pitch(Hz) 400.0

**B** > :

< sec % Hz >



Pitch(Hz) 400.0

Sample #	C1	C11	C21	C31
Description	B3	E4	B4	B3(retake)
Data Rate (Hz)	44100	44100	44100	44100
DURATION (sec)	1.04	0.21	0.21	0.34
Start time	0	0	0	0
End time	1.04	0.21	0.21	0.34
Silence	0	0	0	0
Active	1.04	0.21	0.22	0.34
Data Points	45696	9472	9312	14848
Range	12116 (14 Bits)	6032 (13 Bits)	5004 (13 Bits)	17264 (15 Bits)
PITCH (Hz)				
Mean	205.16	290.11	417.89	204.59
Pitch Range	106.73	32.31	346.79	101.24
Minimum	103.27	265.66	81.36	106.77
Maximum	210	297.97	428.15	208.01
Std Deviation	7.29	4.58	36.23	11.96
Avg. Jitter %	0.38	0.69	1.93	0.64
CONTACT(1:6)%				
Mean	37.95	47.96	43.5	41.95
Range	33.88	12.79	42.26	40.72
Minimum	12.41	42.16	36.89	37.73
Maximum	46.29	54.95	79.15	78.45
Std Deviation	4.59	2.56	6.06	4.98
CONTACT(Tif)	46.29	47.33	38.46	38.31
SPEED(3:2)%				
Mean	189.67	217.77	156.29	307.83
Range	126.03	102.62	247.23	977.49
Minimum	114.7	150	5.39	218.51
Maximum	240.73	252.62	252.62	1196
Std Deviation	19.41	16.67	24.09	109.68
SPEED(Tif)	203.03	238.09	150	310
OPEN(4:6)%				
Mean	62.03	52.02	56.48	58.03
Range	33.88	12.8	42.26	40.72
Minimum	53.7	45.03	20.84	21.54
Maximum	87.58	57.83	63.1	62.26
Std Deviation	4.59	2.56	6.06	4.98
OPEN(Tif)	53.7	52.66	61.53	61.68

C37b  
deer  
44100  
0.21  
0  
0.21  
0  
0.22  
9072  
5667 (13 Bits)

230.51  
194.69  
53.06  
247.75  
28.58  
2.66

27.32  
25.14  
5.77  
30.91  
3.52  
27.01

172.42  
103.75  
140  
243.75  
26.92  
185

72.66  
25.14  
69.08  
94.22  
3.52  
72.98

Sample #	B1	B11	B21	B31	B40b
Description	Belt B4	Belt E4	Belt B4	Belt B4	Belt "here"
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.00941	0.00701	0.00491	0.00502	0.00823
Start time	0.10347	0.08099	0.17484	0.55817	0.01566
End time	0.11288	0.08800	0.17975	0.56319	0.02389
Pitch (1/t) Hz	210	292	415	418	242
Period (t) seconds	0.00476	0.00342	0.00241	0.00239	0.00414
Contacting time (cp) seconds	0.00218	0.00164	0.00156	0.00111	0.00242
Contacting Phase (ccp) seconds	0.00047	0.00051	0.00044	0.00035	0.00042
Decontacting Phase (cop) seconds	0.00171	0.00113	0.00112	0.00076	0.00200
Contact Quotient (cp/t) %	45.8%	48.0%	64.7%	46.4%	58.5%
Speed Quotient (cop/ccp)	3.64	2.22	2.55	2.17	4.76
Contact Index (ccp-cop/cp)	-0.57	-0.38	-0.44	-0.37	-0.65
Slope (25-75% of peak)	664	884	475	1136	1700
Slope (0-25% of peak)	664	522	594	413	744
Points					
xA	0.10594	0.08189	0.17534	0.55942	0.01674
yA	-0.02593	-0.04167	-0.04125	-0.02273	0.11600
xB	0.10600	0.08200	0.17540	0.55953	0.01682
yB	0.01389	0.01577	-0.00561	0.02273	0.17550
xC	0.10612	0.08213	0.17555	0.55961	0.01689
yC	0.09352	0.13066	0.06569	0.11364	0.29450
xD	0.10641	0.08240	0.17578	0.55977	0.01716
yD	0.13333	0.18810	0.10133	0.15909	0.35400
xE	0.10812	0.08353	0.17690	0.56053	0.01916
yE	-0.07778	-0.05952	-0.04667	-0.07273	0.09600
xF	0.11070	0.08531	0.17775	0.56181	0.02088
yF	-0.03150	-0.03810	-0.04267	-0.01932	0.08800
Peak height	0.15926	0.22977	0.14258	0.18182	0.23800
25% of peak height	0.03982	0.05744	0.03565	0.04546	0.05950
75% of peak height	0.11945	0.17233	0.10694	0.13637	0.17850

B40c	B40d	B41b	B45b
Belt "honey"	Belt "every"	Belt "mean"	Belt "mean"
44100	44100	44100	44100
0.00751	0.00672	0.00960	0.00808
0.01692	0.20745	0.05876	0.06174
0.02443	0.21417	0.06836	0.06982
271	293	211	242
0.00369	0.00341	0.00473	0.00413
0.00267	0.00226	0.00218	0.00234
0.00050	0.00077	0.00055	0.00049
0.00217	0.00149	0.00163	0.00185
72.4%	66.3%	46.1%	56.7%
4.34	1.94	2.96	3.78
-0.63	-0.32	-0.50	-0.58
528	486	484	487
377	216	605	305
0.01762	0.20821	0.05900	0.06238
-0.03641	-0.13538	-0.06012	-0.02750
0.01769	0.20830	0.05906	0.06246
-0.01000	-0.11596	-0.02384	-0.00313
0.01779	0.20838	0.05921	0.06256
0.04282	-0.07711	0.04872	0.04563
0.01812	0.20898	0.05955	0.06287
0.06923	-0.05769	0.08500	0.07000
0.02029	0.21047	0.06118	0.06472
-0.03795	-0.14308	-0.05286	-0.02250
0.02131	0.21162	0.06373	0.06651
-0.03385	-0.13654	-0.06571	-0.02750
0.10564	0.07769	0.14512	0.09750
0.02641	0.01942	0.03628	0.02438
0.07923	0.05827	0.10884	0.07313

Sample #	C1	C11	C21	C31	C37B
Description	Country	Country	Country	Country	Country
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.00990	0.00705	0.01063	0.00975	0.00863
Start time	0.47119	0.08490	0.08160	0.09406	0.11032
End time	0.48109	0.09195	0.09223	0.10381	0.11895
Pitch (1/t) Hz	205	289	422	205	238
Period (t) seconds	0.00487	0.00346	0.00237	0.00487	0.00421
Contacting time (cp) seconds	0.00300	0.00223	0.00121	0.00246	0.00159
Contacting Phase (ccp) seconds	0.00087	0.00068	0.00050	0.00053	0.00054
Decontacting Phase (cop) seconds	0.00213	0.00155	0.00071	0.00193	0.00105
Contact Quotient (cp/t) %	61.6%	64.5%	51.1%	50.5%	37.8%
Speed Quotient (cop/ccp)	2.45	2.28	1.42	3.64	1.94
Contact Index (ccp-cop/cp)	-0.42	-0.39	-0.17	-0.57	-0.32
Slope (25-75% of peak)	942	569	465	1694	468
Slope (0-25% of peak)	864	427	552	1506	468
Points					
xA	0.47219	0.08577	0.08445	0.09638	0.11257
yA	-0.09375	-0.03333	-0.08000	-0.13684	-0.02960
xB	0.47231	0.08589	0.08453	0.09647	0.11265
yB	0.00990	0.01786	-0.03583	-0.00131	0.00780
xC	0.47253	0.08607	0.08472	0.09663	0.11281
yC	0.21719	0.12024	0.05250	0.26974	0.08260
xD	0.47306	0.08645	0.08495	0.09691	0.11311
yD	0.32083	0.17143	0.09667	0.40526	0.12000
xE	0.47519	0.08800	0.08566	0.09884	0.11416
yE	-0.12708	-0.07143	-0.01833	-0.21316	-0.05840
xF	0.47706	0.08923	0.08682	0.10125	0.11678
yF	-0.10417	-0.03333	-0.08750	-0.13684	-0.02720
Peak height	0.41458	0.20476	0.17667	0.54210	0.14960
25% of peak height	0.10365	0.05119	0.04417	0.13553	0.03740
75% of peak height	0.31094	0.15357	0.13250	0.40658	0.11220

Sample #	J1	J11	J21	J22	J33B
Description	Jazz	Jazz	Jazz	Jazz	Jazz
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.01030	0.00691	0.00513	0.00526	0.00867
Start time	0.28983	0.19248	0.37676	0.46482	0.19972
End time	0.30013	0.19939	0.38189	0.47008	0.20839
Pitch (1/t) Hz	210	289	431	408	242
Period (t) seconds	0.00477	0.00346	0.00232	0.00245	0.00414
Contacting time (cp) seconds	0.00254	0.00209	0.00131	0.00131	0.00161
Contacting Phase (ccp) seconds	0.00070	0.00063	0.00047	0.00040	0.00044
Decontacting Phase (cop) seconds	0.00184	0.00146	0.00084	0.00091	0.00117
Contact Quotient (cp/t) %	53.2%	60.4%	56.5%	53.5%	38.9%
Speed Quotient (cop/ccp)	2.63	2.32	1.79	2.27	2.66
Contact Index (ccp-cop/cp)	-0.45	-0.40	-0.28	-0.39	-0.45
Slope (25-75% of peak)	1244	901	2093	1370	493
Slope (0-25% of peak)	1244	819	1962	754	339
Points					
xA	0.29183	0.19291	0.37753	0.46552	0.20214
yA	-0.09268	-0.08542	-0.23333	-0.14000	0.02000
xB	0.29193	0.19302	0.37761	0.46562	0.20222
yB	0.03171	0.00469	-0.07639	-0.06464	0.04710
xC	0.29213	0.19322	0.37776	0.46573	0.20233
yC	0.28049	0.18490	0.23750	0.08607	0.10129
xD	0.29253	0.19354	0.37800	0.46592	0.20258
yD	0.40488	0.27500	0.39444	0.16143	0.12839
xE	0.29437	0.19500	0.37884	0.46683	0.20375
yE	-0.17805	-0.15000	-0.22778	-0.14000	-0.00645
xF	0.29660	0.19637	0.37985	0.46797	0.20628
yF	-0.09268	-0.07917	-0.23889	0.13429	0.02129
Peak height	0.49756	0.36042	0.62777	0.30143	0.10839
25% of peak height	0.12439	0.09011	0.15694	0.07536	0.02710
75% of peak height	0.37317	0.27032	0.47083	0.22607	0.08129

J33B2 Jazz	J38B1 Jazz	J38B2 Jazz
44100	44100	44100
0.00886	0.00662	0.00728
0.05364	0.08327	0.07644
0.06250	0.08989	0.08372
236	322	283
0.00423	0.00311	0.00353
0.00250	0.00202	0.00195
0.00061	0.00052	0.00051
0.00189	0.00150	0.00144
59.1%	65.0%	55.2%
3.10	2.88	2.82
-0.51	-0.49	-0.48
1286	456	592
818	332	461
0.05533	0.08406	0.07747
-0.12333	0.04593	-0.07750
0.05544	0.08417	0.07756
-0.03333	0.08241	-0.03604
0.05558	0.08433	0.07770
0.14667	0.15537	0.04687
0.05594	0.08458	0.07798
0.23667	0.19185	0.08833
0.05783	0.08608	0.07942
-0.14333	0.04000	0.08917
0.05956	0.08717	0.08100
-0.12333	0.04370	-0.07667
0.36000	0.14592	0.16583
0.09000	0.03648	0.04146
0.27000	0.10944	0.12437

Sample #	L1	L12	L2	L22	L34b
Description	Legit B4	Legit E4	Legit B4	Legit B4	Legit 'years'
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.01038	0.00752	0.00972	0.00523	0.00469
Start time	0.28265	0.39238	0.14269	0.28467	0.80443
End time	0.29303	0.39990	0.15241	0.28990	0.80912
Pitch (1/t) Hz	207	276	211	424	385
Period (t) seconds	0.00484	0.00362	0.00475	0.00236	0.00260
Contacting time (cp) seconds	0.00207	0.00139	0.00197	0.00118	0.00117
Contacting Phase (ccp) seconds	0.00054	0.00048	0.00057	0.00043	0.00037
Decontacting Phase (cop) seconds	0.00153	0.00091	0.00140	0.00075	0.00080
Contact Quotient (cp/t) %	42.8%	38.4%	41.5%	50.0%	45.0%
Speed Quotient (cop/ccp)	2.83	1.92	2.46	1.74	2.16
Contact Index (ccp-cop/cp)	-0.48	-0.32	-0.42	-0.27	-0.37
Slope (25-75% of peak)	1137	1517	742	583	723
Slope (0-25% of peak)	1868	759	954	467	723
Points					
xA	0.28503	0.39390	0.14431	0.28567	0.80513
yA	-0.07692	-0.06912	-0.04219	-0.07167	0.01364
xB	0.28510	0.39401	0.14438	0.28577	0.80518
yB	0.05385	0.01434	0.02461	-0.02500	0.04978
xC	0.28533	0.39412	0.14456	0.28593	0.80528
yC	0.31538	0.18125	0.15820	0.06833	0.12205
xD	0.28557	0.39438	0.14488	0.28610	0.80550
yD	0.44615	0.26471	0.22500	0.11500	0.15818
xE	0.28710	0.39529	0.14628	0.28685	0.80630
yE	-0.12308	-0.08235	-0.09375	-0.05417	-0.01000
xF	0.28987	0.39752	0.14906	0.28803	0.80773
yF	-0.07949	-0.06618	-0.04688	-0.07167	0.01545
Peak height	0.52307	0.33383	0.26719	0.18667	0.14454
25% of peak height	0.13077	0.08346	0.06680	0.04667	0.03614
75% of peak height	0.39230	0.25037	0.20039	0.14000	0.10841

L35b	L35b2
Legit 'deer'	Legit 'deer'
44100	44100
0.00658	0.00661
0.05517	0.06204
0.06175	0.06865
299	295
0.00335	0.00339
0.00208	0.00124
0.00058	0.00039
0.00150	0.00085
62.1%	36.6%
2.59	2.18
-0.44	-0.37
309	474
248	474
0.05580	0.06293
-0.26600	-0.03895
0.05590	0.06298
-0.24125	-0.01527
0.05606	0.06308
-0.19175	0.03211
0.05638	0.06332
-0.16700	0.05579
0.05788	0.06417
-0.26350	-0.05474
0.05915	0.06632
-0.26650	-0.03316
0.09900	0.09474
0.02475	0.02369
0.07425	0.07106

Sample #	O11	O21	O31	O44B
Description	Opera B4	Opera E4	Opera B5	Opera "rebound"
Data Rate (Hz)	44100	44100	44100	44100
DURATION (sec)	0.00969	0.00720	0.00510	0.00969
Start time	0.16875	0.07050	0.40970	0.16875
End time	0.17844	0.07770	0.41480	0.17844
Pitch (1/t) Hz	204	282	402	400
Period (t) seconds	0.00490	0.00354	0.00249	0.00250
Contacting time (cp) seconds	0.00260	0.00172	0.00129	0.00128
Contacting Phase (ccp) seconds	0.00068	0.00054	0.00060	0.00042
Decontacting Phase (cop) seconds	0.00192	0.00118	0.00069	0.00086
Contact Quotient (cp/t) %	53.1%	48.6%	51.8%	51.2%
Speed Quotient (cop/ccp)	2.82	2.19	1.15	2.05
Contact Index (ccp-cop/cp)	-0.48	-0.37	-0.07	-0.34
Slope (25-75% of peak)	1842	1842	2489	1235
Slope (0-25% of peak)	921	1346	1089	617
Points				
xA	0.16970	0.07073	0.40990	0.04500
yA	-0.21050	-0.22500	-0.21600	-0.08900
xB	0.16990	0.07086	0.41006	0.04510
yB	-0.02630	-0.05000	-0.04175	-0.02725
xC	0.17010	0.07105	0.41020	0.04520
yC	0.34210	0.30000	0.30675	0.09625
xD	0.17038	0.07127	0.41050	0.04542
yD	0.52630	0.47500	0.48100	0.15800
xE	0.17230	0.07245	0.41119	0.04628
yE	-0.21050	-0.10000	-0.21600	-0.08900
xF	0.17460	0.07427	0.41239	0.04750
yF	-0.21050	-0.22500	-0.21600	-0.08900
Peak height	0.73680	0.70000	0.69700	0.24700
25% of peak height	0.18420	0.17500	0.17425	0.06175
75% of peak height	0.55260	0.52500	0.52275	0.18525



Sample #	P1	P12	P22	P33b	P39b
Description	Pop B3	Pop E4	Pop B4	Pop "we"	Pop 'he'
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.01027	0.00764	0.00500	0.00559	0.00648
Start time	0.33520	0.25502	0.08850	0.08704	0.06973
End time	0.34547	0.26266	0.09350	0.09263	0.07621
Pitch (1/t) Hz	202	299	405	351	324
Period (t) seconds	0.00494	0.00334	0.00247	0.00285	0.00309
Contacting time (cp) seconds	0.00304	0.00181	0.00095	0.00158	0.00109
Contacting Phase (ccp) seconds	0.00094	0.00056	0.00034	0.00049	0.00042
Decontacting Phase (cop) seconds	0.00210	0.00125	0.00061	0.00109	0.00067
Contact Quotient (cp/t) %	61.5%	54.2%	38.5%	55.4%	35.3%
Speed Quotient (cop/ccp)	2.23	2.23	1.79	2.22	1.60
Contact Index (ccp-cop/cp)	-0.38	-0.38	-0.28	-0.38	-0.23
Slope (25-75% of peak)	344	455	758	1042	1420
Slope (0-25% of peak)	377	650	337	625	2308
Points					
xA	0.33683	0.25617	0.08947	0.08733	0.07104
yA	-0.05652	-0.02660	-0.05125	0.14714	0.03077
xB	0.33697	0.25624	0.08956	0.08743	0.07108
yB	-0.00489	0.01888	-0.02094	0.20964	0.12308
xC	0.33727	0.25644	0.08964	0.08755	0.07121
yC	0.09837	0.10984	0.03969	0.33464	0.30769
xD	0.33777	0.25673	0.08981	0.08782	0.07146
yD	0.15000	0.15532	0.07000	0.39714	0.40000
xE	0.33987	0.25798	0.09042	0.08891	0.07213
yE	-0.08696	-0.05000	-0.01875	0.12000	-0.01731
xF	0.34177	0.25951	0.09194	0.09018	0.07413
yF	-0.05435	-0.02340	-0.05125	0.14429	0.02885
Peak height	0.20652	0.18192	0.12125	0.25000	0.36923
25% of peak height	0.05163	0.04548	0.03031	0.06250	0.09231
75% of peak height	0.15489	0.13644	0.09094	0.18750	0.27692

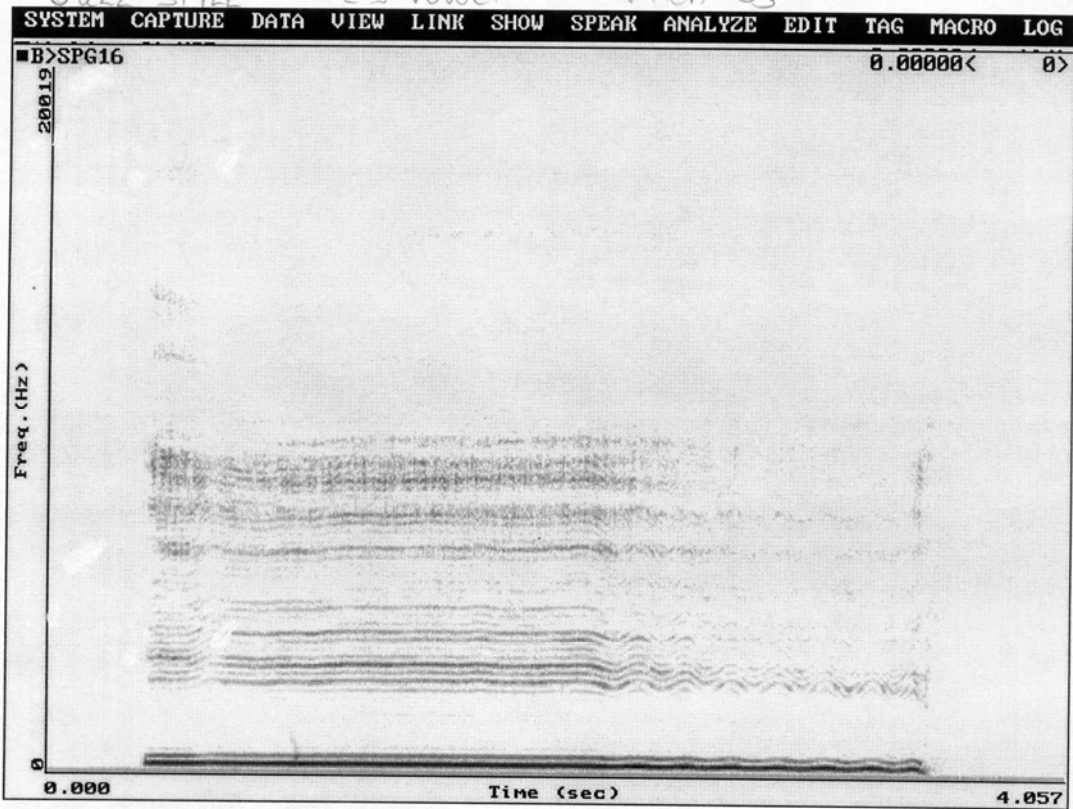
Sample #	R1	R11	R21	R31B	R37B
Description	R&B B4	R&B	R&B	R&B	R&B
Data Rate (Hz)	44100	44100	44100	44100	44100
DURATION (sec)	0.00981	0.00698	0.00638	0.00906	0.00622
Start time	0.12600	0.25551	0.07109	0.03957	0.04890
End time	0.13581	0.26249	0.07747	0.04863	0.05512
Pitch (1/t) Hz	212	292	427	231	313
Period (t) seconds	0.00472	0.00342	0.00234	0.00432	0.00320
Contacting time (cp) seconds	0.00244	0.00142	0.00106	0.00149	0.00167
Contacting Phase (ccp) seconds	0.00069	0.00049	0.00045	0.00054	0.00047
Decontacting Phase (cop) seconds	0.00175	0.00093	0.00061	0.00095	0.00120
Contact Quotient (cp/t) %	51.7%	41.5%	45.3%	34.5%	52.2%
Speed Quotient (cop/ccp)	2.54	1.90	1.36	1.76	2.55
Contact Index (ccp-cop/cp)	-0.43	-0.31	-0.15	-0.28	-0.44
Slope (25-75% of peak)	1939	859	553	697	638
Slope (0-25% of peak)	2046	1146	645	485	478
Points					
xA	0.12722	0.25647	0.07404	0.04197	0.04955
yA	-0.19000	-0.05000	-0.05037	-0.00121	-0.02769
xB	0.12731	0.25653	0.07410	0.04209	0.04963
yB	-0.00583	0.01875	-0.01167	0.05702	0.01058
xC	0.12750	0.25669	0.07424	0.04226	0.04975
yC	0.36250	0.15625	0.06574	0.17348	0.08711
xD	0.12791	0.25696	0.07449	0.04251	0.05002
yD	0.54667	0.22500	0.10444	0.23171	0.12538
xE	0.12966	0.25789	0.07510	0.04346	0.05122
yE	-0.21667	-0.03824	-0.06296	-0.03537	-0.03077
xF	0.13194	0.25989	0.07638	0.04629	0.05275
yF	-0.19333	-0.04412	-0.04889	-0.00610	-0.02385
Peak height	0.73667	0.27500	0.15481	0.23292	0.15307
25% of peak height	0.18417	0.06875	0.03870	0.05823	0.03827
75% of peak height	0.55250	0.20625	0.11611	0.17469	0.11480

Sample #	SPK7
Description	[i] vowel
Data Rate (Hz)	44100
DURATION (sec)	0.01200
Start time	0.02200
End time	0.03400
Pitch (1/t) Hz	161
Period (t) seconds	0.00620
Contacting time (cp) seconds	0.00380
Contacting Phase (ccp) seconds	0.00060
Decontacting Phase (cop) seconds	0.00320
Contact Quotient (cp/t) %	61.29%
Speed Quotient (cop/ccp)	5.33
Contact Index (ccp-cop/cp)	-0.68
Slope (25-75% of peak)	2190
Slope (0-25% of peak)	1205
Points	
xA	0.02380
yA	-0.15000
xB	0.02390
yB	-0.02955
xC	0.02401
yC	0.21135
xD	0.02440
yD	0.33180
xE	0.02760
yE	-0.15000
xF	0.03000
yF	-0.14000
Peak height	0.48180
25% of peak height	0.12045
75% of peak height	0.36135

Jazz style

[i] vowel

Pitch B3

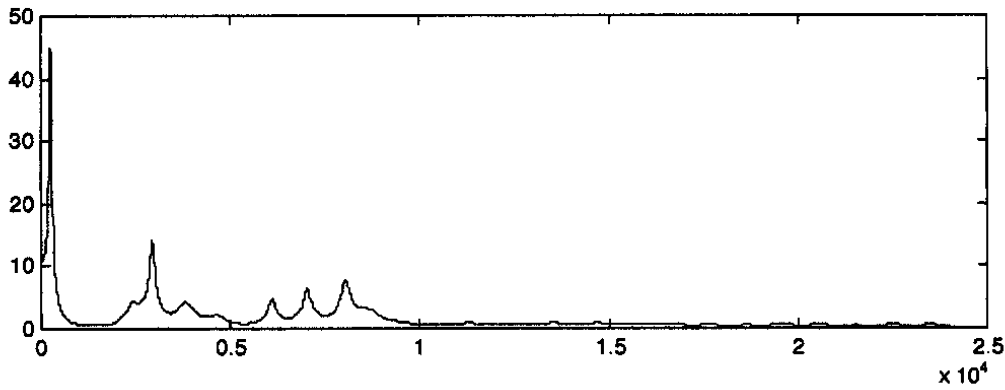
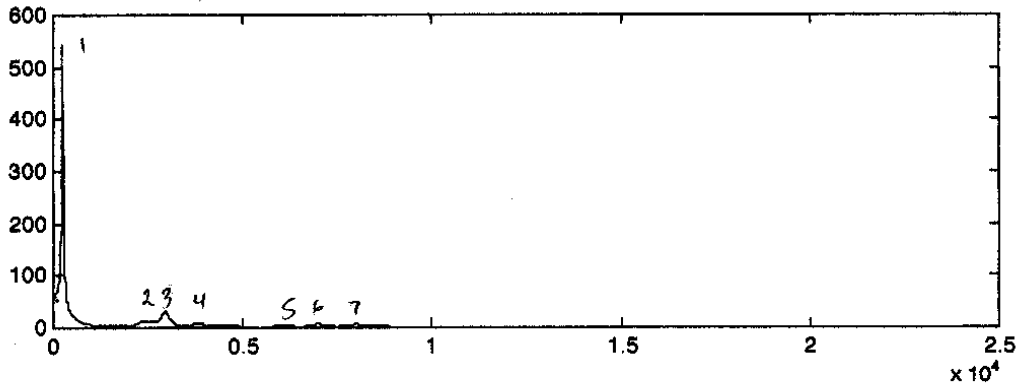


LPC Results from running the whole sample of J1

J1

$$F_0 = 228 \text{ Hz}$$

- 1) 234.37, 542.60
- 2) 2430.00, 13.35
- 3) 2941.50, 33.40
- 4) 3855.60, 8.32
- 5) 6070.31, 5.70
- 6) 7007.80, 6.67
- 7) 8027.3, 7.00

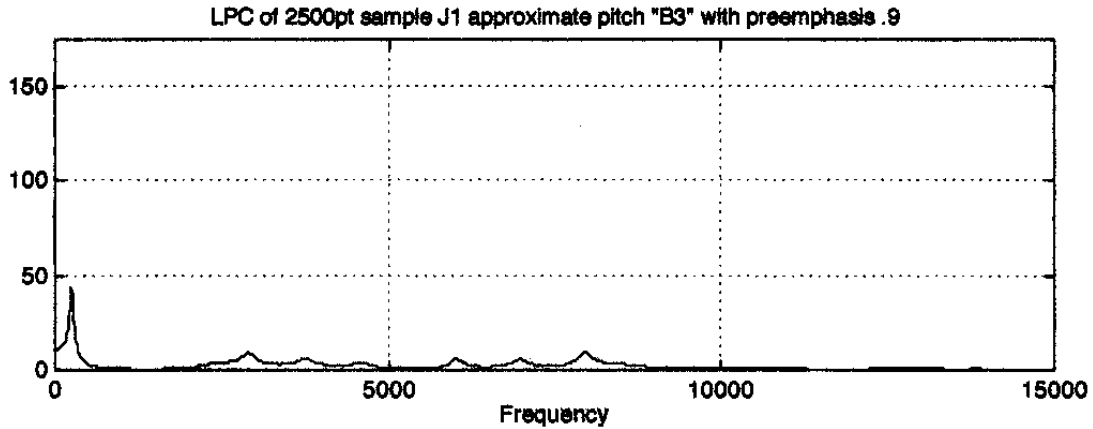
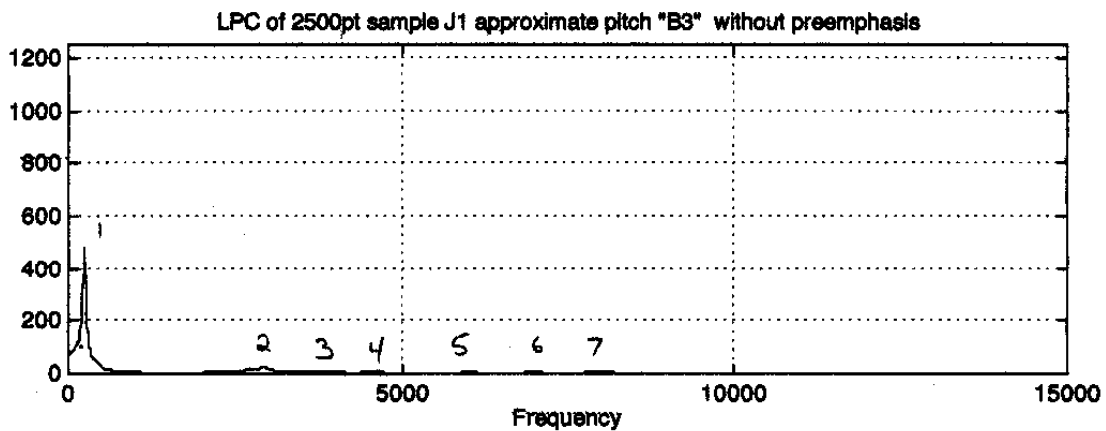


$$.15145833 - .015729167 = .135729163 / 31$$

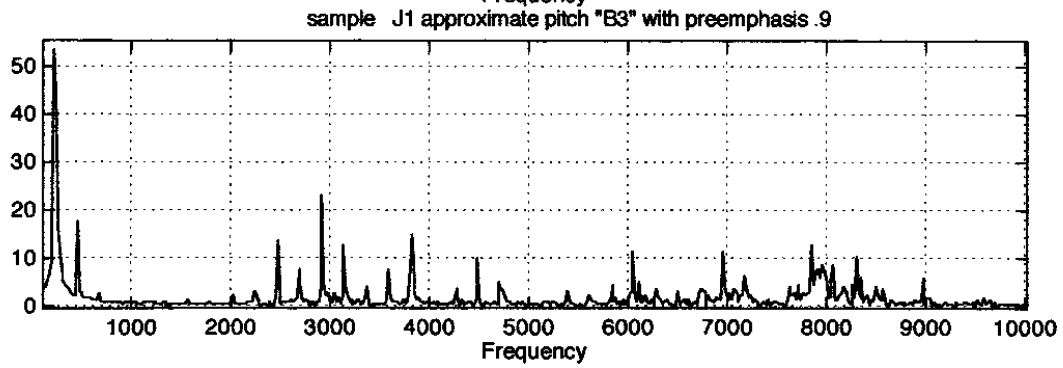
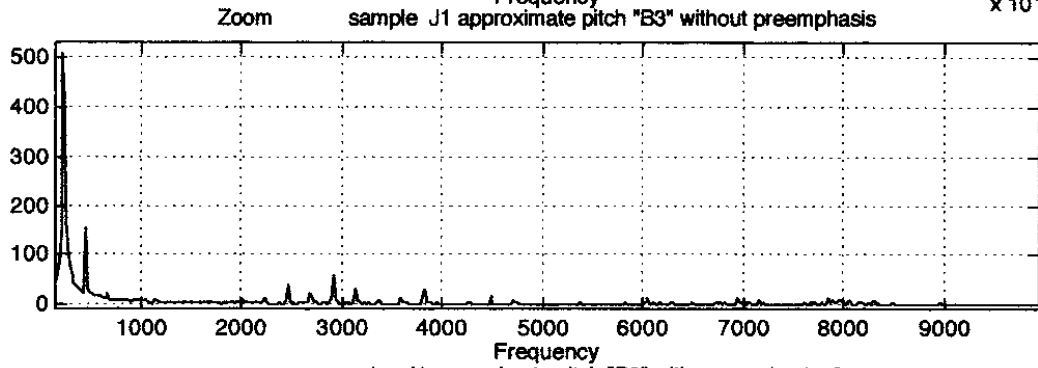
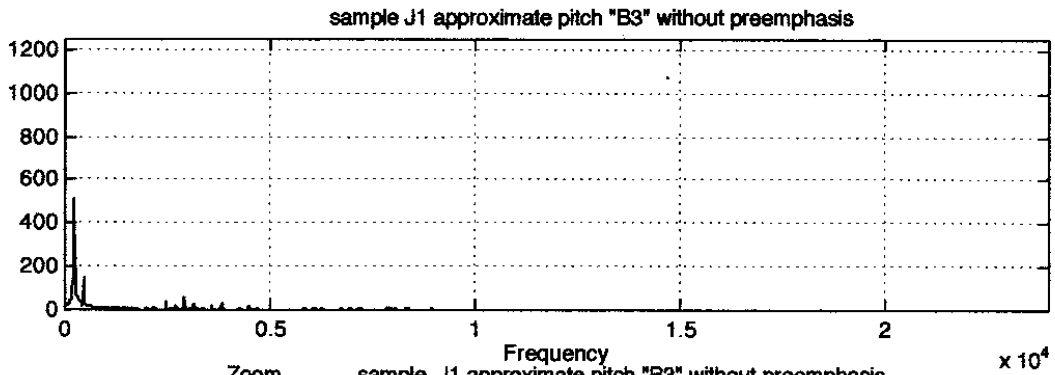
$$= .00437836$$

$$228.3960154$$

(234.75, 484.35)  
(2918.46, 22.92)  
(3783.15, 11.50)  
(4617.15, 5.89)  
(6023.45, 7.85)  
(6984.37, 6.50)  
(7957.03, 9.95)



# DFT Results of J1



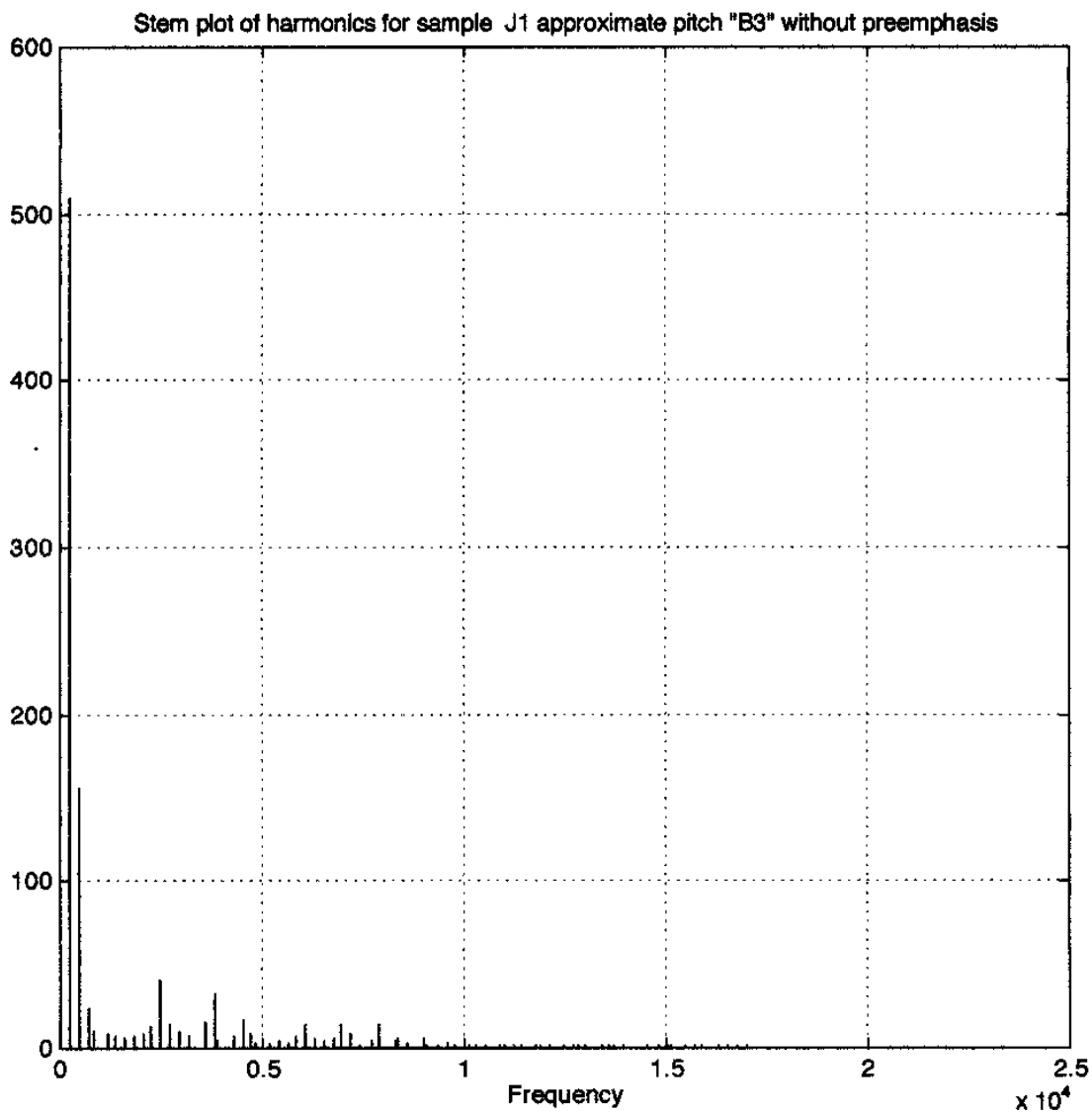
# DFT Numerical Results

Worksheet saved into file: Minitab.J1  
 MTB > Print 'Freq' 'Amp' '% Amp'.

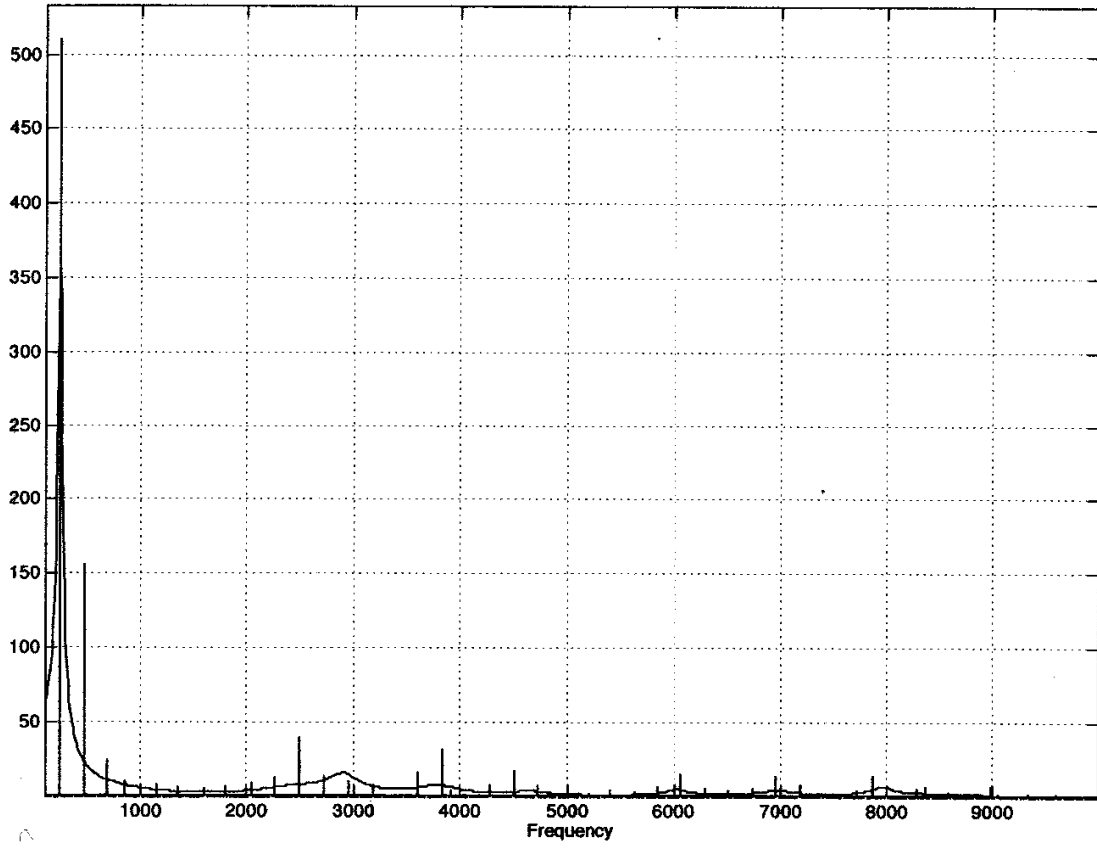
ROW	Freq	Amp	% Amp	
1	234	509.974	100.000	← good tracking
2	468	155.766	30.544	
3	684	24.184	4.742	
4	846	9.982	1.957	
5	1152	8.424	1.652	
6	1350	7.252	1.422	
7	1602	5.970	1.171	
8	1800	6.846	1.343	
9	2034	8.719	1.710	
10	2250	12.691	2.488	
11	2484	40.710	7.983	← lower than speech
12	2718	13.636	2.674	speech
13	2952	10.495	2.058	
14	3186	7.355	1.442	
15	3600	16.059	3.149	
16	3834	32.265	6.327	← not in speech SF?
17	3906	4.751	0.932	
18	4284	7.469	1.465	speech
19	4500	17.067	3.347	←
20	4716	8.284	1.624	
21	4824	2.413	0.473	
22	5202	2.287	0.448	
23	5400	4.797	0.941	speech
24	5634	2.832	0.555	
25	5850	6.537	1.282	
26	6066	14.534	2.850	←
27	6300	5.581	1.094	
28	6516	4.059	0.796	speech
29	6750	5.443	1.067	
30	6966	13.826	2.711	←
31	7182	7.799	1.529	
32	7416	2.116	0.415	
33	7722	4.861	0.953	
34	7866	14.225	2.789	←
35	8280	4.952	0.971	← speech is real
36	8370	6.092	1.195	←
37	8586	3.205	0.628	
38	8982	6.291	1.234	←
39	9036	1.717	0.337	
40	9324	1.547	0.303	
41	9594	2.286	0.448	
42	9774	1.100	0.216	
43	10098	1.527	0.299	
44	10314	1.284	0.252	
45	10548	1.045	0.205	
46	10854	1.031	0.202	
47	10998	1.594	0.313	
48	11214	1.079	0.212	
49	11412	0.905	0.177	
50	11790	0.952	0.187	
51	11880	0.863	0.169	
52	12114	1.046	0.205	
53	12474	0.895	0.176	
54	12690	1.614	0.316	
55	12798	1.750	0.343	

56	13014	1.041	0.204
57	13392	0.888	0.174
58	13608	0.957	0.188
59	13716	0.939	0.184
60	13950	0.946	0.185
61	14346	0.701	0.137
62	14544	0.878	0.172
63	14814	0.830	0.163
64	15030	0.799	0.157
65	15138	0.784	0.154
66	15480	0.850	0.167
67	15696	0.814	0.160
68	15858	0.738	0.145
69	16200	0.693	0.136
70	16290	0.835	0.164
71	16524	0.744	0.146
72	16794	0.793	0.156
73	16992	0.708	0.139
74	17244	0.666	0.131
75	17550	0.642	0.126
76	17838	0.629	0.123
77	18054	0.635	0.125
78	18216	0.646	0.127
79	18414	0.617	0.121
80	18720	0.627	0.123
81	19008	0.611	0.120
82	19152	0.631	0.124
83	19368	0.639	0.125
84	19566	0.628	0.123
85	19980	0.591	0.116
86	20142	0.601	0.118
87	20322	0.573	0.112
88	20520	0.575	0.113
89	20772	0.598	0.117
90	21078	0.580	0.114
91	21204	0.610	0.120
92	21582	0.583	0.114
93	21690	0.588	0.115
94	22032	0.614	0.120
95	22302	0.557	0.109
96	22554	0.583	0.114
97	22752	0.556	0.109
98	22986	0.569	0.112
99	23094	0.571	0.112
100	23490	0.559	0.110
101	23670	0.547	0.107
102	20160	0.179	0.035
103	20430	0.180	0.035
104	20610	0.171	0.034
105	20718	0.158	0.031
106	21042	0.164	0.032
107	21240	0.157	0.031
108	21420	0.141	0.028
109	21564	0.154	0.030
110	21834	0.144	0.028
111	21978	0.138	0.027
112	22104	0.146	0.029
113	22302	0.133	0.026
114	22608	0.144	0.028
115	22824	0.134	0.026

116	22950	0.130	0.025
117	23202	0.139	0.027
118	23418	0.141	0.028
119	23490	0.135	0.026
120	23814	0.133	0.026



Stem plot/LPC overlay of harmonics for sample J1 without preemphasis

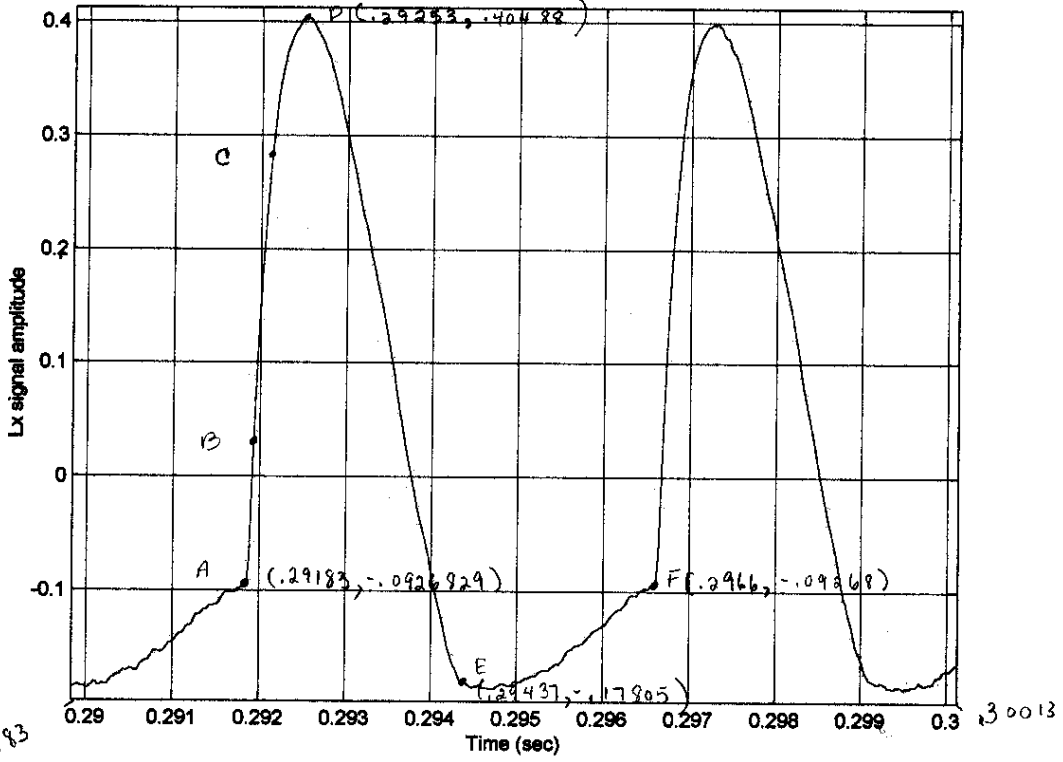


$x \Rightarrow 15\text{mm} = .001$

$y \Rightarrow 20.5\text{m} = .1$

$y \Rightarrow 1\text{m} = .004878$

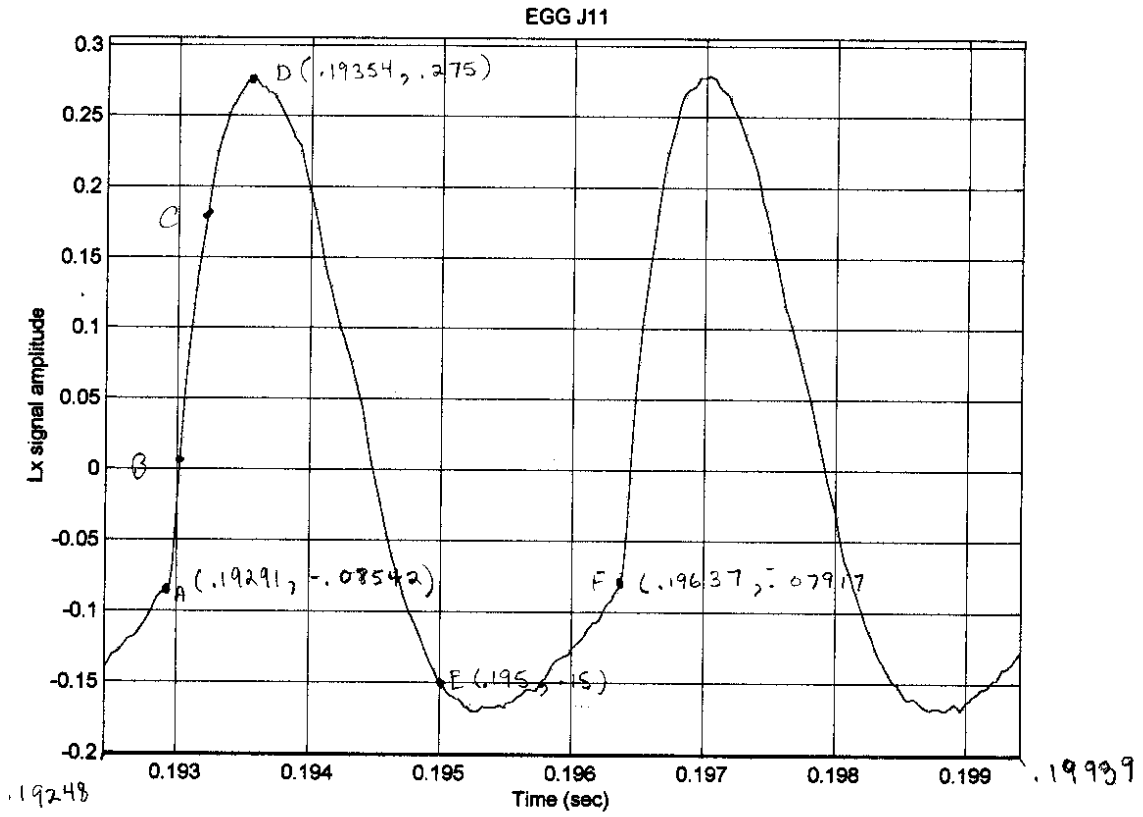
EGG J1



$x \Rightarrow 23 \text{ mm} = .001$

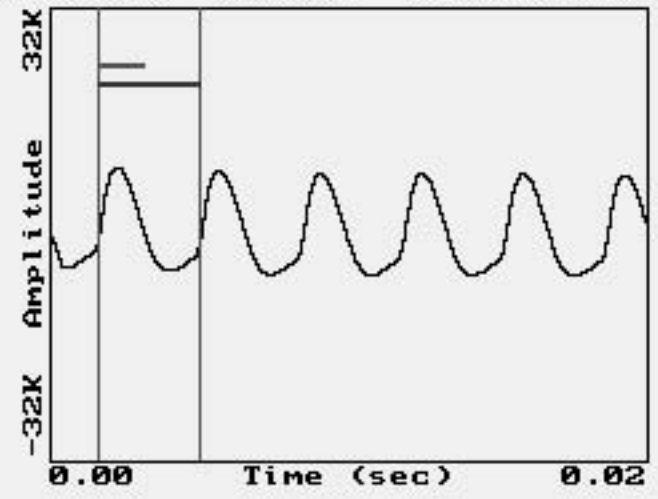
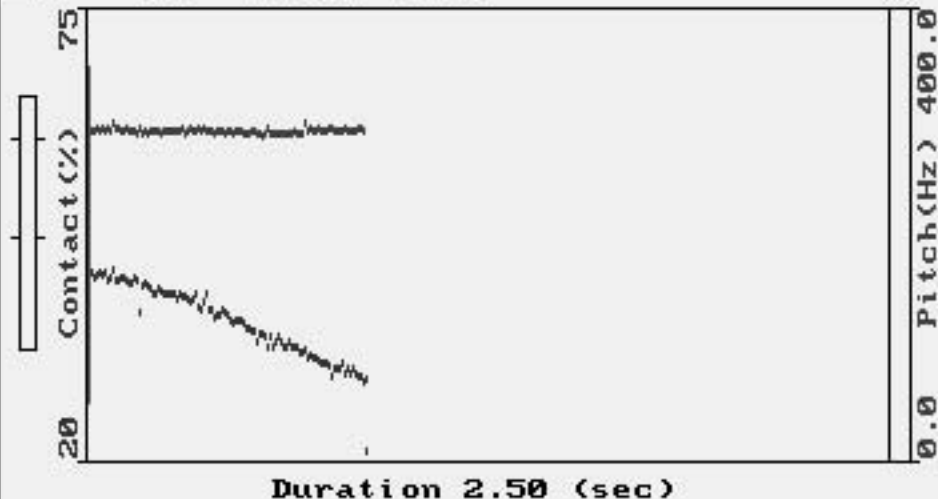
$y \Rightarrow 12 \text{ mm} = .05$

$z \Rightarrow 1 \text{ mm} = .0041666$



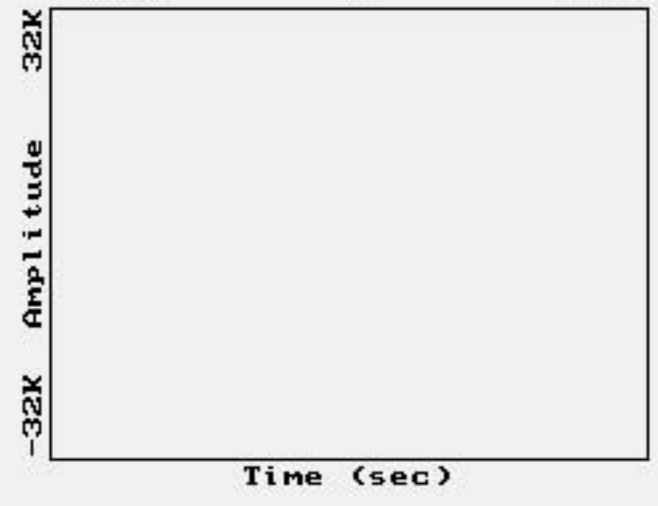
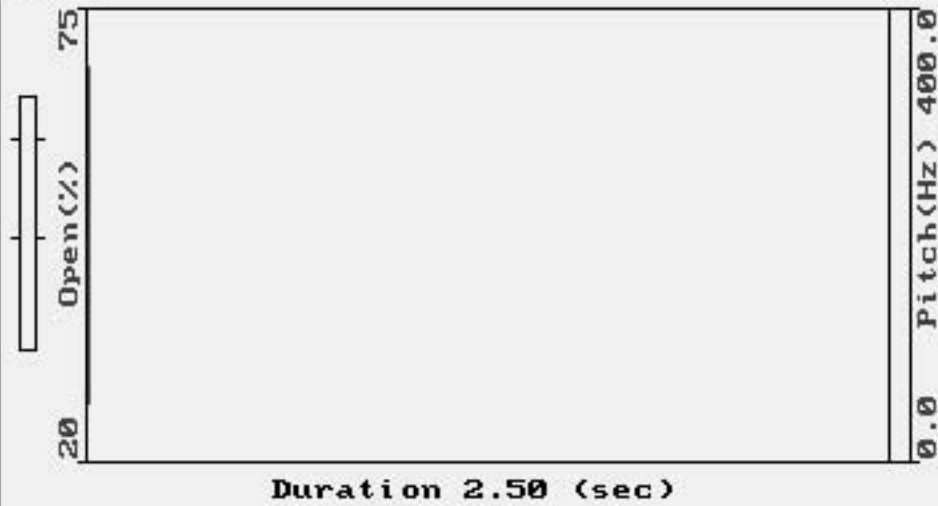
■A> : CH1: J11\_EG~1.NSP

< 0.00 sec 45.39% 290.13 Hz >



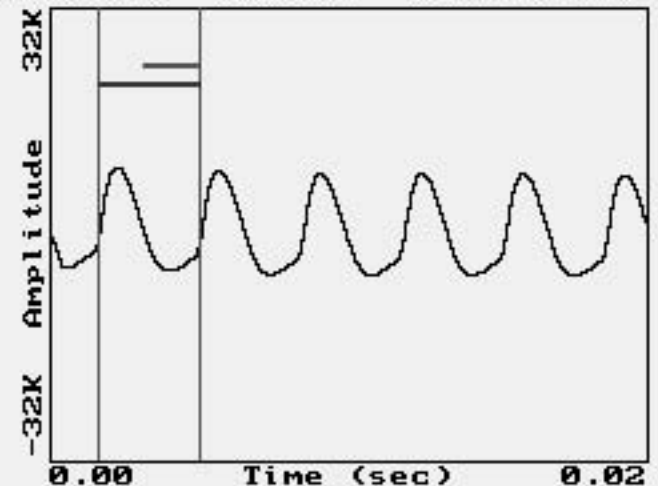
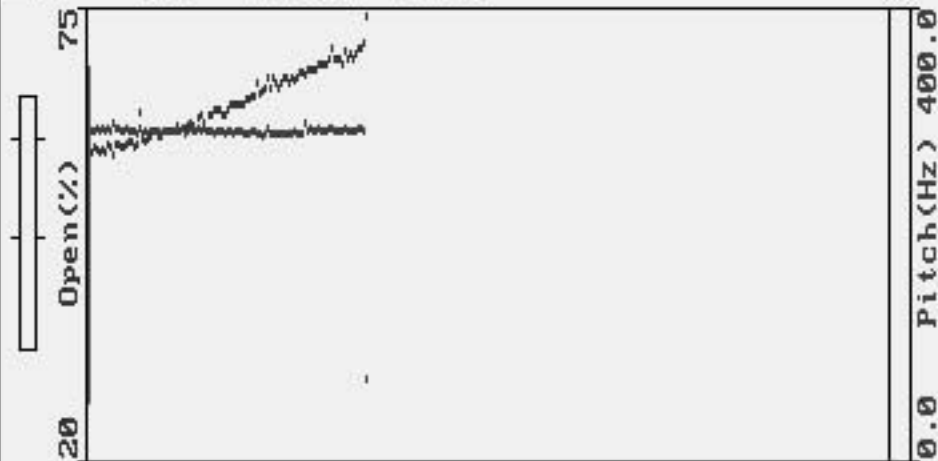
□B> :

< sec % Hz >



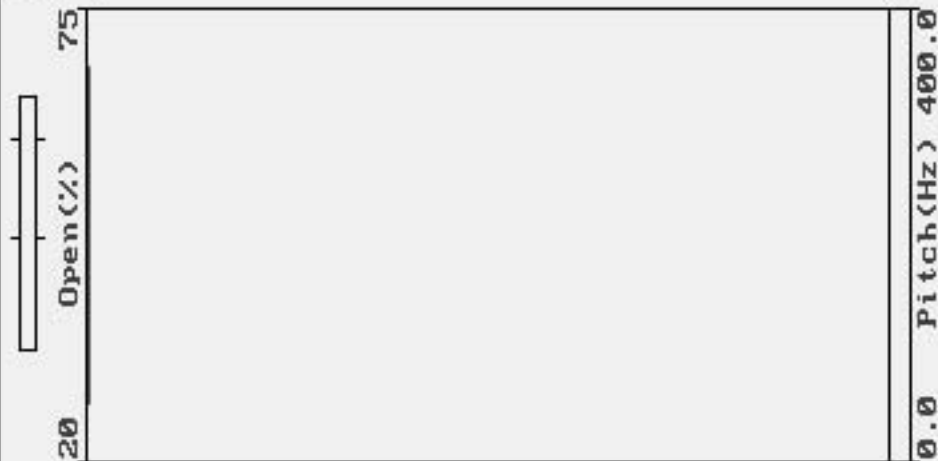
**A** > : CH1: J11\_EG~1.NSP

< 0.00 sec 54.60% 290.13 Hz >



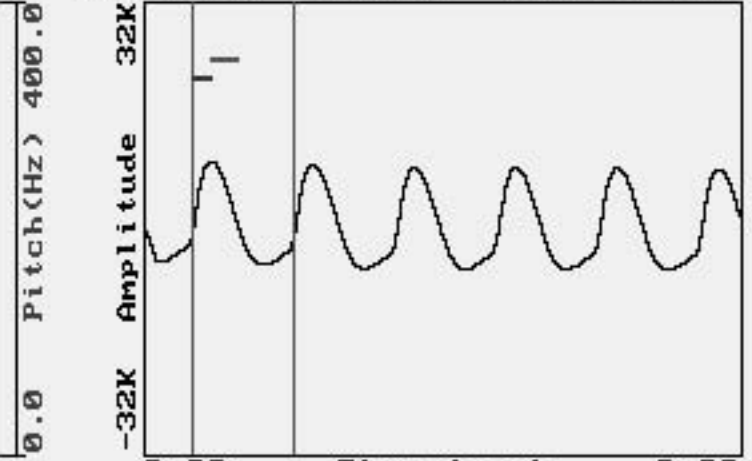
**B** > :

< sec % Hz >



**A** > : CH1: J11\_EG~1.NSP

< 0.00 sec 155.55% 290.13 Hz >

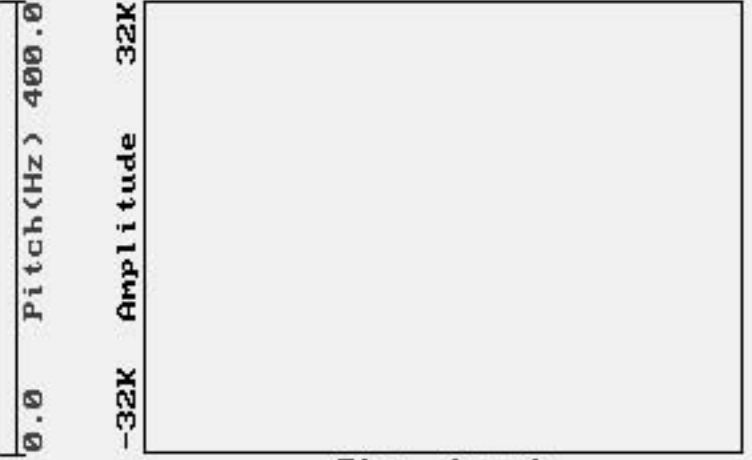


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >

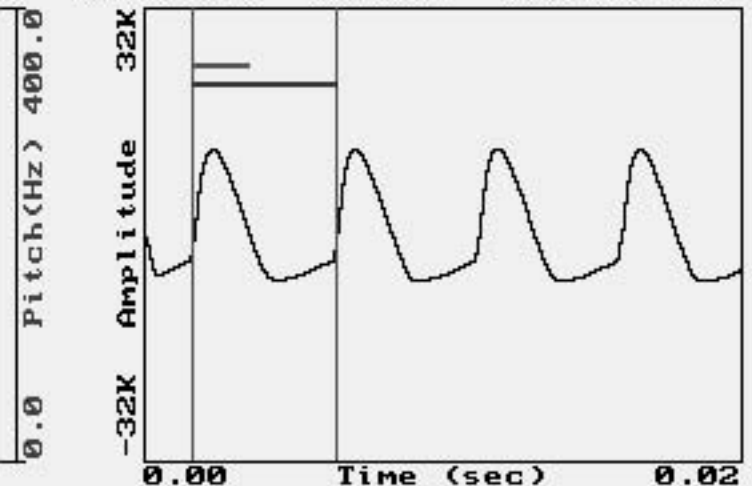
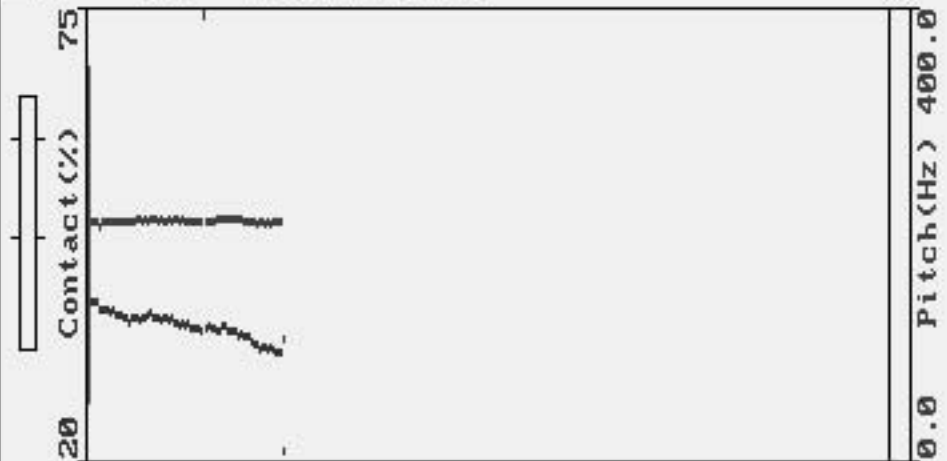


Duration 2.50 (sec)

Pitch(Hz) 400.0

**A** > : CH1: J1\_EGGST.NSP

< 0.00 sec 38.38% 209.00 Hz >

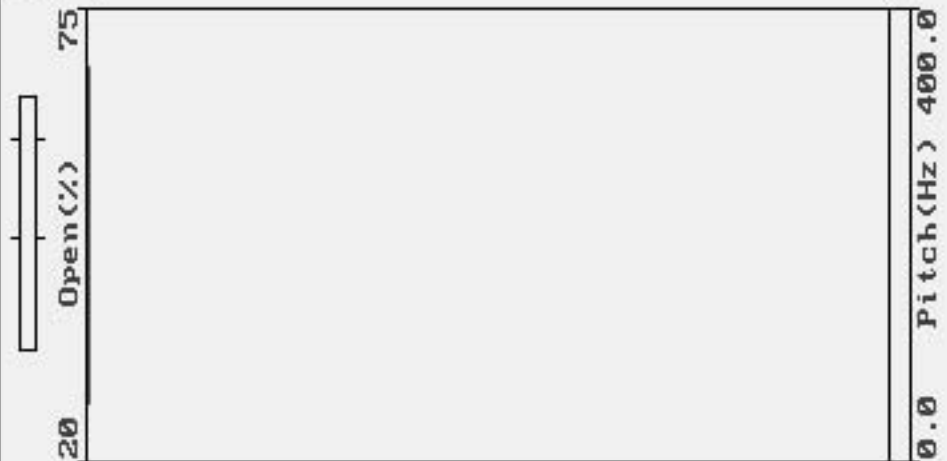


Duration 2.50 (sec)

0.00 Time (sec) 0.02

**B** > :

< sec % Hz >

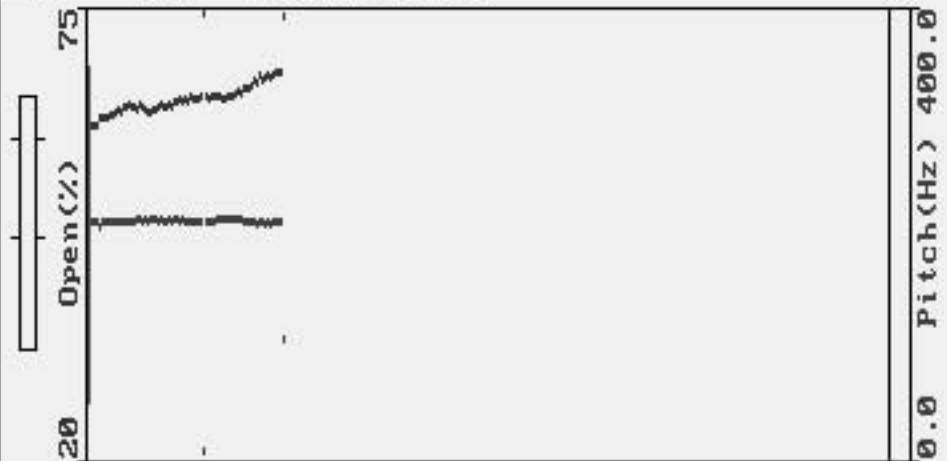


Duration 2.50 (sec)

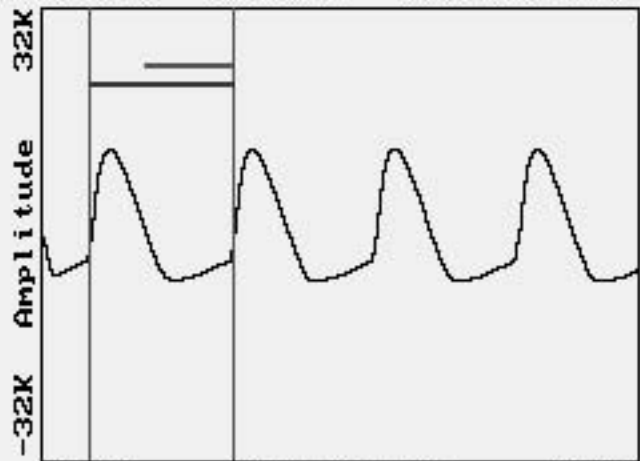
Time (sec)

■A> : CH1: J1\_EGGST.NSP

< 0.00 sec 61.61% 209.00 Hz >

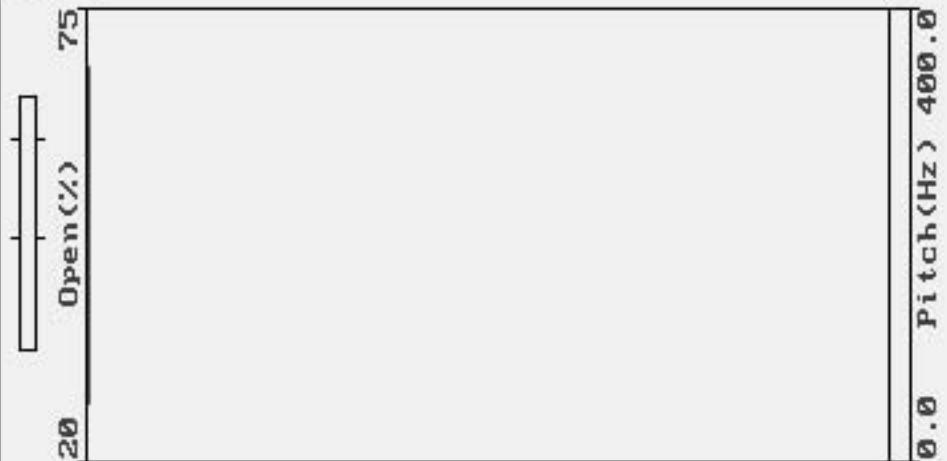


Duration 2.50 (sec)



□B> :

< sec % Hz >

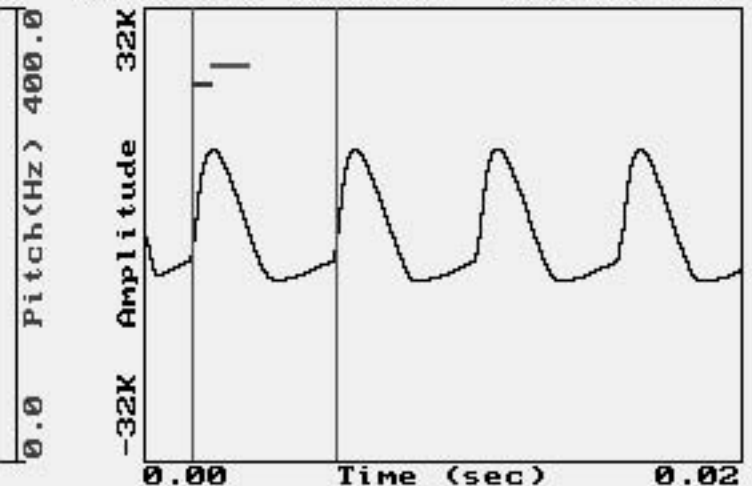
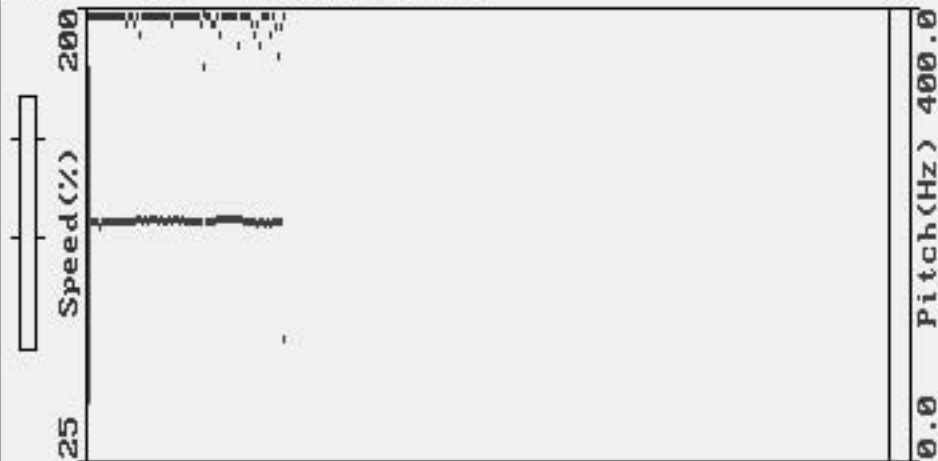


Duration 2.50 (sec)



■A> : CH1: J1\_EGGST.NSP

< 0.00 sec 224.00% 209.00 Hz >

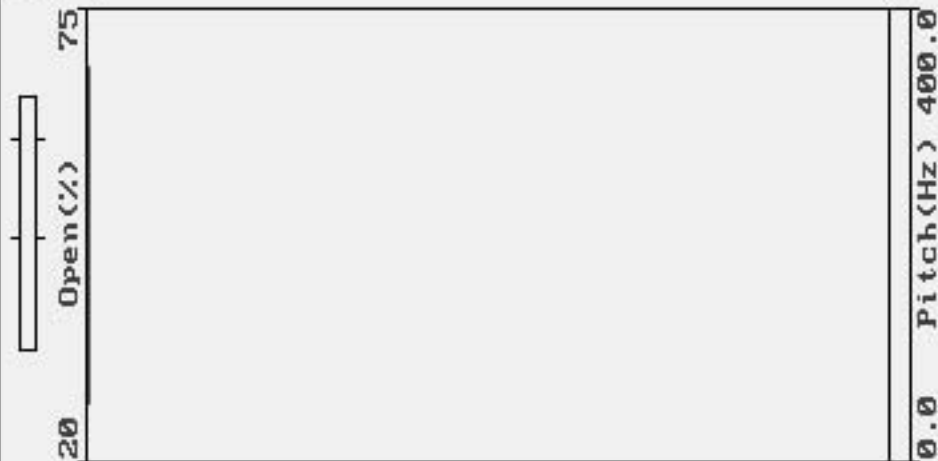


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

□B> :

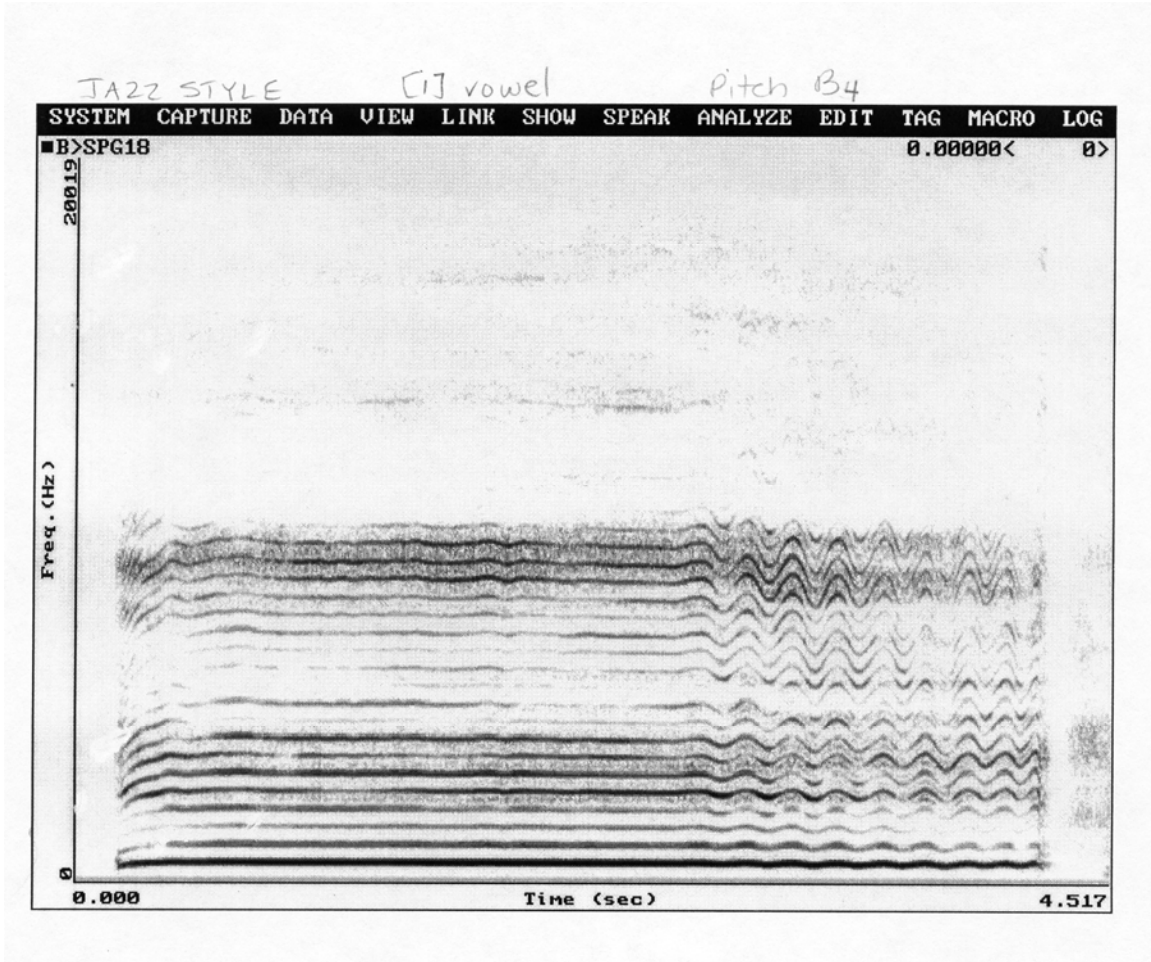
< sec % Hz >



Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

Spectrogram of J21

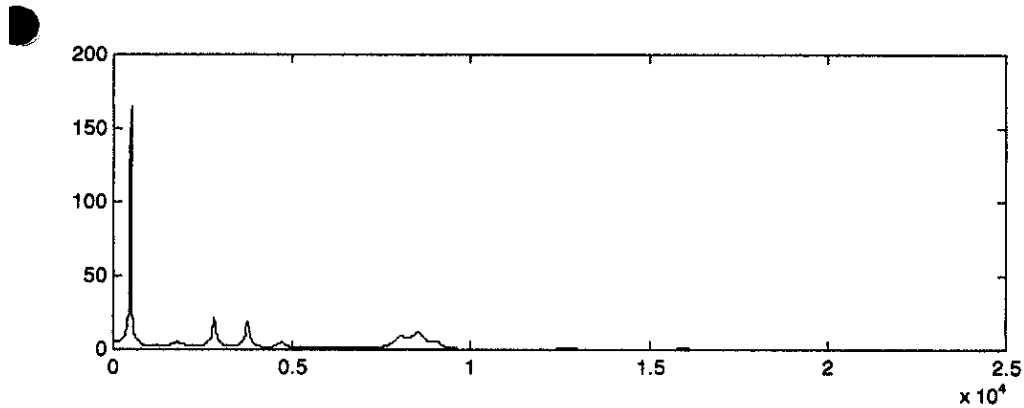
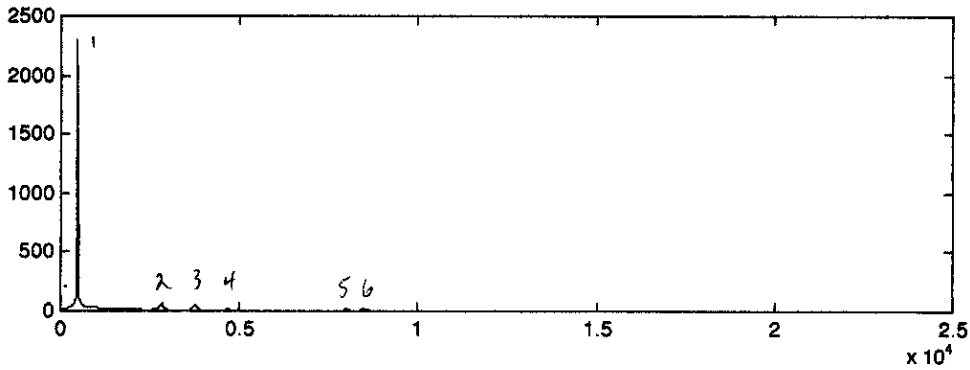


LPC of entire sample of J21

J21

$$F_0 = 471 \text{ Hz}$$

- 1) 468.75 , 2303.03
- 2) 2824.25 , 64.00
- 3) 3750.00 , 49.01
- 4) 4722.00 , 10.40
- 5) 8016.00 , 10.00
- 6) 8521.00 , 12.50

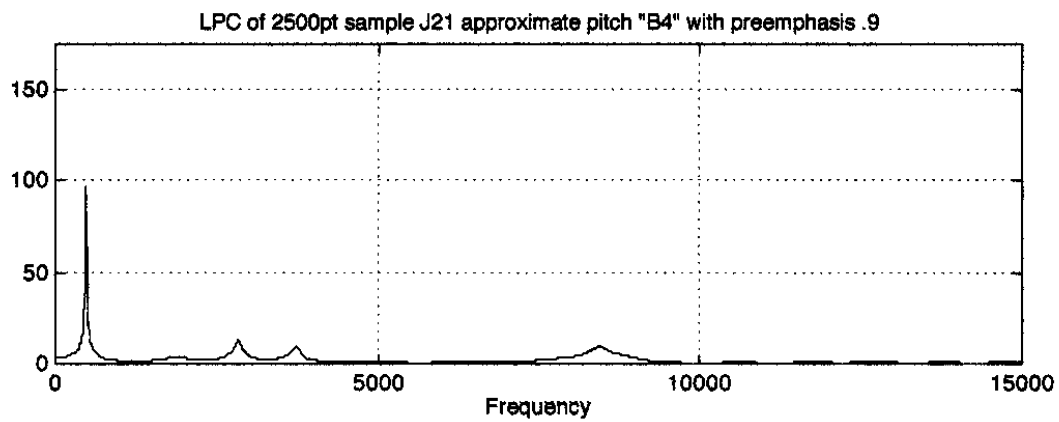
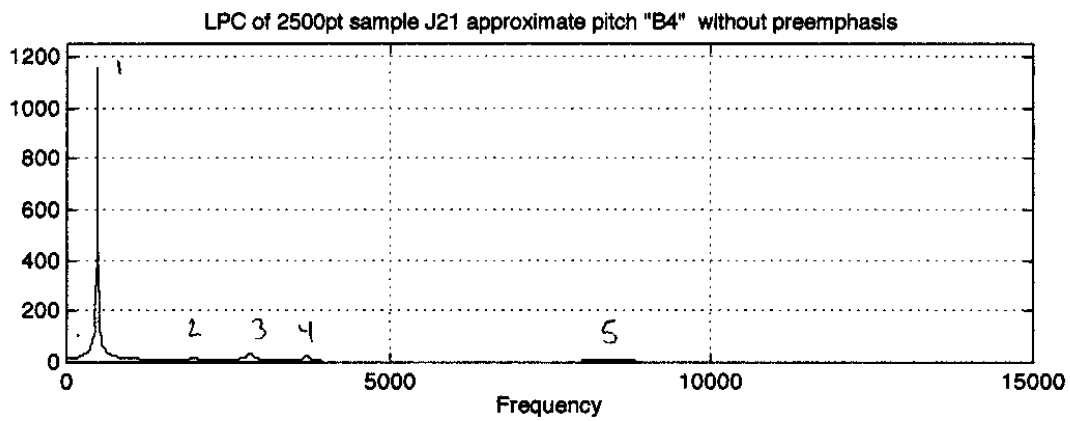


$$.141875 - .0165833333 = .002123588$$

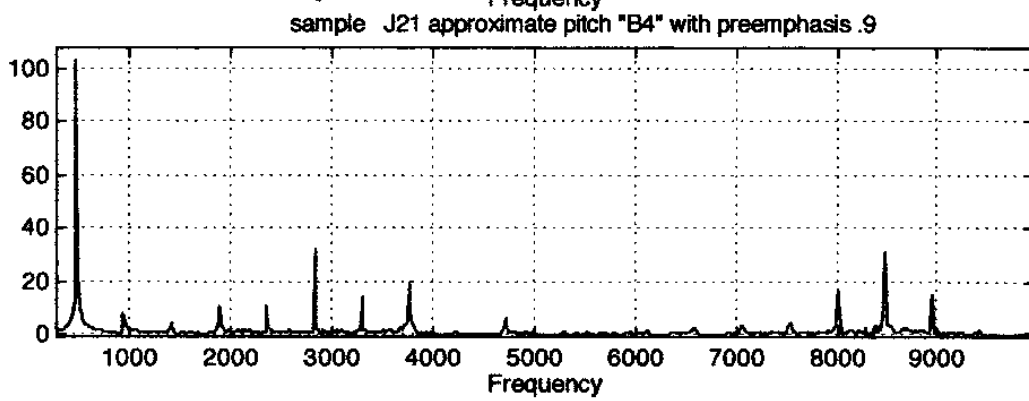
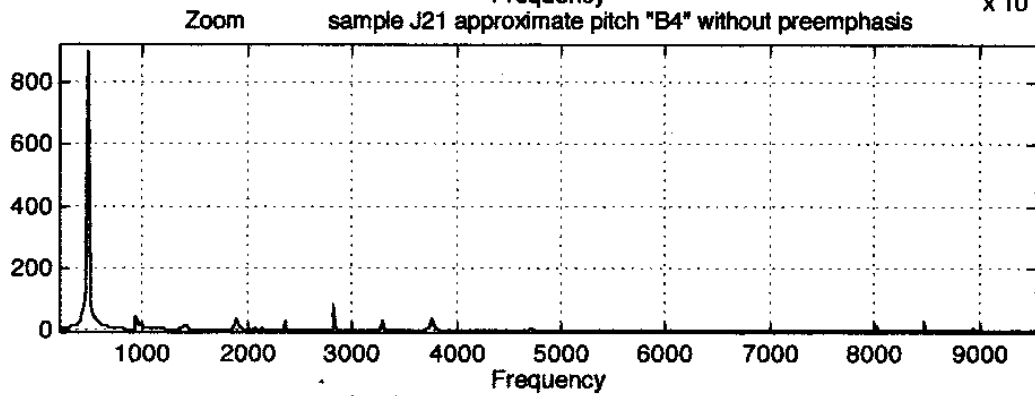
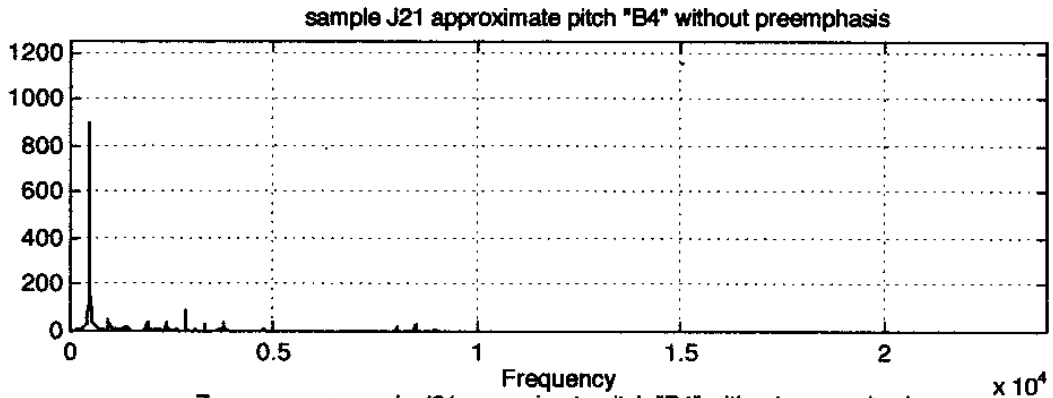
$$470.9012292$$

$$(10000 - 18000)$$

(468.75, -1156.77)  
(1992.18, 13.42)  
(2847.66, 36.82)  
(3726.56, 23.00)  
(8484.38, 9.10)



DFT of sample J21



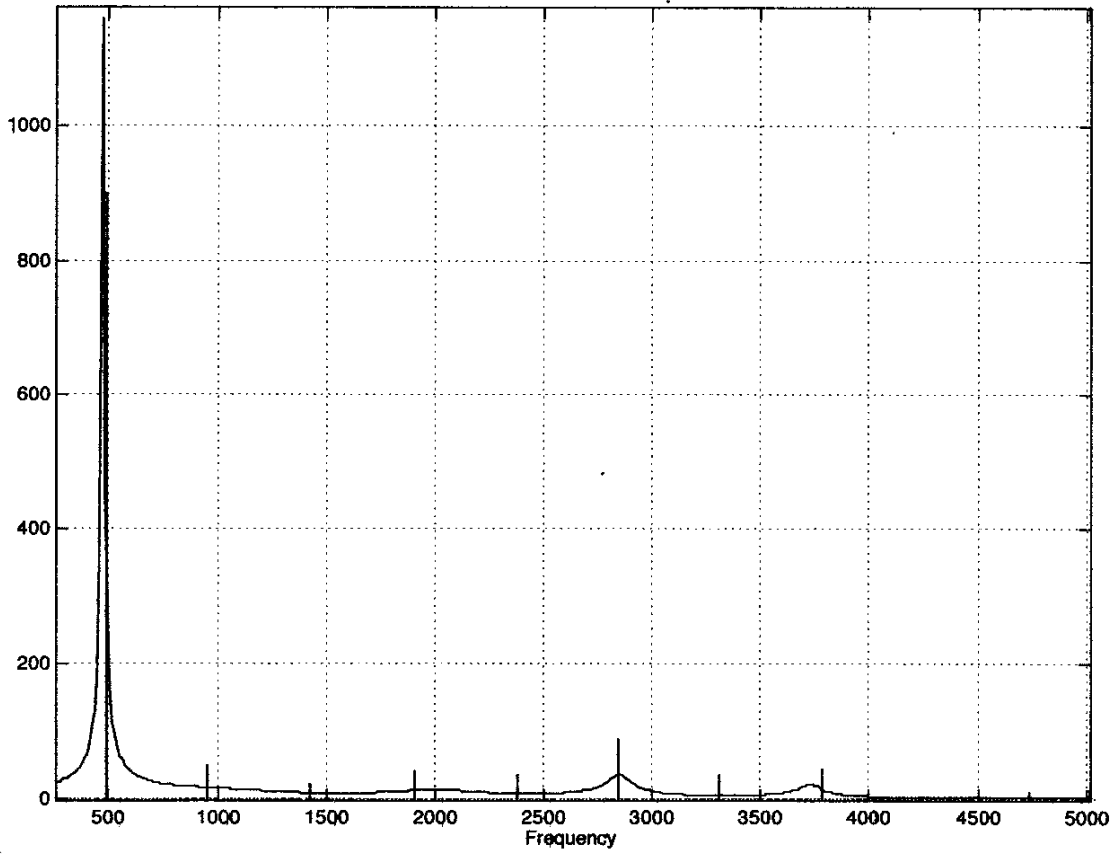
DFT Numerical Results for J21

ROW	Freq	Amp	% Amp
1	486	898.061	100.000 ← a little off with tracking
2	954	49.622	5.525
3	1422	20.822	2.319
4	1908	41.856	4.661
5	2376	36.960	4.116
6	2844	88.276	9.830 ←
7	3312	34.737	3.868
8	3780	42.778	4.763 ← SF?
9	4248	3.030	0.337
10	4734	10.884	1.212 ←
11	5292	1.306	0.145
12	5670	1.396	0.155
13	6138	2.340	0.261
14	6624	1.179	0.131
15	7362	1.814	0.202
16	7938	2.053	0.229
17	8406	3.898	0.434
18	8676	2.585	0.288
19	9252	1.091	0.121
20	9900	0.748	0.083
21	10332	0.837	0.093
22	10530	0.700	0.078
23	11070	0.706	0.079
24	11664	0.709	0.079
25	12060	0.659	0.073
26	12654	0.841	0.094
27	13122	0.691	0.077
28	13662	0.573	0.064
29	14166	0.663	0.074
30	14706	0.544	0.061
31	14886	0.630	0.070
32	15696	0.536	0.060
33	15948	0.631	0.070
34	16470	0.643	0.072
35	16938	0.513	0.057
36	17424	0.476	0.053
37	17964	0.444	0.049
38	18378	0.470	0.052
39	19026	0.486	0.054
40	19476	0.499	0.056
41	19944	0.502	0.056
42	20268	0.515	0.057
43	20736	0.463	0.052
44	21312	0.505	0.056
45	21780	0.532	0.059
46	22248	0.444	0.049
47	22752	0.399	0.044
48	23292	0.397	0.044
49	11412	0.905	0.101
50	11790	0.952	0.106
51	11880	0.863	0.096
52	12114	1.046	0.117
53	12474	0.895	0.100
54	12690	1.614	0.180
55	12798	1.750	0.195
56	13014	1.041	0.116
57	13392	0.888	0.099
58	13608	0.957	0.107

59	13716	0.939	0.105
60	13950	0.946	0.105
61	14346	0.701	0.078
62	14544	0.878	0.098
63	14814	0.830	0.092
64	15030	0.799	0.089
65	15138	0.784	0.087
66	15480	0.850	0.095
67	15696	0.814	0.091
68	15858	0.738	0.082
69	16200	0.693	0.077
70	16290	0.835	0.093
71	16524	0.744	0.083
72	16794	0.793	0.088
73	16992	0.708	0.079
74	17244	0.666	0.074
75	17550	0.642	0.071
76	17838	0.629	0.070
77	18054	0.635	0.071
78	18216	0.646	0.072
79	18414	0.617	0.069
80	18720	0.627	0.070
81	19008	0.611	0.068
82	19152	0.631	0.070
83	19368	0.639	0.071
84	19566	0.628	0.070
85	19980	0.591	0.066
86	20142	0.601	0.067
87	20322	0.573	0.064
88	20520	0.575	0.064
89	20772	0.598	0.067
90	21078	0.580	0.065
91	21204	0.610	0.068
92	21582	0.583	0.065
93	21690	0.588	0.065
94	22032	0.614	0.068
95	22302	0.557	0.062
96	22554	0.583	0.065
97	22752	0.556	0.062
98	22986	0.569	0.063
99	23094	0.571	0.064
100	23490	0.559	0.062
101	23670	0.547	0.061
102	20160	0.179	0.020
103	20430	0.180	0.020
104	20610	0.171	0.019
105	20718	0.158	0.018
106	21042	0.164	0.018
107	21240	0.157	0.017
108	21420	0.141	0.016
109	21564	0.154	0.017
110	21834	0.144	0.016
111	21978	0.138	0.015
112	22104	0.146	0.016
113	22302	0.133	0.015
114	22608	0.144	0.016
115	22824	0.134	0.015
116	22950	0.130	0.014
117	23202	0.139	0.015
118	23418	0.141	0.016



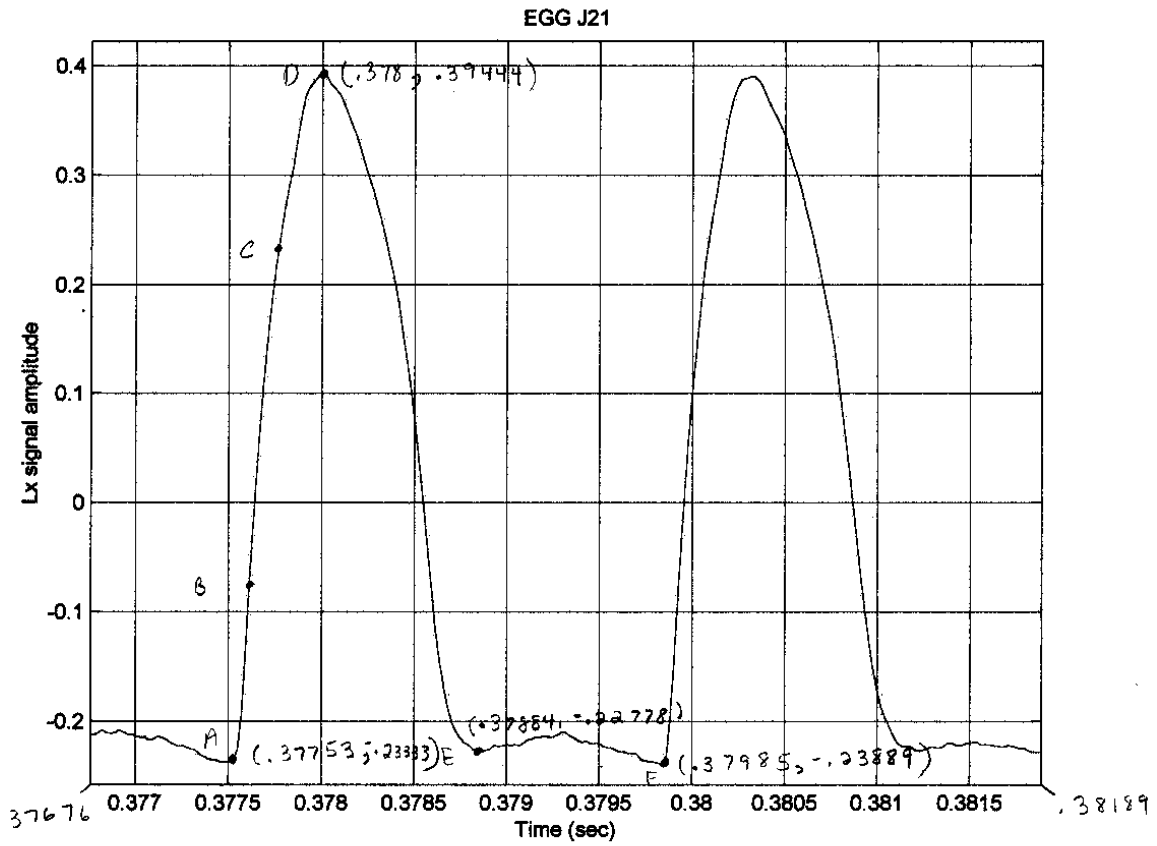
Stem plot/LPC overlay of harmonics for sample J21 without preemphasis

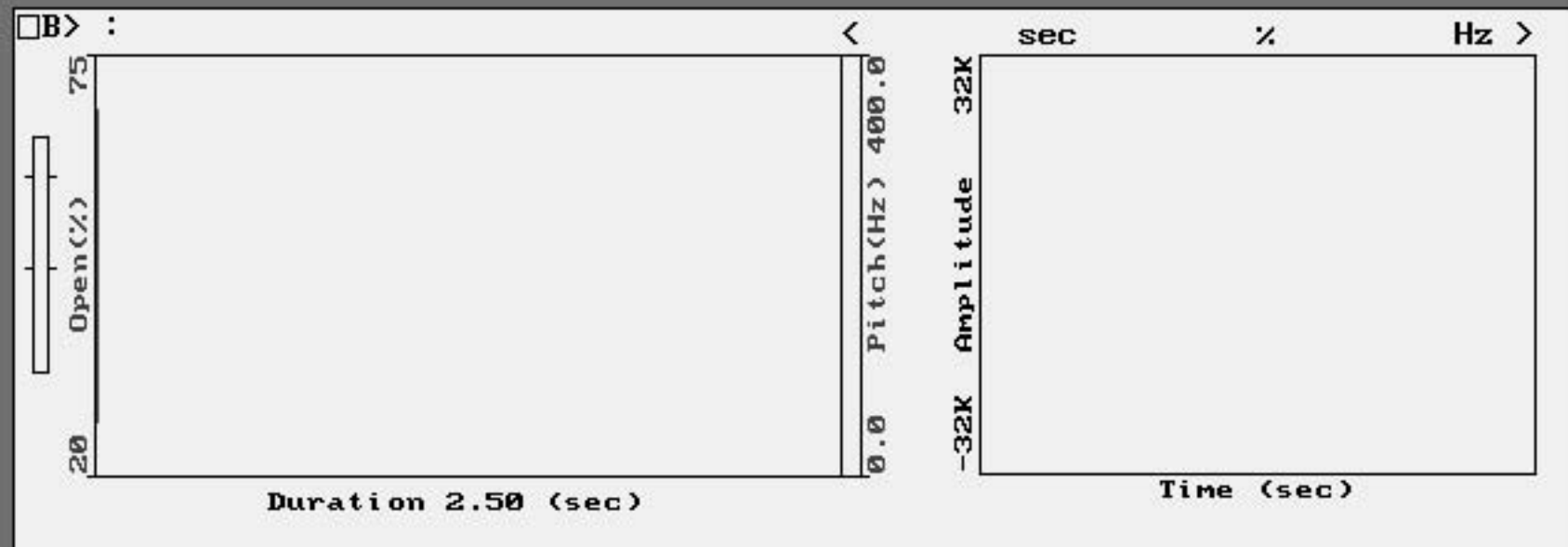
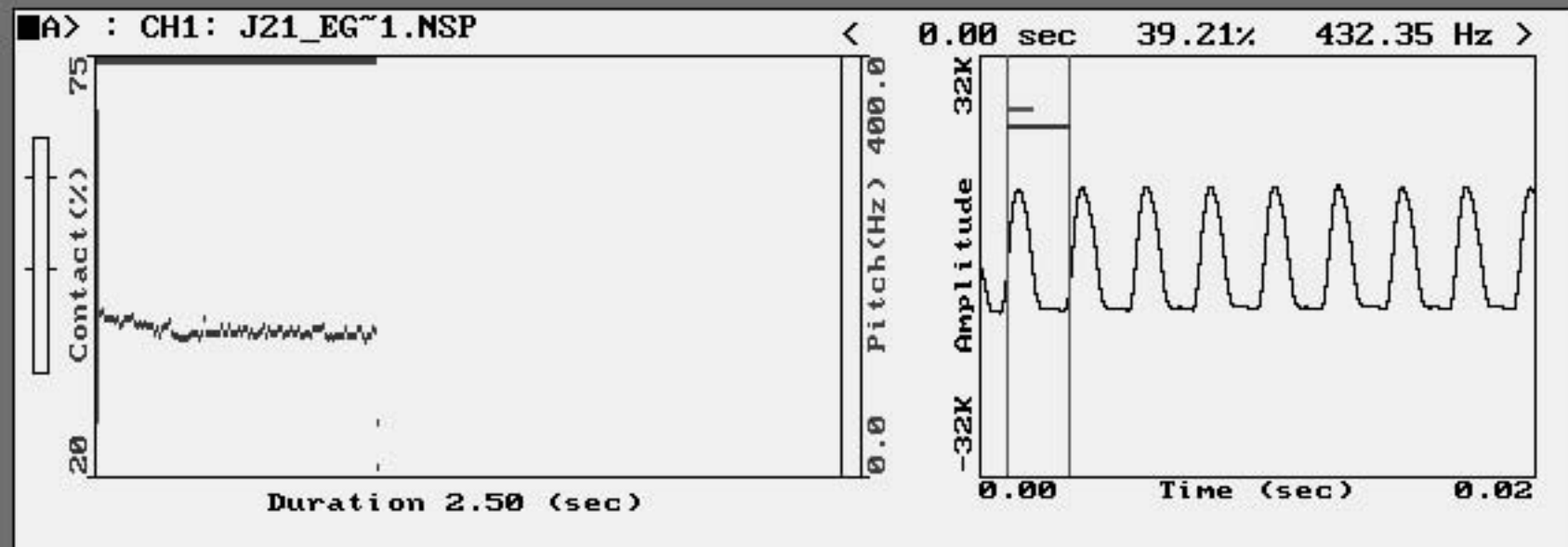


$x \Rightarrow 15.5 \text{ mm} = .0005$

$y \Rightarrow 18 \text{ mm} = .1$

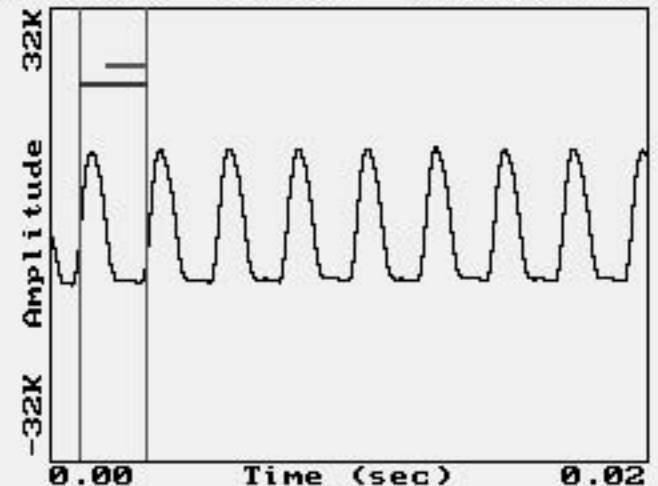
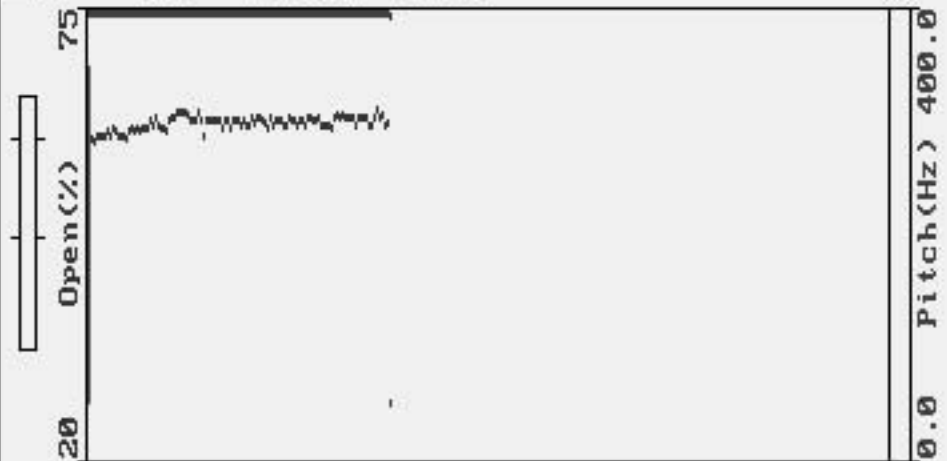
$z \Rightarrow 1 \text{ mm} = .0055555$





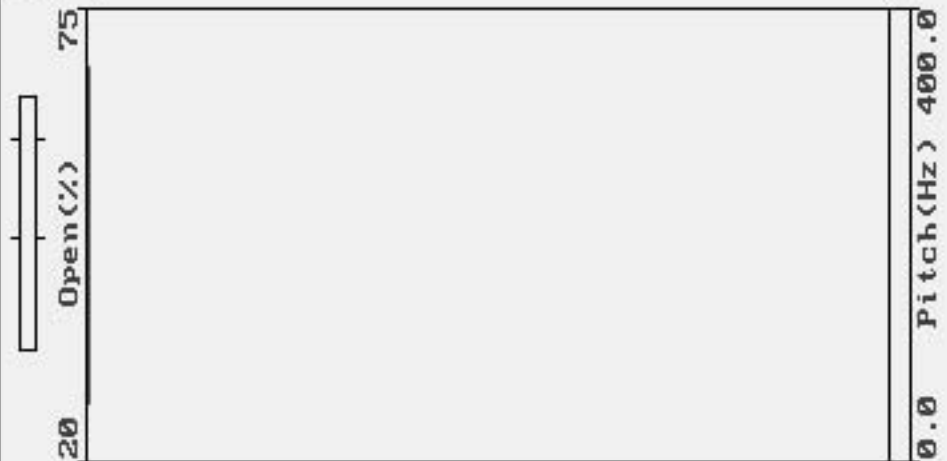
**A** > : CH1: J21\_EG~1.NSP

< 0.00 sec 60.78% 432.35 Hz >



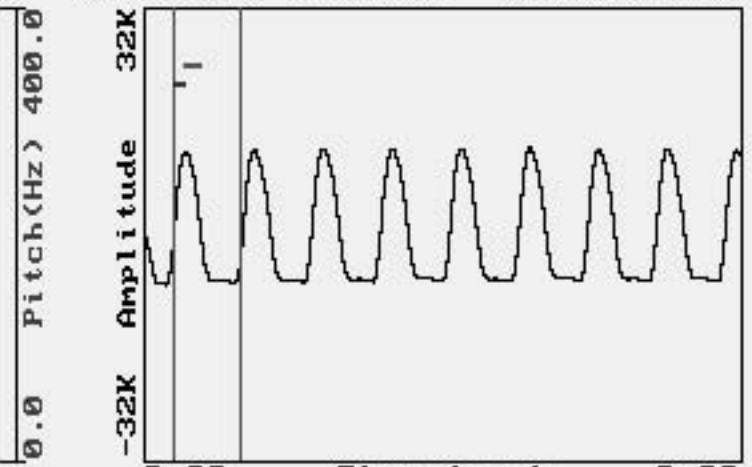
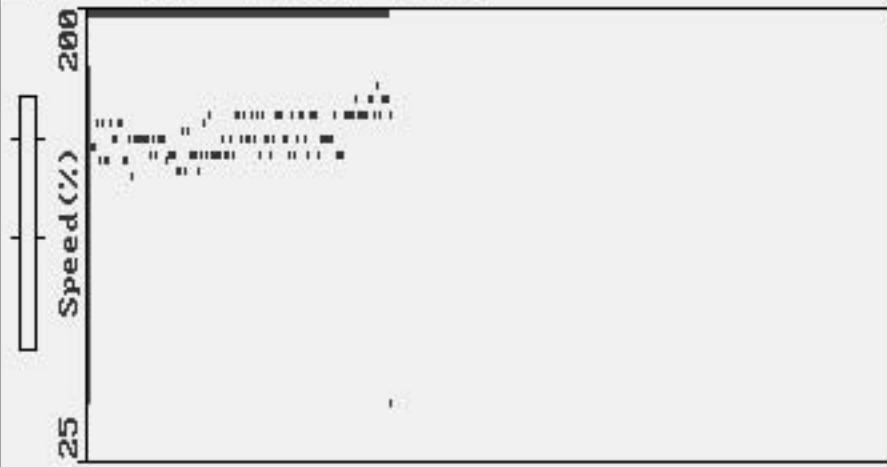
**B** > :

< sec % Hz >



**A** > : CH1: J21\_EG~1.NSP

< 0.00 sec 150.00% 432.35 Hz >

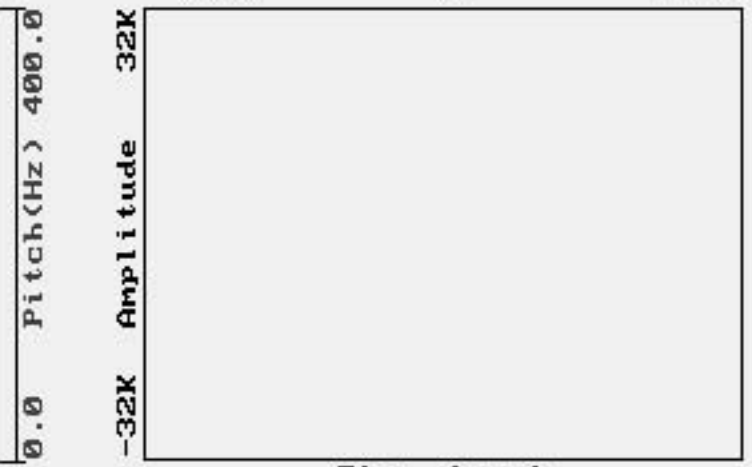


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >



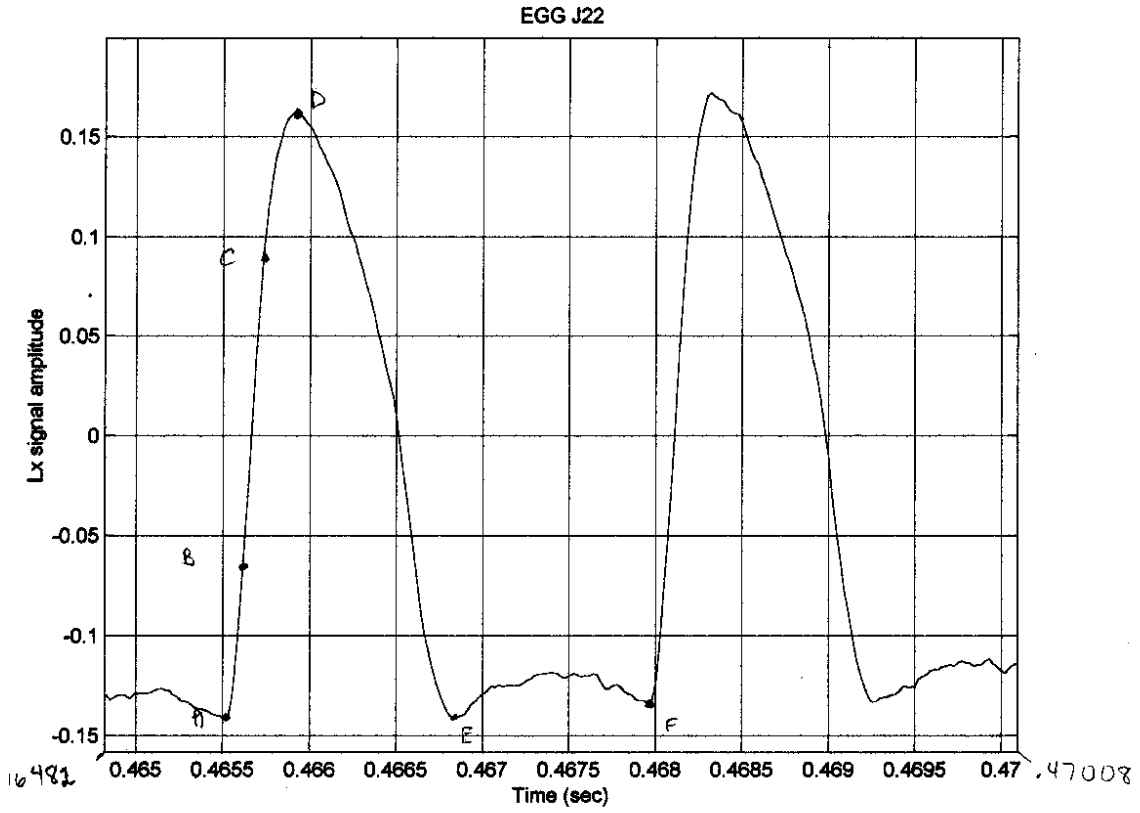
Duration 2.50 (sec)

Pitch(Hz) 400.0

$$x \Rightarrow 15\mu\text{m} = .0005$$

$$y \Rightarrow 17.5\mu\text{m} = .05$$

$$y \Rightarrow 1\mu\text{m} = .0028571$$

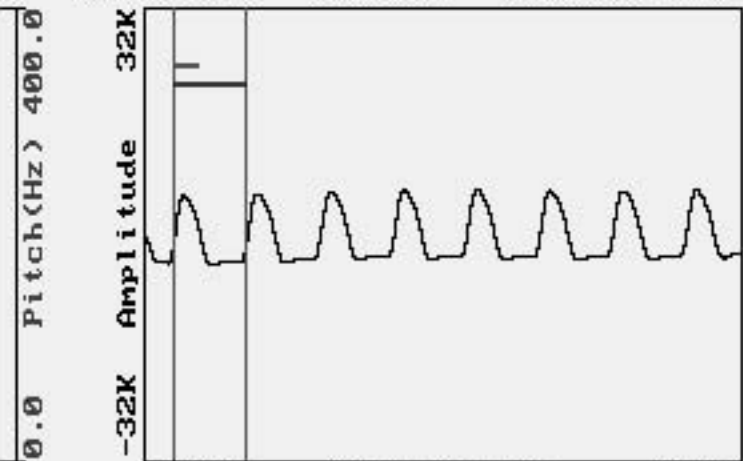


**A** > : CH1: J22\_EG~1.NSP

< 0.00 sec 34.86% 404.59 Hz >



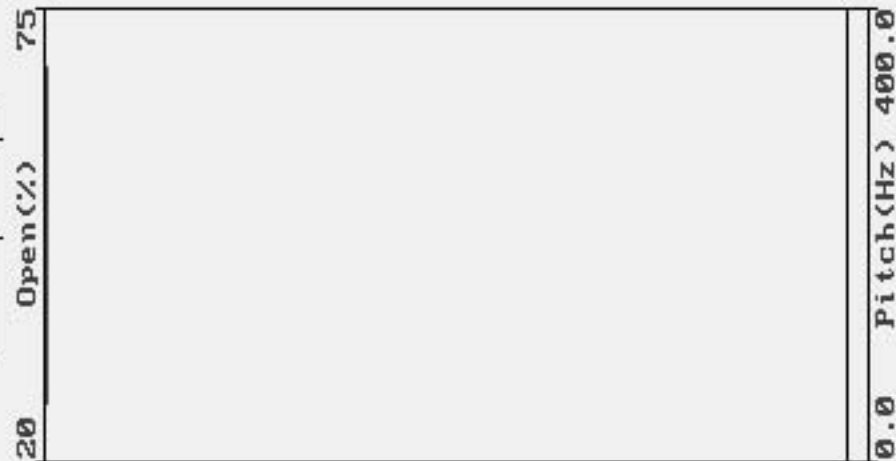
Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

< sec % Hz >



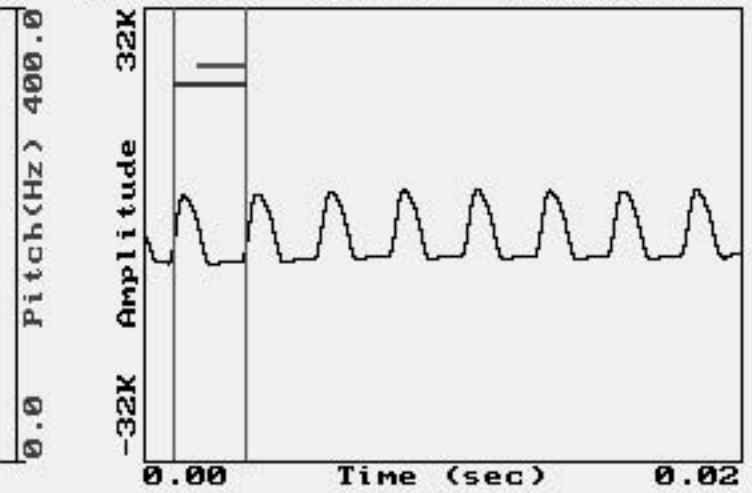
Duration 2.50 (sec)



Time (sec)

**A** > : CH1: J22\_EG~1.NSP

< 0.00 sec 65.13% 404.59 Hz >

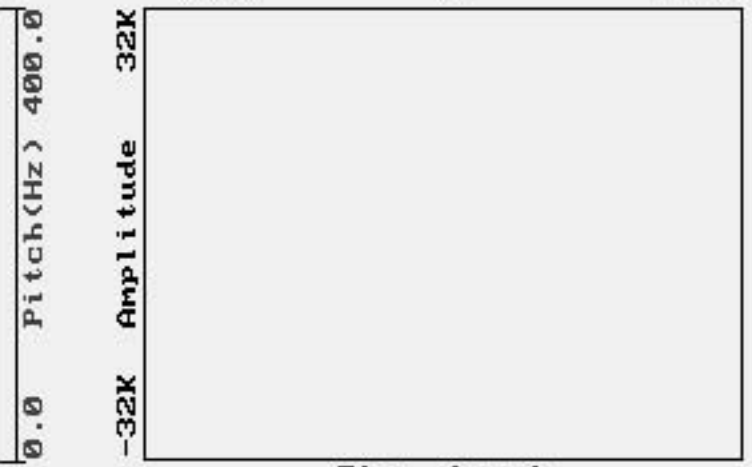


Duration 2.50 (sec)

0.00 Pitch(Hz) 400.0

**B** > :

< sec % Hz >

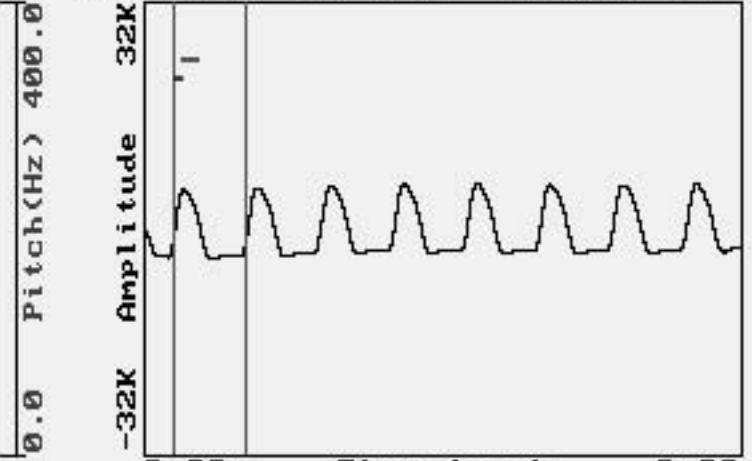


Duration 2.50 (sec)

0.00 Pitch(Hz) 400.0

**A** > : CH1: J22\_EG~1.NSP

< 0.00 sec 192.30% 404.59 Hz >

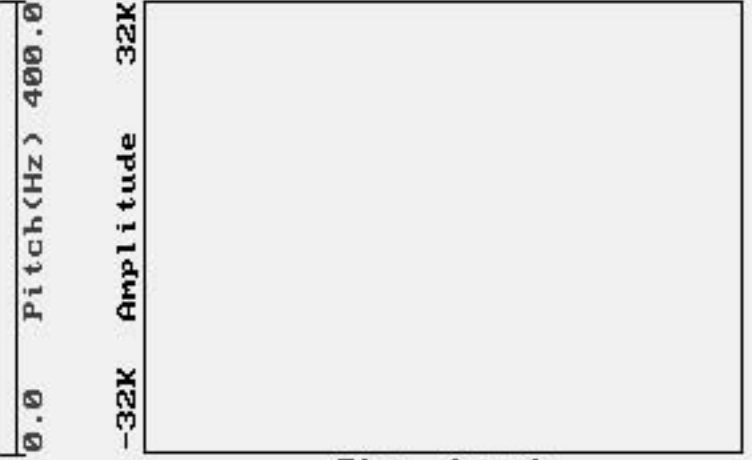


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

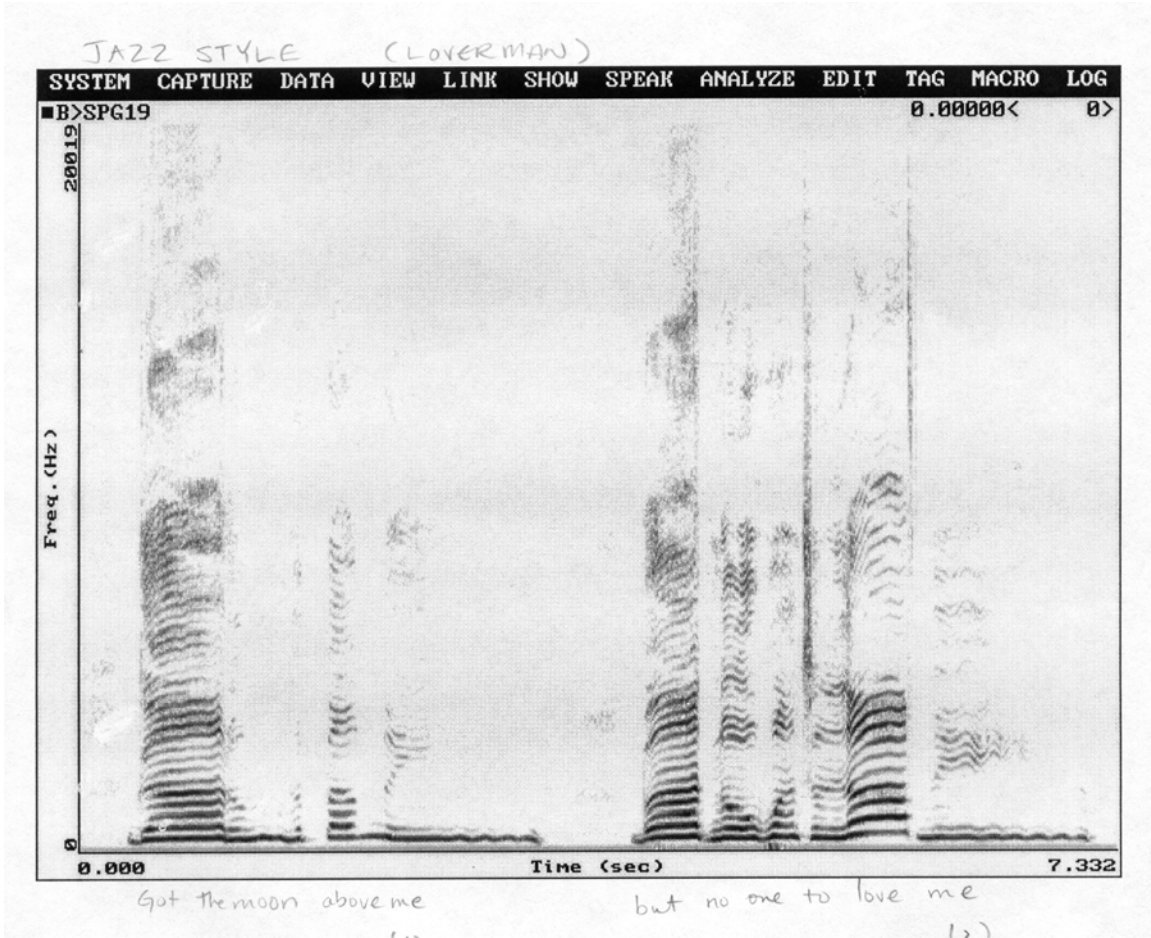
< sec % Hz >



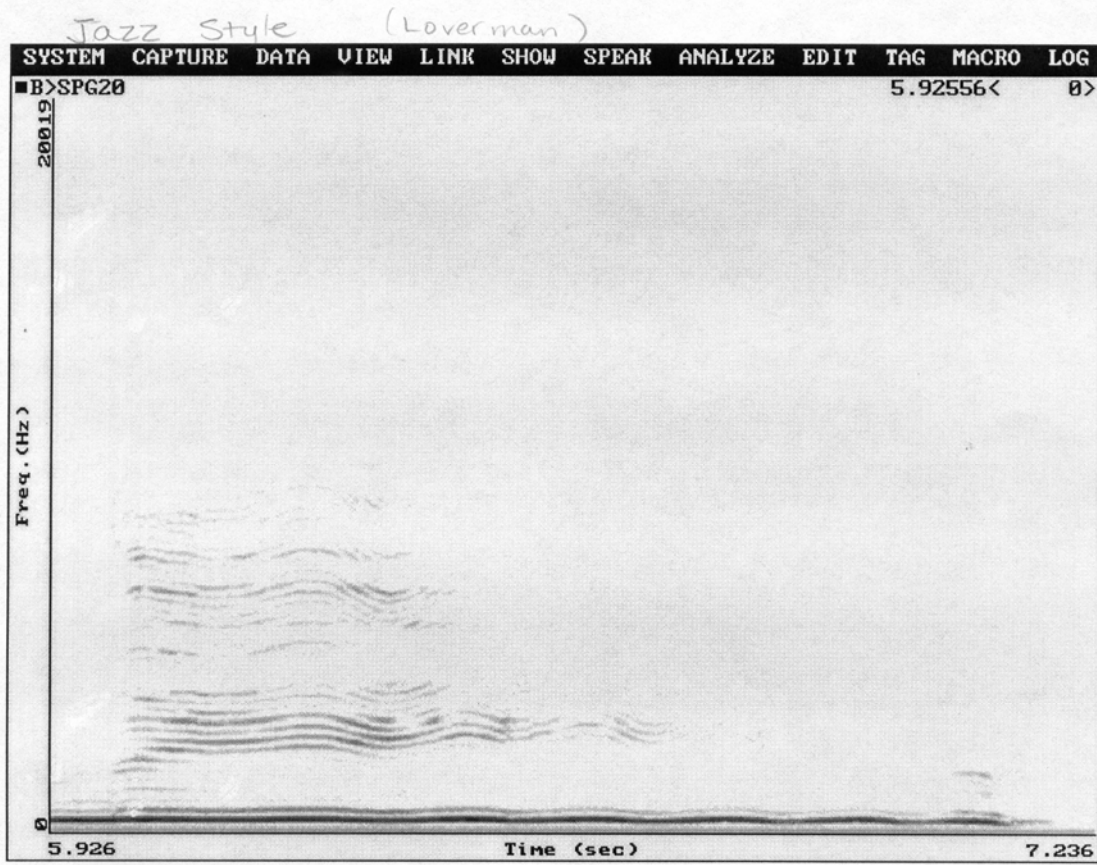
Duration 2.50 (sec)

Pitch(Hz) 400.0

Spectrogram of J33a



Spectrogram of J33b



*me*

LPC of J33b

1) 269.53, 2202.80

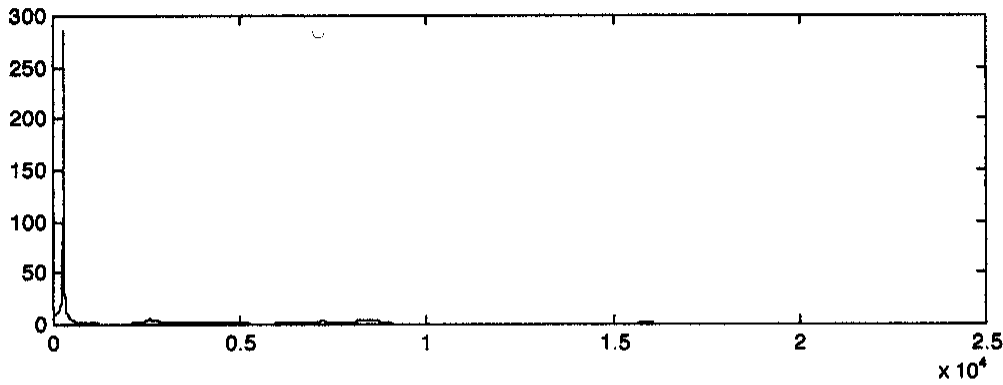
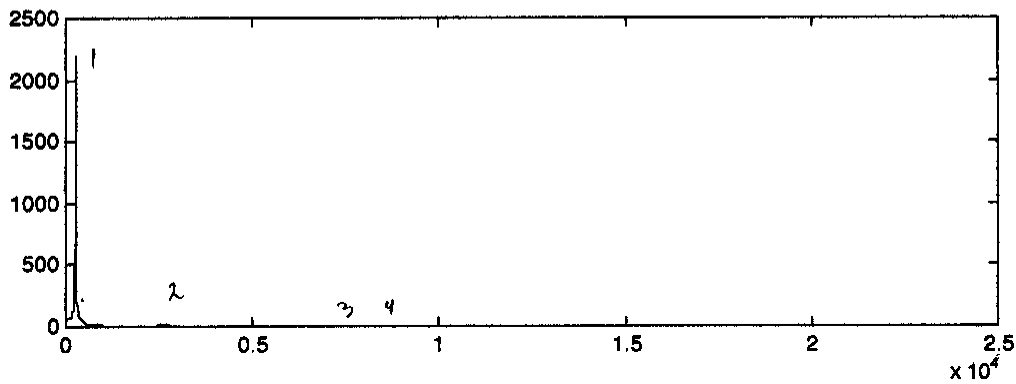
J33(1)

$F_0 = 266 \text{ Hz}$

2) 2612.00, 11.50

3) 7270.00, 2.80

4) 8450.00, 4.20



$$.154875 - .0119375 = .1429375 / 38$$

$$= .003761513$$

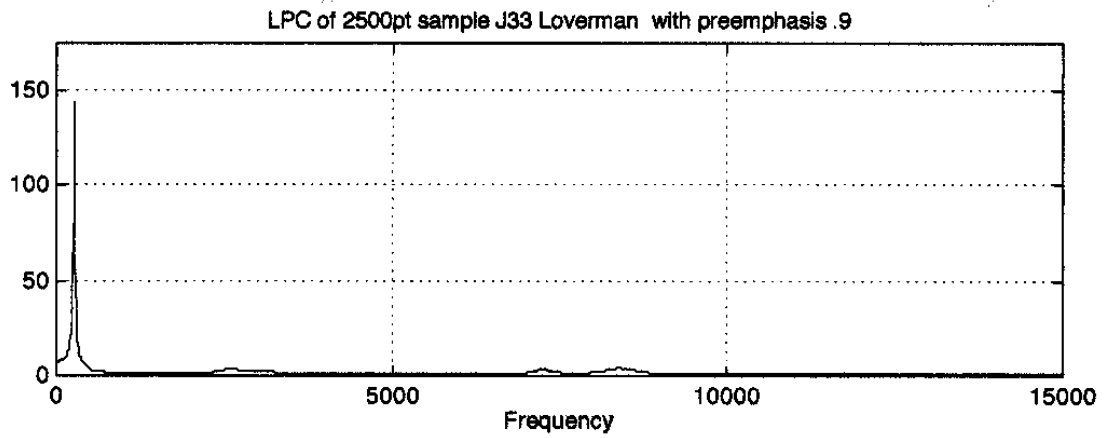
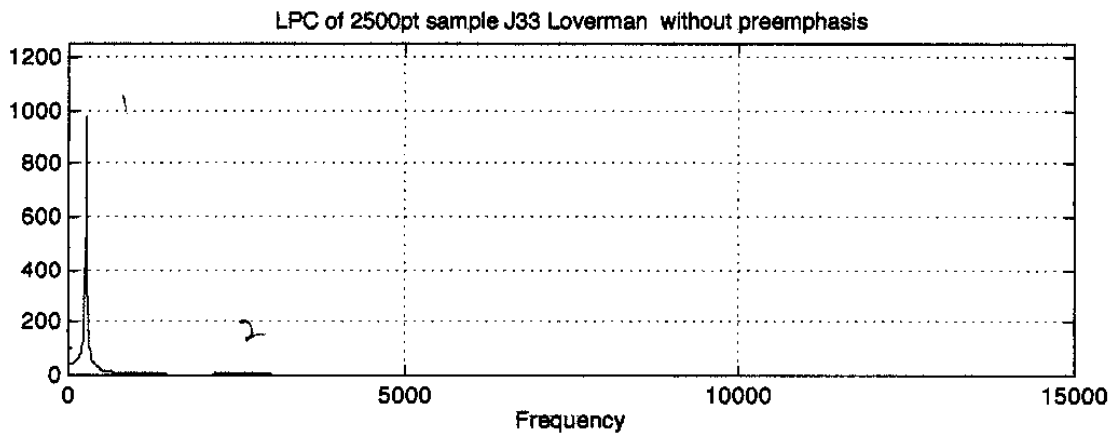
$$265.8504591$$

LPC of J33b

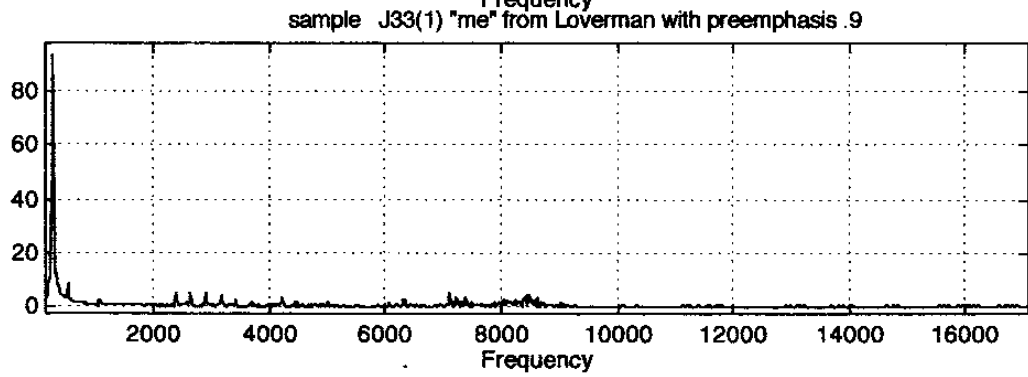
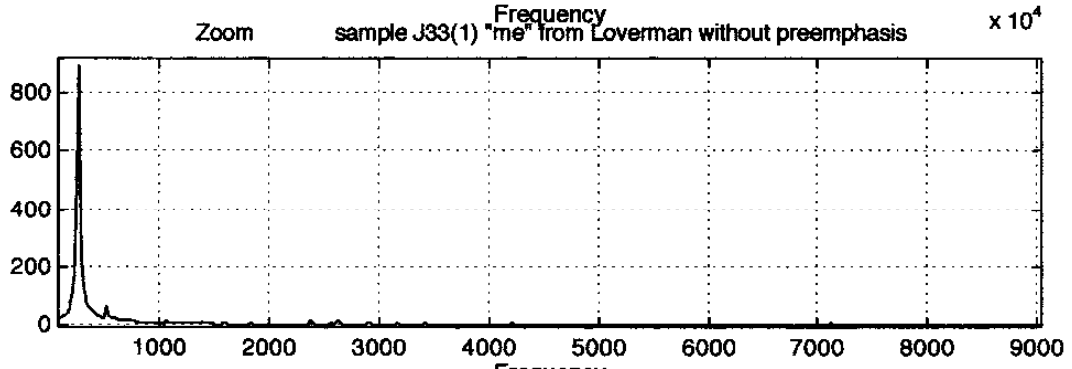
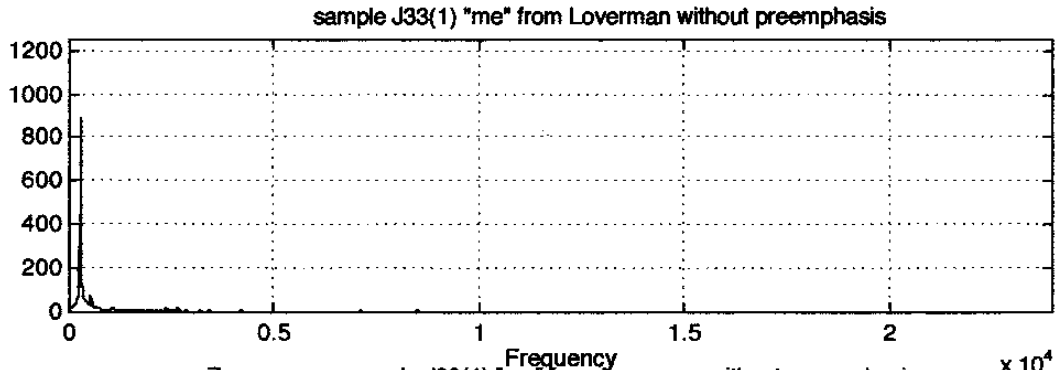
(269.53, 980.15)

J33cst.wav.

