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PART IV

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UNSTEADY LOW-SPEED WINDTUNNEL TEST
OF A STRAKED DELTA WING, OSCILLATING IN PITCH

PART IV: PLOTS OF TIME HISTORIES OF PRESSURES AND OVERALL
LOADS

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) Results of a wind tunnel test of an oscillating straked wing. The report provides unsteady airloads and pressure distributions for a range of incidences (-8 to 50 deg.) and amplitudes (1 to 16 deg.). The wind speed was 80 meters/second, which provided reduced frequencies up to 0.50 based on root chord. The zeroth and first harmonic as well as the continuous time history of the pressure and overall loads were measured. Flow visualization was performed for flow of 30 meters/second using a pulsating laser light sheet. In part IV, the plots of time history data for both pressures and overall air loads for continuous oscillating model are presented for conditions in which non-linearities and higher harmonics are expected. Appendix A includes the pressure plots in a "carpet" format which shows the distributions at every 45 deg of phase angle in a manner similar to the unsteady flow visualization photos. The distributions are shown similarly for all four pressure sections. (See reverse)					
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Geurts, E.G.M.,	"	"	"	"	"
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Persoon, A.J.,	"	"	"	"	"
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Retel, A.P.,	"	"	"	"	"
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Zwaan, R.J.,	"	"	"	"	"
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19. ABSTRACT CONTD

A survey of the test conditions and their runnumbers is given in table 10 of part I.

Appendix B includes plots of overall air loads vs. incidence for continuous oscillating model. A survey of the runnumbers of these plots is given in table 11 of part I.

FOREWORD

This report summarizes the results of the windtunnel test of an oscillating straked wing conducted under a cooperative program of research between General Dynamics Fort Worth Division, Fort Worth, Texas, and the National Aerospace Laboratory (NLR), The Netherlands. The model and support system was designed and fabricated at NLR under a separate program with General Dynamics and NLR funding. The test preparation, wind-tunnel test and reporting were performed at NLR under Air Force Contract F33615-85-C-3013, for the Flight Dynamics Laboratory of the Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, Ohio. The work was administered by Mr. D.W. Kinsey of the Aeromechanics Division (AFWAL/FIM). Additional technical monitoring support was provided by Mr. T. Cord of the Flight Control Division (AFWAL/FIG).

The program manager and principal investigator was Dr. A.M. Cunningham Jr. at General Dynamics and Mr. R.G. den Boer was the principal investigator at NLR. Mr. den Boer was assisted by the following NLR specialists: C.S.G. Dogger, E.G.M. Geurts, A.J. Persoon, A.P. Retèl and R.J. Zwaan.

This report consists of six parts. Part I presents a general description of the model and test program and a discussion of the results. Part II contains the steady pressure distribution plots and the major part of the zeroth and first order harmonic unsteady pressure distribution plots. Part III contains the remainder of the unsteady pressure distribution plots and plots of the steady and the zeroth and first order harmonic unsteady overall loads. Part IV contains time history plots of the unsteady pressures and overall loads. Part V contains power spectral density plots of the overall loads at harmonic oscillation and time history plots of overall loads for (1-cos) model motions. Part VI contains results of the flow visualization program.



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LIST OF SYMBOLS

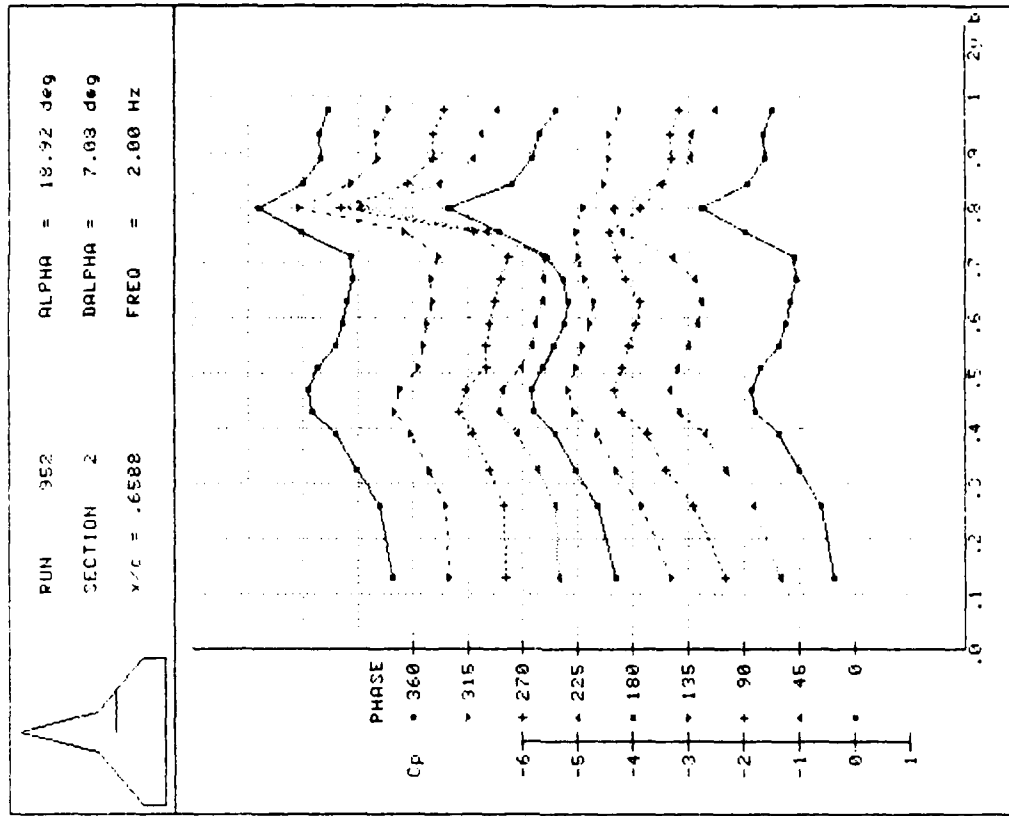
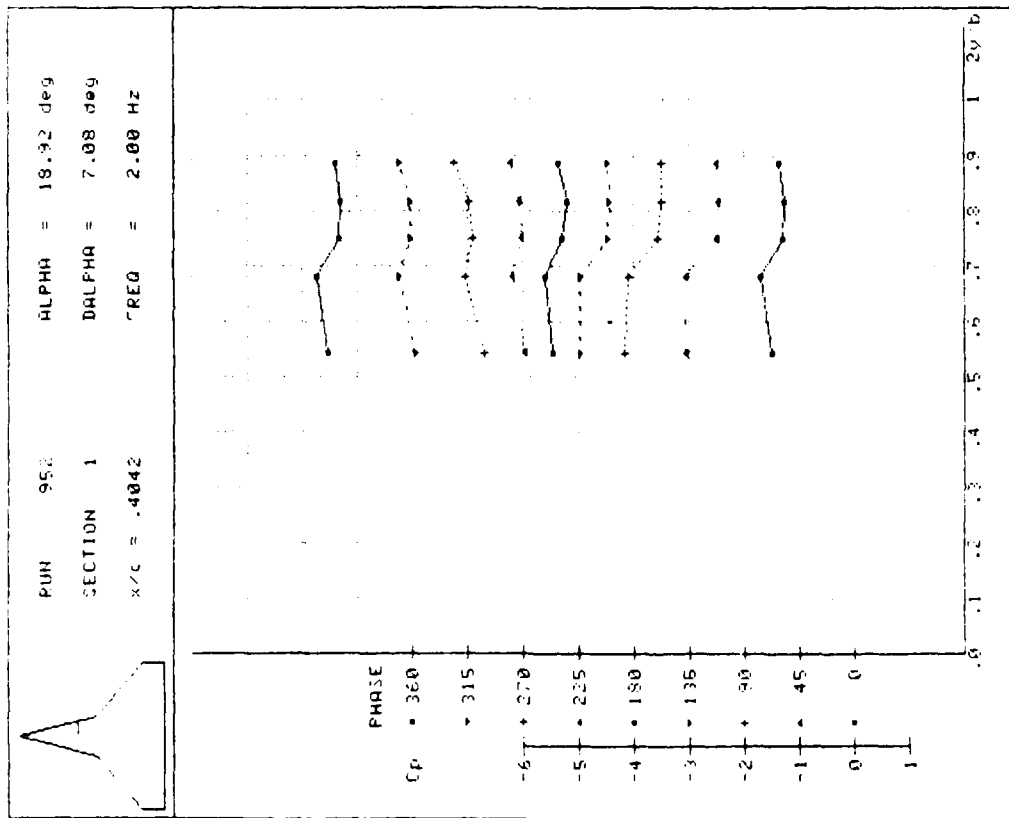
ALPHA, α	wing incidence	(deg)
b	local wing span	(m)
bw	wing span (bw = 0.8000)	(m)
BETA, β	sideslip angle	(deg)
c	local chord	(m)
Cl	wing rolling moment coefficient	
Cm	wing pitching moment coefficient	
	ref. axis = rotation axis $x/cr = 73.27\%$	
Cn	wing yawing moment coefficient	
CN	wing normal force coefficient	
Cp	pressure coefficient	
cr	root chord (cr = 0.7855)	(m)
CT	wing tangential force coefficient	
CY	wing side force coefficient	
DALPHA, $d\alpha$	harmonic oscillation: amplitude of unsteady wing incidence	(deg, rad)
f, FREQ	frequency	(Hz)
l	wing rolling moment (figure 1, part I)	(Nm)
m	wing pitching moment (figure 1, part I)	
	ref. axis $x/cr = 73.27\%$	(Nm)
n	wing yawing moment (figure 1, part I)	(Nm)
N	wing normal force (figure 1, part I)	(Nm)
RUN	run number	
t	time	(s)
T	wing tangential force (figure 1, part I)	(N)
	apex: $x=0$ (figures 1, 5, part I)	
y	spanwise coordinate in wing reference plane (figures 1, 5, part I) y-axis is the rotation axis; $x/cr = 73.27\%$	(N)
Y	wing side force (figure 1, part I)	(N)
<u>GREEK</u>		
α , ALPHA	wing incidence	(deg)
$d\alpha$, DALPHA	harmonic oscillation: amplitude of unsteady wing incidence	(deg, rad)
β , BETA	sideslip angle	(deg)

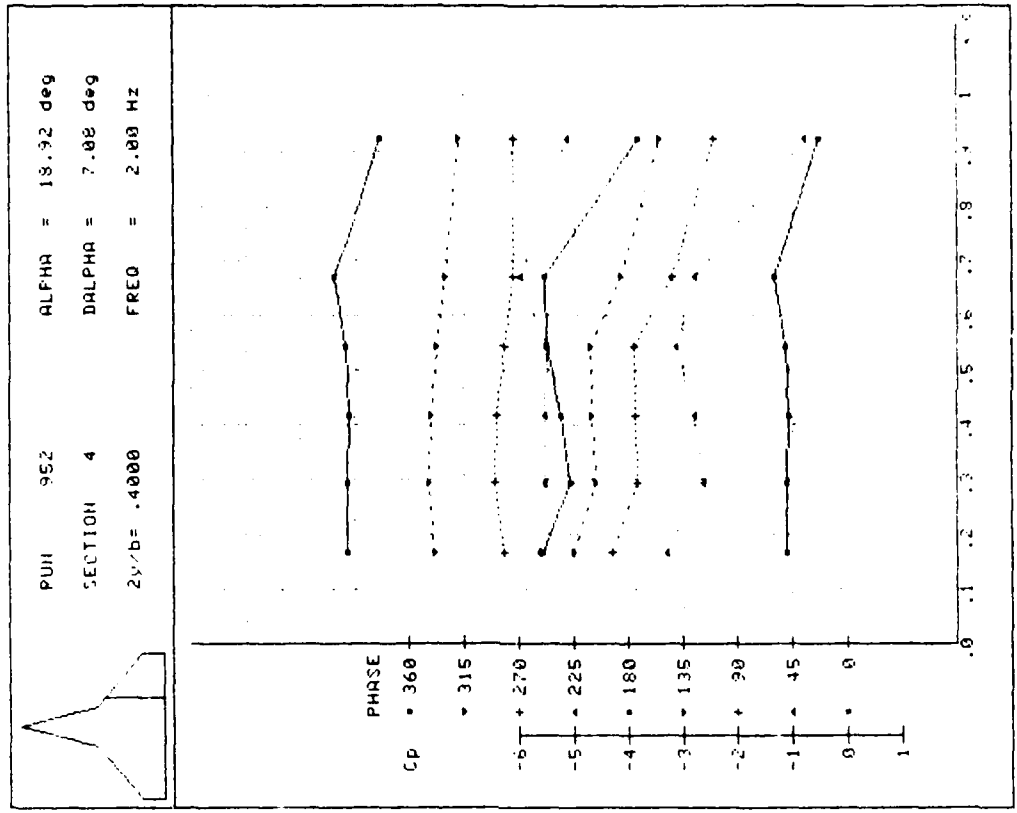
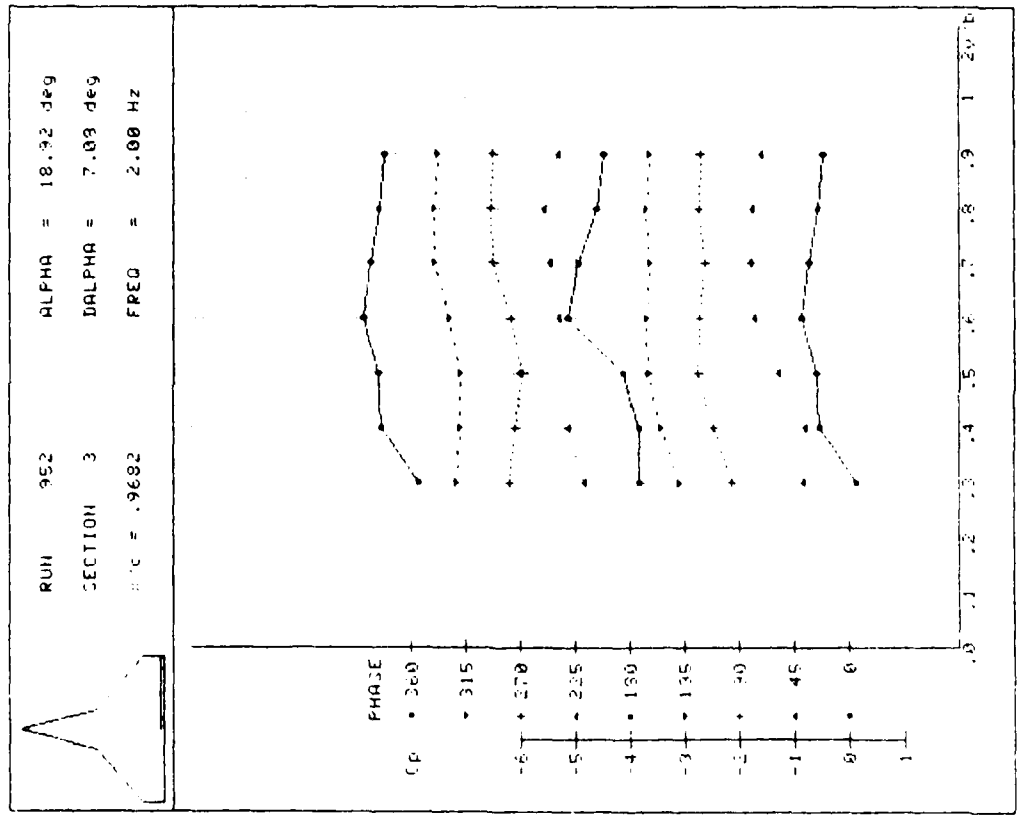
APPENDIX A
PLOTS OF TIME HISTORIES OF PRESSURES
FOR CONTINUOUS OSCILLATING MODEL

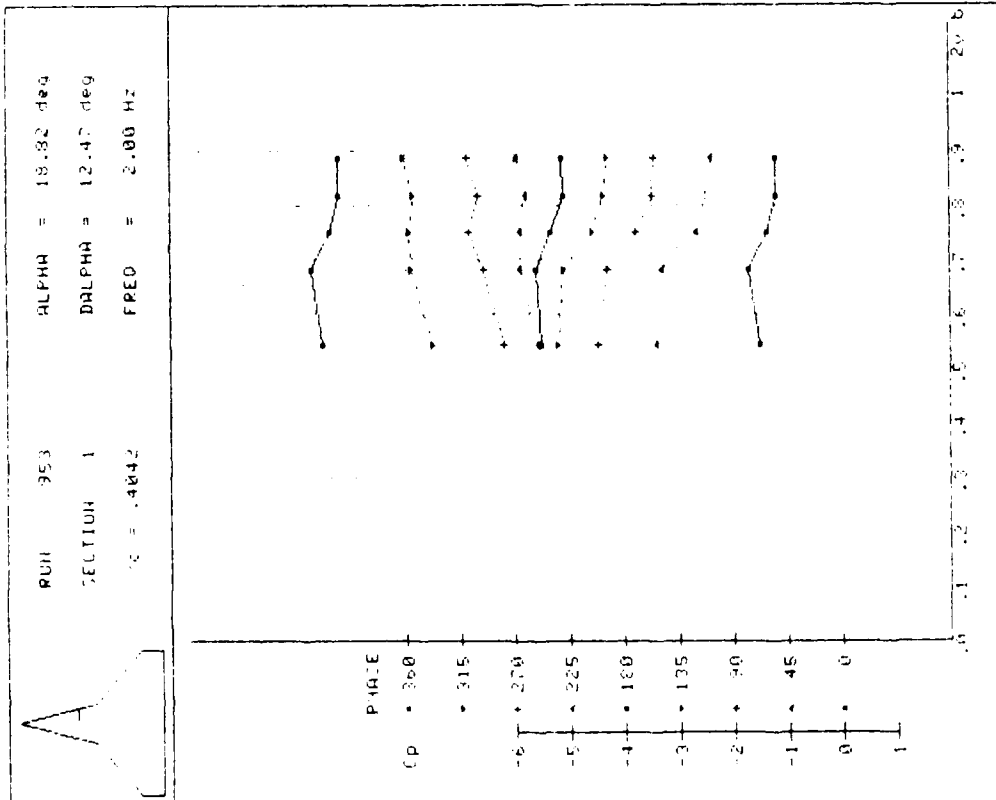
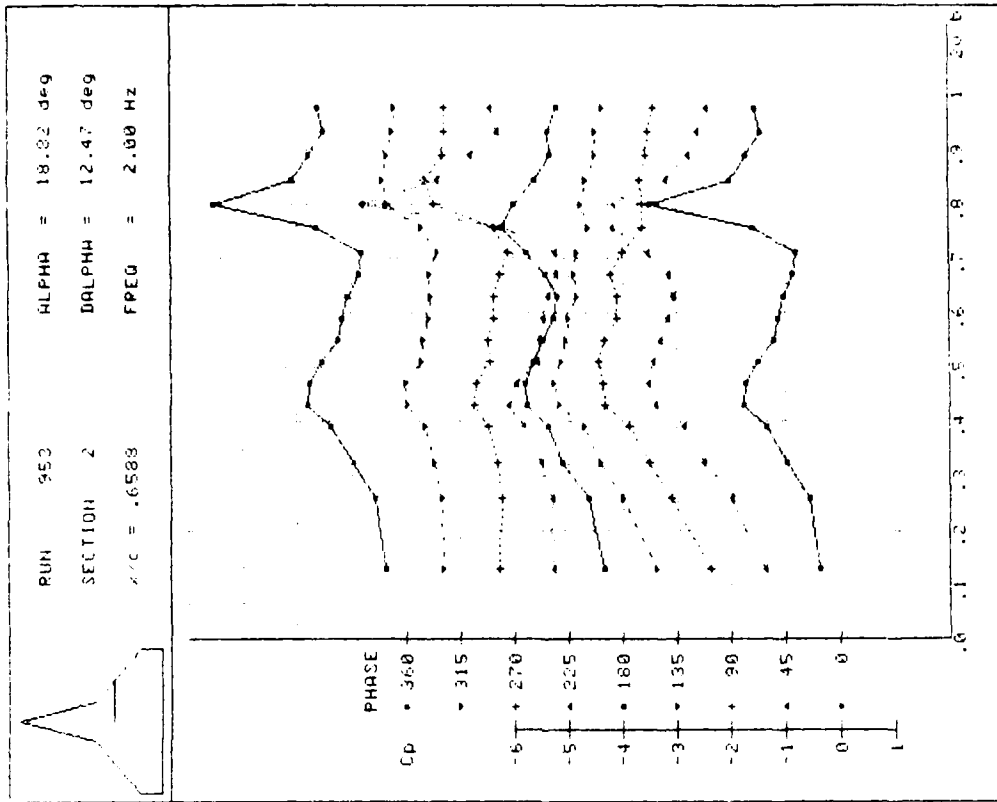
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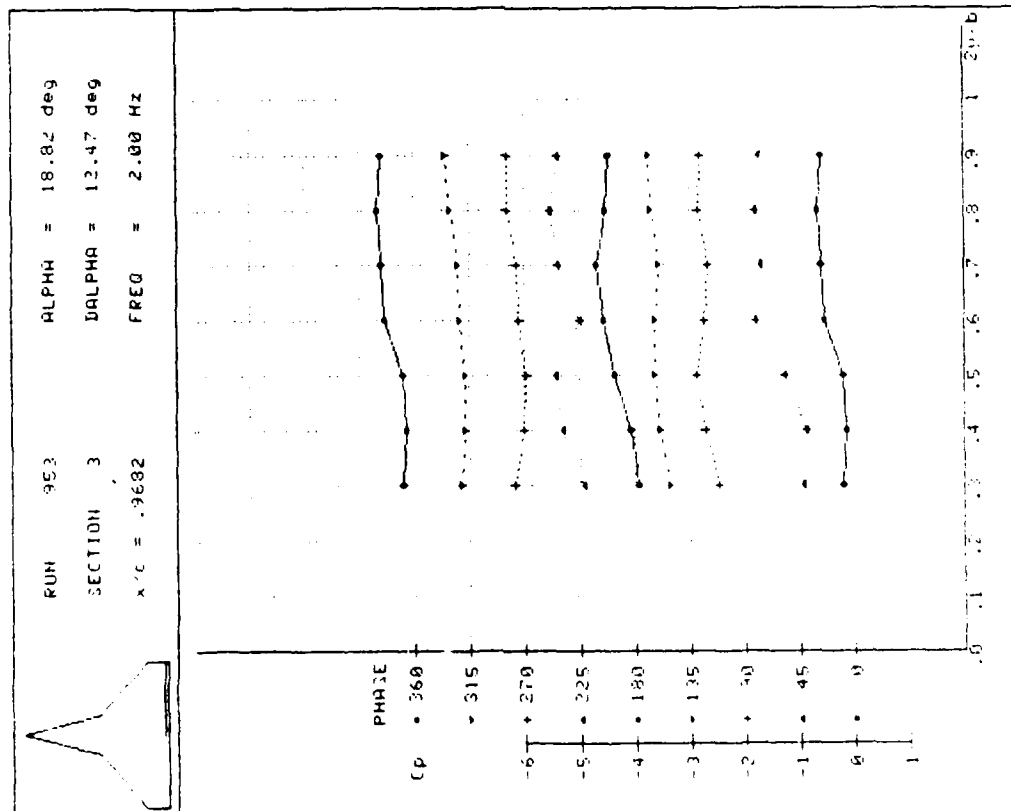
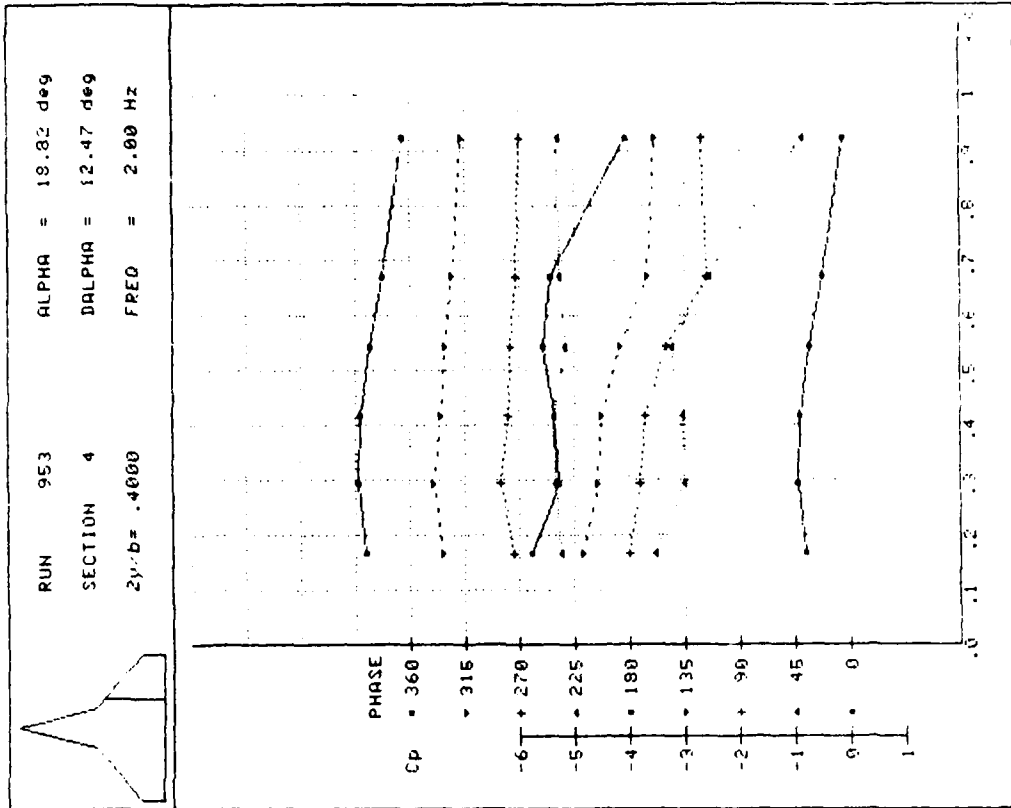
- * x/c indicates the position of the pressure sections relative to the root chord ($c_r = 0.7855$ m),
- * $2y/b$ indicates the position of the pressure section relative to the wing span ($b_w = 0.8000$ m).

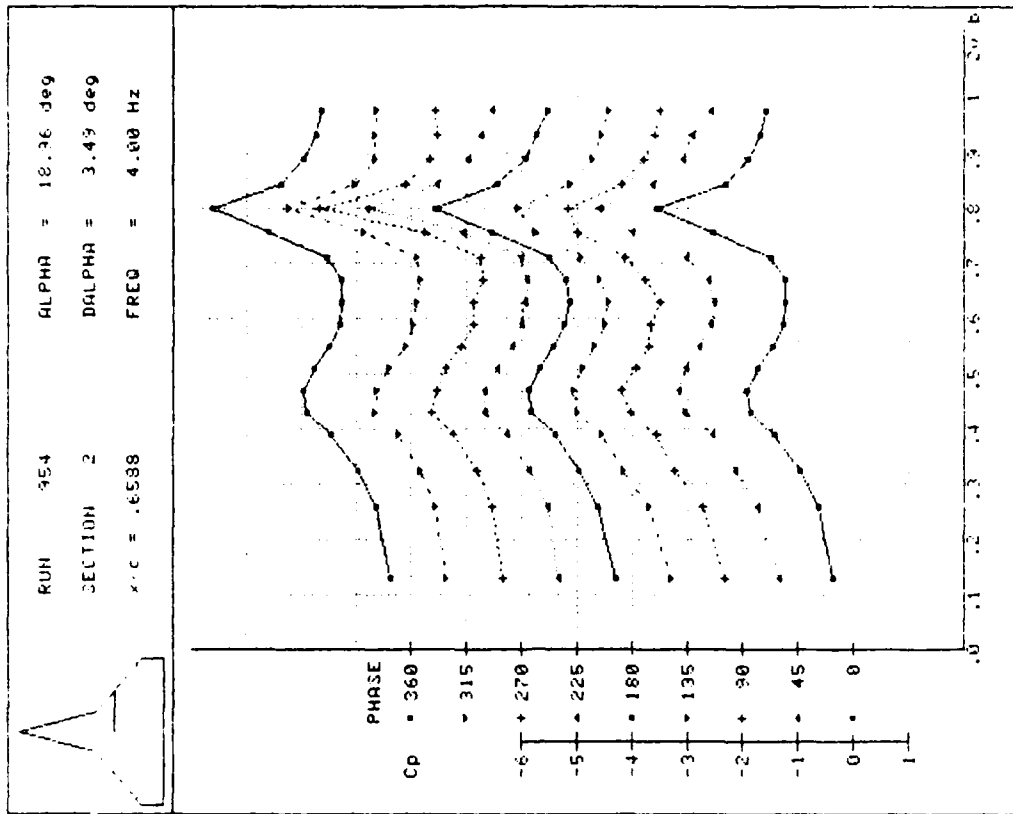
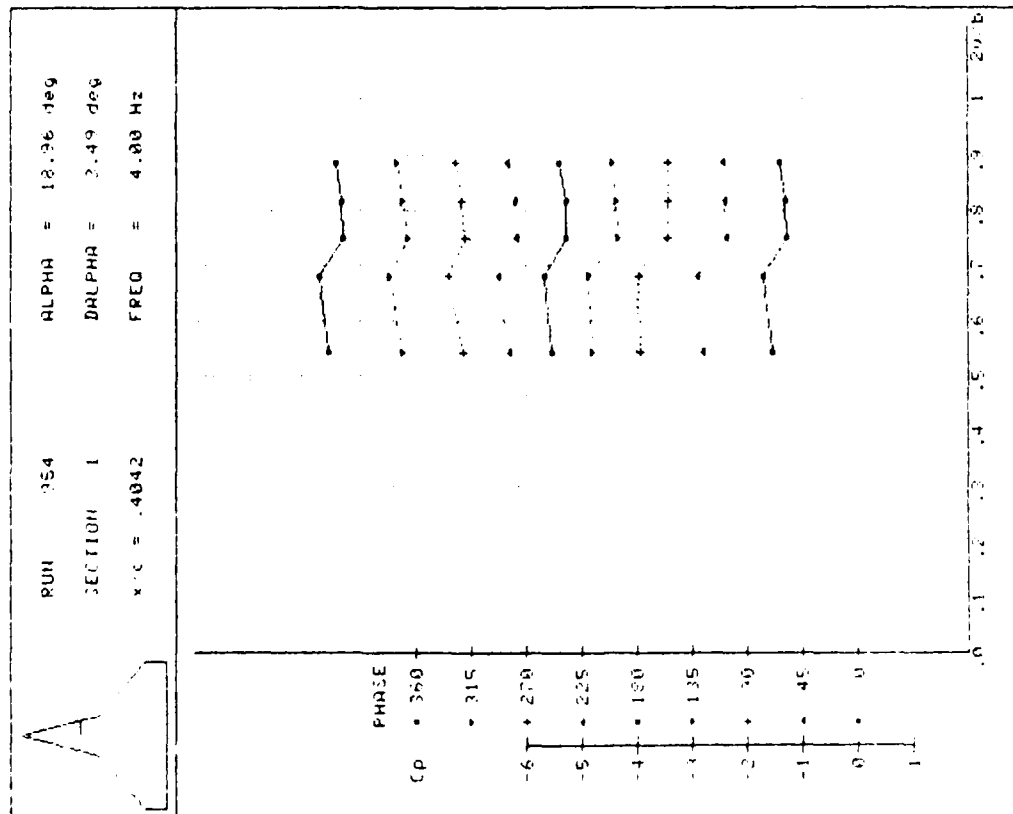
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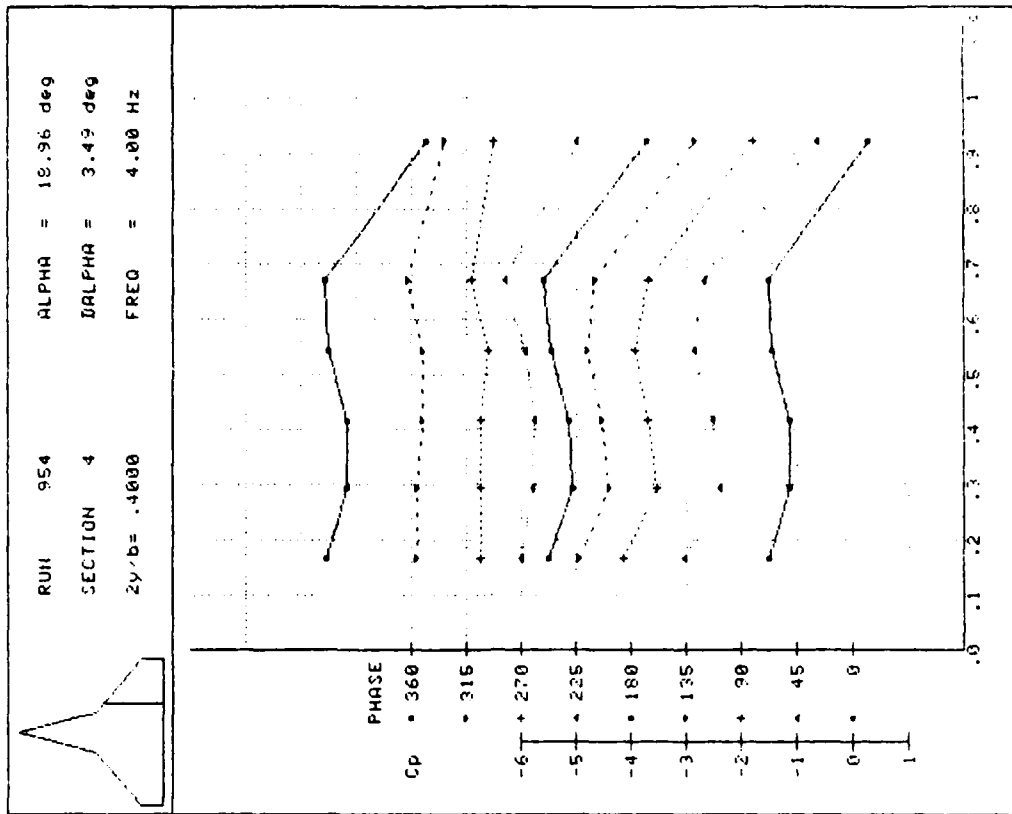
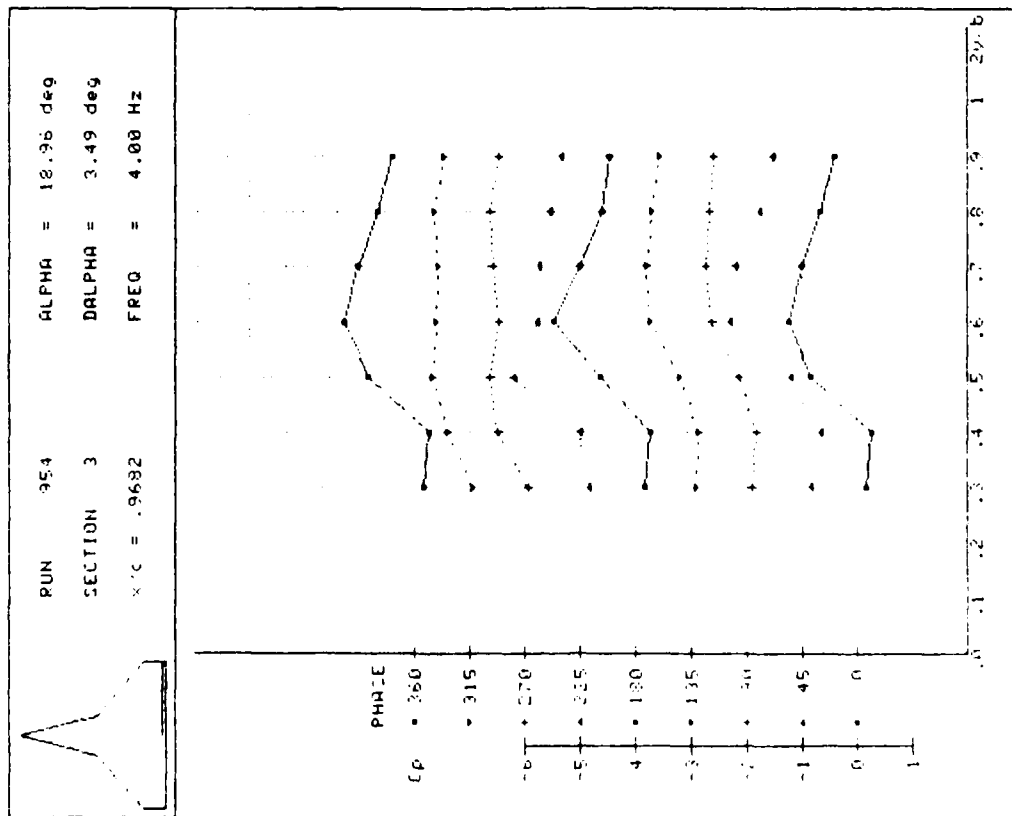


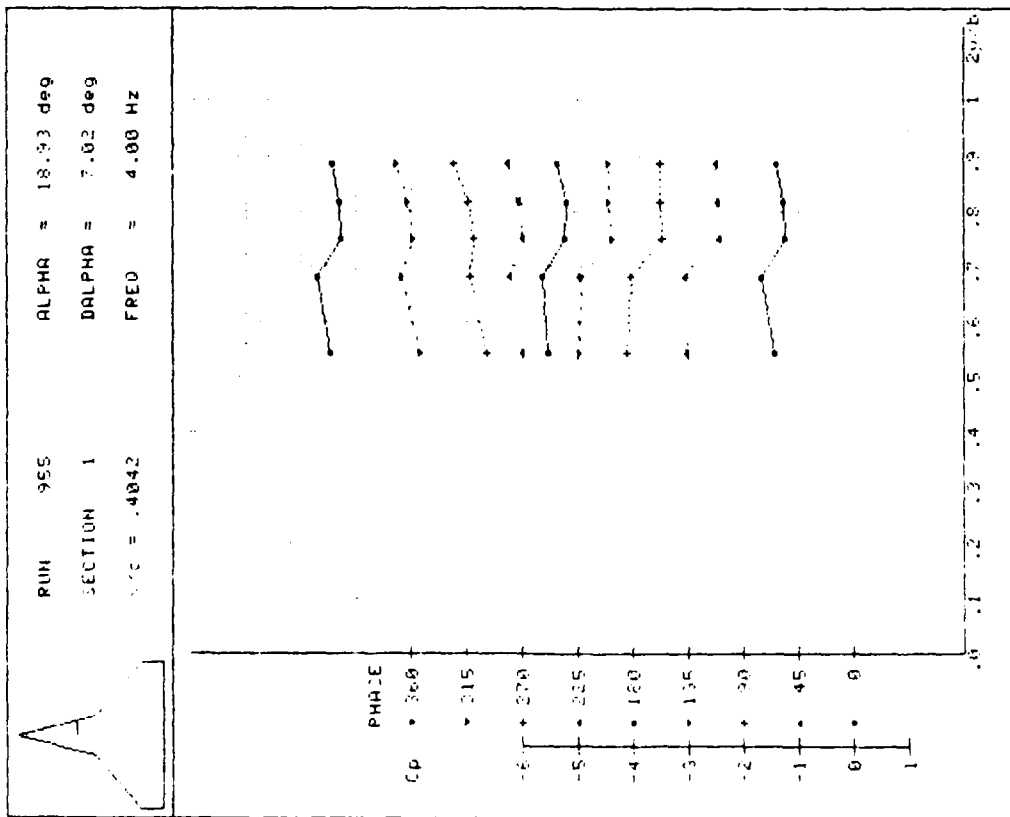
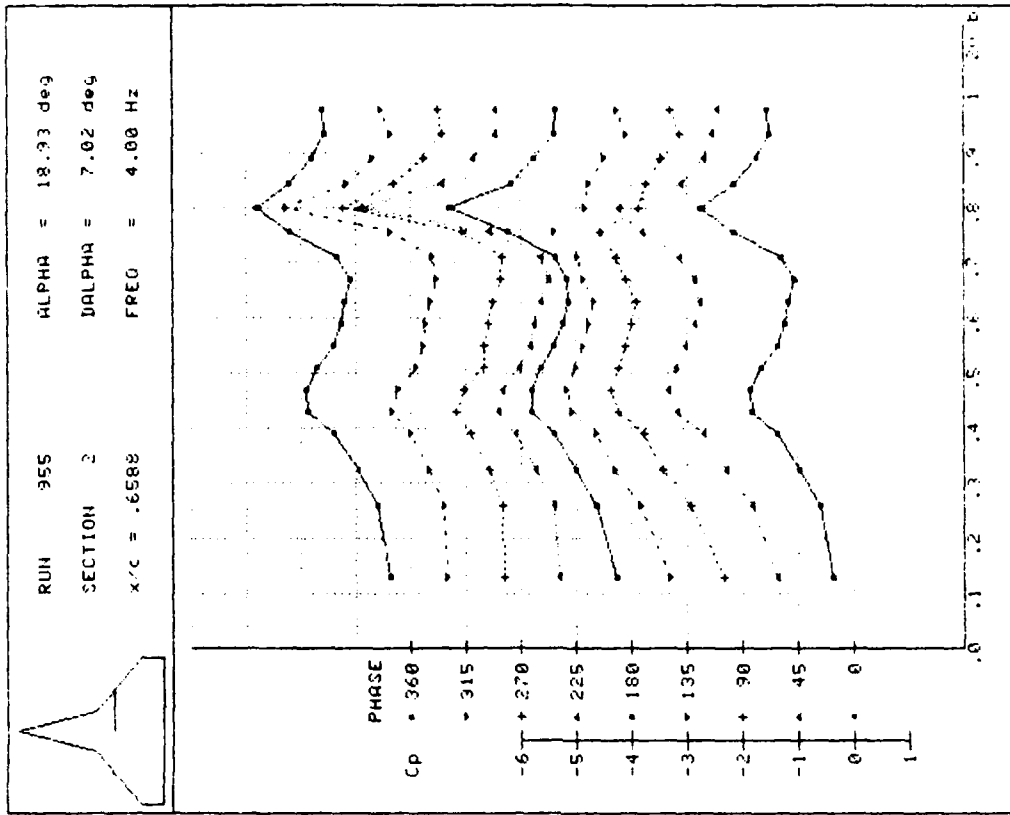


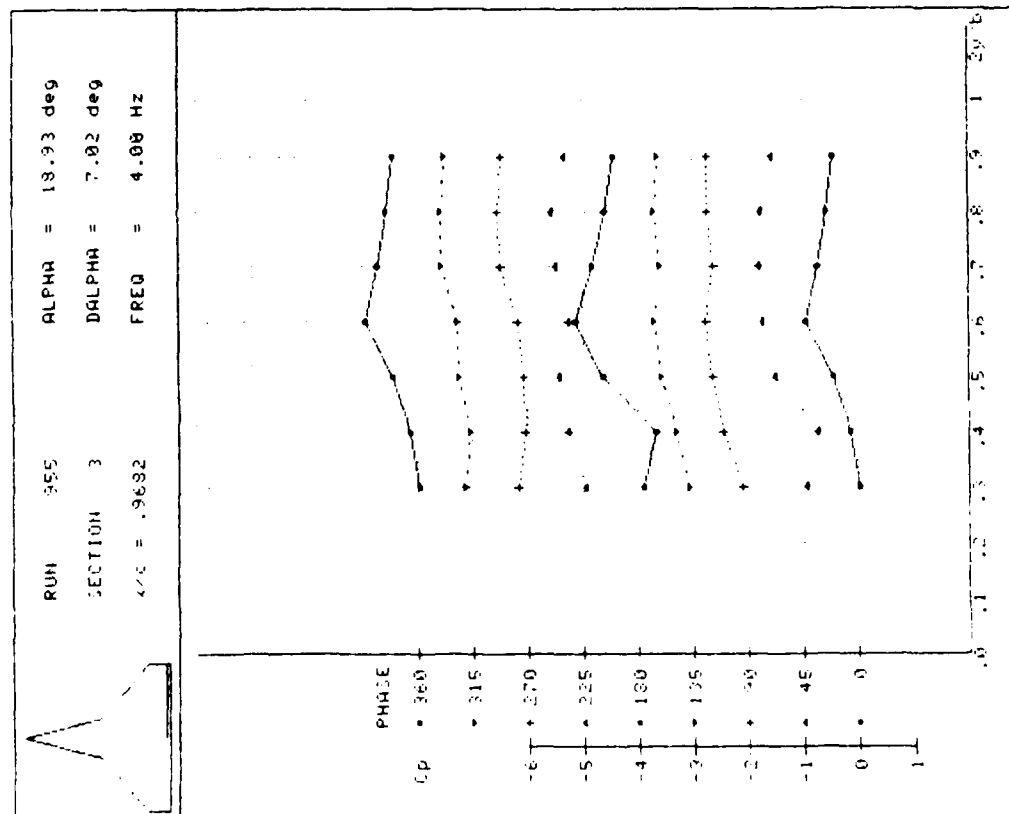
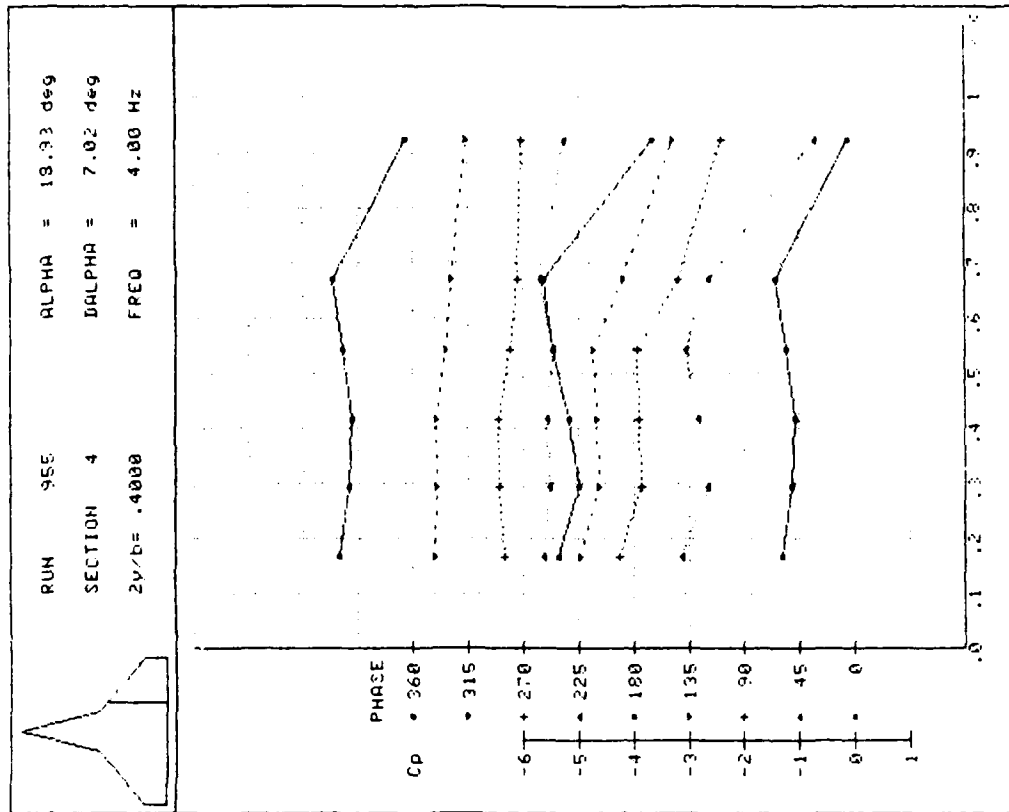


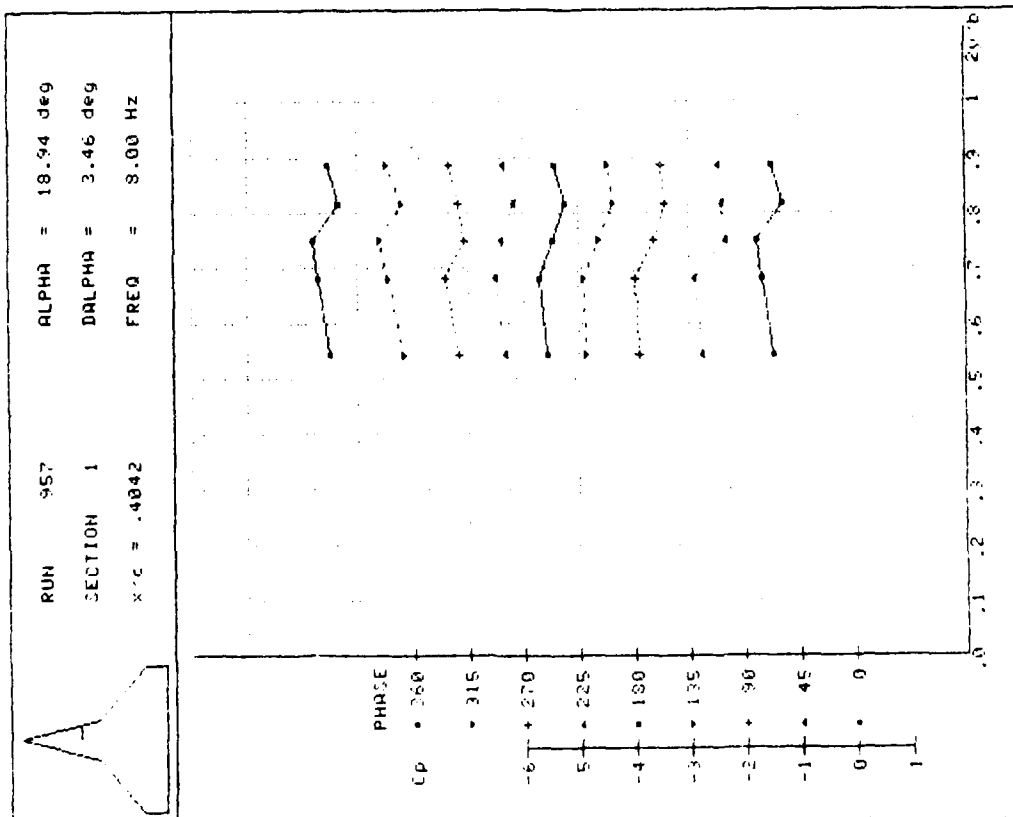
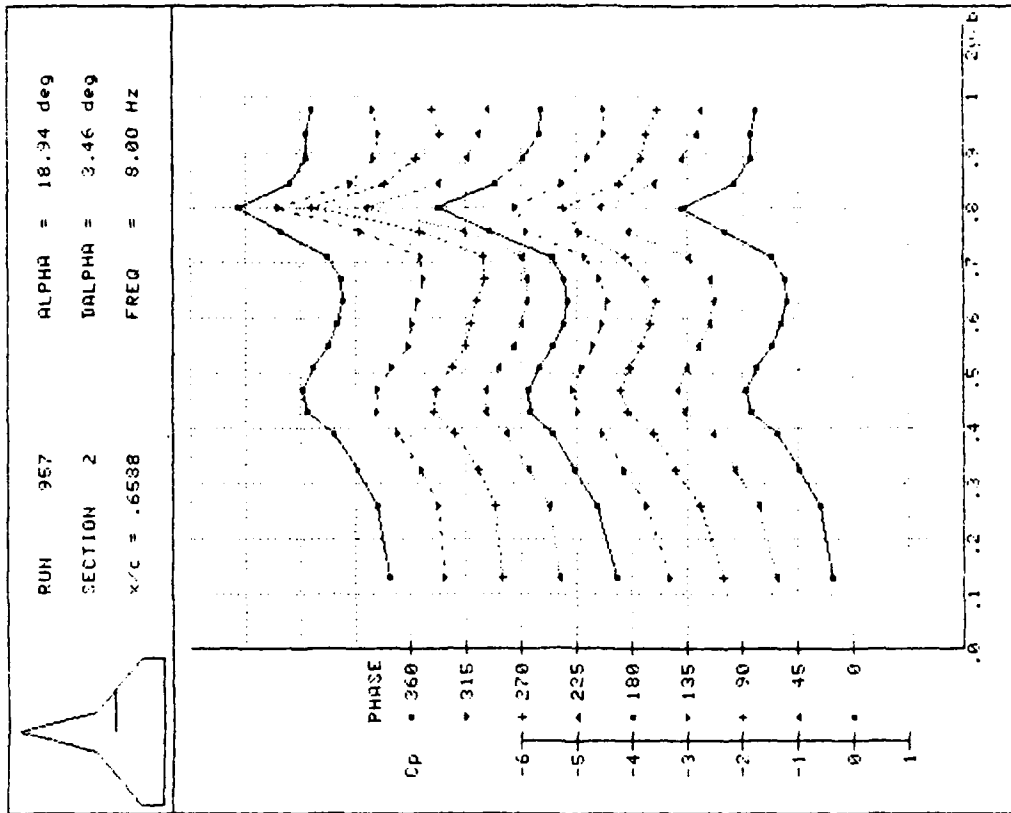


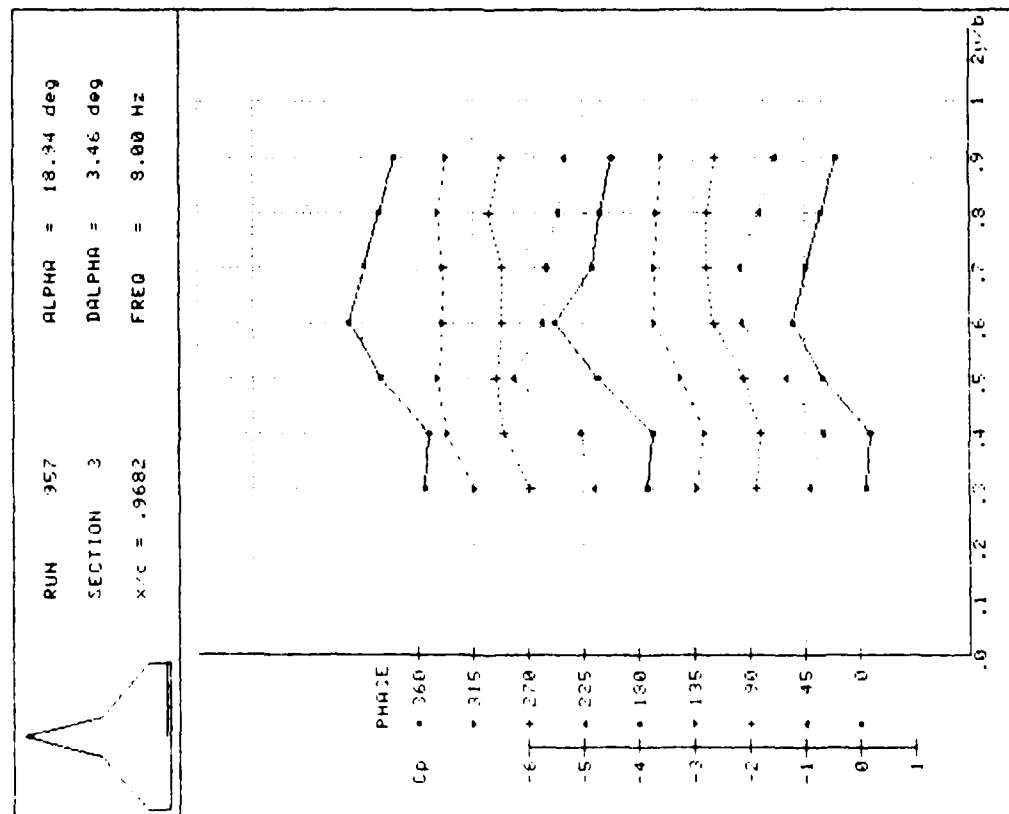
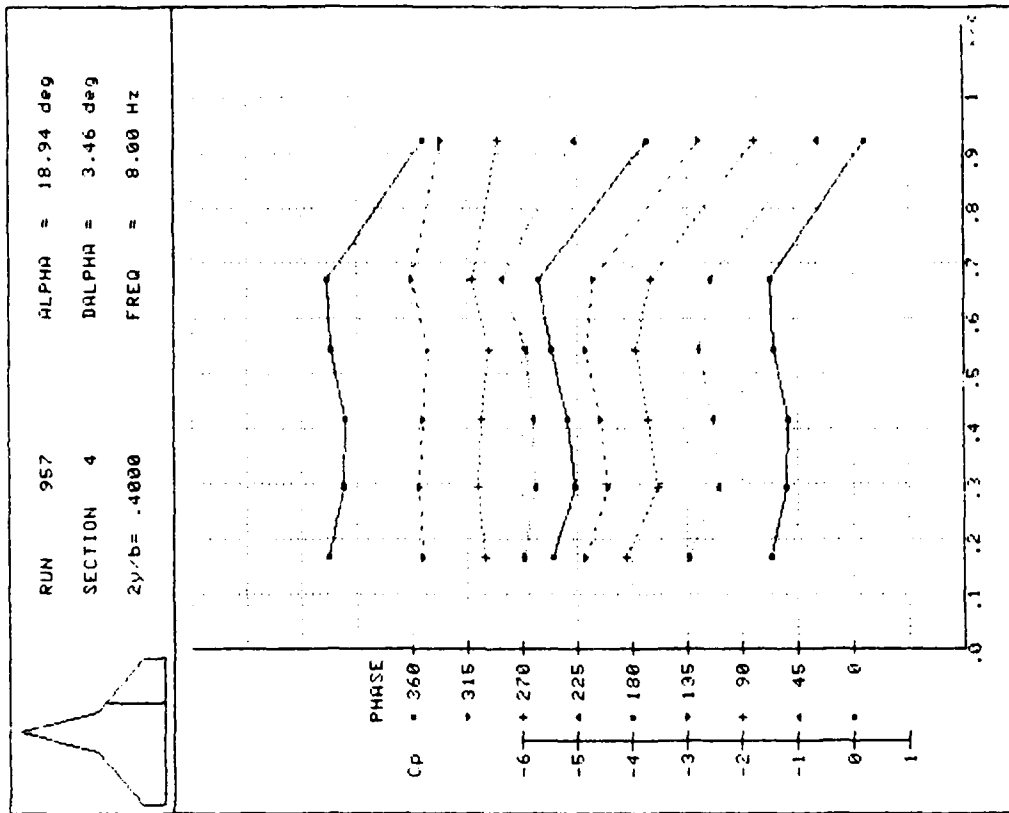


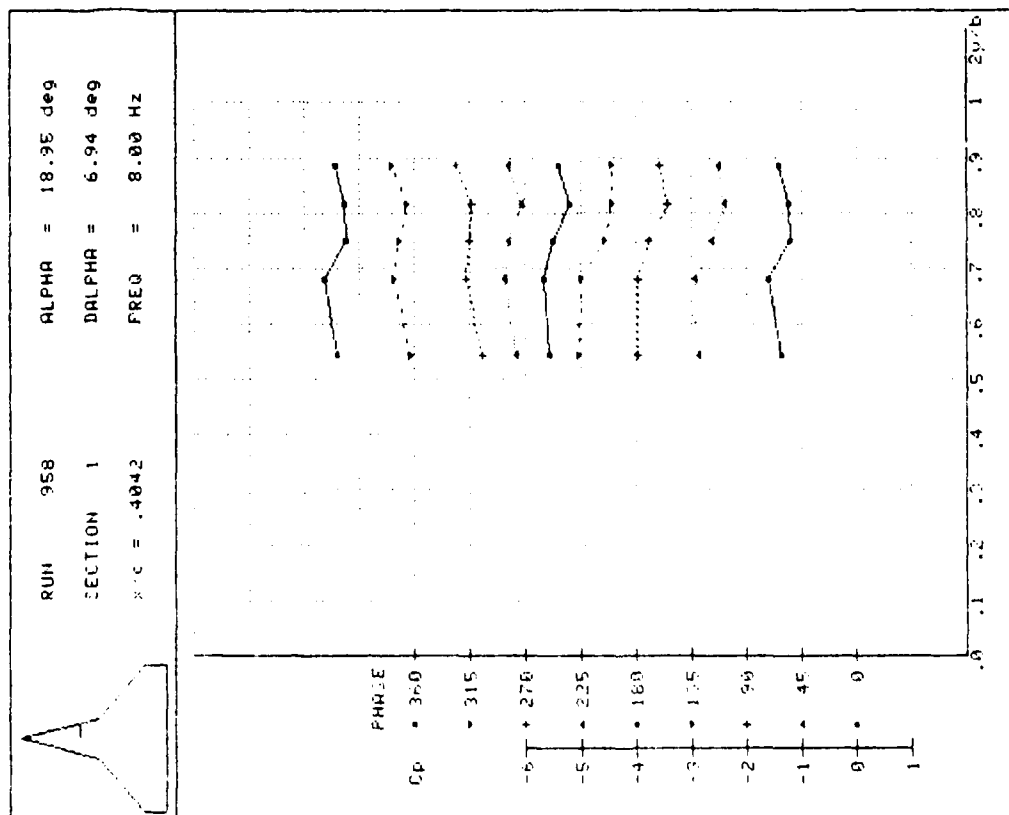
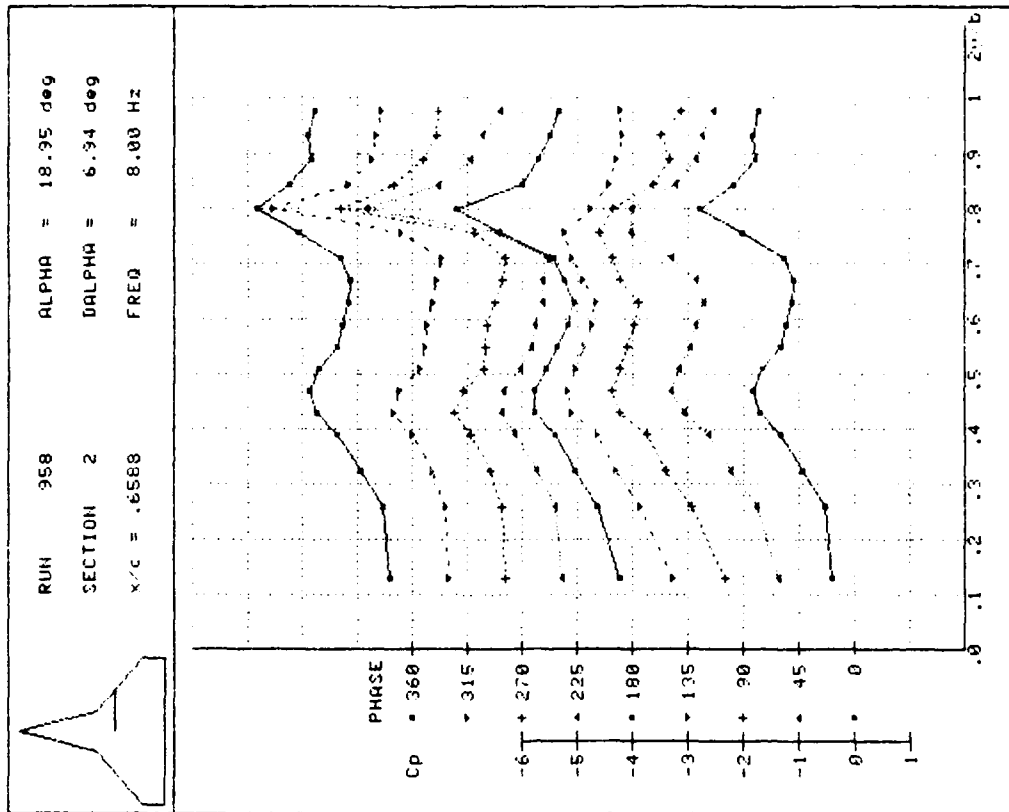


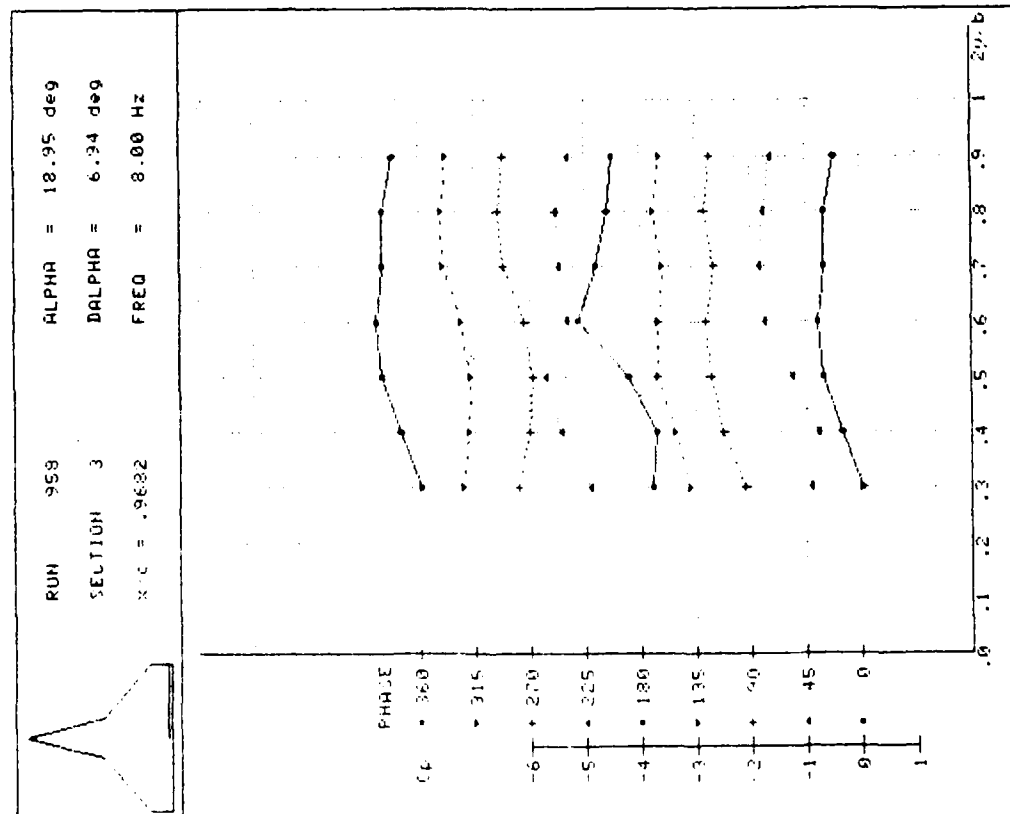
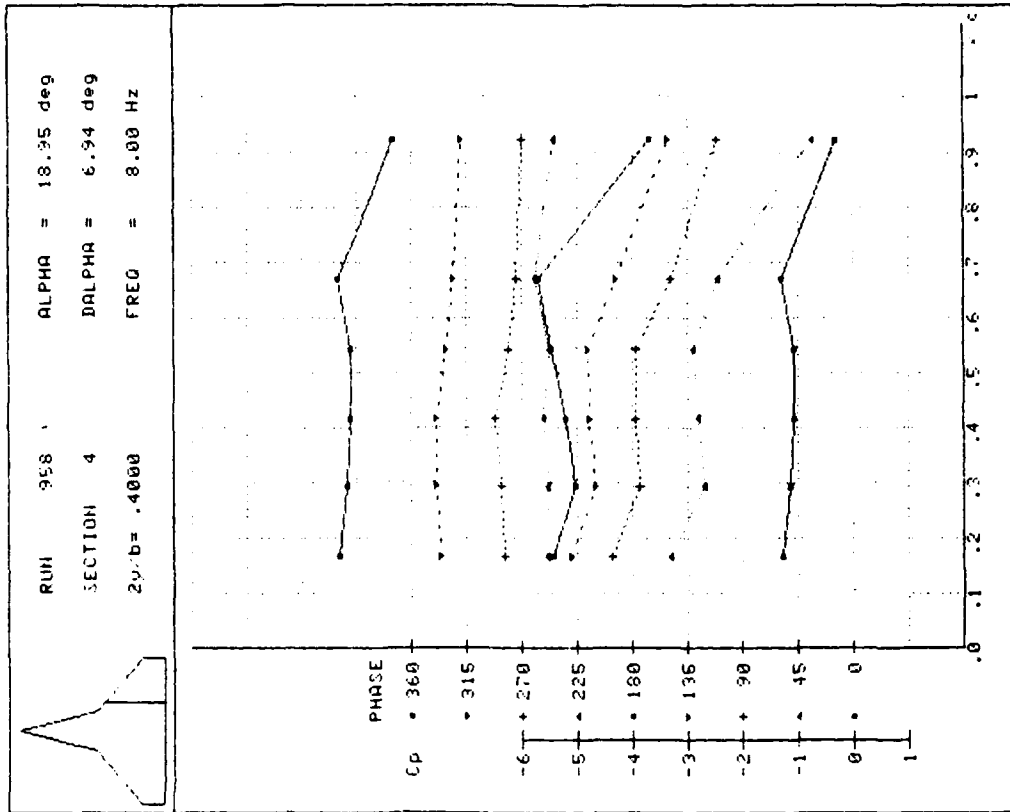


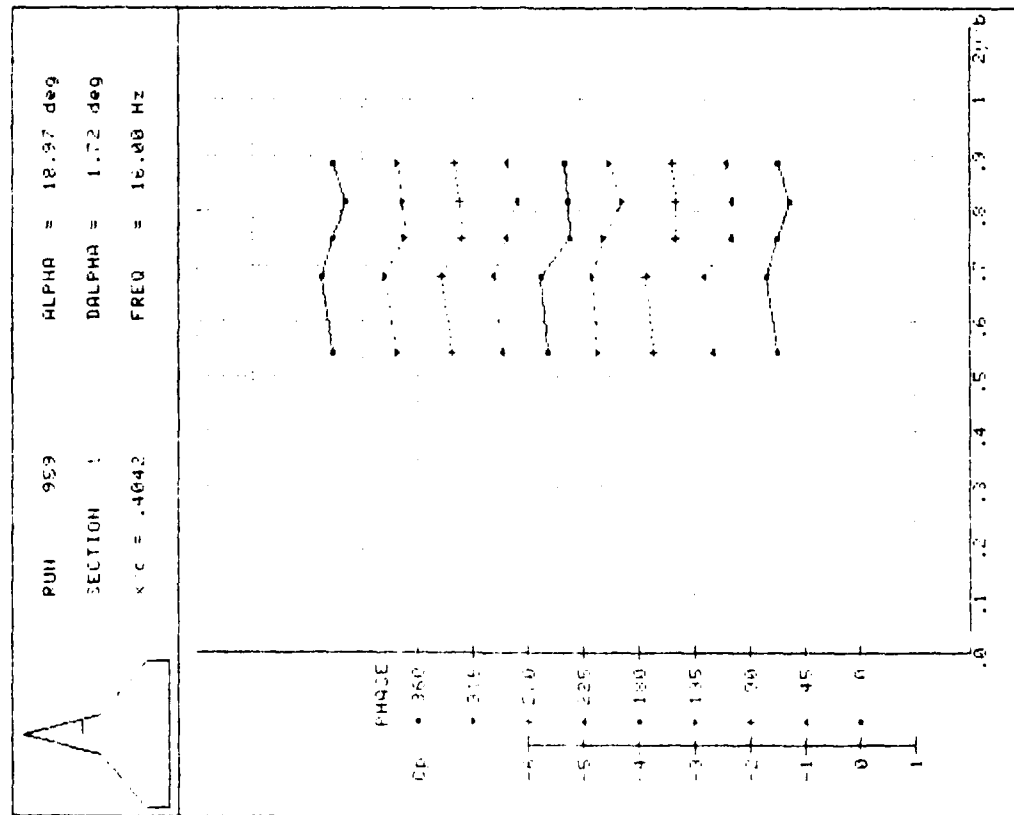
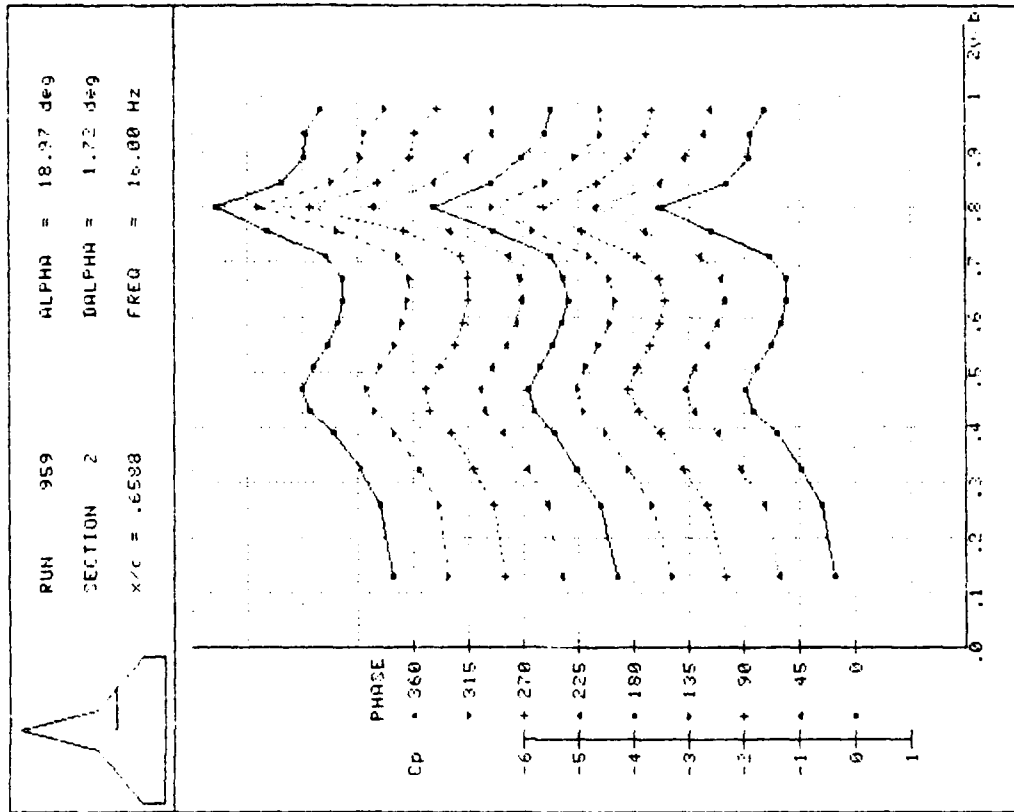


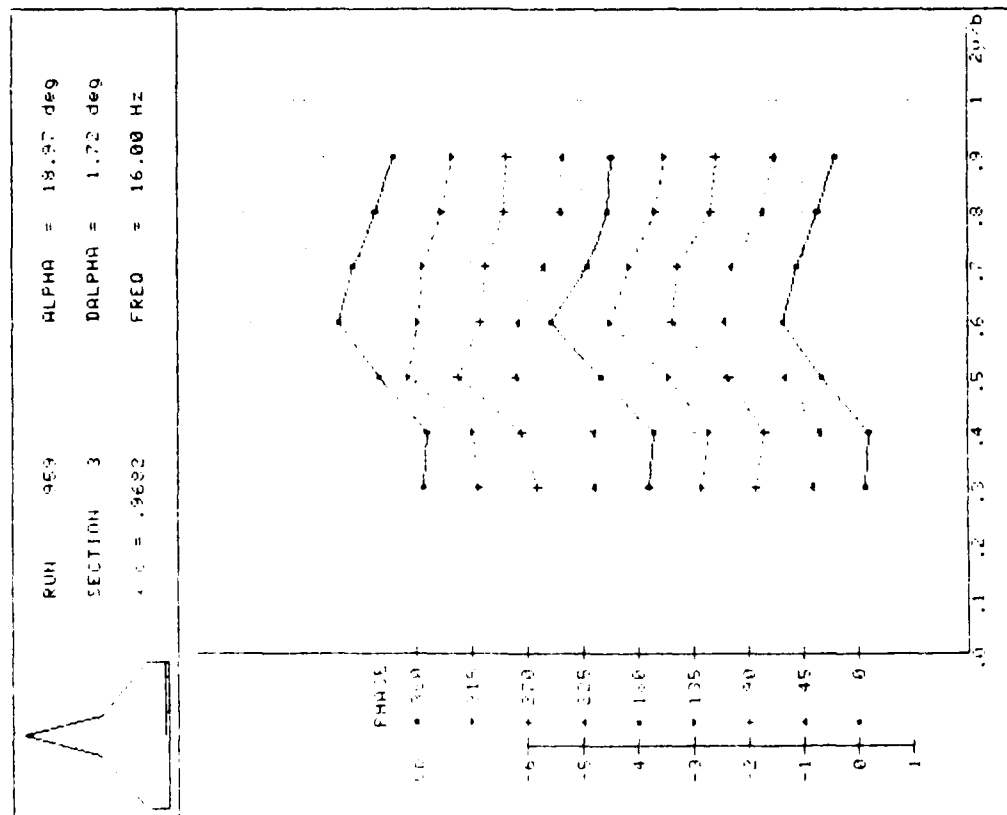
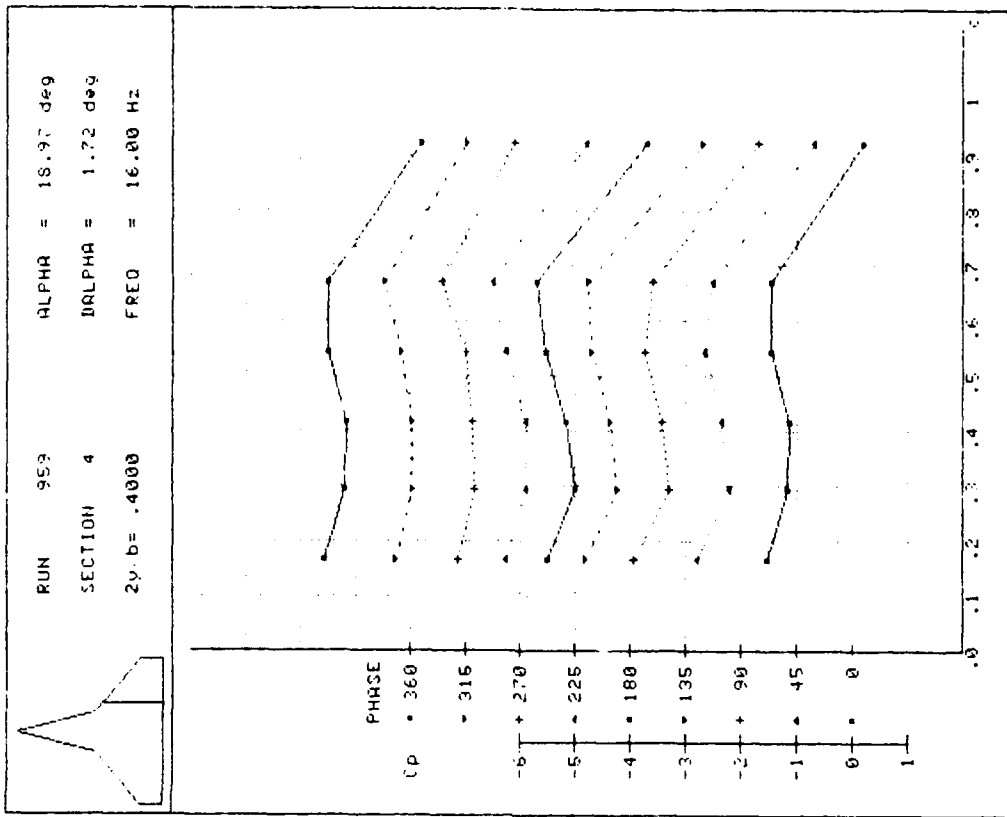