(2623.71, 6.38)



DFT of J33b



DFT Numerical Results of J33b

MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	288	891.662	100.000
2	540	70.068	7.858
3	756	17.091	1.917
4	1080	19.276	2.162
5	1332	8.882	0.996
6	1620	7.636	0.856
7	1908	5.736	0.643
8	2394	20.854	2.339
9	2646	18.711	2.098
10	2916	12.610	1.414
11	3186	12.047	1.351
12	3438	9.000	1.009
13	3744	3.906	0.438
14	3996	3.621	0.406
15	4230	7.859	0.881
16	4698	2.720	0.305
17	5004	3.556	0.399
18	5184	2.946	0.330
19	5544	2.163	0.243
20	5868	2.106	0.236
21	6084	3.868	0.434
22	6336	5.228	0.586
23	6552	2.403	0.270
24	6876	2.707	0.304
25	7128	7.627	0.855
26	7398	4.379	0.491
27	7866	3.132	0.351
28	8118	3.638	0.408
29	8424	4.461	0.500
30	8640	4.314	0.484
31	8892	1.921	0.215
32	9108	1.992	0.223
33	9432	1.326	0.149
34	9738	1.304	0.146
35	10116	1.323	0.148
36	10368	1.324	0.148
37	10620	1.224	0.137
38	11052	1.156	0.130
39	11268	1.354	0.152
40	11412	1.500	0.168
41	11736	1.180	0.132
42	12096	1.077	0.121
43	12456	1.081	0.121
44	12618	1.044	0.117
45	12996	1.246	0.140
46	13140	1.141	0.128
47	13608	0.947	0.106
48	13914	1.258	0.141
49	14076	1.061	0.119
50	14310	0.976	0.110
51	14670	1.025	0.115
52	14868	0.990	0.111
53	15336	0.954	0.107
54	15570	1.081	0.121
55	15732	1.235	0.139
56	16164	1.177	0.132

*good tracking*

*← low f2*

*←*

*←*

*←*

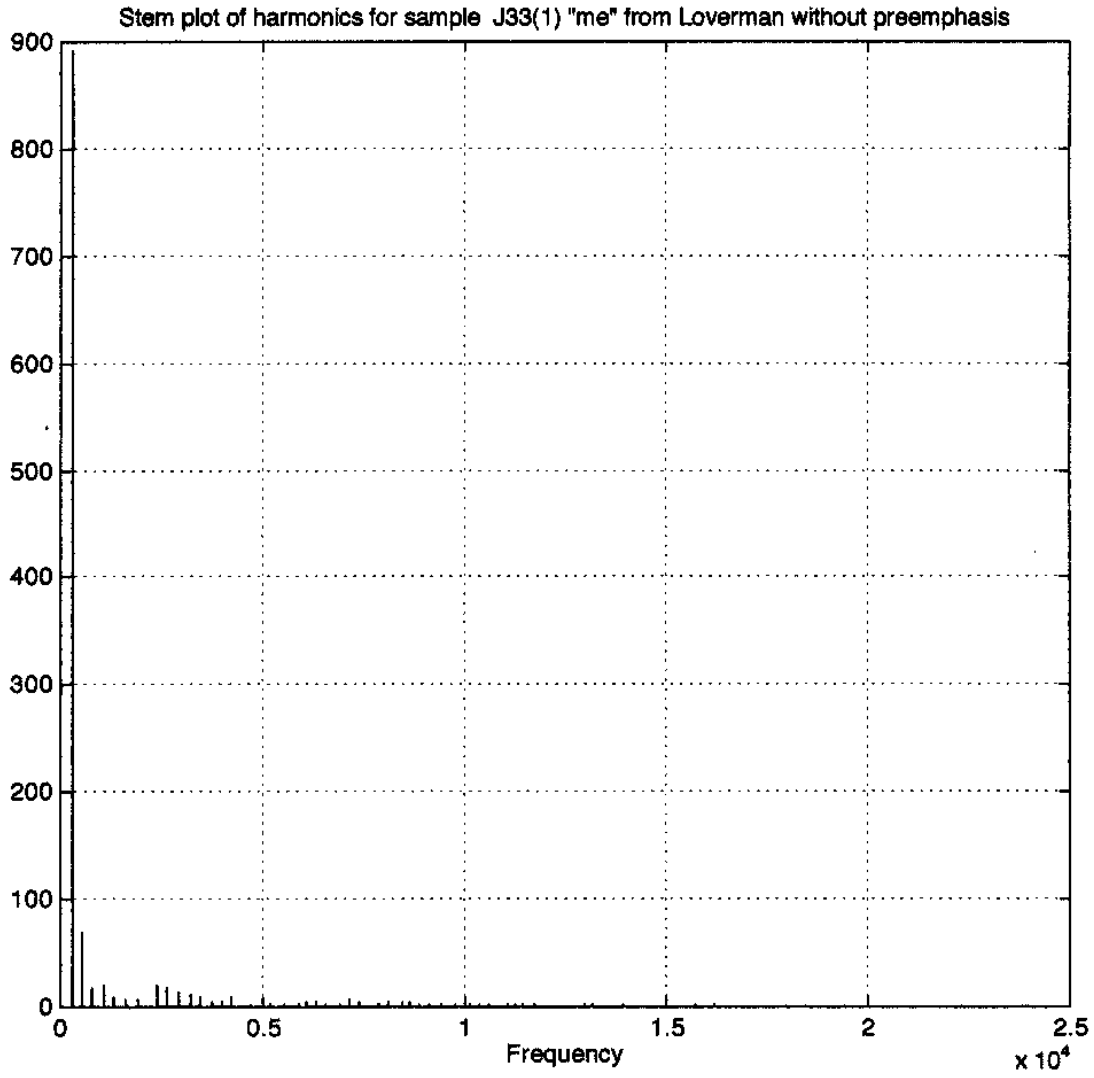
*←*

*←*

57	16488	0.836	0.094
58	16704	1.006	0.113
59	16902	1.059	0.119
60	17316	0.878	0.098
61	17460	0.875	0.098
62	17820	0.822	0.092
63	18252	0.775	0.087
64	18468	0.751	0.084
65	18684	0.774	0.087
66	19044	0.752	0.084
67	19260	0.768	0.086
68	19656	0.733	0.082
69	19980	0.746	0.084
70	20160	0.761	0.085
71	20520	0.756	0.085
72	20628	0.722	0.081
73	20934	0.729	0.082
74	21276	0.738	0.083
75	21492	0.735	0.082
76	21924	0.758	0.085
77	22140	0.724	0.081
78	22482	0.716	0.080
79	22842	0.704	0.079
80	23112	0.702	0.079
81	23382	0.707	0.079
82	23508	0.716	0.080
83	19368	0.639	0.072
84	19566	0.628	0.070
85	19980	0.591	0.066
86	20142	0.601	0.067
87	20322	0.573	0.064
88	20520	0.575	0.064
89	20772	0.598	0.067
90	21078	0.580	0.065
91	21204	0.610	0.068
92	21582	0.583	0.065
93	21690	0.588	0.066
94	22032	0.614	0.069
95	22302	0.557	0.062
96	22554	0.583	0.065
97	22752	0.556	0.062
98	22986	0.569	0.064
99	23094	0.571	0.064
100	23490	0.559	0.063
101	23670	0.547	0.061
102	20160	0.179	0.020
103	20430	0.180	0.020
104	20610	0.171	0.019
105	20718	0.158	0.018
106	21042	0.164	0.018
107	21240	0.157	0.018
108	21420	0.141	0.016
109	21564	0.154	0.017
110	21834	0.144	0.016
111	21978	0.138	0.016
112	22104	0.146	0.016
113	22302	0.133	0.015
114	22608	0.144	0.016
115	22824	0.134	0.015
116	22950	0.130	0.015

117	23202	0.139	0.016
118	23418	0.141	0.016
119	23490	0.135	0.015
120	23814	0.133	0.015

DFT Stem plot for J33b



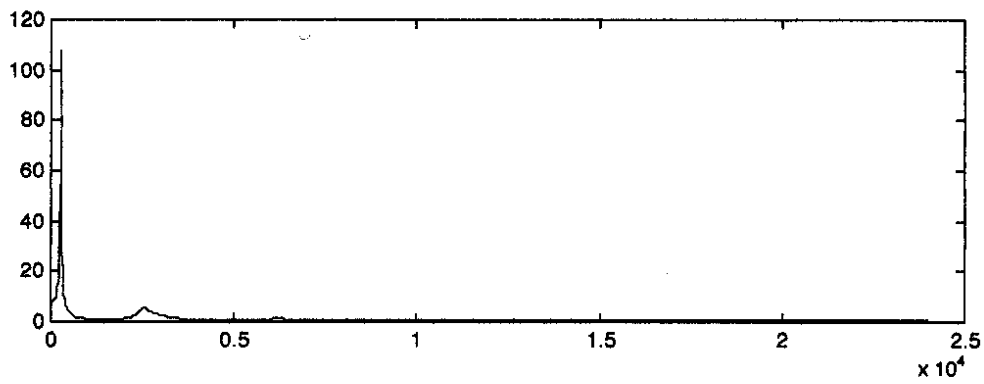
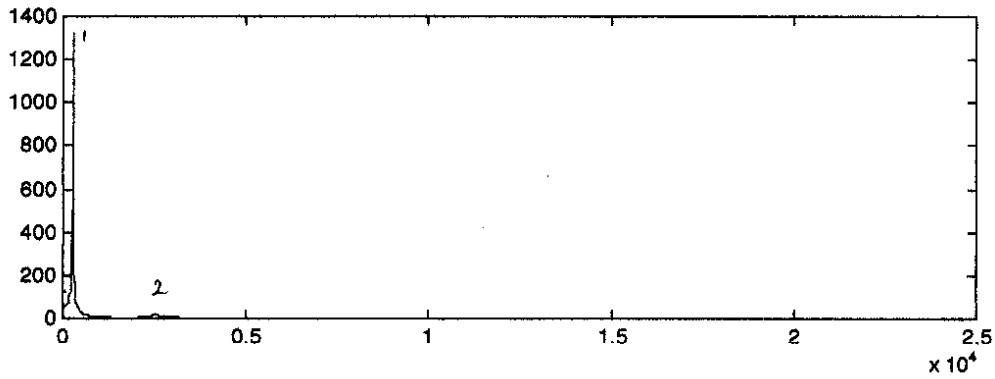
LPC of J33c

1) 269.53, 1323.61

J 33(2)

$F_0 = 26012$

2) 2531.80, 16.30



$$.154875 - .012526833 = .142354167/37$$

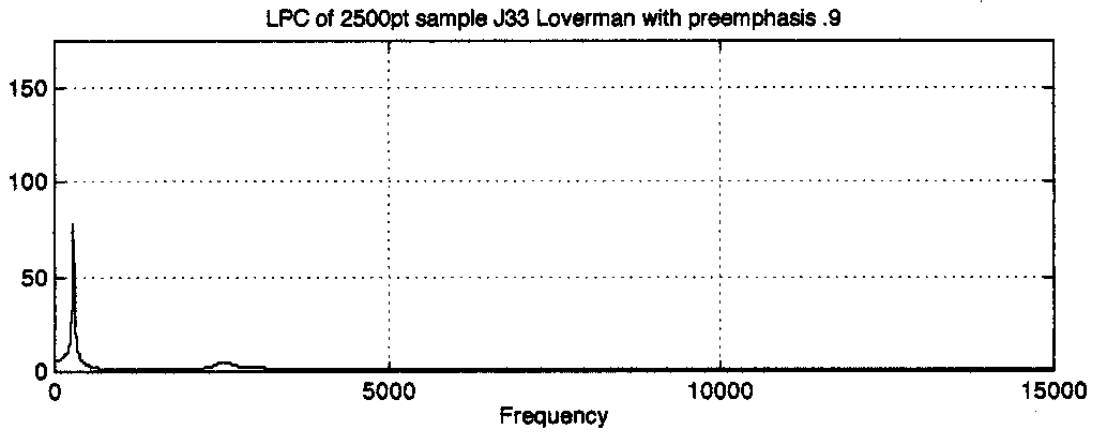
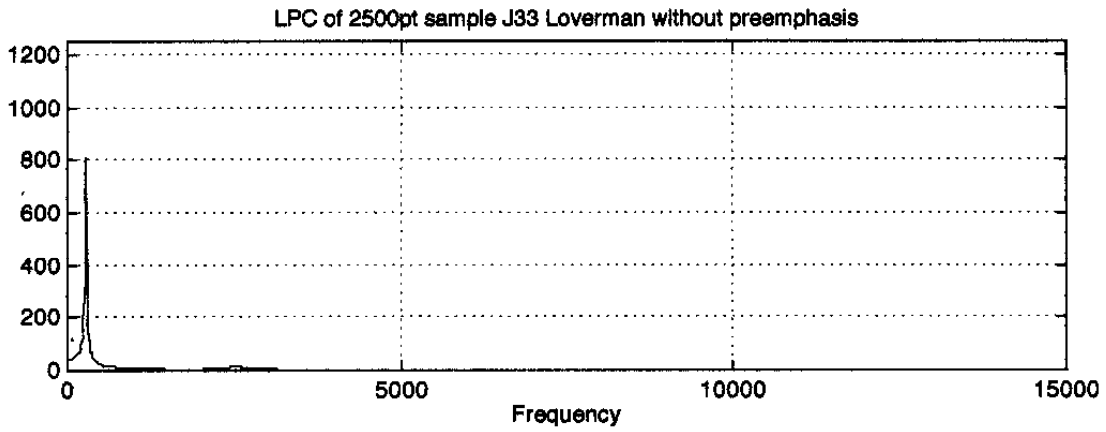
$$= .00384741$$

$$259.9151172$$

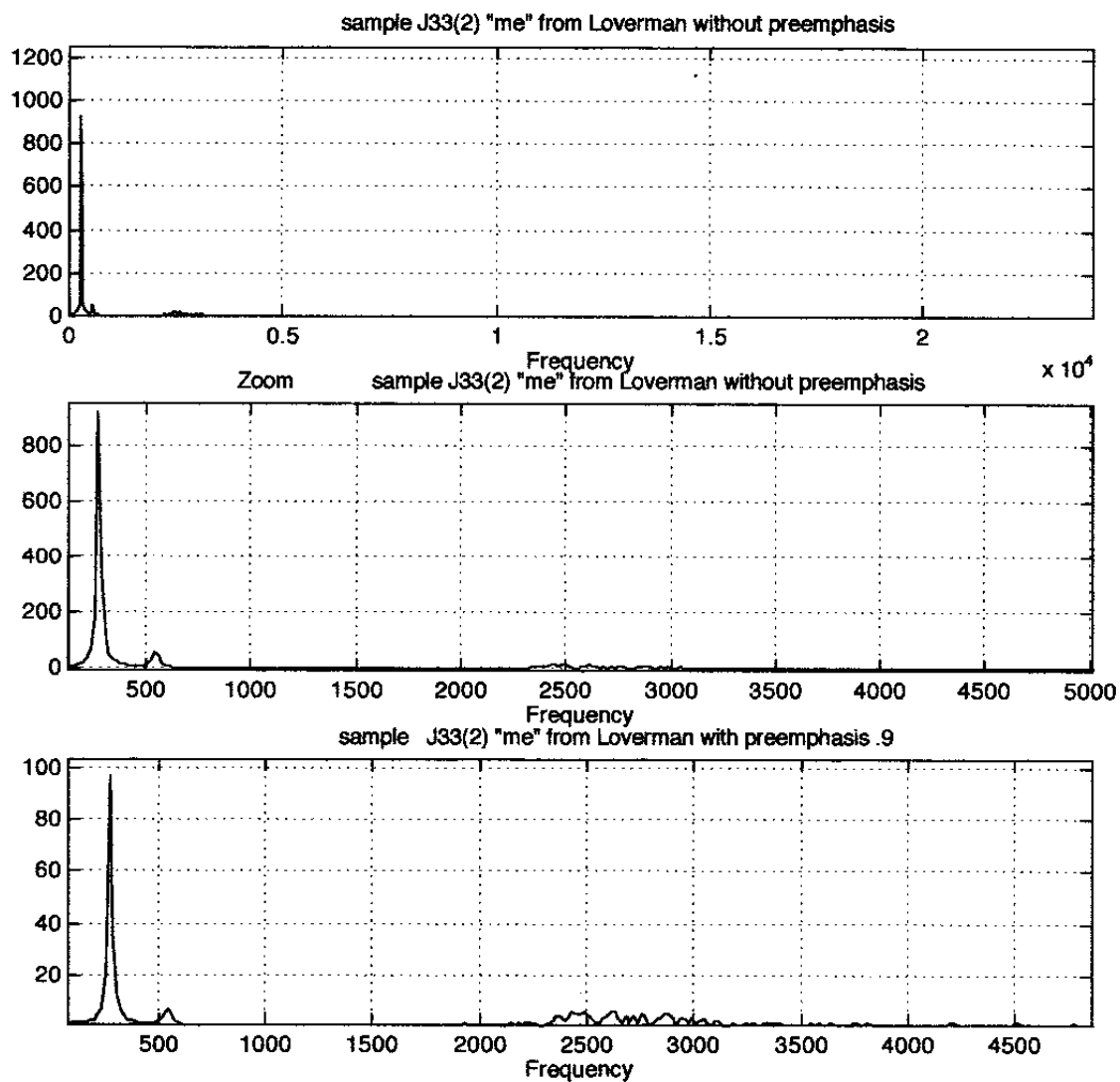
LPC of J33c

$F_1(281, 810)$   
 $F_2(2520, 14)$

J33(2) cst. wav



DFT results for J33c



DFT Numerical Results for J33c

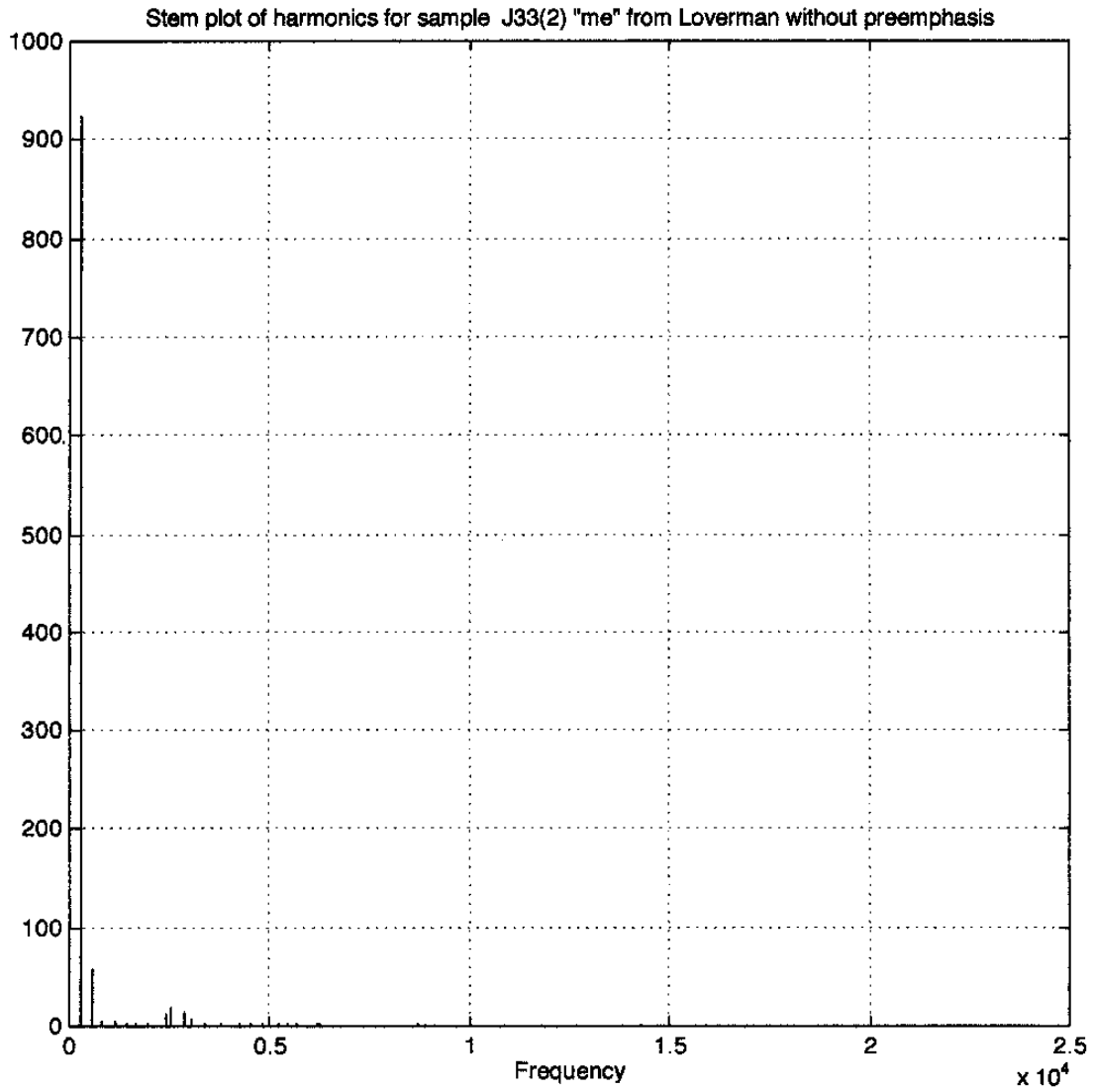
ROW	Freq	Amp	% Amp
1	288	923.072	100.000
2	558	56.609	6.133
3	810	5.060	0.548
4	1116	4.357	0.472
5	1404	1.927	0.209
6	1656	2.920	0.316
7	1944	3.025	0.328
8	2376	12.449	1.349
9	2502	19.231	2.083
10	2880	13.196	1.430
11	3060	7.829	0.848
12	3348	2.589	0.280
13	3780	3.252	0.352
14	4140	0.998	0.108
15	4212	1.453	0.157
16	4536	1.472	0.159
17	4788	1.371	0.148
18	5202	1.412	0.153
19	5436	1.658	0.180
20	5670	1.328	0.144
21	6156	1.390	0.151
22	6246	2.075	0.225
23	6624	0.506	0.055
24	6966	0.561	0.061
25	7308	0.950	0.103
26	7524	0.924	0.100
27	7704	0.675	0.073
28	8028	0.689	0.075
29	8460	0.902	0.098
30	8676	1.195	0.130
31	9000	0.852	0.092
32	9234	0.588	0.064
33	9468	0.503	0.055
34	9900	0.293	0.032
35	10134	0.319	0.035
36	10350	0.293	0.032
37	10656	0.293	0.032
38	11052	0.258	0.028
39	11322	0.303	0.033
40	11628	0.283	0.031
41	11718	0.419	0.045
42	12078	0.300	0.032
43	12384	0.446	0.048
44	12654	0.269	0.029
45	12978	0.256	0.028
46	13284	0.269	0.029
47	13446	0.304	0.033
48	13716	0.259	0.028
49	14022	0.229	0.025
50	14508	0.233	0.025
51	14724	0.241	0.026
52	14868	0.236	0.026
53	15264	0.216	0.023
54	15660	0.231	0.025
55	15912	0.217	0.024
56	16128	0.226	0.025
57	16344	0.201	0.022
58	16704	0.215	0.023

--- good tracking  
 ← low F2

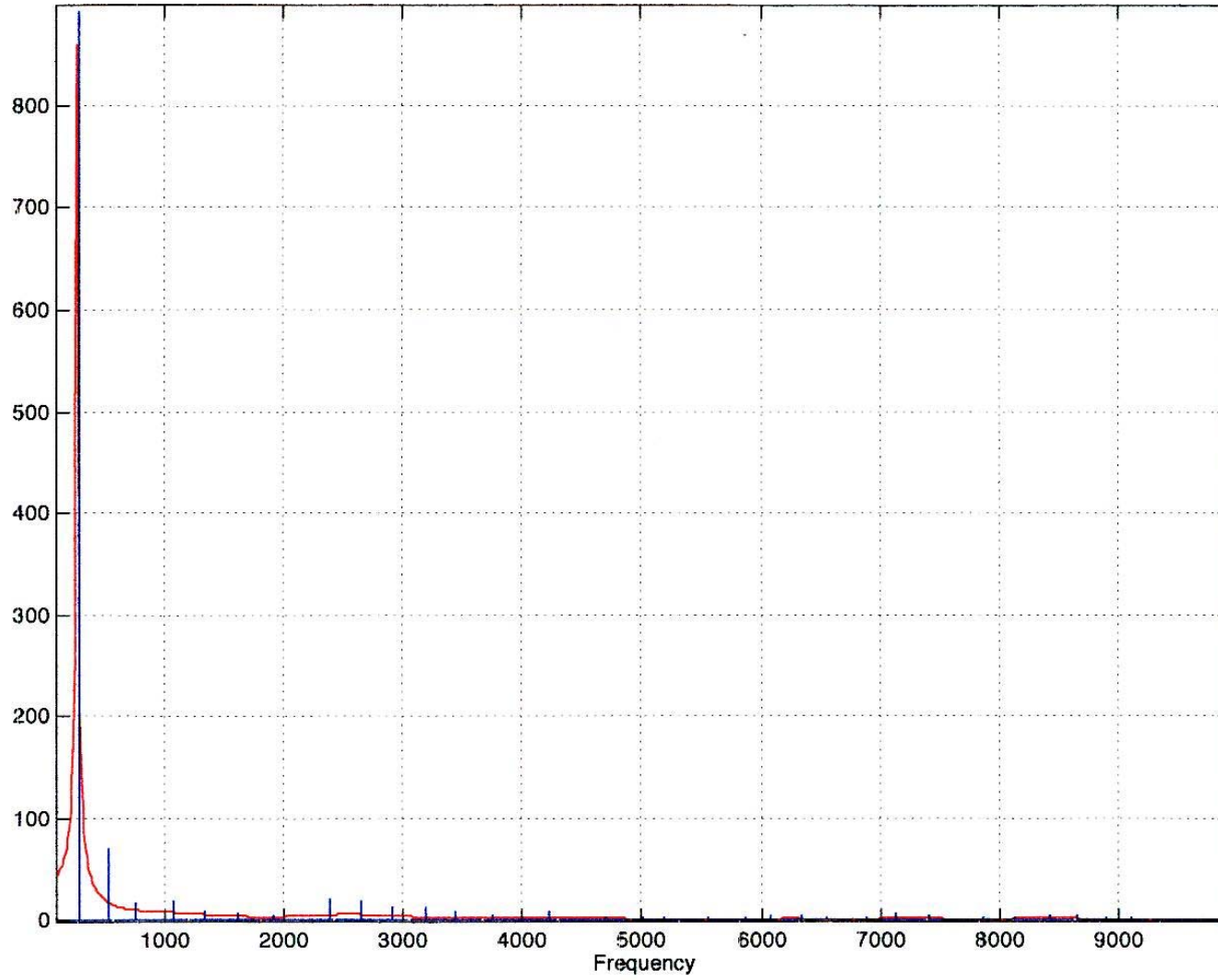
59	16938	0.206	0.022
60	17316	0.213	0.023
61	17622	0.214	0.023
62	17892	0.194	0.021
63	18036	0.220	0.024
64	18342	0.205	0.022
65	18630	0.201	0.022
66	19044	0.194	0.021
67	19314	0.195	0.021
68	19476	0.182	0.020
69	19926	0.187	0.020
70	20106	0.222	0.024
71	20556	0.191	0.021
72	20718	0.187	0.020
73	20952	0.197	0.021
74	21240	0.197	0.021
75	21564	0.186	0.020
76	21834	0.182	0.020
77	22284	0.193	0.021
78	22356	0.178	0.019
79	22806	0.186	0.020
80	23004	0.169	0.018
81	23220	0.179	0.019
82	23508	0.174	0.019
83	19368	0.639	0.069
84	19566	0.628	0.068
85	19980	0.591	0.064
86	20142	0.601	0.065
87	20322	0.573	0.062
88	20520	0.575	0.062
89	20772	0.598	0.065
90	21078	0.580	0.063
91	21204	0.610	0.066
92	21582	0.583	0.063
93	21690	0.588	0.064
94	22032	0.614	0.067
95	22302	0.557	0.060
96	22554	0.583	0.063
97	22752	0.556	0.060
98	22986	0.569	0.062
99	23094	0.571	0.062
100	23490	0.559	0.061
101	23670	0.547	0.059
102	20160	0.179	0.019
103	20430	0.180	0.020
104	20610	0.171	0.019
105	20718	0.158	0.017
106	21042	0.164	0.018
107	21240	0.157	0.017
108	21420	0.141	0.015
109	21564	0.154	0.017
110	21834	0.144	0.016
111	21978	0.138	0.015
112	22104	0.146	0.016
113	22302	0.133	0.014
114	22608	0.144	0.016
115	22824	0.134	0.014
116	22950	0.130	0.014
117	23202	0.139	0.015
118	23418	0.141	0.015

119 23490 0.135 0.015  
120 23814 0.133  
0.014

DFT stem plot of J33c



Stem plot/LPC overlay of harmonics for sample J33(1) without preemphasis

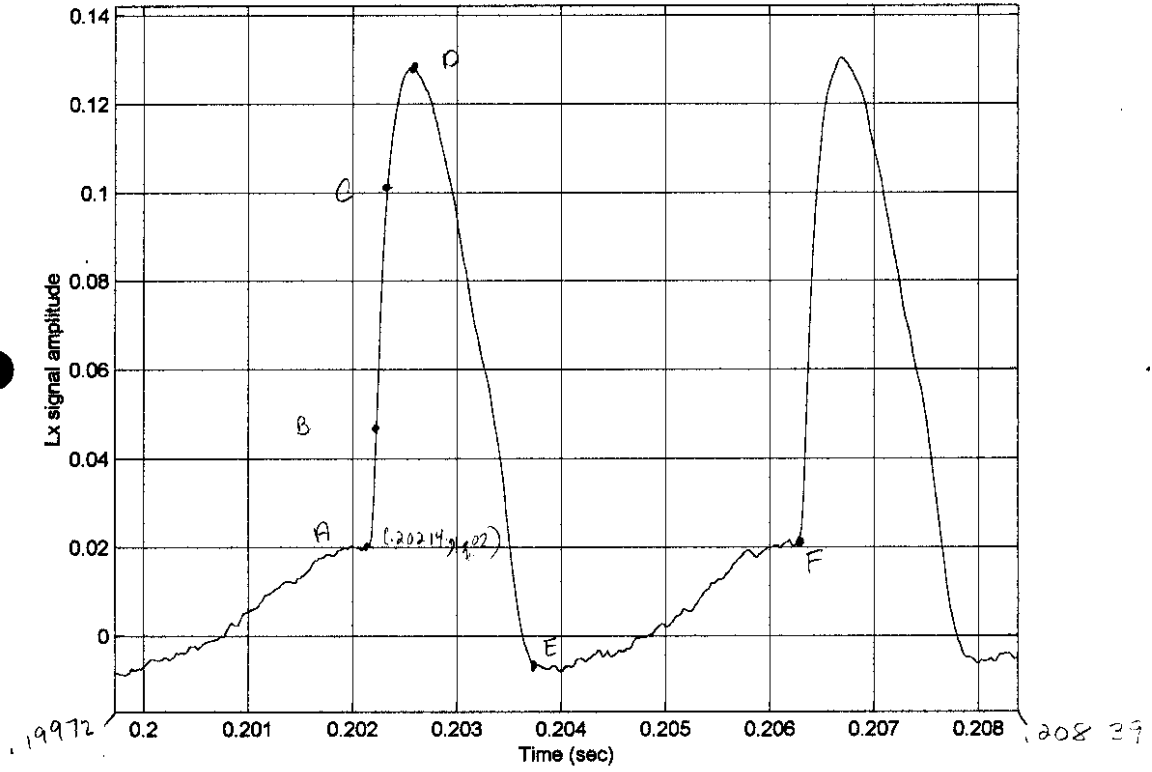


$x \Rightarrow 18 \text{ mm} = .001$

$y \Rightarrow 15.5 \text{ mm} = .01$

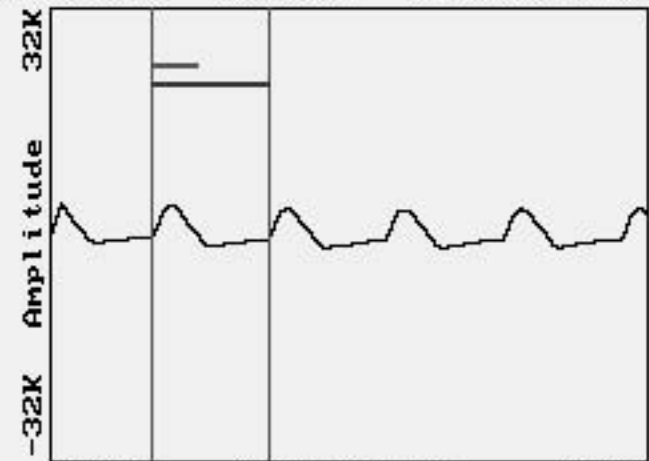
$y \Rightarrow 1 \text{ mm} = .0012903$

EGG J33B



■A> : CH1: J33B\_E~1.NSP

< 0.00 sec 38.28% 252.00 Hz >



Duration 2.50 (sec)

0.00 Time (sec) 0.02

□B> :

< sec % Hz >

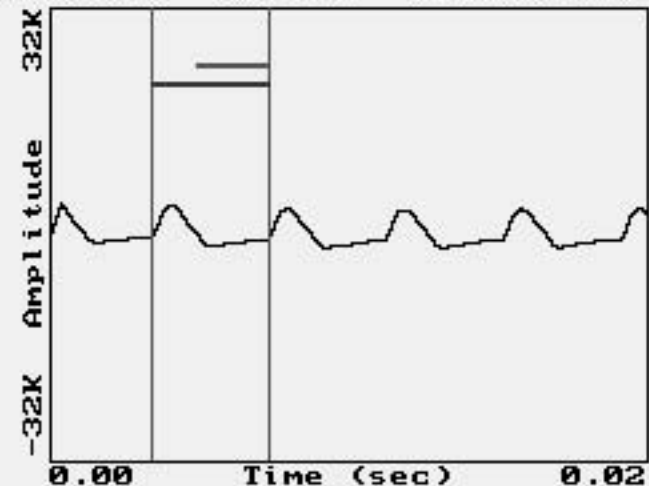
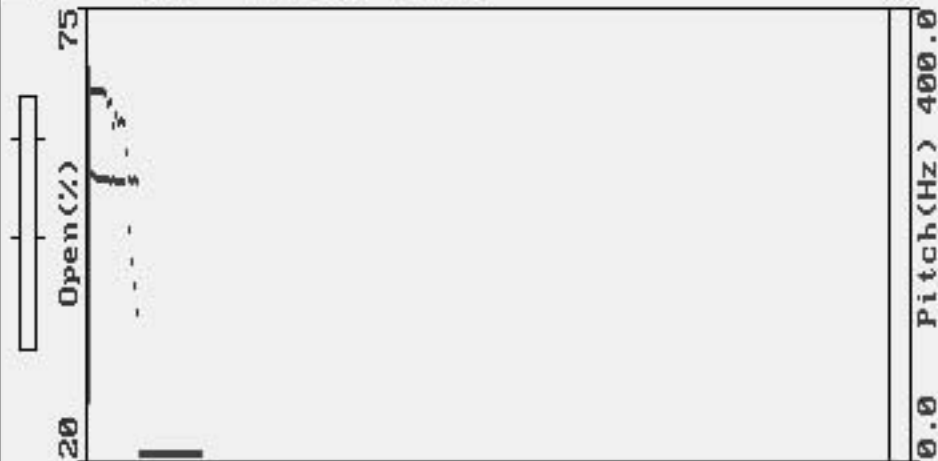


Duration 2.50 (sec)

Time (sec)

**A** > : CH1: J33B\_E~1.NSP

< 0.00 sec 61.71% 252.00 Hz >



Duration 2.50 (sec)

0.00 Pitch(Hz) 400.0  
-32K Amplitude 32K  
0.00 Time (sec) 0.02

**B** > :

< sec % Hz >



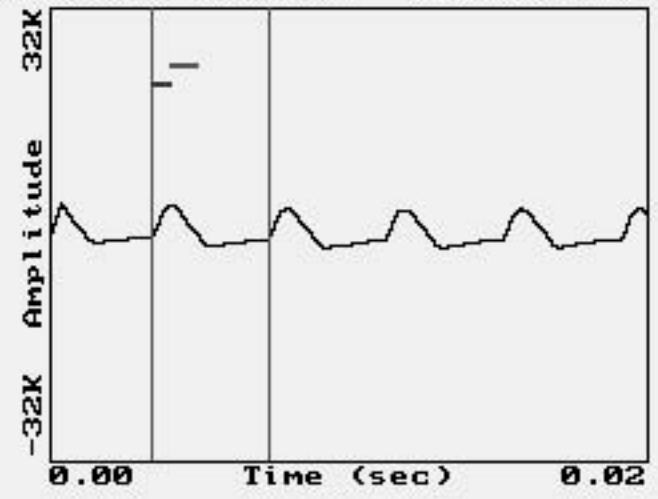
Duration 2.50 (sec)

Time (sec)

0.00 Pitch(Hz) 400.0  
-32K Amplitude 32K

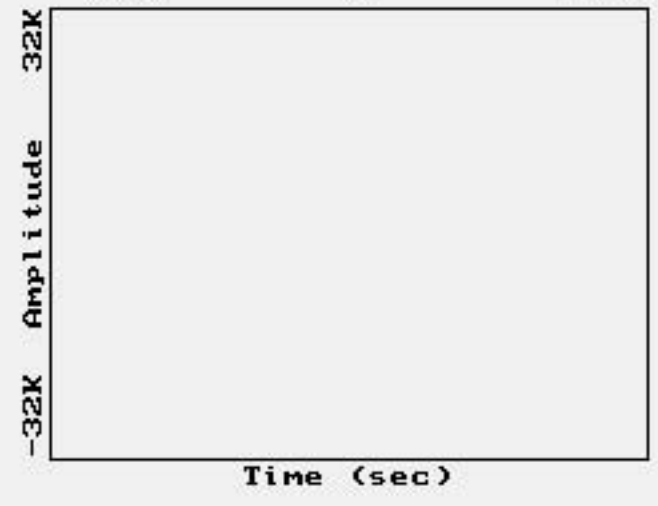
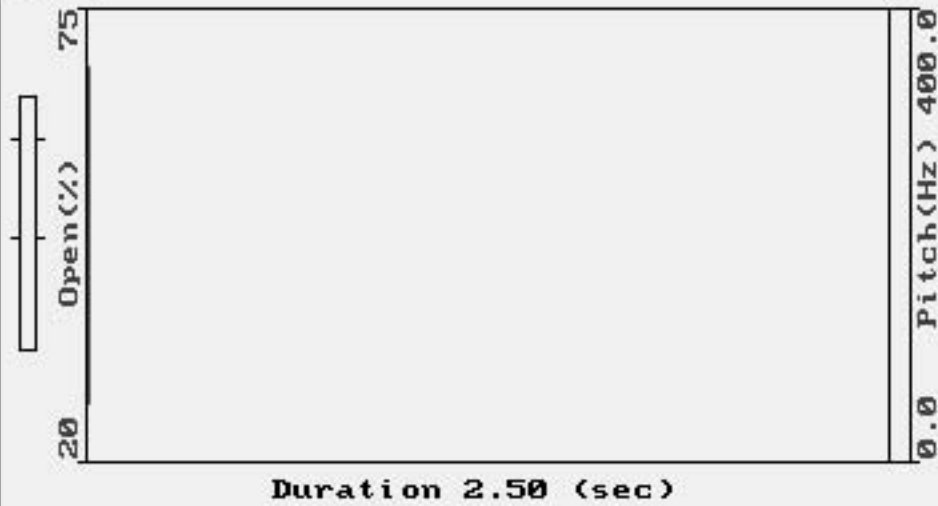
■A> : CH1: J33B\_E~1.NSP

< 0.00 sec 148.14% 252.00 Hz >

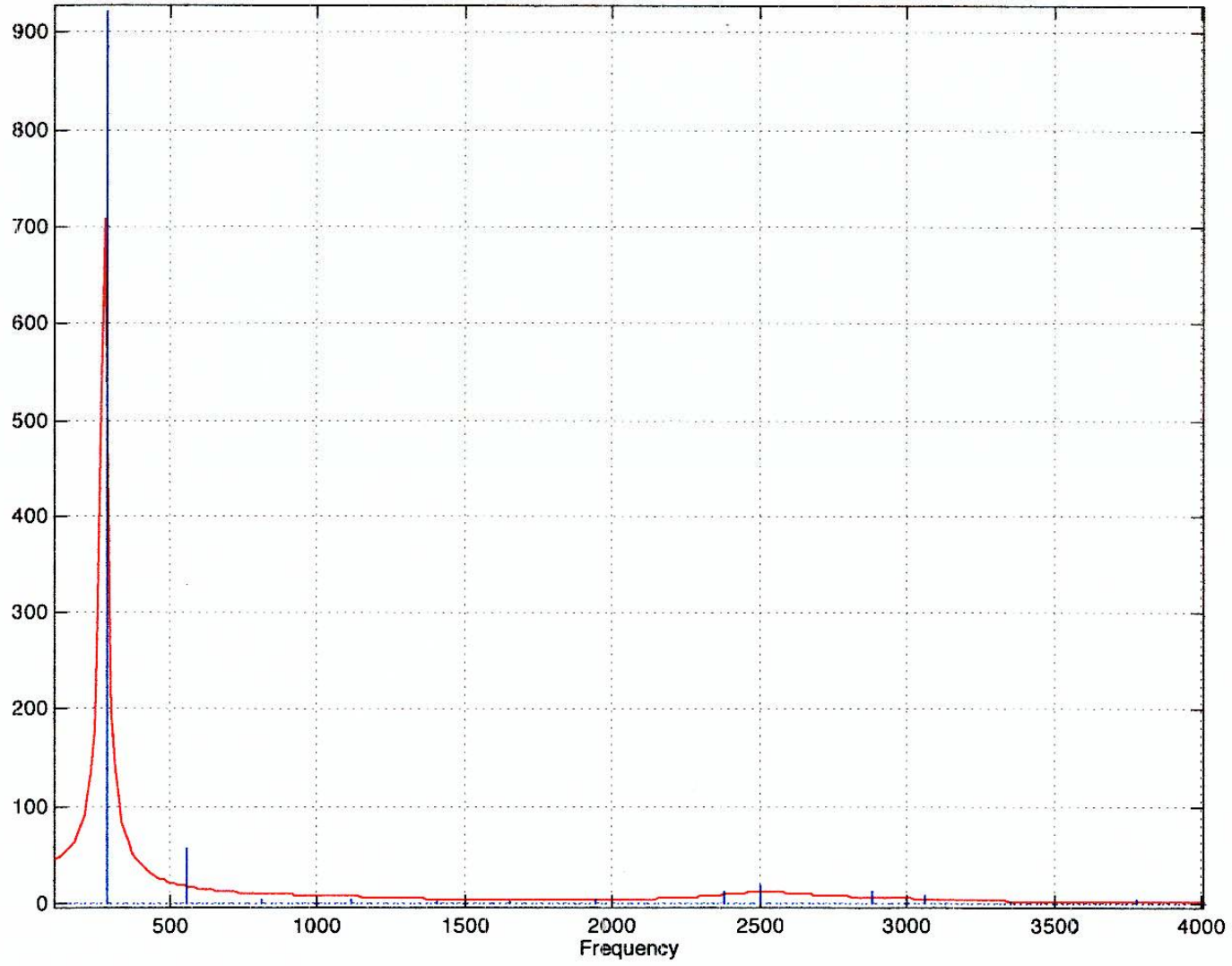


□B> :

< sec % Hz >



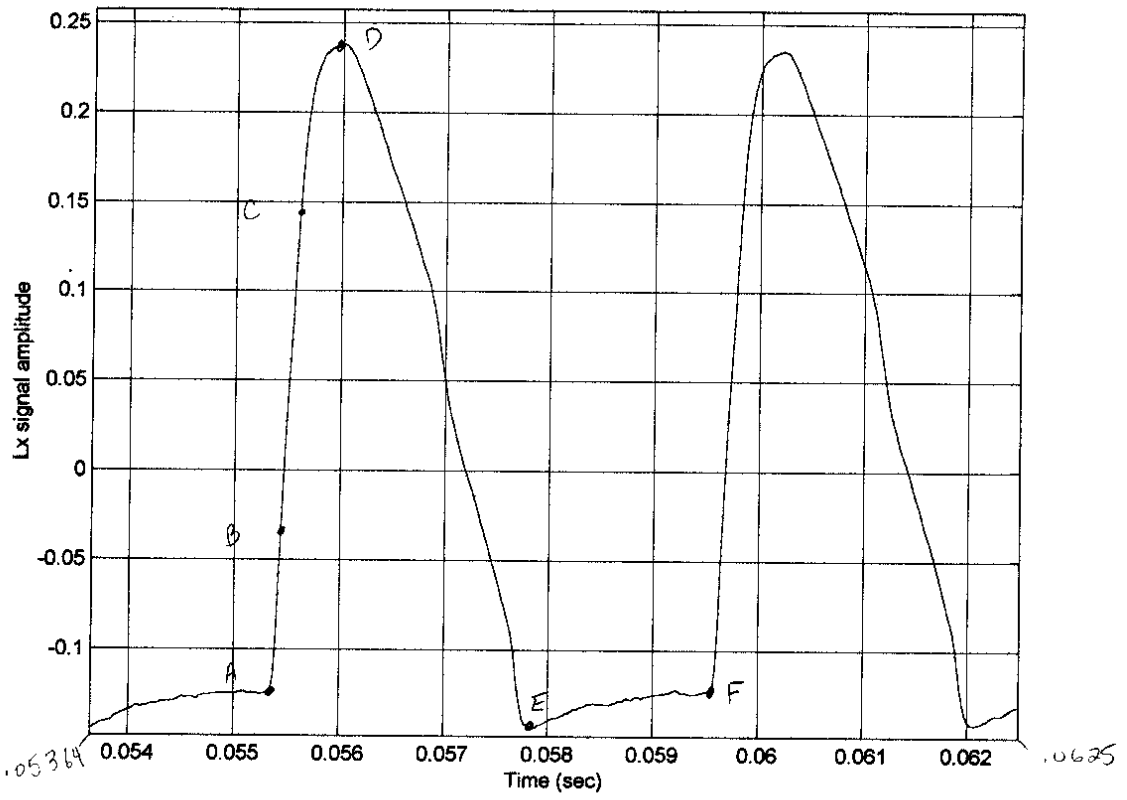
Stem plot/LPC overlay of harmonics for sample J33(2) without preemphasis

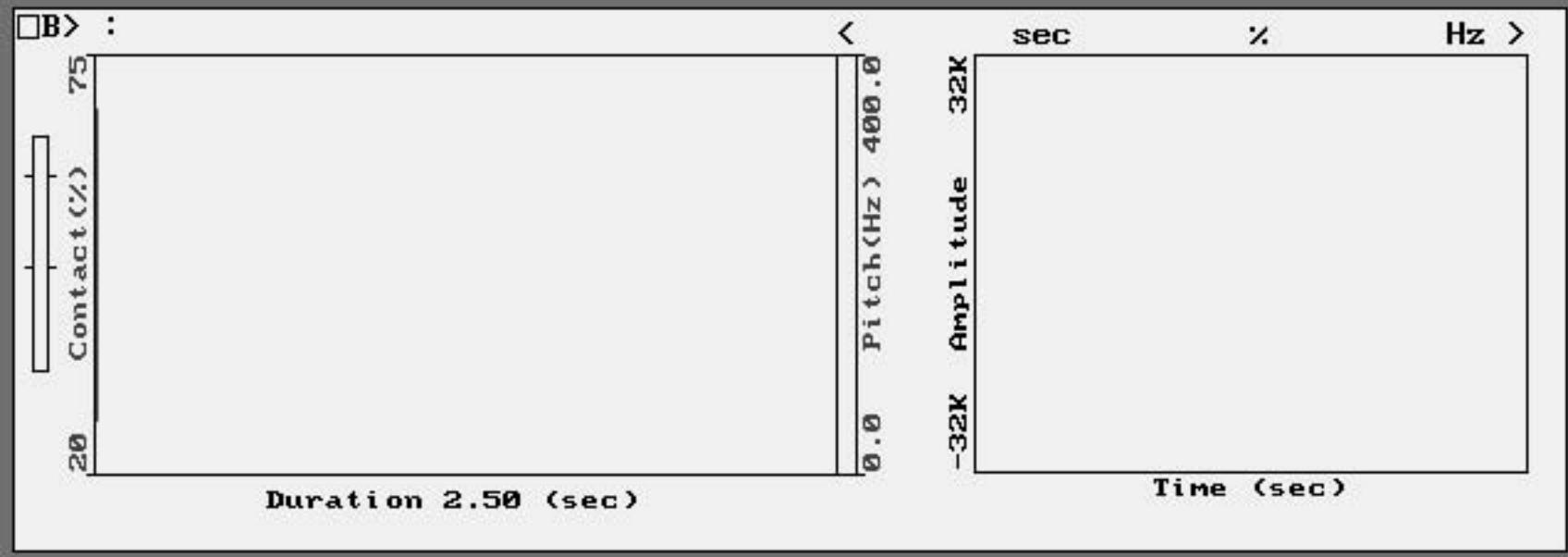
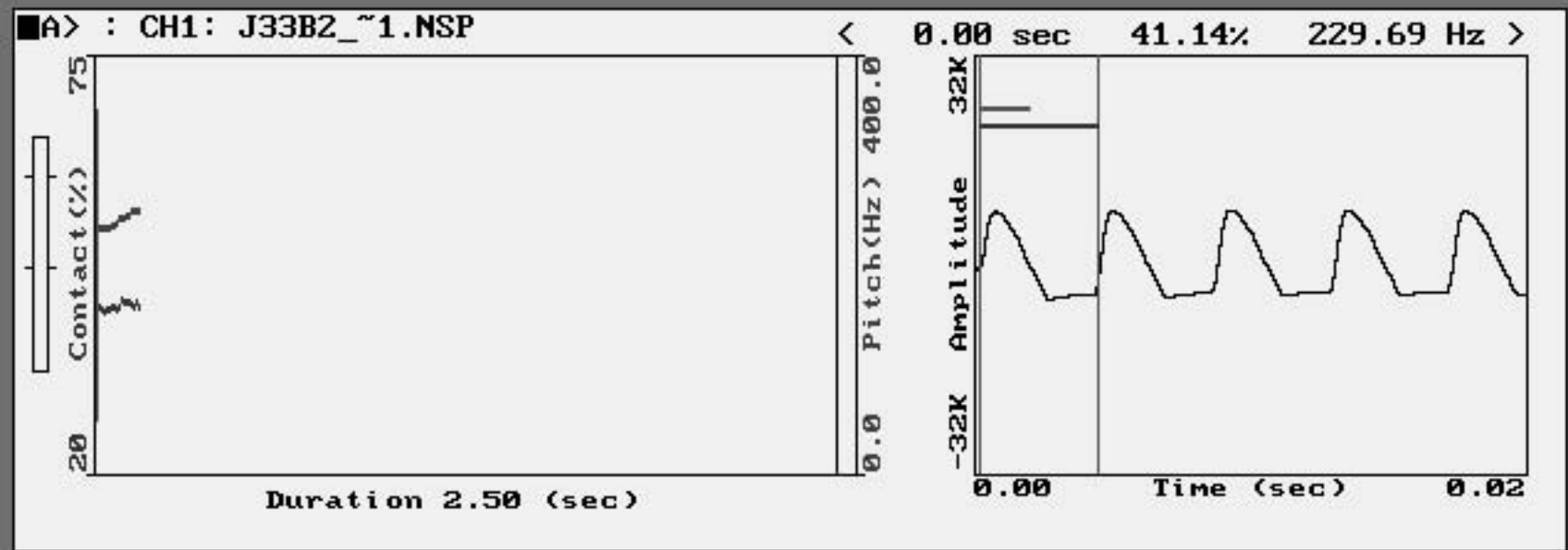


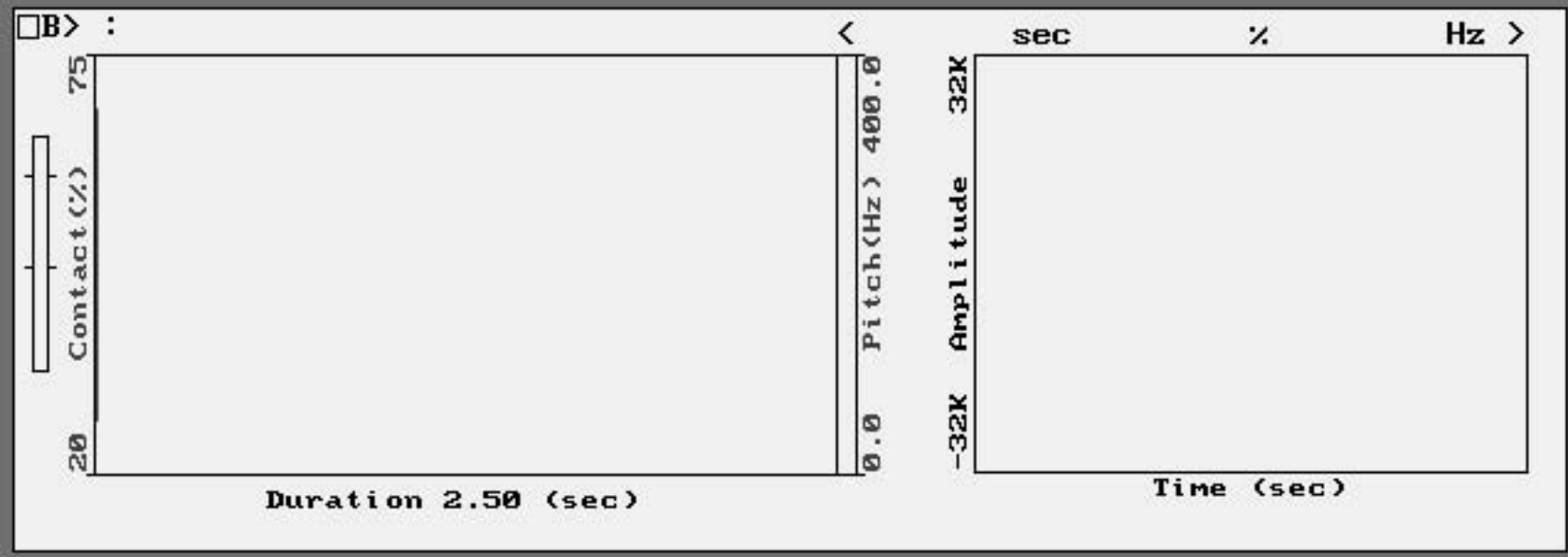
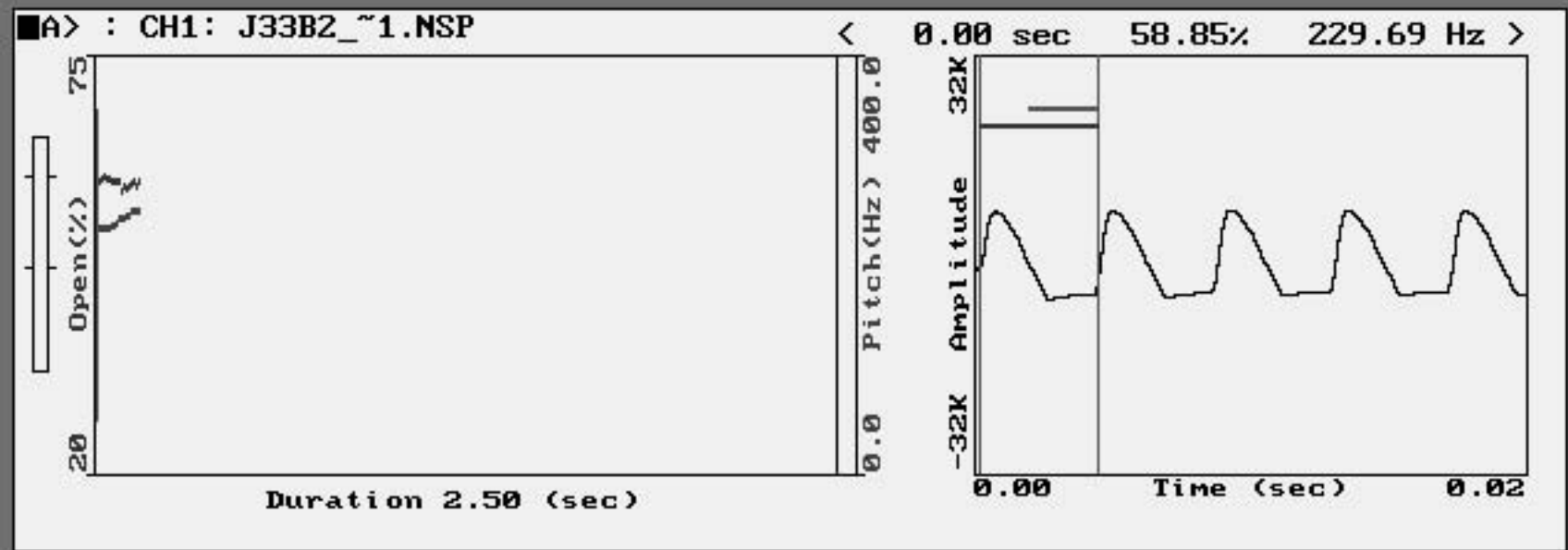
$$x \Rightarrow 18 \mu\text{m} = .001$$
$$y \Rightarrow 15 \mu\text{m} = .05$$

$$y \Rightarrow 1 \mu\text{m} = .0033333$$

EGG J33B2

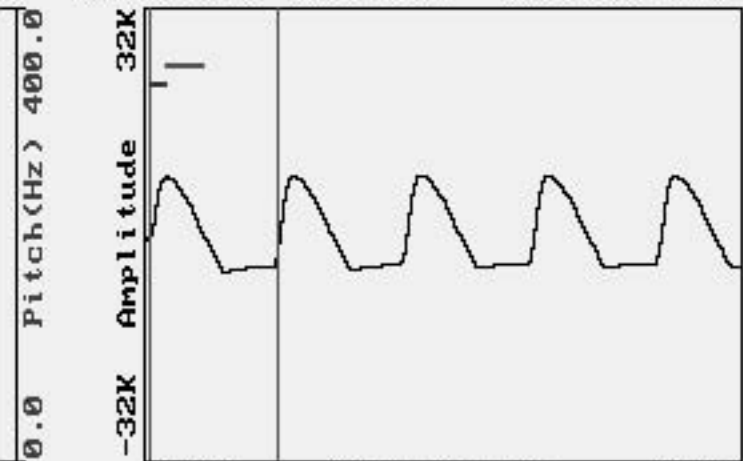






■A> : CH1: J33B2\_~1.NSP

< 0.00 sec 229.16% 229.69 Hz >



Pitch(Hz) 400.0

Duration 2.50 (sec)

□B> :

< sec % Hz >



Pitch(Hz) 400.0

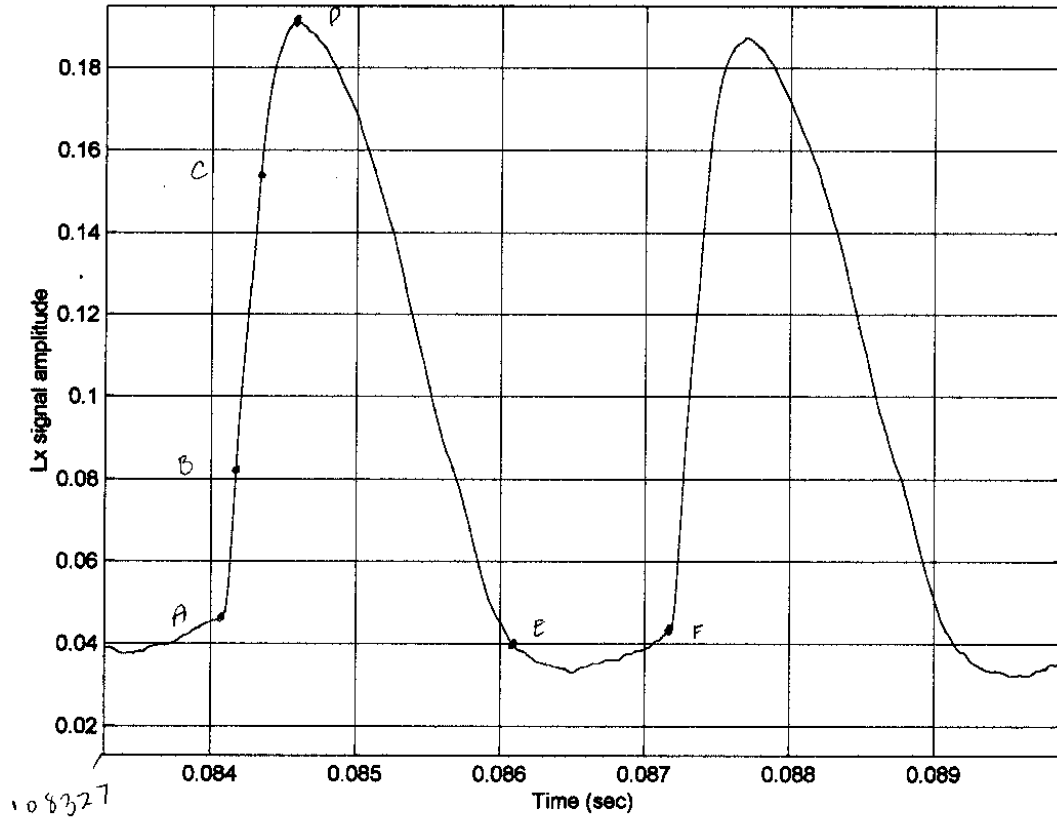
Duration 2.50 (sec)

$x \Rightarrow 24\text{mm} = .001$

$y \Rightarrow 13.5\text{mm} = .02$

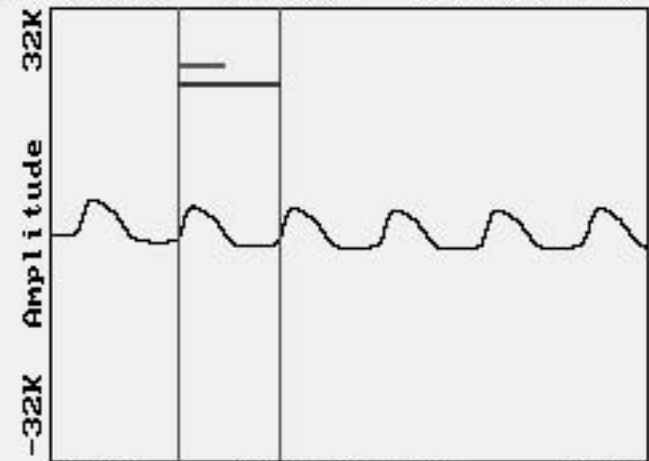
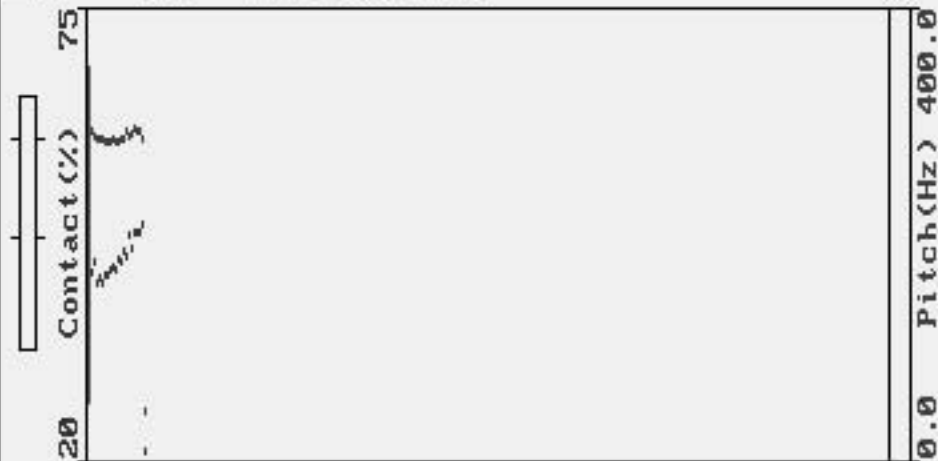
$y \Rightarrow 1\text{mm} = .0014814$

EGG J38B1



**A** > : CH1: J38B2\_~1.NSP

< 0.00 sec 45.69% 292.05 Hz >



Duration 2.50 (sec)

0.00 Time (sec) 0.02

**B** > :

< sec % Hz >

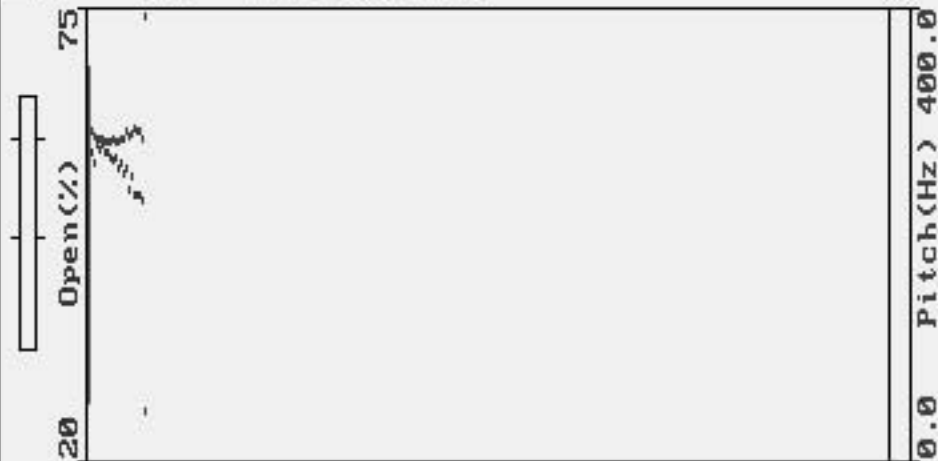


Duration 2.50 (sec)

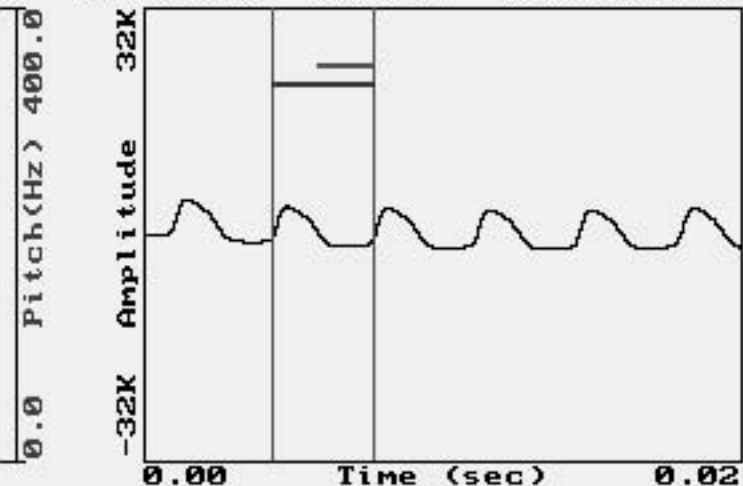
Time (sec)

■A> : CH1: J38B2\_~1.NSP

< 0.00 sec 54.30% 292.05 Hz >



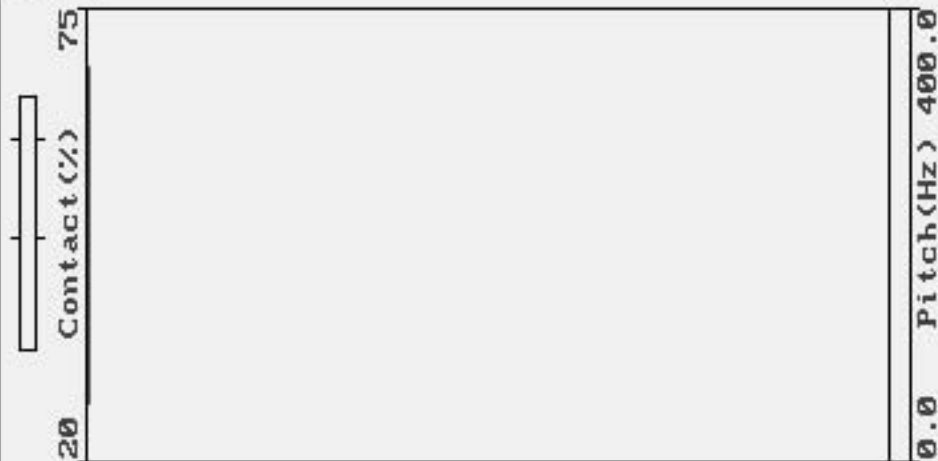
Duration 2.50 (sec)



0.00 Time (sec) 0.02

□B> :

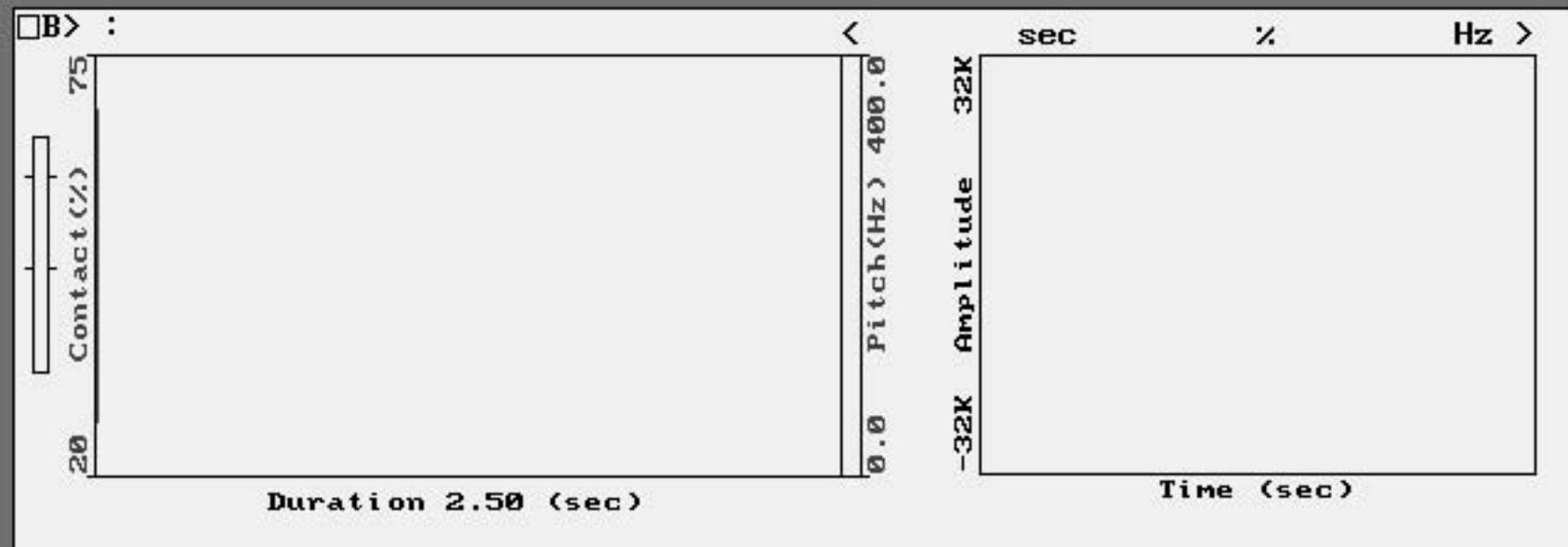
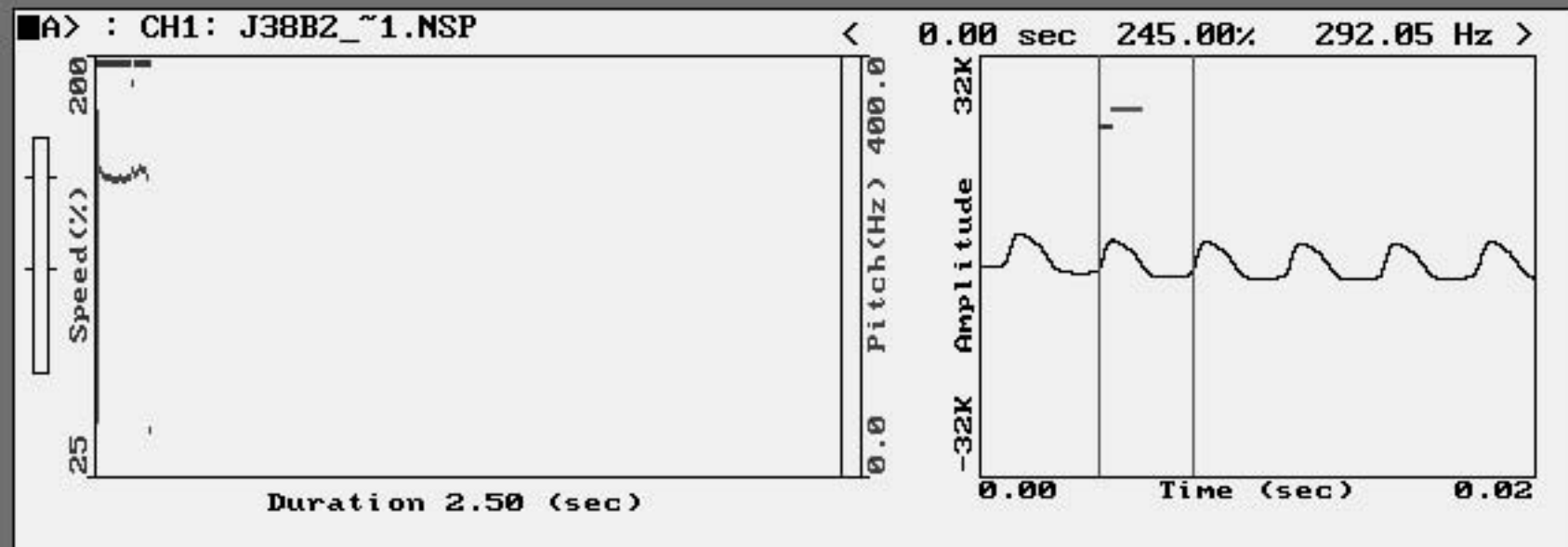
< sec % Hz >



Duration 2.50 (sec)

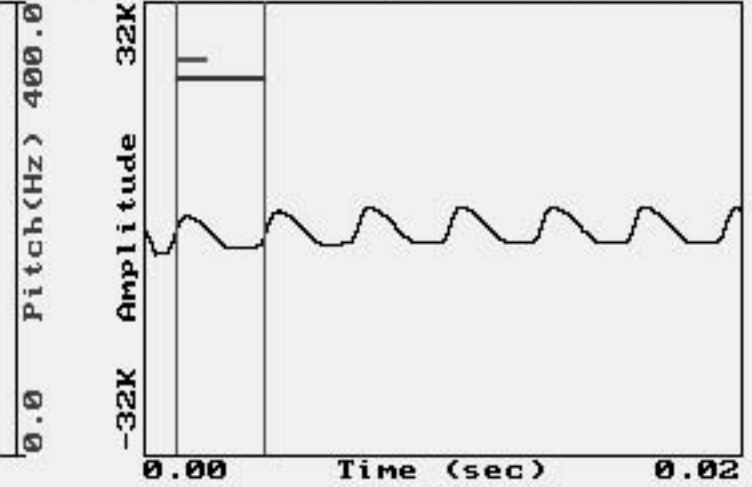
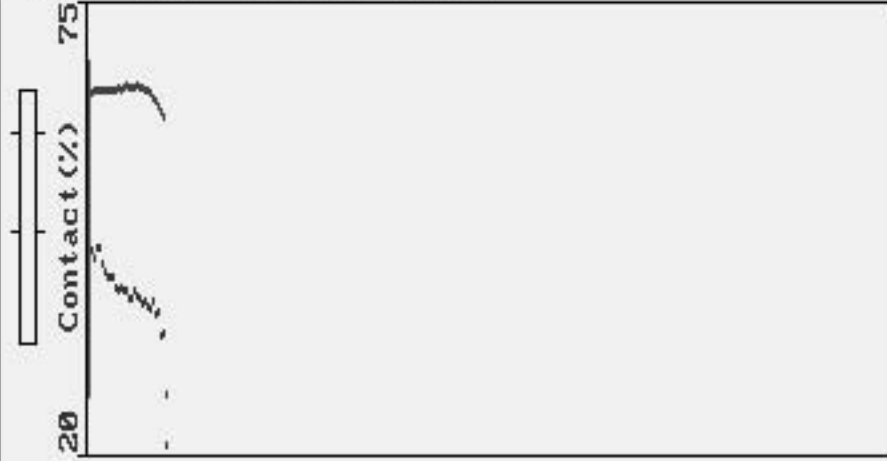


Time (sec)



**A** > : CH1: J38B\_E~1.NSP

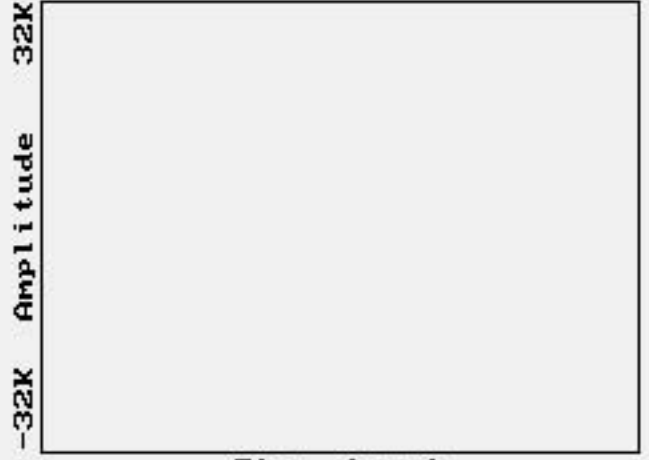
< 0.00 sec 33.83% 331.58 Hz >



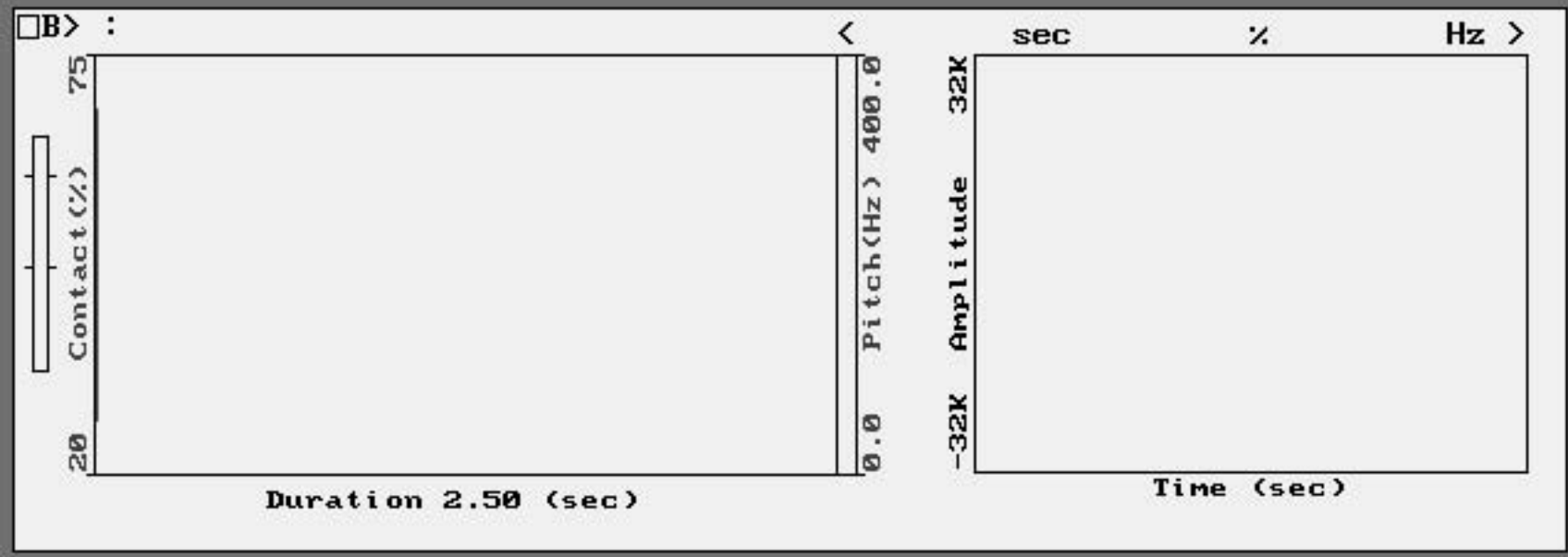
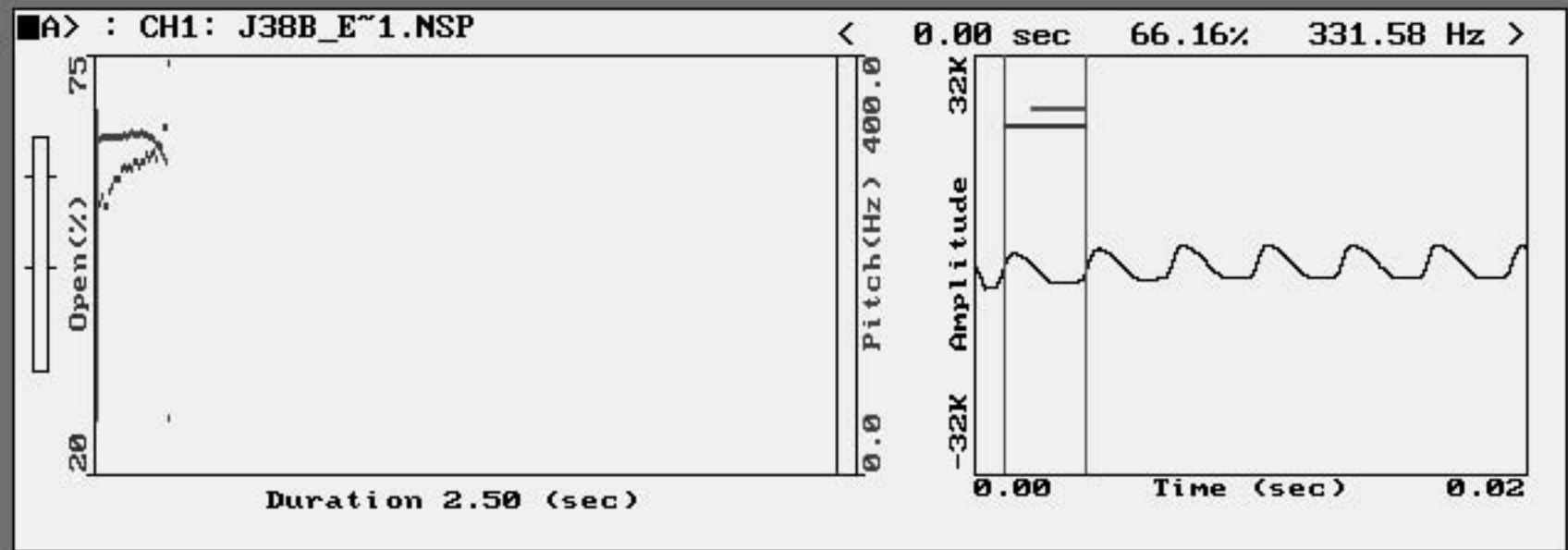
0.0 Pitch(Hz) 400.0

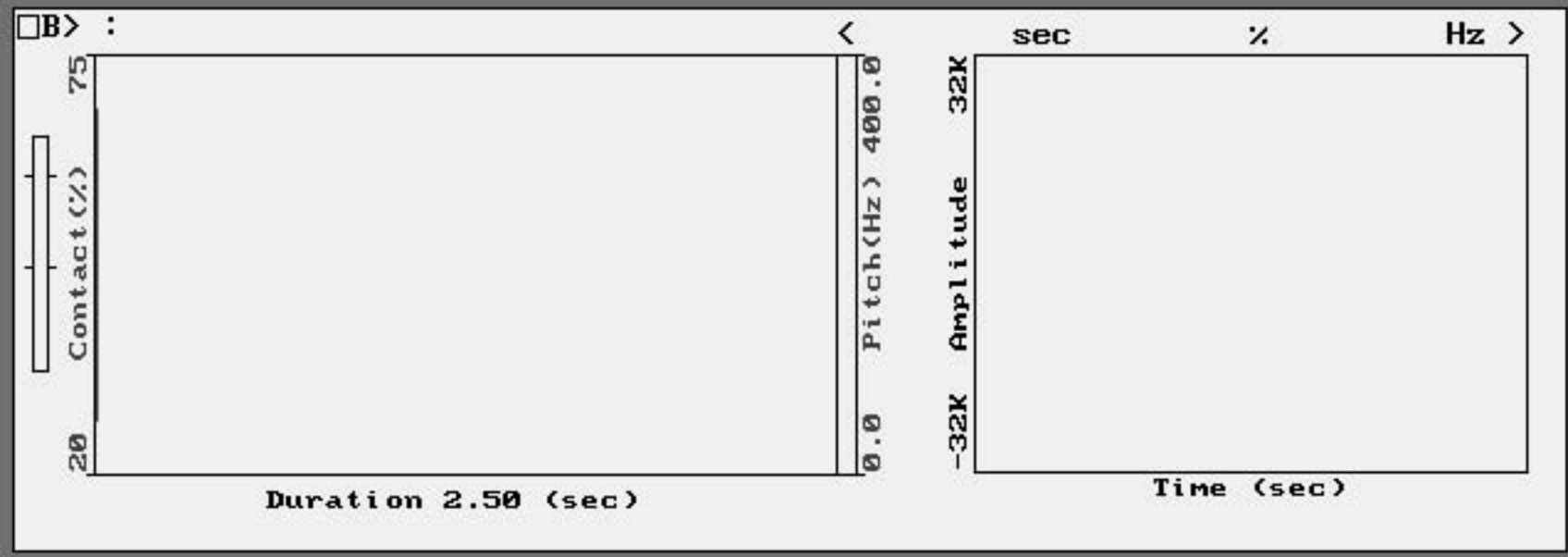
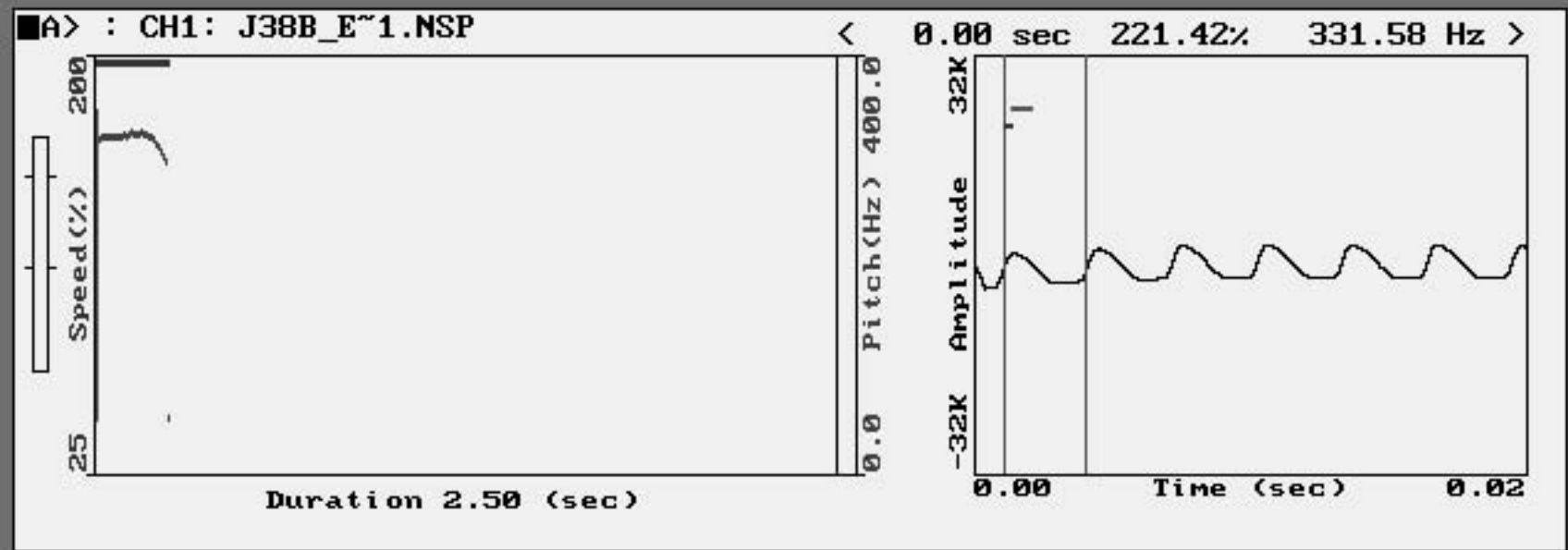
**B** > :

< sec % Hz >



0.0 Pitch(Hz) 400.0

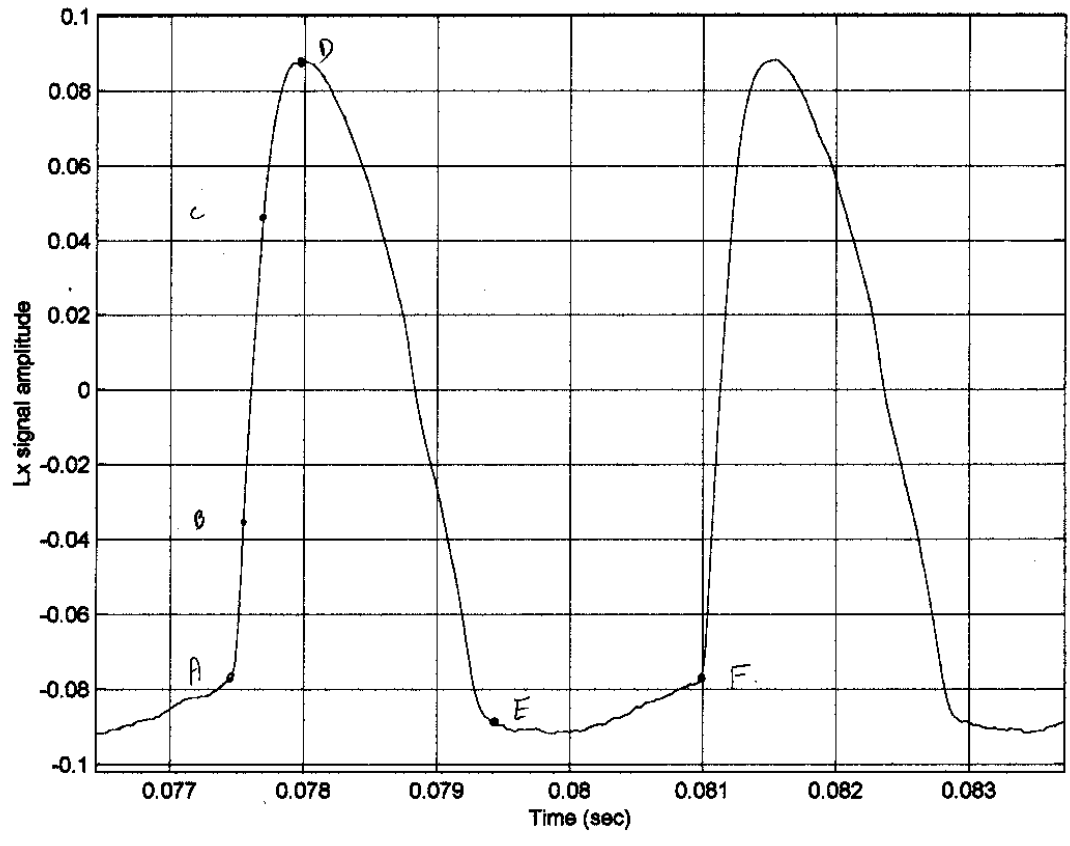




$x \Rightarrow 2\frac{1}{2} \text{ mm} = .001$   
 $y \Rightarrow 12 \text{ mm} = .02$

$y \Rightarrow 1 \text{ mm} = .0016666$

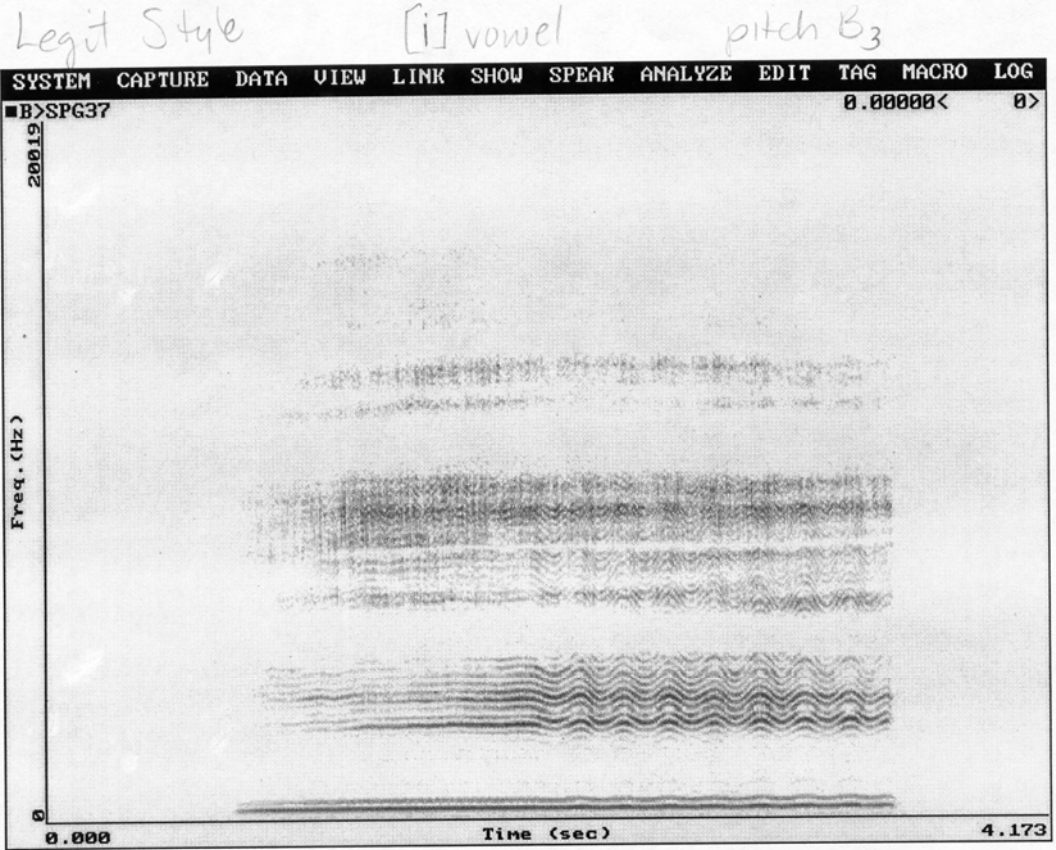
EGG J38B2



Sample #	J1	J11	J21	J33b
Description	Jazz B3	Jazz E4	Jazz B4	Jazz "me"
Data Rate (Hz)	44100	44100	44100	44100
DURATION (sec)	0.62	0.87	0.95	0.37
Start time	0	0	0	0
End time	0.62	0.87	0.95	0.37
Silence	0	0	0	0.24
Active	0.62	0.88	0.96	0.16
Data Points	27136	38400	41728	16512
Range	12591 (14 Bits)	9832 (14 Bits)	12688 (14 Bits)	4762 (13 Bits)
PITCH (Hz)				
Mean	211.88	291.02	429.89	249.44
Pitch Range	526.97	232.78	399.13	31.61
Minimum	103.03	67.22	46.32	242.3
Maximum	630	300	445.45	273.91
Std Deviation	38.98	14.18	19.31	4.58
Avg. Jitter %	1.88	0.74	1	0.57
CONTACT(1:6)%				
Mean	36.21	36.29	38.46	41.01
Range	79.59	39.14	37.5	45.12
Minimum	16.12	6.25	4.08	18.06
Maximum	95.71	45.39	41.58	63.18
Std Deviation	6.21	4.59	1.91	9.91
CONTACT(Tif)	38.38	45.39	39.21	38.28
SPEED(3:2)%				
Mean	202.64	156.53	151.73	159.13
Range	220.13	91.3	152.53	217.69
Minimum	29.87	89.65	111.1	45.45
Maximum	250	180.95	263.63	263.14
Std Deviation	17.85	10.81	10.86	54.61
SPEED(Tif)	224	155.55	150	148.14
OPEN(4:6)%				
Mean	63.77	63.69	61.52	58.97
Range	79.59	39.15	37.49	45.11
Minimum	4.28	54.6	58.41	36.81
Maximum	83.87	93.75	95.9	81.92
Std Deviation	6.21	4.59	1.91	9.91
OPEN(Tif)	61.61	54.6	60.78	61.71

J33b2	J38b Jazz "daisies"	J38b2 Jazz "green"
44100	44100	44100
0.15	0.26	0.18
0	0	0
0.15	0.26	0.18
0	0	0
0.17	0.26	0.2
6720	11264	8080
8696 (14 Bits)	3712 (12 Bits)	5176 (13 Bits)
236.46	318.82	282.39
201.78	283.38	257.02
50.22	48.19	38.95
252	331.57	295.97
32.16	31.59	35.07
3.62	2.59	4.15
40.56	38.86	43.59
34.23	39.61	43.58
8.31	5.24	6.09
42.54	44.85	49.67
5.47	4.77	5.88
41.14	33.83	45.69
260.49	232.97	233.63
55.84	124.28	69.8
229.16	140	191.3
285	264.28	261.1
10.64	15.8	12.88
229.16	221.42	245
59.42	61.12	56.39
34.23	39.61	43.59
57.45	55.14	50.31
91.68	94.75	93.9
5.47	4.77	5.88
58.85	66.16	54.3

Spectrogram of L1

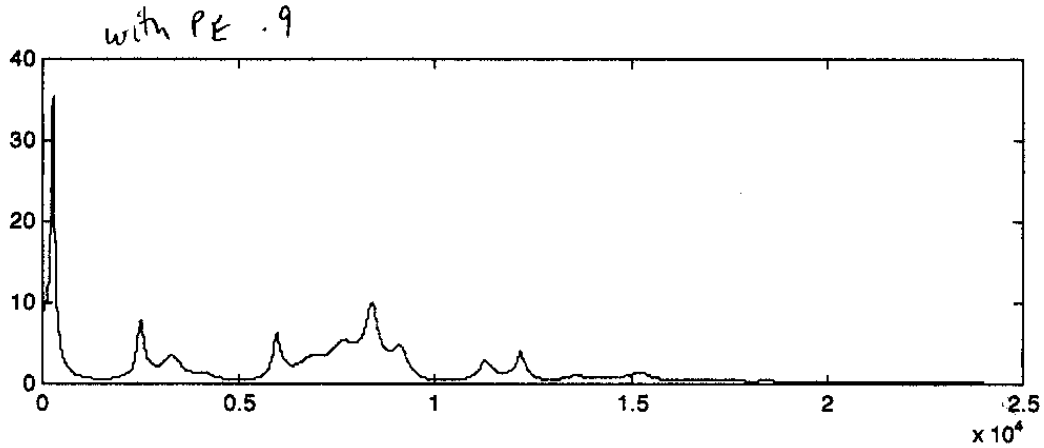
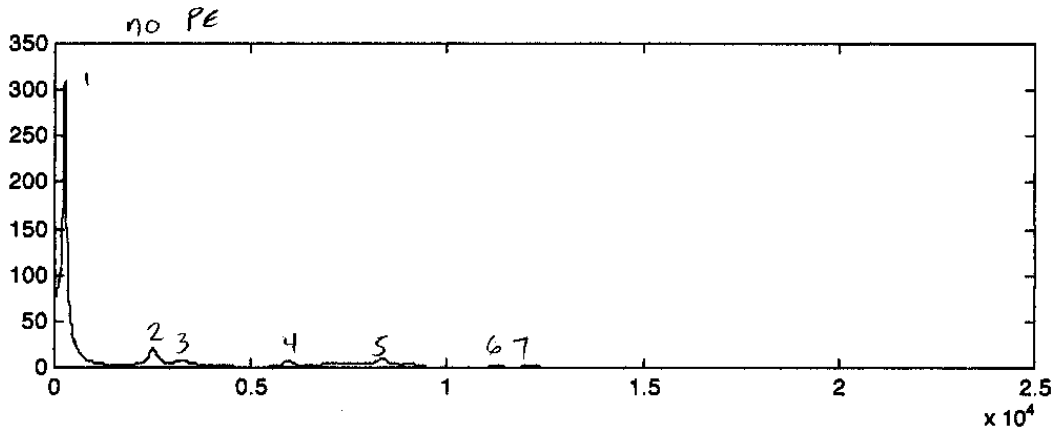


LPC of whole sample of L1

	F	dB
1)	257.81	310.72
2)	2484.38	26.57
3)	3282.60	7.62
4)	5961.11	7.24
5)	8378.85	8.87
6)	11275	2.00
7)	12188	2.45

L1

$$F_0 = 225 \text{ Hz}$$



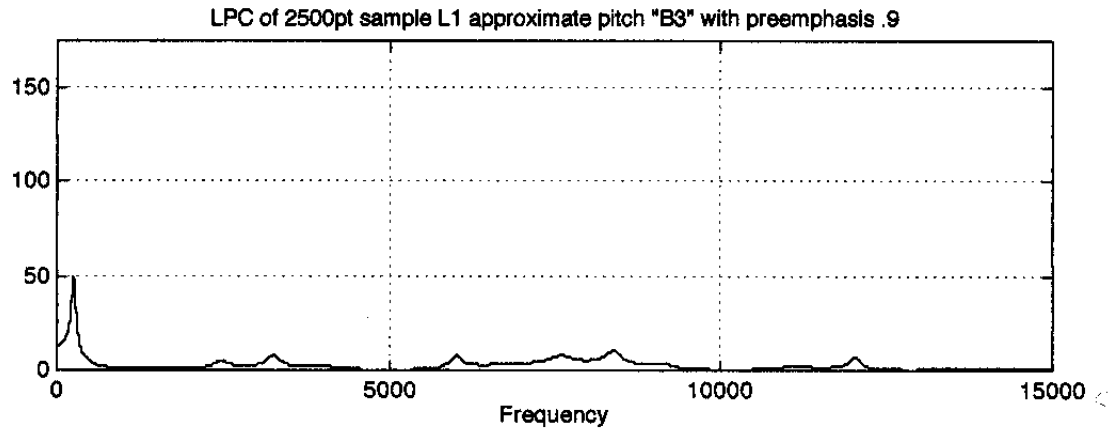
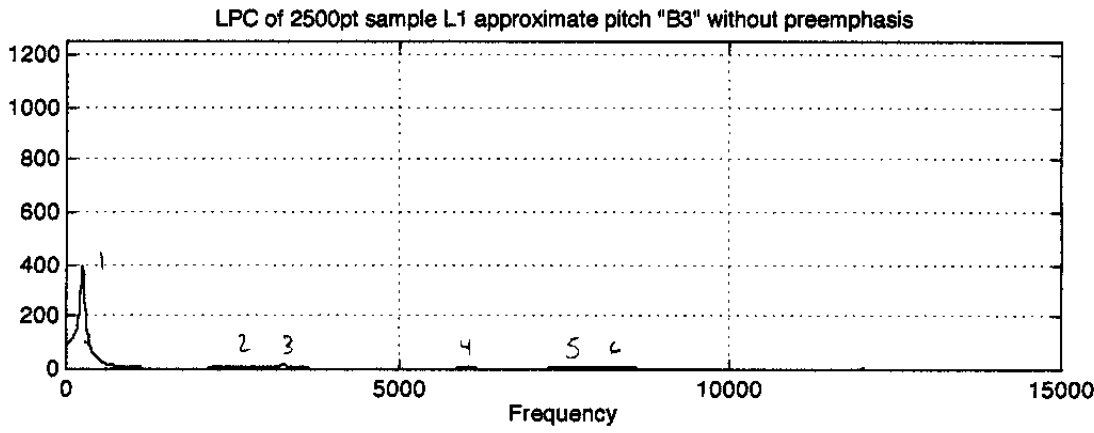
$$.15745833 - .00175 = .15570833 / 35 = T$$

$$= \frac{1}{T} = F$$

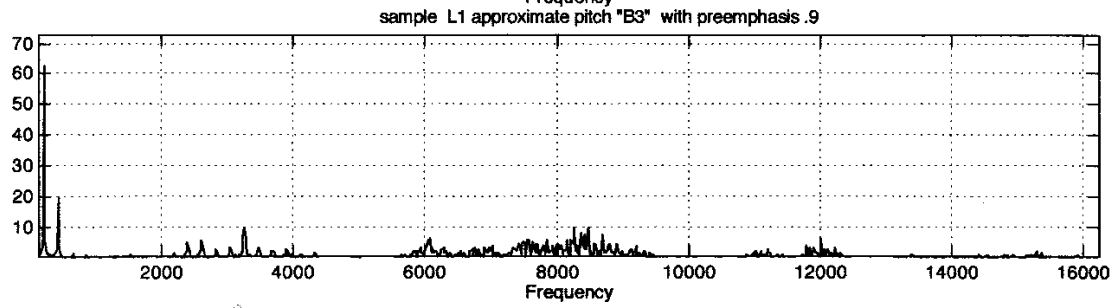
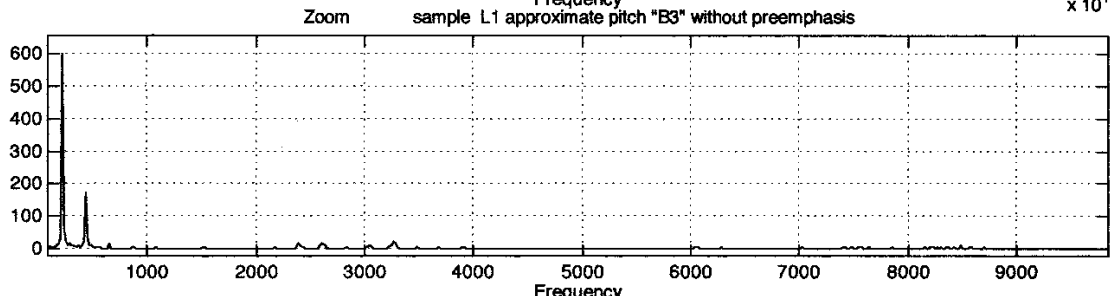
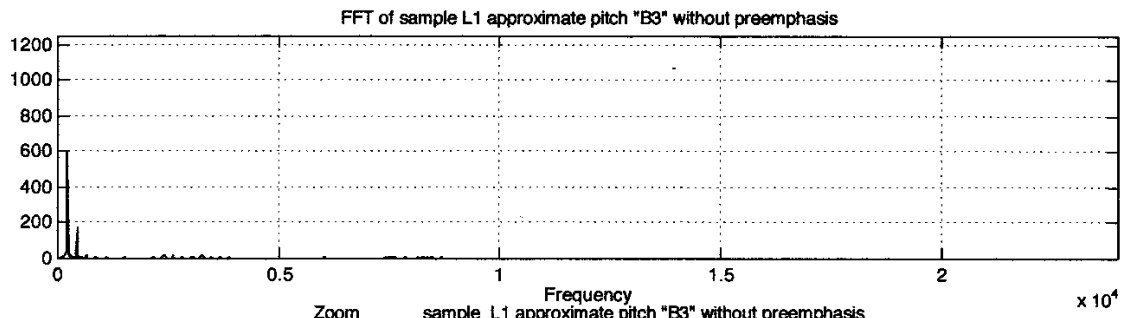
$$= 225 \text{ Hz}$$

$$\text{input } 10,000 - 18,000 = 7999 \text{ pts.}$$

(246.09, 393.21)  
 (2472.65, 11.19)  
 (3269.53, 14.20)  
 (6011.72, 9.21)  
 (7593.75, 7.14)  
 (8378.91, 8.33)



# DFT of sample L1



DFT Numerical Results

Worksheet saved into file: Minitab.L1  
 MTB > Read 'L1-harm' 'Freq e4' 'Amp e4' 'Norm/amp'.  
 120 ROWS READ

ROW	Freq e4	Amp e4	Norm/amp
1	0.0234	0.0602454	1.00000
2	0.0450	0.0175767	0.29175
3	0.0666	0.0016391	0.02721
4	0.0882	0.0009474	0.01573

MTB > Center 'Freq e4' 'Amp e4' 'Freq' 'Amp';  
 SUBC> Location 0.0;  
 SUBC> Scale .0001.  
 MTB > Center 'Norm/amp' '% Amp';  
 SUBC> Location 0.0;  
 SUBC> Scale .01.  
 MTB > Save 'Minitab.L1'

Worksheet saved into file: Minitab.L1  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	234	602.454	100.000
2	450	175.767	29.175
3	666	16.391	2.721
4	882	9.474	1.573
5	1098	5.472	0.908
6	1332	2.742	0.455
7	1548	5.577	0.926
8	1944	1.638	0.272
9	2196	6.732	1.117
10	2412	17.318	2.875
11	2628	17.526	2.909
12	2844	7.545	1.252
13	3060	10.948	1.817
14	3276	23.743	3.941
15	3492	8.649	1.436
16	3690	5.893	0.978
17	3924	5.454	0.905
18	4122	2.268	0.377
19	4356	2.419	0.402
20	4770	0.939	0.156
21	5004	0.967	0.160
22	5076	0.701	0.116
23	5436	0.829	0.138
24	5706	1.588	0.264
25	5868	4.270	0.709
26	6084	8.724	1.448
27	6300	4.833	0.802
28	6552	2.641	0.438
29	6768	4.435	0.736
30	7038	5.101	0.847
31	7344	4.044	0.671
32	7560	7.124	1.182
33	7650	6.603	1.096
34	7866	5.945	0.987
35	8280	9.902	1.644

*— knocking*

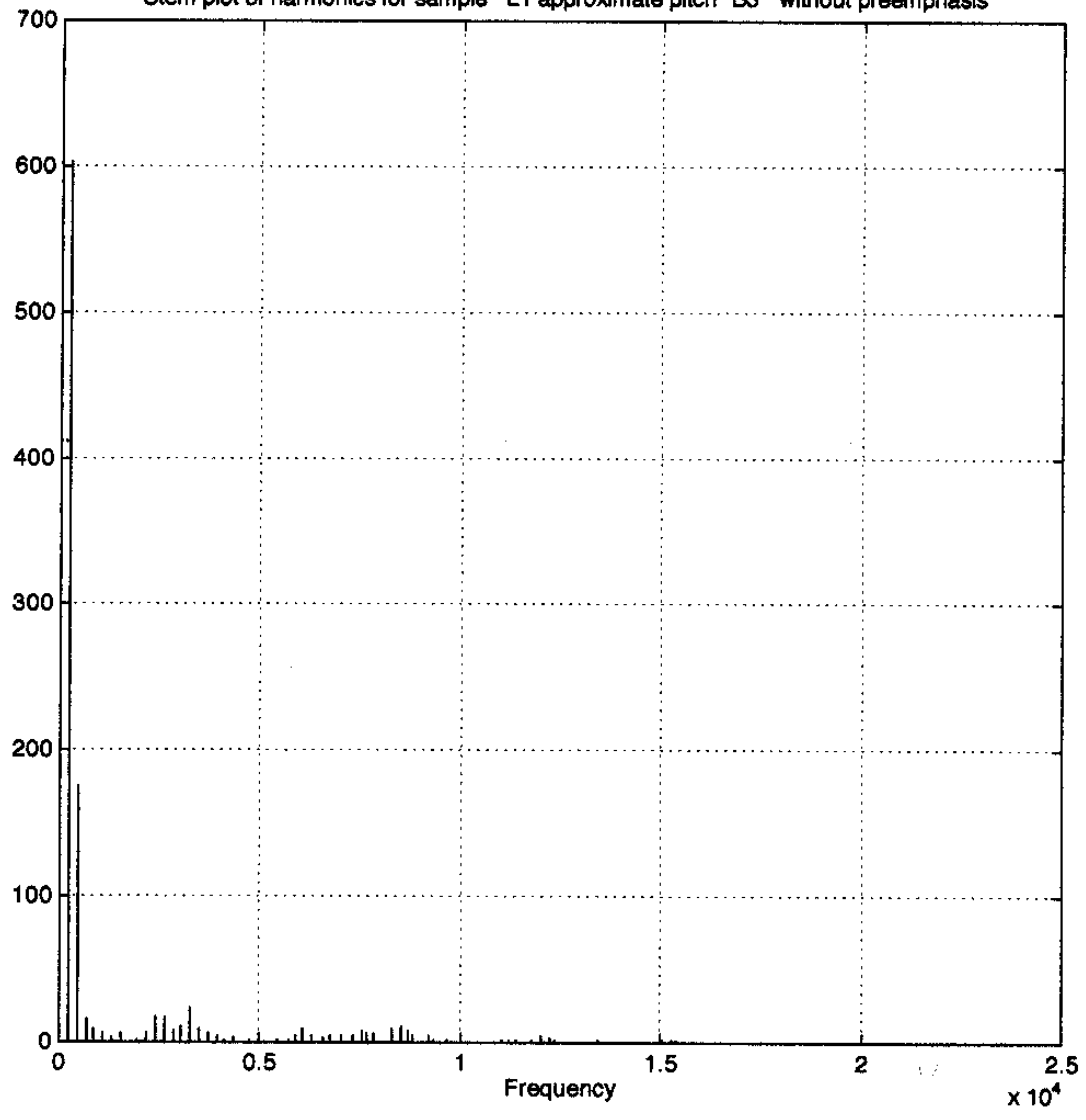
*— close to open h.*

*— close to open h.*

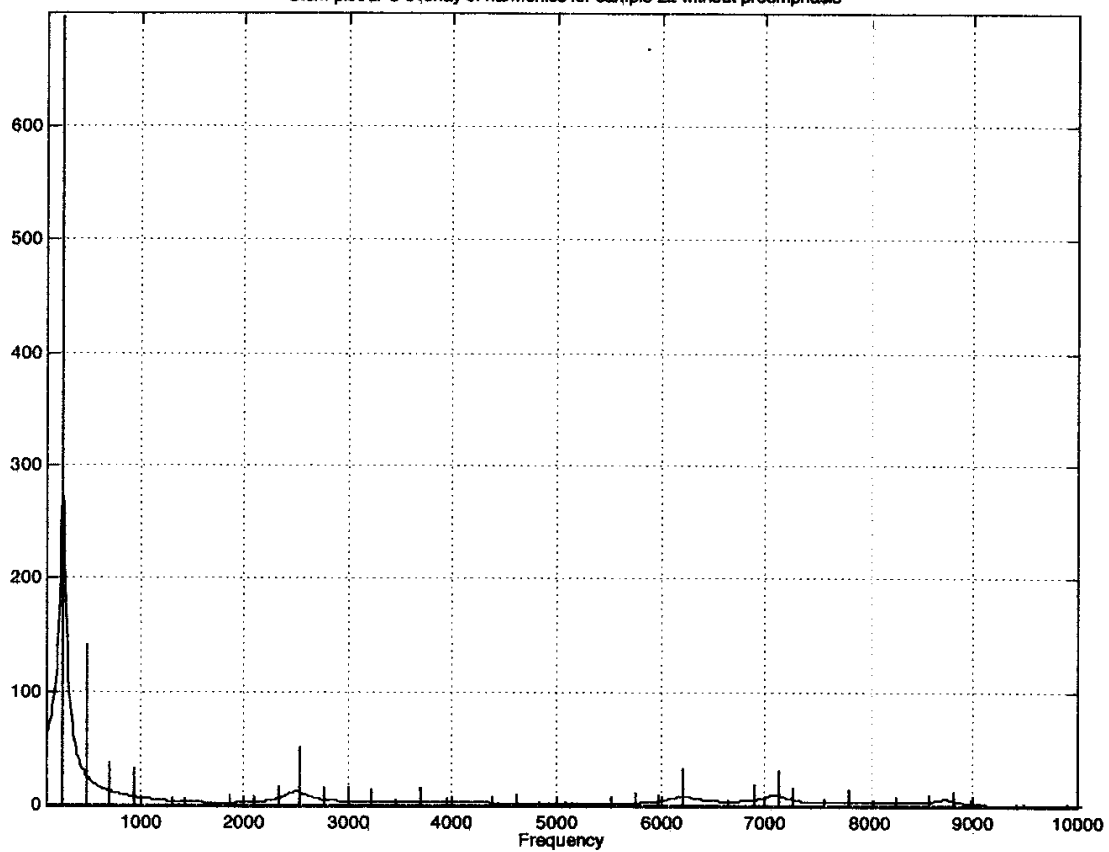
36	8496	10.391	1.725
37	8712	7.304	1.212
38	8820	4.605	0.764
39	9216	4.359	0.724
40	9342	2.310	0.383
41	9648	0.853	0.142
42	9792	0.637	0.106
43	10098	0.434	0.072
44	10224	0.384	0.064
45	10476	0.743	0.123
46	10782	0.386	0.064
47	11034	2.116	0.351
48	11214	2.340	0.388
49	11376	1.007	0.167
50	11772	0.872	0.145
51	12024	4.860	0.807
52	12240	3.126	0.519
53	12330	0.914	0.152
54	12546	0.434	0.072
55	12888	0.227	0.038
56	13176	0.465	0.077
57	13428	0.906	0.150
58	13518	0.642	0.107
59	13770	0.506	0.084
60	14130	0.360	0.060
61	14202	0.657	0.109
62	14598	0.755	0.125
63	14670	0.604	0.100
64	15066	0.801	0.133
65	15282	1.451	0.241
66	15372	0.862	0.143
67	15768	0.458	0.076
68	15930	0.587	0.097
69	16092	0.544	0.090
70	16344	0.472	0.078
71	16632	0.453	0.075
72	16794	0.387	0.064
73	17100	0.316	0.052
74	17226	0.400	0.066
75	17496	0.260	0.043
76	17784	0.256	0.043
77	17982	0.183	0.030
78	18198	0.212	0.035
79	18504	0.173	0.029
80	18810	0.202	0.034
81	18990	0.167	0.028
82	19242	0.170	0.028
83	19404	0.199	0.033
84	19638	0.187	0.031
85	19872	0.172	0.029
86	20070	0.214	0.036
87	20376	0.147	0.024
88	20502	0.192	0.032
89	20862	0.189	0.031
90	21042	0.144	0.024
91	21330	0.155	0.026
92	21582	0.180	0.030
93	21708	0.171	0.028
94	21960	0.179	0.030
95	22212	0.156	0.026

96	22464	0.149	0.025
97	22770	0.146	0.024
98	22986	0.147	0.024
99	23148	0.160	0.027
100	23454	0.154	0.026
101	23670	0.155	0.026
102	20160	0.179	0.030
103	20430	0.180	0.030
104	20610	0.171	0.028
105	20718	0.158	0.026
106	21042	0.164	0.027
107	21240	0.157	0.026
108	21420	0.141	0.023
109	21564	0.154	0.026
110	21834	0.144	0.024
111	21978	0.138	0.023
112	22104	0.146	0.024
113	22302	0.133	0.022
114	22608	0.144	0.024
115	22824	0.134	0.022
116	22950	0.130	0.022
117	23202	0.139	0.023
118	23418	0.141	0.023
119	23490	0.135	0.022
120	23814	0.133	0.022

Stem plot of harmonics for sample L1 approximate pitch "B3" without preemphasis



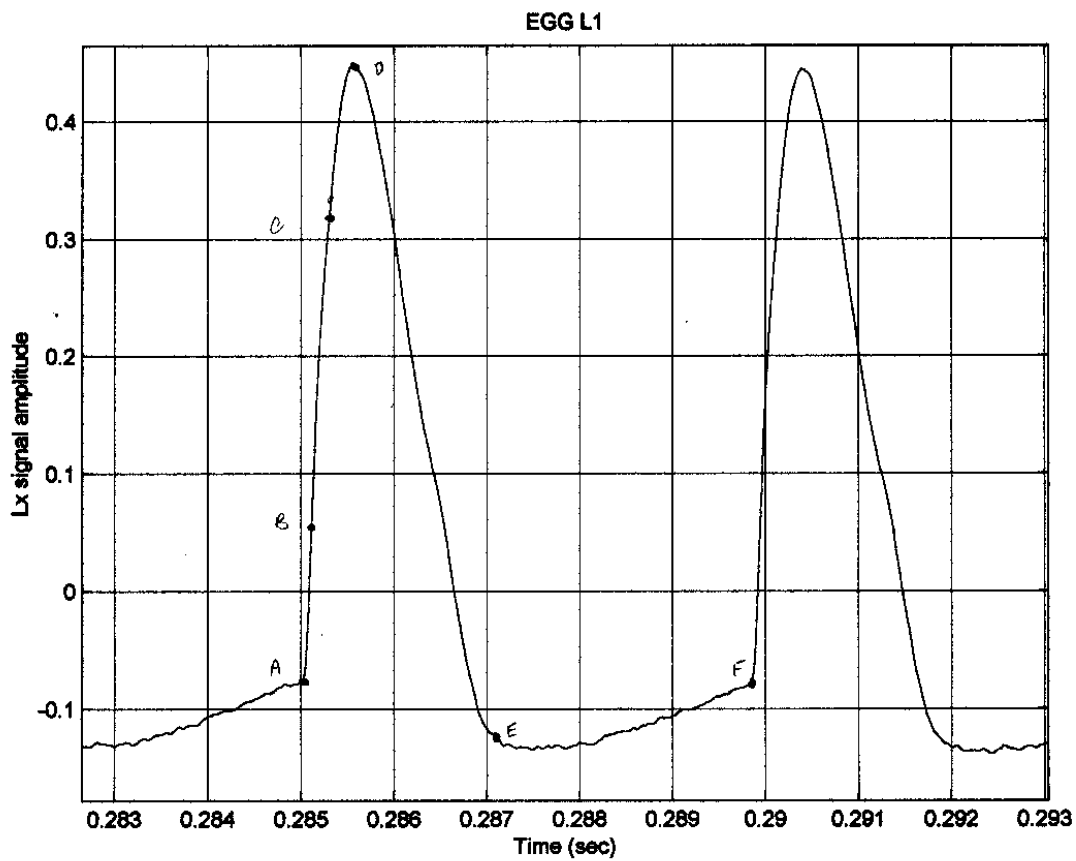
Stem plot/LPC overlay of harmonics for sample L2 without preemphasis



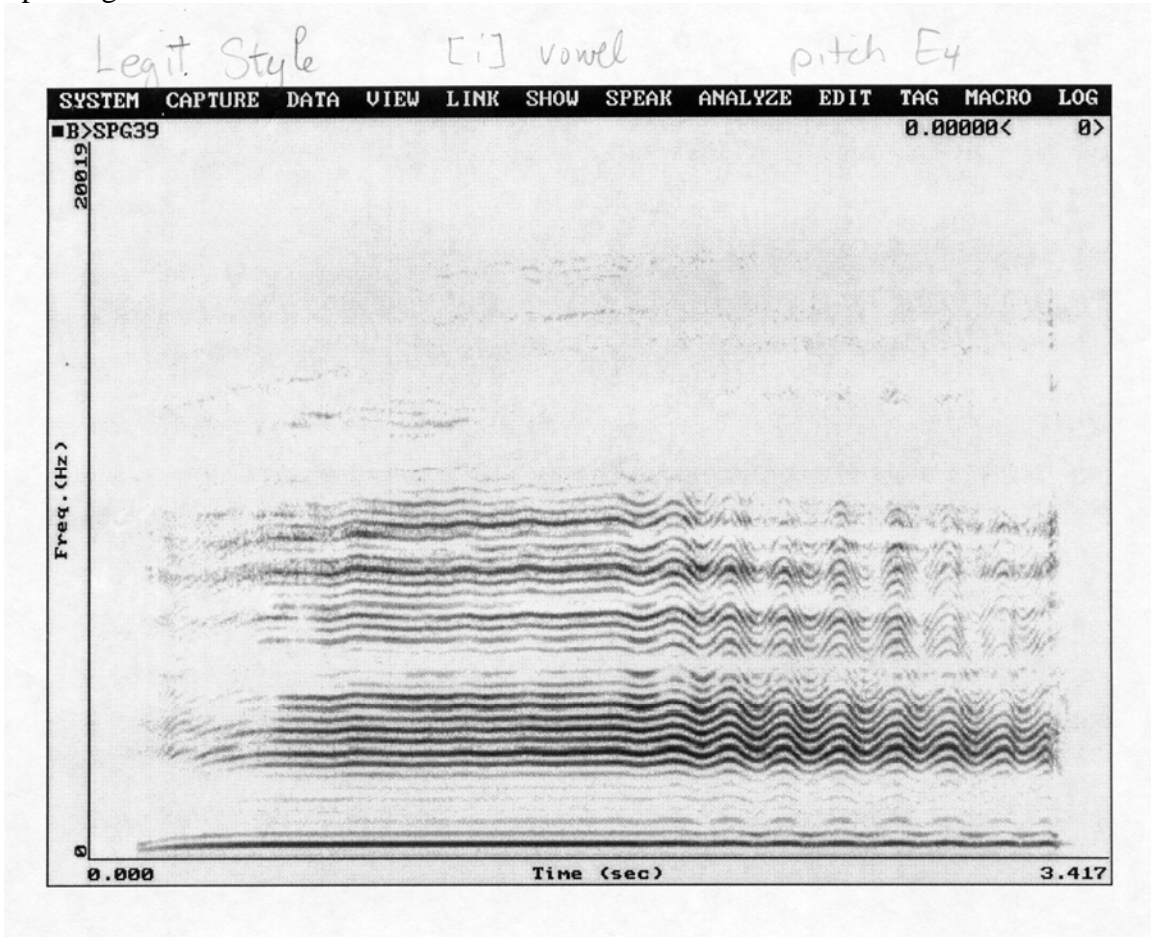
$$x \Rightarrow 15 \text{ mm} = .001$$

$$y \Rightarrow 19.5 \mu\text{m} = .1$$

$$y \Rightarrow 1 \text{ mm} = .0051282$$



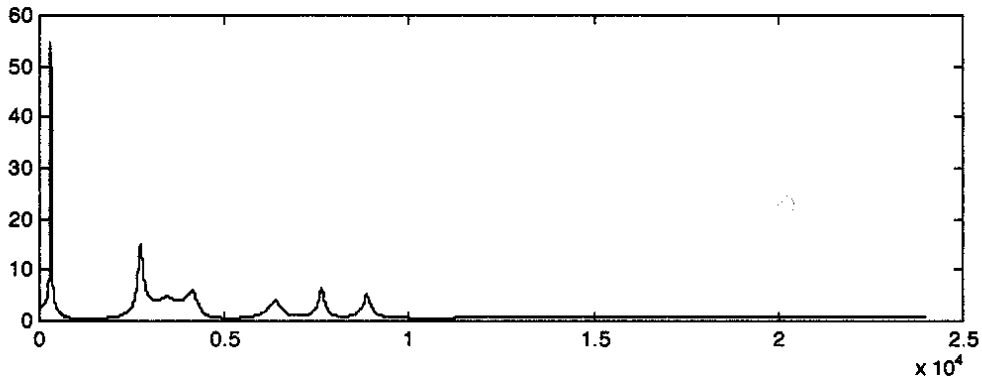
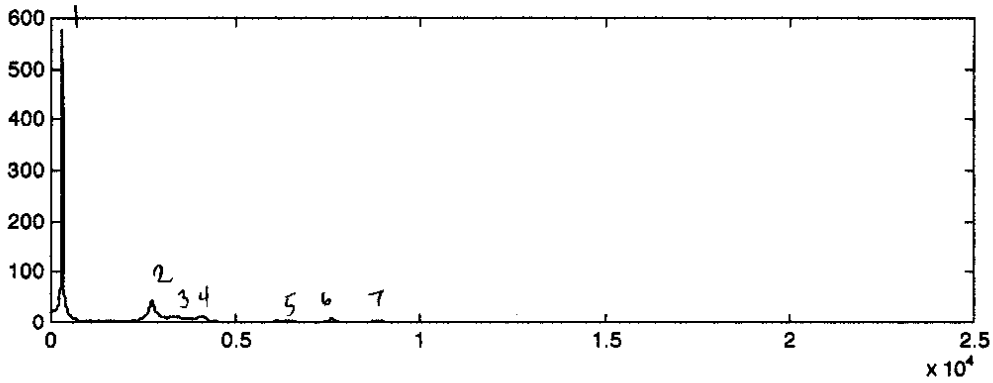
Spectrogram of L12



	F	.dB
1)	304.68	575.45
2)	2718.75	43.81
3)	3395	10.6
4)	4101.56	11.72
5)	6363.28	5.06
6)	7628.90	6.88
7)	8847.66	5.14

L12

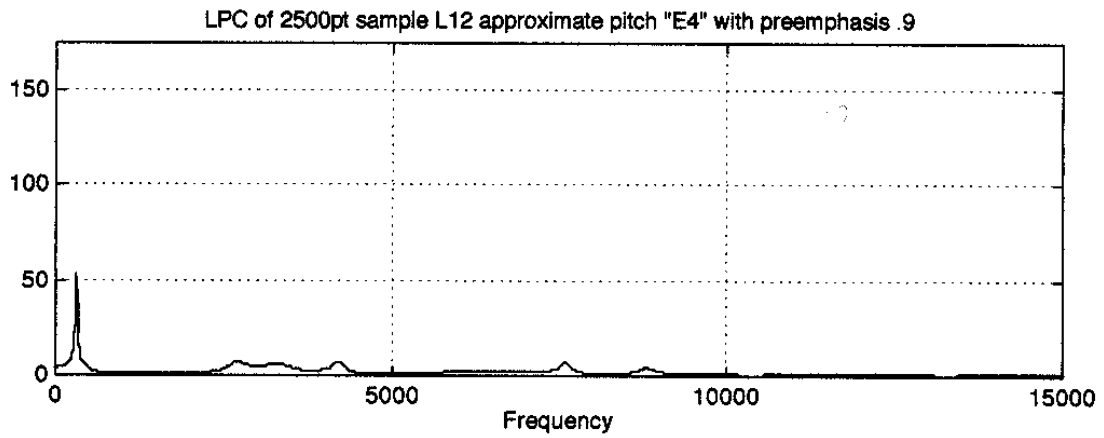
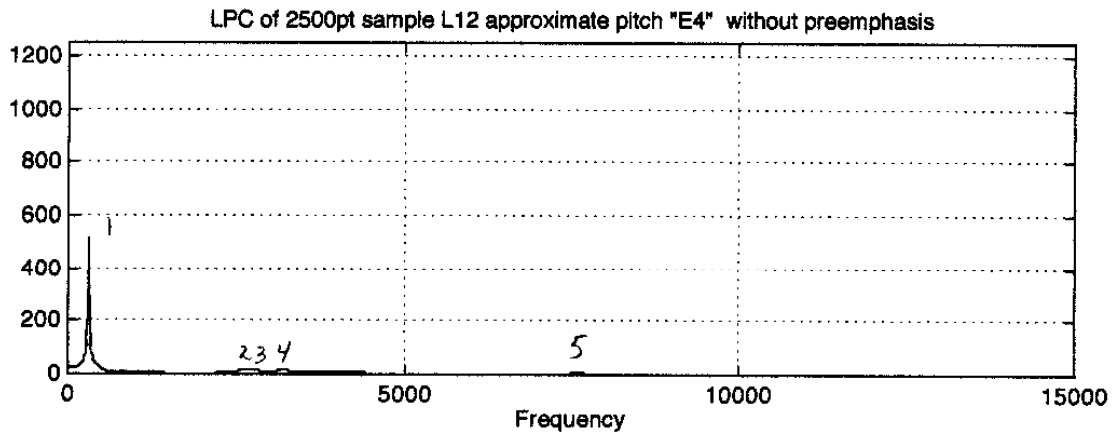
$$F_0 = 306 \text{ Hz}$$



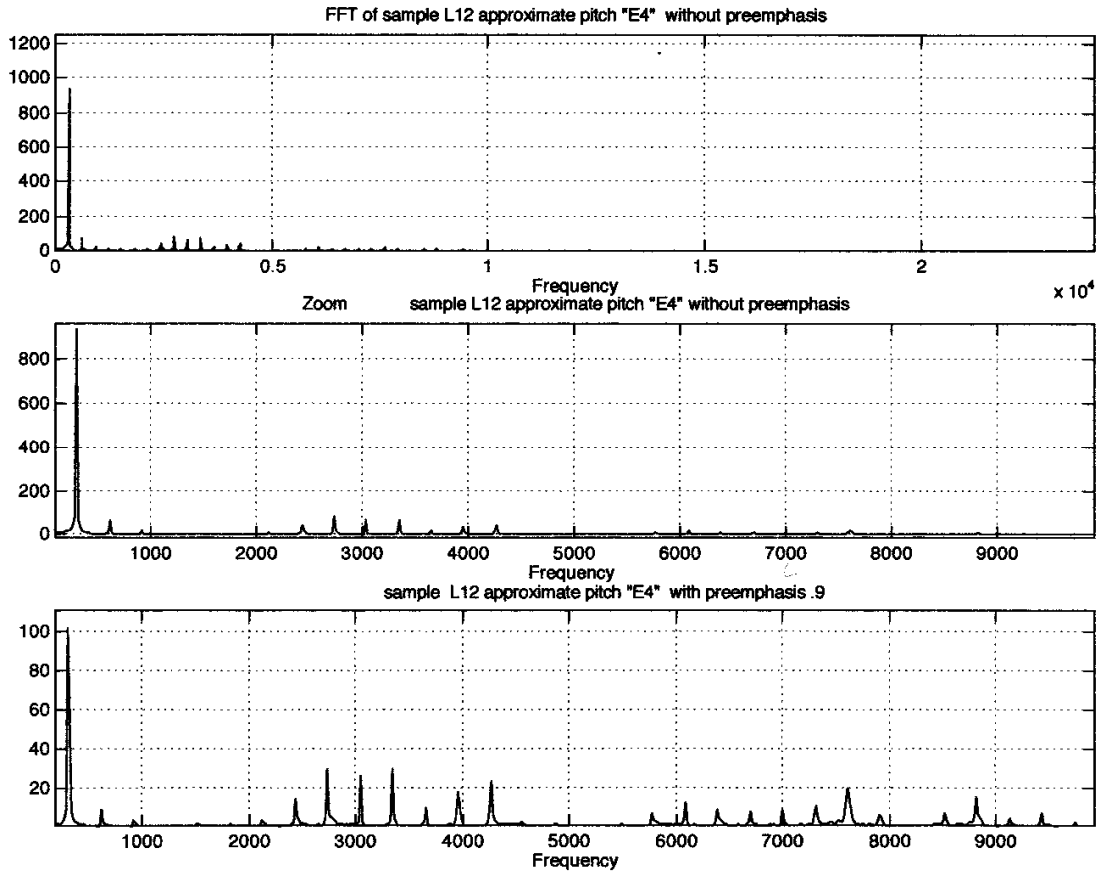
$$.15914583 - .0053333333 = .153812497 / 47 = .00327264$$

$$1/T = 305.57 \text{ Hz}$$

(304.69, 517.22)  
(2671.88, 16.19)  
(3222.66, 13.22)  
(4218.75, 10.22)  
(7593.75, 6.48)



# DFT Results for L12



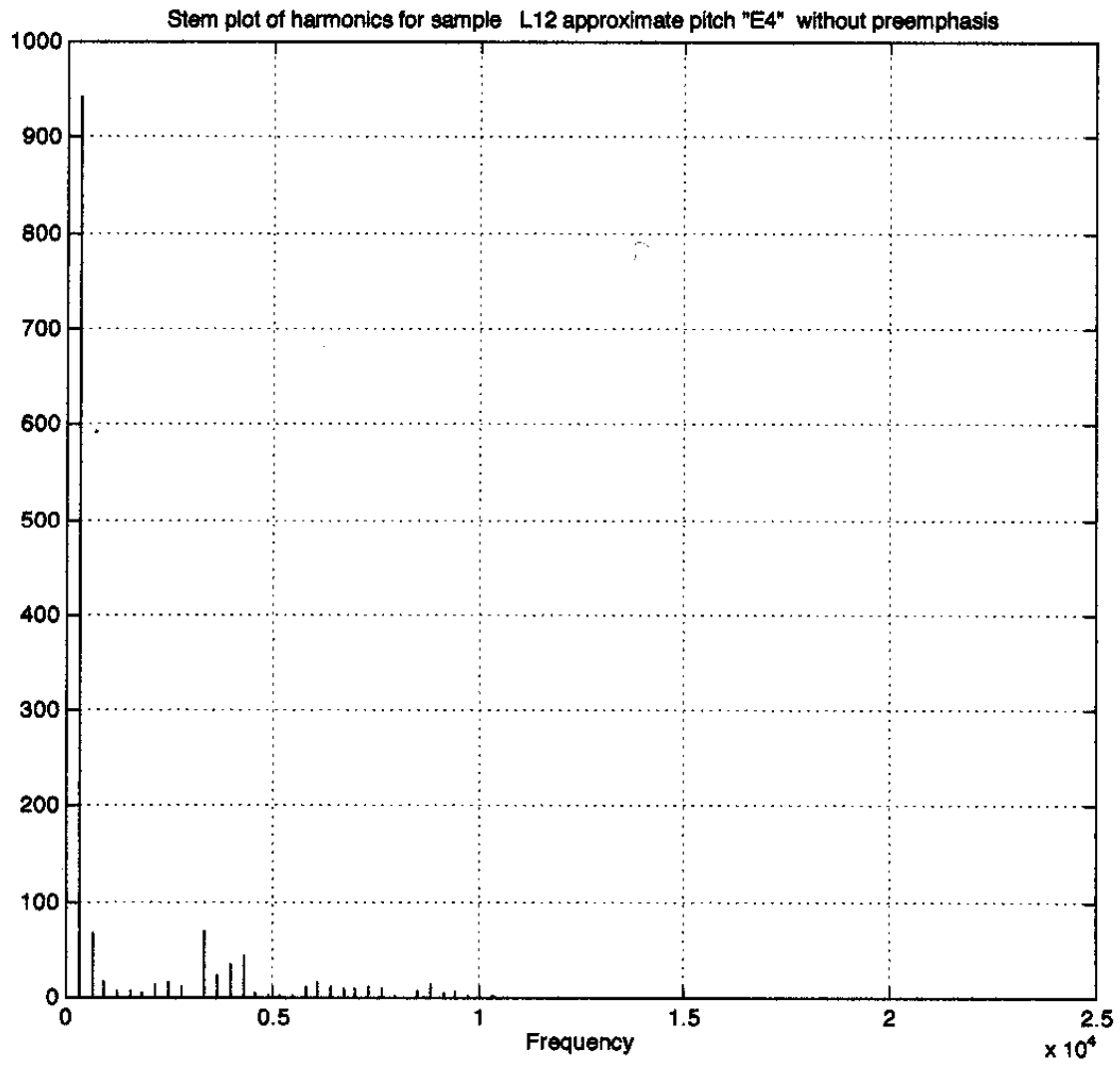
DFT Numerical Results

Worksheet saved into file: Minitab.L12  
MTB > Print 'Freq' 'Amp' '% Amp'.

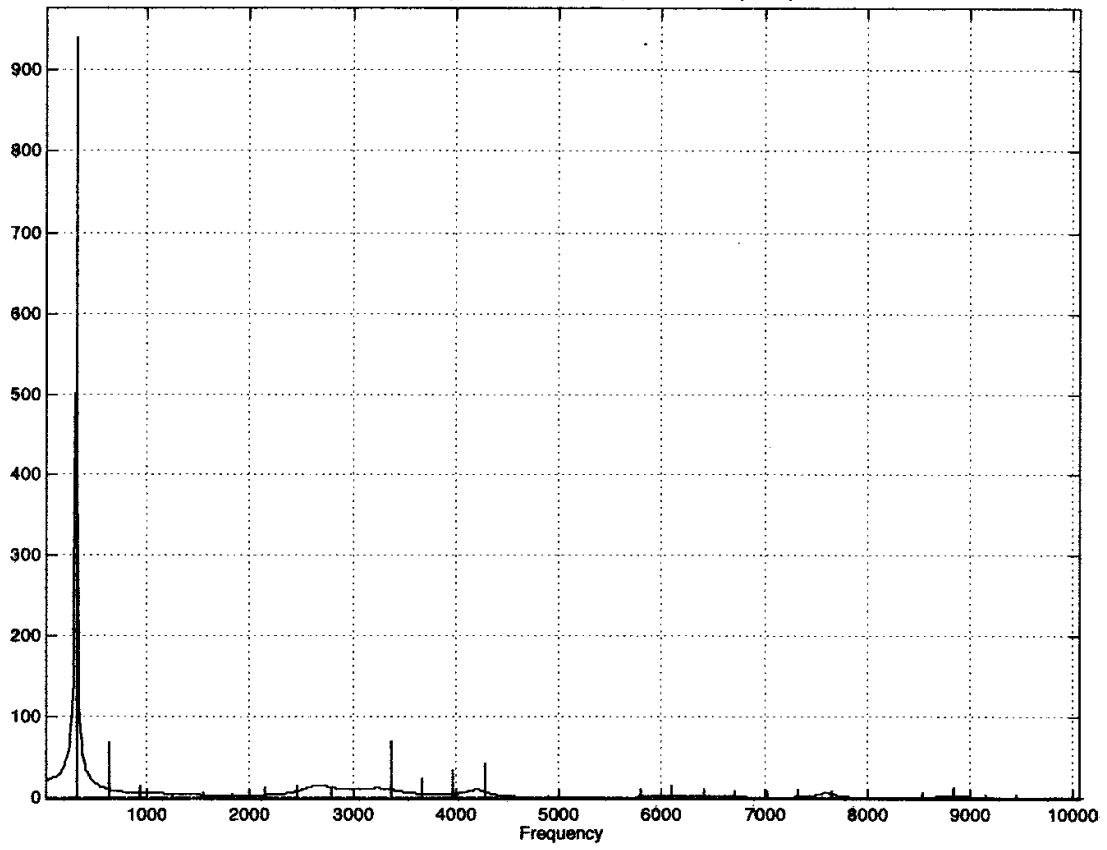
ROW	Freq	Amp	% Amp
1	324	941.222	100.000
2	630	68.116	7.237
3	936	16.773	1.782
4	1242	6.126	0.651
5	1548	7.243	0.770
6	1836	5.457	0.580
7	2142	13.253	1.408
8	2466	16.257	1.727
9	2790	10.982	1.167
10	3366	70.034	7.441 ←
11	3672	23.361	2.482
12	3978	35.092	3.728
13	4284	43.498	4.621 ←
14	4572	3.704	0.394
15	4896	2.892	0.307
16	5184	1.356	0.144
17	5490	1.591	0.169
18	5796	10.755	1.143
19	6102	16.604	1.764 ←
20	6408	11.477	1.219
21	6714	10.207	1.084
22	7020	9.886	1.050
23	7326	11.858	1.260 ←
24	7650	9.490	1.008
25	7974	1.558	0.165
26	8532	6.629	0.704 ←
27	8838	14.307	1.520 ←
28	9144	4.614	0.490
29	9450	6.202	0.659
30	9756	1.609	0.171
31	10062	0.478	0.051
32	10368	1.554	0.165
33	10674	0.101	0.011
34	10980	0.219	0.023
35	11286	0.929	0.099
36	11592	0.886	0.094
37	11880	1.106	0.117
38	12186	0.744	0.079
39	12510	0.309	0.033
40	13086	0.313	0.033
41	13410	0.141	0.015
42	13716	0.451	0.048
43	14004	0.400	0.043
44	14310	0.338	0.036
45	14634	0.268	0.028
46	14922	0.115	0.012
47	15228	0.492	0.052
48	15534	0.238	0.025
49	15822	0.232	0.025
50	16128	0.161	0.017
51	16452	0.160	0.017
52	16776	0.252	0.027
53	17082	0.170	0.018
54	17388	0.102	0.011
55	17784	0.077	0.008

56	18108	0.097	0.010
57	18432	0.095	0.010
58	18738	0.077	0.008
59	19080	0.080	0.009
60	19440	0.098	0.010
61	19800	0.089	0.009
62	20196	0.072	0.008
63	20466	0.087	0.009
64	20772	0.092	0.010
65	21186	0.080	0.008
66	21366	0.081	0.009
67	21834	0.074	0.008
68	21942	0.072	0.008
69	22320	0.072	0.008
70	22698	0.069	0.007
71	23004	0.067	0.007
72	23328	0.068	0.007
73	23580	0.065	0.007
74	17226	0.400	0.042
75	17496	0.260	0.028
76	17784	0.256	0.027
77	17982	0.183	0.019
78	18198	0.212	0.023
79	18504	0.173	0.018
80	18810	0.202	0.021
81	18990	0.167	0.018
82	19242	0.170	0.018
83	19404	0.199	0.021
84	19638	0.187	0.020
85	19872	0.172	0.018
86	20070	0.214	0.023
87	20376	0.147	0.016
88	20502	0.192	0.020
89	20862	0.189	0.020
90	21042	0.144	0.015
91	21330	0.155	0.017
92	21582	0.180	0.019
93	21708	0.171	0.018
94	21960	0.179	0.019
95	22212	0.156	0.017
96	22464	0.149	0.016
97	22770	0.146	0.016
98	22986	0.147	0.016
99	23148	0.160	0.017
100	23454	0.154	0.016
101	23670	0.155	0.016
102	20160	0.179	0.019
103	20430	0.180	0.019
104	20610	0.171	0.018
105	20718	0.158	0.017
106	21042	0.164	0.017
107	21240	0.157	0.017
108	21420	0.141	0.015
109	21564	0.154	0.016
110	21834	0.144	0.015
111	21978	0.138	0.015
112	22104	0.146	0.015
113	22302	0.133	0.014
114	22608	0.144	0.015
115	22824	0.134	0.014

116	22950	0.130	0.014
117	23202	0.139	0.015
118	23418	0.141	0.015
119	23490	0.135	0.014
120	23814	0.133	0.014



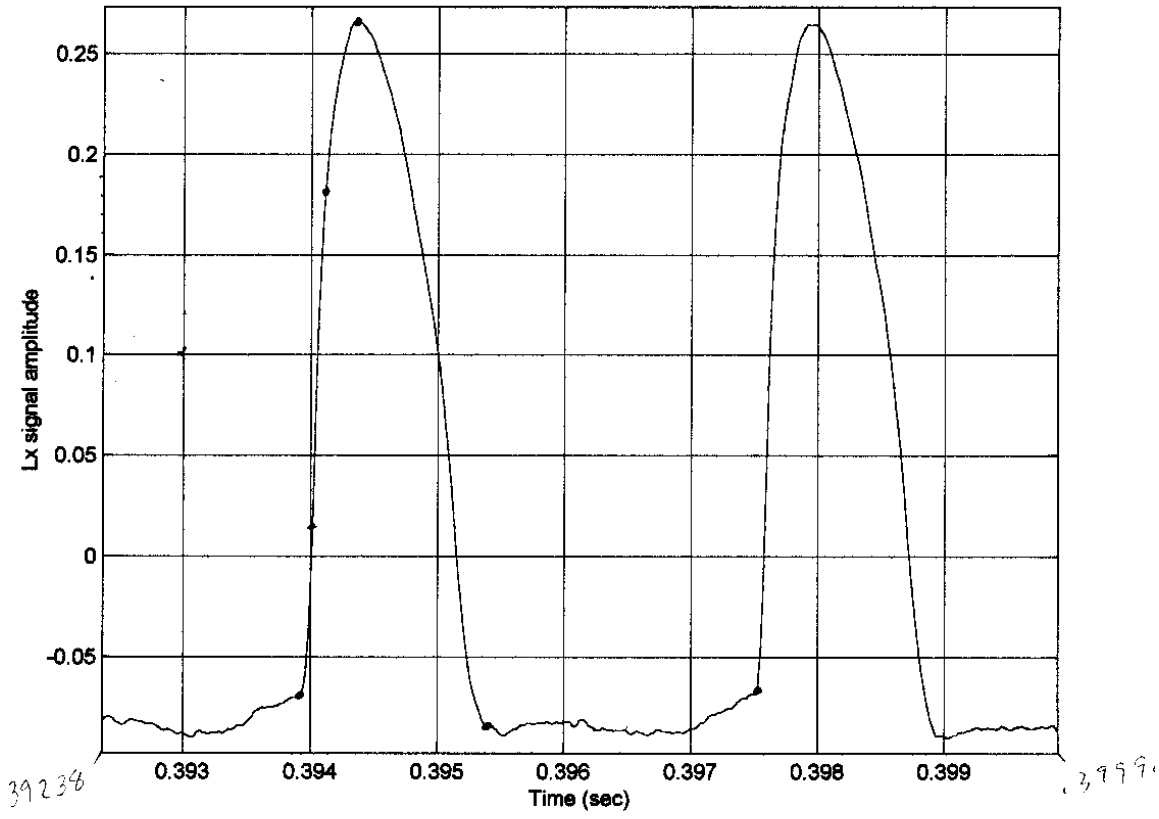
Stem plot/LPC overlay of harmonics for sample L.12 without preemphasis



$x \Rightarrow 21\text{mm} = .001$   
 $y \Rightarrow 17\text{mm} = .05$

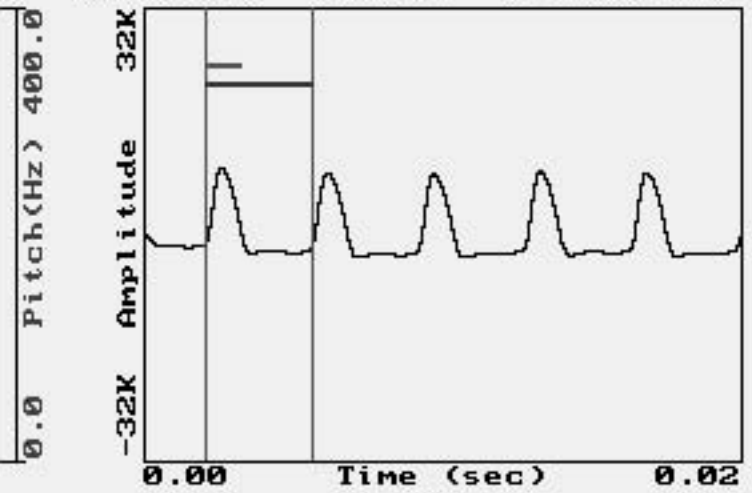
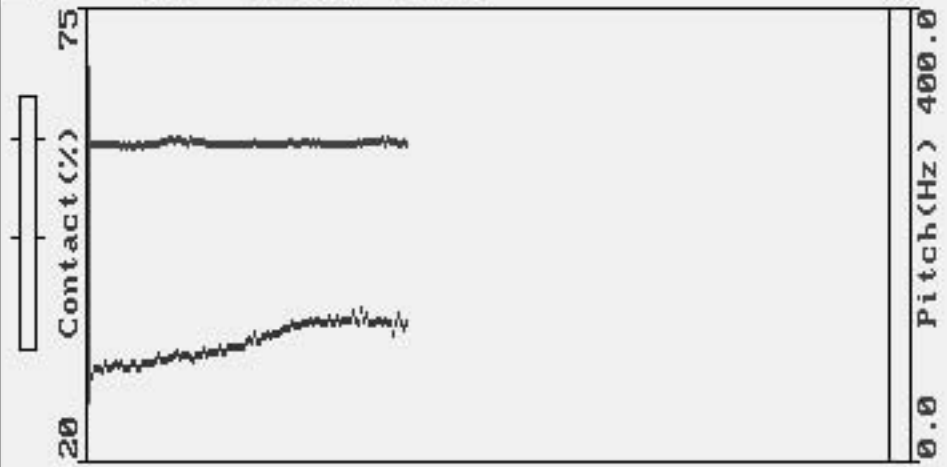
$z \Rightarrow 1\text{mm} = .0029411$

EGG L12



■A> : CH1: L12\_EG~1.NSP

< 0.00 sec 32.07% 277.36 Hz >

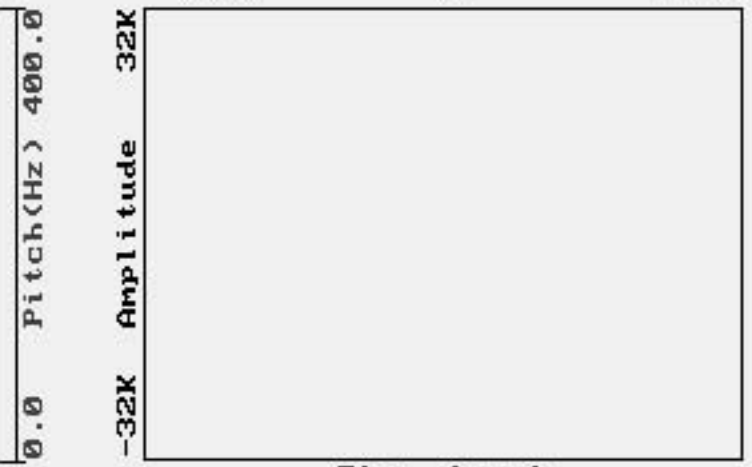


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

□B> :

< sec % Hz >

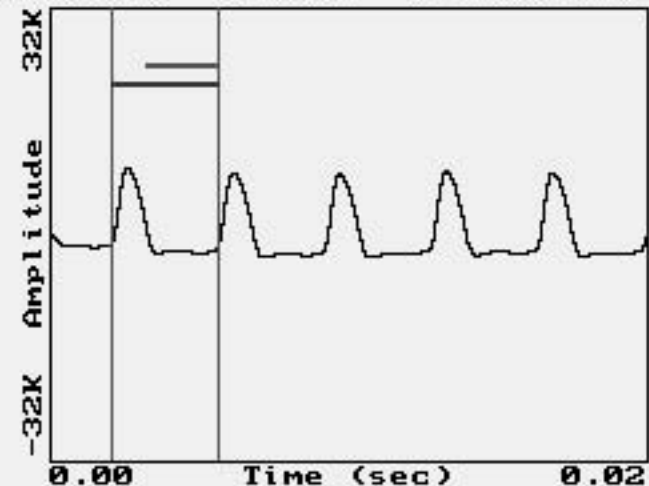
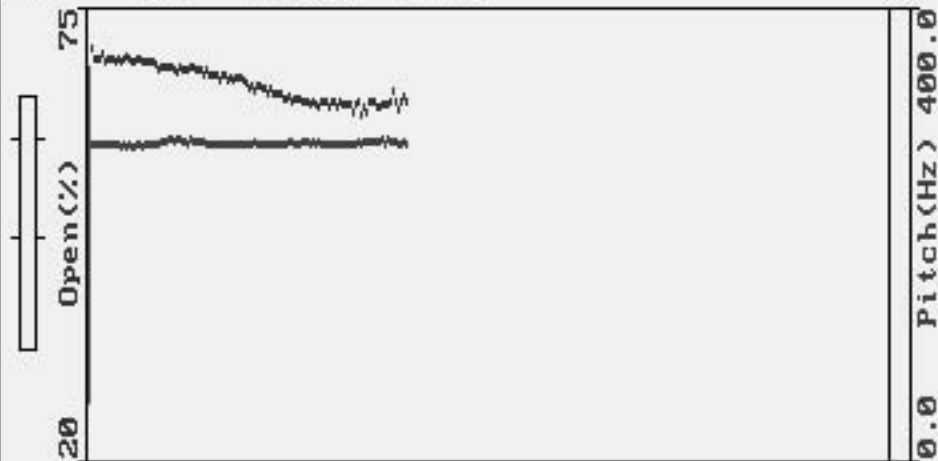


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

**A** > : CH1: L12\_EG~1.NSP

< 0.00 sec 67.92% 277.36 Hz >



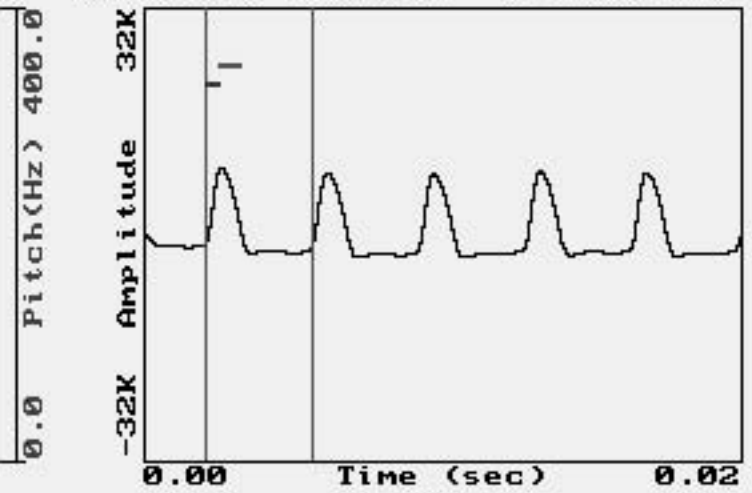
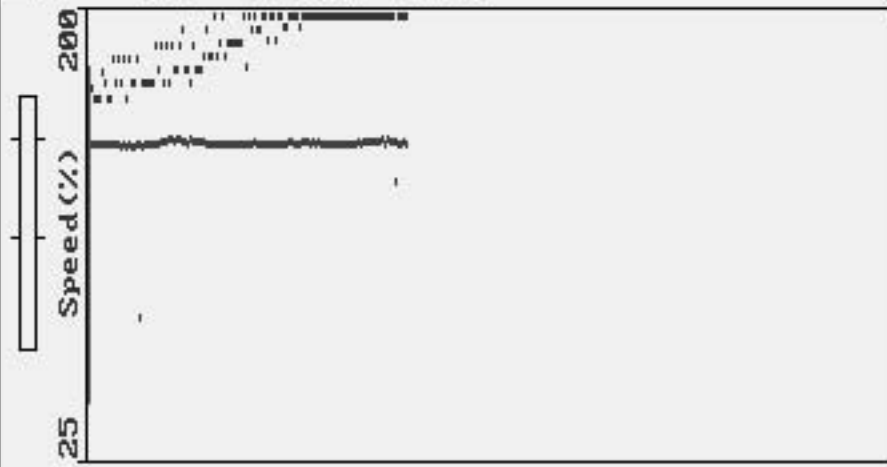
**B** > :

< sec % Hz >



**A** > : CH1: L12\_EG~1.NSP

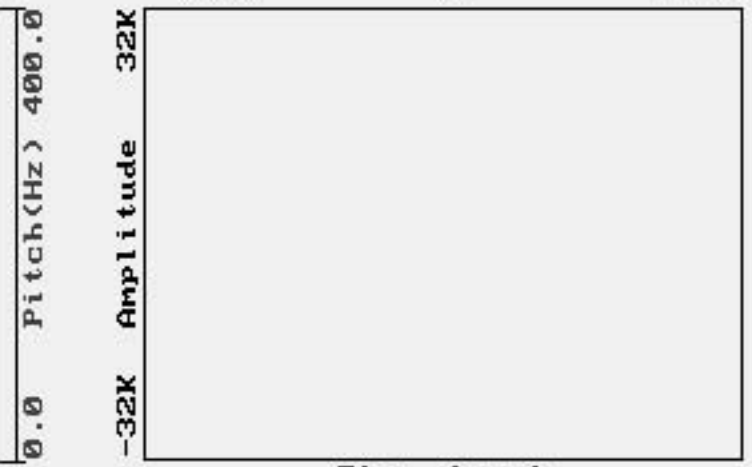
< 0.00 sec 168.42% 277.36 Hz >



Pitch(Hz) 400.0

**B** > :

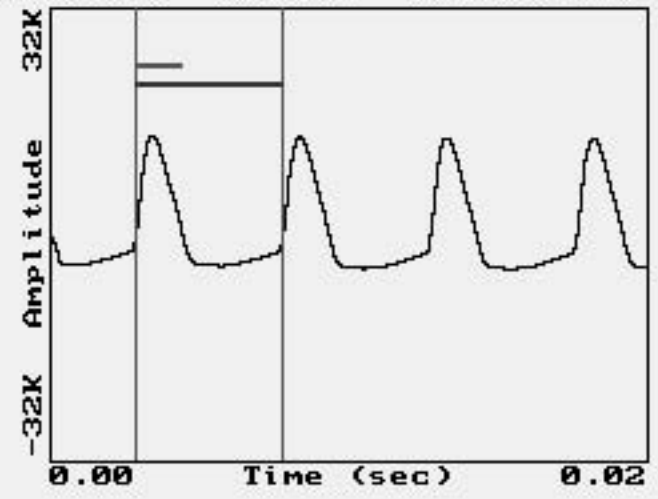
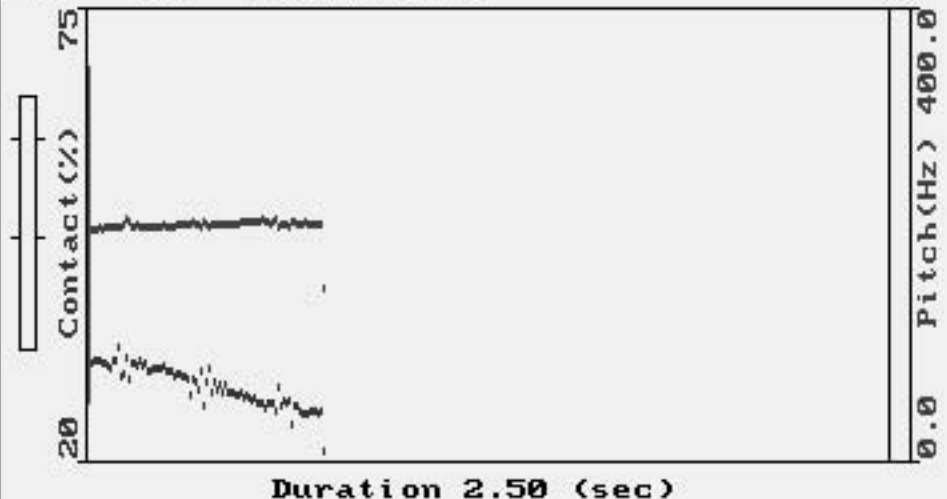
< sec % Hz >



Pitch(Hz) 400.0

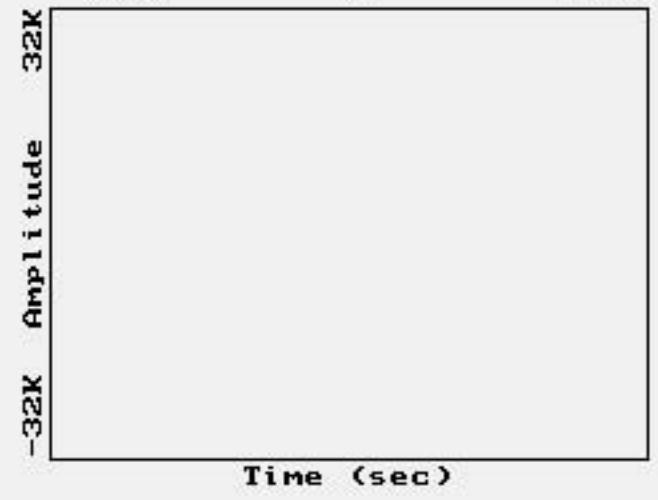
**A** > : CH1: L1\_EGGST.NSP

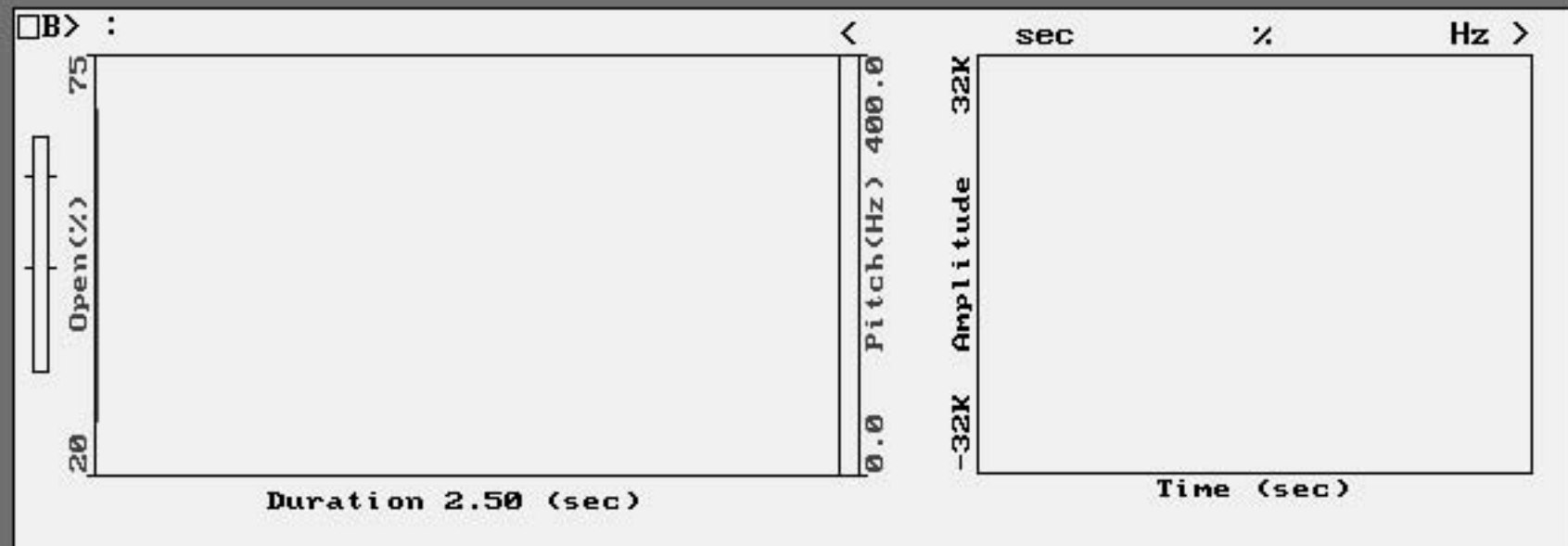
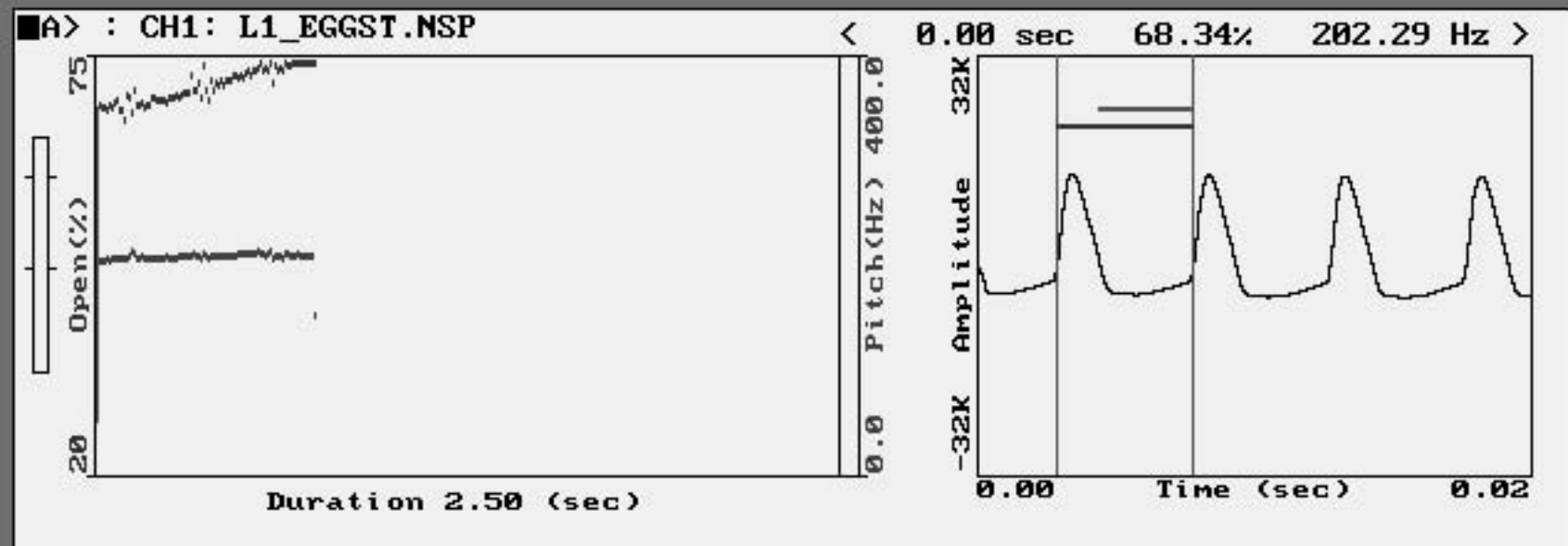
< 0.00 sec 31.65% 202.29 Hz >



**B** > :

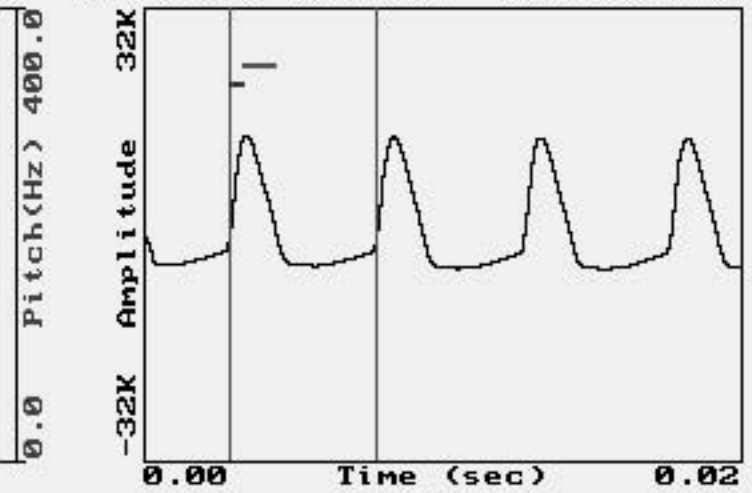
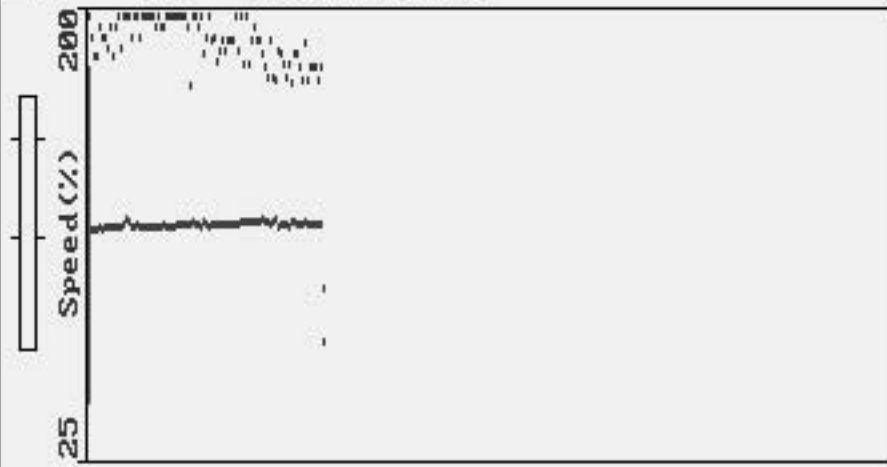
< sec % Hz >





**A** > : CH1: L1\_EGGST.NSP

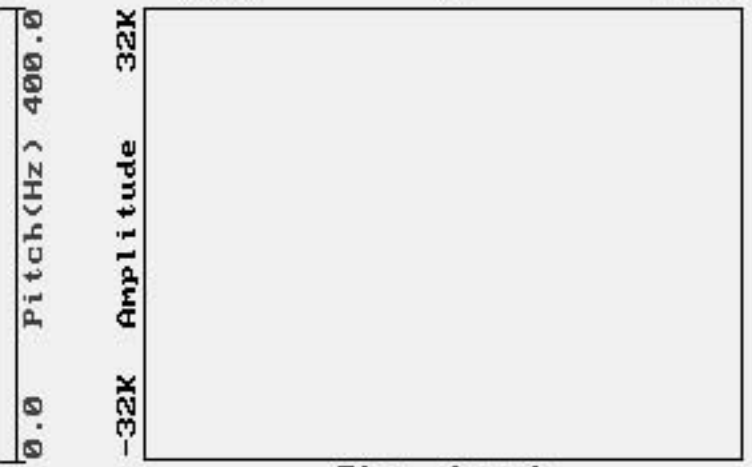
< 0.00 sec 200.00% 202.29 Hz >



Pitch(Hz) 400.0

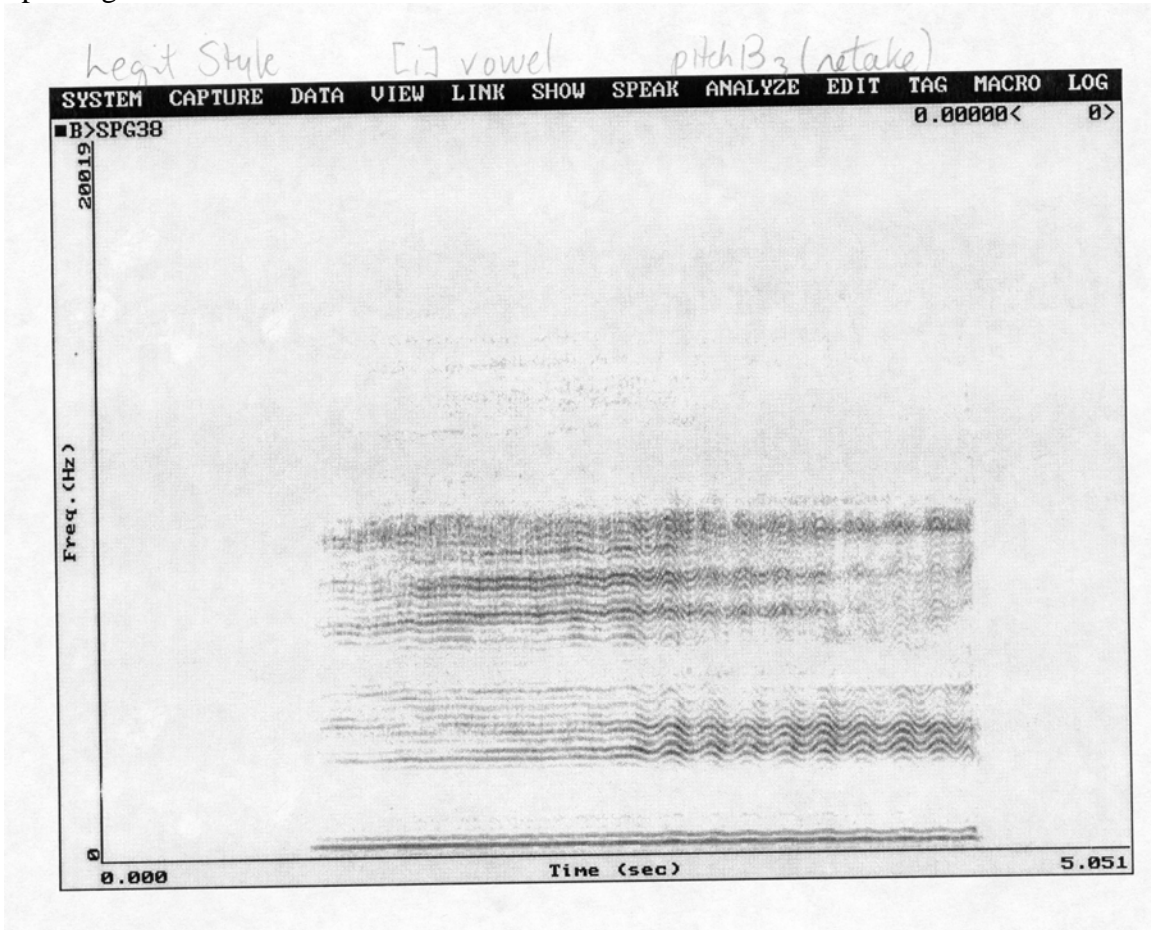
**B** > :

< sec % Hz >



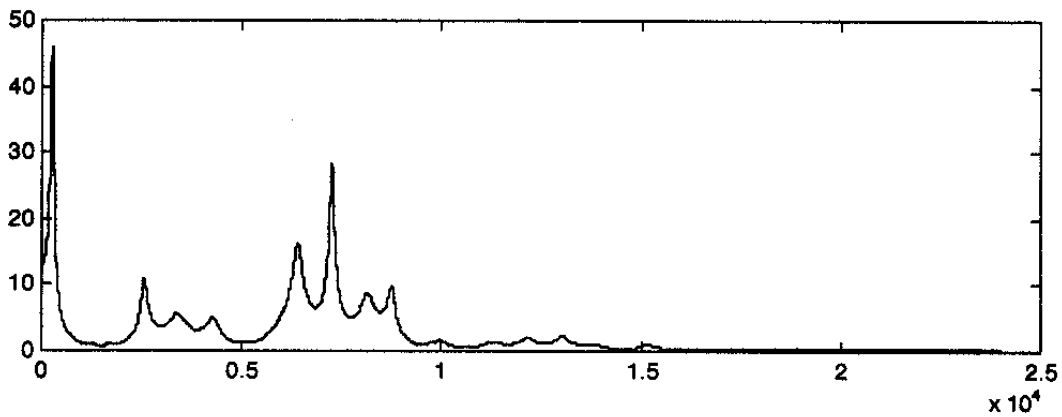
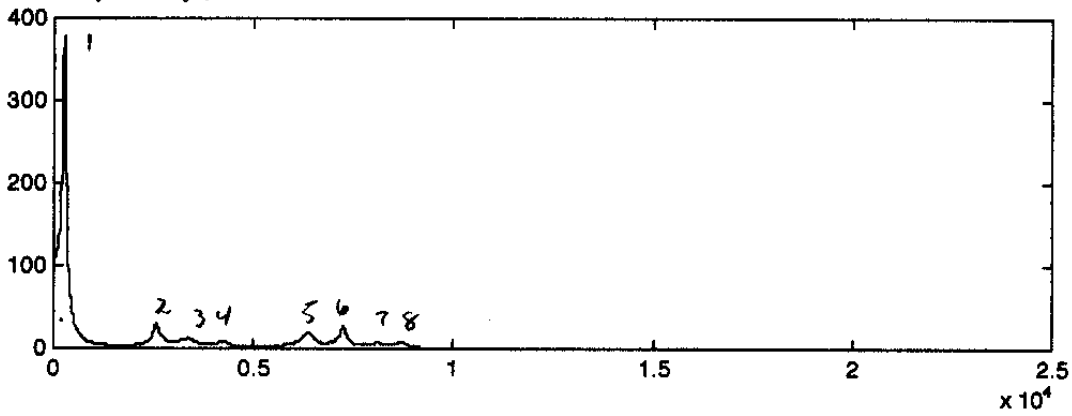
Pitch(Hz) 400.0

Spectrogram of L2



LPC of whole sample L2

	F	dB	L2	F <sub>0</sub> = 229 Hz
1)	257.82	377.08		
2)	2554.68	29.95	8)	8730.46
				dB
3)	3375.00	12.19		
4)	4253.91	8.64		
5)	6375.00	18.68		
6)	7242.18	25.89		
7)	8109.38	7.03		



$$\begin{aligned}
 .1601875 - .002083333 &= .157479167 / 36 \\
 &= .004374421 \approx T \\
 10000 - 18000 &= 7999 \text{ pts} \\
 T &= 229 \text{ Hz}
 \end{aligned}$$

(246.09, 425.17)

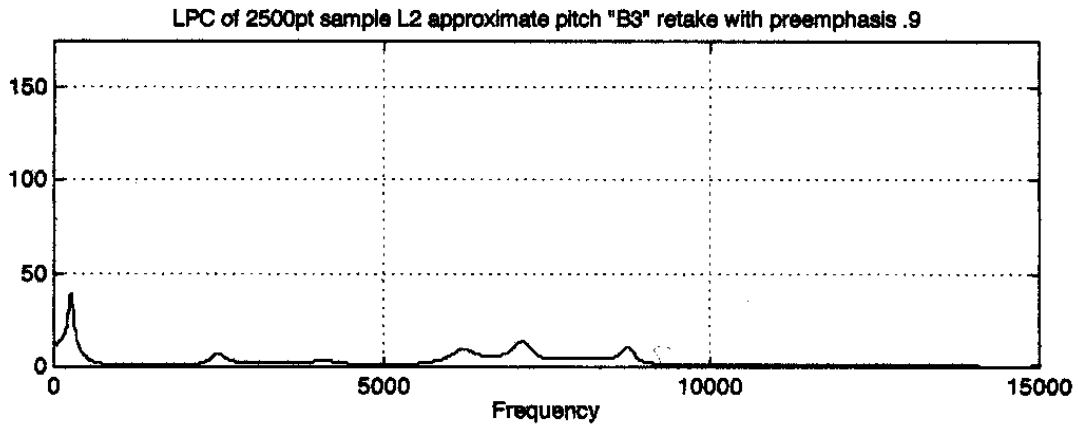
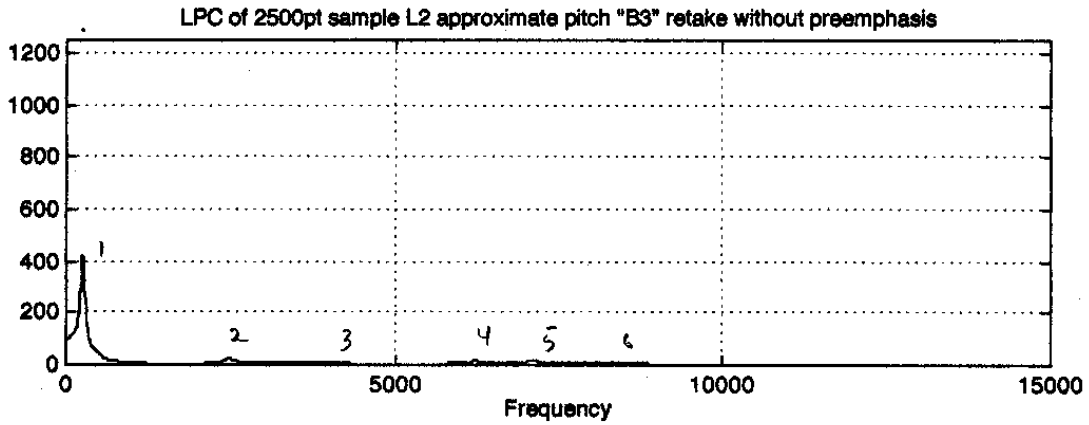
(2484.38, 23.63)

(4101.56, 6.47)

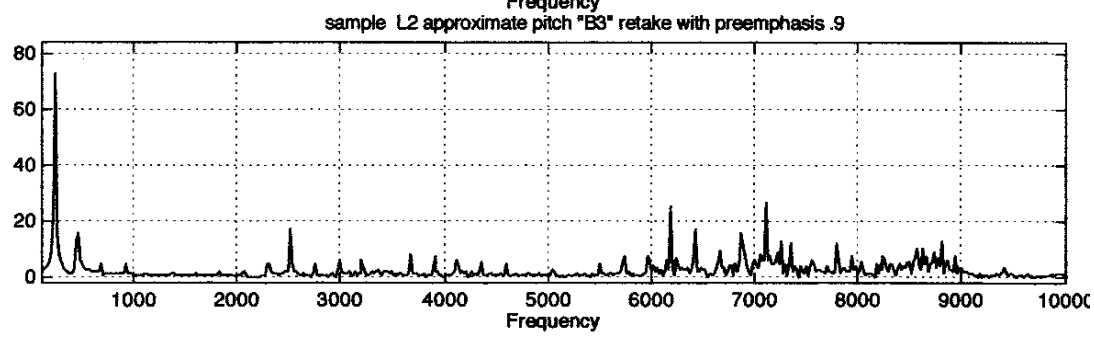
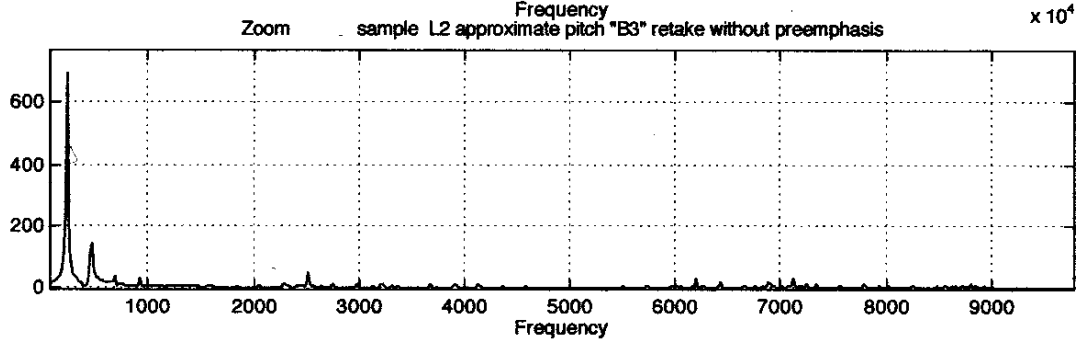
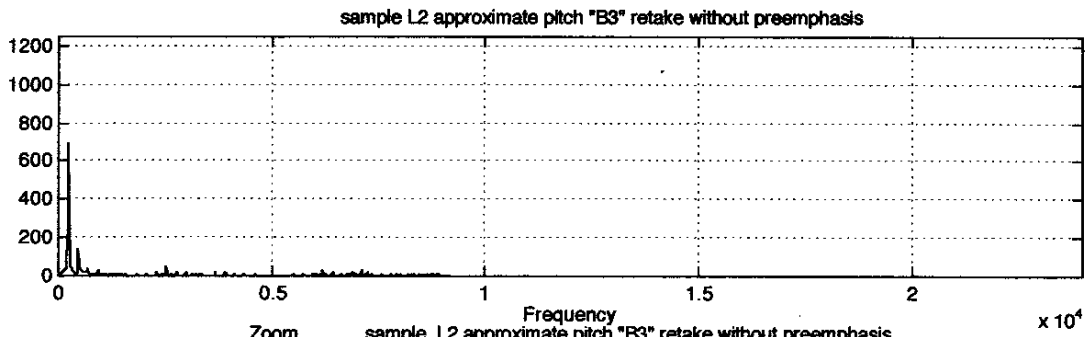
(6222.66, 13.33)

(7101.56, 15.73)

(8730.47, 10.03)



# DFT of L2



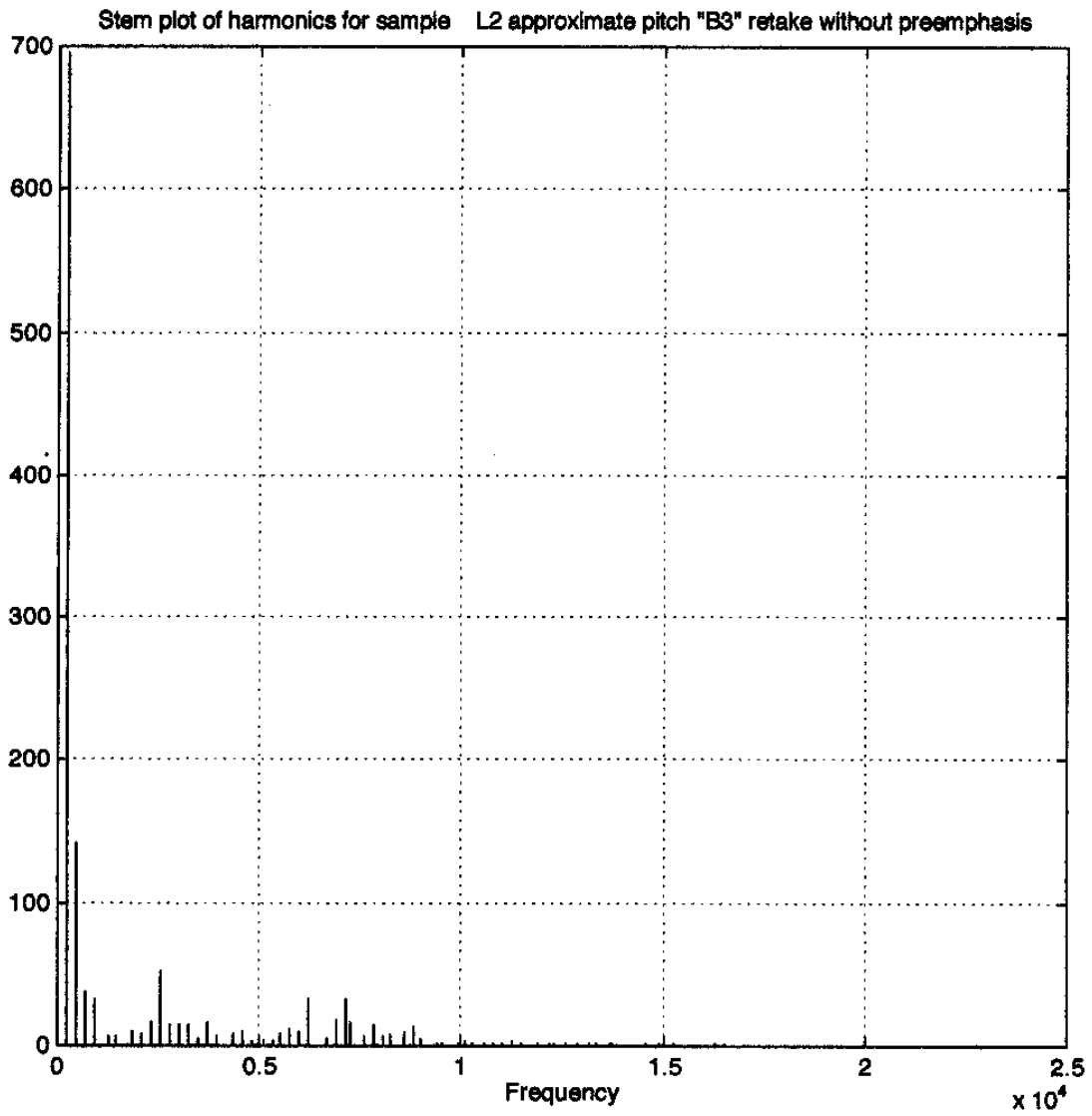
DFT Numerical Results of L2

Worksheet saved into file: Minitab.L2  
 MTB > Print 'Freq' 'Amp' '% Amp'.

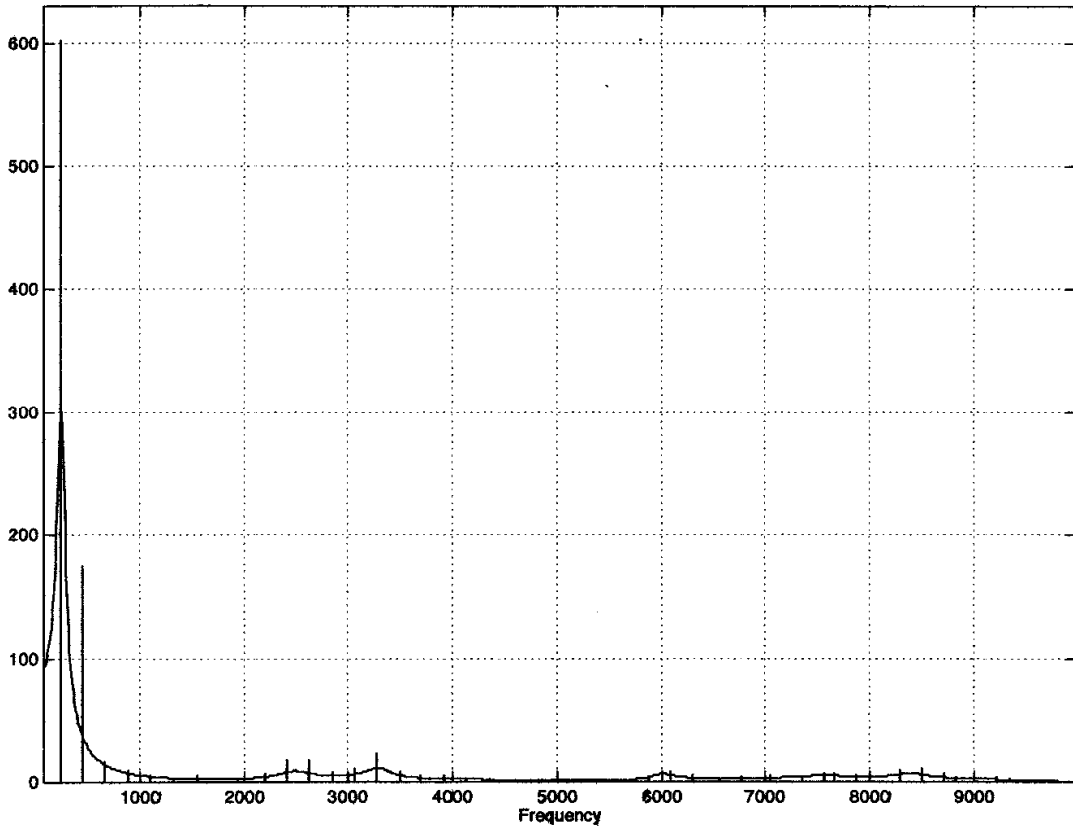
ROW	Freq	Amp	% Amp
1	252	695.843	100.000
2	486	141.686	20.362
3	702	38.127	5.479
4	936	32.674	4.696
5	1296	5.985	0.860
6	1422	6.793	0.976
7	1854	9.041	1.299
8	2088	8.717	1.253
9	2322	17.076	2.454
10	2538	51.505	7.402
11	2772	15.421	2.216
12	3006	15.381	2.210
13	3222	13.964	2.007
14	3456	4.922	0.707
15	3690	16.593	2.385
16	3942	5.946	0.855
17	4374	8.877	1.276
18	4608	9.161	1.317
19	4824	3.123	0.449
20	5076	3.790	0.545
21	5364	2.478	0.356
22	5526	7.668	1.102
23	5760	10.721	1.541
24	5976	9.443	1.357
25	6210	33.286	4.784
26	6642	4.700	0.675
27	6894	18.328	2.634
28	7128	32.051	4.606
29	7272	15.606	2.243
30	7578	5.943	0.854
31	7812	14.291	2.054
32	8046	5.751	0.826
33	8262	7.503	1.078
34	8586	10.367	1.490
35	8820	12.880	1.851
36	8982	4.683	0.673
37	9414	1.359	0.195
38	9486	1.679	0.241
39	9900	1.510	0.217
40	10116	3.097	0.445
41	10260	1.635	0.235
42	10584	1.300	0.187
43	10800	1.234	0.177
44	11016	1.154	0.166
45	11268	3.364	0.483
46	11502	1.071	0.154
47	11880	1.439	0.207
48	12186	1.625	0.234
49	12294	0.940	0.135
50	12582	1.216	0.175
51	12888	1.287	0.185
52	13194	1.378	0.198
53	13338	1.010	0.145
54	13698	2.075	0.298
55	13770	1.716	0.247

56	14148	0.774	0.111
57	14364	0.789	0.113
58	14544	0.826	0.119
59	14886	0.836	0.120
60	15048	1.097	0.158
61	15282	1.265	0.182
62	15588	0.700	0.101
63	15858	0.666	0.096
64	16038	0.746	0.107
65	16308	1.015	0.146
66	16542	0.868	0.125
67	16794	0.588	0.084
68	17136	0.623	0.089
69	17370	0.584	0.084
70	17586	0.581	0.084
71	17910	0.581	0.084
72	18144	0.551	0.079
73	18396	0.563	0.081
74	18648	0.582	0.084
75	18972	0.537	0.077
76	19152	0.569	0.082
77	19332	0.545	0.078
78	19674	0.573	0.082
79	19818	0.532	0.076
80	20088	0.537	0.077
81	20322	0.560	0.081
82	20610	0.536	0.077
83	20898	0.544	0.078
84	21222	0.532	0.076
85	21492	0.530	0.076
86	21582	0.538	0.077
87	21960	0.541	0.078
88	22158	0.520	0.075
89	22500	0.535	0.077
90	22698	0.536	0.077
91	22932	0.511	0.073
92	23202	0.503	0.072
93	23508	0.518	0.074
94	23742	0.530	0.076
95	22212	0.156	0.022
96	22464	0.149	0.021
97	22770	0.146	0.021
98	22986	0.147	0.021
99	23148	0.160	0.023
100	23454	0.154	0.022
101	23670	0.155	0.022
102	20160	0.179	0.026
103	20430	0.180	0.026
104	20610	0.171	0.025
105	20718	0.158	0.023
106	21042	0.164	0.024
107	21240	0.157	0.023
108	21420	0.141	0.020
109	21564	0.154	0.022
110	21834	0.144	0.021
111	21978	0.138	0.020
112	22104	0.146	0.021
113	22302	0.133	0.019
114	22608	0.144	0.021
115	22824	0.134	0.019

116	22950	0.130	0.019
117	23202	0.139	0.020
118	23418	0.141	0.020
119	23490	0.135	0.019
120	23814	0.133	0.019



Stem plot/LPC overlay of harmonics for sample L1 without preemphasis

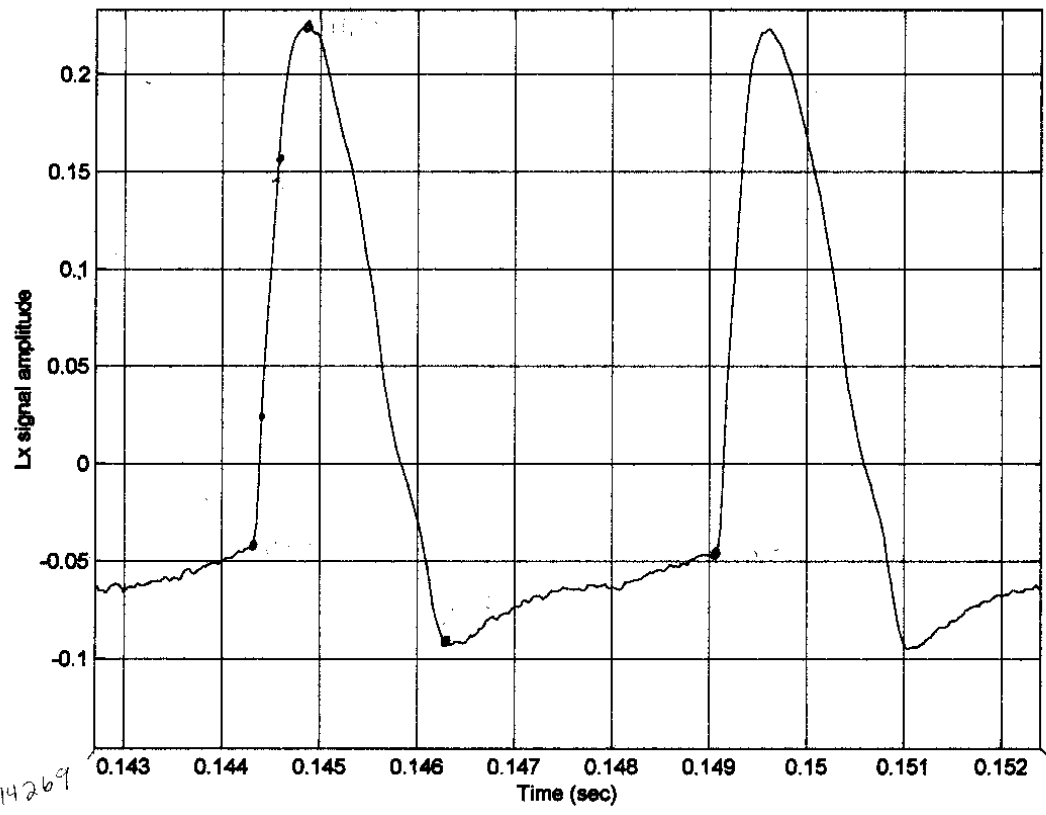


$x \Rightarrow 16 \text{ mm} = .001$

$y \Rightarrow 16 \text{ mm} = .05$

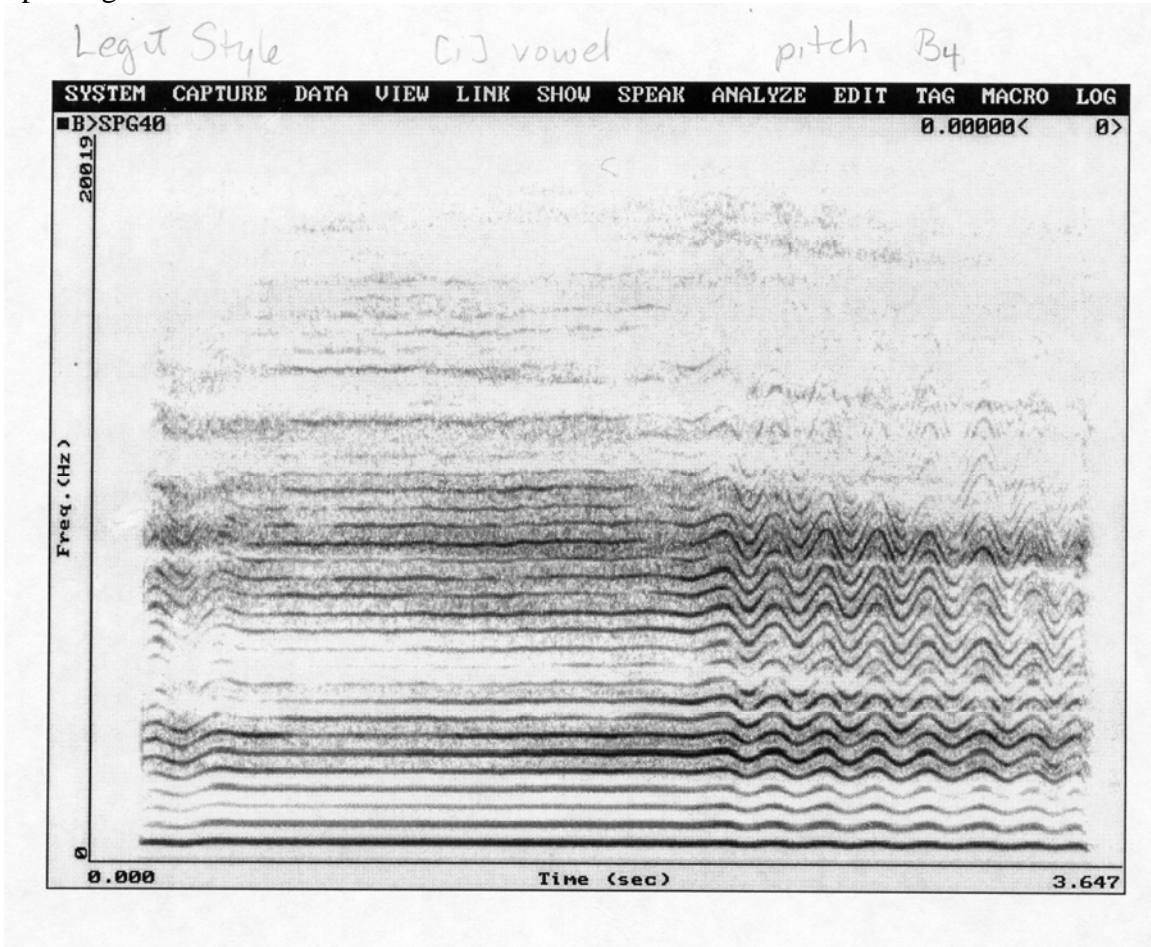
$t_{\text{min}} y \Rightarrow .003125$

EGG L2

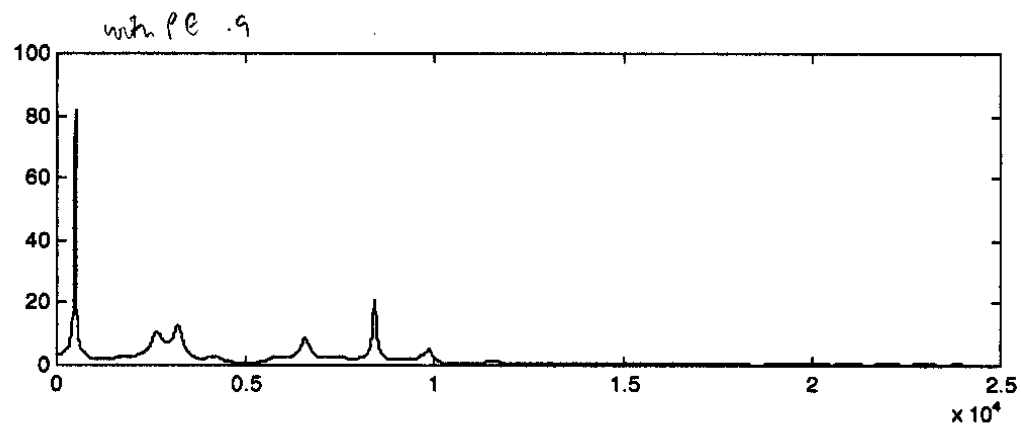
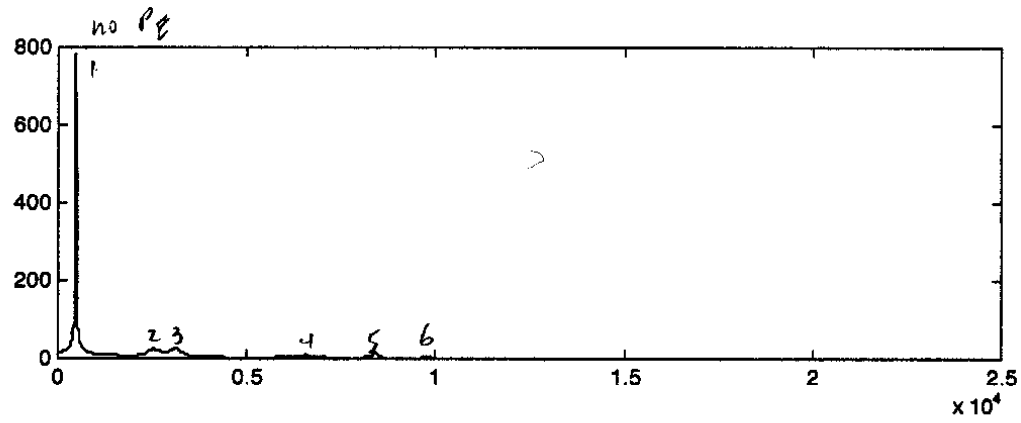


.14269

Spectrogram for L22



- |    |         |               |       |                        |
|----|---------|---------------|-------|------------------------|
| 1) | $F$     | $\frac{dB}{}$ | $L22$ | $F_0 = 468 \text{ Hz}$ |
| 2) | 468.75  | 782.60        |       |                        |
| 3) | 2542.98 | 25.57         |       |                        |
| 4) | 3152.34 | 27.88         |       |                        |
| 5) | 6585.92 | 8.17          |       |                        |
| 6) | 8414.05 | 16.94         |       |                        |
|    | 9796.85 | 3.60          |       |                        |
- $N = 50$

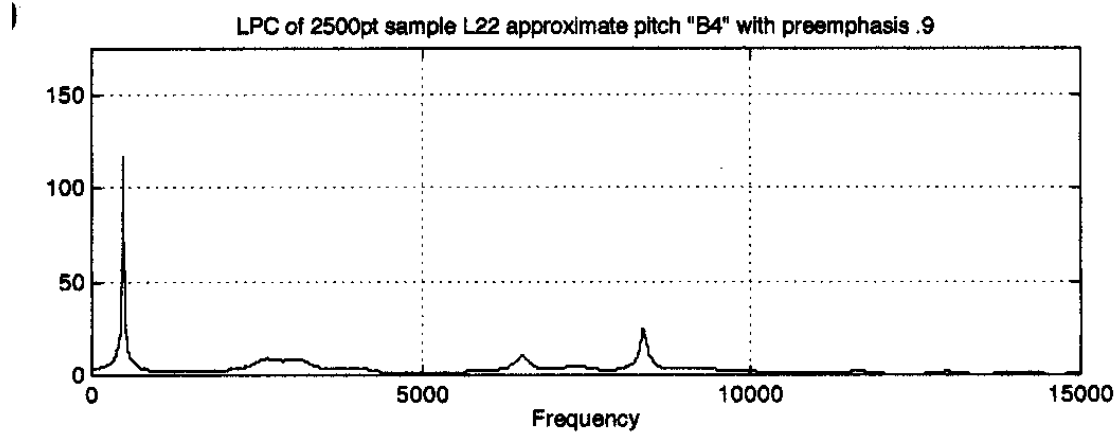
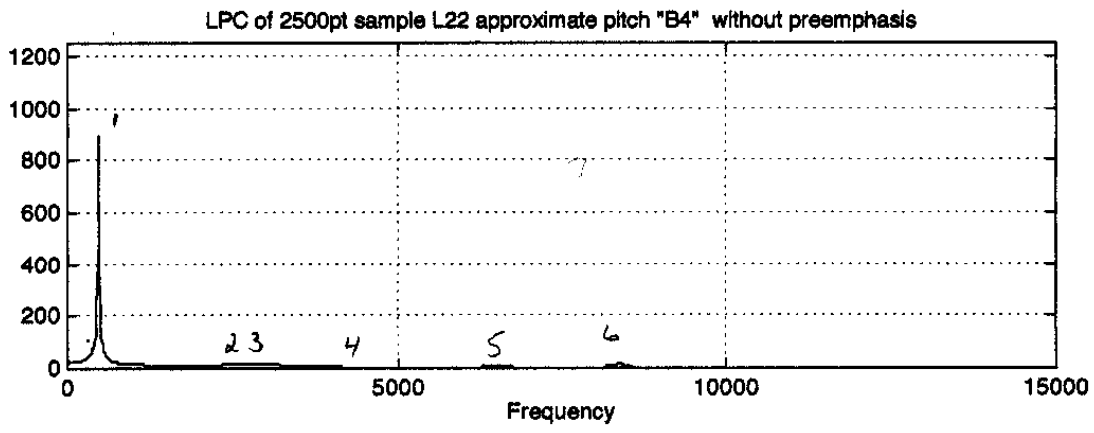


$$.14864583 - .005375 = .14327083 / 67 = .002138371$$

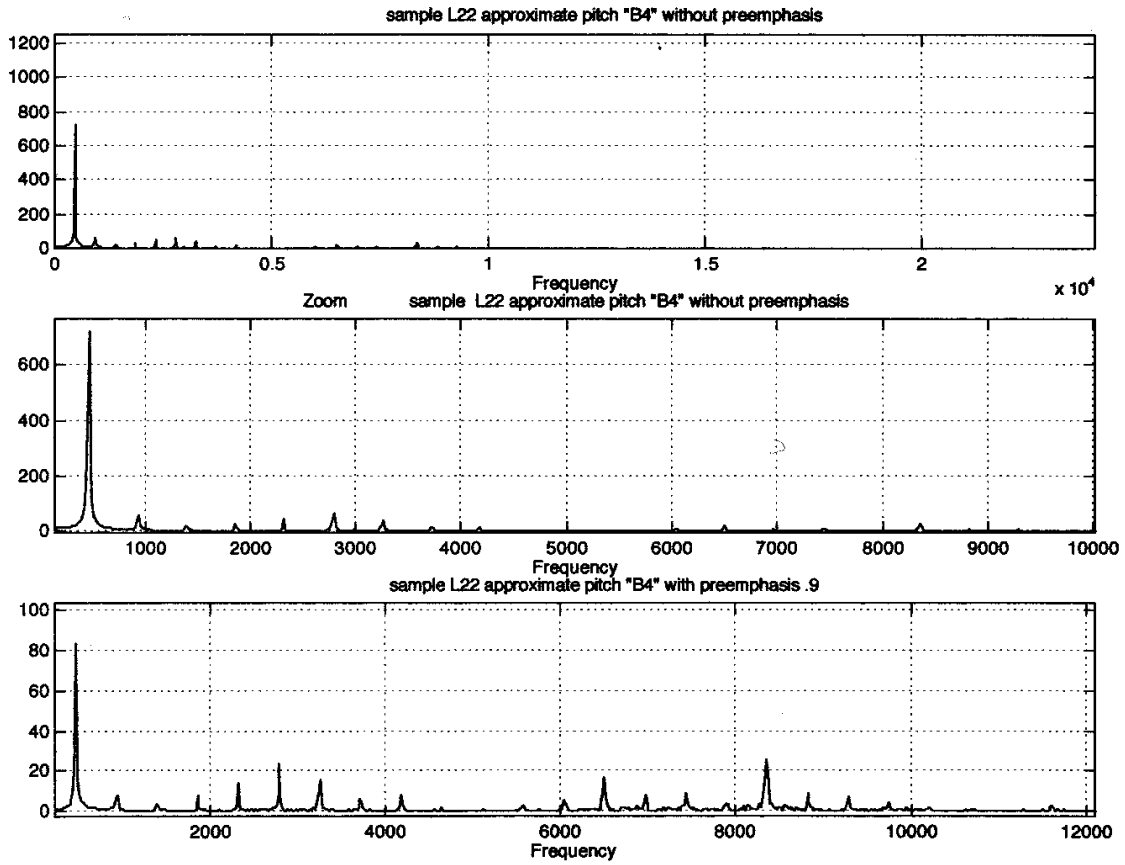
$$\frac{1}{f} = 467.6457867$$

468 Hz

(468.75, 893.61)  
 (2566.41, 18.19)  
 (3070.31, 18.23)  
 (4007.81, 6.00)  
 (6503.91, 9.10)  
 (8378.91, 17.54)



# DFT Results for L22



DFT Numerical Results for L22

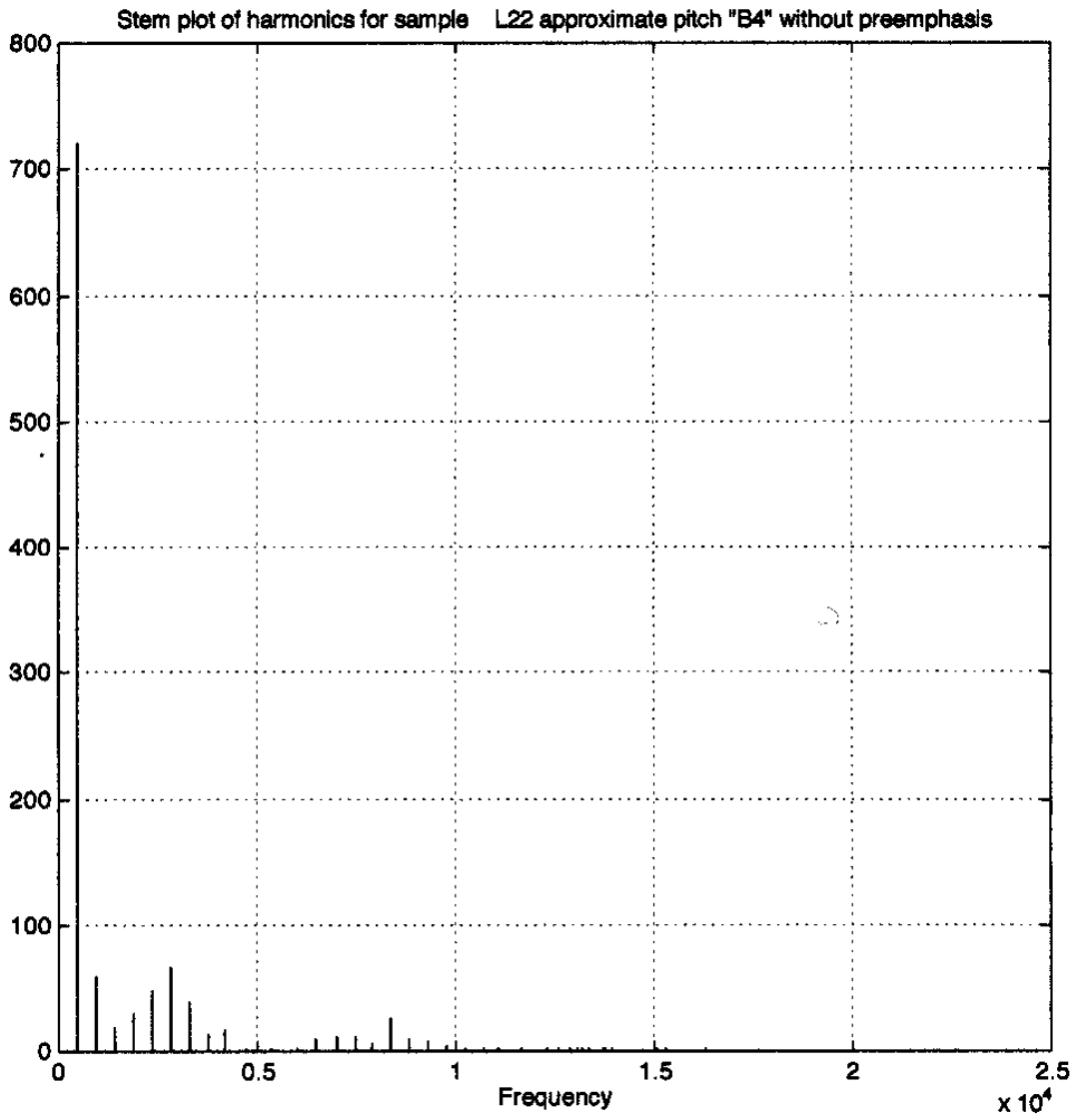
Worksheet saved into file: Minitab.L22  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	486	720.156	100.000 ←
2	954	59.603	8.276
3	1404	19.134	2.657
4	1872	29.926	4.156
5	2340	48.055	6.673
6	2808	65.732	9.127 ←
7	3276	38.556	5.354
8	3744	13.310	1.848
9	4194	16.414	2.279 ←
10	4698	1.213	0.168
11	5364	1.042	0.145
12	6012	2.537	0.352
13	6498	8.513	1.182
14	6984	10.301	1.430
15	7452	10.737	1.491 —
16	7902	4.828	0.670
17	8370	26.443	3.672 —
18	8838	8.589	1.193
19	9306	6.780	0.942
20	9774	4.542	0.631
21	10224	1.803	0.250
22	10692	0.965	0.134
23	11052	0.969	0.135
24	11628	1.941	0.269
25	12114	0.805	0.112
26	12582	0.430	0.060
27	13032	1.304	0.181
28	13500	0.635	0.088
29	13968	1.791	0.249
30	14544	0.750	0.104
31	15192	0.541	0.075
32	15552	0.491	0.068
33	16164	0.369	0.051
34	16578	0.333	0.046
35	17190	0.439	0.061
36	17424	0.370	0.051
37	17820	0.357	0.050
38	18324	0.312	0.043
39	18954	0.337	0.047
40	19260	0.295	0.041
41	19980	0.268	0.037
42	20286	0.282	0.039
43	20826	0.310	0.043
44	21294	0.284	0.039
45	21906	0.265	0.037
46	22194	0.271	0.038
47	22896	0.255	0.035
48	23166	0.256	0.036
49	12294	0.940	0.131
50	12582	1.216	0.169
51	12888	1.287	0.179
52	13194	1.378	0.191
53	13338	1.010	0.140
54	13698	2.075	0.288
55	13770	1.716	0.238

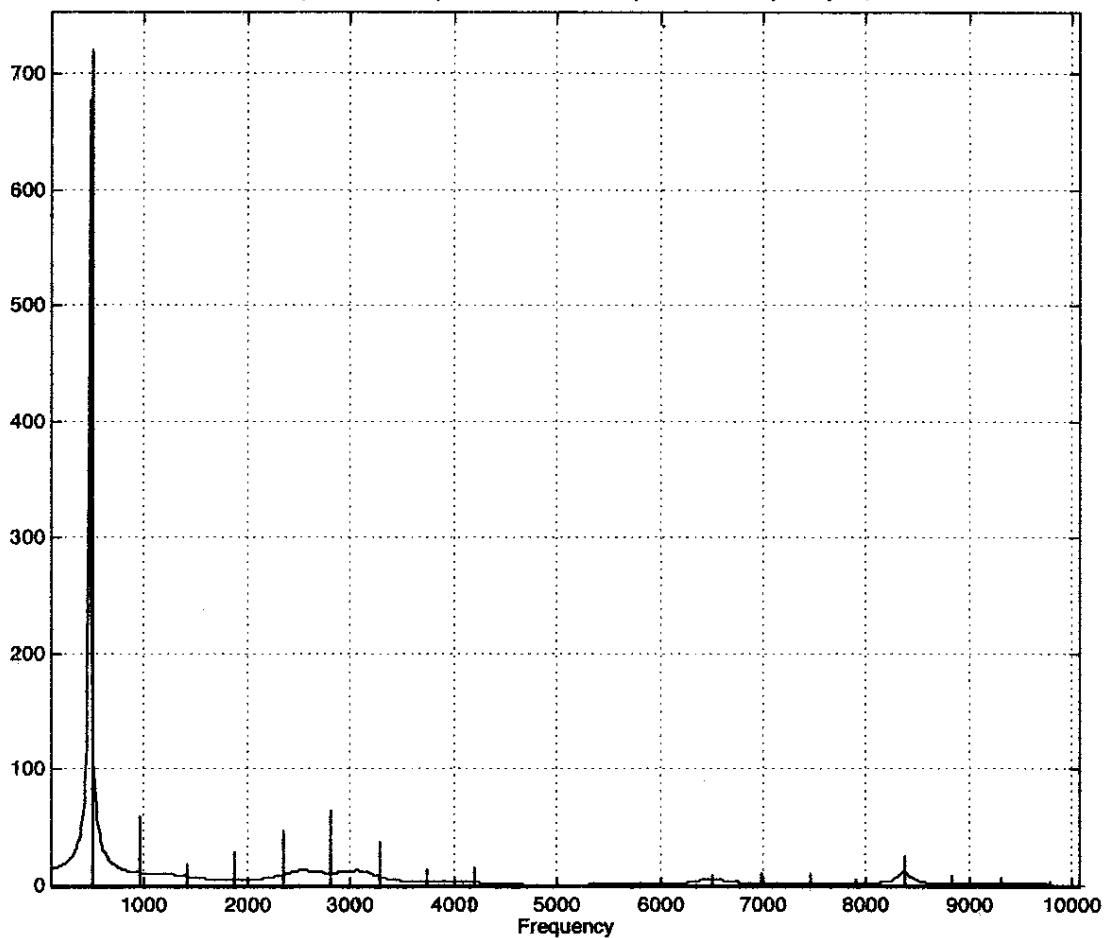
56	14148	0.774	0.108
57	14364	0.789	0.110
58	14544	0.826	0.115
59	14886	0.836	0.116
60	15048	1.097	0.152
61	15282	1.265	0.176
62	15588	0.700	0.097
63	15858	0.666	0.092
64	16038	0.746	0.104
65	16308	1.015	0.141
66	16542	0.868	0.120
67	16794	0.588	0.082
68	17136	0.623	0.086
69	17370	0.584	0.081
70	17586	0.581	0.081
71	17910	0.581	0.081
72	18144	0.551	0.077
73	18396	0.563	0.078
74	18648	0.582	0.081
75	18972	0.537	0.075
76	19152	0.569	0.079
77	19332	0.545	0.076
78	19674	0.573	0.080
79	19818	0.532	0.074
80	20088	0.537	0.075
81	20322	0.560	0.078
82	20610	0.536	0.074
83	20898	0.544	0.076
84	21222	0.532	0.074
85	21492	0.530	0.074
86	21582	0.538	0.075
87	21960	0.541	0.075
88	22158	0.520	0.072
89	22500	0.535	0.074
90	22698	0.536	0.074
91	22932	0.511	0.071
92	23202	0.503	0.070
93	23508	0.518	0.072
94	23742	0.530	0.074
95	22212	0.156	0.022
96	22464	0.149	0.021
97	22770	0.146	0.020
98	22986	0.147	0.020
99	23148	0.160	0.022
100	23454	0.154	0.021
101	23670	0.155	0.022
102	20160	0.179	0.025
103	20430	0.180	0.025
104	20610	0.171	0.024
105	20718	0.158	0.022
106	21042	0.164	0.023
107	21240	0.157	0.022
108	21420	0.141	0.020
109	21564	0.154	0.021
110	21834	0.144	0.020
111	21978	0.138	0.019
112	22104	0.146	0.020
113	22302	0.133	0.018
114	22608	0.144	0.020
115	22824	0.134	0.019

116	22950	0.130	0.018
117	23202	0.139	0.019
118	23418	0.141	0.020
119	23490	0.135	0.019
120	23814	0.133	

0.019



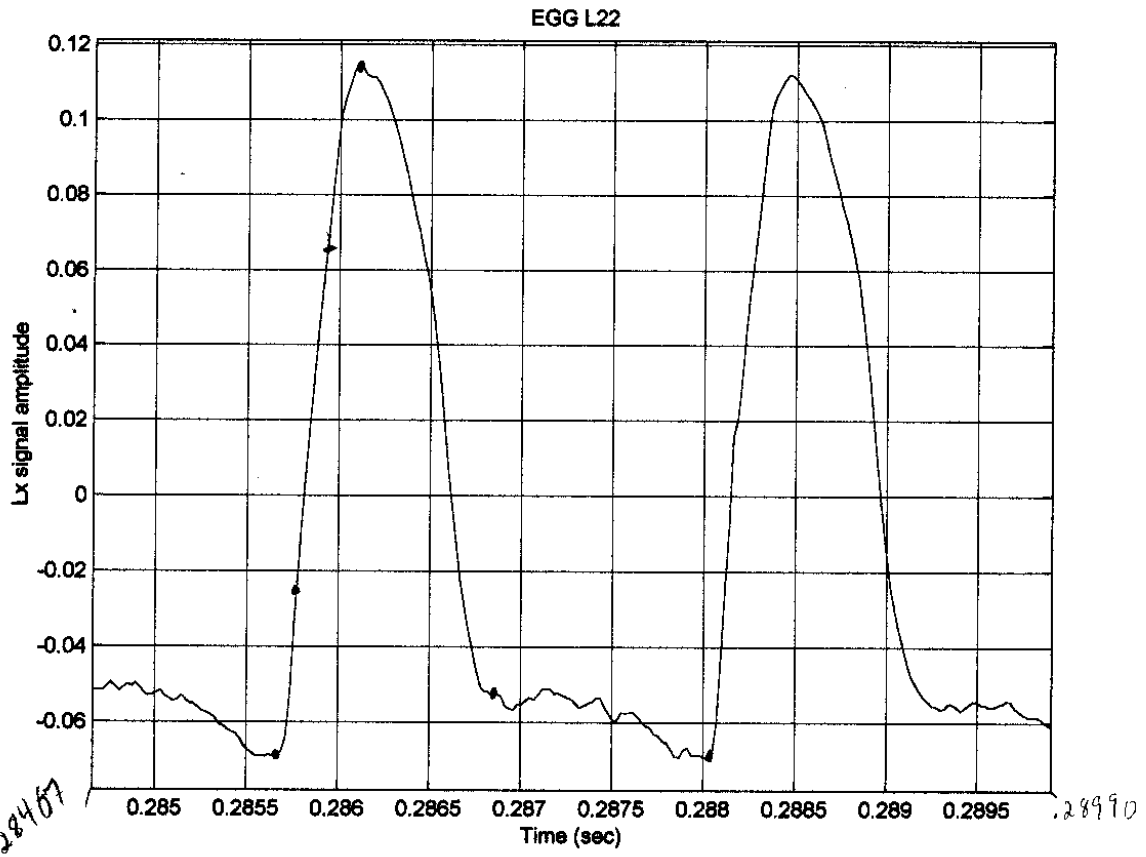
Stem plot/LPC overlay of harmonics for sample L22 without preemphasis

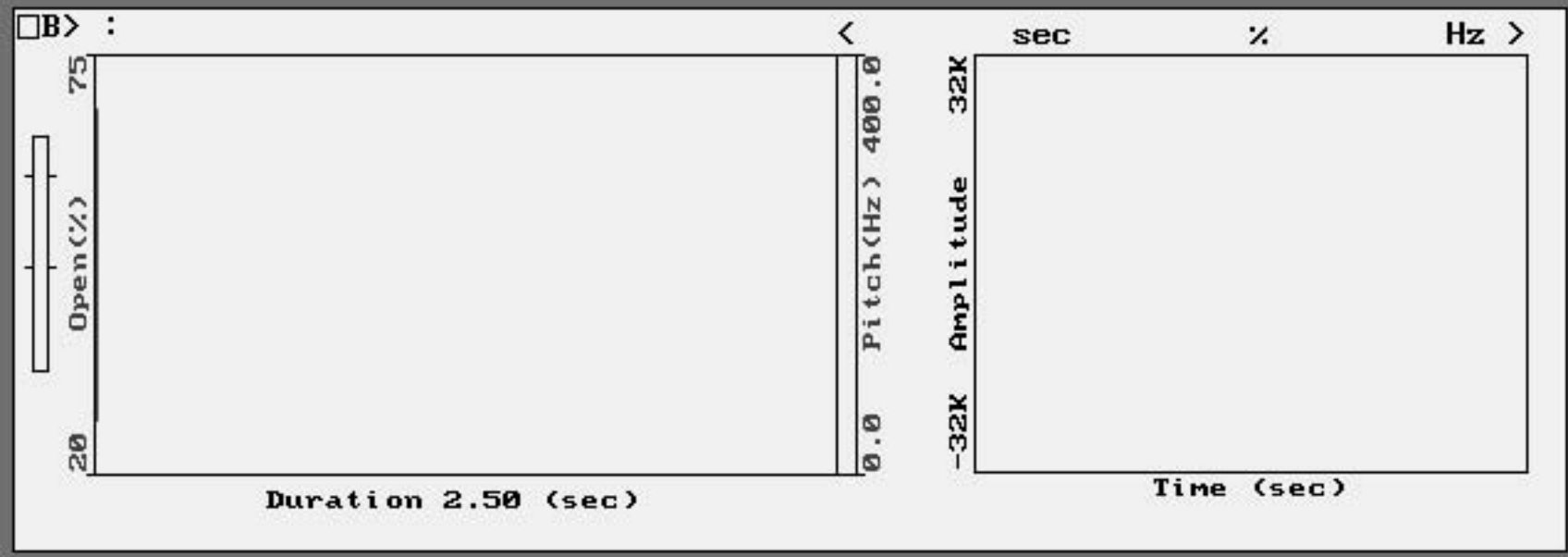
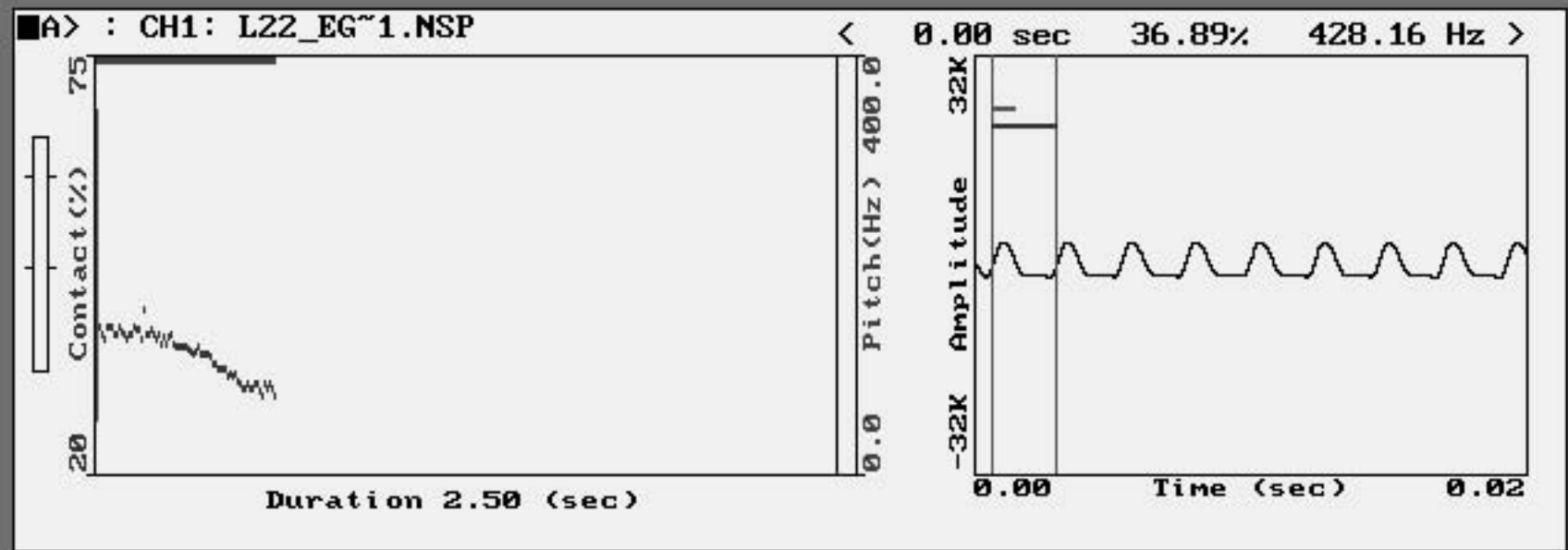


$x \Rightarrow 15 \text{ mm} = .0005$

$y \Rightarrow 12 \text{ mm} = .02$

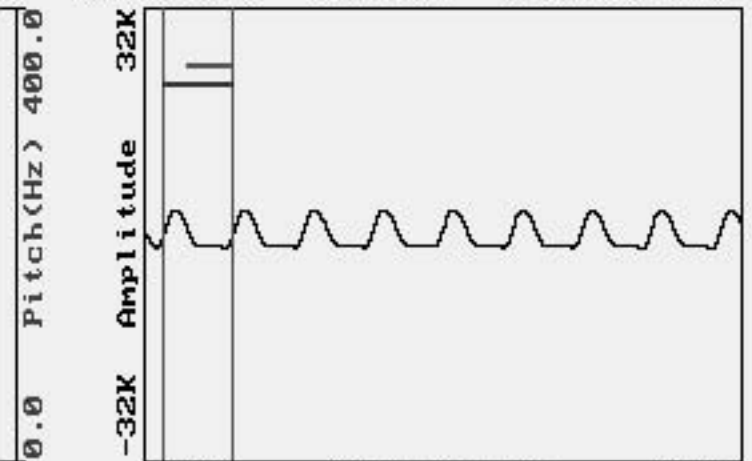
$y \text{ 1mm} = .001666667$





**A** > : CH1: L22\_EG~1.NSP

< 0.00 sec 63.10% 428.16 Hz >

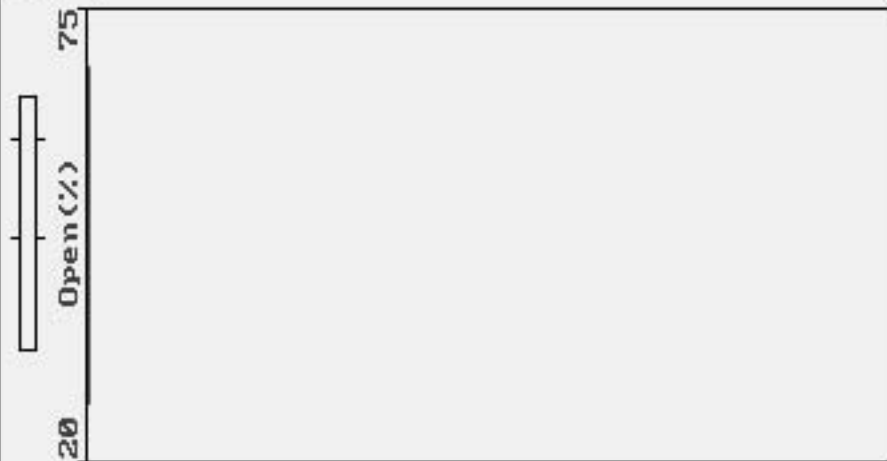


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0  
-32K Amplitude 32K  
0.00 Time (sec) 0.02

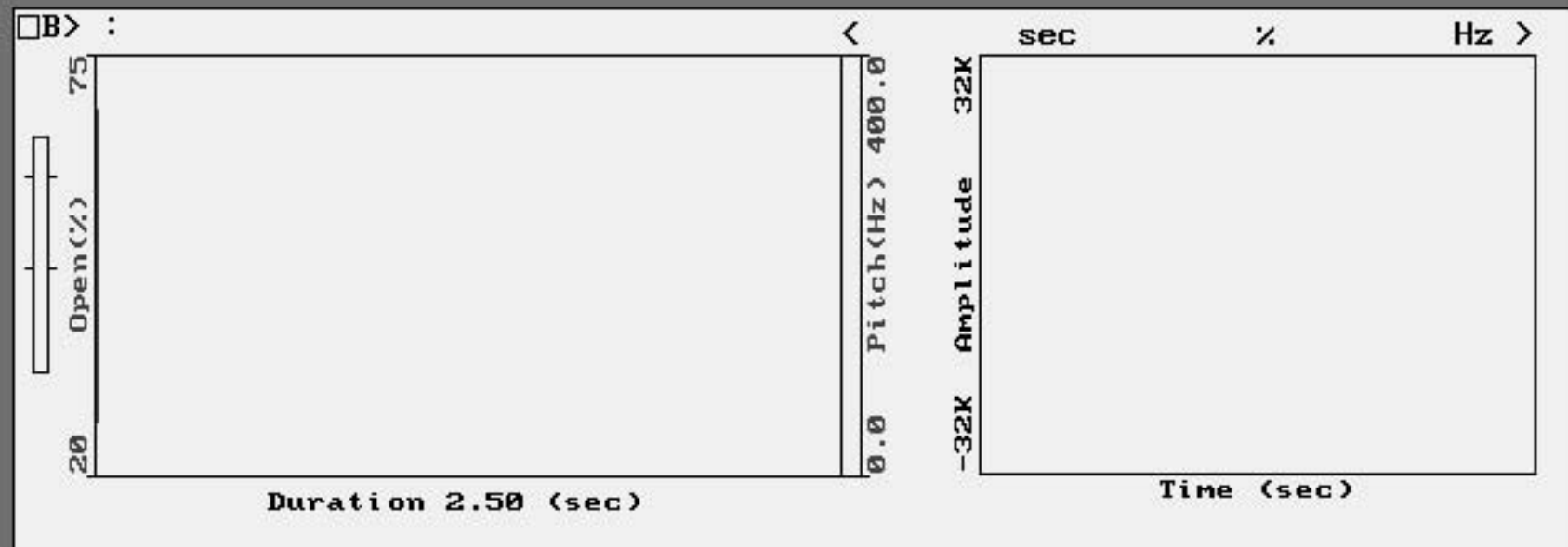
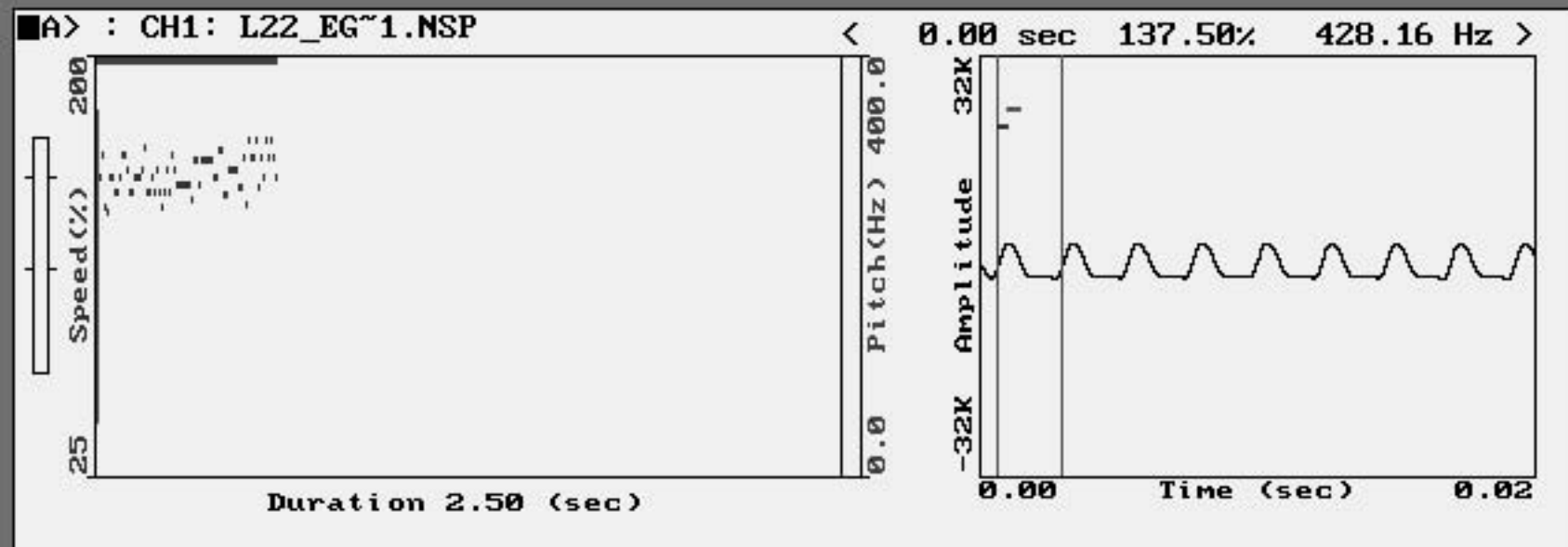
**B** > :

< sec % Hz >



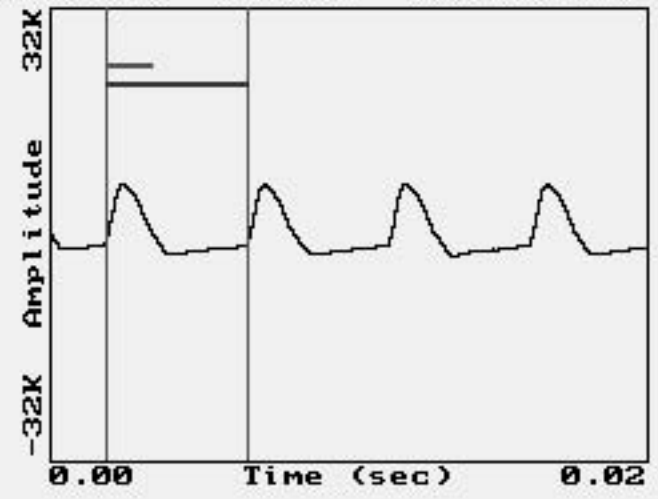
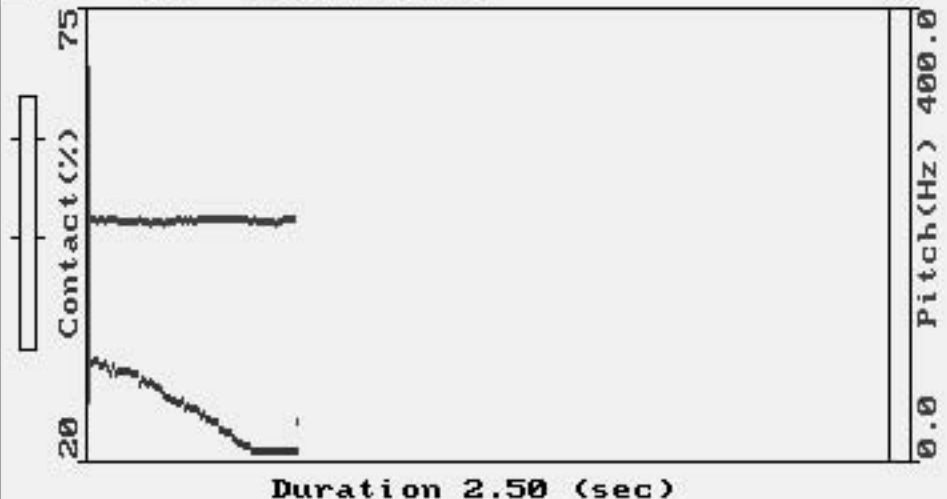
Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0  
-32K Amplitude 32K  
Time (sec)



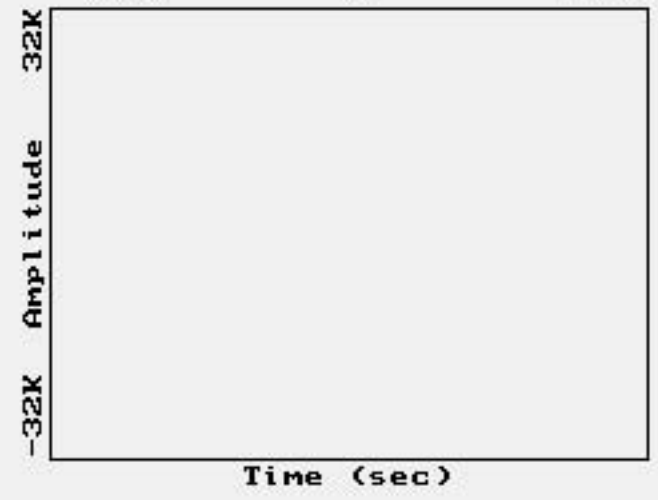
■A> : CH1: L2\_EGGST.NSP

< 0.00 sec 32.22% 209.00 Hz >



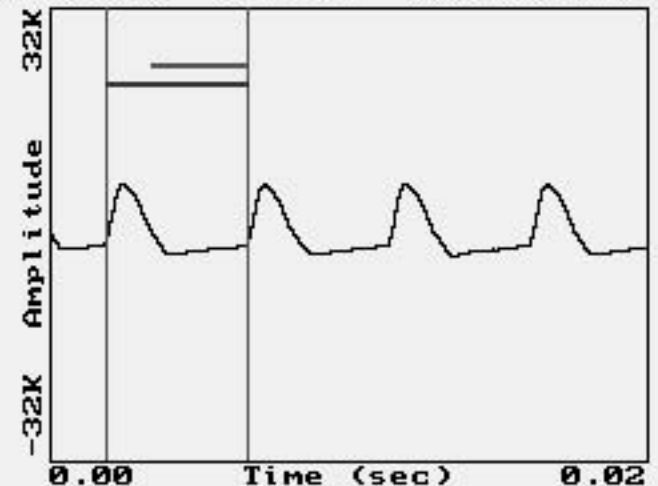
□B> :

< sec % Hz >



**A** > : CH1: L2\_EGGST.NSP

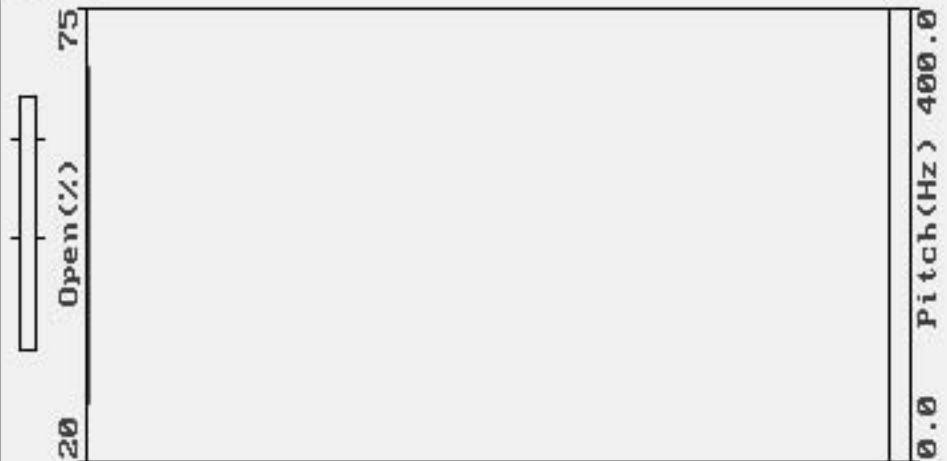
< 0.00 sec 67.77% 209.00 Hz >



Duration 2.50 (sec)

**B** > :

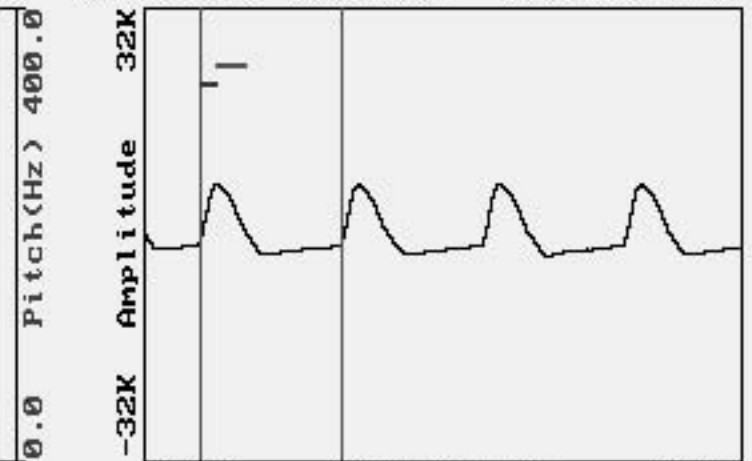
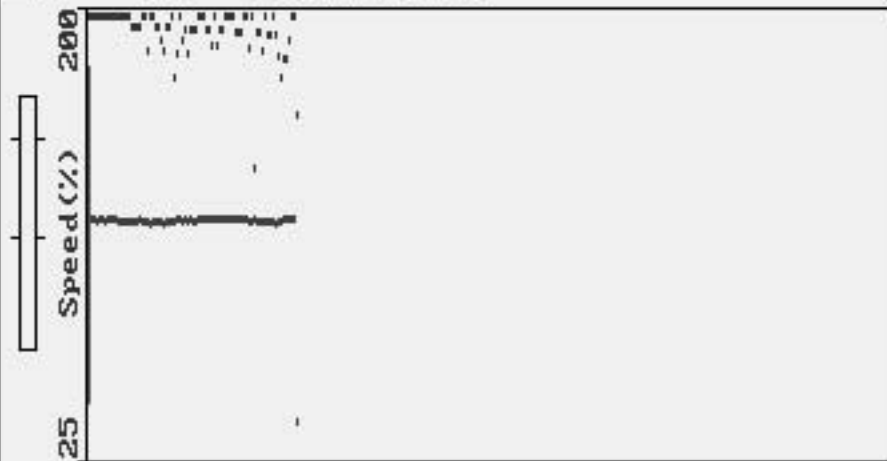
< sec % Hz >



Duration 2.50 (sec)

**A** > : CH1: L2\_EGGST.NSP

< 0.00 sec 209.09% 209.00 Hz >

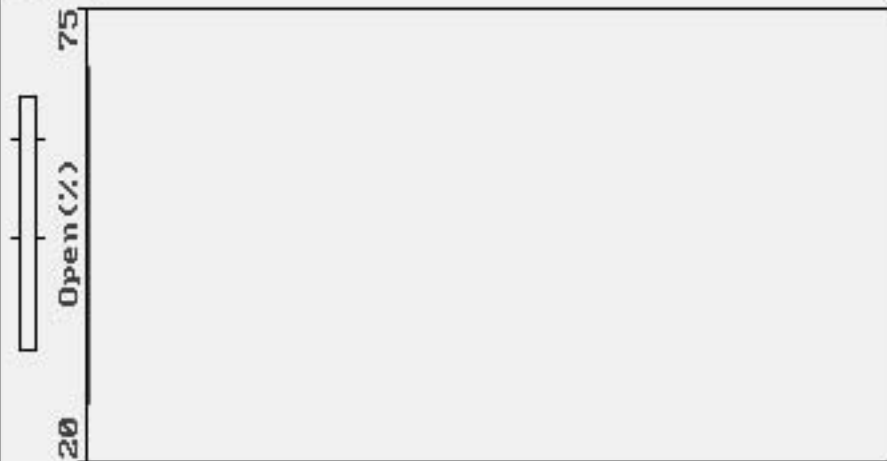


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >

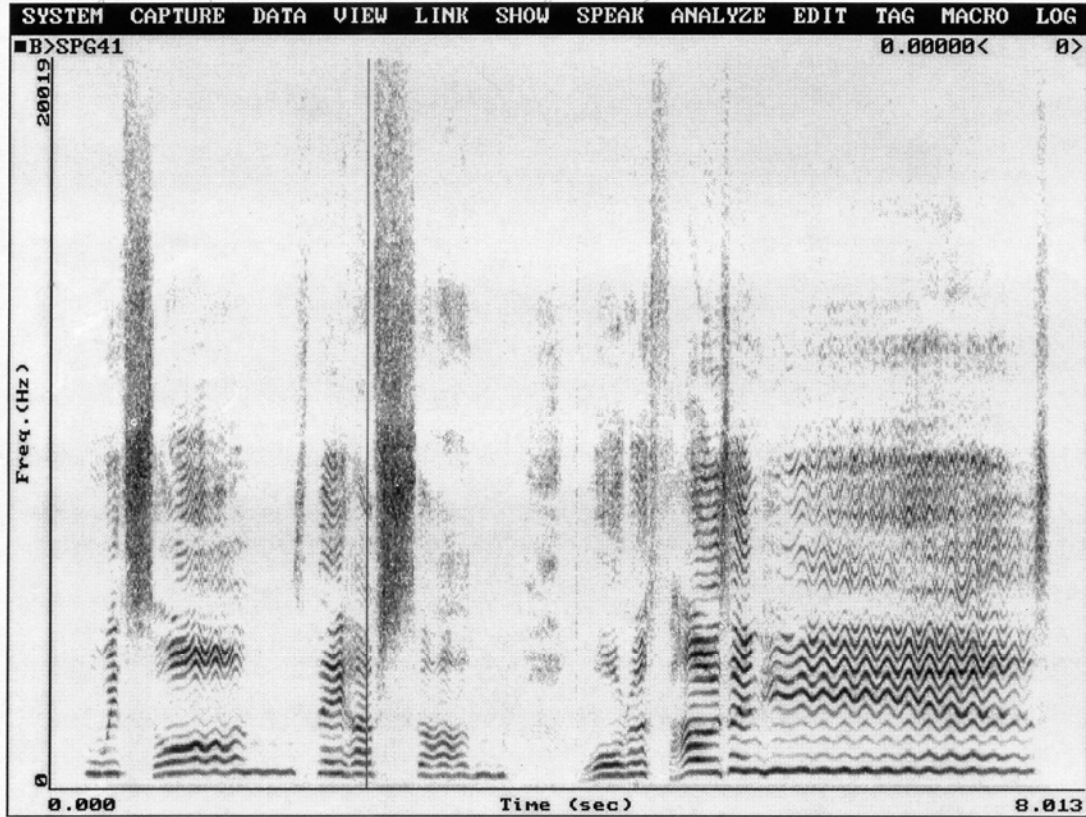


Duration 2.50 (sec)

Pitch(Hz) 400.0

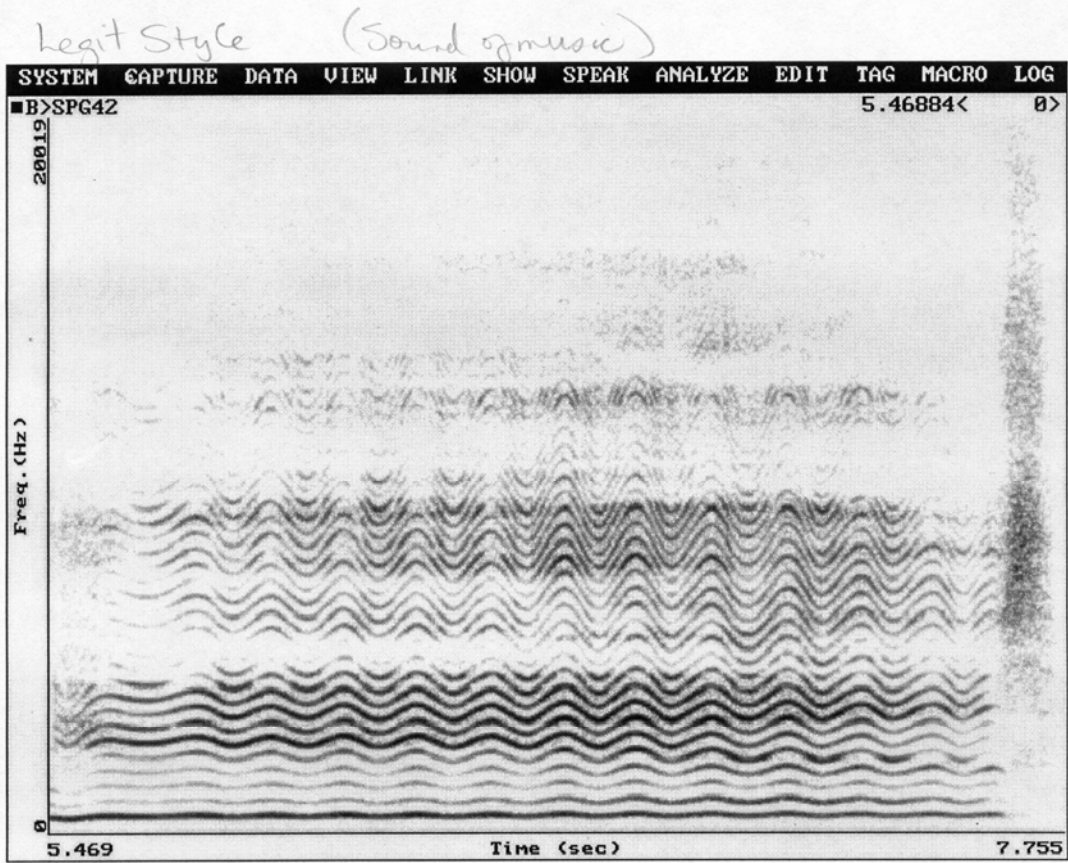
Spectrogram for L34a

*legit style (The Sound of Music)*



*with songs they have sung for a thousand years*

Spectrogram for L34b



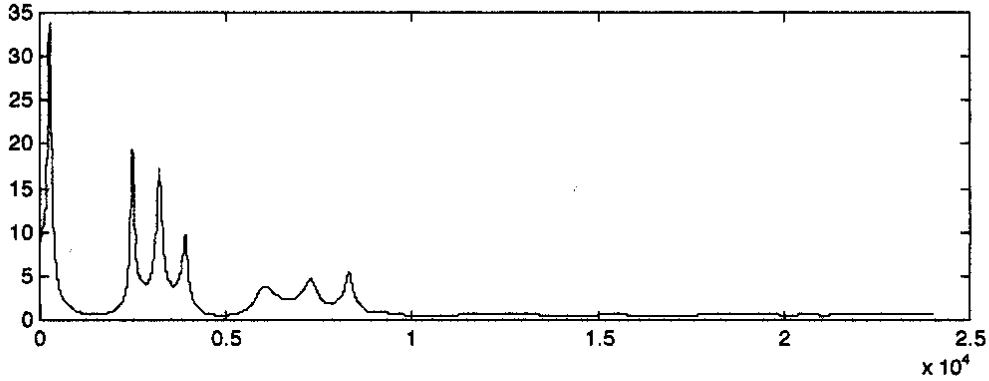
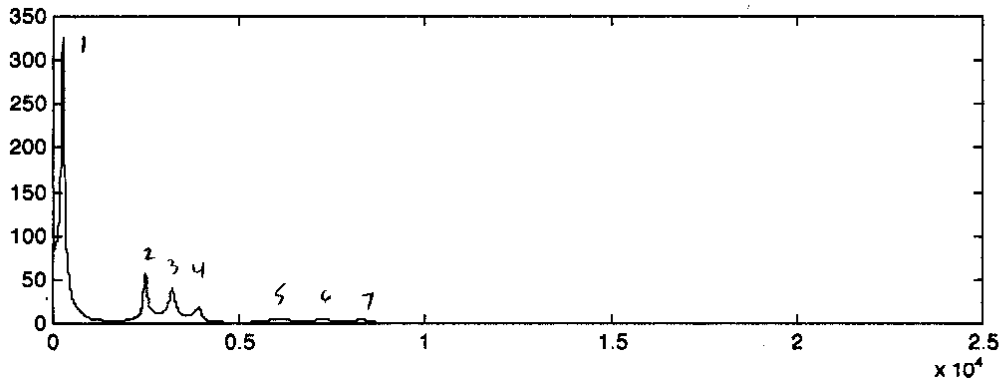
*years*

LPC for L34b

L34

$$F_0 = 228 \text{ Hz}$$

- 1) 257.81 325.64
- 2) 2484.38 56.50
- 3) 3199.22 39.56
- 4) 3902.34 18.03
- 5) 6034.75 4.99
- 6) 7252.75 5.11
- 7) 8296.88 5.30



$$.1564375 - .0075208333 = .148916667/34 = .004379902$$

$$\frac{1}{f} = 228.3156122$$

$$= 228 \text{ Hz}$$

LPC of 2500pts of L34b

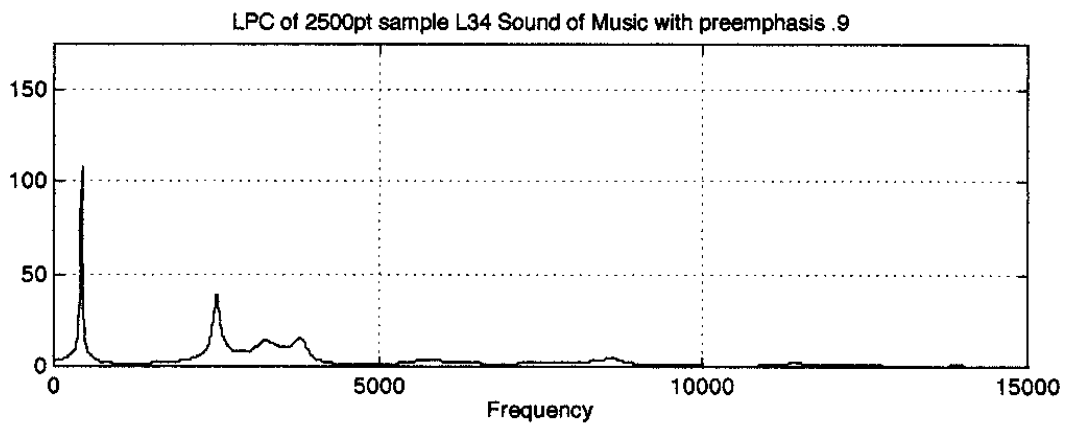
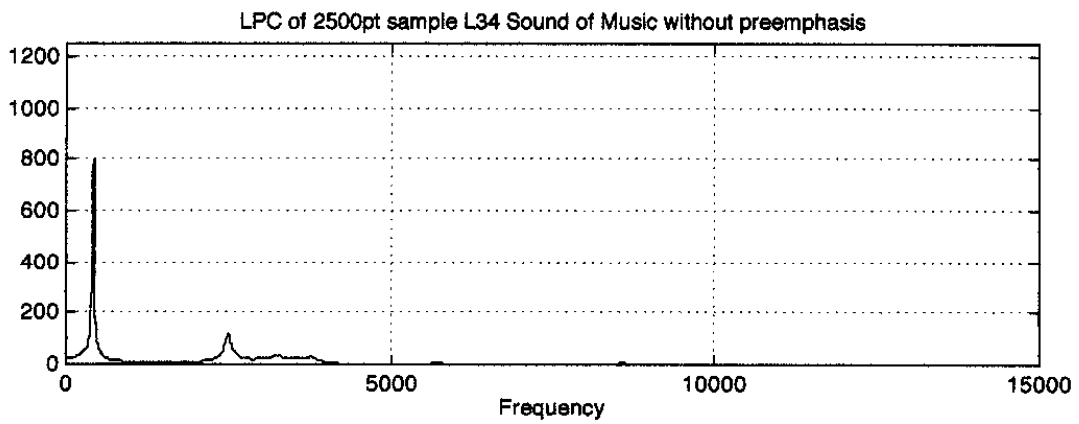
$F_1(432, 804)$

$F_2(2496, 118)$

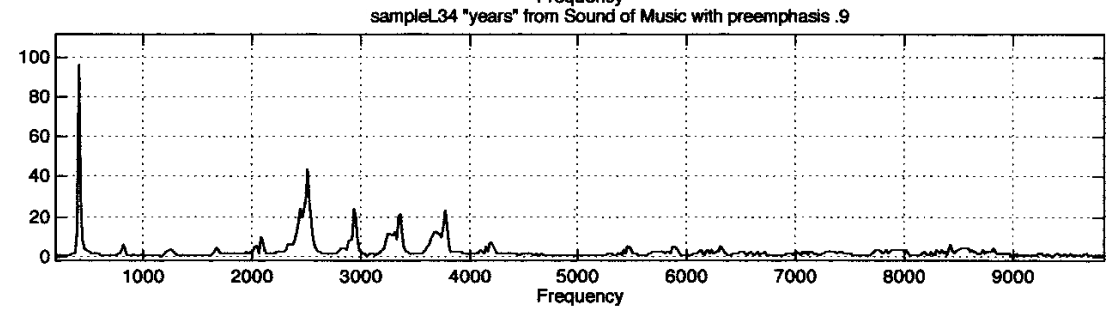
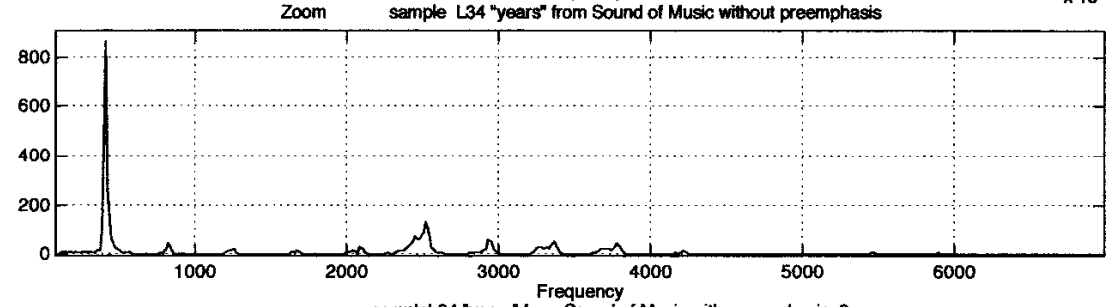
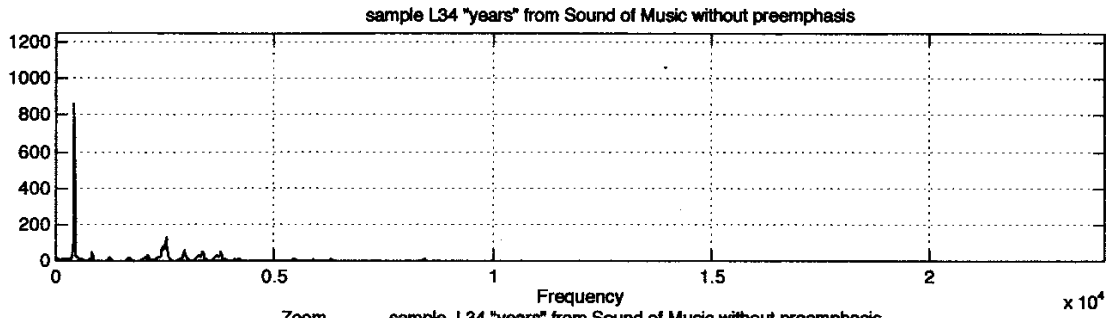
$F_3(3246, 31)$

$F_4(3773, 30)$

L34 estimation



DFT's of L34b



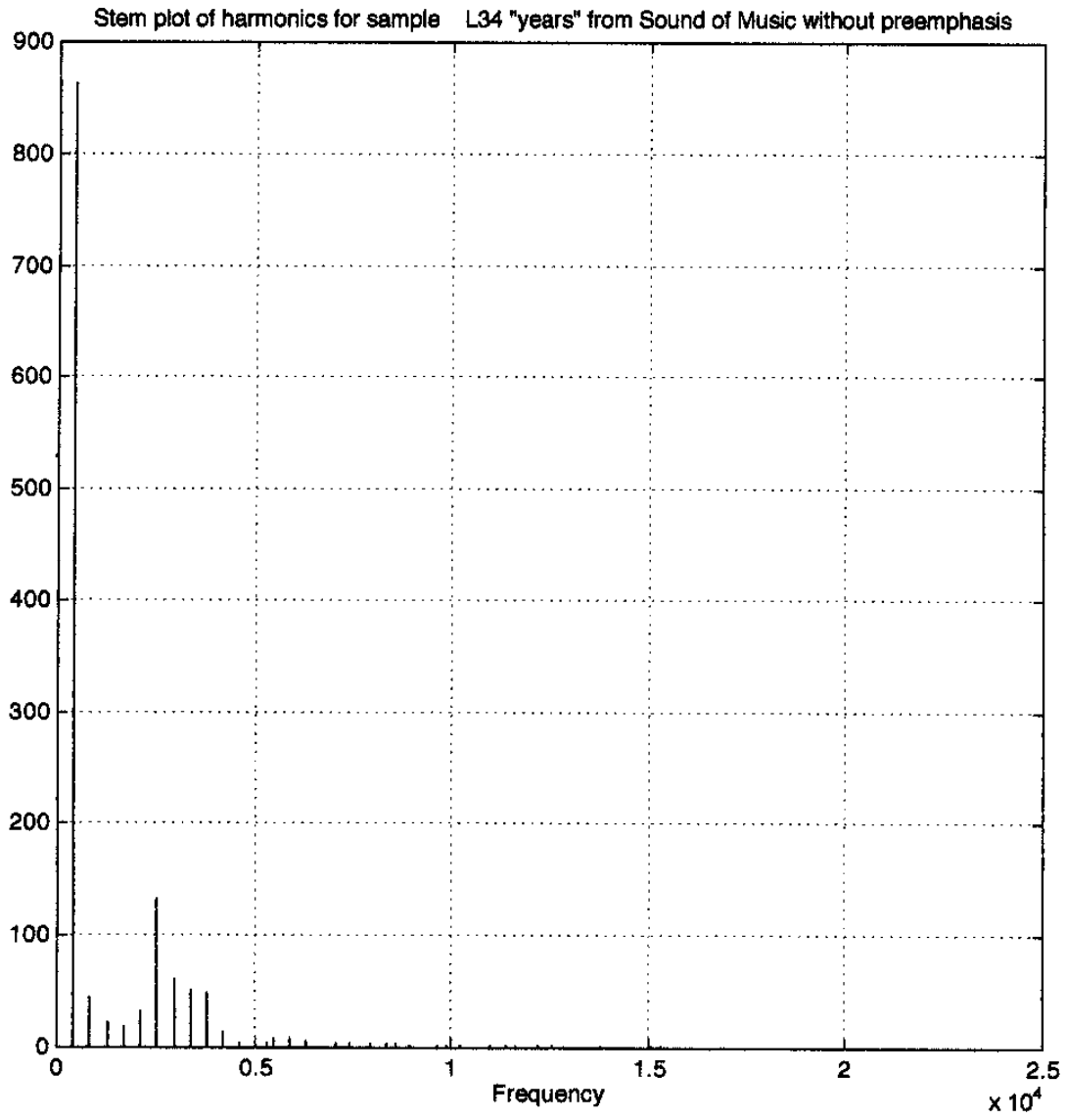
## DFT Numerical Results

Worksheet saved into file: Minitab.L34  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	432	862.830	100.000
2	846	44.970	5.212
3	1278	21.892	2.537
4	1692	18.231	2.113
5	2106	32.824	3.804
6	2538	133.769	15.504
7	2952	62.100	7.197
8	3384	50.368	5.838
9	3798	48.343	5.603
10	4230	13.925	1.614
11	4590	3.231	0.374
12	5310	3.169	0.367
13	5490	7.616	0.883
14	5904	7.545	0.874
15	6318	6.417	0.744
16	7074	3.125	0.362
17	7434	3.375	0.391
18	7938	4.321	0.501
19	8352	3.448	0.400
20	8586	4.666	0.541
21	8946	1.927	0.223
22	9666	1.611	0.187
23	9900	1.053	0.122
24	10224	1.106	0.128
25	10962	1.327	0.154
26	11376	2.434	0.282
27	11646	1.431	0.166
28	12204	1.303	0.151
29	12582	1.079	0.125
30	12996	0.767	0.089
31	13446	0.734	0.085
32	13860	0.885	0.103
33	14130	0.755	0.088
34	14724	0.647	0.075
35	14994	0.751	0.087
36	15606	0.847	0.098
37	15894	0.661	0.077
38	16434	0.644	0.075
39	16722	0.579	0.067
40	17172	0.565	0.066
41	17586	0.567	0.066
42	18108	0.687	0.080
43	18522	0.532	0.062
44	18882	0.525	0.061
45	19422	0.555	0.064
46	19980	0.505	0.059
47	20232	0.511	0.059
48	20664	0.481	0.056
49	21006	0.484	0.056
50	21582	0.470	0.055
51	21942	0.461	0.053
52	22428	0.455	0.053
53	23004	0.449	0.052
54	23166	0.441	0.051
55	13770	1.716	0.199

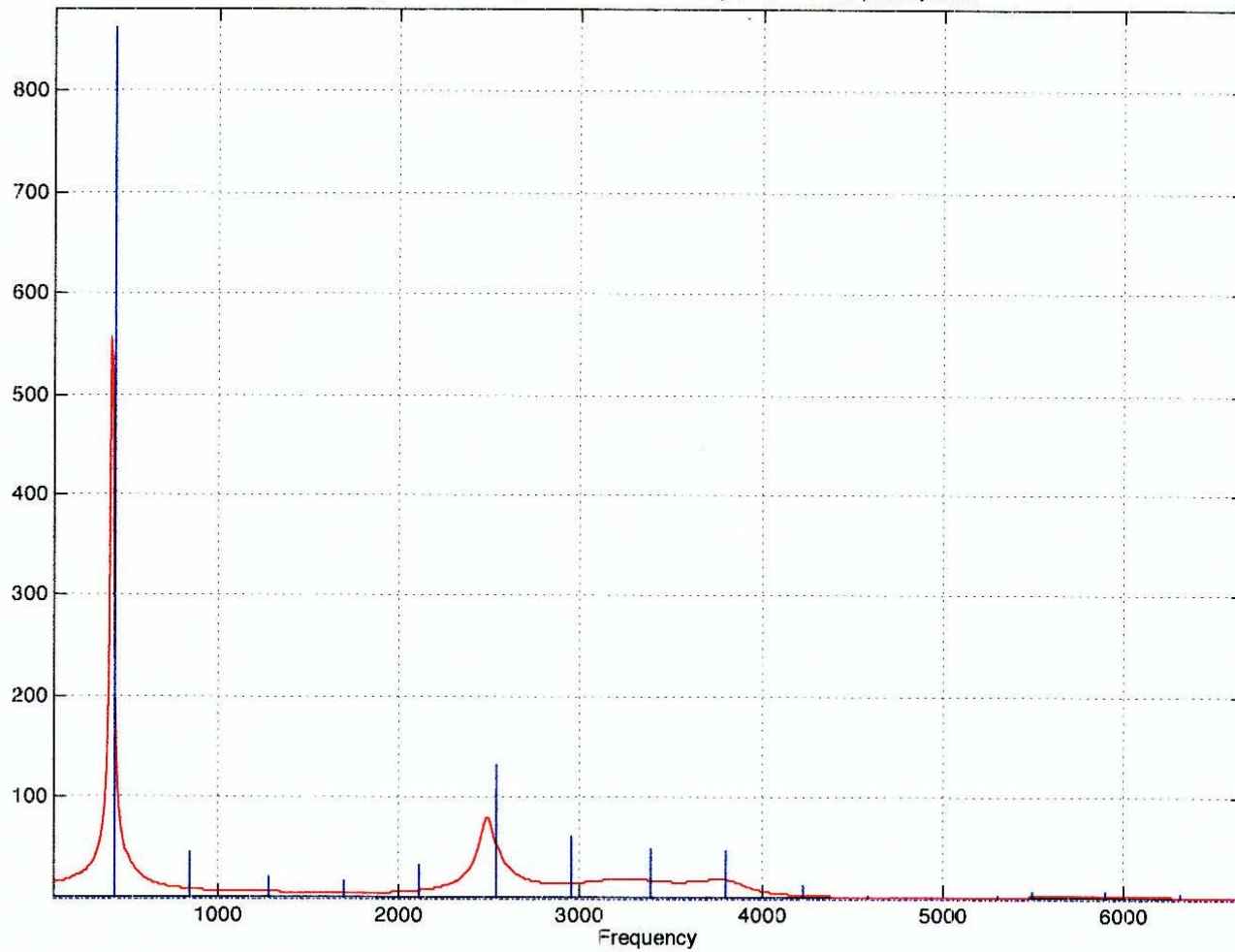
56	14148	0.774	0.090
57	14364	0.789	0.091
58	14544	0.826	0.096
59	14886	0.836	0.097
60	15048	1.097	0.127
61	15282	1.265	0.147
62	15588	0.700	0.081
63	15858	0.666	0.077
64	16038	0.746	0.086
65	16308	1.015	0.118
66	16542	0.868	0.101
67	16794	0.588	0.068
68	17136	0.623	0.072
69	17370	0.584	0.068
70	17586	0.581	0.067
71	17910	0.581	0.067
72	18144	0.551	0.064
73	18396	0.563	0.065
74	18648	0.582	0.067
75	18972	0.537	0.062
76	19152	0.569	0.066
77	19332	0.545	0.063
78	19674	0.573	0.066
79	19818	0.532	0.062
80	20088	0.537	0.062
81	20322	0.560	0.065
82	20610	0.536	0.062
83	20898	0.544	0.063
84	21222	0.532	0.062
85	21492	0.530	0.061
86	21582	0.538	0.062
87	21960	0.541	0.063
88	22158	0.520	0.060
89	22500	0.535	0.062
90	22698	0.536	0.062
91	22932	0.511	0.059
92	23202	0.503	0.058
93	23508	0.518	0.060
94	23742	0.530	0.061
95	22212	0.156	0.018
96	22464	0.149	0.017
97	22770	0.146	0.017
98	22986	0.147	0.017
99	23148	0.160	0.019
100	23454	0.154	0.018
101	23670	0.155	0.018
102	20160	0.179	0.021
103	20430	0.180	0.021
104	20610	0.171	0.020
105	20718	0.158	0.018
106	21042	0.164	0.019
107	21240	0.157	0.018
108	21420	0.141	0.016
109	21564	0.154	0.018
110	21834	0.144	0.017
111	21978	0.138	0.016
112	22104	0.146	0.017
113	22302	0.133	0.015
114	22608	0.144	0.017
115	22824	0.134	0.016

116	22950	0.130	0.015
117	23202	0.139	0.016
118	23418	0.141	0.016
119	23490	0.135	0.016
120	23814	0.133	0.015