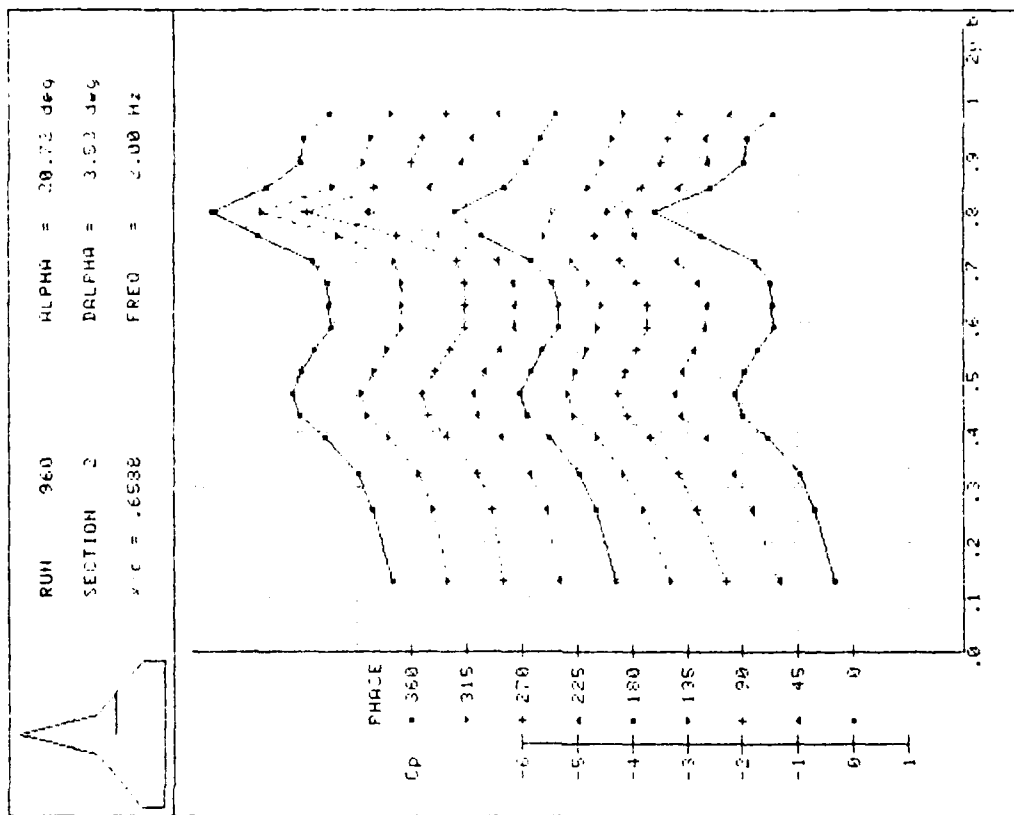
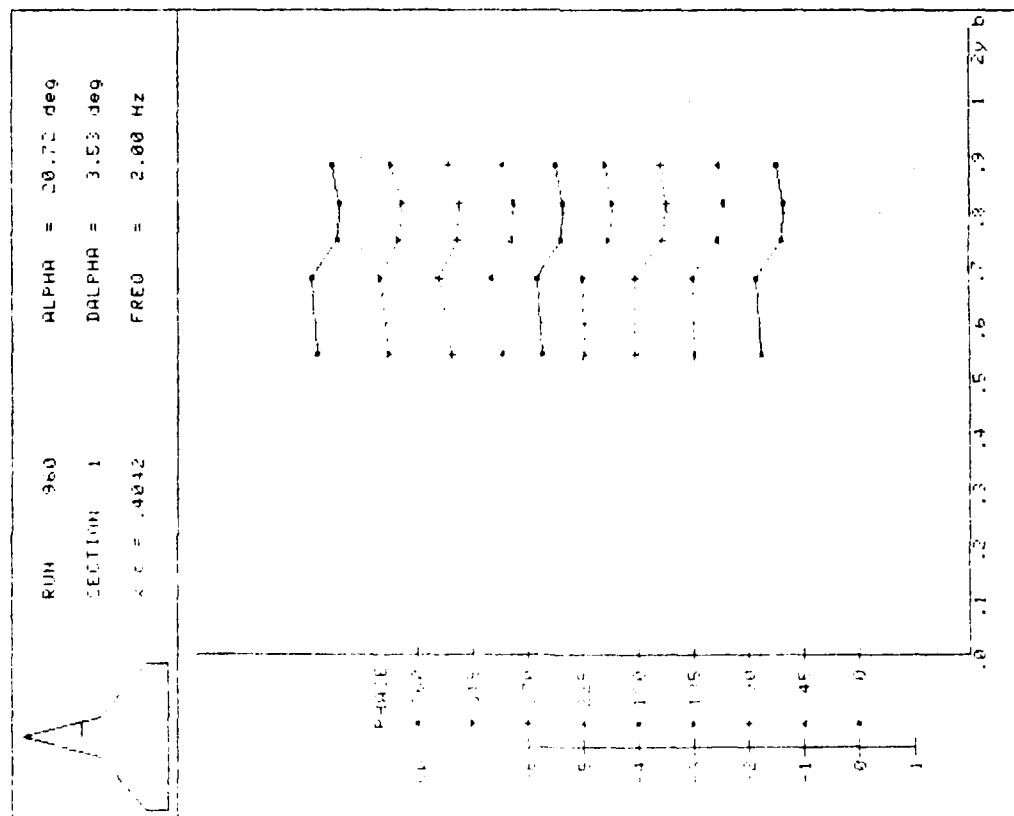


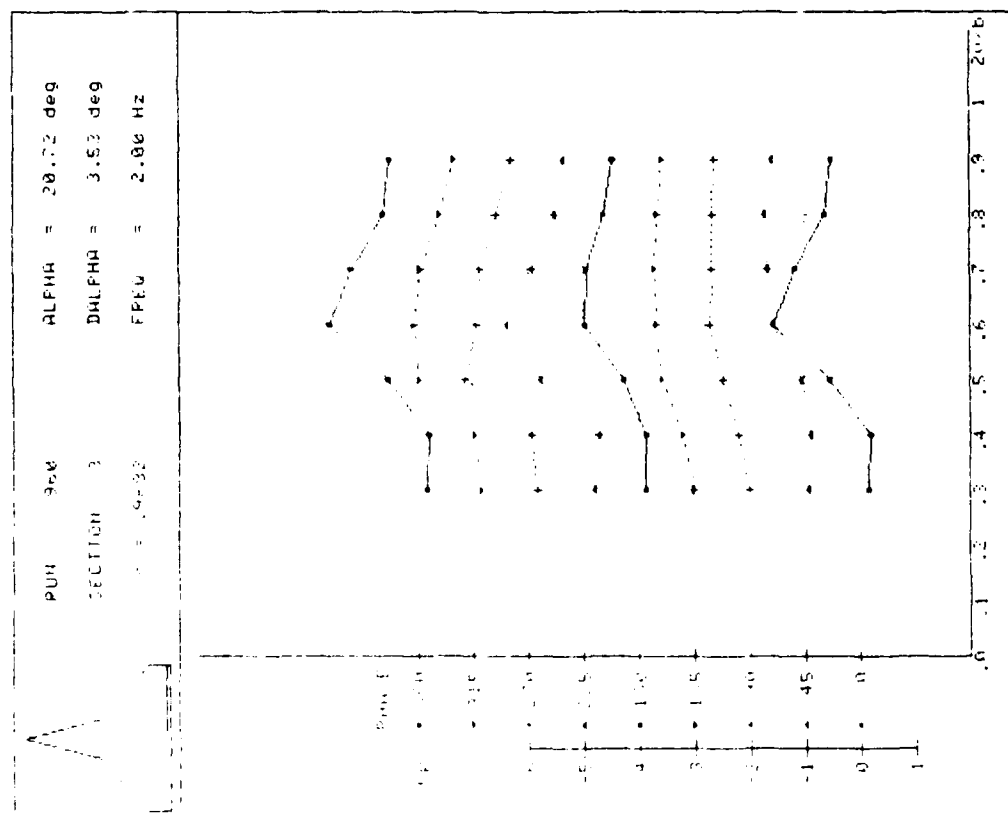
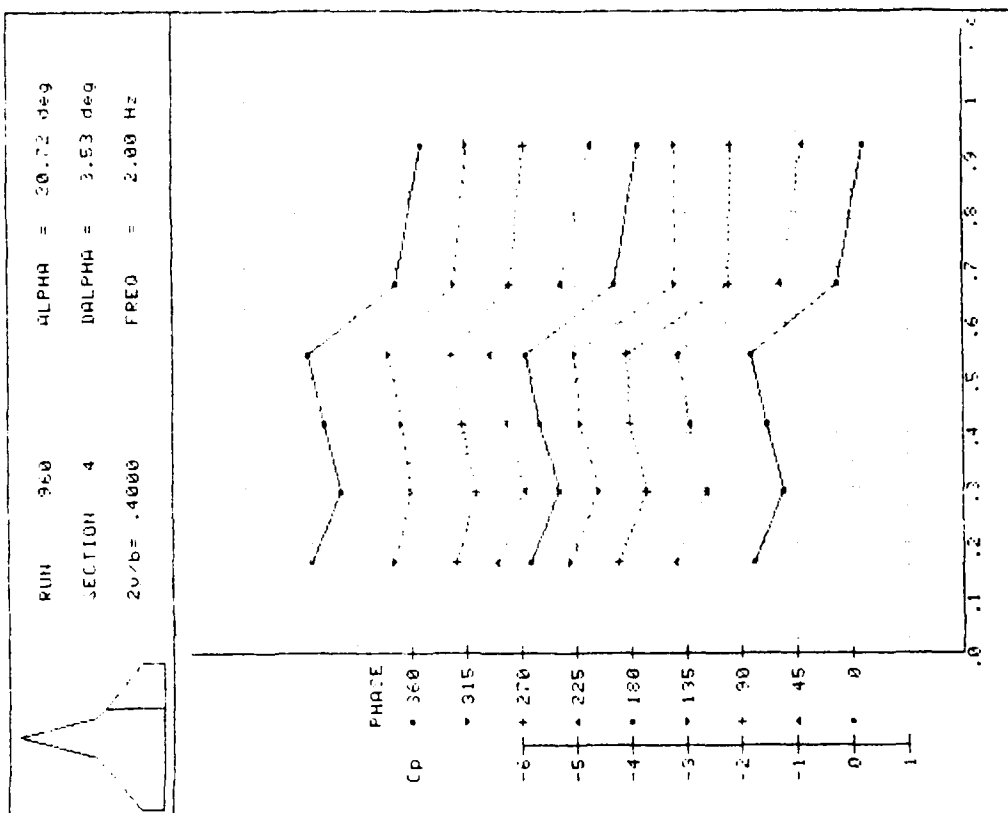


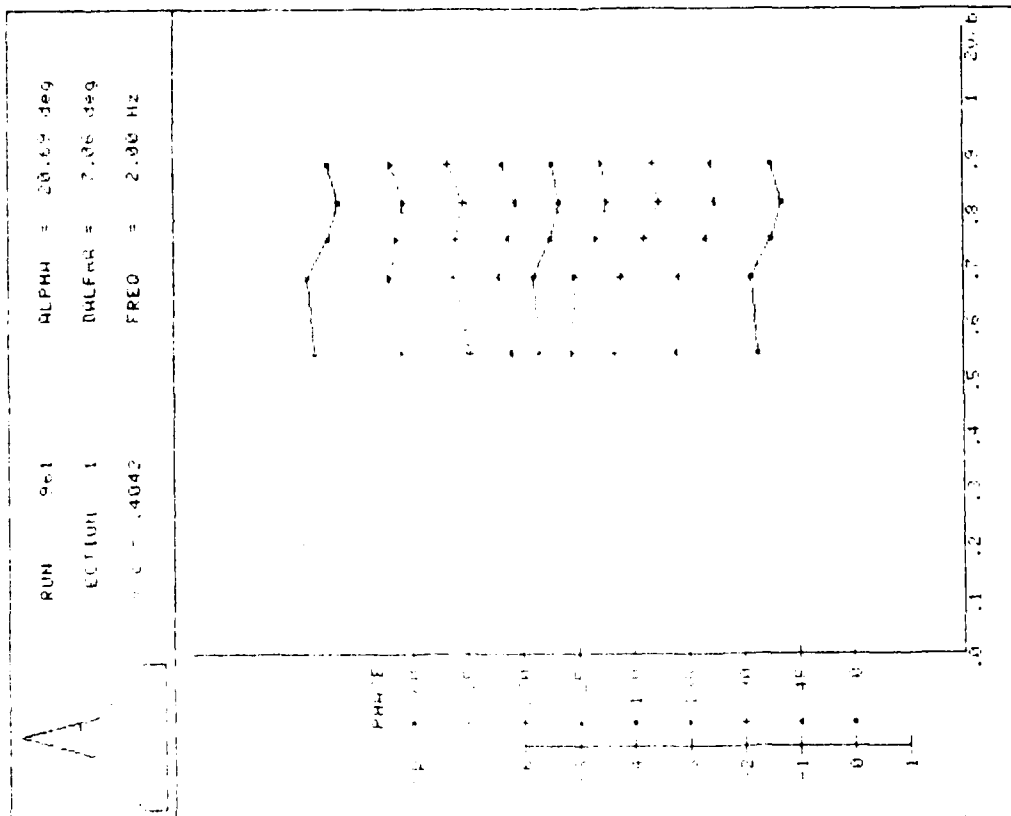
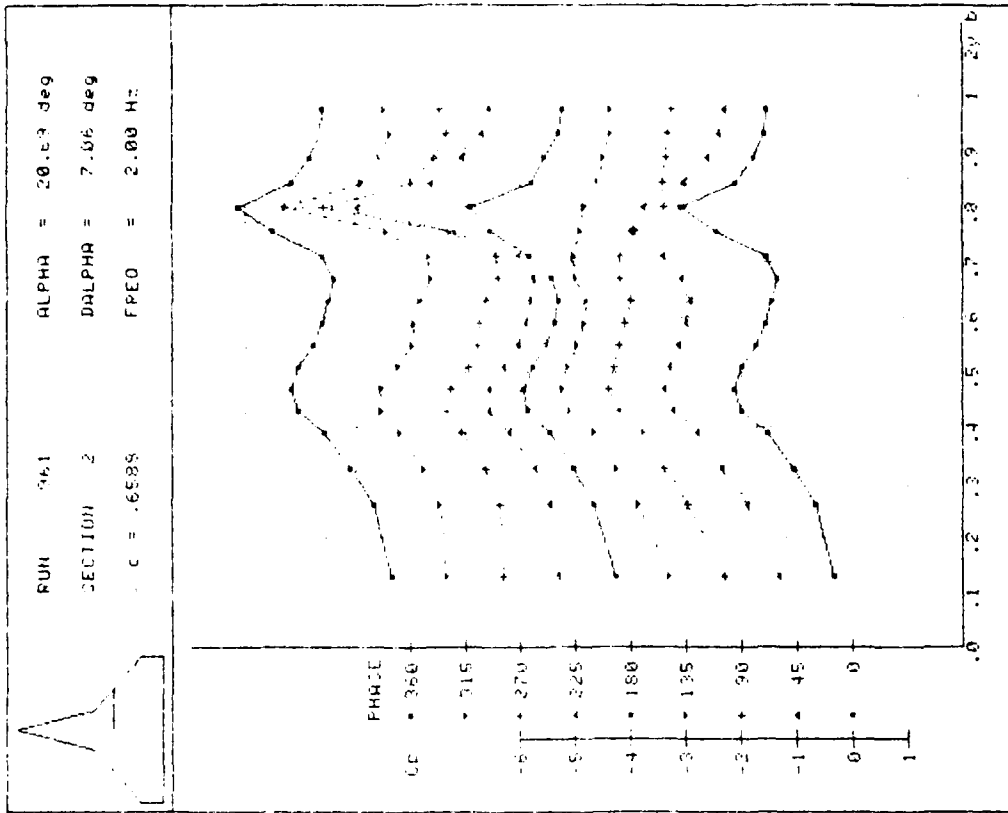


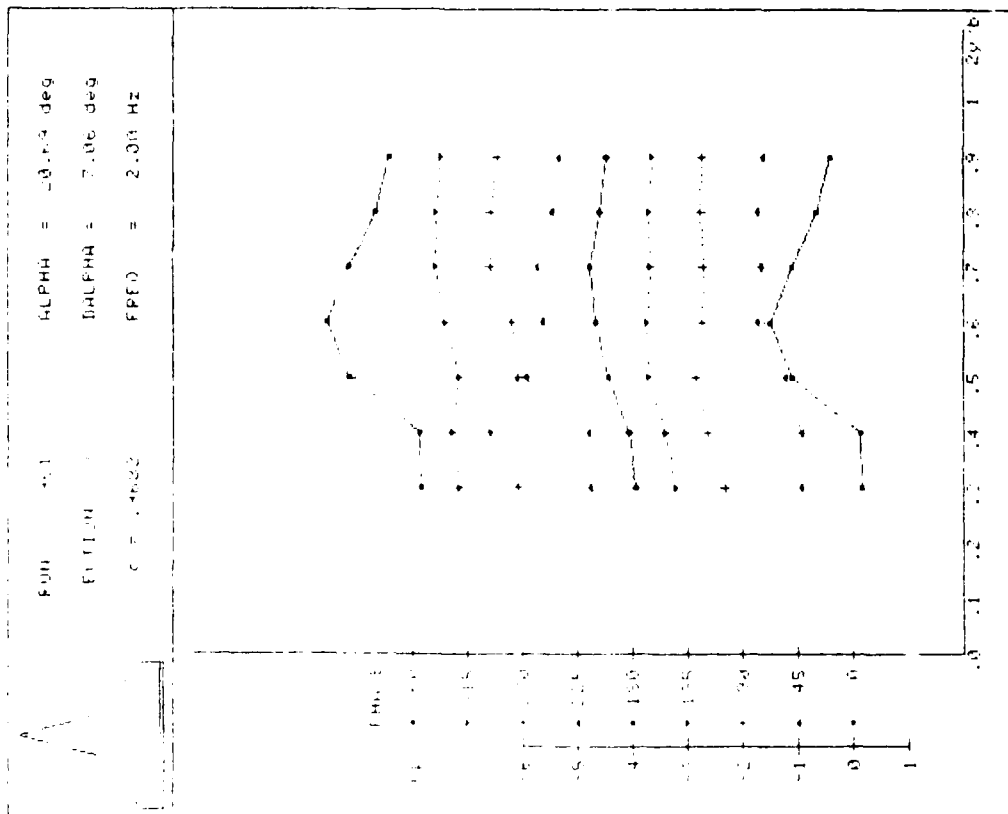
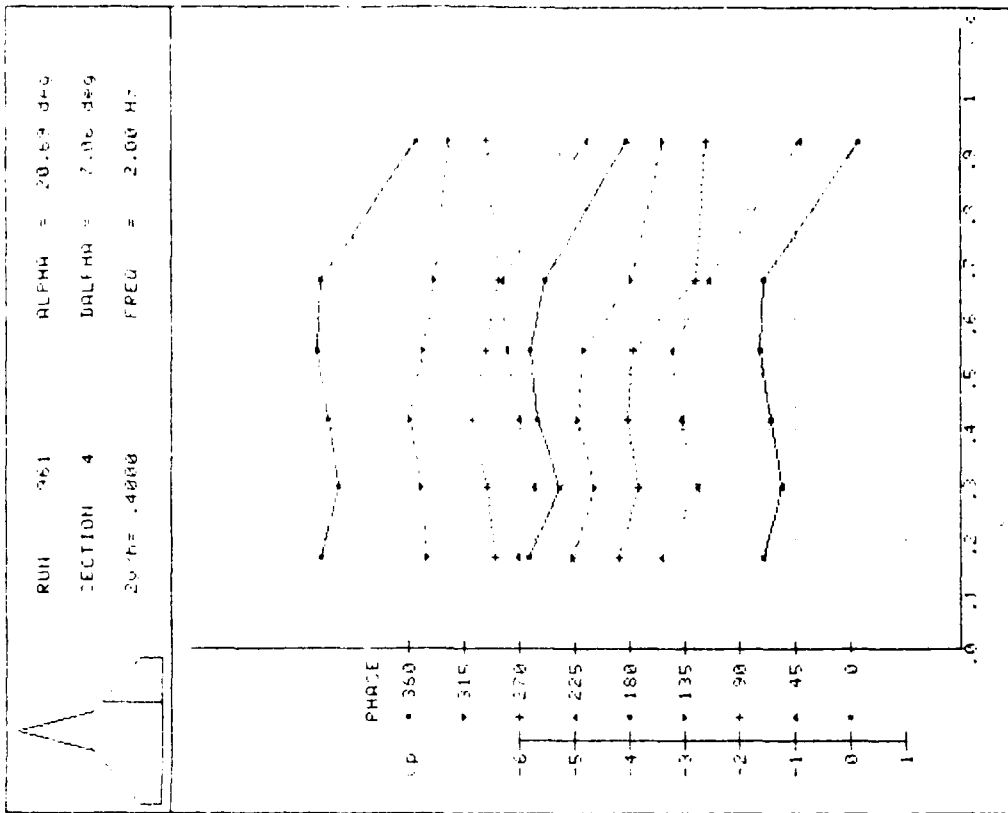


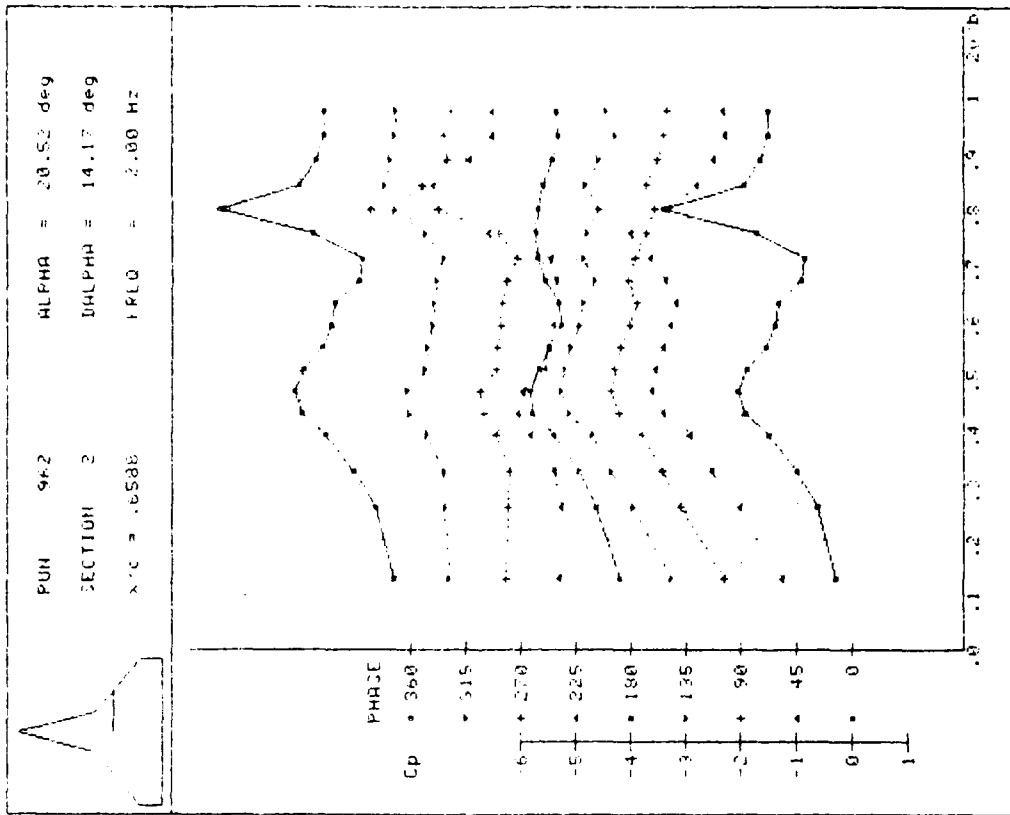
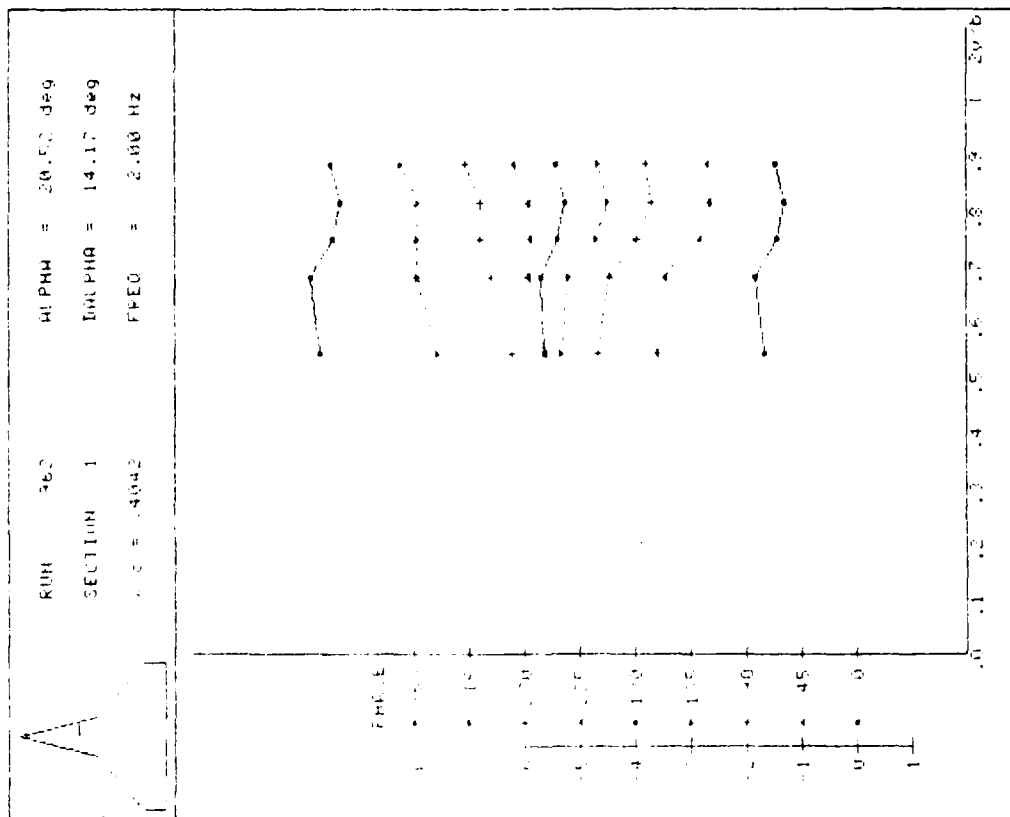


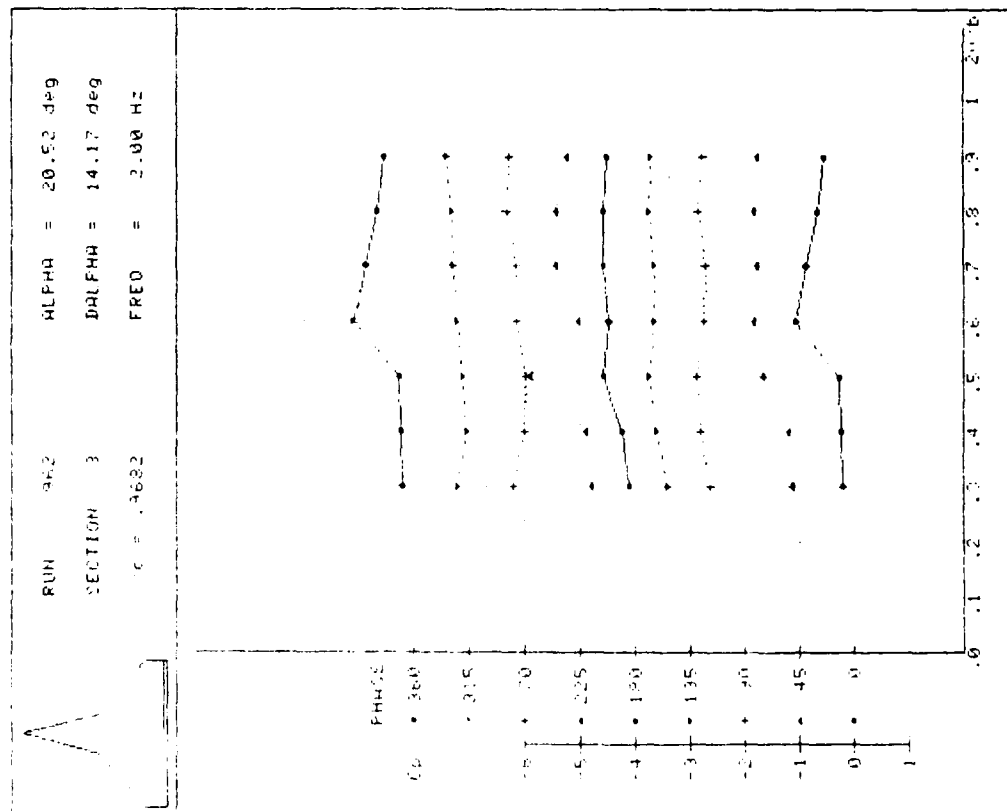
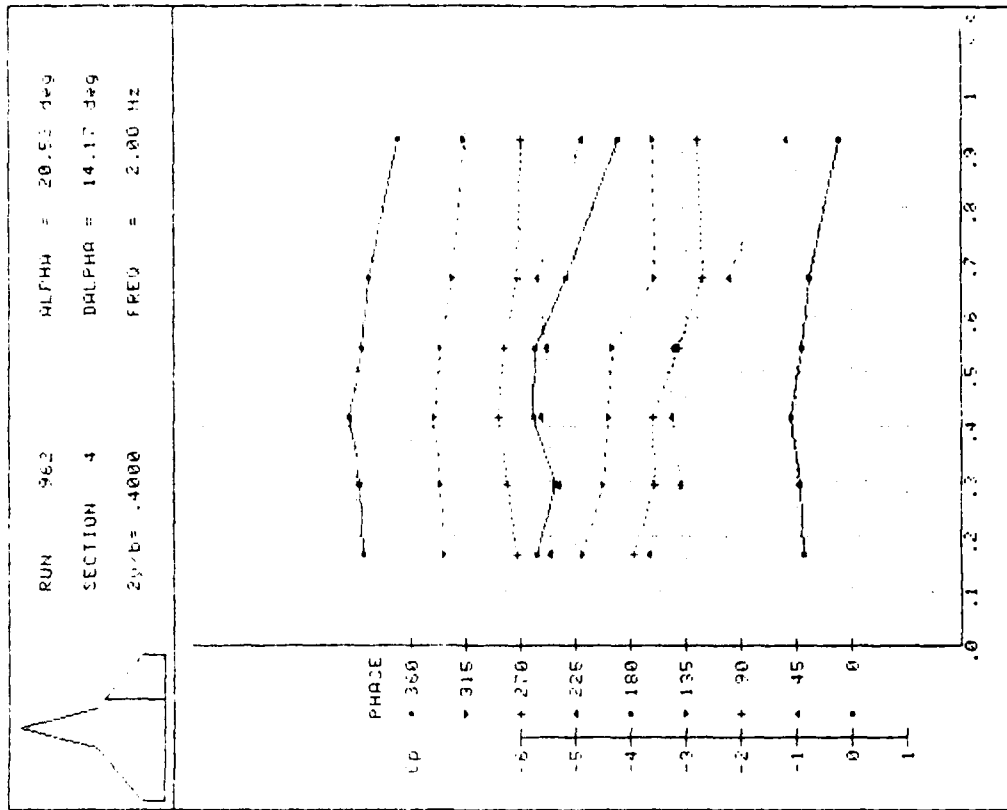


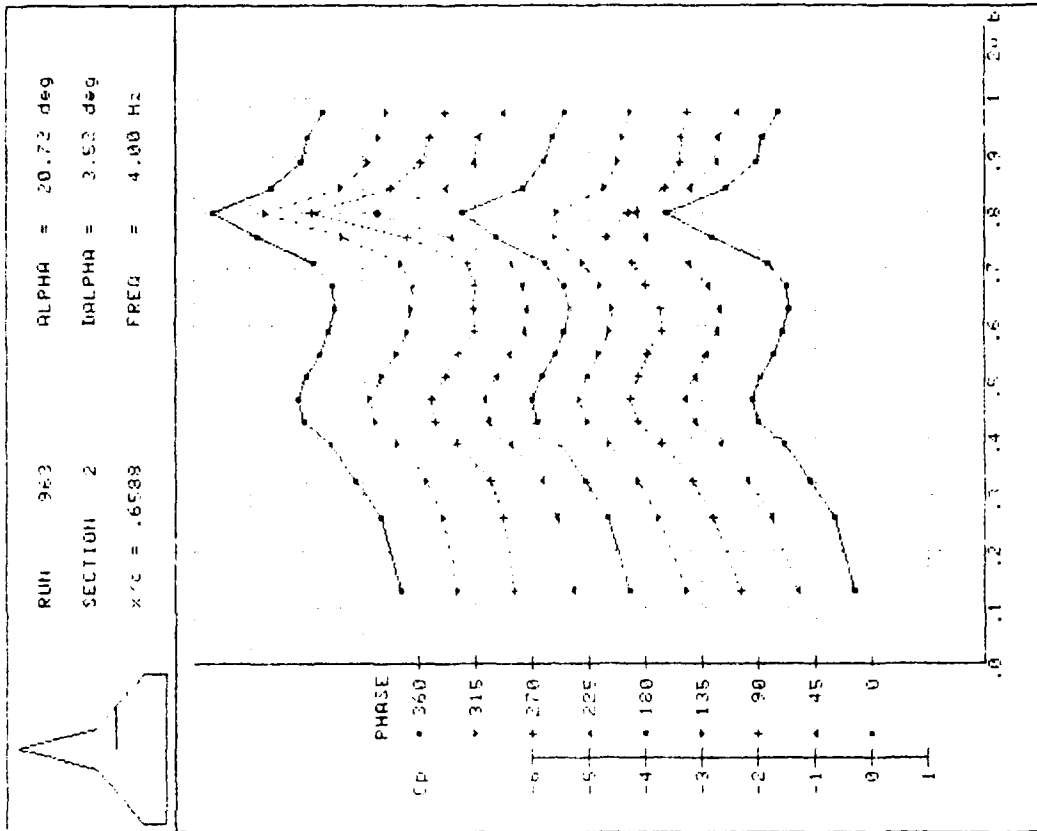
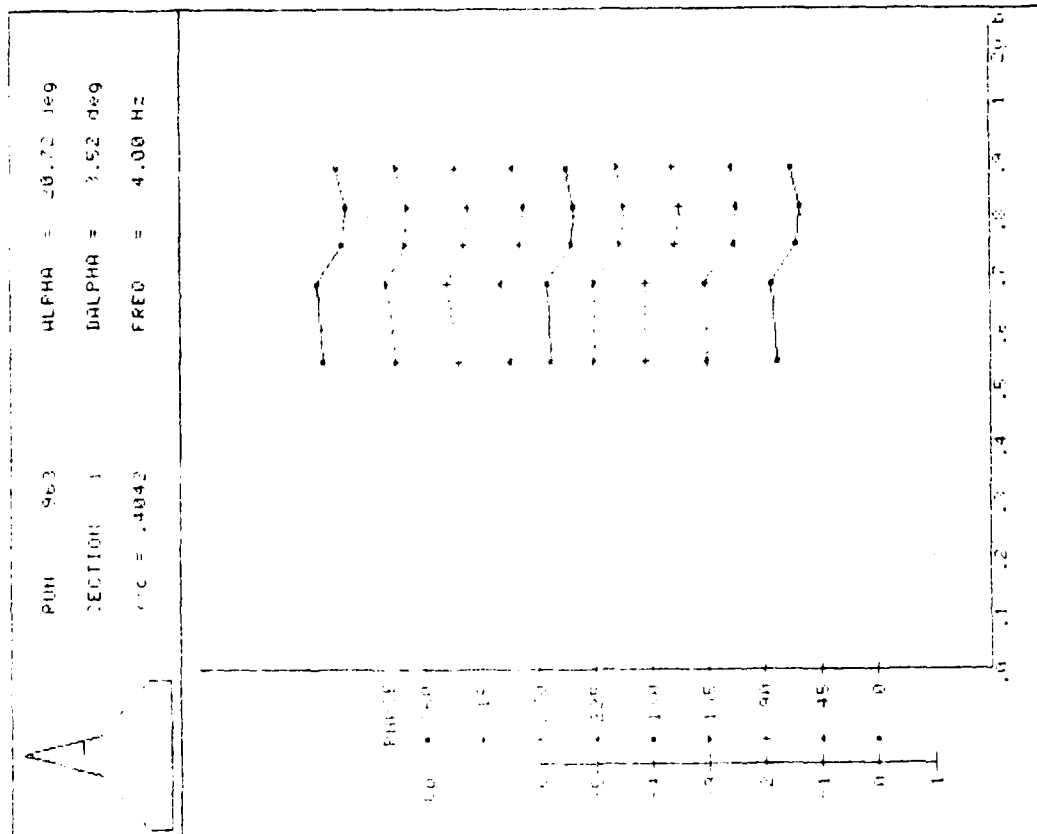


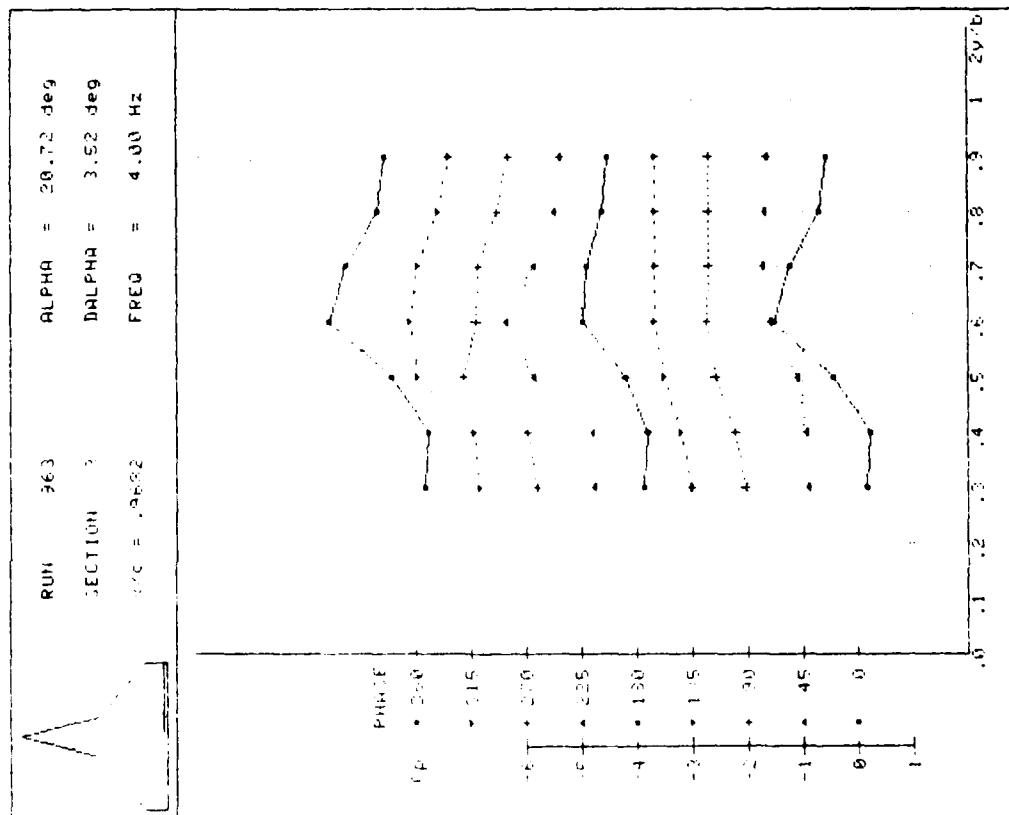
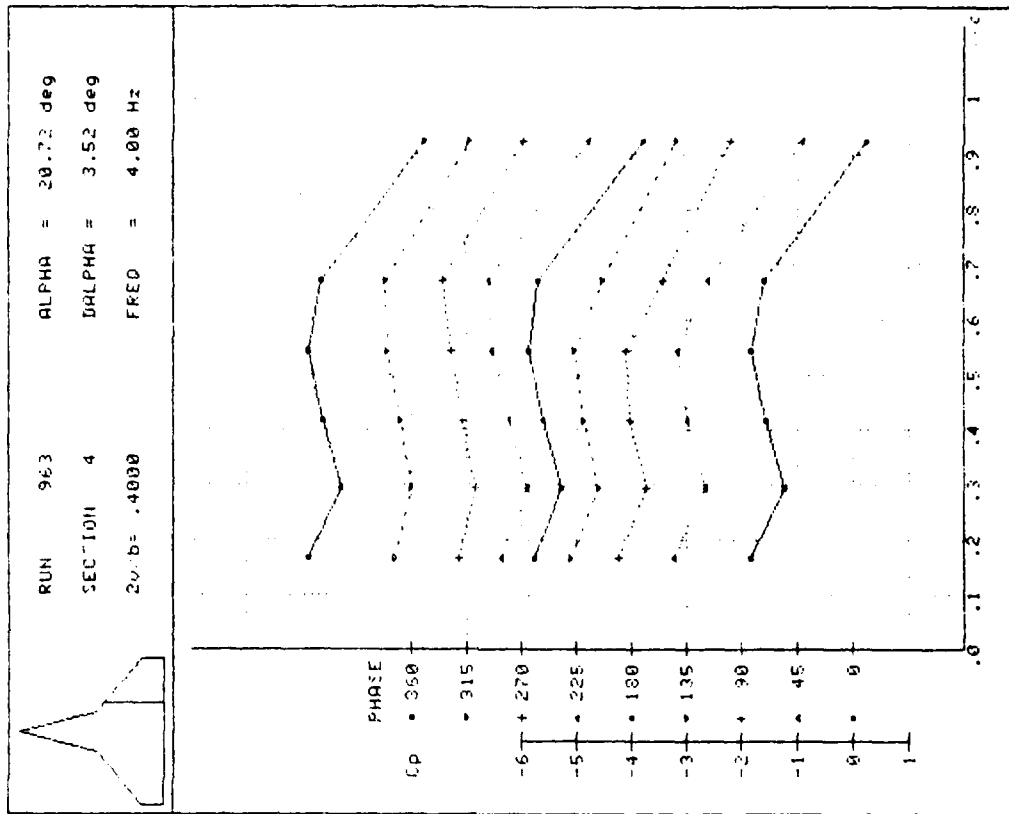


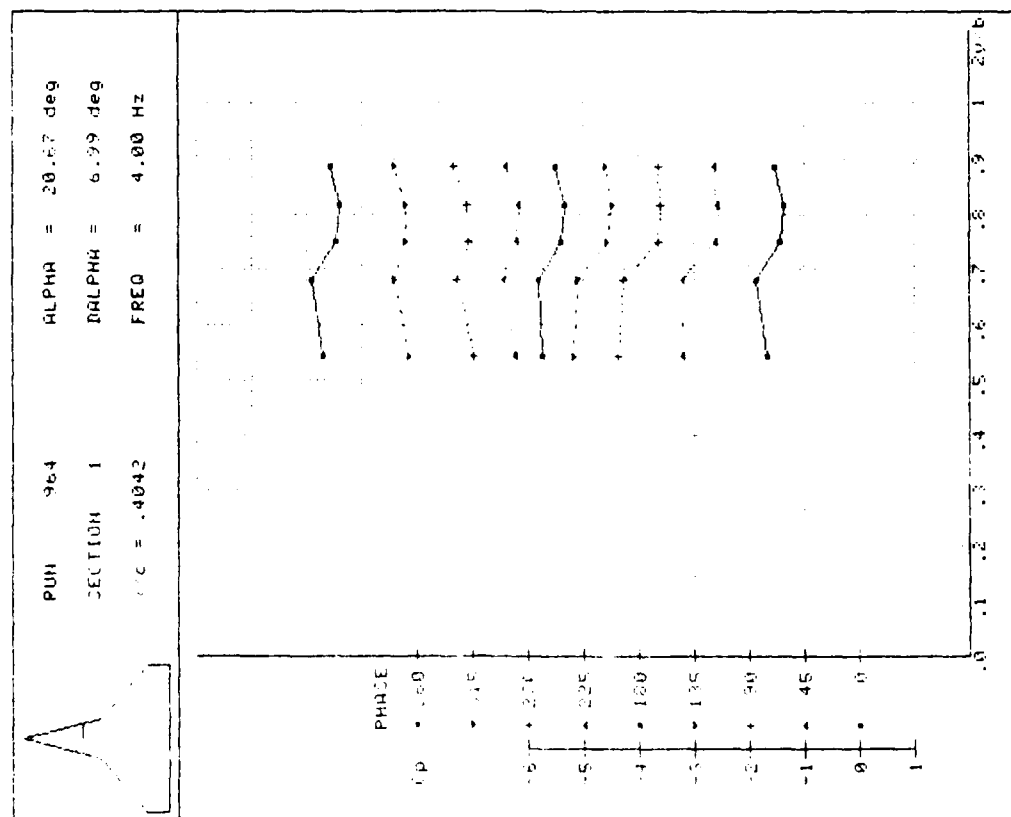
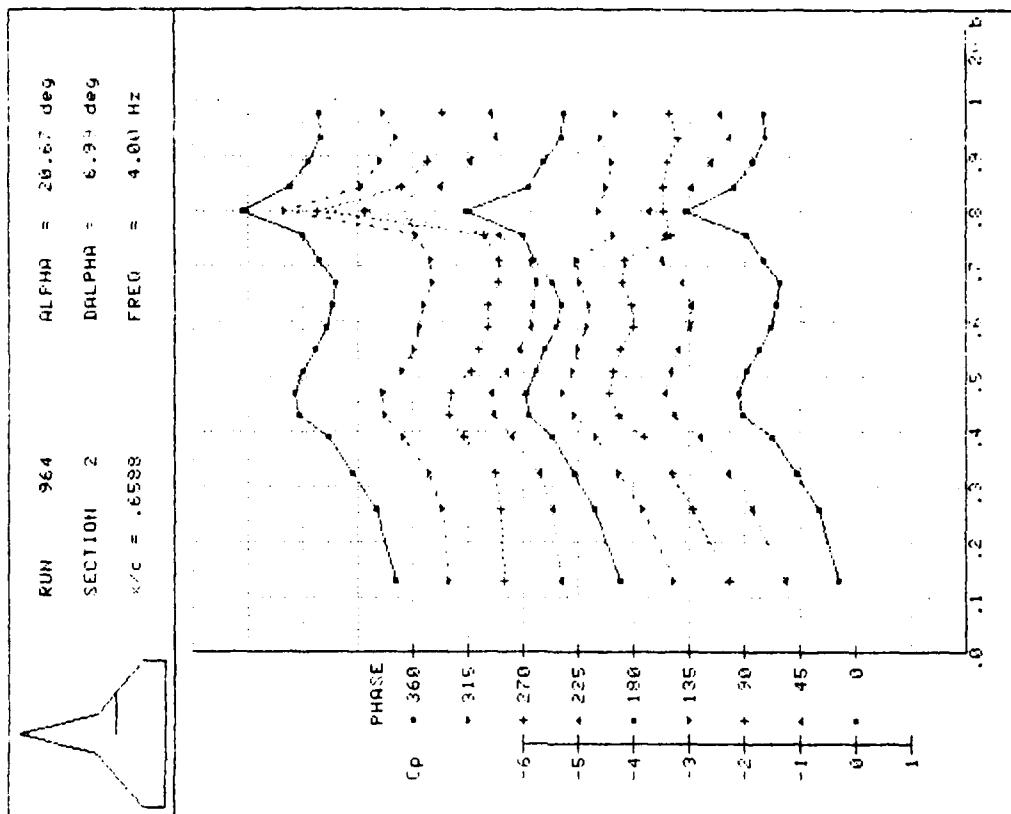


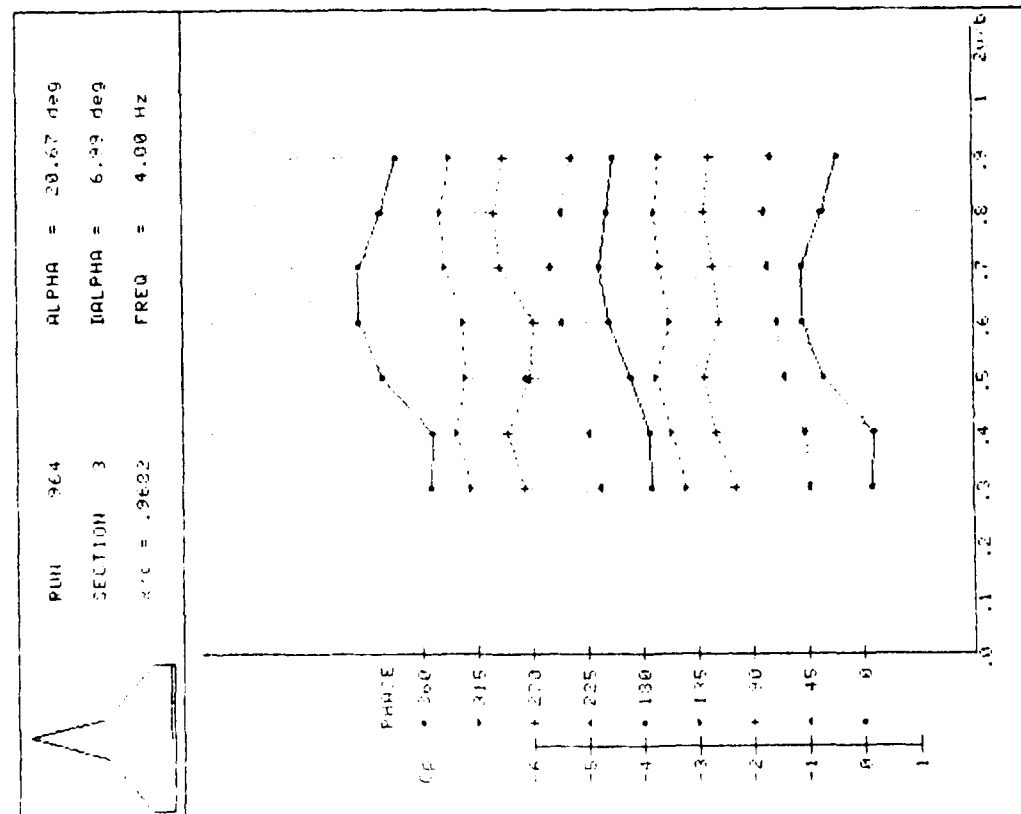
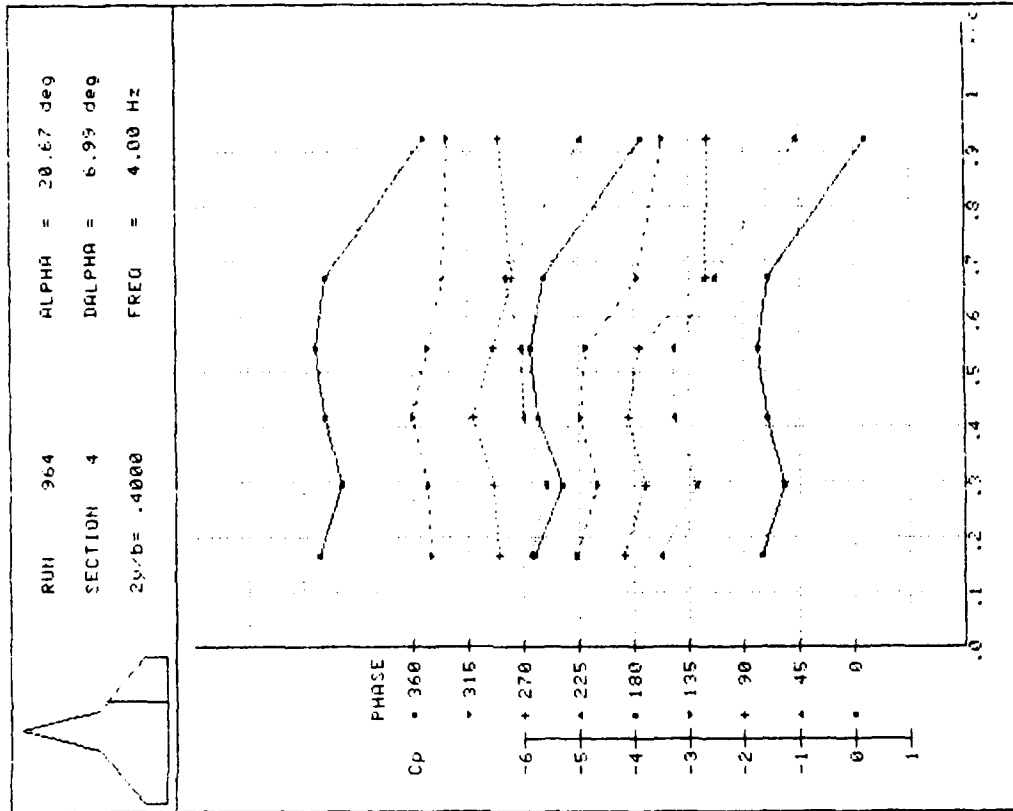


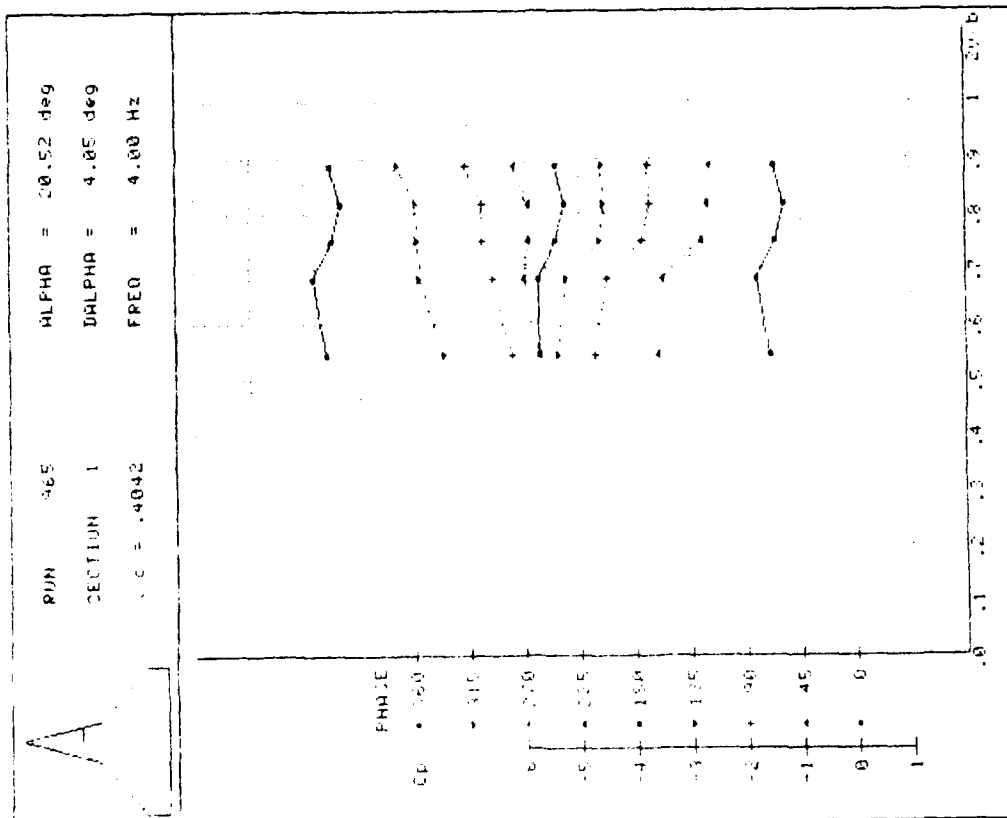
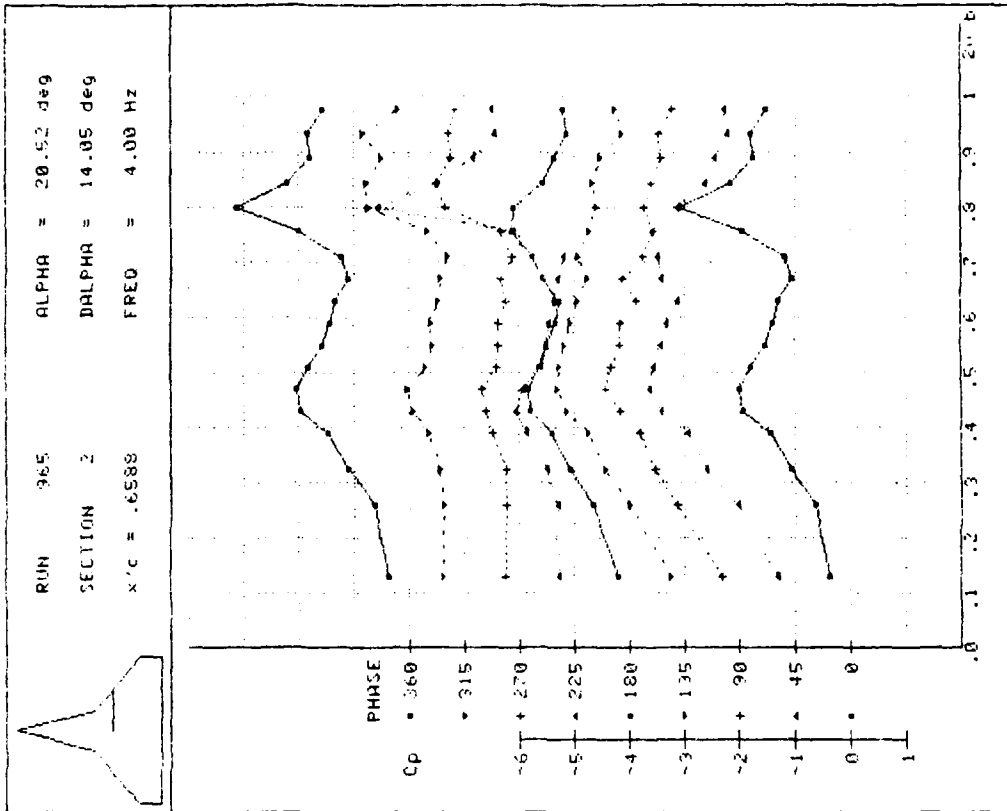


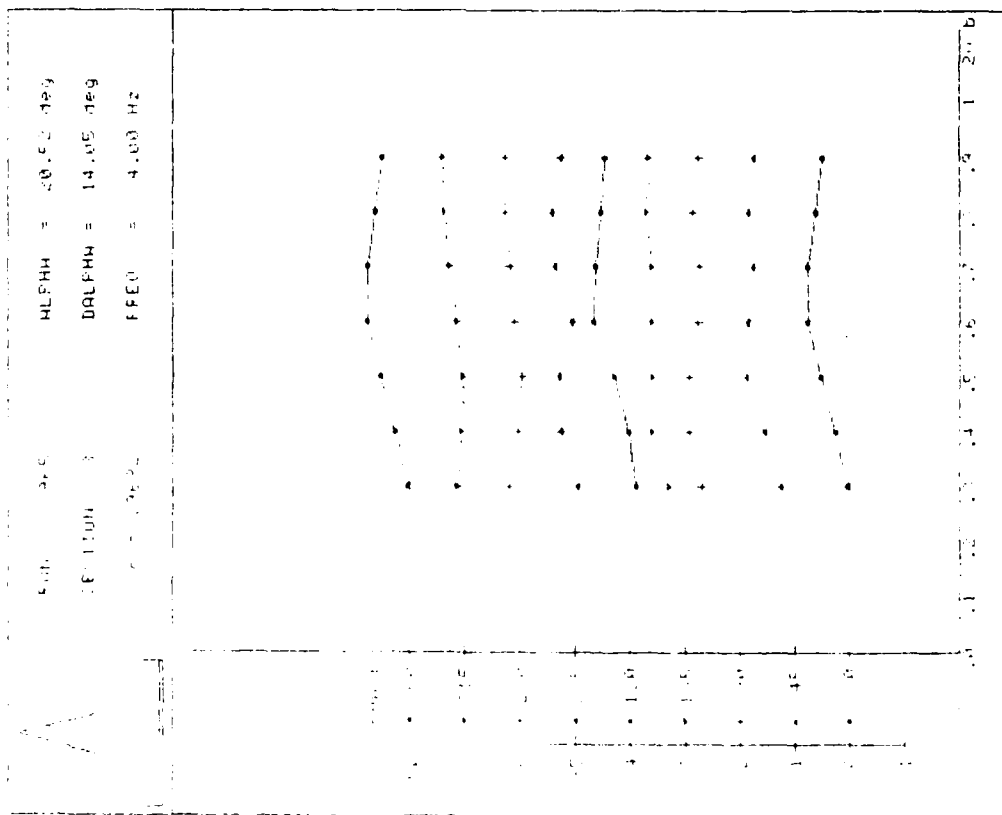
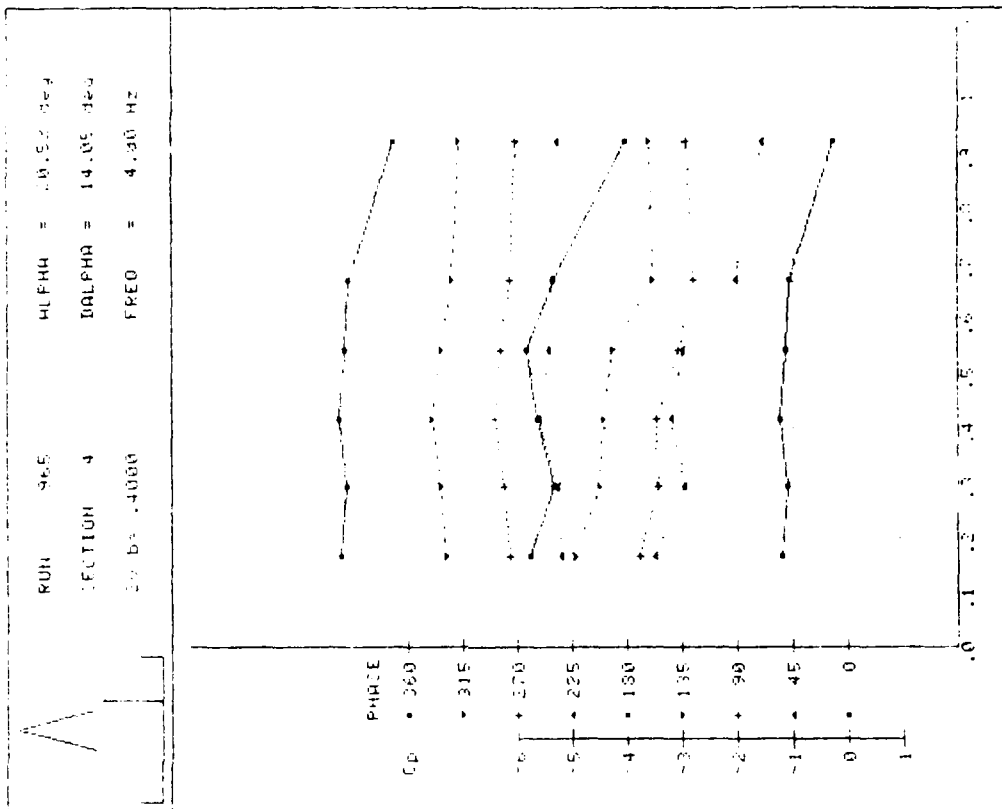


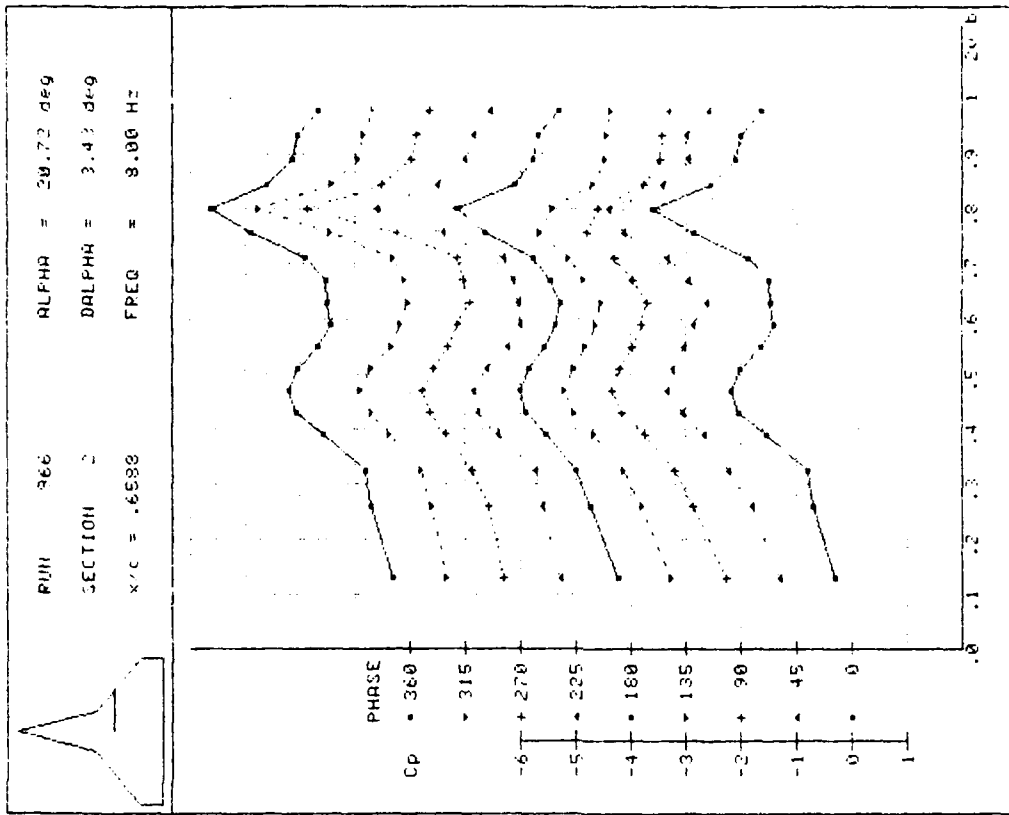
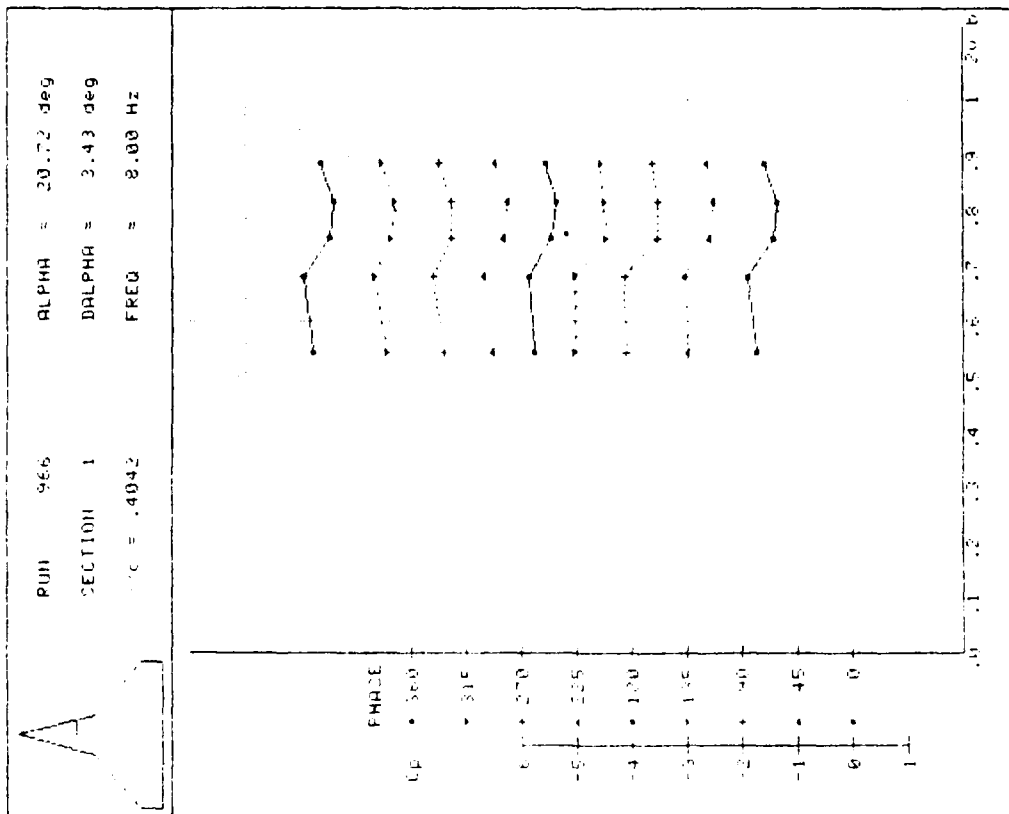


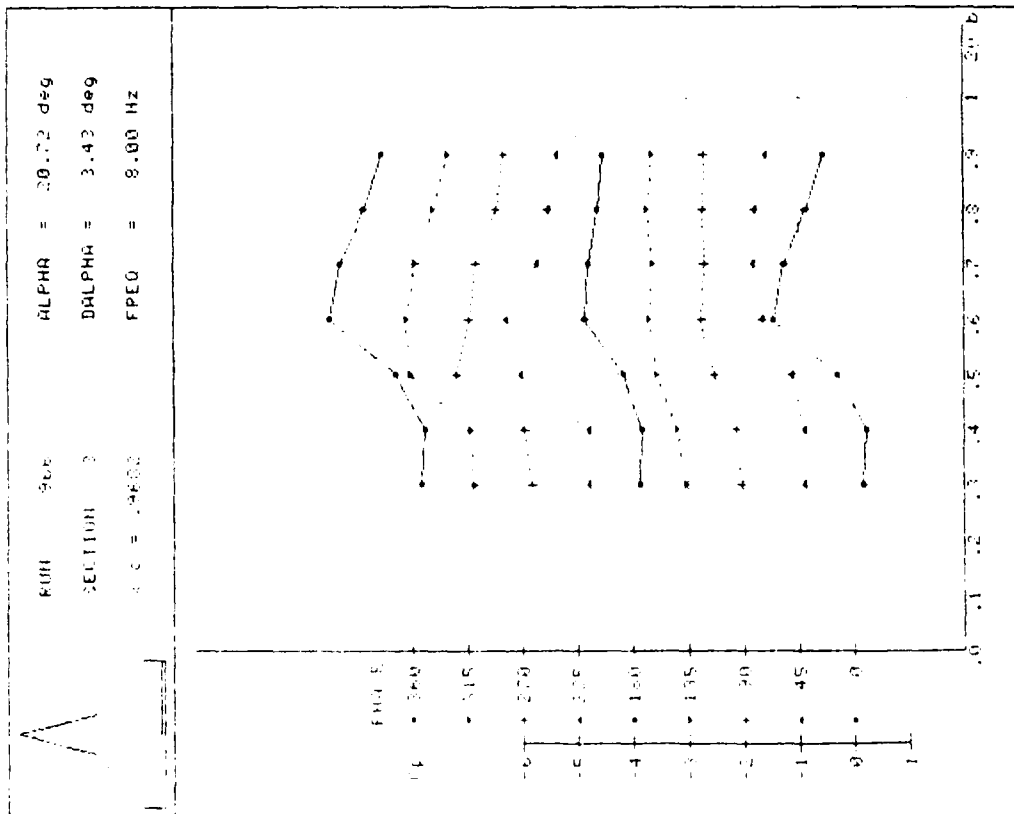
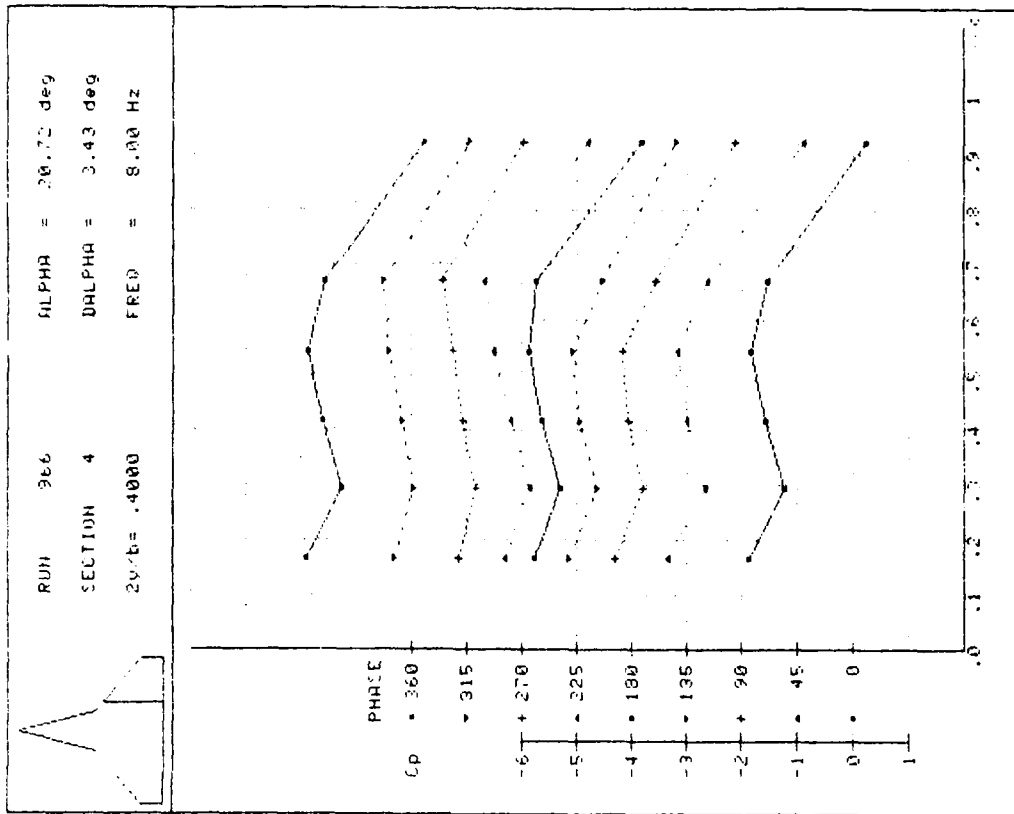