# DFT/LPC Overlay of L34b

Stem plot/LPC overlay of harmonics for sample L34 without preemphasis

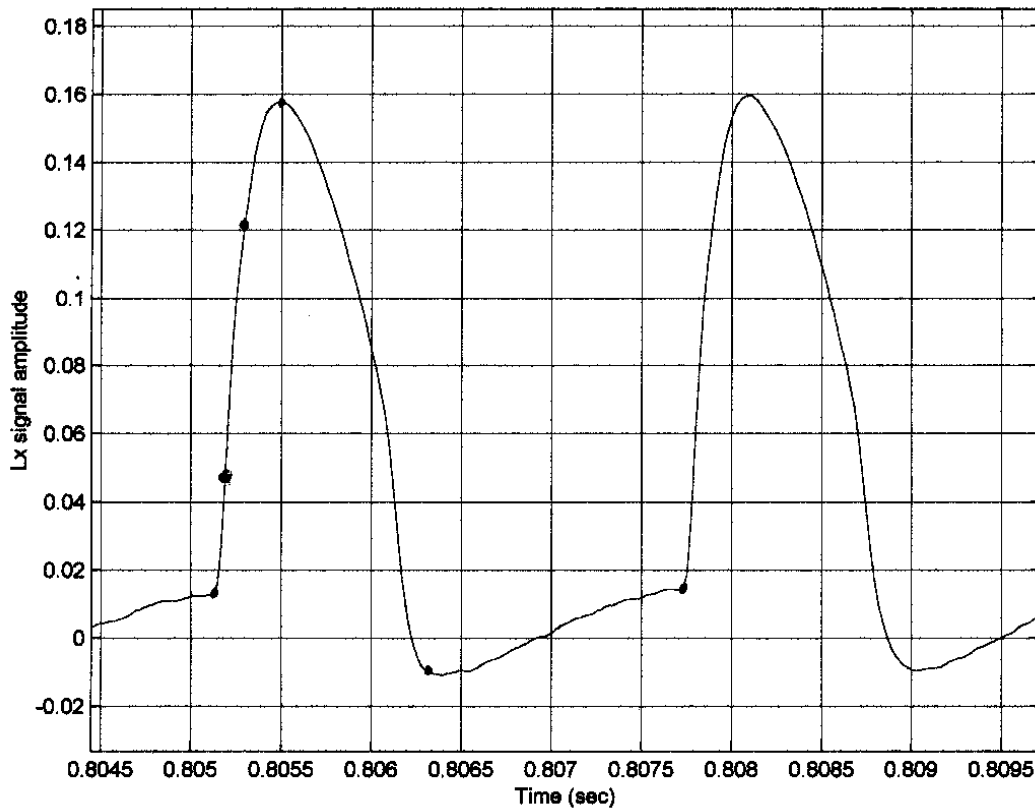


$x \rightarrow 15 \text{ mm} = .0005$

$y \rightarrow 11 \text{ mm} = .02$

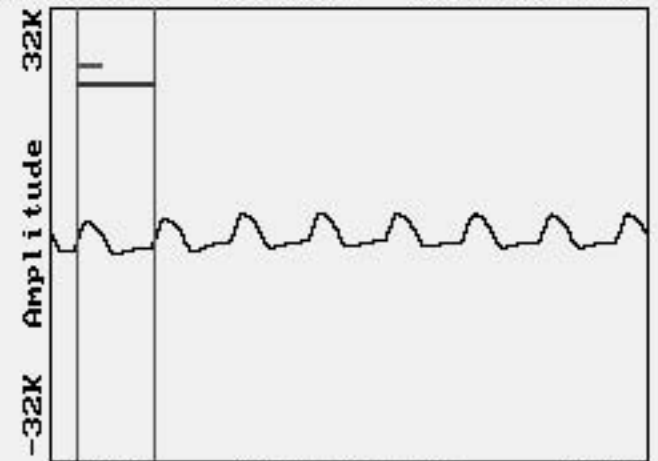
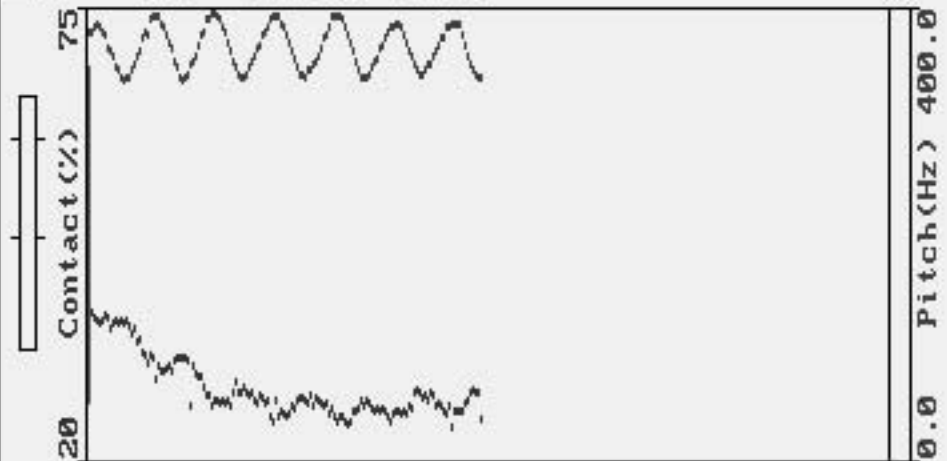
$y_{\text{time}} = .001818182$

EGG L34B



**A** > : CH1: L34B\_E~1.NSP

< 0.00 sec 29.56% 383.48 Hz >

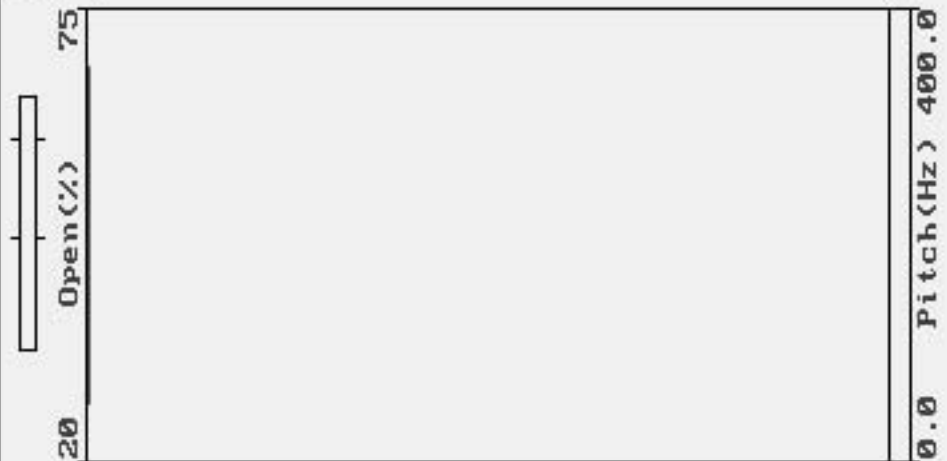


Duration 2.50 (sec)

0.00 Time (sec) 0.02

**B** > :

< sec % Hz >

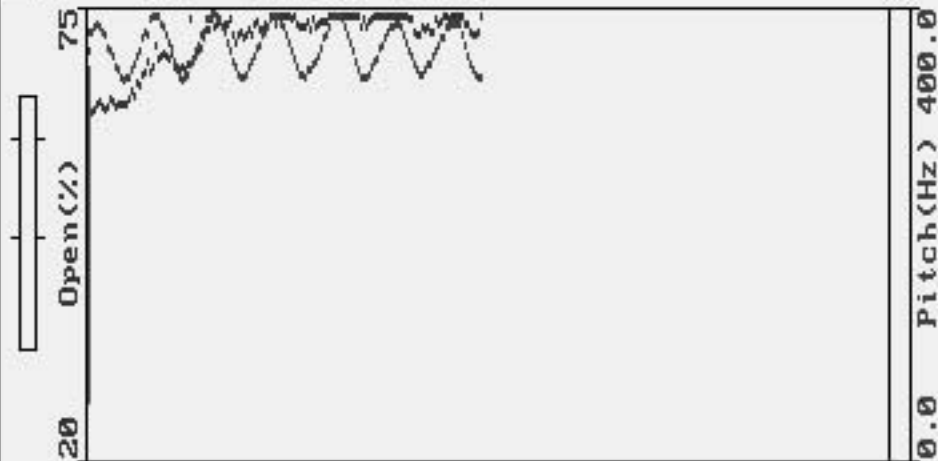


Duration 2.50 (sec)

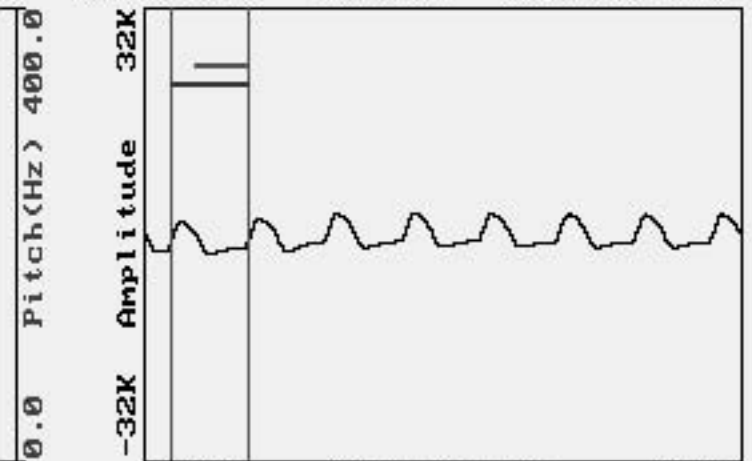
Time (sec)

**A** > : CH1: L34B\_E~1.NSP

< 0.00 sec 70.43% 383.48 Hz >



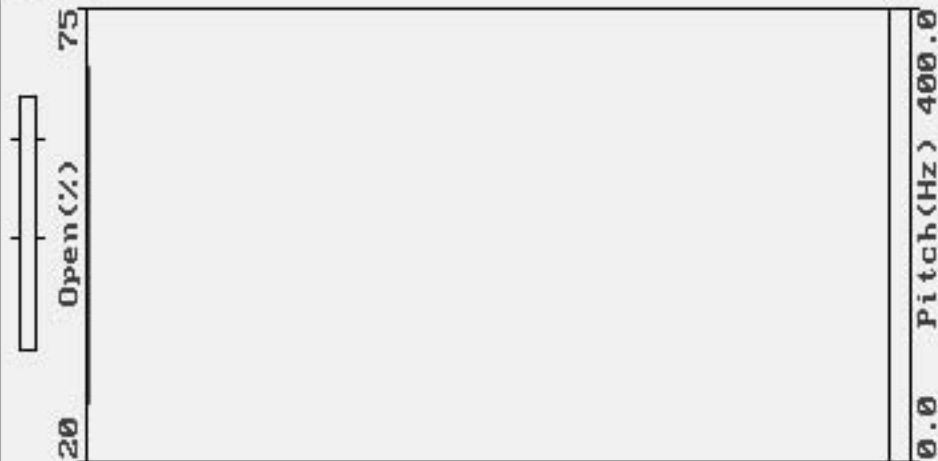
Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

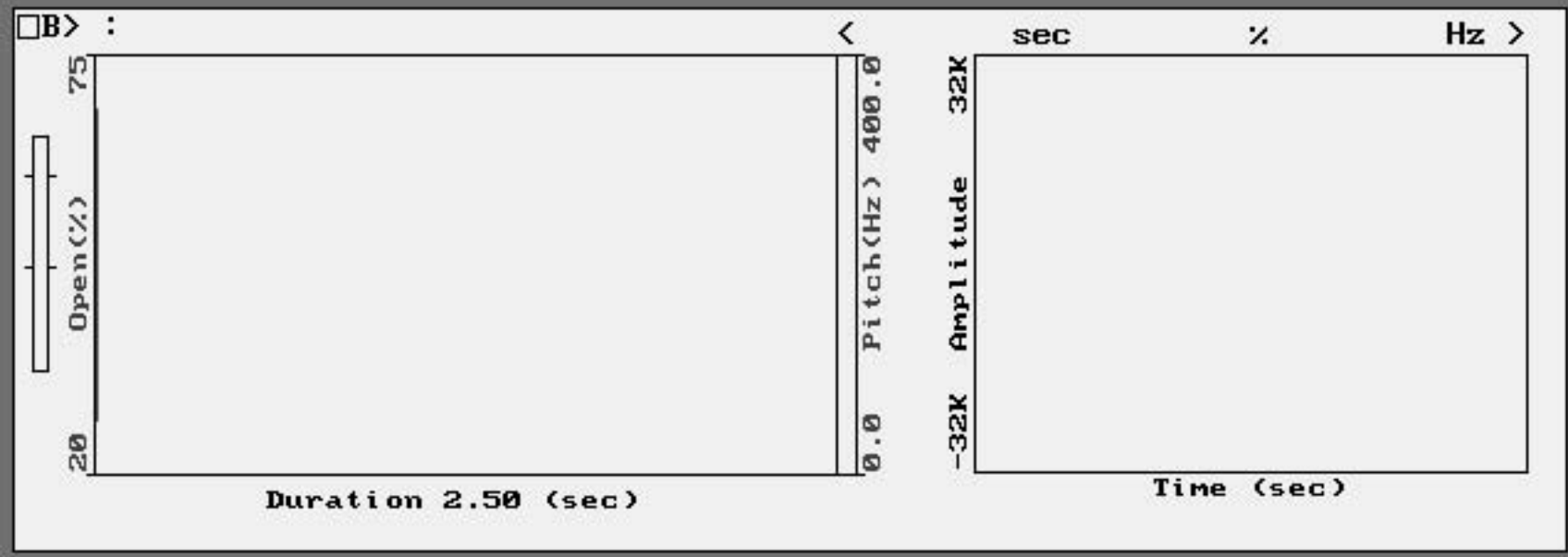
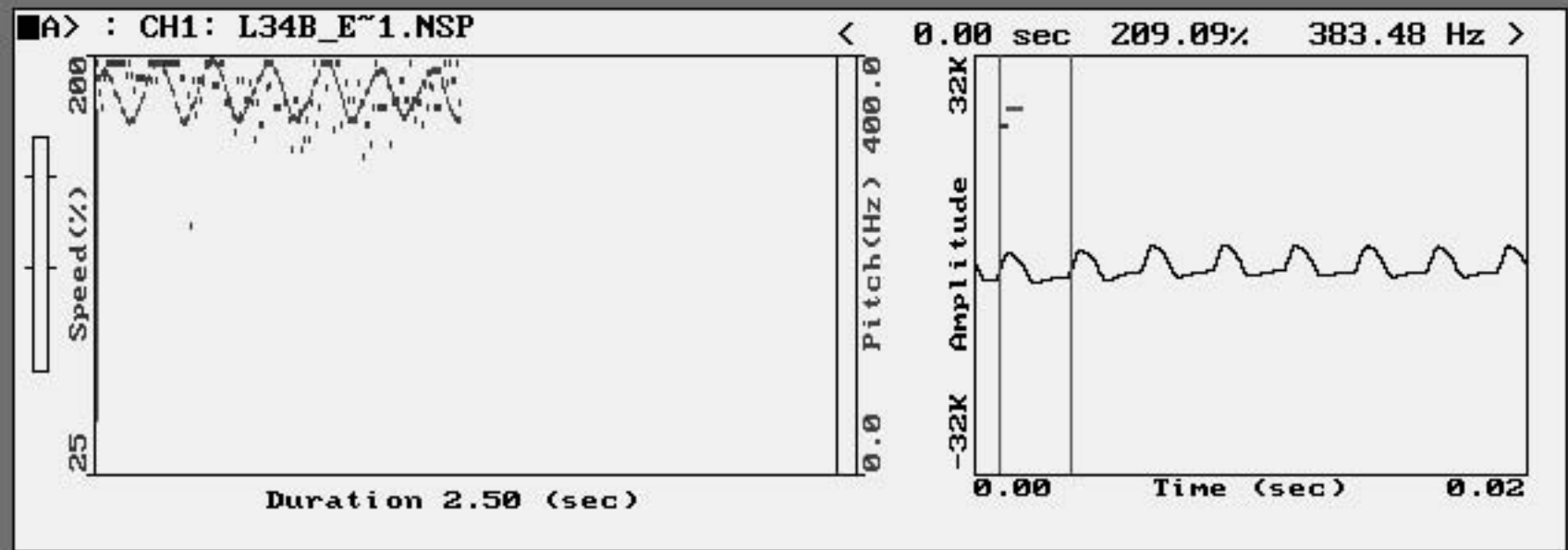
< sec % Hz >



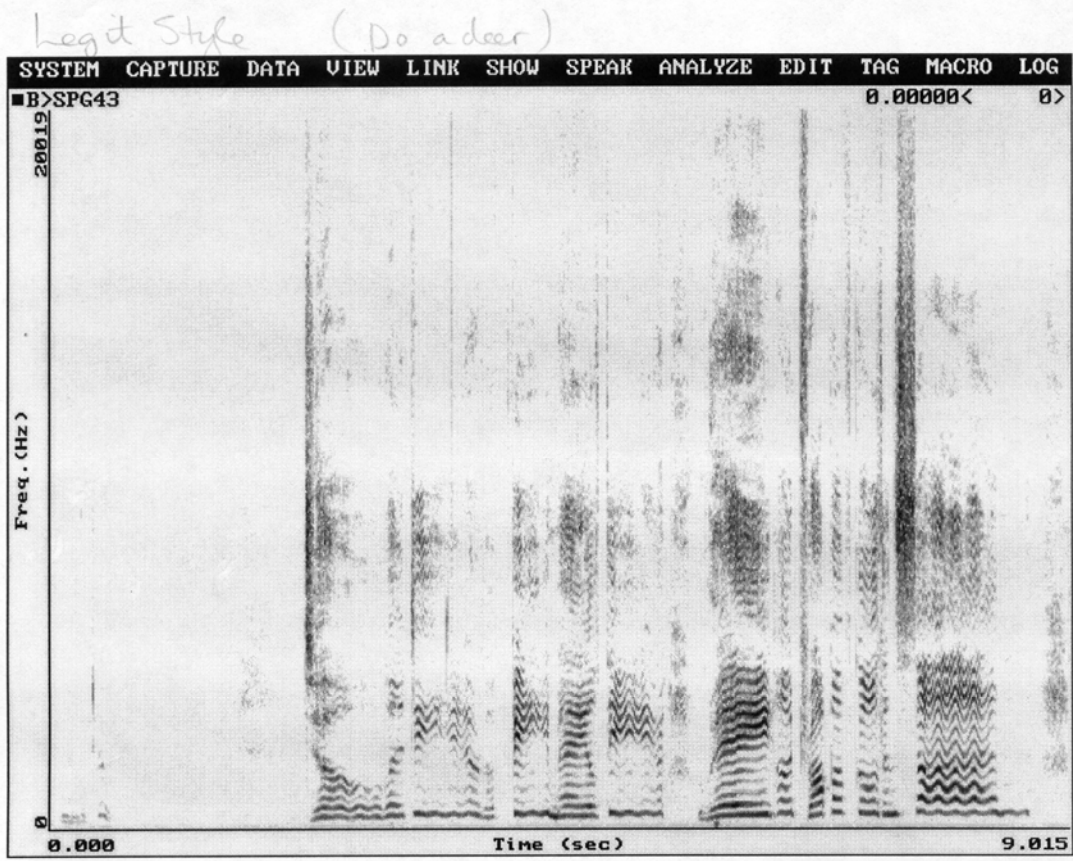
Duration 2.50 (sec)



Time (sec)



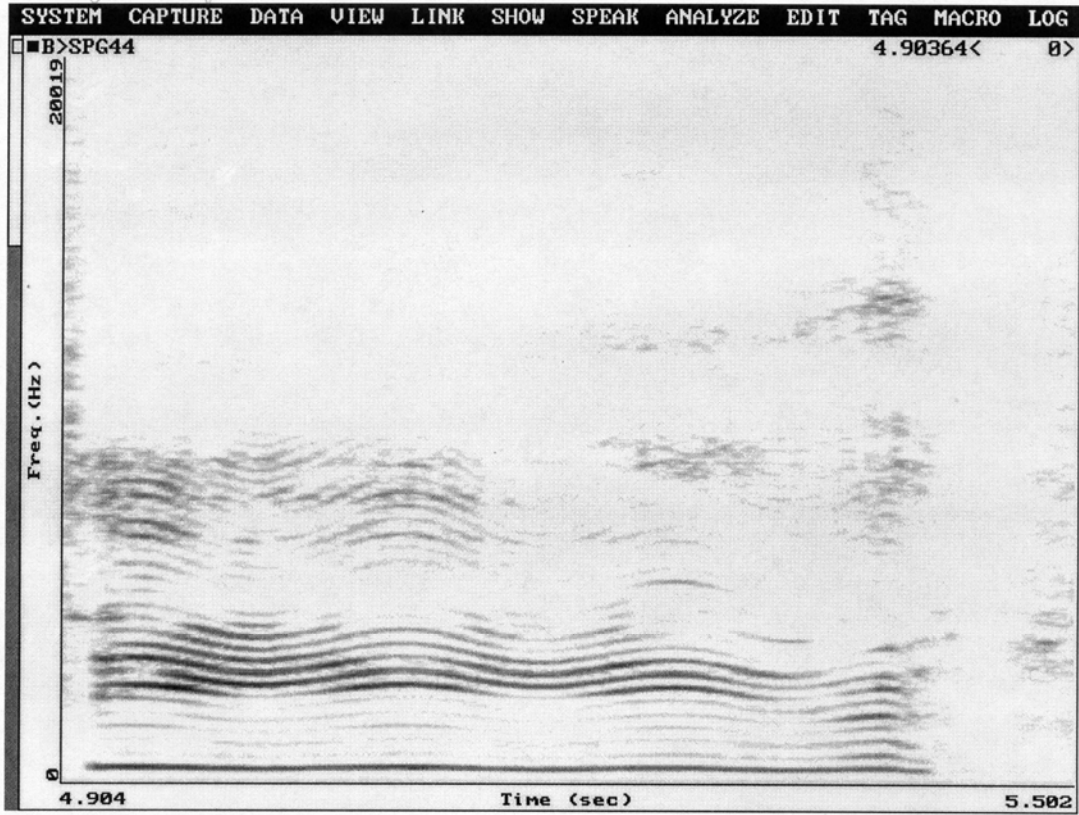
Spectrogram of B35a



*Do a deer a female deer re a drop of golden sun*

Spectrogram of B35b

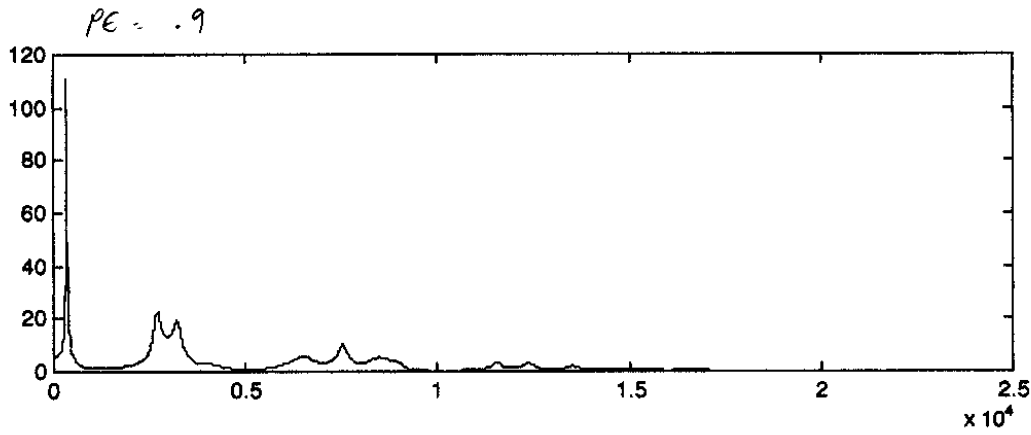
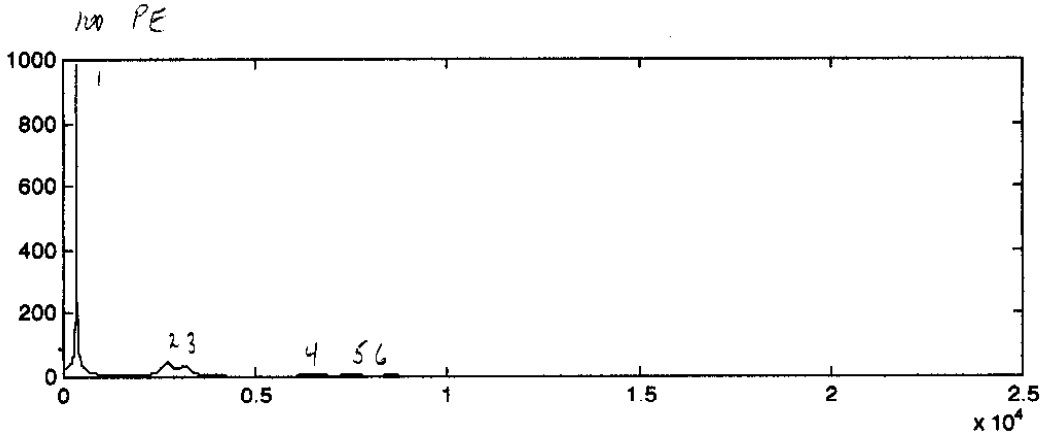
*Legit Style (Do a deer)*



*deer*

	F	LS	
1)	339.84	985.34	L356
2)	2671.80	45.60	
3)	3171.00	34.00	
4)	≈ 6500.00	6.00	
5)	7523.45	8.29	
6)	8519.6	3.98	

$$F_0 = 346 \text{ Hz}$$



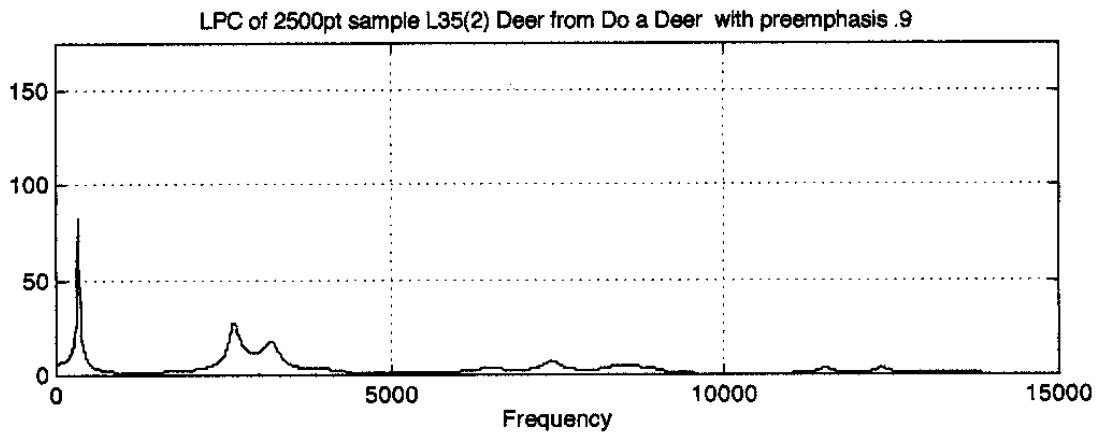
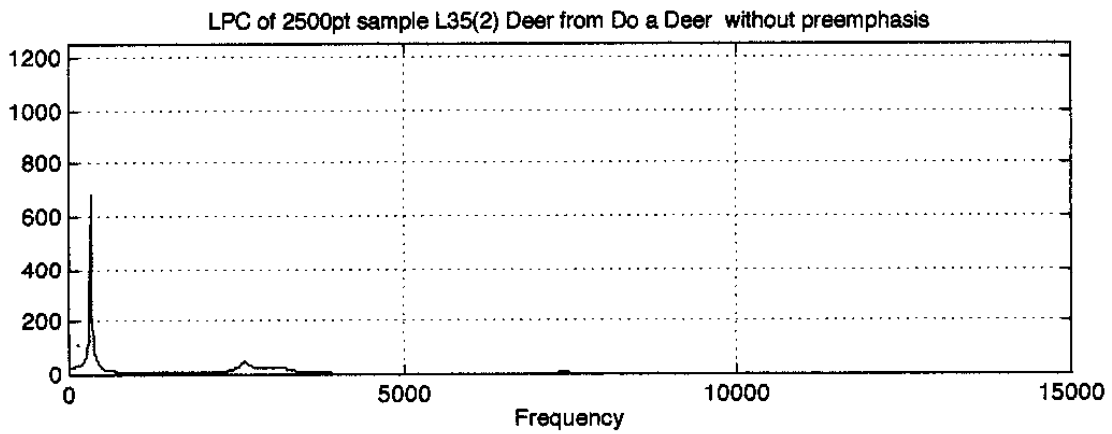
$$\begin{aligned}
 .13877083 - .0087916667 &= .129979164 / 45 \\
 &= .002888426 = T \\
 \frac{1}{T} &= 346.2093355
 \end{aligned}$$

LPC of 2500 points for L35b

( 328.13, 682.77 )

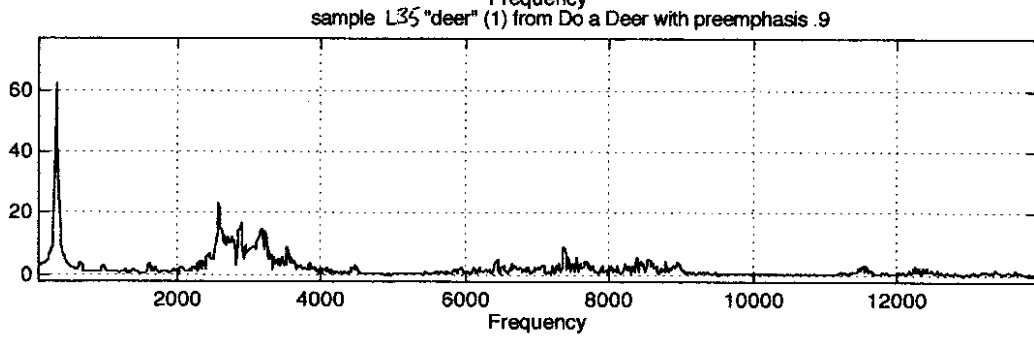
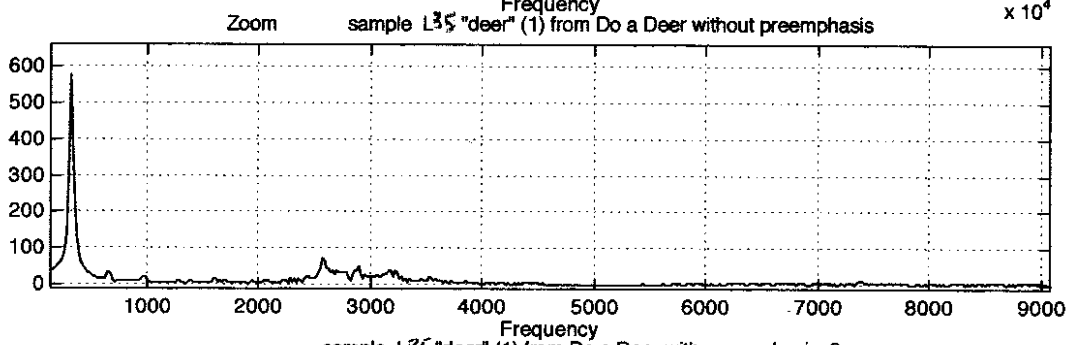
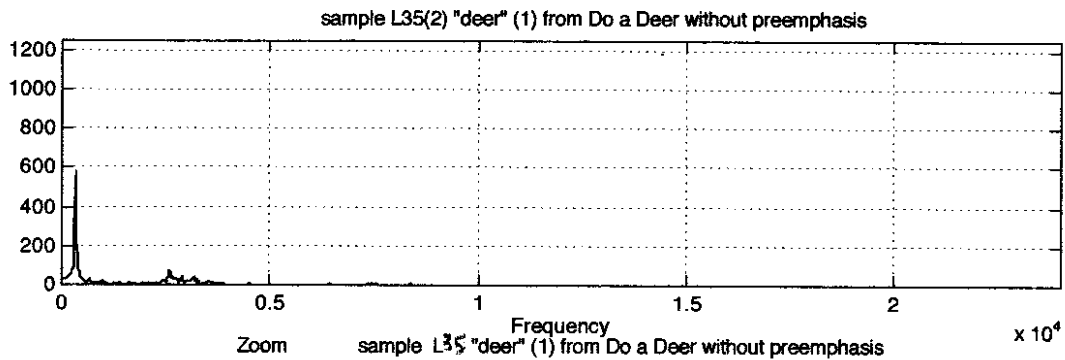
( 2625.00, 48.13 )

( 3152.35, 26.53 )





# DFT Results for L35b



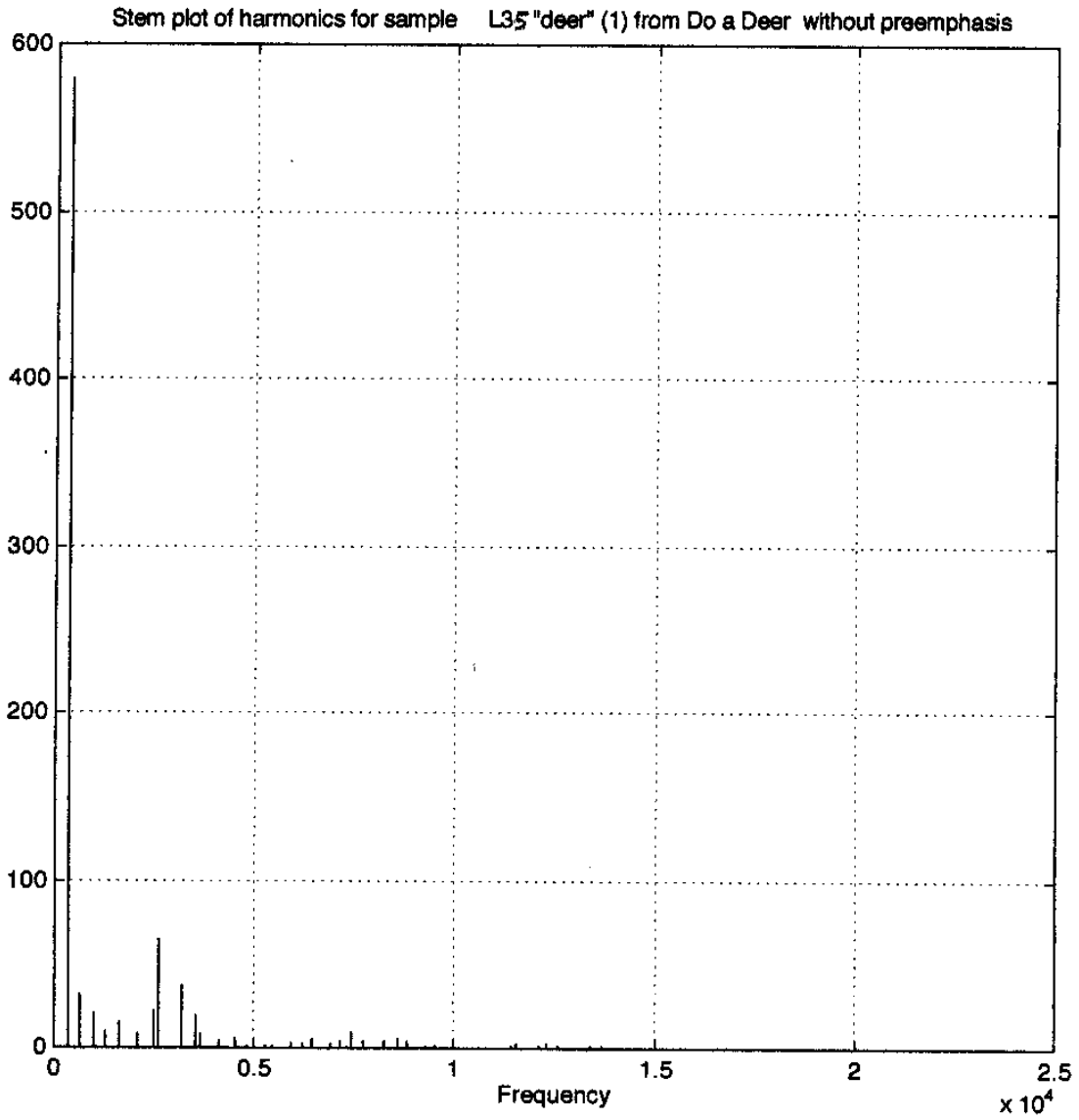
DFT Numerical Results for L35b

MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	342	578.942	100.000
2	666	31.696	5.475
3	990	20.213	3.491
4	1296	9.685	1.673
5	1638	15.568	2.689
6	2088	8.531	1.474
7	2466	22.082	3.814
8	2610	64.210	11.091
9	3204	37.309	6.444
10	3546	19.697	3.402
11	3654	8.957	1.547
12	4104	4.390	0.758
13	4500	5.431	0.938
14	4806	1.044	0.180
15	5256	0.917	0.158
16	5454	1.664	0.287
17	5940	2.635	0.455
18	6210	3.427	0.592
19	6462	6.133	1.059
20	6876	3.245	0.561
21	7110	3.711	0.641
22	7398	10.089	1.743
23	7740	4.154	0.717
24	8244	3.990	0.689
25	8568	4.912	0.848
26	8802	4.037	0.697
27	9288	1.268	0.219
28	9504	0.736	0.127
29	9846	0.421	0.073
30	10332	0.380	0.066
31	10584	0.580	0.100
32	10890	0.551	0.095
33	11412	0.989	0.171
34	11556	2.608	0.450
35	12096	0.927	0.160
36	12276	2.217	0.383
37	12582	1.408	0.243
38	13068	0.553	0.095
39	13392	1.095	0.189
40	13662	1.053	0.182
41	13914	0.419	0.072
42	14328	0.308	0.053
43	14814	0.331	0.057
44	14922	0.384	0.066
45	15516	0.456	0.079
46	15768	0.387	0.067
47	16002	0.286	0.049
48	16290	0.286	0.049
49	16776	0.462	0.080
50	17064	0.317	0.055
51	17532	0.246	0.042
52	17730	0.183	0.032
53	18180	0.214	0.037
54	18594	0.199	0.034
55	18720	0.185	0.032
56	19170	0.174	0.030

57	19386	0.197	0.034
58	19710	0.189	0.033
59	20196	0.208	0.036
60	20646	0.177	0.031
61	20916	0.173	0.030
62	21240	0.155	0.027
63	21654	0.160	0.028
64	21762	0.168	0.029
65	22230	0.164	0.028
66	22500	0.146	0.025
67	22788	0.148	0.025
68	23328	0.144	0.025
69	23472	0.158	0.027
70	17586	0.581	0.100
71	17910	0.581	0.100
72	18144	0.551	0.095
73	18396	0.563	0.097
74	18648	0.582	0.101
75	18972	0.537	0.093
76	19152	0.569	0.098
77	19332	0.545	0.094
78	19674	0.573	0.099
79	19818	0.532	0.092
80	20088	0.537	0.093
81	20322	0.560	0.097
82	20610	0.536	0.093
83	20898	0.544	0.094
84	21222	0.532	0.092
85	21492	0.530	0.092
86	21582	0.538	0.093
87	21960	0.541	0.093
88	22158	0.520	0.090
89	22500	0.535	0.092
90	22698	0.536	0.093
91	22932	0.511	0.088
92	23202	0.503	0.087
93	23508	0.518	0.089
94	23742	0.530	0.092
95	22212	0.156	0.027
96	22464	0.149	0.026
97	22770	0.146	0.025
98	22986	0.147	0.025
99	23148	0.160	0.028
100	23454	0.154	0.027
101	23670	0.155	0.027
102	20160	0.179	0.031
103	20430	0.180	0.031
104	20610	0.171	0.030
105	20718	0.158	0.027
106	21042	0.164	0.028
107	21240	0.157	0.027
108	21420	0.141	0.024
109	21564	0.154	0.027
110	21834	0.144	0.025
111	21978	0.138	0.024
112	22104	0.146	0.025
113	22302	0.133	0.023
114	22608	0.144	0.025
115	22824	0.134	0.023
116	22950	0.130	0.022

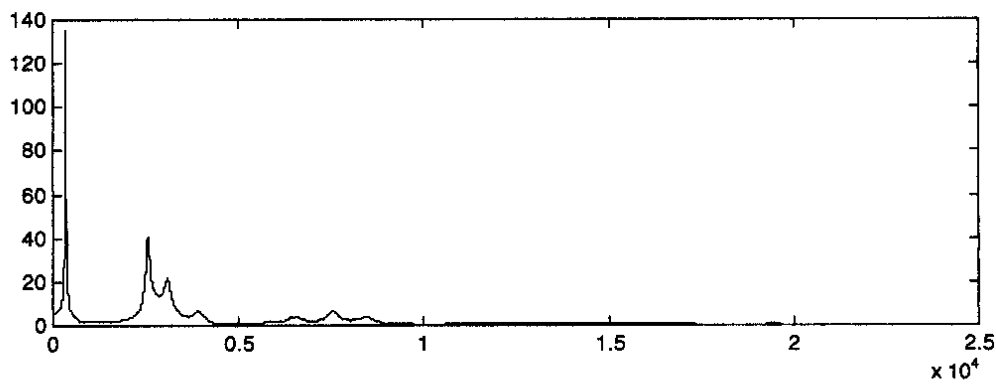
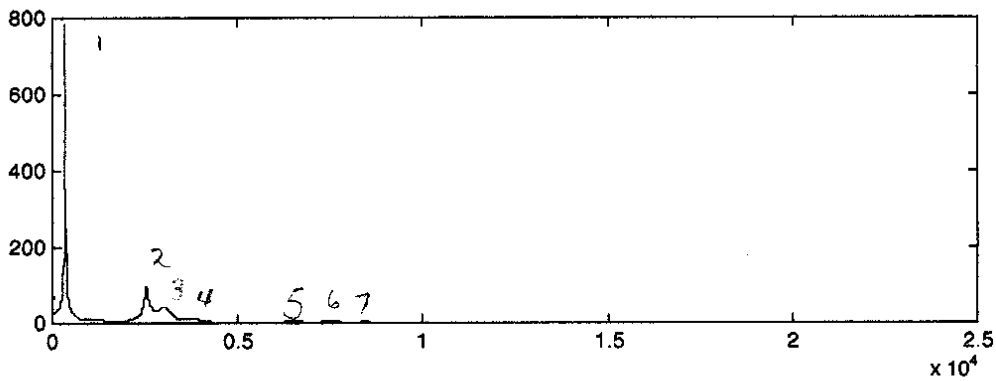
117	23202	0.139	0.024
118	23418	0.141	0.024
119	23490	0.135	0.023
120	23814	0.133	0.023



	F	dB
1)	351.56	783.91
2)	2542.97	98.22
3)	3046.86	43.86
4)	3890	10
5)	6539.05	3.90
6)	7558.60	6.12
7)	8472.65	3.08

L35c

$$F_0 = 342 \text{ Hz}$$



$$.16025 - .0050416667 = .1552083334 \sqrt[53] = .002928459$$

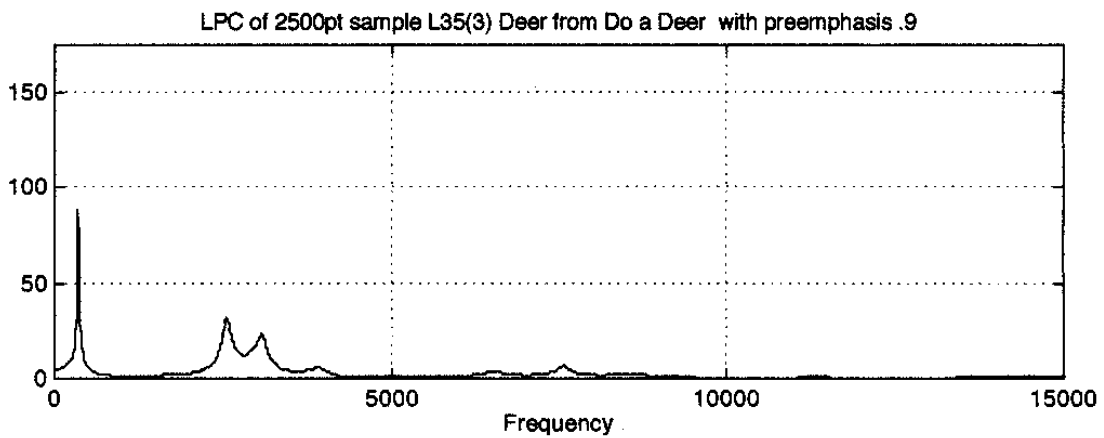
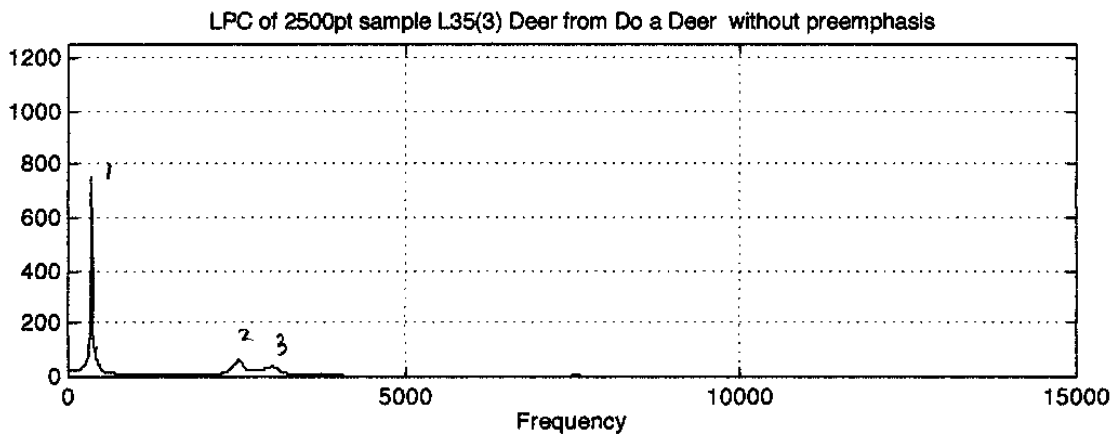
$$\frac{1}{f} = 341.4765086$$

LPC of 2500 point sample of L35c

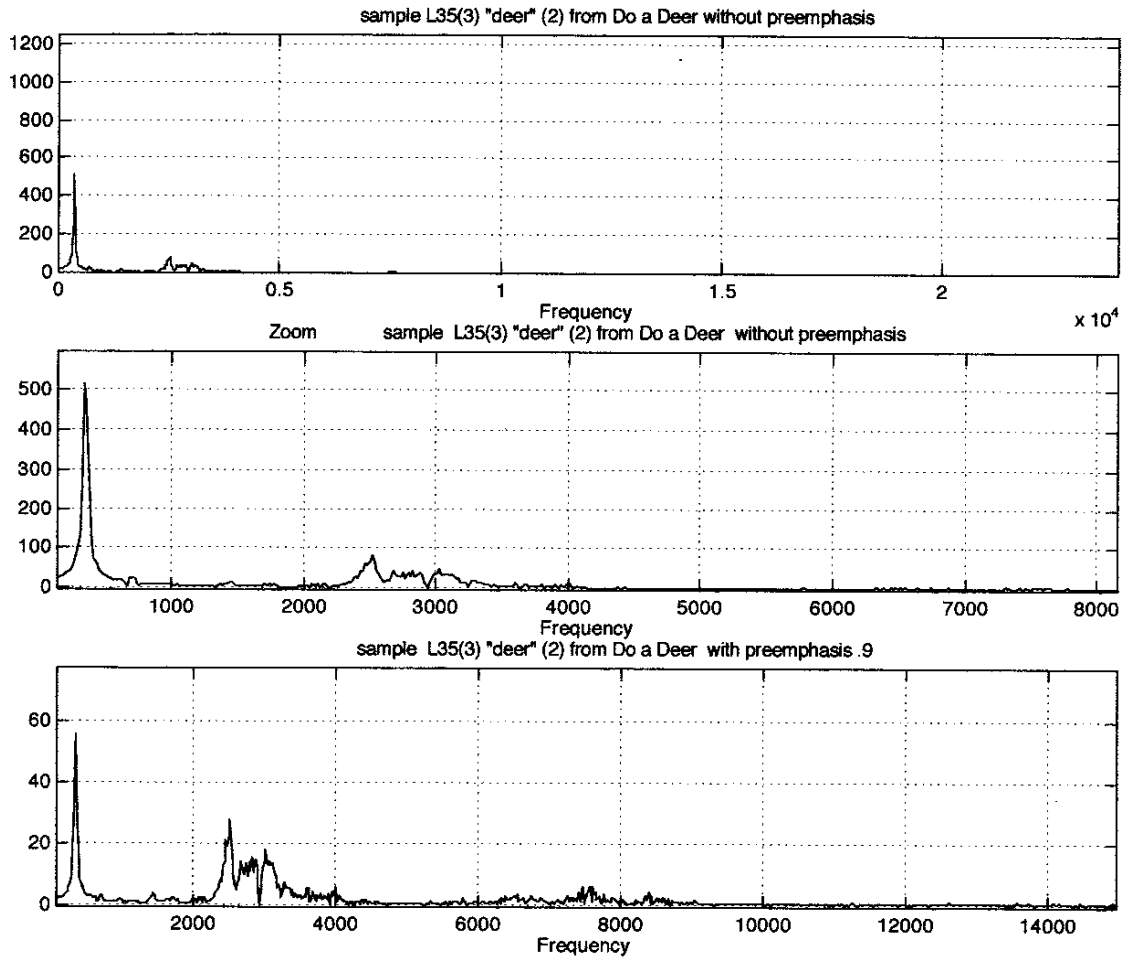
(351.56, 755.08)

(2519.53, 64.98)

(3035.16, 39.18)



# DFT Results of L35c



DFT Numerical Results for L35c

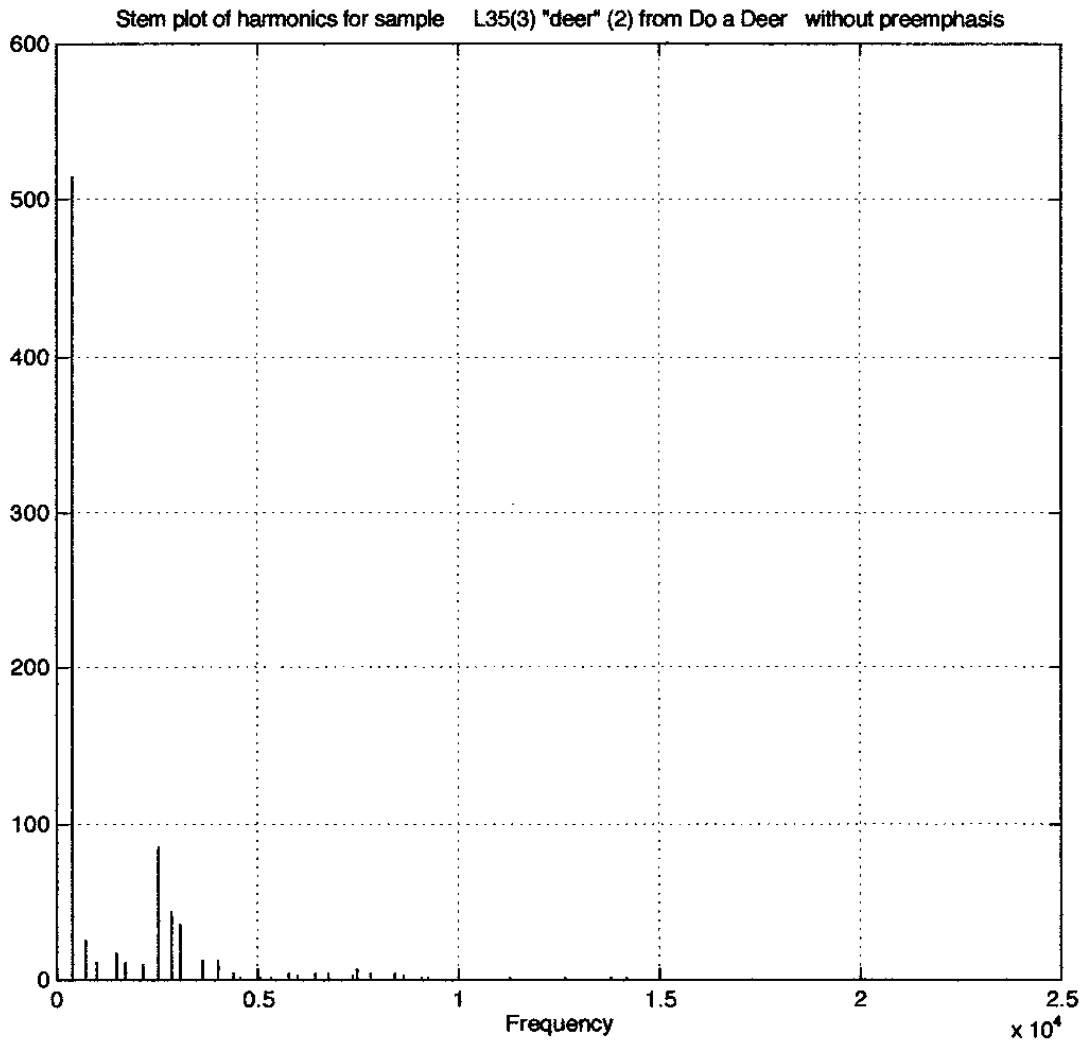
Worksheet saved into file: Minitab.L35(3)  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	360	514.041	100.000
2	702	26.076	5.073
3	1008	11.606	2.258
4	1458	16.443	3.199
5	1728	10.864	2.114
6	2124	9.610	1.869
7	2538	84.662	16.470
8	2844	44.454	8.648
9	3096	35.371	6.881
10	3618	12.806	2.491
11	4014	12.646	2.460
12	4392	3.810	0.741
13	4572	2.022	0.393
14	5040	1.113	0.217
15	5346	1.565	0.304
16	5796	3.740	0.728
17	5976	2.158	0.420
18	6408	4.201	0.817
19	6768	3.905	0.760
20	7344	3.093	0.602
21	7488	7.242	1.409
22	7794	3.805	0.740
23	8424	4.304	0.837
24	8640	2.458	0.478
25	9054	1.804	0.351
26	9252	0.964	0.188
27	9810	0.616	0.120
28	10026	0.737	0.143
29	10368	0.587	0.114
30	10692	0.599	0.116
31	11268	1.010	0.196
32	11502	0.635	0.124
33	12024	0.642	0.125
34	12150	0.593	0.115
35	12636	0.837	0.163
36	12816	0.538	0.105
37	13464	0.615	0.120
38	13770	0.733	0.143
39	14184	0.933	0.181
40	14472	0.700	0.136
41	14670	0.593	0.115
42	15120	0.633	0.123
43	15336	0.672	0.131
44	15804	0.491	0.096
45	16290	0.575	0.112
46	16524	0.524	0.102
47	17010	0.650	0.126
48	17136	0.483	0.094
49	17532	0.431	0.084
50	18126	0.450	0.088
51	18468	0.454	0.088
52	18864	0.407	0.079
53	18990	0.452	0.088
54	19476	0.459	0.089
55	19872	0.482	0.094

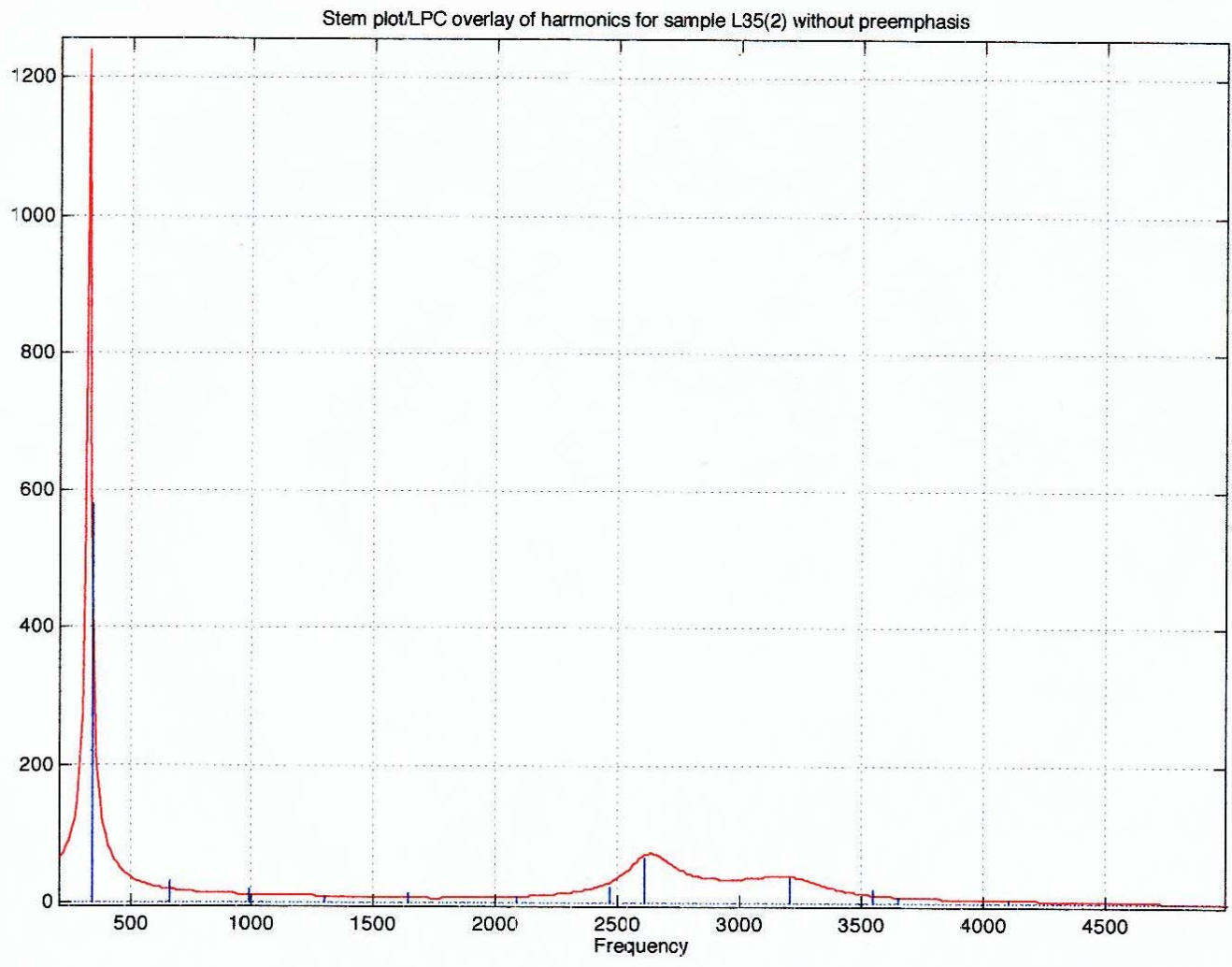
56	20034	0.429	0.083
57	20628	0.401	0.078
58	21006	0.379	0.074
59	21330	0.358	0.070
60	21582	0.369	0.072
61	22086	0.357	0.069
62	22284	0.371	0.072
63	22536	0.347	0.067
64	23184	0.339	0.066
65	23526	0.347	0.067
66	22500	0.146	0.028
67	22788	0.148	0.029
68	23328	0.144	0.028
69	23472	0.158	0.031
70	17586	0.581	0.113
71	17910	0.581	0.113
72	18144	0.551	0.107
73	18396	0.563	0.110
74	18648	0.582	0.113
75	18972	0.537	0.105
76	19152	0.569	0.111
77	19332	0.545	0.106
78	19674	0.573	0.111
79	19818	0.532	0.104
80	20088	0.537	0.104
81	20322	0.560	0.109
82	20610	0.536	0.104
83	20898	0.544	0.106
84	21222	0.532	0.103
85	21492	0.530	0.103
86	21582	0.538	0.105
87	21960	0.541	0.105
88	22158	0.520	0.101
89	22500	0.535	0.104
90	22698	0.536	0.104
91	22932	0.511	0.099
92	23202	0.503	0.098
93	23508	0.518	0.101
94	23742	0.530	0.103
95	22212	0.156	0.030
96	22464	0.149	0.029
97	22770	0.146	0.028
98	22986	0.147	0.029
99	23148	0.160	0.031
100	23454	0.154	0.030
101	23670	0.155	0.030
102	20160	0.179	0.035
103	20430	0.180	0.035
104	20610	0.171	0.033
105	20718	0.158	0.031
106	21042	0.164	0.032
107	21240	0.157	0.031
108	21420	0.141	0.027
109	21564	0.154	0.030
110	21834	0.144	0.028
111	21978	0.138	0.027
112	22104	0.146	0.028
113	22302	0.133	0.026
114	22608	0.144	0.028
115	22824	0.134	0.026

116	22950	0.130	0.025
117	23202	0.139	0.027
118	23418	0.141	0.027
119	23490	0.135	0.026
120	23814	0.133	

0.026



# DFT/LPC Overlay of L35b

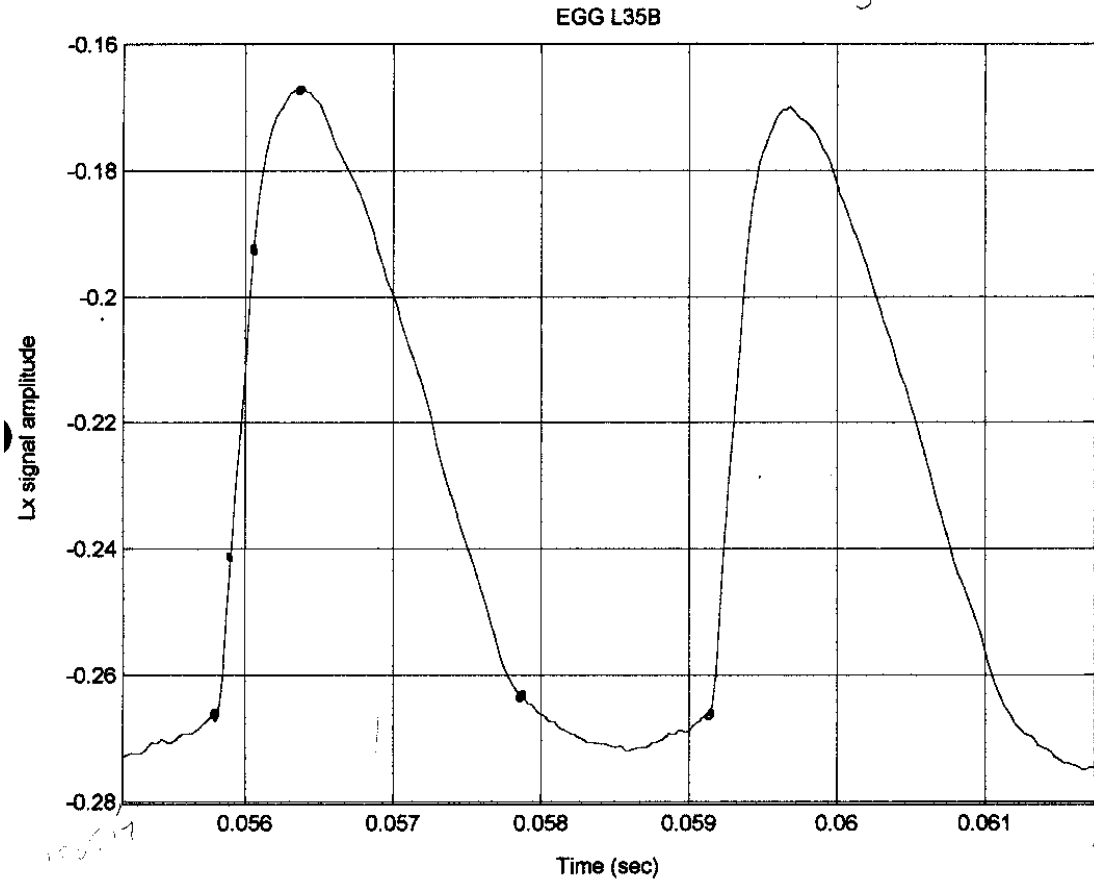


L35b single wave slope analysis

$$\lambda \Rightarrow 24 \text{ mm} = .001$$

$$y \Rightarrow 20 \text{ mm} = .02$$

$$y \text{ 1mm} = .001$$

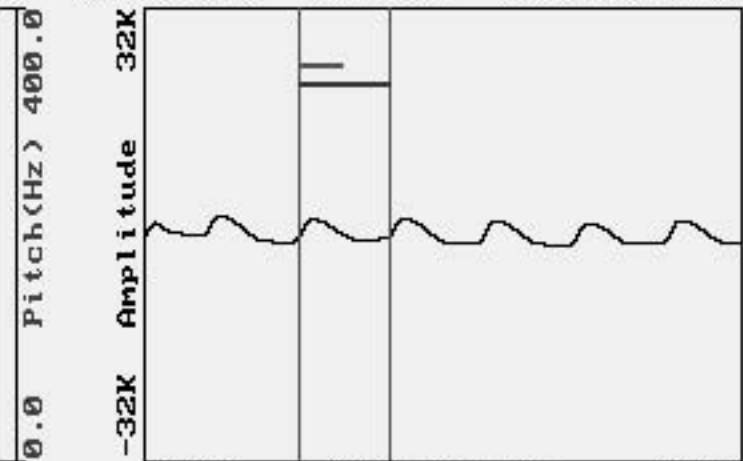


**A** > : CH1: L35B\_E~2.NSP

< 0.00 sec 47.76% 329.10 Hz >



Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

< sec % Hz >



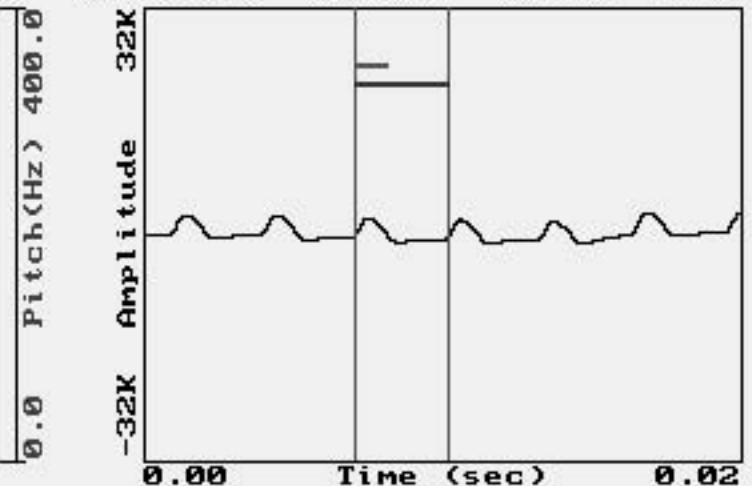
Duration 2.50 (sec)



Time (sec)

**A** > : CH1: L35B\_E~1.NSP

< 0.00 sec 33.81% 317.27 Hz >



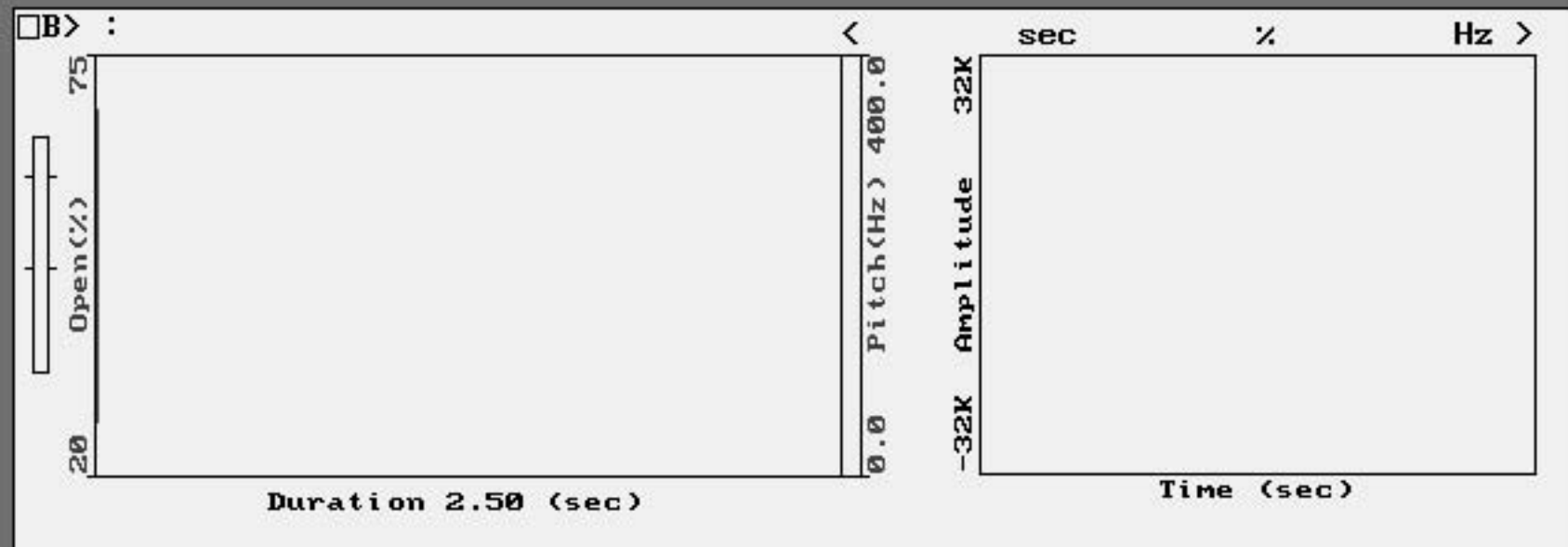
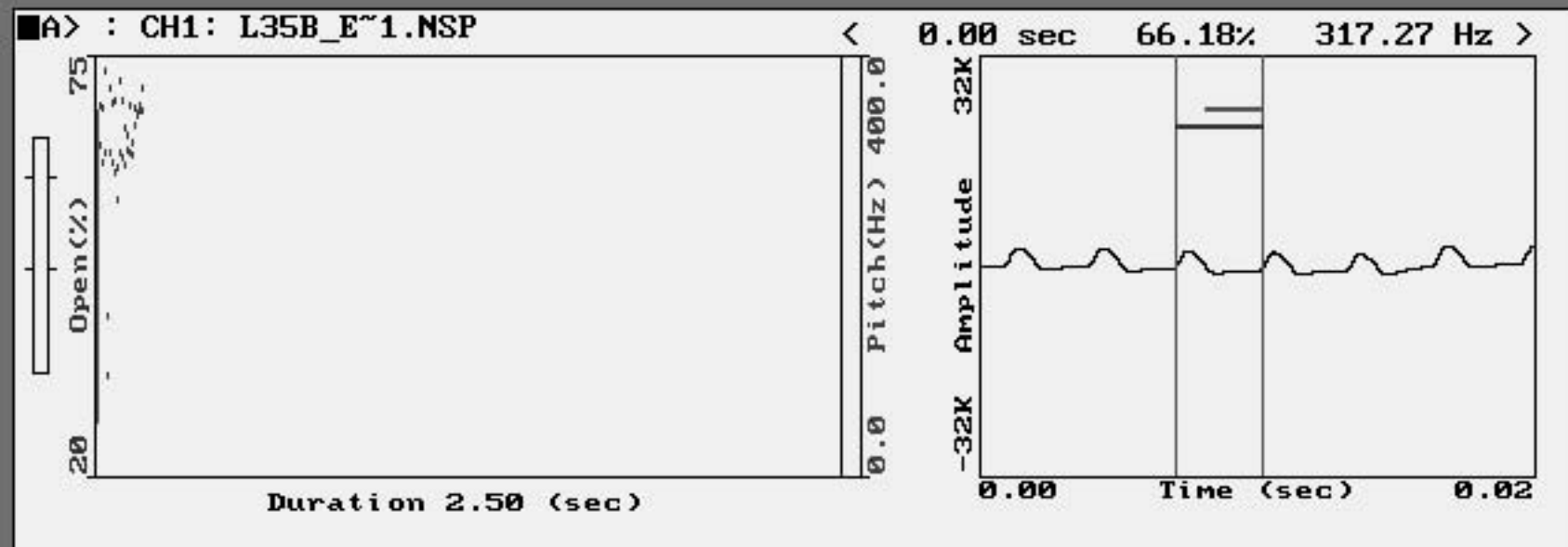
Duration 2.50 (sec)

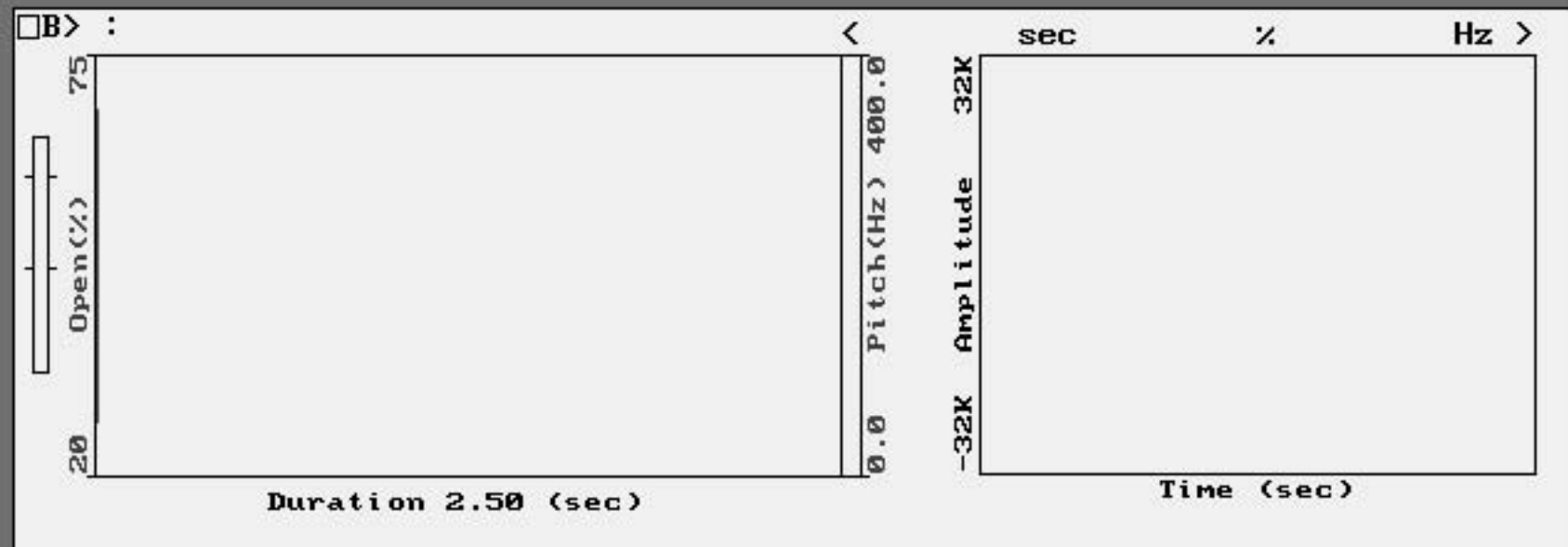
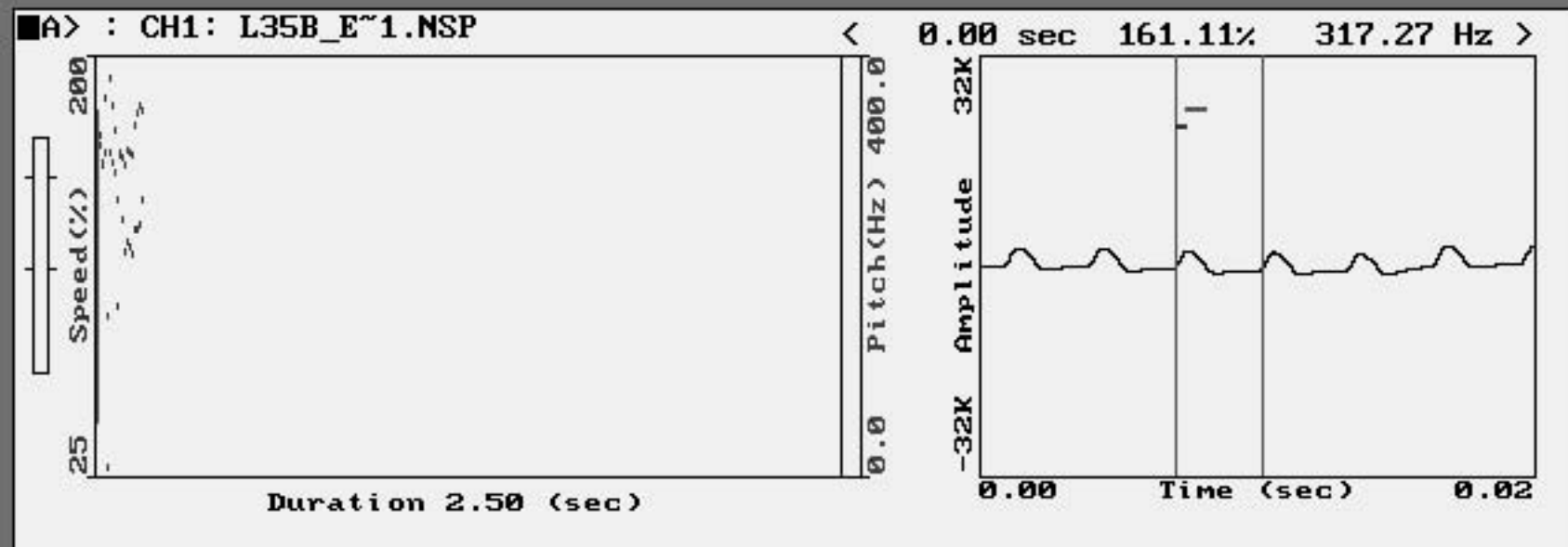
**B** > :

< sec % Hz >

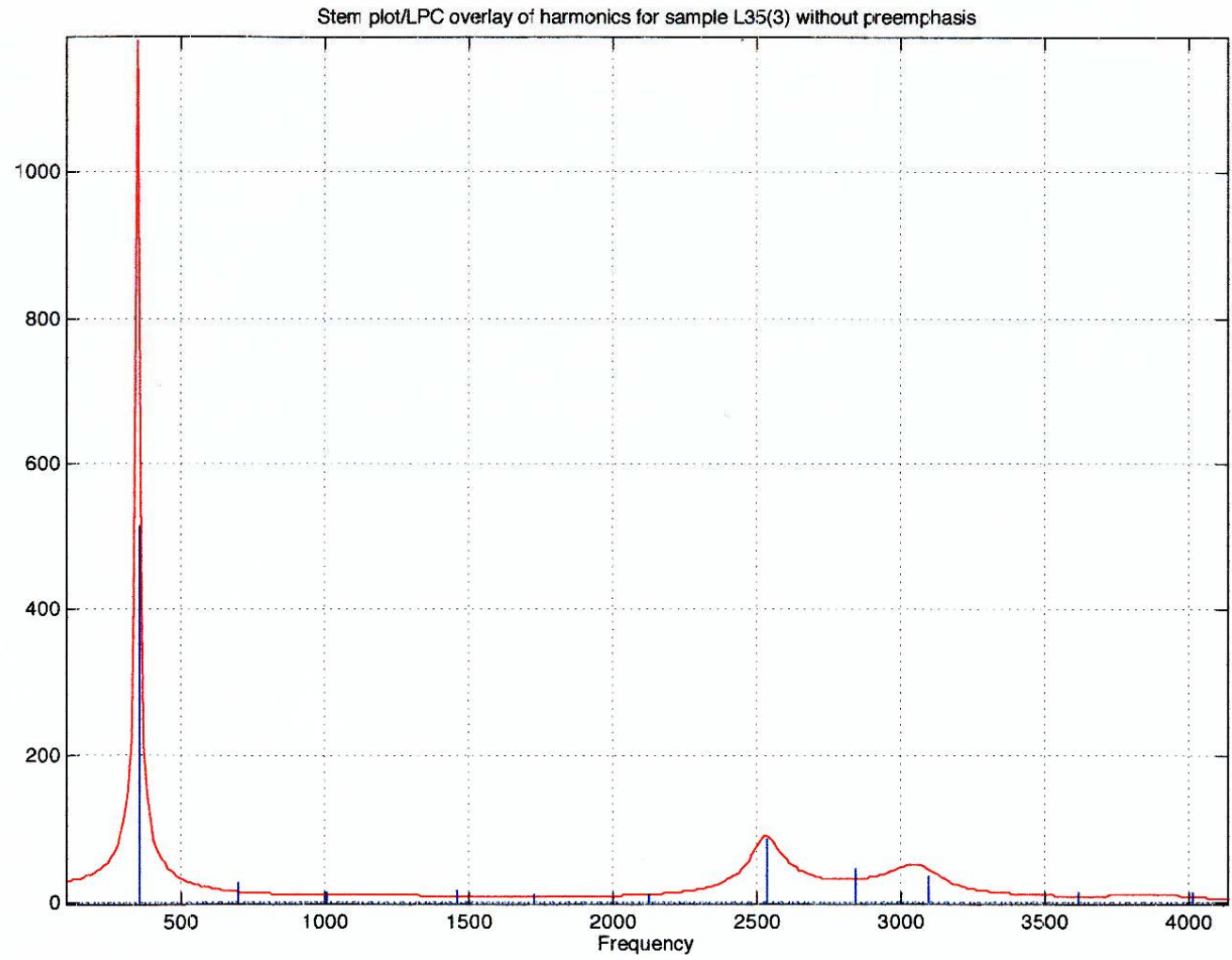


Duration 2.50 (sec)





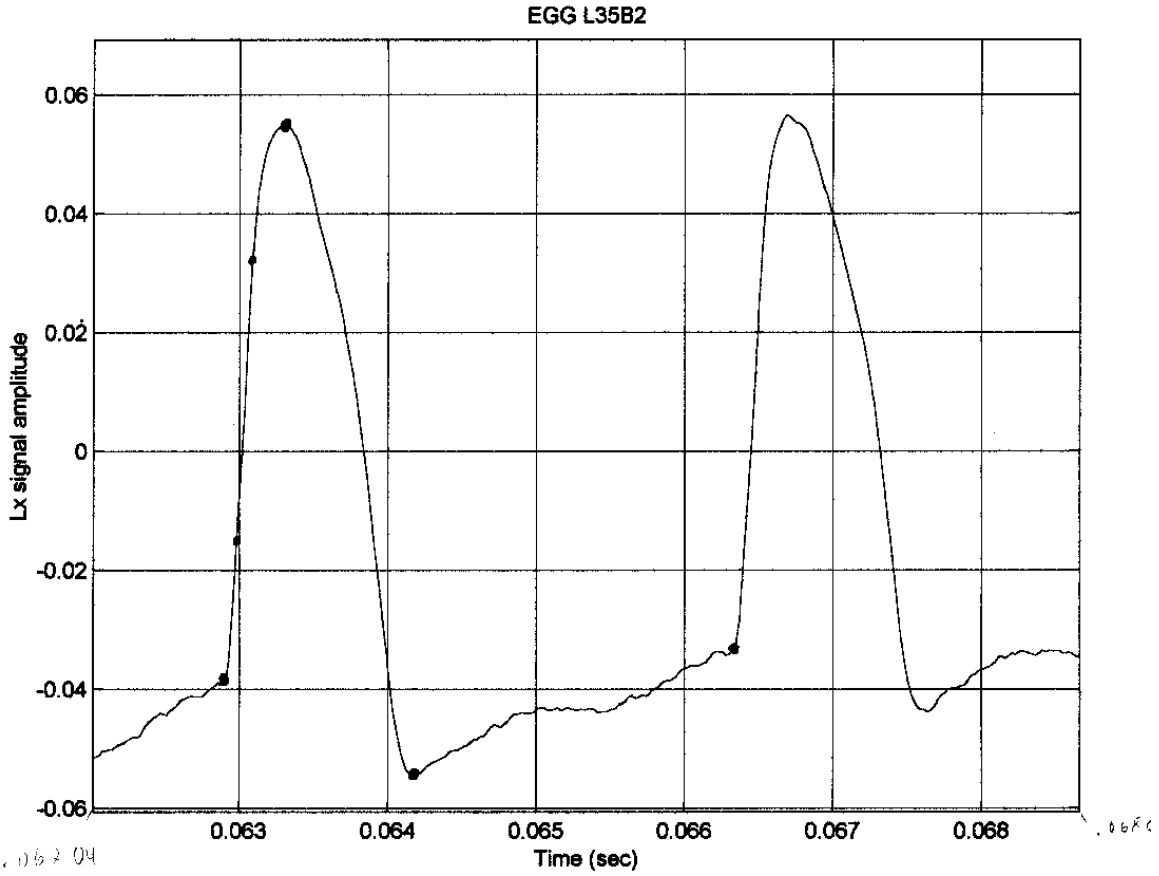
# DFT/LPC Overlay for B35c



L35c single wave slope analysis

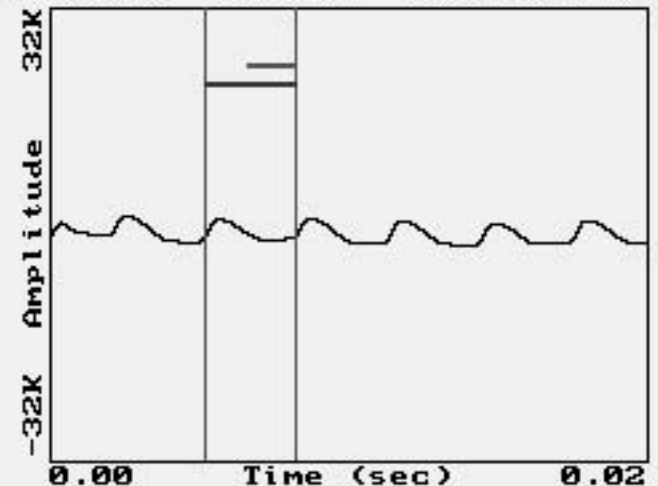
$$x \Rightarrow 23\frac{1}{2} \text{mm} = 0.0235$$
$$y \Rightarrow 19 \text{mm} = 0.019$$

$$y \text{ 1mm} = 0.001052632$$



**A** > : CH1: L35B\_E~2.NSP

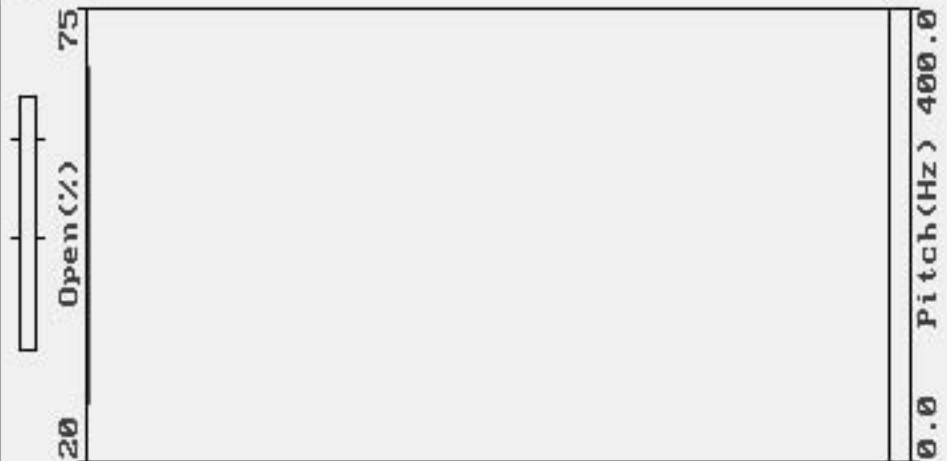
< 0.00 sec 52.23% 329.10 Hz >



Duration 2.50 (sec)

**B** > :

< sec % Hz >

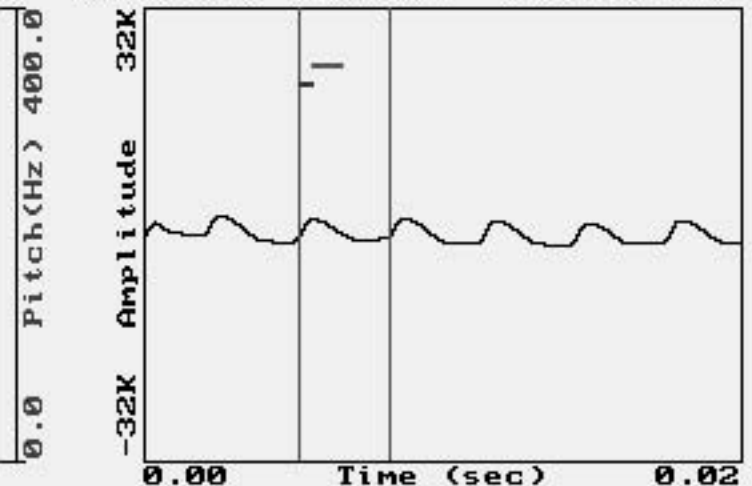


Duration 2.50 (sec)

Time (sec)

■A> : CH1: L35B\_E~2.NSP

< 0.00 sec 236.84% 329.10 Hz >

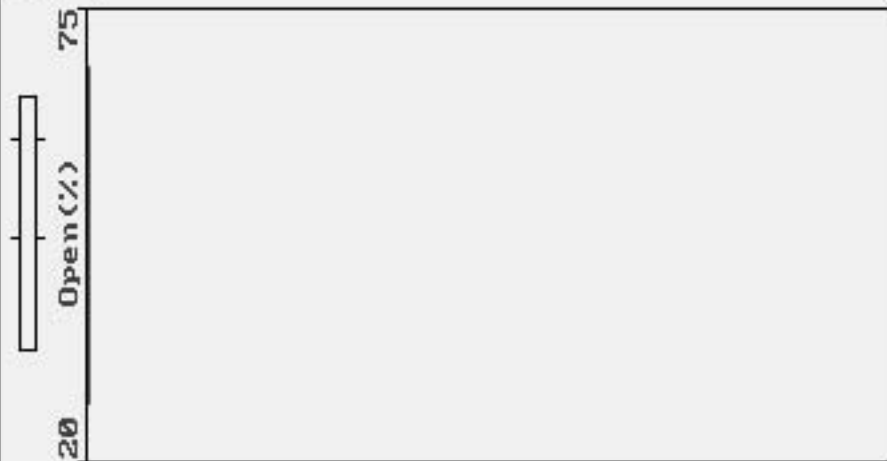


Duration 2.50 (sec)

Pitch(Hz) 400.0

□B> :

< sec % Hz >



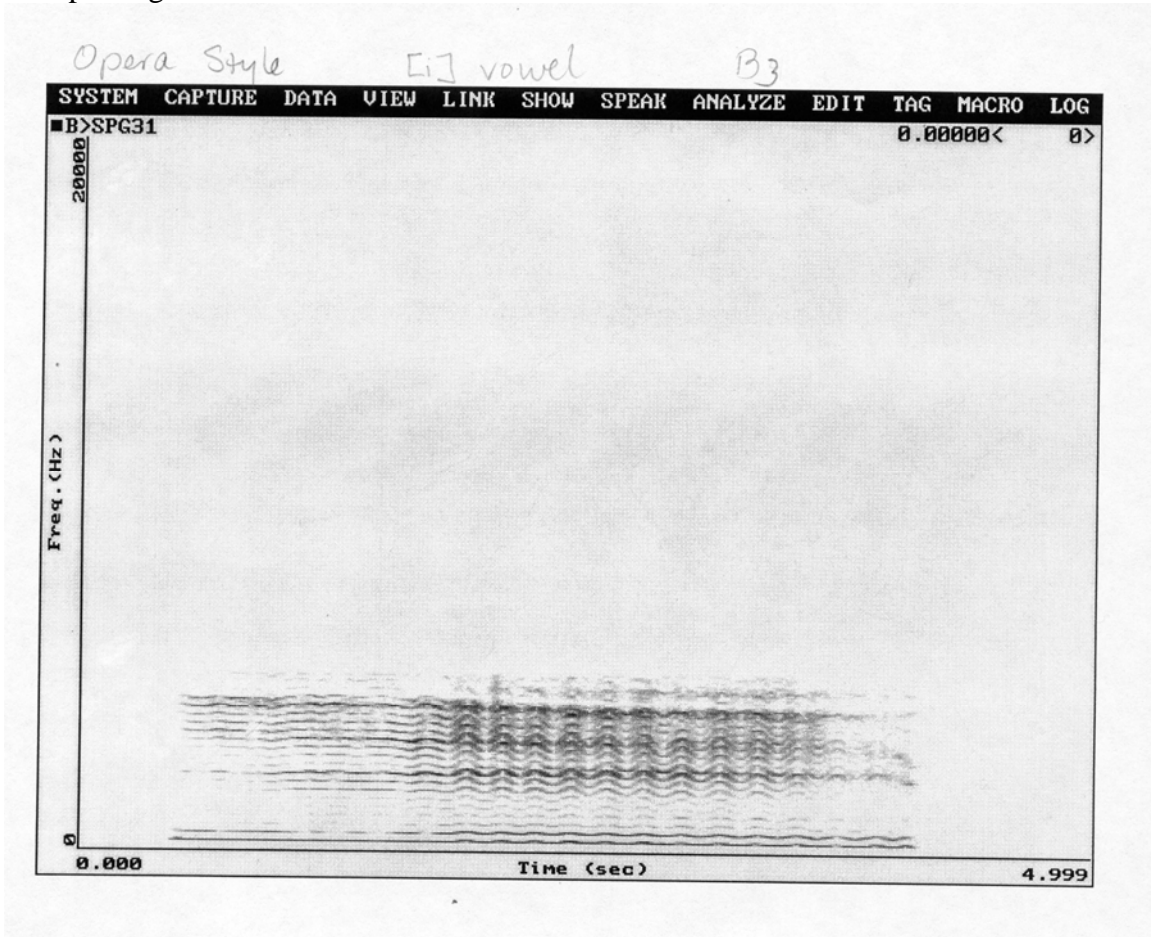
Duration 2.50 (sec)

Pitch(Hz) 400.0

Sample #	L1	L2	L12	L22	L34b
Description					
Data Rate (Hz)	44100	44100			
DURATION (sec)	0.74	0.68	1	0.6	1.23
Start time	0	0	0	0	0
End time	0.74	0.68	1	0.6	1.23
Silence	0	0	0	0	0
Active	0.74	0.69	1	0.62	1.24
Data Points	32512	29952	44032	26624	54272
Range	15524 (14 Bits)	8231 (14 Bits)	9702 (14 Bits)	4012 (12 Bits)	4406 (13 Bits)
PITCH (Hz)					
Mean	206.83	209.17	280.68	427.13	369.19
Pitch Range	62.52	184.32	71.47	378.15	336.21
Minimum	149.49	28.72	213.04	58.48	68.37
Maximum	212.01	213.04	284.51	436.63	404.58
Std Deviation	5.08	15.52	4.45	23.15	23.52
Avg. Jitter %	0.48	1.7	0.3	1.18	0.65
CONTACT(1:6)%					
Mean	28.01	24.17	33.62	34.93	27.75
Range	23.87	30.53	10.52	38.04	33.36
Minimum	9.14	1.69	27.05	4.11	4.34
Maximum	33.01	32.22	37.57	42.15	37.7
Std Deviation	2.84	5.51	2.34	3.58	4
CONTACT(Tif)	31.65	32.22	32.07	36.89	29.56
SPEED(3:2)%					
Mean	190.14	197.85	194.8	151.53	189.41
Range	145.53	86.54	280.56	67.47	524.46
Minimum	68.75	138.46	77.77	105.25	55.54
Maximum	214.28	225	358.33	172.72	580
Std Deviation	14.83	12.64	22.19	8.63	31.41
SPEED(Tif)	200	209.09	168.42	137.5	209.09
OPEN(4:6)%					
Mean	71.97	75.81	66.36	65.05	72.23
Range	23.87	30.53	10.53	38.04	33.37
Minimum	66.97	67.77	62.41	57.84	62.28
Maximum	90.84	98.3	72.94	95.88	95.65
Std Deviation	2.84	5.51	2.34	3.58	4
OPEN(Tif)	68.34	67.77	67.92	63.1	70.43

L35b	L35b2
0.16	0.15
0	0
0.16	0.15
0.01	0.01
0.16	0.16
6880	6784
4026 (12 Bits)	2748 (12 Bits)
283.91	295.58
231.07	256.21
124.57	72.89
355.64	329.1
64.19	42.42
19.81	5.75
33.11	42.91
77.72	43.72
17.76	7.27
95.48	50.99
12.49	7.15
33.81	47.76
186.62	222.48
1989.05	145.02
23.45	145.45
2012.5	290.47
293.88	25.01
161.11	236.84
66.87	57.07
77.71	43.72
4.51	49
82.22	92.72
12.49	7.15
66.18	52.23

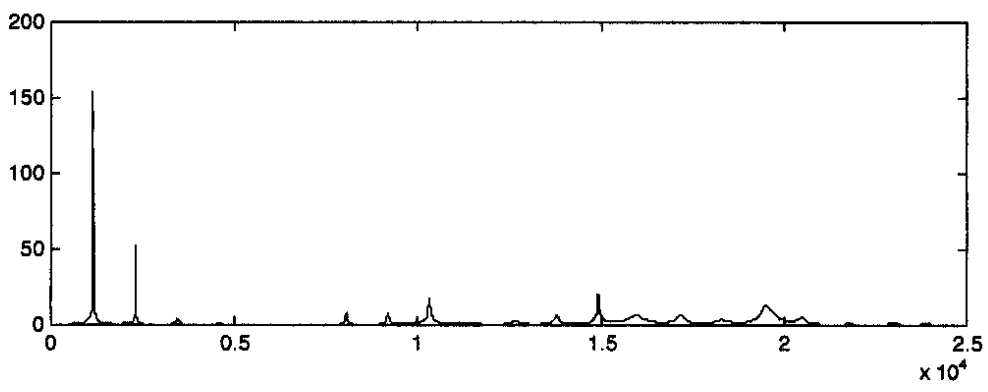
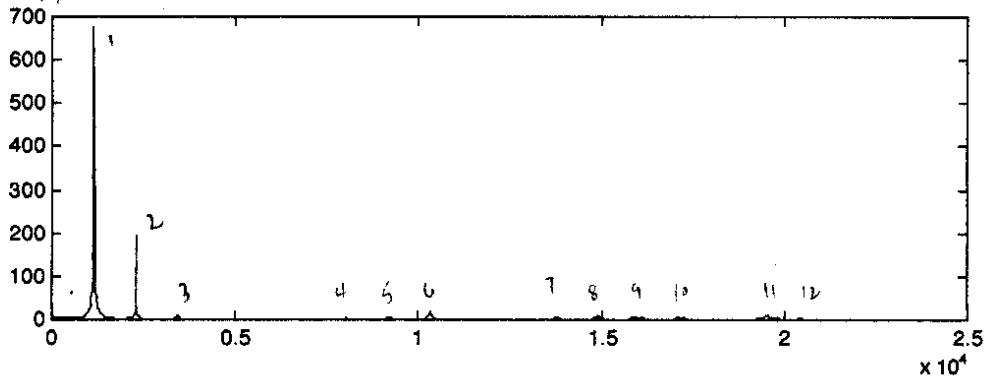
O1 Spectrogram



	Freq	Amp
1)	1148.44	674.33
2)	2206.88	193.08
3)	3421.88	11.19
4)	8050.78	6.82
5)	9.99.21	5.60
6)	10312.00	17.65
7)	13804.00	4.00
8)	14941	11.00

	Freq	Amp
9)	15990.00	5.0
10)	17175.00	4.00
11)	19555	8.5

$F_0 = 1135 \text{ Hz}$



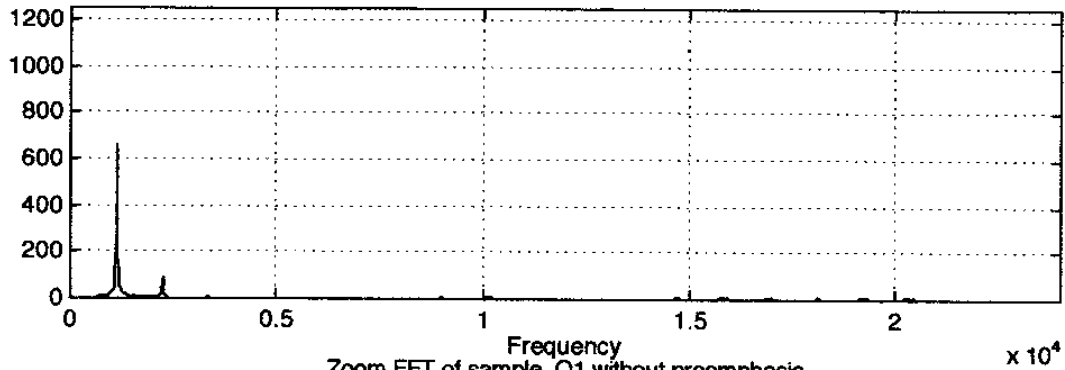
$0.060845837 - 0.0005208333$  <sup>68</sup>

$= 1135 \text{ Hz}$

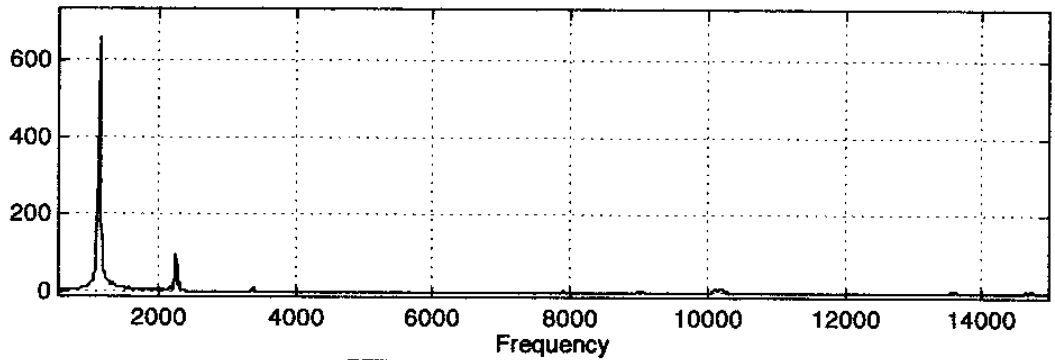
read in  
100 - 7000  $\times 10^4$

0.

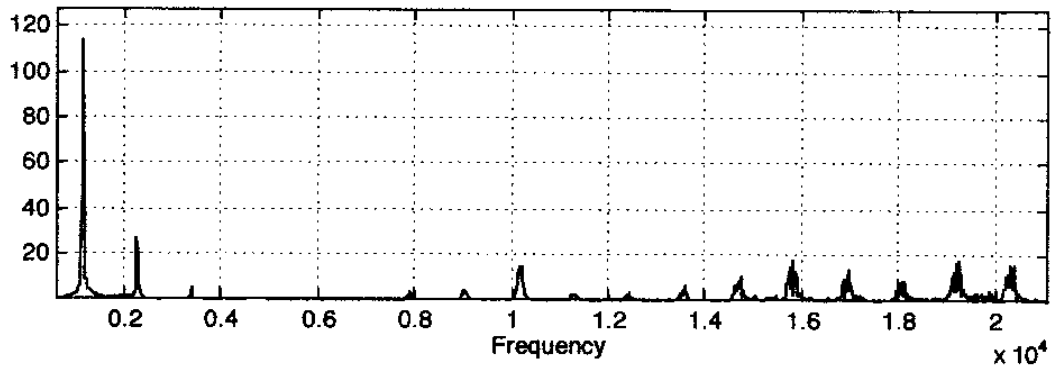
FFT of sample O1 without preemphasis



Zoom FFT of sample O1 without preemphasis



FFT of sample O1 with preemphasis .9



Worksheet saved into file: Minitab.01  
MTB > Print 'Freq' 'Amp' '% Amp'.

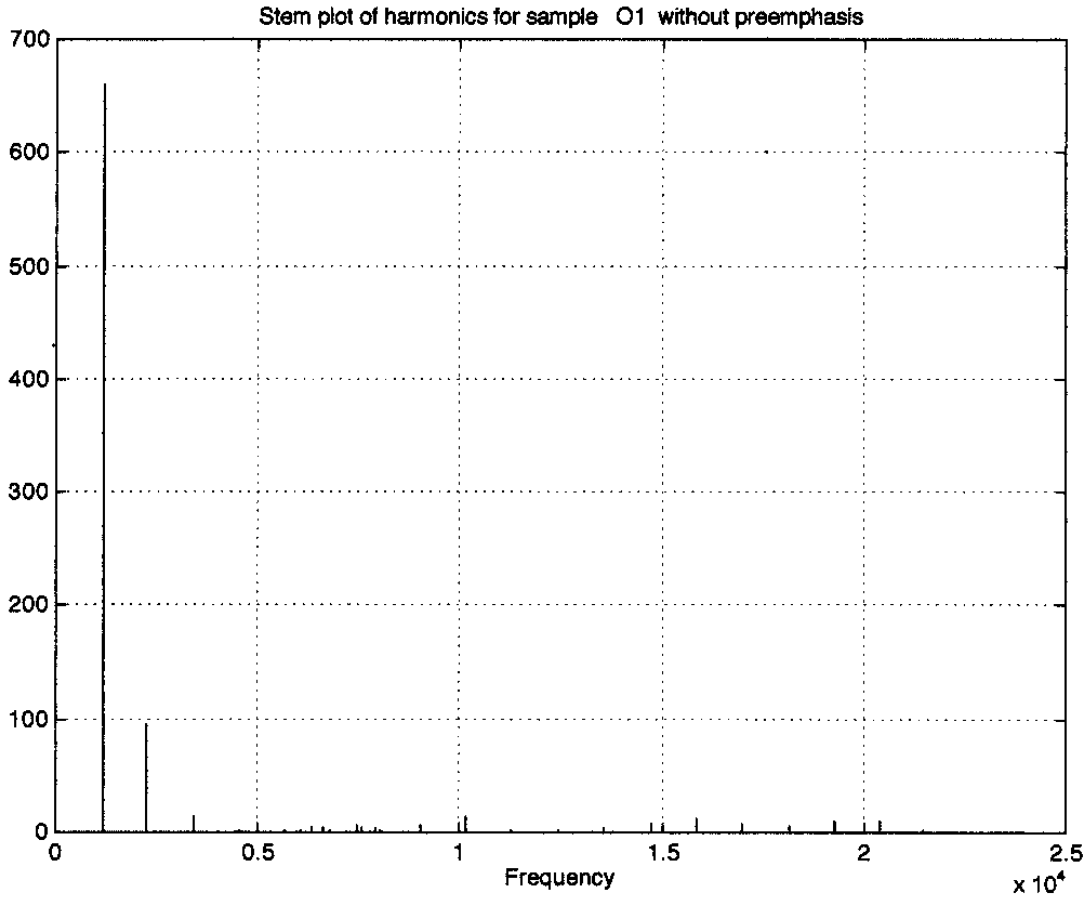
ROW	Freq	Amp	% Amp
1	1152	660.129	100.000
2	2268	94.542	14.322
3	3402	13.804	2.091
4	4536	1.616	0.245
5	5652	1.354	0.205
6	6804	1.366	0.207
7	7920	4.085	0.619
8	9036	5.259	0.797
9	10170	13.520	2.048
10	11250	2.717	0.412
11	12456	2.625	0.398
12	13590	4.629	0.701
13	14760	7.302	1.106
14	15840	11.342	1.718
15	16974	8.241	1.248
16	18144	5.501	0.833
17	19278	10.033	1.520
18	20412	9.203	1.394
19	21474	1.077	0.163
20	6030	2.095	0.317
21	6318	4.908	0.743
22	6642	4.441	0.673
23	6930	0.726	0.110
24	7452	5.210	0.789
25	7542	3.836	0.581
26	8028	2.396	0.363
27	8298	0.360	0.054
28	8604	0.285	0.043
29	8856	0.522	0.079
30	9198	0.363	0.055
31	9576	0.204	0.031
32	9810	0.133	0.020
33	10026	0.103	0.016
34	10458	0.118	0.018
35	10692	0.273	0.041
36	10962	0.437	0.066
37	11412	0.338	0.051
38	11736	0.527	0.080
39	11844	0.541	0.082
40	12312	0.562	0.085
41	12600	0.226	0.034
42	12870	0.305	0.046
43	13122	0.387	0.059
44	13410	0.543	0.082
45	13824	0.323	0.049
46	14076	0.346	0.052
47	14472	0.103	0.016
48	14688	0.169	0.026
49	14922	0.201	0.030
50	15210	0.159	0.024
51	15570	0.234	0.035
52	15822	0.264	0.040
53	16308	0.104	0.016
54	16488	0.115	0.017
55	16722	0.059	0.009

*high pitch*

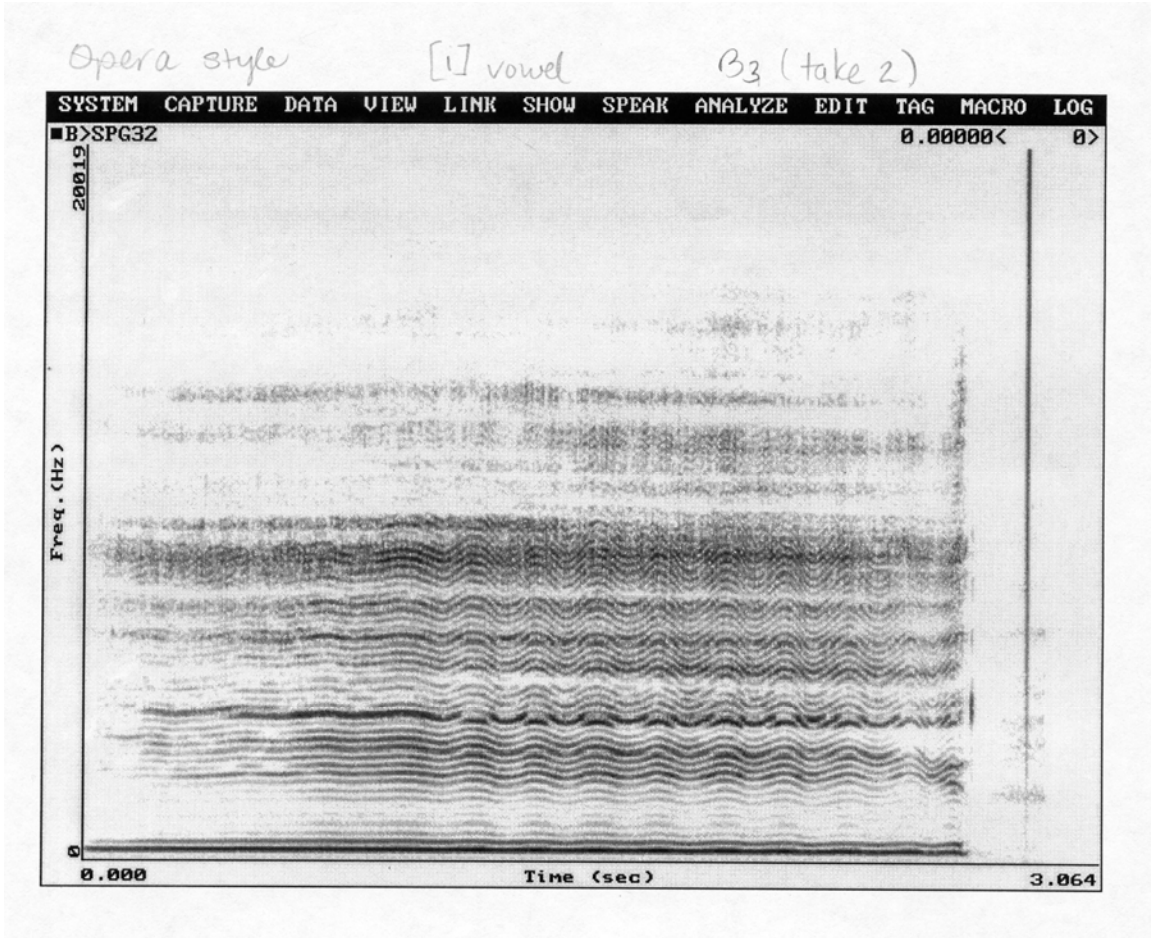
56	17082	0.147	0.022
57	17496	0.122	0.018
58	17856	0.092	0.014
59	18162	0.079	0.012
60	18324	0.085	0.013
61	18720	0.082	0.012
62	19044	0.047	0.007
63	19314	0.074	0.011
64	19530	0.088	0.013
65	19782	0.046	0.007
66	20304	0.043	0.007
67	20484	0.036	0.005
68	20754	0.038	0.006
69	21114	0.040	0.006
70	21312	0.040	0.006
71	21636	0.031	0.005
72	21924	0.033	0.005
73	22392	0.033	0.005
74	22752	0.031	0.005
75	23058	0.027	0.004
76	23328	0.031	0.005
77	23580	0.027	0.004
78	19746	0.381	0.058
79	19836	0.374	0.057
80	20070	0.350	0.053
81	20466	0.350	0.053
82	20592	0.352	0.053
83	20880	0.359	0.054
84	21222	0.348	0.053
85	21510	0.359	0.054
86	21708	0.365	0.055
87	21942	0.345	0.052
88	22176	0.372	0.056
89	22464	0.345	0.052
90	22626	0.341	0.052
91	23022	0.337	0.051
92	23202	0.322	0.049
93	23472	0.323	0.049
94	23724	0.327	0.050
95	22302	0.557	0.084
96	22554	0.583	0.088
97	22752	0.556	0.084
98	22986	0.569	0.086
99	23094	0.571	0.086
100	23490	0.559	0.085
101	23670	0.547	0.083
102	20160	0.179	0.027
103	20430	0.180	0.027
104	20610	0.171	0.026
105	20718	0.158	0.024
106	21042	0.164	0.025
107	21240	0.157	0.024
108	21420	0.141	0.021
109	21564	0.154	0.023
110	21834	0.144	0.022
111	21978	0.138	0.021
112	22104	0.146	0.022
113	22302	0.133	0.020
114	22608	0.144	0.022
115	22824	0.134	0.020

116	22950	0.130	0.020
117	23202	0.139	0.021
118	23418	0.141	0.021
119	23490	0.135	0.020
120	23814	0.133	

0.020



Spectrogram for O11



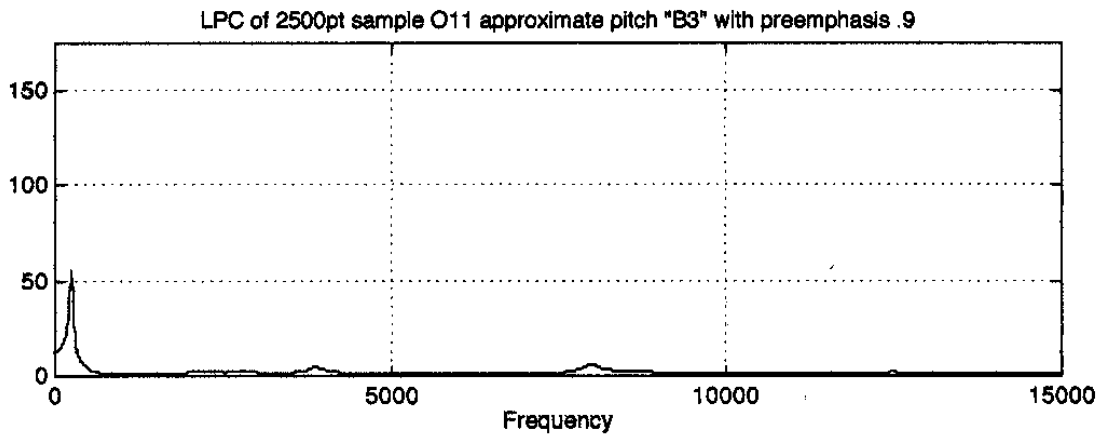
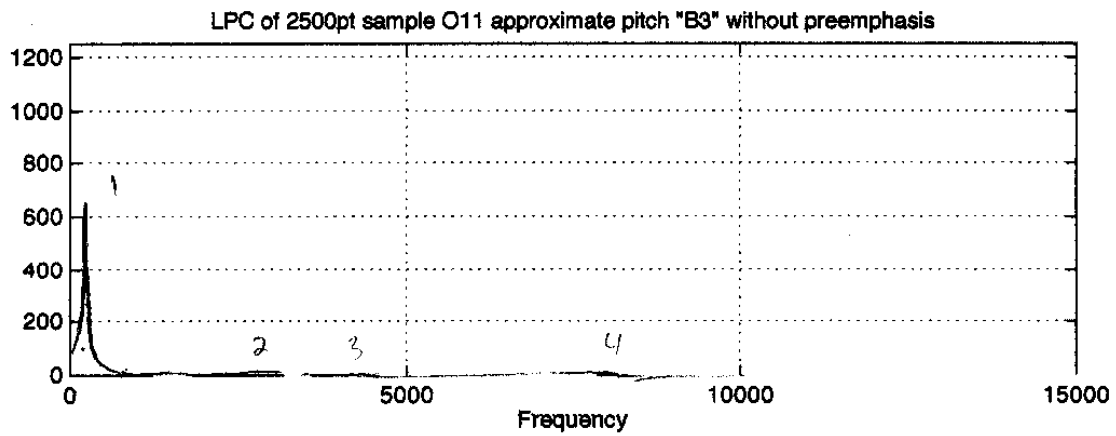


(234.38, 658.81)

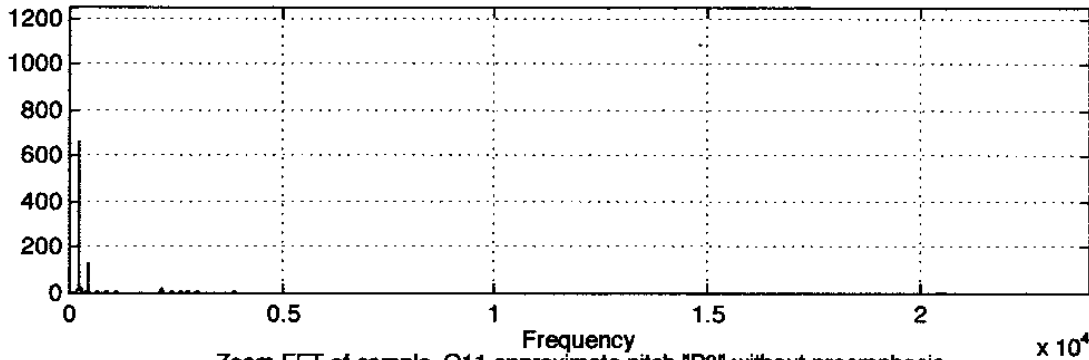
(2180.38, 9.30)

(3902.35, 8.95)

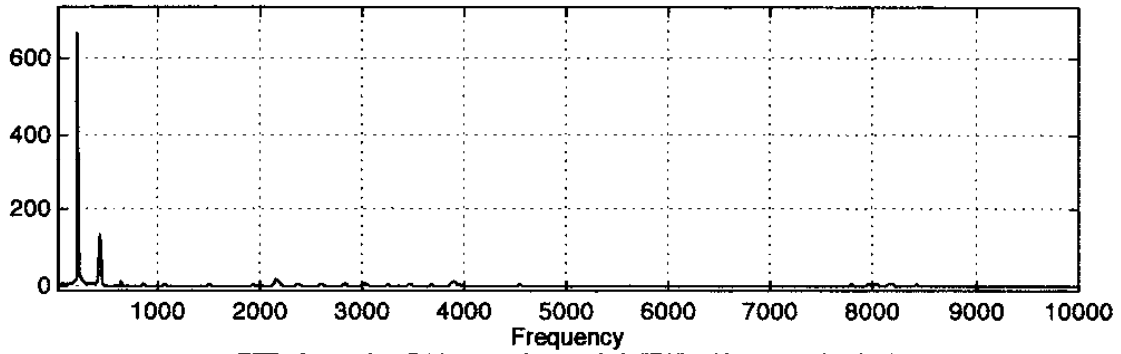
(7989.16, 6.96)



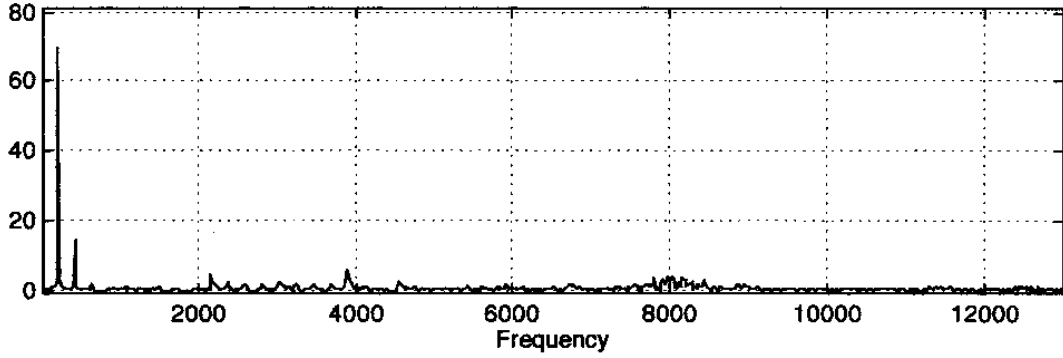
FFT of sample O11 approximate pitch "B3" without preemphasis



Zoom FFT of sample O11 approximate pitch "B3" without preemphasis



FFT of sample O11 approximate pitch "B3" with preemphasis .9

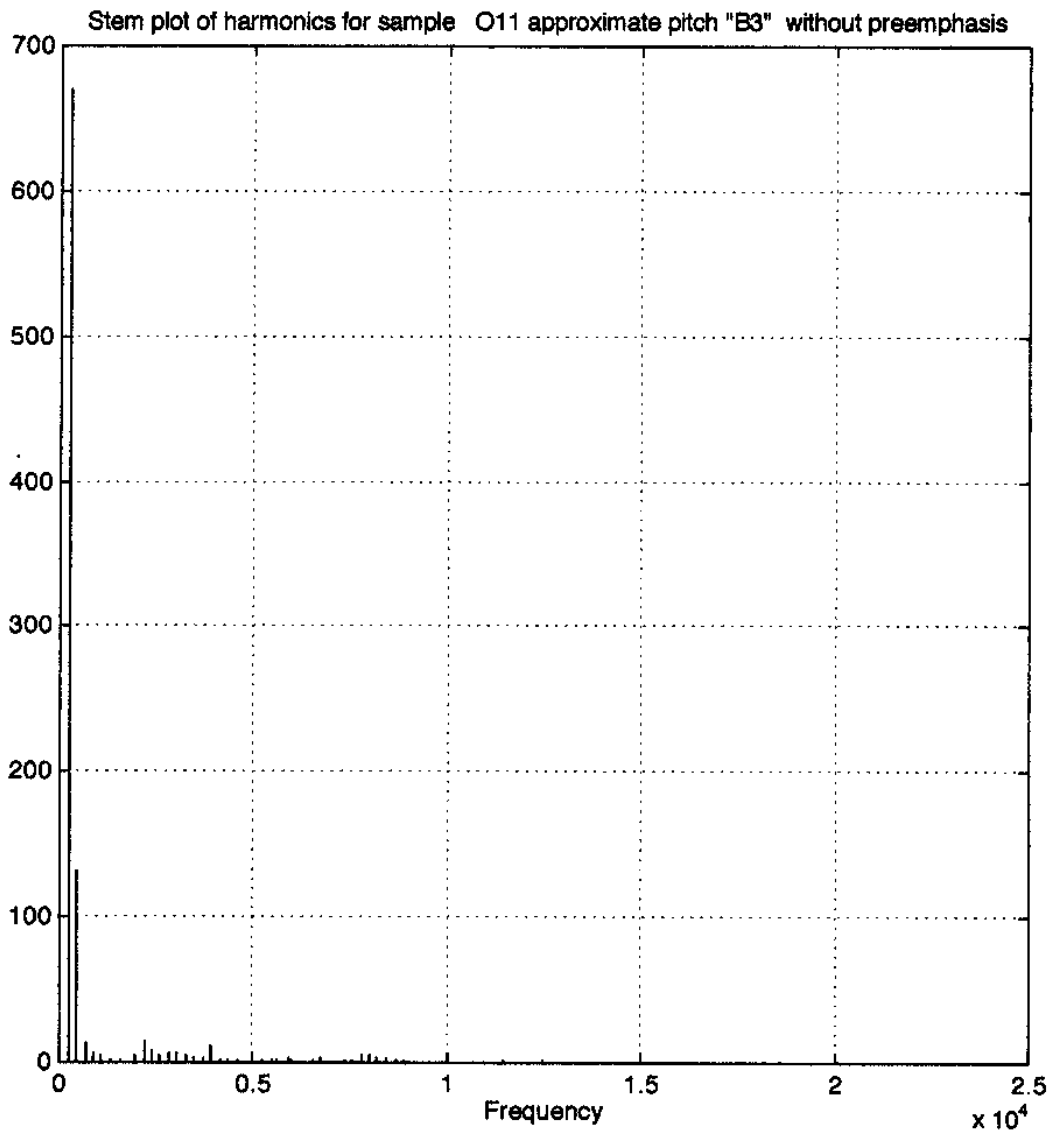


Worksheet saved into file: Minitab.011  
MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	234	669.363	100.000 ←
2	450	132.778	19.836
3	666	13.089	1.955
4	882	5.862	0.876
5	1098	5.423	0.810
6	1314	2.223	0.332
7	1548	1.206	0.180
8	1962	4.373	0.653
9	2178	15.416	2.303 ← <i>low</i>
10	2394	7.837	1.171
11	2610	5.628	0.841
12	2826	6.449	0.963
13	3042	7.105	1.062 ←
14	3258	4.253	0.635
15	3492	4.103	0.613
16	3690	3.879	0.580
17	3924	12.278	1.834 ←
18	4140	2.008	0.300
19	4356	1.387	0.207
20	4590	2.301	0.344
21	4824	0.647	0.097
22	5220	1.047	0.156
23	5454	1.396	0.209
24	5634	1.487	0.222
25	5922	2.656	0.397
26	6012	1.530	0.229
27	6318	0.690	0.103
28	6534	1.324	0.198
29	6732	2.642	0.395
30	6966	0.641	0.096
31	7344	0.978	0.146
32	7578	2.199	0.329
33	7812	4.301	0.643
34	8028	4.739	0.708
35	8172	3.862	0.577
36	8442	3.375	0.504
37	8676	1.083	0.162
38	8910	2.321	0.347
39	9036	0.789	0.118
40	9450	0.278	0.041
41	9666	0.352	0.053
42	9882	0.403	0.060
43	9990	0.484	0.072
44	10206	0.456	0.068
45	10476	0.168	0.025
46	10818	0.130	0.019
47	11034	0.263	0.039
48	11250	0.722	0.108
49	11466	0.932	0.139
50	11628	0.450	0.067
51	11988	0.276	0.041
52	12186	0.252	0.038
53	12492	1.262	0.188
54	12546	0.734	0.110
55	12834	0.440	0.066

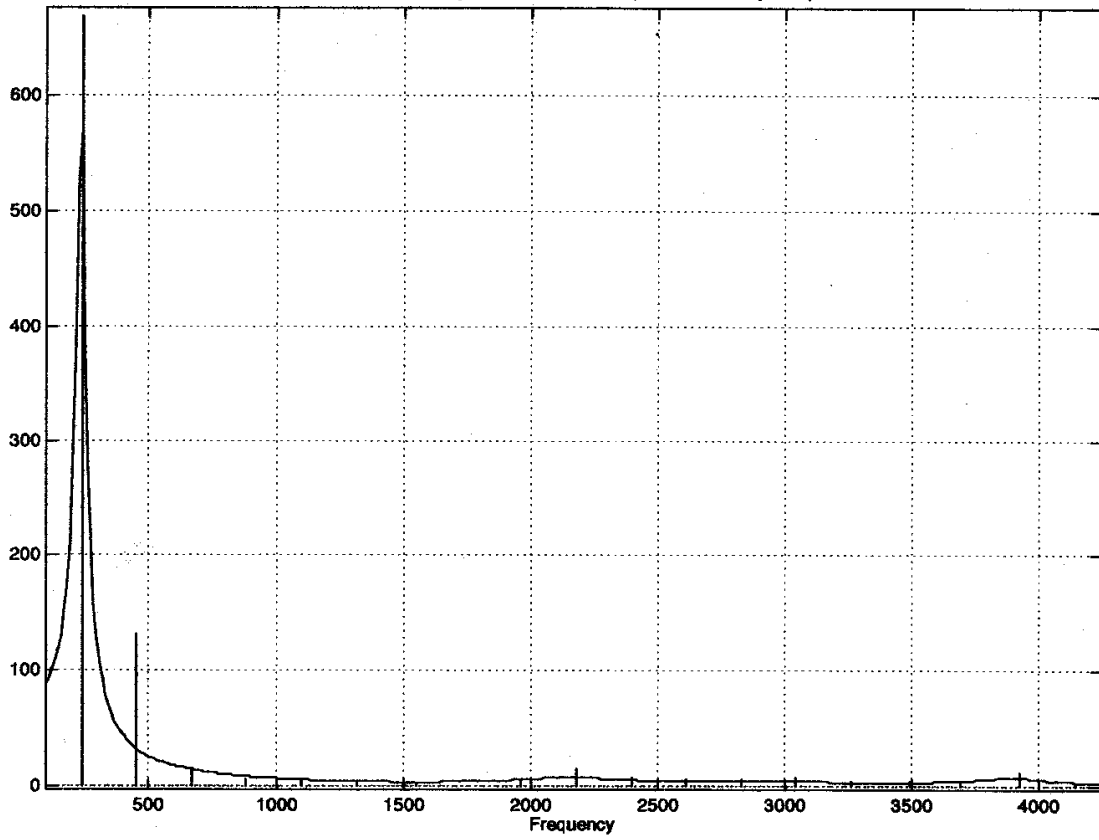
56	13032	0.127	0.019
57	13284	0.101	0.015
58	13626	0.072	0.011
59	13878	0.139	0.021
60	14094	0.309	0.046
61	14292	0.298	0.044
62	14418	0.202	0.030
63	14724	0.123	0.018
64	14940	0.217	0.032
65	15210	0.109	0.016
66	15498	0.106	0.016
67	15624	0.211	0.032
68	15840	0.165	0.025
69	16092	0.092	0.014
70	16344	0.056	0.008
71	16524	0.129	0.019
72	16812	0.070	0.010
73	17172	0.118	0.018
74	17316	0.097	0.015
75	17478	0.057	0.008
76	17766	0.054	0.008
77	18108	0.044	0.007
78	18216	0.066	0.010
79	18450	0.062	0.009
80	18702	0.058	0.009
81	18918	0.047	0.007
82	19224	0.066	0.010
83	19368	0.059	0.009
84	19674	0.056	0.008
85	19962	0.058	0.009
86	20070	0.058	0.009
87	20412	0.061	0.009
88	20538	0.044	0.007
89	20844	0.045	0.007
90	21078	0.048	0.007
91	21330	0.060	0.009
92	21582	0.042	0.006
93	21690	0.048	0.007
94	22068	0.050	0.008
95	22302	0.043	0.006
96	22428	0.041	0.006
97	22752	0.033	0.005
98	22932	0.030	0.005
99	23184	0.014	0.002
100	23490	0.019	0.003
101	23652	0.011	0.002
102	20160	0.179	0.027
103	20430	0.180	0.027
104	20610	0.171	0.026
105	20718	0.158	0.024
106	21042	0.164	0.025
107	21240	0.157	0.023
108	21420	0.141	0.021
109	21564	0.154	0.023
110	21834	0.144	0.021
111	21978	0.138	0.021
112	22104	0.146	0.022
113	22302	0.133	0.020
114	22608	0.144	0.022
115	22824	0.134	0.020

116	22950	0.130	0.019
117	23202	0.139	0.021
118	23418	0.141	0.021
119	23490	0.135	0.020
120	23814	0.133	0.020

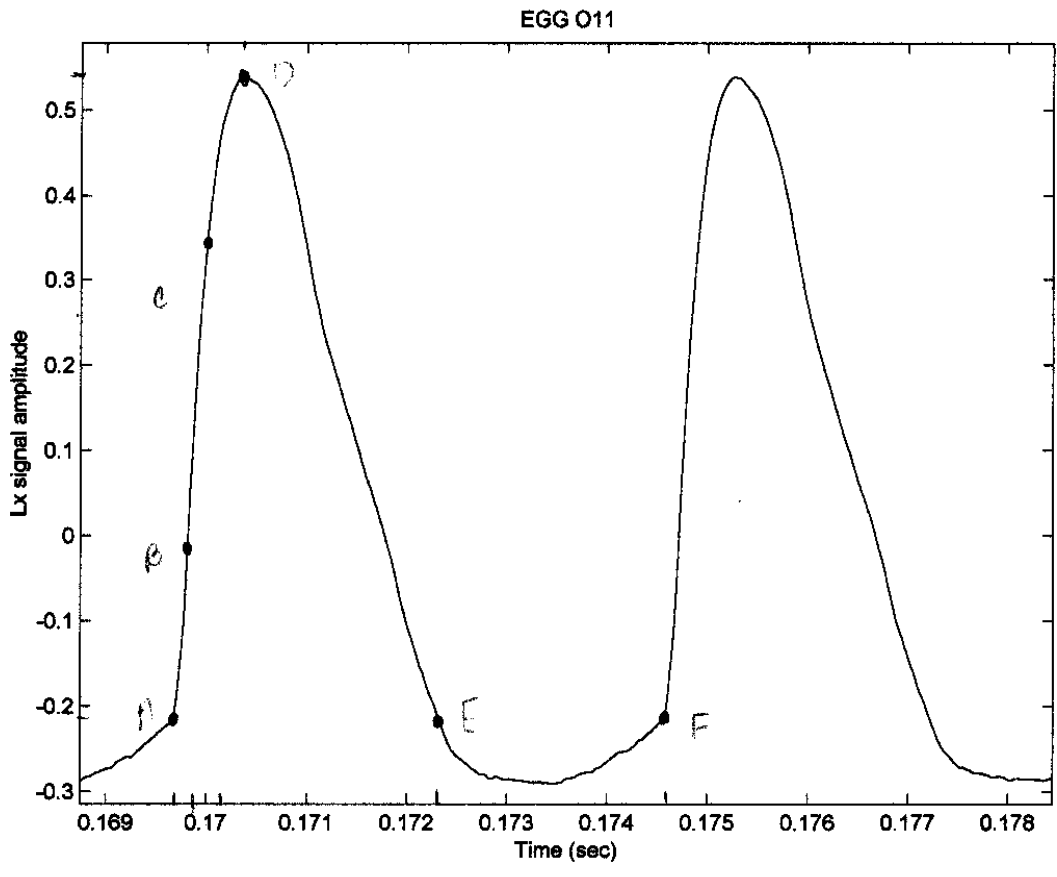




Stem plot/LPC overlay of harmonics for sample O11 without preemphasis



$d = 19 \text{ mm}$   
 $r = 1001 = 16 \text{ mm}$

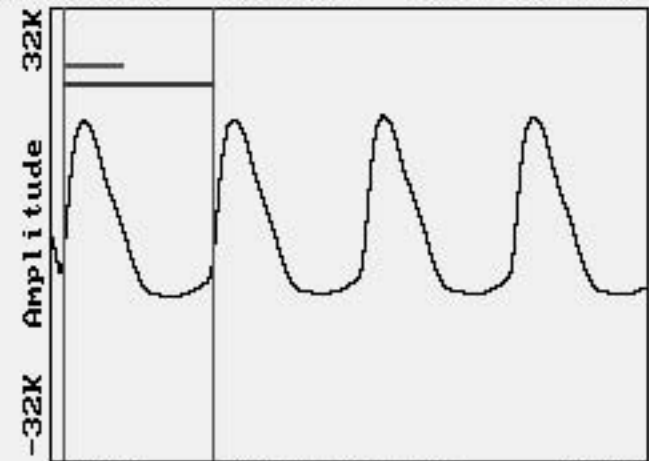


**A** > : CH1: 011\_EG~1.NSP

< 0.00 sec 39.46% 197.76 Hz >



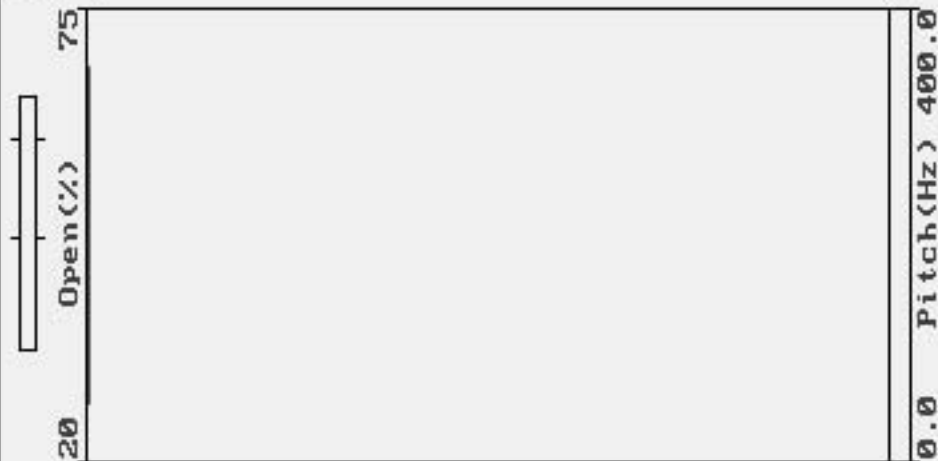
Duration 2.50 (sec)



0.00 Time (sec) 0.02

**B** > :

< sec % Hz >



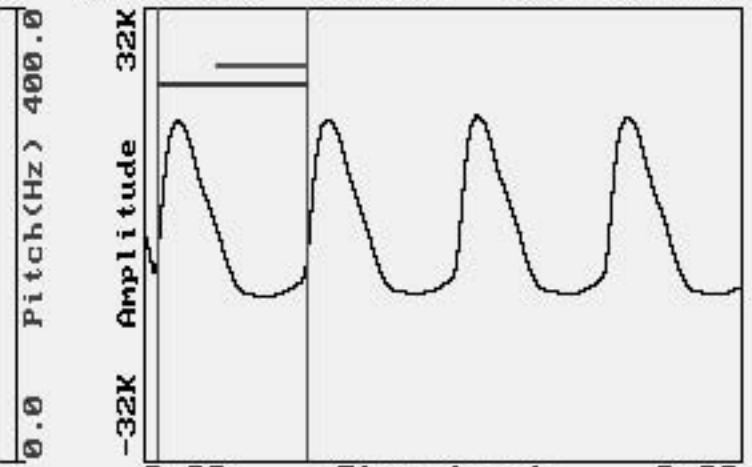
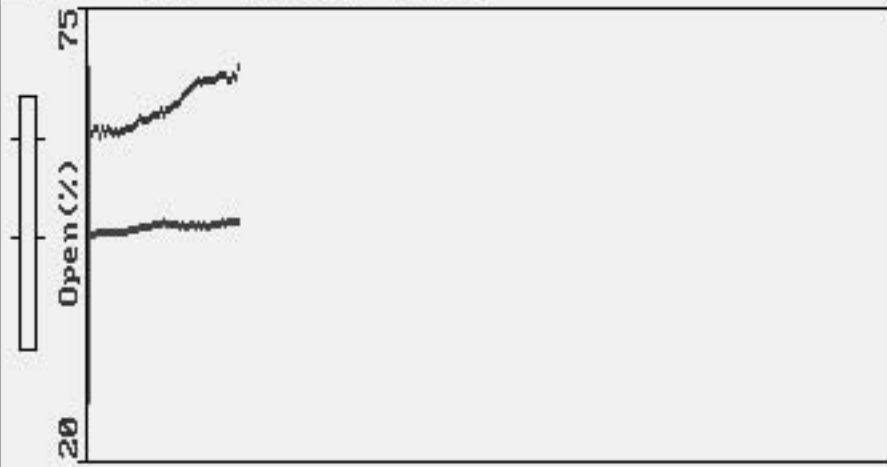
Duration 2.50 (sec)



Time (sec)

**A** > : CH1: 011\_EG~1.NSP

< 0.00 sec 60.53% 197.76 Hz >

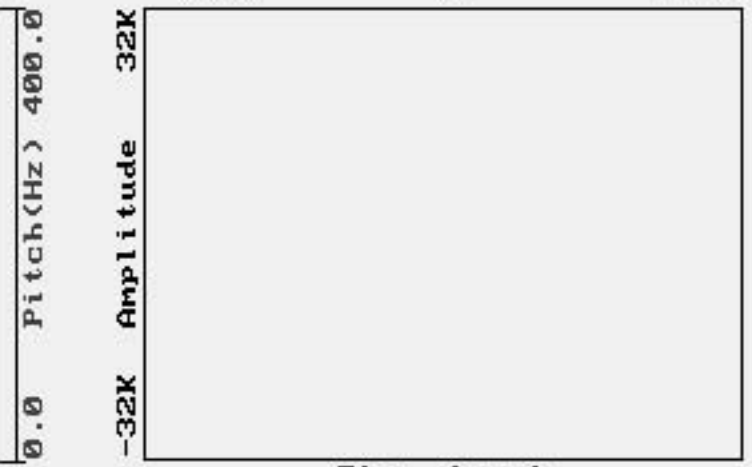


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

**B** > :

< sec % Hz >

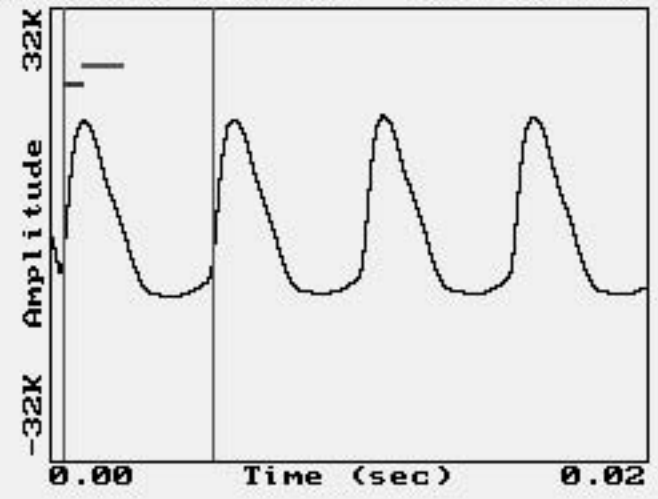
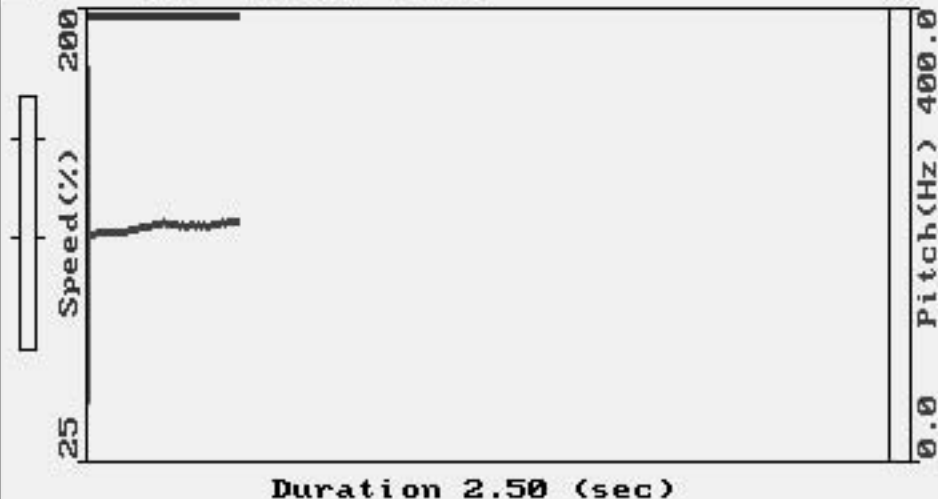


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

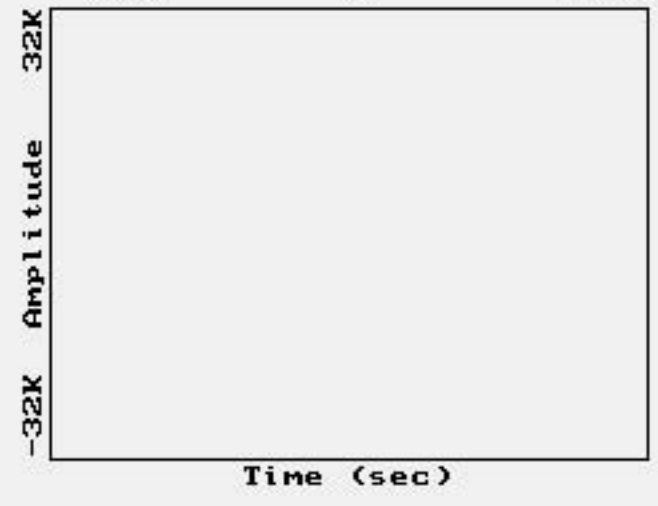
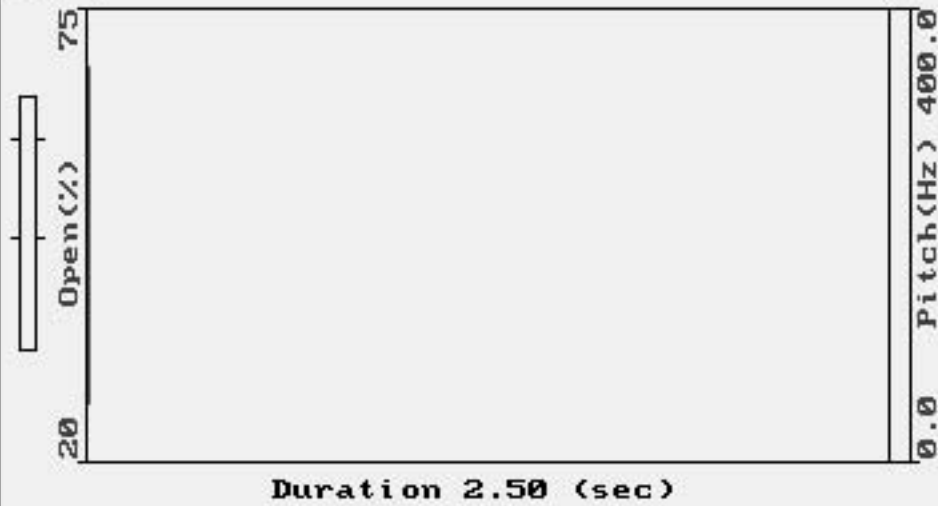
■A> : CH1: 011\_EG~1.NSP

< 0.00 sec 238.46% 197.76 Hz >



□B> :

< sec % Hz >

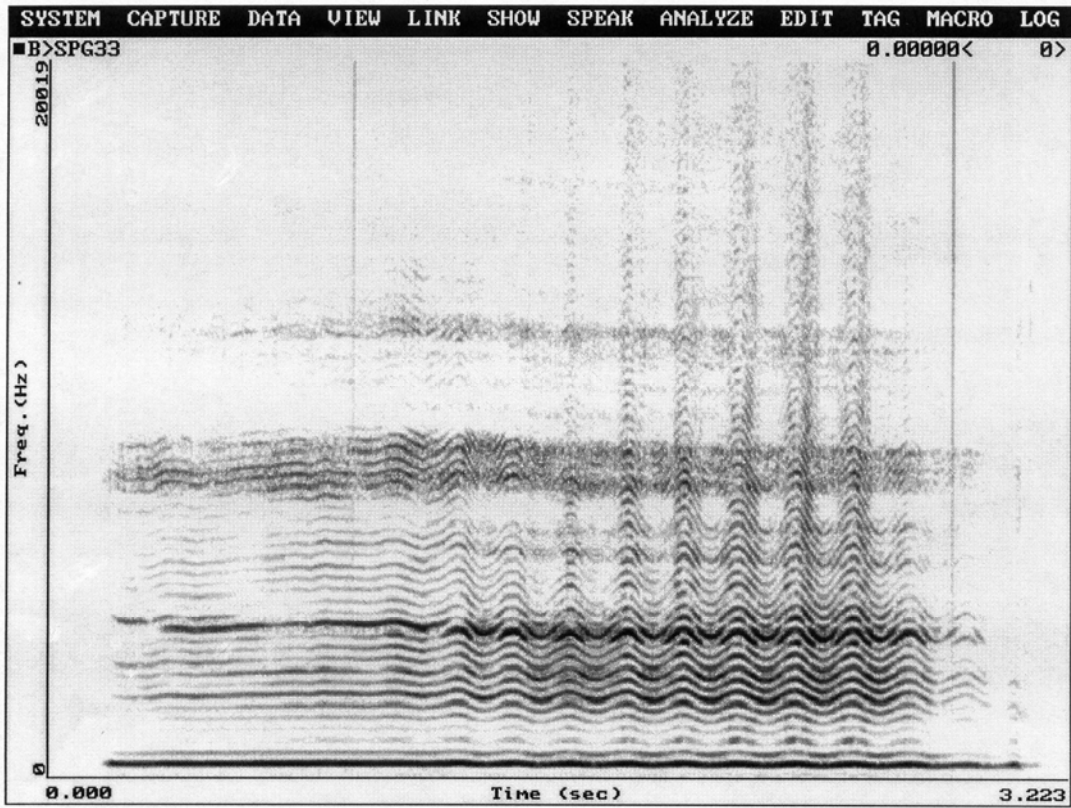


Spectrogram of O21

Opera Style

[i] vowel

E4

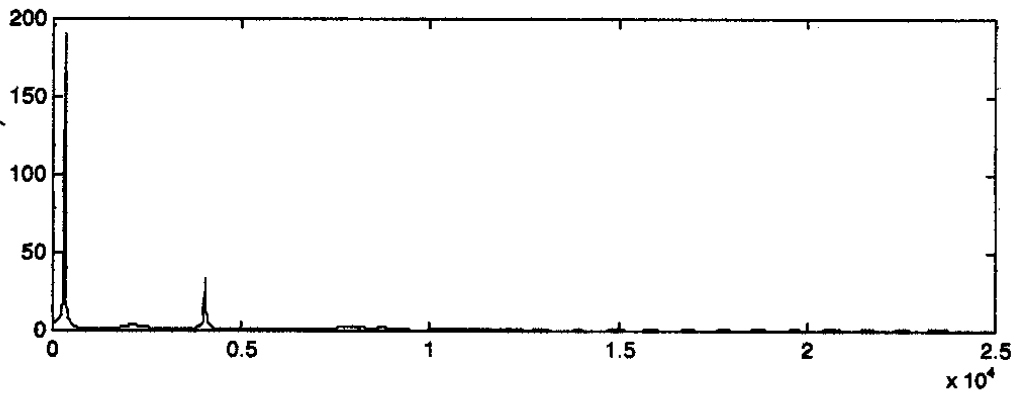
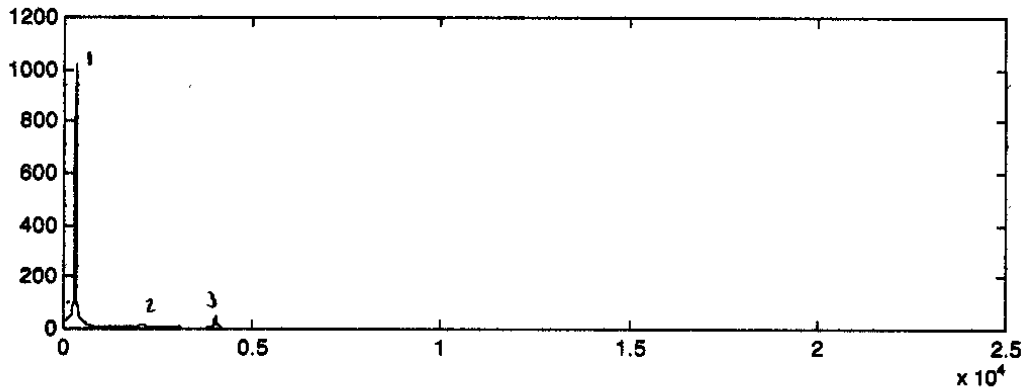


LPC of O21

- 1) 316.41, 1022.95
- 2) 2107.00 14.40
- 3) 4031.25 48.95

O21

$F_0 = 310 \text{ Hz}$



$$.15733333 - .002708333 = .154624997$$

48

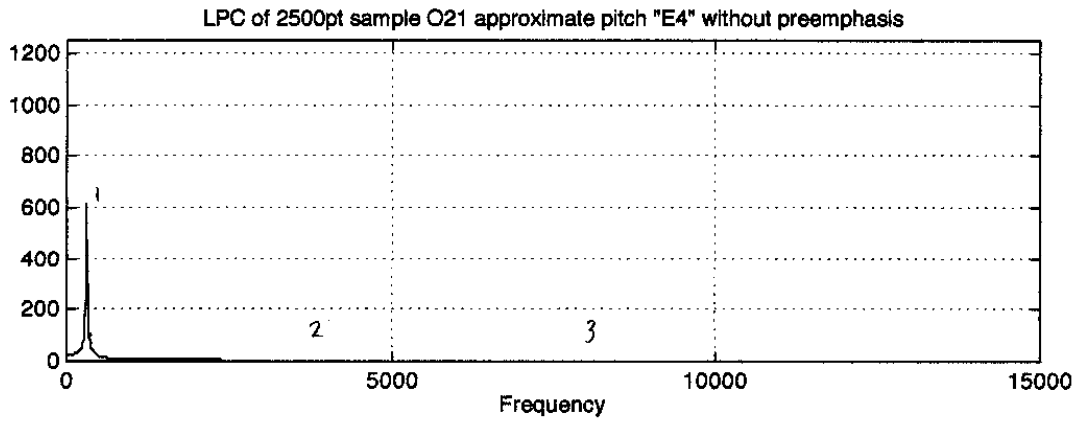
310.43 Hz

1000-10000 pt

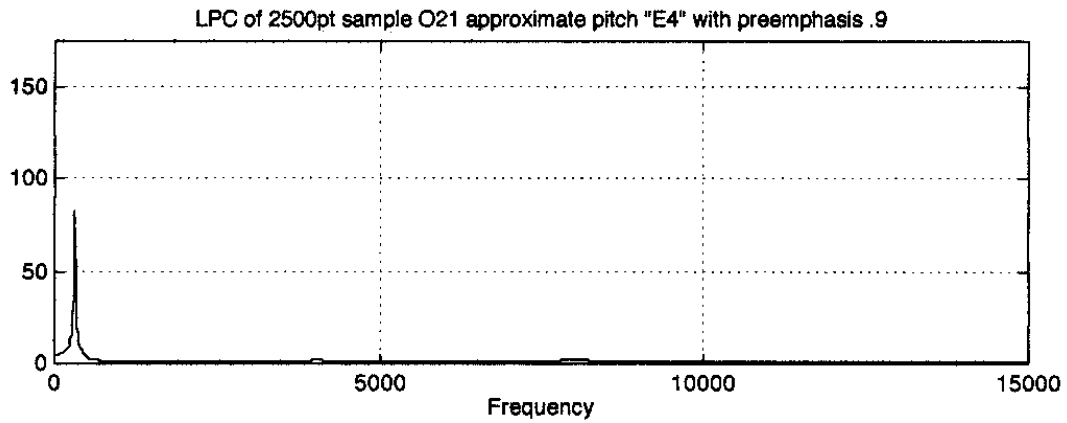
LPC of O21 trimmed 2500pt sample

( 304.69, 615.94 )

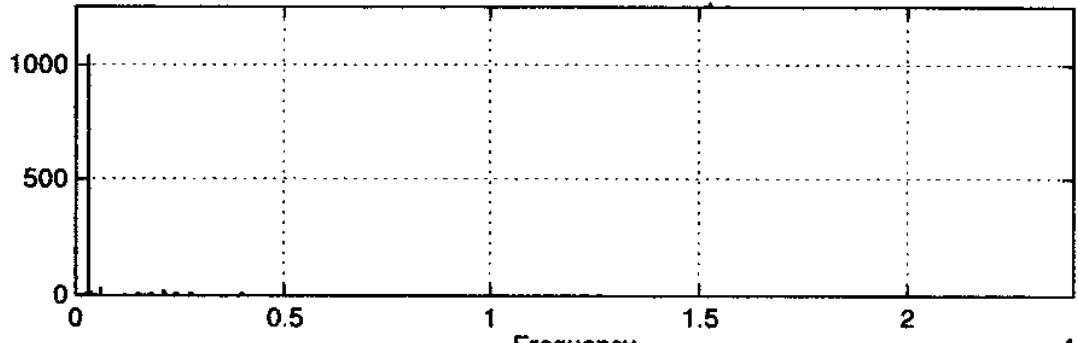
)



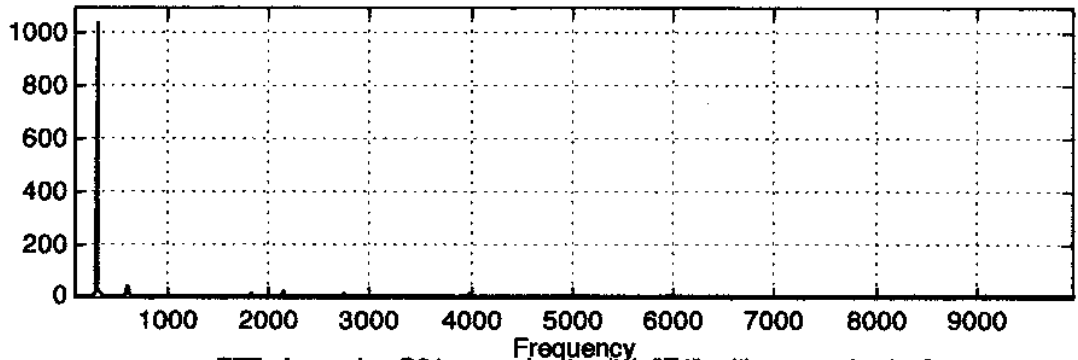
)



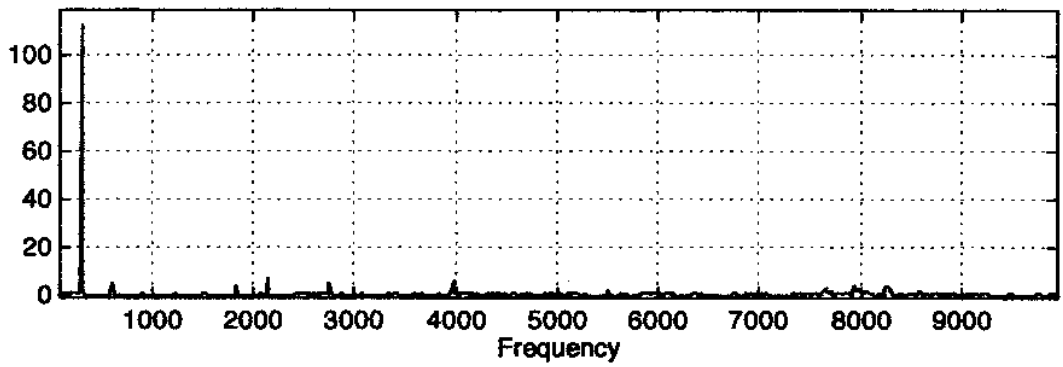
FFT of sample O21 approximate pitch "E4" without preemphasis



Zoom FFT of sample O21 approximate pitch "E4" without preemphasis x 10<sup>4</sup>



FFT of sample O21 approximate pitch "E4" with preemphasis .9

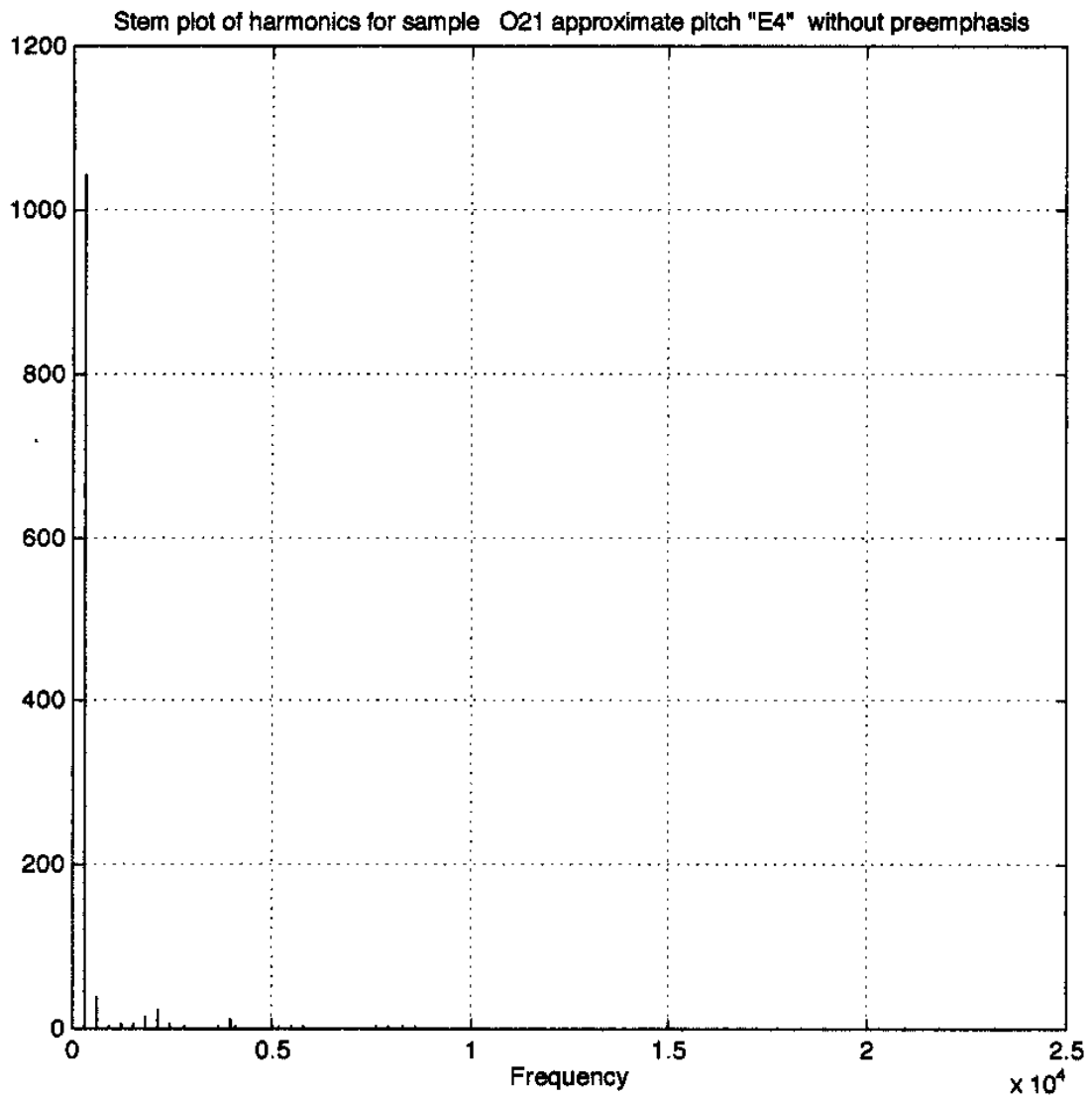


Worksheet saved into file: Minitab.021  
MTB > Print 'Freq' 'Amp' '% Amp'.