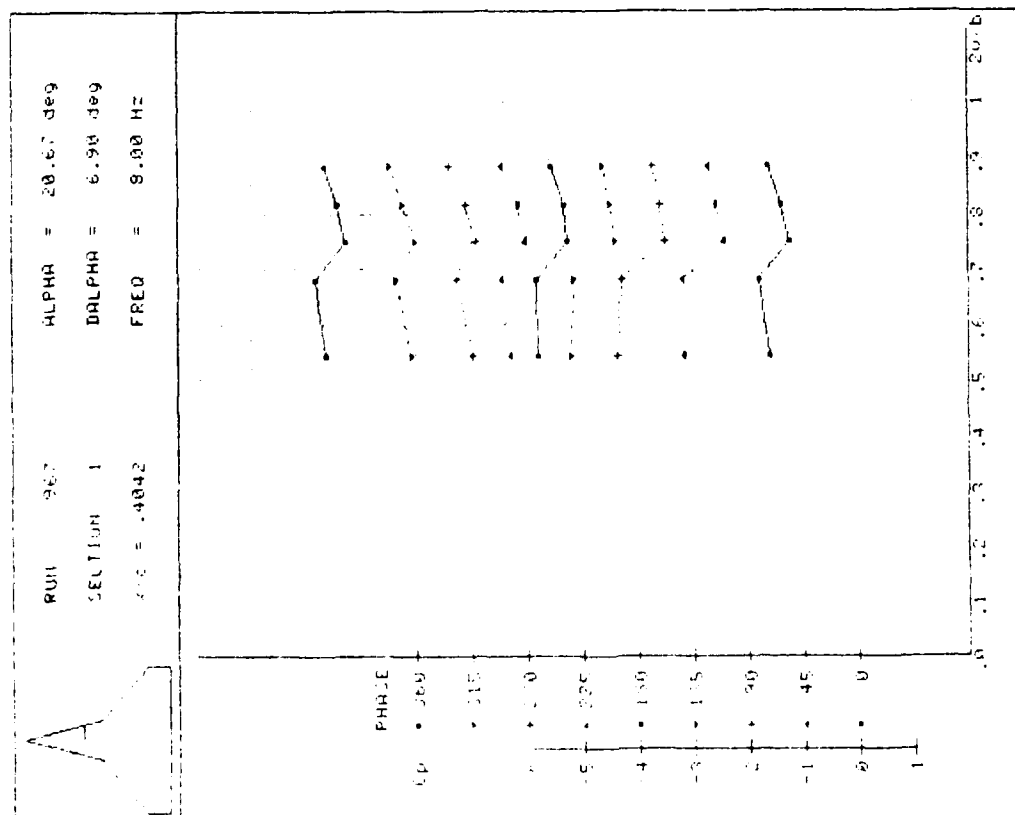
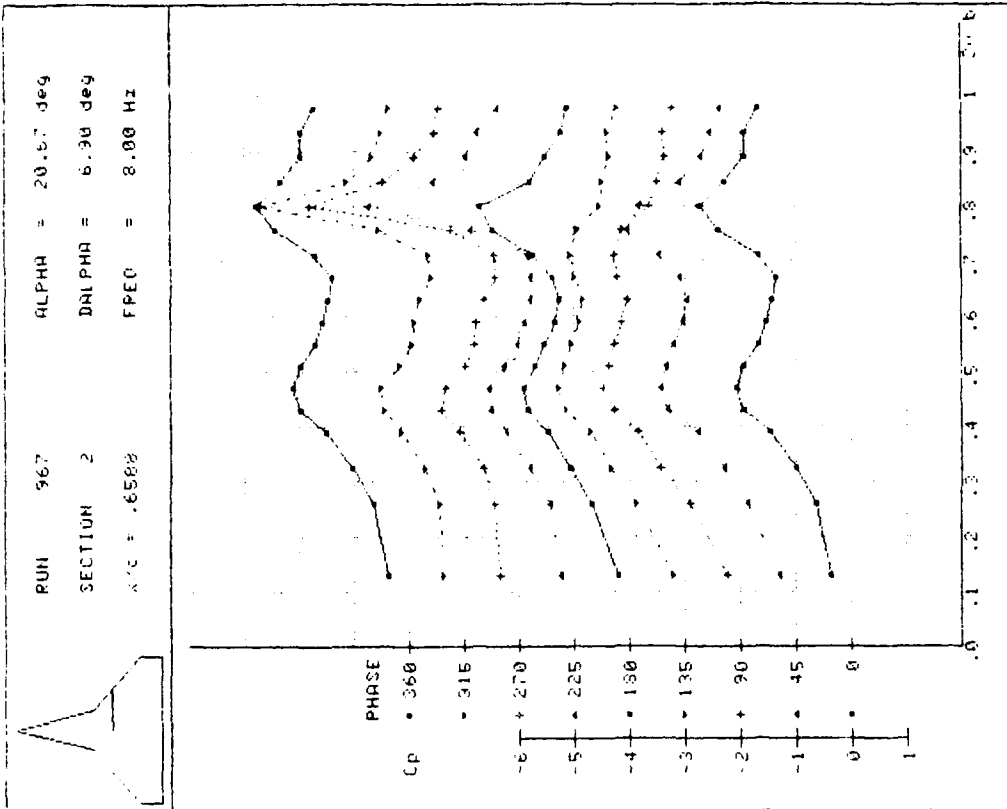


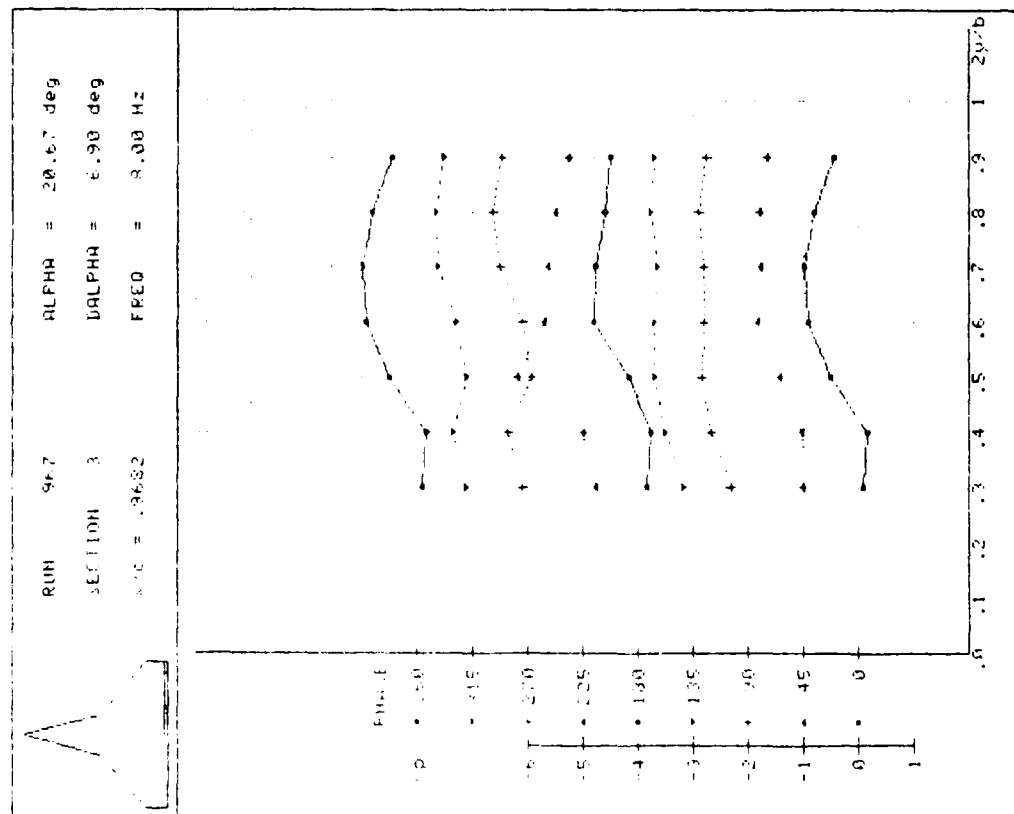
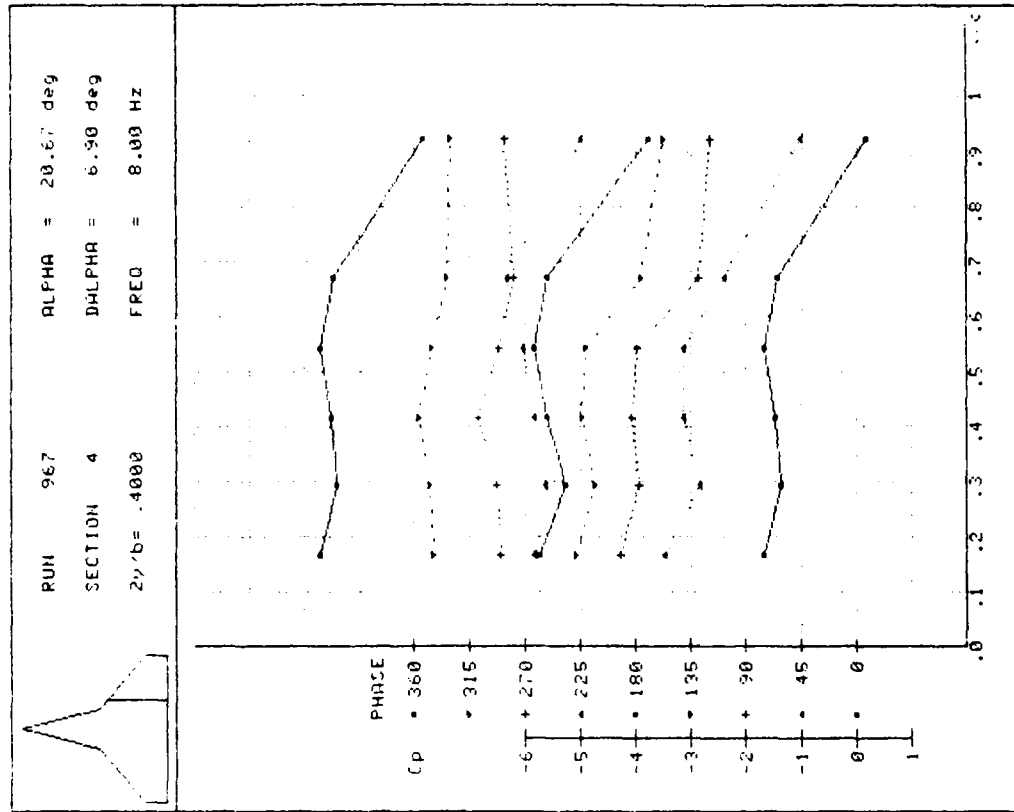


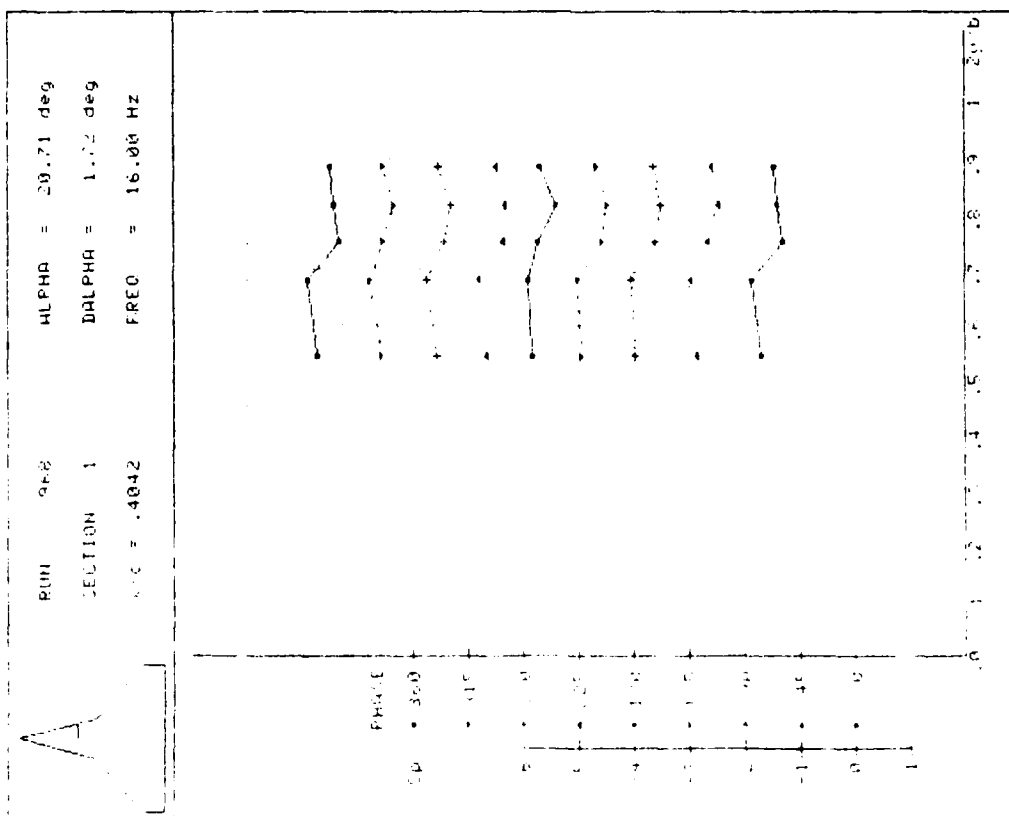
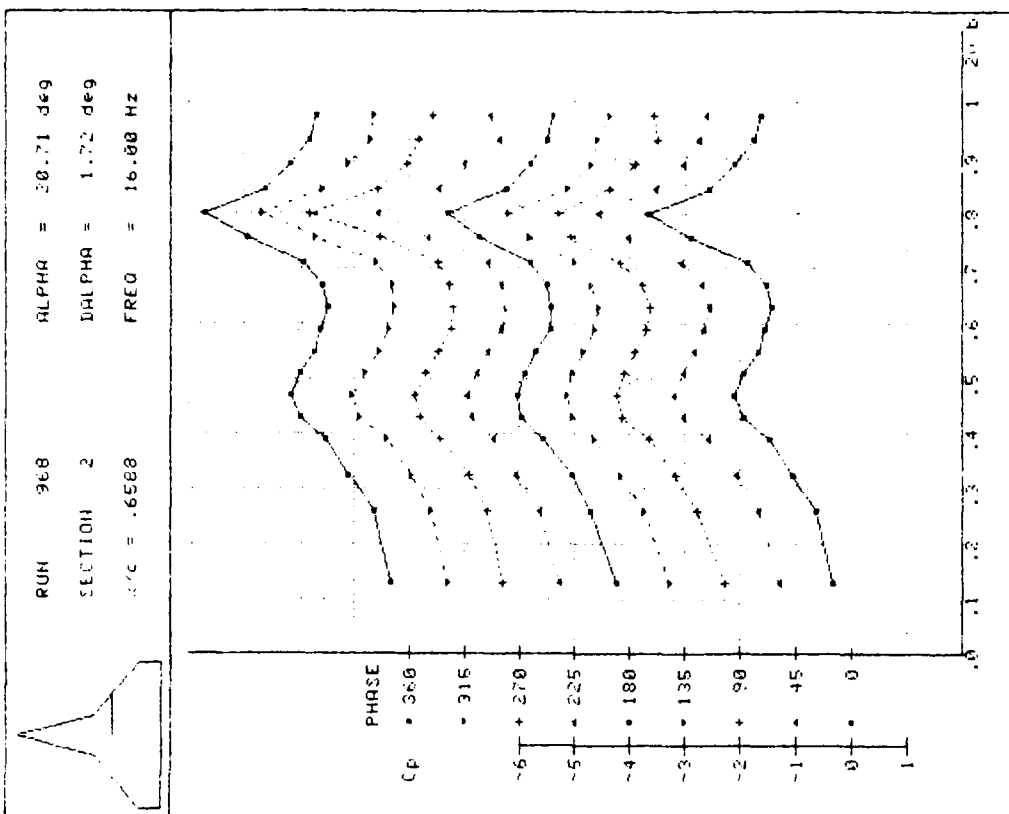


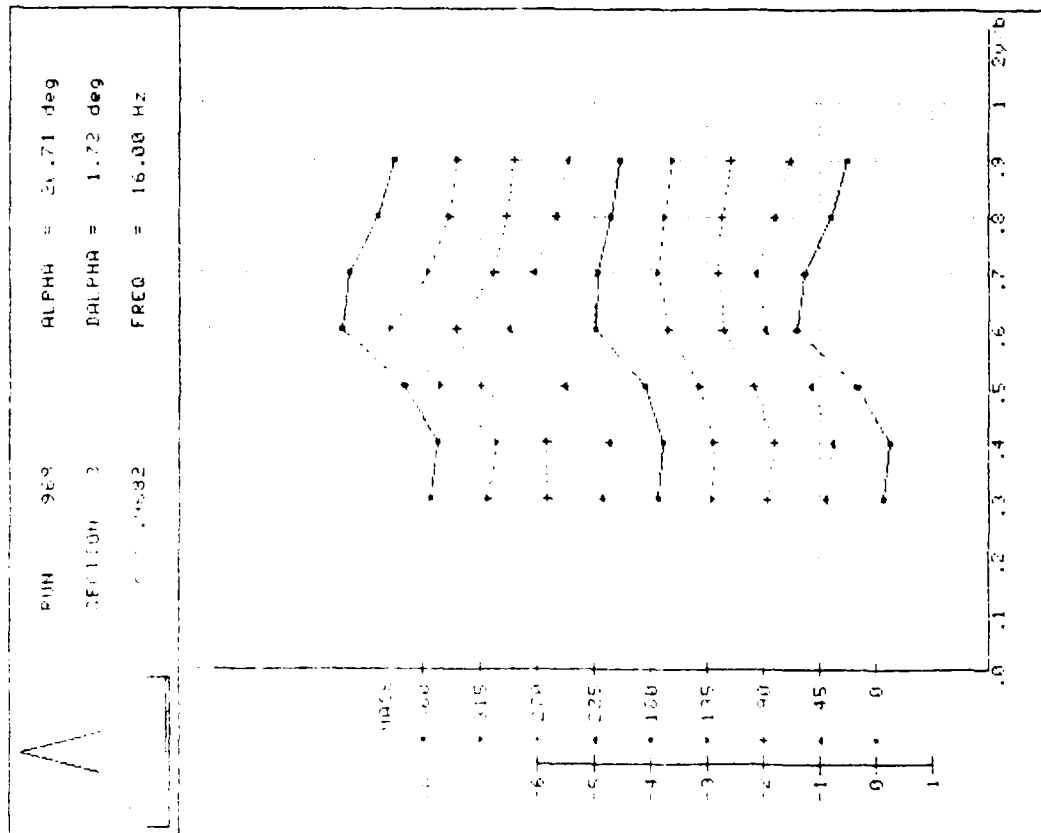
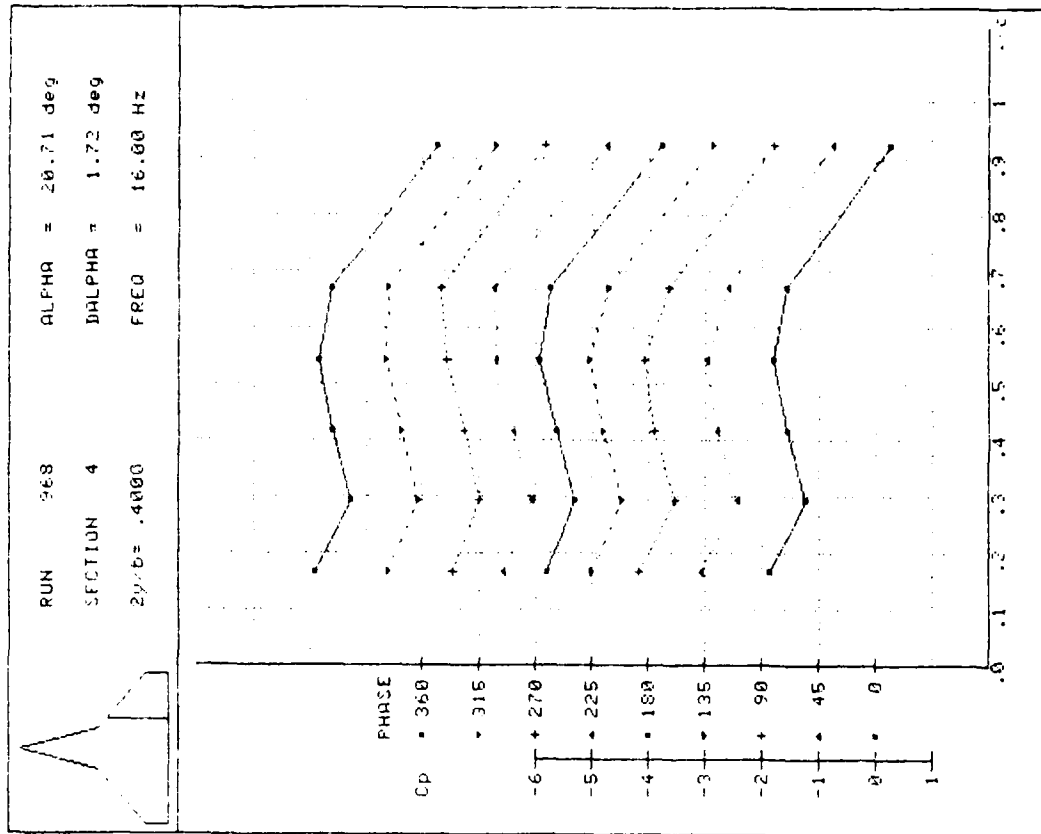


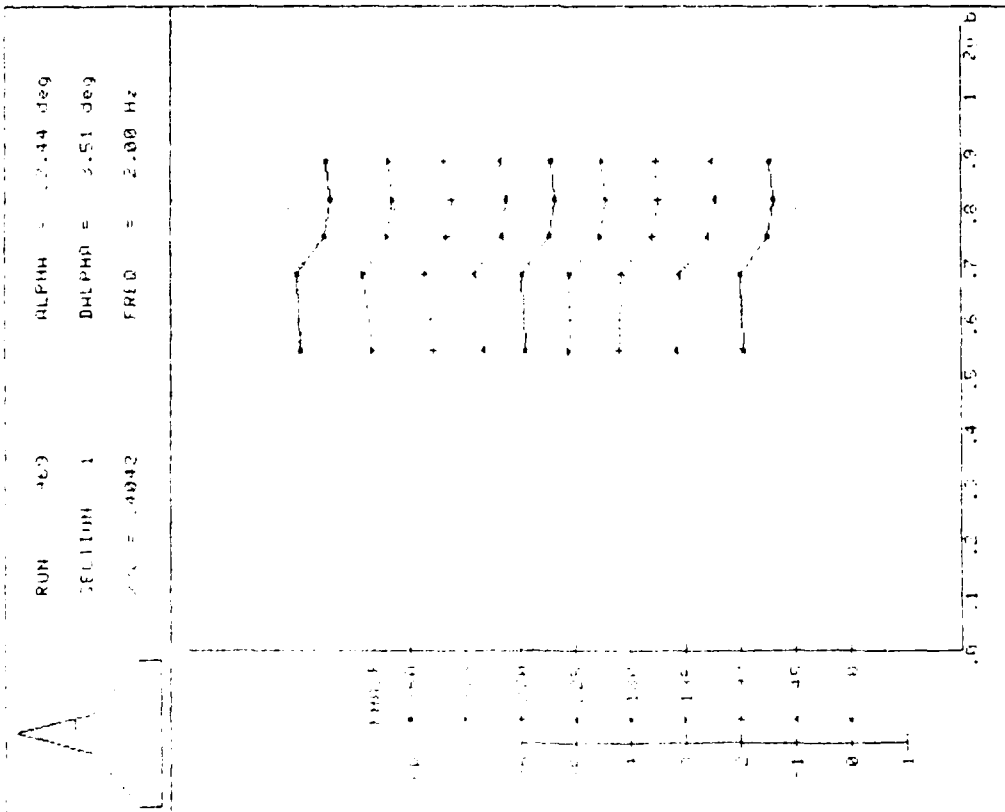
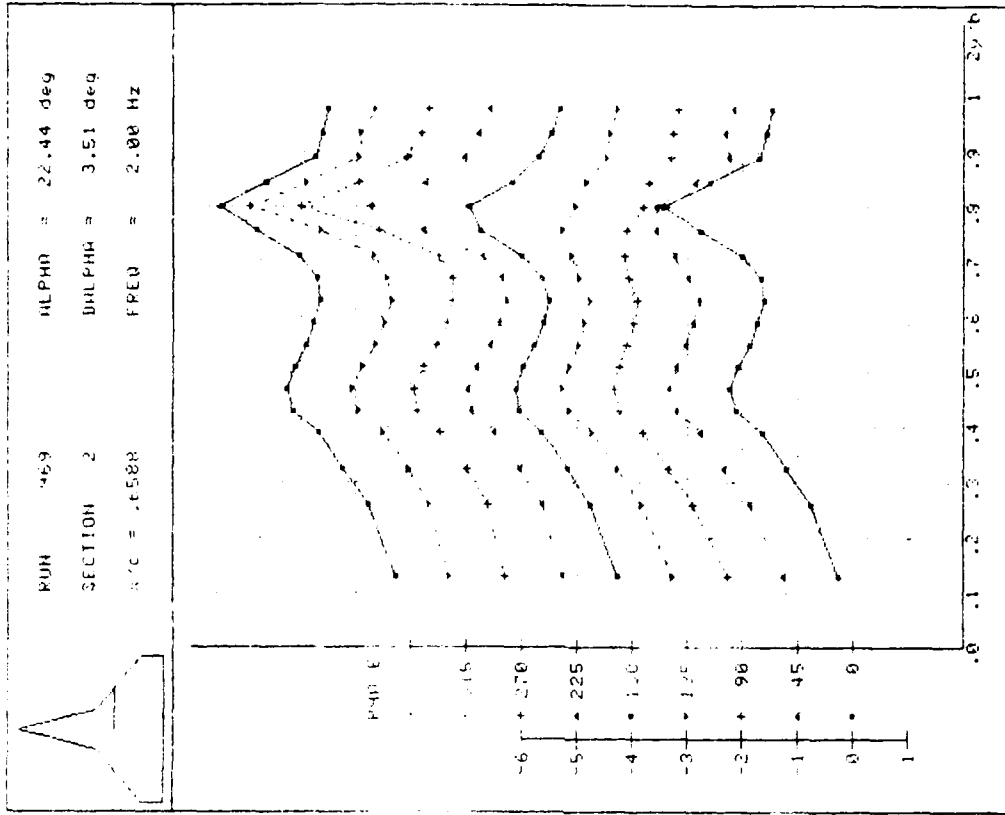


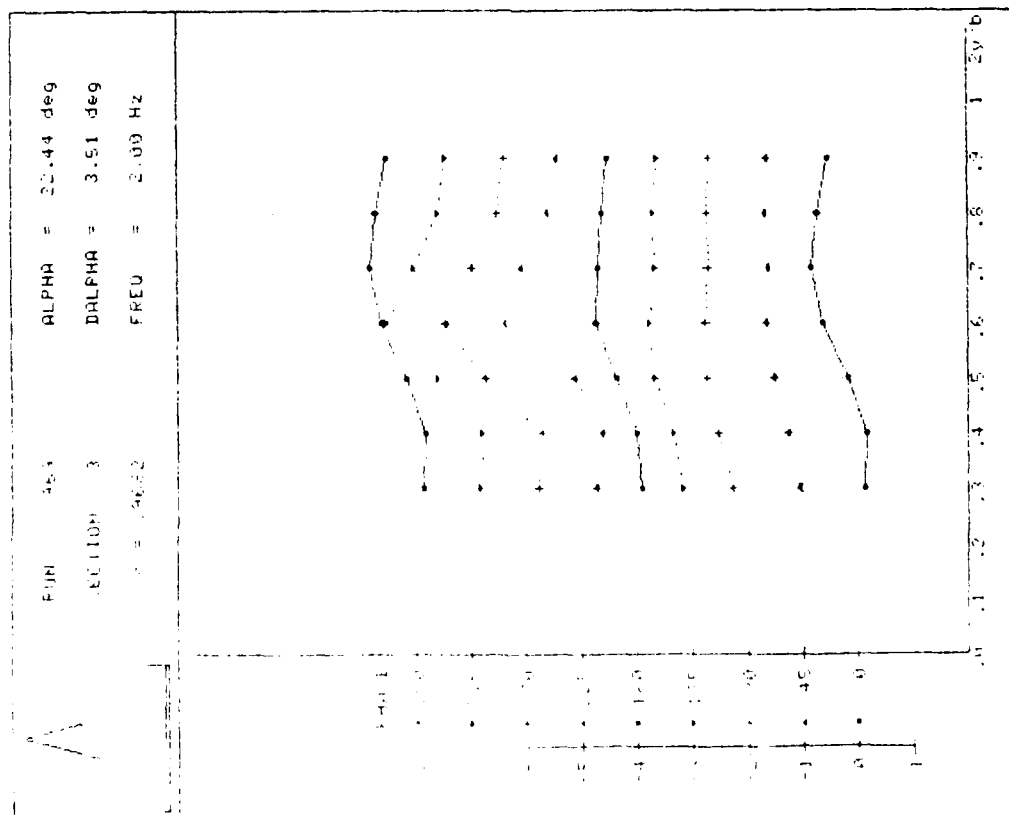
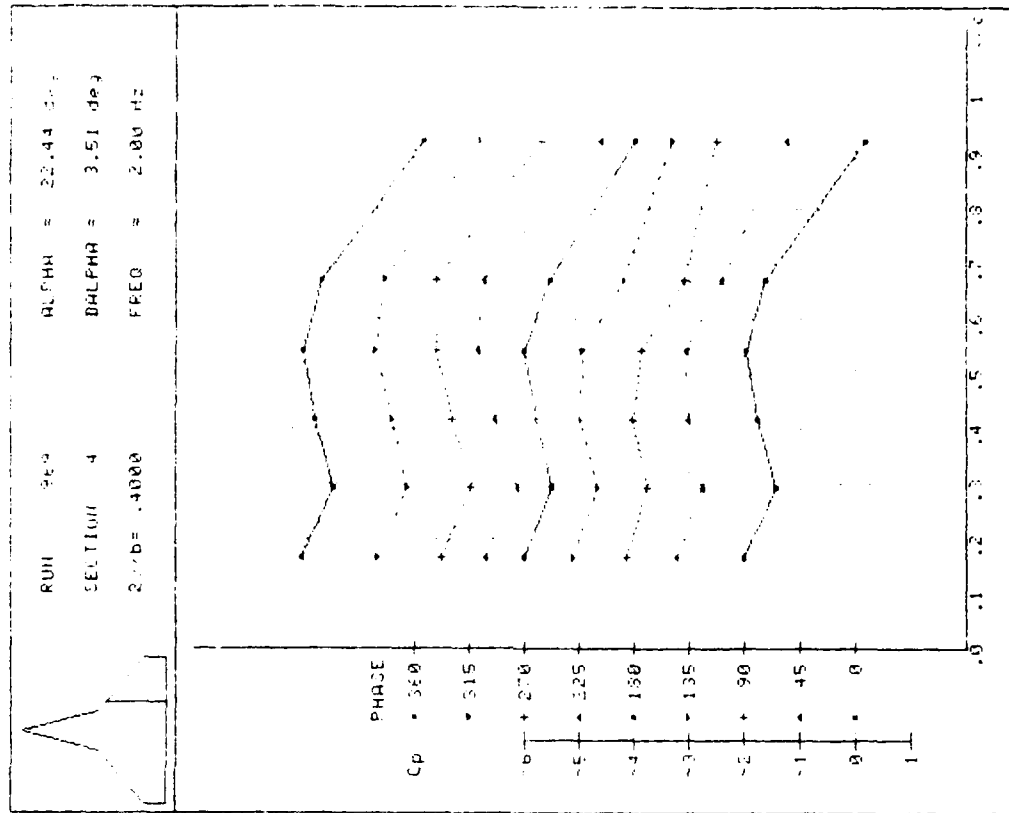


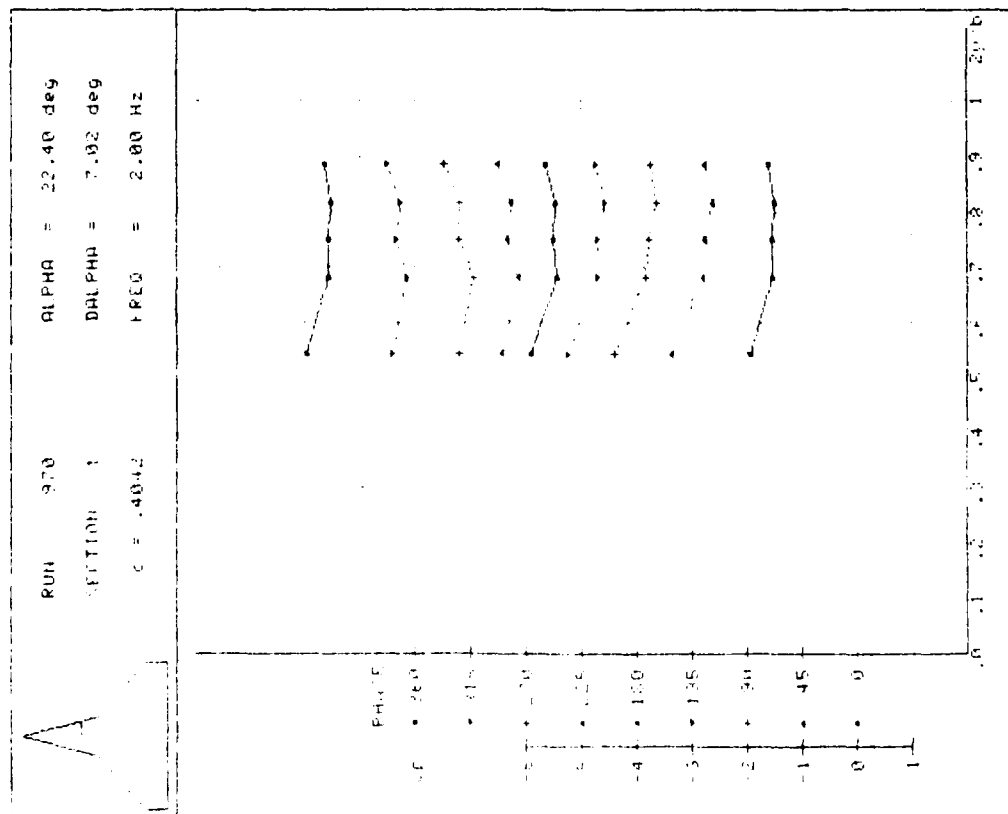
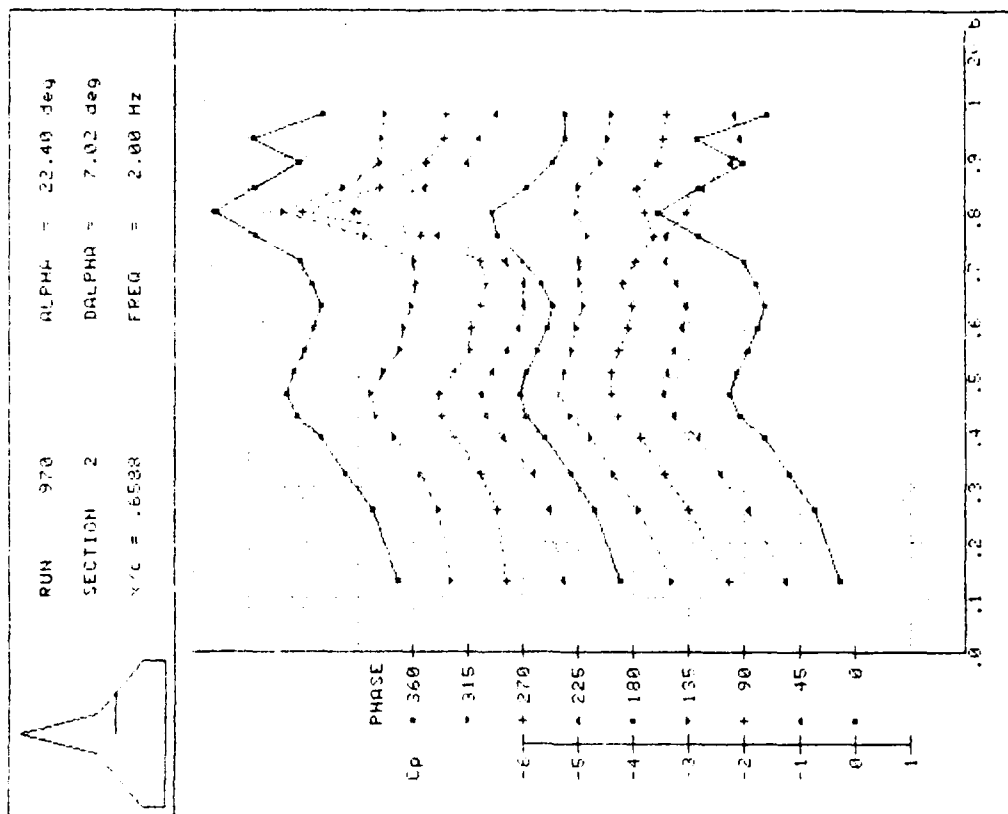


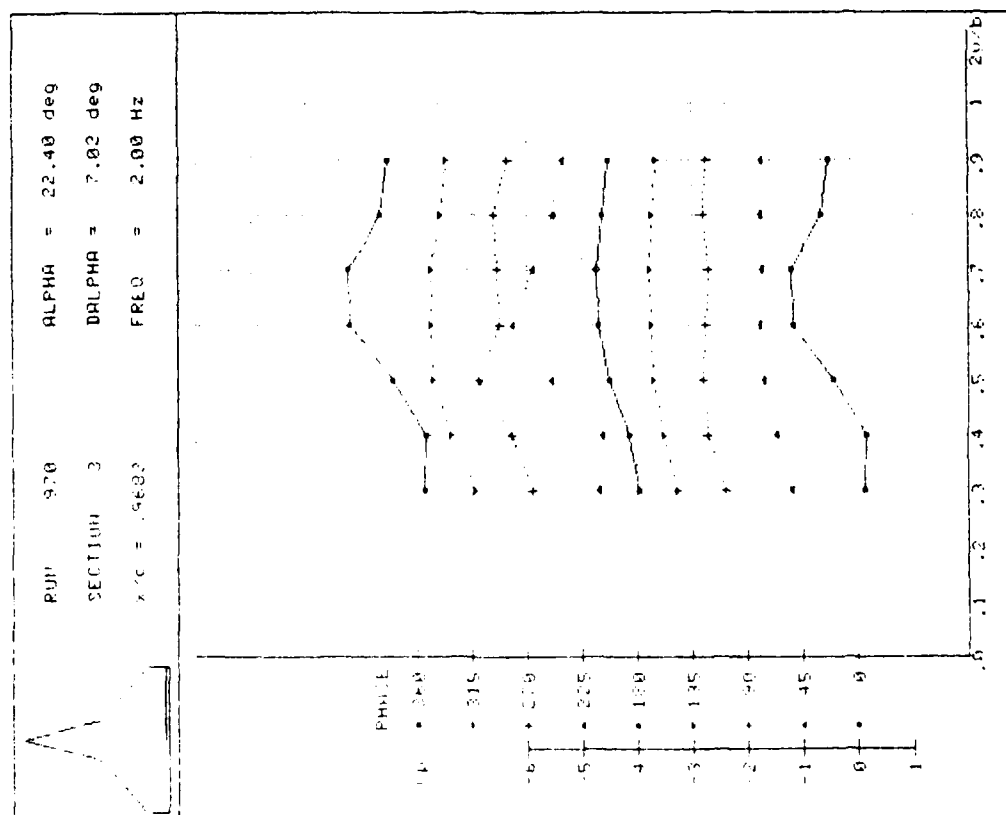
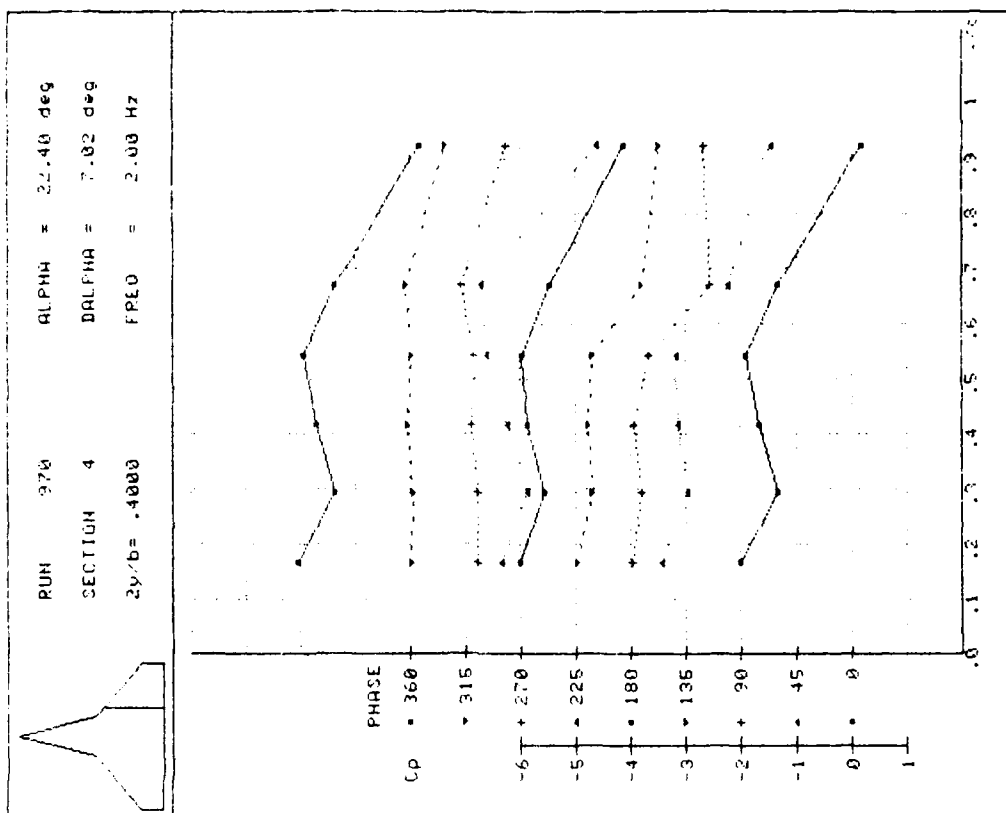


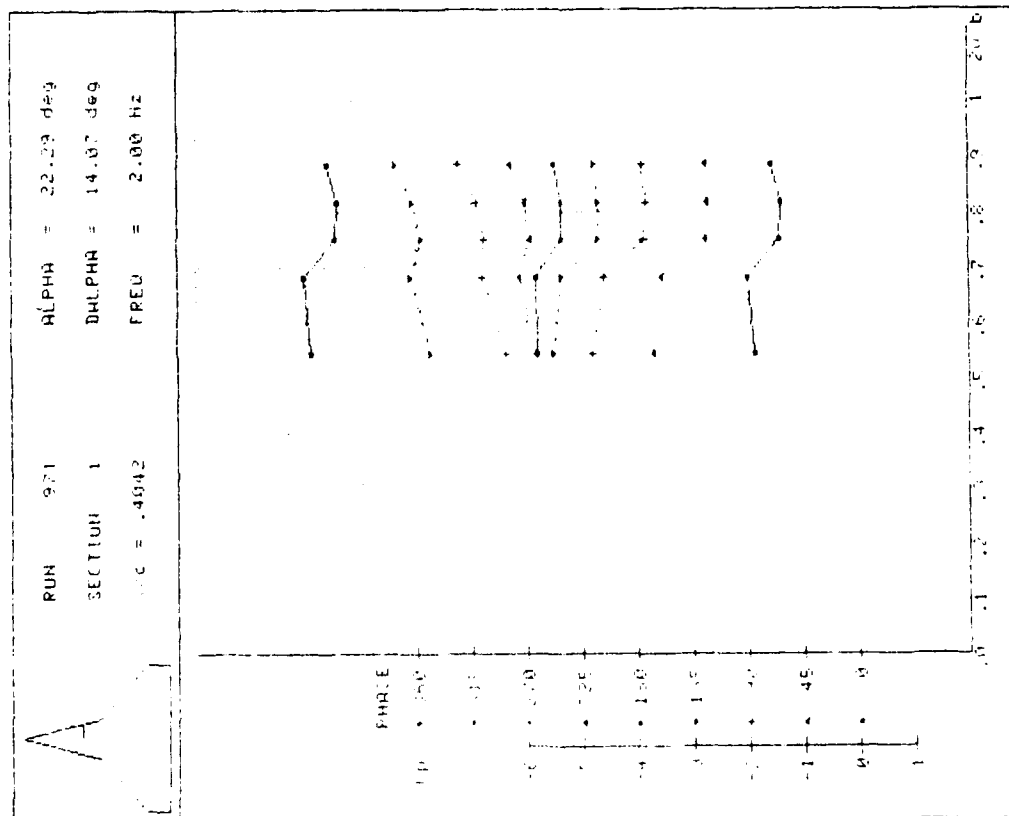
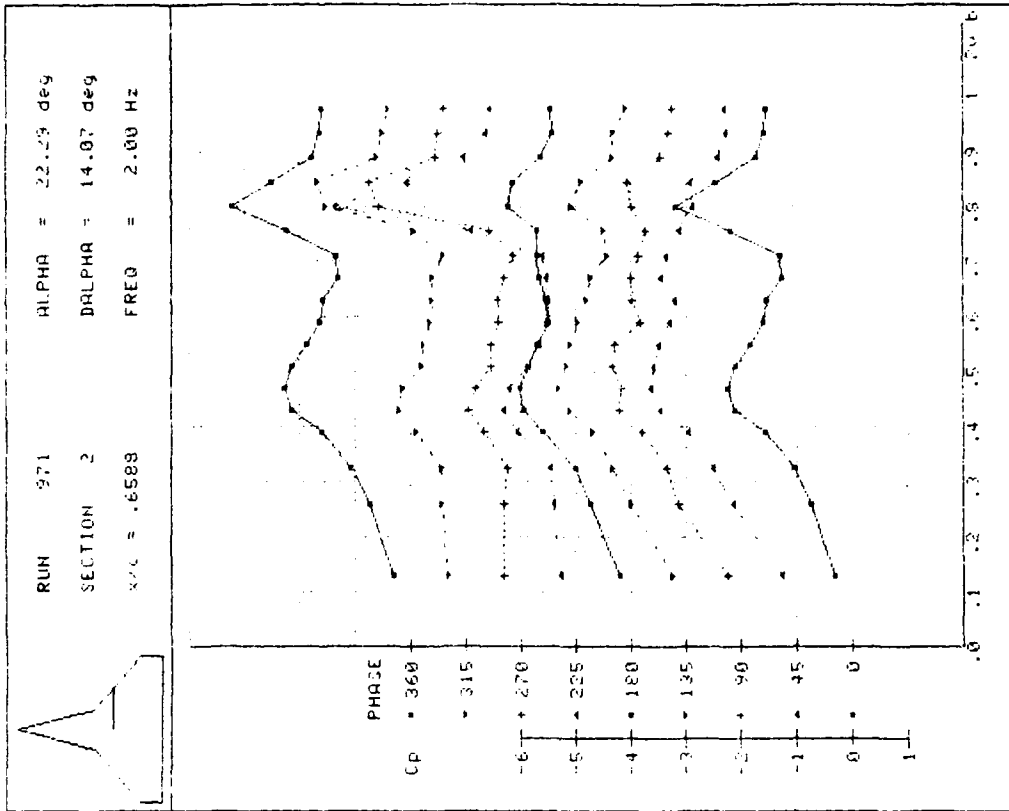


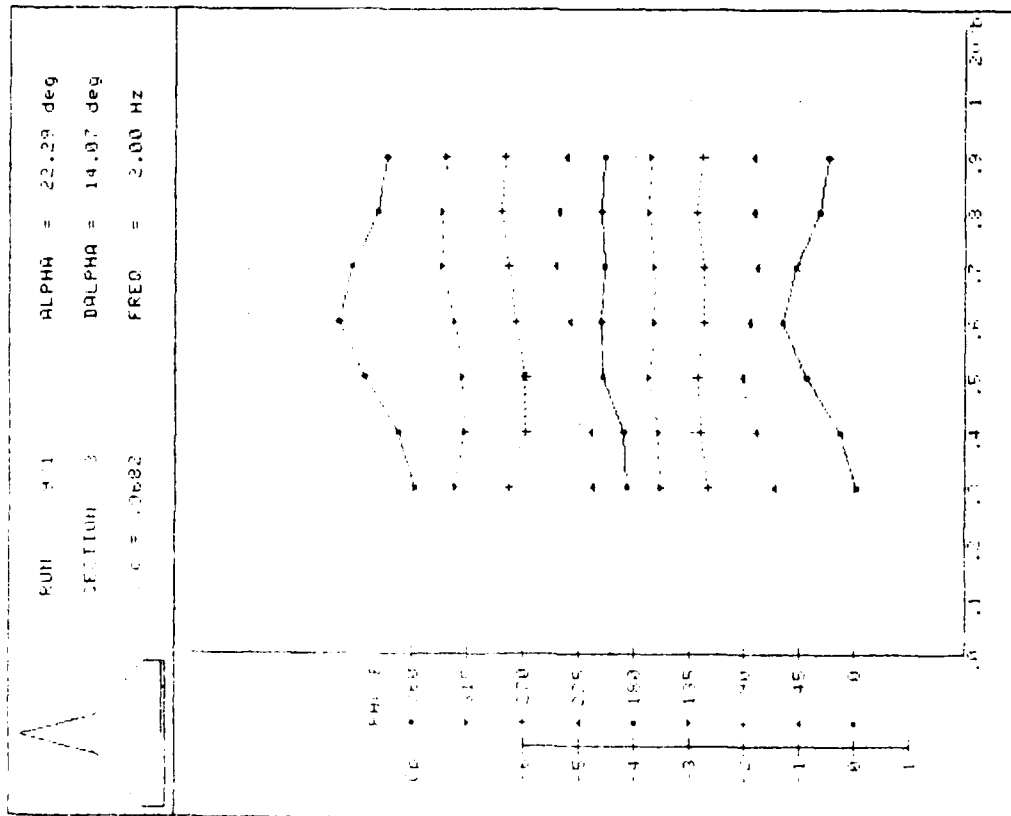
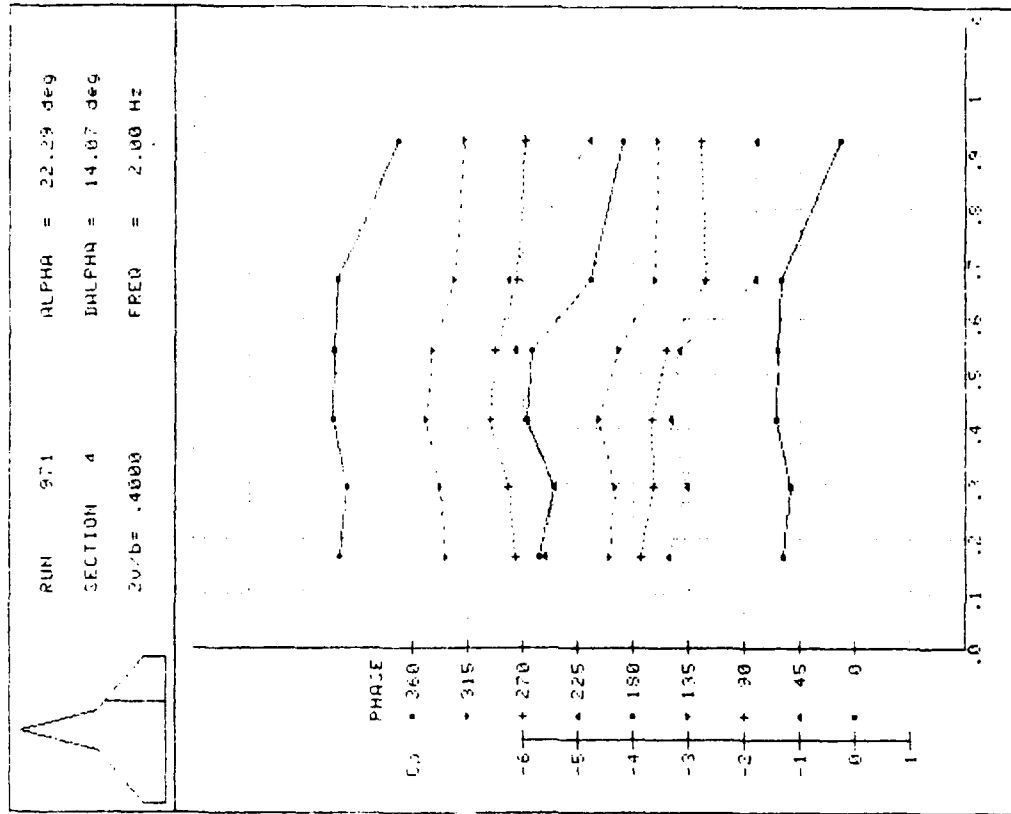


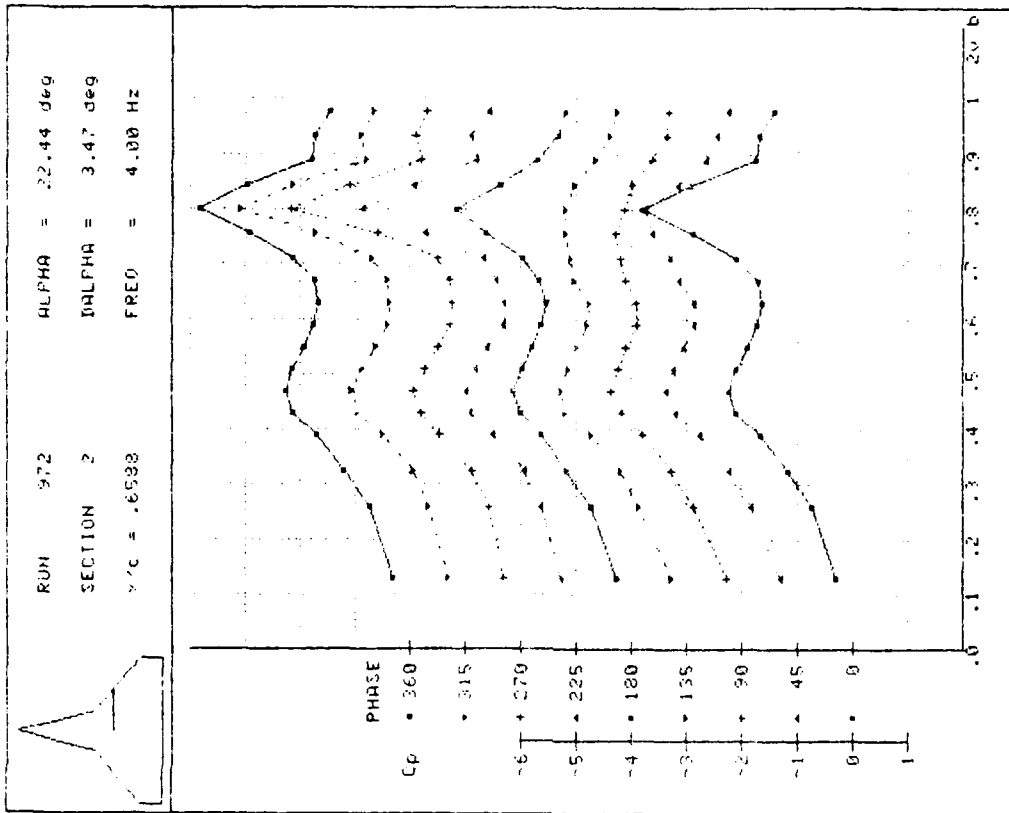
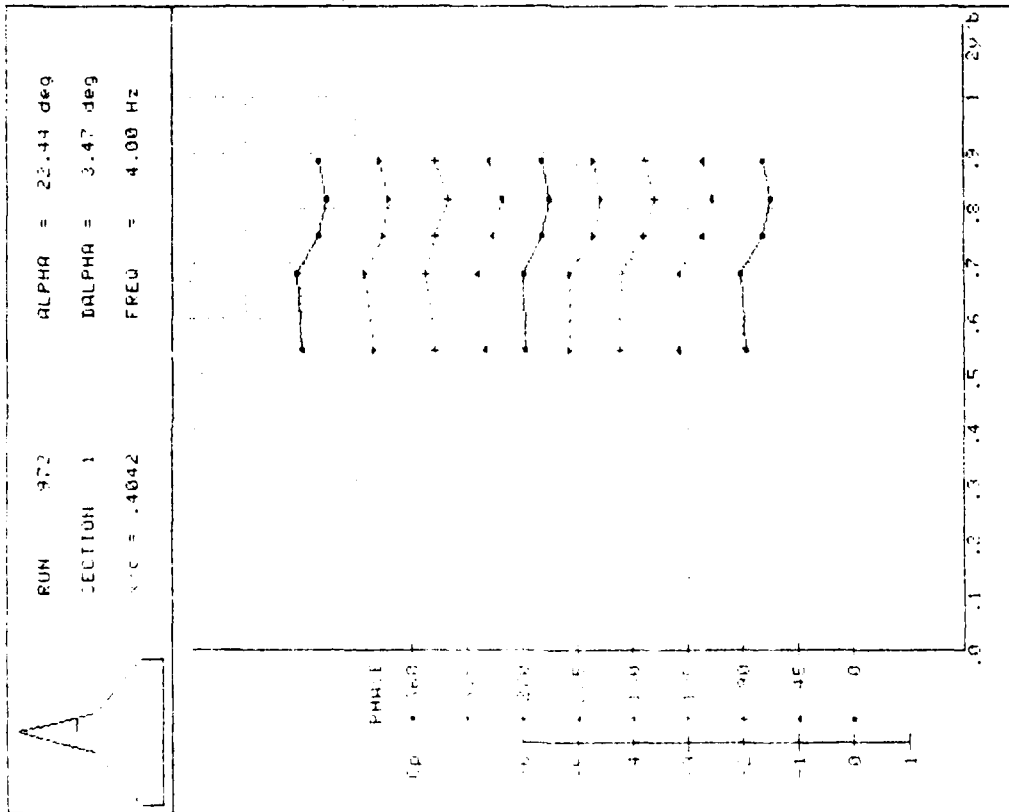


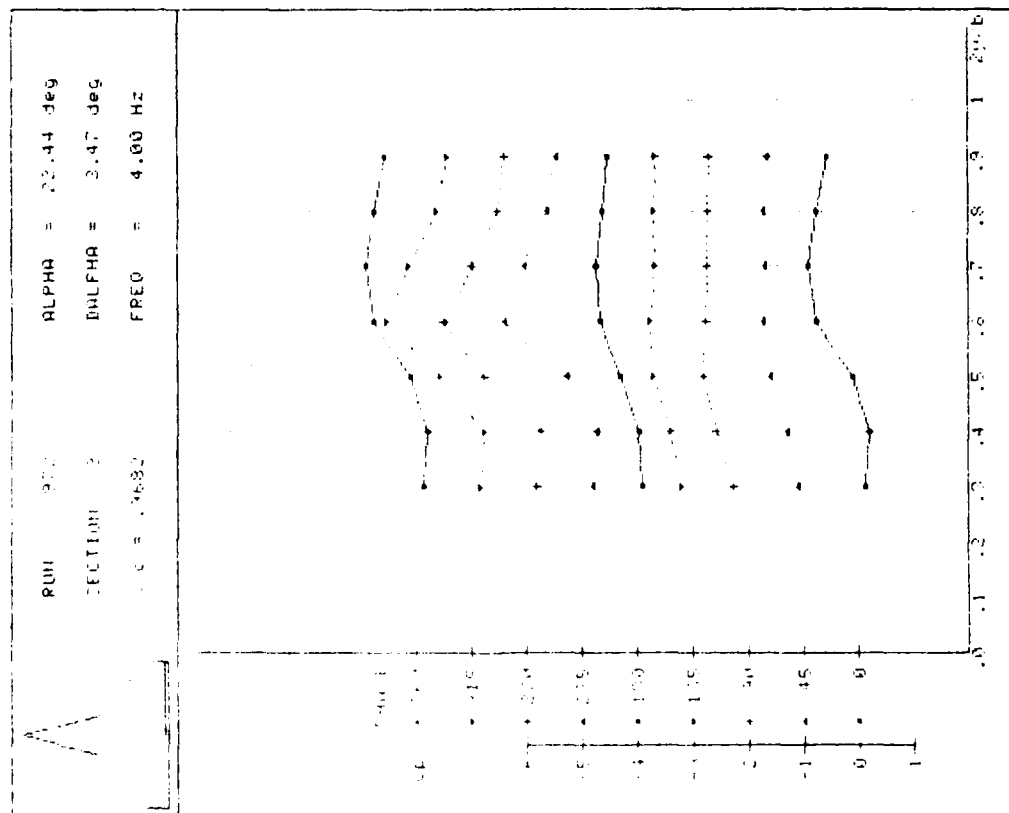
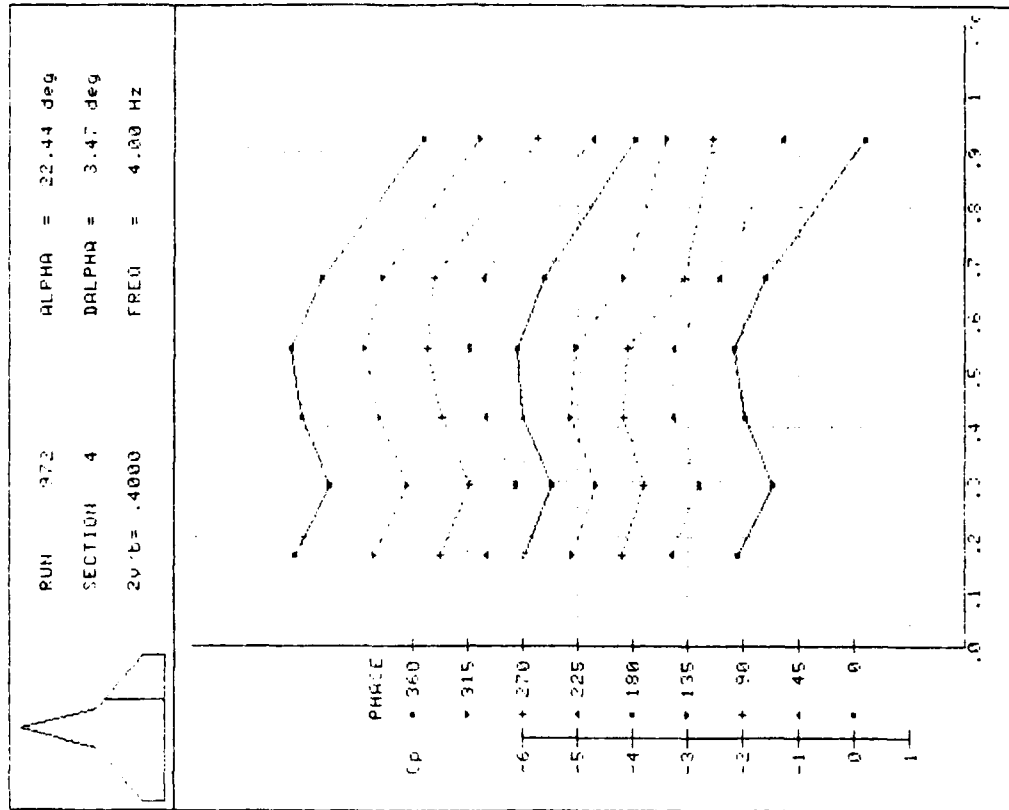


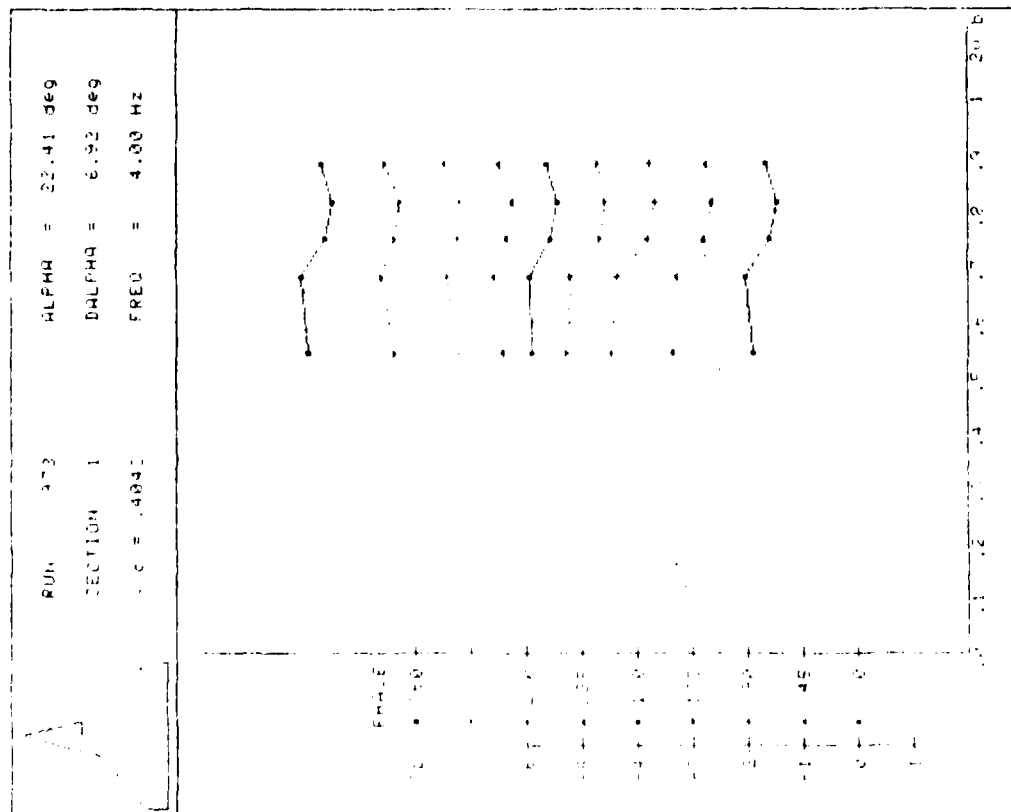
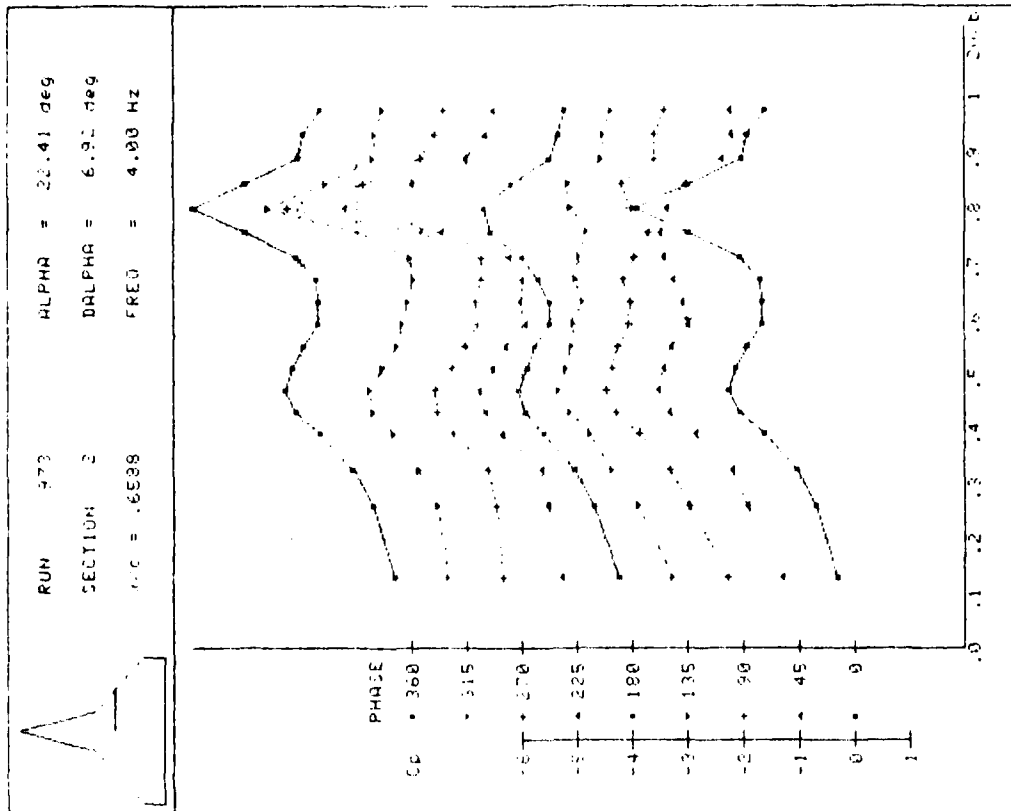


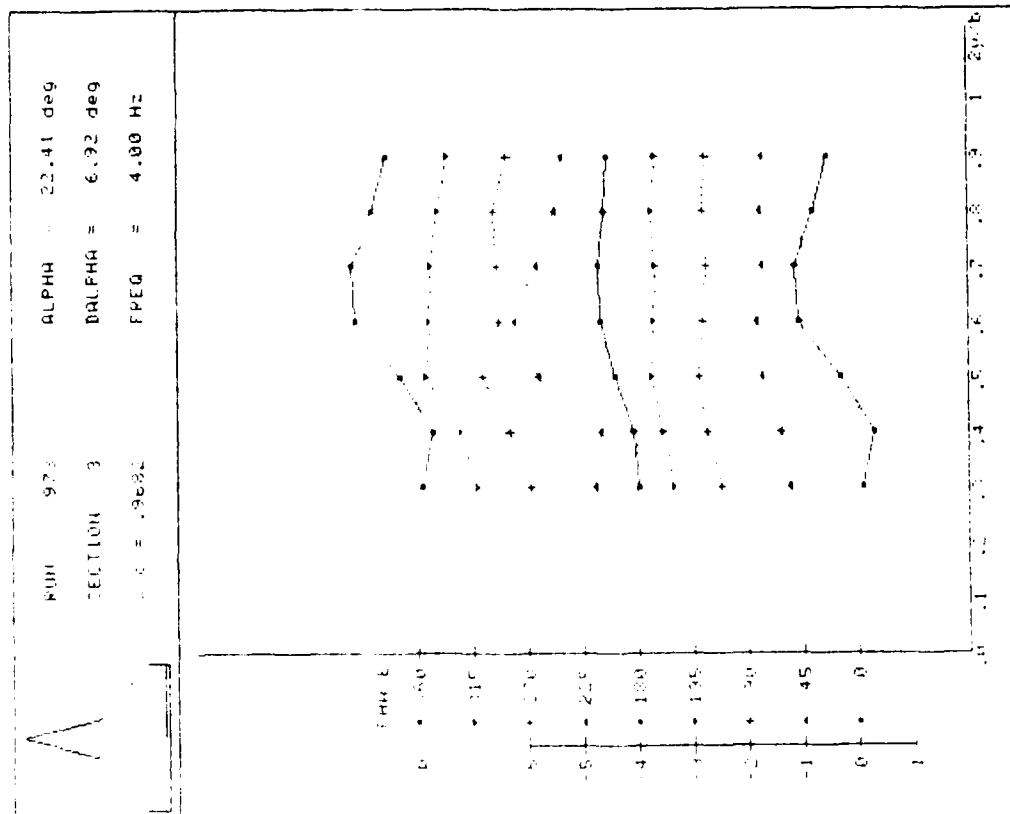
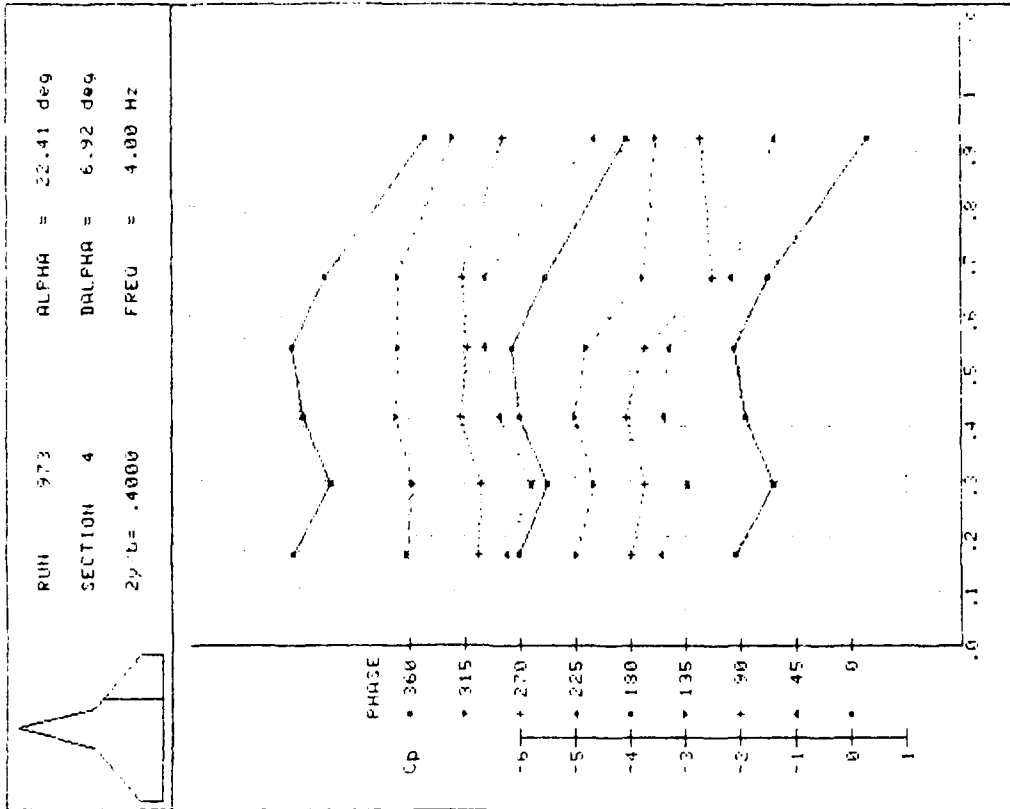


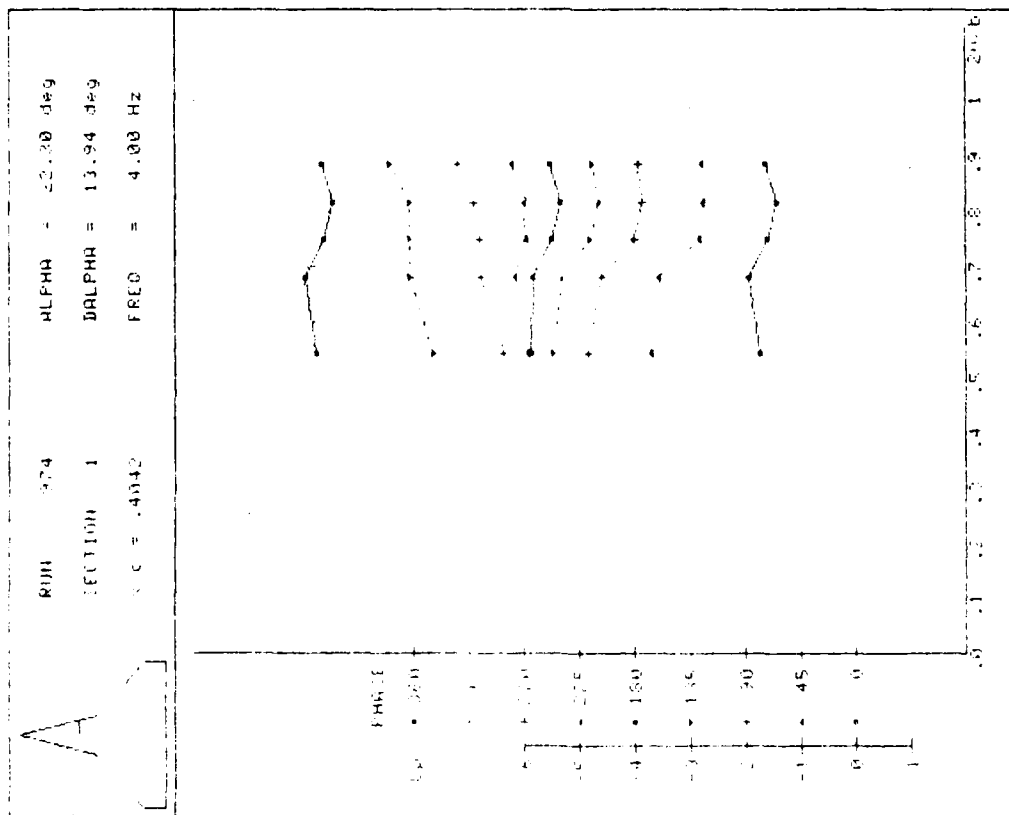
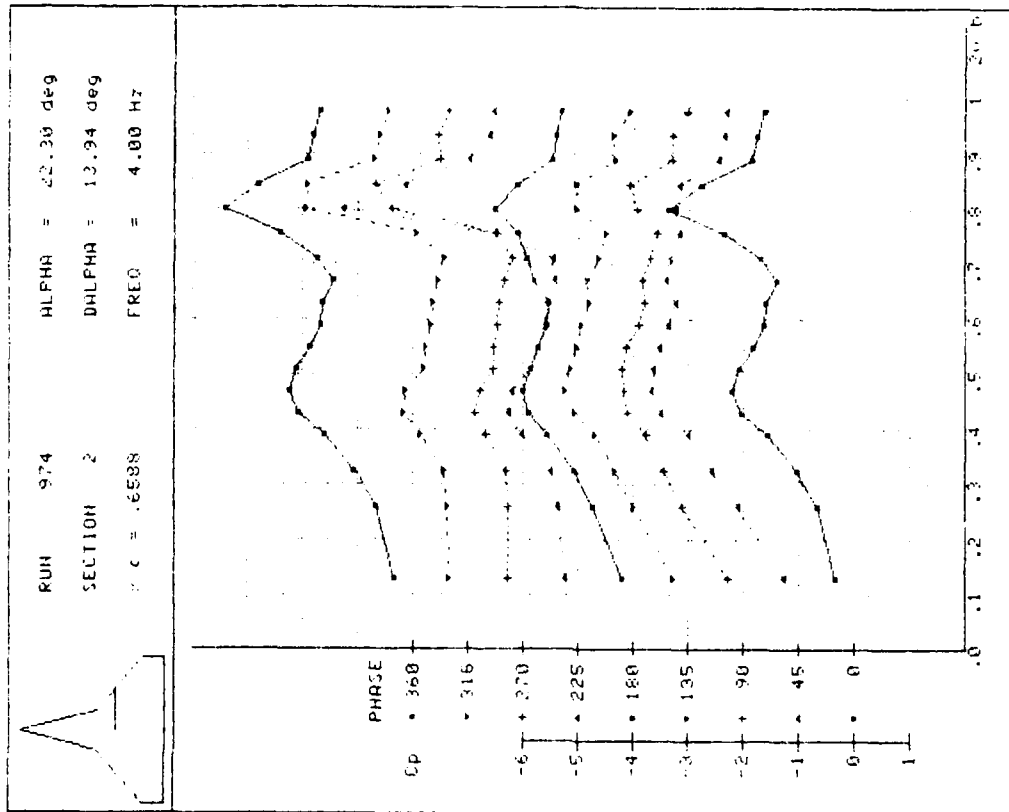