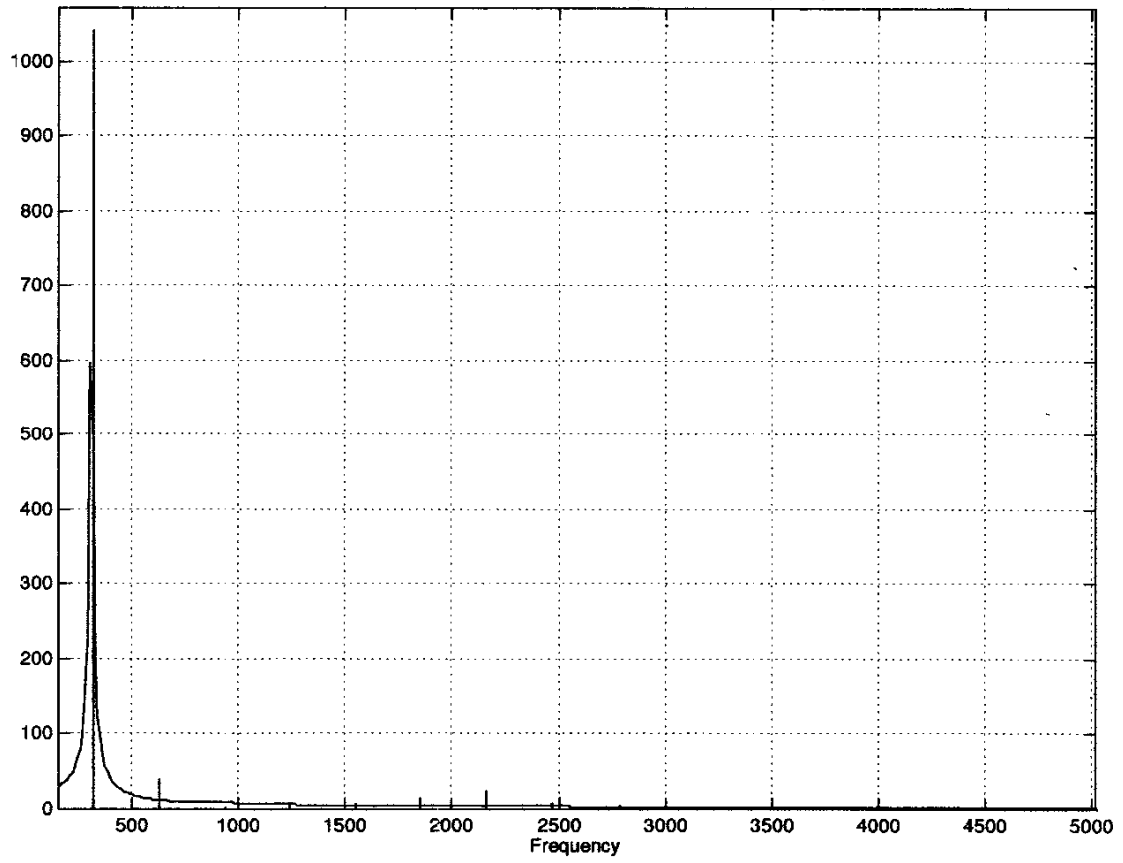
ROW	Freq	Amp	% Amp
1	324	1042.40	100.000 —
2	630	38.34	3.678
3	936	3.31	0.318
4	1242	4.82	0.463
5	1548	6.42	0.615
6	1854	13.67	1.311
7	2160	23.99	2.301 — <i>low</i>
8	2466	6.26	0.601
9	2790	3.65	0.351
10	3114	0.79	0.076
11	3690	1.73	0.166
12	3996	11.39	1.092 —
13	4104	1.67	0.160
14	4608	0.31	0.030
15	4914	1.30	0.124
16	5220	1.67	0.160
17	5526	1.82	0.175
18	5832	1.93	0.186
19	6138	0.97	0.093
20	6444	0.82	0.079
21	6768	0.28	0.027
22	7074	0.39	0.037
23	7380	0.79	0.076
24	7668	4.24	0.407
25	7974	3.27	0.314
26	8298	2.61	0.251
27	8622	1.63	0.157
28	9180	0.64	0.061
29	9342	0.16	0.016
30	9810	0.05	0.005
31	9990	0.12	0.012
32	10440	0.11	0.011
33	10764	0.21	0.020
34	11016	0.23	0.022
35	11322	0.48	0.046
36	11790	0.35	0.034
37	11970	0.80	0.077
38	12366	0.31	0.030
39	12564	0.19	0.019
40	12870	0.13	0.012
41	13410	0.07	0.006
42	13518	0.11	0.010
43	13824	0.10	0.009
44	14346	0.05	0.005
45	14508	0.09	0.008
46	14958	0.09	0.009
47	15300	0.16	0.015
48	15642	0.10	0.009
49	15822	0.11	0.010
50	16254	0.06	0.006
51	16596	0.05	0.005
52	16812	0.04	0.004
53	17082	0.04	0.004
54	17604	0.03	0.003
55	17802	0.03	0.003

56	18234	0.04	0.004
57	18342	0.05	0.005
58	18918	0.02	0.002
59	19170	0.04	0.004
60	19440	0.03	0.002
61	19872	0.03	0.003
62	20214	0.03	0.003
63	20322	0.03	0.003
64	20682	0.03	0.003
65	20988	0.03	0.003
66	21384	0.03	0.003
67	21636	0.02	0.002
68	22122	0.02	0.002
69	22356	0.02	0.002
70	22590	0.02	0.002
71	23130	0.02	0.002
72	23274	0.02	0.002
73	23598	0.02	0.002
74	17316	0.10	0.009
75	17478	0.06	0.005
76	17766	0.05	0.005
77	18108	0.04	0.004
78	18216	0.07	0.006
79	18450	0.06	0.006
80	18702	0.06	0.006
81	18918	0.05	0.005
82	19224	0.07	0.006
83	19368	0.06	0.006
84	19674	0.06	0.005
85	19962	0.06	0.006
86	20070	0.06	0.006
87	20412	0.06	0.006
88	20538	0.04	0.004
89	20844	0.05	0.004
90	21078	0.05	0.005
91	21330	0.06	0.006
92	21582	0.04	0.004
93	21690	0.05	0.005
94	22068	0.05	0.005
95	22302	0.04	0.004
96	22428	0.04	0.004
97	22752	0.03	0.003
98	22932	0.03	0.003
99	23184	0.01	0.001
100	23490	0.02	0.002
101	23652	0.01	0.001
102	20160	0.18	0.017
103	20430	0.18	0.017
104	20610	0.17	0.016
105	20718	0.16	0.015
106	21042	0.16	0.016
107	21240	0.16	0.015
108	21420	0.14	0.014
109	21564	0.15	0.015
110	21834	0.14	0.014
111	21978	0.14	0.013
112	22104	0.15	0.014
113	22302	0.13	0.013
114	22608	0.14	0.014
115	22824	0.13	0.013

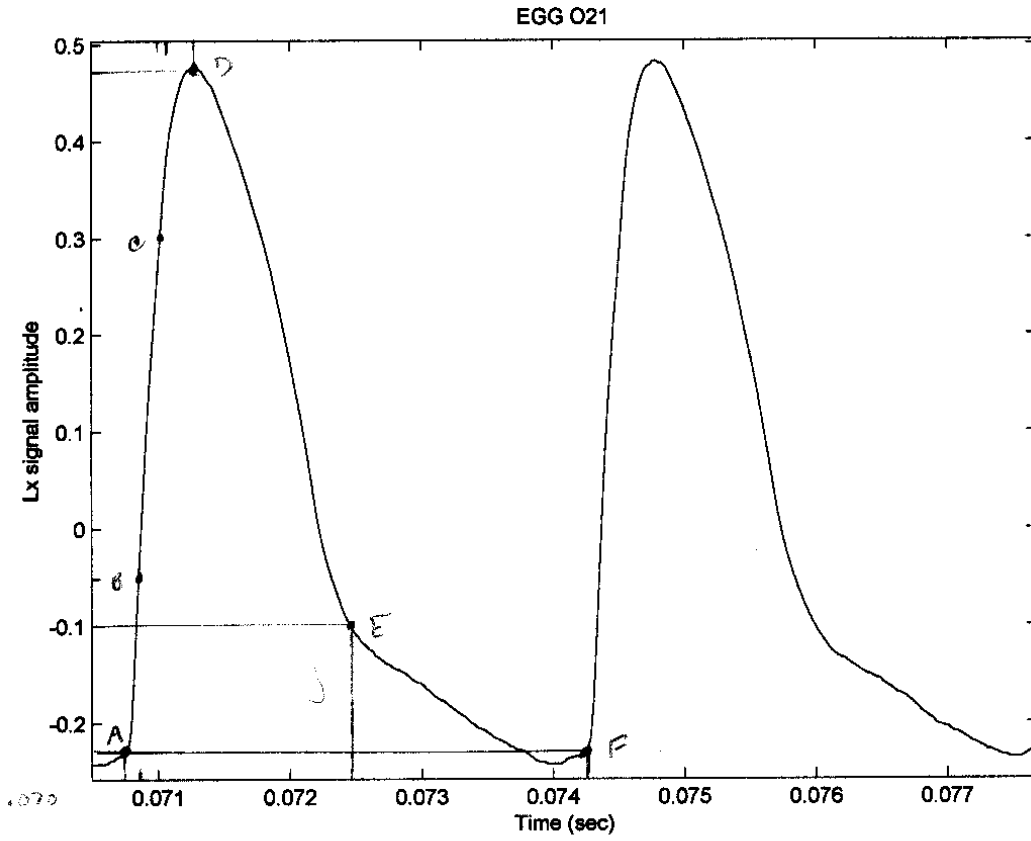
116	22950	0.13	0.012
117	23202	0.14	0.013
118	23418	0.14	0.014
119	23490	0.13	0.013
120	23814	0.13	0.013



Stem plot/LPC overlay of harmonics for sample O21 without preemphasis



x → 22 mm = .001  
y → 16 mm = .1

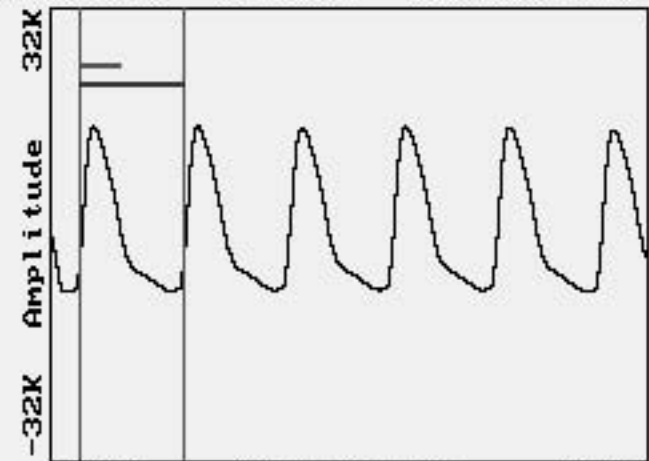


■A> : CH1: 021\_EG~1.NSP

< 0.00 sec 37.66% 286.36 Hz >

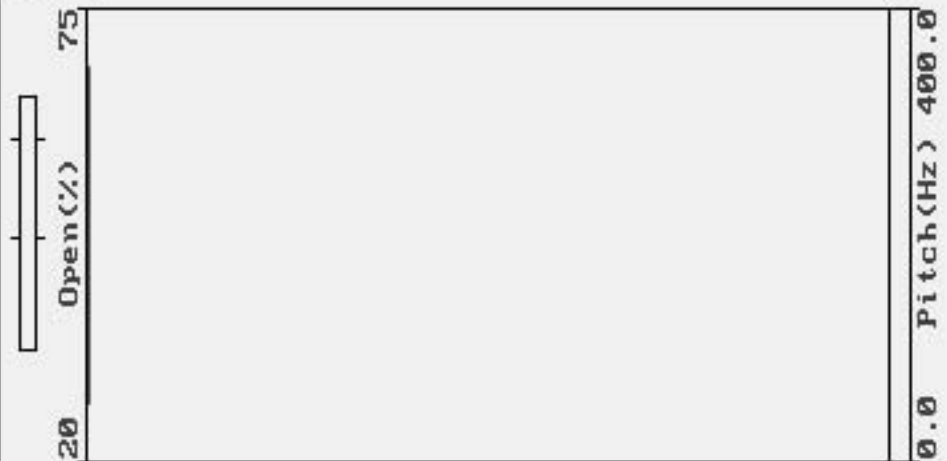


Duration 2.50 (sec)



□B> :

< sec % Hz >

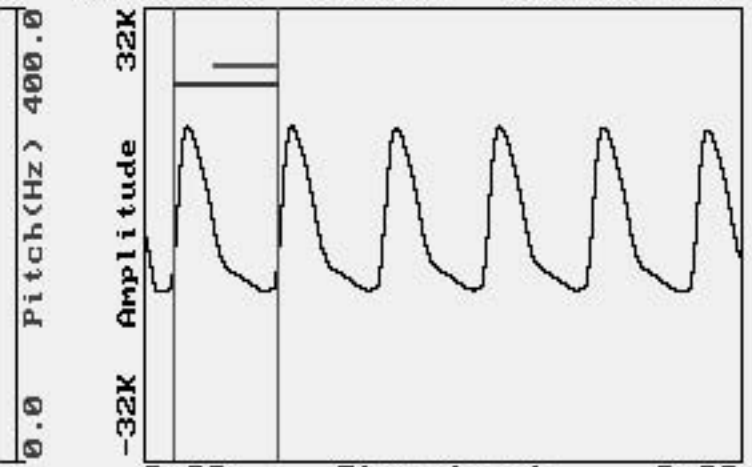
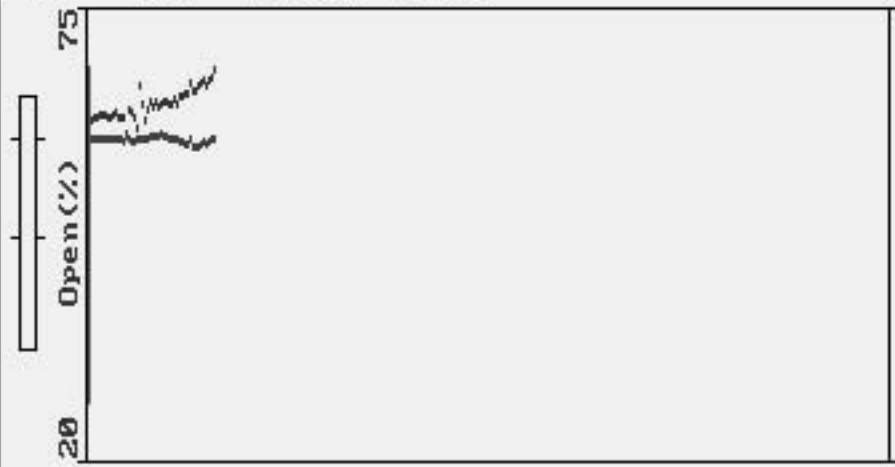


Duration 2.50 (sec)



■A> : CH1: 021\_EG~1.NSP

< 0.00 sec 62.33% 286.36 Hz >

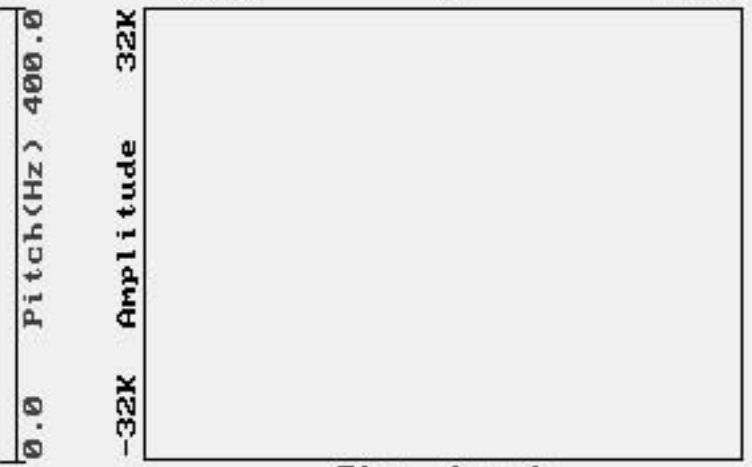


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

□B> :

< sec % Hz >

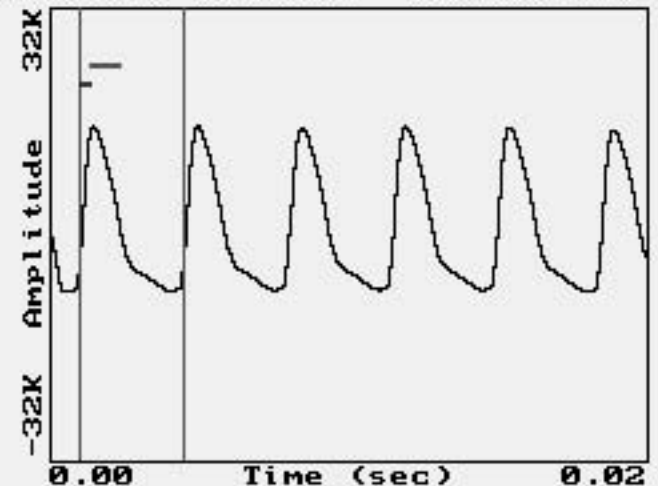


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

■A> : CH1: 021\_EG~1.NSP

< 0.00 sec 262.50% 286.36 Hz >

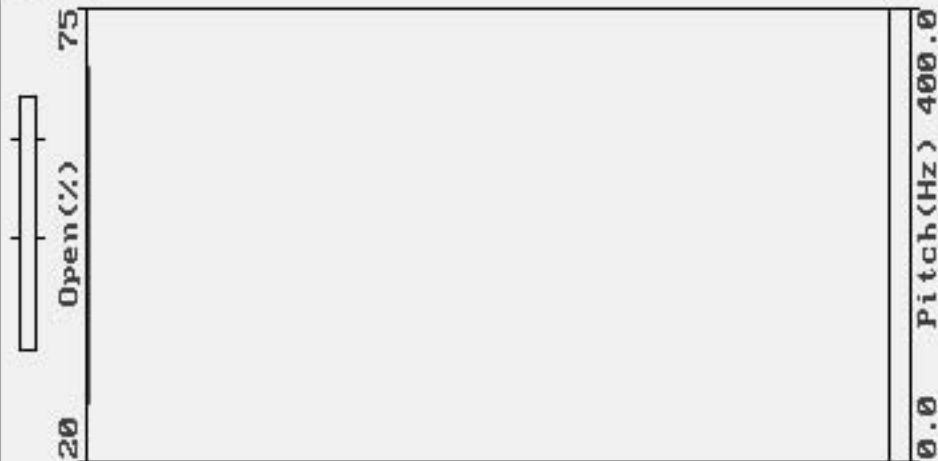


Duration 2.50 (sec)

Pitch(Hz) 400.0

□B> :

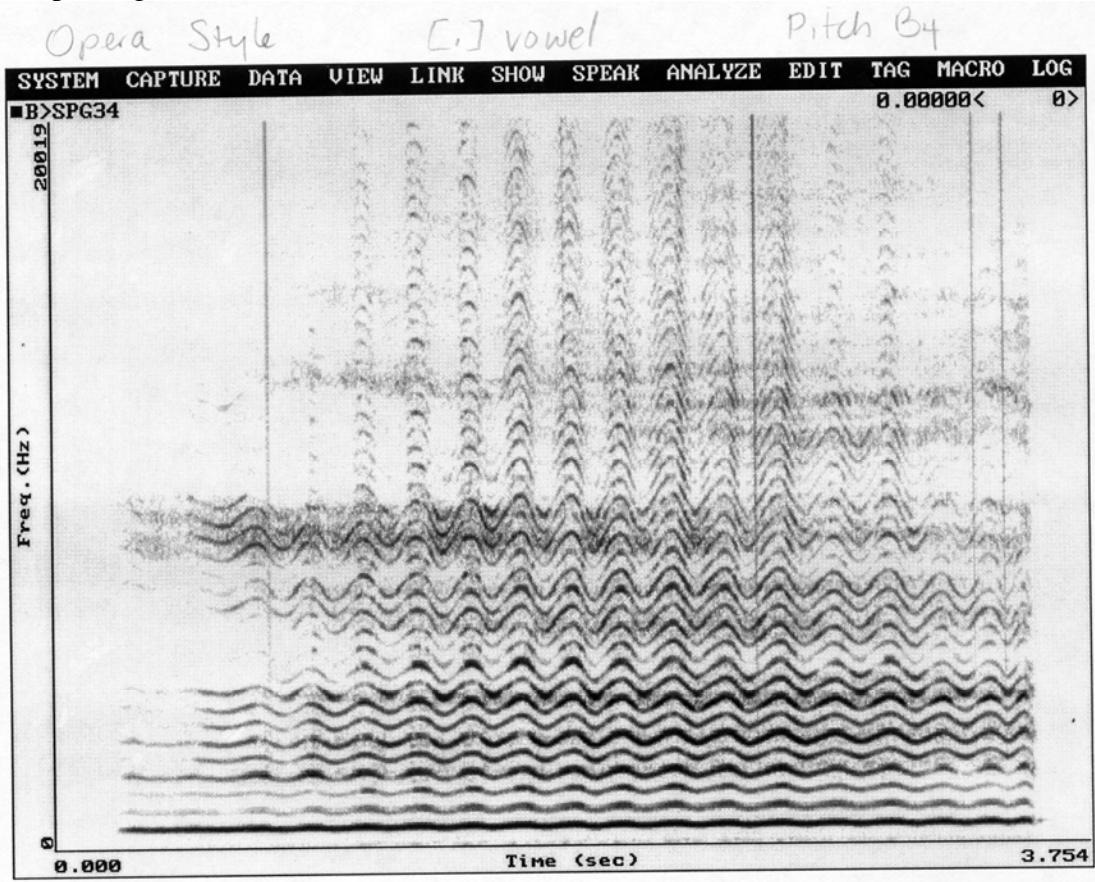
< sec % Hz >



Duration 2.50 (sec)

Pitch(Hz) 400.0

O31 Spectrogram

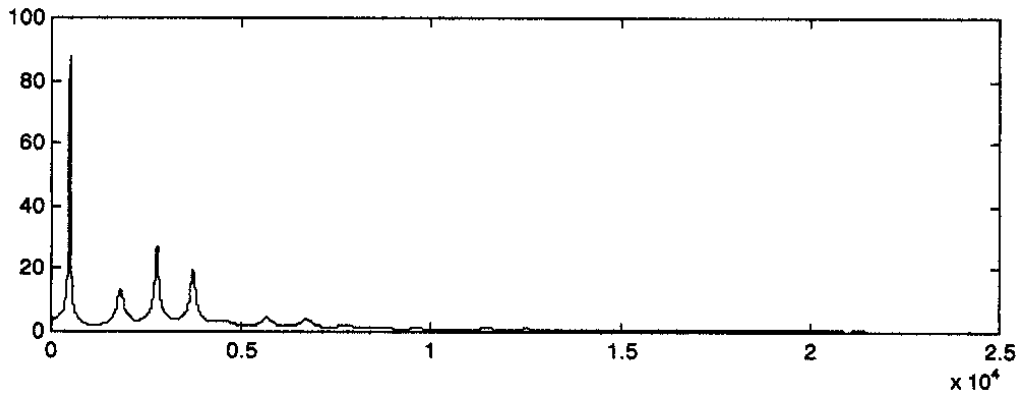
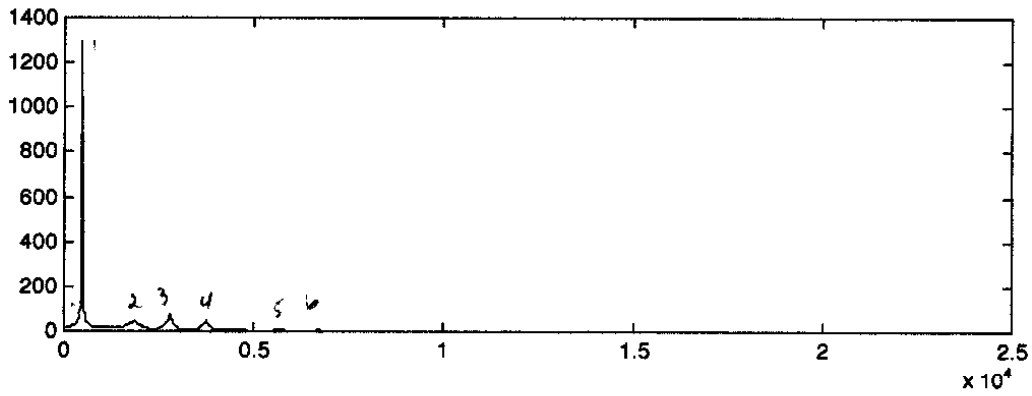


LPC of O31

- 1) 468.75, 1297.08
- 2) 1863.27, 43.75
- 3) 2789.08, 79.7
- 4) 3726.57, 49.3
- 5) 5680, 7.0
- 6) 8710, 5.0

O31

$$F_0 = 469 \text{ Hz}$$



$$.0930625 - .012104167 = .080958333 / 38$$

$$469.3772536$$

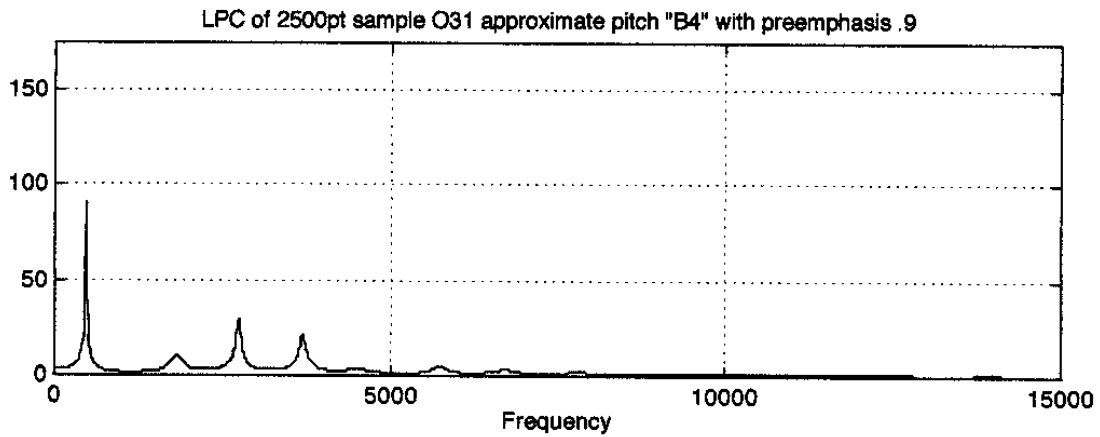
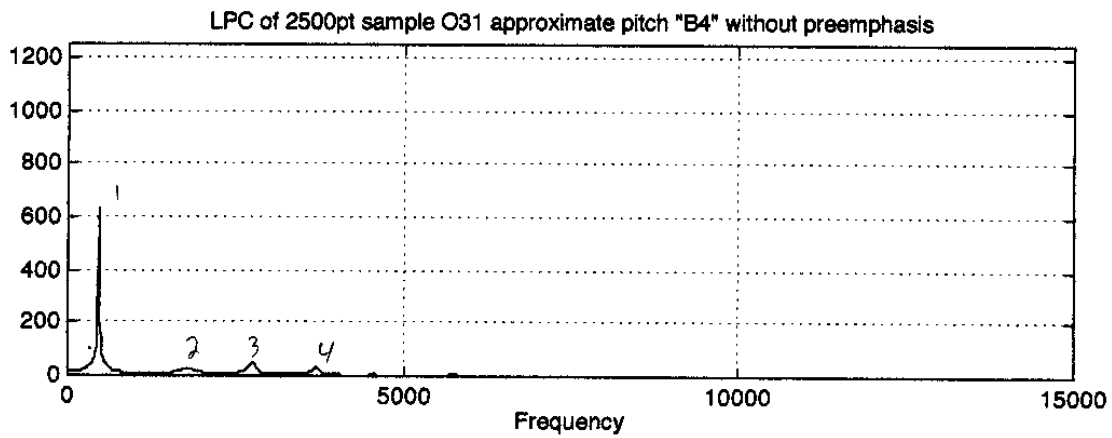
12.1

(457.03; 637.05)

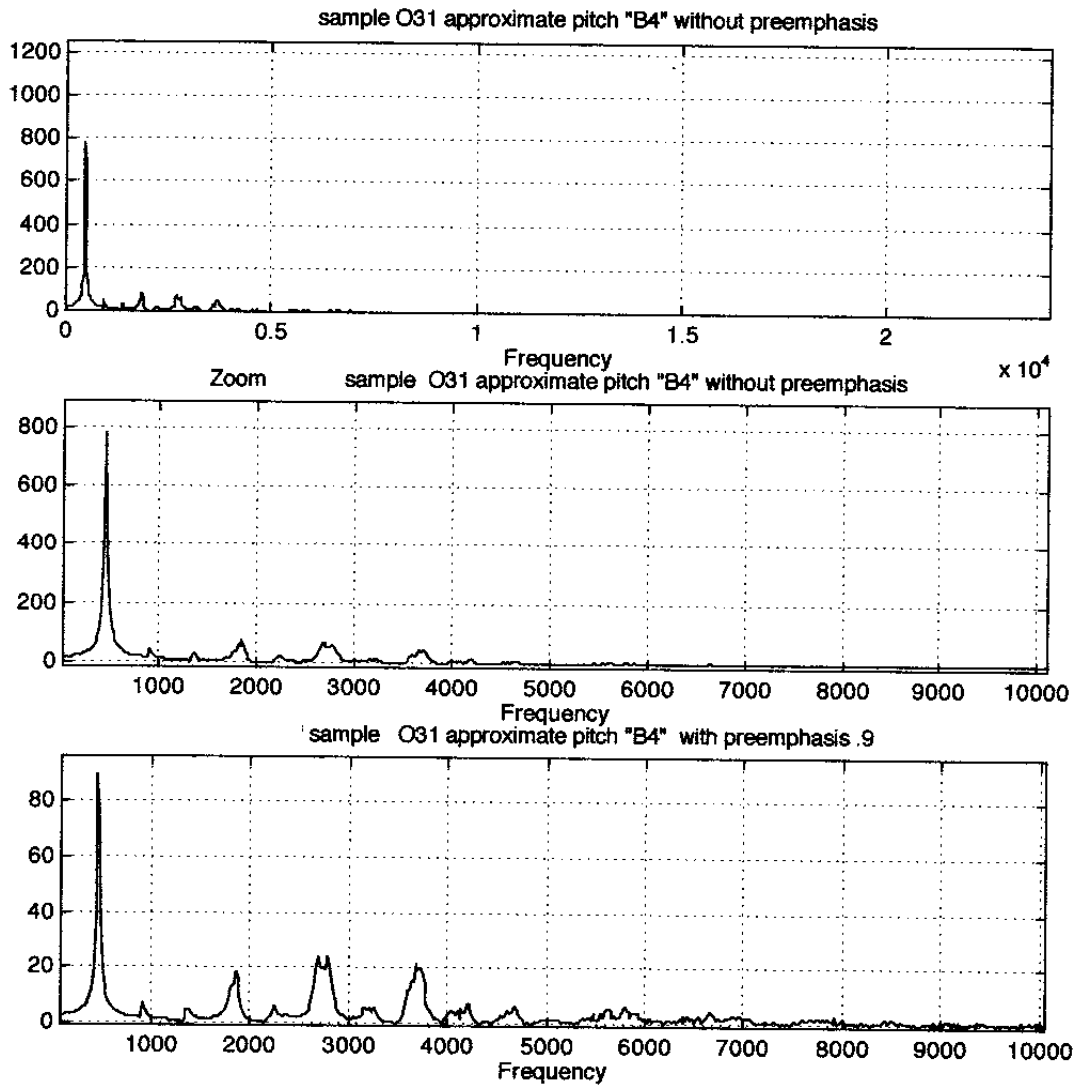
(1792.97; 25.98)

(2742.19; 51.96)

(3703.13; 30.53)



# DFT of O31



DFT Numerical Results for O31

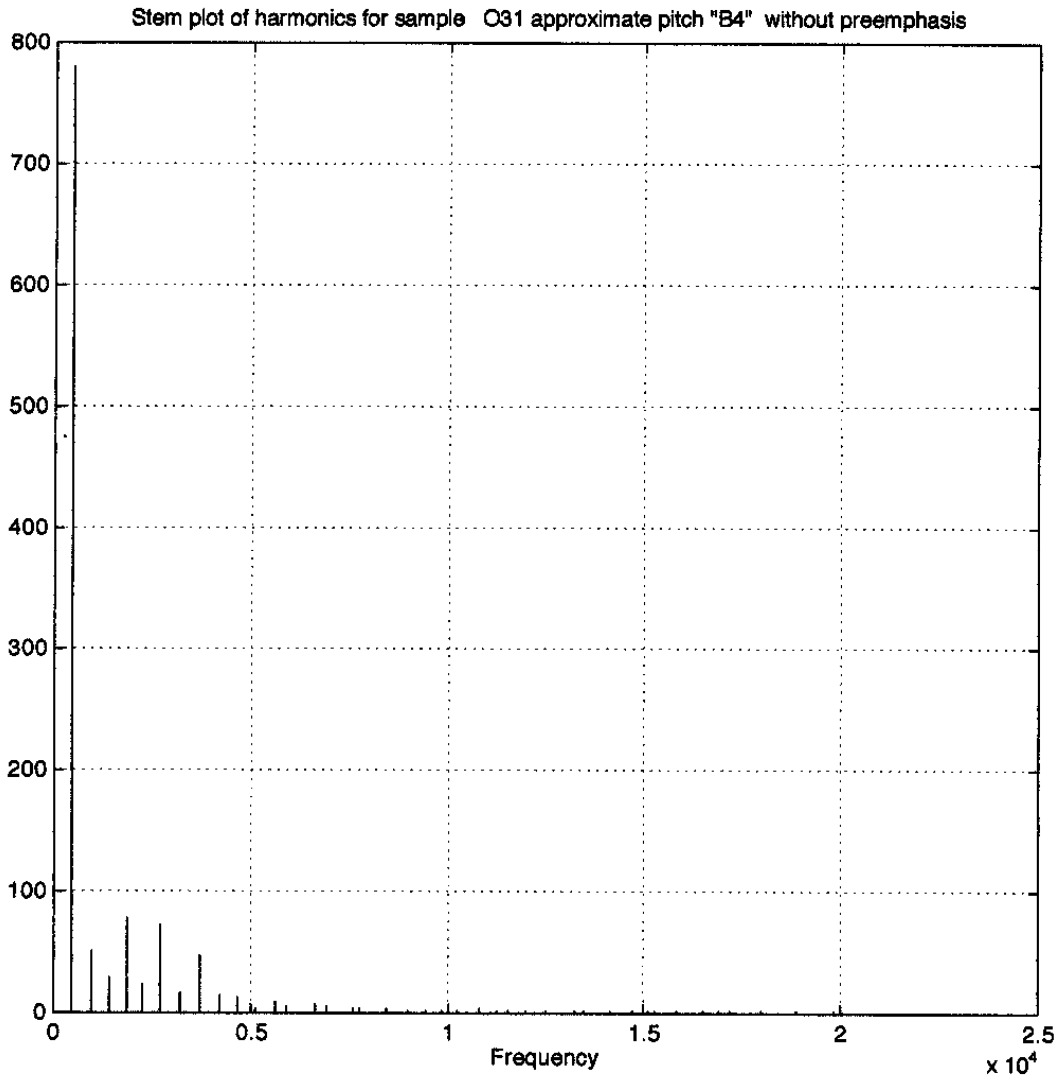
Worksheet saved into file: Minitab.031  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	468	780.895	100.000
2	936	50.187	6.427
3	1386	29.198	3.739
4	1872	78.860	10.099
5	2268	22.819	2.922
6	2718	72.564	9.292
7	3186	16.792	2.150
8	3690	46.969	6.015
9	4230	15.285	1.957
10	4698	12.581	1.611
11	5112	4.261	0.546
12	5634	9.188	1.177
13	5940	6.271	0.803
14	6660	6.628	0.849
15	6930	5.293	0.678
16	7614	3.284	0.421
17	7776	3.889	0.498
18	8442	3.048	0.390
19	9000	2.452	0.314
20	9450	2.328	0.298
21	9828	2.190	0.280
22	10260	2.213	0.283
23	10836	2.793	0.358
24	11268	1.382	0.177
25	11520	2.119	0.271
26	11988	1.424	0.182
27	12474	1.645	0.211
28	13212	1.404	0.180
29	13464	1.104	0.141
30	14112	1.531	0.196
31	14688	1.076	0.138
32	15066	1.115	0.143
33	15264	1.280	0.164
34	15804	1.143	0.146
35	16506	0.982	0.126
36	16920	1.117	0.143
37	17172	0.949	0.121
38	17946	0.997	0.128
39	18288	0.875	0.112
40	18882	0.921	0.118
41	19224	0.850	0.109
42	19818	0.925	0.118
43	20016	0.831	0.106
44	20520	0.840	0.108
45	21186	0.837	0.107
46	21546	0.788	0.101
47	22122	0.826	0.106
48	22302	0.791	0.101
49	23112	0.749	0.096
50	23418	0.721	0.092
51	16596	0.049	0.006
52	16812	0.038	0.005
53	17082	0.041	0.005
54	17604	0.027	0.003
55	17802	0.027	0.003

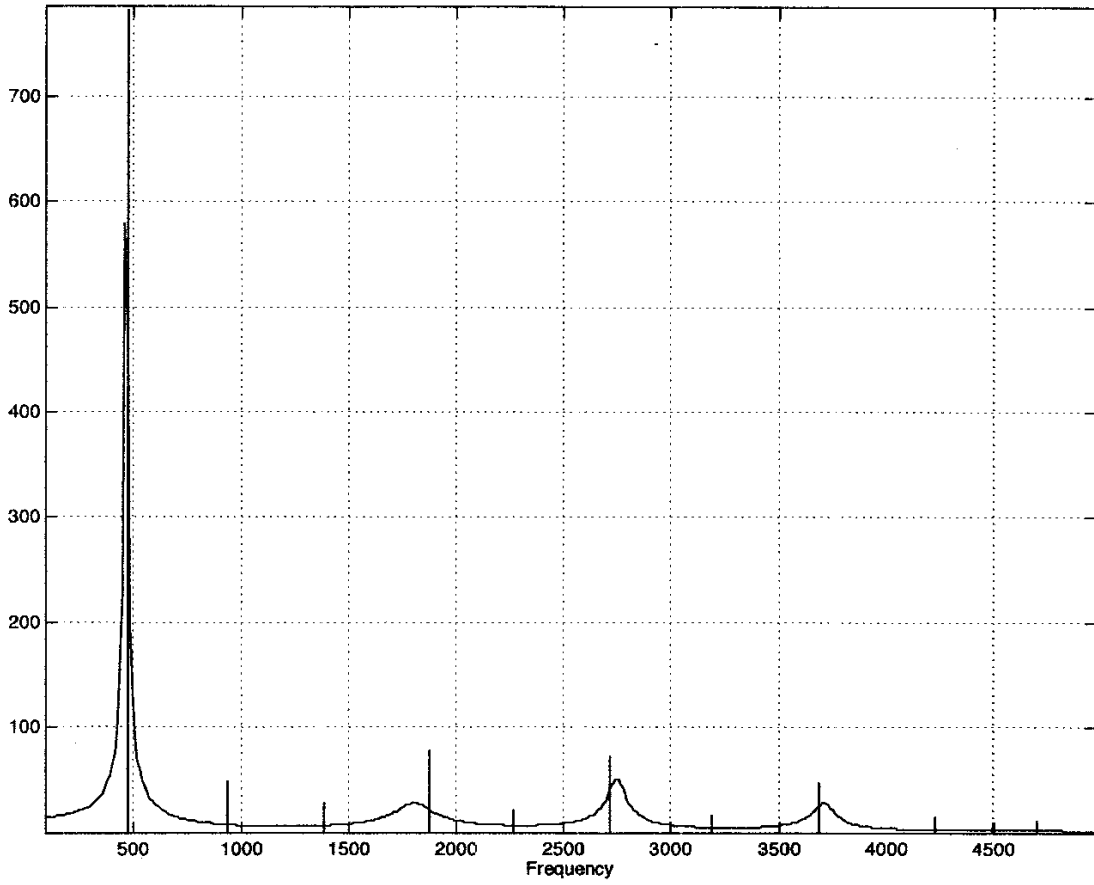
56	18234	0.040	0.005
57	18342	0.048	0.006
58	18918	0.022	0.003
59	19170	0.037	0.005
60	19440	0.026	0.003
61	19872	0.027	0.003
62	20214	0.027	0.003
63	20322	0.035	0.004
64	20682	0.035	0.004
65	20988	0.034	0.004
66	21384	0.032	0.004
67	21636	0.025	0.003
68	22122	0.025	0.003
69	22356	0.023	0.003
70	22590	0.022	0.003
71	23130	0.019	0.002
72	23274	0.018	0.002
73	23598	0.017	0.002
74	17316	0.097	0.012
75	17478	0.057	0.007
76	17766	0.054	0.007
77	18108	0.044	0.006
78	18216	0.066	0.008
79	18450	0.062	0.008
80	18702	0.058	0.007
81	18918	0.047	0.006
82	19224	0.066	0.008
83	19368	0.059	0.008
84	19674	0.056	0.007
85	19962	0.058	0.007
86	20070	0.058	0.007
87	20412	0.061	0.008
88	20538	0.044	0.006
89	20844	0.045	0.006
90	21078	0.048	0.006
91	21330	0.060	0.008
92	21582	0.042	0.005
93	21690	0.048	0.006
94	22068	0.050	0.006
95	22302	0.043	0.005
96	22428	0.041	0.005
97	22752	0.033	0.004
98	22932	0.030	0.004
99	23184	0.014	0.002
100	23490	0.019	0.002
101	23652	0.011	0.001
102	20160	0.179	0.023
103	20430	0.180	0.023
104	20610	0.171	0.022
105	20718	0.158	0.020
106	21042	0.164	0.021
107	21240	0.157	0.020
108	21420	0.141	0.018
109	21564	0.154	0.020
110	21834	0.144	0.018
111	21978	0.138	0.018
112	22104	0.146	0.019
113	22302	0.133	0.017
114	22608	0.144	0.019
115	22824	0.134	0.017

116	22950	0.130	0.017
117	23202	0.139	0.018
118	23418	0.141	0.018
119	23490	0.135	0.017
120	23814	0.133	

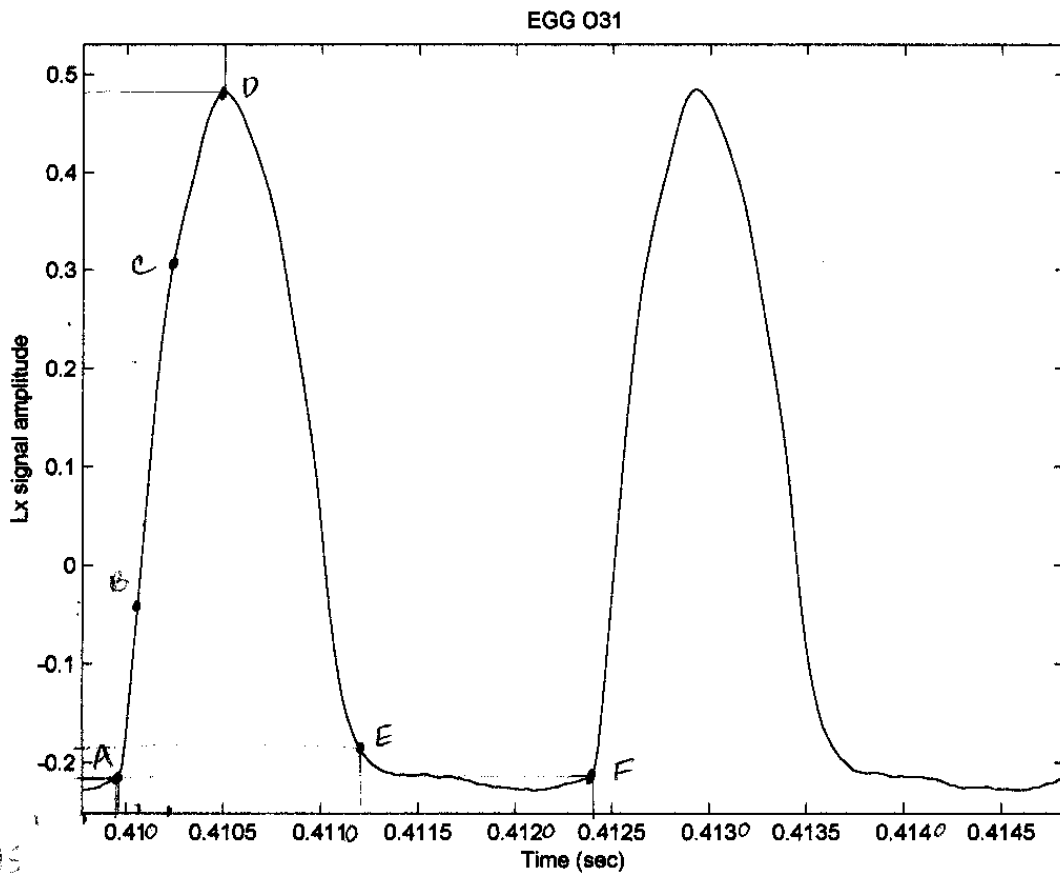
0.017



Stem plot/LPC overlay of harmonics for sample O31 without preemphasis

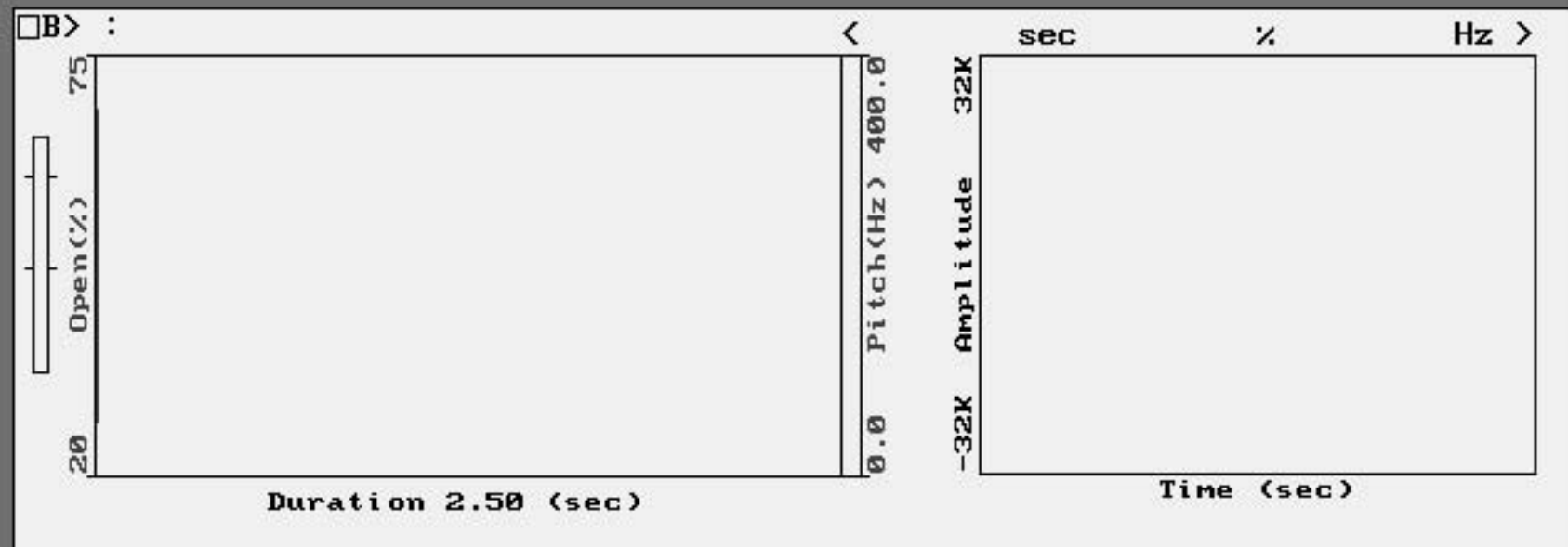
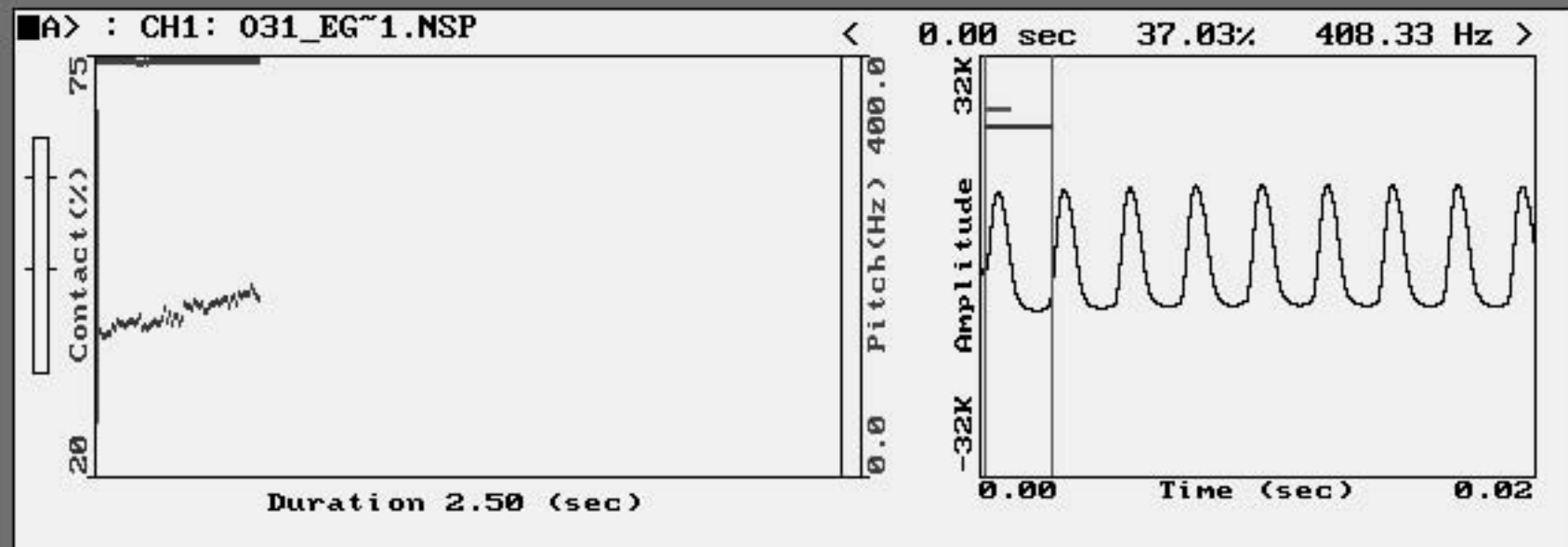


x → 16ms = .0005  
y → 16ms = .1



195

(1-11)

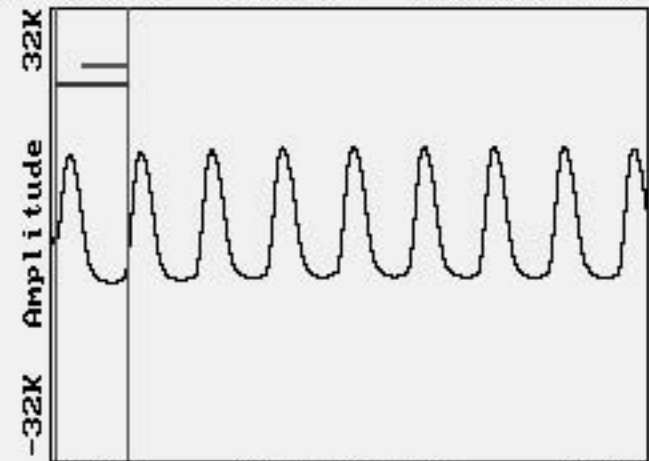


**A** > : CH1: 031\_EG~1.NSP

< 0.00 sec 62.96% 408.33 Hz >



Duration 2.50 (sec)



**B** > :

< sec % Hz >

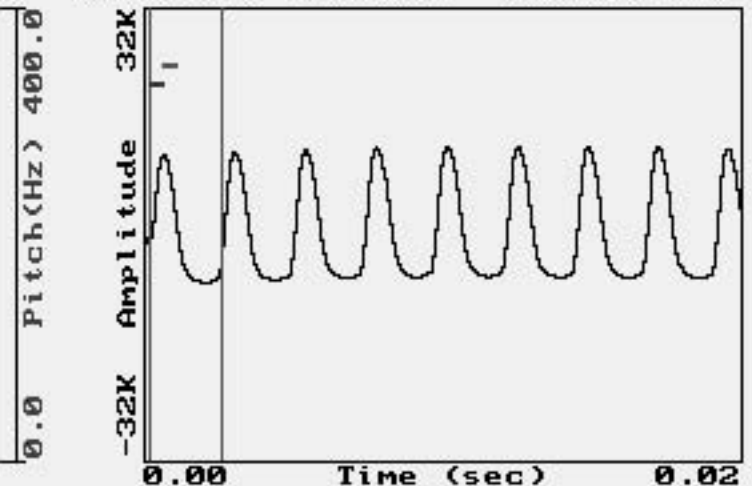
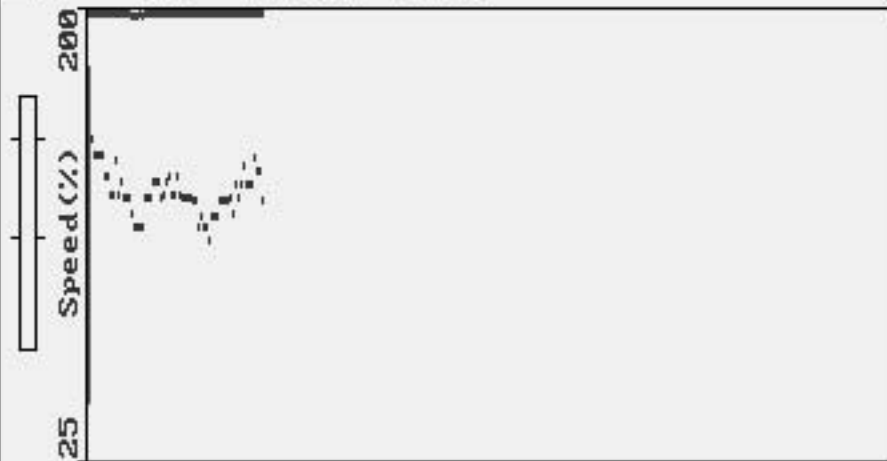


Duration 2.50 (sec)



■A> : CH1: 031\_EG~1.NSP

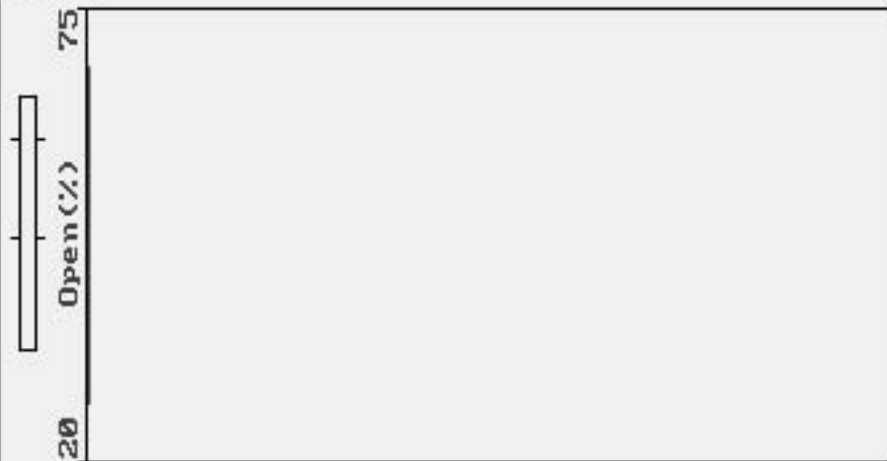
< 0.00 sec 122.22% 408.33 Hz >



Pitch(Hz) 400.0

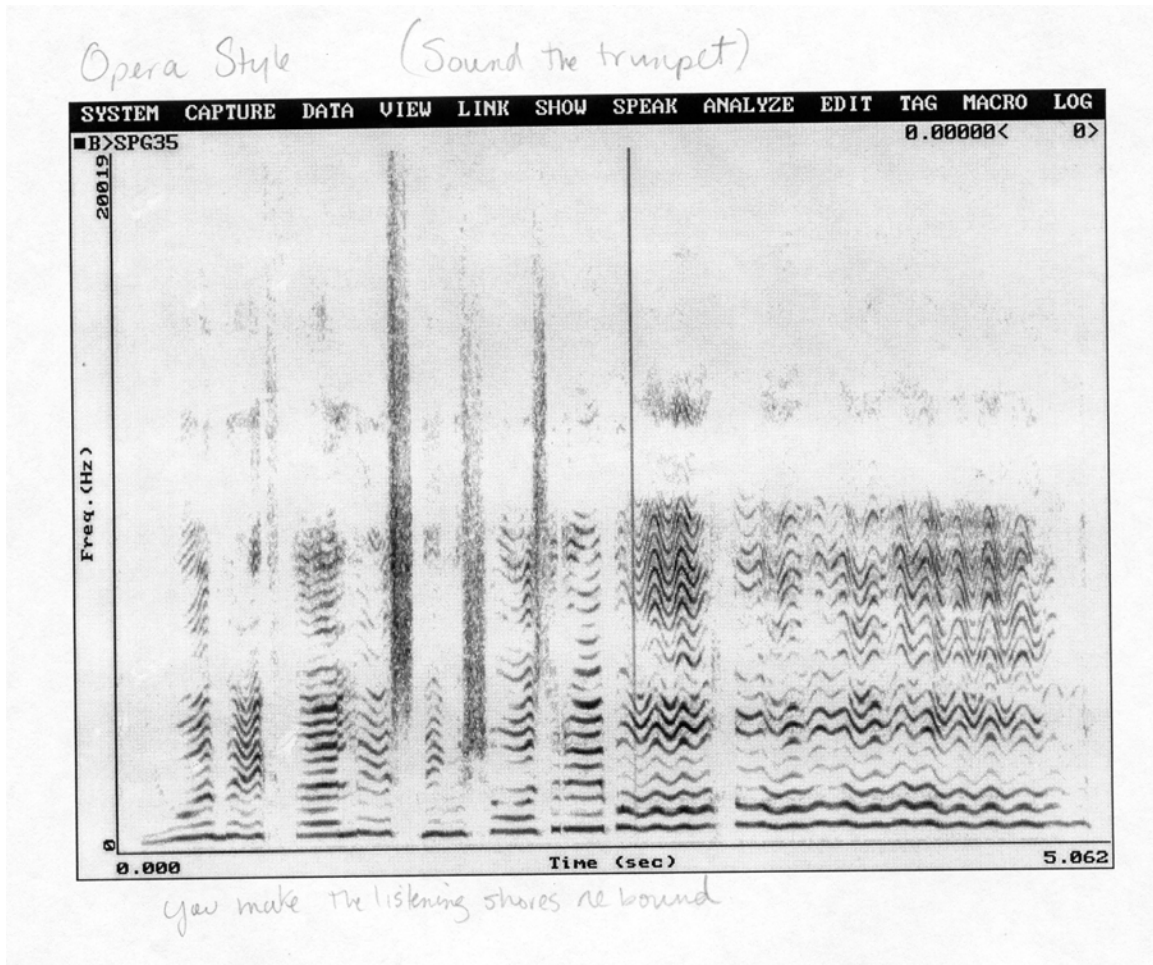
□B> :

< sec % Hz >



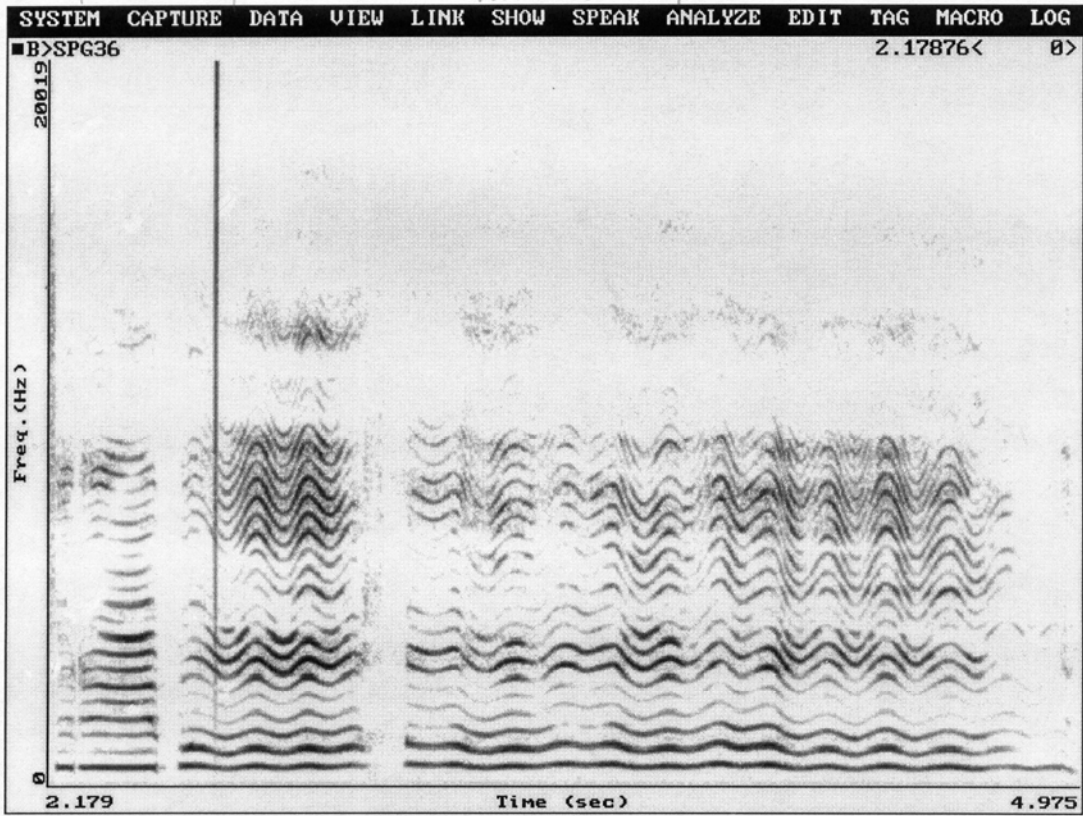
Pitch(Hz) 400.0

Spectrograms of O44 running sample



Opera Style

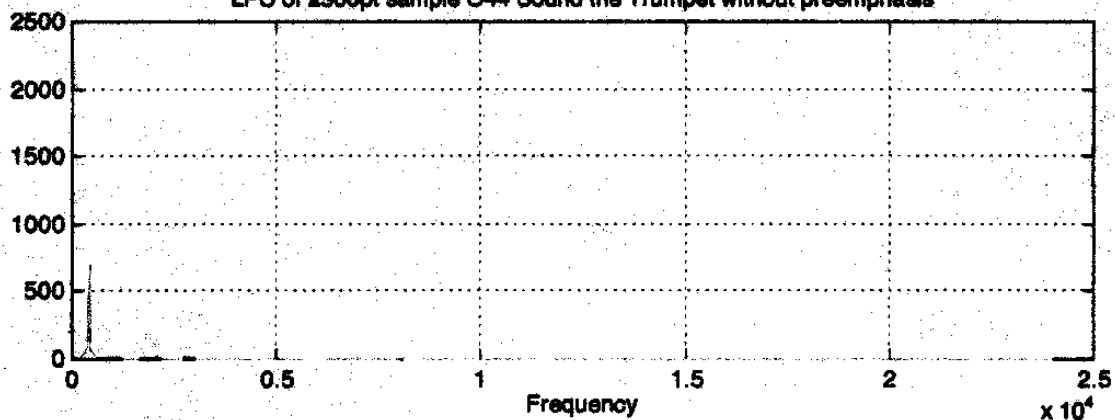
Sound The trumpet



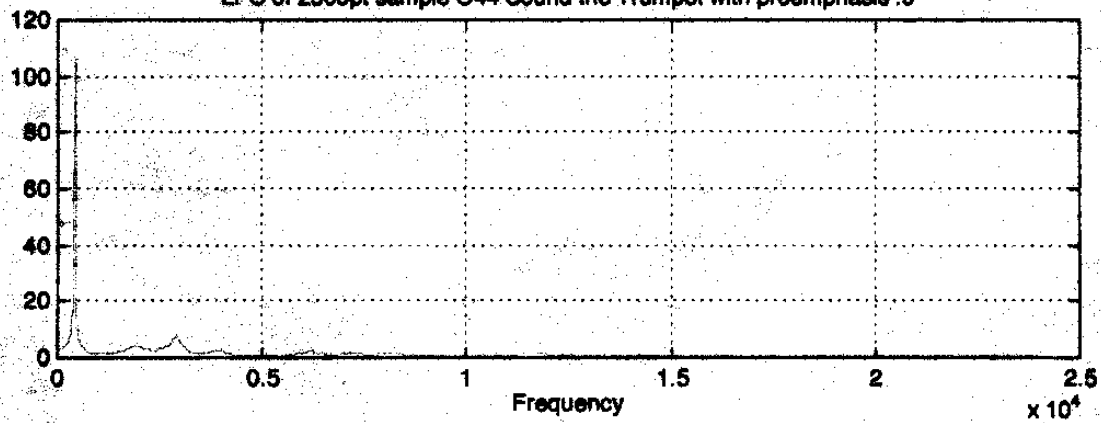
re

bound

LPC of 2500pt sample O44 Sound the Trumpet without preemphasis



LPC of 2500pt sample O44 Sound the Trumpet with preemphasis .9



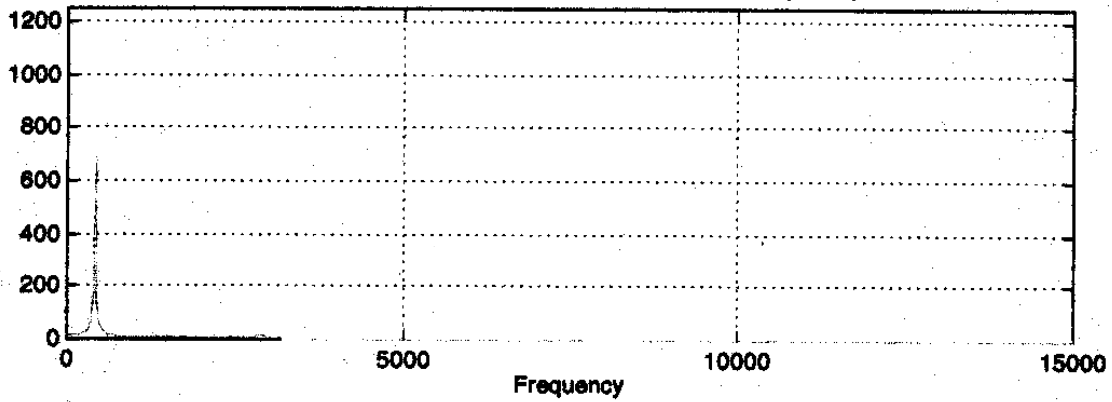
044est.wav

F1 (422, 696)

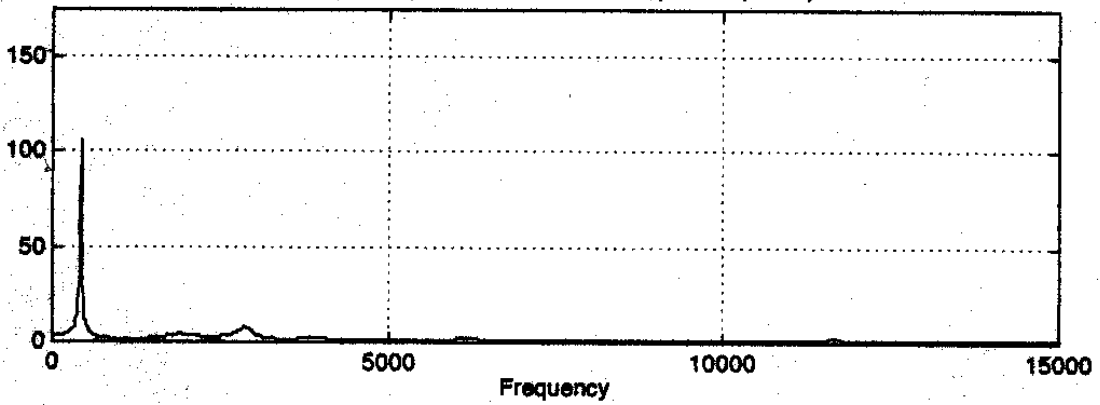
F2 (1979, 12)

F3 (2894, 16)

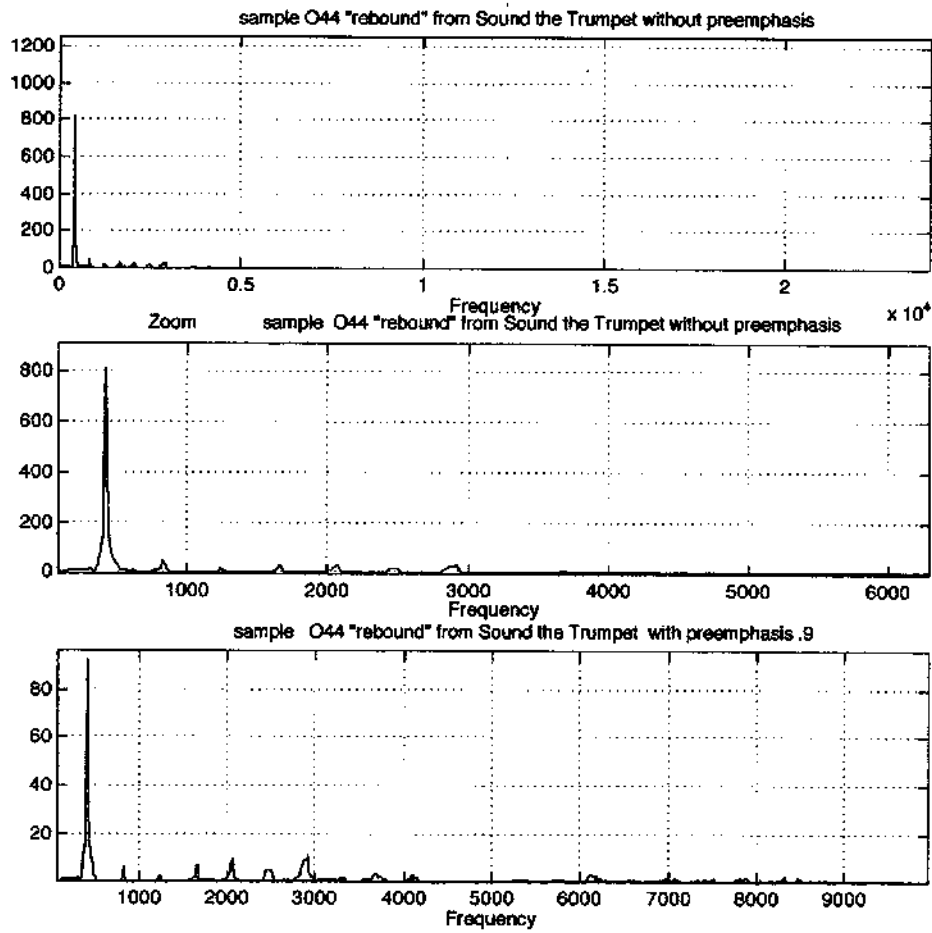
LPC of 2500pt sample O44 Sound the Trumpet without preemphasis



LPC of 2500pt sample O44 Sound the Trumpet with preemphasis .9



# DFT of Classical sample O44



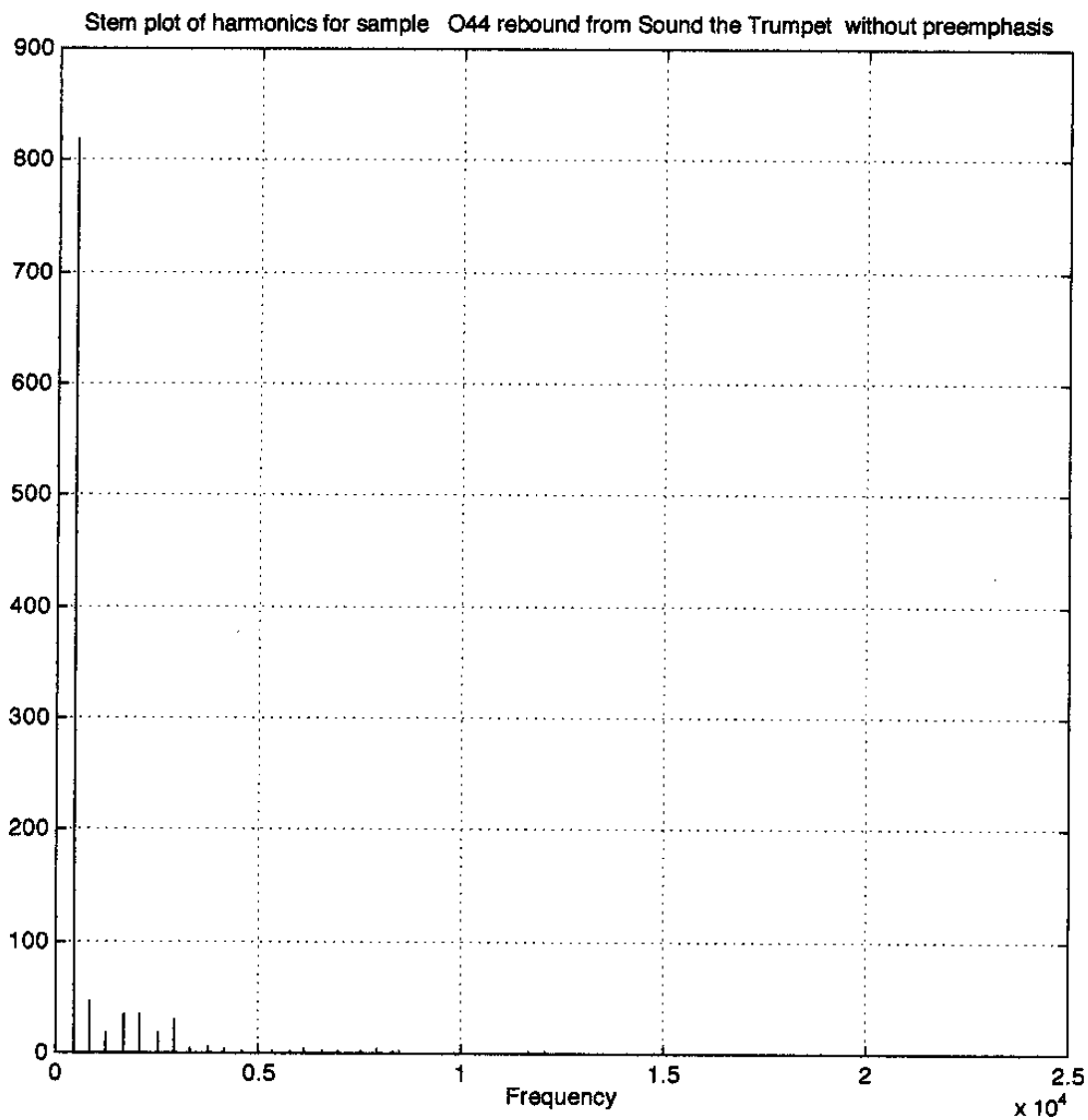
DFT Numerical Results

Worksheet saved into file: Minitab.044  
 MTB > Print 'Freq' 'Amp' '% Amp'.

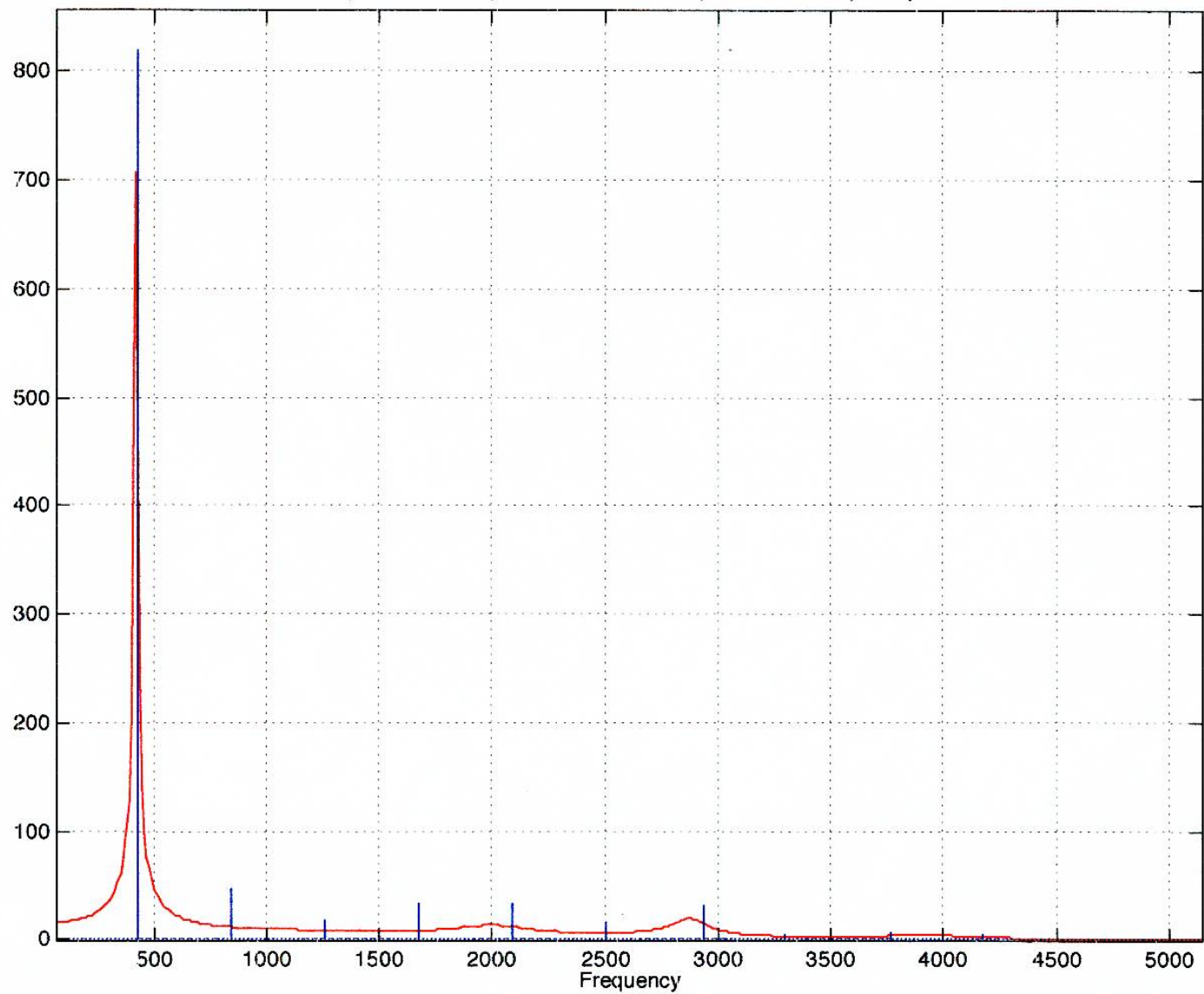
ROW	Freq	Amp	% Amp
1	432	819.288	100.000 ←
2	846	47.063	5.744 ←
3	1260	18.747	2.288
4	1674	33.681	4.111
5	2088	34.259	4.182 ←
6	2502	17.241	2.104
7	2934	30.853	3.766 ←
8	3294	4.918	0.600
9	3762	6.259	0.764
10	4176	4.581	0.559
11	4590	1.600	0.195
12	5310	1.880	0.229
13	5760	1.514	0.185
14	6138	4.144	0.506
15	6552	2.072	0.253
16	6966	2.014	0.246
17	7506	2.103	0.257
18	7902	3.113	0.380
19	8334	2.716	0.331
20	8496	1.613	0.197
21	9180	0.585	0.071
22	9396	0.382	0.047
23	9990	0.781	0.095
24	10440	0.751	0.092
25	10854	0.825	0.101
26	11232	0.736	0.090
27	11664	1.690	0.206
28	12060	1.427	0.174
29	12402	0.281	0.034
30	13086	0.206	0.025
31	13266	0.397	0.048
32	13806	0.336	0.041
33	14166	0.351	0.043
34	14688	0.246	0.030
35	14976	0.410	0.050
36	15390	0.276	0.034
37	16002	0.097	0.012
38	16416	0.115	0.014
39	16722	0.074	0.009
40	17226	0.080	0.010
41	17820	0.092	0.011
42	18180	0.125	0.015
43	18630	0.140	0.017
44	19152	0.071	0.009
45	19566	0.088	0.011
46	19962	0.057	0.007
47	20412	0.064	0.008
48	20700	0.053	0.006
49	21204	0.048	0.006
50	21726	0.044	0.005
51	22068	0.053	0.006
52	22482	0.044	0.005
53	22842	0.040	0.005
54	23184	0.045	0.005
55	17802	0.027	0.003

56	18234	0.040	0.005
57	18342	0.048	0.006
58	18918	0.022	0.003
59	19170	0.037	0.005
60	19440	0.026	0.003
61	19872	0.027	0.003
62	20214	0.027	0.003
63	20322	0.035	0.004
64	20682	0.035	0.004
65	20988	0.034	0.004
66	21384	0.032	0.004
67	21636	0.025	0.003
68	22122	0.025	0.003
69	22356	0.023	0.003
70	22590	0.022	0.003
71	23130	0.019	0.002
72	23274	0.018	0.002
73	23598	0.017	0.002
74	17316	0.097	0.012
75	17478	0.057	0.007
76	17766	0.054	0.007
77	18108	0.044	0.005
78	18216	0.066	0.008
79	18450	0.062	0.008
80	18702	0.058	0.007
81	18918	0.047	0.006
82	19224	0.066	0.008
83	19368	0.059	0.007
84	19674	0.056	0.007
85	19962	0.058	0.007
86	20070	0.058	0.007
87	20412	0.061	0.007
88	20538	0.044	0.005
89	20844	0.045	0.006
90	21078	0.048	0.006
91	21330	0.060	0.007
92	21582	0.042	0.005
93	21690	0.048	0.006
94	22068	0.050	0.006
95	22302	0.043	0.005
96	22428	0.041	0.005
97	22752	0.033	0.004
98	22932	0.030	0.004
99	23184	0.014	0.002
100	23490	0.019	0.002
101	23652	0.011	0.001
102	20160	0.179	0.022
103	20430	0.180	0.022
104	20610	0.171	0.021
105	20718	0.158	0.019
106	21042	0.164	0.020
107	21240	0.157	0.019
108	21420	0.141	0.017
109	21564	0.154	0.019
110	21834	0.144	0.018
111	21978	0.138	0.017
112	22104	0.146	0.018
113	22302	0.133	0.016
114	22608	0.144	0.018
115	22824	0.134	0.016

116	22950	0.130	0.016
117	23202	0.139	0.017
118	23418	0.141	0.017
119	23490	0.135	0.016
120	23814	0.133	0.016



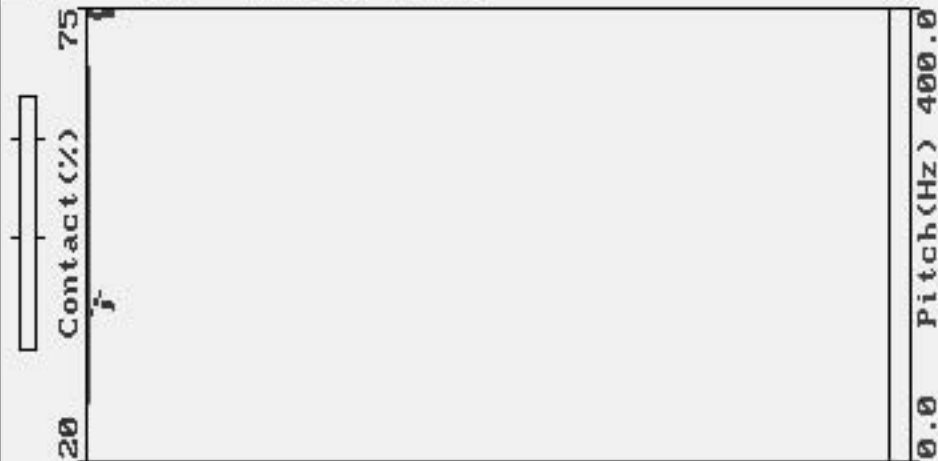
Stem plot/LPC overlay of harmonics for sample O44 without preemphasis



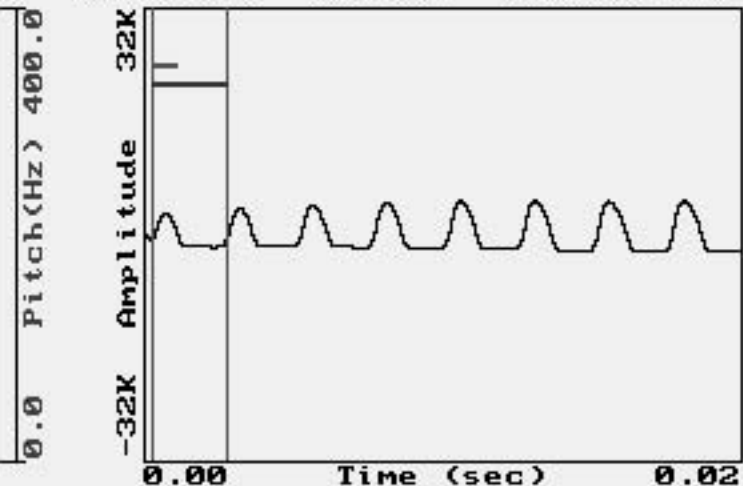


■A> : CH1: 044B\_E~1.NSP

< 0.00 sec 31.19% 404.59 Hz >

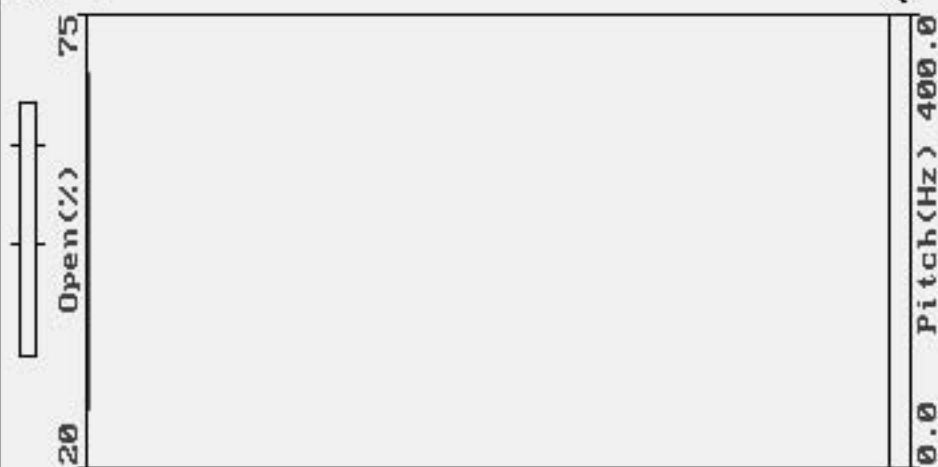


Duration 2.50 (sec)

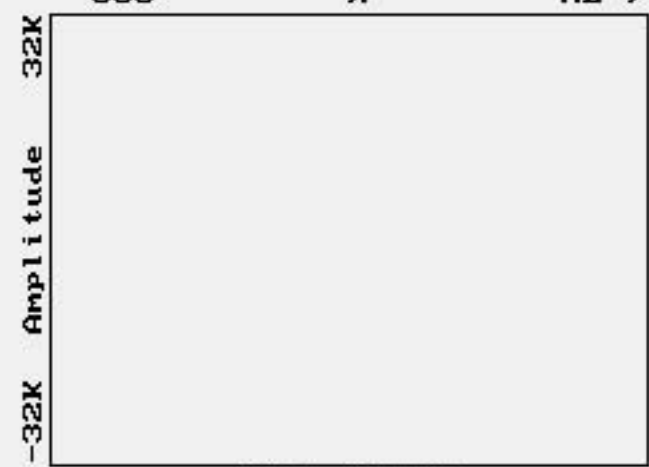


< sec % Hz >

□B> :



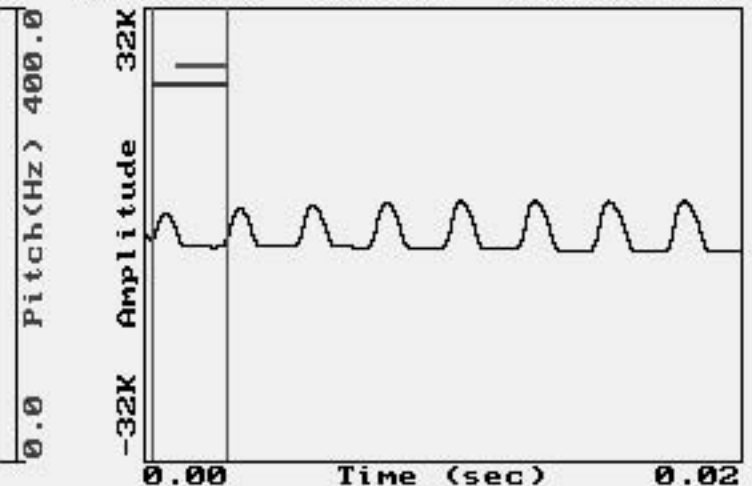
Duration 2.50 (sec)



Time (sec)

■A> : CH1: 044B\_E~1.NSP

< 0.00 sec 68.80% 404.59 Hz >



Pitch(Hz) 400.0

□B> :

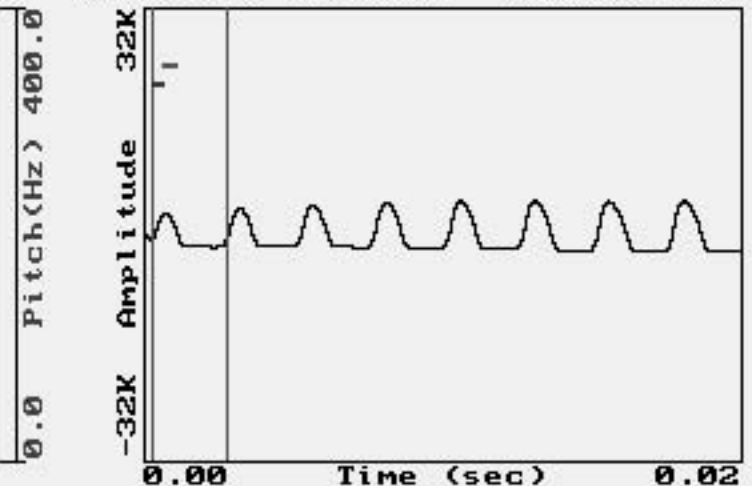
< sec % Hz >



Pitch(Hz) 400.0

**A> : CH1: 044B\_E~1.NSP**

< 0.00 sec 112.50% 404.59 Hz >



Duration 2.50 (sec)

Pitch(Hz) 400.0

**B> :**

< sec % Hz >

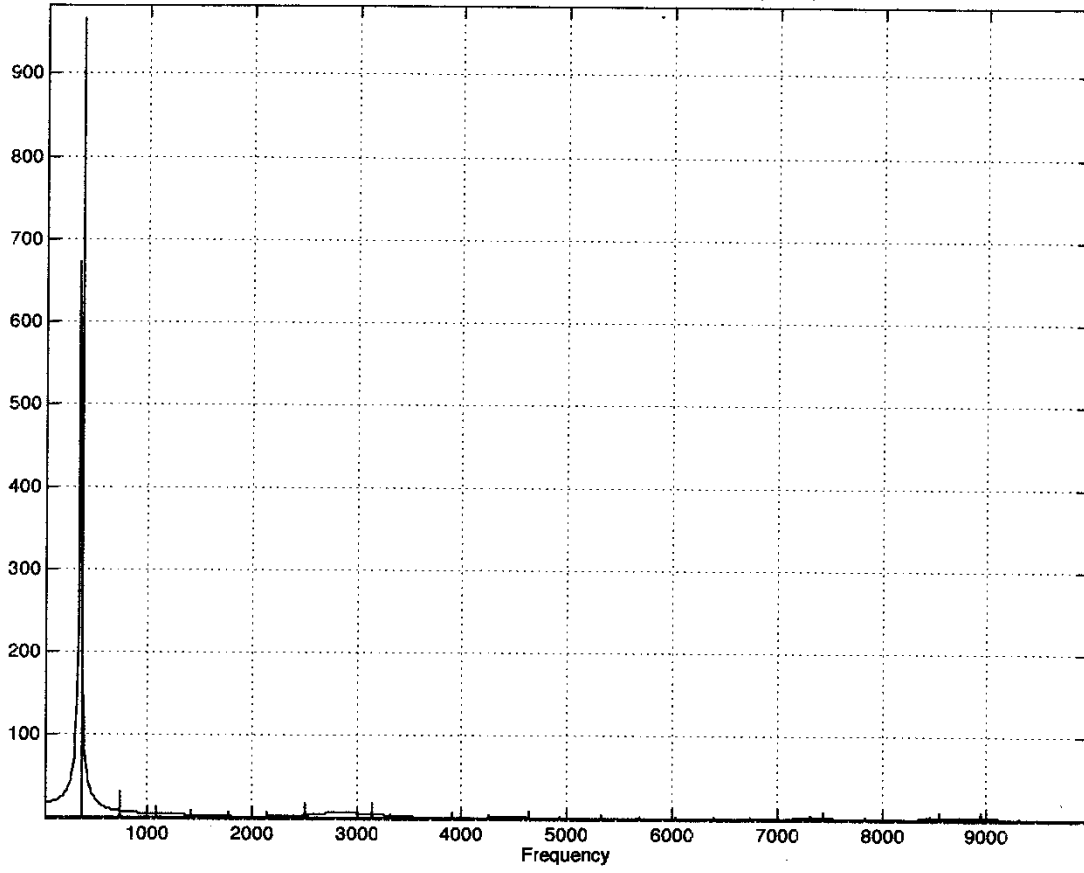


Duration 2.50 (sec)

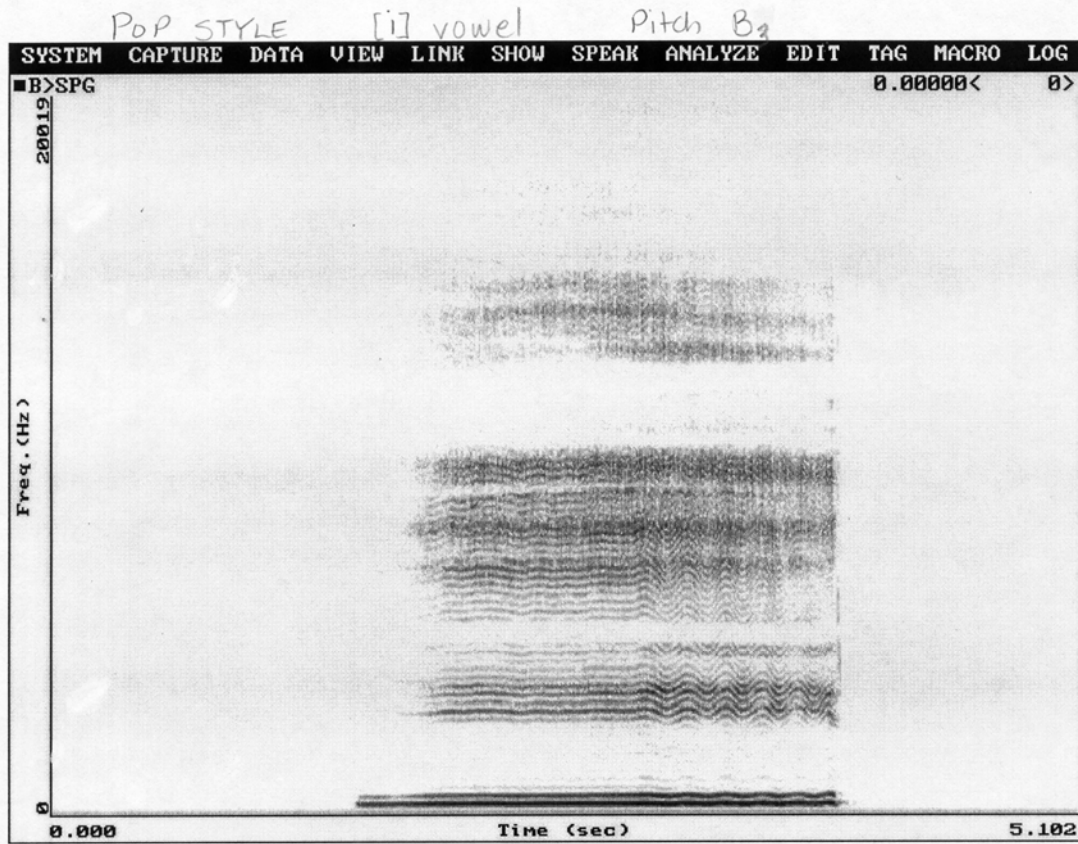
Pitch(Hz) 400.0

Sample #	O11	O21	O31	O44b
Description	Opera B4	OperaE4	Opera B5	Opera "rebound"
Data Rate (Hz)	44100 Hz	44100Hz	44100	44100
DURATION (sec)	0.48	0.40 sec	0.55 sec	0.08 sec
Start time	0	0.00 sec	0.00 sec	0.00 sec
End time	0.48	0.40 sec	0.55 sec	0.08 sec
Silence	0	0.00 sec	0.00 sec	0.00 sec
Active	0.48	0.40 sec	0.56 sec	0.08 sec
Data Points	20992	17664	24321	3584
Range	17397 (15 Bits)	15836 (14 Bits)	19013 (15 Bits)	5272 (13 Bits)
PITCH (Hz)				
Mean	203.95	283.55 Hz	419.10 Hz	408.45 Hz
Pitch Range	100.3	112.05 Hz	371.00 Hz	215.21 Hz
Minimum	109.7	180.00 Hz	70.00 Hz	397.29 Hz
Maximum	210	292.05 Hz	441.00 Hz	612.50 Hz
Std Deviation	10.22	10.30 Hz	26.31 Hz	36.78 Hz
Avg. Jitter %	0.48%	0.51%	1.05%	0.71%
CONTACT(1:6)%				
Mean	36.28%	36.14%	40.76%	38.65%
Range	24.85%	19.86%	37.64%	25.75%
Minimum	15.42%	20.00%	7.45%	31.19%
Maximum	40.27%	39.86%	45.09%	56.94%
Std Deviation	3.48%	2.27%	2.85%	3.68%
CONTACT(Tif)	39.46%	37.66%	37.03%	31.19%
SPEED(3:2)%				
Mean	230.43%	238.49%	128.17%	170.58%
Range	43.49%	144.45%	126.09%	74.16%
Minimum	208.68%	188.88%	73.91%	112.50%
Maximum	252.17%	333.33%	200.00%	186.66%
Std Deviation	9.94%	20.03%	10.87%	21.37%
SPEED(Tif)	238.46%	262.59%	122.22%	112.50%
OPEN(4:6)%				
Mean	63.70%	63.84%	59.22%	61.33%
Range	24.85%	19.87%	37.63%	25.76%
Minimum	59.72%	60.13%	54.90%	43.04%
Maximum	84.57%	80.00%	92.53%	68.80%
Std Deviation	3.48%	2.27%	2.85%	3.68%
OPEN(Tif)	60.53%	62.33%	62.96%	68.80%

Stem plot/LPC overlay of harmonics for sample P39 without preemphasis



Spectrogram of P01

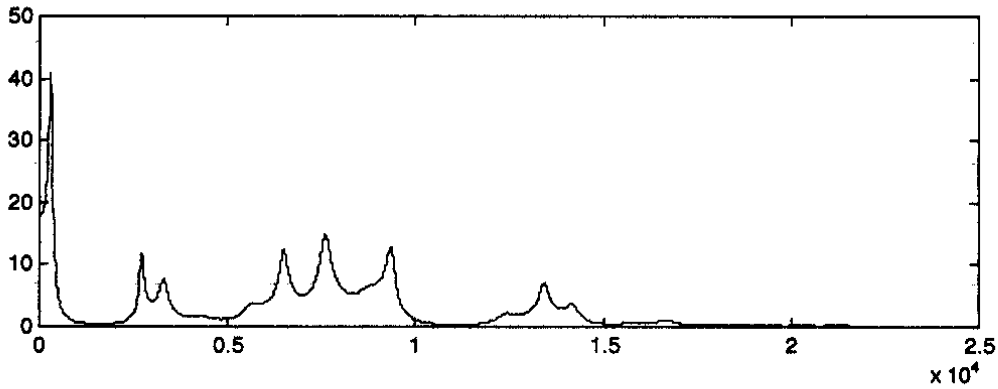
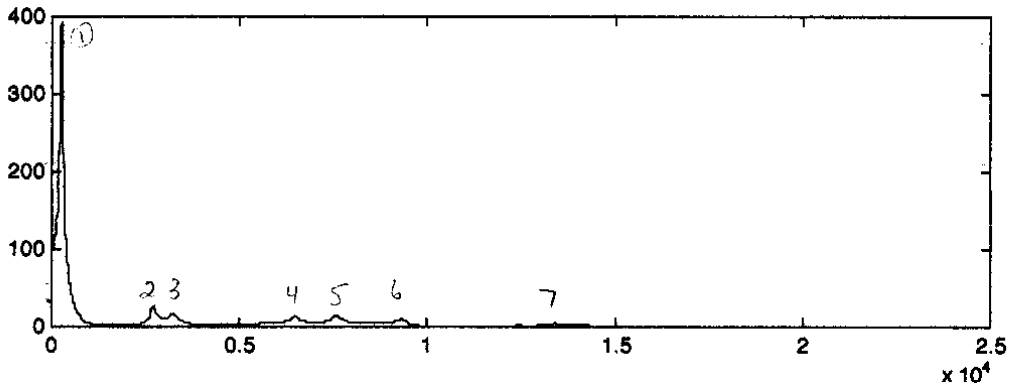


LPC of P01 whole sample

P01

$F_0 = 225 \text{ Hz}$

- 1) 257.81, 391.23
- 2) 2695.31, 28.13
- 3) 3269.5, 15.95
- 4) 6492.10, 13.18
- 5) 7593.75, 14.47
- 6) 9328.15, 10.14
- 7) 13422.00, 4.3

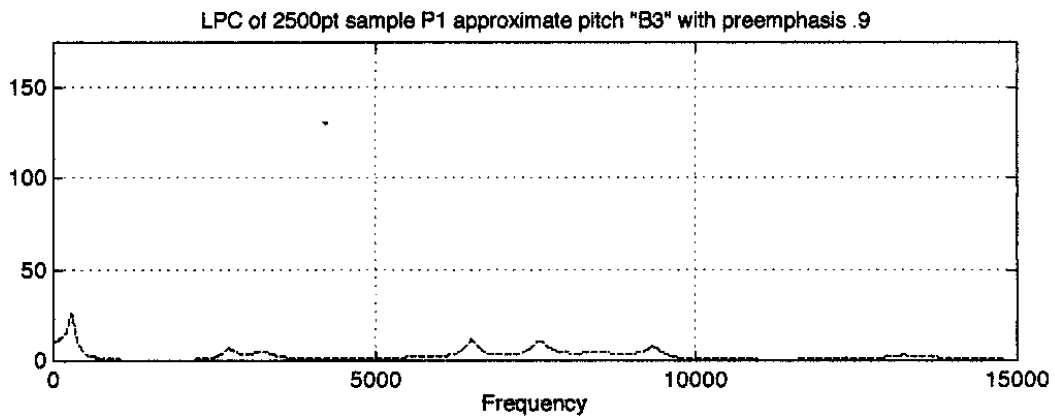
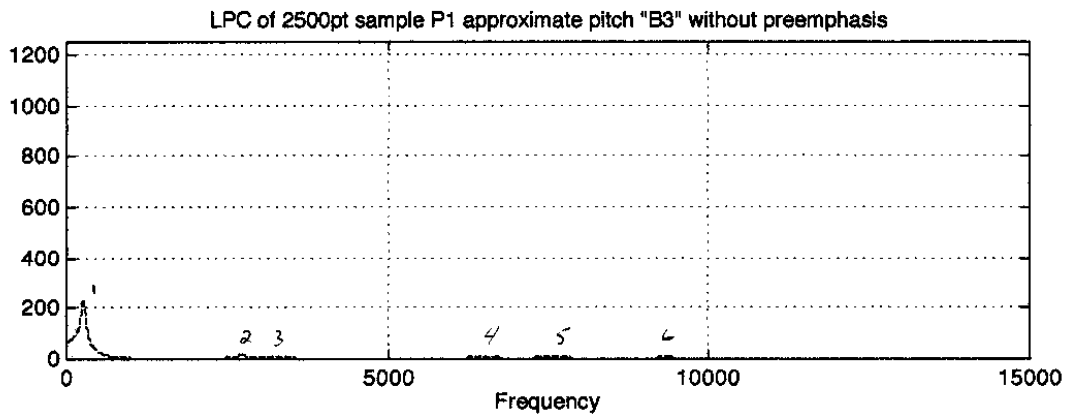


$$.1578125 - .015541667 = .10239583$$

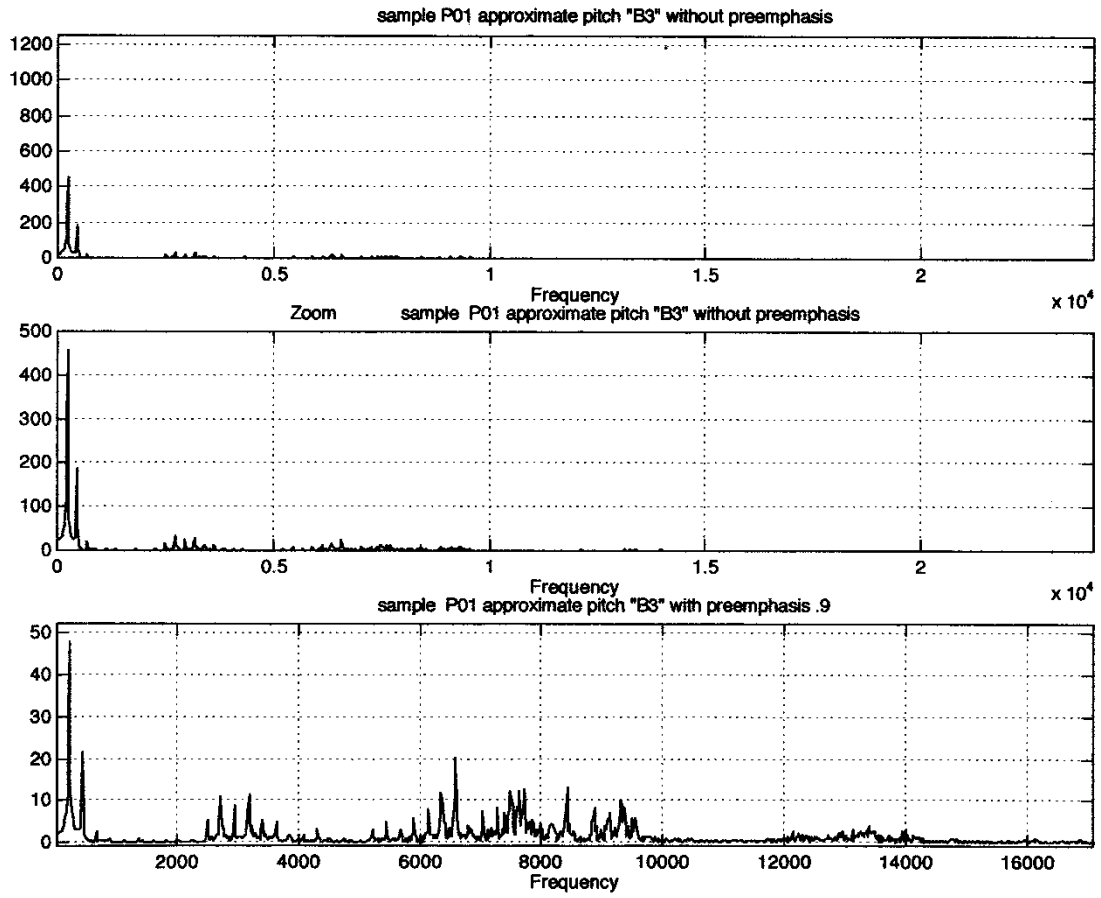
$$.004445964$$

$$= 224.9231225$$

- 1 (257.81, 236.49)
- 2 (2730.46, 14.09)
- 3 (3246.05, 9.84)
- 4 (6492.23, 11.44)
- 5 (7570.35, 9.87)
- 6 (9338.30, 5.81)



# DFT of P01

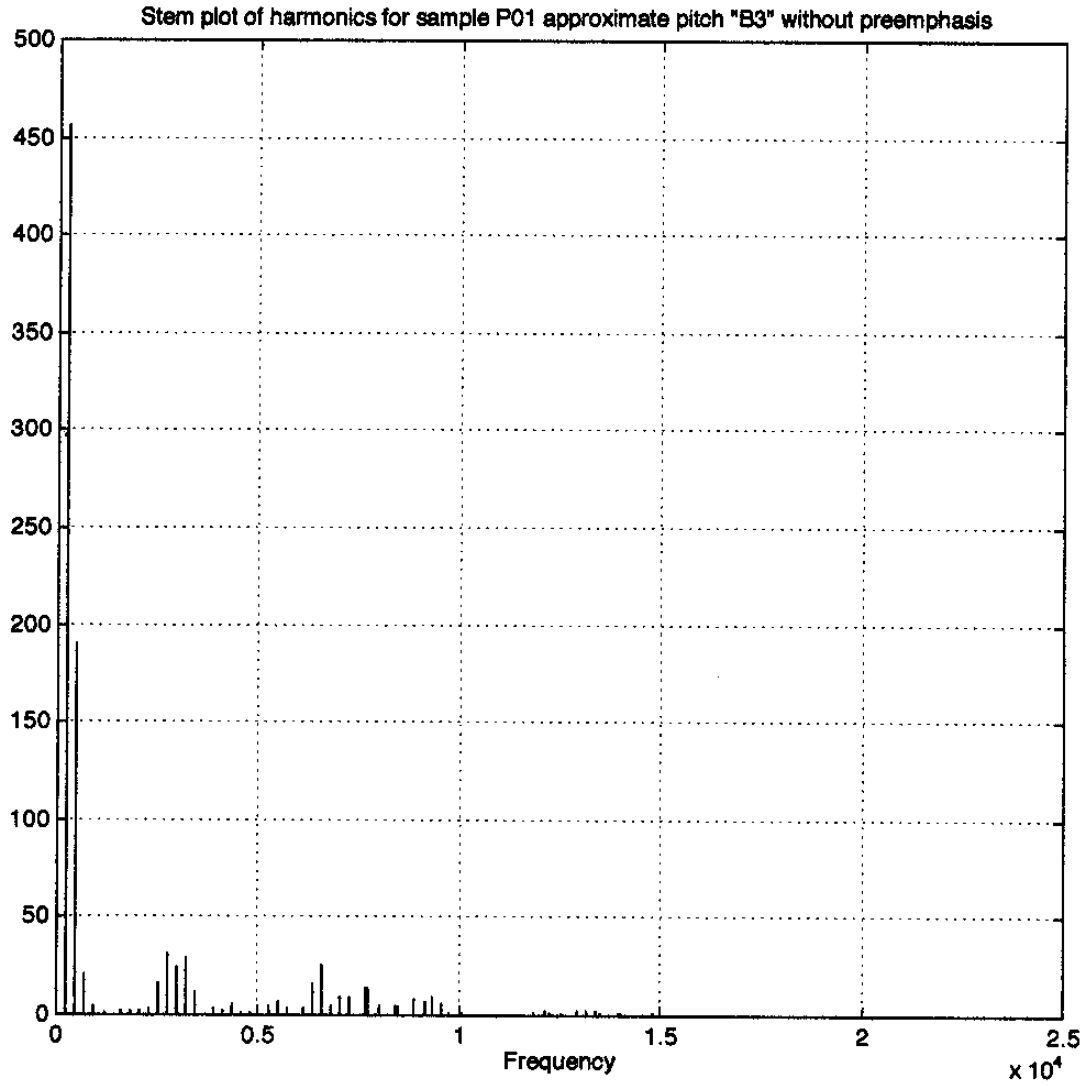


DFT Numerical Results of P01

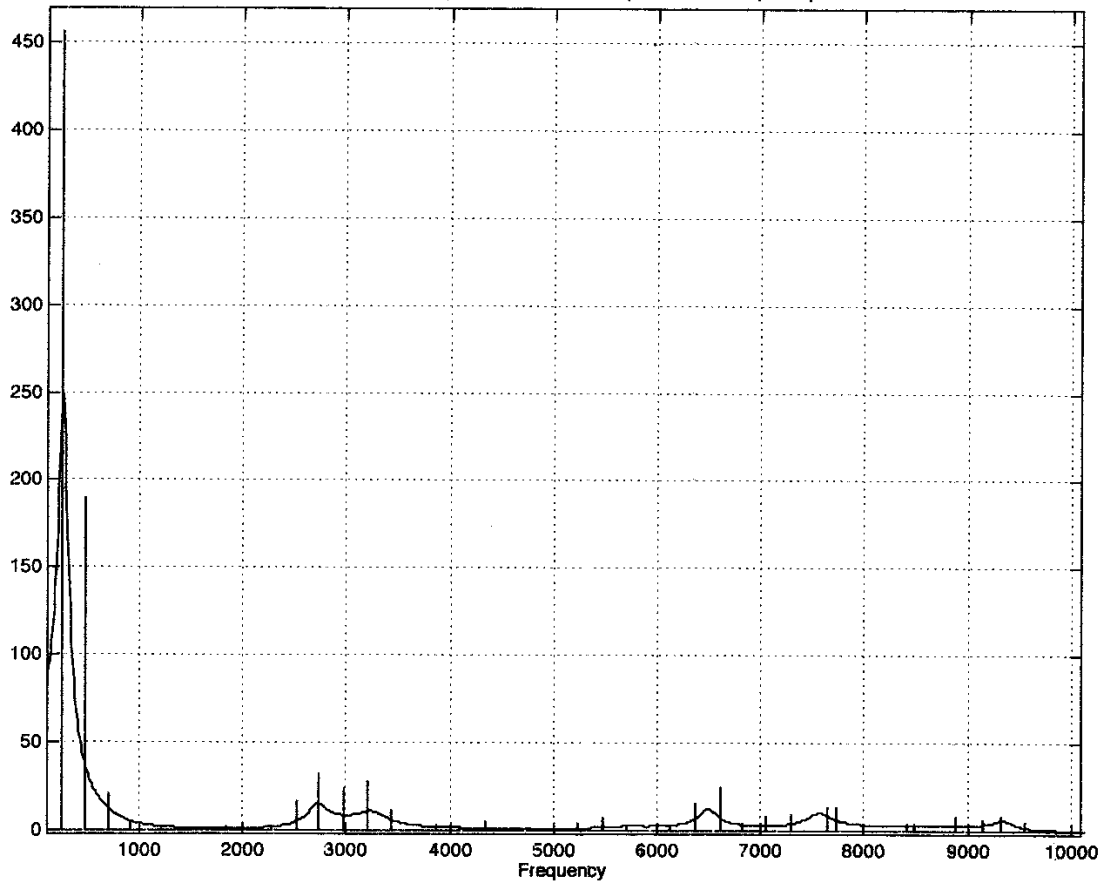
ROW	Freq	Amp	% Amp	
1	252	456.252	100.000	← F1 tracking F0
2	468	189.567	41.549	lower % P2 Transpk
3	702	20.961	4.594	
4	918	4.827	1.058	
5	1206	1.068	0.234	
6	1602	1.846	0.405	
7	1836	2.202	0.483	
8	2052	1.860	0.408	
9	2286	2.995	0.656	
10	2520	16.724	3.665	
11	2736	32.198	7.057	← F2
12	2970	24.495	5.369	} closer together than speech
13	3204	28.791	6.310	
14	3438	11.404	2.499	
15	3870	3.821	0.837	
16	4104	2.757	0.604	
17	4338	5.539	1.214	← a little higher than speech
18	4554	1.499	0.328	
19	4788	1.635	0.358	
20	5058	0.540	0.118	
21	5238	4.704	1.031	
22	5472	7.374	1.616	← similar to speech
23	5706	3.965	0.869	
24	6120	3.627	0.795	
25	6372	15.929	3.491	
26	6606	25.647	5.621	← not in speech
27	6822	4.562	1.000	
28	7056	8.855	1.941	
29	7290	9.322	2.043	
30	7650	13.578	2.976	← not in speech
31	7740	13.510	2.961	
32	7992	4.733	1.037	
33	8406	4.298	0.942	
34	8478	4.176	0.915	
35	8892	8.381	1.837	← similar to speech
36	9144	6.768	1.483	
37	9324	9.051	1.984	
38	9558	5.431	1.190	
39	9738	1.498	0.328	
40	10062	0.633	0.139	
41	10422	0.491	0.108	
42	10494	0.490	0.107	
43	10764	0.330	0.072	
44	10998	0.278	0.061	
45	11322	0.267	0.059	
46	11610	0.322	0.071	
47	11844	0.786	0.172	
48	12150	2.164	0.474	
49	12258	1.572	0.345	
50	12528	1.154	0.253	
51	12906	1.923	0.421	
52	13140	2.150	0.471	
53	13410	2.795	0.613	←
54	13518	1.349	0.296	
55	13950	1.181	0.259	
56	14040	1.154	0.253	
57	14310	0.505	0.111	
58	14544	0.292	0.064	

59	14796	0.811	0.178
60	15174	0.325	0.071
61	15408	0.260	0.057
62	15552	0.295	0.065
63	15948	0.330	0.072
64	16092	0.357	0.078
65	16308	0.209	0.046
66	16614	0.504	0.110
67	16884	0.499	0.109
68	17082	0.169	0.037
69	17460	0.120	0.026
70	17676	0.242	0.053
71	17856	0.164	0.036
72	18072	0.133	0.029
73	18306	0.111	0.024
74	18684	0.080	0.017
75	18936	0.062	0.014
76	19116	0.088	0.019
77	19332	0.061	0.013
78	19584	0.073	0.016
79	19836	0.056	0.012
80	20232	0.062	0.014
81	20484	0.066	0.014
82	20646	0.067	0.015
83	20898	0.066	0.014
84	21204	0.063	0.014
85	21456	0.051	0.011
86	21690	0.057	0.012
87	21870	0.045	0.010
88	22086	0.037	0.008
89	22374	0.042	0.009
90	22662	0.039	0.009
91	22932	0.025	0.006
92	23112	0.030	0.006
93	23382	0.024	0.005
94	23598	0.028	0.006
95	18846	0.255	0.056
96	19026	0.263	0.058
97	19278	0.203	0.045
98	19440	0.162	0.035
99	19566	0.166	0.036
100	19782	0.181	0.040
101	20034	0.161	0.035
102	20160	0.179	0.039
103	20430	0.180	0.039
104	20610	0.171	0.037
105	20718	0.158	0.035
106	21042	0.164	0.036
107	21240	0.157	0.034
108	21420	0.141	0.031
109	21564	0.154	0.034
110	21834	0.144	0.032
111	21978	0.138	0.030
112	22104	0.146	0.032
113	22302	0.133	0.029
114	22608	0.144	0.032
115	22824	0.134	0.029
116	22950	0.130	0.028
117	23202	0.139	0.030
118	23418	0.141	0.031

119	23490	0.135	0.029
120	23814	0.133	0.029



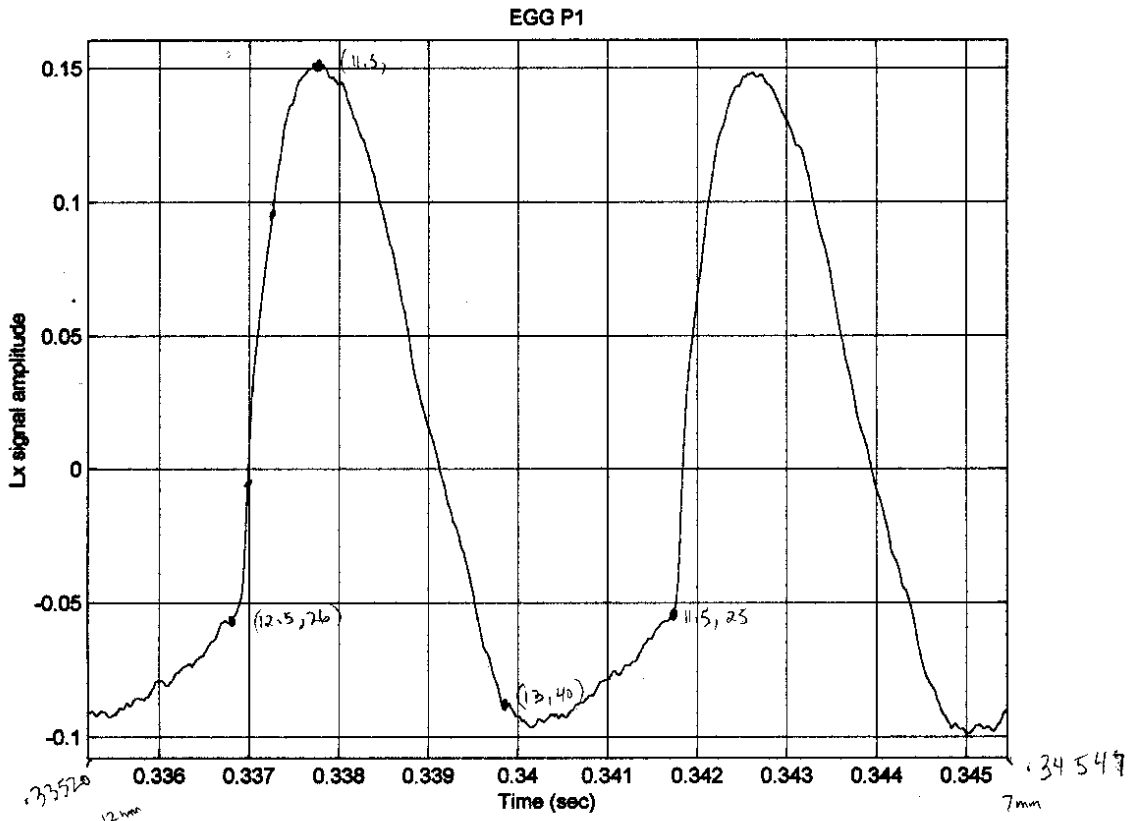
Stem plot/LPC overlay of harmonics for sample P01 without preemphasis



$$x \Rightarrow 15 \text{ mm} = .001$$

$$y \Rightarrow 23 \text{ mm} = .05$$

$$y_{\text{mm}} = .002173913$$



$$A (.33683, -.05652)$$

$$B (.336967, -.00489)$$

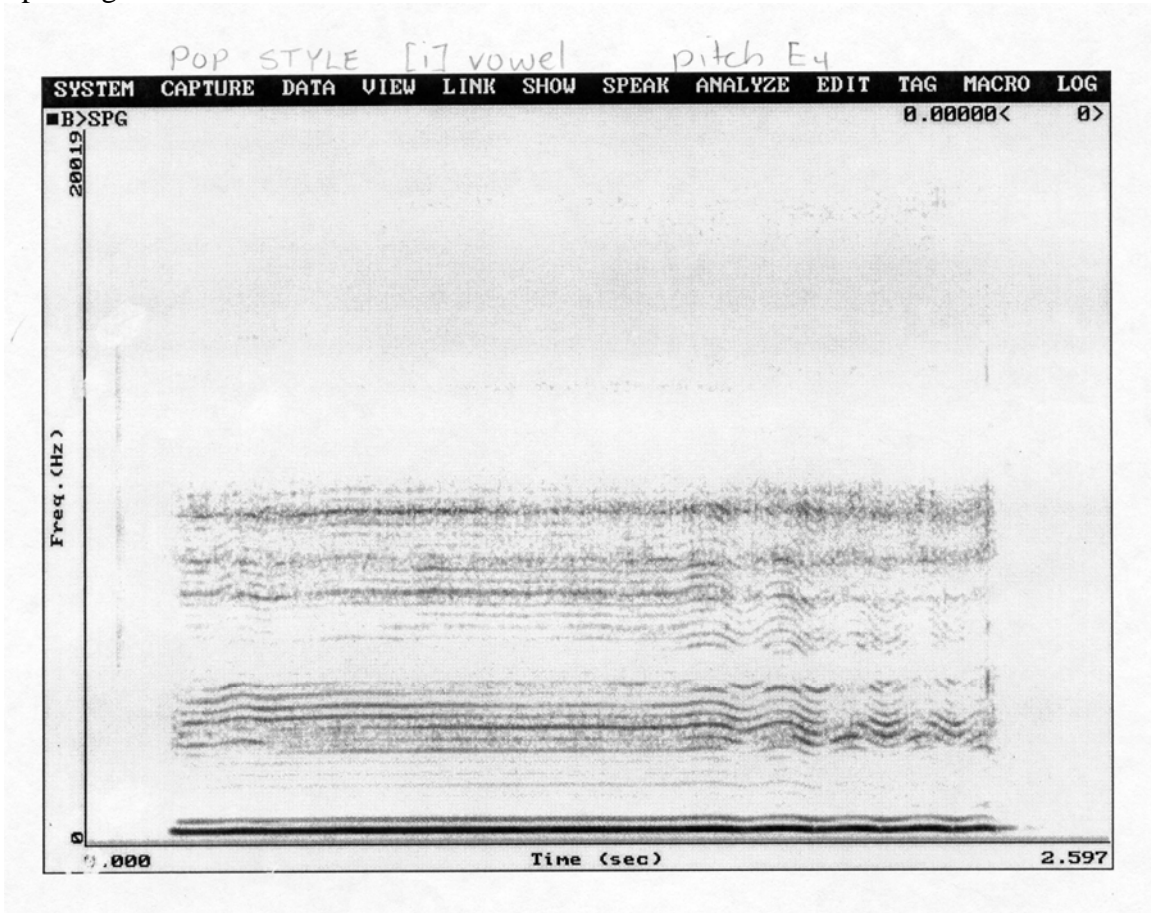
$$C (.337267, -.09837)$$

$$D (.33777, .15000)$$

$$E (.33987, -.08696)$$

$$F (.34177, -.05435)$$

Spectrogram of P12

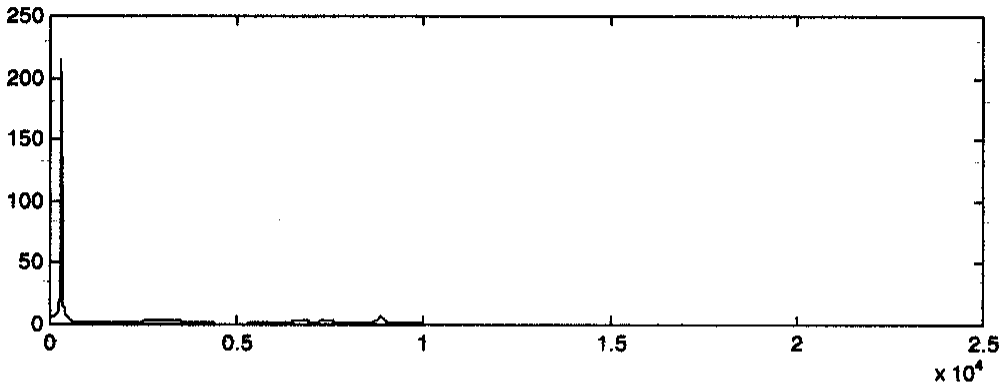
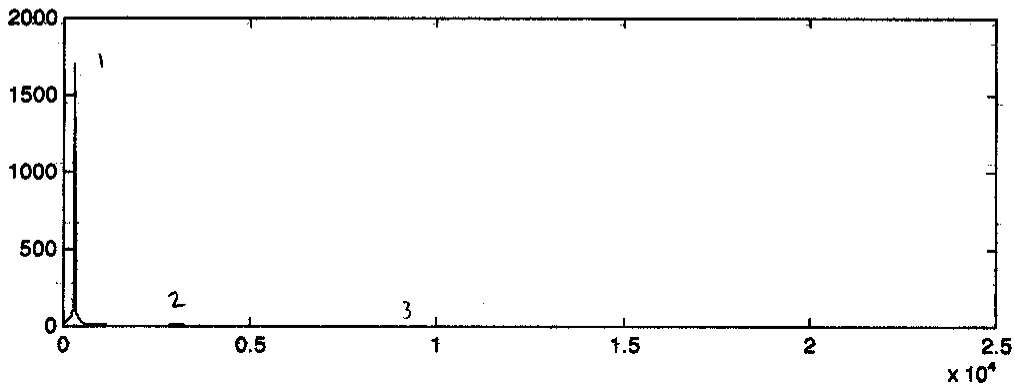


LPC of whole sample P12

P12

$$F_0 = 306 \text{ Hz}$$

- 1) 304.69, 1700.16
- 2) 3071.36, 8.30
- 3) 8859.35, 4.85



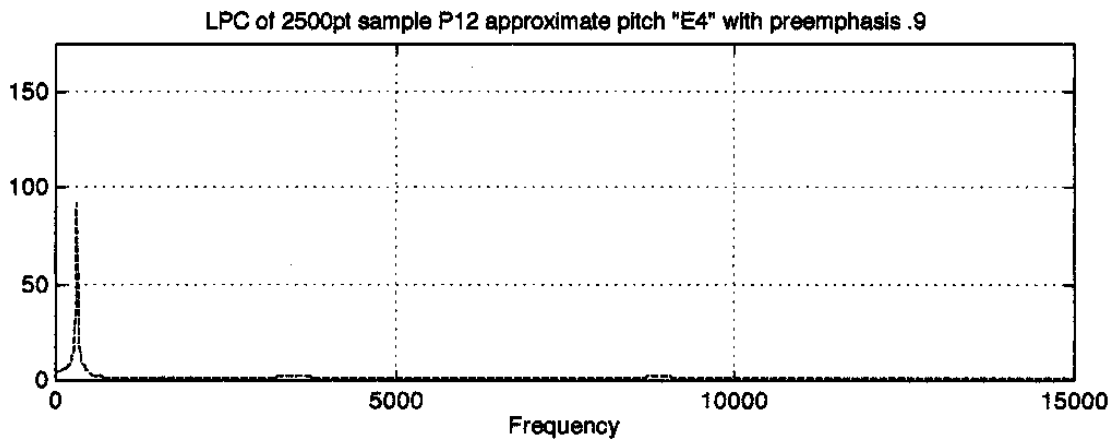
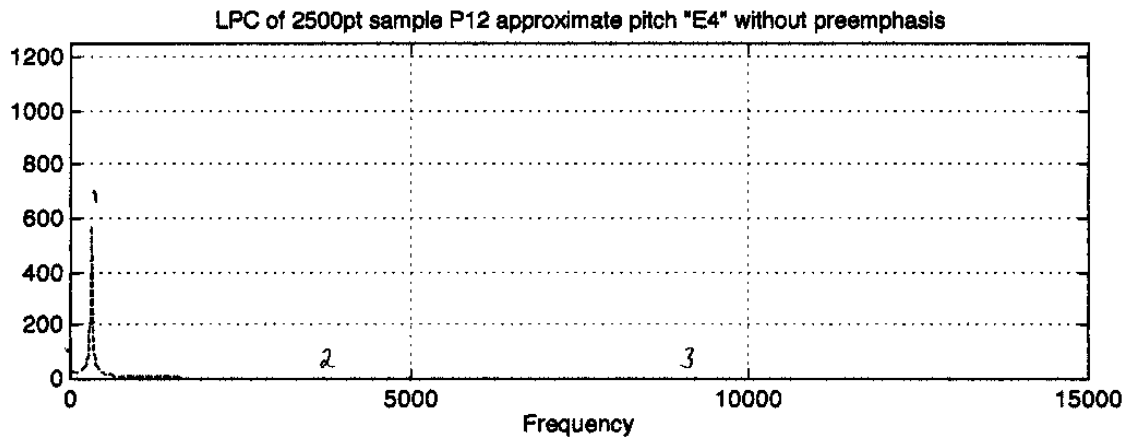
$$.15495833 - .00783333 = .147124997$$

45.