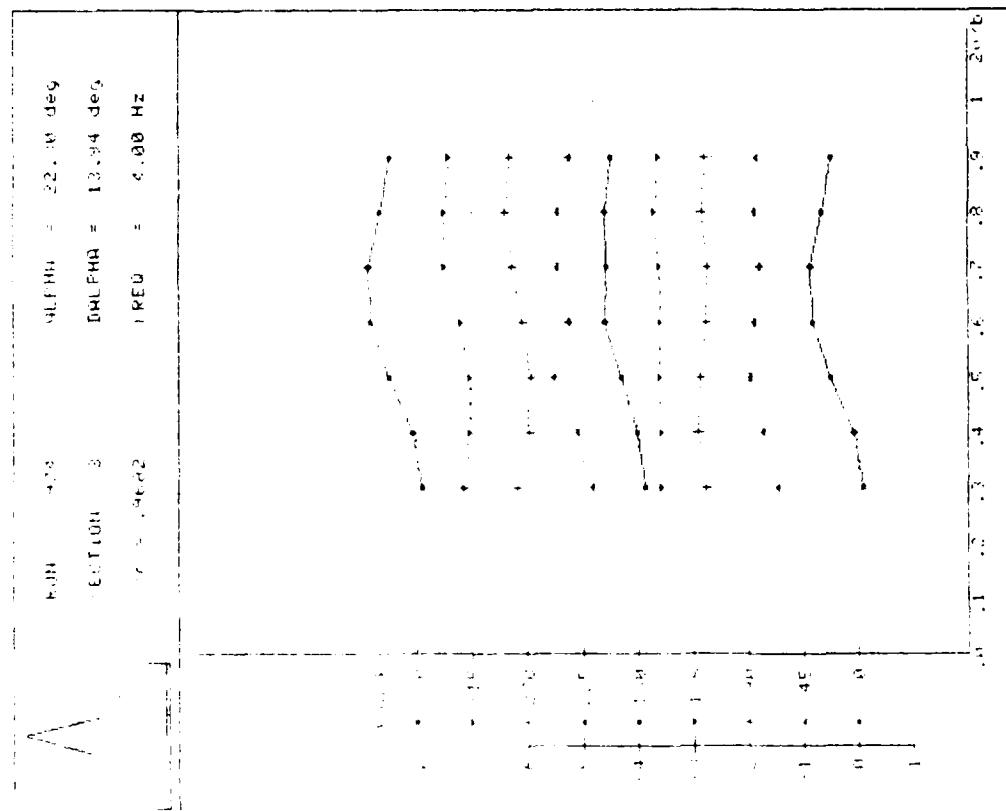
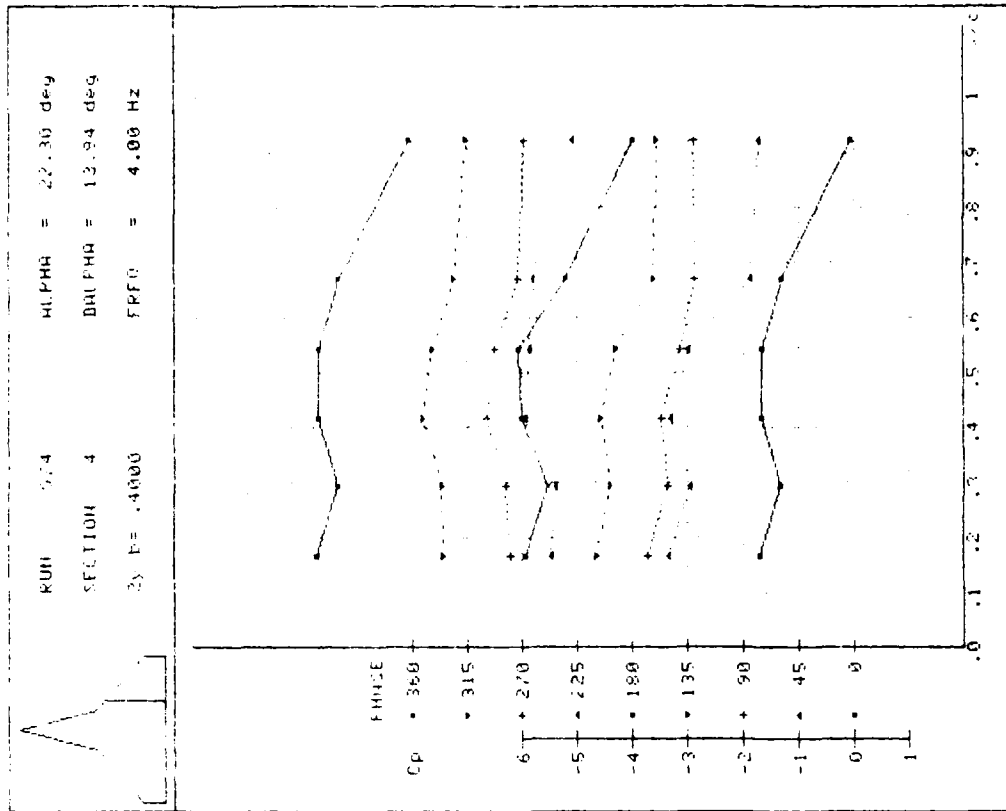


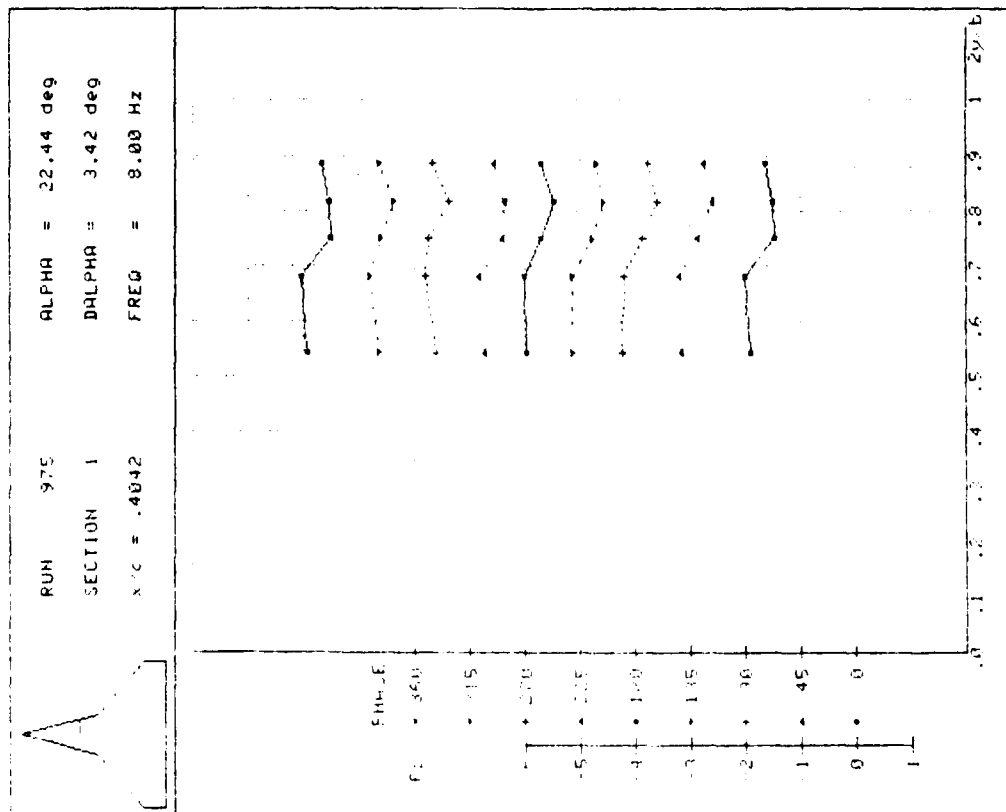
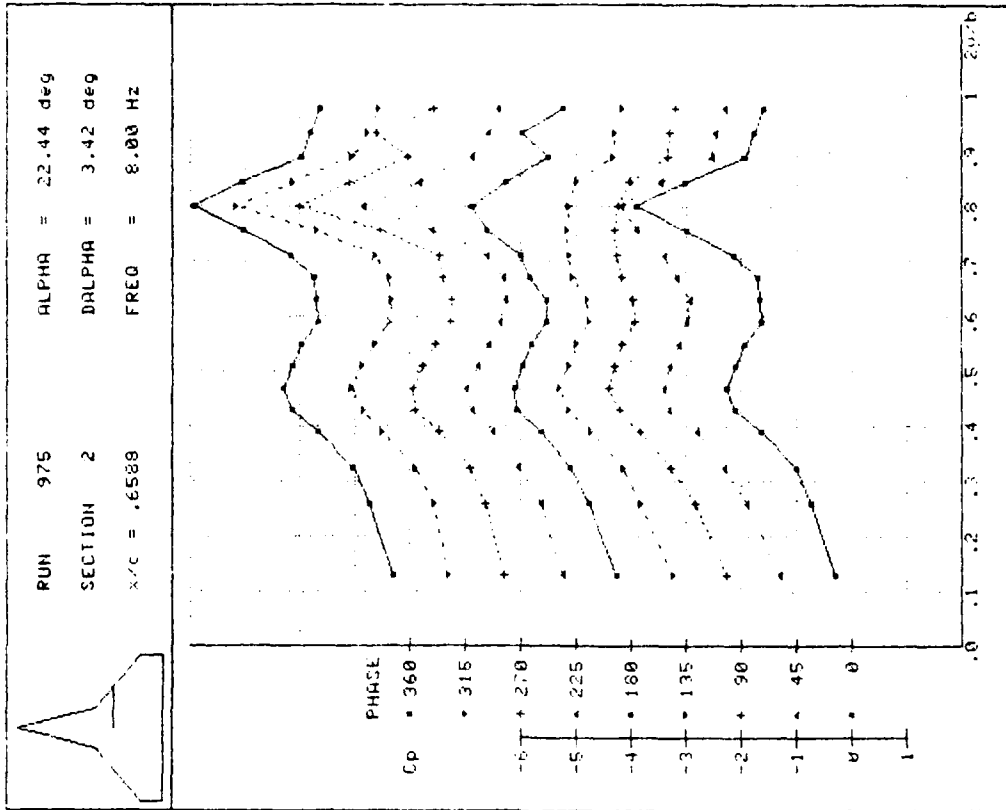


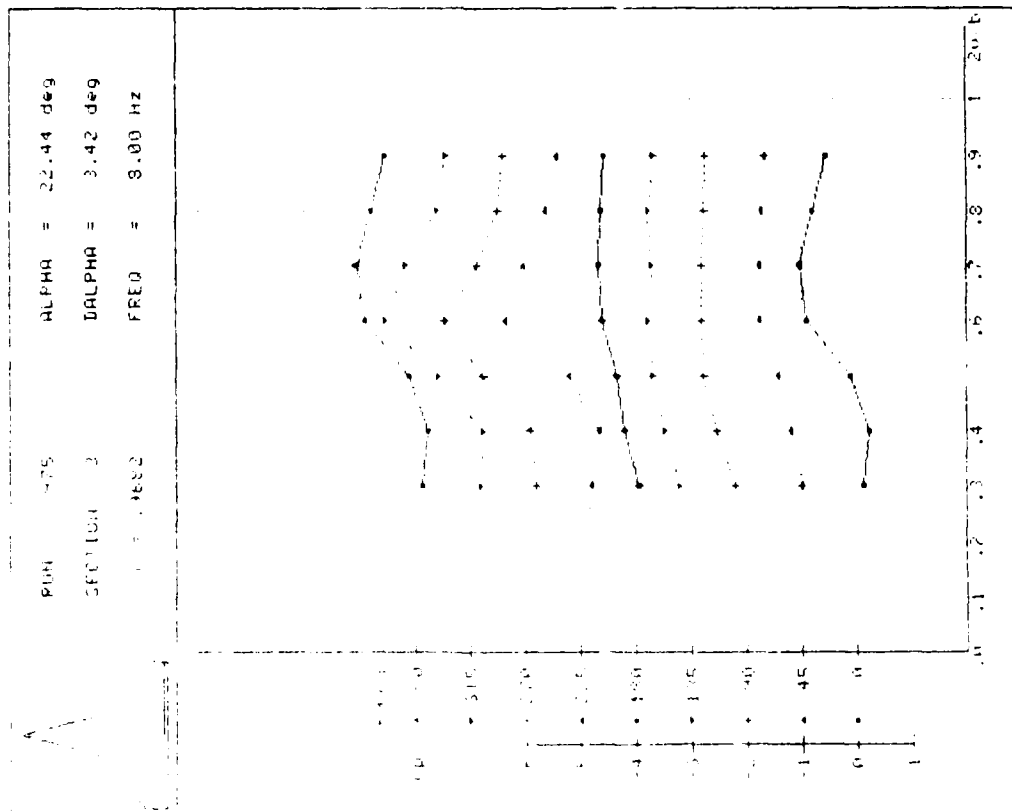
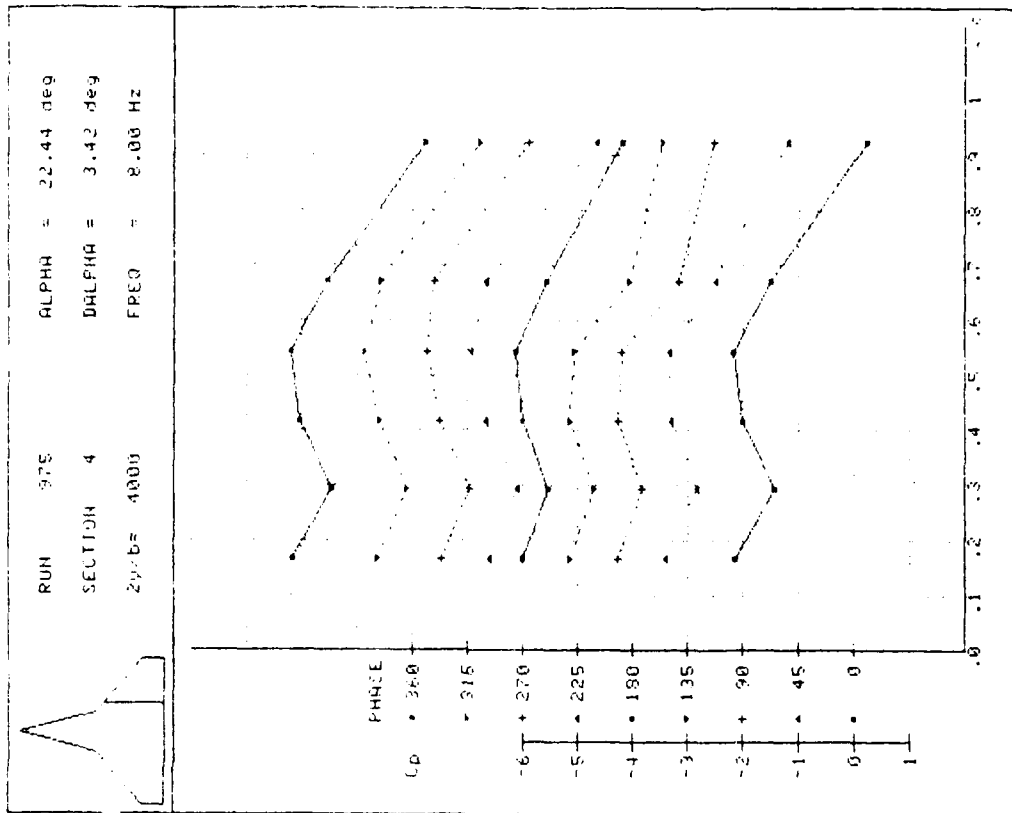


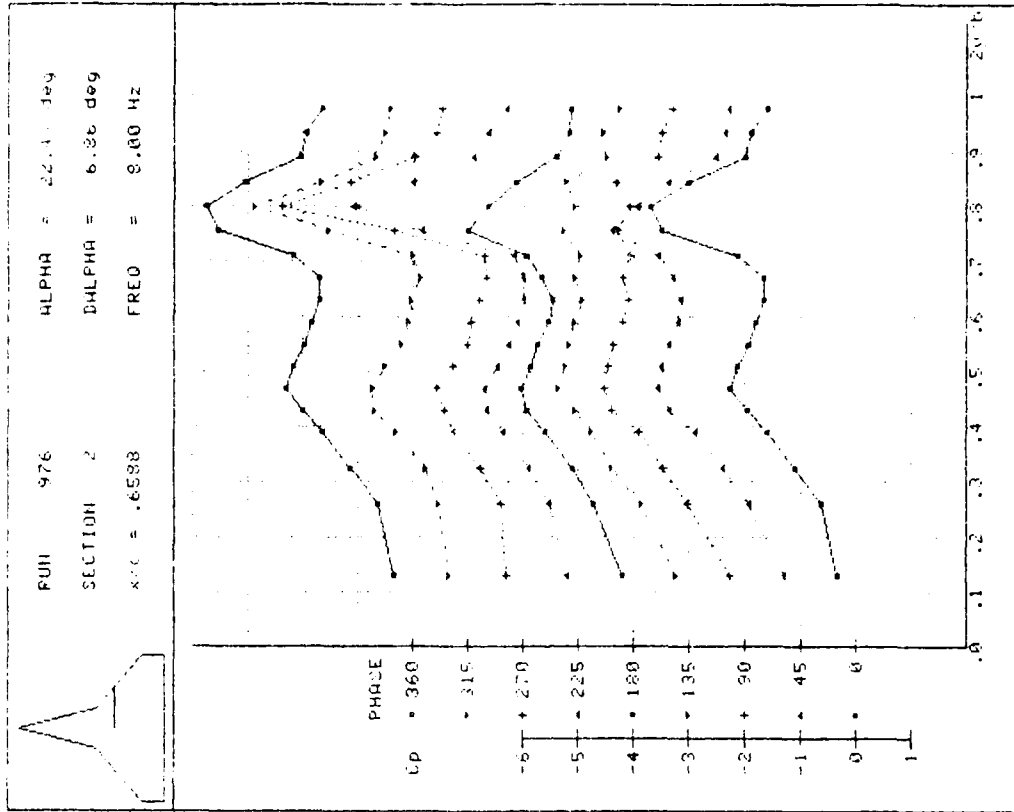
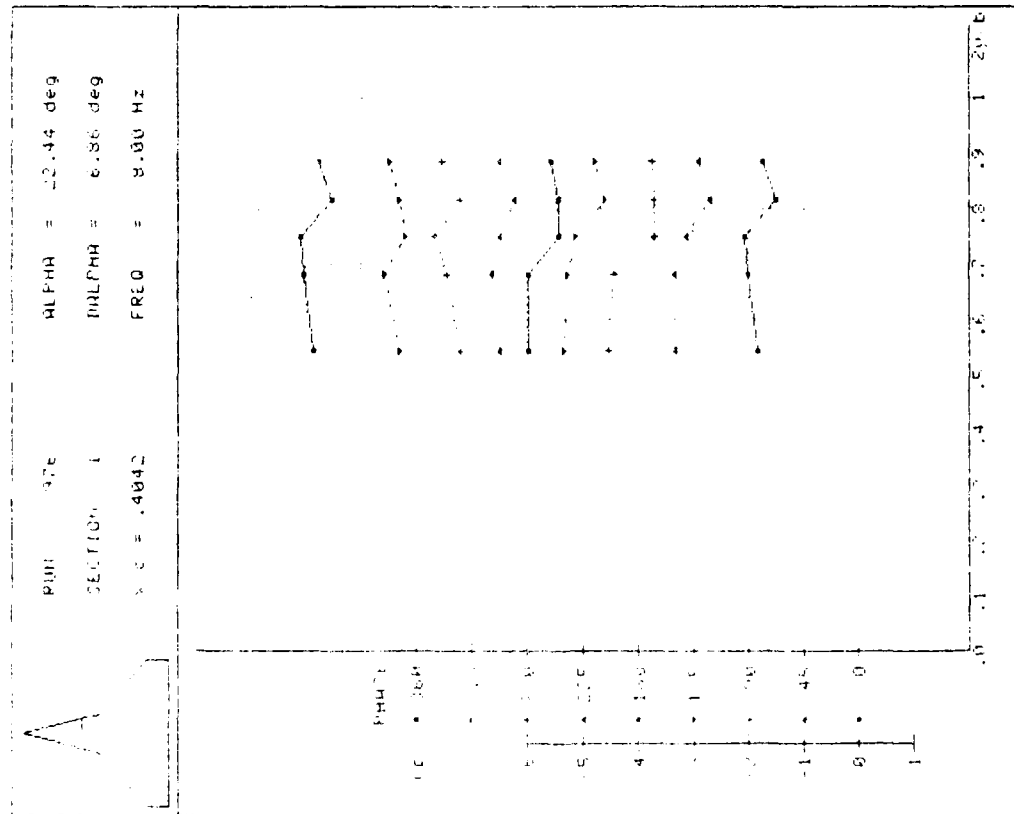


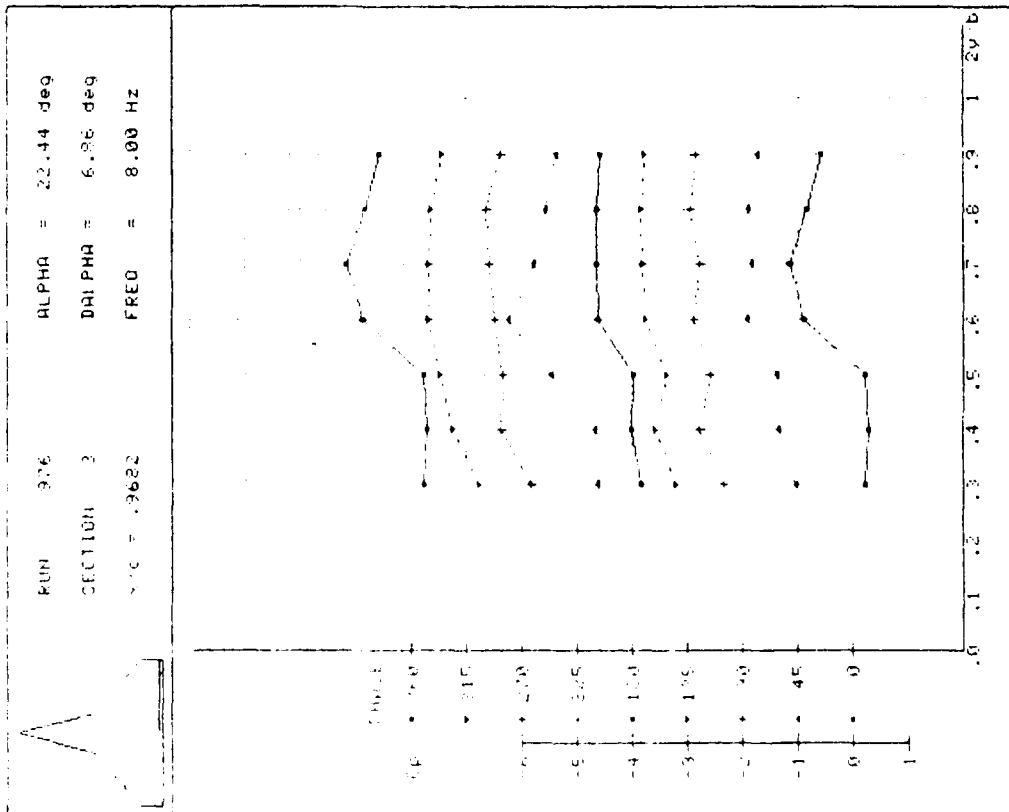
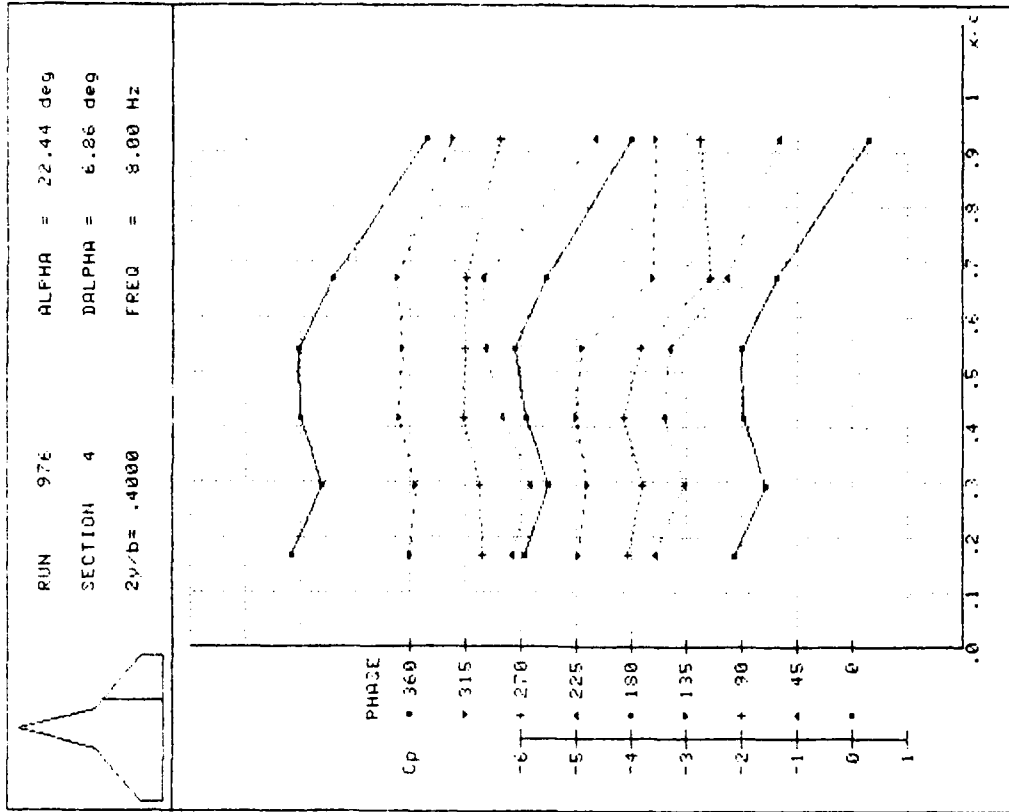


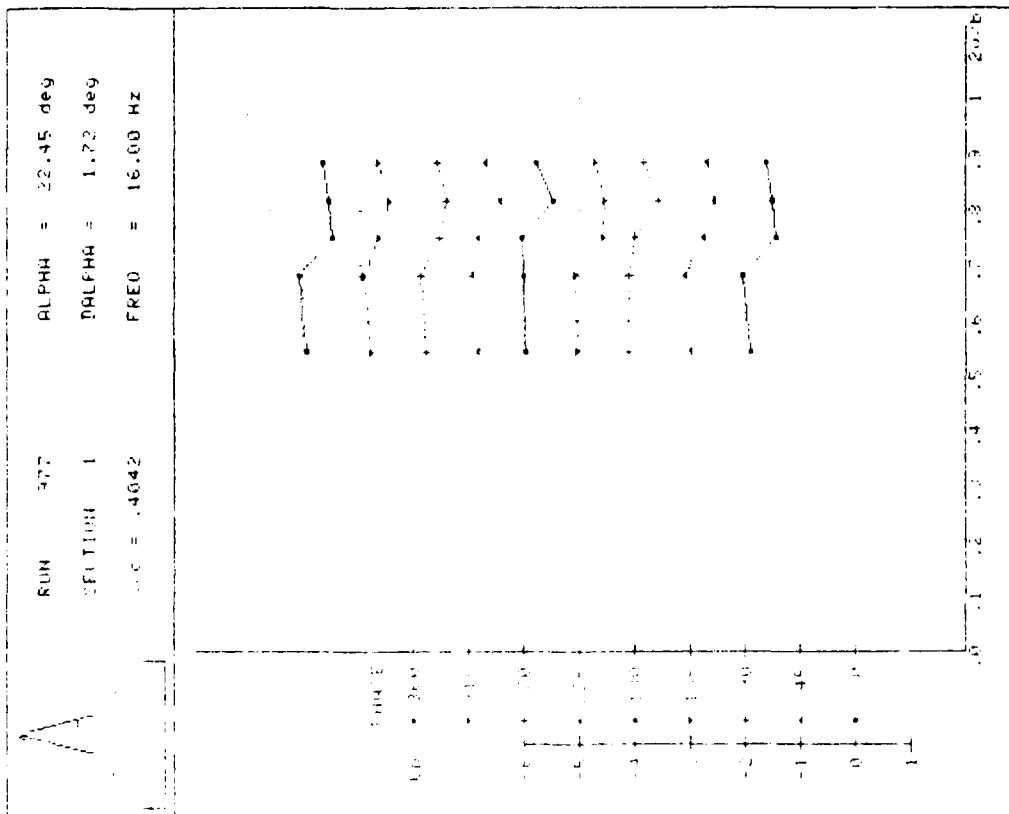
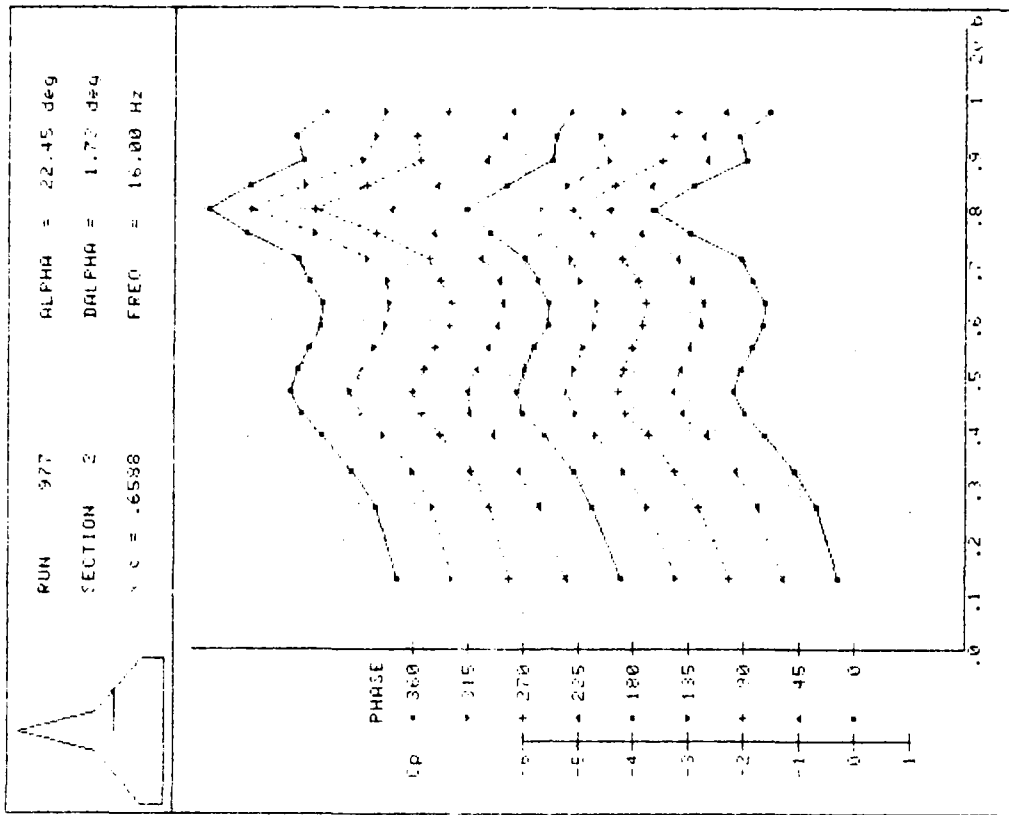


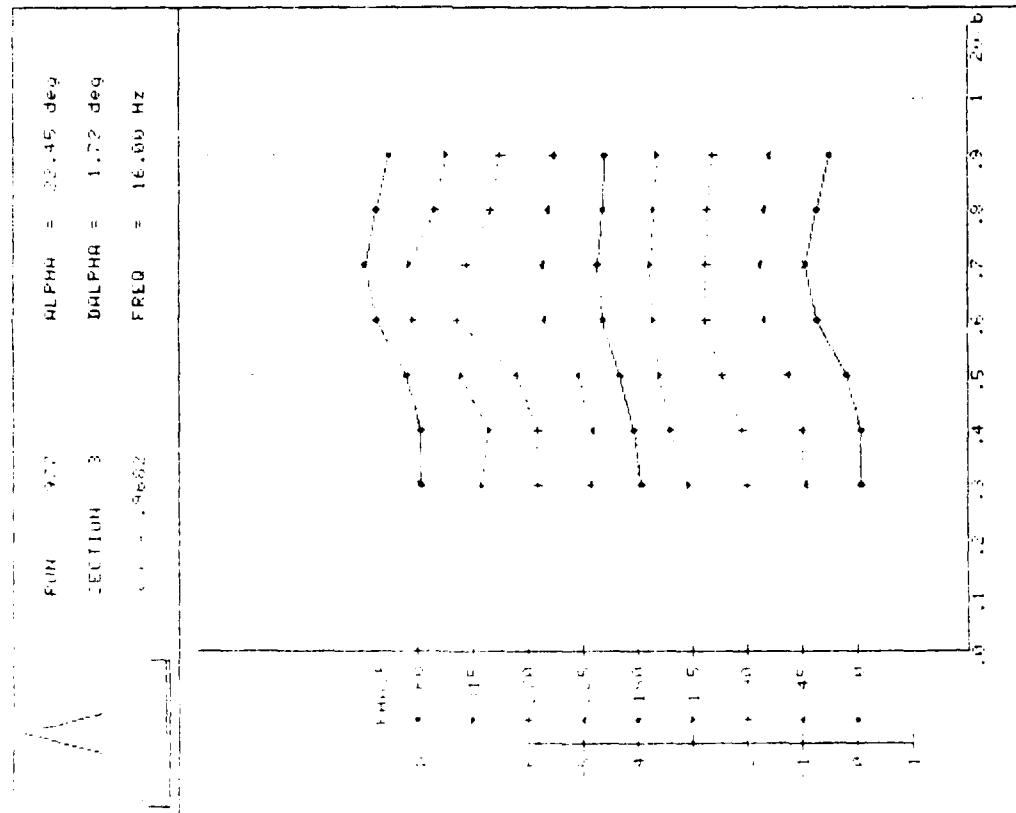
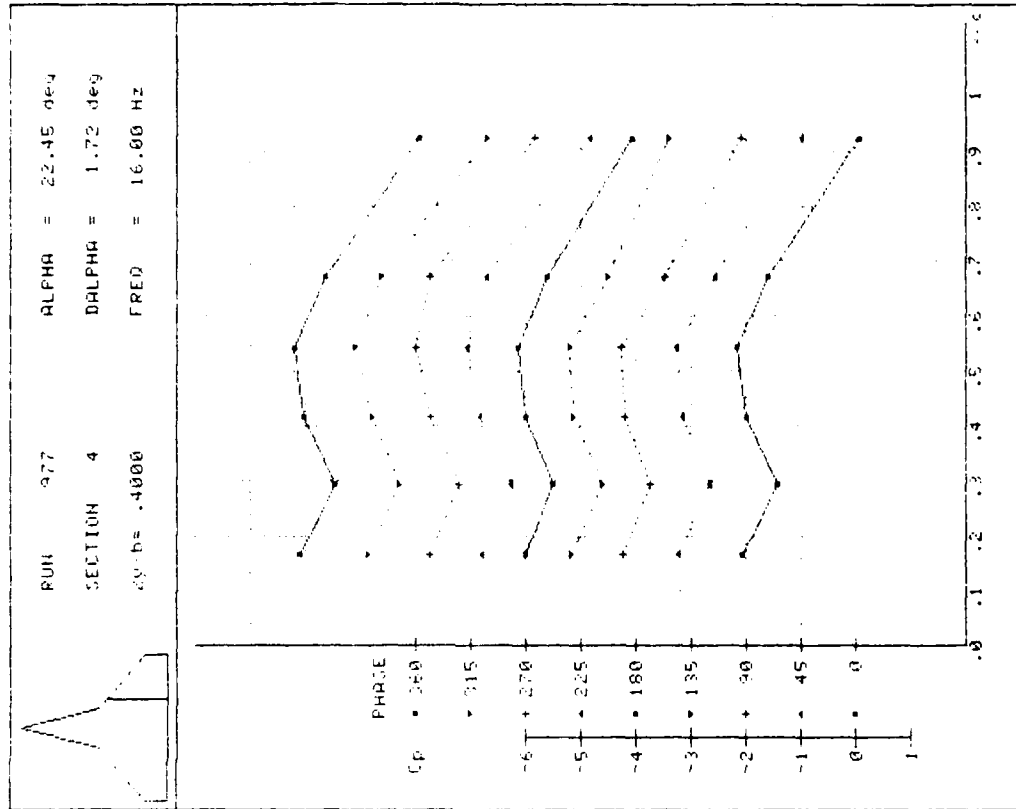


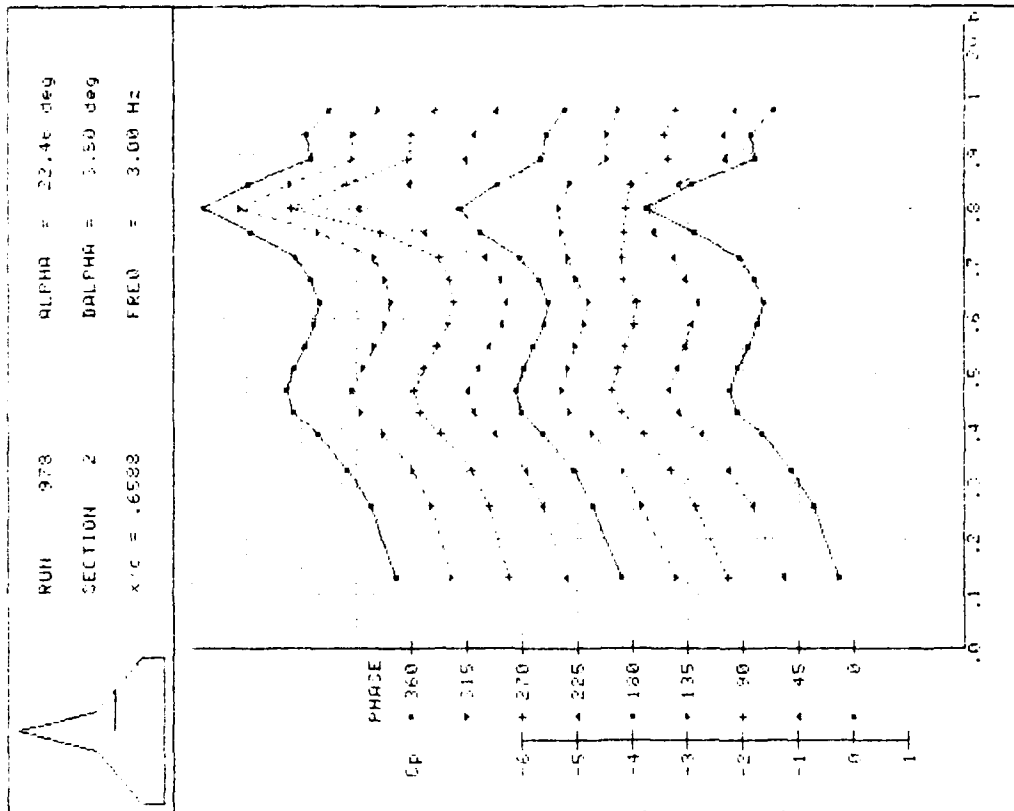
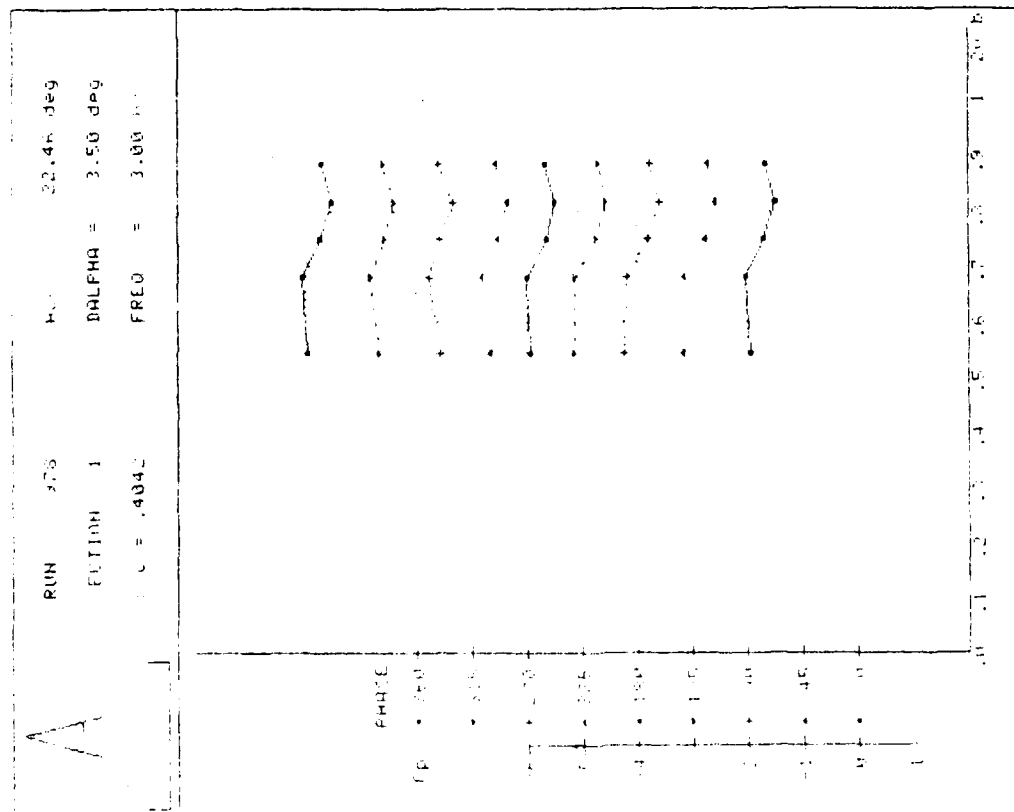


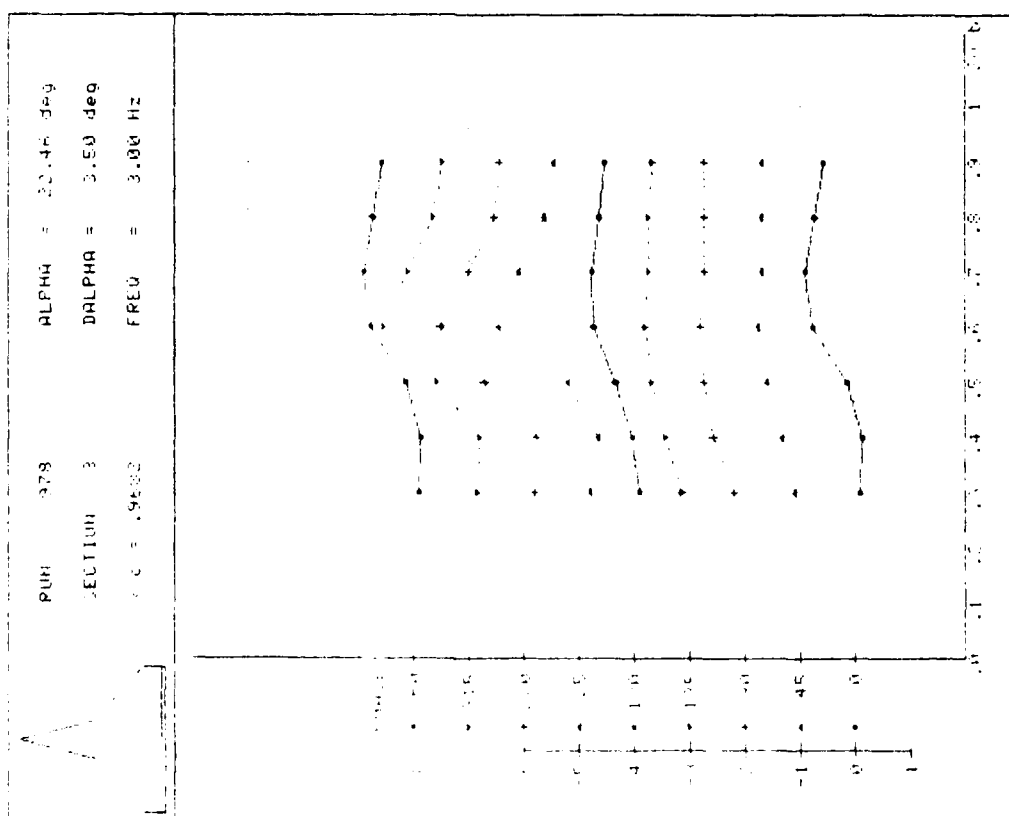
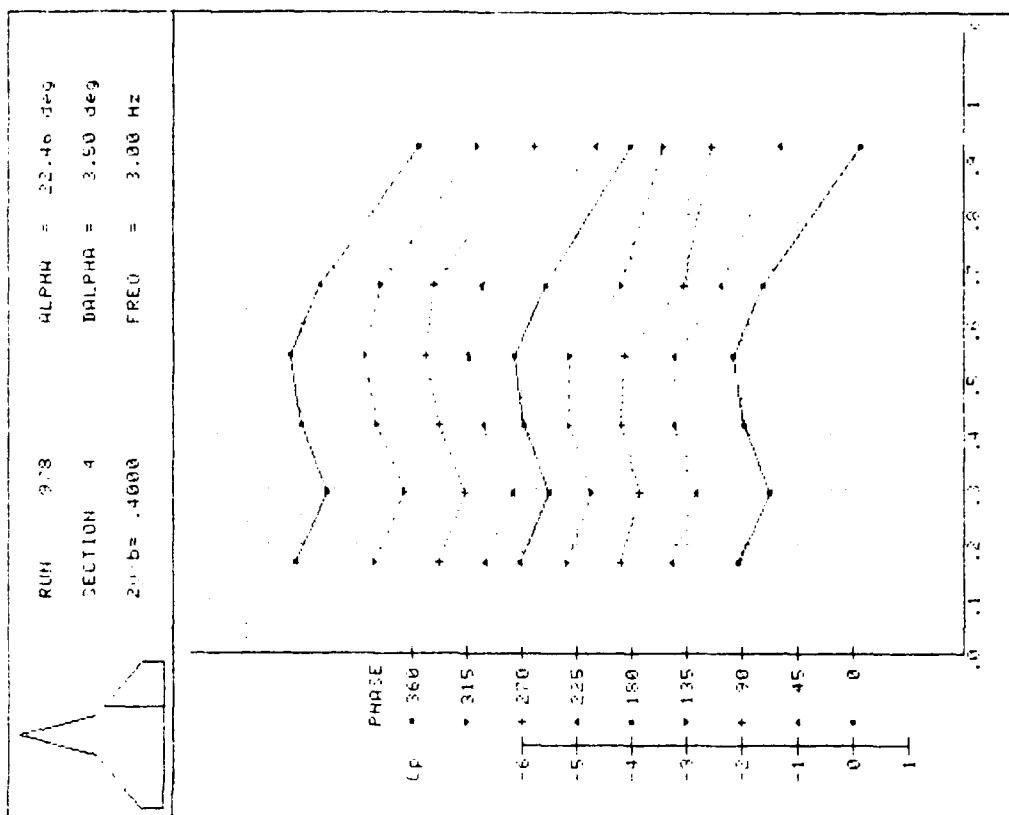


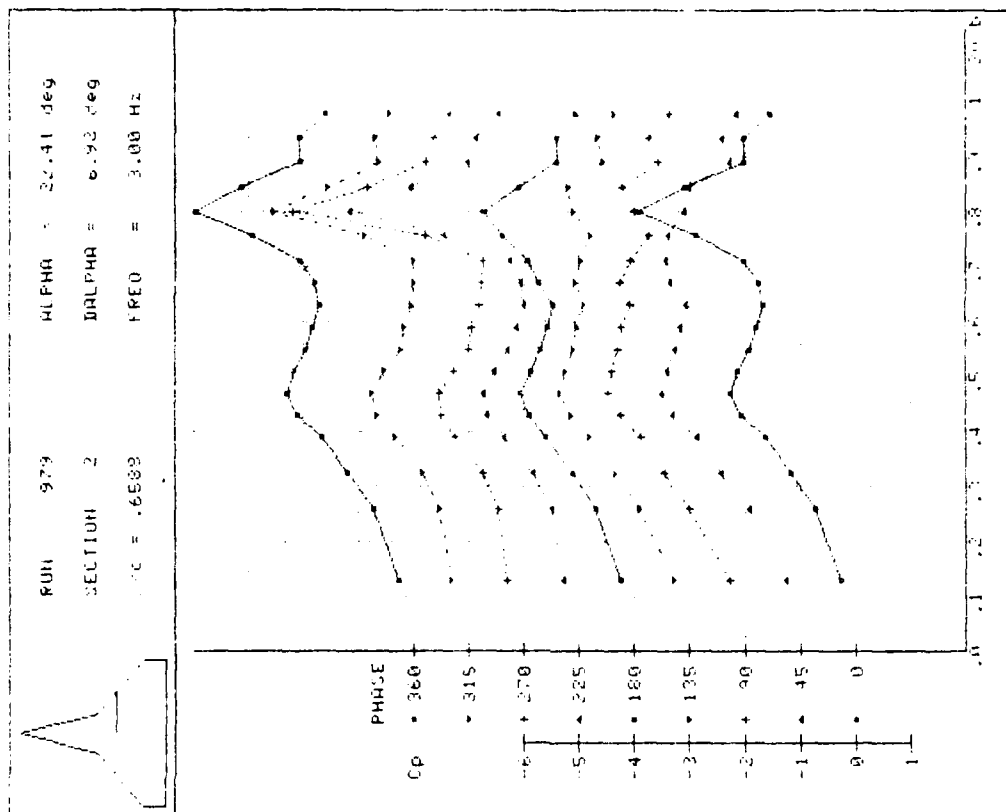
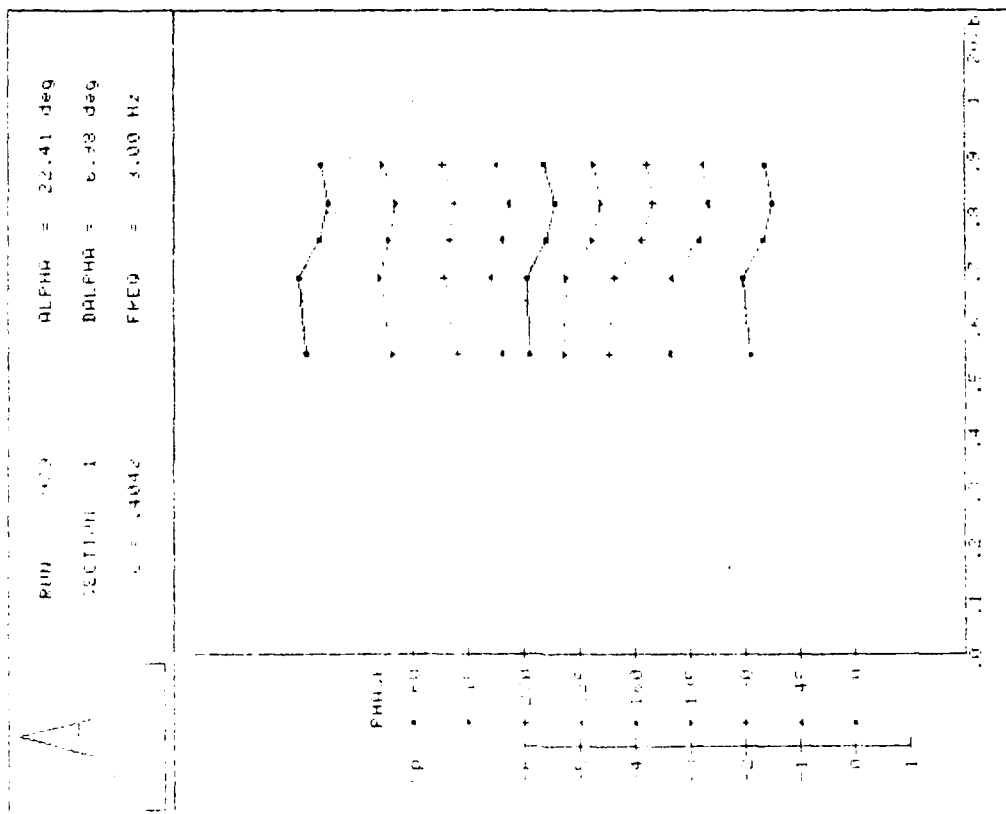


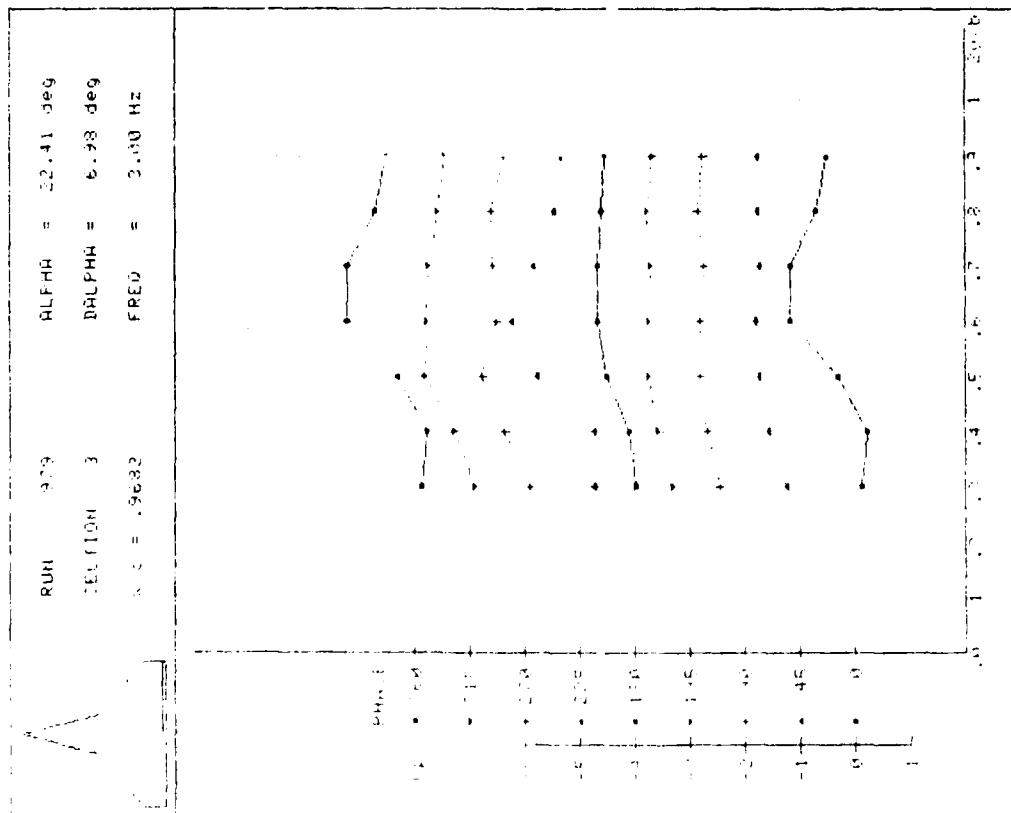
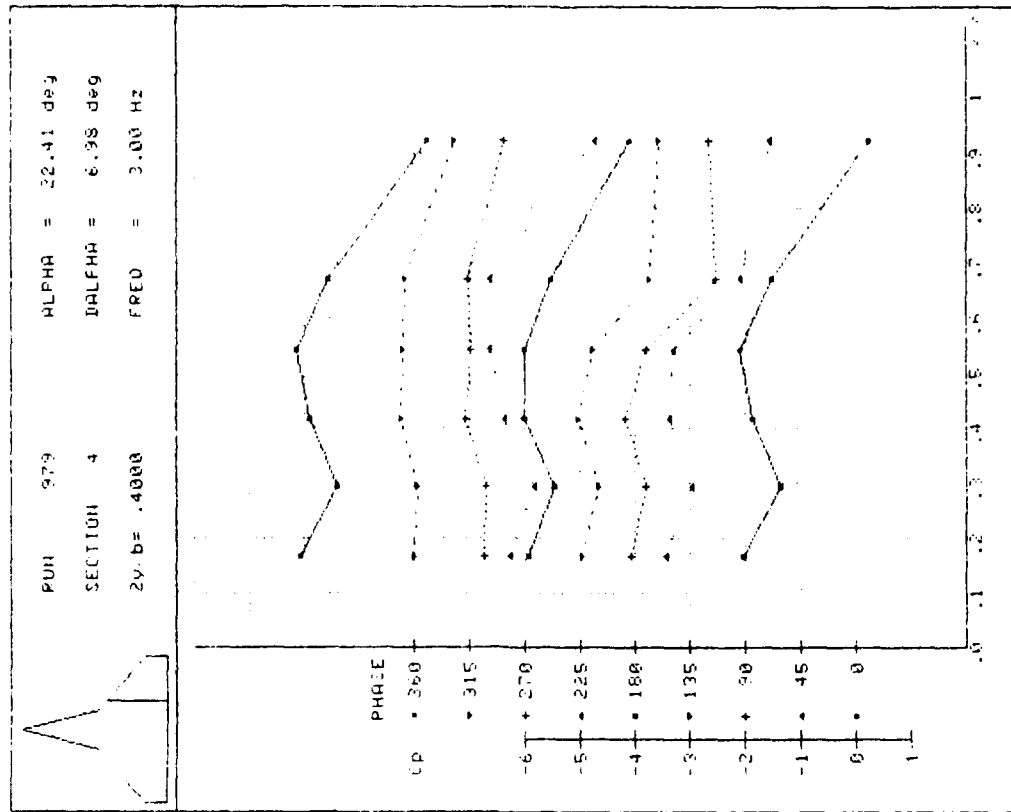


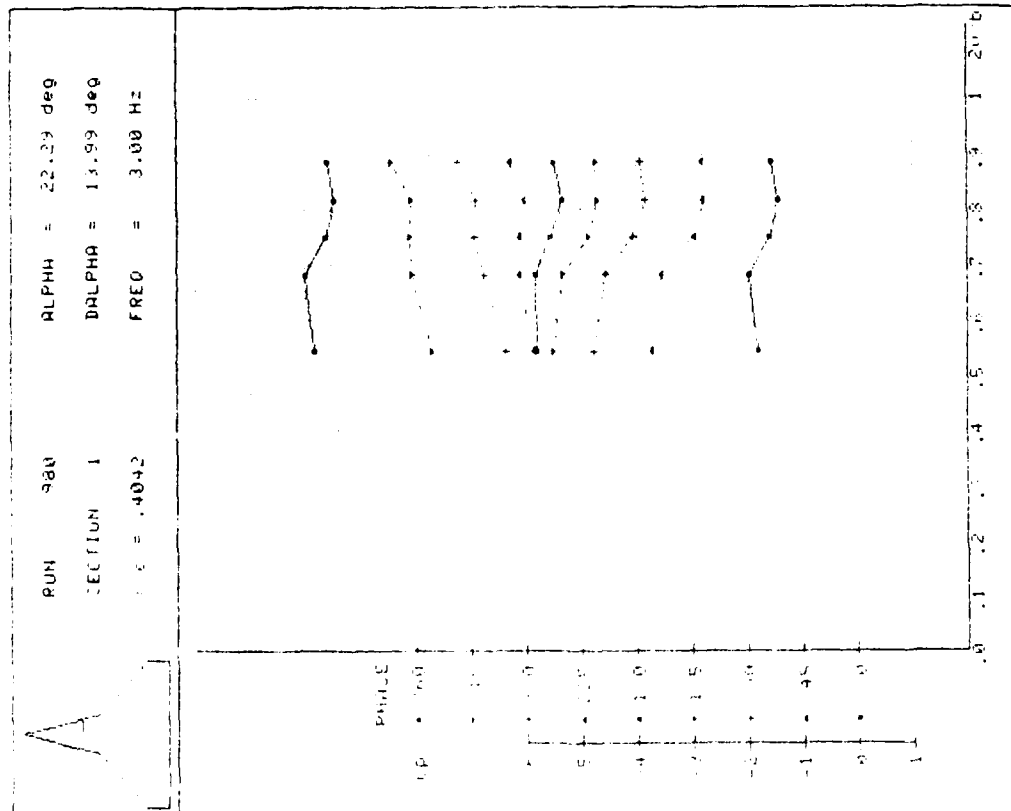
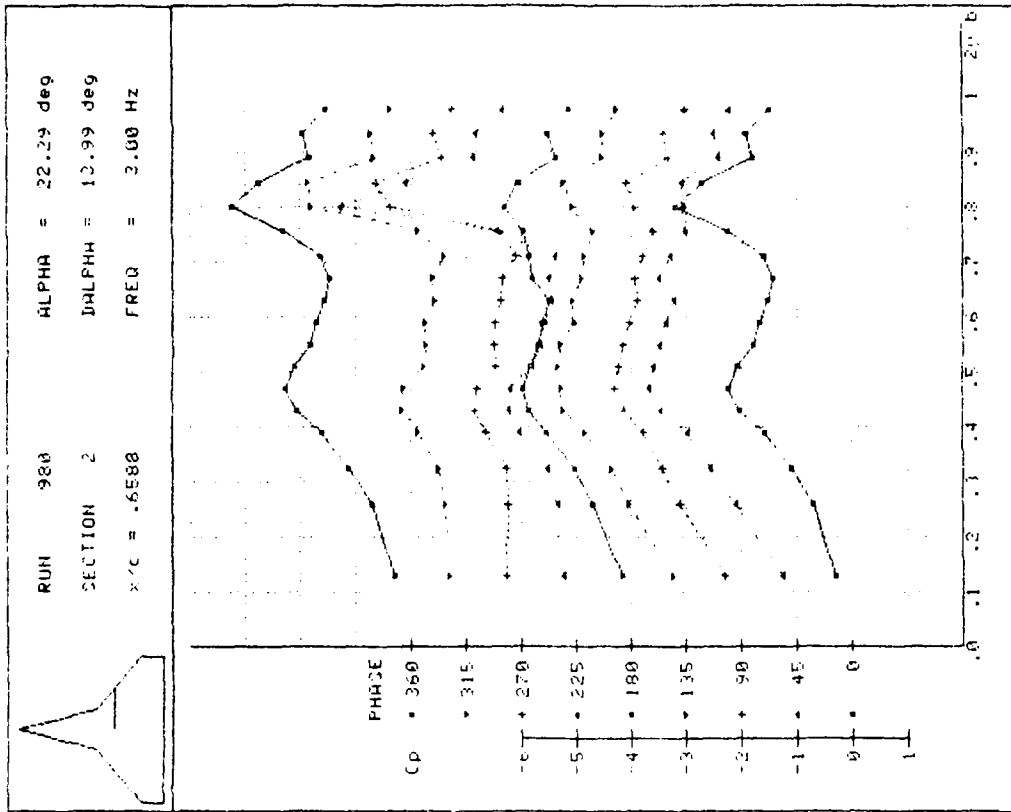


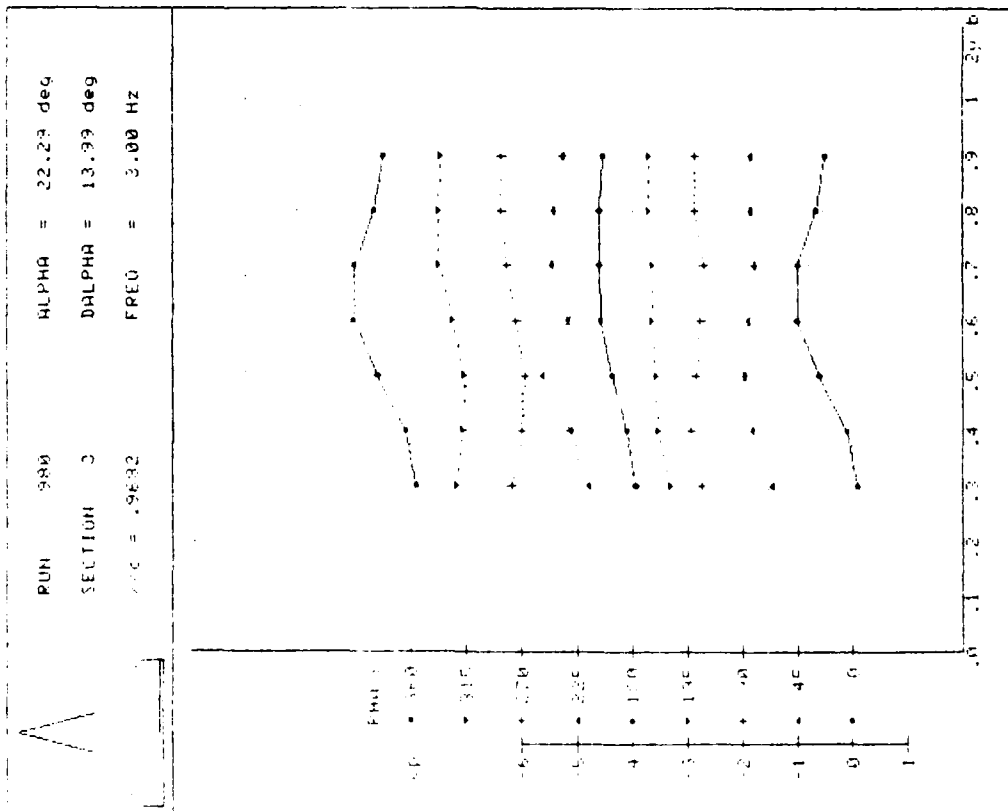
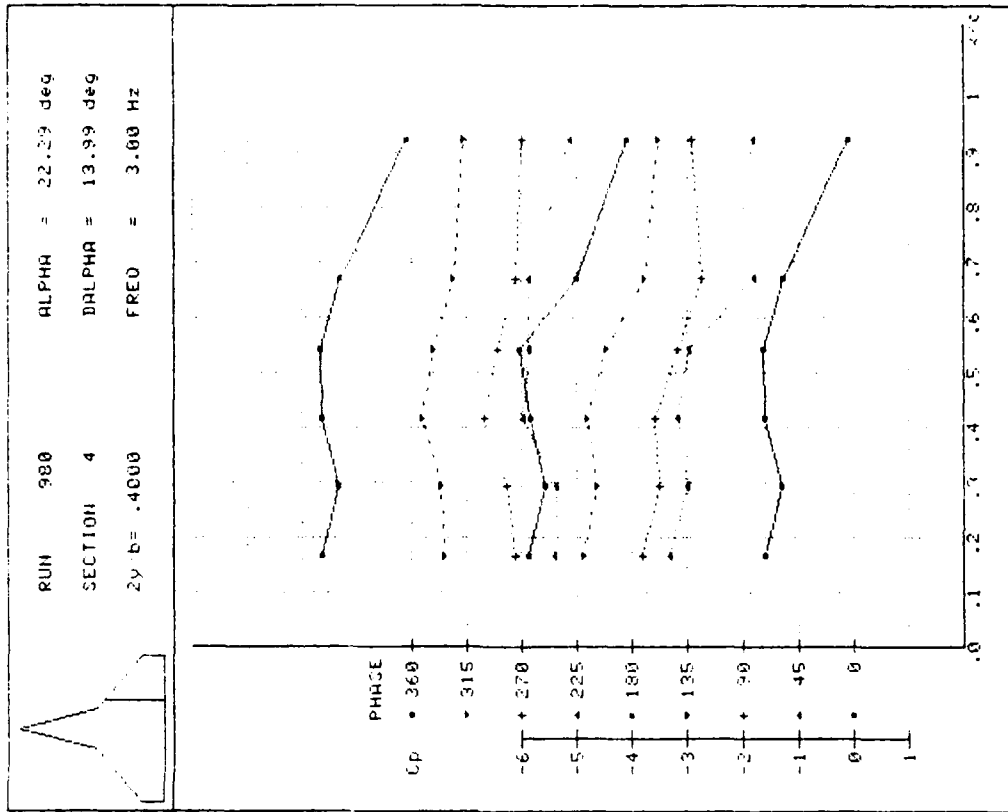


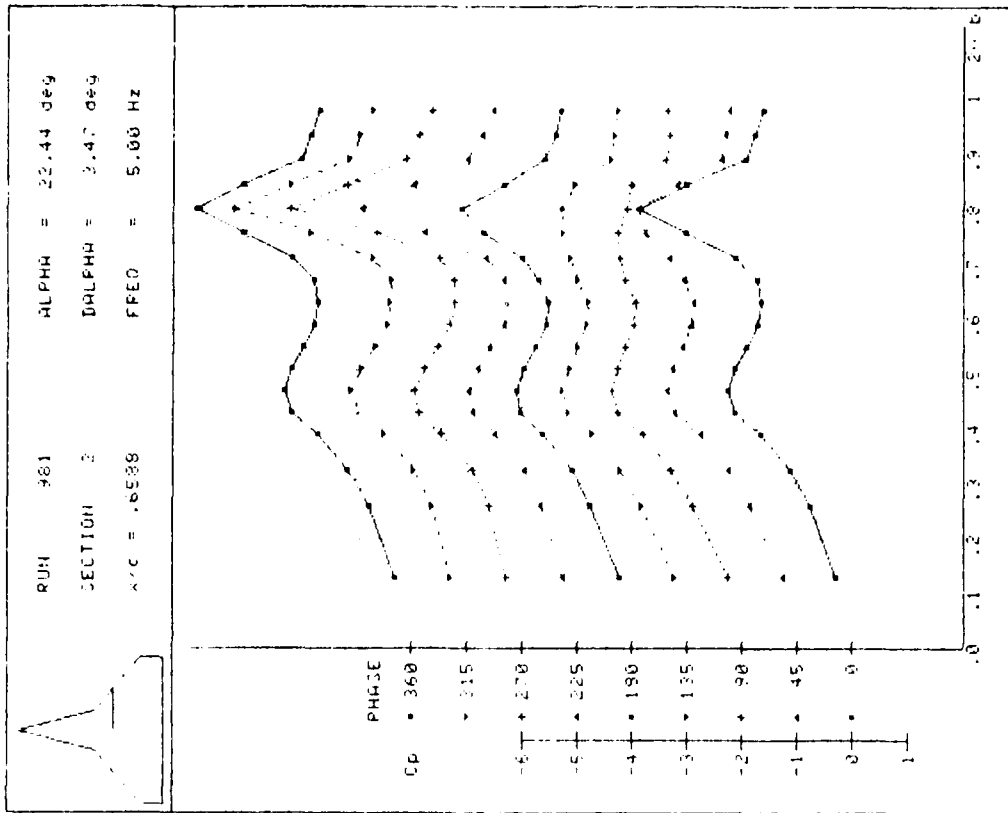
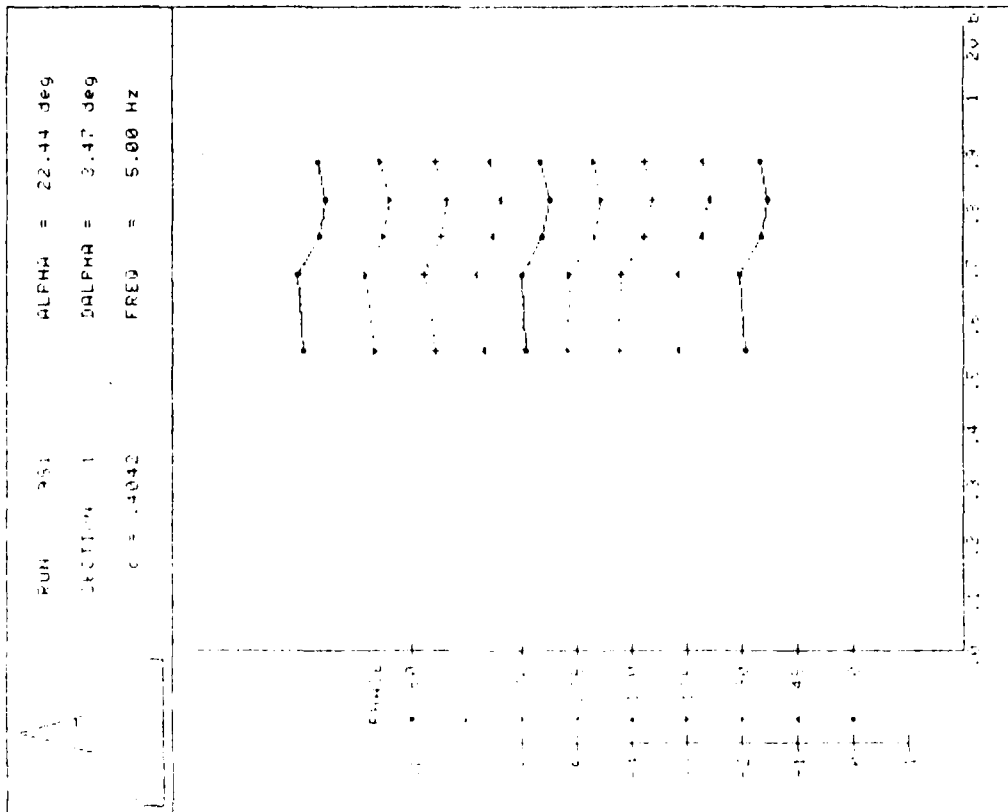


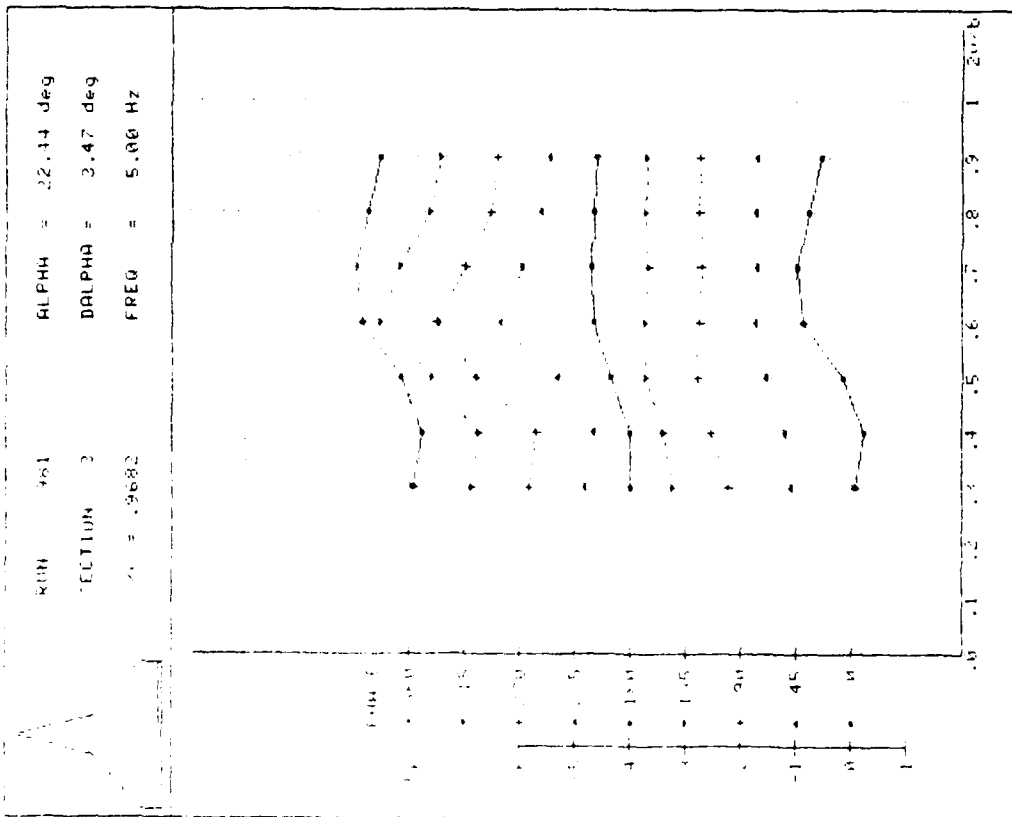
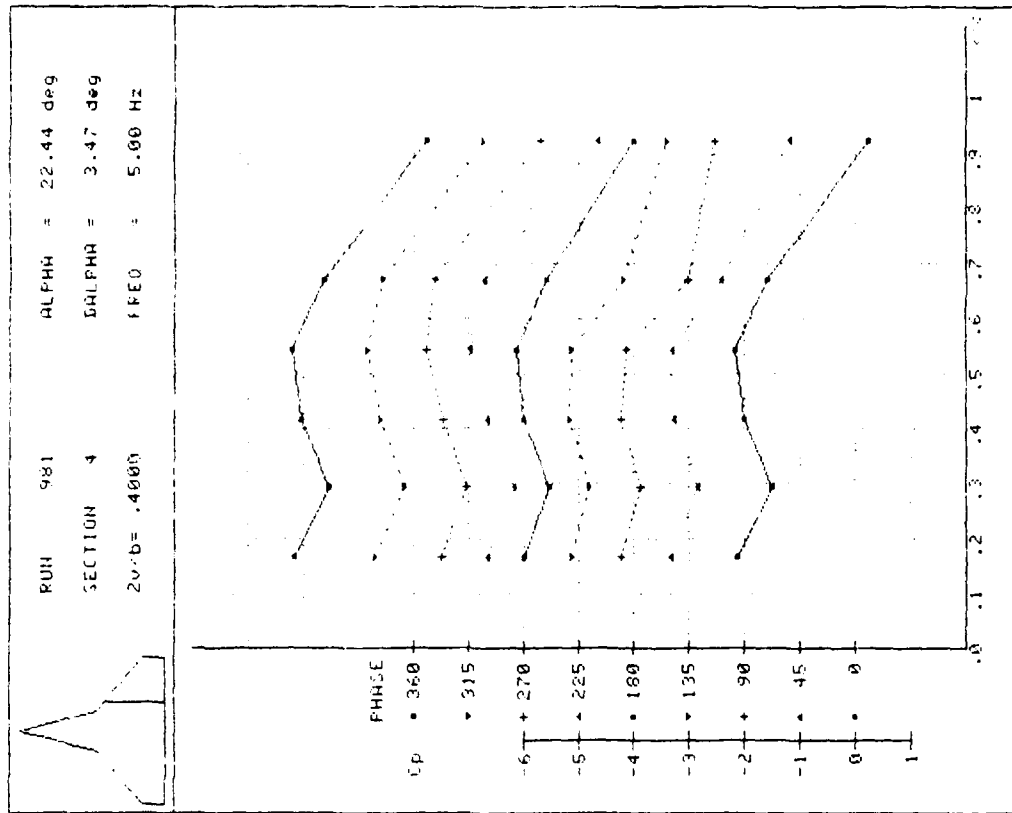


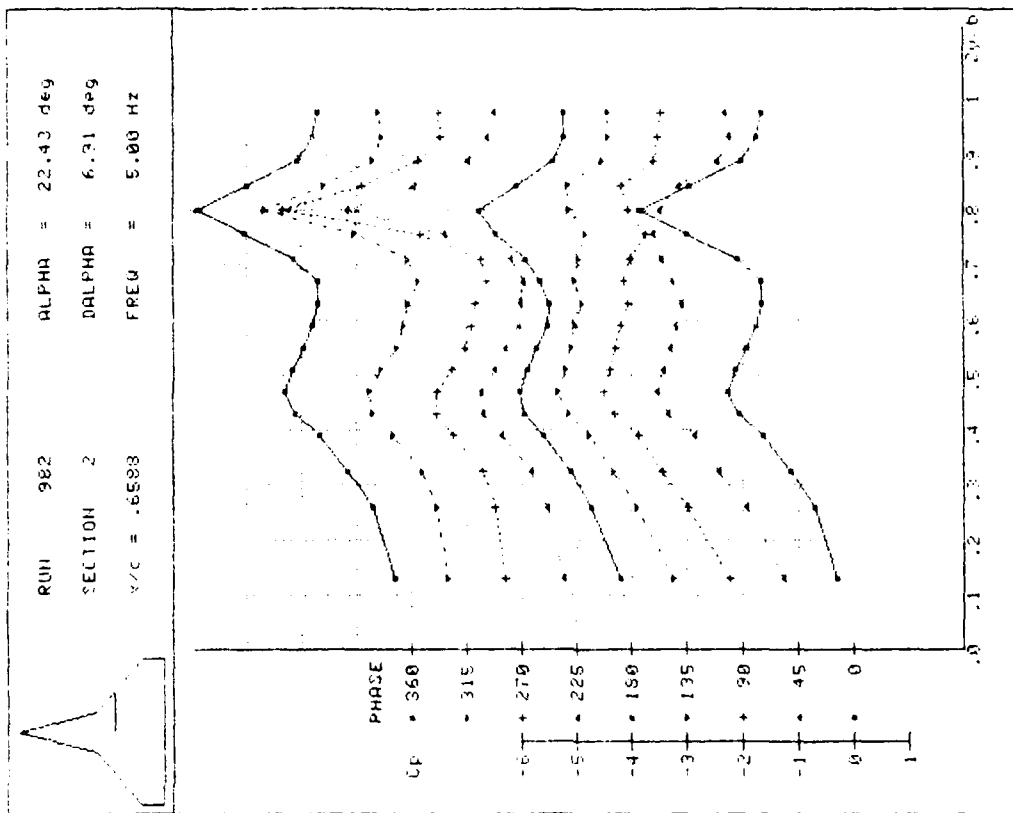
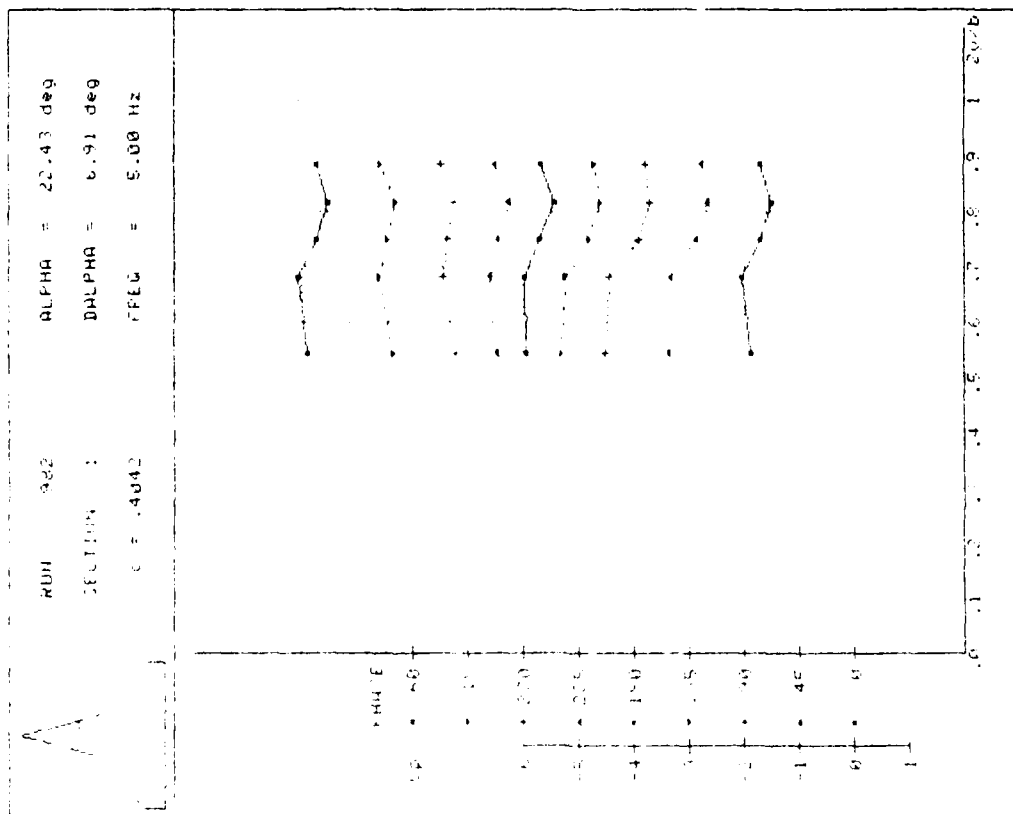


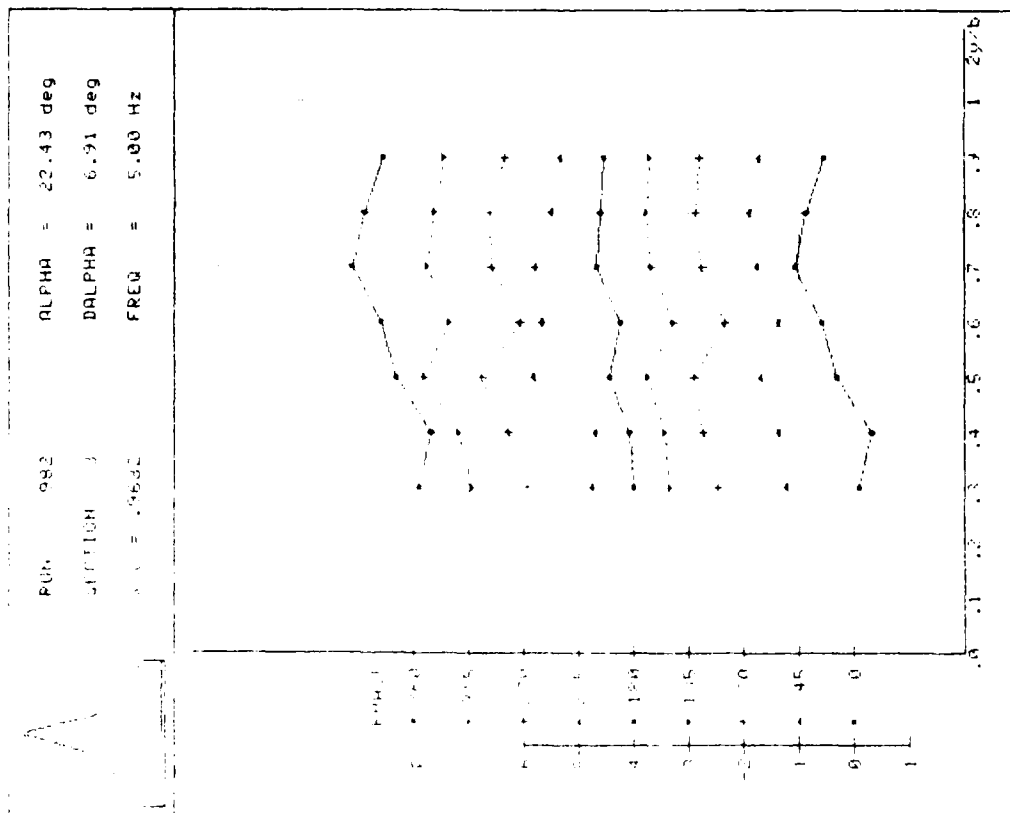
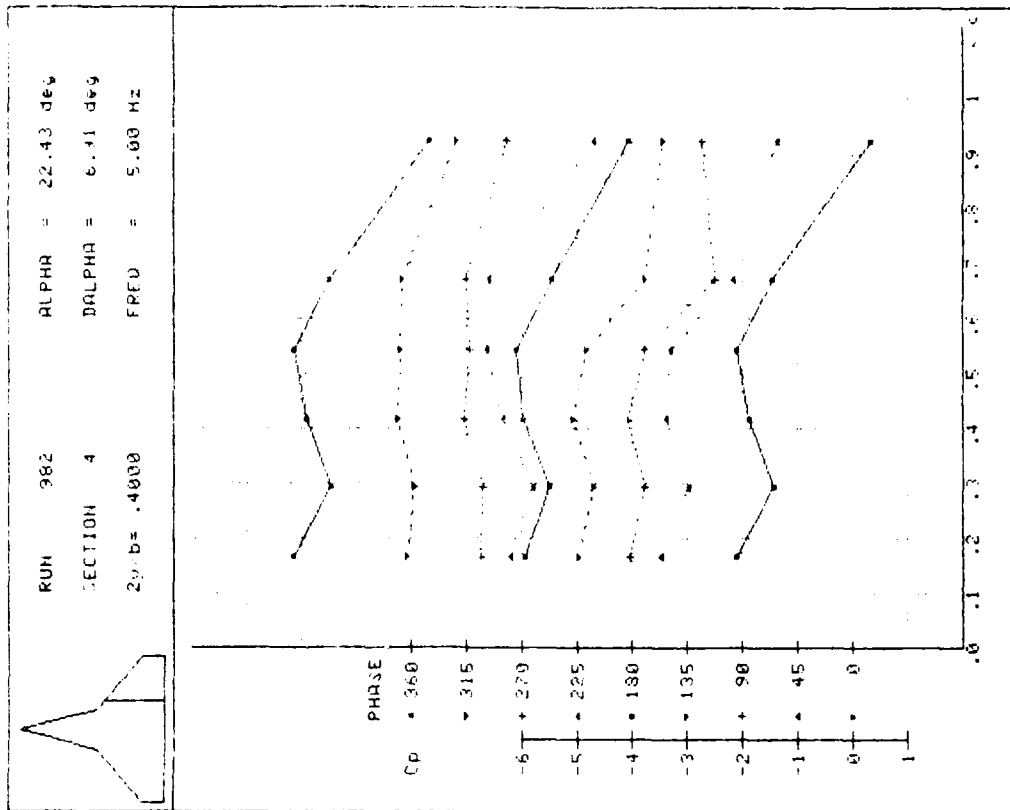


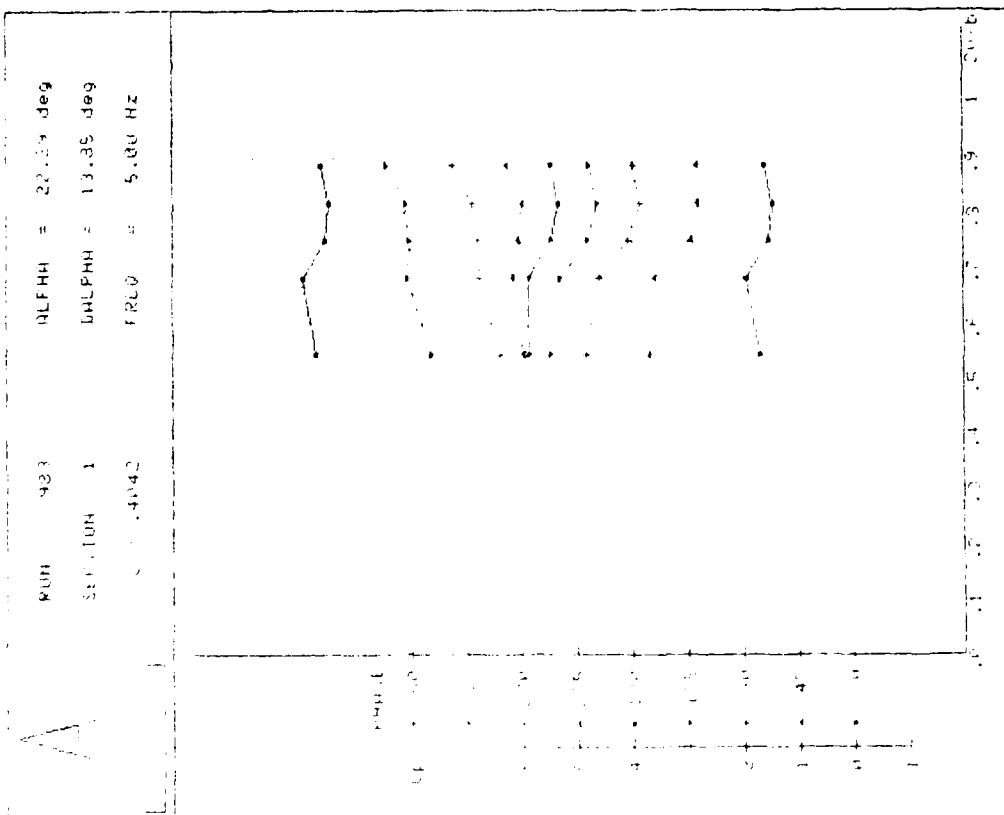
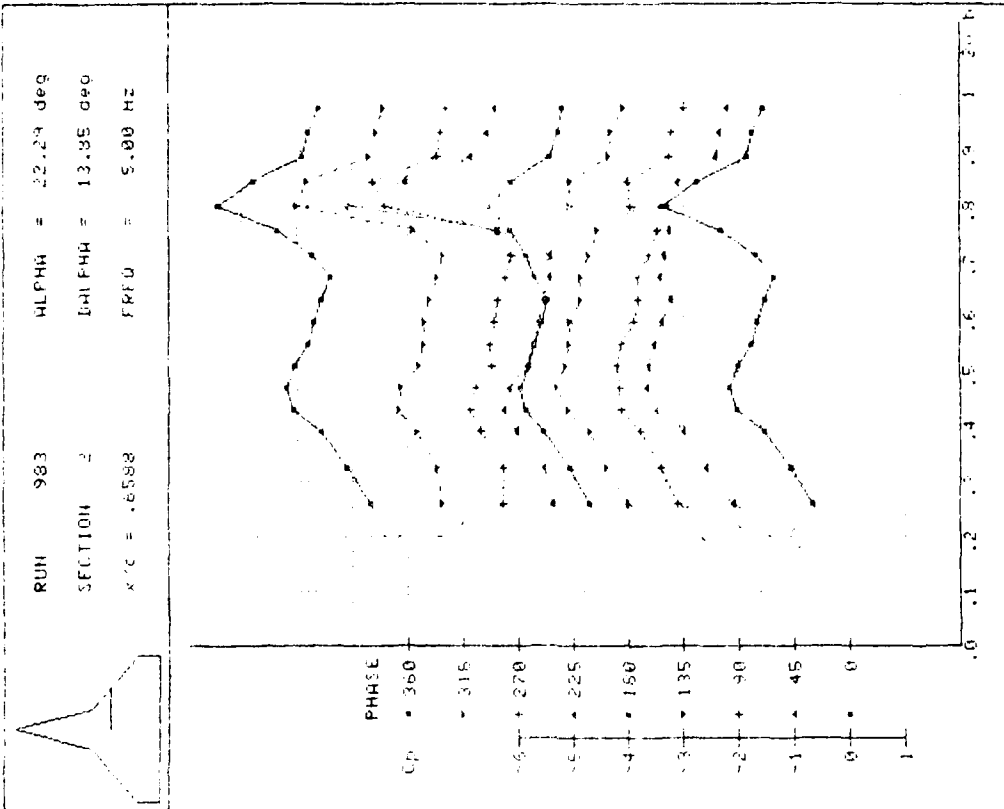


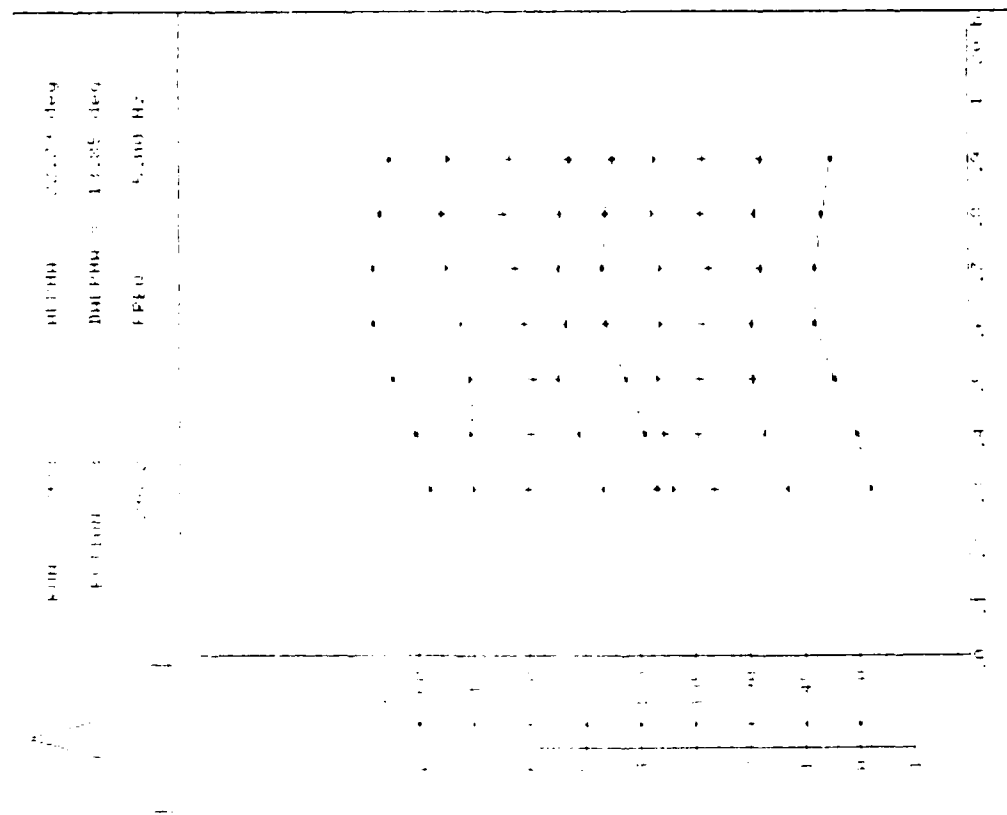
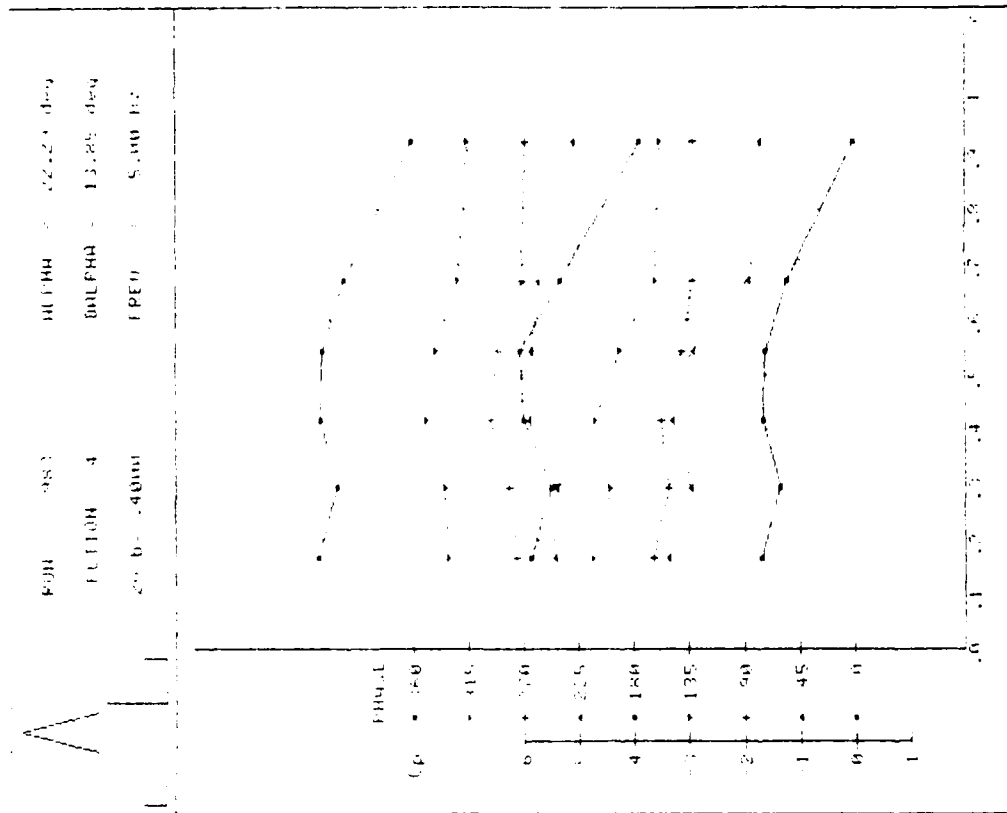


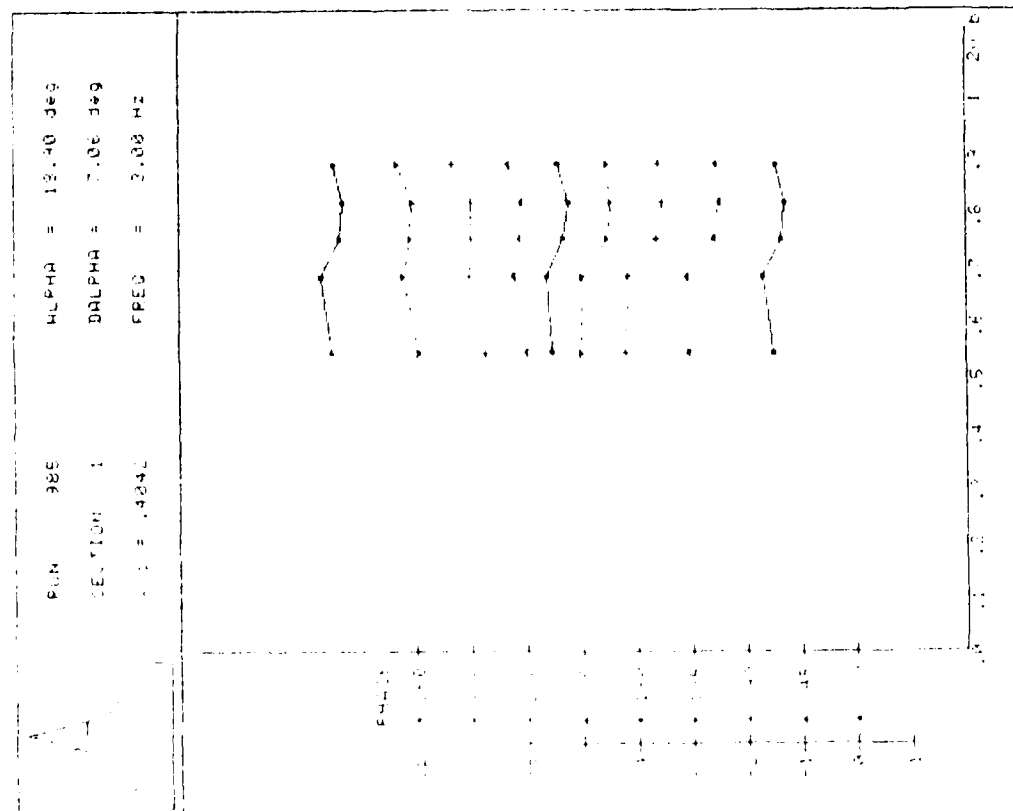
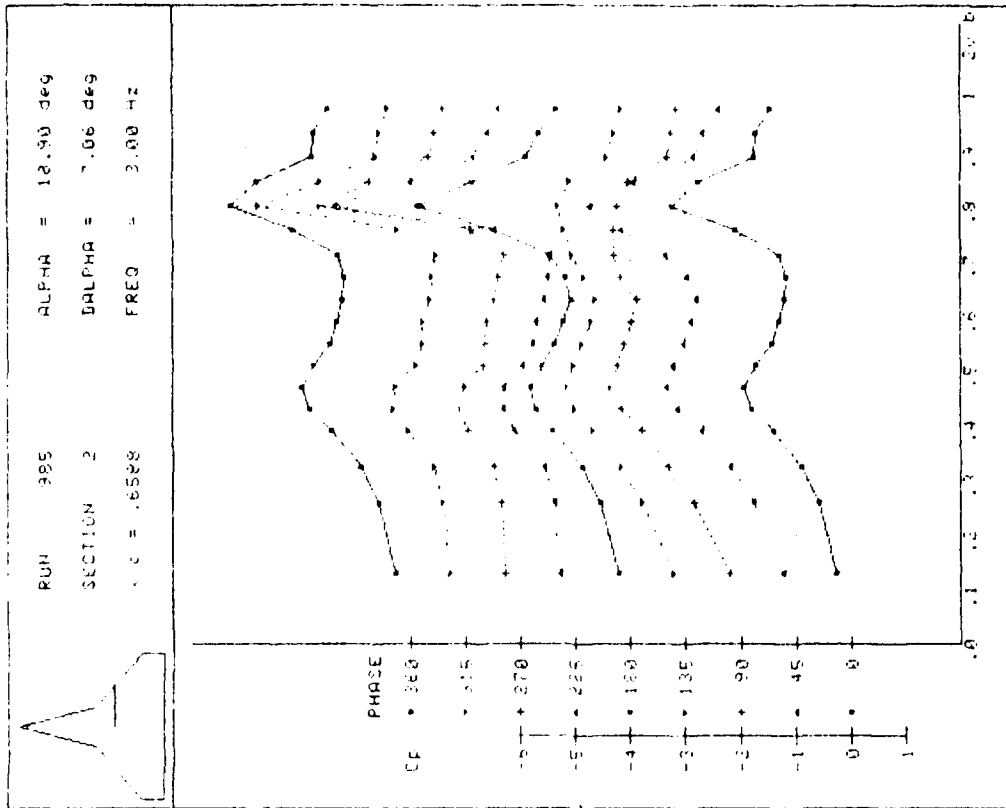


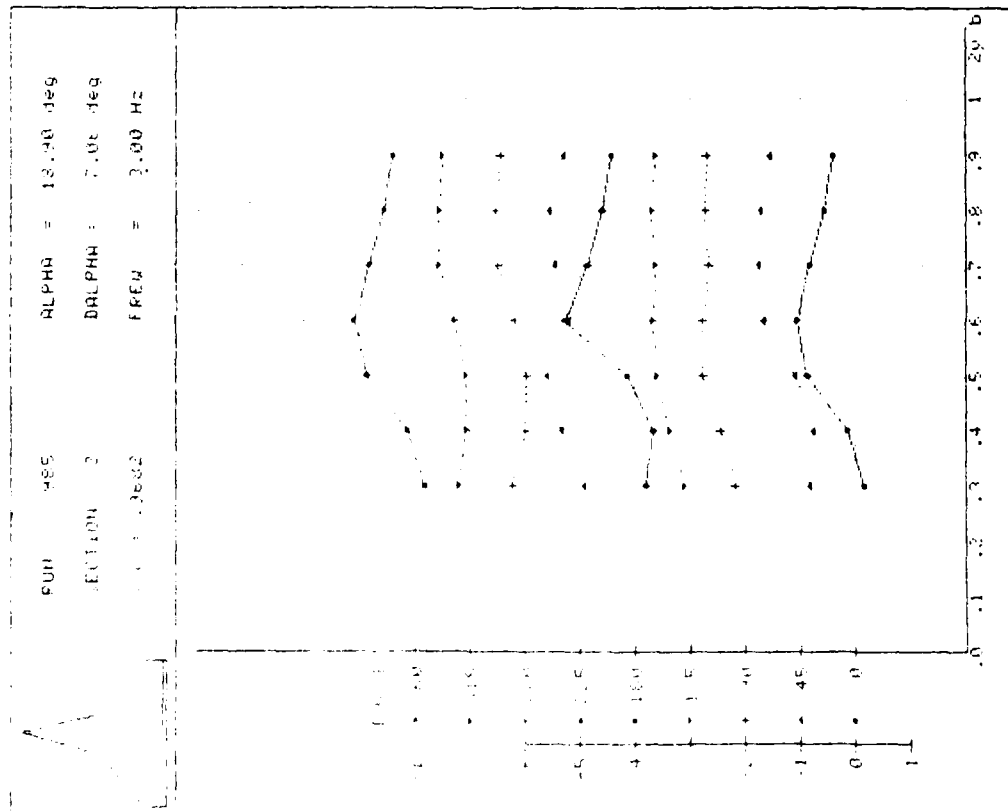
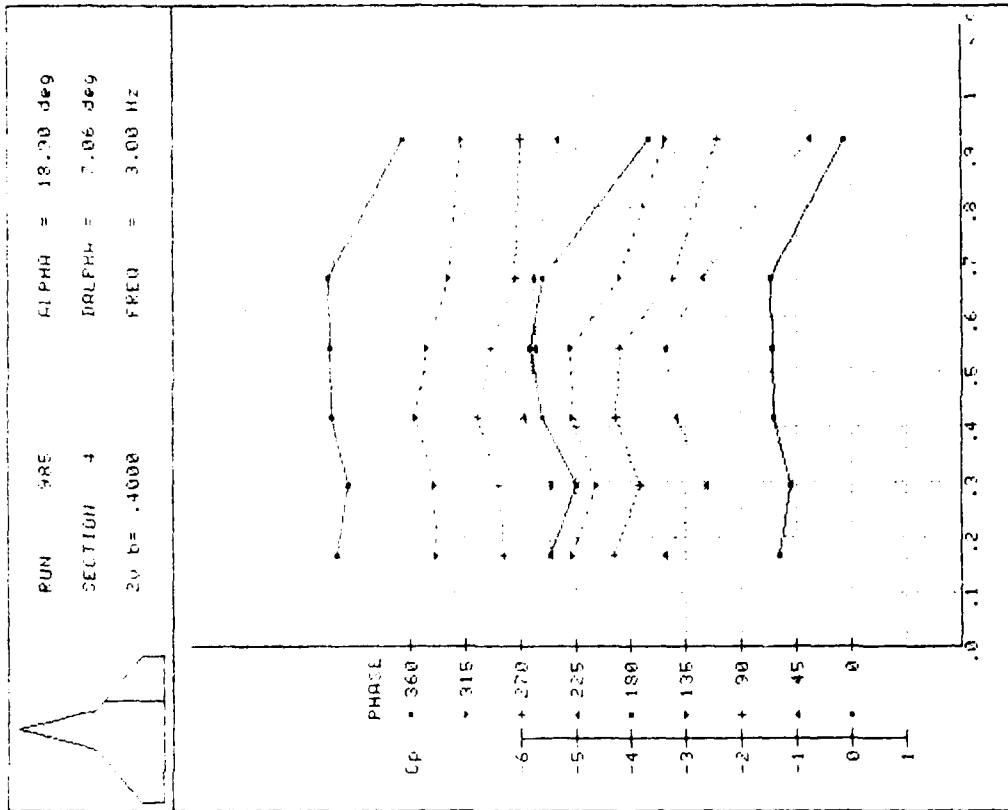


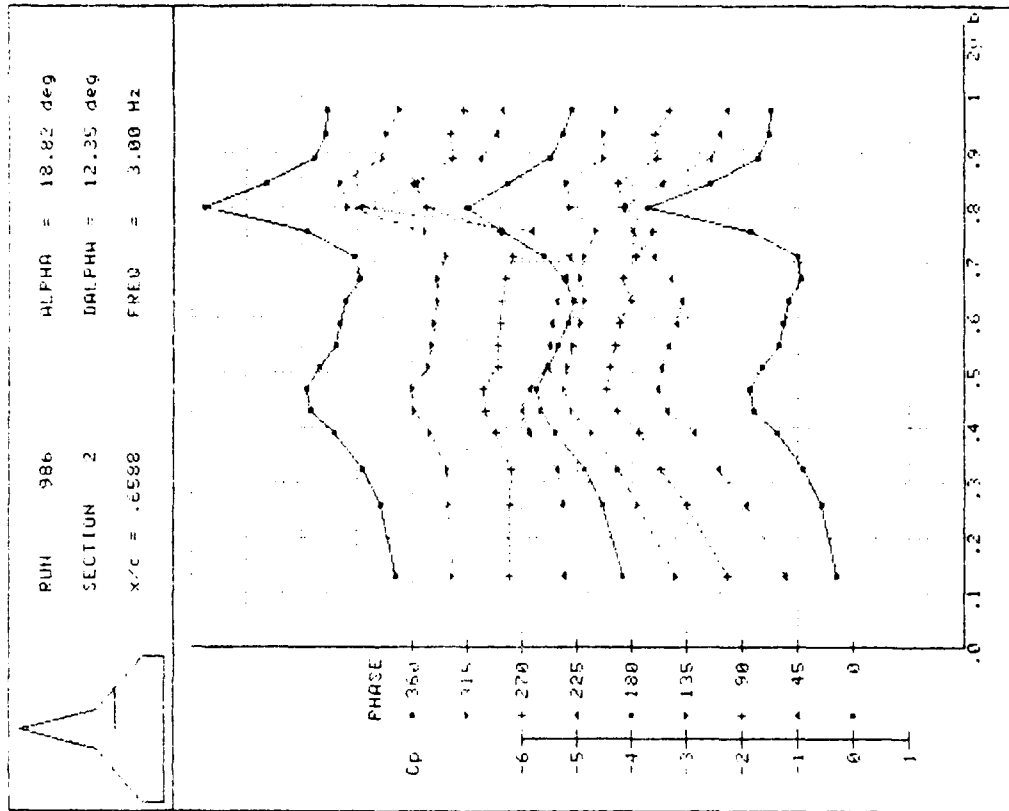
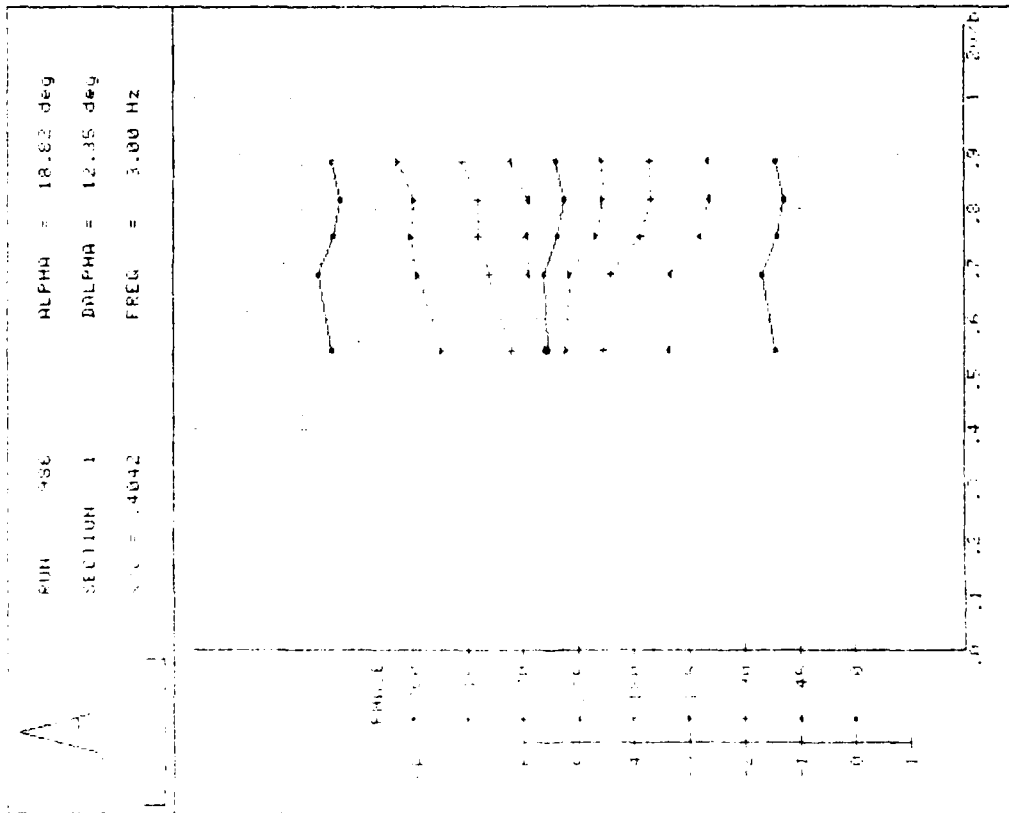


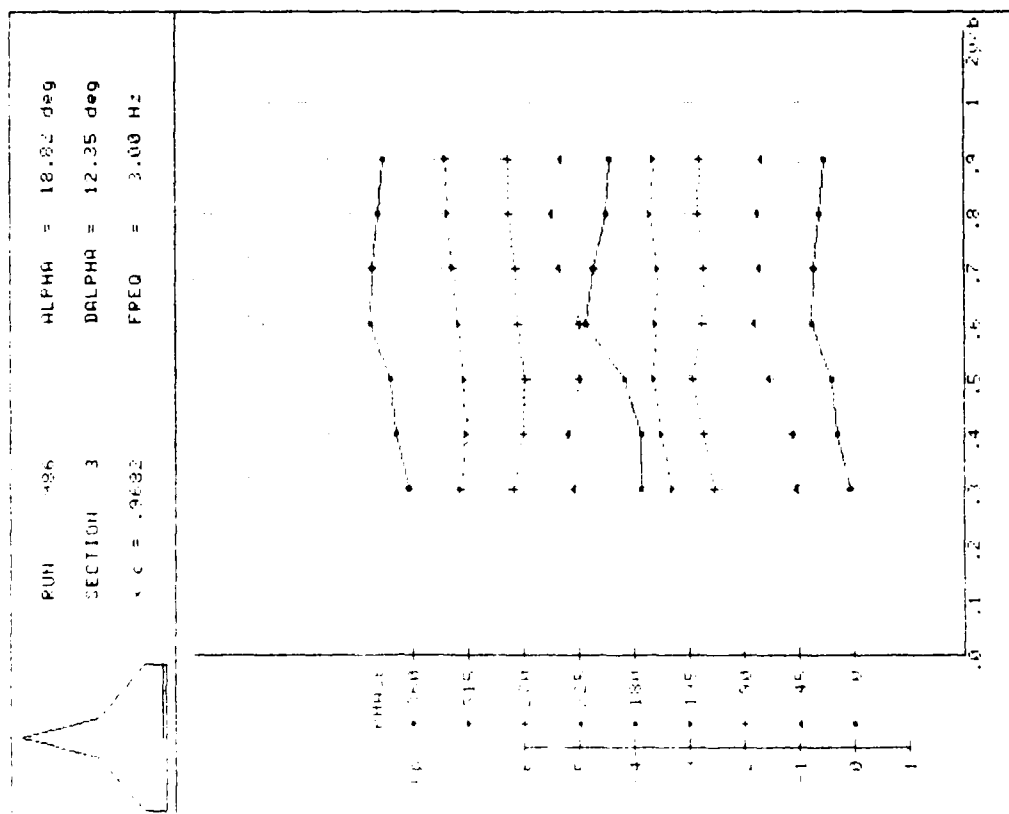
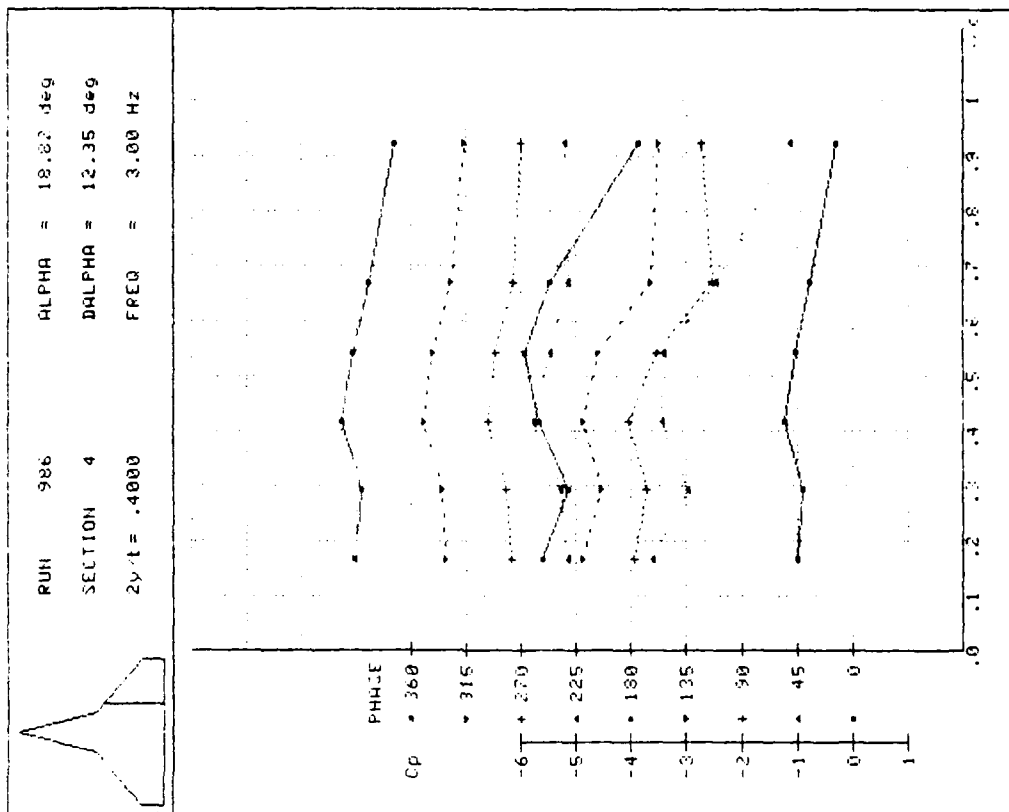


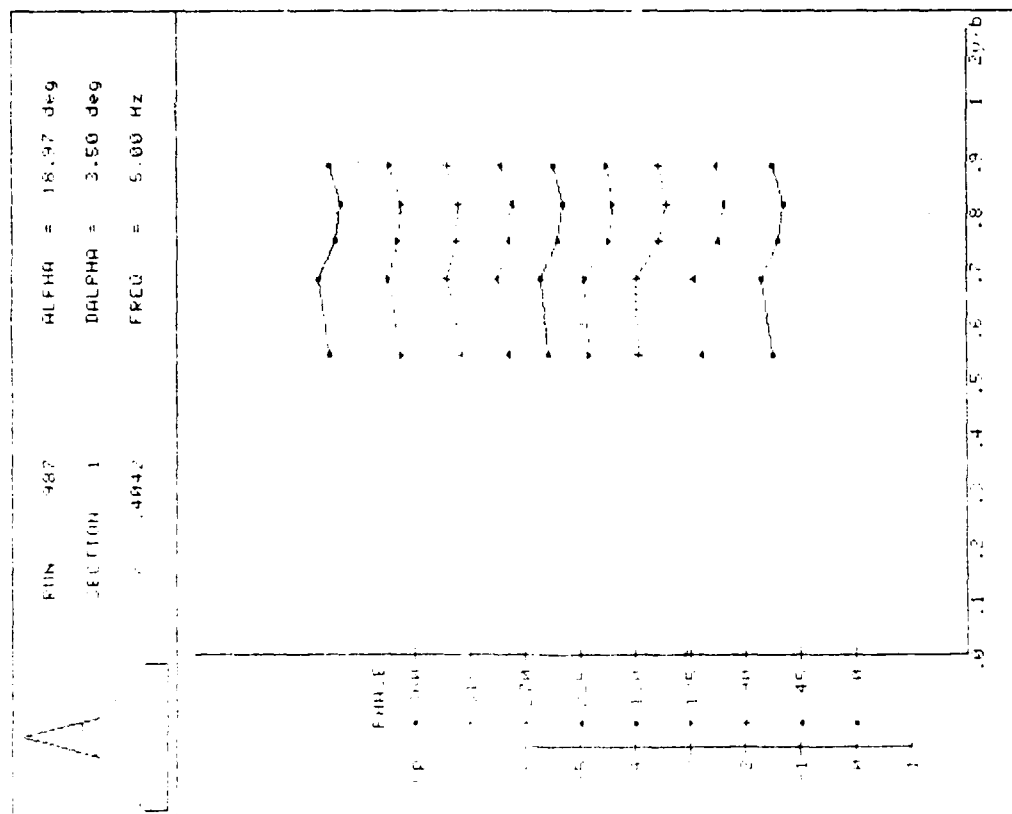
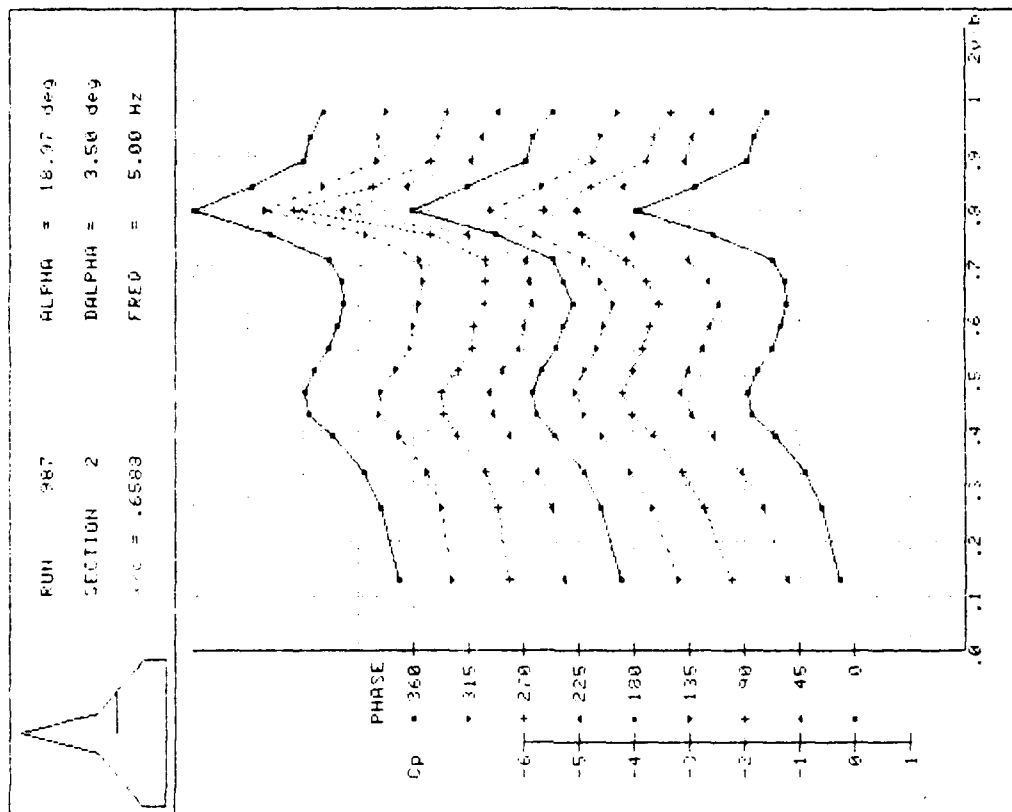


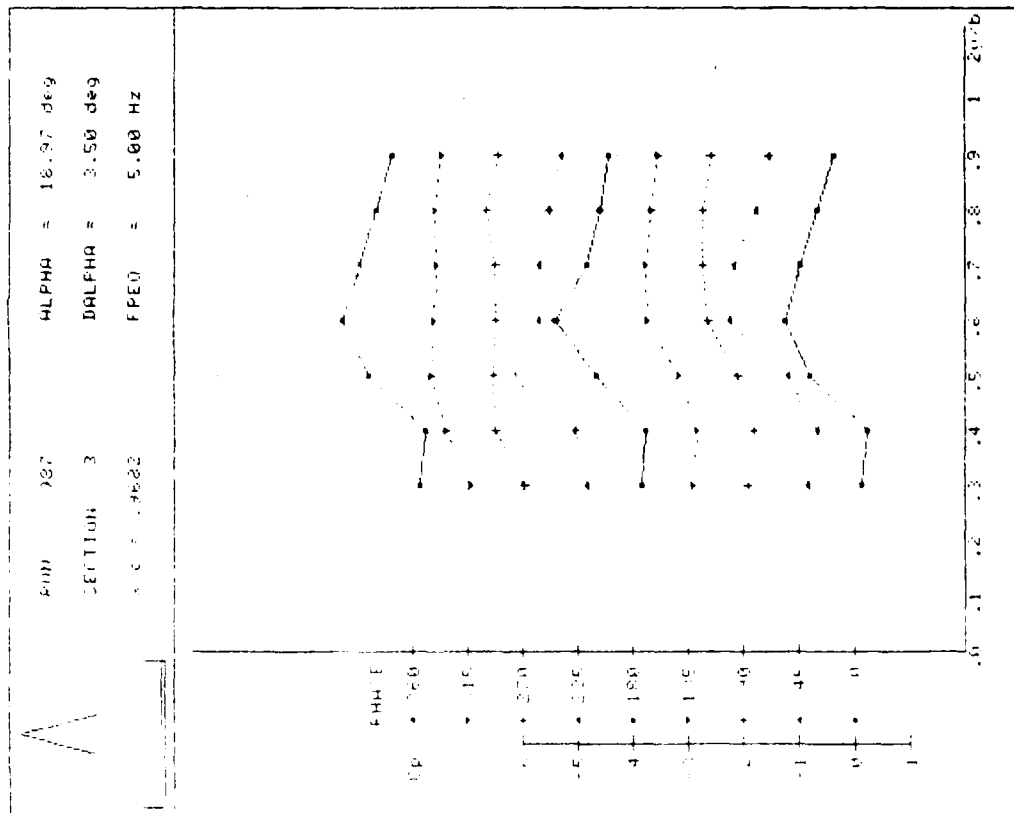
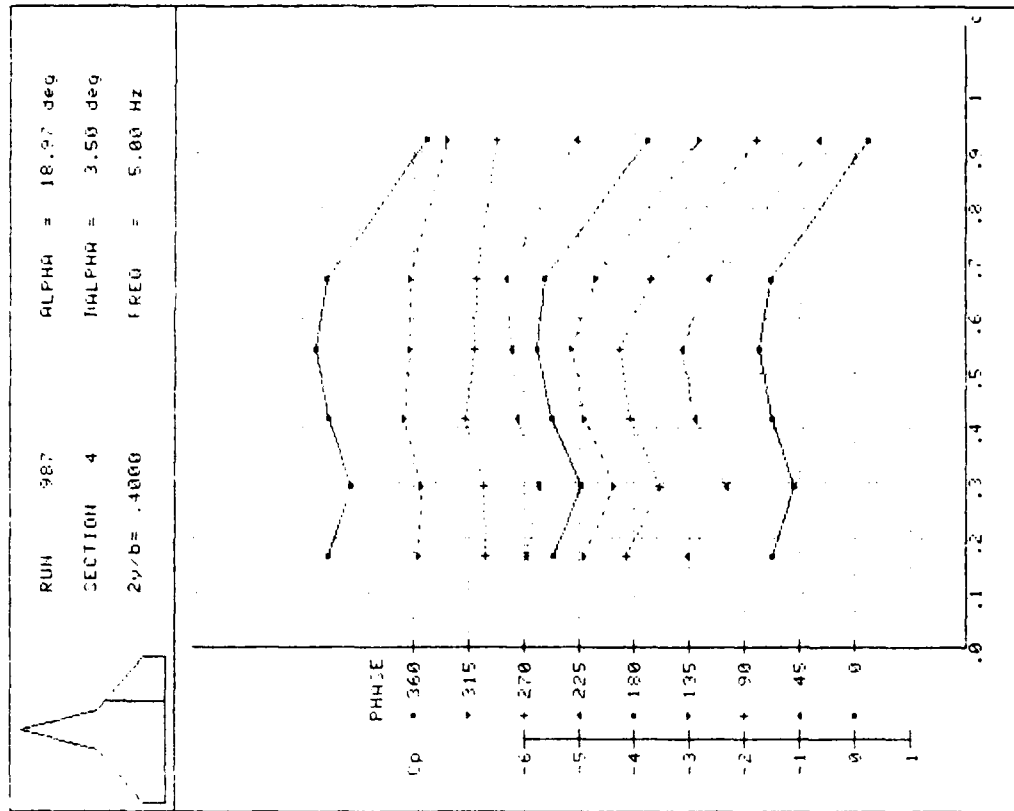


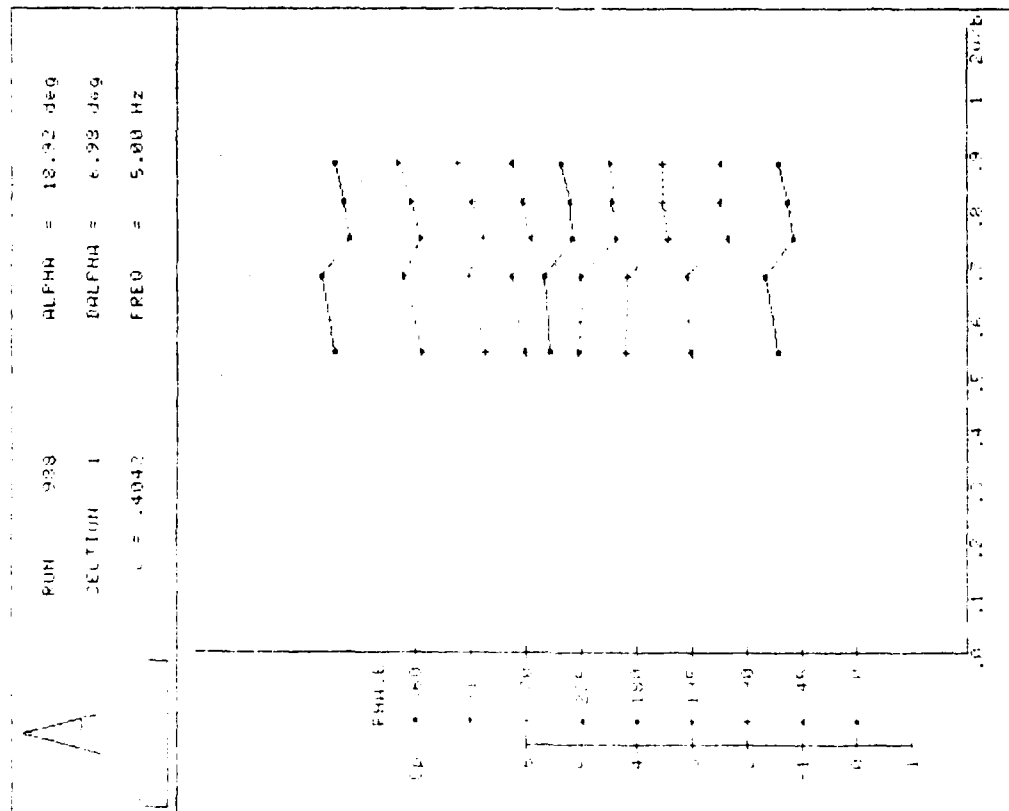
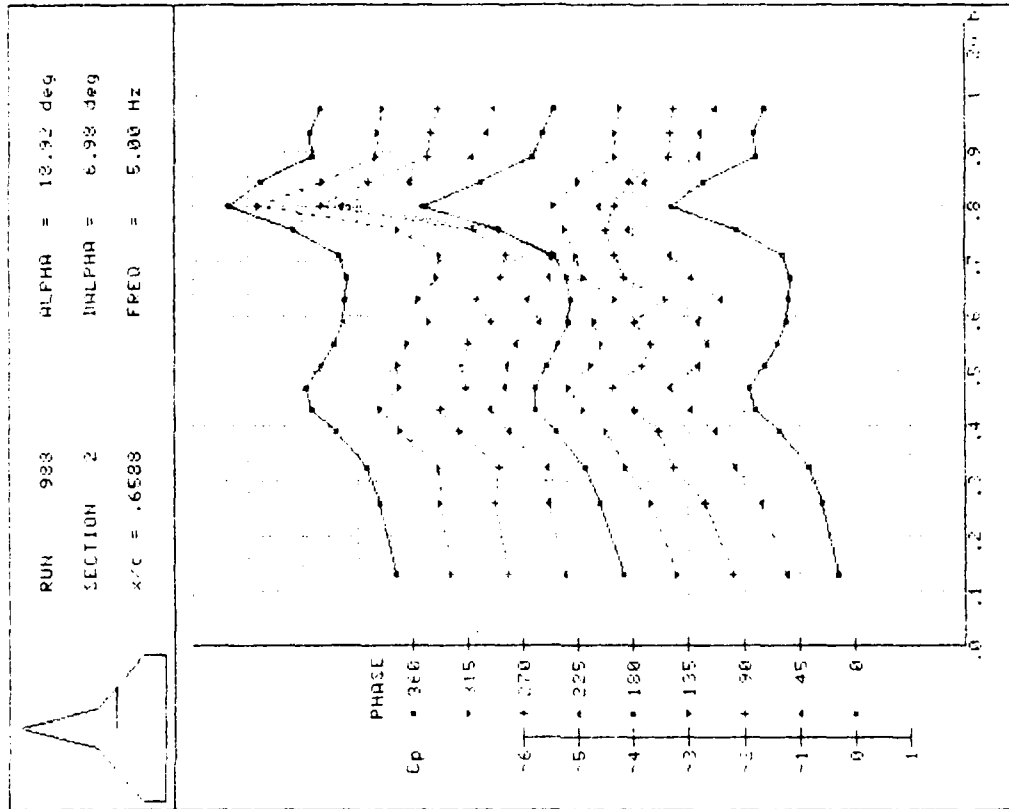


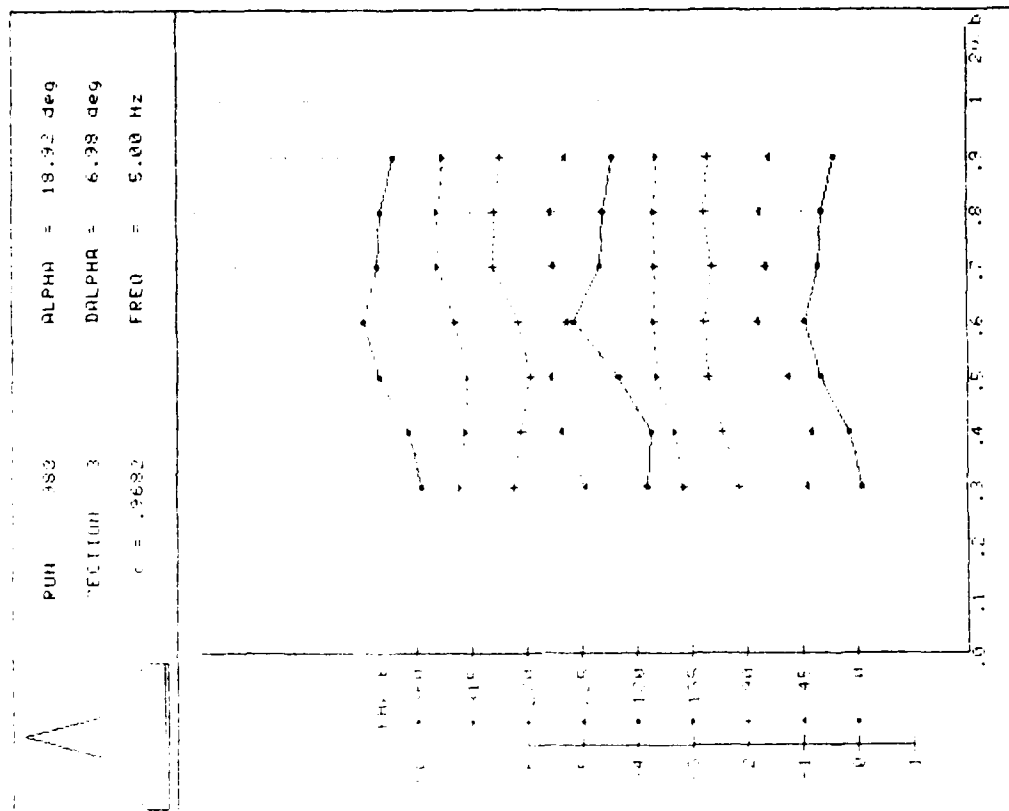
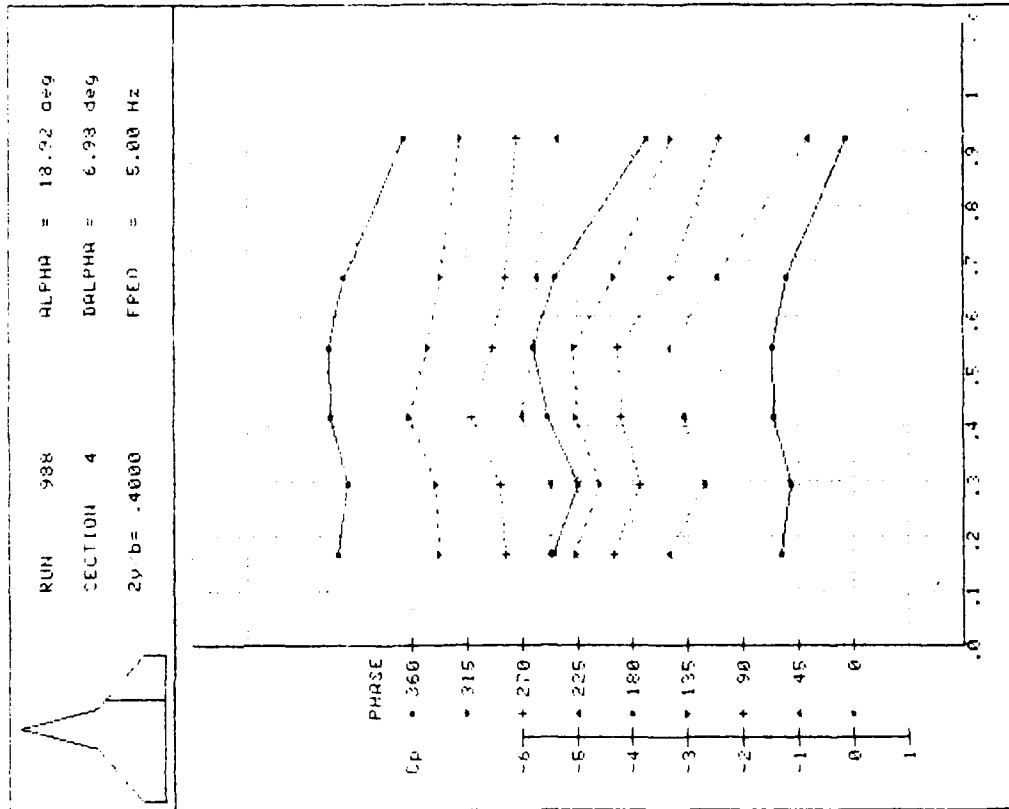


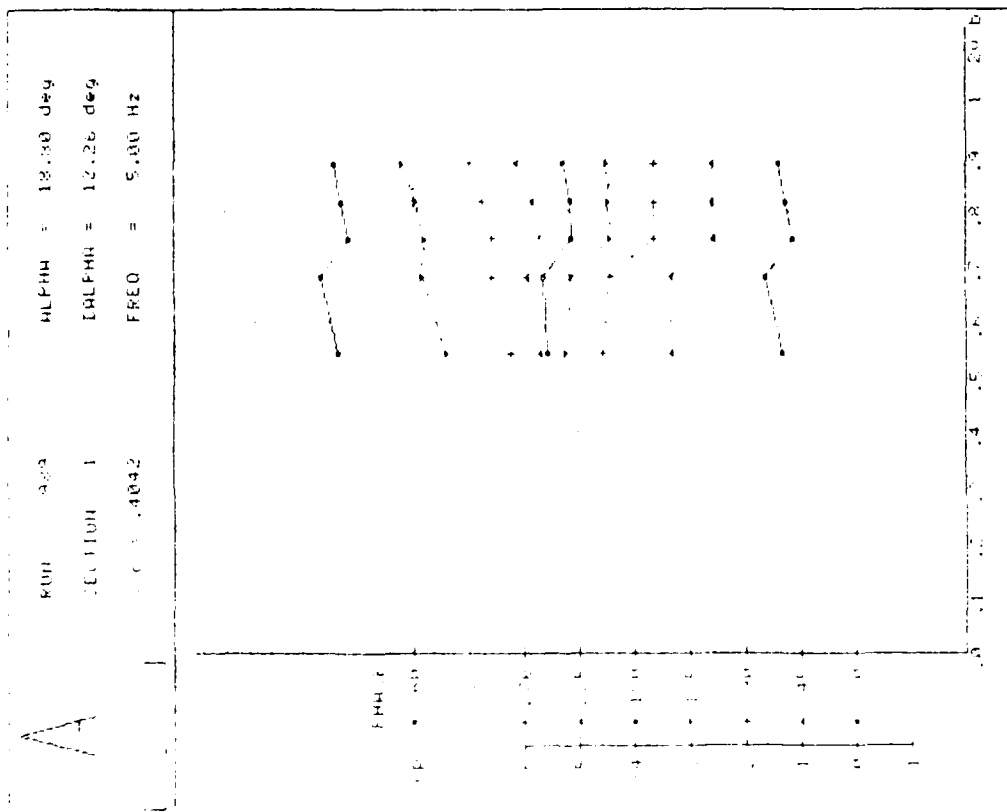
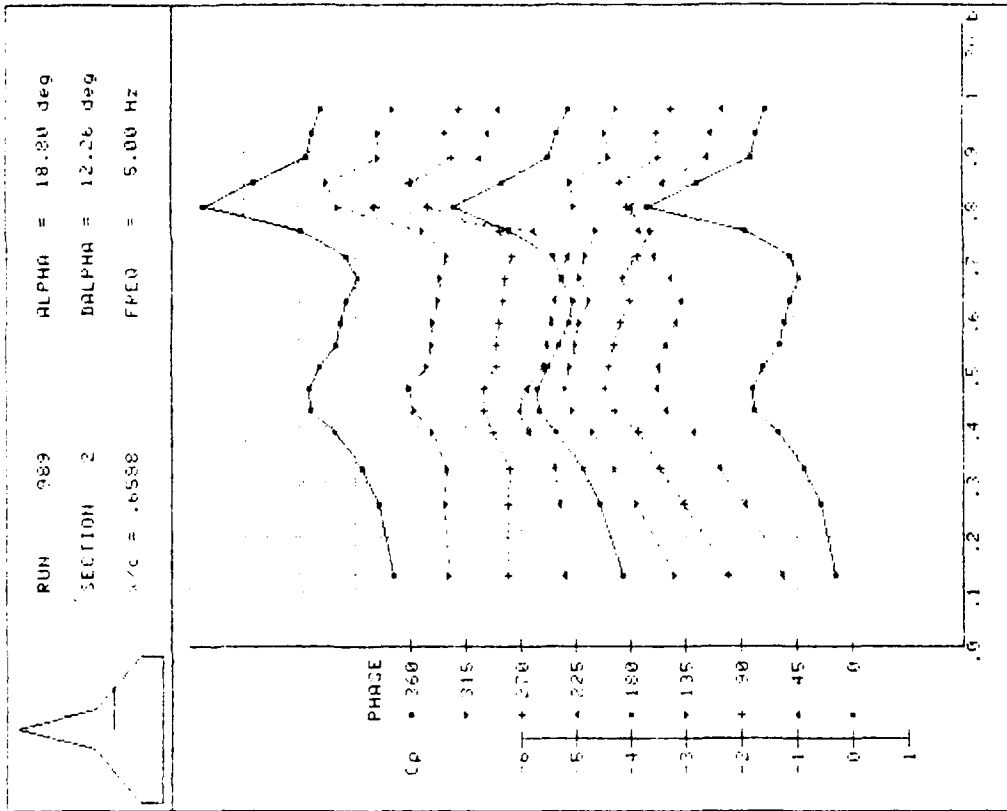


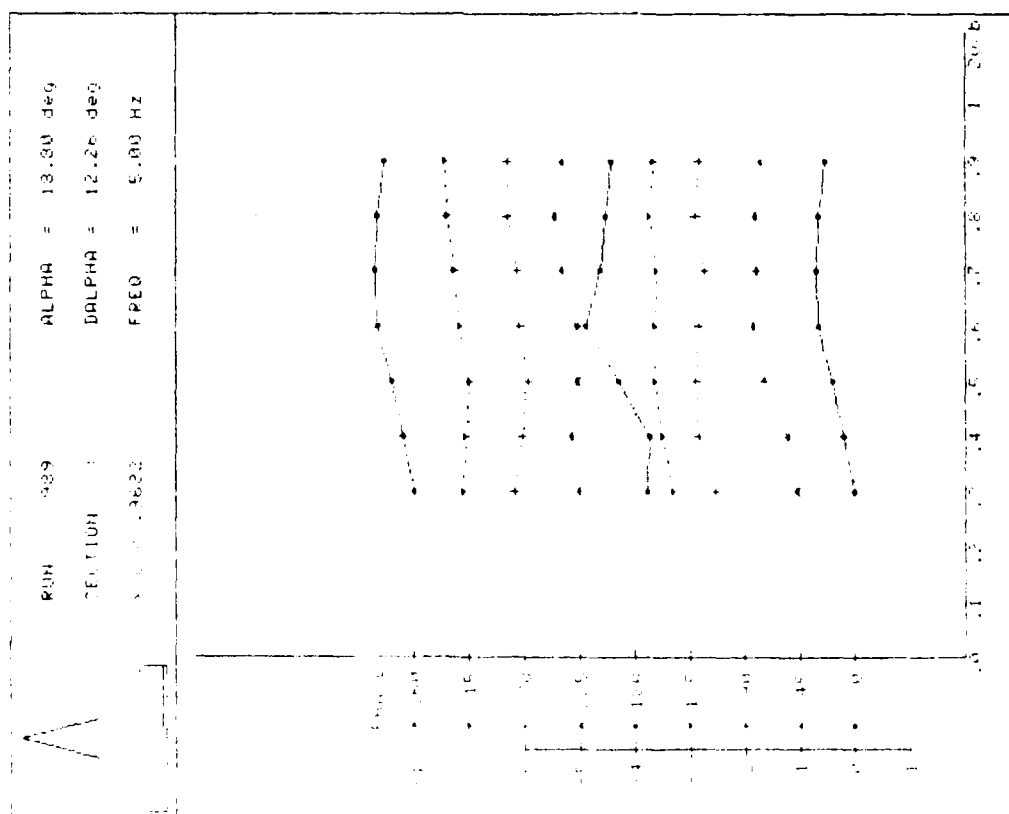
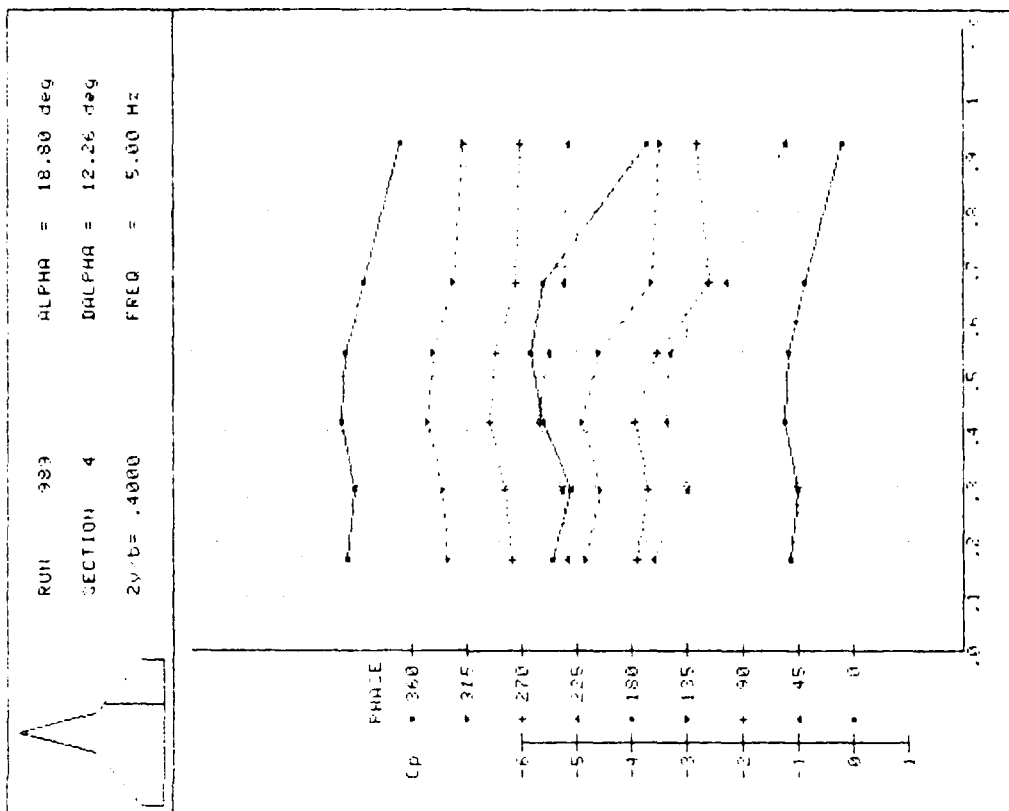