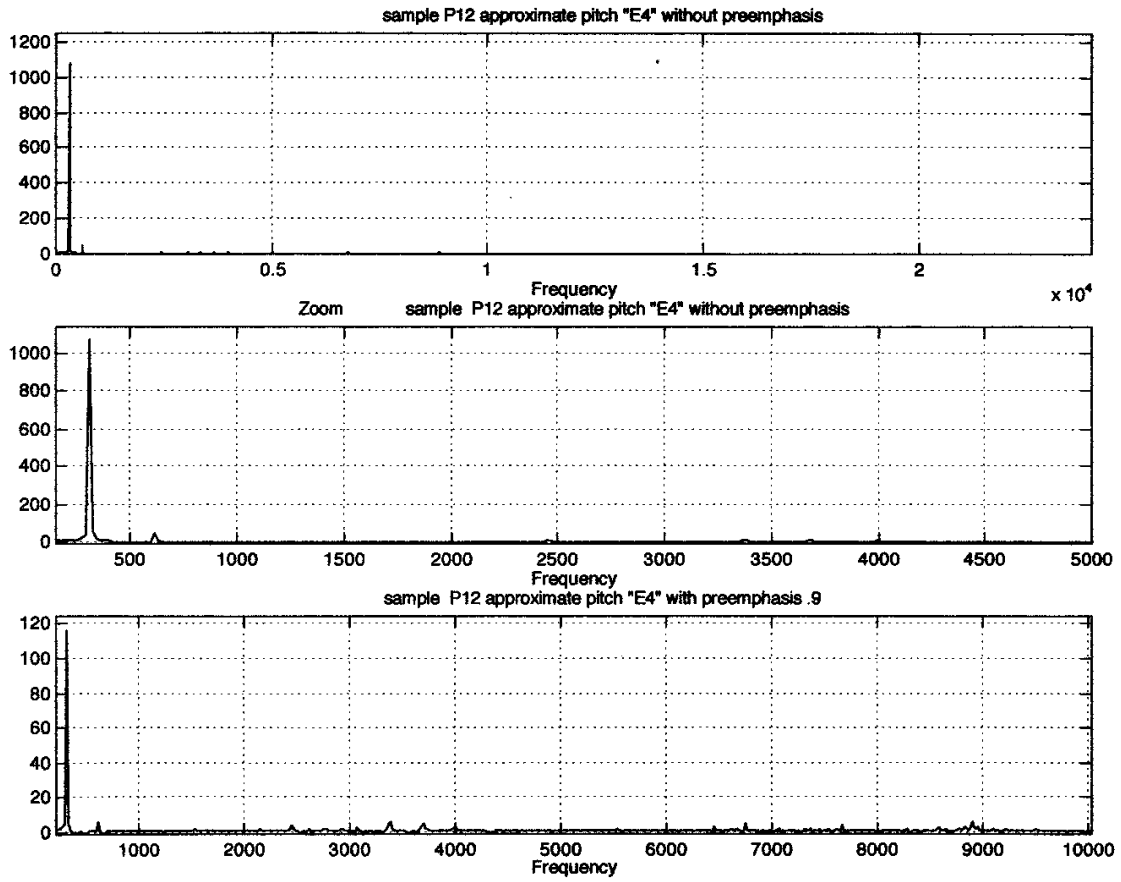
$$= .003269444$$

$$305.8623682$$

(364.69, 571.5)  
(3363.30, 3.90)  
(8847.62, 1.94)



# DFT of P12



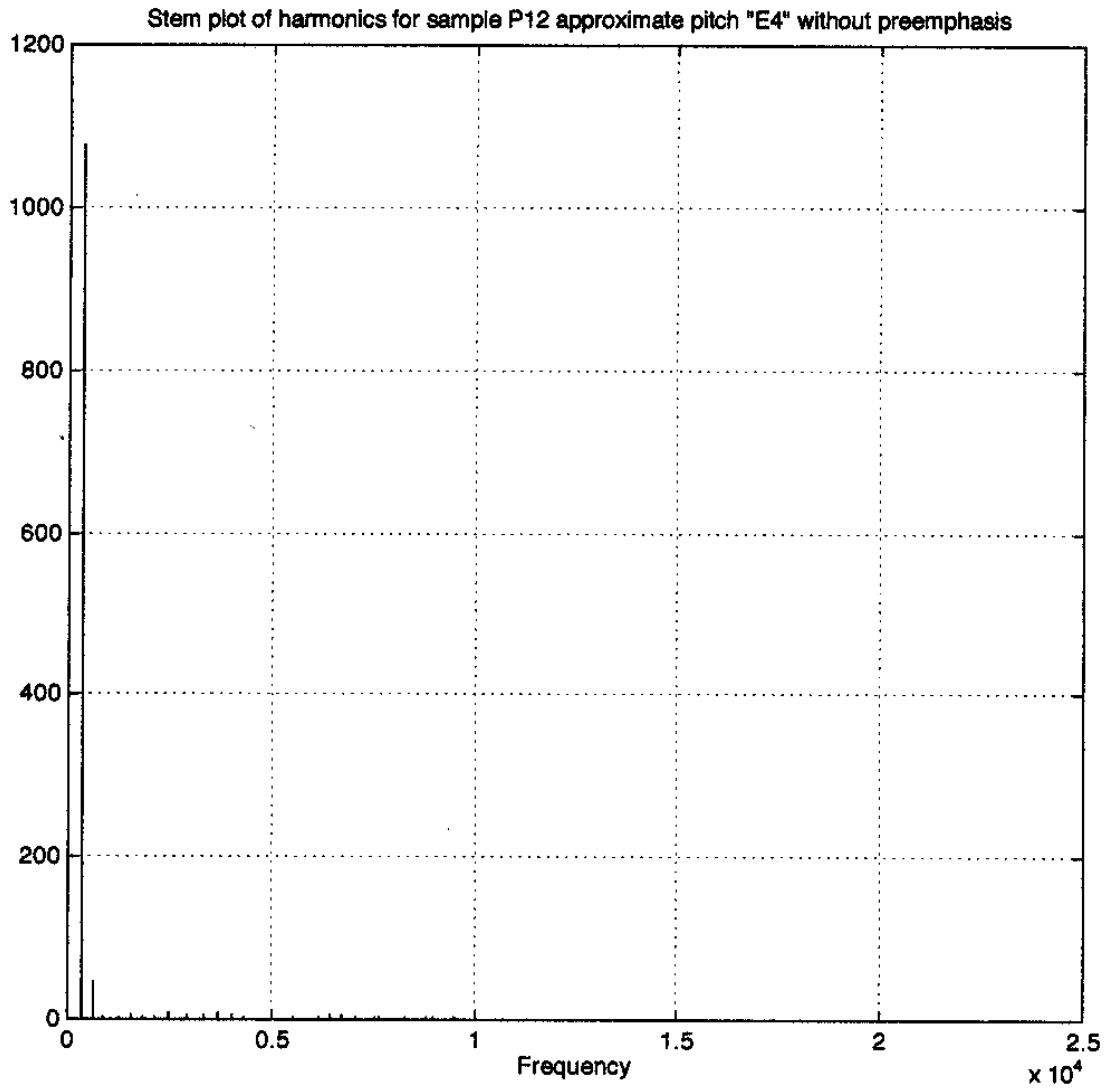
DFT Numerical Results of P12

ROW	Freq	Amp	% Amp
1	324	1077.02	100.000 ← F1
2	630	45.84	4.257
3	846	1.44	0.134
4	1242	2.65	0.246
5	1548	4.64	0.431
6	1854	4.13	0.384
7	2160	3.54	0.329
8	2466	9.44	0.877 -
9	2934	4.98	0.462
10	3366	6.03	0.560
11	3690	9.80	0.910 -
12	4014	6.73	0.625
13	4320	1.97	0.183
14	4626	1.12	0.104
15	4932	1.12	0.104
16	5238	0.92	0.085
17	5544	3.44	0.320
18	5850	1.08	0.100
19	6156	1.67	0.155
20	6462	4.57	0.424
21	6768	5.49	0.510
22	7074	1.82	0.169
23	7542	1.78	0.165
24	7686	3.59	0.333
25	7992	0.79	0.073
26	8298	1.98	0.184
27	8838	2.56	0.237
28	8964	2.57	0.239
29	9522	1.49	0.139
30	9756	0.35	0.033
31	9990	0.33	0.031
32	10458	0.32	0.030
33	10566	0.25	0.023
34	11070	0.31	0.029
35	11268	0.13	0.012
36	11772	0.13	0.012
37	11952	0.16	0.014
38	12258	0.29	0.027 ←
39	12708	0.09	0.008
40	13032	0.27	0.025
41	13302	0.18	0.016
42	13482	0.20	0.019
43	13932	0.21	0.020
44	14148	0.21	0.019
45	14508	0.11	0.011
46	14814	0.10	0.009
47	15318	0.11	0.010
48	15570	0.10	0.009
49	15894	0.10	0.009
50	16272	0.15	0.014
51	16470	0.18	0.017
52	16902	0.16	0.014
53	17208	0.14	0.013
54	17406	0.20	0.019
55	17892	0.13	0.012
56	18090	0.13	0.012
57	18522	0.12	0.011
58	18738	0.14	0.013

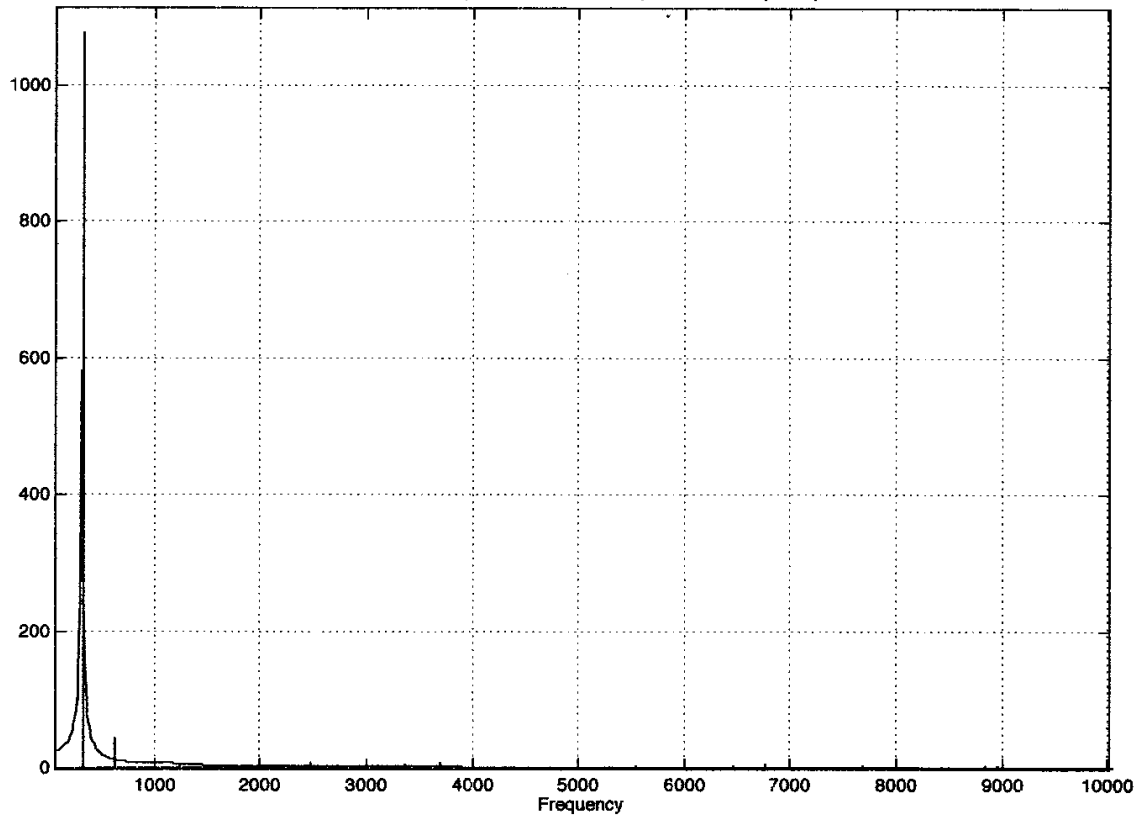
*extreme forward tracking*

59	19224	0.13	0.012
60	19512	0.12	0.011
61	19818	0.07	0.007
62	19998	0.08	0.008
63	20502	0.07	0.007
64	20826	0.07	0.006
65	20970	0.07	0.007
66	21258	0.06	0.006
67	21654	0.06	0.006
68	22140	0.07	0.006
69	22410	0.07	0.006
70	22644	0.06	0.005
71	23058	0.06	0.005
72	23292	0.05	0.005
73	23580	0.05	0.005
74	14652	0.48	0.044
75	14814	0.40	0.038
76	14994	0.24	0.023
77	15300	0.23	0.022
78	15462	0.33	0.030
79	15714	0.27	0.025
80	15858	0.30	0.028
81	16110	0.39	0.036
82	16290	0.52	0.048
83	16470	0.33	0.031
84	16596	0.26	0.024
85	16776	0.23	0.021
86	17100	0.25	0.023
87	17244	0.24	0.023
88	17478	0.30	0.028
89	17550	0.22	0.021
90	17820	0.18	0.017
91	18054	0.28	0.026
92	18180	0.43	0.040
93	18396	0.33	0.031
94	18666	0.23	0.022
95	18846	0.25	0.024
96	19026	0.26	0.024
97	19278	0.20	0.019
98	19440	0.16	0.015
99	19566	0.17	0.015
100	19782	0.18	0.017
101	20034	0.16	0.015
102	20160	0.18	0.017
103	20430	0.18	0.017
104	20610	0.17	0.016
105	20718	0.16	0.015
106	21042	0.16	0.015
107	21240	0.16	0.015
108	21420	0.14	0.013
109	21564	0.15	0.014
110	21834	0.14	0.013
111	21978	0.14	0.013
112	22104	0.15	0.014
113	22302	0.13	0.012
114	22608	0.14	0.013
115	22824	0.13	0.012
116	22950	0.13	0.012
117	23202	0.14	0.013
118	23418	0.14	0.013

119	23490	0.13	0.012
120	23814	0.13	0.012



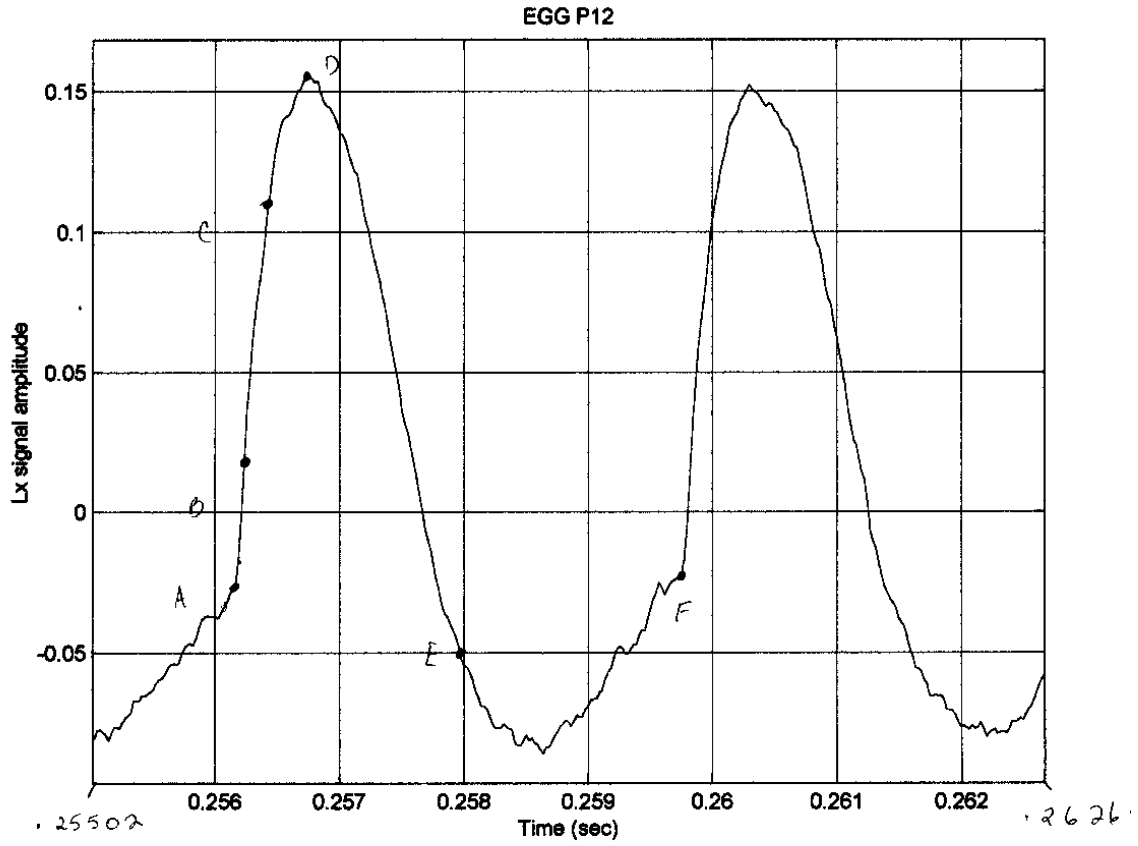
Stem plot/LPC overlay of harmonics for sample P12 without preemphasis



$$x \Rightarrow 20.5 \text{ mm} = .001$$

$$y \Rightarrow 23.5 \text{ mm} = .05$$

$$z \Rightarrow 1 \text{ mm} = .00212766$$



A (.25617, -.02660)

B (.25624, .01888)

C (.25644, .10984)

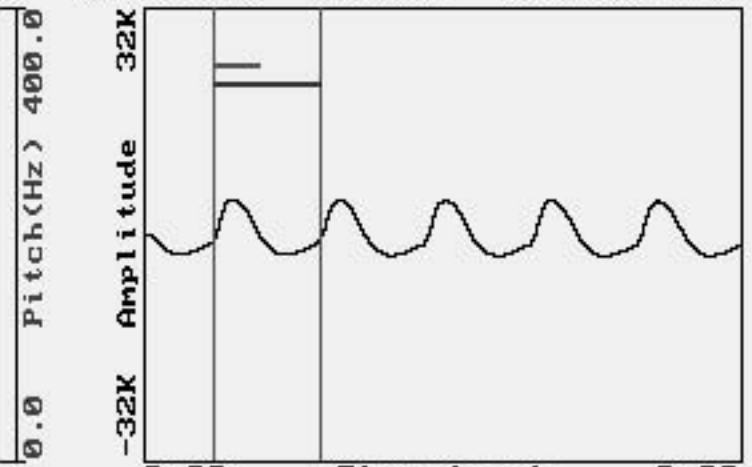
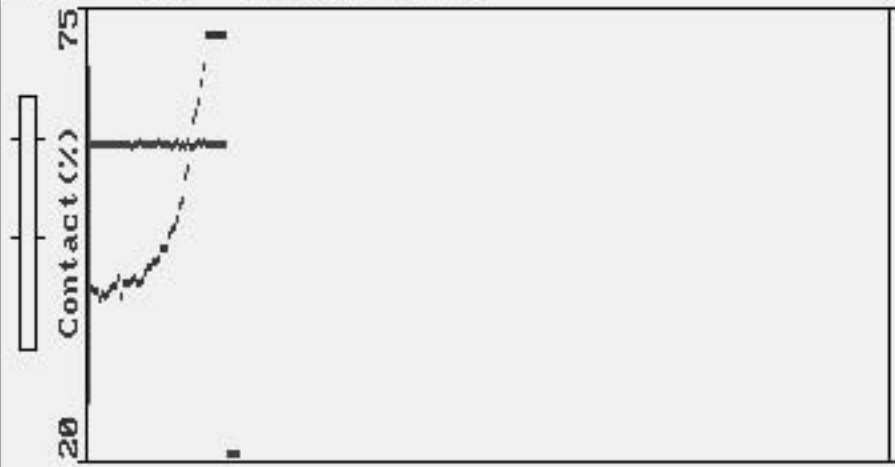
D (.25673, .15532)

E (.25798, -.05)

F (.25951, -.02340)

**A** > : CH1: P12\_EG~1.NSP

< 0.00 sec 41.40% 280.89 Hz >

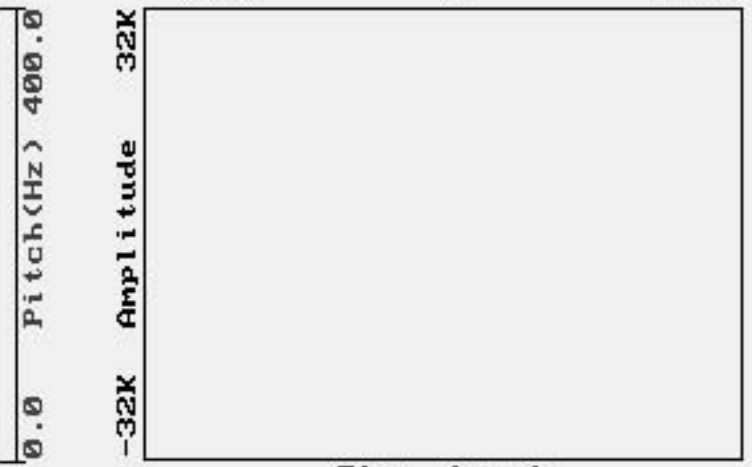


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >

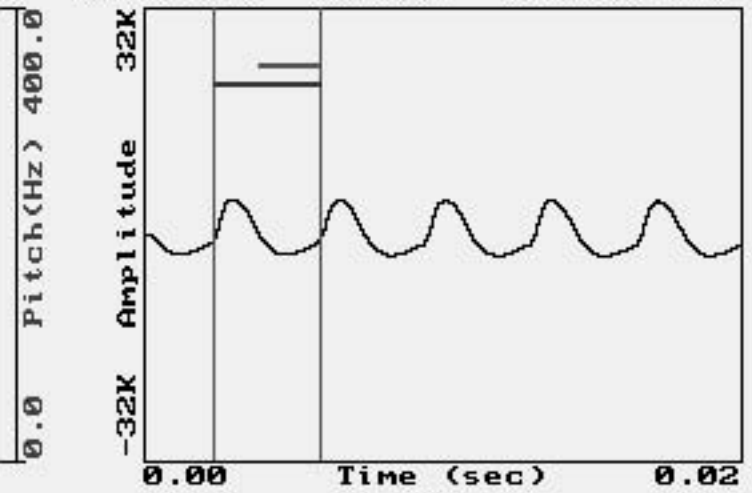


Duration 2.50 (sec)

Pitch(Hz) 400.0

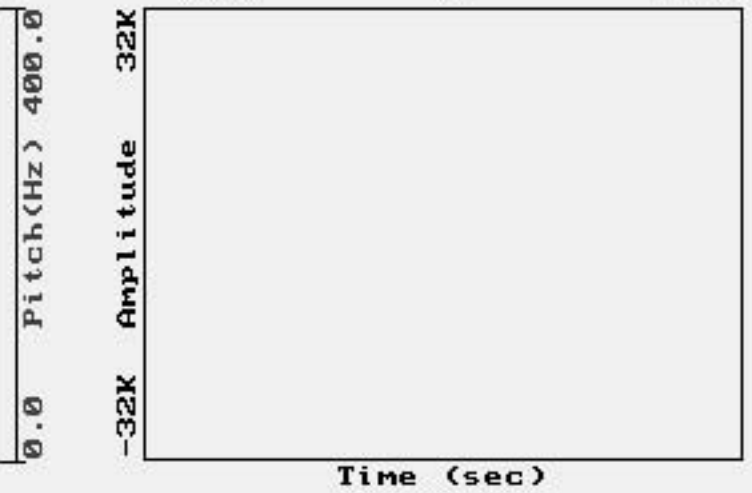
**A** > : CH1: P12\_EG~1.NSP

< 0.00 sec 58.59% 280.89 Hz >



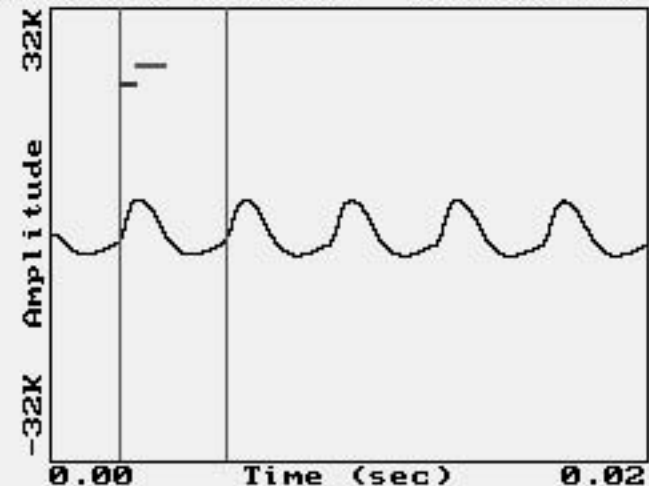
**B** > :

< sec % Hz >



**A** > : CH1: P12\_EG~1.NSP

< 0.00 sec 182.60% 280.89 Hz >



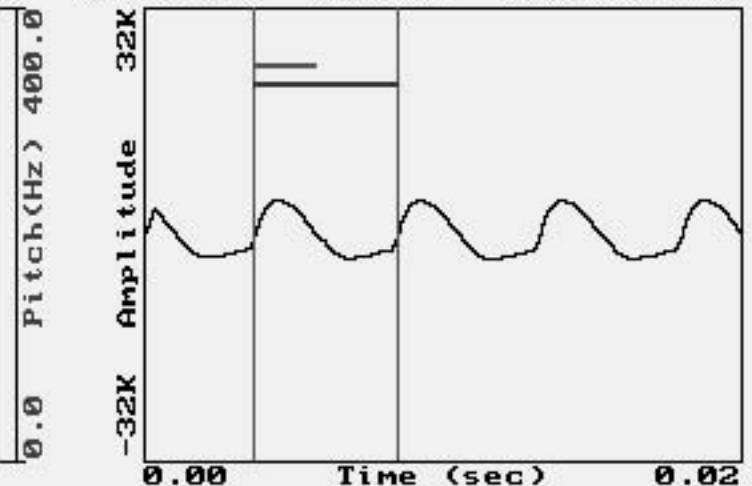
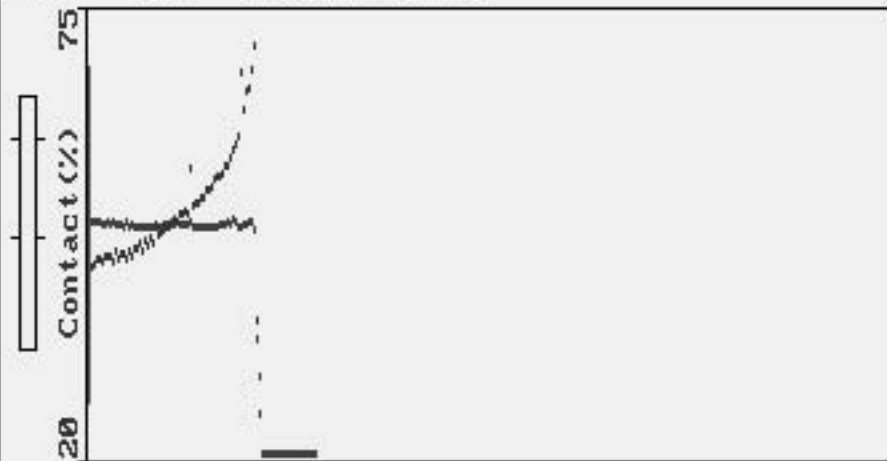
**B** > :

< sec % Hz >



**A** > : CH1: P1\_EGGST.NSP

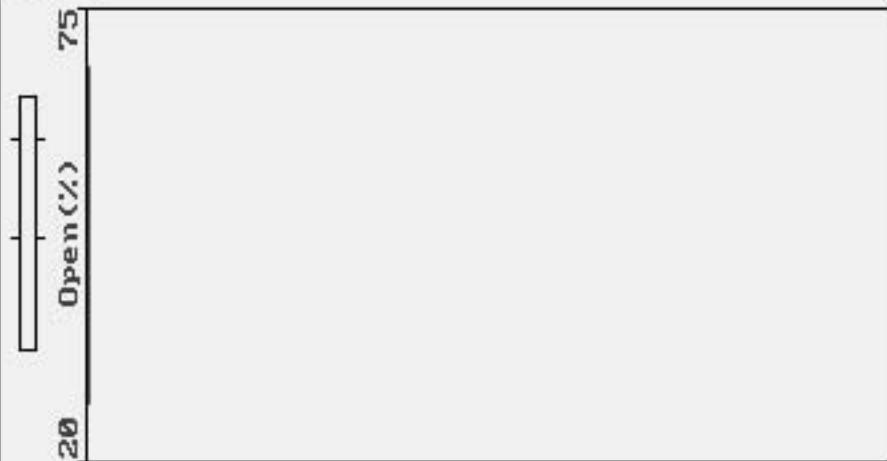
< 0.00 sec 43.60% 209.00 Hz >



Duration 2.50 (sec)

**B** > :

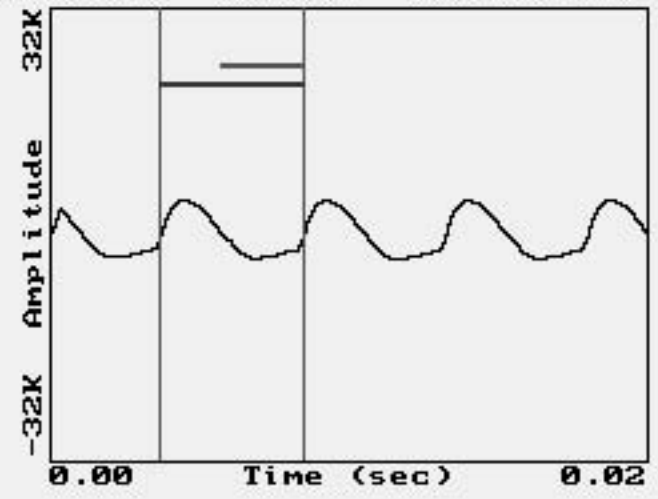
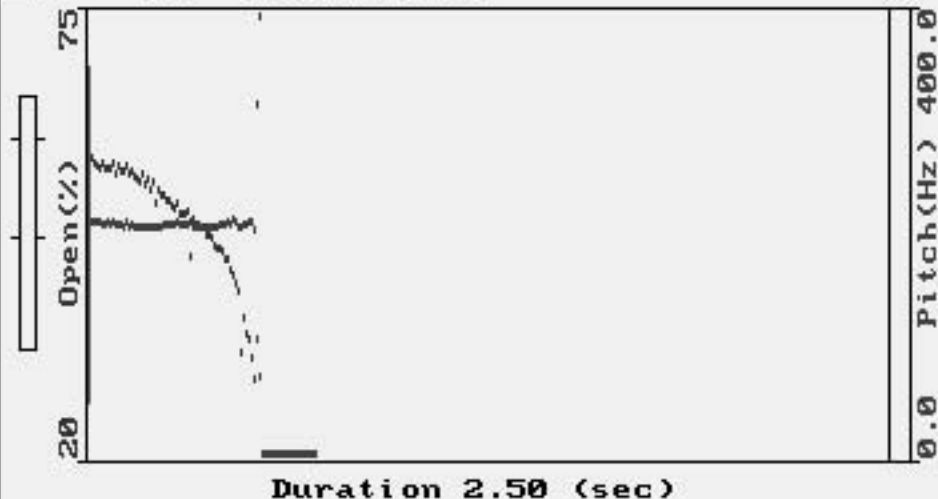
< sec % Hz >



Duration 2.50 (sec)

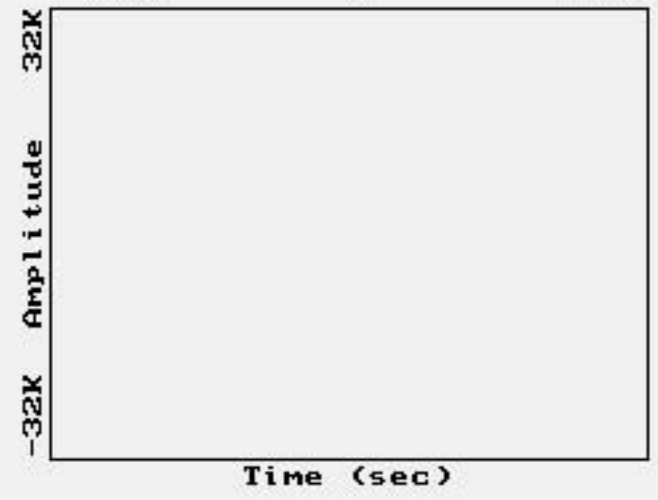
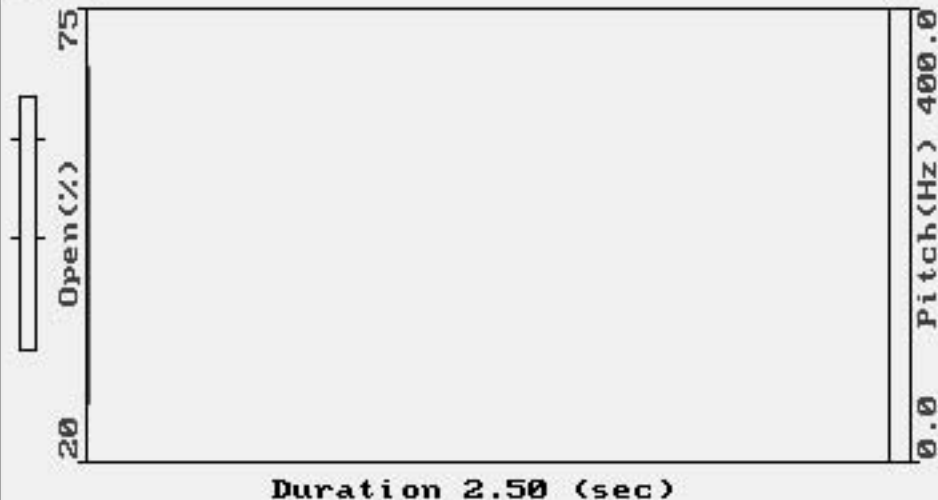
**A** > : CH1: P1\_EGGST.NSP

< 0.00 sec 56.39% 209.00 Hz >



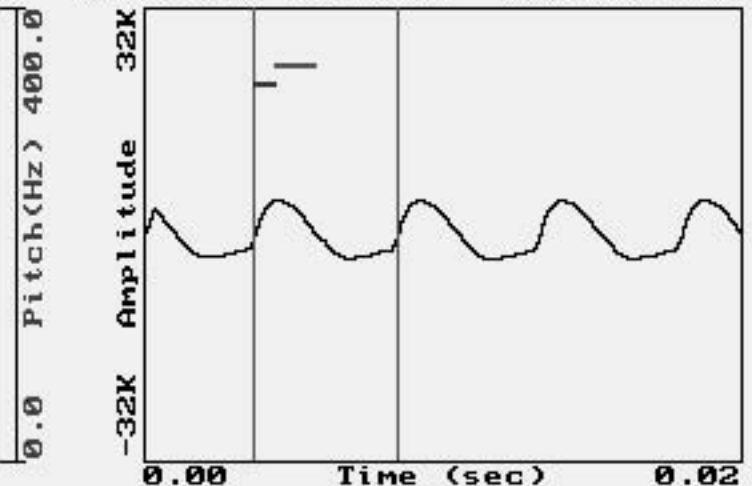
**B** > :

< sec % Hz >



**A** > : CH1: P1\_EGGST.NSP

< 0.00 sec 187.50% 209.00 Hz >

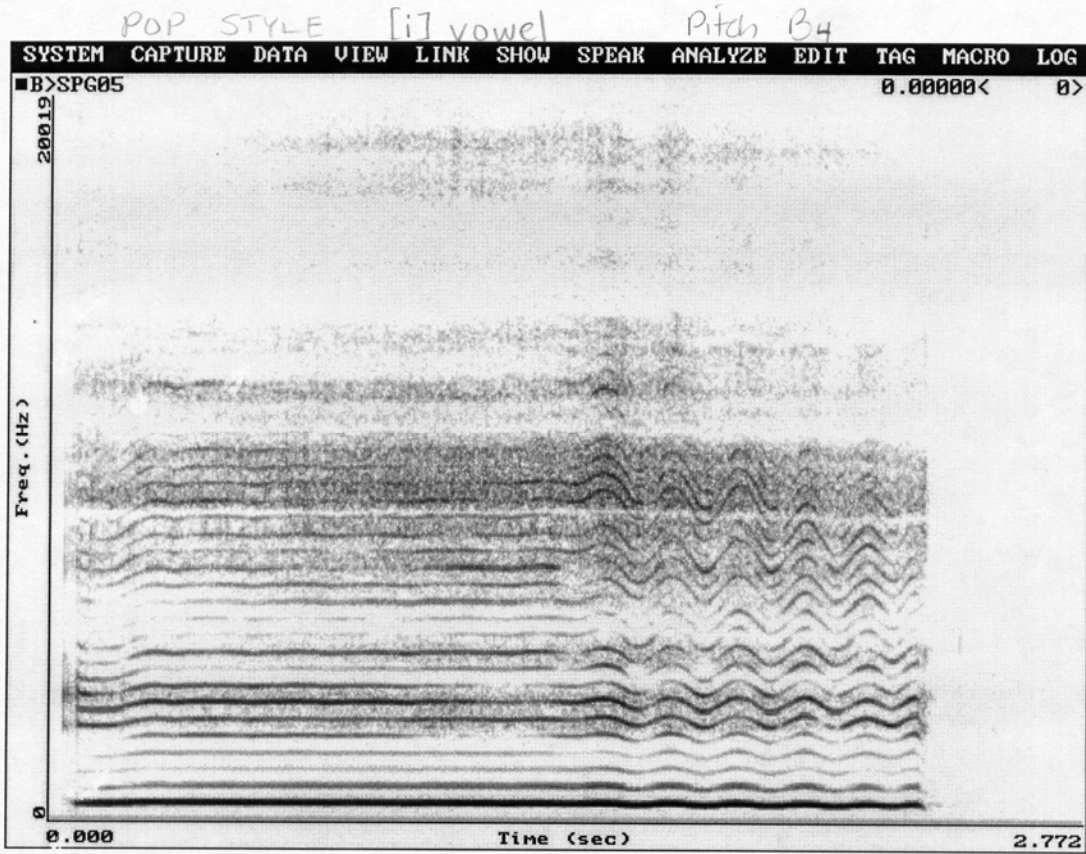


< sec % Hz >

**B** > :



Spectrogram of P22

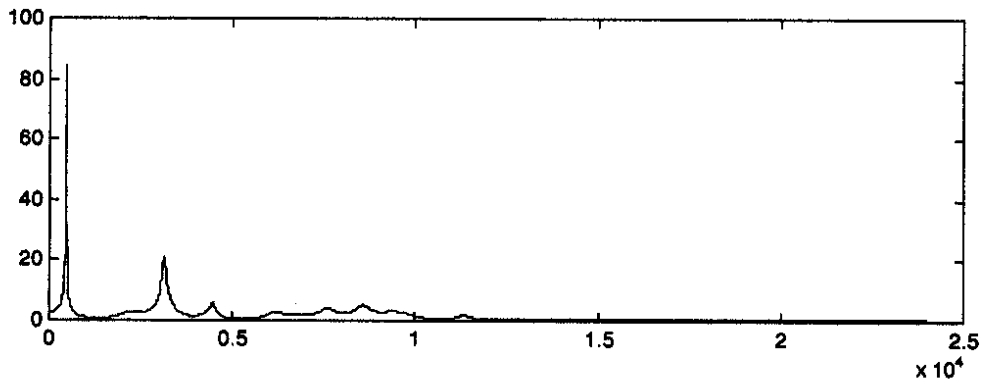
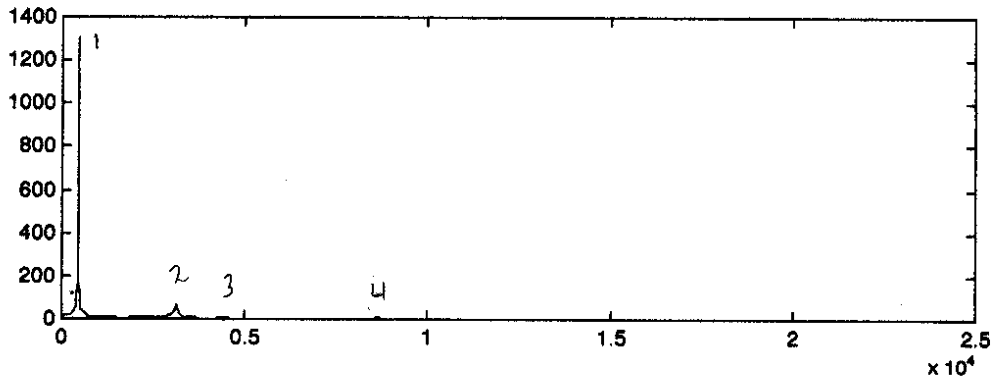


LPC of whole sample P22

P22

$F_0 = 445 \text{ Hz}$

- 1) 445.31, 1309.35
- 2) 3128.90, 62.5
- 3) 4464.8, 9.10
- 4) 8648.20, 5.18



$$.147 - .0052708333 = \frac{.141729167}{63}$$

$$= .002249669$$

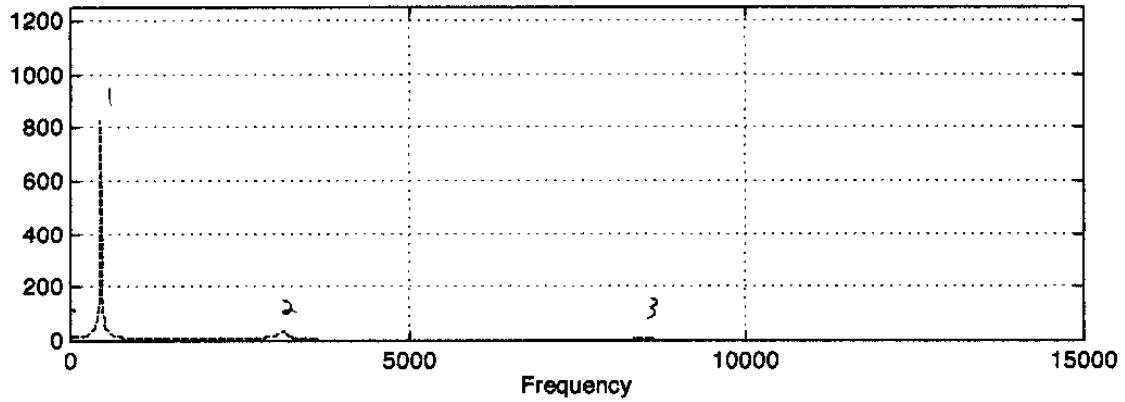
$$444.5097741$$

(445.31, 829.16)

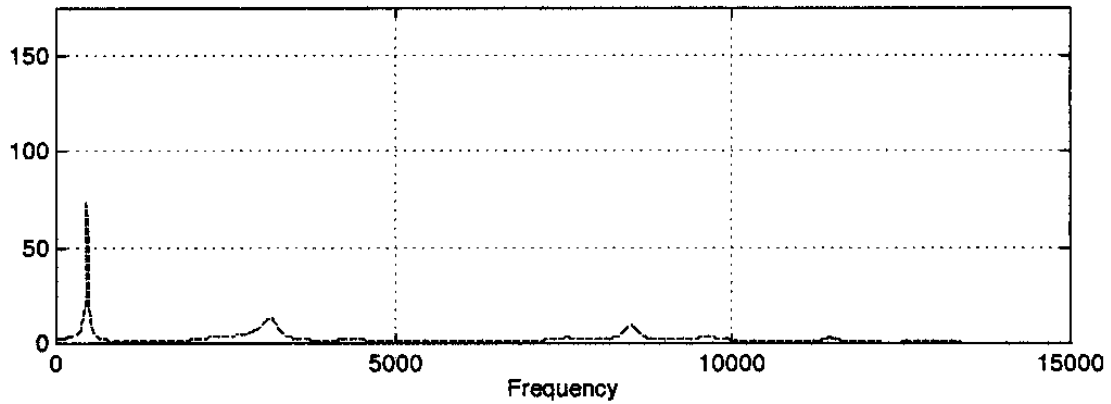
(3140.62, 35.62)

(8507.81, 7.97)

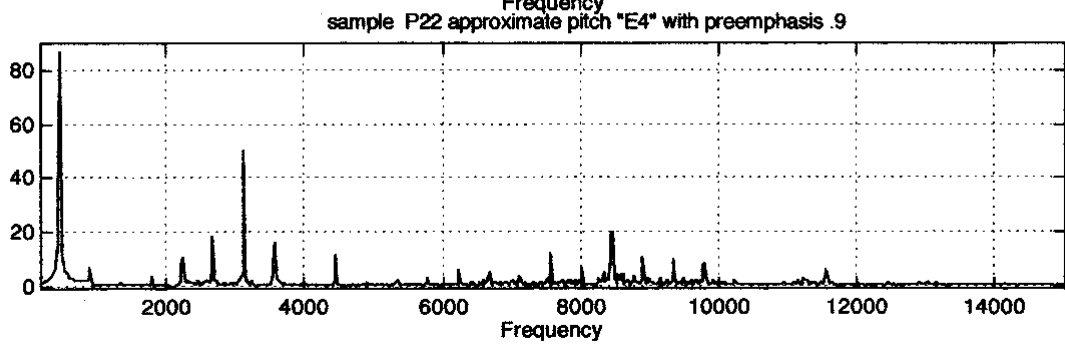
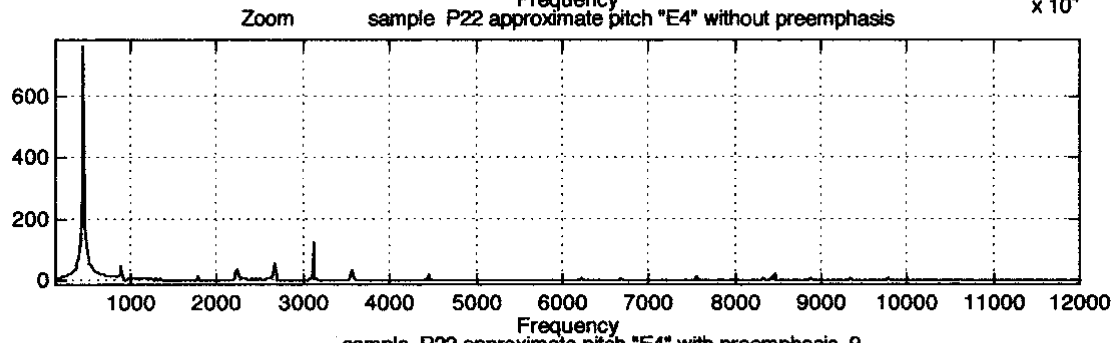
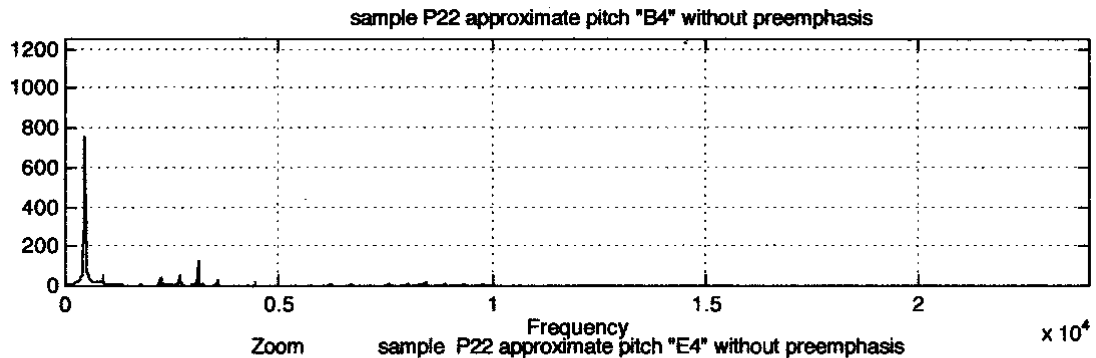
LPC of 2500pt sample P22 approximate pitch "B4" without preemphasis



LPC of 2500pt sample P22 approximate pitch "B4" with preemphasis .9



DFT of P22

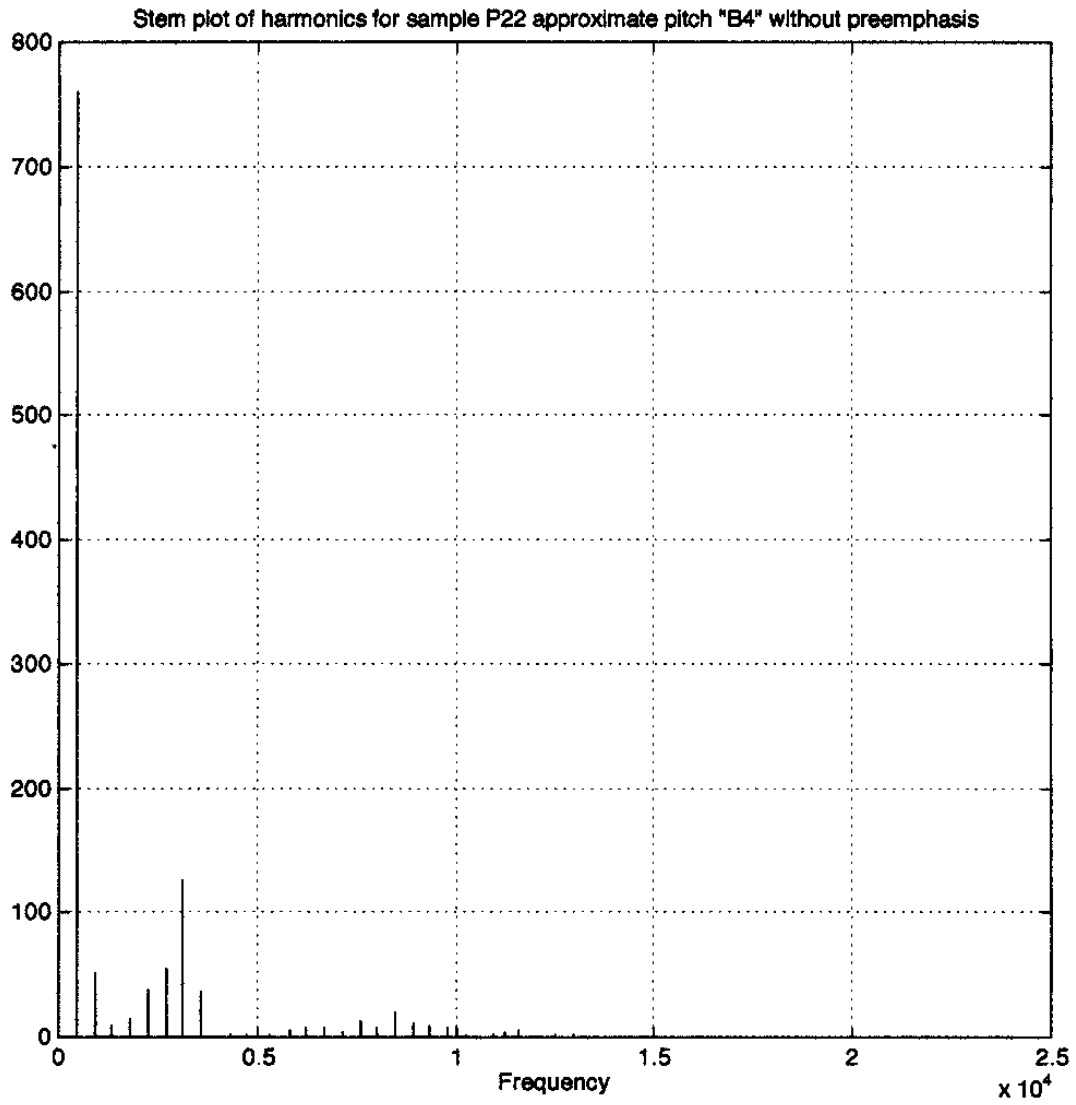


DFT Numerical Results of P22

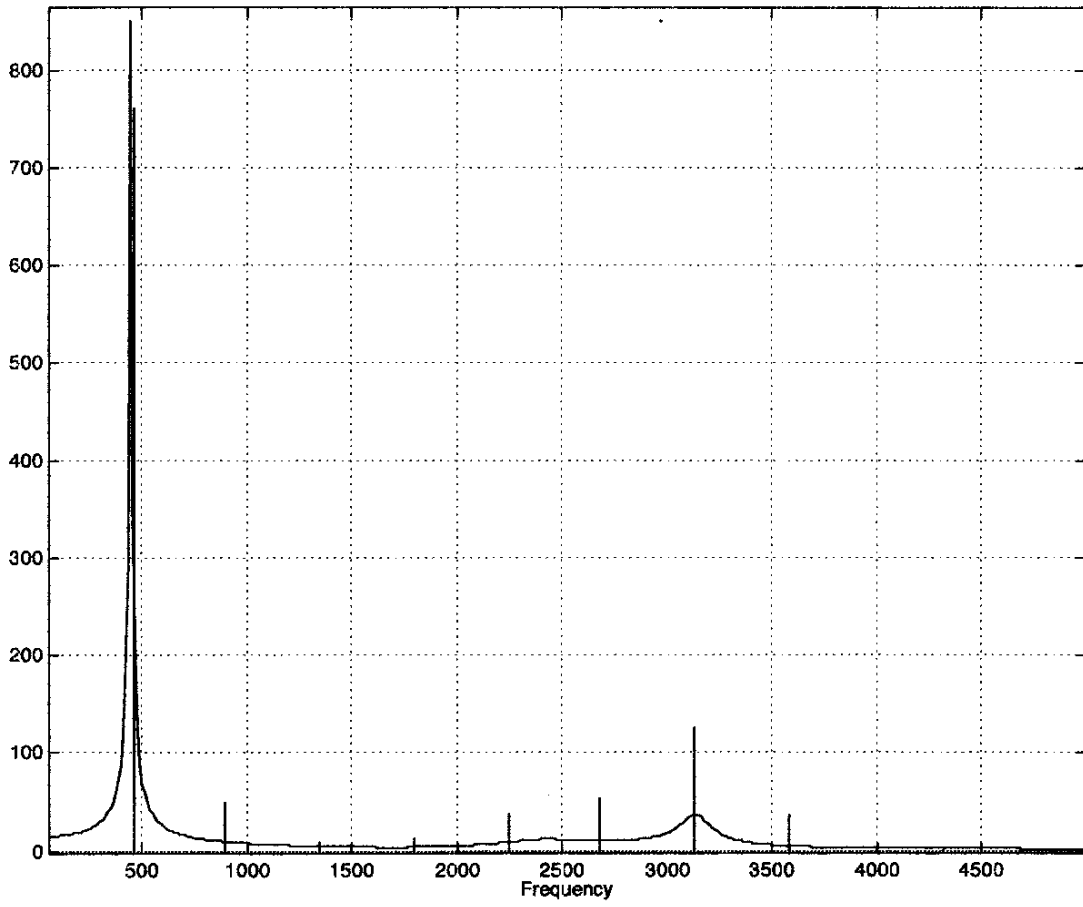
ROW	Freq	Amp	% Amp	
1	468	760.540	100.000	← F1 format tracking
2	900	50.588	6.652	
3	1350	9.916	1.304	
4	1800	14.144	1.860	
5	2250	38.056	5.004	
6	2682	55.006	7.233	← F2
7	3132	126.078	16.577	← F3 } very close together
8	3582	35.989	4.732	
9	4320	2.109	0.277	
10	4698	2.296	0.302	
11	5310	1.430	0.188	
12	5796	4.731	0.622	
13	6246	8.051	1.059	← near speech format
14	6696	6.810	0.895	
15	7128	4.299	0.565	
16	7578	13.645	1.794	← not in speech
17	8028	6.927	0.911	
18	8478	19.897	2.616	← near speech formats
19	8910	10.487	1.379	
20	9360	9.257	1.217	
21	9810	7.383	0.971	
22	10242	1.745	0.229	
23	10944	1.267	0.167	
24	11232	2.858	0.376	
25	11574	5.119	0.673	
26	12294	0.753	0.099	
27	12474	1.037	0.136	
28	12942	1.180	0.155	←
29	13410	0.660	0.087	
30	13932	0.635	0.083	
31	14490	0.682	0.090	
32	14850	0.644	0.085	
33	15606	0.584	0.077	
34	15750	0.600	0.079	
35	16344	0.596	0.078	
36	16920	0.702	0.092	
37	17190	0.598	0.079	
38	17928	0.671	0.088	
39	18108	0.598	0.079	
40	18594	0.702	0.092	
41	19134	0.559	0.074	
42	19494	0.519	0.068	
43	20232	0.483	0.064	
44	20538	0.485	0.064	
45	20934	0.480	0.063	
46	21690	0.485	0.064	
47	21888	0.483	0.064	
48	22302	0.459	0.060	
49	22788	0.457	0.060	
50	23292	0.449	0.059	
51	16470	0.180	0.024	
52	16902	0.155	0.020	
53	17208	0.135	0.018	
54	17406	0.205	0.027	
55	17892	0.126	0.017	
56	18090	0.128	0.017	
57	18522	0.121	0.016	
58	18738	0.143	0.019	

59	19224	0.126	0.017
60	19512	0.118	0.016
61	19818	0.074	0.010
62	19998	0.083	0.011
63	20502	0.074	0.010
64	20826	0.068	0.009
65	20970	0.072	0.010
66	21258	0.064	0.008
67	21654	0.063	0.008
68	22140	0.068	0.009
69	22410	0.067	0.009
70	22644	0.055	0.007
71	23058	0.056	0.007
72	23292	0.054	0.007
73	23580	0.053	0.007
74	14652	0.477	0.063
75	14814	0.404	0.053
76	14994	0.245	0.032
77	15300	0.235	0.031
78	15462	0.327	0.043
79	15714	0.267	0.035
80	15858	0.303	0.040
81	16110	0.390	0.051
82	16290	0.521	0.069
83	16470	0.334	0.044
84	16596	0.258	0.034
85	16776	0.227	0.030
86	17100	0.246	0.032
87	17244	0.245	0.032
88	17478	0.300	0.039
89	17550	0.223	0.029
90	17820	0.179	0.023
91	18054	0.278	0.037
92	18180	0.429	0.056
93	18396	0.334	0.044
94	18666	0.234	0.031
95	18846	0.255	0.034
96	19026	0.263	0.035
97	19278	0.203	0.027
98	19440	0.162	0.021
99	19566	0.166	0.022
100	19782	0.181	0.024
101	20034	0.161	0.021
102	20160	0.179	0.024
103	20430	0.180	0.024
104	20610	0.171	0.022
105	20718	0.158	0.021
106	21042	0.164	0.022
107	21240	0.157	0.021
108	21420	0.141	0.019
109	21564	0.154	0.020
110	21834	0.144	0.019
111	21978	0.138	0.018
112	22104	0.146	0.019
113	22302	0.133	0.018
114	22608	0.144	0.019
115	22824	0.134	0.018
116	22950	0.130	0.017
117	23202	0.139	0.018
118	23418	0.141	0.019

119	23490	0.135	0.018
120	23814	0.133	0.018



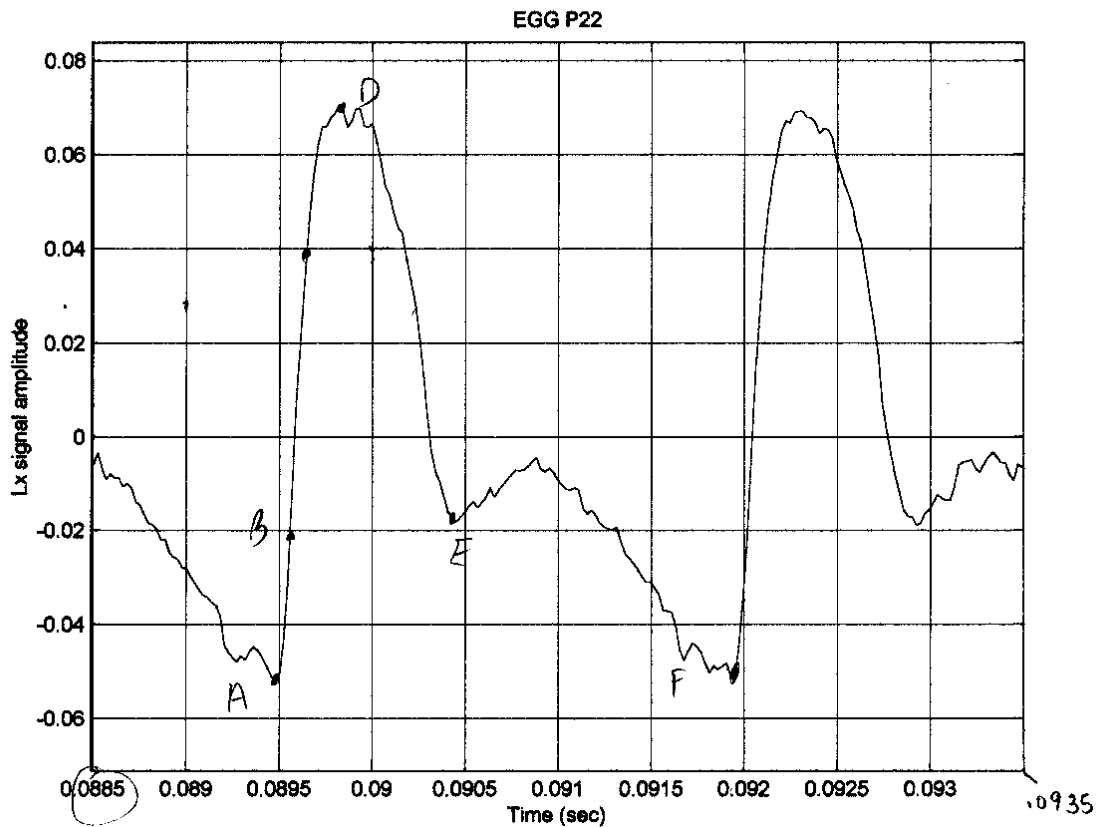
Stem plot/LPC overlay of harmonics for sample P22 without preemphasis



$$x \Rightarrow 16 \text{ mm} = .0005$$

$$y \Rightarrow 16 \text{ mm} = .02$$

$$y \Rightarrow 1 \text{ mm} = .00125$$



$$A (.08947, -.05125)$$

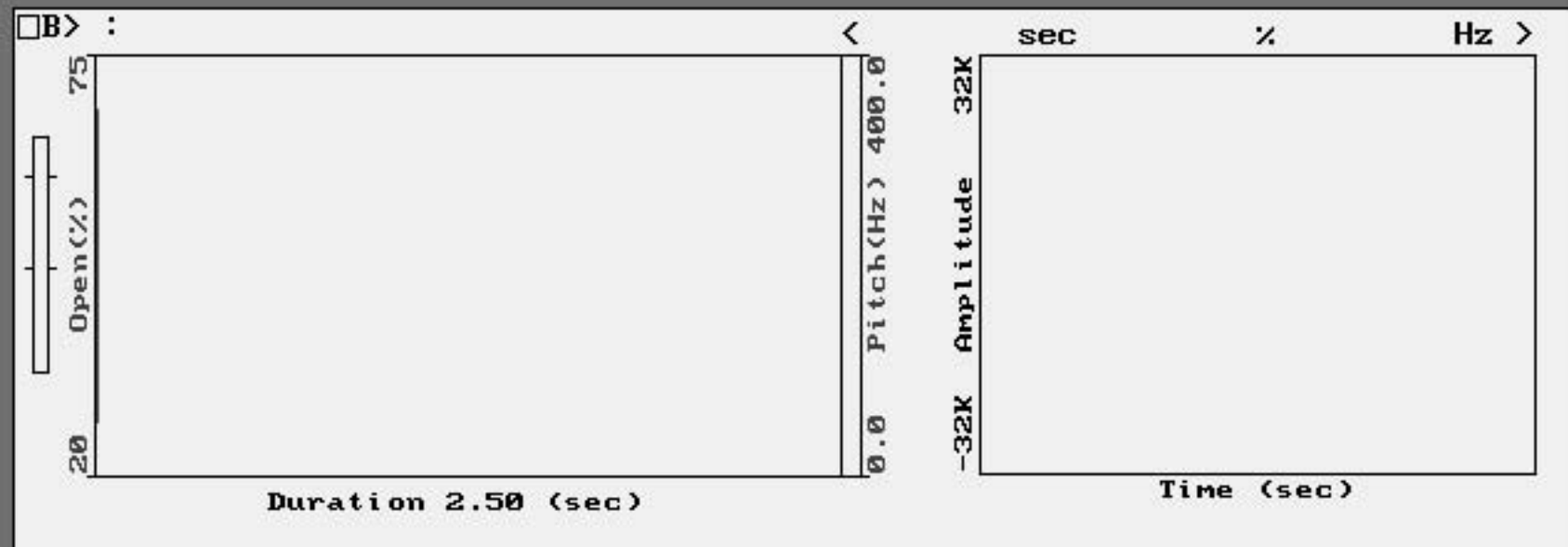
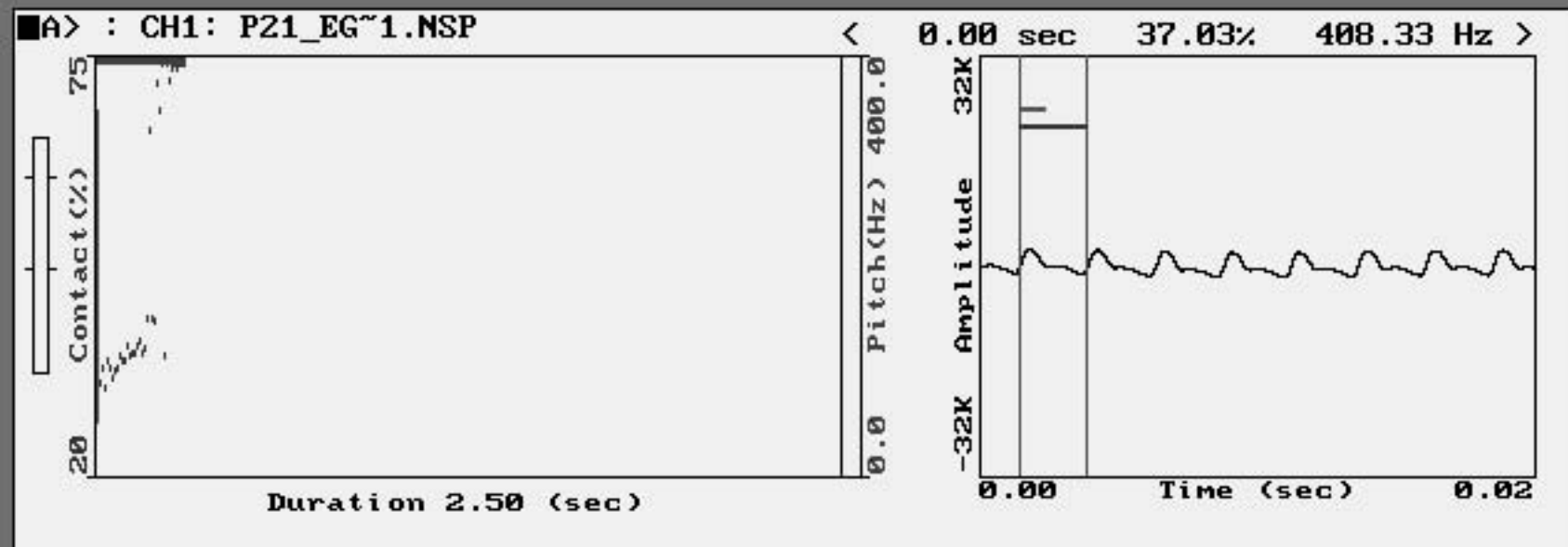
$$B (.08956, -.02094)$$

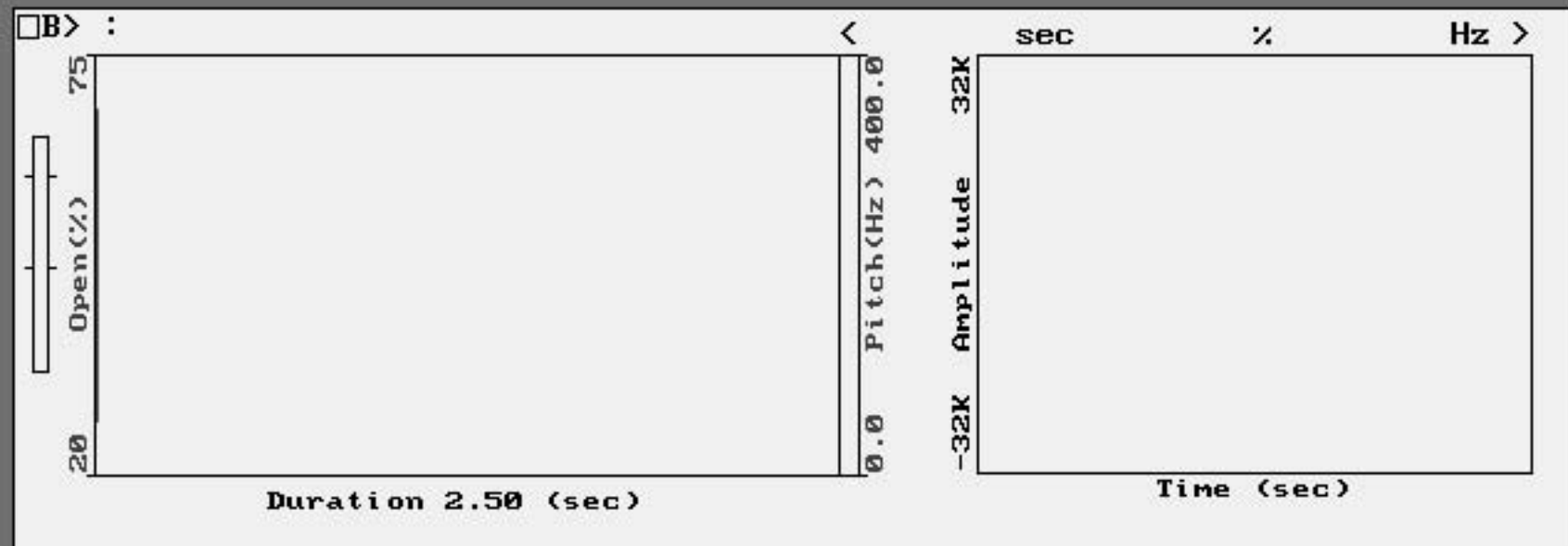
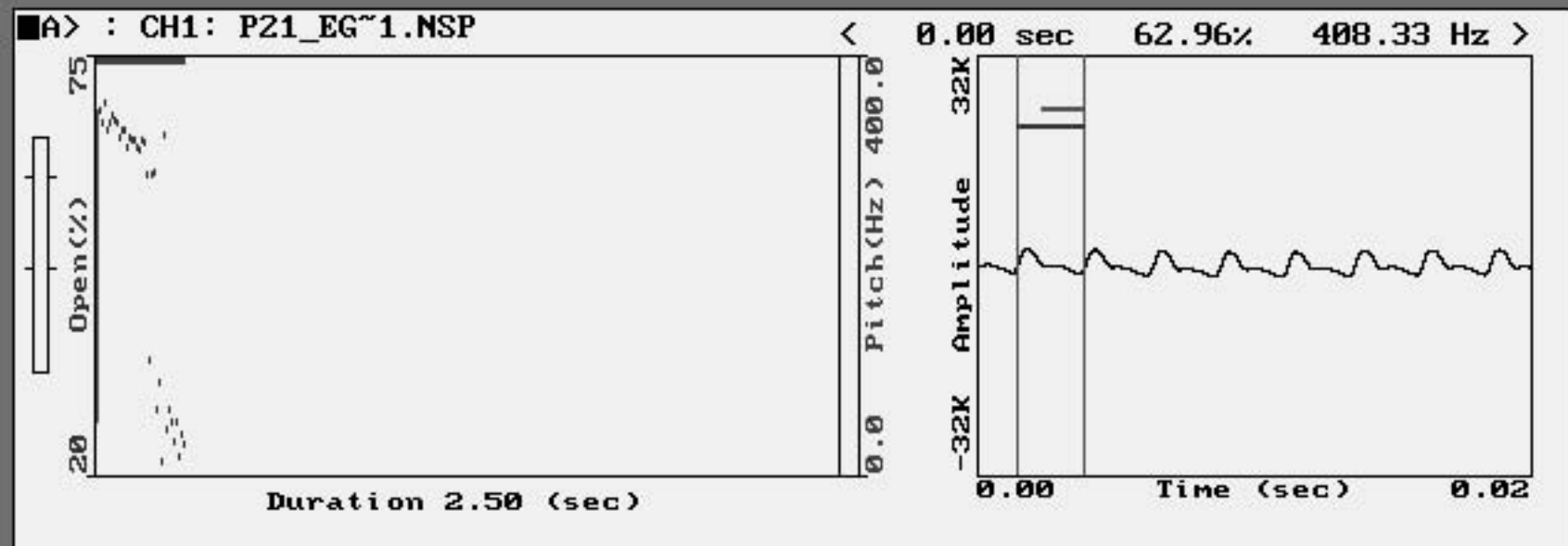
$$C (.08964, .03969)$$

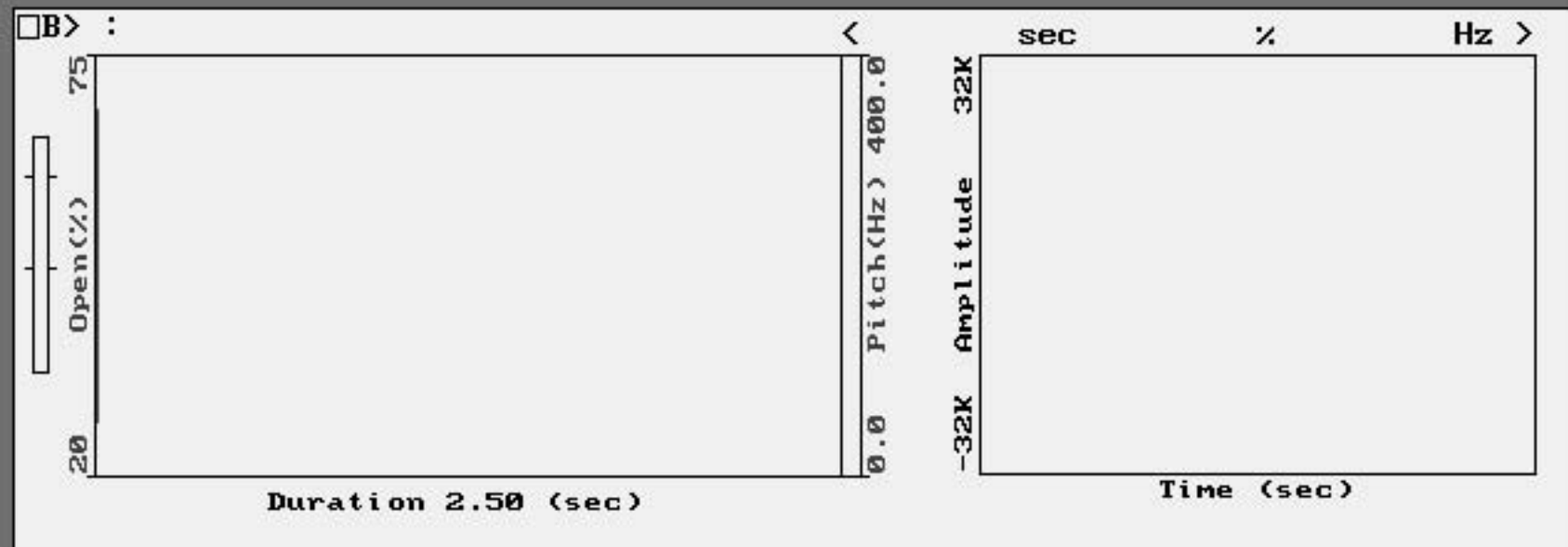
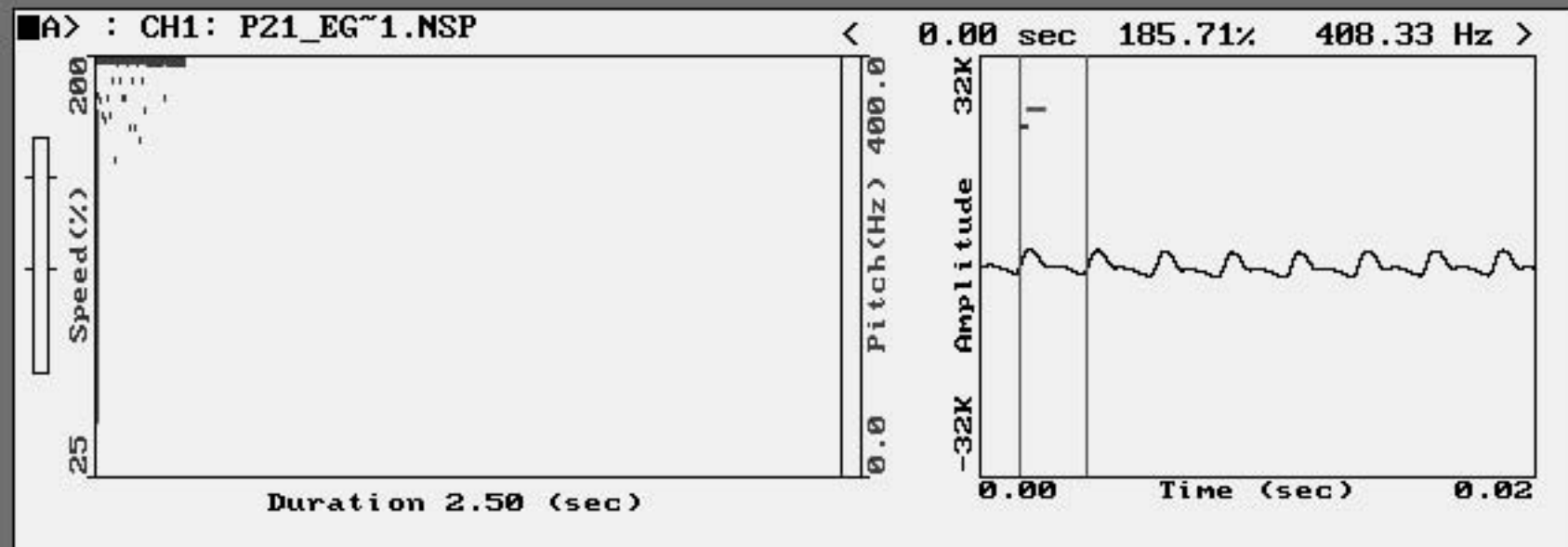
$$D (.08981, .07000)$$

$$E (.09042, -.01875)$$

$$F (.09194, -.05125)$$

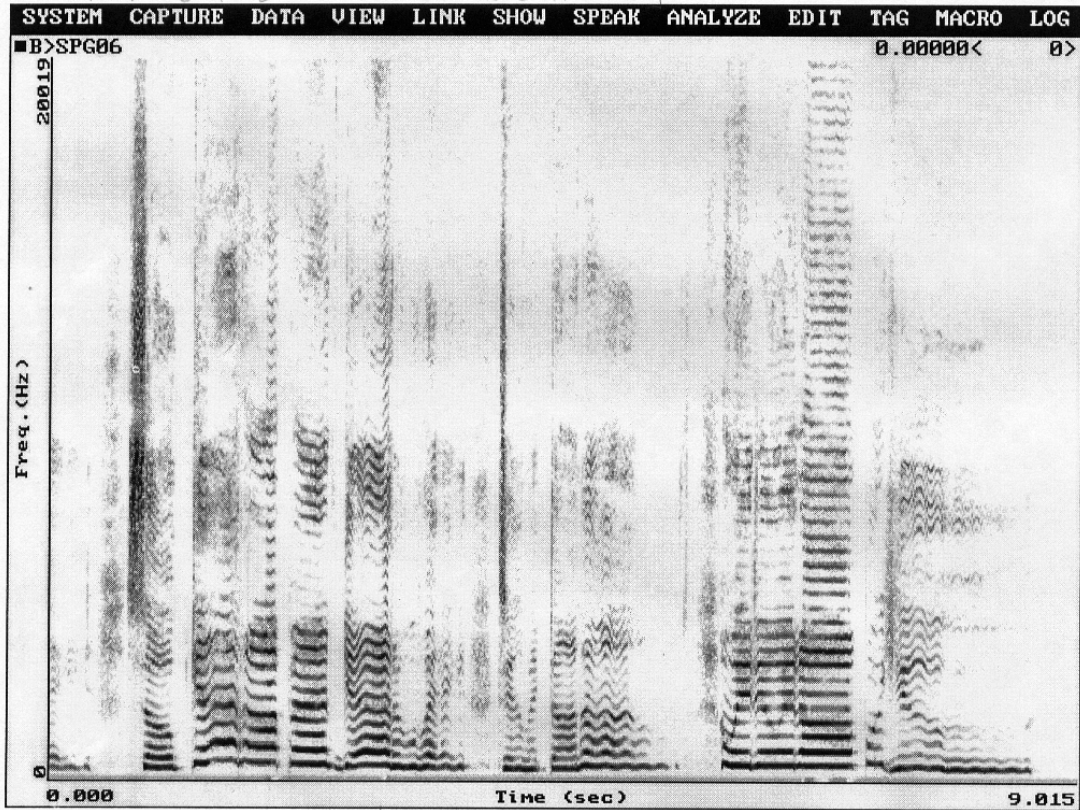






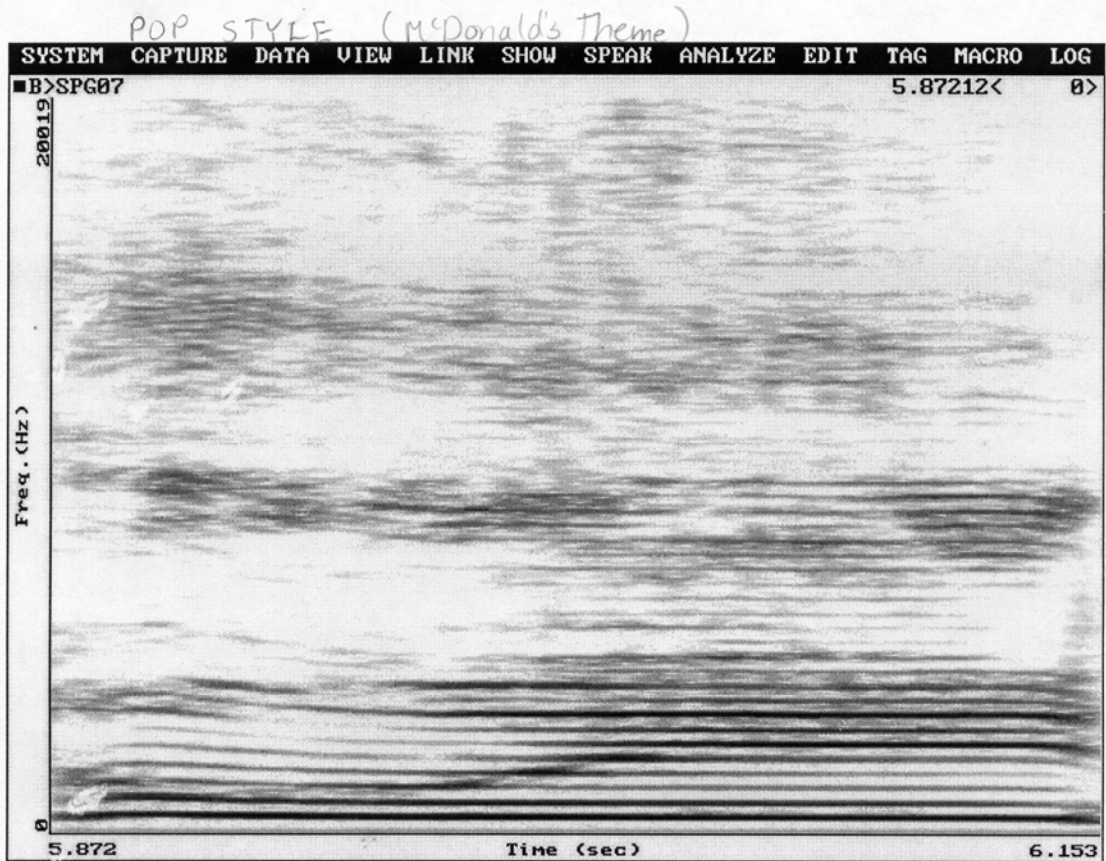
Spectrogram P33a

POP STYLE [McDonald's theme]



so get up and get away to MacDonal'ds we dont all for you

Spectrogram P33b



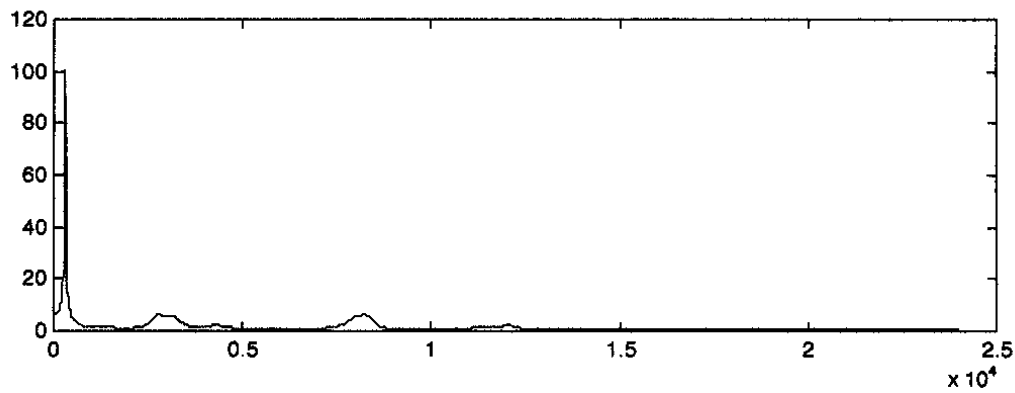
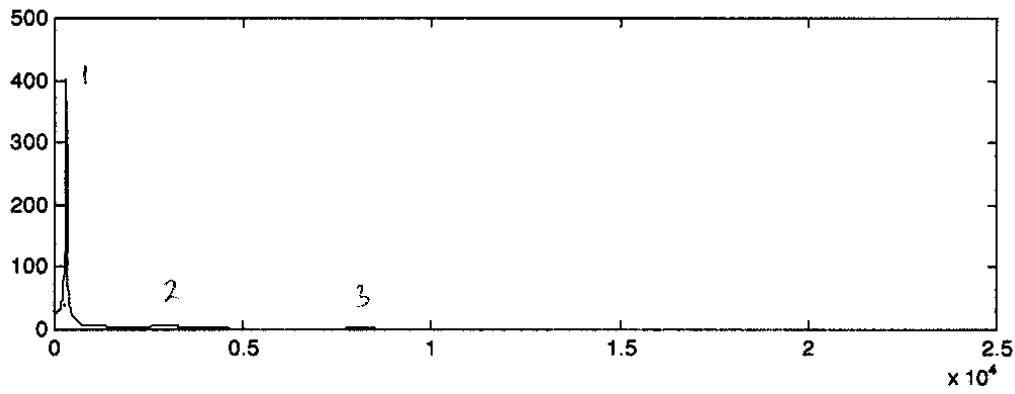
W

E

P33

$$F_0 = 289 \text{ Hz}$$

- 1) 304.68, 402.12
- 2) 2882.90, 7.56
- 3) 8179.60, 3.10



$$.0439375 - .0023958333 = .041541667 / 12$$

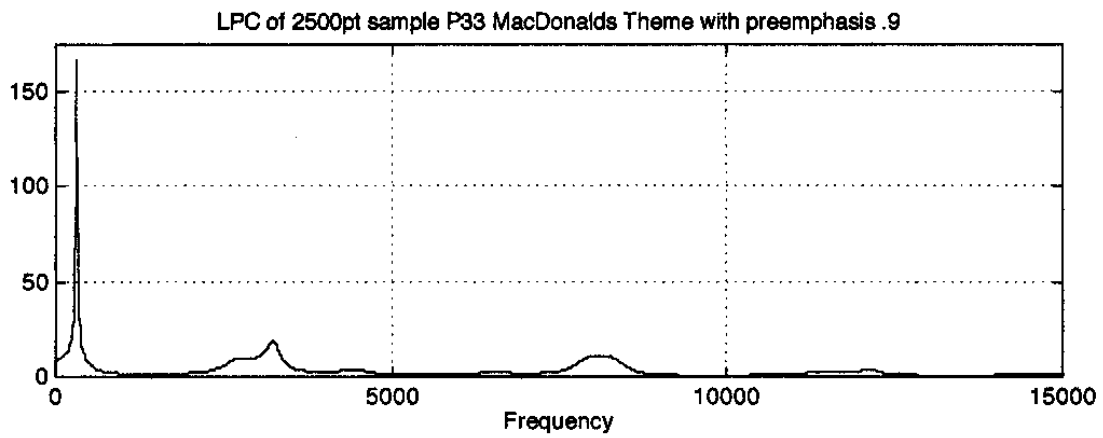
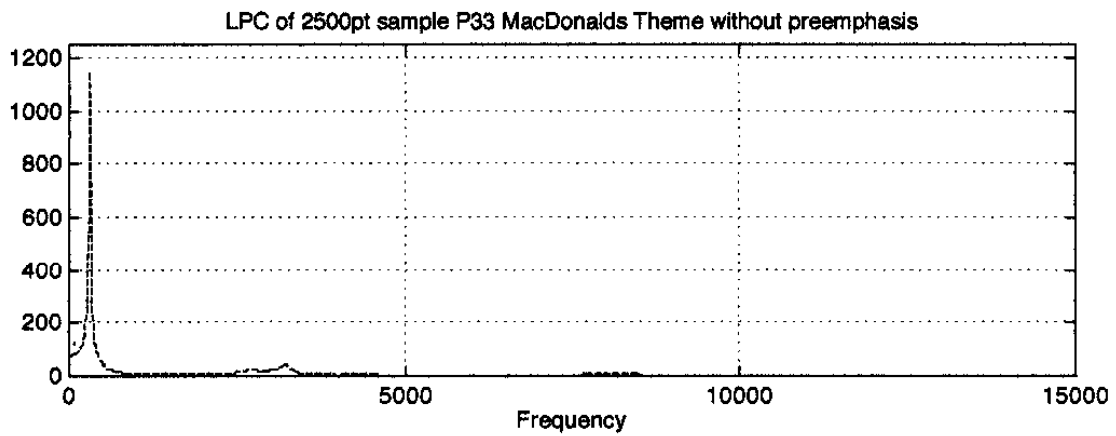
$$.003461806$$

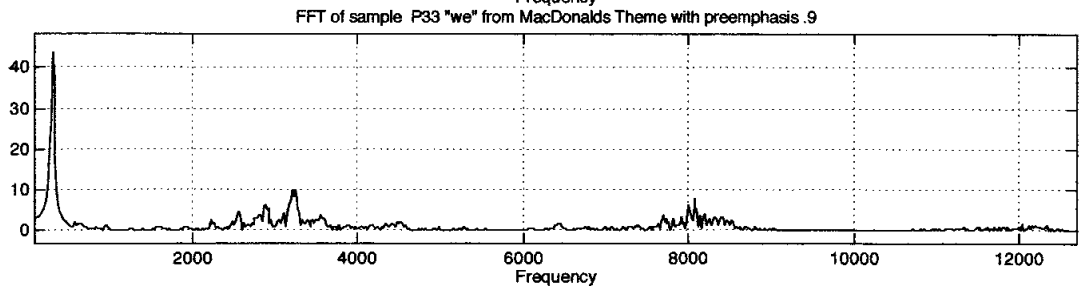
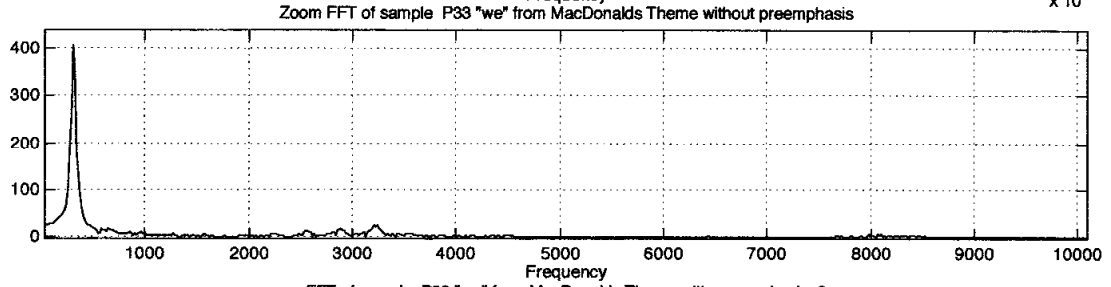
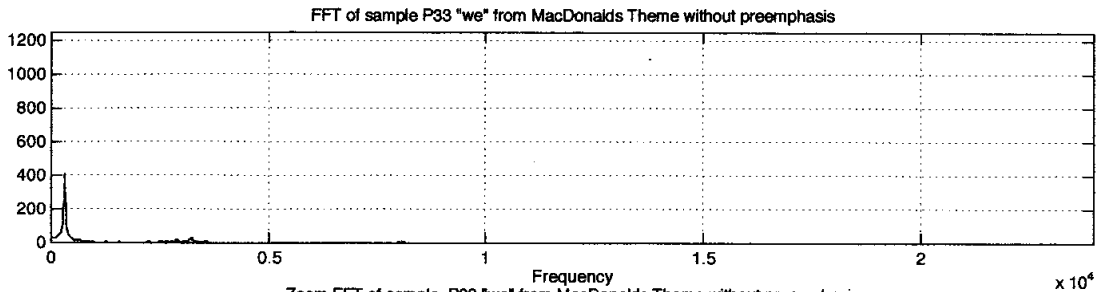
[ 40 - 2300 ]

288.8665975

$F_1(305, 1140)$   
 $F_2(2101, 23)$   
 $F_3(3222, 39)$

P33c54.wav





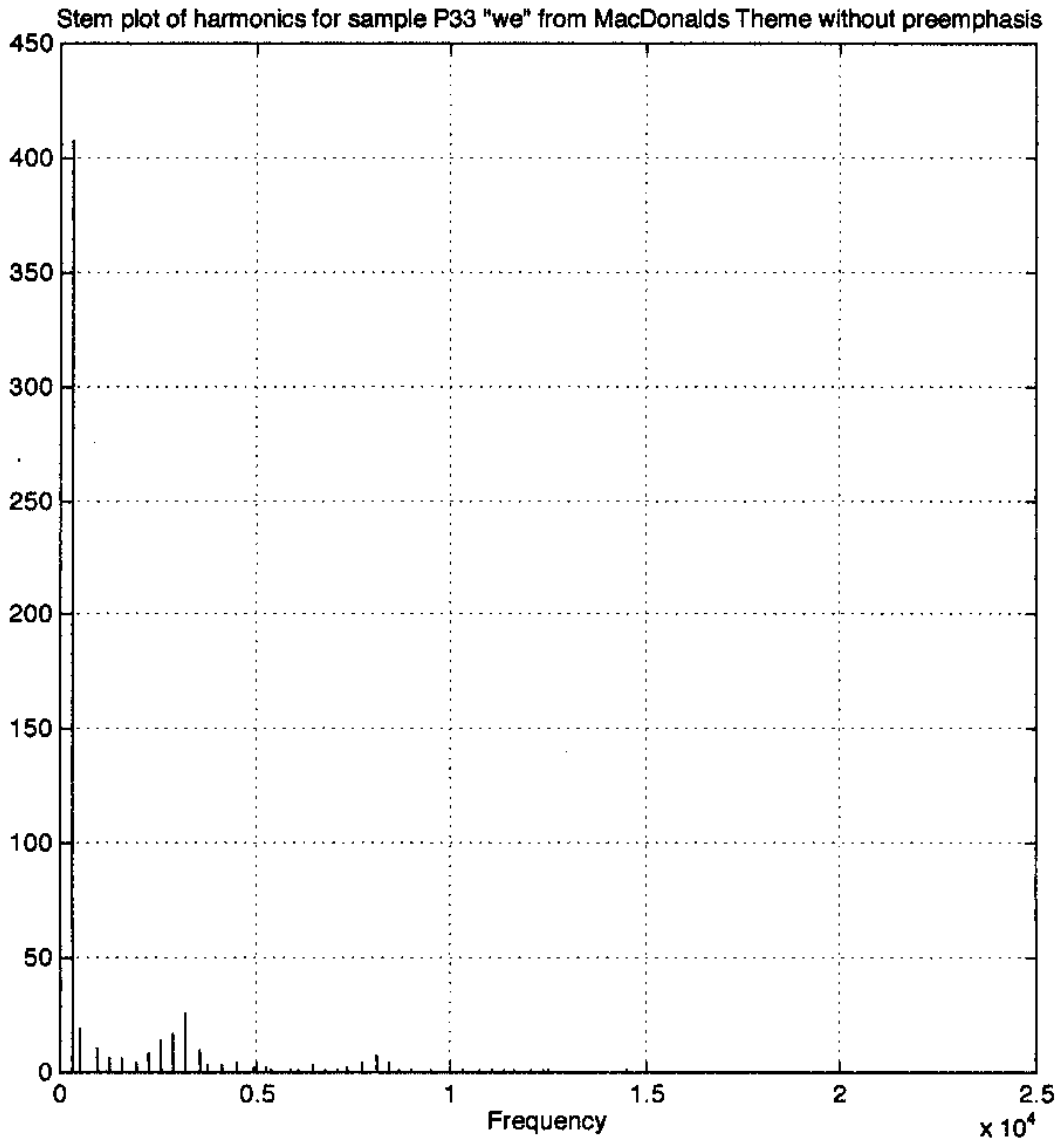
Worksheet saved into file: Minitab.P33  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	324	406.954	100.000 ← F11 allowed tracking
2	522	19.371	4.760
3	972	11.111	2.730
4	1278	6.449	1.585
5	1584	6.182	1.519
6	1944	4.390	1.079
7	2250	9.063	2.227
8	2574	14.171	3.482
9	2898	17.113	4.205 ← 2.2% error close
10	3222	25.777	6.334 ← (3.1%)
11	3564	9.409	2.312
12	3780	3.725	0.915
13	4176	3.174	0.780
14	4500	4.679	1.150 <sup>5</sup>
15	4986	1.603	0.394
16	5292	1.901	0.467
17	5418	1.112	0.273
18	5922	1.044	0.257
19	6102	1.200	0.295
20	6444	2.694	0.662
21	6768	1.172	0.288
22	7092	1.436	0.353
23	7380	1.959	0.482
24	7704	4.058	0.997
25	8082	7.932	1.949 ← near speed frame +
26	8442	3.958	0.973
27	8694	1.276	0.314
28	9000	0.807	0.198
29	9504	0.590	0.145
30	9774	0.530	0.130
31	9990	0.546	0.134
32	10314	0.613	0.151
33	10728	0.718	0.176
34	11052	0.817	0.201
35	11376	0.814	0.200
36	11628	0.943	0.232
37	12042	1.096	0.269
38	12348	1.259	0.309 ←
39	12510	0.575	0.141
40	13086	0.443	0.109
41	13248	0.448	0.110
42	13680	0.441	0.108
43	14004	0.510	0.125
44	14310	0.471	0.116
45	14508	0.577	0.142
46	14976	0.429	0.105
47	15138	0.442	0.109
48	15606	0.384	0.094
49	15984	0.399	0.098
50	16074	0.356	0.087
51	16416	0.342	0.084
52	16920	0.363	0.089
53	17046	0.345	0.085
54	17550	0.327	0.080
55	17856	0.359	0.088

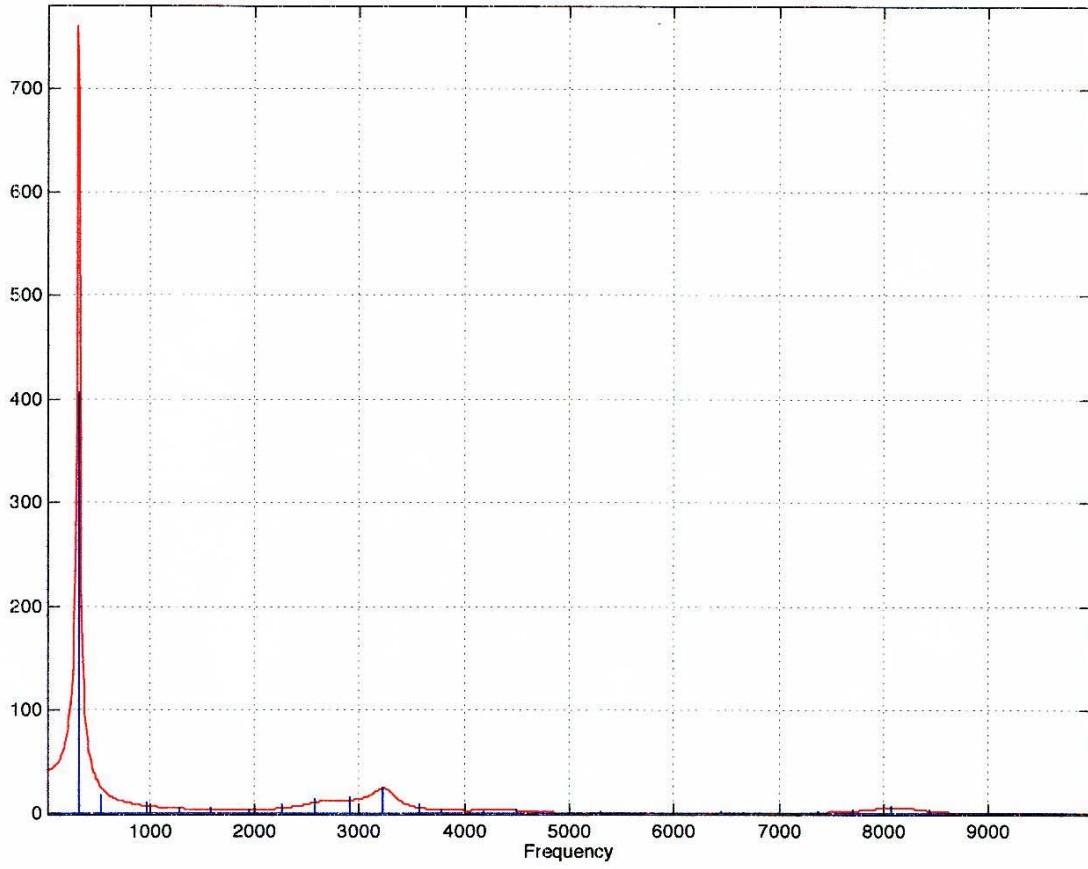
56	18144	0.385	0.095
57	18468	0.391	0.096
58	18846	0.390	0.096
59	19152	0.339	0.083
60	19386	0.363	0.089
61	19764	0.292	0.072
62	20016	0.276	0.068
63	20340	0.321	0.079
64	20646	0.279	0.069
65	21150	0.290	0.071
66	21420	0.311	0.076
67	21762	0.313	0.077
68	22050	0.299	0.073
69	22410	0.319	0.078
70	22626	0.275	0.067
71	23112	0.298	0.073
72	23256	0.278	0.068
73	23670	0.306	0.075
74	14652	0.477	0.117
75	14814	0.404	0.099
76	14994	0.245	0.060
77	15300	0.235	0.058
78	15462	0.327	0.080
79	15714	0.267	0.066
80	15858	0.303	0.074
81	16110	0.390	0.096
82	16290	0.521	0.128
83	16470	0.334	0.082
84	16596	0.258	0.063
85	16776	0.227	0.056
86	17100	0.246	0.060
87	17244	0.245	0.060
88	17478	0.300	0.074
89	17550	0.223	0.055
90	17820	0.179	0.044
91	18054	0.278	0.068
92	18180	0.429	0.105
93	18396	0.334	0.082
94	18666	0.234	0.057
95	18846	0.255	0.063
96	19026	0.263	0.065
97	19278	0.203	0.050
98	19440	0.162	0.040
99	19566	0.166	0.041
100	19782	0.181	0.045
101	20034	0.161	0.040
102	20160	0.179	0.044
103	20430	0.180	0.044
104	20610	0.171	0.042
105	20718	0.158	0.039
106	21042	0.164	0.040
107	21240	0.157	0.039
108	21420	0.141	0.035
109	21564	0.154	0.038
110	21834	0.144	0.035
111	21978	0.138	0.034
112	22104	0.146	0.036
113	22302	0.133	0.033
114	22608	0.144	0.036
115	22824	0.134	0.033

116	22950	0.130	0.032
117	23202	0.139	0.034
118	23418	0.141	0.035
119	23490	0.135	0.033
120	23814	0.133	

0.033



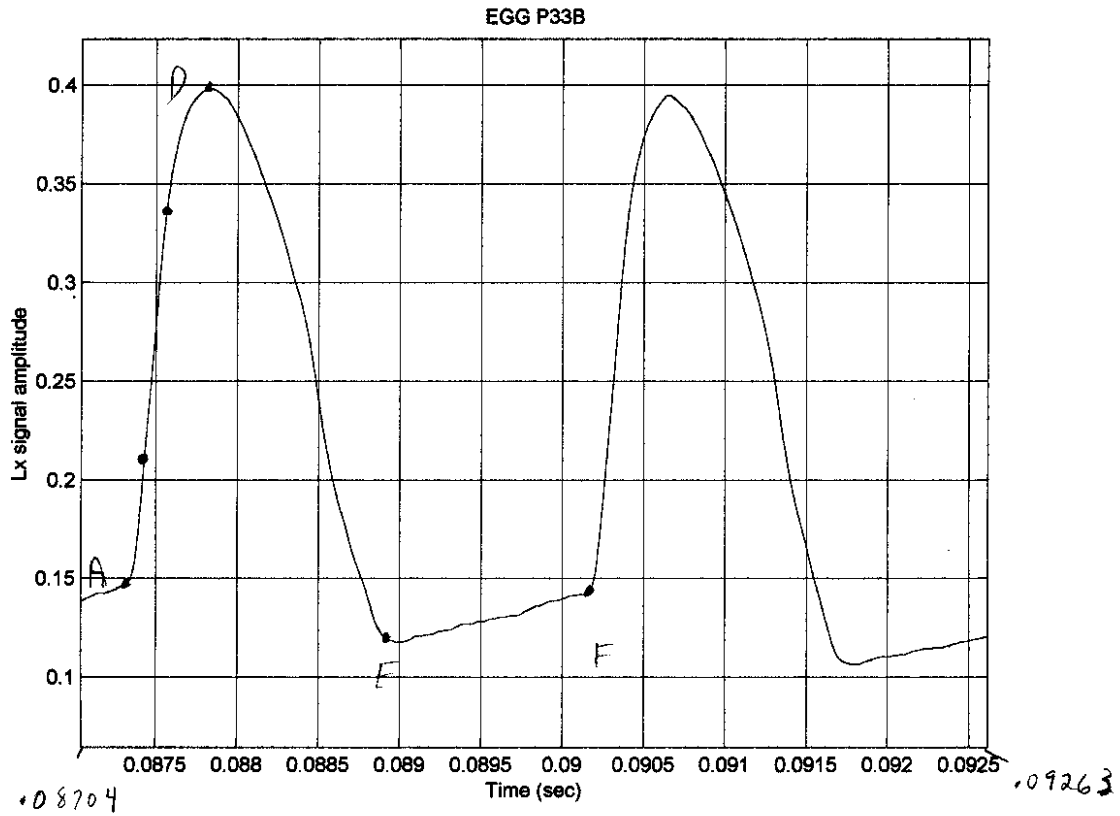
Stem plot/LPC overlay of harmonics for sample P33 without preemphasis



$$x \Rightarrow 14 \text{ mm} = .0005$$

$$y \Rightarrow 17.5 \text{ mm} = .05$$

$$y \Rightarrow 1 \text{ mm} = .000857143$$



$$A (.08733, .14714)$$

$$B (.08743, .20964)$$

$$C (.08755, .33464)$$

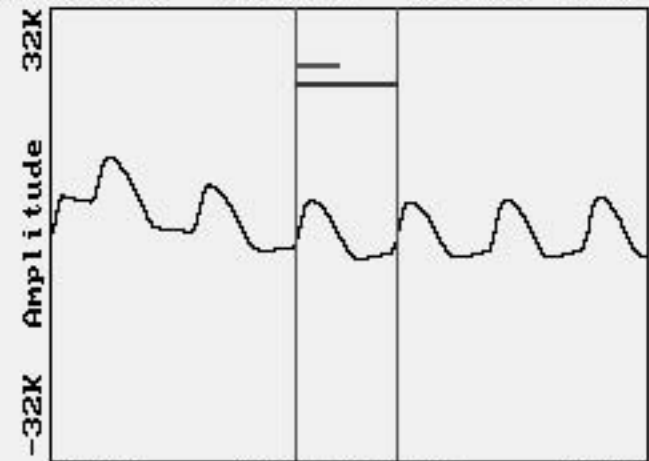
$$D (.08782, .39714)$$

$$E (.08891, .12000)$$

$$F (.09018, .14429)$$

**A** > : CH1: P33B\_E~1.NSP

< 0.00 sec 41.21% 297.97 Hz >



Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

**B** > :

< sec % Hz >

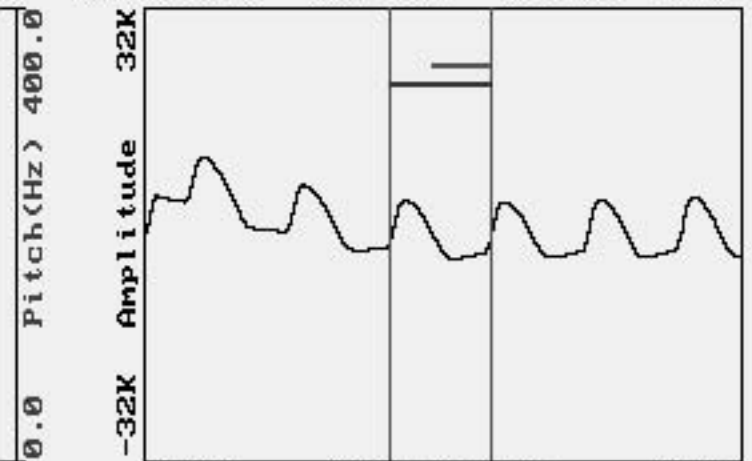


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

**A** > : CH1: P33B\_E~1.NSP

< 0.00 sec 58.78% 297.97 Hz >

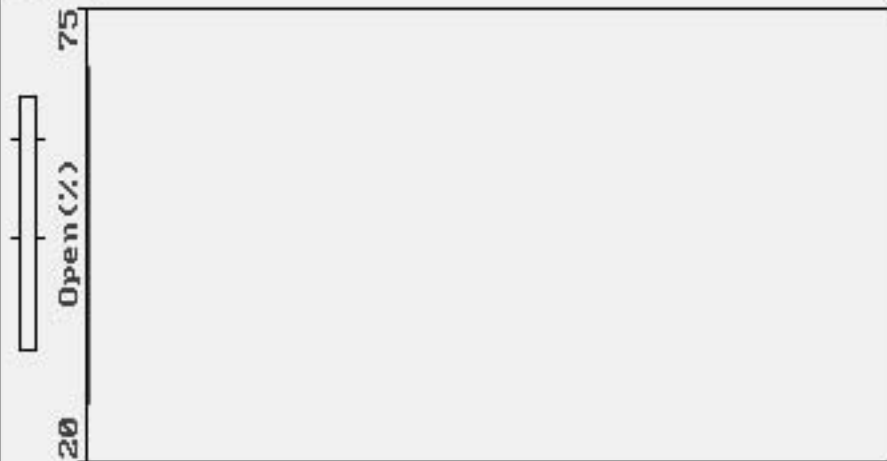


Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0

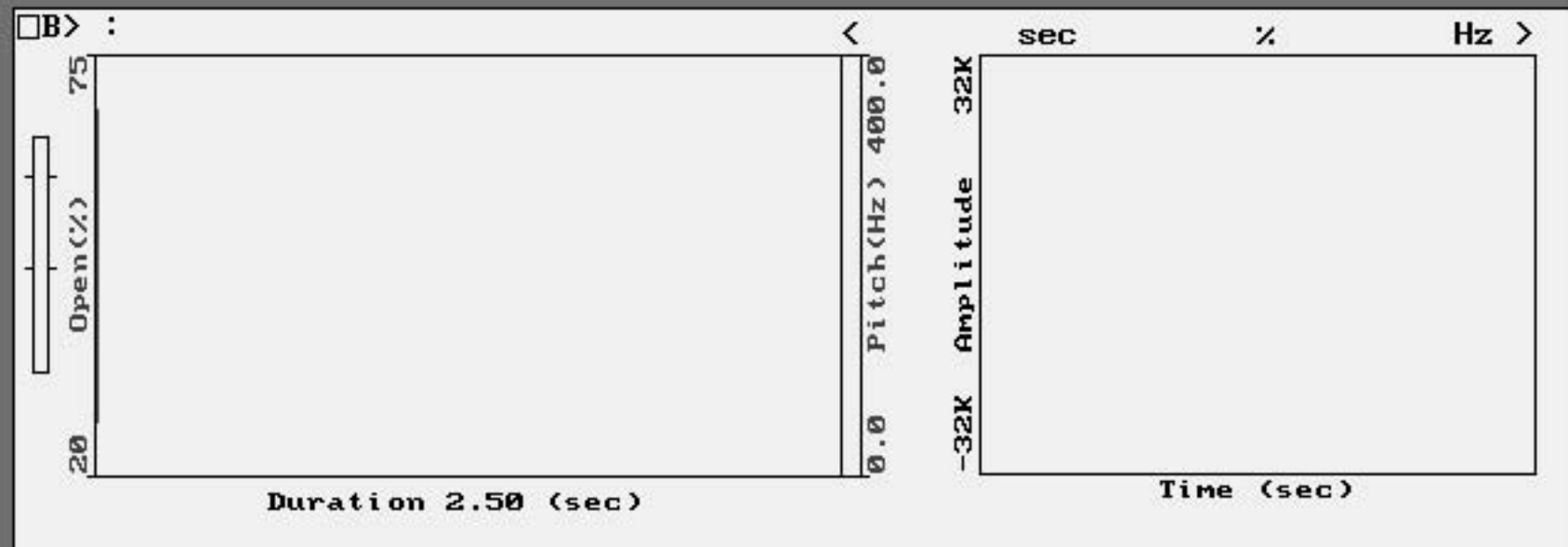
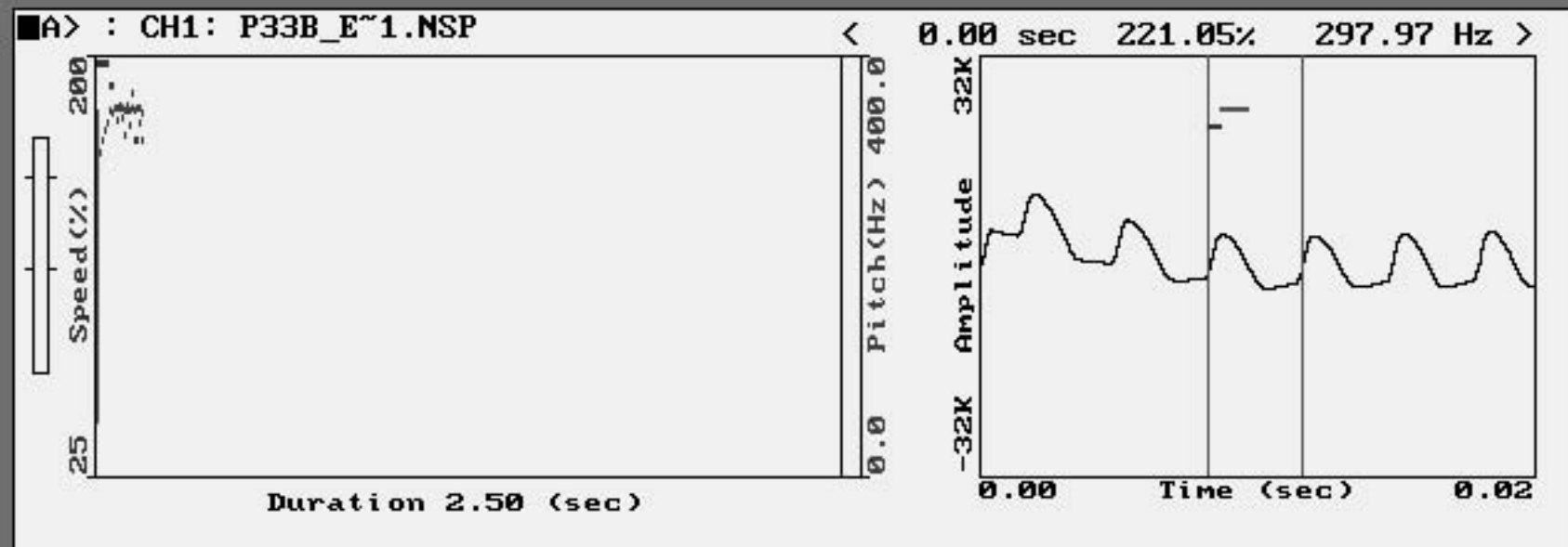
**B** > :

< sec % Hz >



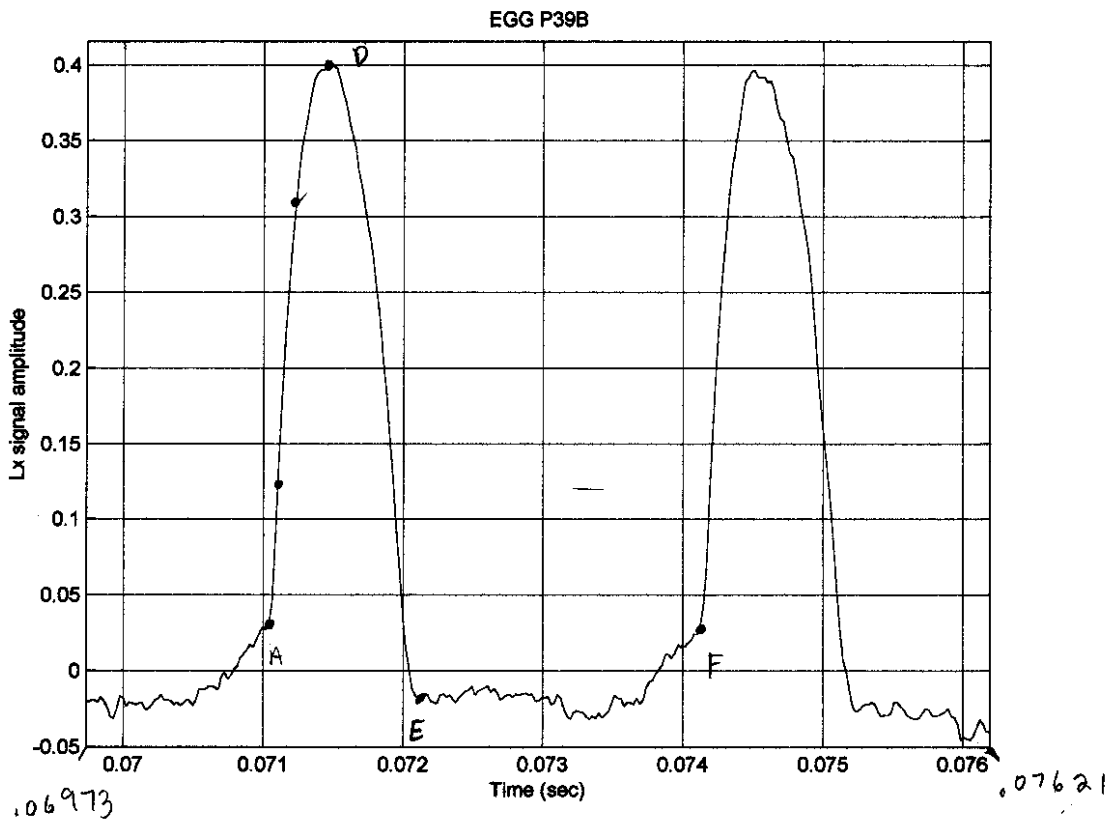
Duration 2.50 (sec)

0.0 Pitch(Hz) 400.0



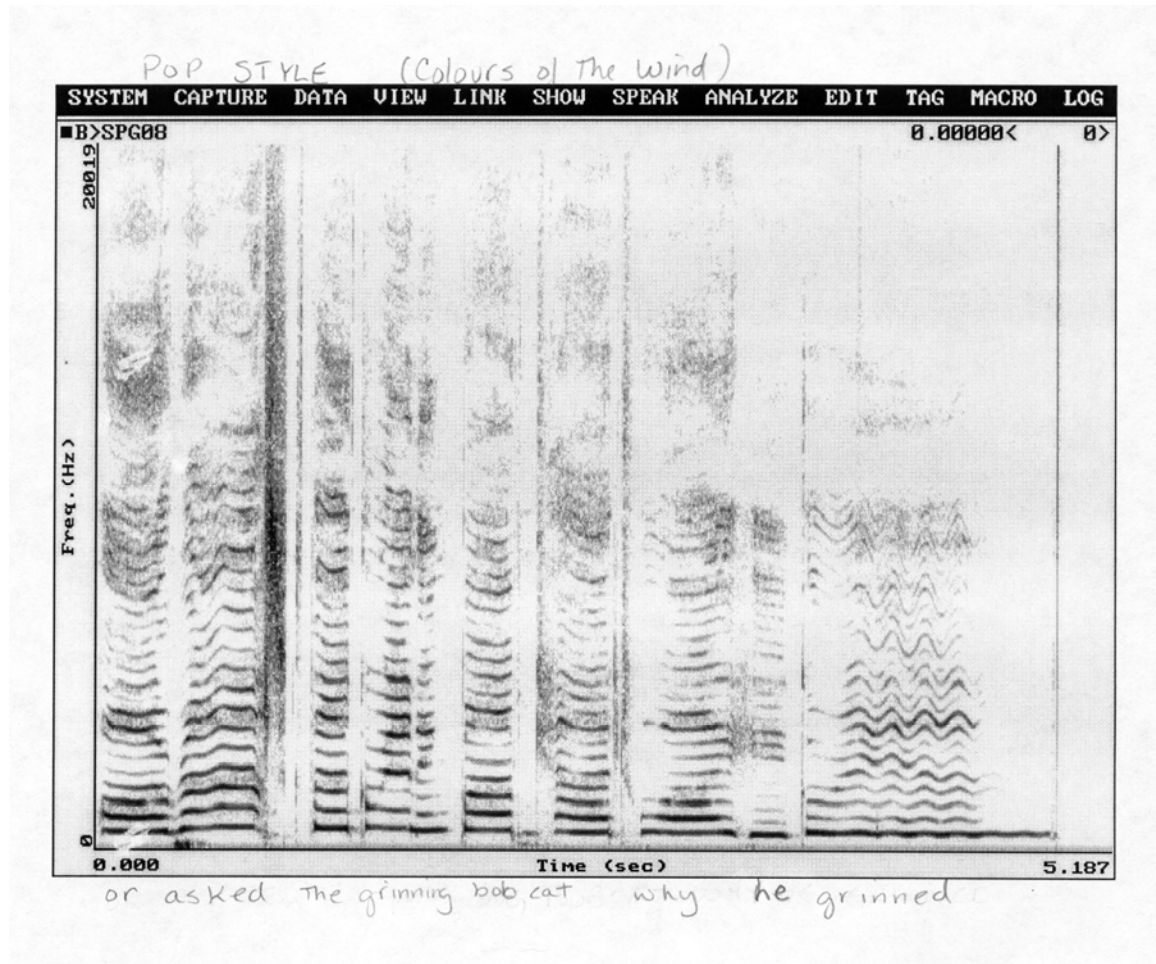
$x \rightarrow 24 \text{ mm} = .001$   
 $y \rightarrow 13 \text{ mm} = .05$

$y \rightarrow 1 \text{ mm} = .00384615$

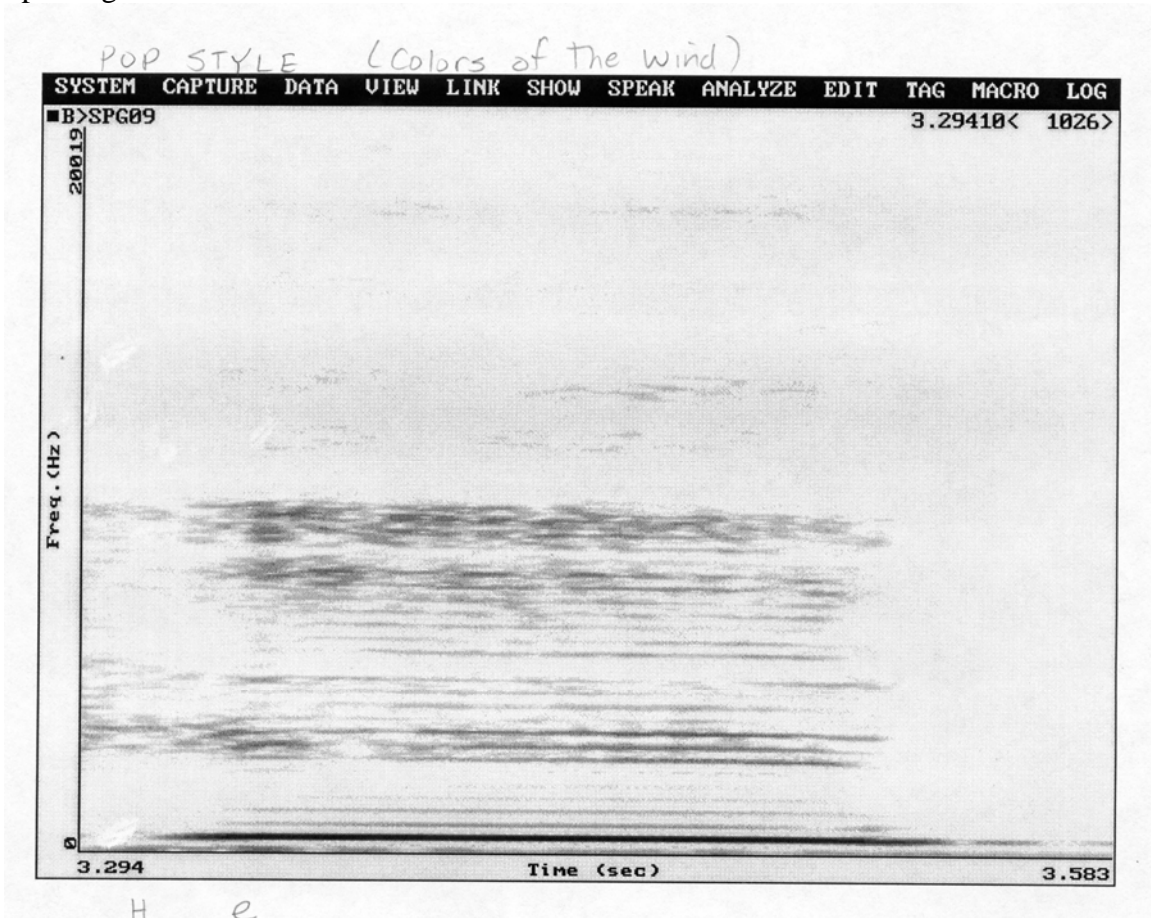


- A (.07104, .03077.)
- B (.07108, .12308.)
- C (.07121, .30769.)
- D (.07146, .40000.)
- E (.07213, -.01731.)
- F (.07413, .02885.)