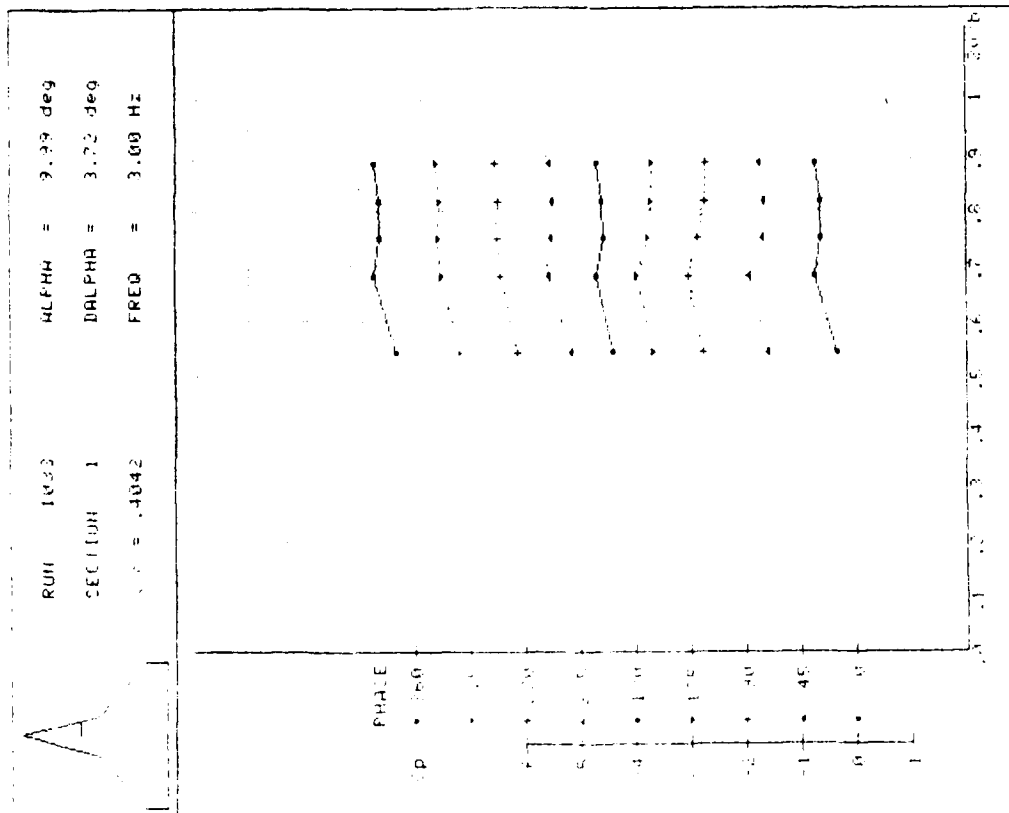
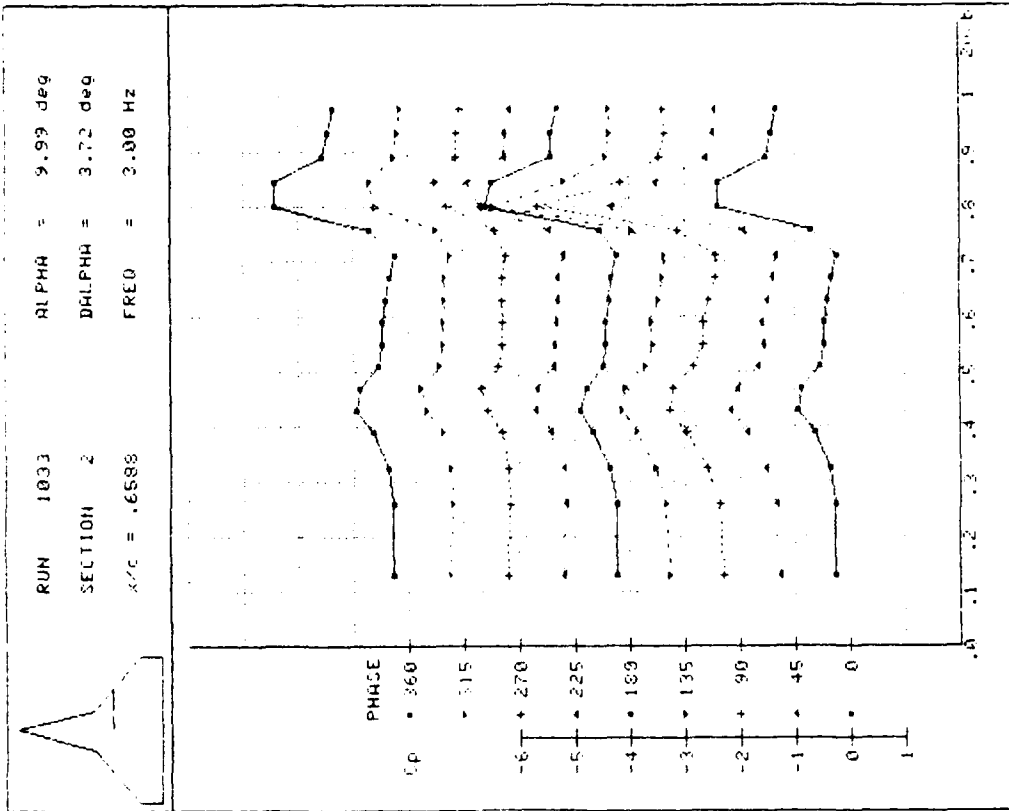


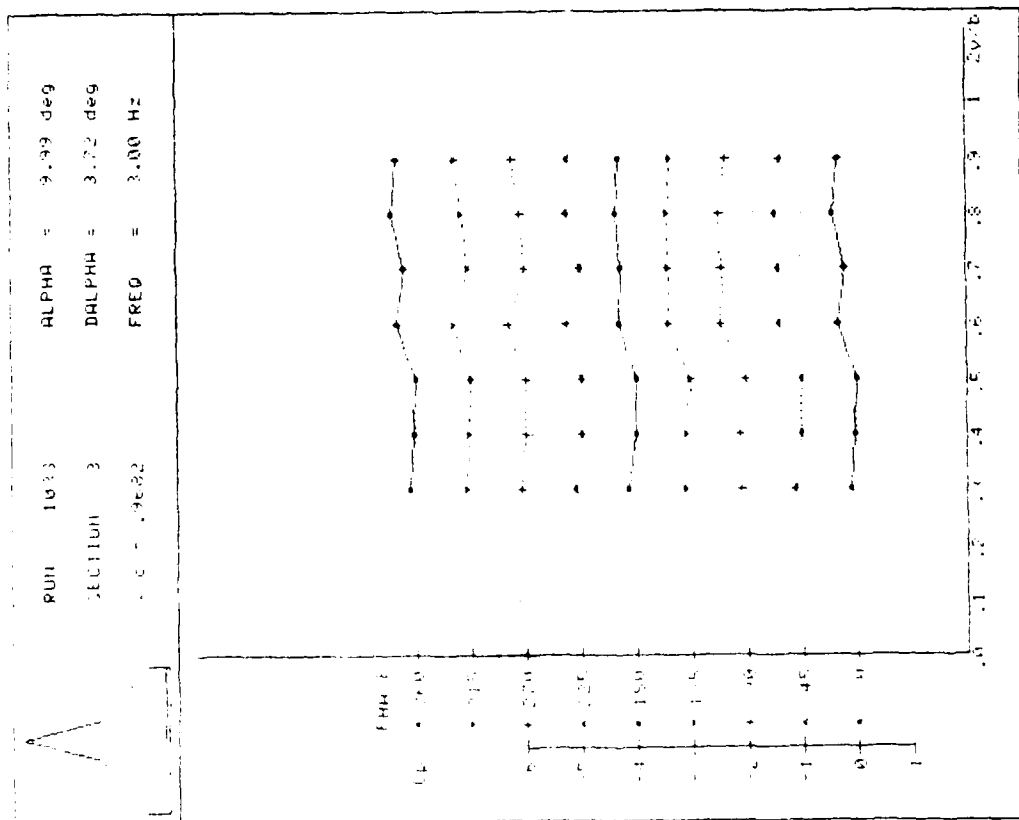
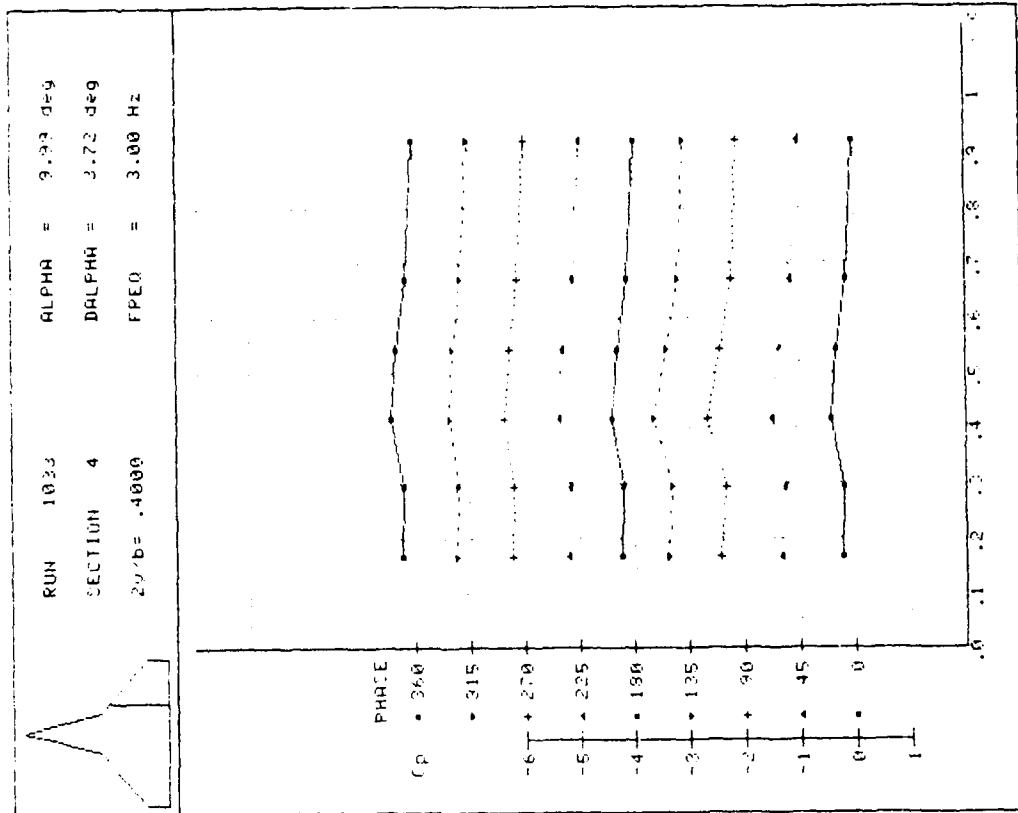


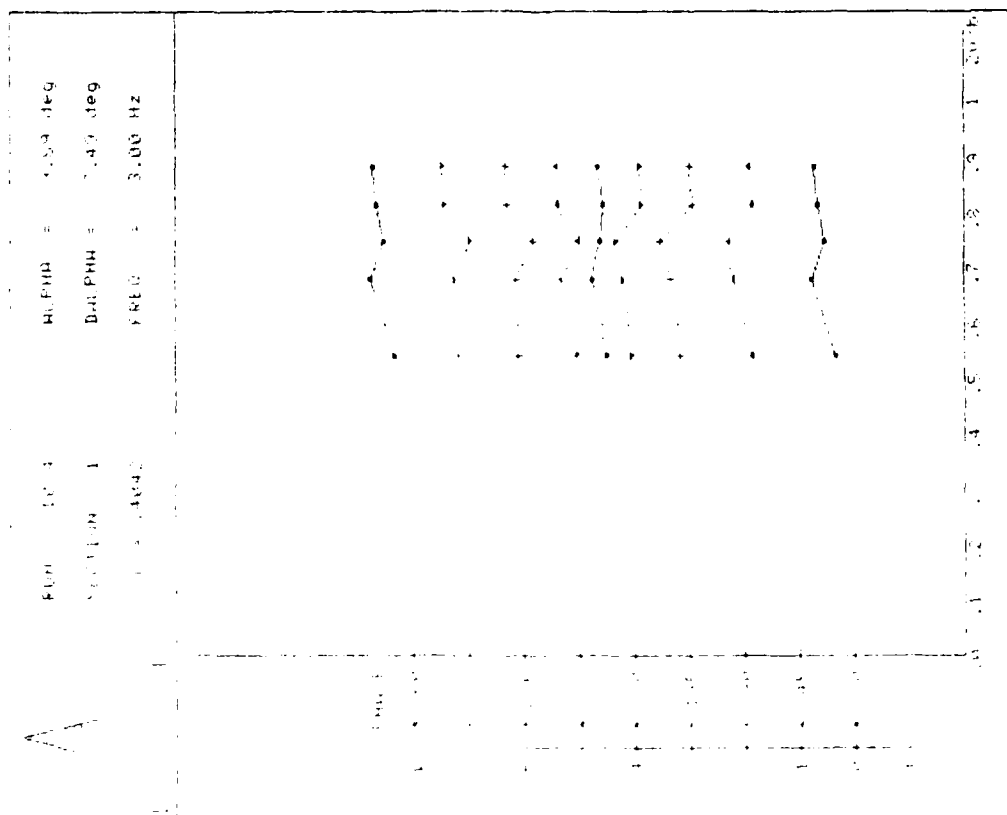
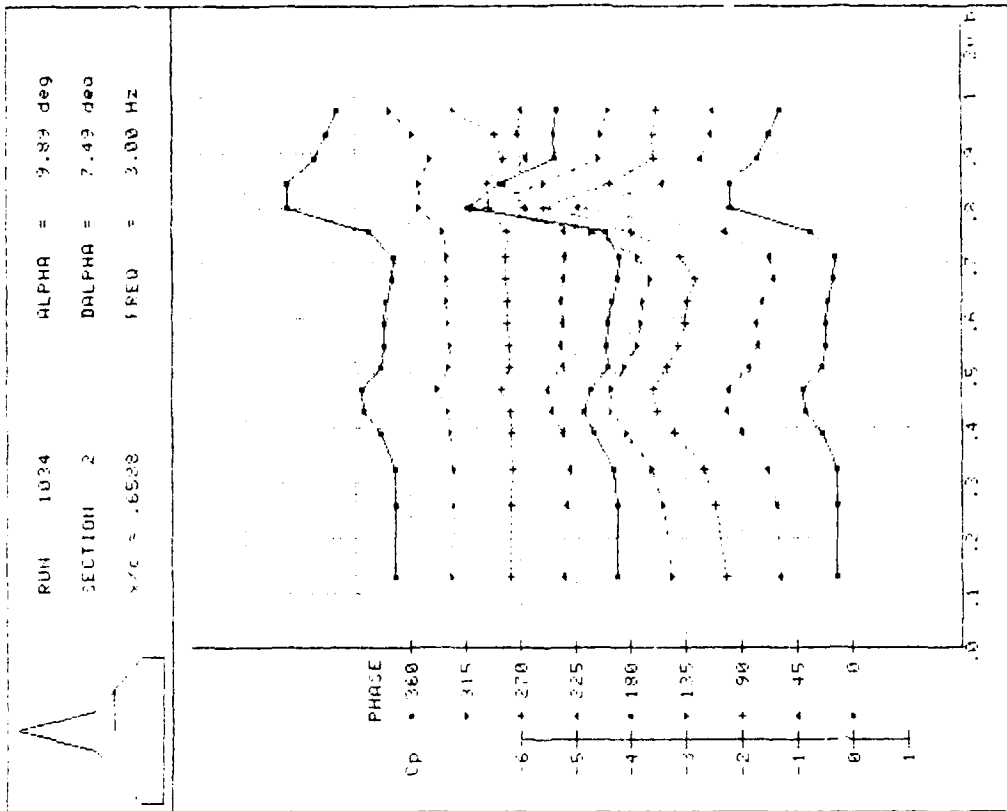


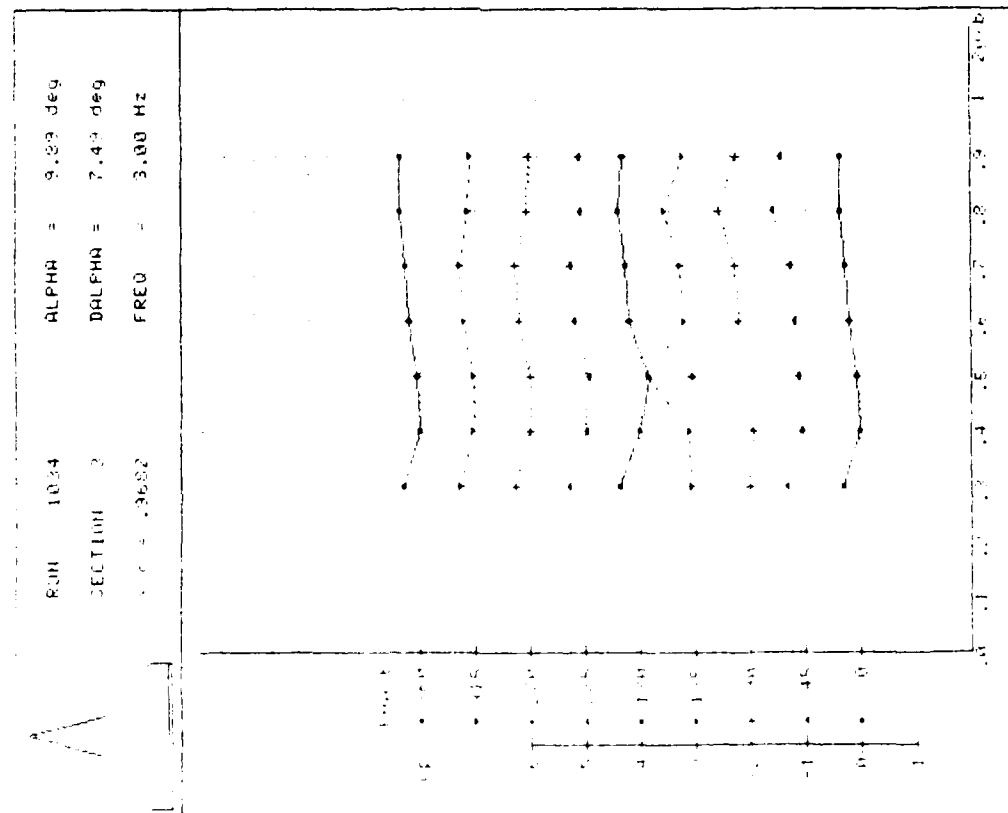
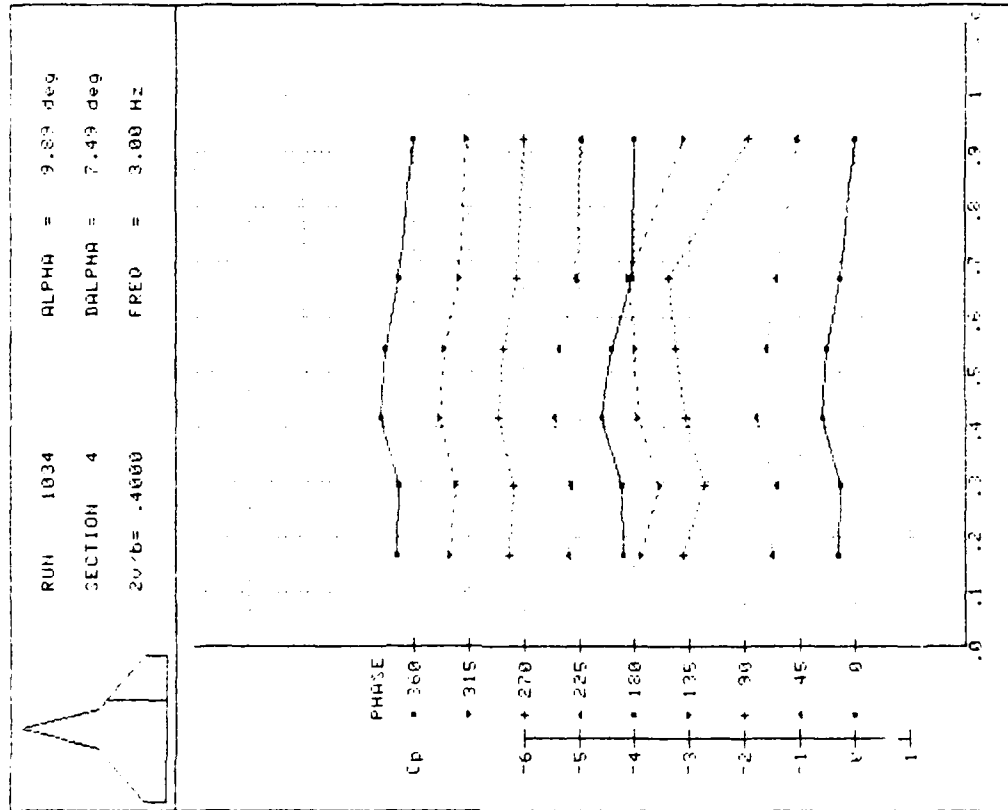


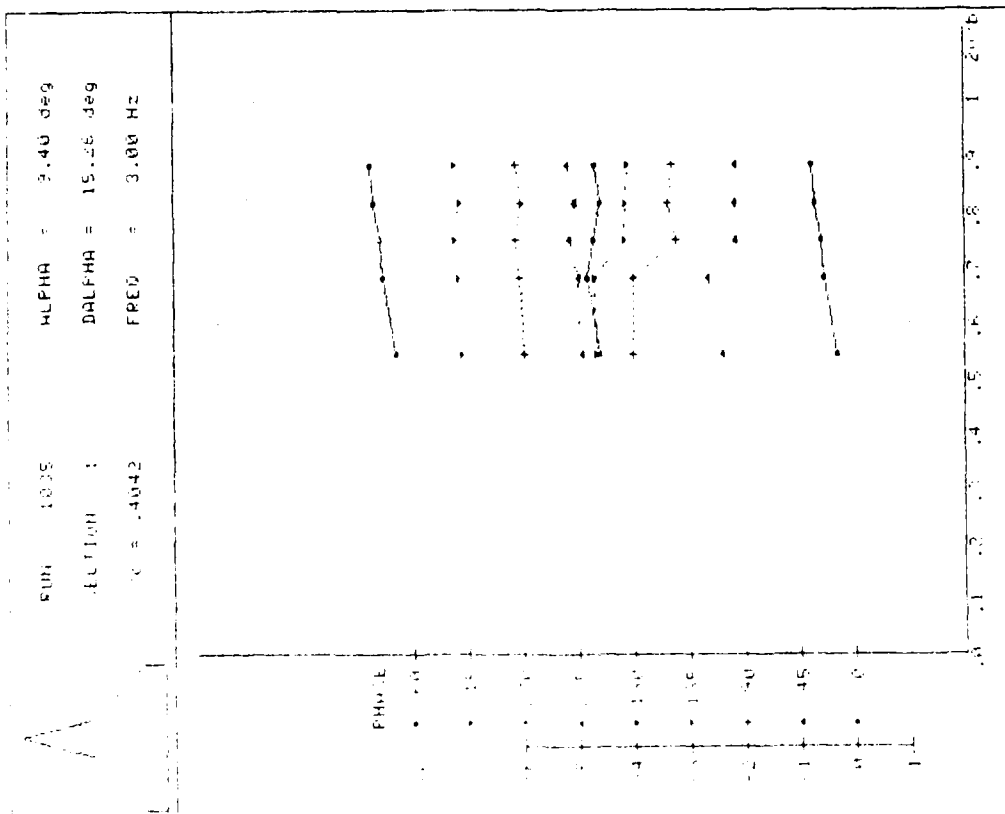
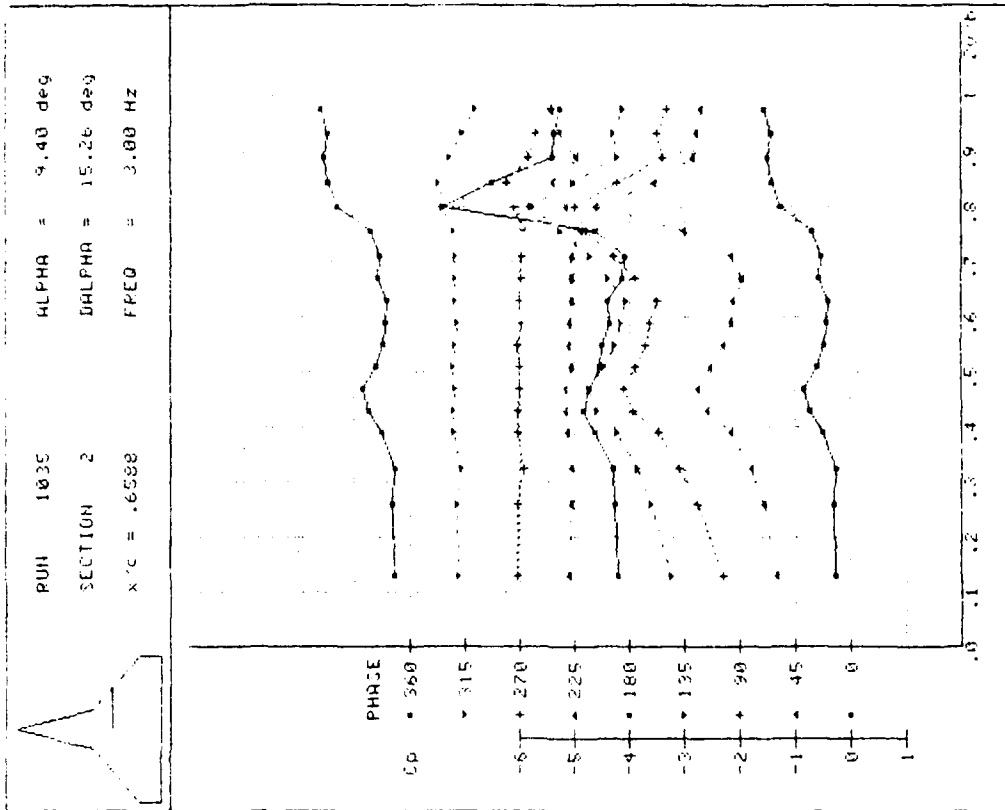


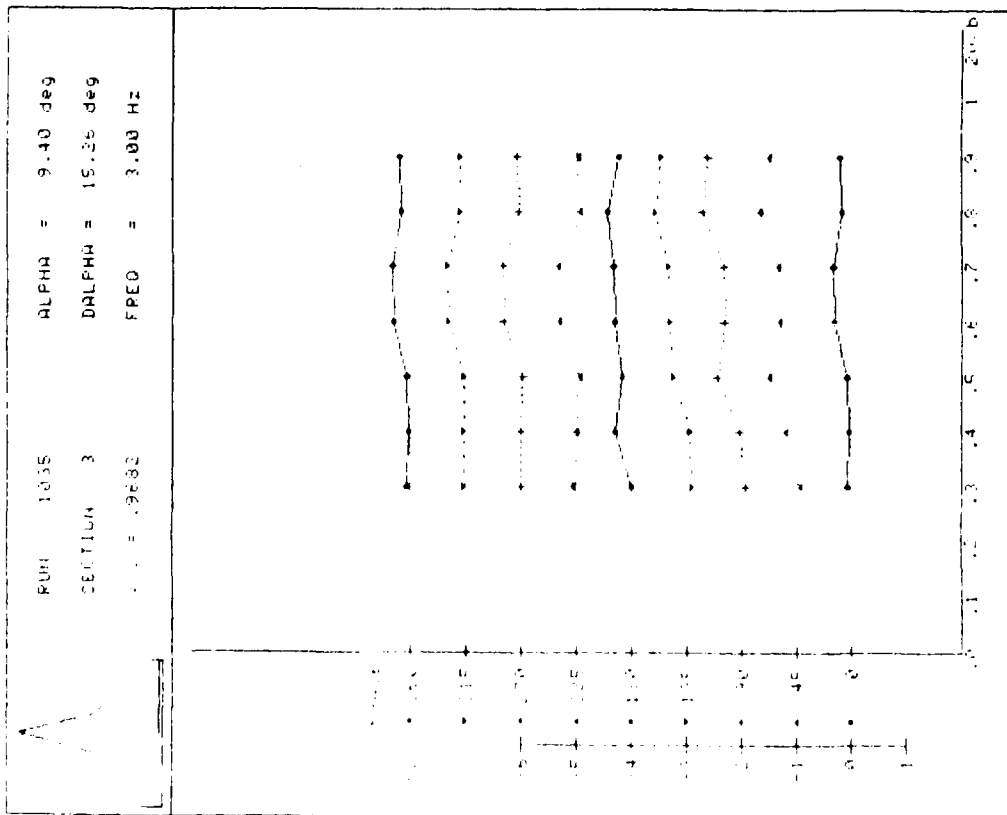
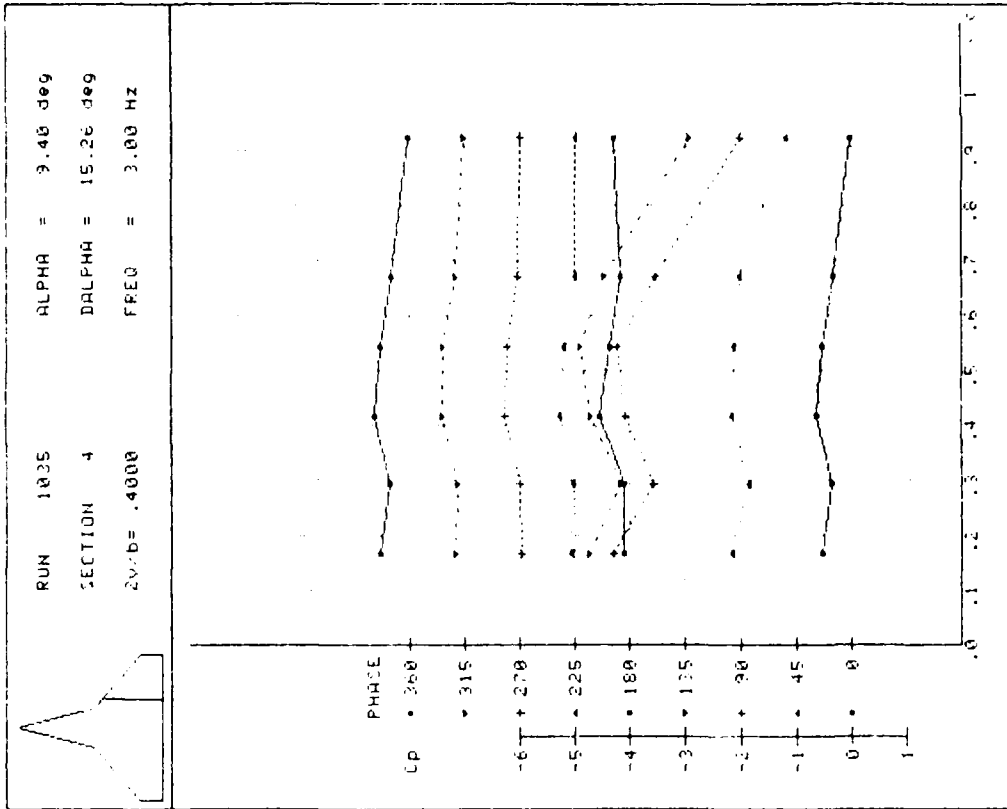


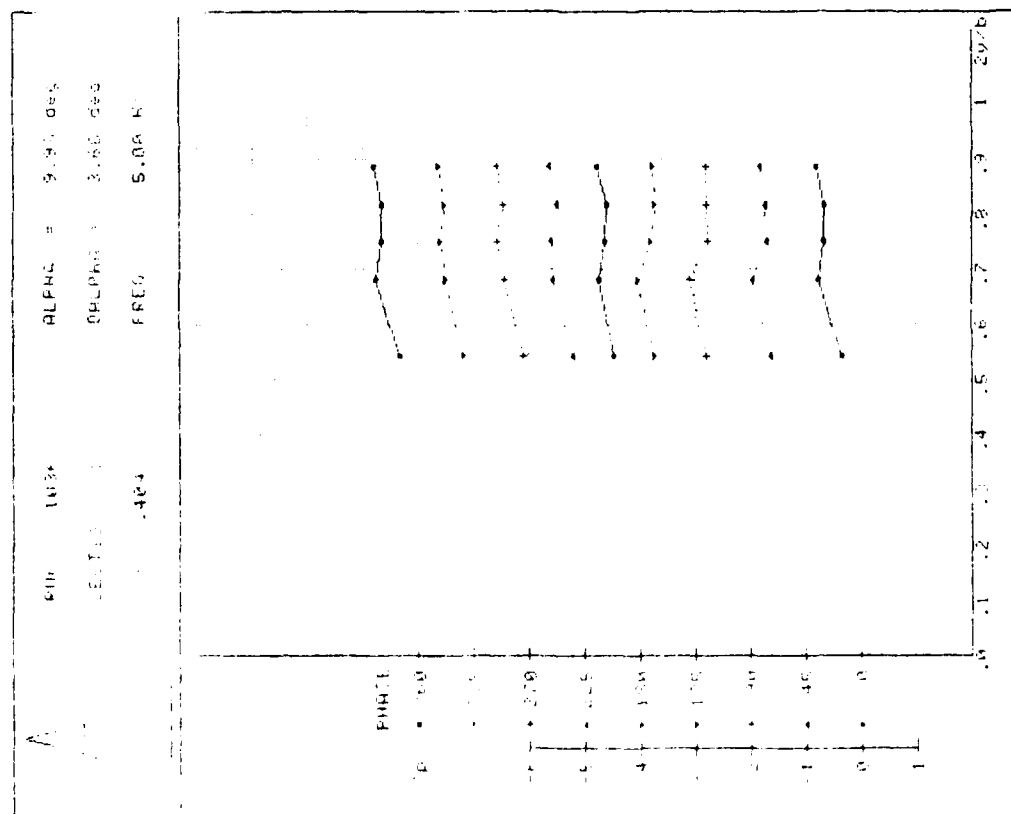
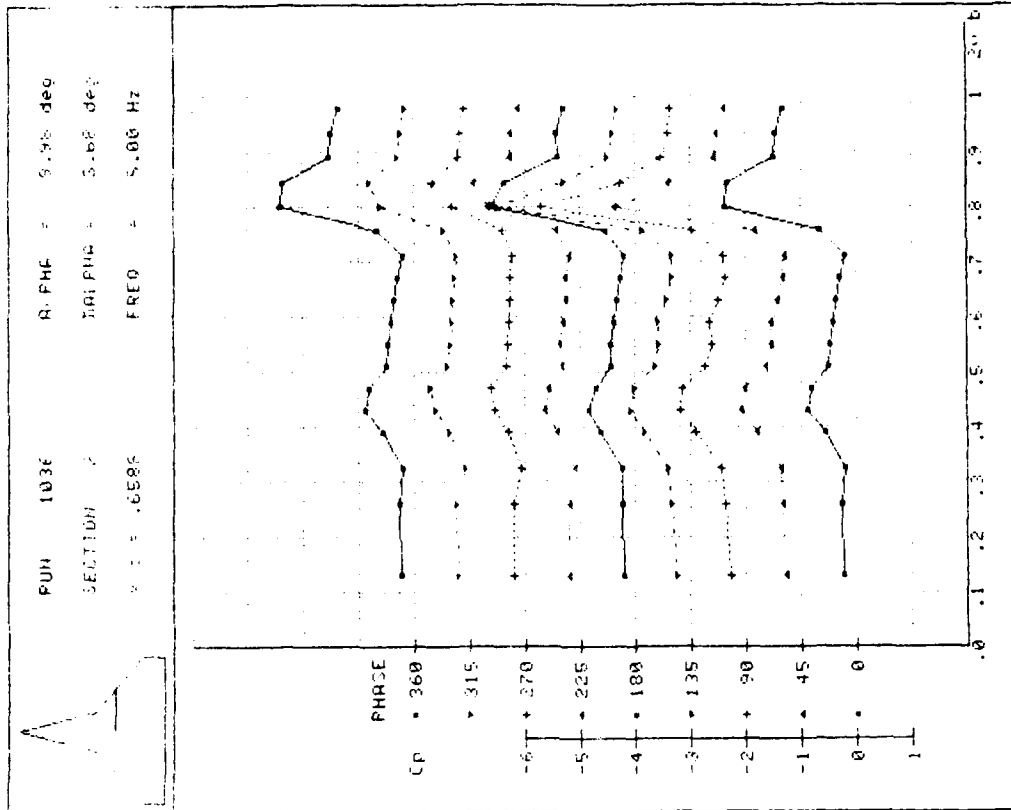


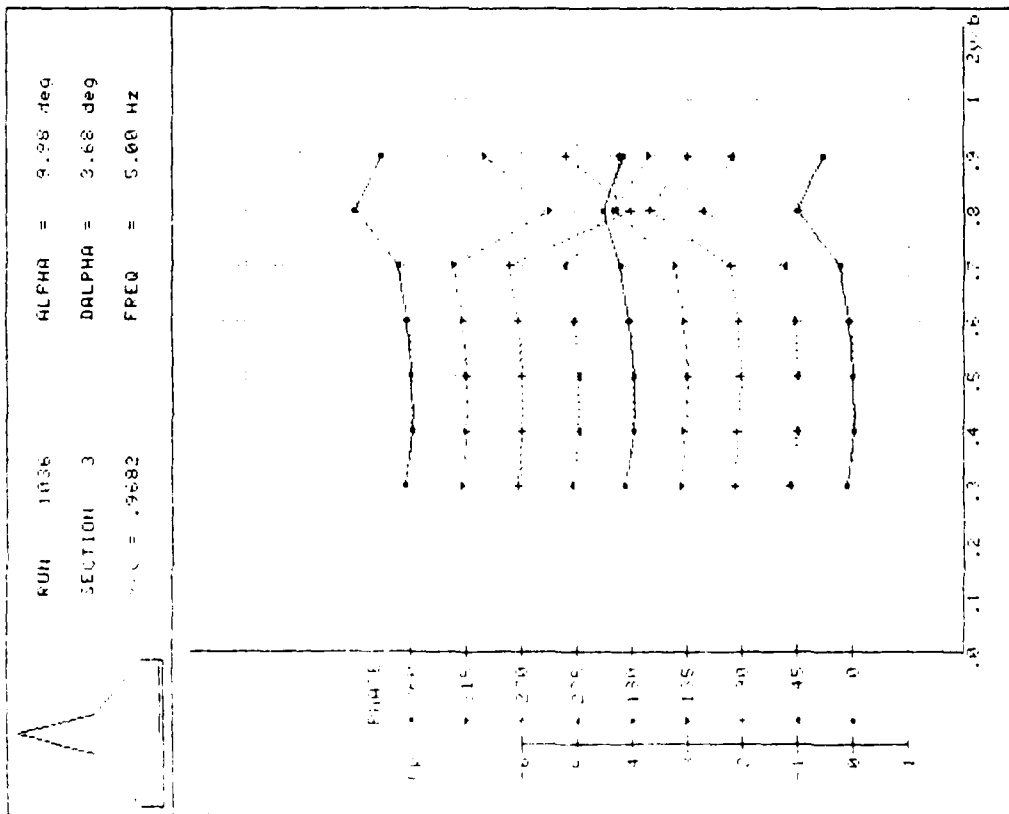
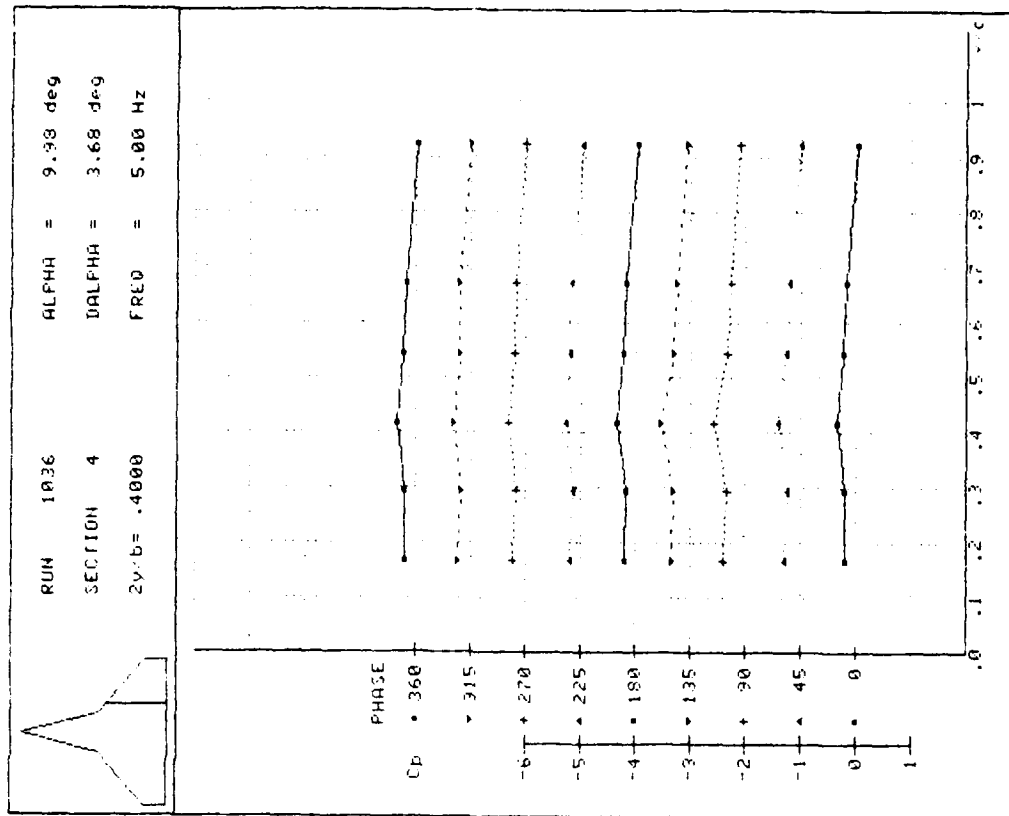


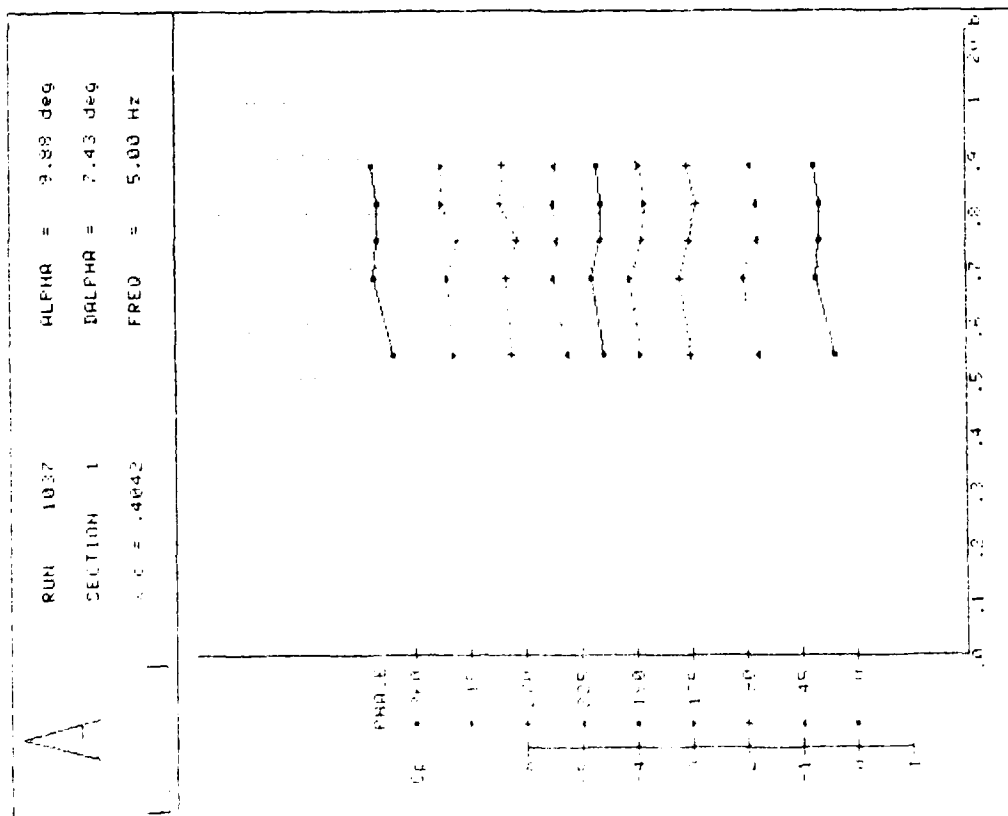
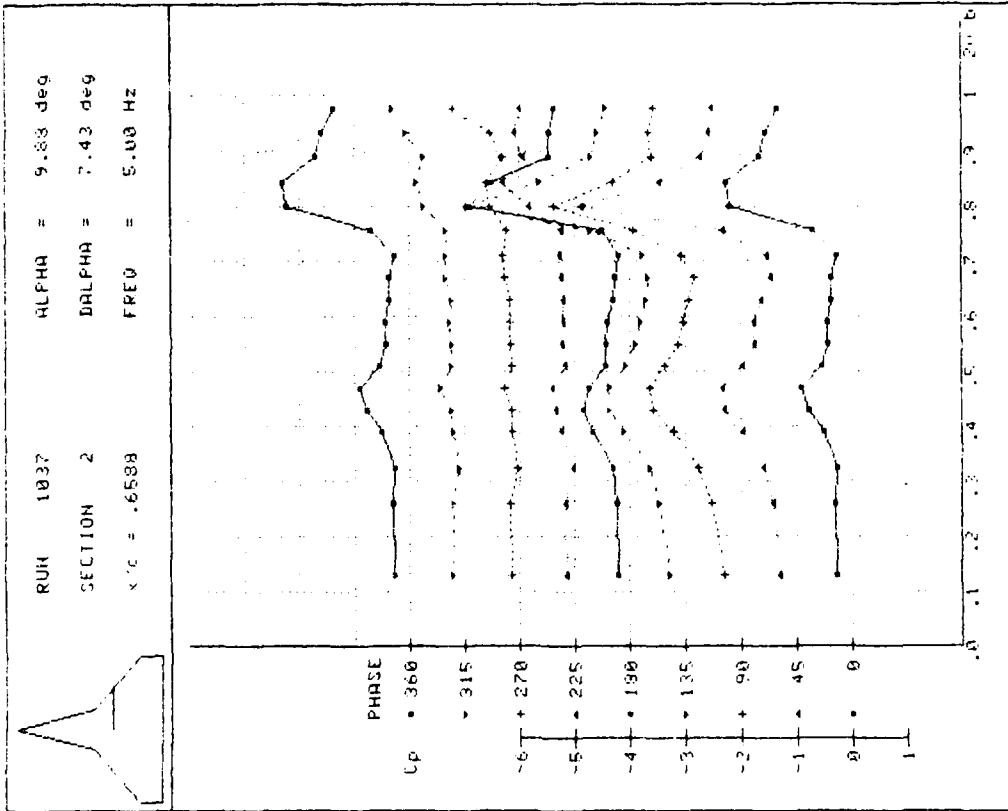


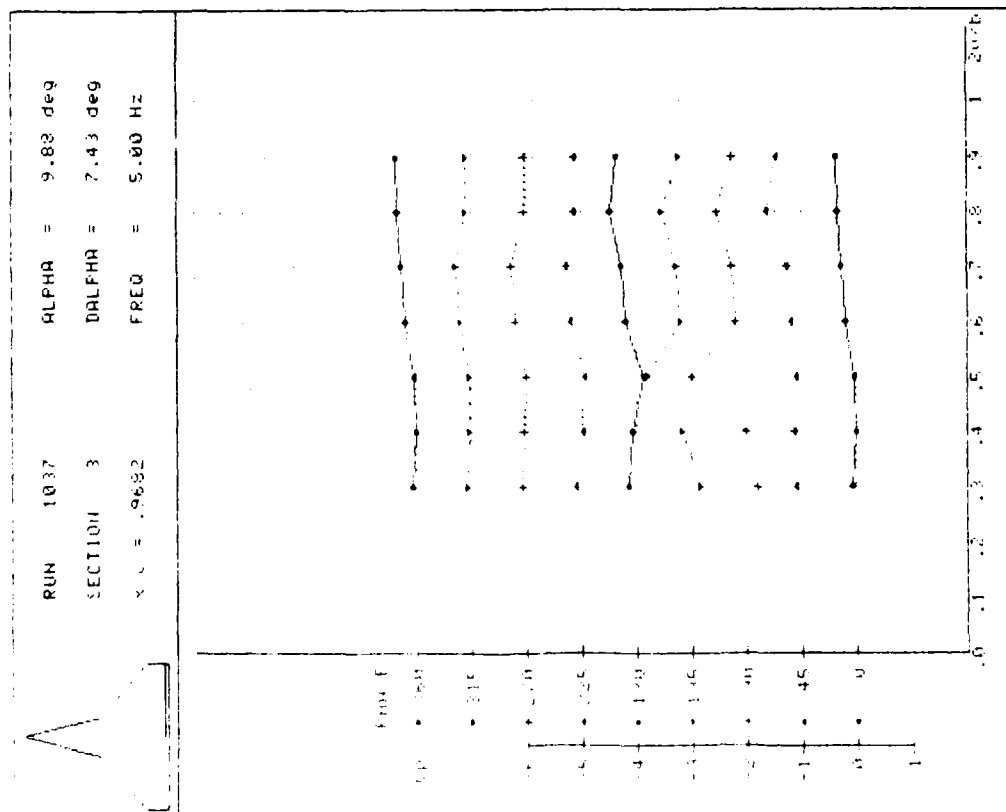
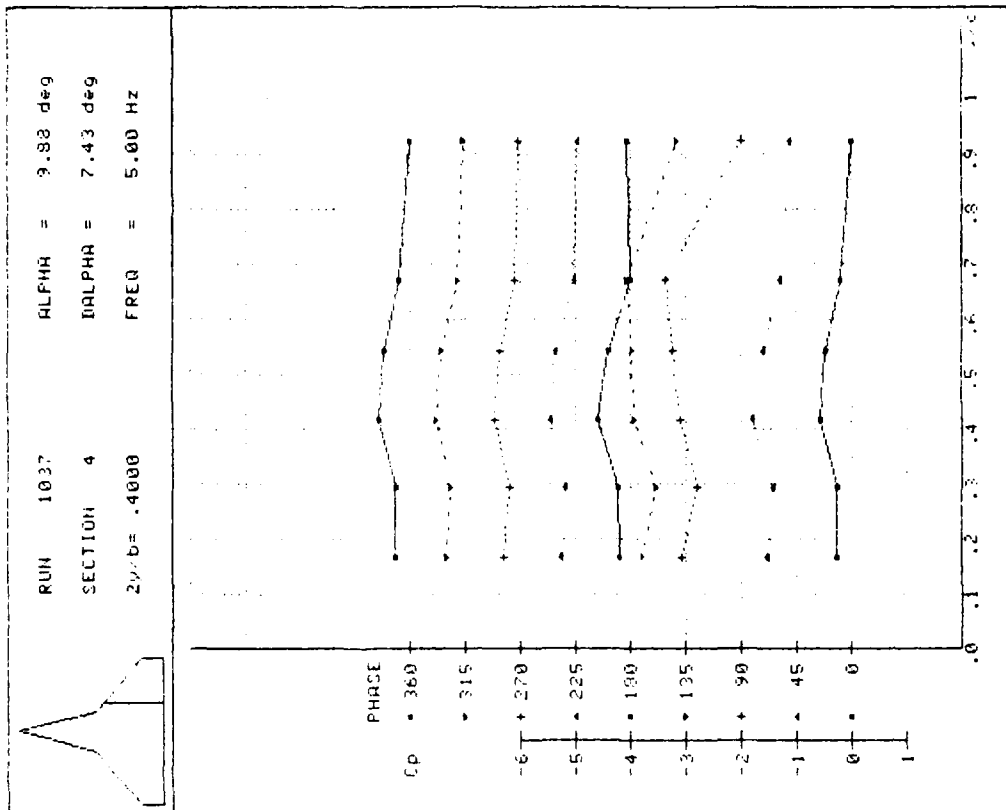


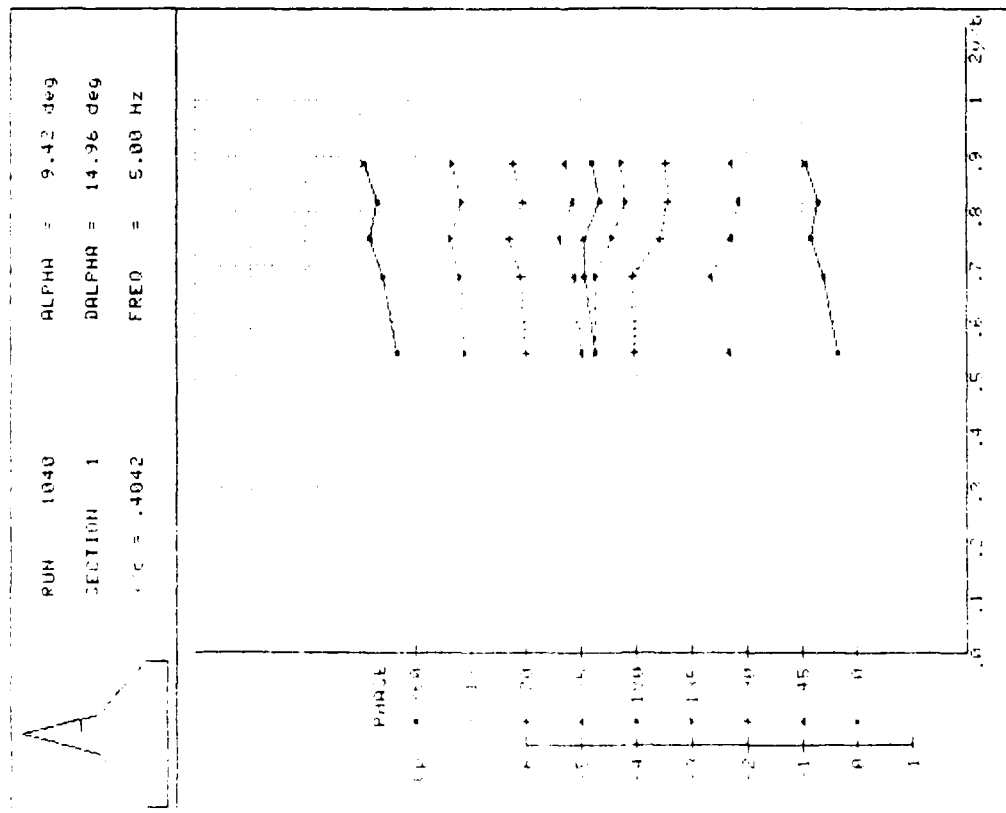
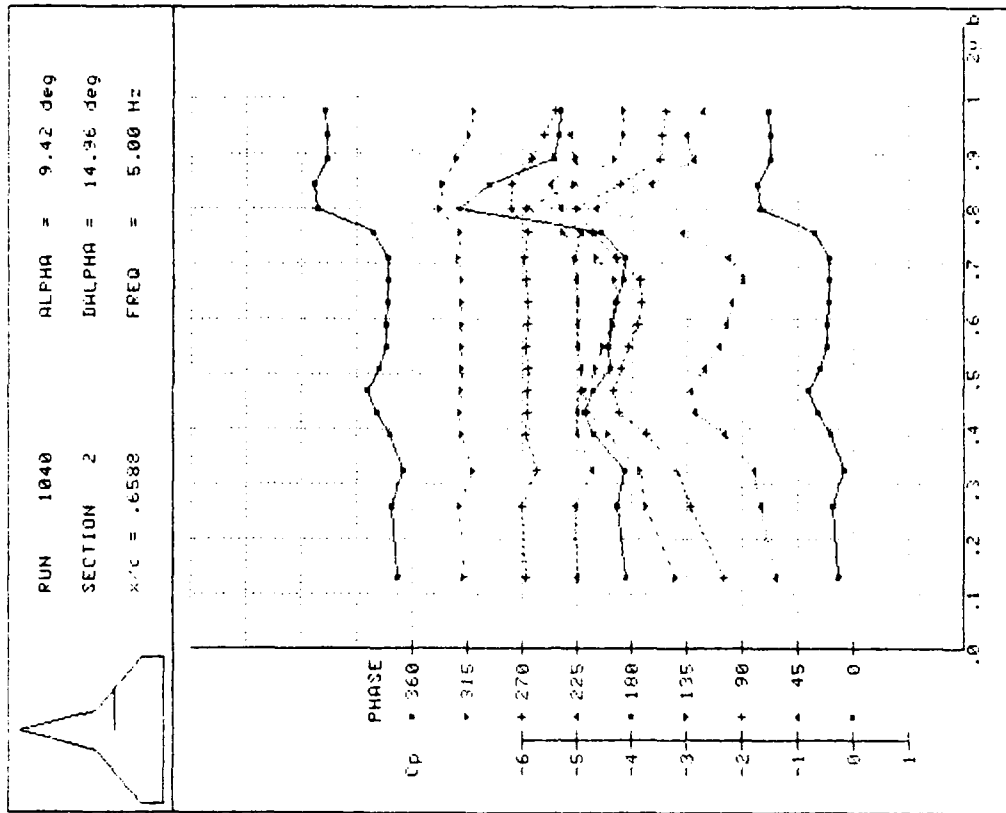


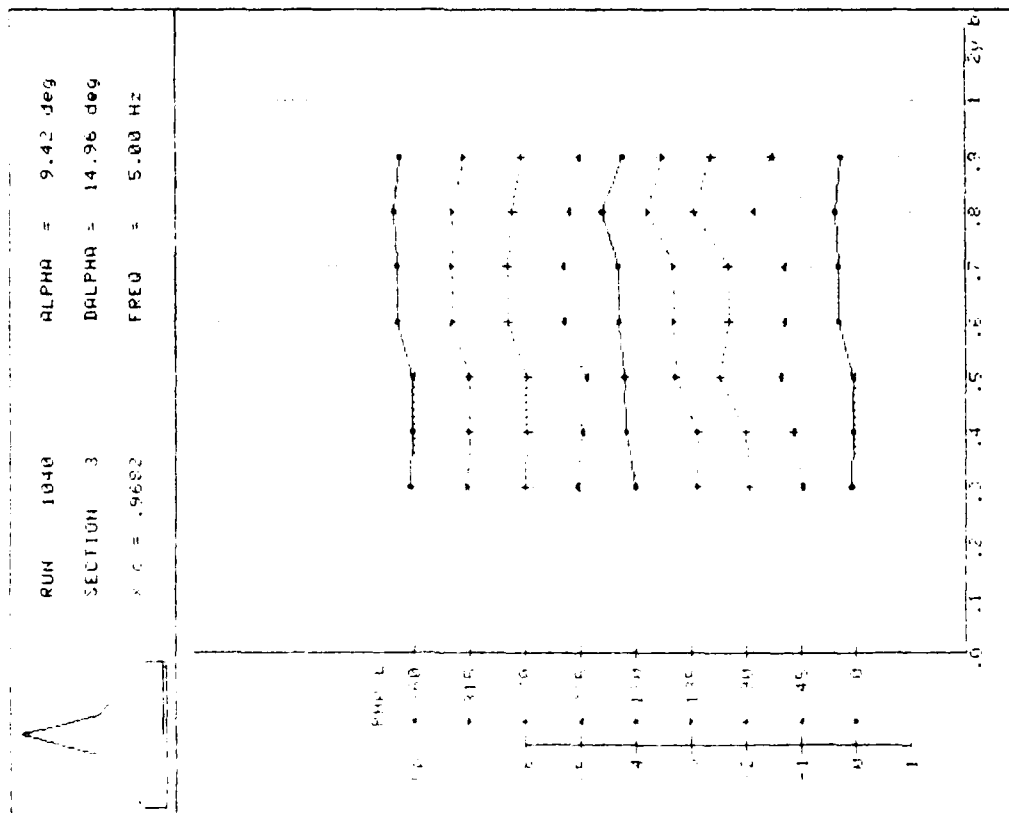
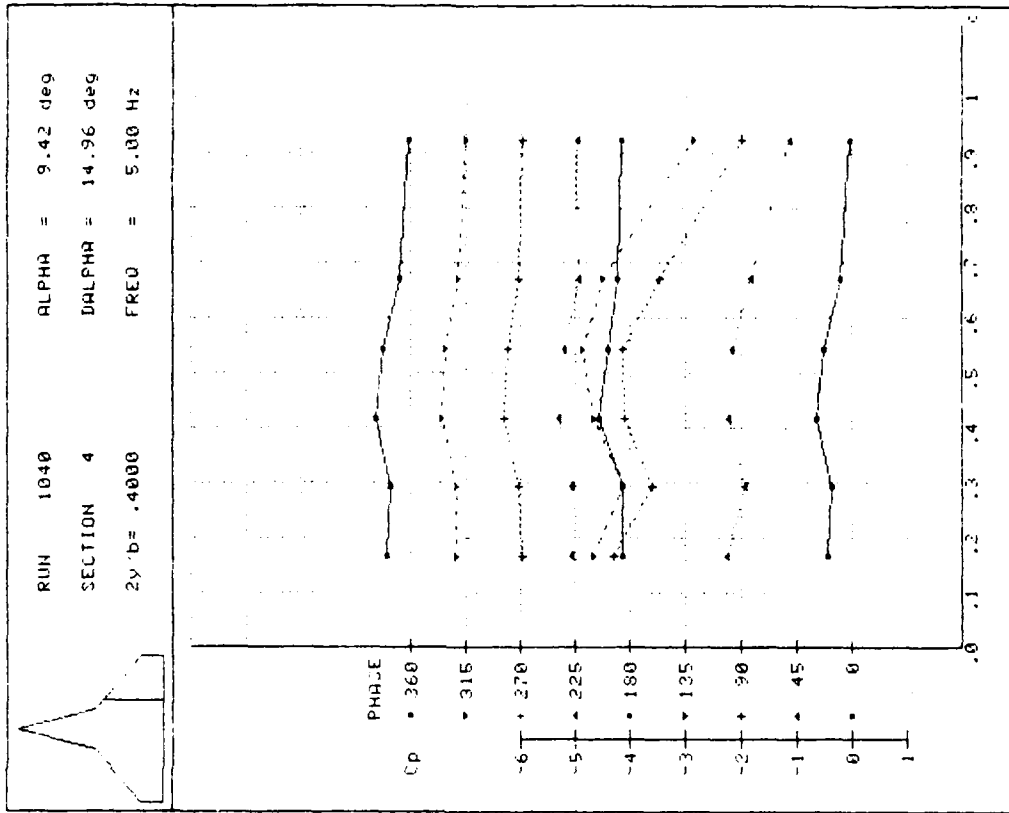


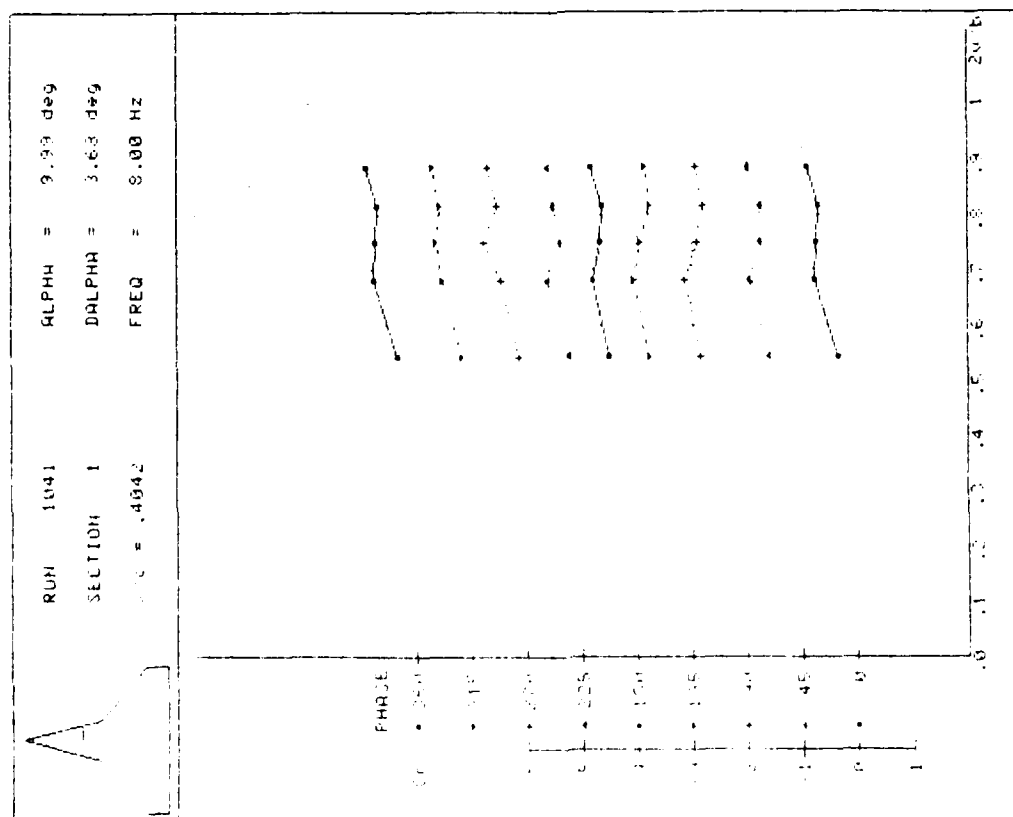
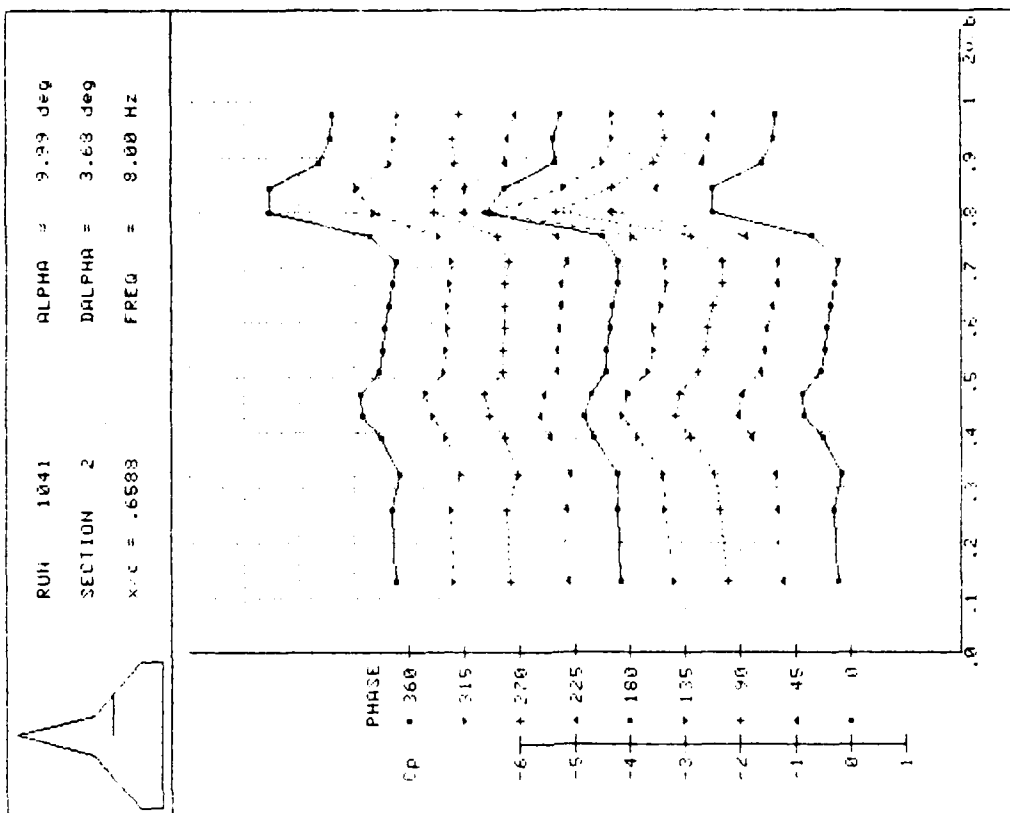


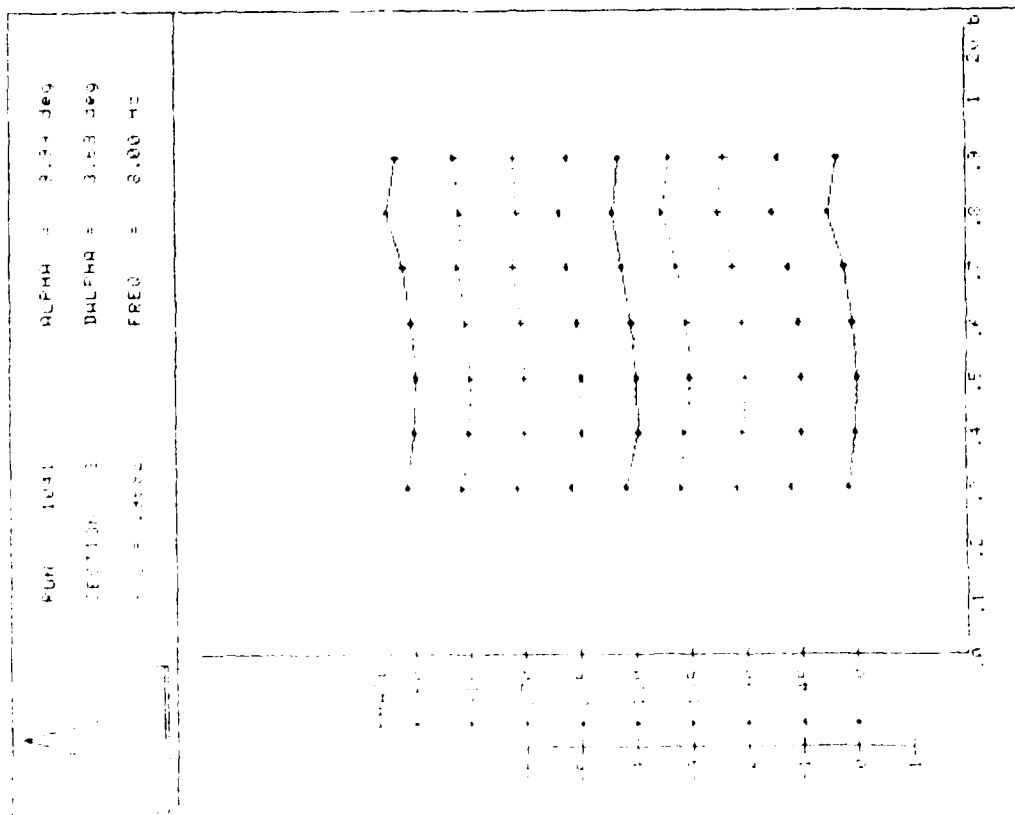
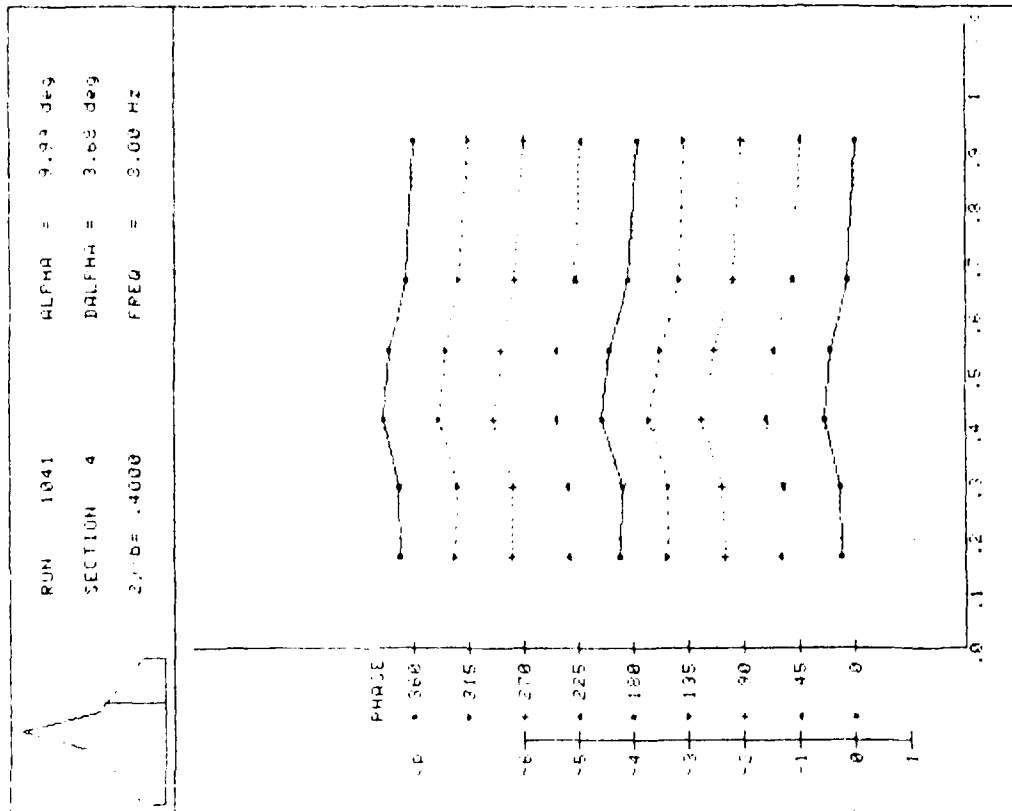


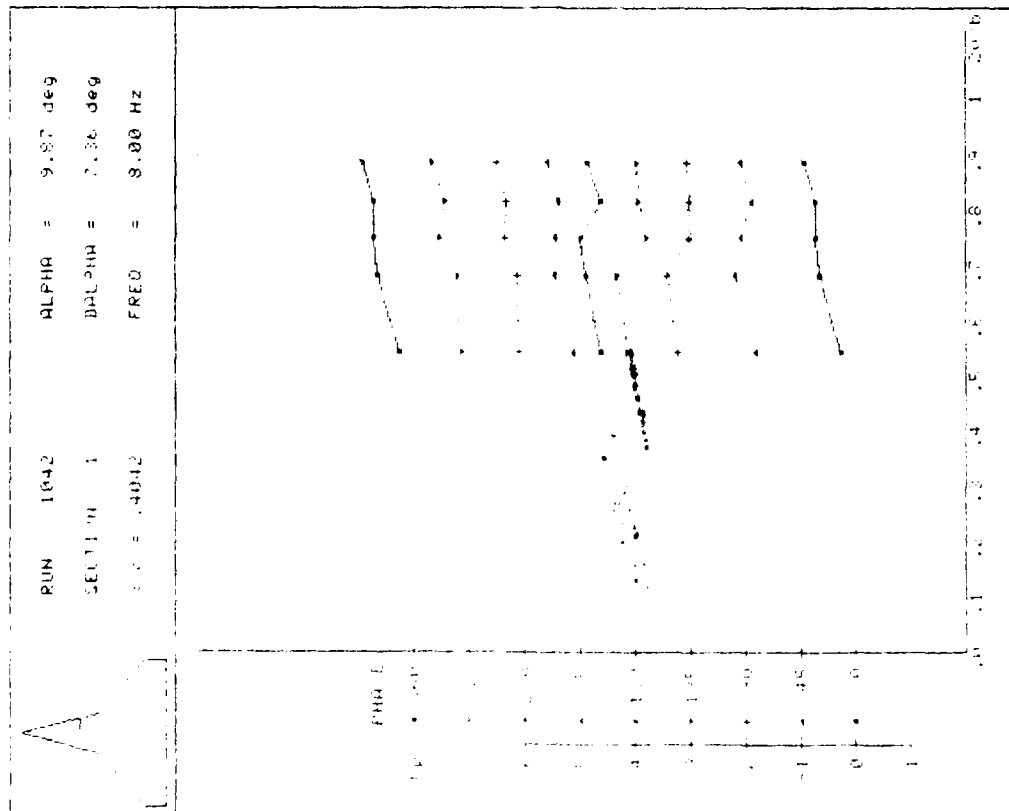
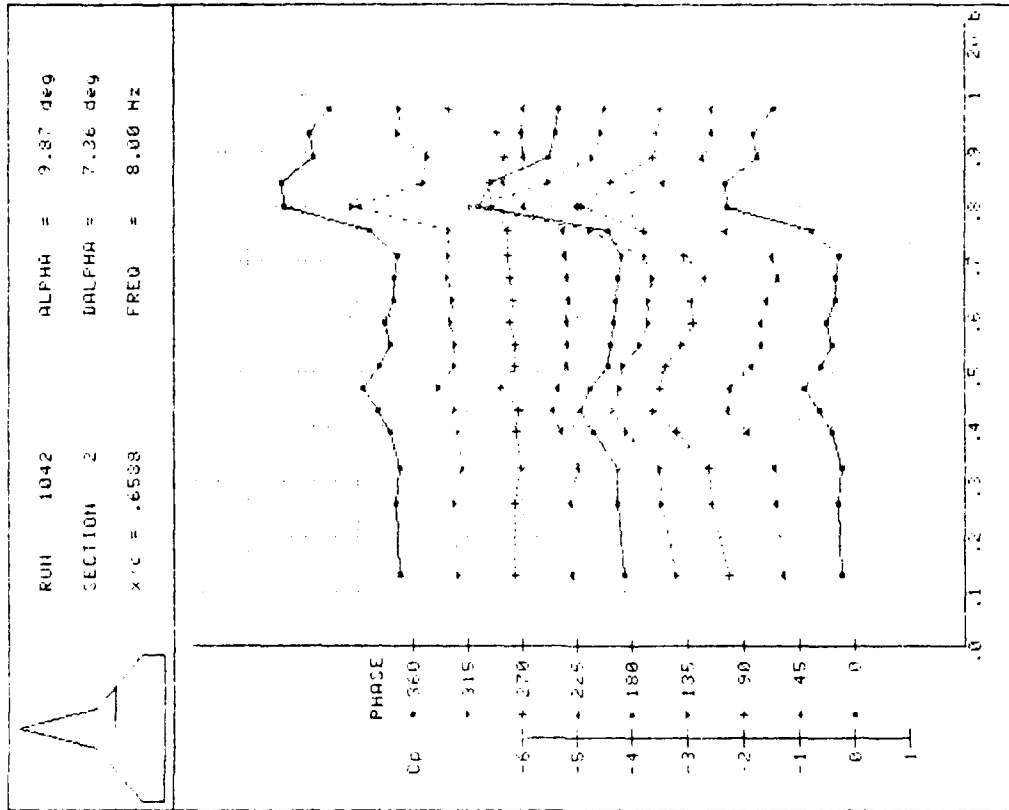