Spectrogram of P39a



Spectrogram of P39b

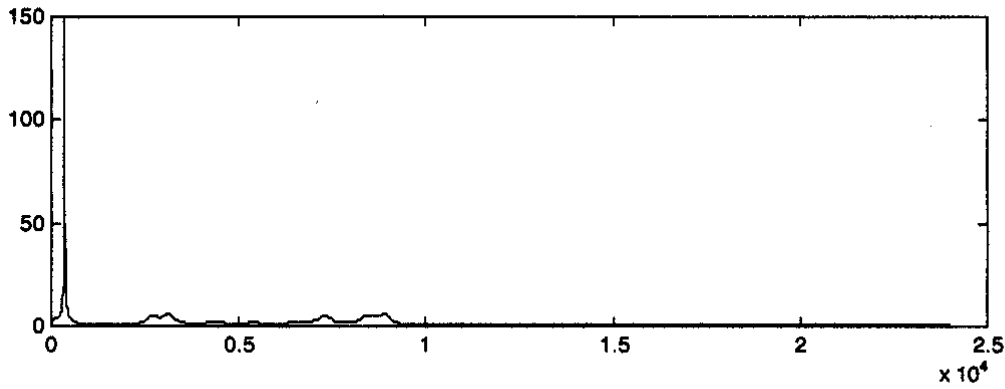
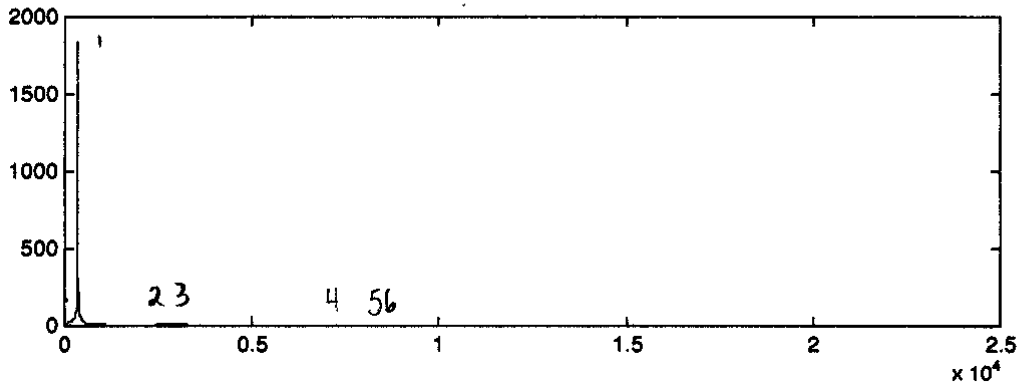


LPC of whole sample P39b

P39

$F_0 = 353 \text{ Hz}$

- 1) 351.56, 1836.60
- 2) 2671.5, 12.40
- 3) 3117.26, 14.80
- 4) 7312.48, 5.43
- 5) 8542.60, 4.95
- 6) 8895.56, 5.00

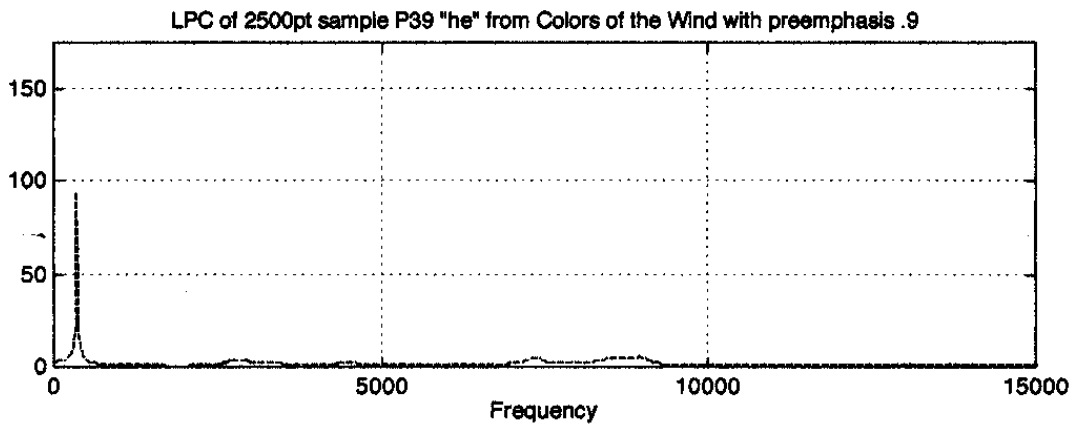
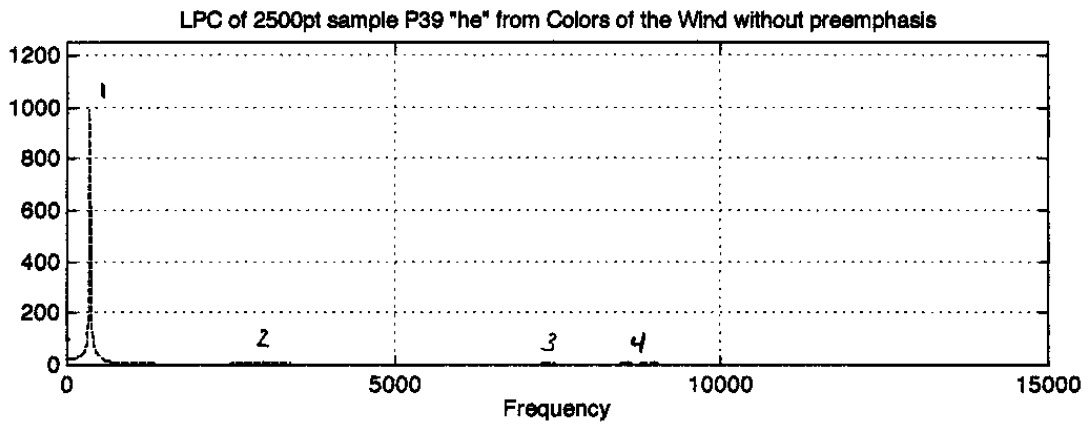


$$.11527083 - .0075833333 = \frac{.107687497}{38}$$

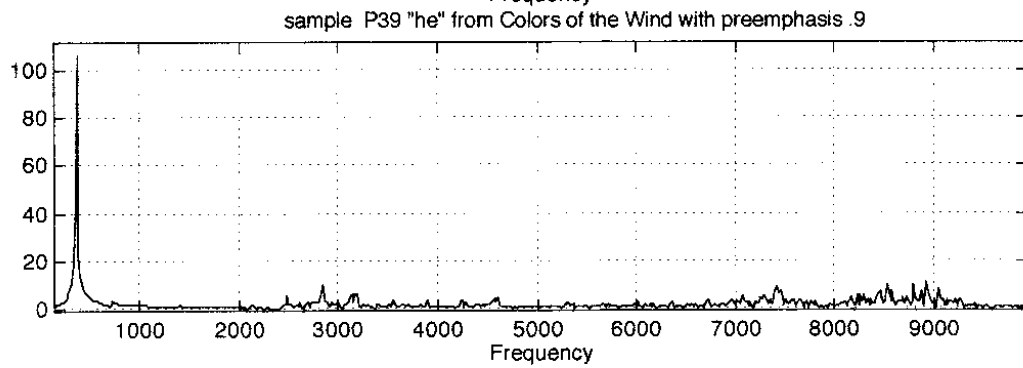
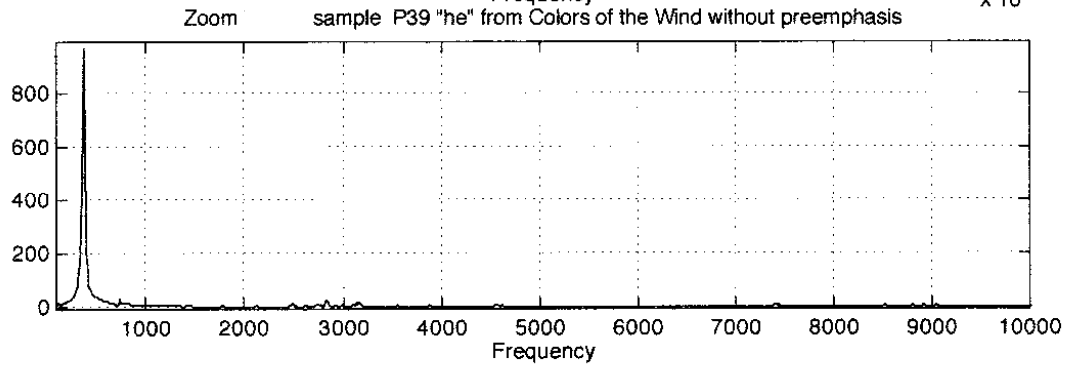
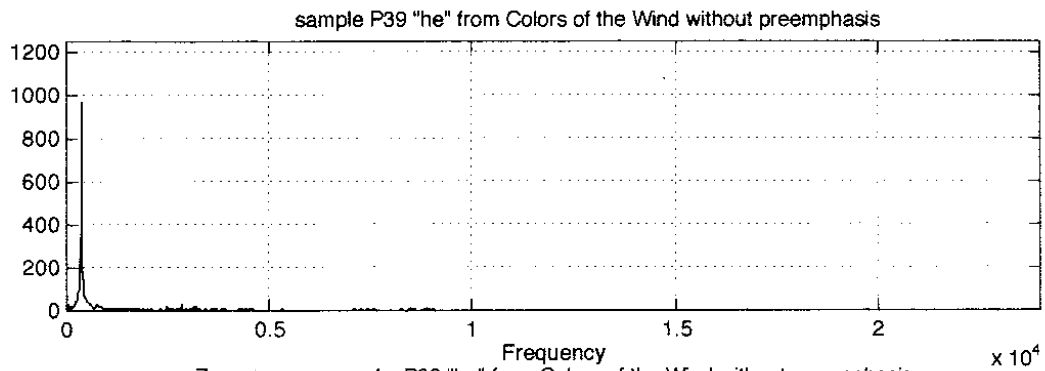
$$= .002833882$$

$$352.8729059$$

- 1 (351.56, 986.4)
- 2 (2800.90, 10.34)
- 3 (7359.38, 5.38)
- 4 (8941.41, 4.80)



# DFT of B39b



DFT Numerical Results

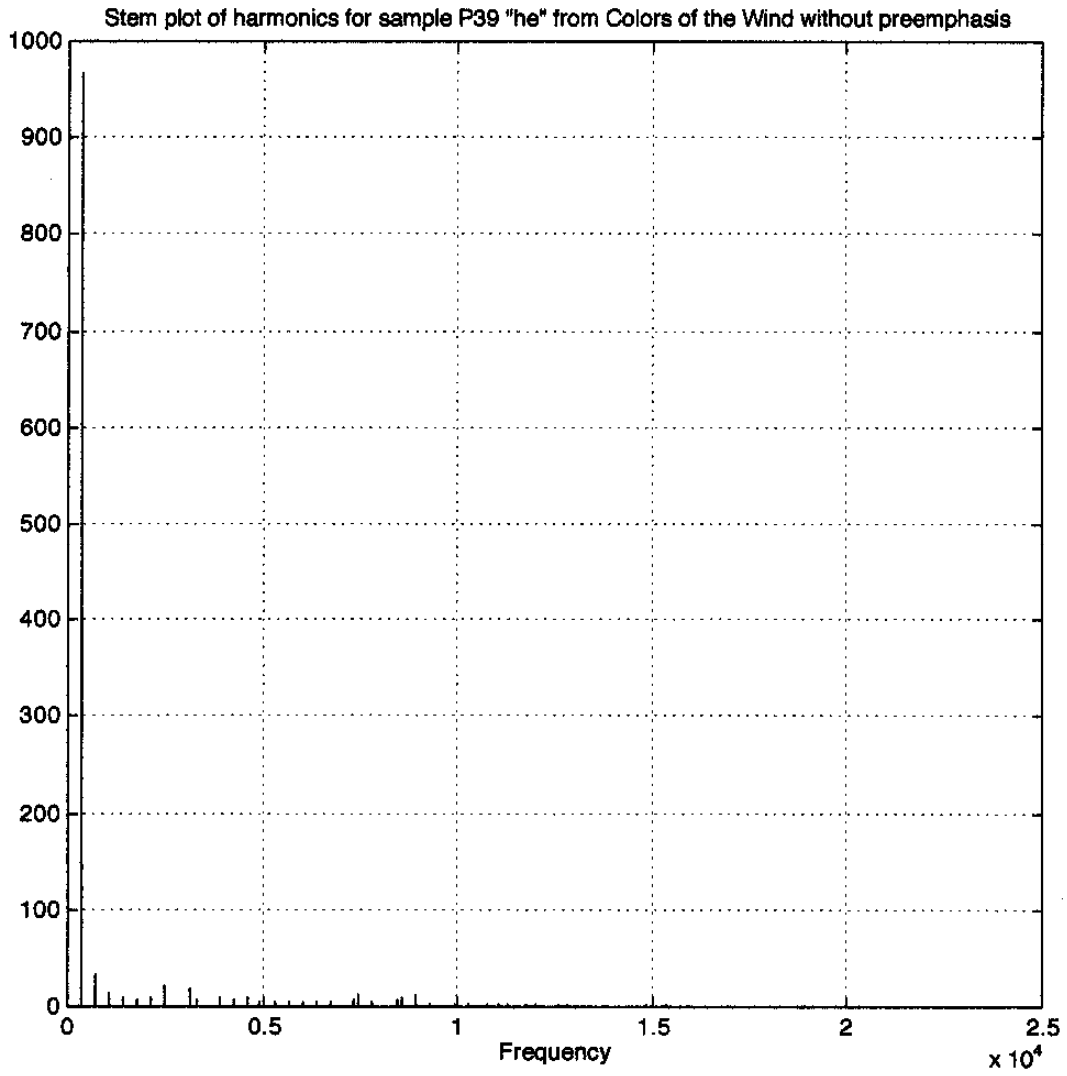
Worksheet saved into file: Minitab.P39  
 MTB > Print 'Freq' 'Amp' '% Amp'.

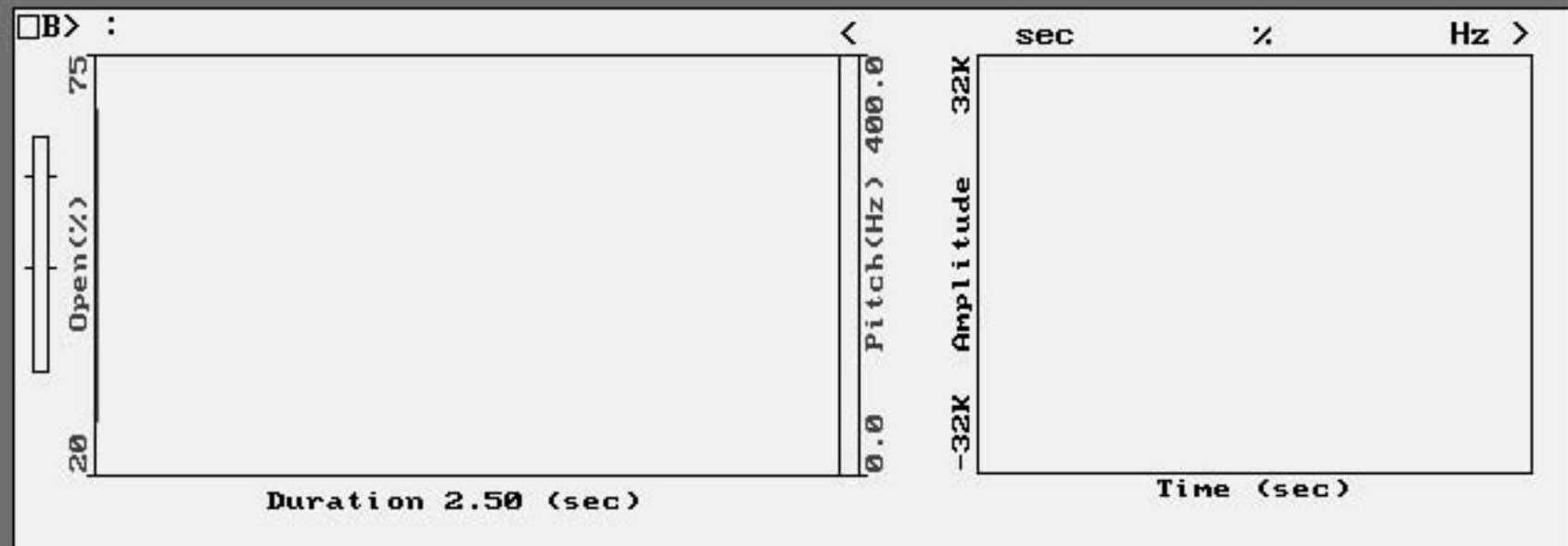
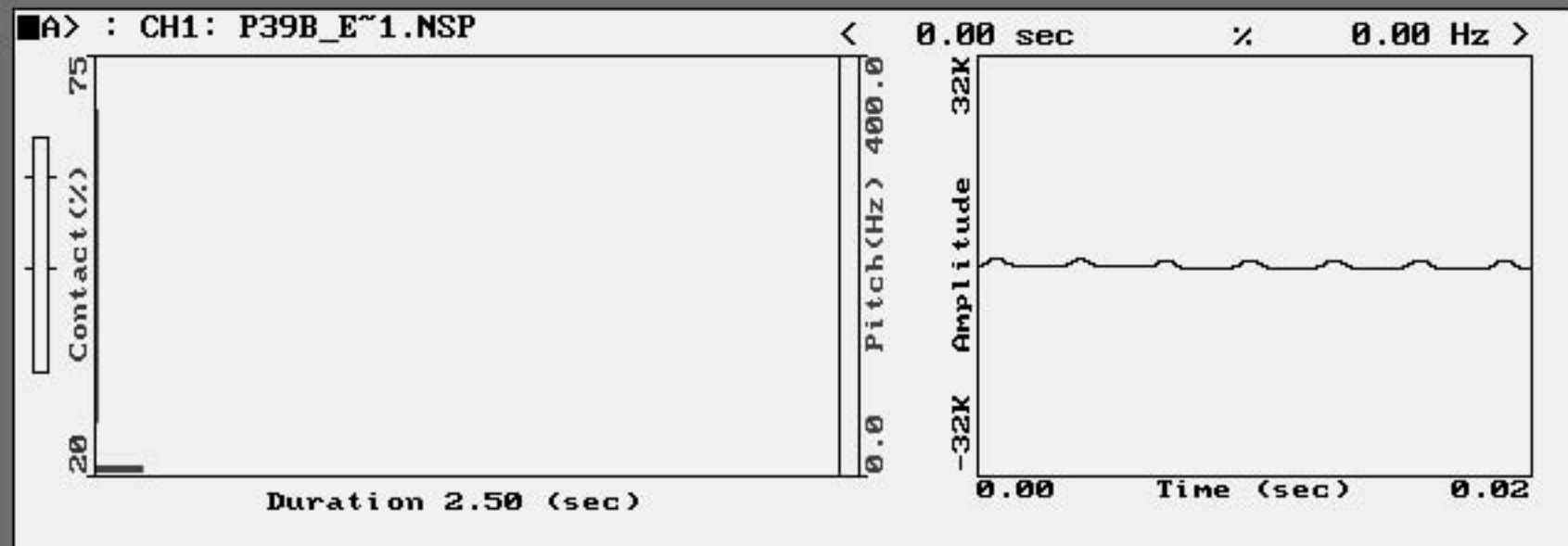
ROW	Freq	Amp	% Amp
1	378	966.216	100.000 ← F1 extreme formant tracking 751
2	738	32.445	3.358
3	1080	14.720	1.524
4	1422	10.556	1.092
5	1782	8.000	0.828
6	2142	8.947	0.926
7	2502	20.200	2.091
8	3150	18.366	1.901 ← F2 very close together 2800
9	3312	6.258	0.648
10	3906	8.469	0.876
11	4248	7.043	0.729
12	4626	9.380	0.971 ←
13	4932	3.635	0.376
14	5328	5.356	0.554
15	5688	4.247	0.440
16	6030	3.973	0.411
17	6390	4.435	0.459
18	6750	4.735	0.490
19	7308	5.987	0.620
20	7434	10.980	1.136 ← not in speech
21	7830	3.768	0.390
22	8460	6.927	0.717
23	8550	10.283	1.064
24	8946	11.425	1.182 ← similar to speech
25	9306	3.232	0.334
26	9900	1.578	0.163
27	10260	1.533	0.159
28	10728	2.256	0.233
29	11070	1.701	0.176
30	11304	1.726	0.179
31	11736	1.281	0.133
32	12006	1.396	0.144
33	12618	1.728	0.179 ←
34	12798	1.423	0.147
35	13374	1.125	0.116
36	13644	1.042	0.108
37	14130	1.102	0.114
38	14490	1.170	0.121
39	14850	1.228	0.127
40	15030	1.301	0.135
41	15390	1.313	0.136
42	15858	1.039	0.108
43	16326	1.091	0.113
44	16758	1.045	0.108
45	17100	1.399	0.145
46	17316	1.124	0.116
47	17658	1.001	0.104
48	18018	1.053	0.109
49	18378	1.080	0.112
50	18792	0.992	0.103
51	19278	0.897	0.093
52	19512	0.935	0.097
53	19926	0.967	0.100
54	20412	0.989	0.102
55	20646	0.823	0.085

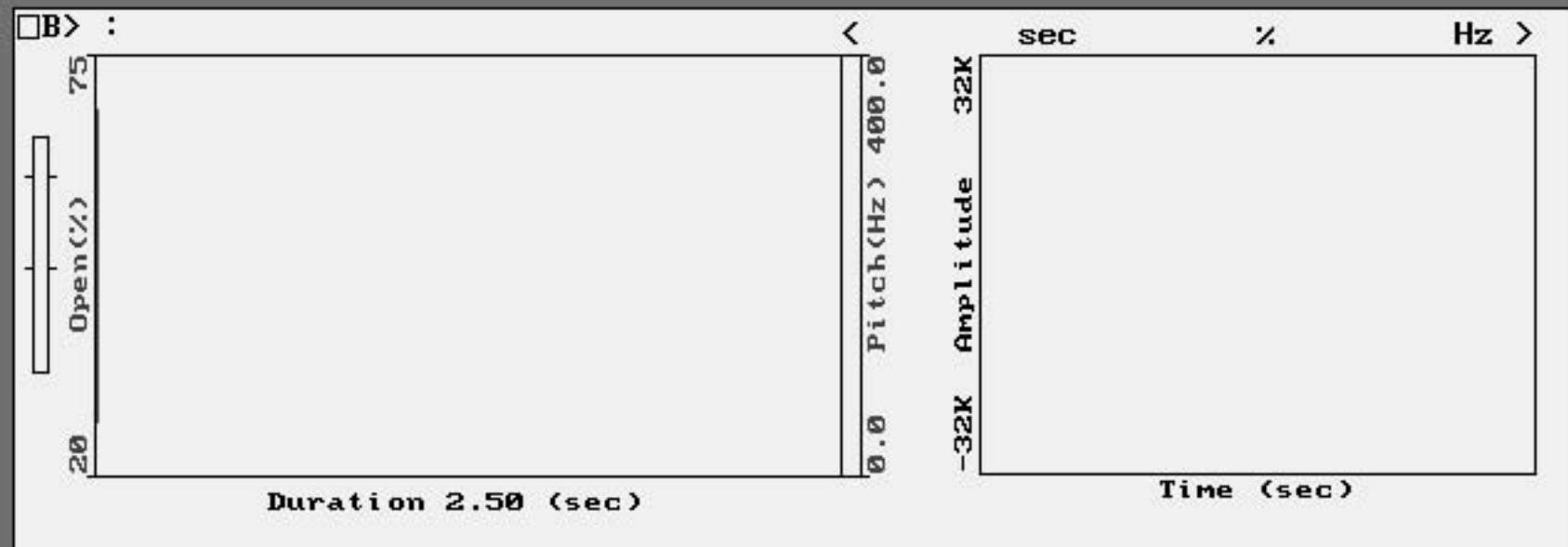
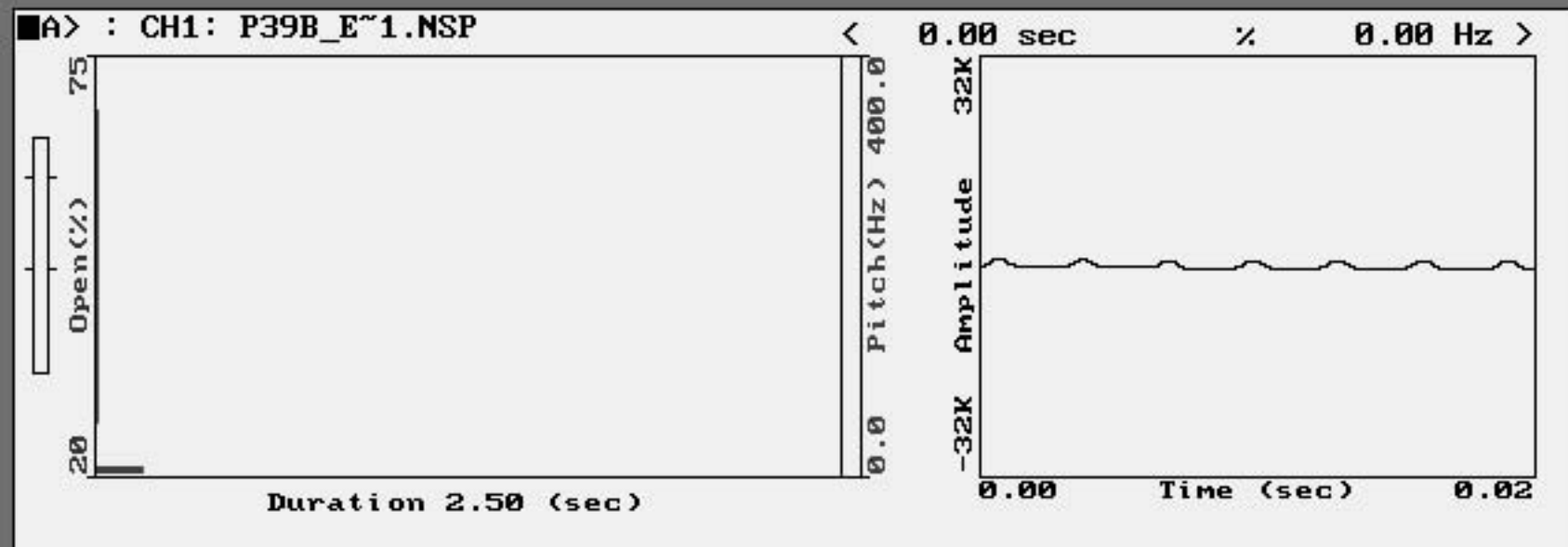
56	21078	0.896	0.093
57	21618	0.828	0.086
58	22032	0.828	0.086
59	22392	0.786	0.081
60	22590	0.774	0.080
61	23148	0.753	0.078
62	23490	0.768	0.079
63	20340	0.321	0.033
64	20646	0.279	0.029
65	21150	0.290	0.030
66	21420	0.311	0.032
67	21762	0.313	0.032
68	22050	0.299	0.031
69	22410	0.319	0.033
70	22626	0.275	0.028
71	23112	0.298	0.031
72	23256	0.278	0.029
73	23670	0.306	0.032
74	14652	0.477	0.049
75	14814	0.404	0.042
76	14994	0.245	0.025
77	15300	0.235	0.024
78	15462	0.327	0.034
79	15714	0.267	0.028
80	15858	0.303	0.031
81	16110	0.390	0.040
82	16290	0.521	0.054
83	16470	0.334	0.035
84	16596	0.258	0.027
85	16776	0.227	0.023
86	17100	0.246	0.025
87	17244	0.245	0.025
88	17478	0.300	0.031
89	17550	0.223	0.023
90	17820	0.179	0.018
91	18054	0.278	0.029
92	18180	0.429	0.044
93	18396	0.334	0.035
94	18666	0.234	0.024
95	18846	0.255	0.026
96	19026	0.263	0.027
97	19278	0.203	0.021
98	19440	0.162	0.017
99	19566	0.166	0.017
100	19782	0.181	0.019
101	20034	0.161	0.017
102	20160	0.179	0.019
103	20430	0.180	0.019
104	20610	0.171	0.018
105	20718	0.158	0.016
106	21042	0.164	0.017
107	21240	0.157	0.016
108	21420	0.141	0.015
109	21564	0.154	0.016
110	21834	0.144	0.015
111	21978	0.138	0.014
112	22104	0.146	0.015
113	22302	0.133	0.014
114	22608	0.144	0.015
115	22824	0.134	0.014

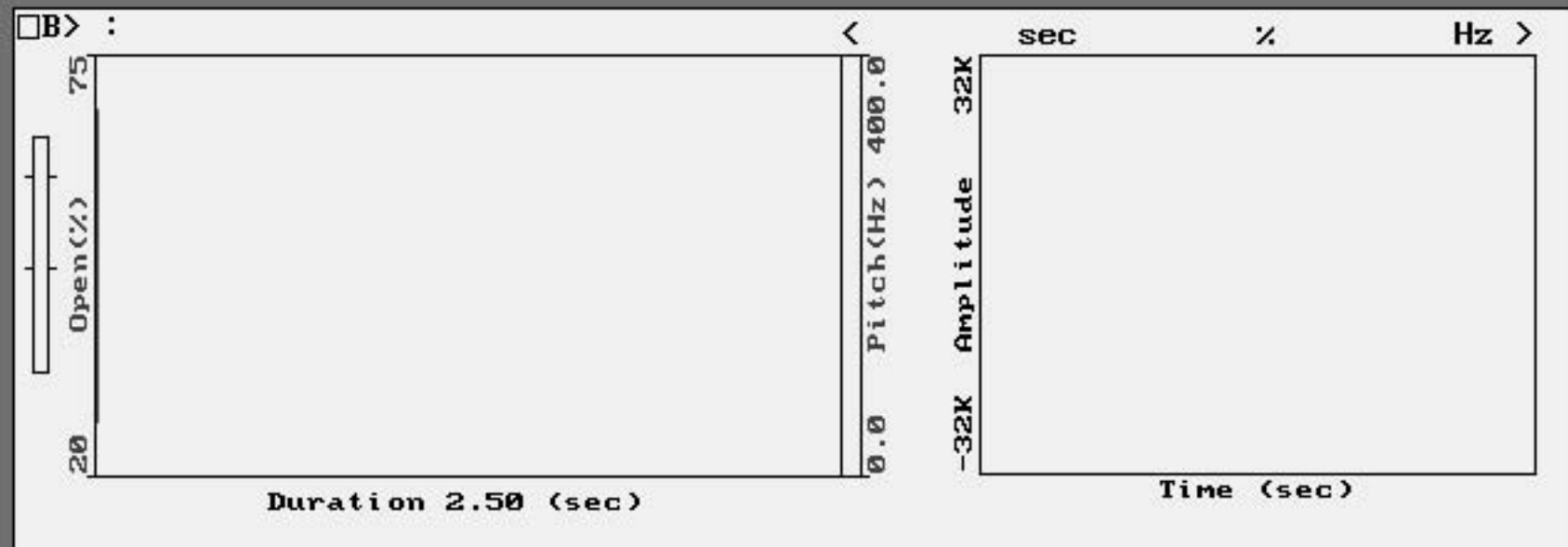
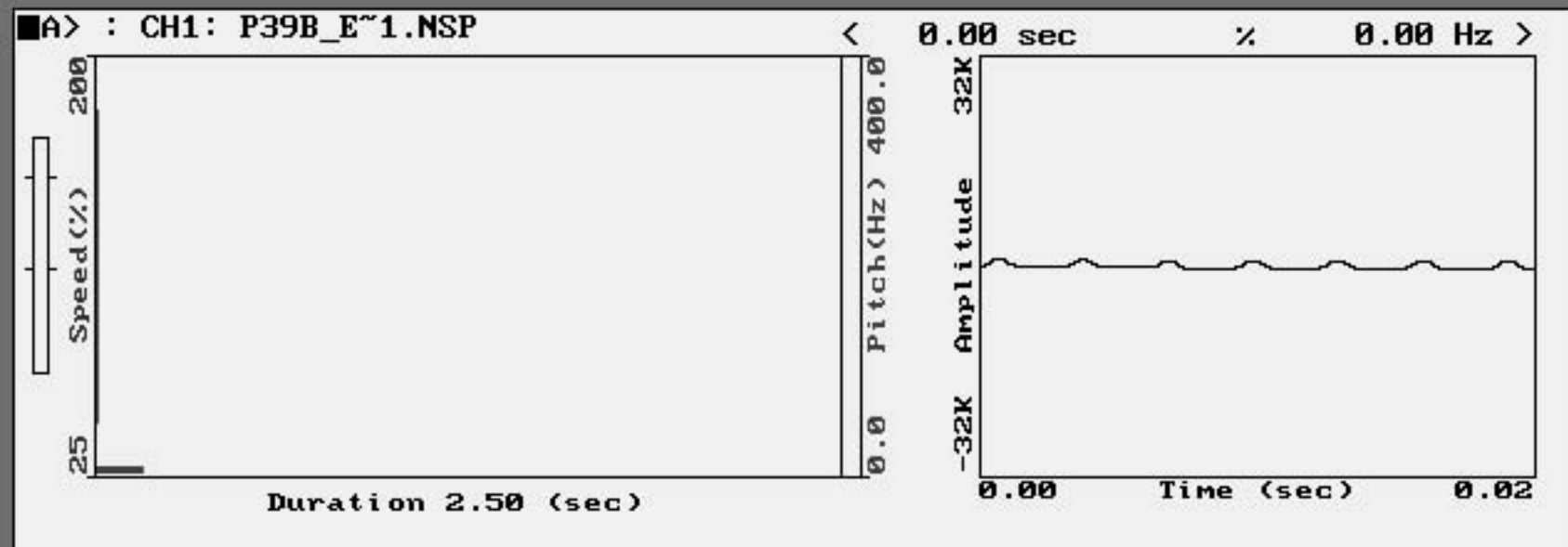
116	22950	0.130	0.013
117	23202	0.139	0.014
118	23418	0.141	0.015
119	23490	0.135	0.014
120	23814	0.133	

0.014









Sample #	P1	P12	P21	P33b	P39b
Description					gain too low
Data Rate (Hz)	44100	44100	44100	44100	
DURATION (sec)	0.75	0.48	0.3	0.16	
Start time	0	0	0	0	
End time	0.75	0.48	0.3	0.16	
Silence	0.22	0.15	0	0.05	
Active	0.55	0.37	0.32	0.15	
Data Points	33280	21248	13312	7056	
Range	8638 (14 Bits)	7623 (13 Bits)	3159 (12 Bits)	11366 (14 Bits)	
PITCH (Hz)					
Mean	204.99	280.18	403.88	345.88	
Pitch Range	147.7	9.01	378.34	57.67	
Minimum	68.47	277.35	37.69	297.97	
Maximum	216.17	286.36	416.03	355.64	
Std Deviation	16.45	1.87	38.46	12.11	
Avg. Jitter %	0.62	0.44	3.95	0.33	
CONTACT(1:6)%					
Mean	50.33	47	48.66	46.32	
Range	47.52	33.37	72.27	11.17	
Minimum	24.53	39.24	7.35	41.21	
Maximum	72.05	72.61	79.62	52.38	
Std Deviation	7.29	8.86	18.91	2.9	
CONTACT(Tif)					
SPEED(3:2)%					
Mean	182.73	155.6	272.05	182.54	
Range	102.37	92.59	402.78	59.71	
Minimum	115.27	111.1	105.55	162.5	
Maximum	217.64	203.69	508.33	222.21	
Std Deviation	15.41	18.97	115.98	14.93	
SPEED(Tif)					
OPEN(4:6)%					
Mean	49.65	52.98	51.32	53.66	
Range	47.52	33.38	72.27	11.16	
Minimum	27.94	27.37	20.37	47.61	
Maximum	75.46	60.75	92.64	58.77	
Std Deviation	7.29	8.86	18.91	2.9	
OPEN(Tif)					

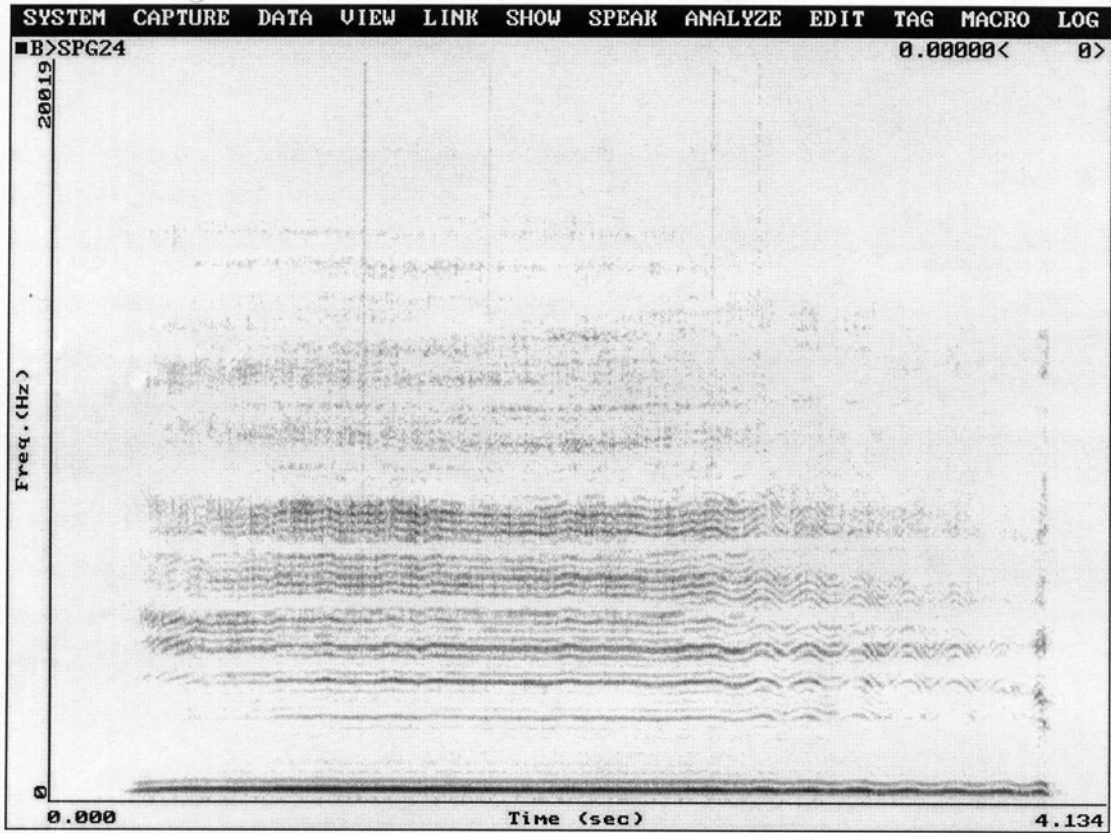
Sample #	R1	R11	R21	R31b	R37b
Description					
Data Rate (Hz)	44100 Hz	44100 Hz	44100 Hz	44100 Hz	44100 Hz
DURATION (sec)	0.37	0.48	0.85	0.16	0.15
Start time	0	0	0	0	0
End time	0.37	0.48	0.85	0.16	0.15
Silence	0	0	0.42	0.01	0
Active	0.39	0.49	0.46	0.16	0.16
Data Points	16192	21248	37376	7168	6432
Range	17975 (15 Bits)	8238 (14 Bits)	4299 (13 Bits)	6876 (13 Bits)	3931 (12 Bits)
PITCH (Hz)					
Mean	209.99	292.19	423.55	250.87	312.64
Pitch Range	169.44	135.32	463.21	429.12	277.06
Minimum	44.63	170.93	140.89	219.4	54.51
Maximum	214.07	306.25	604.1	648.52	331.57
Std Deviation	18.98	10.44	43.71	67.07	39.08
Avg. Jitter %	1.75	0.49	4.34	1.62	3.72
CONTACT(1:6)%					
Mean	38.55	35.22	46.1	29.82	38.62
Range	31.32	31.56	56.19	41.75	37.97
Minimum	8.29	32	27.46	27.36	5.19
Maximum	39.61	63.56	83.65	69.11	43.16
Std Deviation	3.49	3.07	15.98	6.7	5.36
CONTACT(Tif)					
SPEED(3:2)%					
Mean	217.68	160.42	113.45	139.77	210.76
Range	20.31	173.85	107.38	103.3	78.67
Minimum	207.69	26.15	42.62	73.17	162.5
Maximum	228	200	150	176.47	241.17
Std Deviation	5.6	16.43	36.13	18.44	17.39
SPEED(Tif)					
OPEN(4:6)%					
Mean	61.43	64.76	53.88	70.16	61.36
Range	31.32	31.57	56.18	41.75	37.97
Minimum	60.38	36.43	16.34	30.88	56.83
Maximum	91.7	68	72.52	72.63	94.8
Std Deviation	3.49	3.07	15.98	6.7	5.36
OPEN(Tif)					

Spectrogram for R1

R+B style

[i] vowel

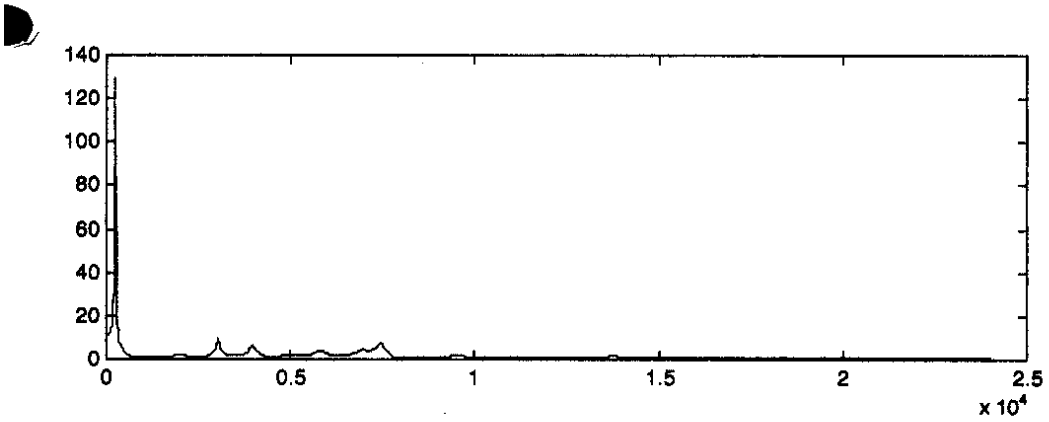
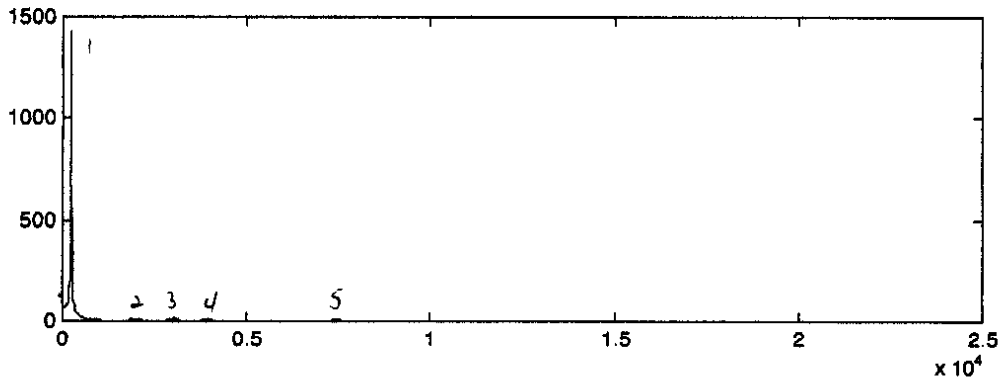
Pitch B3



LPC of whole sample R1

- 1) 234.38 , 1433.41
- 2) 2010.00, 7.00
- 3) 3035.15, 18.70
- 4) 3961.00, 10.55
- 5) 7462.00, 6.70

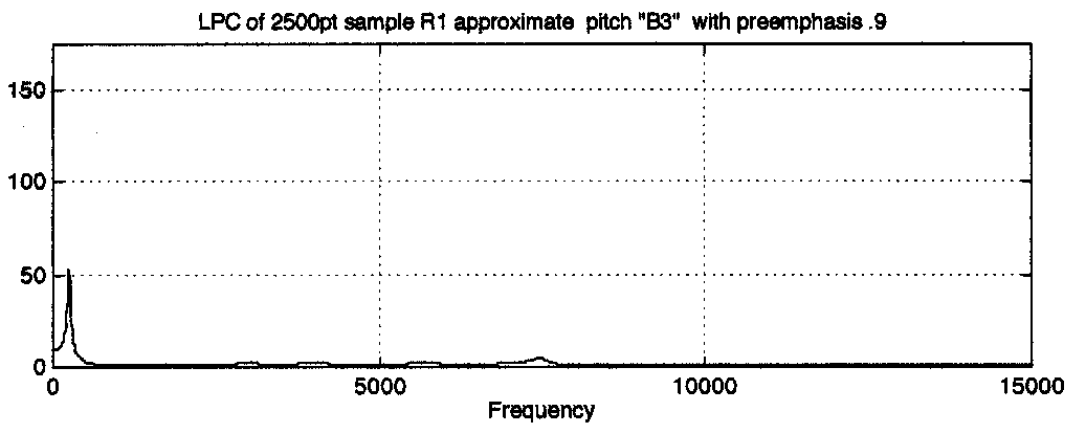
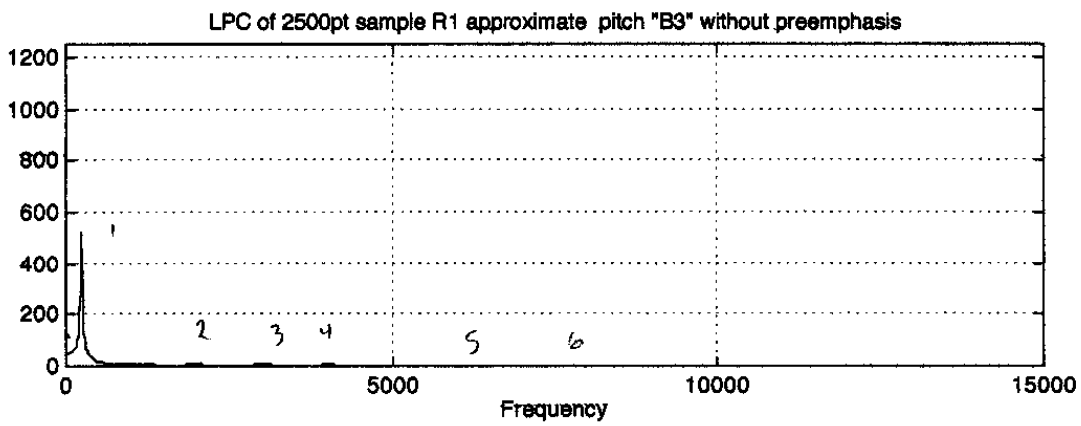
$$F_0 = 232 \text{ Hz}$$



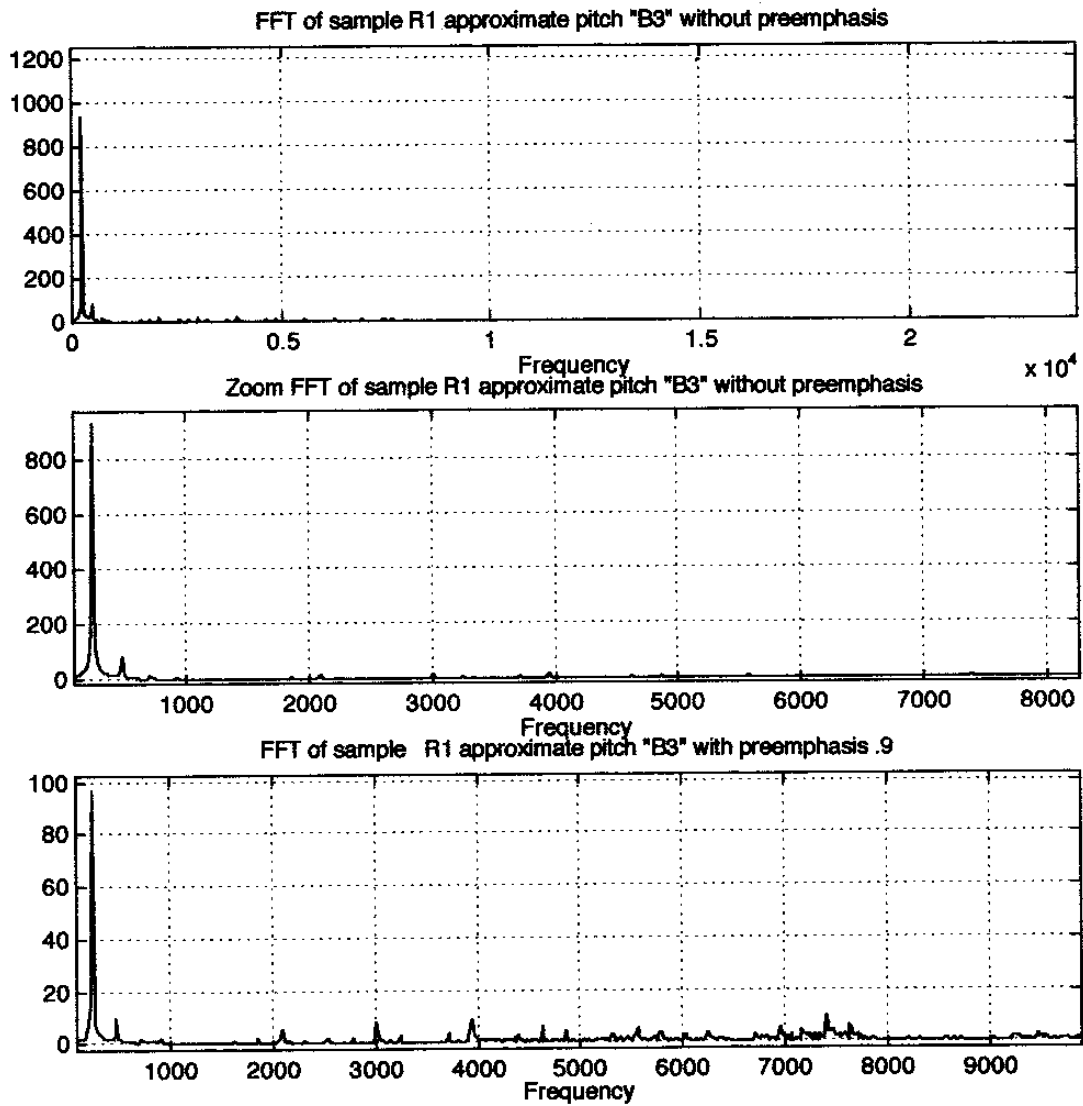
$$.15764583 - .0069583333 = .150687497$$

$$232.2687728$$

(234.38, 520.47)  
(1993.95, 4.55)  
(3022.57, 5.98)  
(4019.50, 4.79)  
(5788.99, 2.73)  
(7474.53, 3.84)



# DFT Results for R1

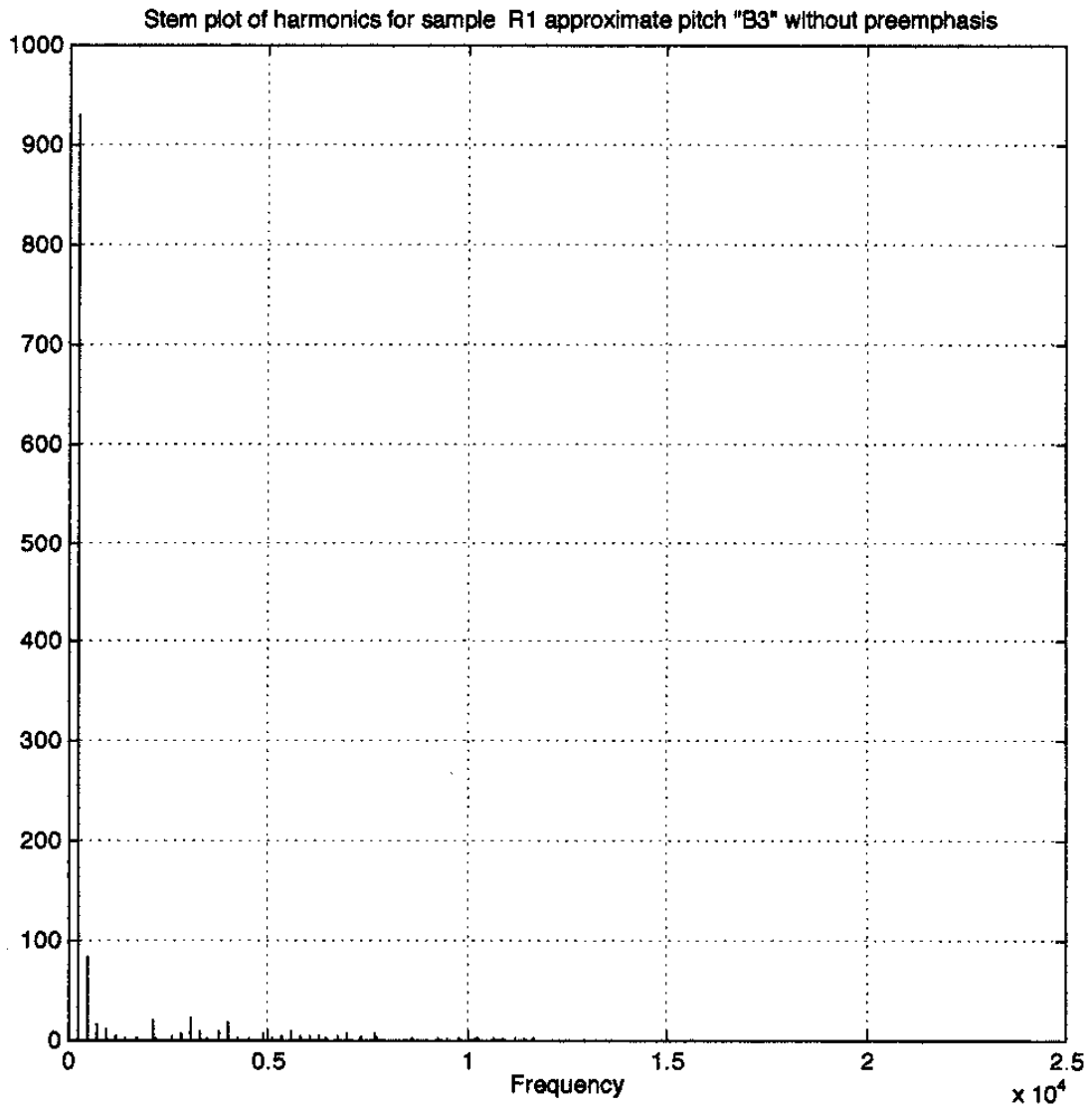


DFT Numerical Results

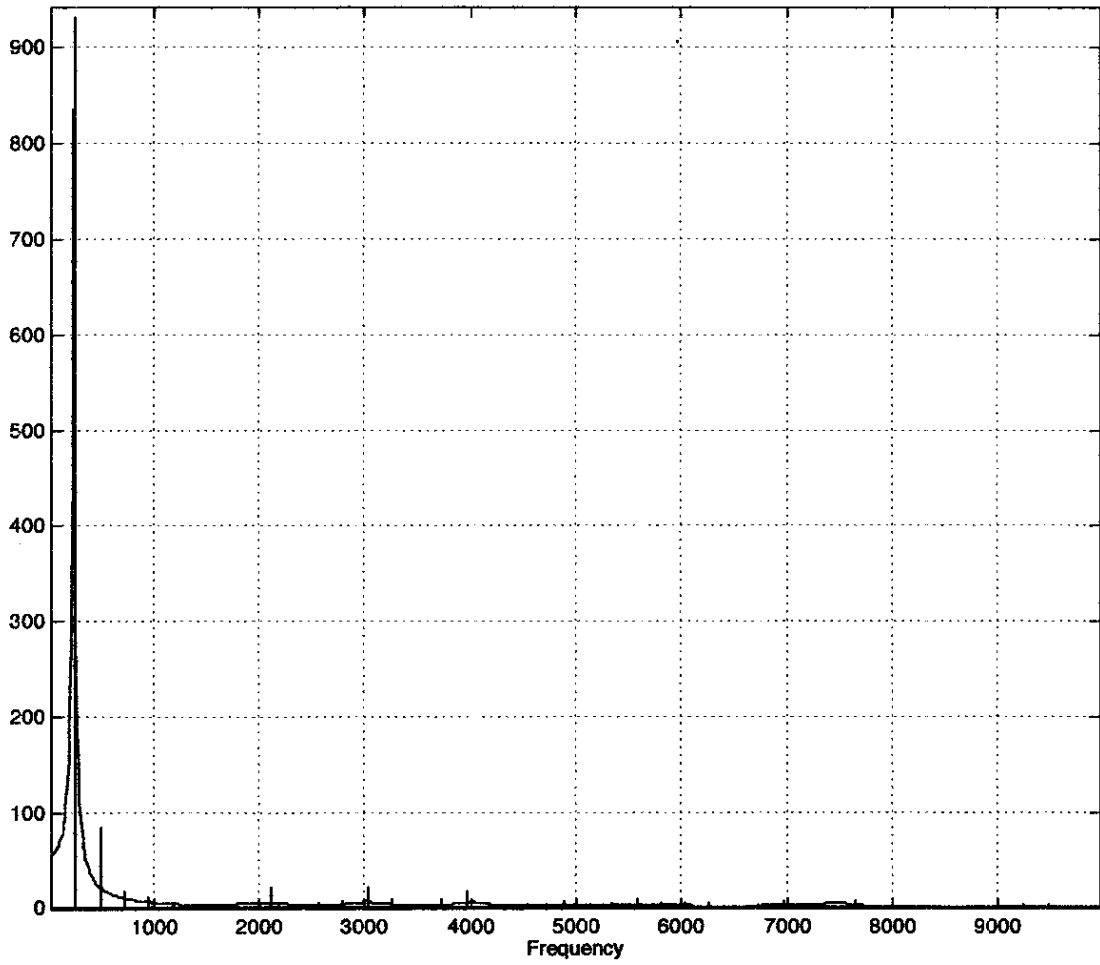
ROW	Freq	Amp	% Amp	
1	252	930.227	100.000	- <i>nothing good</i>
2	486	84.430	9.076	
3	720	17.195	1.848	
4	936	11.470	1.233	
5	1188	4.718	0.507	
6	1422	3.205	0.345	
7	1710	2.626	0.282	
8	2106	21.034	2.261	← <i>105 Hz</i>
9	2178	3.025	0.325	
10	2556	5.508	0.592	
11	2790	6.429	0.691	
12	3024	22.426	2.411	←
13	3258	8.412	0.904	
14	3474	1.657	0.178	
15	3726	8.357	0.898	
16	3960	18.237	1.960	←
17	4212	2.635	0.283	
18	4536	2.650	0.285	
19	4878	8.137	0.875	
20	5094	1.519	0.163	
21	5346	4.899	0.527	
22	5580	8.748	0.940	
23	5814	5.211	0.560	
24	6030	4.150	0.446	
25	6264	5.504	0.592	
26	6462	1.251	0.135	
27	6732	3.878	0.417	
28	6966	6.908	0.743	
29	7308	3.794	0.408	
30	7650	7.588	0.816	
31	7722	3.000	0.322	
32	8118	0.762	0.082	
33	8334	0.976	0.105	
34	8604	1.177	0.127	
35	8730	0.818	0.088	
36	9054	0.801	0.086	
37	9252	2.260	0.243	
38	9486	2.398	0.258	
39	9792	1.330	0.143	
40	10170	1.541	0.166	
41	10260	1.275	0.137	
42	10656	1.312	0.141	
43	10890	1.333	0.143	
44	11160	1.221	0.131	
45	11412	1.223	0.131	
46	11646	1.783	0.192	
47	11880	1.110	0.119	
48	12042	0.715	0.077	
49	12420	0.553	0.059	
50	12636	0.785	0.084	
51	12780	0.753	0.081	
52	13176	0.856	0.092	
53	13428	0.488	0.052	
54	13554	0.944	0.101	
55	13788	0.928	0.100	
56	14058	0.846	0.091	
57	14310	0.554	0.060	
58	14652	0.784	0.084	

59	14778	0.761	0.082
60	15066	0.572	0.062
61	15282	0.589	0.063
62	15570	0.713	0.077
63	15840	0.462	0.050
64	16056	0.484	0.052
65	16452	0.477	0.051
66	16686	0.462	0.050
67	16920	0.652	0.070
68	17046	0.447	0.048
69	17370	0.458	0.049
70	17604	0.587	0.063
71	17838	0.495	0.053
72	18234	0.471	0.051
73	18486	0.769	0.083
74	18720	0.556	0.060
75	18954	0.473	0.051
76	19062	0.371	0.040
77	19386	0.390	0.042
78	19746	0.381	0.041
79	19836	0.374	0.040
80	20070	0.350	0.038
81	20466	0.350	0.038
82	20592	0.352	0.038
83	20880	0.359	0.039
84	21222	0.348	0.037
85	21510	0.359	0.039
86	21708	0.365	0.039
87	21942	0.345	0.037
88	22176	0.372	0.040
89	22464	0.345	0.037
90	22626	0.341	0.037
91	23022	0.337	0.036
92	23202	0.322	0.035
93	23472	0.323	0.035
94	23724	0.327	0.035
95	22302	0.557	0.060
96	22554	0.583	0.063
97	22752	0.556	0.060
98	22986	0.569	0.061
99	23094	0.571	0.061
100	23490	0.559	0.060
101	23670	0.547	0.059
102	20160	0.179	0.019
103	20430	0.180	0.019
104	20610	0.171	0.018
105	20718	0.158	0.017
106	21042	0.164	0.018
107	21240	0.157	0.017
108	21420	0.141	0.015
109	21564	0.154	0.017
110	21834	0.144	0.015
111	21978	0.138	0.015
112	22104	0.146	0.016
113	22302	0.133	0.014
114	22608	0.144	0.016
115	22824	0.134	0.014
116	22950	0.130	0.014
117	23202	0.139	0.015
118	23418	0.141	0.015

119 23490 0.135 0.014  
120 23814 0.133  
0.014



Stem plot/LPC overlay of harmonics for sample R1 without preemphasis

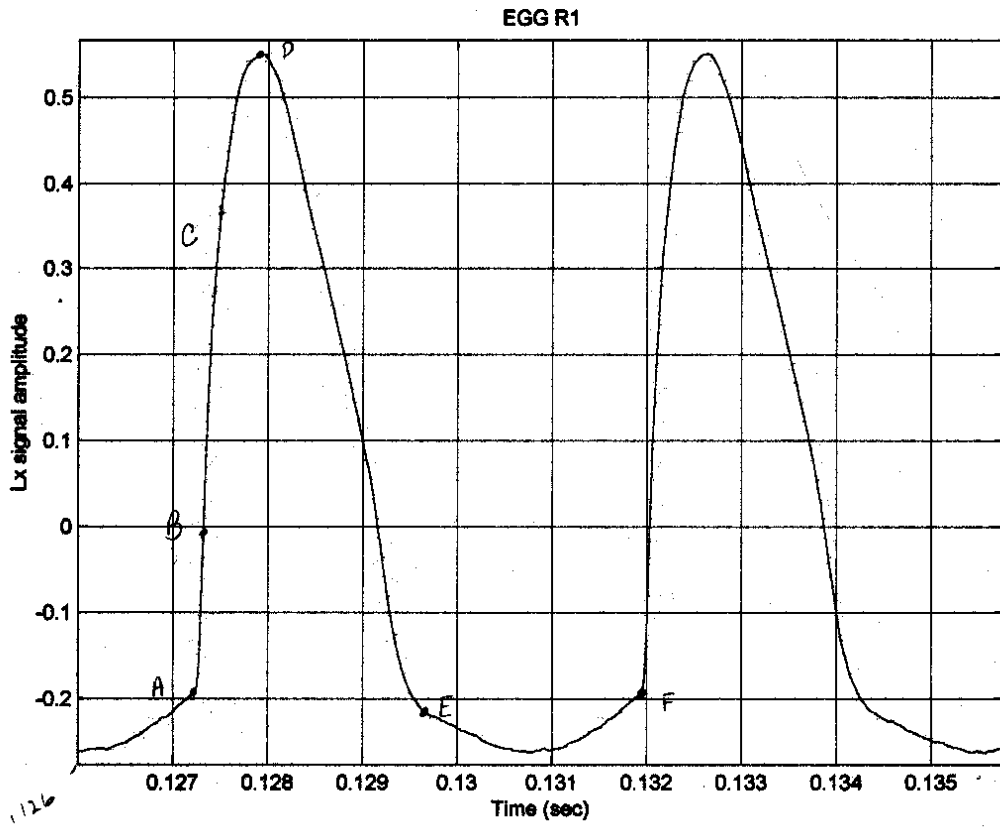


$$x \Rightarrow 16 \text{ mm} = .001$$

$$y \Rightarrow 15 \text{ mm} = .1$$

$$x \Rightarrow 1 \text{ mm} = .0000625$$

$$y \Rightarrow 1 \text{ mm} = .0066666$$

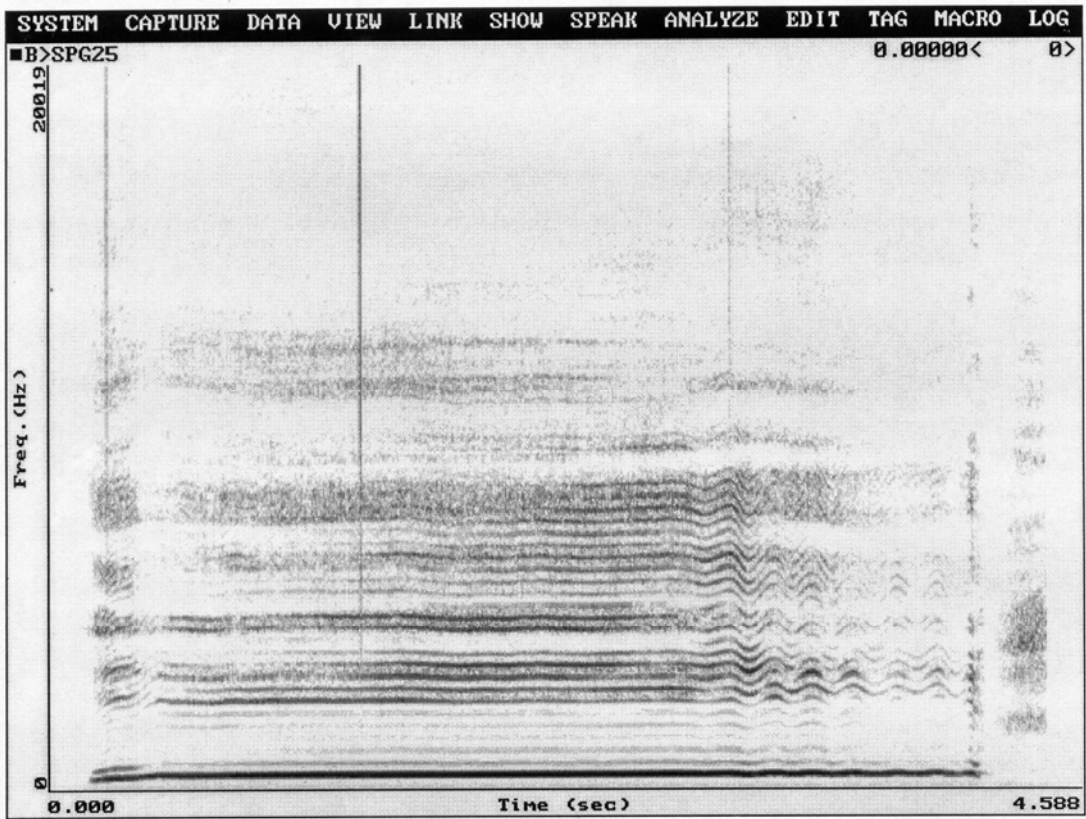


Spectrogram of R11

R+B style

[i] vowel

pitch E<sub>4</sub>



LPC of R11

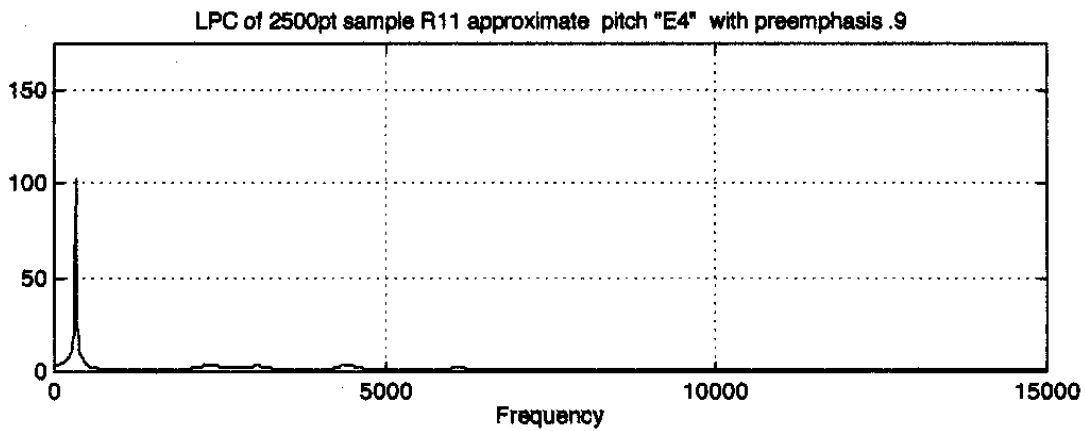
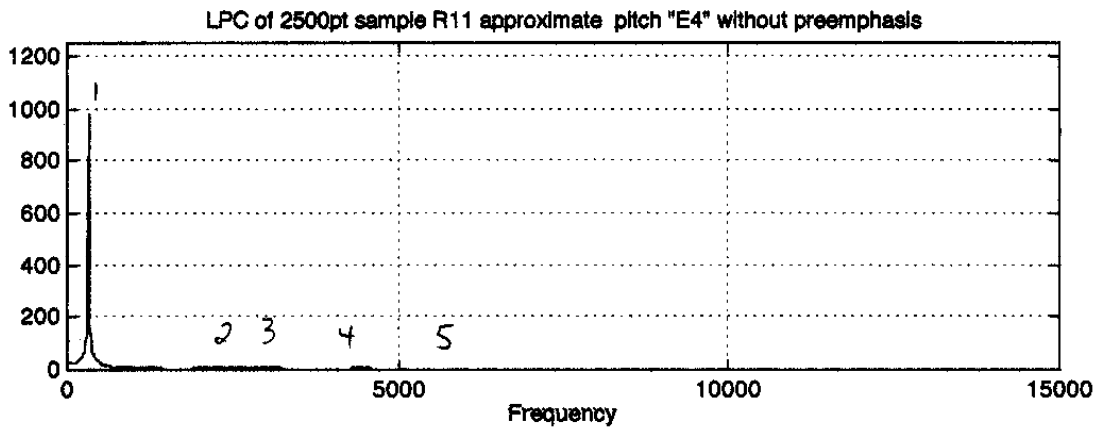
(328.13, 979.34)

(2296.88, 11.74)

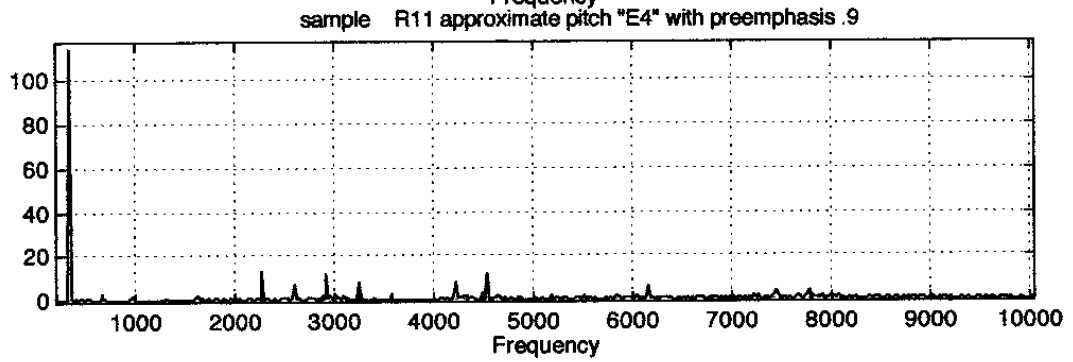
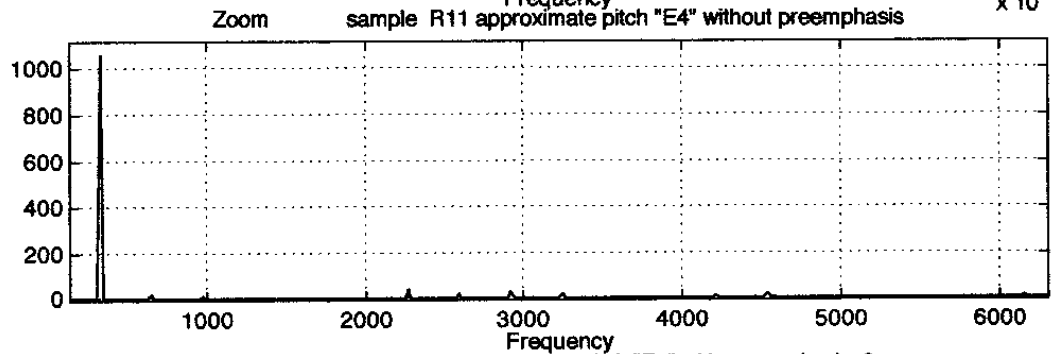
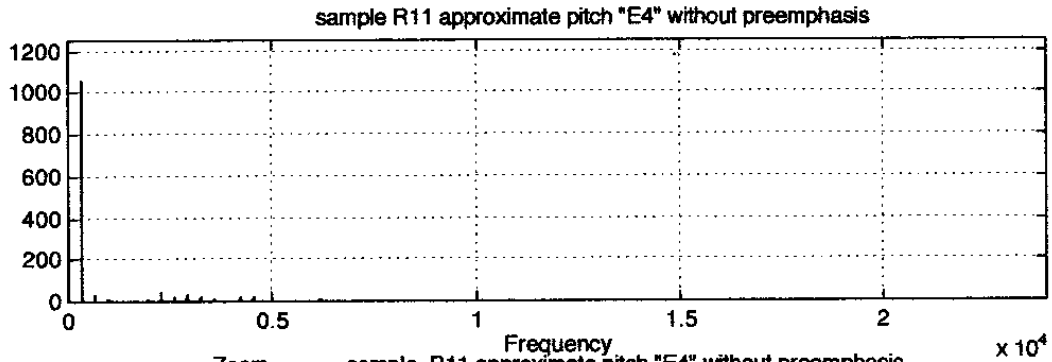
(3023.59, 8.37)

(4429.69, 6.29)

(6070.31, 2.52)



DFT Results for R11



DFT Numerical Results

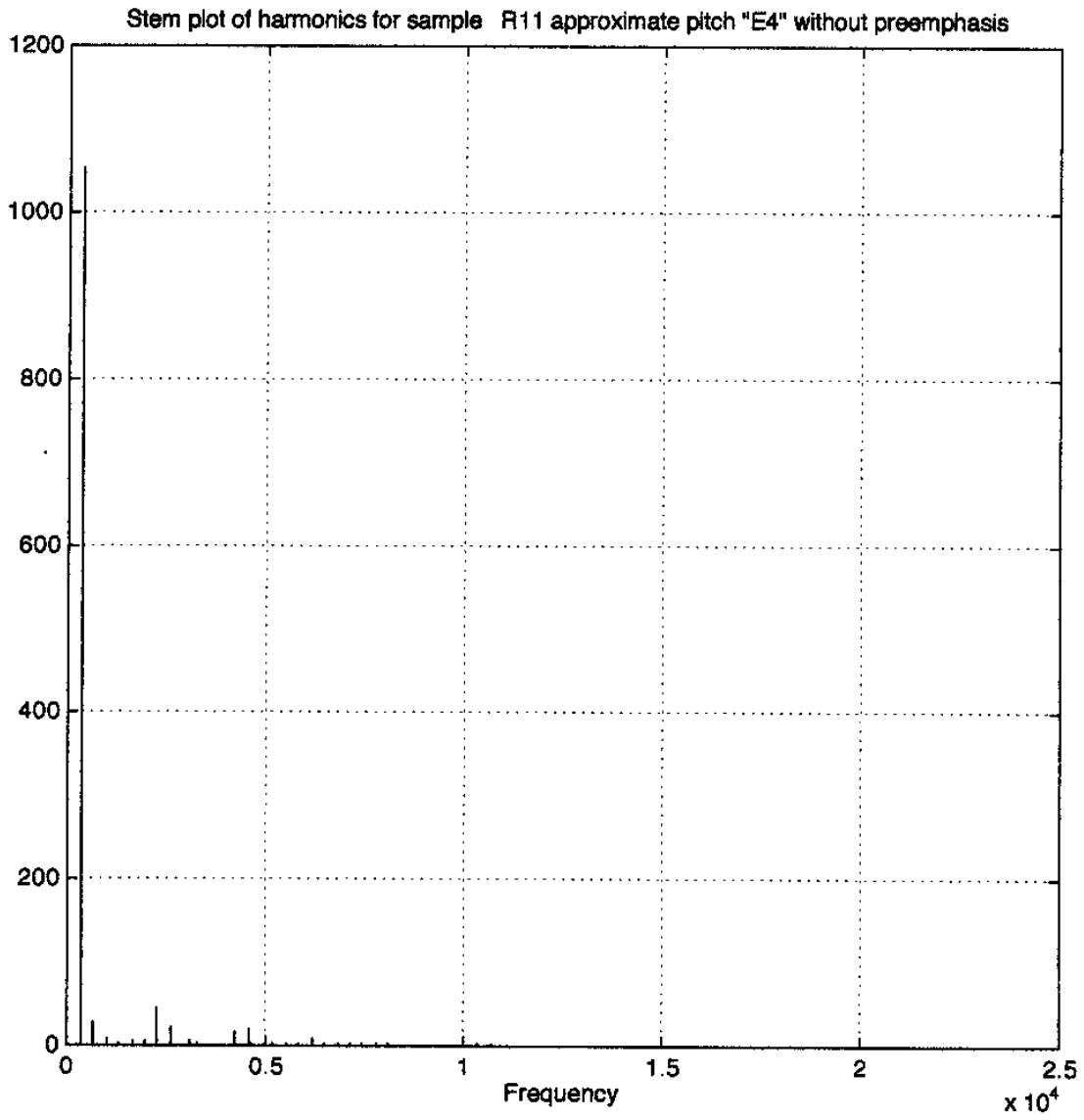
Worksheet saved into file: Minitab.R11  
 MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	342	1054.44	100.000
2	666	27.03	2.563
3	990	9.53	0.904
4	1314	4.19	0.397
5	1638	5.21	0.494
6	1962	5.81	0.551
7	2286	46.04	4.366
8	2610	21.68	2.056
9	3096	5.30	0.502
10	3294	1.60	0.152
11	3690	0.71	0.067
12	4230	17.57	1.667
13	4554	20.75	1.968
14	4662	3.35	0.318
15	5202	3.32	0.315
16	5526	1.68	0.159
17	5850	2.57	0.244
18	6174	9.63	0.914
19	6498	2.67	0.253
20	6822	2.10	0.200
21	7146	2.73	0.259
22	7470	3.97	0.376
23	7794	3.51	0.333
24	8082	1.46	0.139
25	8442	0.43	0.040
26	8766	1.07	0.101
27	9144	0.58	0.055
28	9486	0.44	0.042
29	10044	0.34	0.032
30	10386	1.59	0.151
31	10710	1.73	0.164
32	10854	0.99	0.094
33	11394	0.46	0.043
34	11682	1.00	0.095
35	11844	0.53	0.050
36	12330	0.39	0.037
37	12762	0.10	0.010
38	12996	0.24	0.023
39	13338	0.44	0.042
40	13644	0.16	0.015
41	13950	0.12	0.012
42	14418	0.17	0.016
43	14796	0.10	0.010
44	14922	0.10	0.009
45	15426	0.12	0.011
46	15840	0.08	0.007
47	16056	0.10	0.010
48	16470	0.08	0.007
49	16686	0.07	0.007
50	16974	0.09	0.009
51	17550	0.06	0.005
52	17910	0.08	0.007
53	18162	0.16	0.015
54	18450	0.16	0.015
55	18720	0.20	0.019

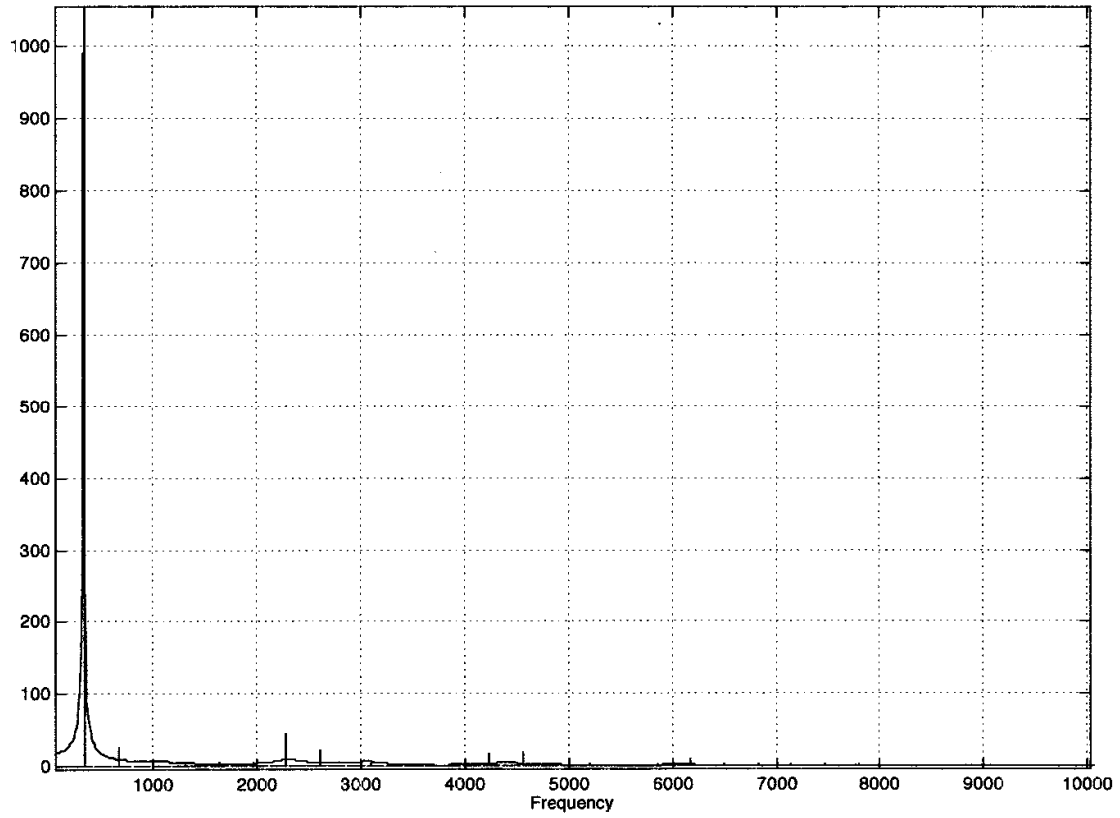
—  
 — *low Fz*

56	19242	0.10	0.009
57	19566	0.09	0.008
58	19746	0.08	0.007
59	20286	0.06	0.005
60	20466	0.06	0.005
61	20880	0.04	0.003
62	21132	0.04	0.004
63	21492	0.04	0.004
64	21906	0.05	0.005
65	22140	0.04	0.004
66	22446	0.04	0.004
67	22860	0.03	0.003
68	23184	0.02	0.002
69	23652	0.02	0.002
70	17604	0.59	0.056
71	17838	0.50	0.047
72	18234	0.47	0.045
73	18486	0.77	0.073
74	18720	0.56	0.053
75	18954	0.47	0.045
76	19062	0.37	0.035
77	19386	0.39	0.037
78	19746	0.38	0.036
79	19836	0.37	0.035
80	20070	0.35	0.033
81	20466	0.35	0.033
82	20592	0.35	0.033
83	20880	0.36	0.034
84	21222	0.35	0.033
85	21510	0.36	0.034
86	21708	0.37	0.035
87	21942	0.34	0.033
88	22176	0.37	0.035
89	22464	0.34	0.033
90	22626	0.34	0.032
91	23022	0.34	0.032
92	23202	0.32	0.030
93	23472	0.32	0.031
94	23724	0.33	0.031
95	22302	0.56	0.053
96	22554	0.58	0.055
97	22752	0.56	0.053
98	22986	0.57	0.054
99	23094	0.57	0.054
100	23490	0.56	0.053
101	23670	0.55	0.052
102	20160	0.18	0.017
103	20430	0.18	0.017
104	20610	0.17	0.016
105	20718	0.16	0.015
106	21042	0.16	0.016
107	21240	0.16	0.015
108	21420	0.14	0.013
109	21564	0.15	0.015
110	21834	0.14	0.014
111	21978	0.14	0.013
112	22104	0.15	0.014
113	22302	0.13	0.013
114	22608	0.14	0.014
115	22824	0.13	0.013

116	22950	0.13	0.012
117	23202	0.14	0.013
118	23418	0.14	0.013
119	23490	0.13	0.013
120	23814	0.13	0.013



Stem plot/LPC overlay of harmonics for sample R11 without preemphasis

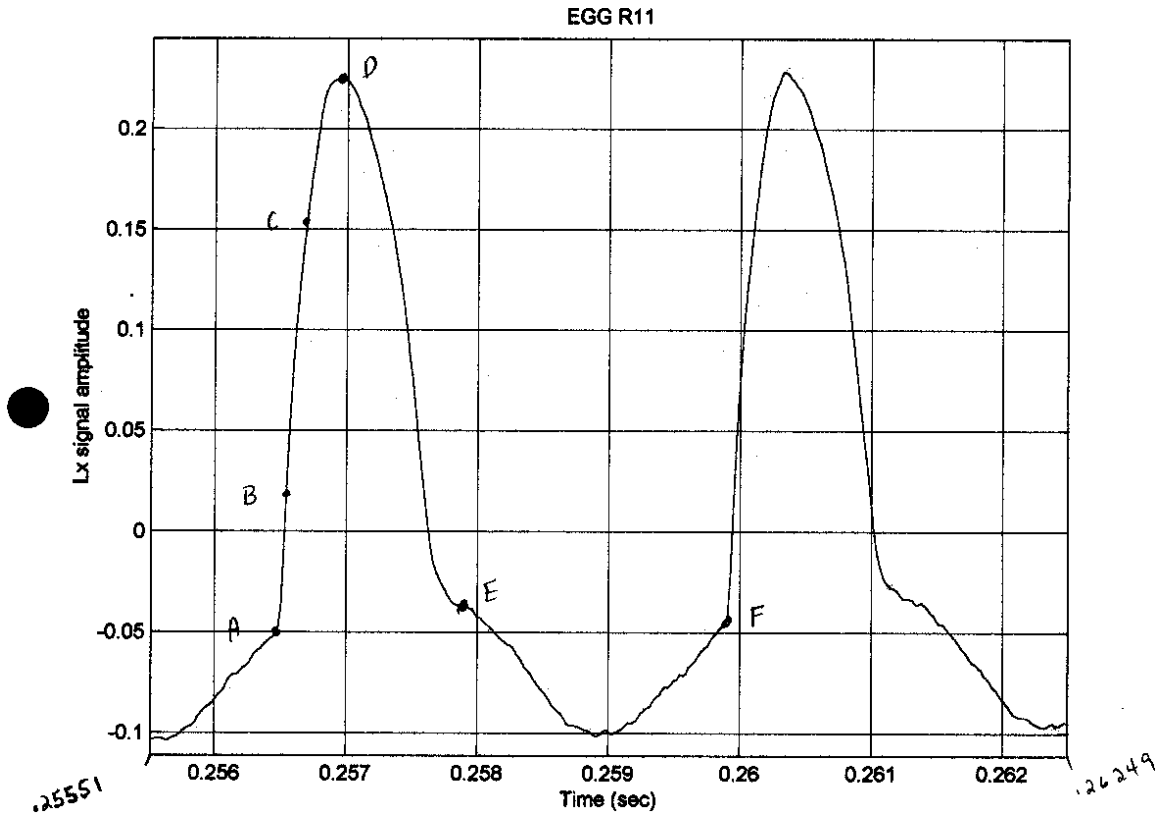


$$x \Rightarrow 22.5 \text{ mm} = .001$$

$$y \Rightarrow 17 \text{ m} = .05$$

$$x \Rightarrow 1 \text{ mm} = .0000944$$

$$y \Rightarrow 1 \text{ m} = .0029411$$



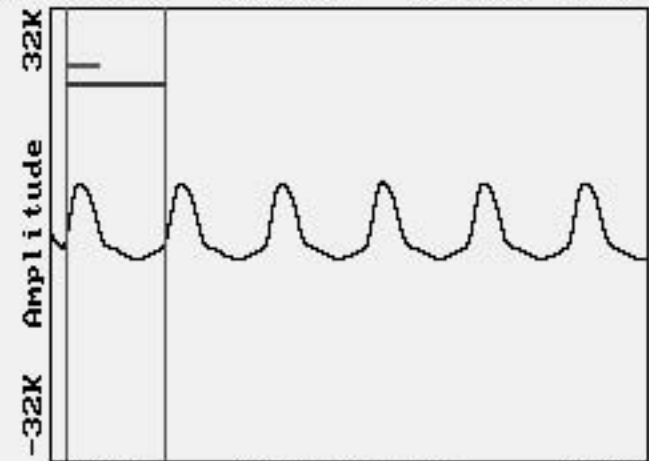


■A> : CH1: R11\_EG~1.NSP

< 0.00 sec 34.22% 295.97 Hz >



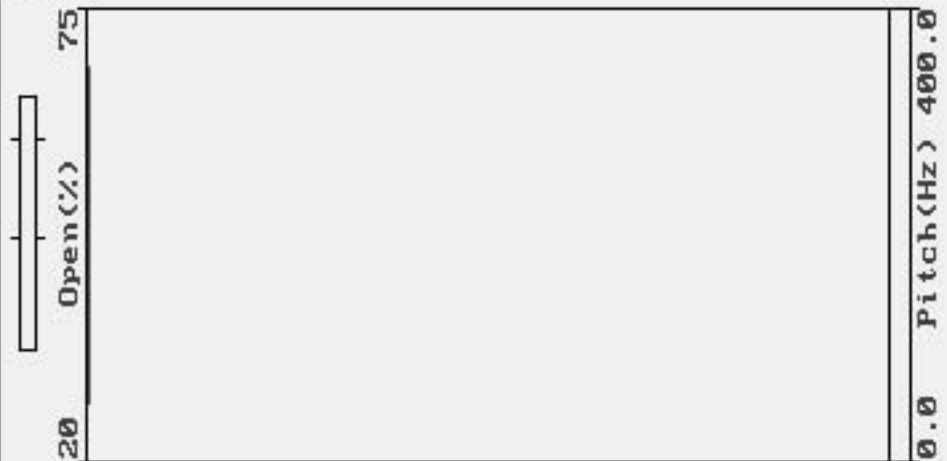
Duration 2.50 (sec)



0.00 Time (sec) 0.02

□B> :

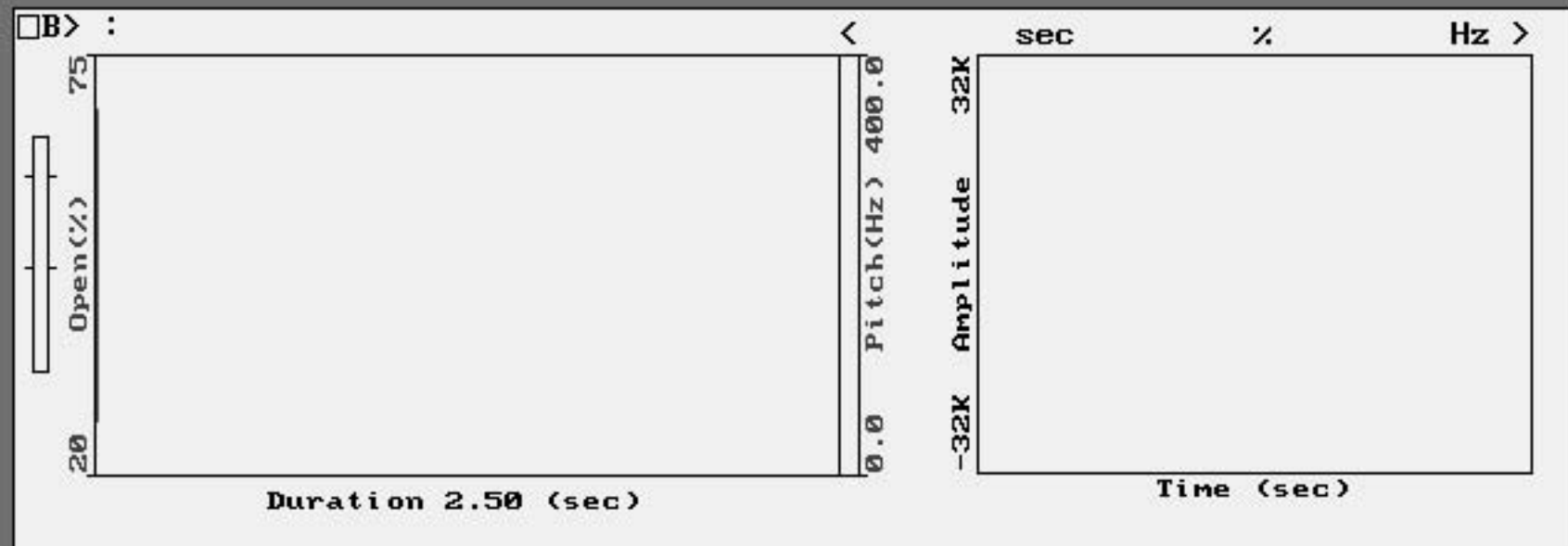
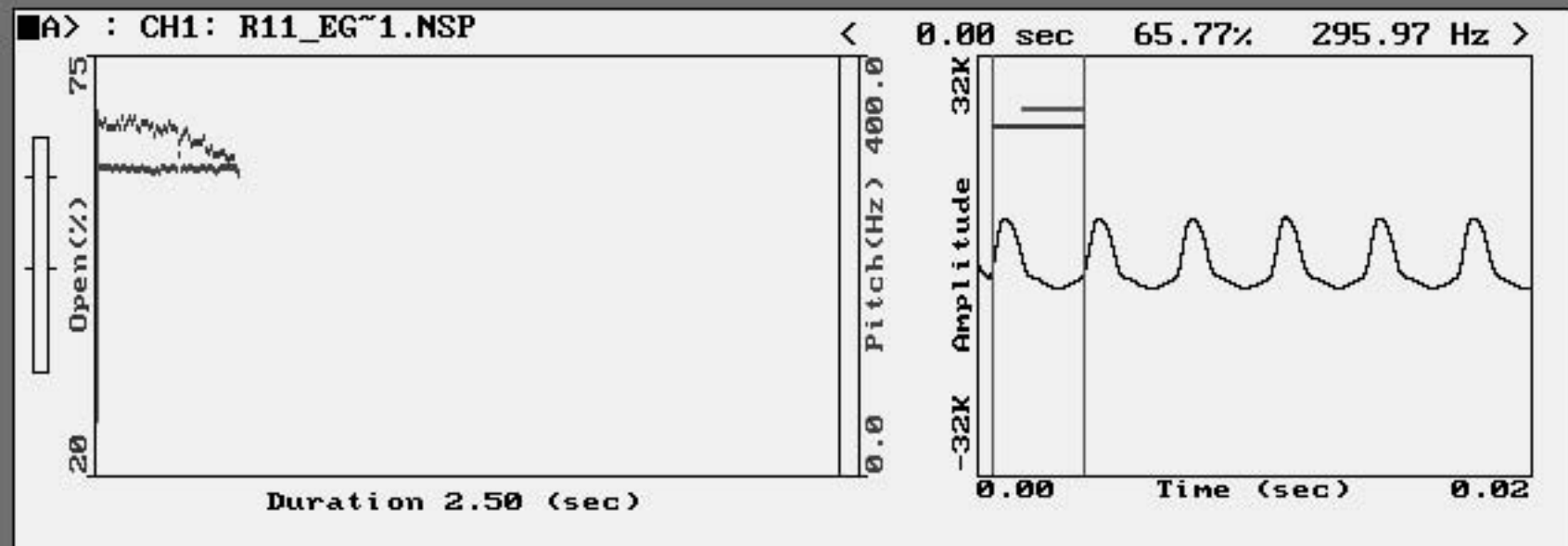
< sec % Hz >

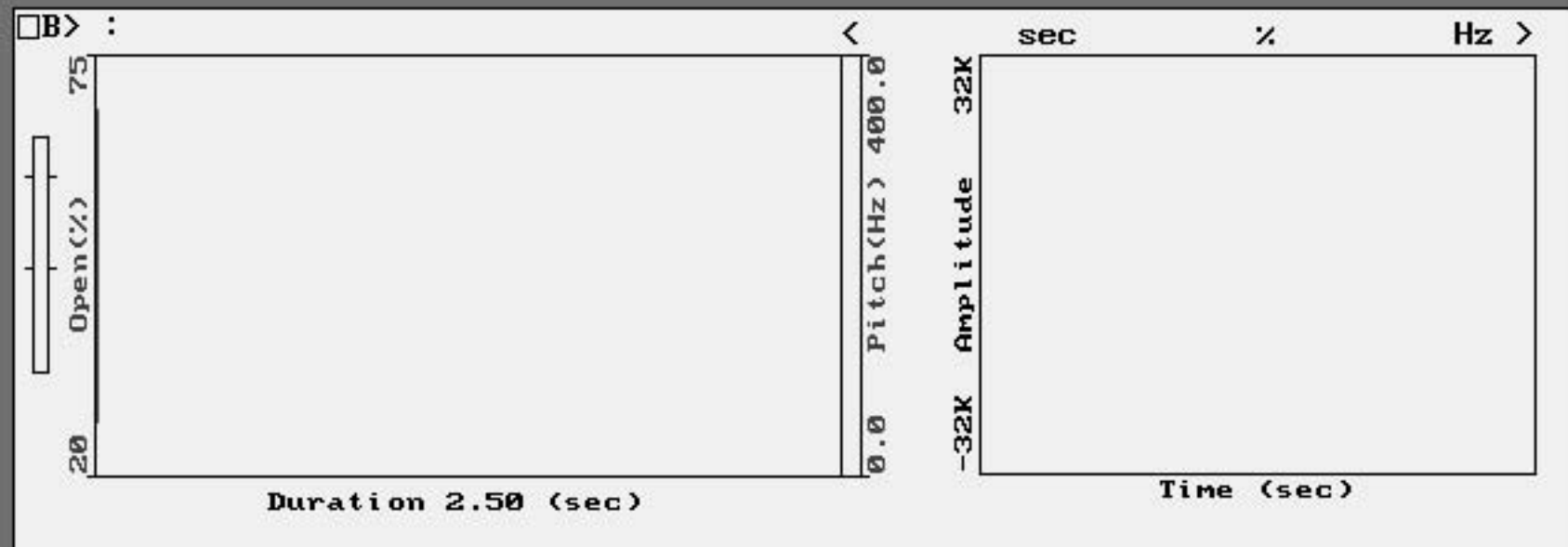
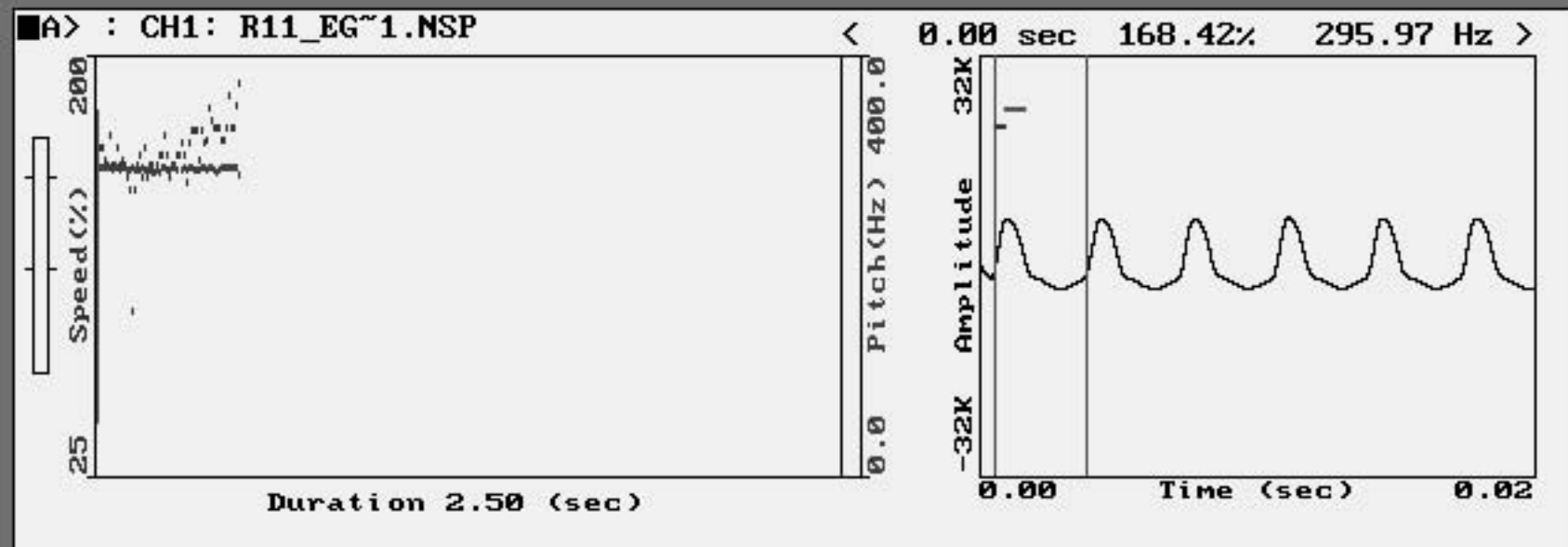


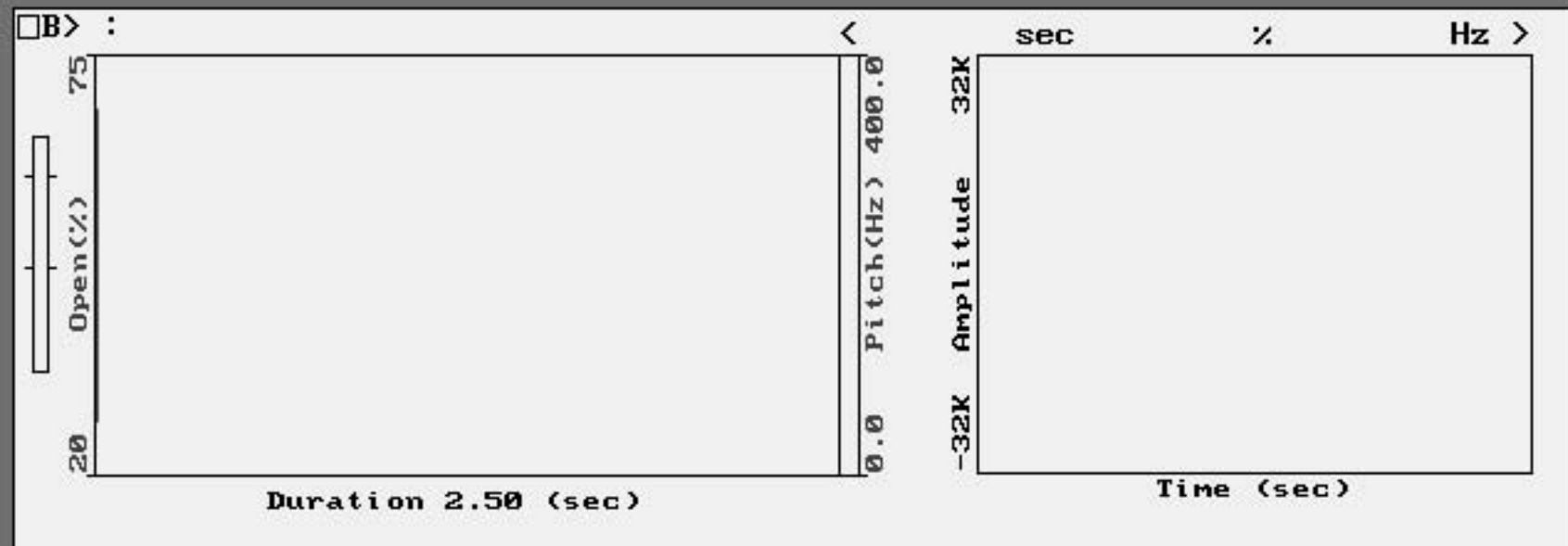
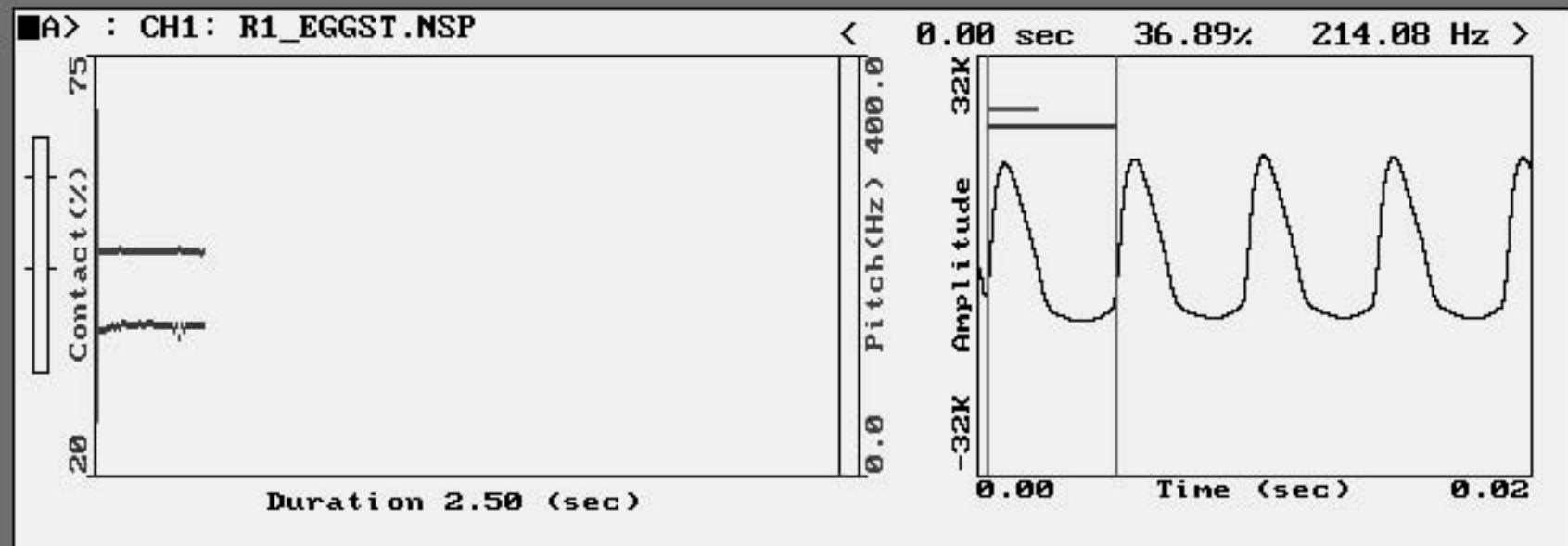
Duration 2.50 (sec)



Time (sec)





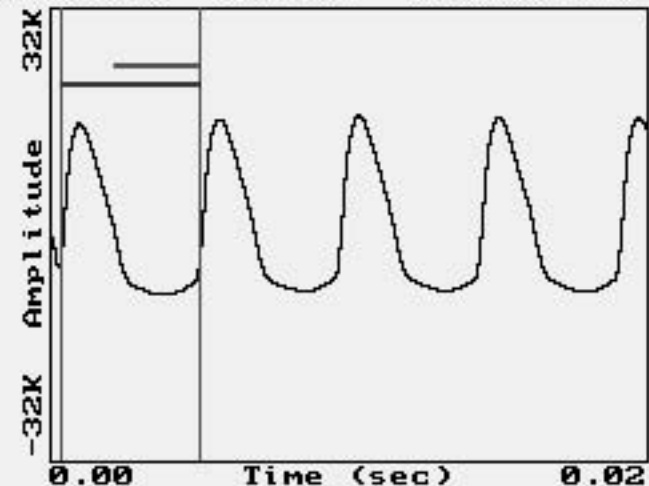


**A** > : CH1: R1\_EGGST.NSP

< 0.00 sec 63.10% 214.08 Hz >

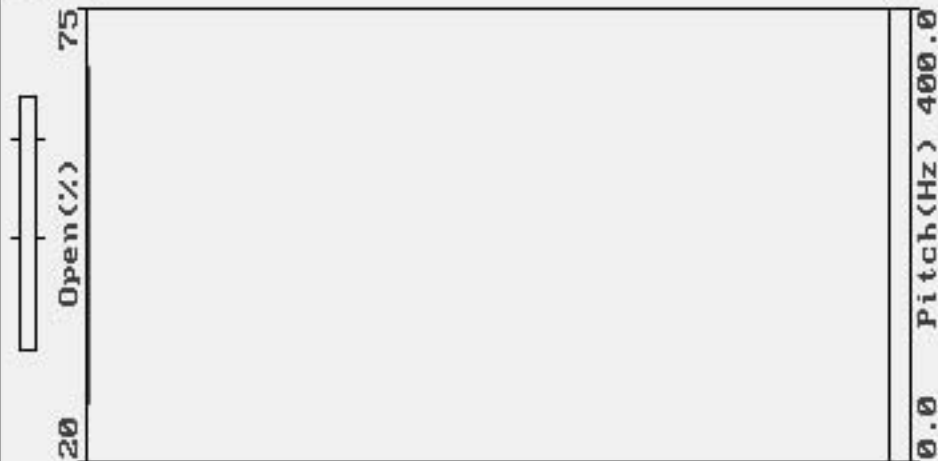


Duration 2.50 (sec)



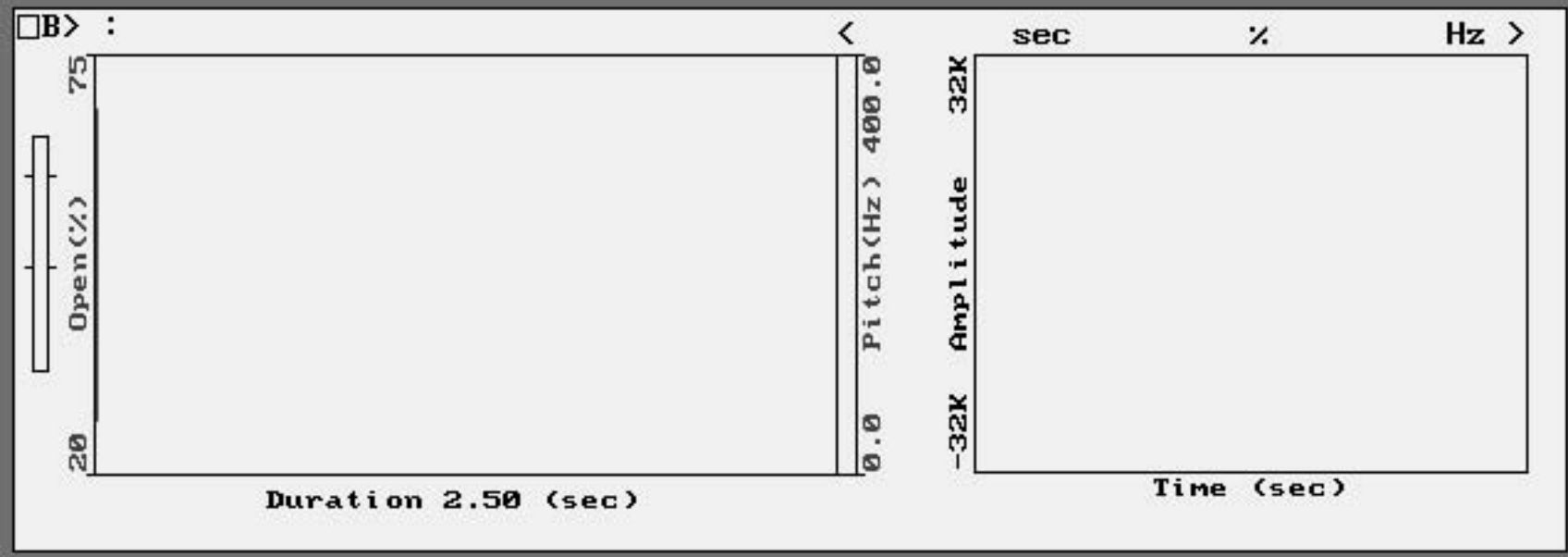
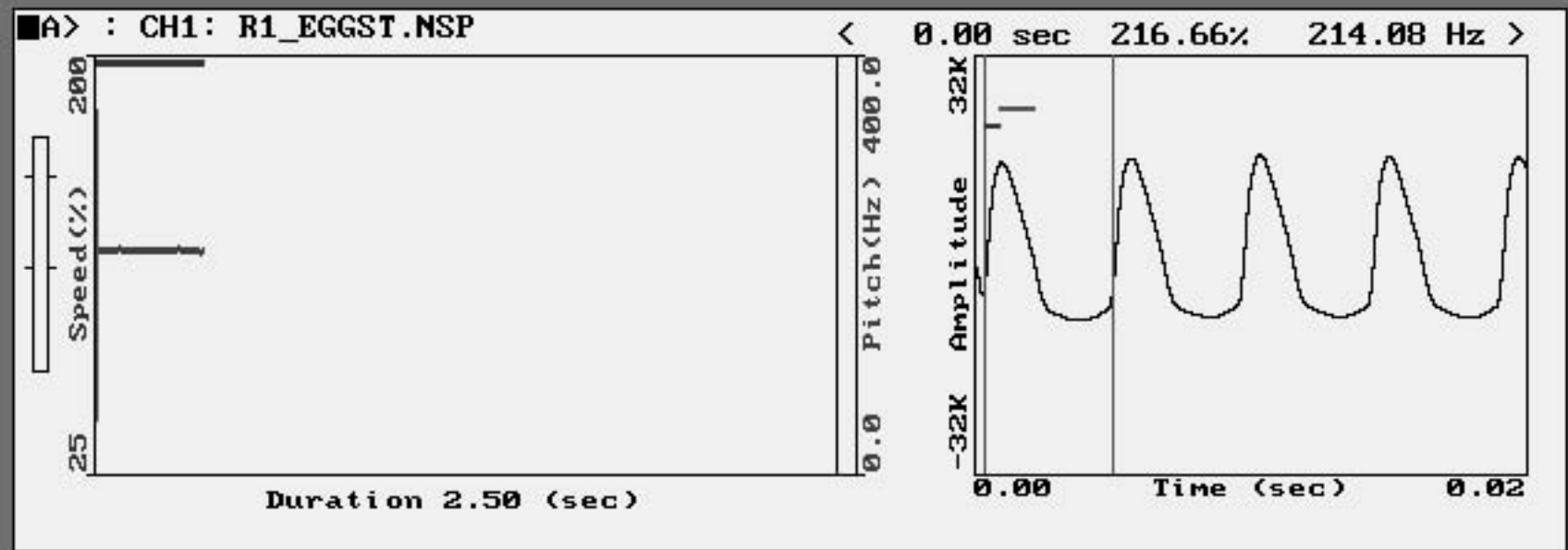
**B** > :

< sec % Hz >

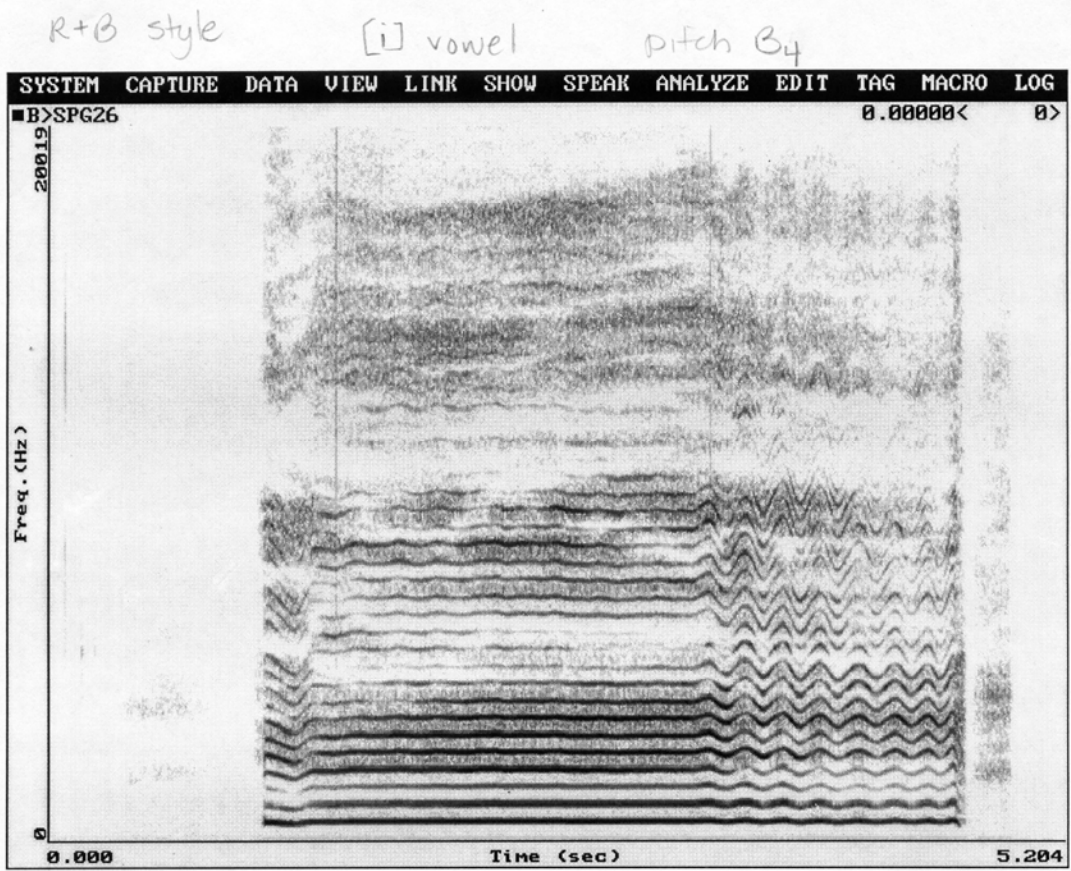


Duration 2.50 (sec)



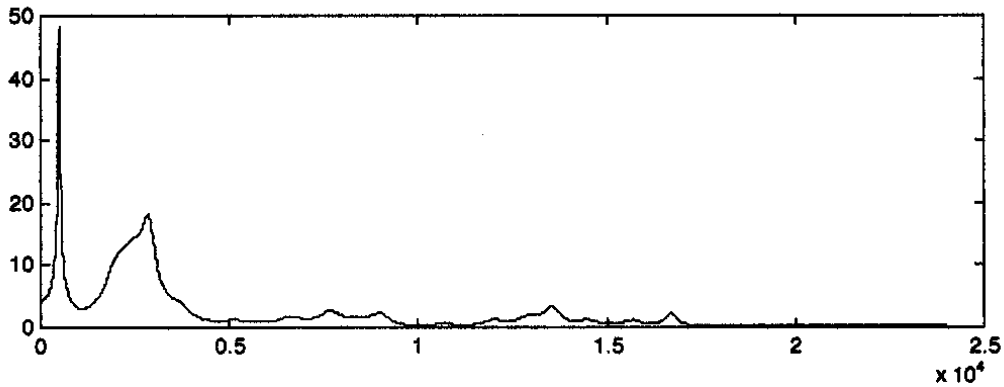
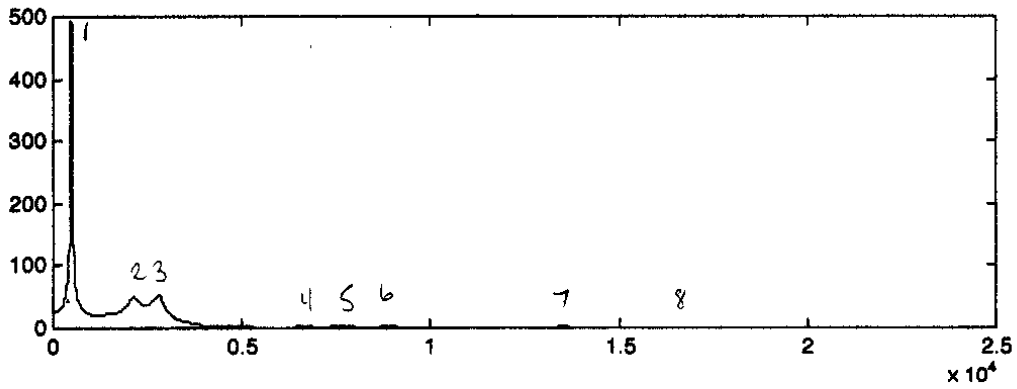


Spectrogram of R21



LPC for whole sample of R21

- 1) 468.75, 494.98    R21    8) 16705.00, 1.20     $F_0 = 464 \text{ Hz}$   
 2) 2132.85, 50.04  
 3) 2777.5, 53.10  
 4) 6630.00, 2.00  
 5) 7668.00, 3.00  
 6) 9000.00, 2.00  
 7) 13592.00, 2.1

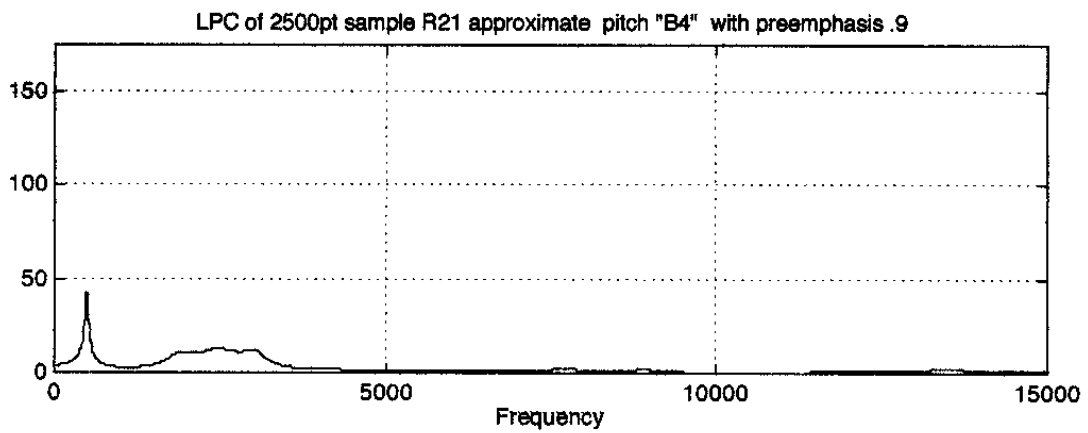
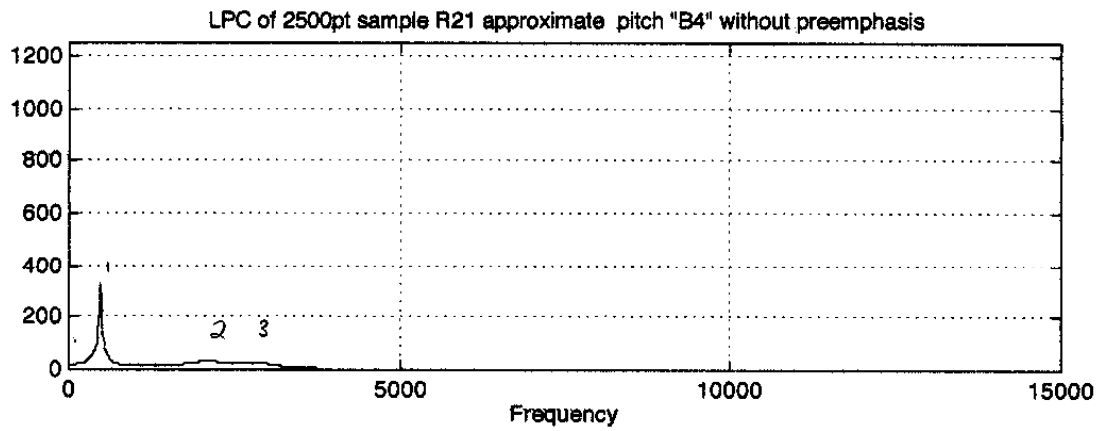


$$.1274375 - .011041667 = .113333333 / 54$$

$$= .002155478$$

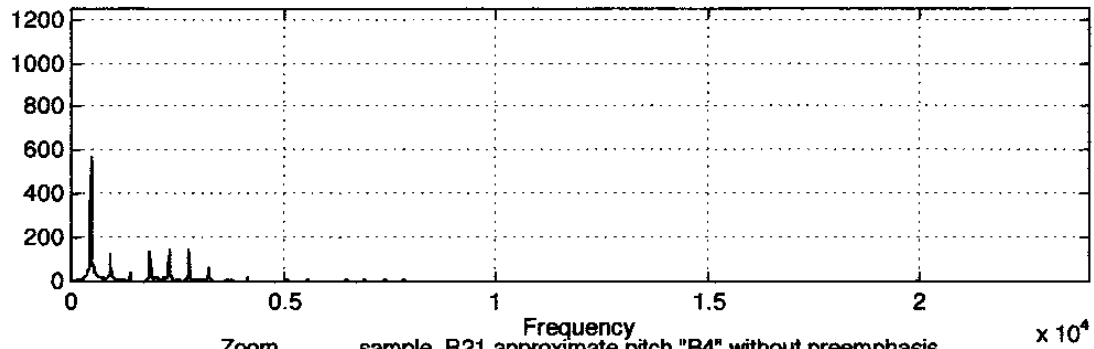
$$463.9341341$$

(480.67, 331.2)  
(2097.63, 31.46)  
(2734.72, 25.60)

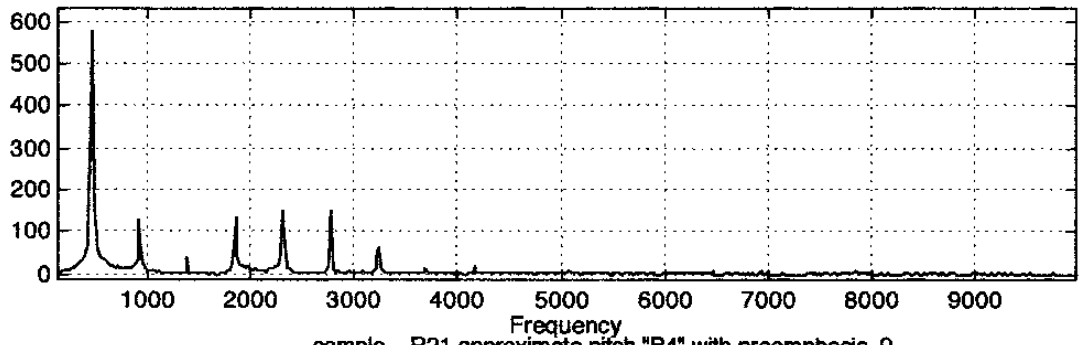


# DFT Results of R21

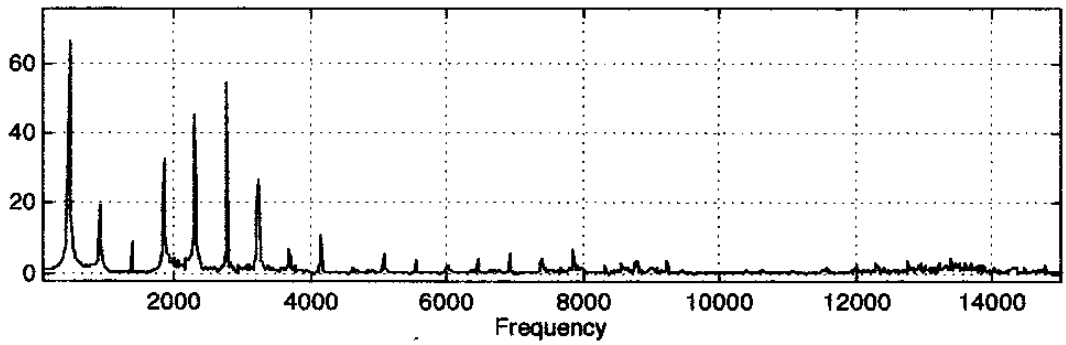
sample R21 approximate pitch "B4" without preemphasis



Zoom sample R21 approximate pitch "B4" without preemphasis



sample R21 approximate pitch "B4" with preemphasis .9



Worksheet saved into file: Minitab.R21  
MTB > Print 'Freq' 'Amp' '% Amp'.