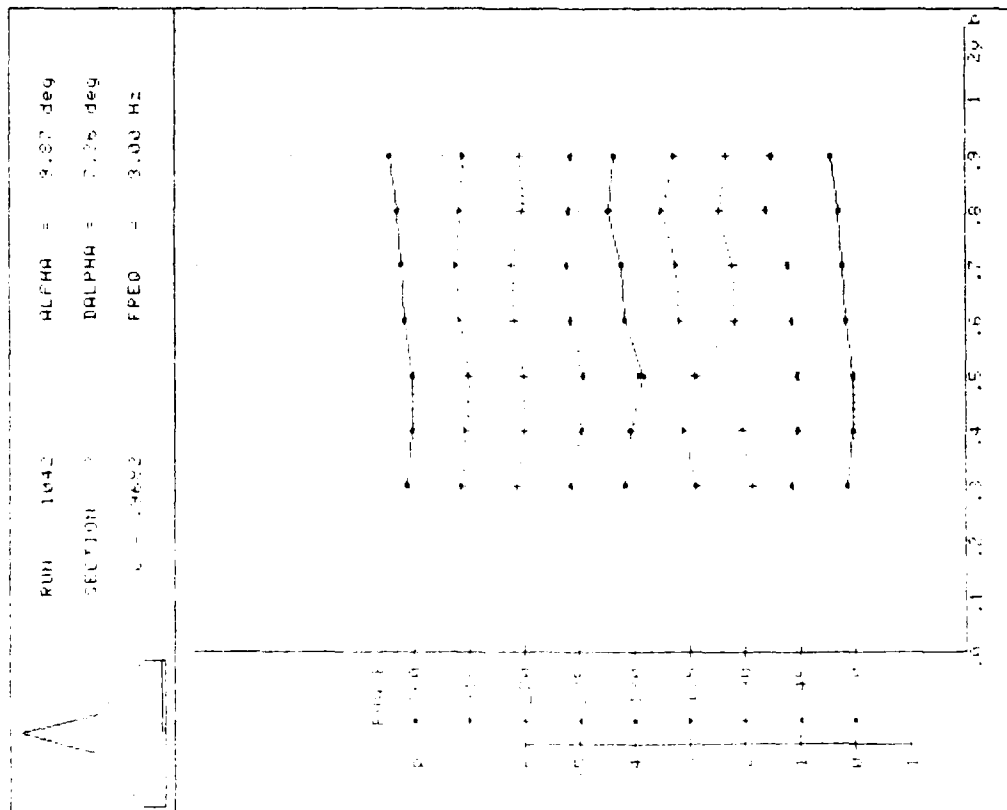
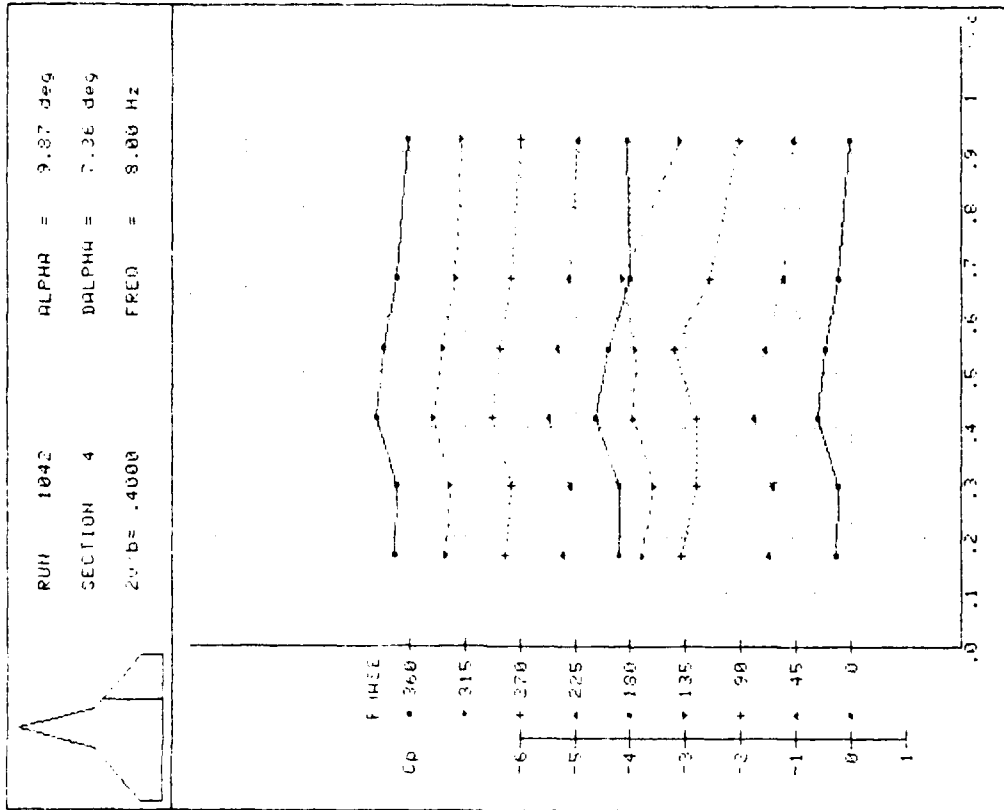


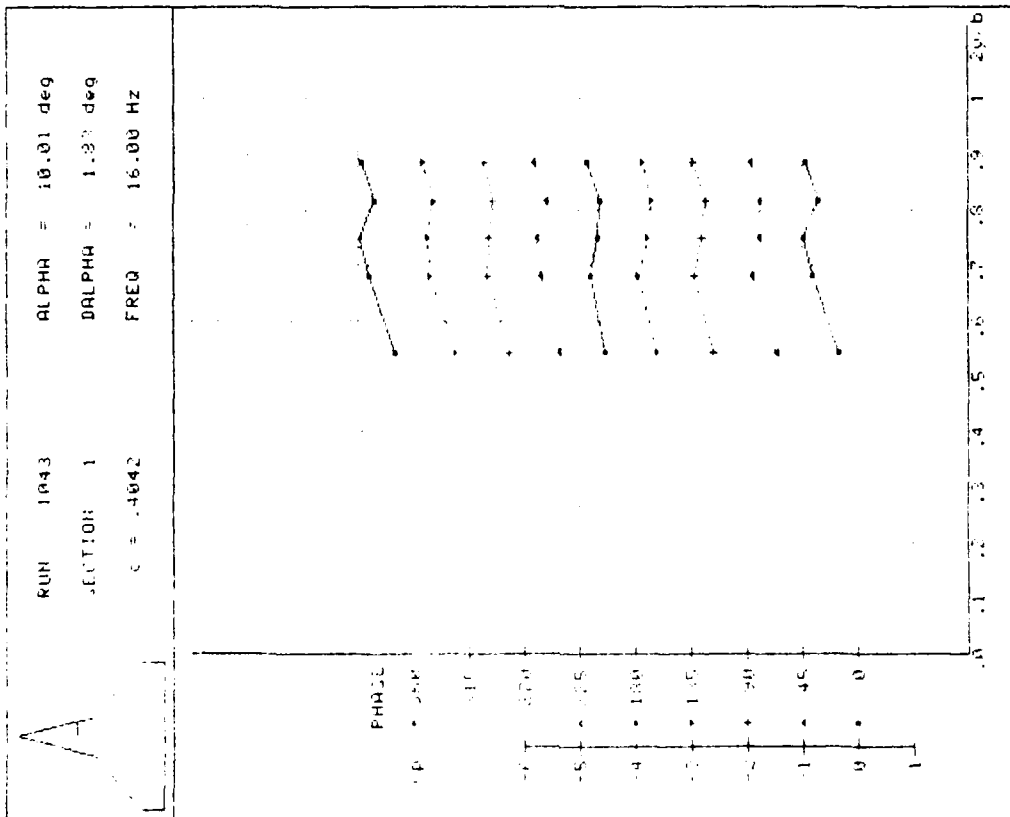
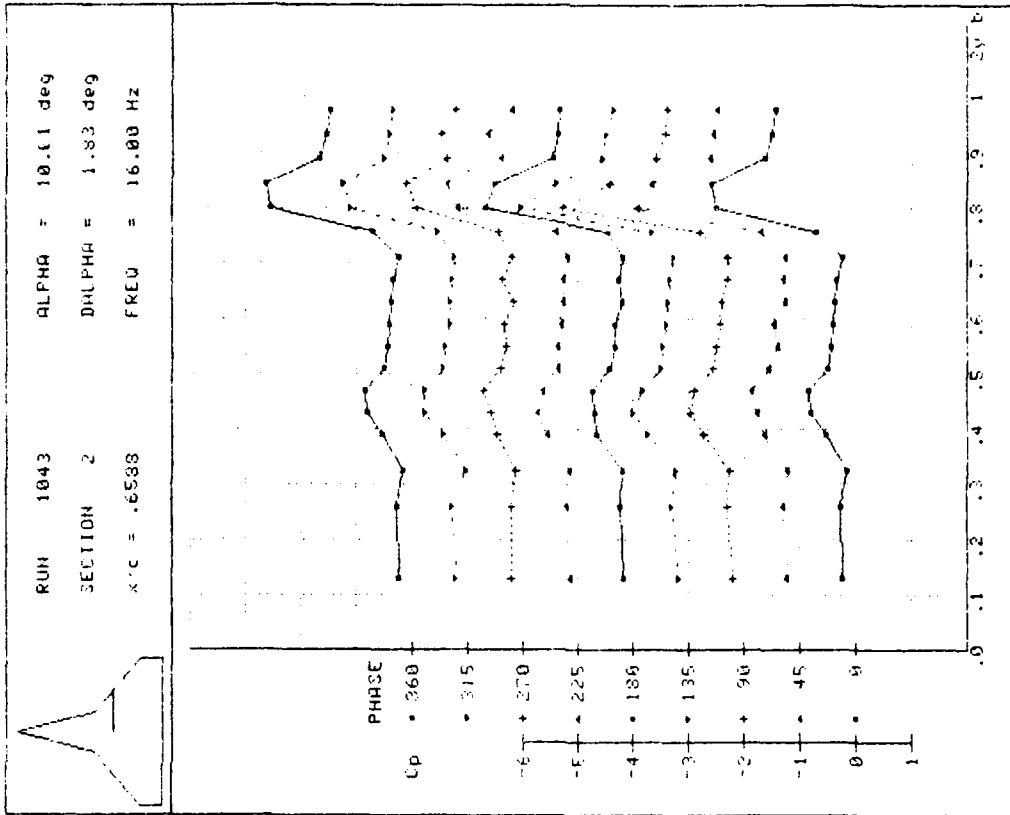


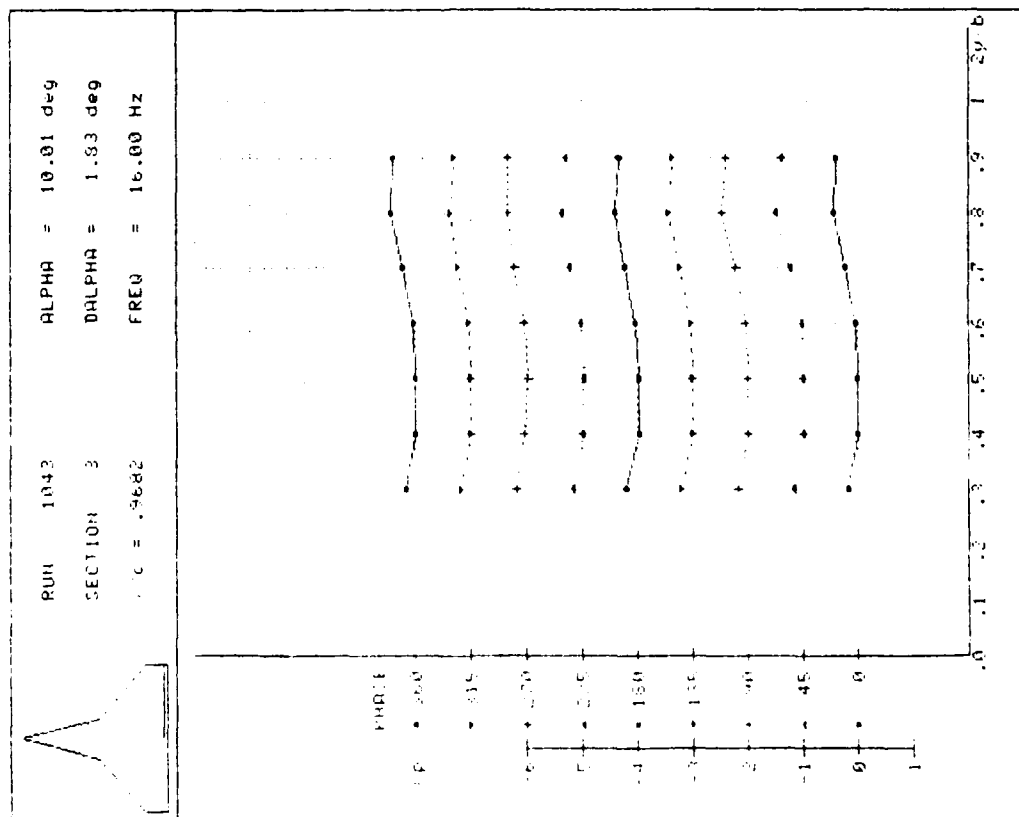
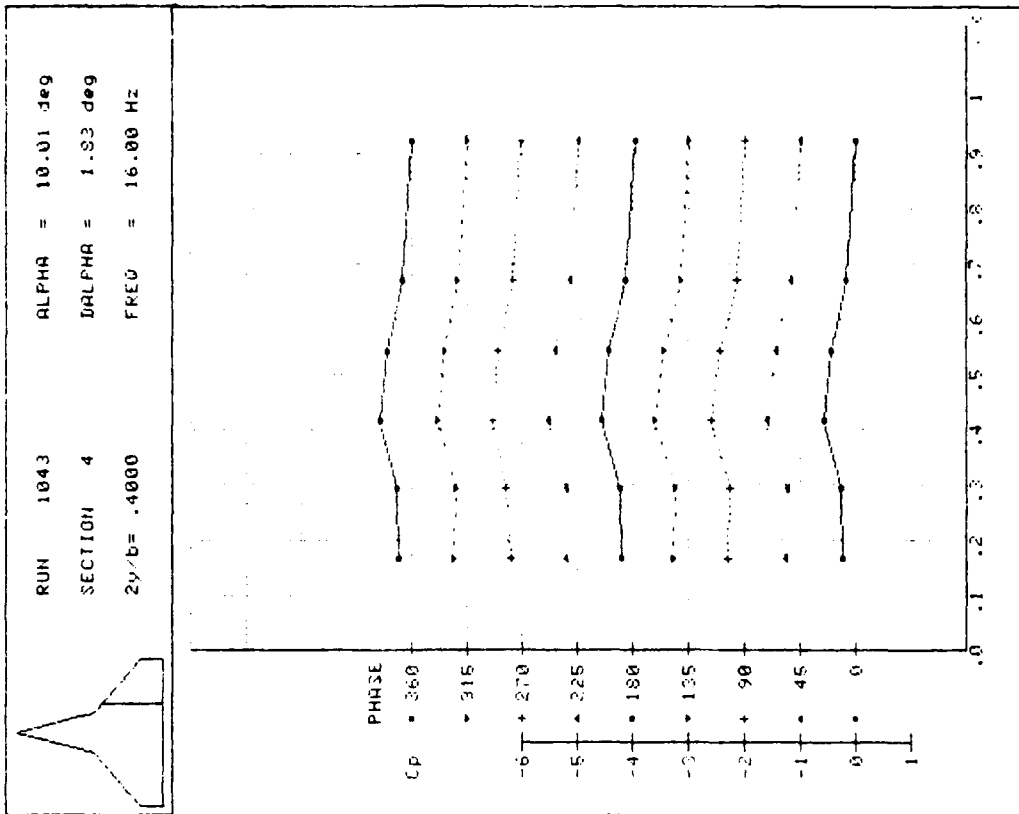


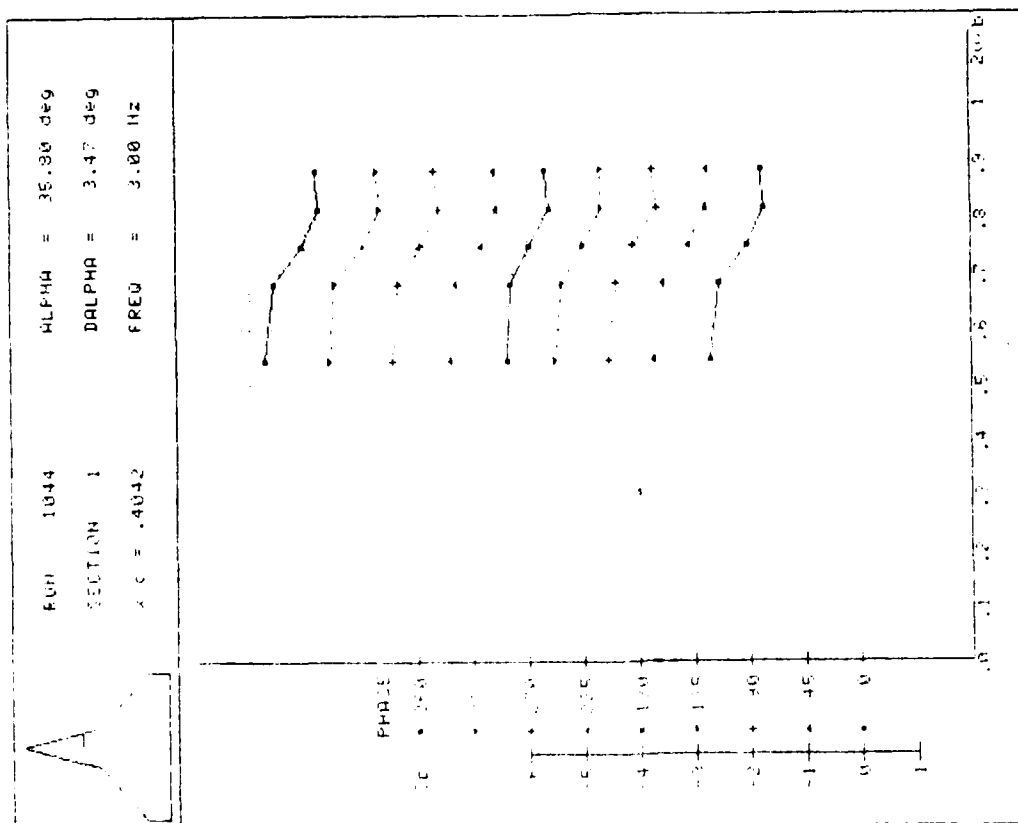
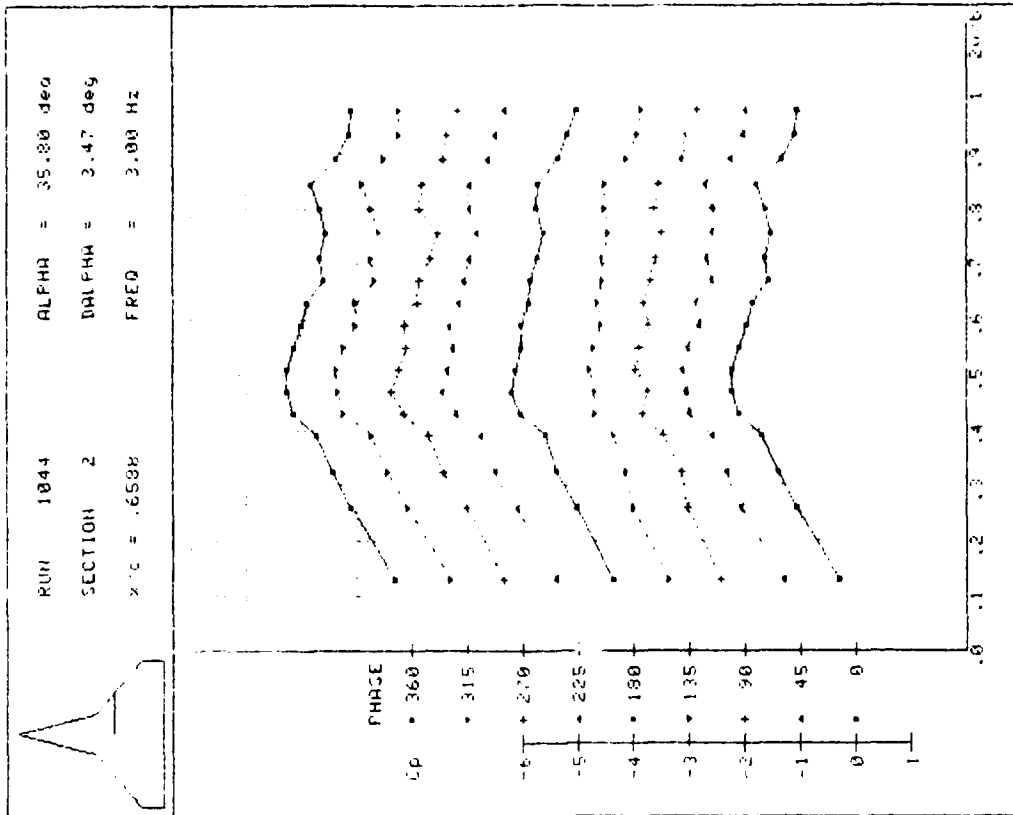


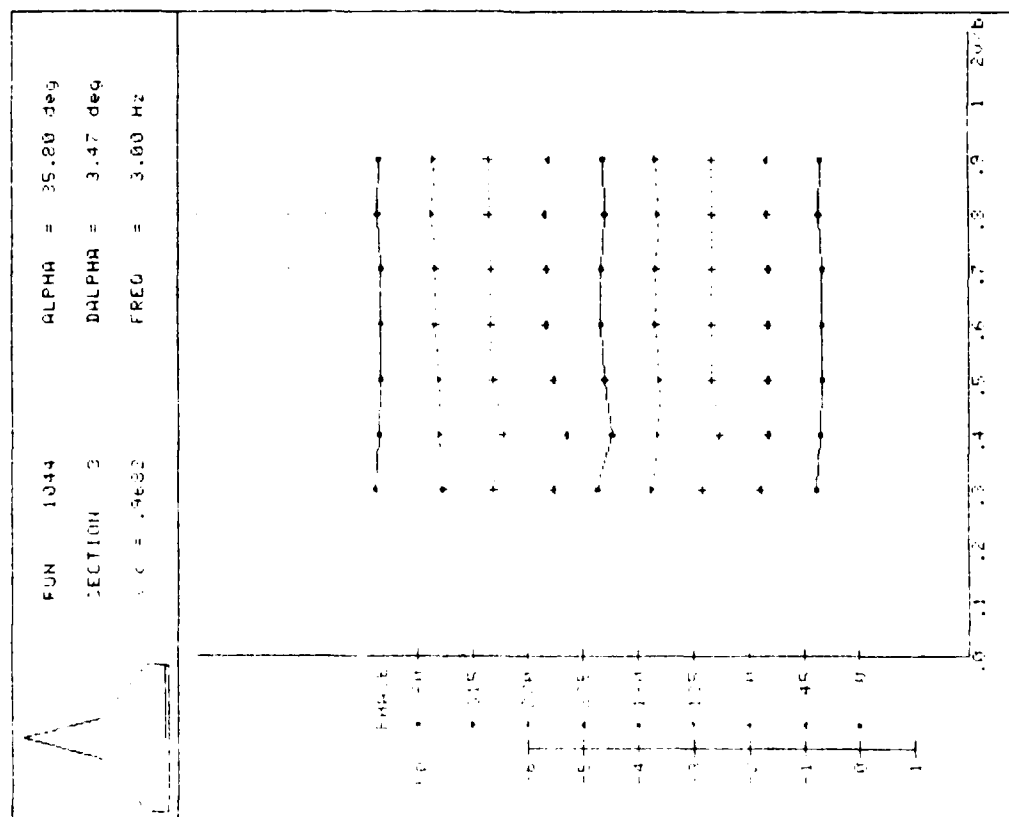
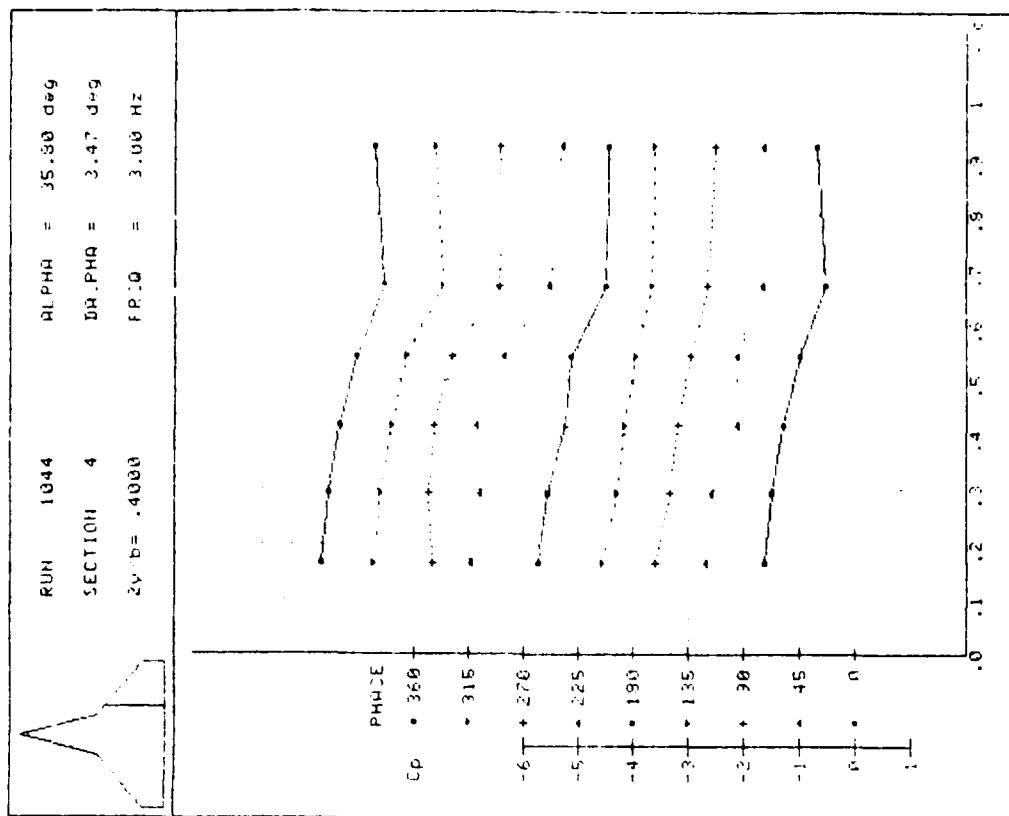


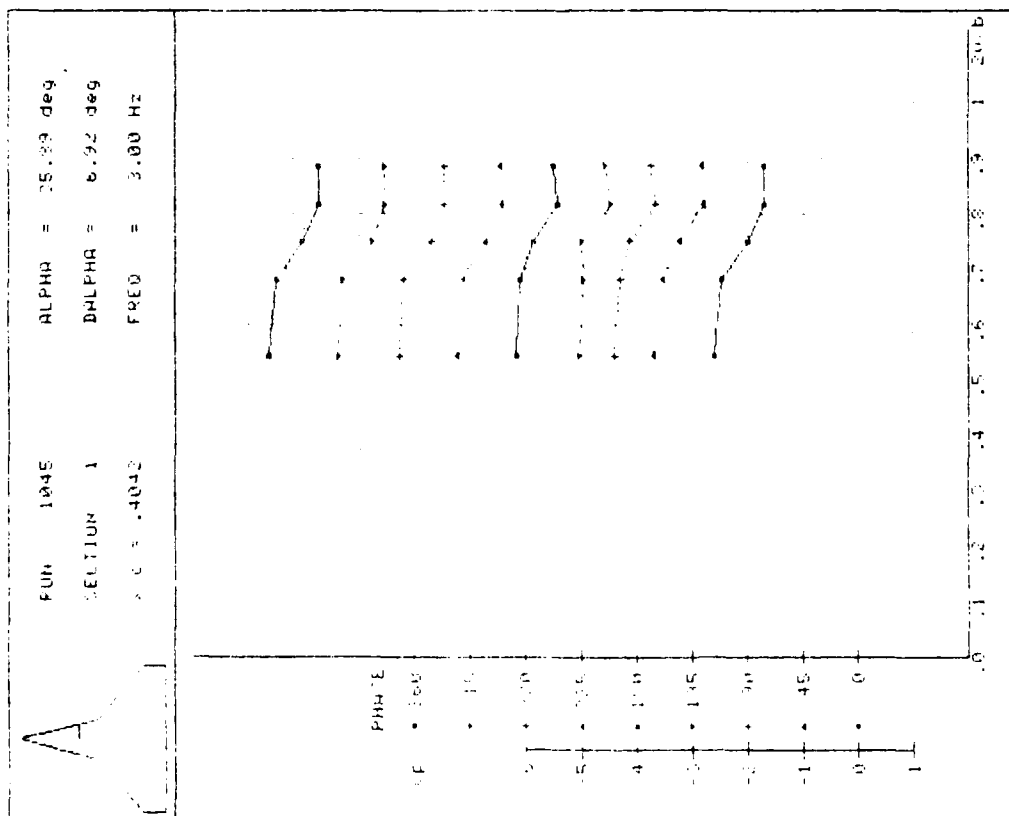
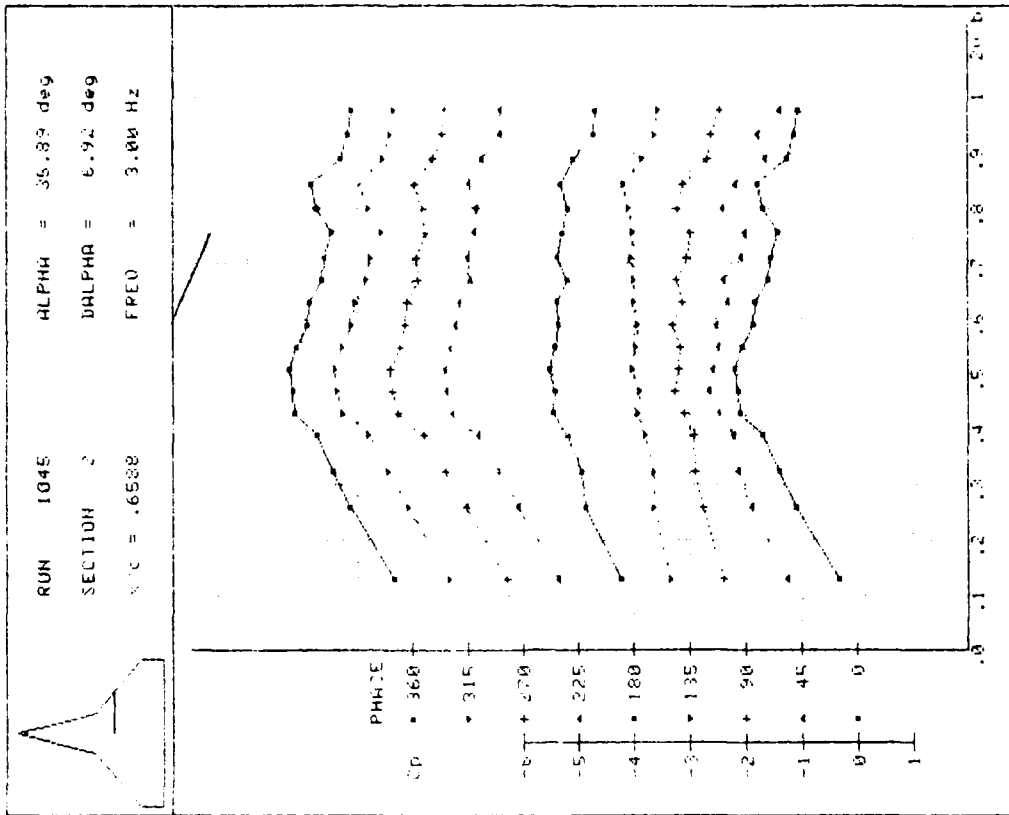


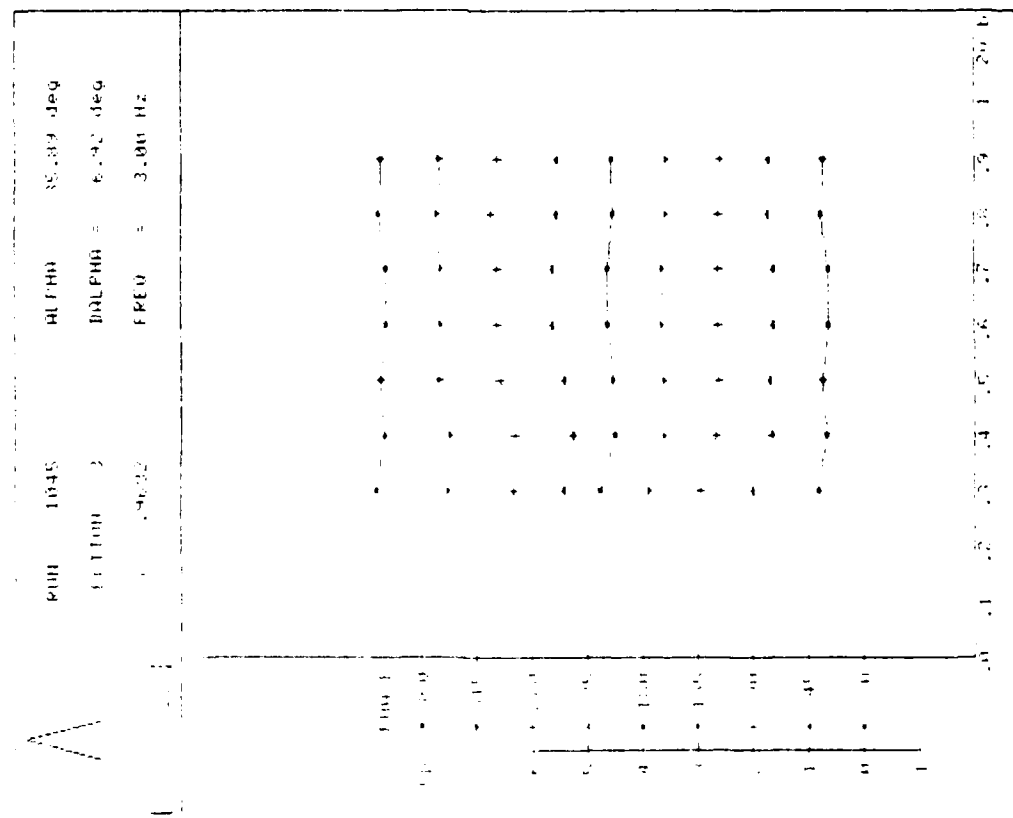
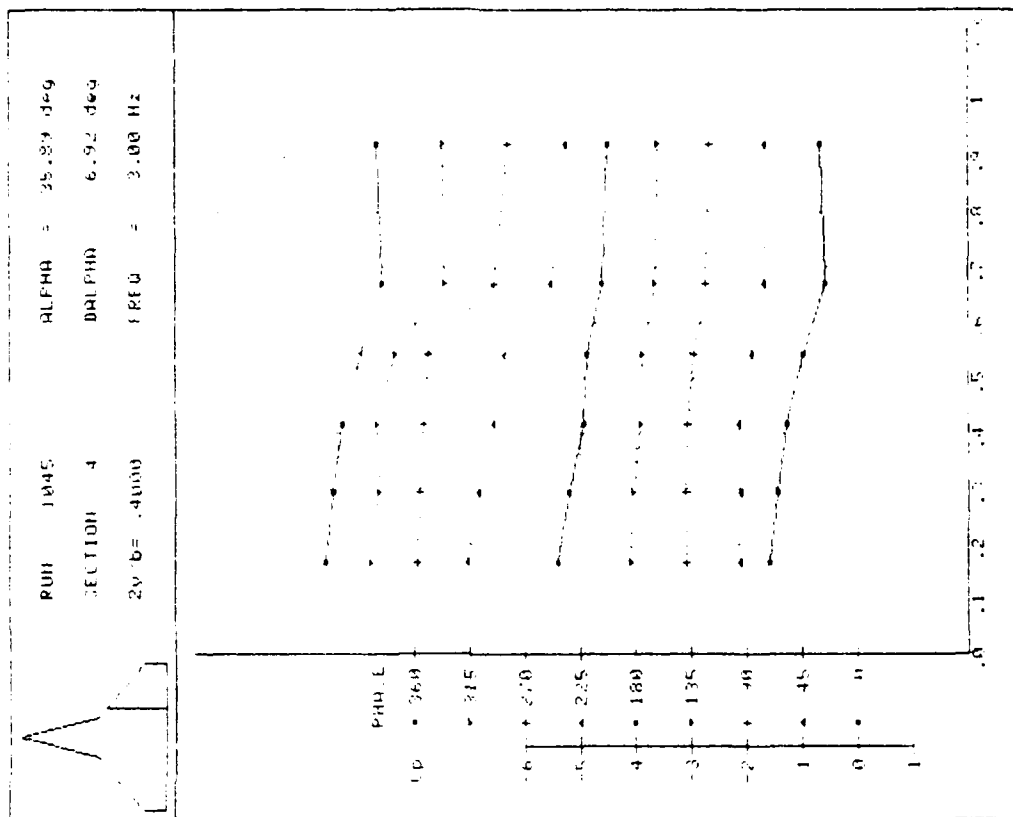


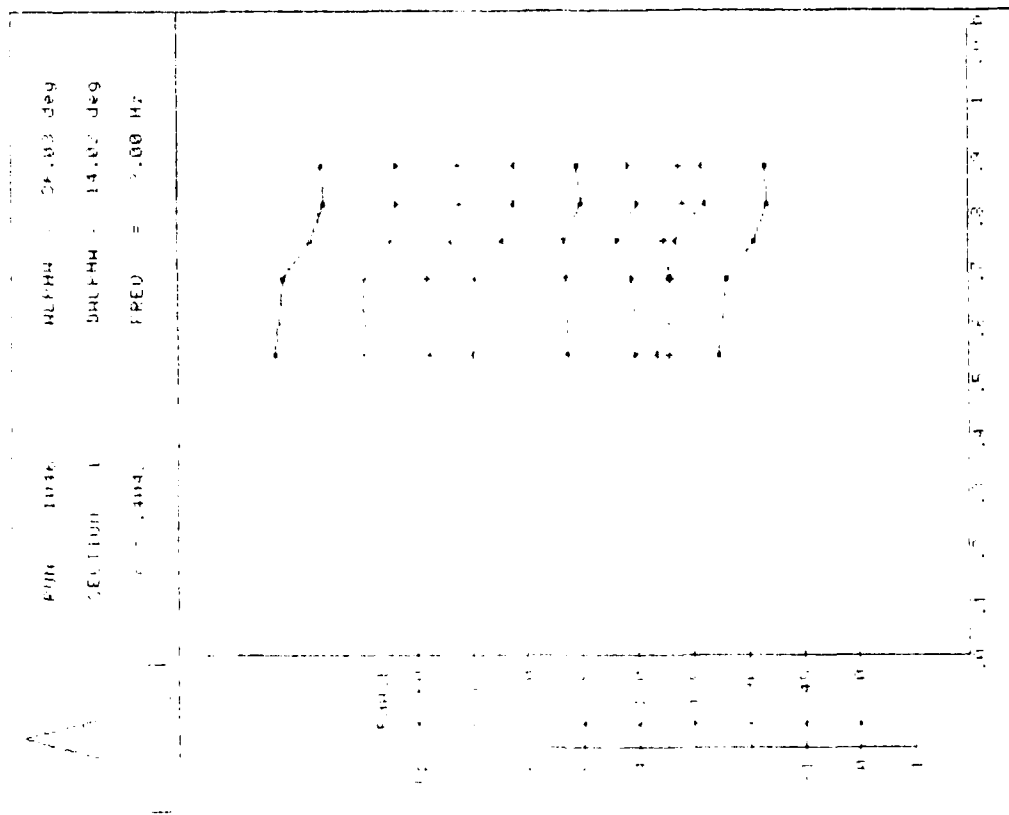
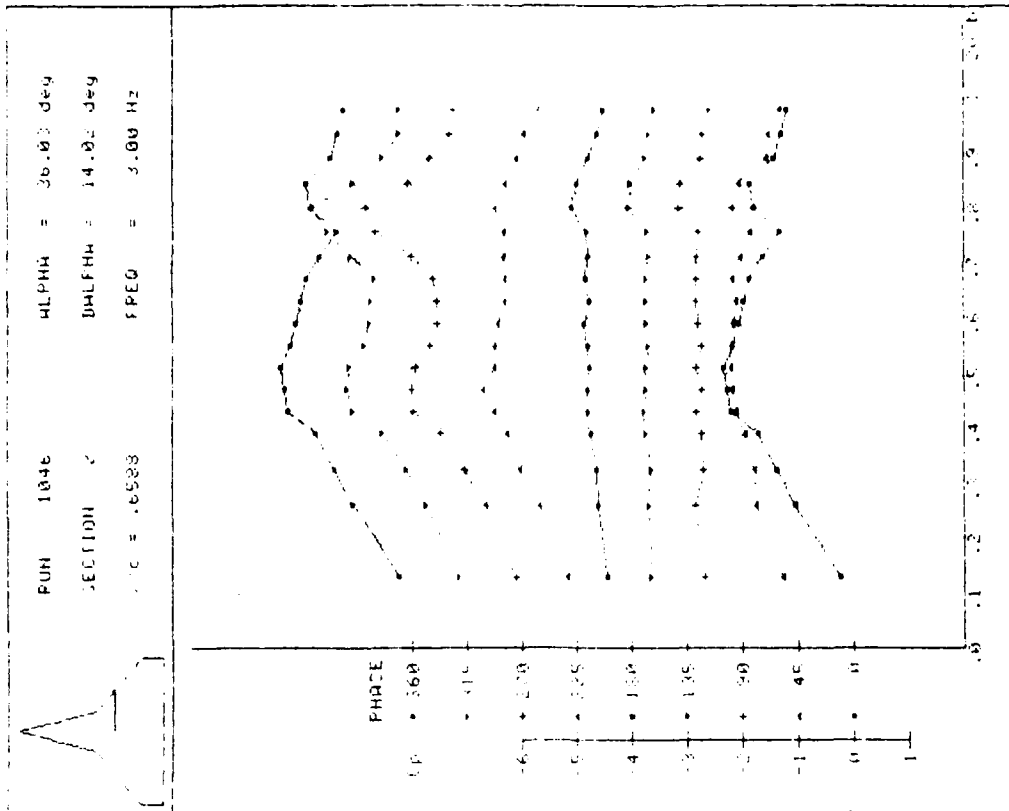


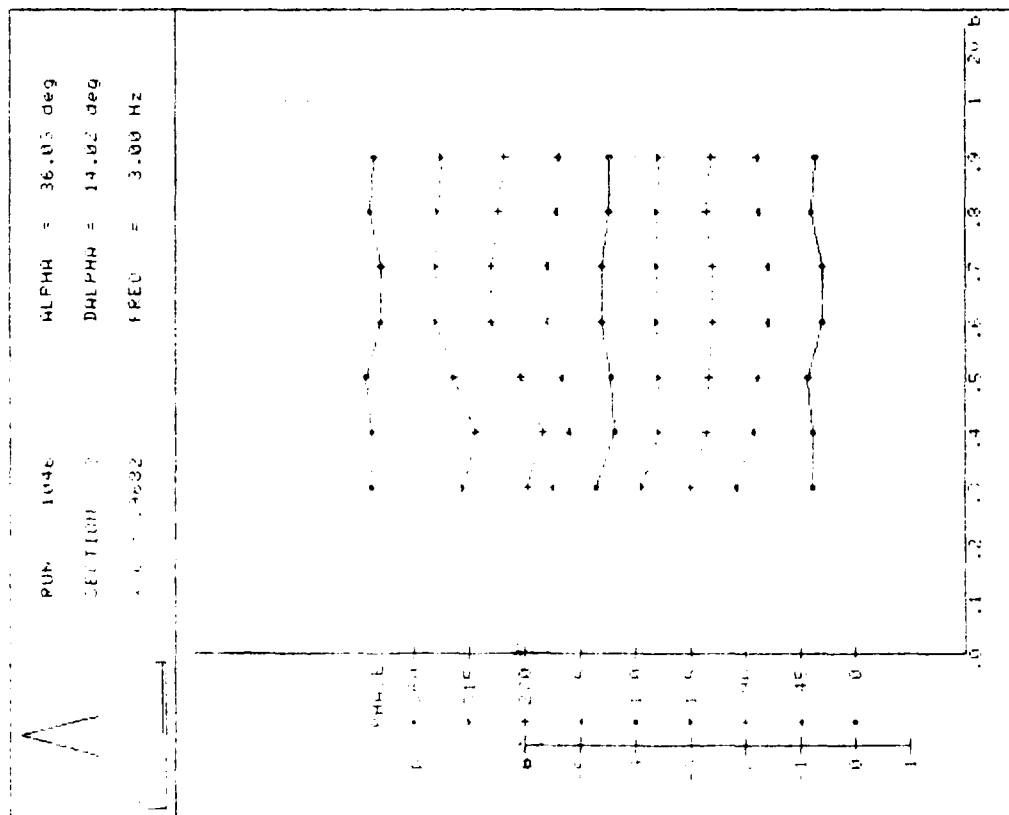
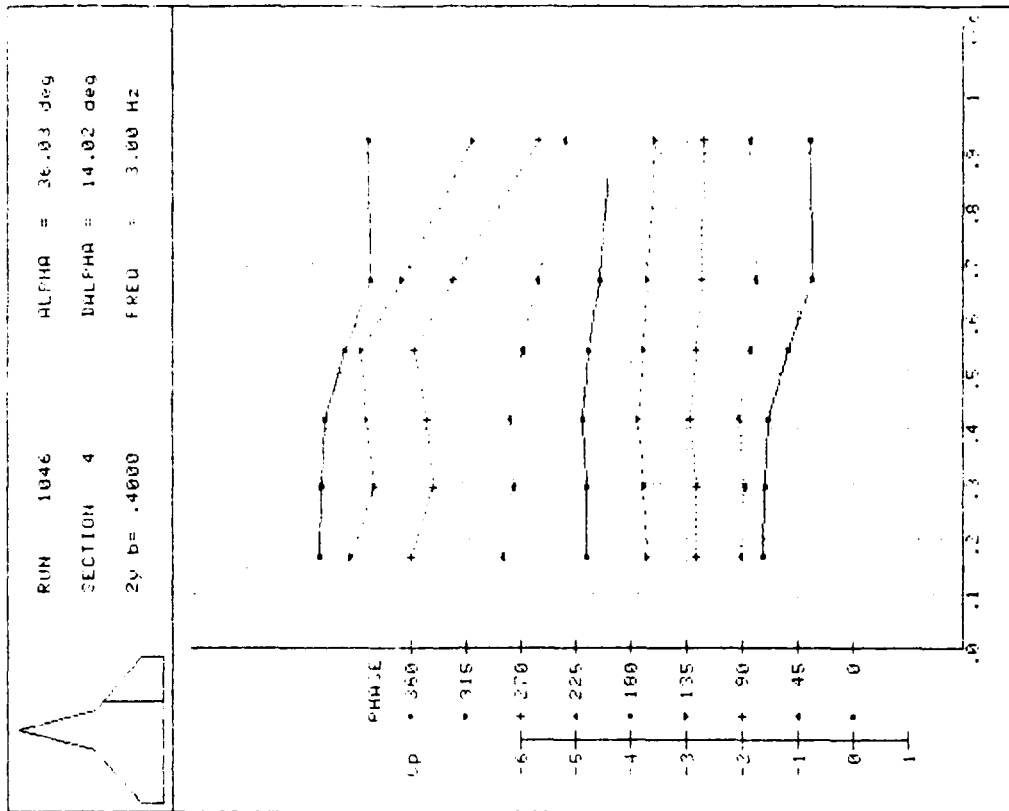


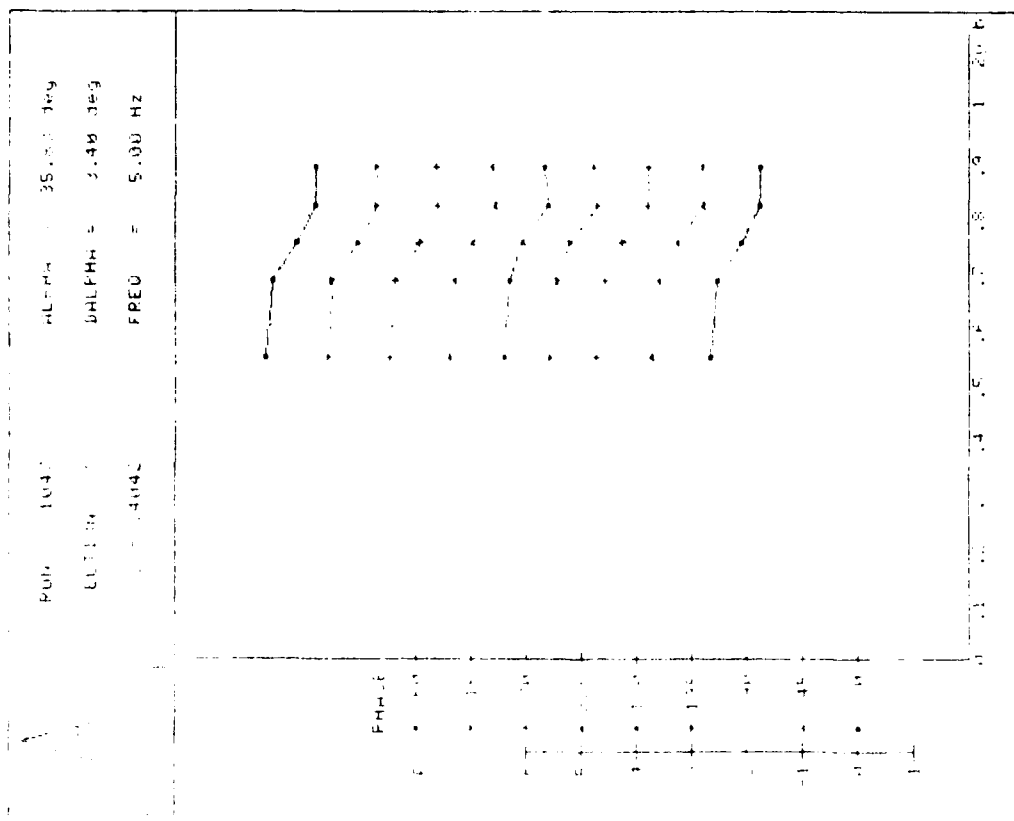
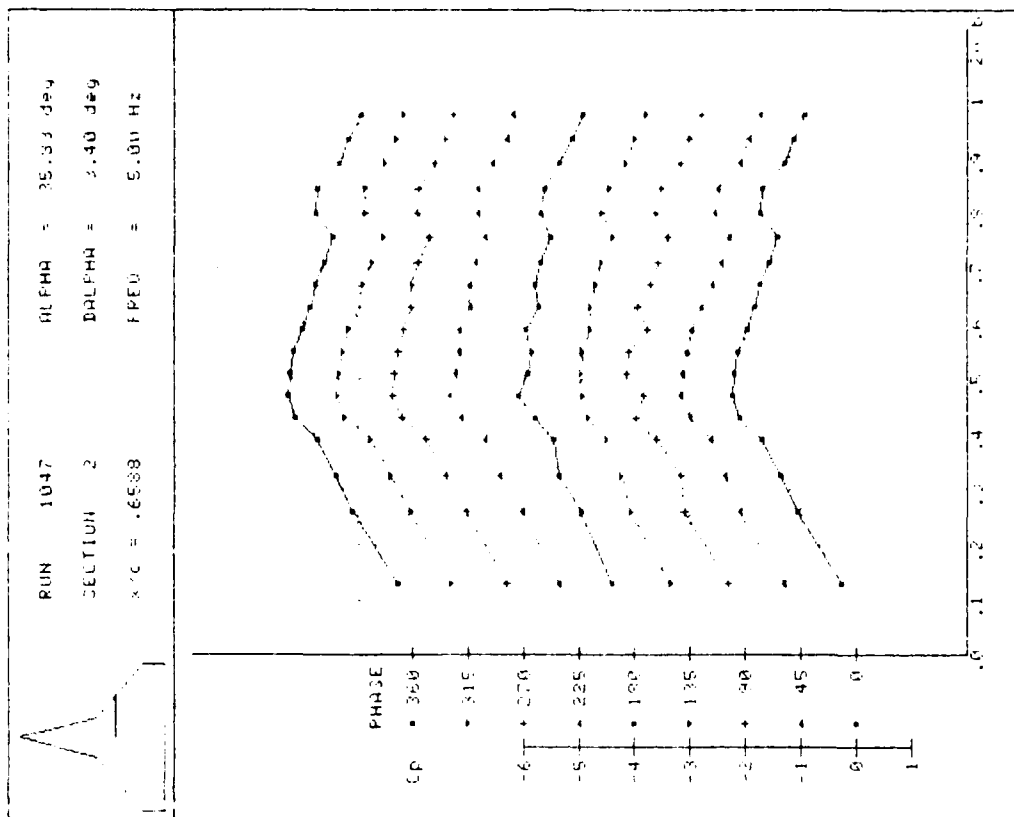


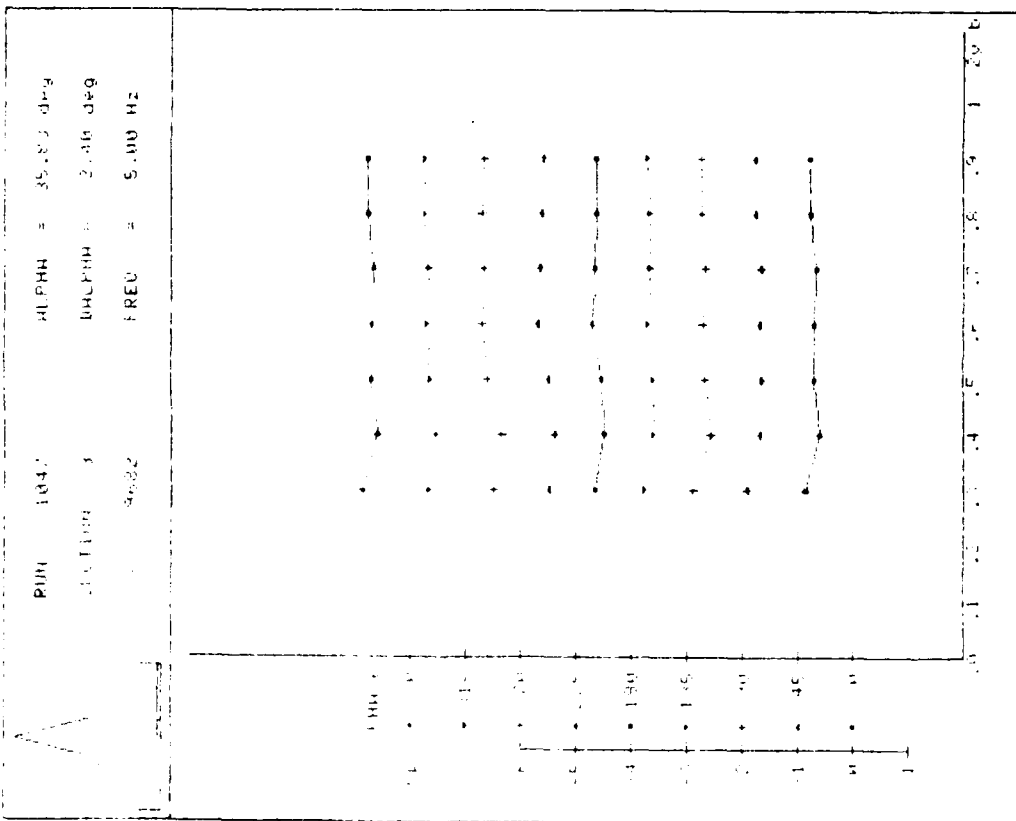
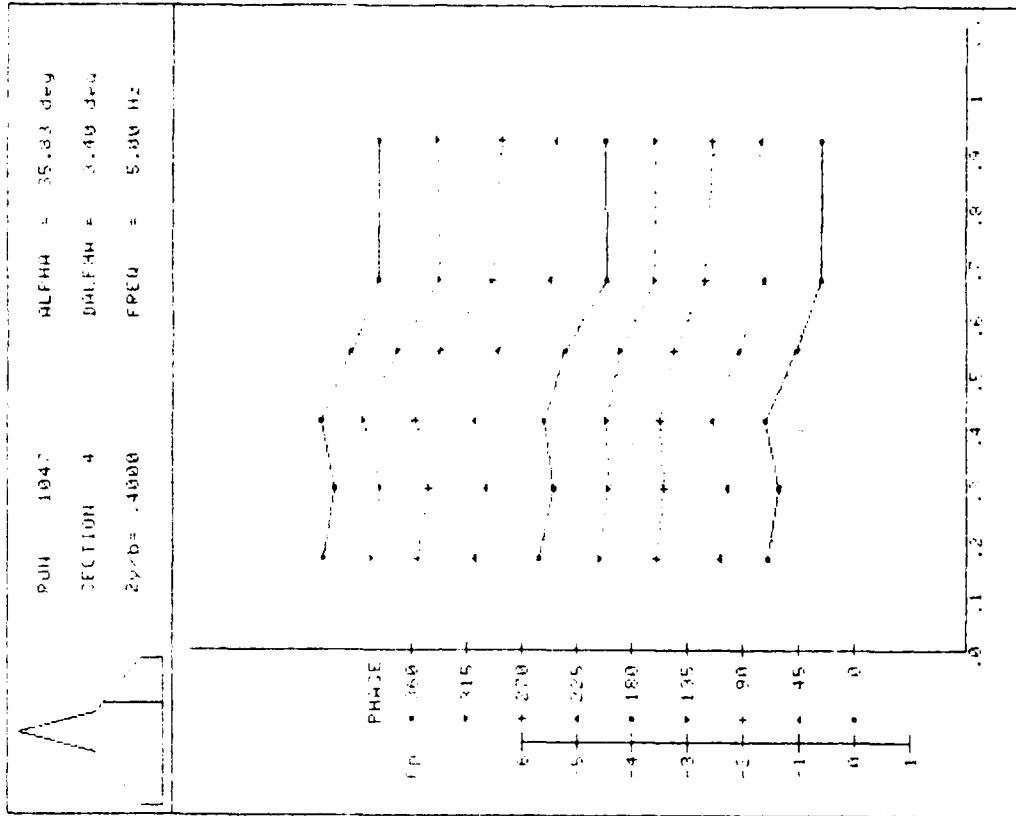


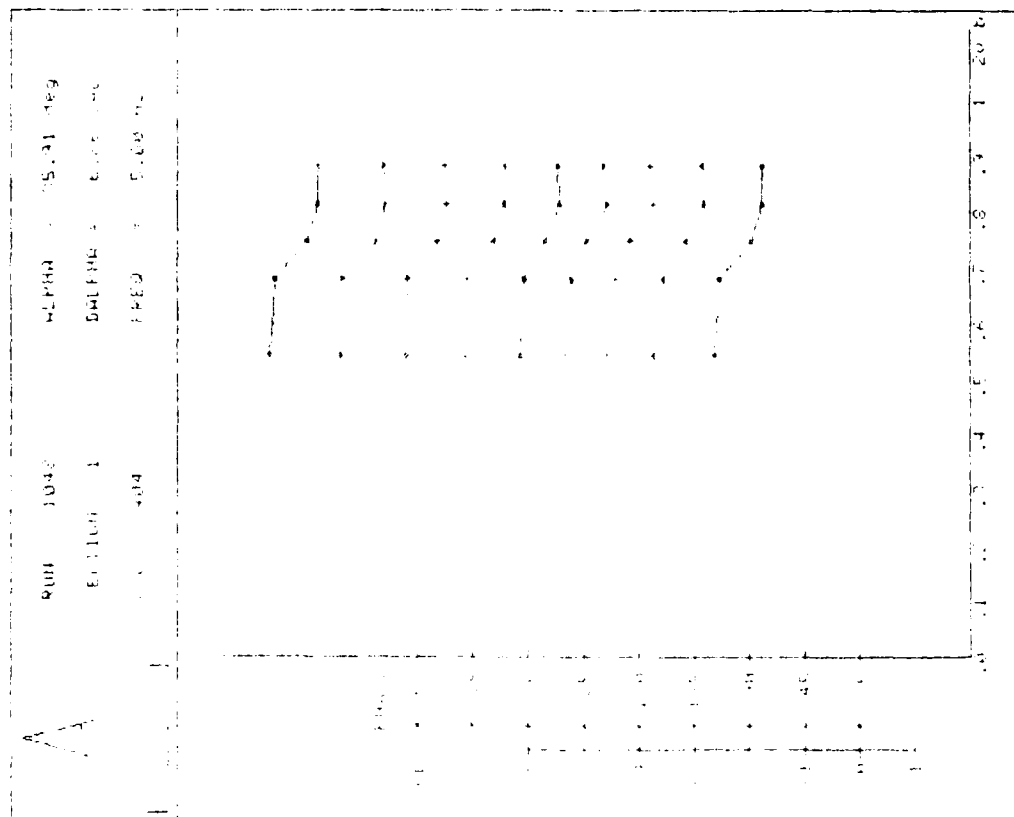
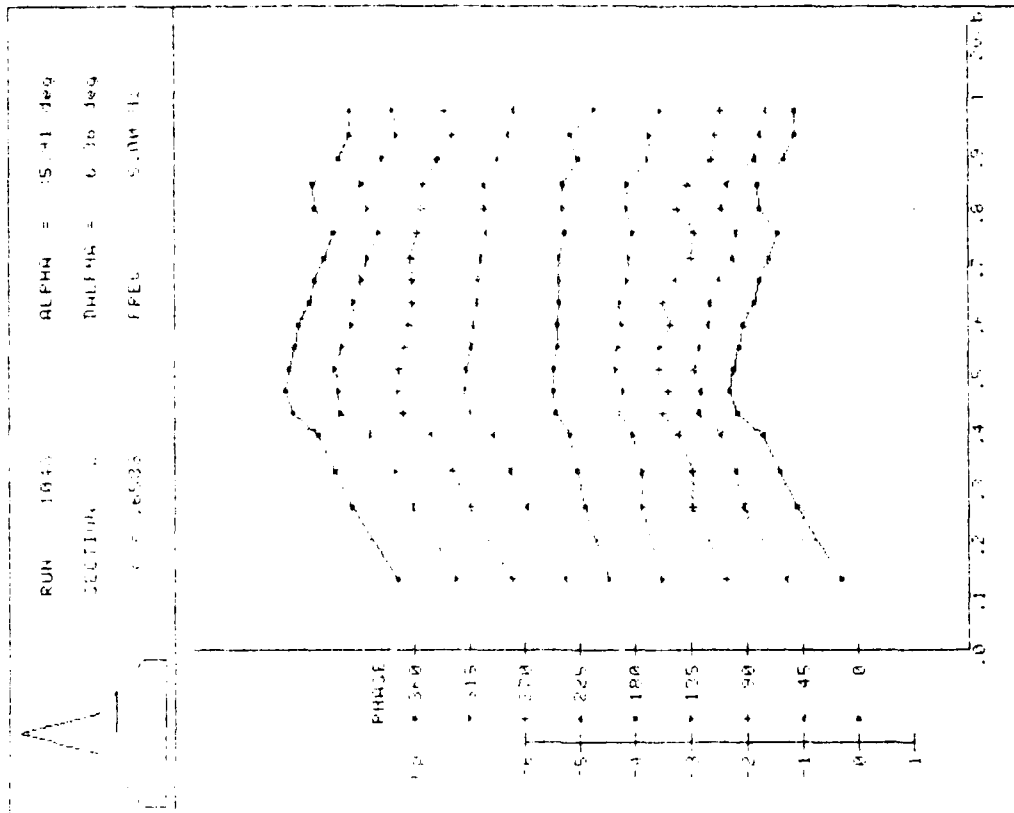


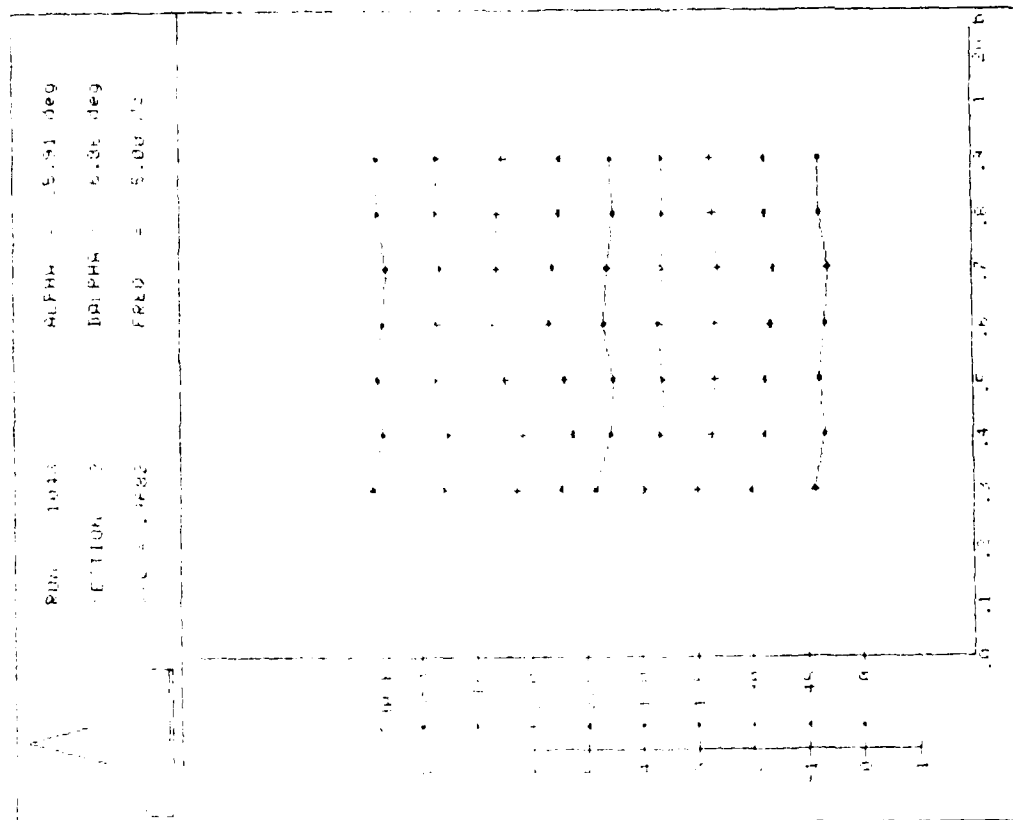
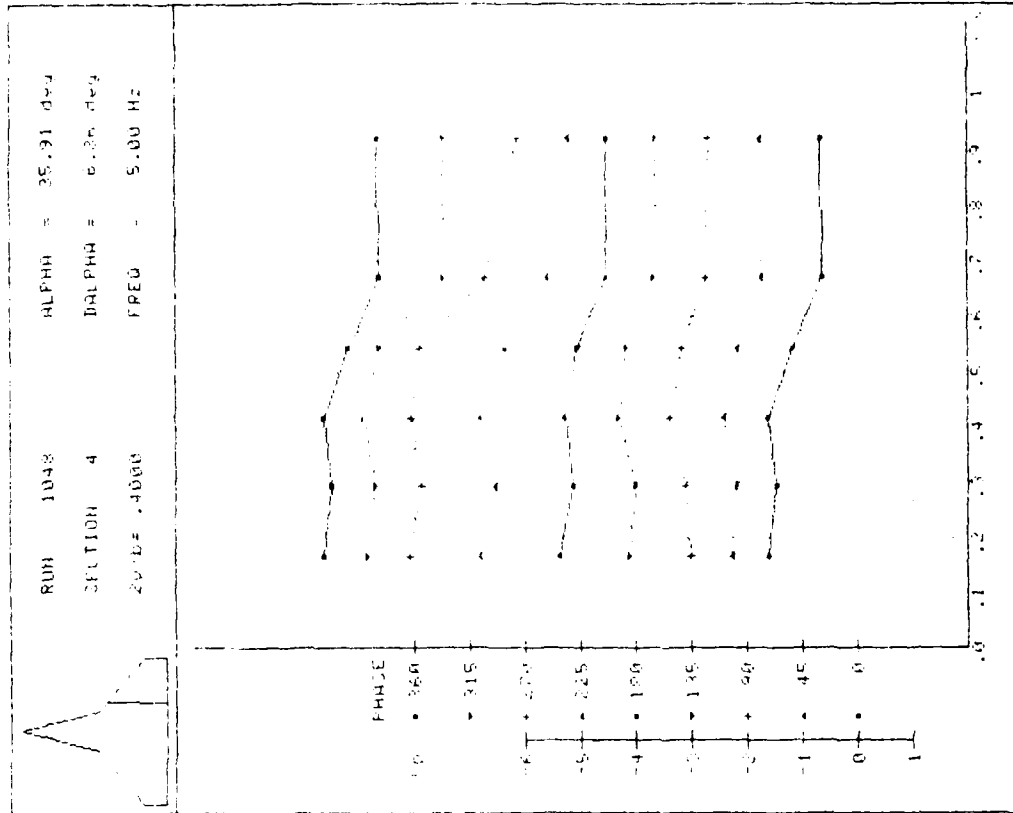


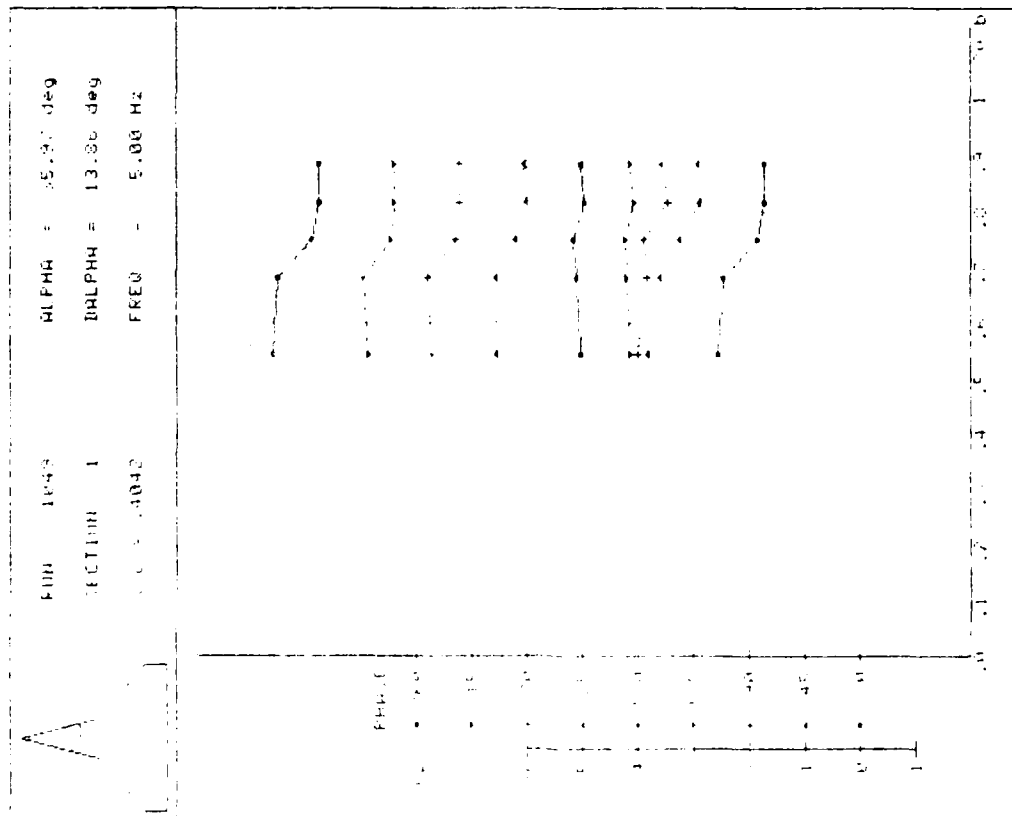
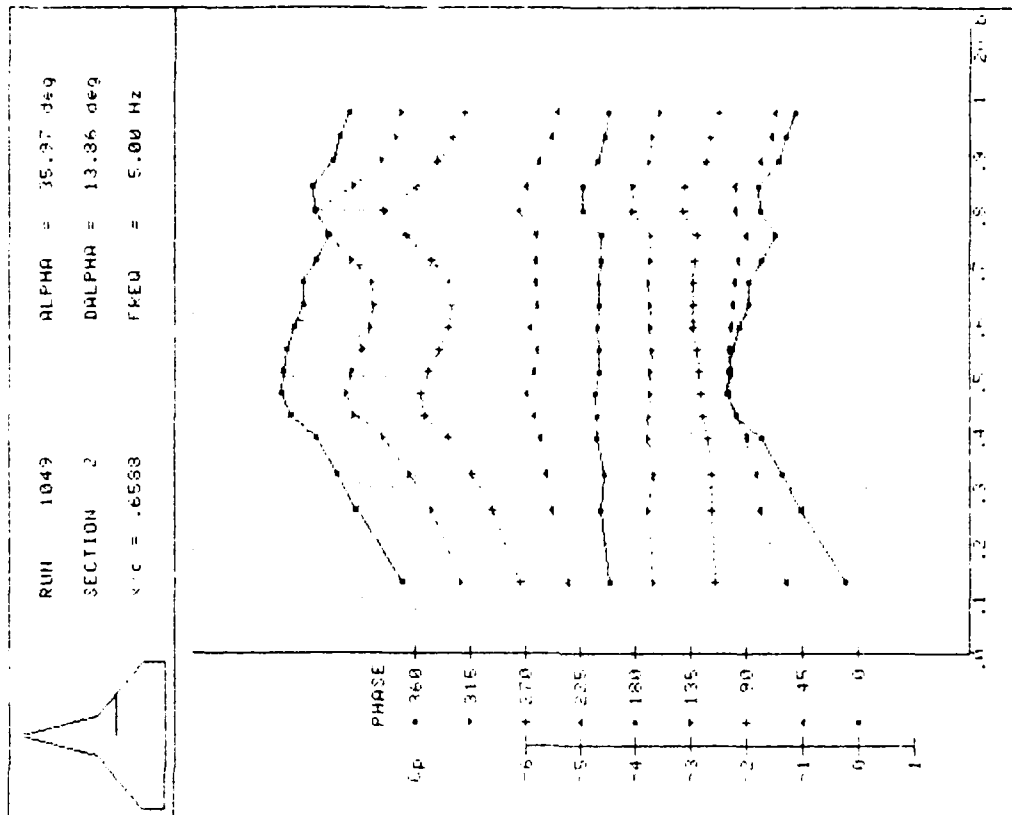