ROW	Freq	Amp	% Amp
1	486	576.512	100.000
2	936	128.783	22.338
3	1404	41.905	7.269
4	1872	132.991	23.068
5	2322	150.018	26.022
6	2790	150.490	26.104
7	3258	64.125	11.123
8	3708	13.930	2.416
9	4194	5.212	0.904
10	4950	2.365	0.410
11	5382	1.834	0.318
12	6012	1.717	0.298
13	6480	6.426	1.115
14	6948	6.421	1.114
15	7416	5.451	0.946
16	7866	7.281	1.263
17	8334	2.635	0.457
18	8784	3.404	0.591
19	9252	2.965	0.514
20	9558	1.040	0.180
21	10188	0.901	0.156
22	10638	1.048	0.182
23	11088	1.007	0.175
24	11574	1.789	0.310
25	12024	2.174	0.377
26	12780	2.753	0.477
27	13230	2.107	0.366
28	13698	2.309	0.400
29	14040	1.427	0.247
30	14490	1.359	0.236
31	15156	0.923	0.160
32	15714	1.658	0.288
33	15930	0.867	0.150
34	16506	1.502	0.261
35	16830	1.103	0.191
36	17334	0.680	0.118
37	17892	0.671	0.116
38	18342	0.694	0.120
39	18936	0.656	0.114
40	19386	0.583	0.101
41	20088	0.545	0.095
42	20286	0.667	0.116
43	20718	0.509	0.088
44	21330	0.463	0.080
45	21996	0.478	0.083
46	22428	0.468	0.081
47	22716	0.440	0.076
48	23274	0.426	0.074
49	16686	0.069	0.012
50	16974	0.093	0.016
51	17550	0.058	0.010
52	17910	0.078	0.014
53	18162	0.158	0.027
54	18450	0.157	0.027
55	18720	0.202	0.035

← good format tracking

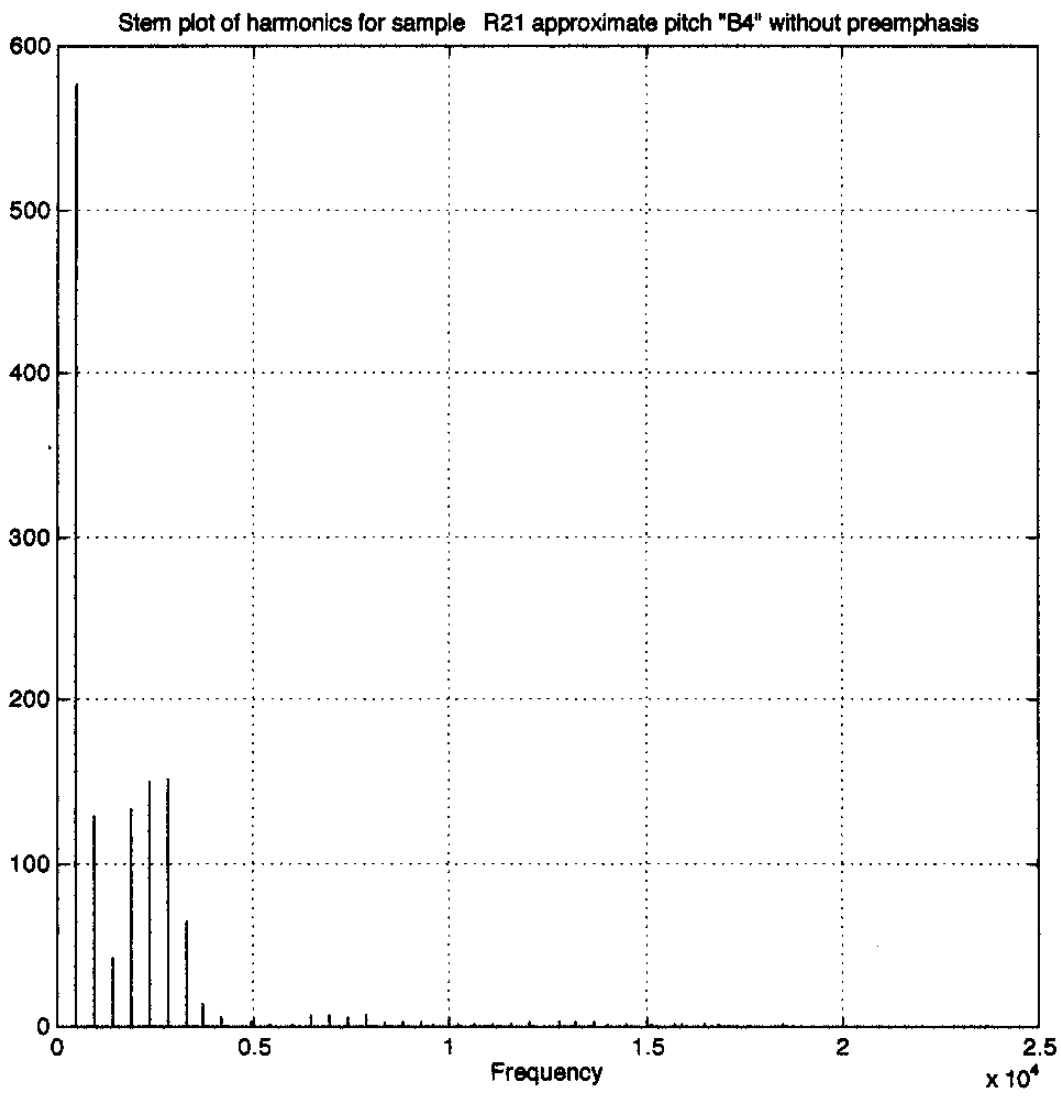
cluster

←

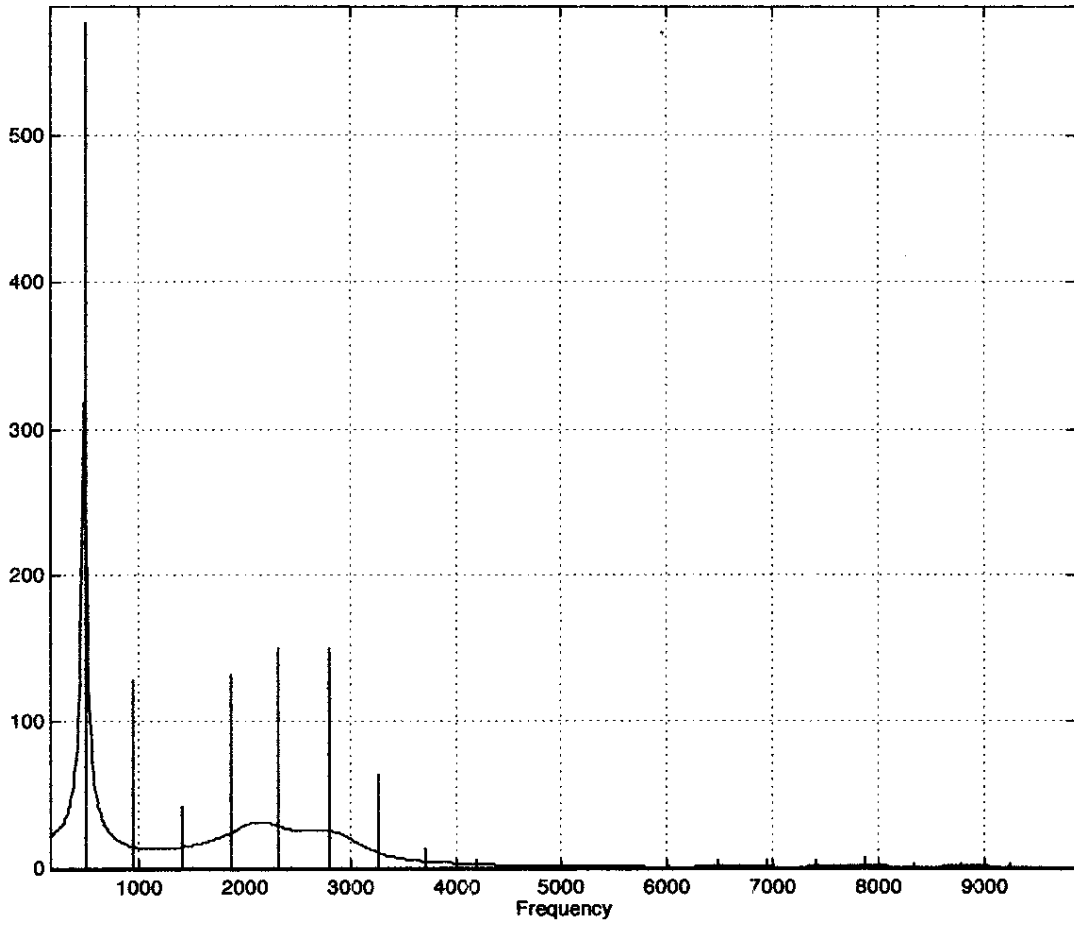
56	19242	0.097	0.017
57	19566	0.088	0.015
58	19746	0.078	0.014
59	20286	0.055	0.010
60	20466	0.057	0.010
61	20880	0.036	0.006
62	21132	0.043	0.007
63	21492	0.044	0.008
64	21906	0.051	0.009
65	22140	0.042	0.007
66	22446	0.039	0.007
67	22860	0.026	0.005
68	23184	0.021	0.004
69	23652	0.023	0.004
70	17604	0.587	0.102
71	17838	0.495	0.086
72	18234	0.471	0.082
73	18486	0.769	0.133
74	18720	0.556	0.096
75	18954	0.473	0.082
76	19062	0.371	0.064
77	19386	0.390	0.068
78	19746	0.381	0.066
79	19836	0.374	0.065
80	20070	0.350	0.061
81	20466	0.350	0.061
82	20592	0.352	0.061
83	20880	0.359	0.062
84	21222	0.348	0.060
85	21510	0.359	0.062
86	21708	0.365	0.063
87	21942	0.345	0.060
88	22176	0.372	0.065
89	22464	0.345	0.060
90	22626	0.341	0.059
91	23022	0.337	0.058
92	23202	0.322	0.056
93	23472	0.323	0.056
94	23724	0.327	0.057
95	22302	0.557	0.097
96	22554	0.583	0.101
97	22752	0.556	0.097
98	22986	0.569	0.099
99	23094	0.571	0.099
100	23490	0.559	0.097
101	23670	0.547	0.095
102	20160	0.179	0.031
103	20430	0.180	0.031
104	20610	0.171	0.030
105	20718	0.158	0.027
106	21042	0.164	0.028
107	21240	0.157	0.027
108	21420	0.141	0.024
109	21564	0.154	0.027
110	21834	0.144	0.025
111	21978	0.138	0.024
112	22104	0.146	0.025
113	22302	0.133	0.023
114	22608	0.144	0.025
115	22824	0.134	0.023

116	22950	0.130	0.023
117	23202	0.139	0.024
118	23418	0.141	0.024
119	23490	0.135	0.023
120	23814	0.133	

0.023



Stem plot/LPC overlay of harmonics for sample R21 without preemphasis

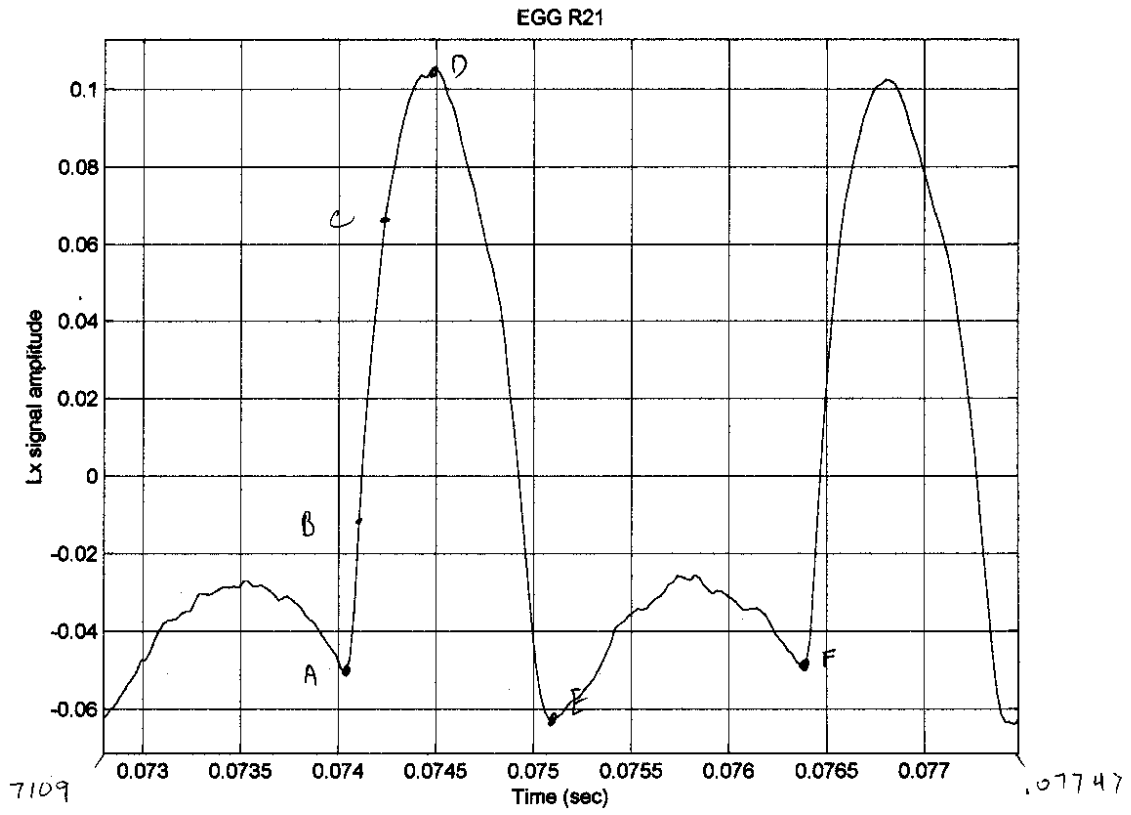


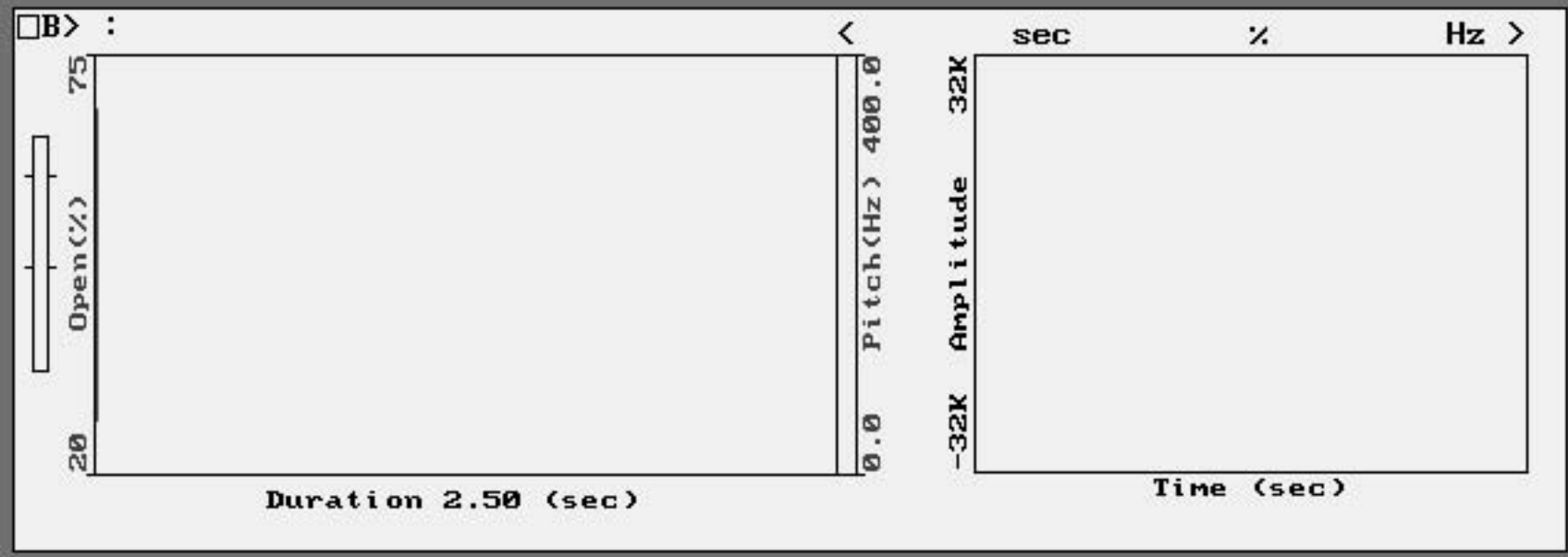
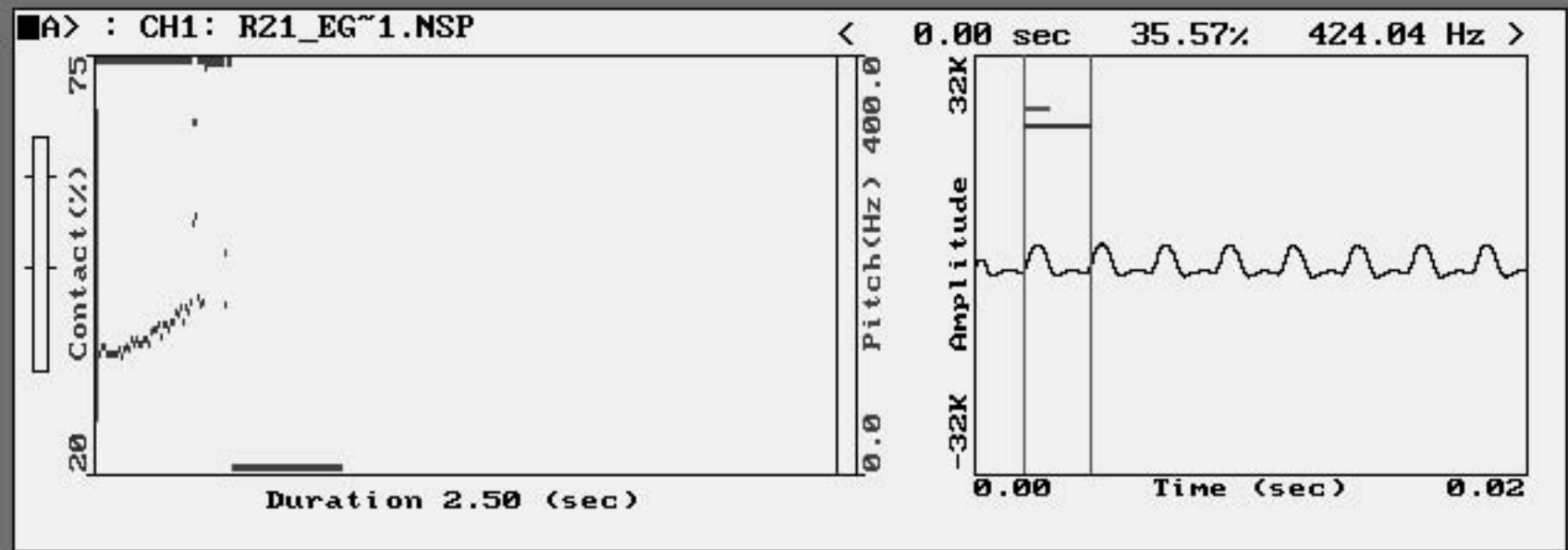
$$x \Rightarrow 17 \text{ mm} = .0005$$

$$y \Rightarrow 13.5 \text{ mm} = .02$$

$$x \Rightarrow 1 \text{ mm} = .0000294$$

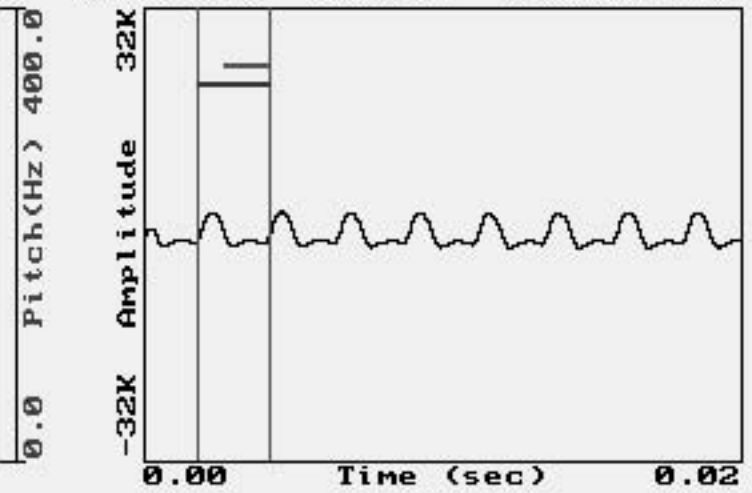
$$y \Rightarrow 1 \text{ mm} = .0014814$$





**A** > : CH1: R21\_EG~1.NSP

< 0.00 sec 64.42% 424.04 Hz >

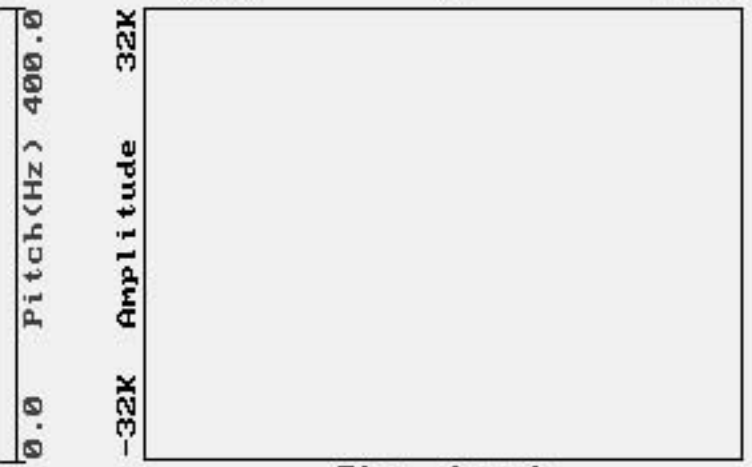


Pitch(Hz) 400.0

Duration 2.50 (sec)

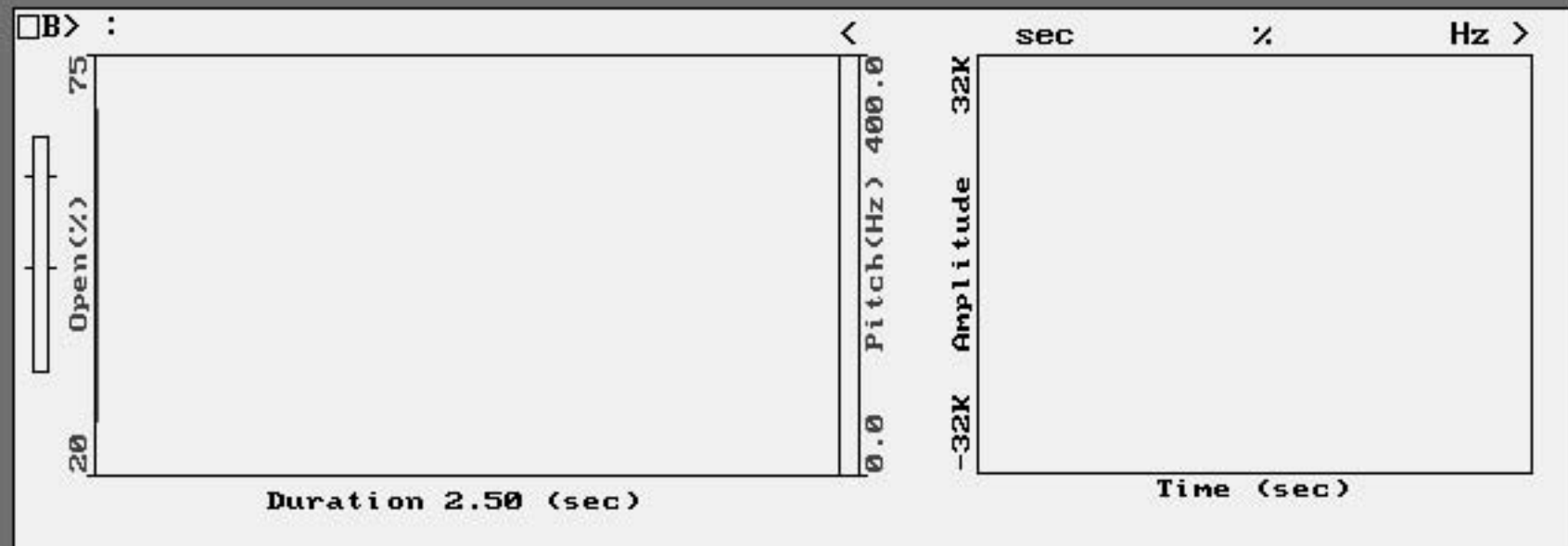
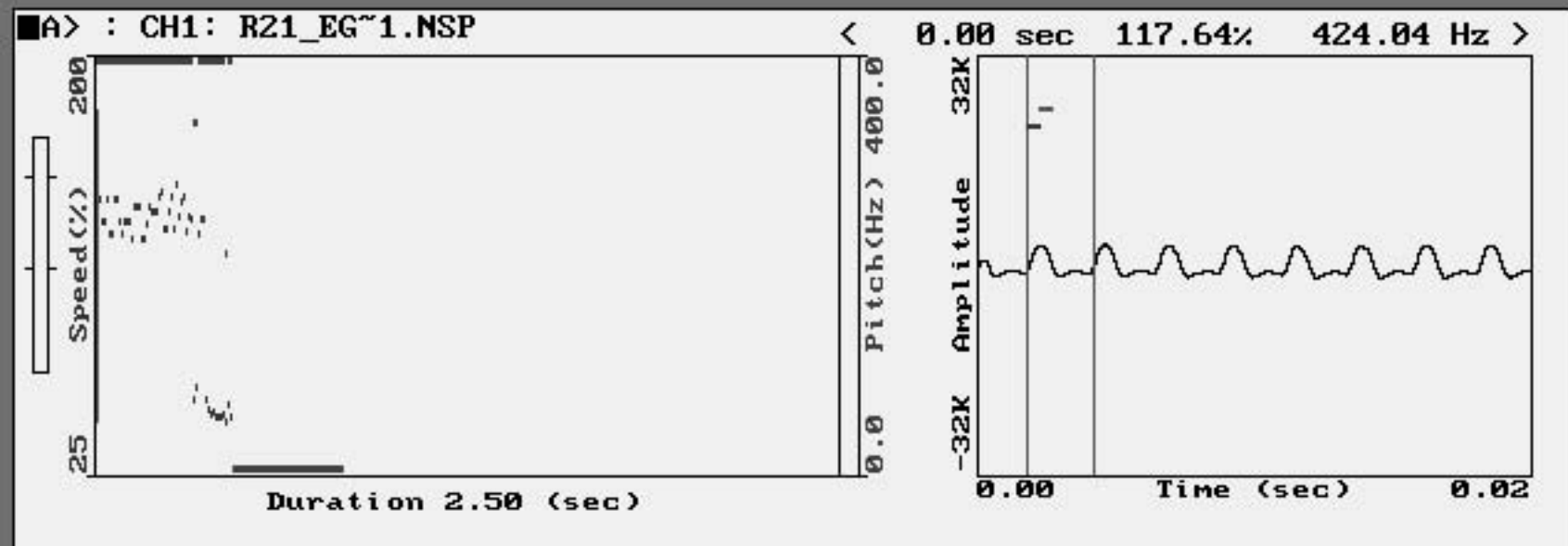
**B** > :

< sec % Hz >

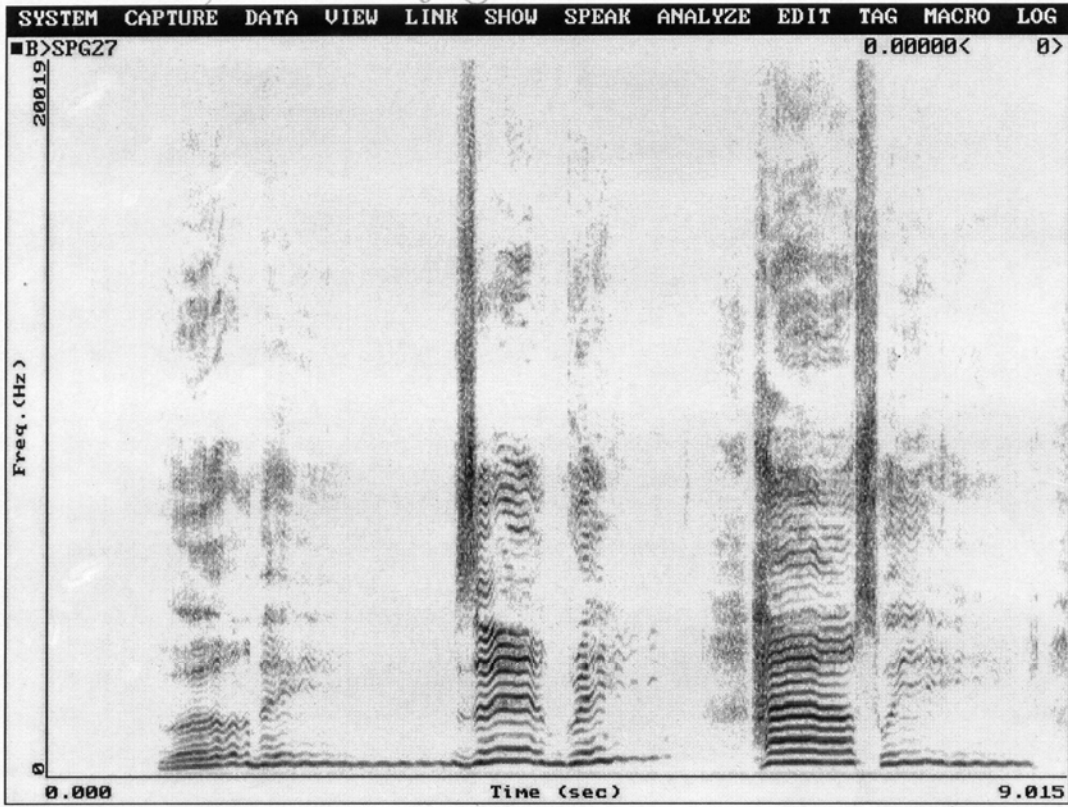


Pitch(Hz) 400.0

Duration 2.50 (sec)



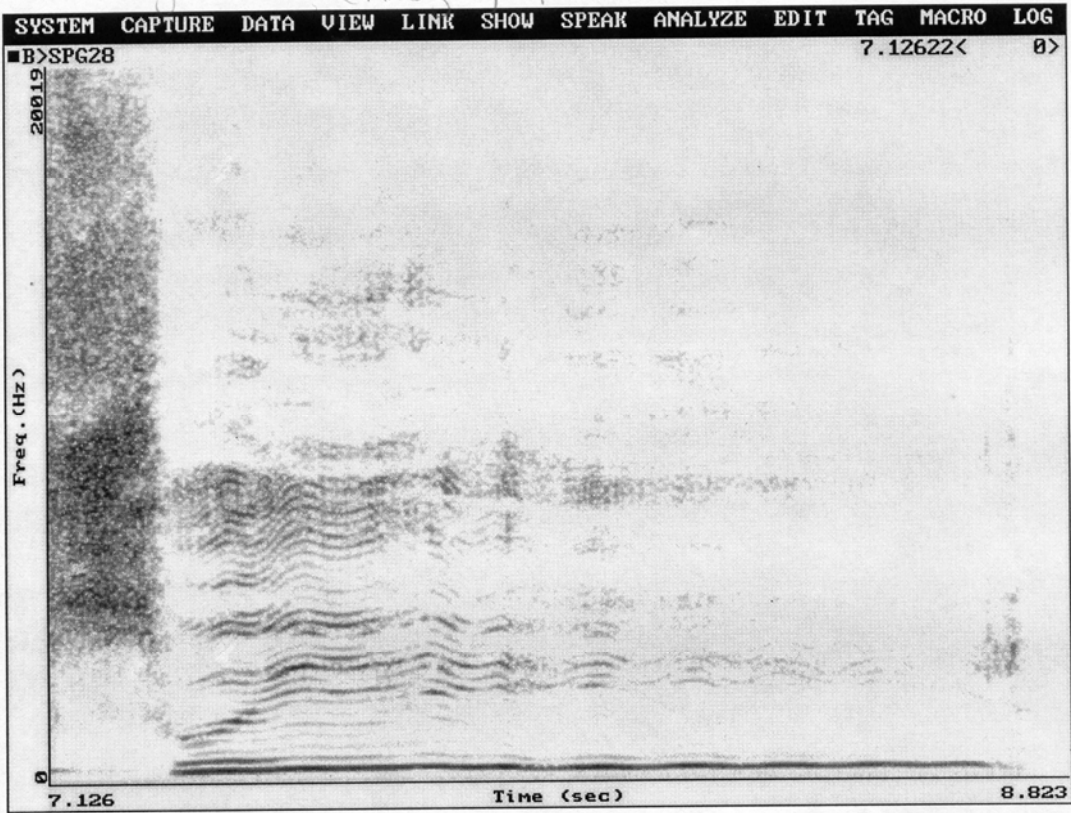
R+B style (Amazing Grace)



Amaz ——— ing grace how Sweet

R+B style

(Amazing Grace)



sweet

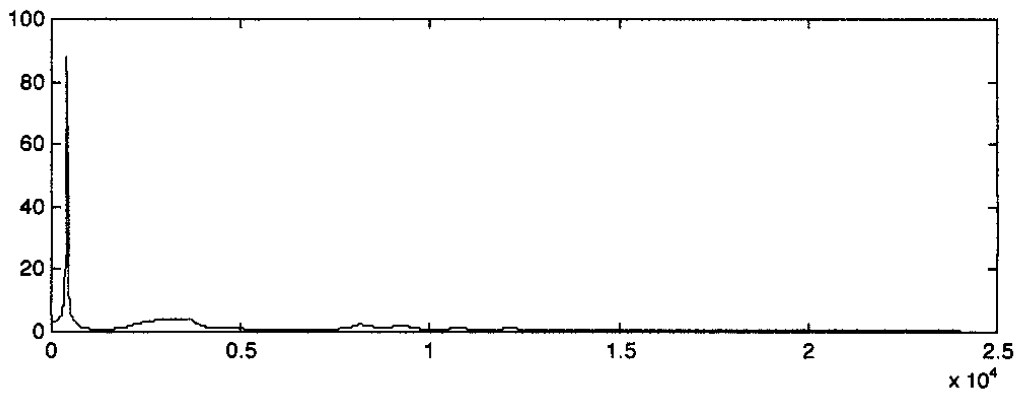
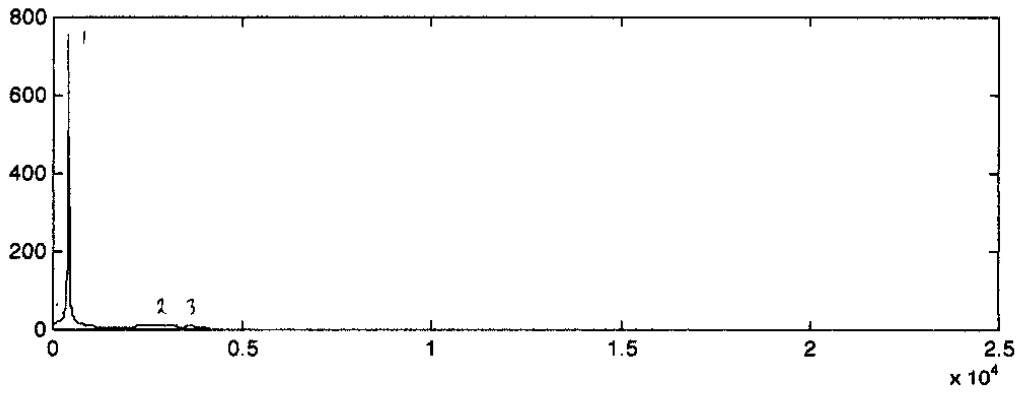
1) 398.44, 757.30

R31

$F_0 = 397 \text{ Hz}$

2) 2354.00, 11.25

3) 3035.15, 12.11



$$.11897917 - .015664167 = .103375003$$

10000 - 40000

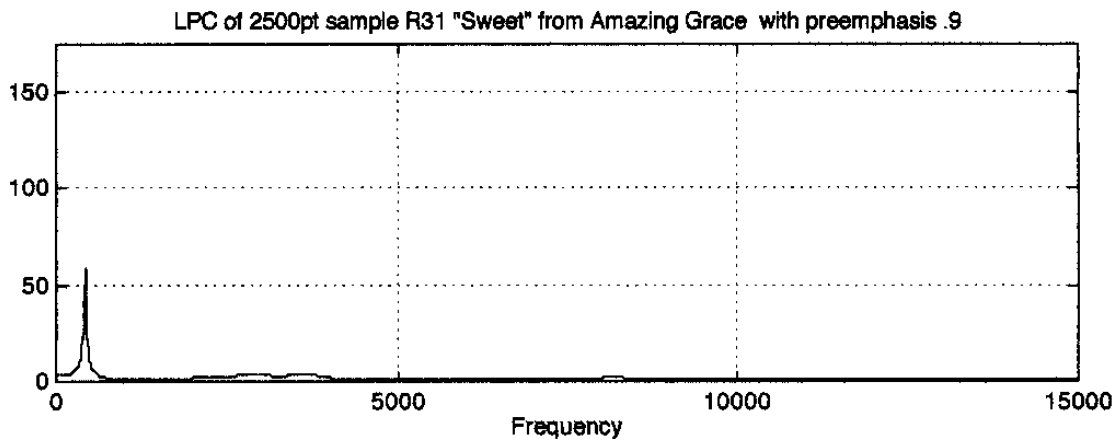
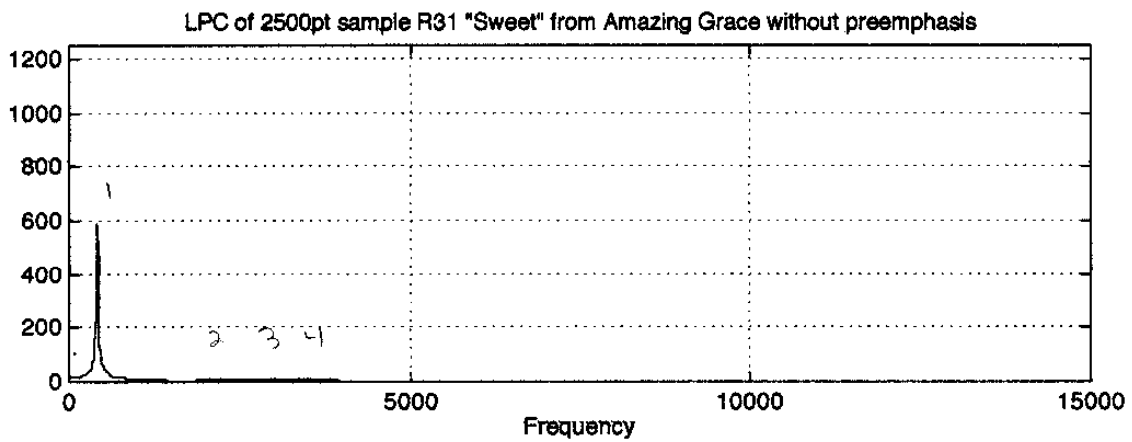
396.6142569

(410.16, 588.62)

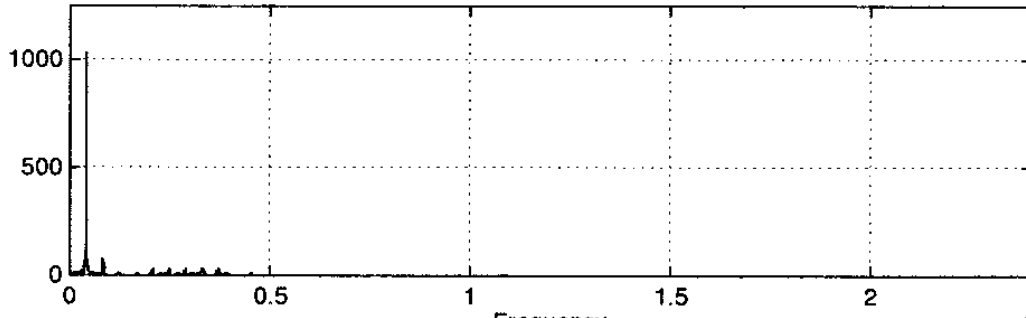
(2310.31, 9.31)

(2968.75, 11.09)

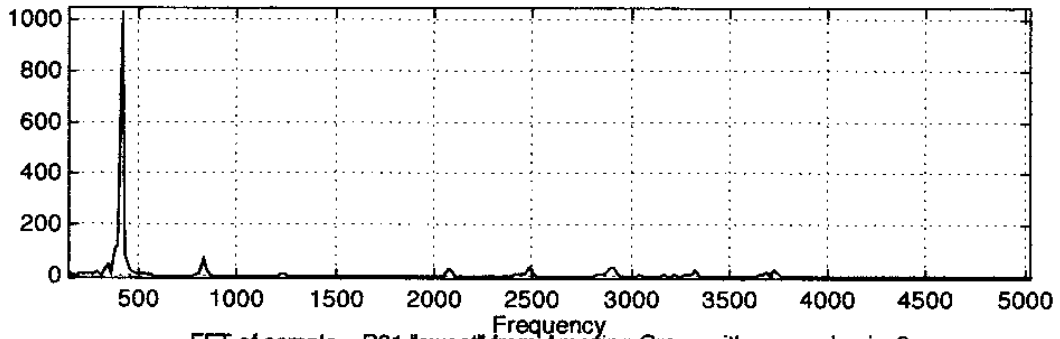
(3714.45, 8.71)



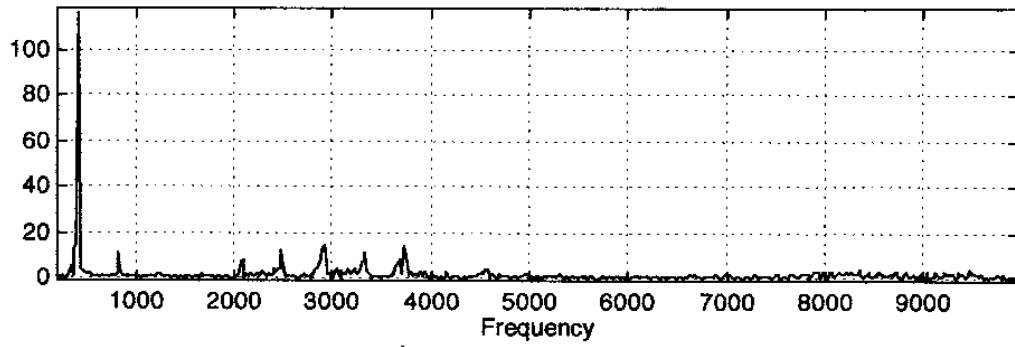
FFT of sample R31 "sweet" from Amazing Grace without preemphasis



Zoom FFT of sample R31 "sweet" from Amazing Grace without preemphasis  $\times 10^4$



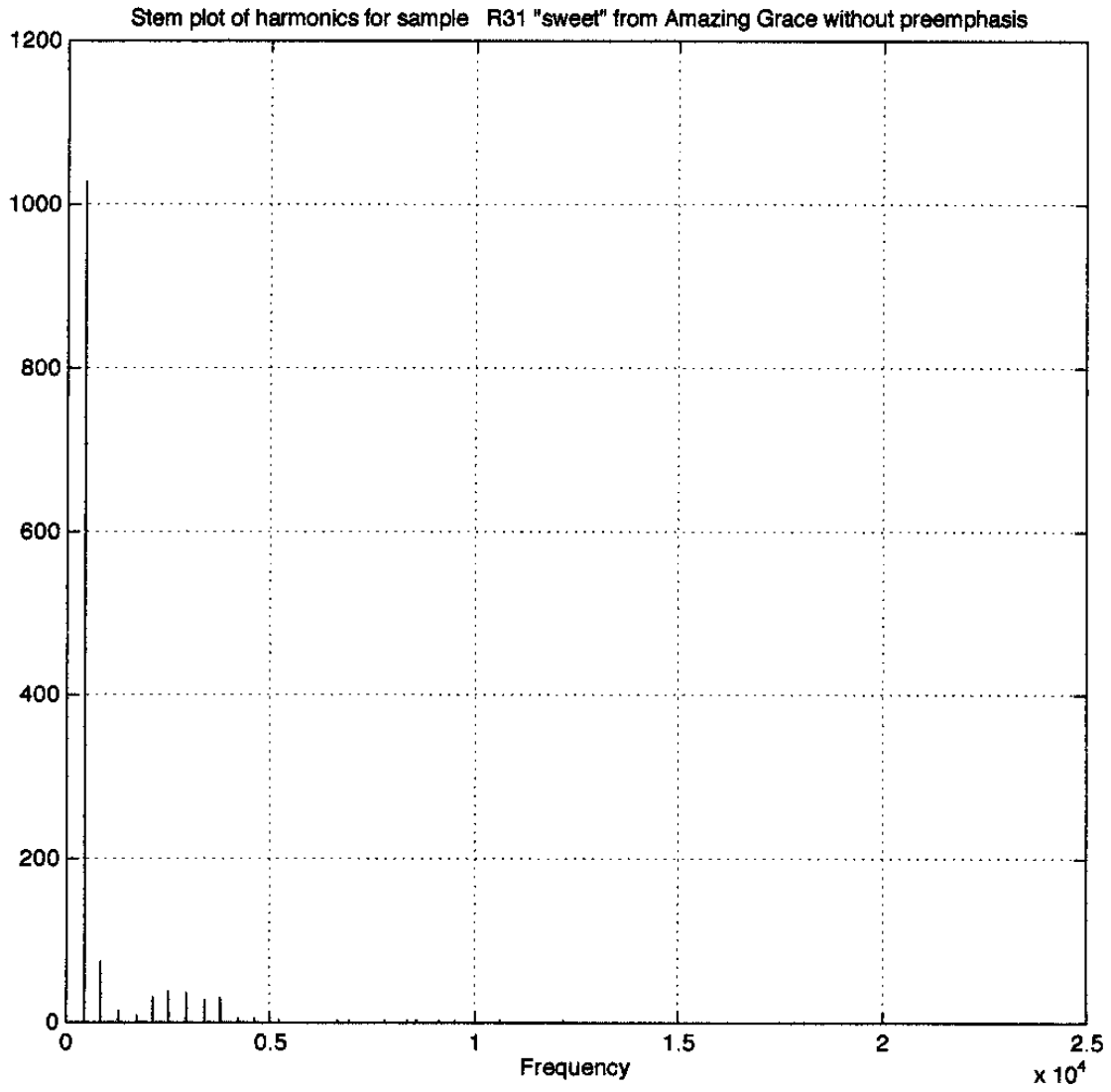
FFT of sample R31 "sweet" from Amazing Grace with preemphasis .9



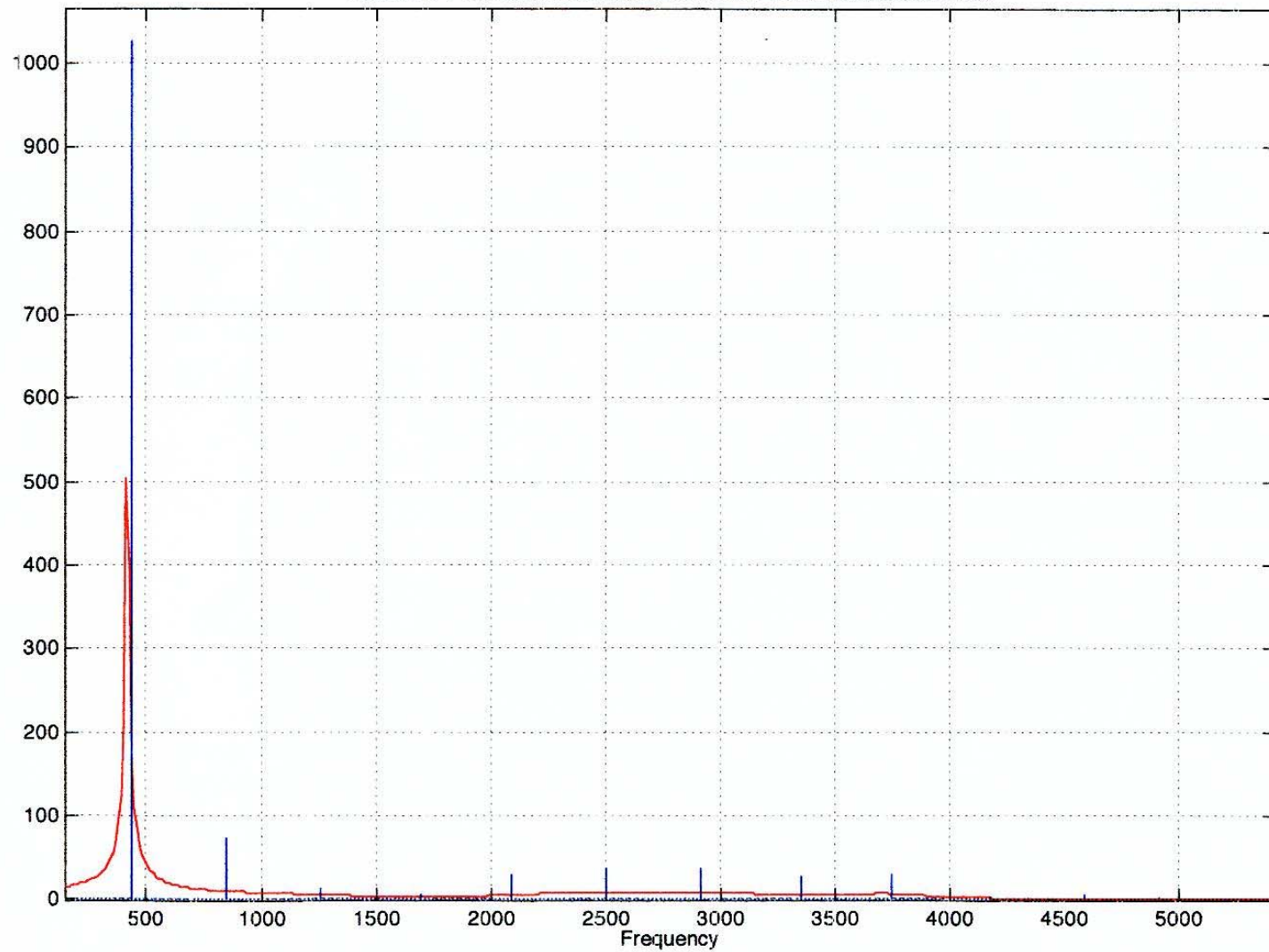
ROW	Freq	Amp	% Amp
1	432	1027.30	100.000 ←
2	846	72.63	7.070
3	1260	13.93	1.356
4	1692	7.03	0.684
5	2088	29.39	2.861
6	2502	37.02	3.604 ←
7	2916	36.94	3.596
8	3348	27.43	2.670
9	3744	29.61	2.882 ←
10	4176	4.61	0.448
11	4590	6.24	0.607
12	5220	2.03	0.198
13	5508	0.90	0.087
14	6138	0.81	0.079
15	6642	2.40	0.234
16	6894	2.13	0.208
17	7416	1.35	0.131
18	7794	3.00	0.292
19	8370	3.49	0.340
20	8568	3.80	0.370
21	9144	2.80	0.272
22	9522	3.60	0.350
23	9828	1.23	0.120
24	10440	0.79	0.077
25	10638	1.70	0.166
26	11088	1.21	0.118
27	11754	1.05	0.103
28	12150	2.08	0.202
29	12420	0.69	0.068
30	13086	1.00	0.098
31	13518	0.99	0.096
32	13770	0.72	0.070
33	14400	1.14	0.111
34	14814	0.76	0.074
35	15138	0.91	0.088
36	15588	0.40	0.039
37	15876	0.51	0.049
38	16272	0.49	0.048
39	16884	0.29	0.028
40	17190	0.40	0.039
41	17874	0.46	0.045
42	17982	0.34	0.033
43	18576	0.23	0.022
44	18864	0.31	0.030
45	19584	0.19	0.018
46	19710	0.21	0.020
47	20358	0.22	0.021
48	20664	0.19	0.018
49	21060	0.21	0.020
50	21546	0.17	0.016
51	22158	0.14	0.014
52	22500	0.11	0.010
53	22788	0.14	0.014
54	23418	0.09	0.009
55	18720	0.20	0.020
56	19242	0.10	0.009
57	19566	0.09	0.009
58	19746	0.08	0.008

59	20286	0.06	0.005
60	20466	0.06	0.006
61	20880	0.04	0.004
62	21132	0.04	0.004
63	21492	0.04	0.004
64	21906	0.05	0.005
65	22140	0.04	0.004
66	22446	0.04	0.004
67	22860	0.03	0.003
68	23184	0.02	0.002
69	23652	0.02	0.002
70	17604	0.59	0.057
71	17838	0.50	0.048
72	18234	0.47	0.046
73	18486	0.77	0.075
74	18720	0.56	0.054
75	18954	0.47	0.046
76	19062	0.37	0.036
77	19386	0.39	0.038
78	19746	0.38	0.037
79	19836	0.37	0.036
80	20070	0.35	0.034
81	20466	0.35	0.034
82	20592	0.35	0.034
83	20880	0.36	0.035
84	21222	0.35	0.034
85	21510	0.36	0.035
86	21708	0.37	0.036
87	21942	0.34	0.034
88	22176	0.37	0.036
89	22464	0.34	0.034
90	22626	0.34	0.033
91	23022	0.34	0.033
92	23202	0.32	0.031
93	23472	0.32	0.031
94	23724	0.33	0.032
95	22302	0.56	0.054
96	22554	0.58	0.057
97	22752	0.56	0.054
98	22986	0.57	0.055
99	23094	0.57	0.056
100	23490	0.56	0.054
101	23670	0.55	0.053
102	20160	0.18	0.017
103	20430	0.18	0.018
104	20610	0.17	0.017
105	20718	0.16	0.015
106	21042	0.16	0.016
107	21240	0.16	0.015
108	21420	0.14	0.014
109	21564	0.15	0.015
110	21834	0.14	0.014
111	21978	0.14	0.013
112	22104	0.15	0.014
113	22302	0.13	0.013
114	22608	0.14	0.014
115	22824	0.13	0.013
116	22950	0.13	0.013
117	23202	0.14	0.014
118	23418	0.14	0.014

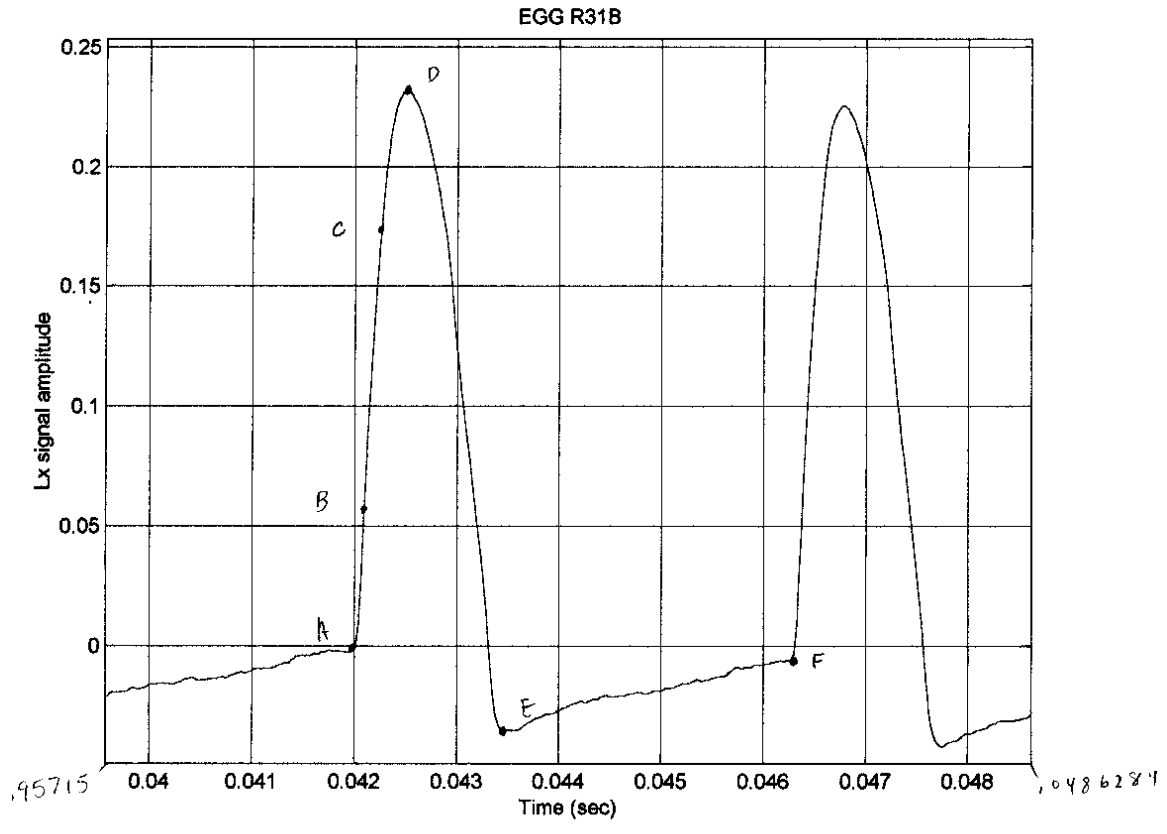
119	23490	0.13	0.013
120	23814	0.13	0.013



Stem plot/LPC overlay of harmonics for sample R31 without preemphasis

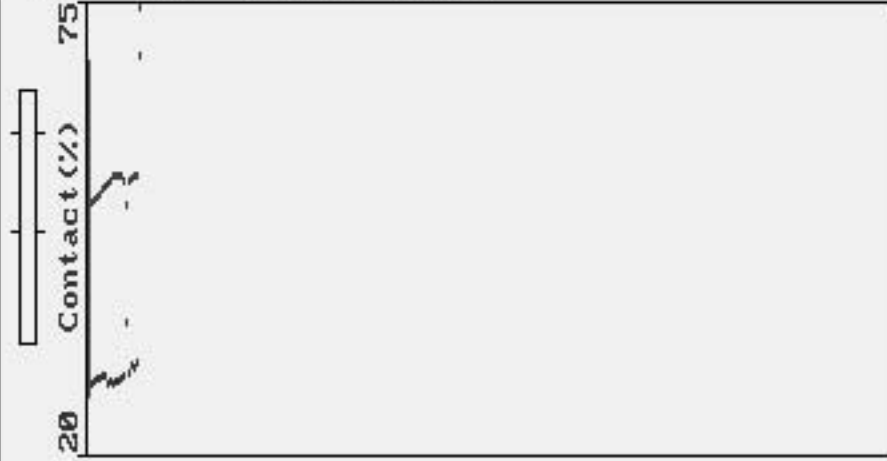


$x \Rightarrow 17.5 \text{ mm} = 1.001$   
 $y \Rightarrow 20.5 \text{ mm} = 1.05$   
 $x \Rightarrow 1 \text{ mm} =$   
 $y \Rightarrow 1 \text{ mm} = 1002439$

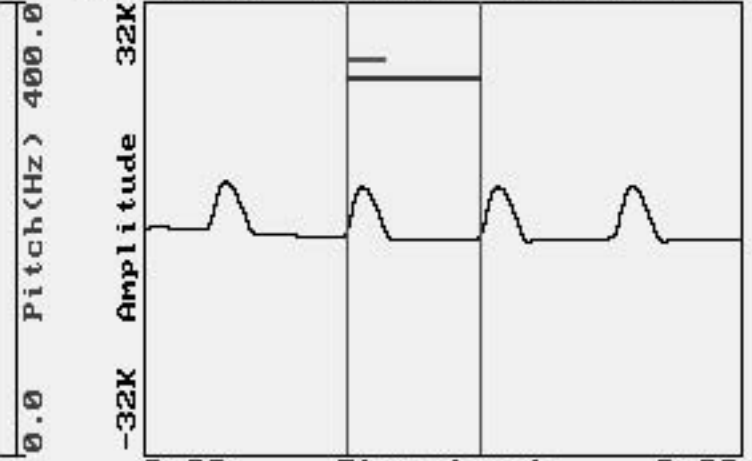


■A> : CH1: R31B\_E~1.NSP

< 0.00 sec 27.36% 219.40 Hz >



Duration 2.50 (sec)



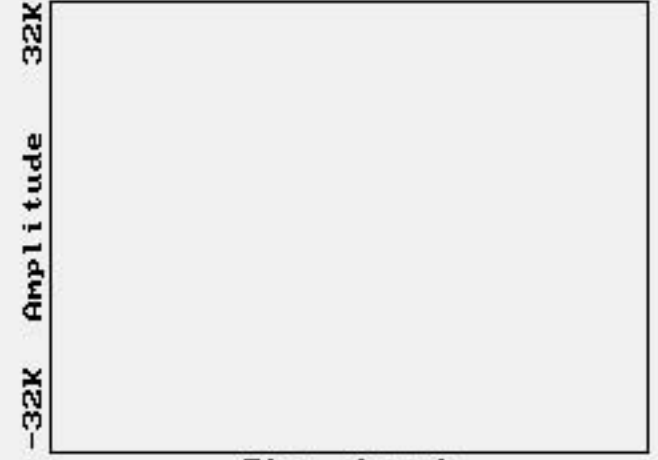
Time (sec) 0.00 0.02

□B> :

< sec % Hz >



Duration 2.50 (sec)



Time (sec)

**A** > : CH1: R31B\_E~1.NSP

< 0.00 sec 72.63% 219.40 Hz >



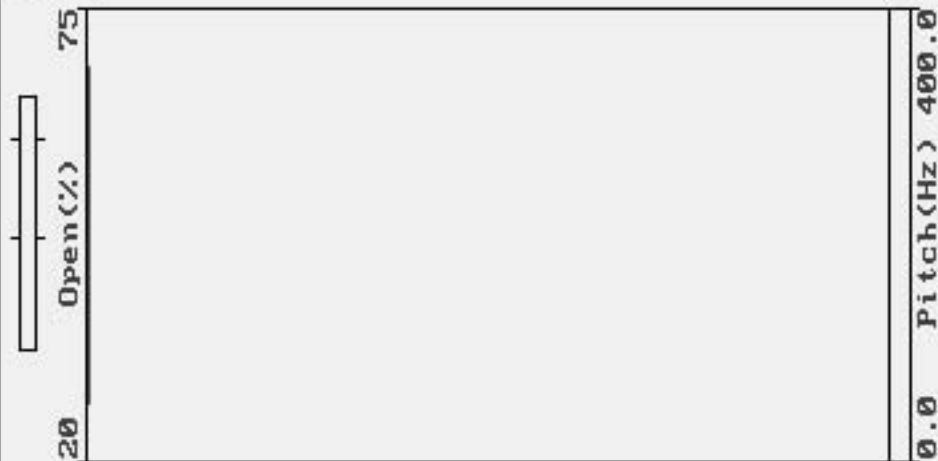
Duration 2.50 (sec)



0.00 0.02

**B** > :

< sec % Hz >



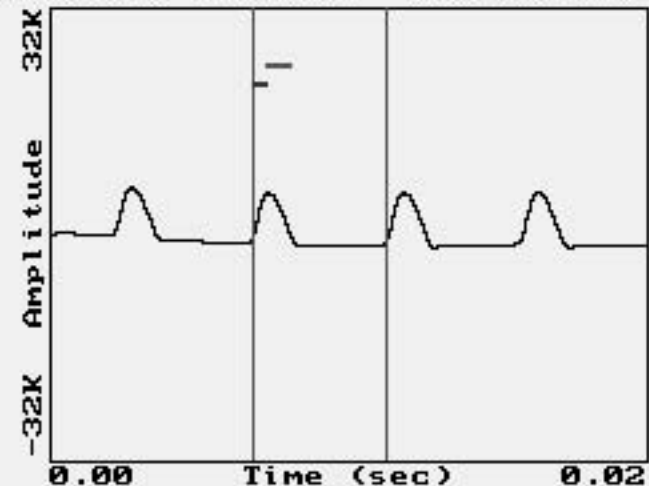
Duration 2.50 (sec)



0.00 0.02

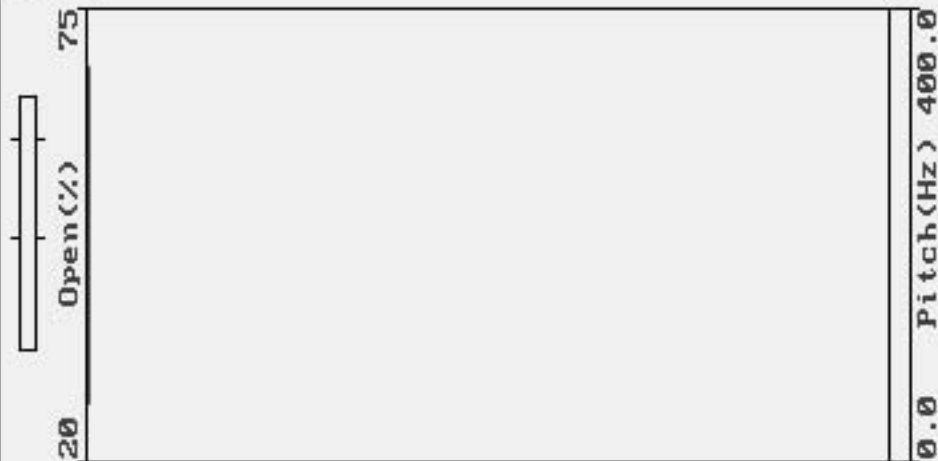
■A> : CH1: R31B\_E~1.NSP

< 0.00 sec 150.00% 219.40 Hz >



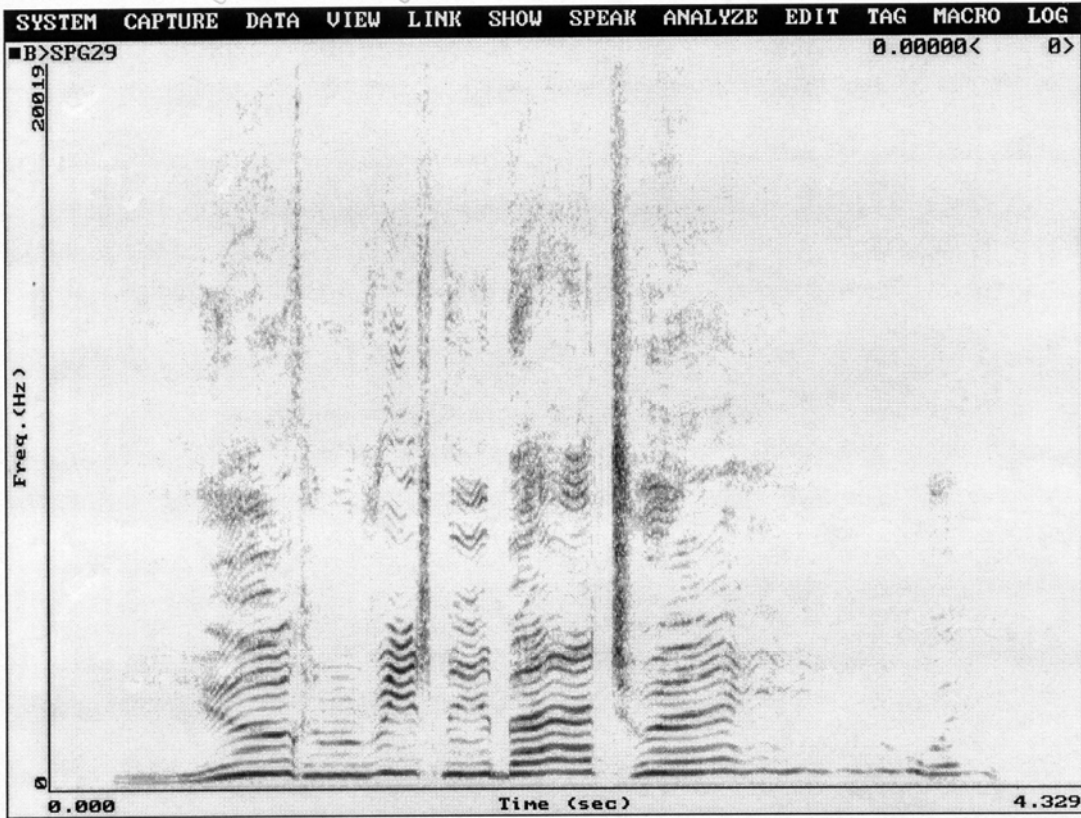
□B> :

< sec % Hz >



Spectrogram of R37a

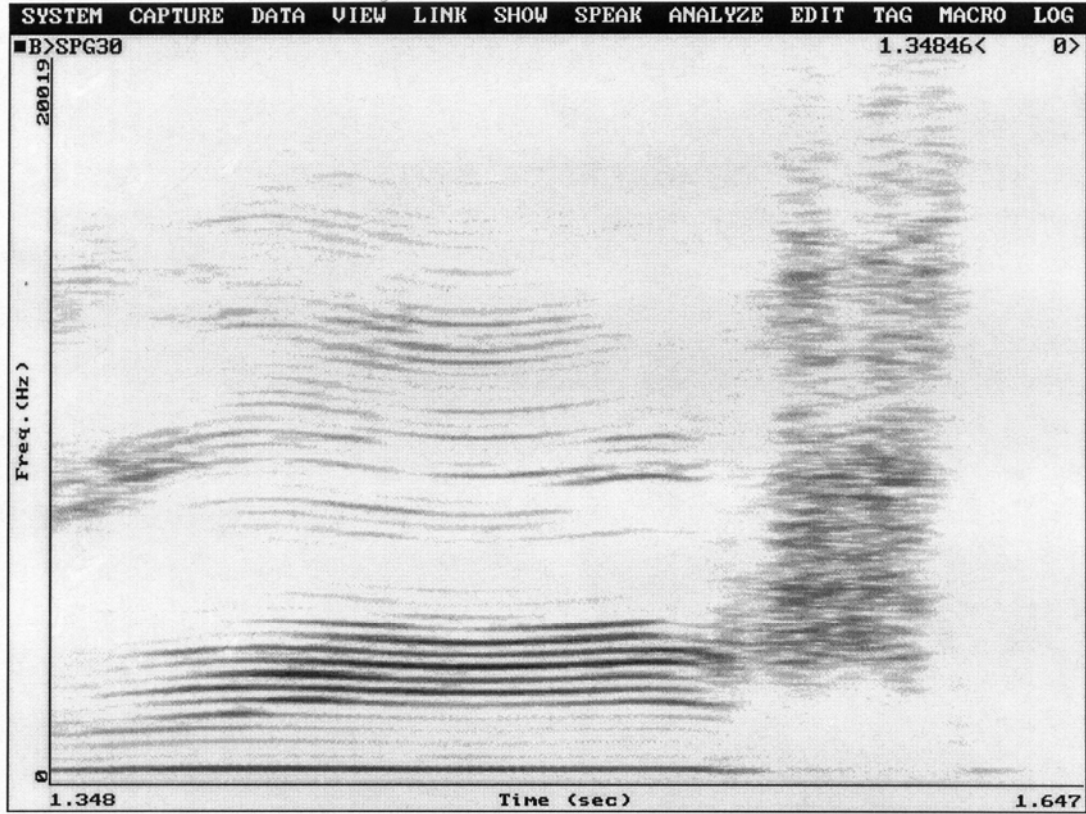
*R+B style (you can reach me)*



*You can reach me by trainway*

Spectrogram of R37b

*R+B style (you can reach me)*



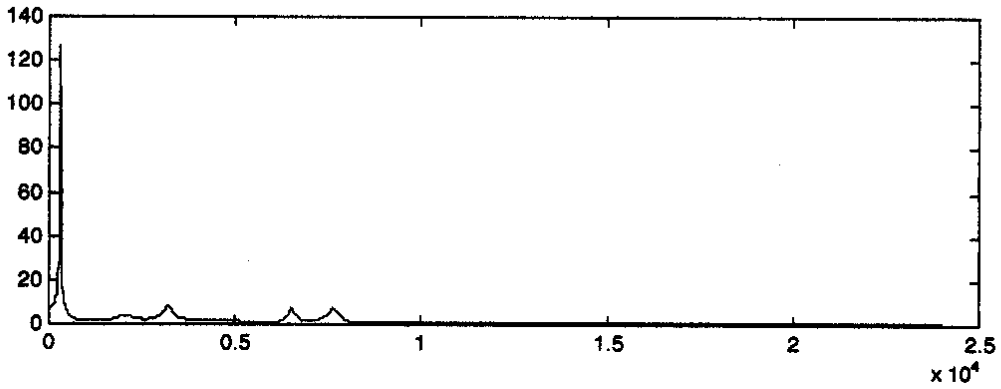
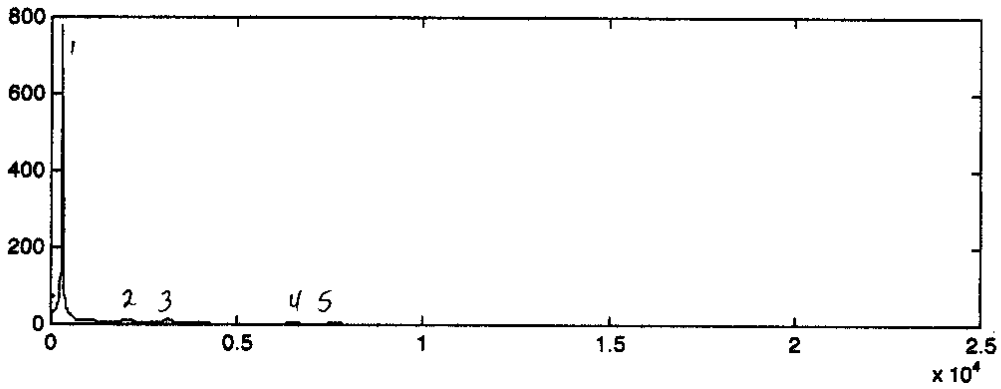
*reach*

LPC of entire sample of R37b

- 1) 292.97, -777.40
- 2) 2109.00, 11.37
- 3) 3175.80, 14.95
- 4) 6520.00, 5.50
- 5) 7640.70, 6.25

R37

$$F_0 = 294 \text{ Hz}$$



$$.097 - .0050208333 = .091979167$$

$$= .603406636$$

$$= 293.5447328 \text{ Hz}$$

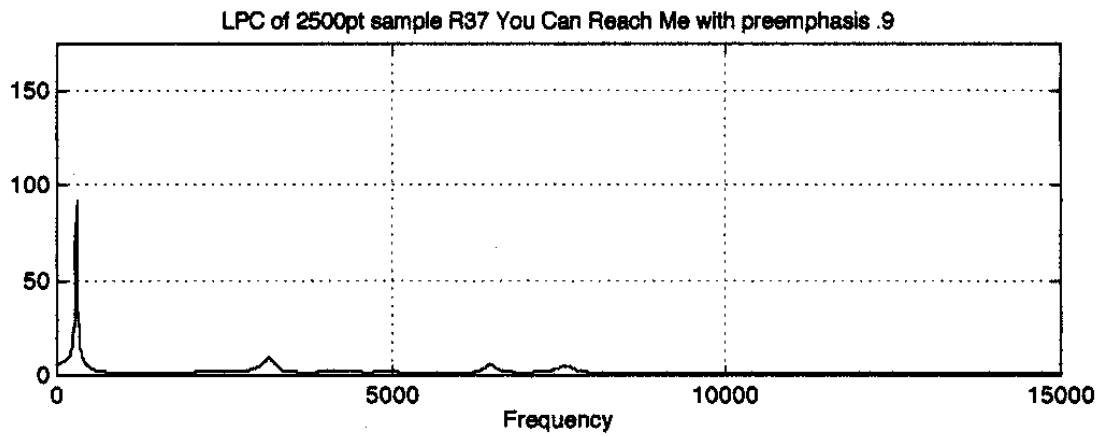
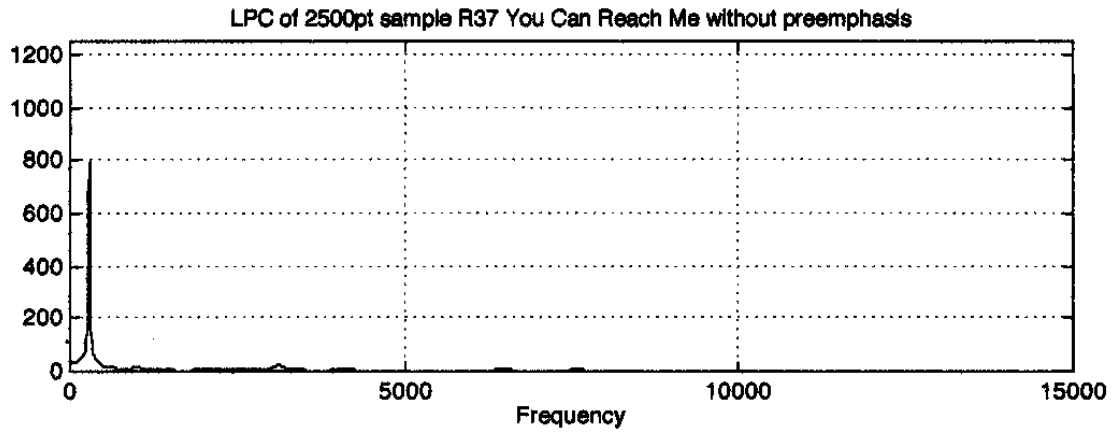
221

R37cst.wav

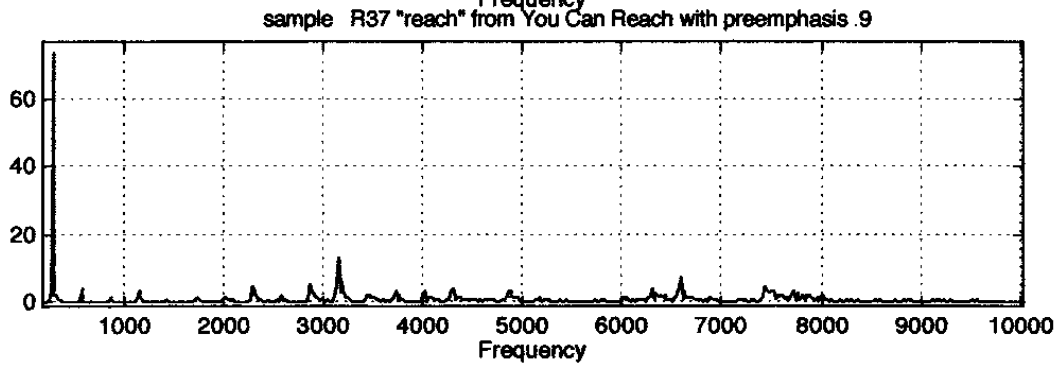
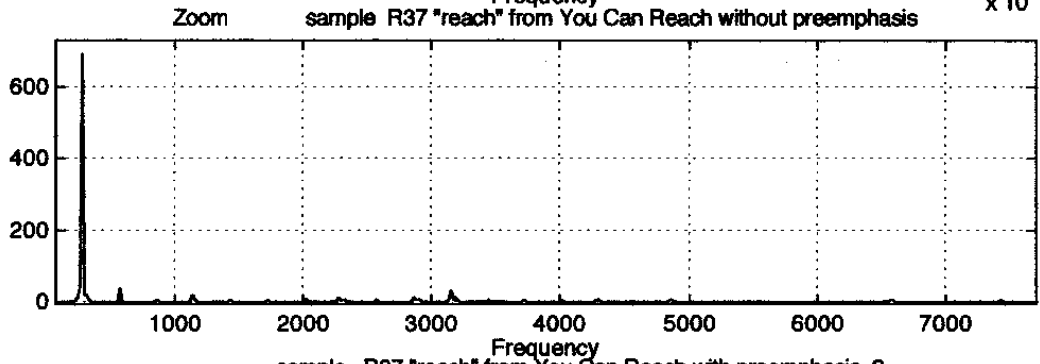
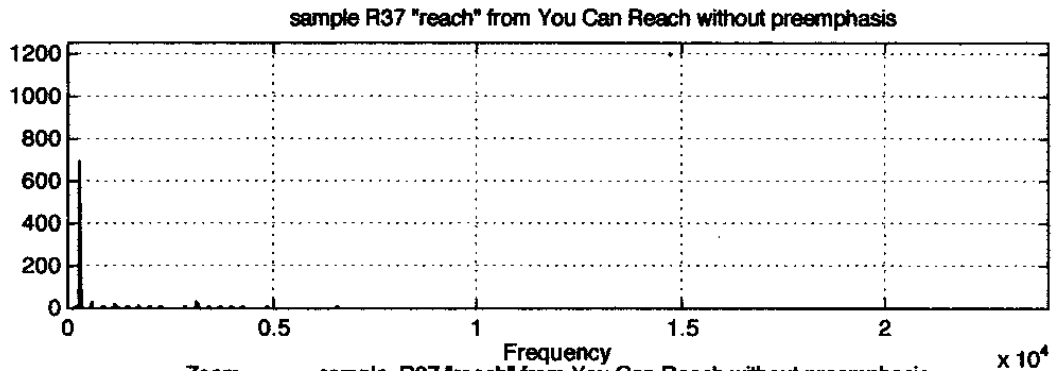
F1(293, 799)

F2(2263, 9)

F3(3132, 26)



# DFT Results



## DFT Numerical Results

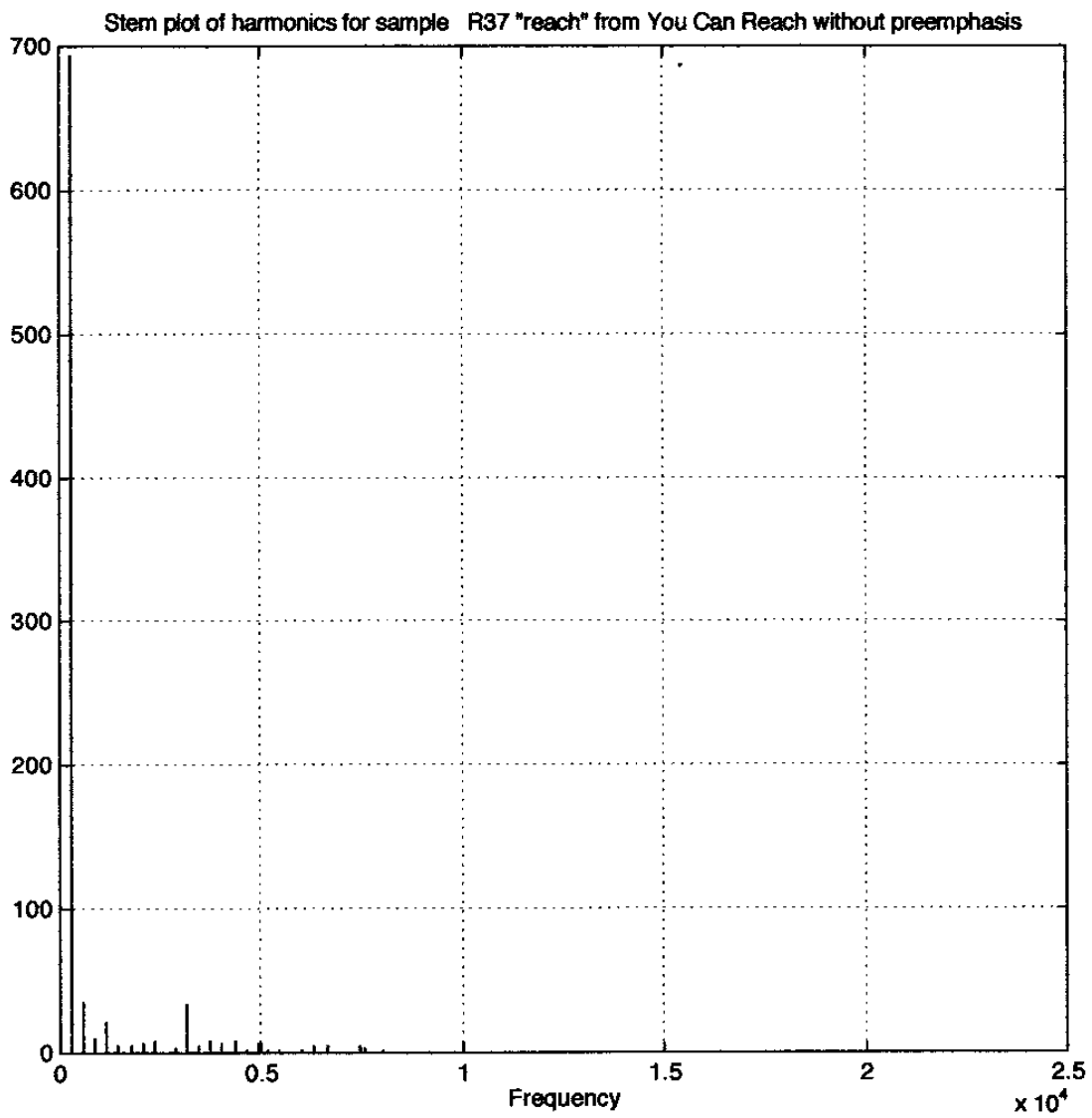
Worksheet saved into file: Minitab.R37  
MTB > Print 'Freq'-'% Amp'.

ROW	Freq	Amp	% Amp
1	306	692.911	100.000 ←
2	594	36.061	5.204
3	882	10.235	1.477
4	1170	20.789	3.000 ←
5	1458	5.447	0.786
6	1746	5.468	0.789
7	2034	6.736	0.972
8	2340	7.722	1.114 ←
9	2862	2.661	0.384
10	3168	33.976	4.903 ←
11	3456	5.253	0.758
12	3744	7.492	1.081 ←
13	4032	6.534	0.943
14	4320	7.541	1.088 ←
15	4662	1.231	0.178
16	4896	5.769	0.833
17	5166	2.002	0.289
18	5454	0.977	0.141
19	5742	0.597	0.086
20	6030	2.095	0.302
21	6318	4.908	0.708
22	6642	4.441	0.641
23	6930	0.726	0.105
24	7452	5.210	0.752
25	7542	3.836	0.554
26	8028	2.396	0.346
27	8298	0.360	0.052
28	8604	0.285	0.041
29	8856	0.522	0.075
30	9198	0.363	0.052
31	9576	0.204	0.029
32	9810	0.133	0.019
33	10026	0.103	0.015
34	10458	0.118	0.017
35	10692	0.273	0.039
36	10962	0.437	0.063
37	11412	0.338	0.049
38	11736	0.527	0.076
39	11844	0.541	0.078
40	12312	0.562	0.081
41	12600	0.226	0.033
42	12870	0.305	0.044
43	13122	0.387	0.056
44	13410	0.543	0.078
45	13824	0.323	0.047
46	14076	0.346	0.050
47	14472	0.103	0.015
48	14688	0.169	0.024
49	14922	0.201	0.029
50	15210	0.159	0.023
51	15570	0.234	0.034
52	15822	0.264	0.038
53	16308	0.104	0.015
54	16488	0.115	0.017
55	16722	0.059	0.008

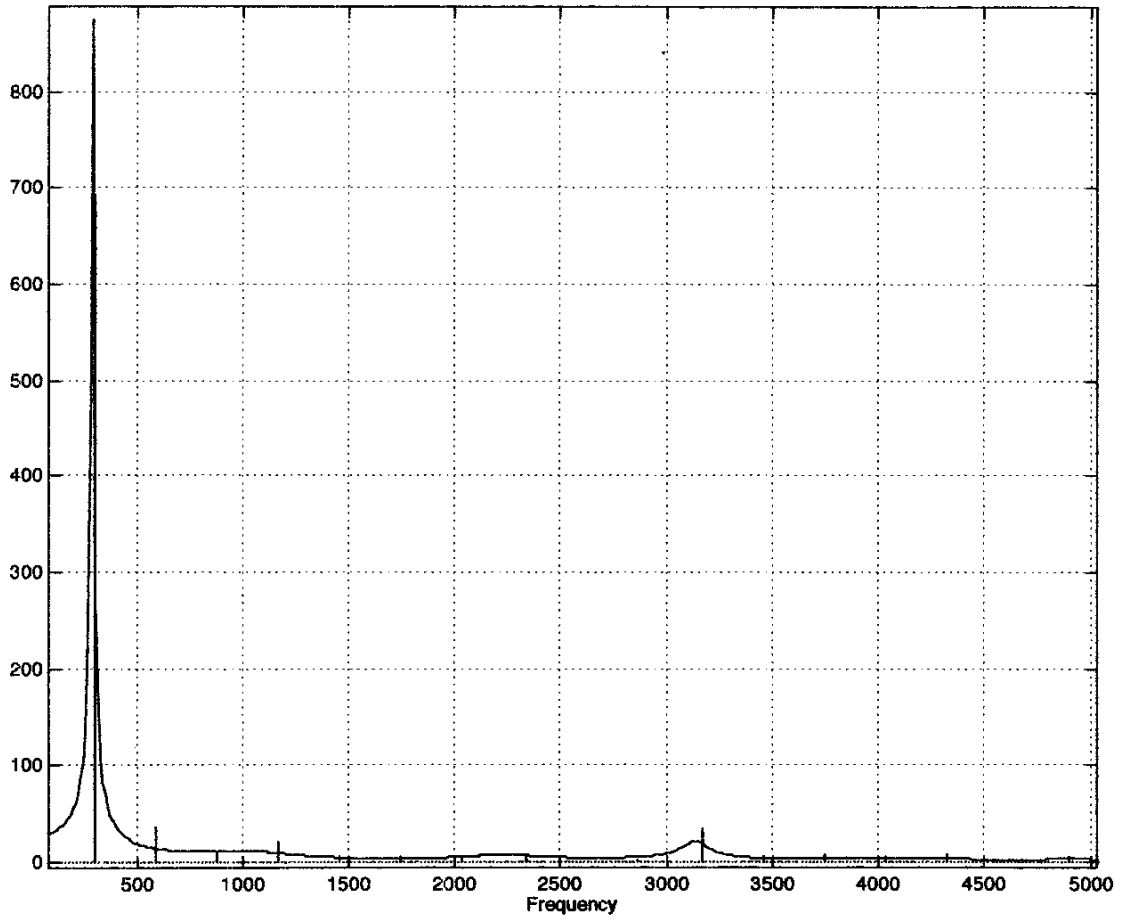
56	17082	0.147	0.021
57	17496	0.122	0.018
58	17856	0.092	0.013
59	18162	0.079	0.011
60	18324	0.085	0.012
61	18720	0.082	0.012
62	19044	0.047	0.007
63	19314	0.074	0.011
64	19530	0.088	0.013
65	19782	0.046	0.007
66	20304	0.043	0.006
67	20484	0.036	0.005
68	20754	0.038	0.005
69	21114	0.040	0.006
70	21312	0.040	0.006
71	21636	0.031	0.004
72	21924	0.033	0.005
73	22392	0.033	0.005
74	22752	0.031	0.004
75	23058	0.027	0.004
76	23328	0.031	0.005
77	23580	0.027	0.004
78	19746	0.381	0.055
79	19836	0.374	0.054
80	20070	0.350	0.050
81	20466	0.350	0.051
82	20592	0.352	0.051
83	20880	0.359	0.052
84	21222	0.348	0.050
85	21510	0.359	0.052
86	21708	0.365	0.053
87	21942	0.345	0.050
88	22176	0.372	0.054
89	22464	0.345	0.050
90	22626	0.341	0.049
91	23022	0.337	0.049
92	23202	0.322	0.046
93	23472	0.323	0.047
94	23724	0.327	0.047
95	22302	0.557	0.080
96	22554	0.583	0.084
97	22752	0.556	0.080
98	22986	0.569	0.082
99	23094	0.571	0.082
100	23490	0.559	0.081
101	23670	0.547	0.079
102	20160	0.179	0.026
103	20430	0.180	0.026
104	20610	0.171	0.025
105	20718	0.158	0.023
106	21042	0.164	0.024
107	21240	0.157	0.023
108	21420	0.141	0.020
109	21564	0.154	0.022
110	21834	0.144	0.021
111	21978	0.138	0.020
112	22104	0.146	0.021
113	22302	0.133	0.019
114	22608	0.144	0.021
115	22824	0.134	0.019

116	22950	0.130	0.019
117	23202	0.139	0.020
118	23418	0.141	0.020
119	23490	0.135	0.019
120	23814	0.133	

0.019



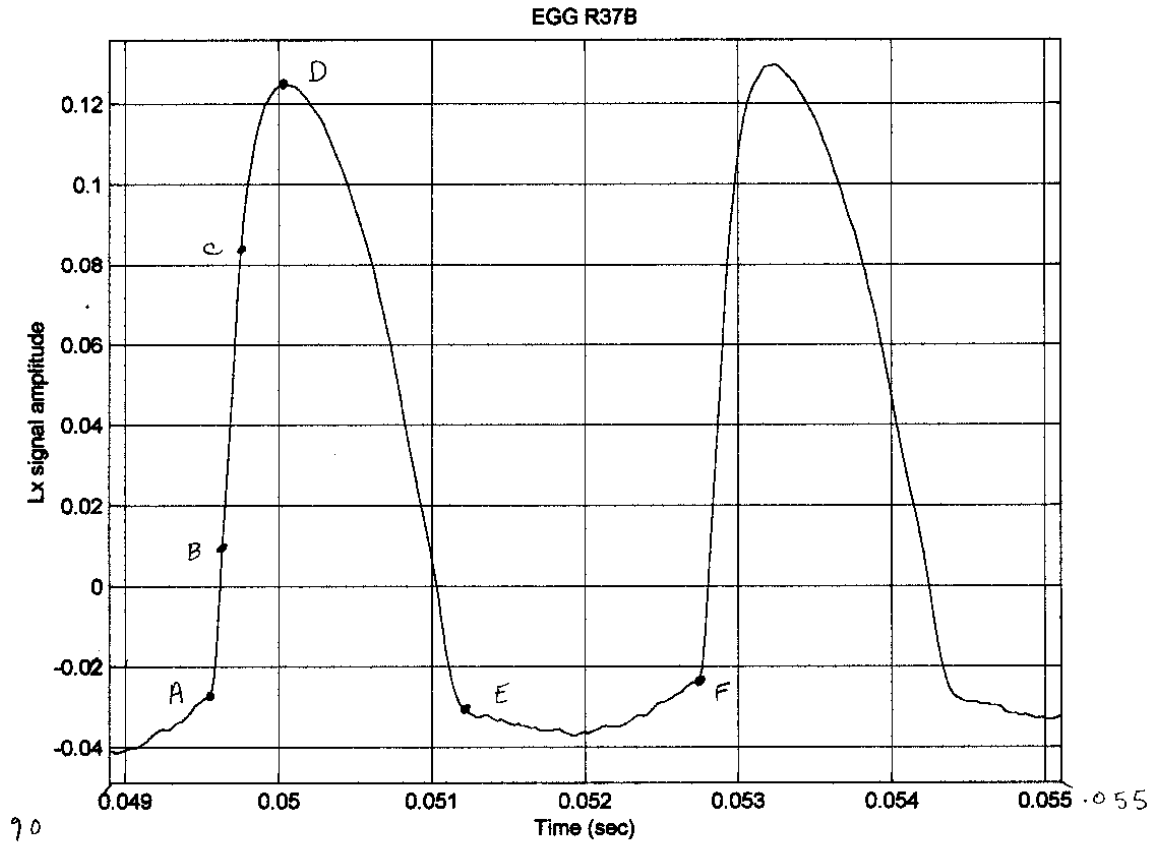
Stem plot/LPC overlay of harmonics for sample R37 without preemphasis

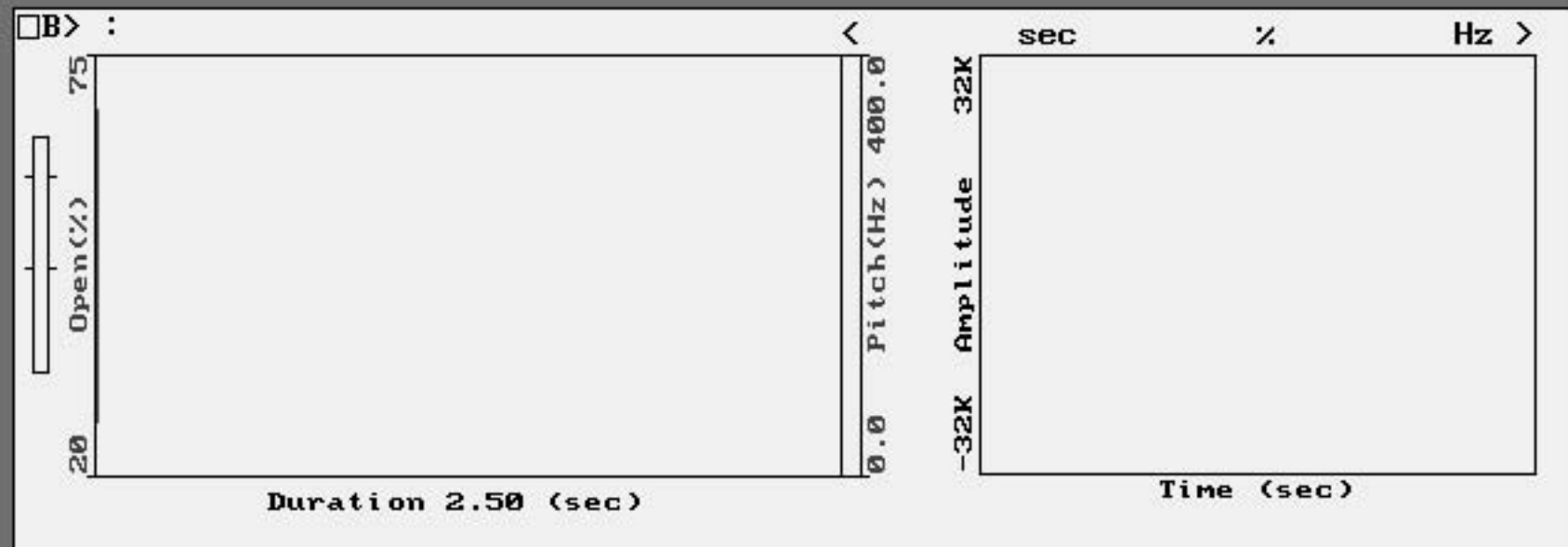
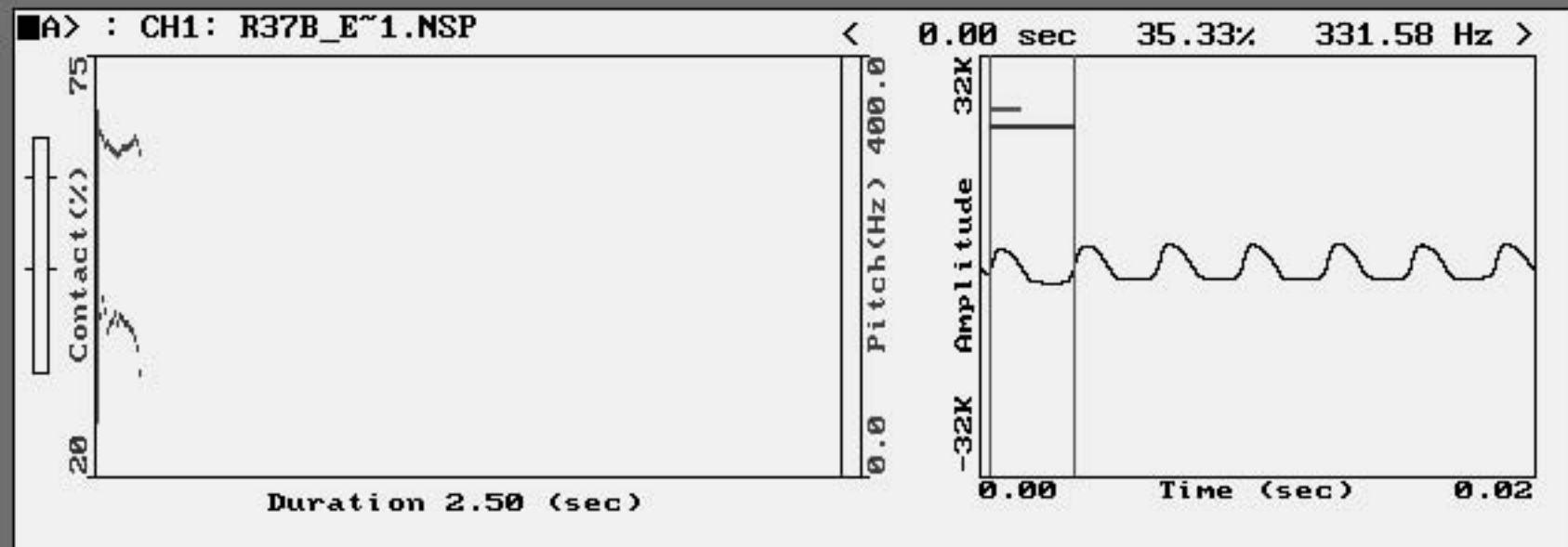


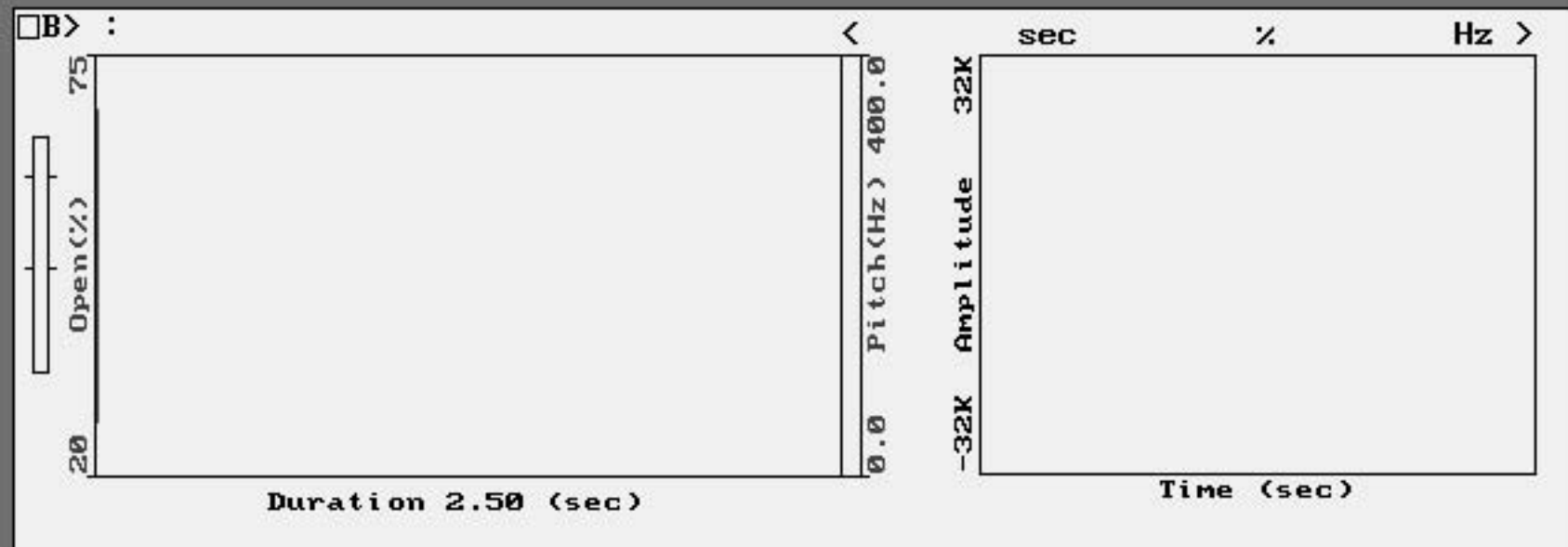
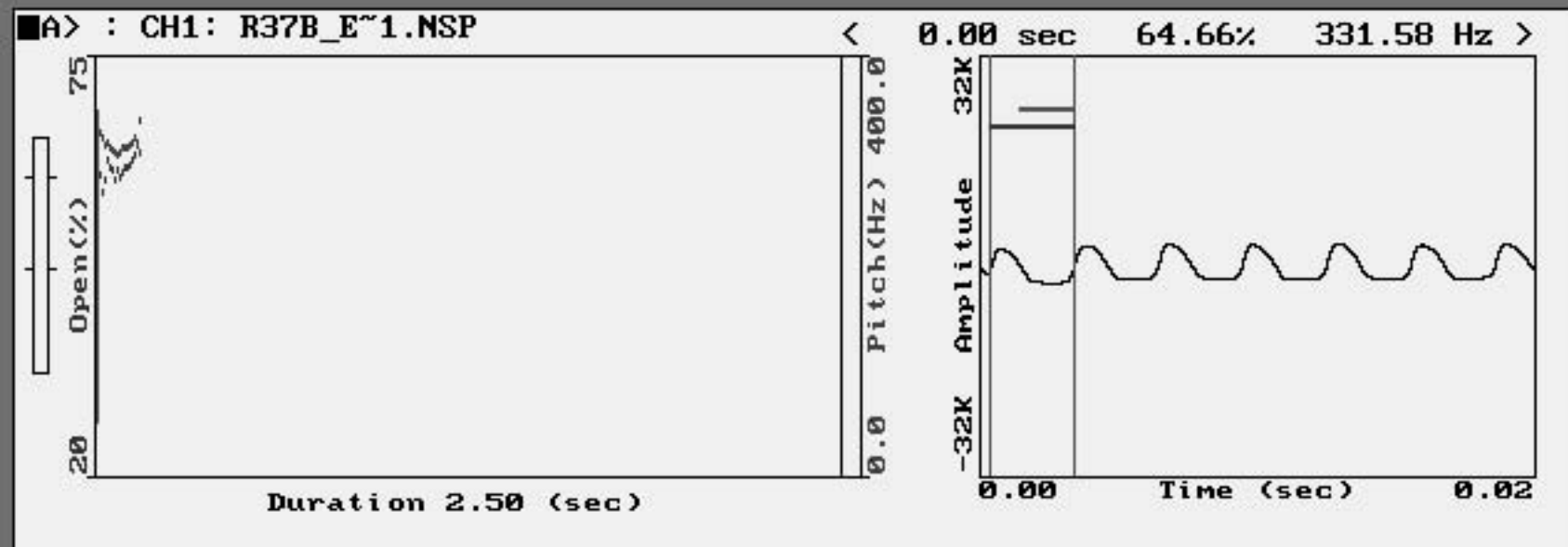
$$x \Rightarrow 25.5 \text{ mm} = .001$$

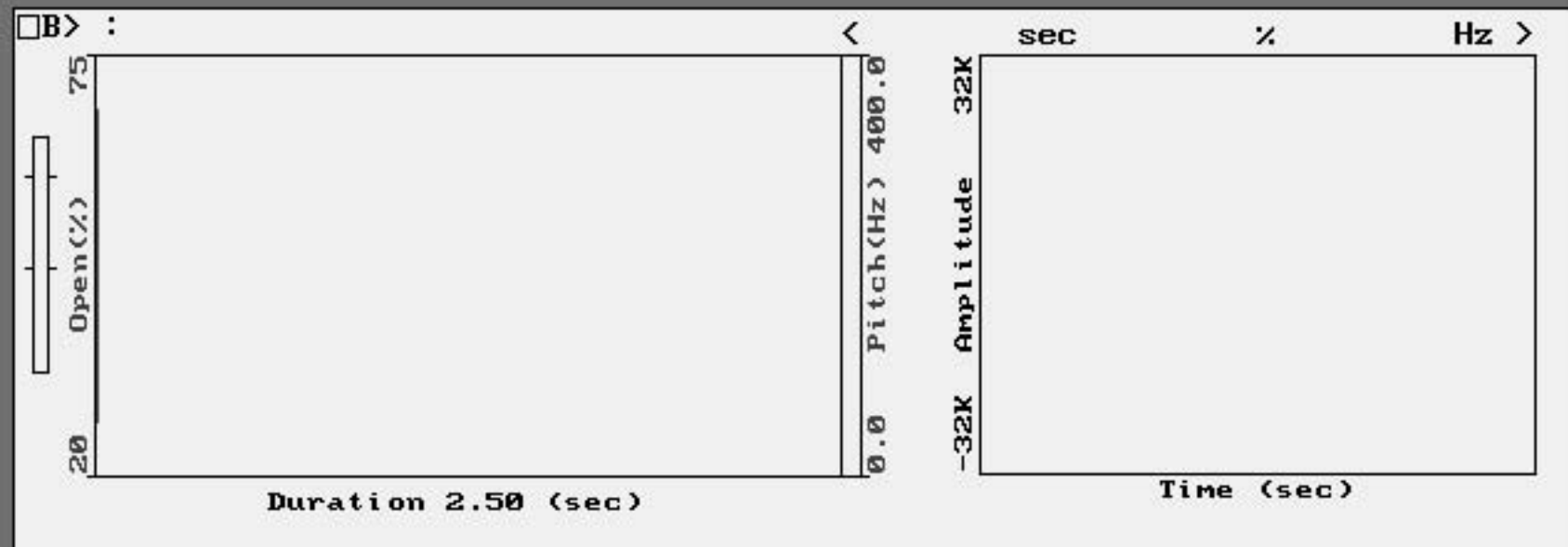
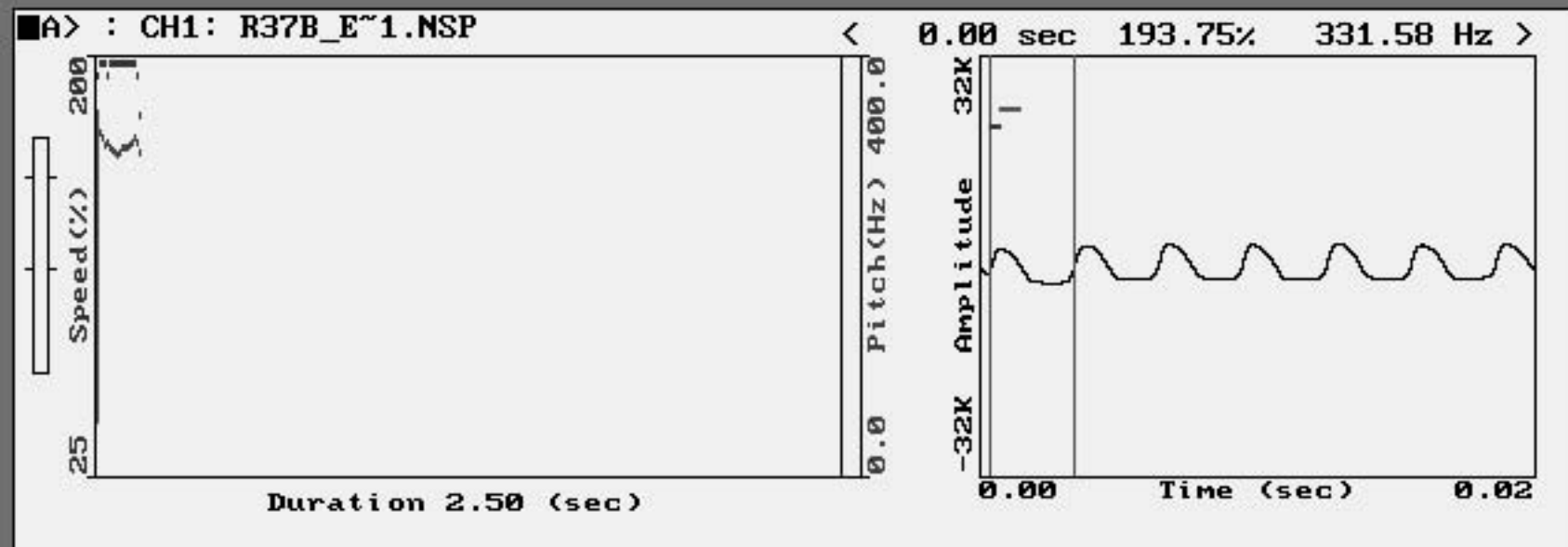
$$y \Rightarrow 13 \text{ mm} = .02$$

$$y \Rightarrow 1 \text{ mm} = .0015384$$



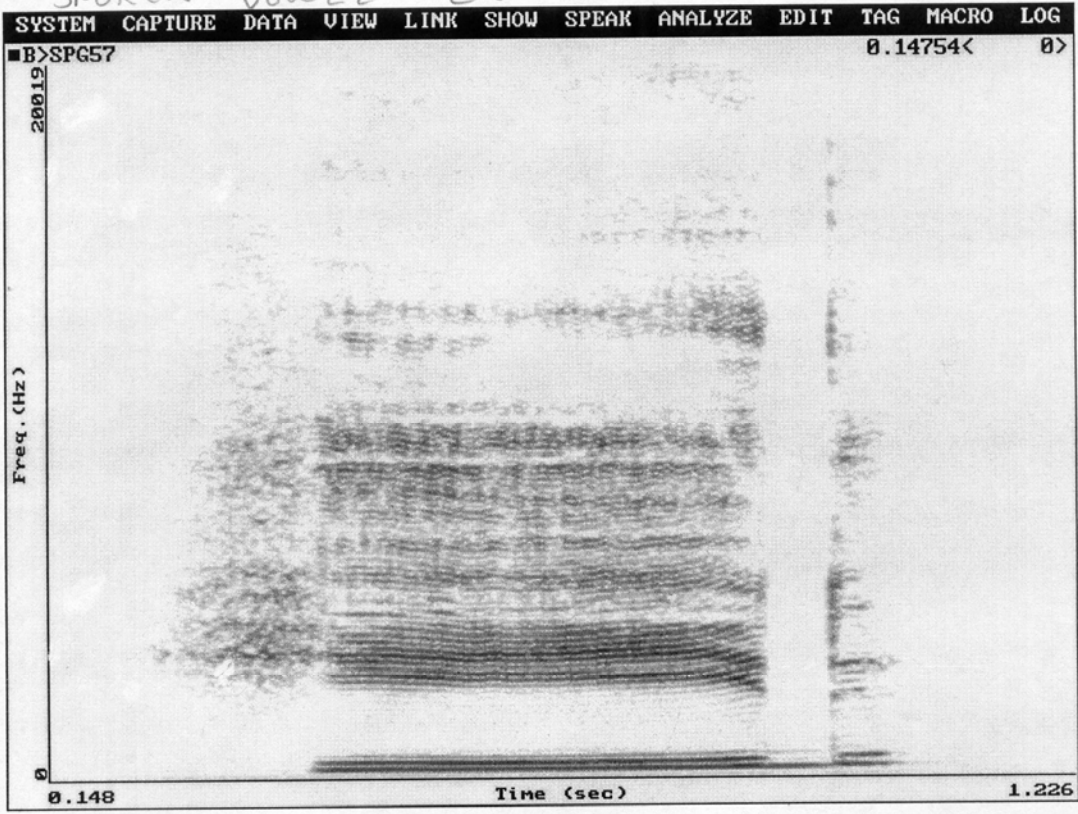






Sample #	SPK7
Description	Modal Voice
Data Rate (Hz)	44100 Hz
DURATION (sec)	0.24
Start time	0
End time	0.24
Silence	0.05
Active	0.23
Data Points	10624
Range	11707 (14 Bits)
PITCH (Hz)	
Mean	160.78
Pitch Range	7.72
Minimum	158.06
Maximum	165.78
Std Deviation	2.06
Avg. Jitter (%)	23.00%
CONTACT(1:6)	
Mean	41.85
Range	31.61
Minimum	37.9
Maximum	69.51
Std Deviation	5.1
CONTACT(Tif)	37.91%
SPEED(3:2)	
Mean	363.26
Range	56.29
Minimum	334.61
Maximum	390.9
Std Deviation	14.15
SPEED(Tif)	363.63%
OPEN(4:6)	
Mean	58.87%
Range	7.95%
Minimum	54.13%
Maximum	62.08%
Std Deviation	2.24%
OPEN(Tif)	62.08%

SPOKEN VOWEL [ɪ]

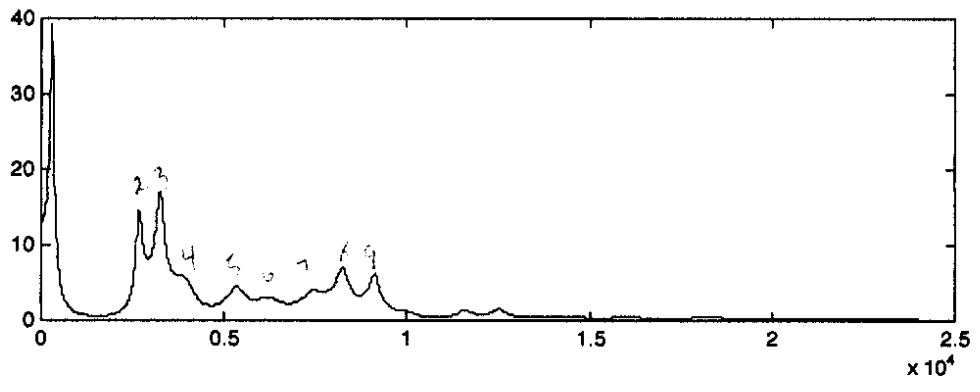
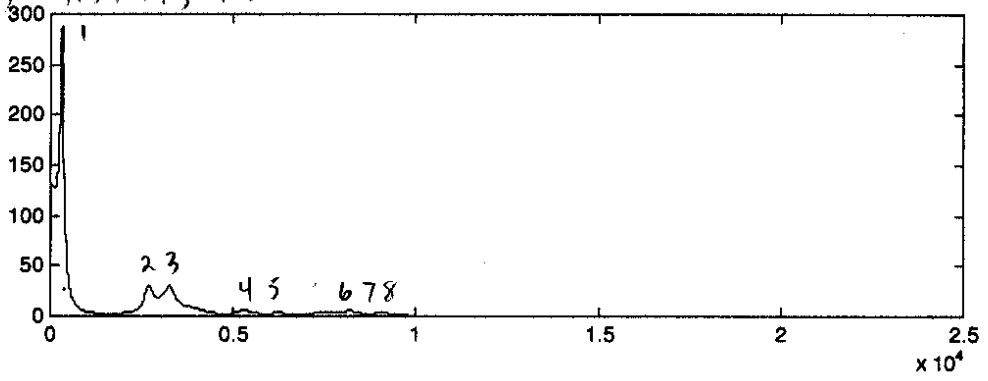


H -- E E --- D

- 1) 316.41, 287.37
- 2) 2682.97, 31.15
- 3) 3246.15, 30.77
- 4) 5338.95, 5.76
- 5) 6246.50, 3.26
- 6) 7417.40, 3.71
- 7) 8214.60, 5.88
- 8) 9124.49, 4.60

SPK 7

$$F_0 = 177 \text{ Hz}$$



$$.14714583 - .0059166667 = \frac{.141229164}{25}$$

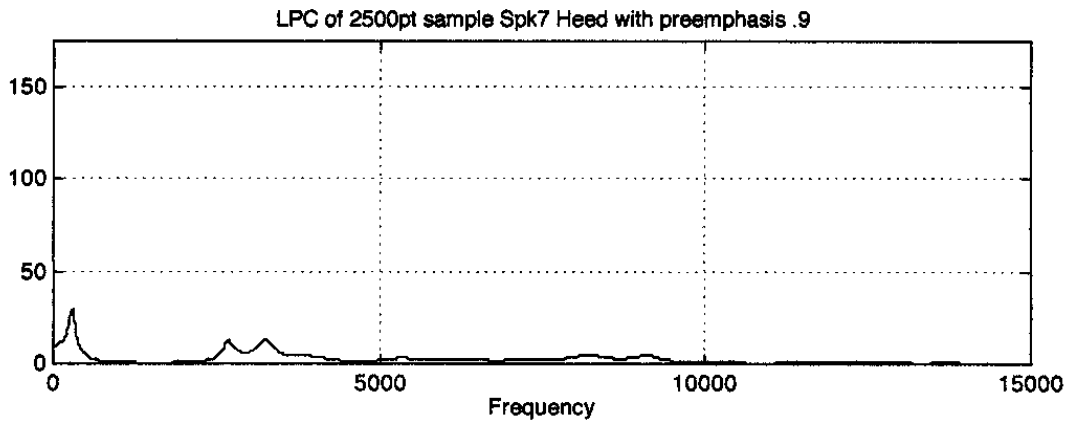
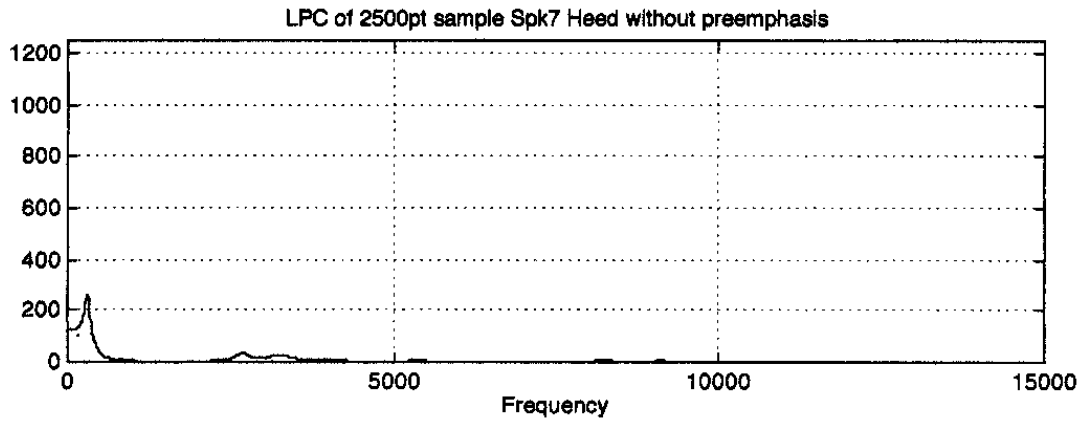
$$.005649167$$

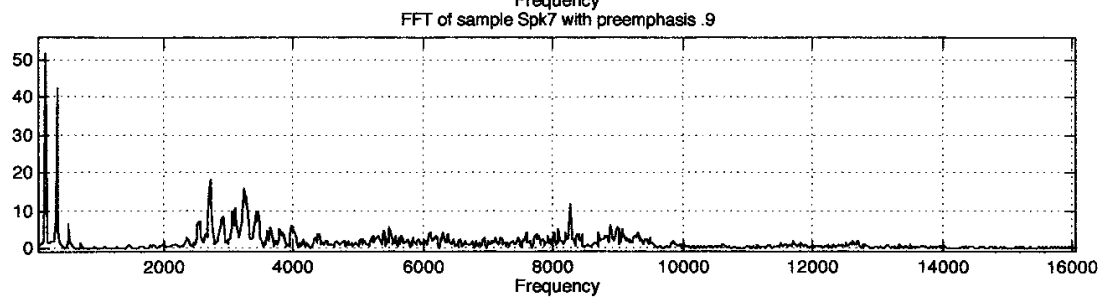
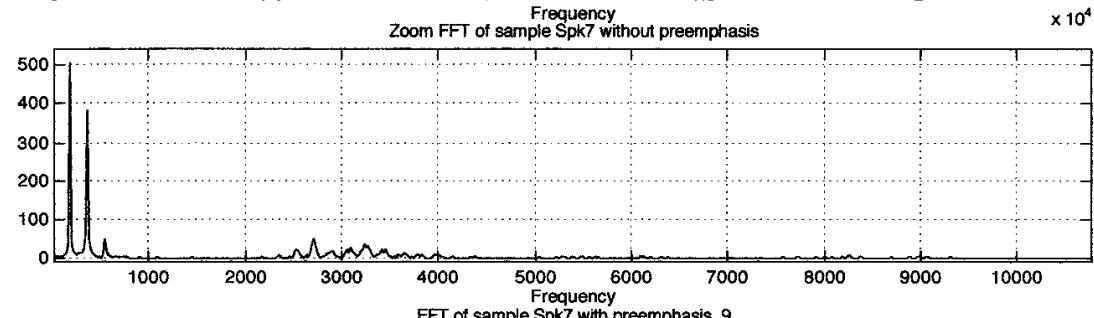
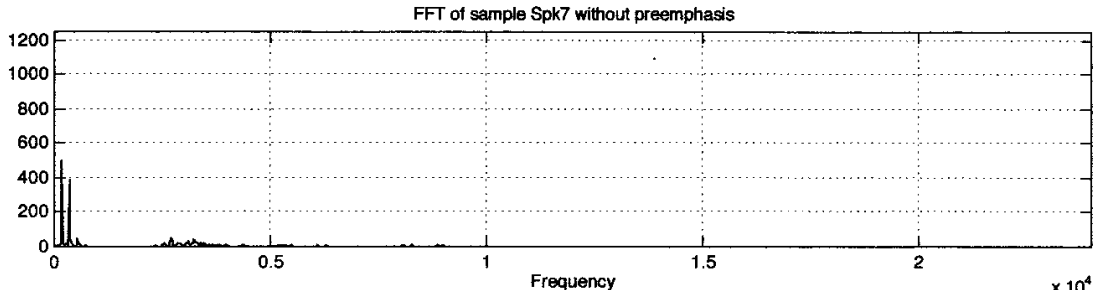
$$177.0172625$$

S5

F1 (305, 265)  
F2 (2684, 34)  
F3 (3268, 29)

Spk7 se st. wav





# SPK 7 Harmonics

L.P.C.

Average Female (1)

ROW	Freq	Amp	% Amp	
1	<u>198</u>	506.132	100.000	← F1
2	<u>378</u>	385.963	76.257	
3	<u>558</u>	49.197	9.720	
4	<u>738</u>	7.830	1.547	
5	<u>918</u>	4.438	0.877	
6	<u>1260</u>	2.161	0.427	
7	<u>1458</u>	4.163	0.822	
8	<u>1638</u>	2.751	0.544	
9	<u>1836</u>	3.313	0.655	
10	<u>2016</u>	3.476	0.687	
11	<u>2196</u>	4.621	0.913	
12	<u>2376</u>	11.509	2.274	
13	<u>2556</u>	22.362	4.418	
14	<u>2736</u>	52.260	10.325	← F2
15	<u>2934</u>	21.175	4.184	
16	<u>3114</u>	26.371	5.210	
17	<u>3294</u>	33.323	6.584	← F3
18	<u>3492</u>	15.357	3.034	
19	<u>3798</u>	10.295	2.034	
20	<u>3978</u>	11.667	2.305	← F4
21	<u>4158</u>	4.371	0.864	
22	<u>4392</u>	7.802	1.542	← F5
23	<u>4536</u>	3.207	0.634	
24	<u>4716</u>	3.546	0.701	
25	<u>4896</u>	2.331	0.461	
26	<u>5220</u>	3.435	0.679	
27	<u>5400</u>	6.846	1.353	
28	<u>5490</u>	7.741	1.530	← F6
29	<u>5670</u>	5.062	1.000	
30	<u>5940</u>	2.768	0.547	
31	<u>6120</u>	5.473	1.081	
32	<u>6318</u>	5.527	1.092	← F7
33	<u>6480</u>	2.720	0.537	
34	<u>6660</u>	2.257	0.446	
35	<u>6930</u>	2.765	0.546	
36	<u>7200</u>	3.133	0.619	
37	<u>7398</u>	2.625	0.519	
38	<u>7596</u>	4.429	0.875	
39	<u>7758</u>	4.538	0.897	
40	<u>7938</u>	3.789	0.749	
41	<u>8100</u>	5.737	1.133	
42	<u>8280</u>	12.391	2.448	← F8
43	<u>8460</u>	3.479	0.687	
44	<u>8712</u>	3.772	0.745	
45	<u>8892</u>	5.596	1.106	← F9
46	<u>9072</u>	4.573	0.903	
47	<u>9324</u>	3.666	0.724	
48	<u>9432</u>	2.610	0.516	
49	<u>9666</u>	0.990	0.196	
50	<u>9864</u>	1.489	0.294	← F10
51	<u>10026</u>	1.235	0.244	
52	<u>10350</u>	0.714	0.141	
53	<u>10530</u>	0.777	0.154	
54	<u>10620</u>	0.811	0.160	
55	<u>10818</u>	0.519	0.103	
56	<u>11088</u>	0.608	0.120	
57	<u>11268</u>	0.688	0.136	
58	<u>11520</u>	1.134	0.224	

316 F

2683 F

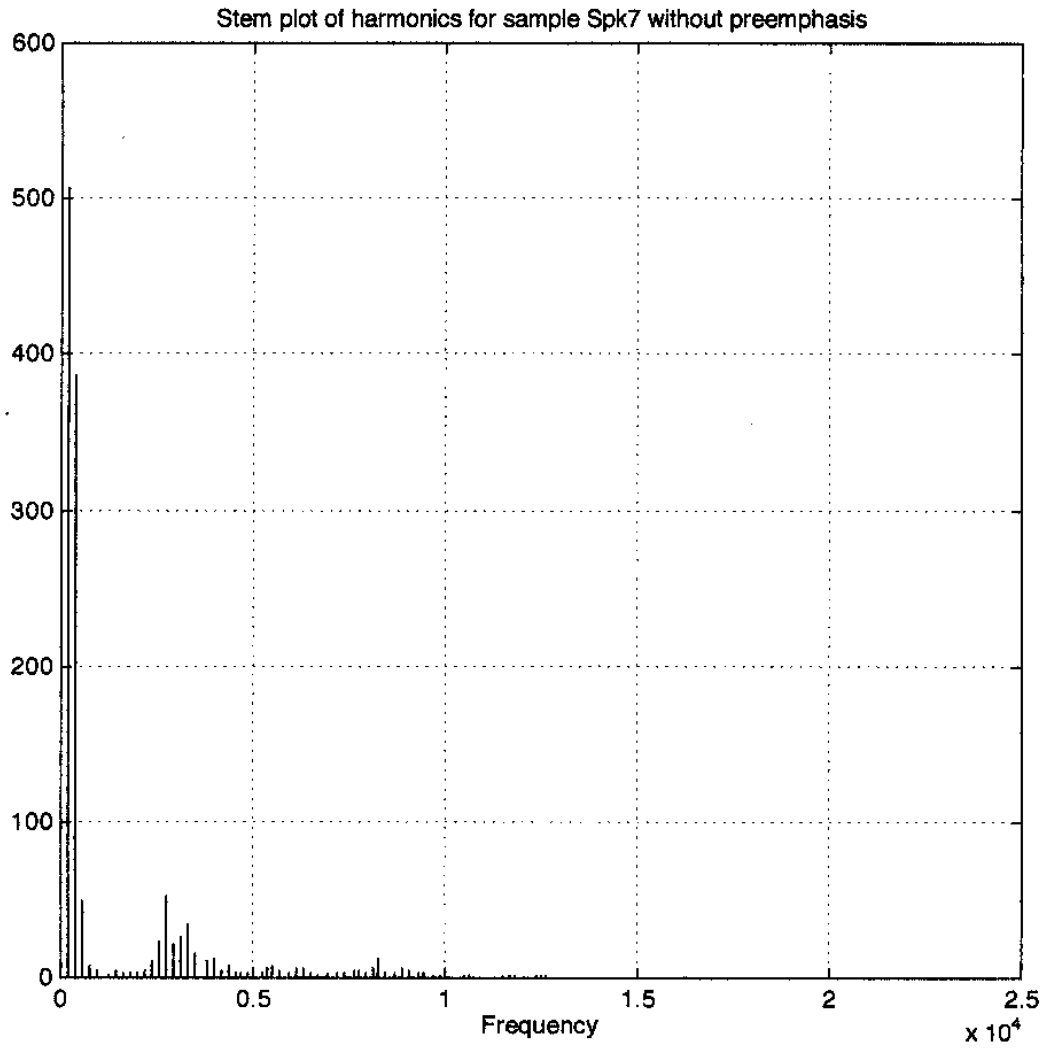
3246 F

5339 F

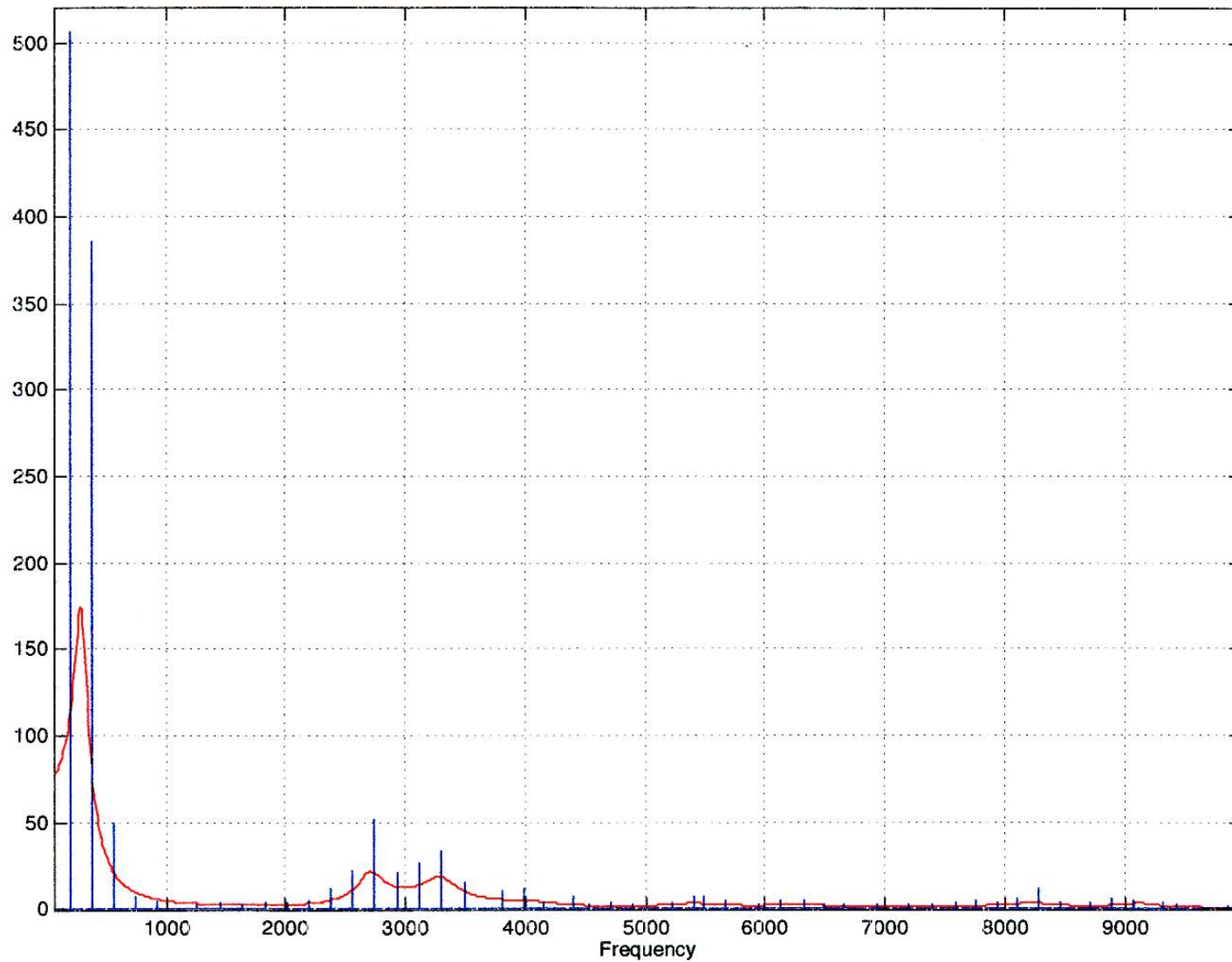
SP ?

59	11700	1.417	0.280 - F11
60	11826	1.316	0.260
61	12060	0.690	0.136
62	12348	0.977	0.193
63	12528	1.007	0.199
64	<u>12636</u>	1.309	0.259 -
65	12816	0.624	0.123
66	13140	0.508	0.100
67	13338	0.400	0.079
68	13518	0.438	0.086
69	13680	0.495	0.098
70	13824	0.377	0.075
71	14094	0.238	0.047
72	14292	0.273	0.054
73	14472	0.520	0.103
74	14652	0.477	0.094
75	14814	0.404	0.080
76	14994	0.245	0.048
77	15300	0.235	0.046
78	15462	0.327	0.065
79	15714	0.267	0.053
80	15858	0.303	0.060
81	16110	0.390	0.077
82	16290	0.521	0.103
83	16470	0.334	0.066
84	16596	0.258	0.051
85	16776	0.227	0.045
86	17100	0.246	0.049
87	17244	0.245	0.048
88	17478	0.300	0.059
89	17550	0.223	0.044
90	17820	0.179	0.035
91	18054	0.278	0.055
92	18180	0.429	0.085
93	18396	0.334	0.066
94	18666	0.234	0.046
95	18846	0.255	0.050
96	19026	0.263	0.052
97	19278	0.203	0.040
98	19440	0.162	0.032
99	19566	0.166	0.033
100	19782	0.181	0.036
101	20034	0.161	0.032
102	20160	0.179	0.035
103	20430	0.180	0.036
104	20610	0.171	0.034
105	20718	0.158	0.031
106	21042	0.164	0.032
107	21240	0.157	0.031
108	21420	0.141	0.028
109	21564	0.154	0.030
110	21834	0.144	0.028
111	21978	0.138	0.027
112	22104	0.146	0.029
113	22302	0.133	0.026
114	22608	0.144	0.029
115	22824	0.134	0.026
116	22950	0.130	0.026
117	23202	0.139	0.027
118	23418	0.141	0.028

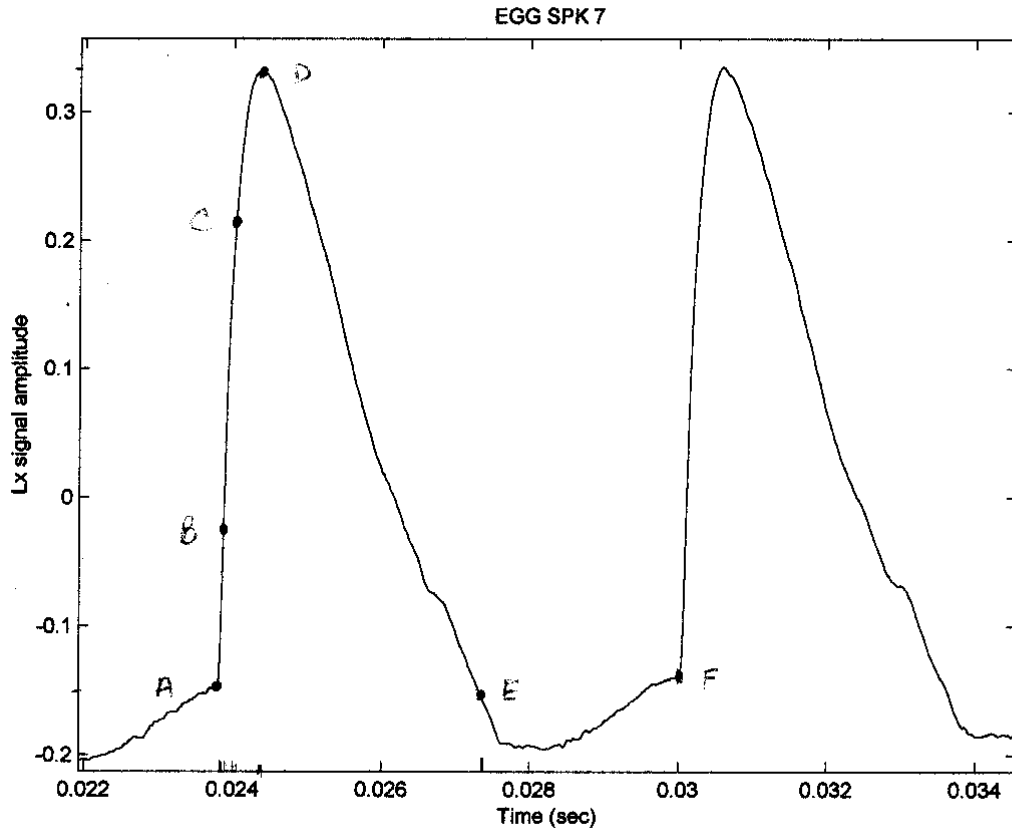
119	23490	0.135	0.027
120	23814	0.133	0.026



Stem plot/LPC overlay of harmonics for sample Spk7 without preemphasis

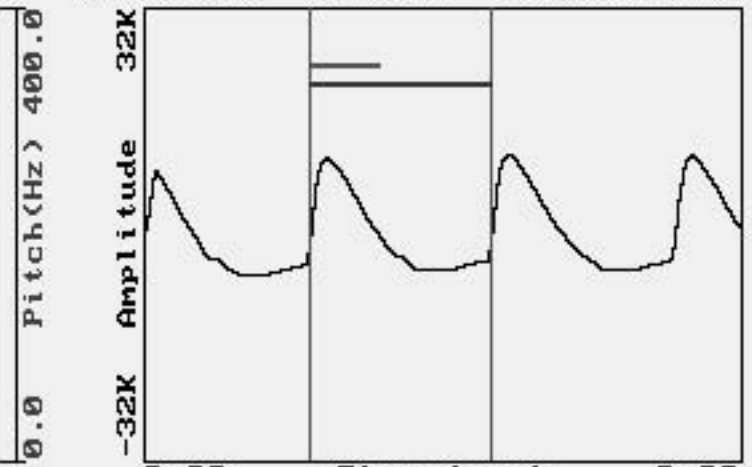


• 1 = 22mm  $\Rightarrow$  y axis  
• 0.001 = 125mm  $\Rightarrow$  x axis



**A** > : CH1: SPK7\_E~1.NSP

< 0.00 sec 37.91% 163.94 Hz >

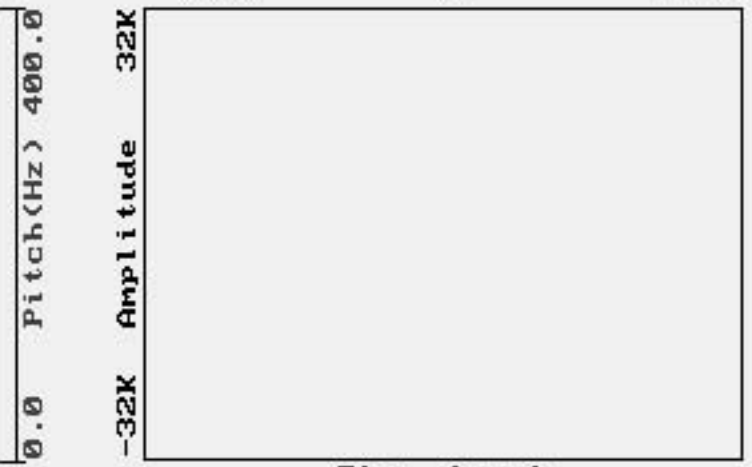


Duration 2.50 (sec)

Pitch(Hz) 400.0

**B** > :

< sec % Hz >

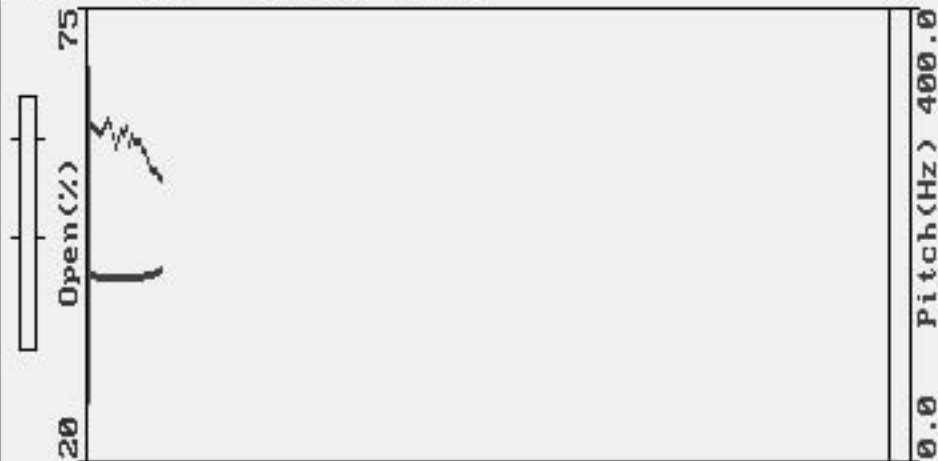


Duration 2.50 (sec)

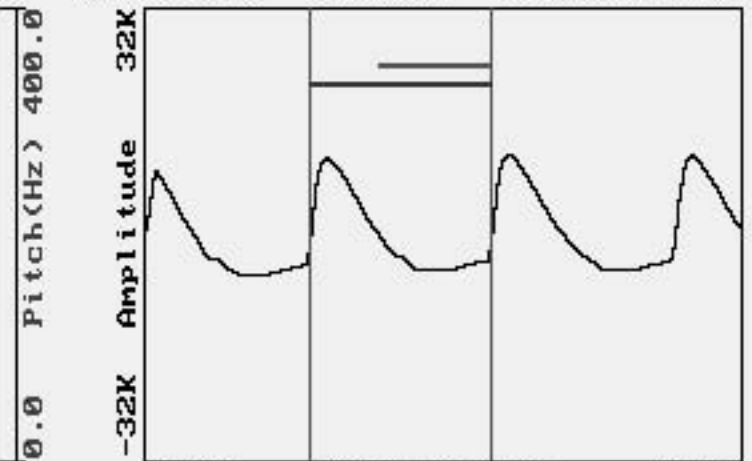
Pitch(Hz) 400.0

■A> : CH1: SPK7\_E~1.NSP

< 0.00 sec 62.08% 163.94 Hz >



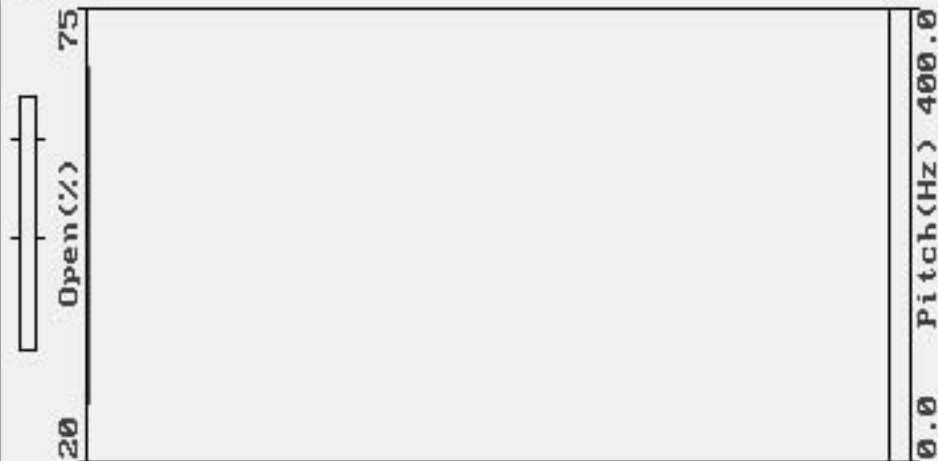
Duration 2.50 (sec)



Time (sec)

□B> :

< sec % Hz >



Duration 2.50 (sec)



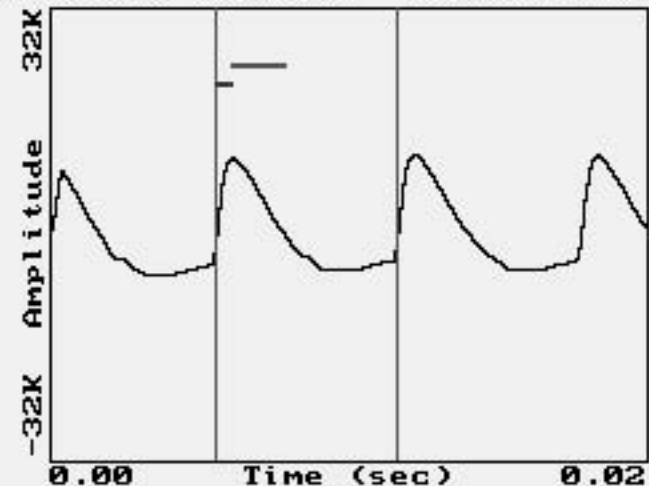
Time (sec)

■A> : CH1: SPK7\_E~1.NSP

< 0.00 sec 363.63% 163.94 Hz >

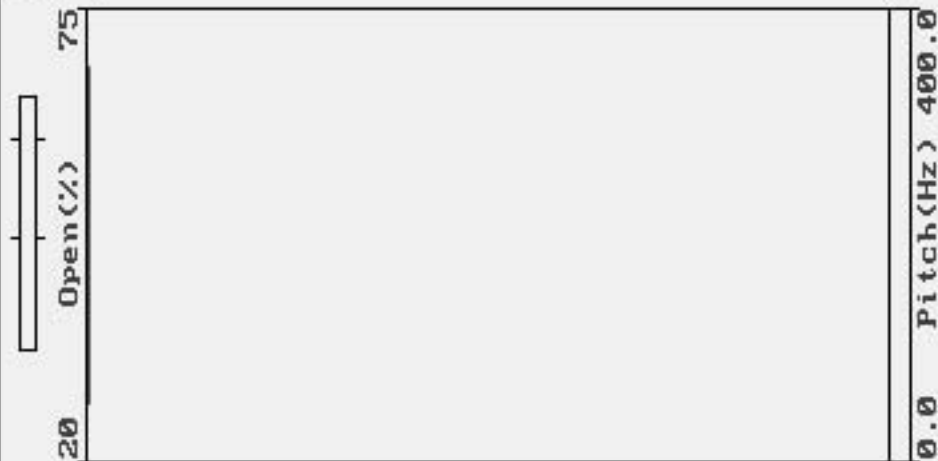


Duration 2.50 (sec)



□B> :

< sec % Hz >



Duration 2.50 (sec)



Appendix B Fluoroscopy and MRI

Figure Xray fluoroscopy of Lisa showing a sagittal view of the classical voice quality on the vowel [i]



Figure Figure Xray fluoroscopy of Lisa showing a sagittal view of the belt voice quality on the vowel [i]



Figure Figure Xray fluoroscopy of Lisa showing a coronal view of the classical voice quality on the vowel [i]



Figure Xray fluoroscopy of Lisa showing a coronal view of the belt voice quality on the vowel [i]



These xrays seem to be consistent with the previous research by Estill and Sundberg. The epilaryngeal area is wider in classical than belt. The [i] tongue position is similar in these qualities although the classical tongue position may be slightly more compressed than the belt tongue. The shadow of the mandible obscured some on the tongue in both sagittal samples. However, in the moving pictures, the physiological configurations of the tongue, pharynx and vocal folds were more easily distinguished. The corresponding shadows were then outlined on the still frames. The velar position is slightly higher in classical than in belt. The LGG measurements seem to indicate similar physiological configurations to that shown in the Xrays. The TA muscles look squarer shaped in belt than in classical. This is consistent with the LGG results, which showed a more rectangular peak shape for belt and a more triangular peak shape for classical. Peak shape and triangularity is thought to be an indication of phase lag in the vocal fold vibration. Phase lag is attributed in part to the shape of the shape of the vocal folds. It was very hard to distinguish on the xray whether there was surface bulging or what the forces of adduction were. The xrays, also show that the plane of the vocal folds was different in classical than in belt, probably due to the laryngeal position and the position of the epiglottis. In classical the larynx was lower and the epiglottis forward and in belt the laryngeal position was higher and the epiglottis pulled down. The ventricular folds and the vocal folds are much closer to horizontal in the belt quality than the classical. The xrays also showed a wider opening of the piriform sinuses in the classical quality than in the belt quality.

MRI for ah vowel