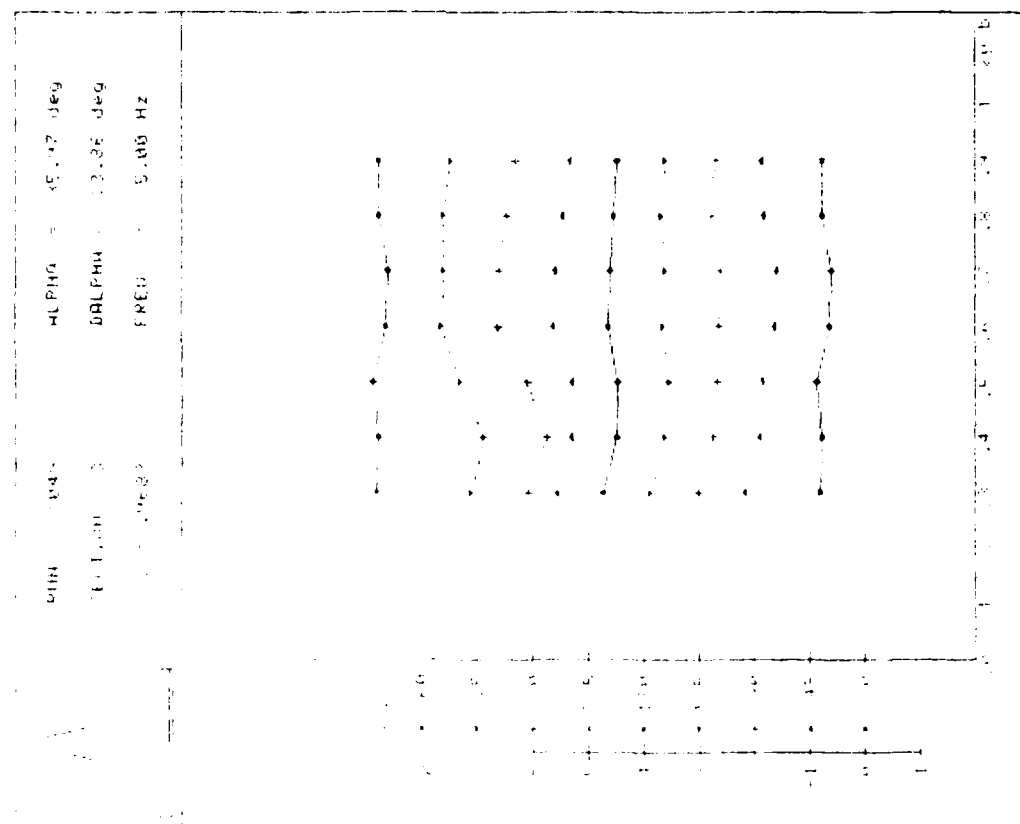
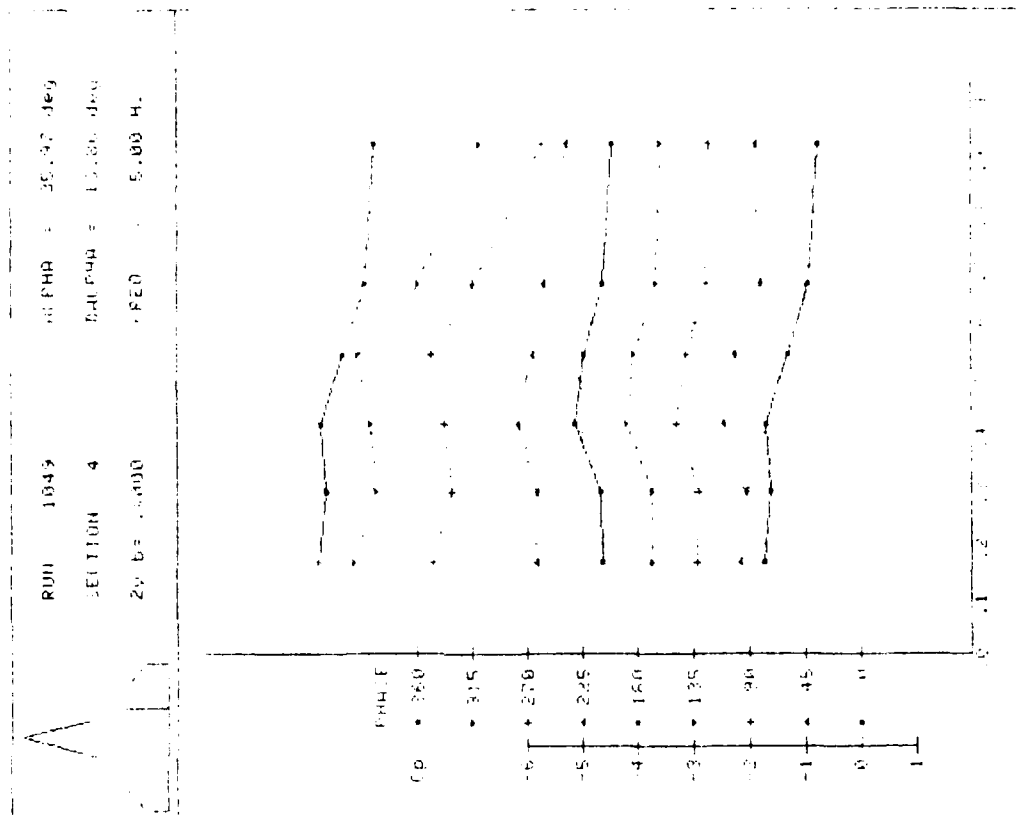


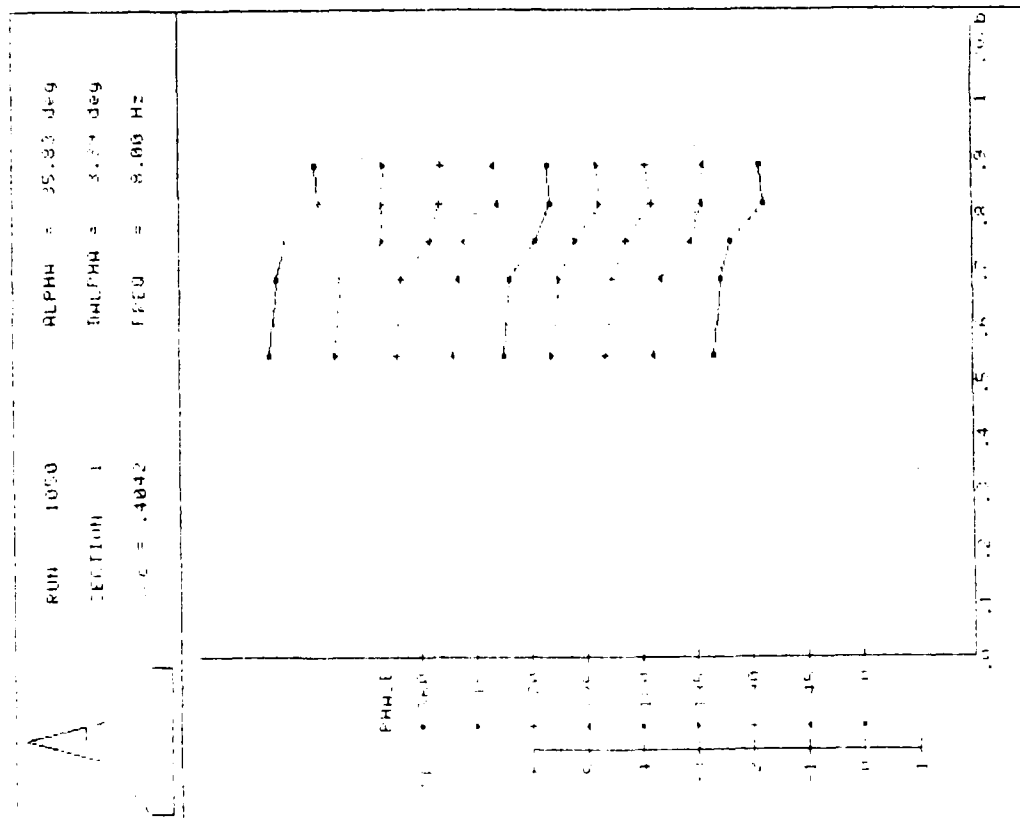
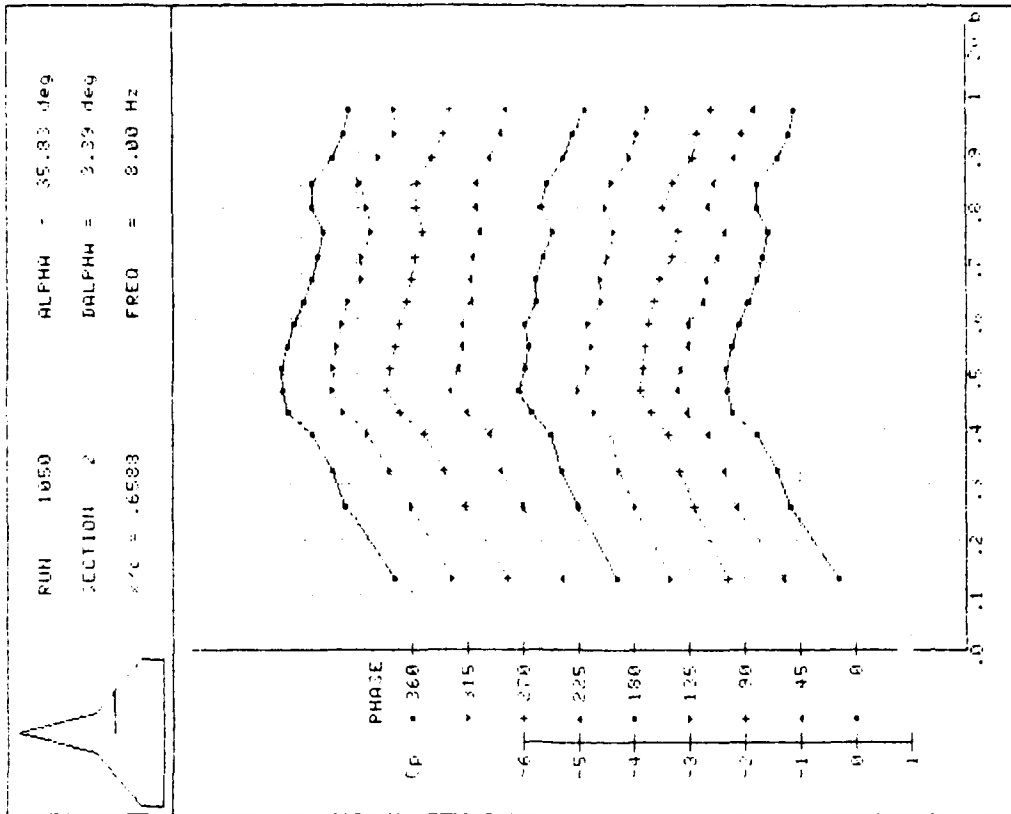


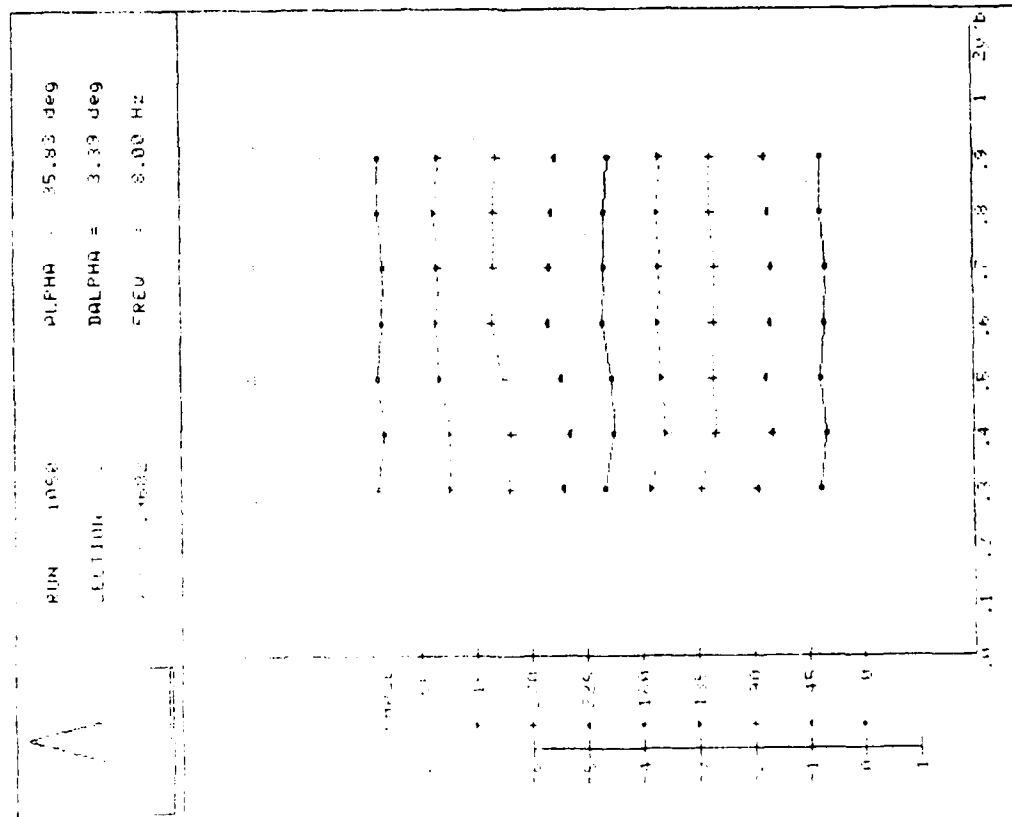
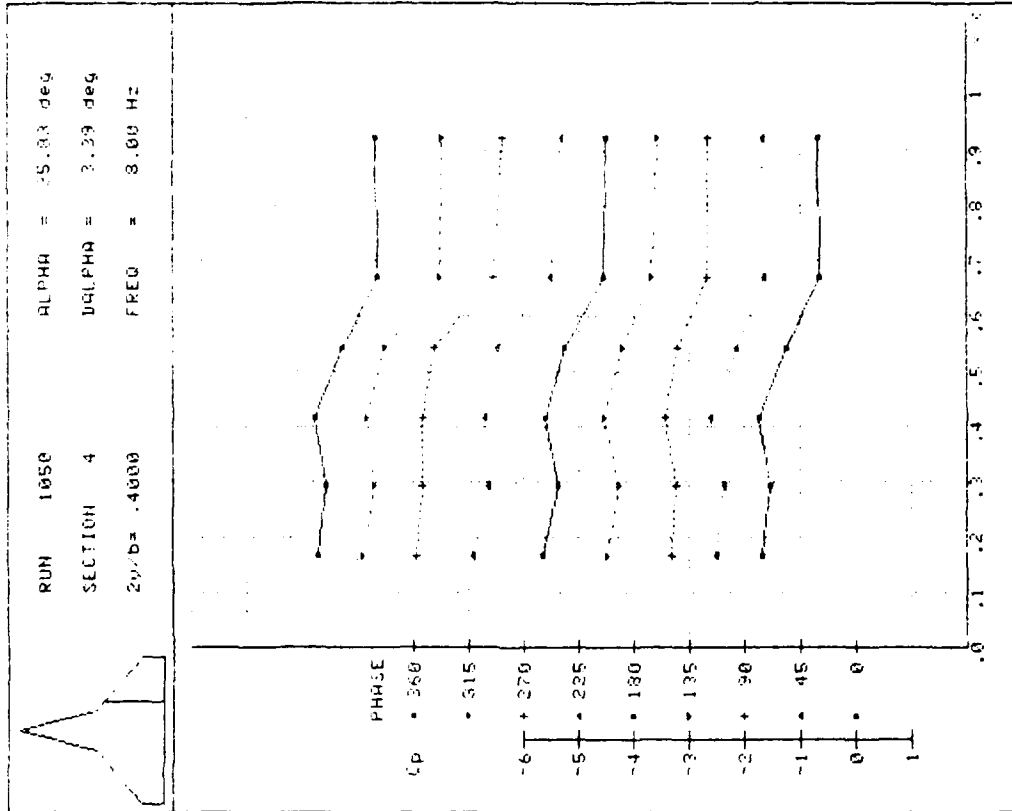


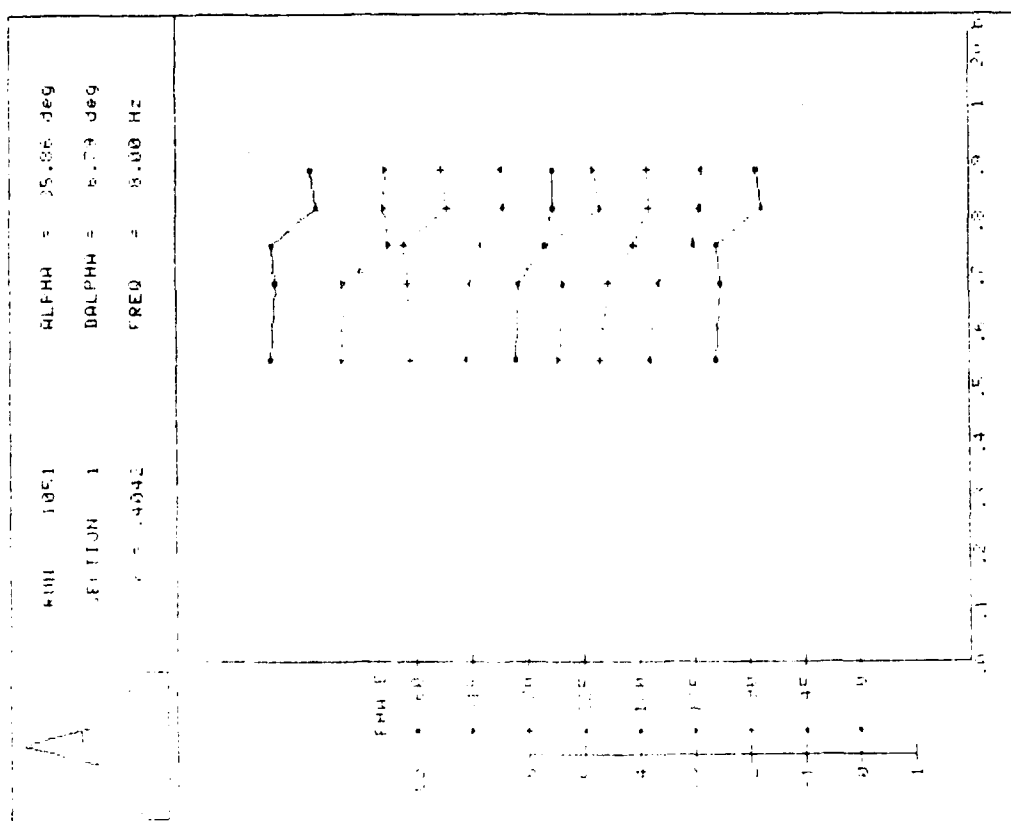
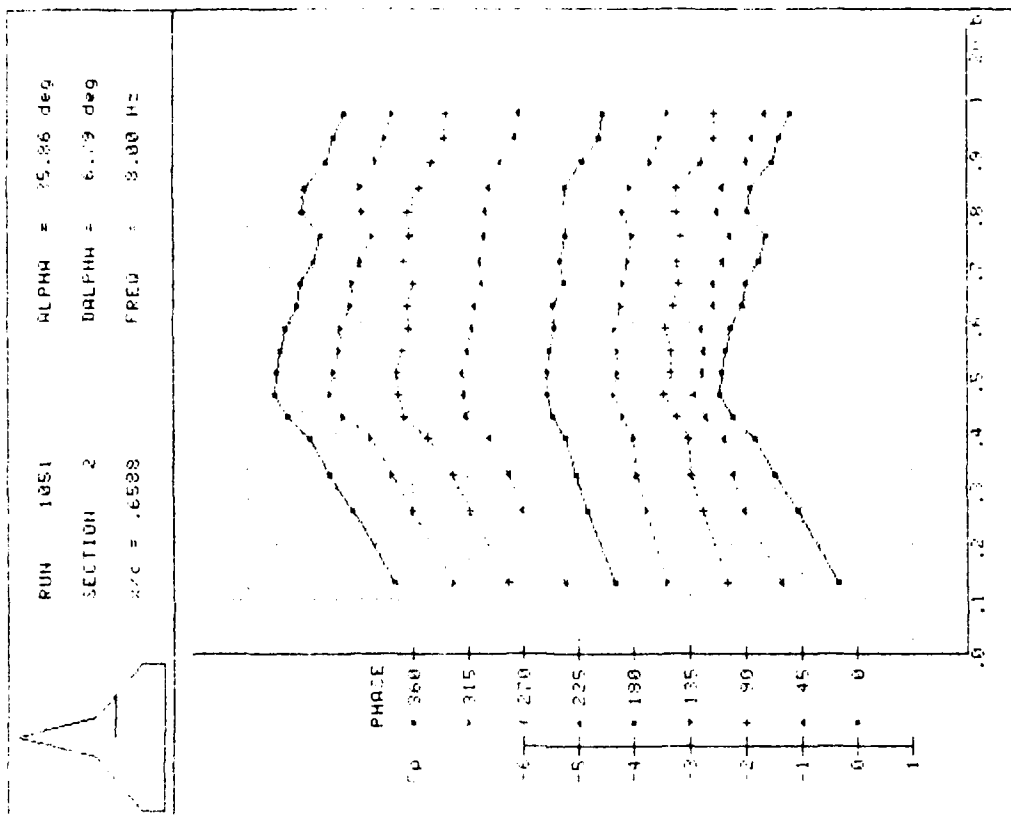


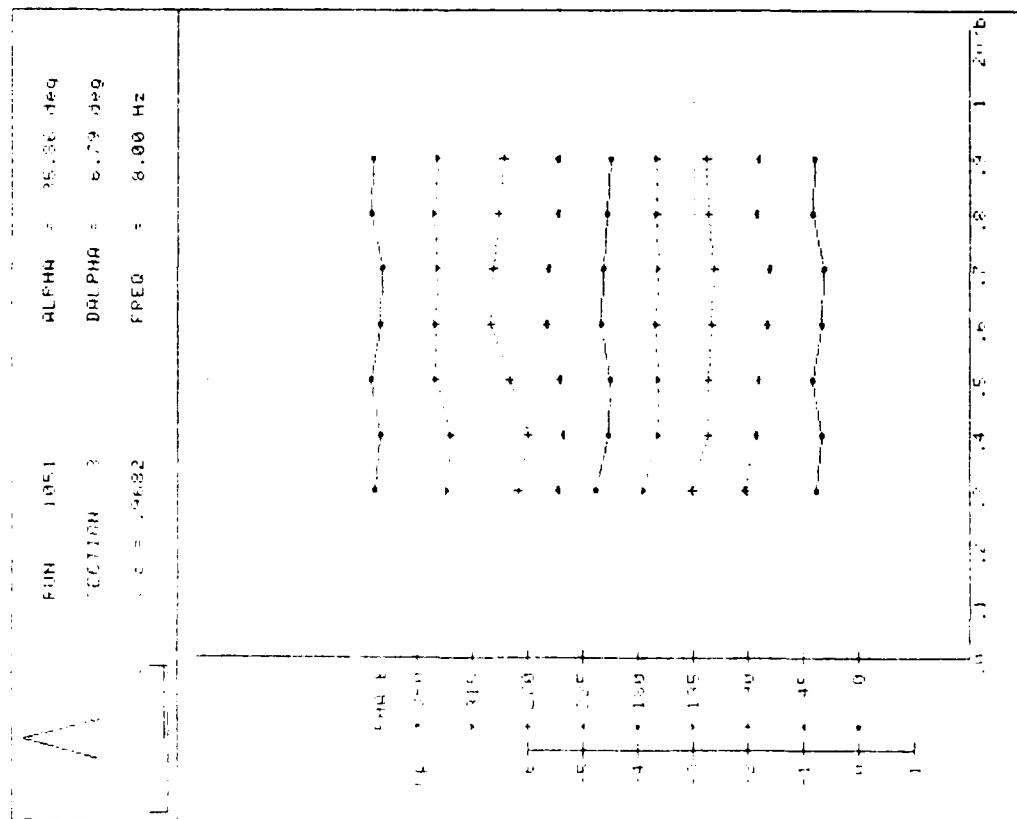
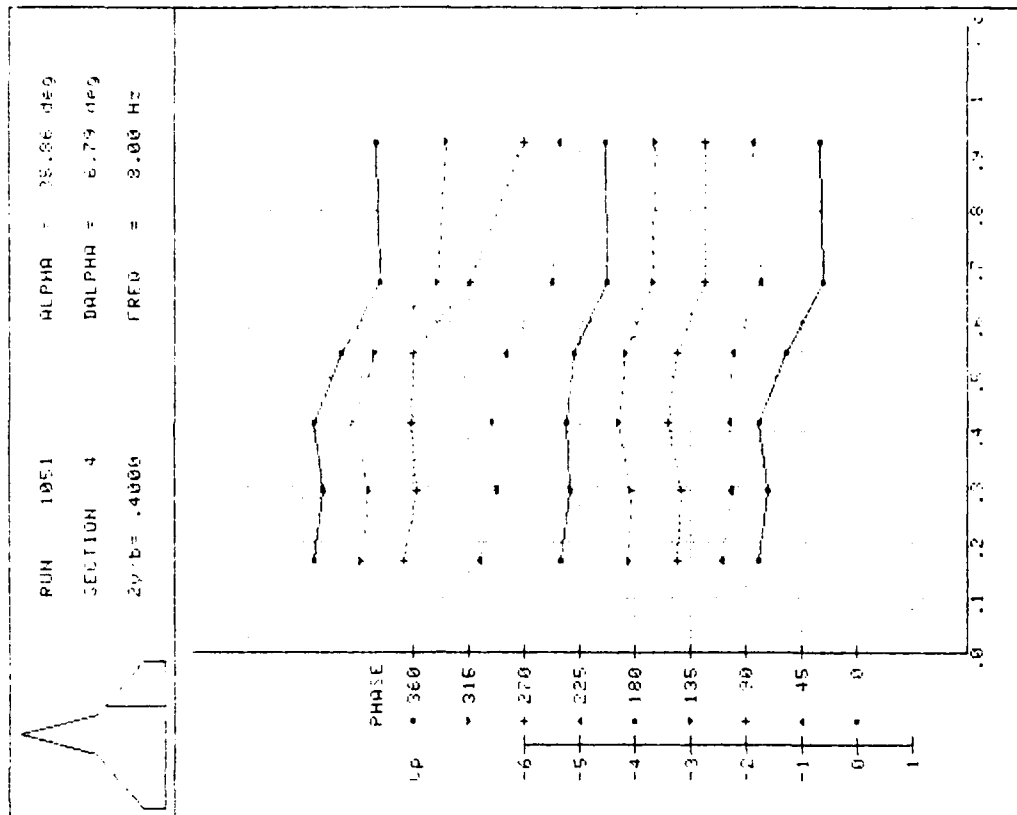


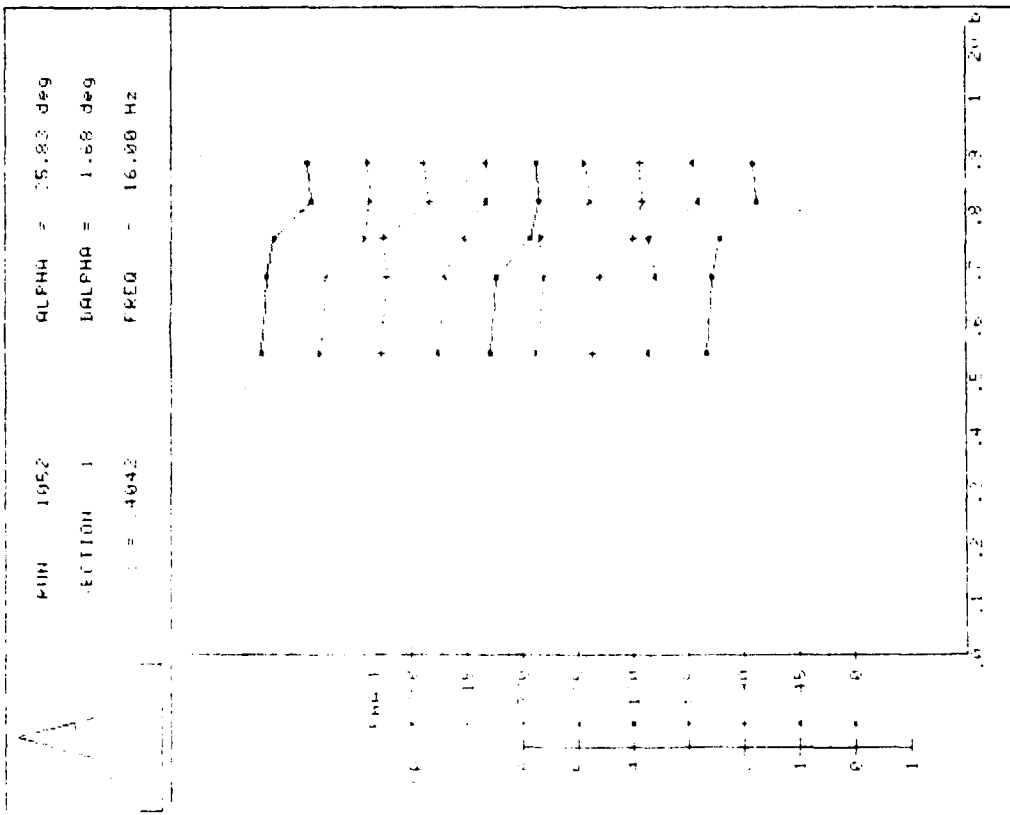
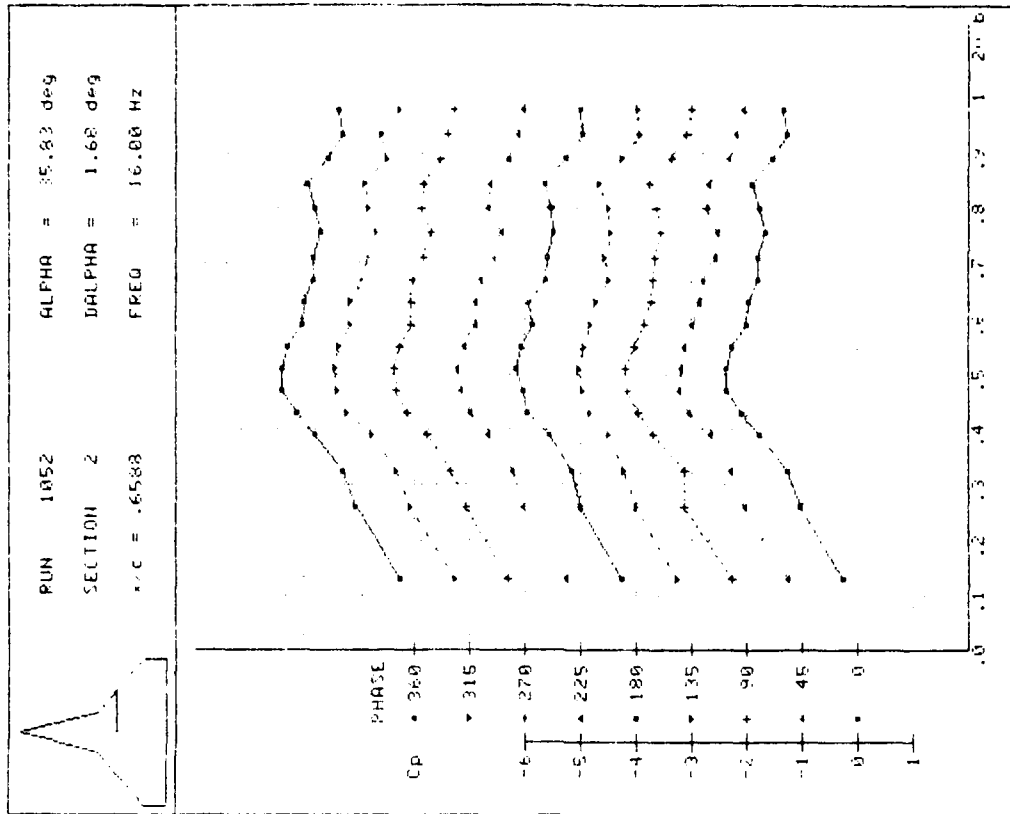


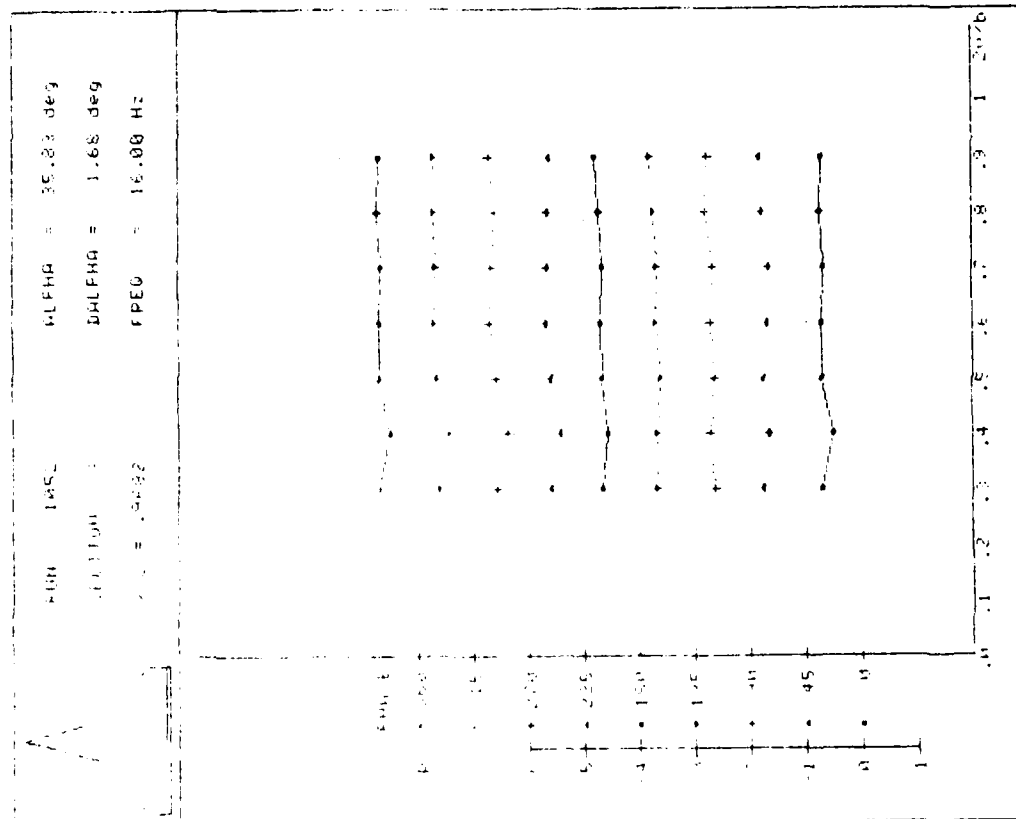
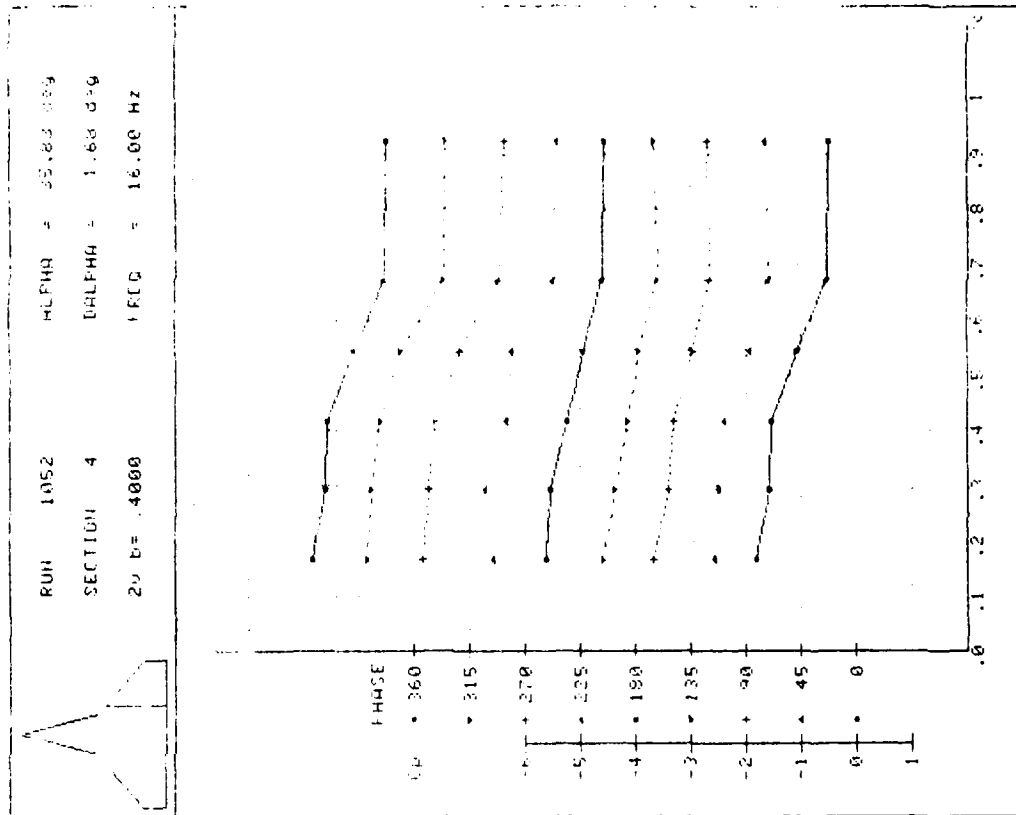


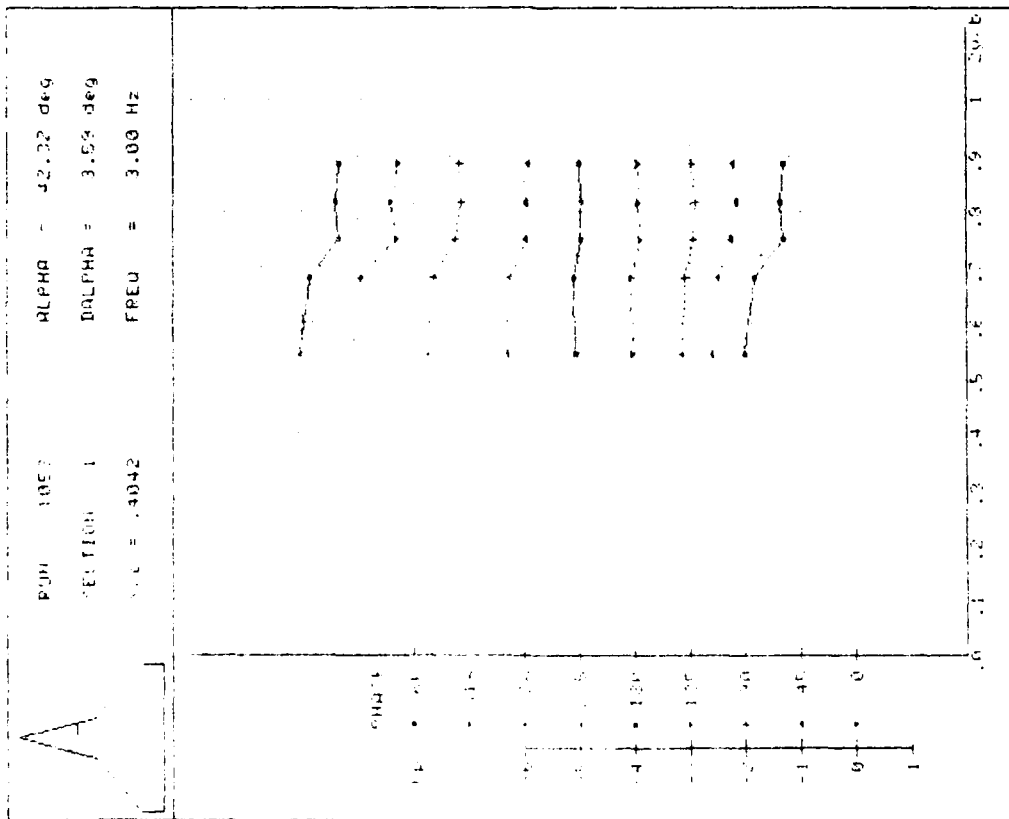
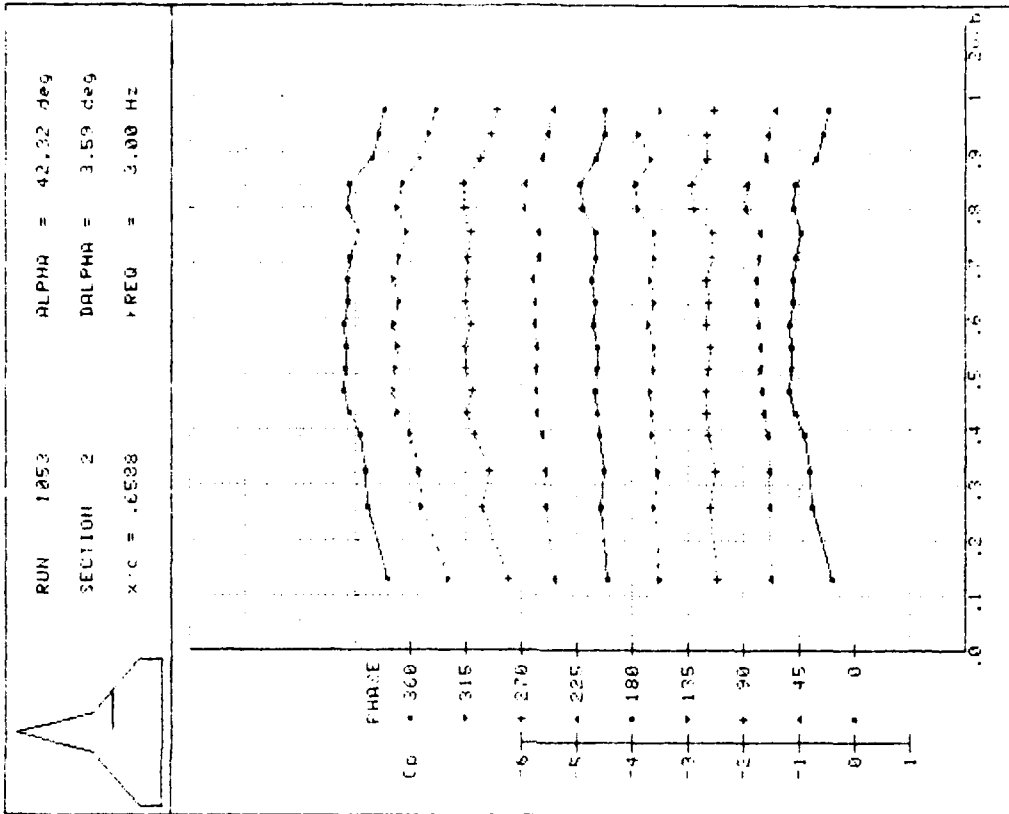


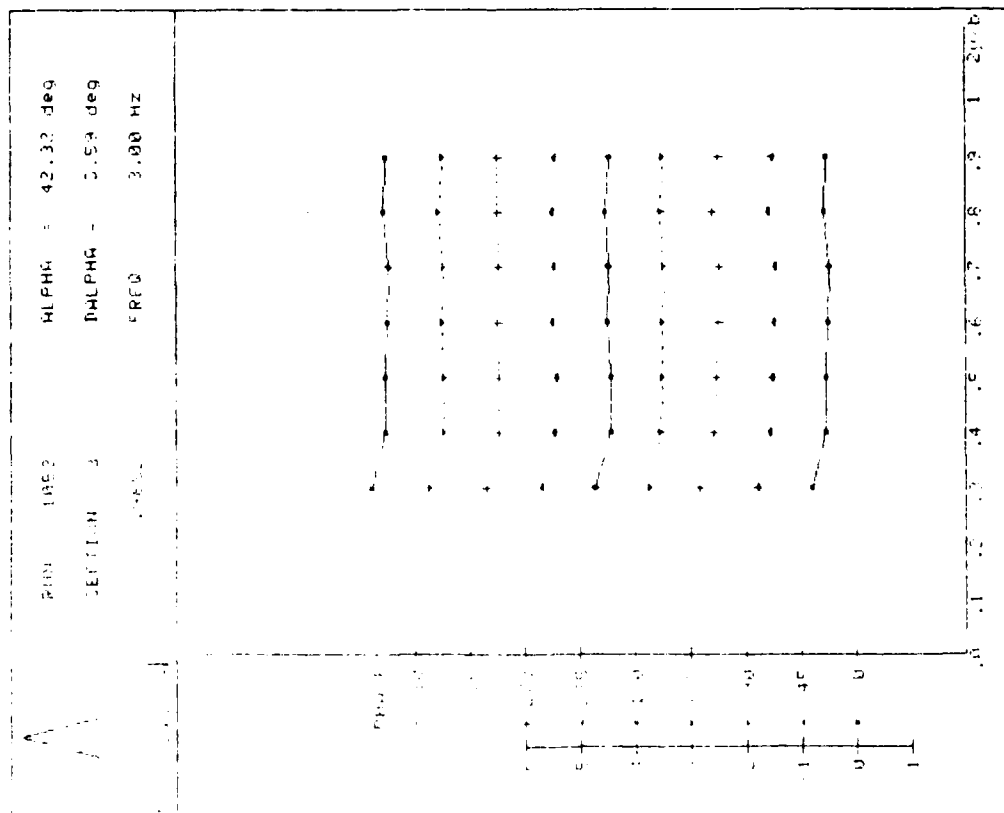
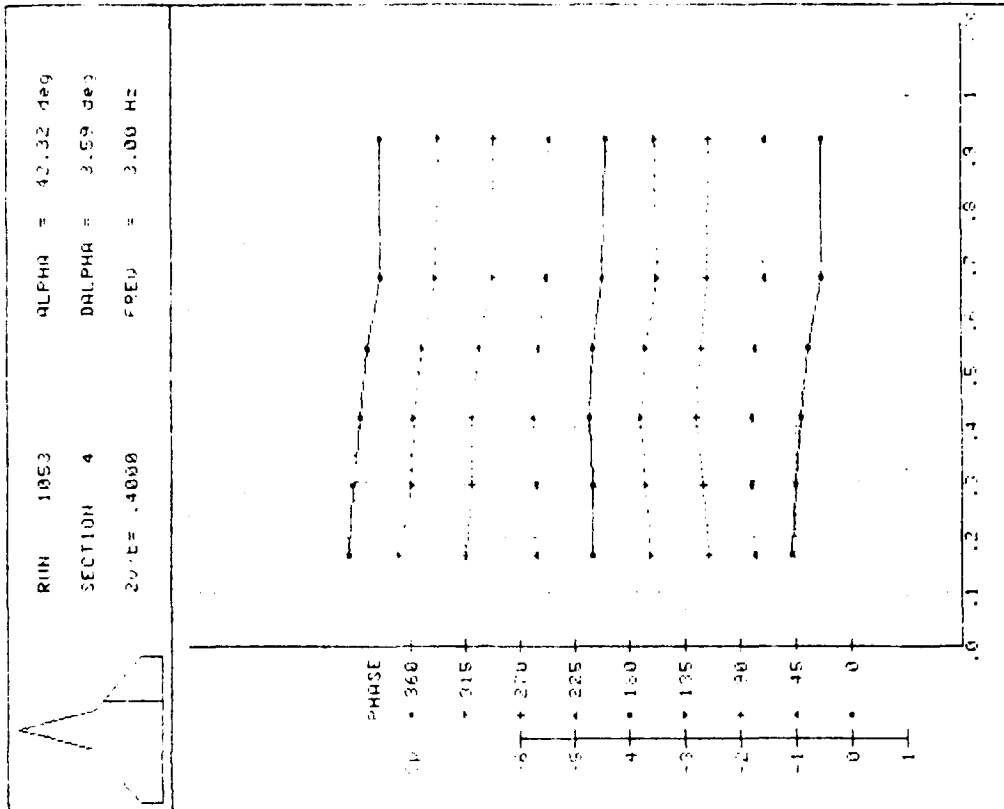


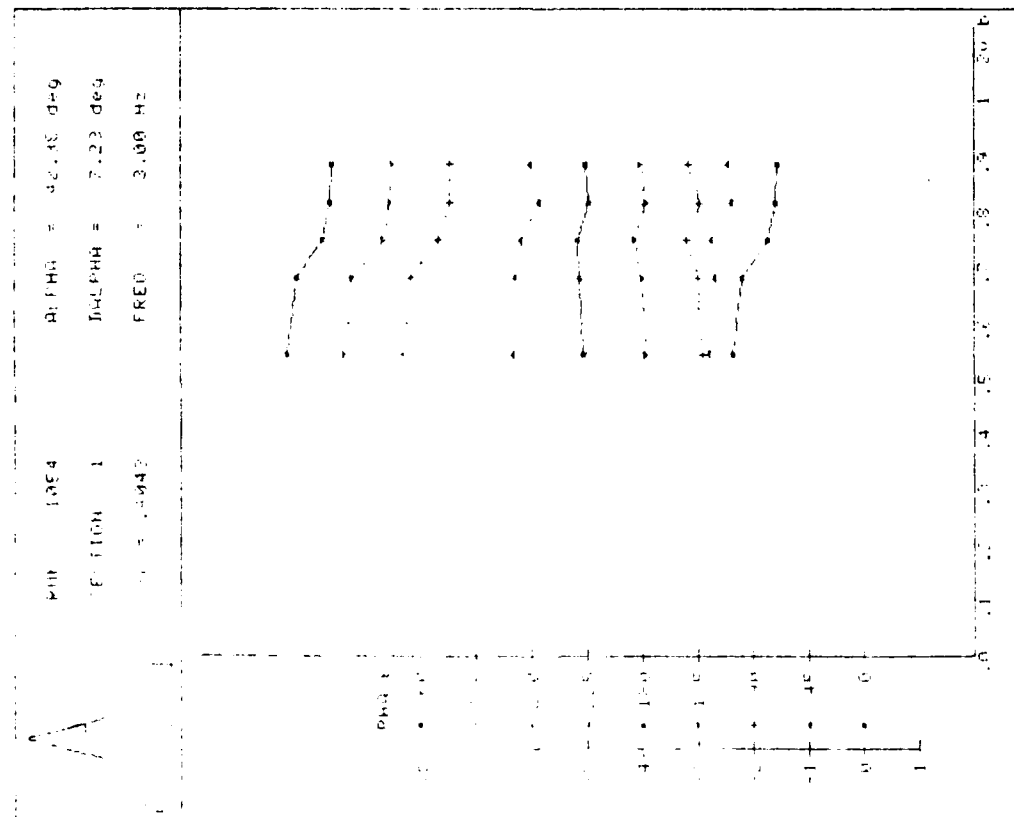
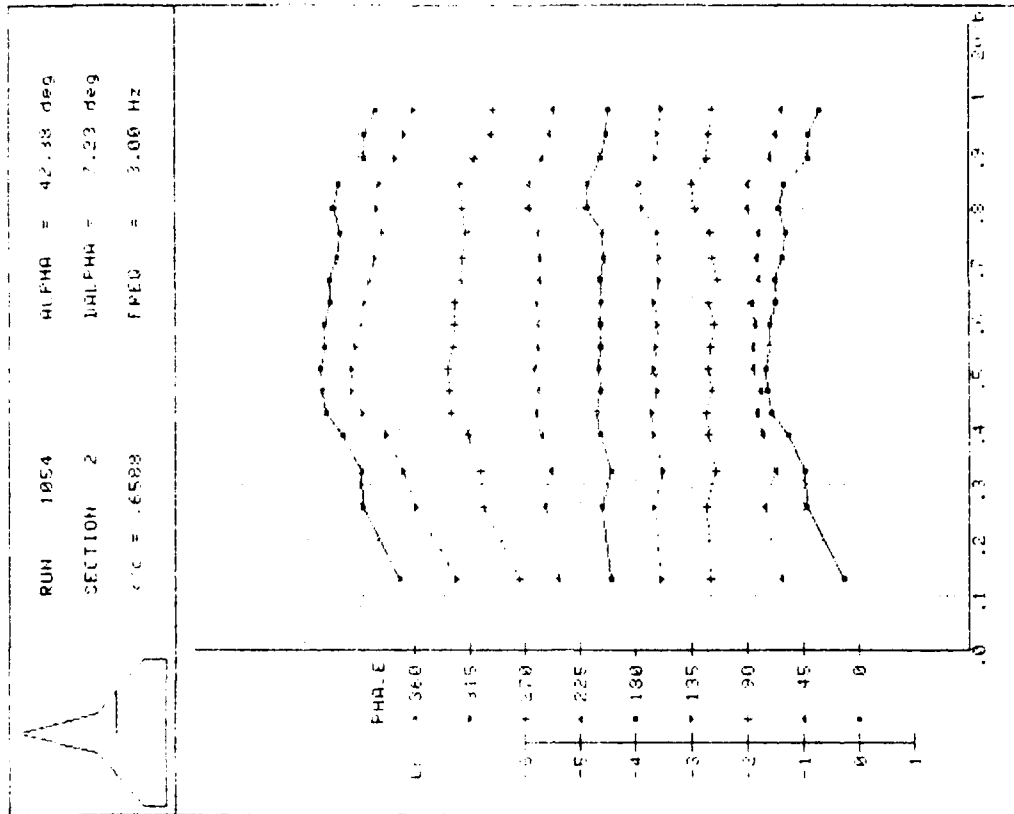


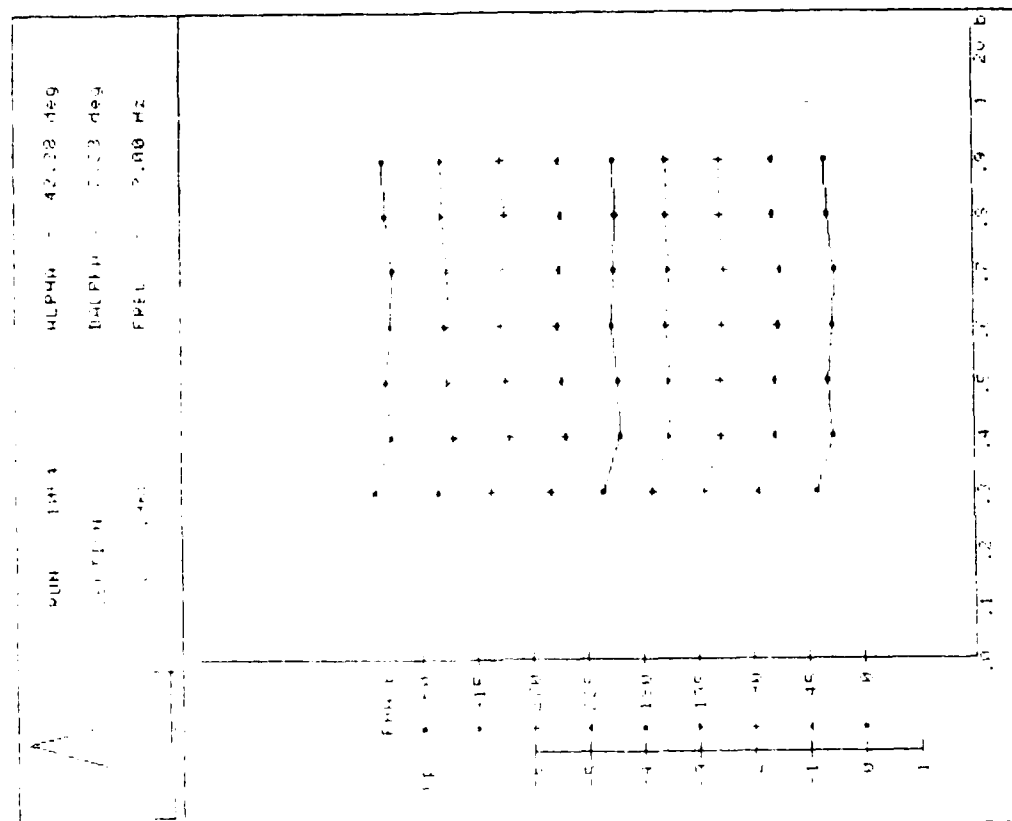
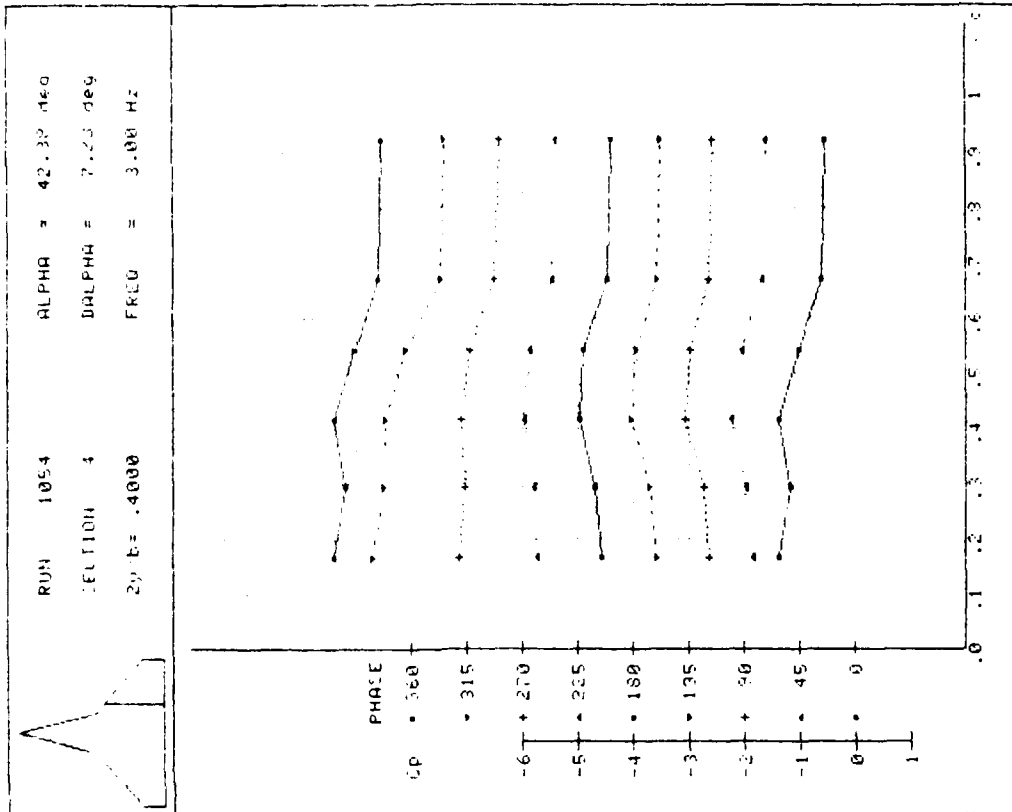


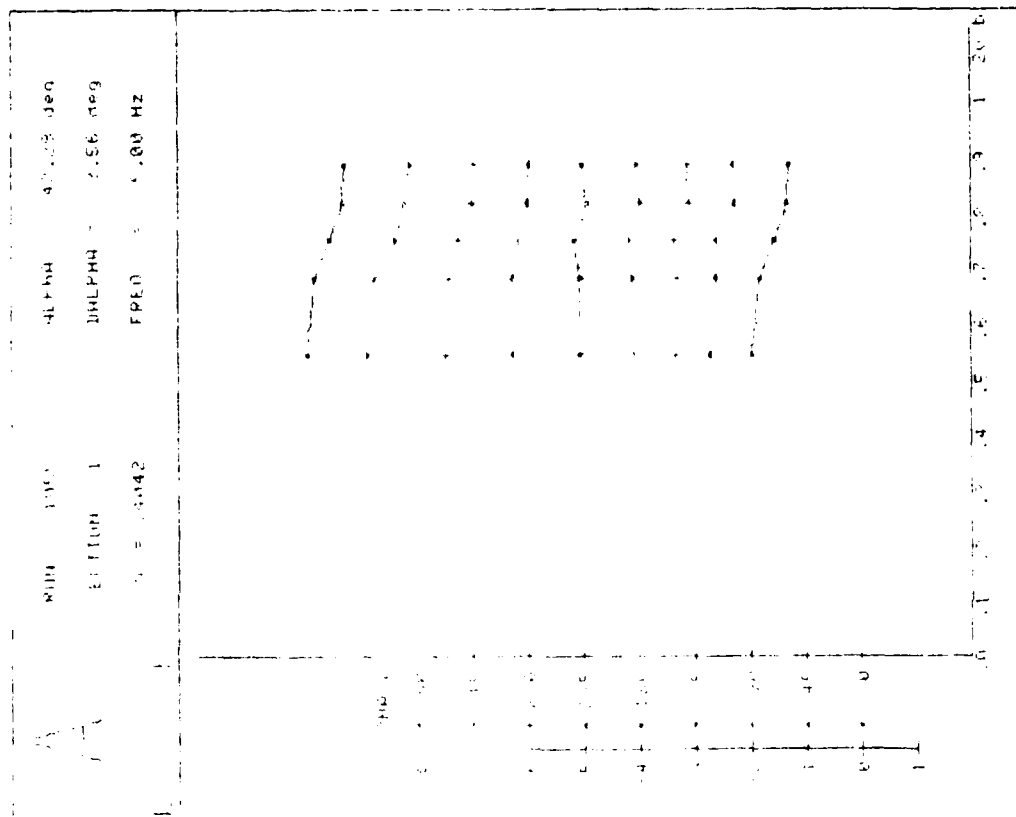
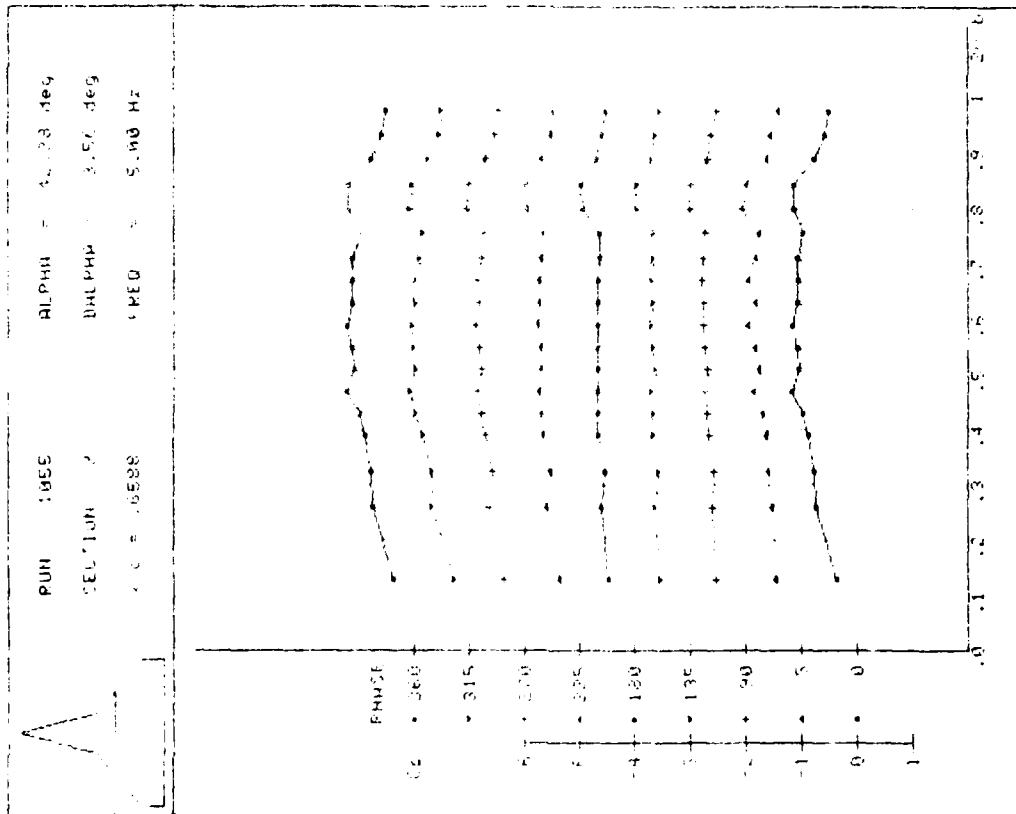


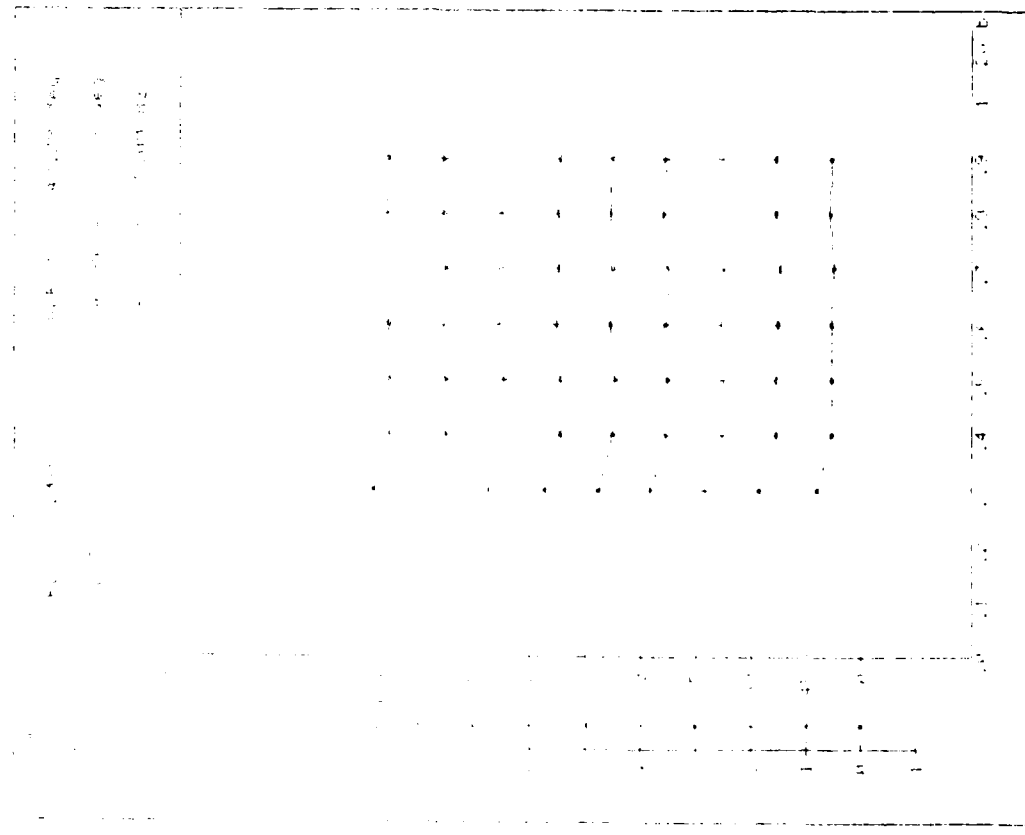
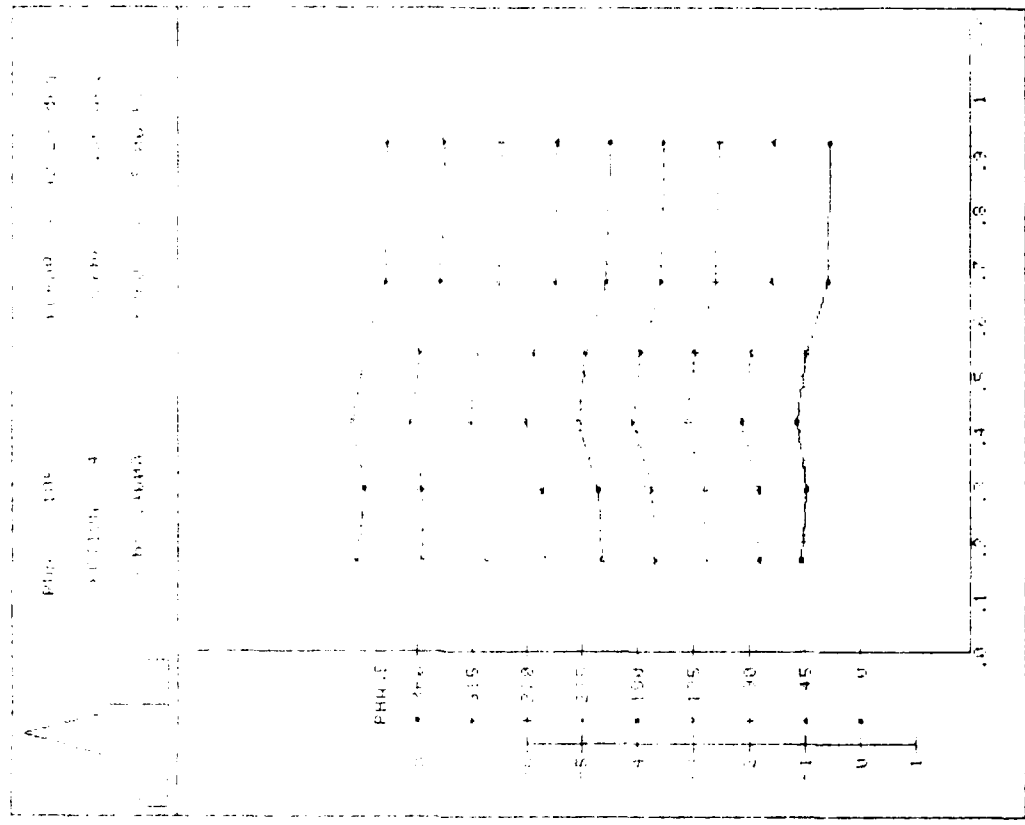


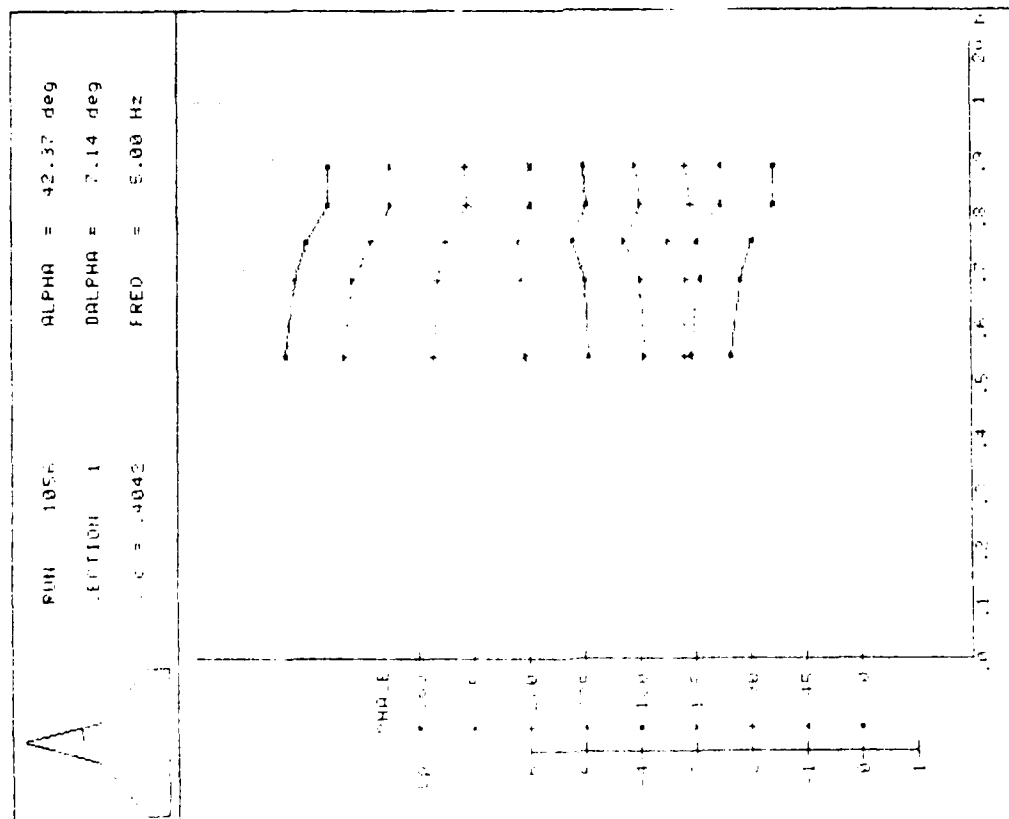
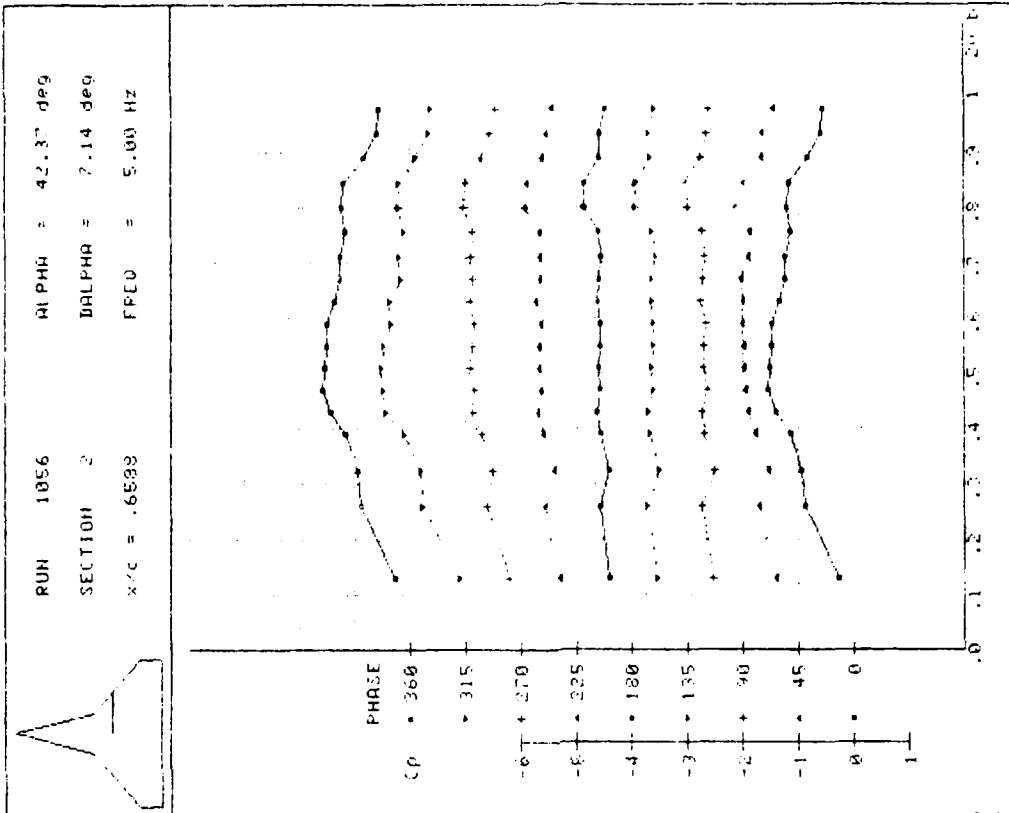


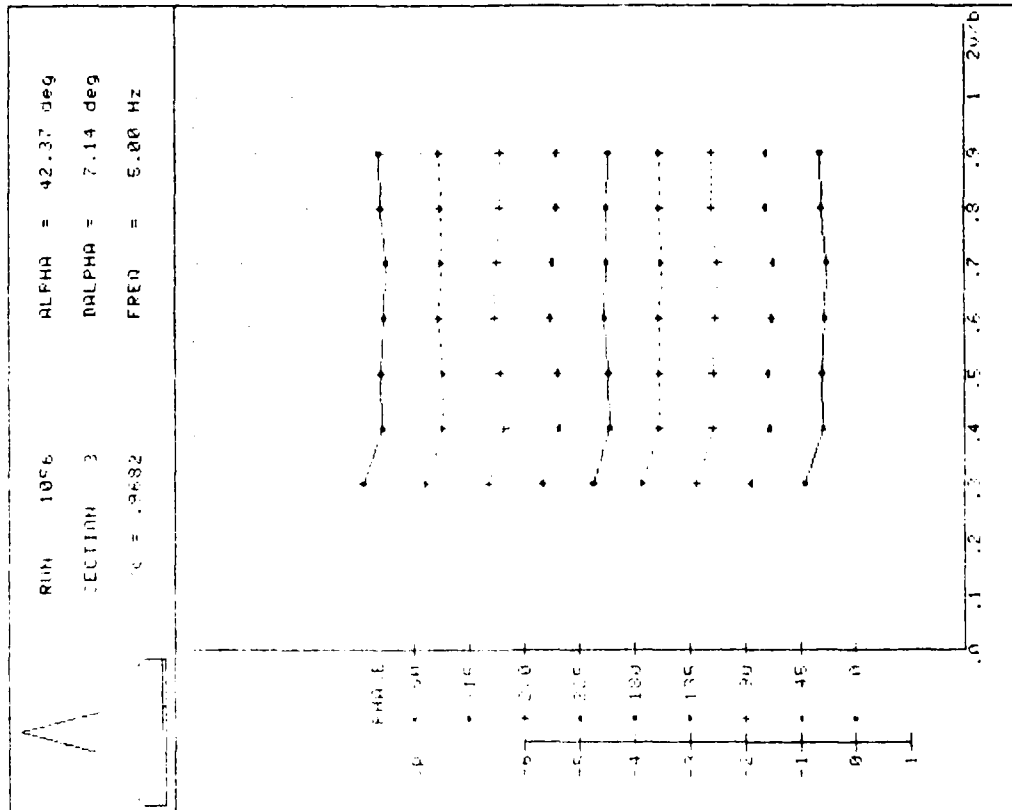
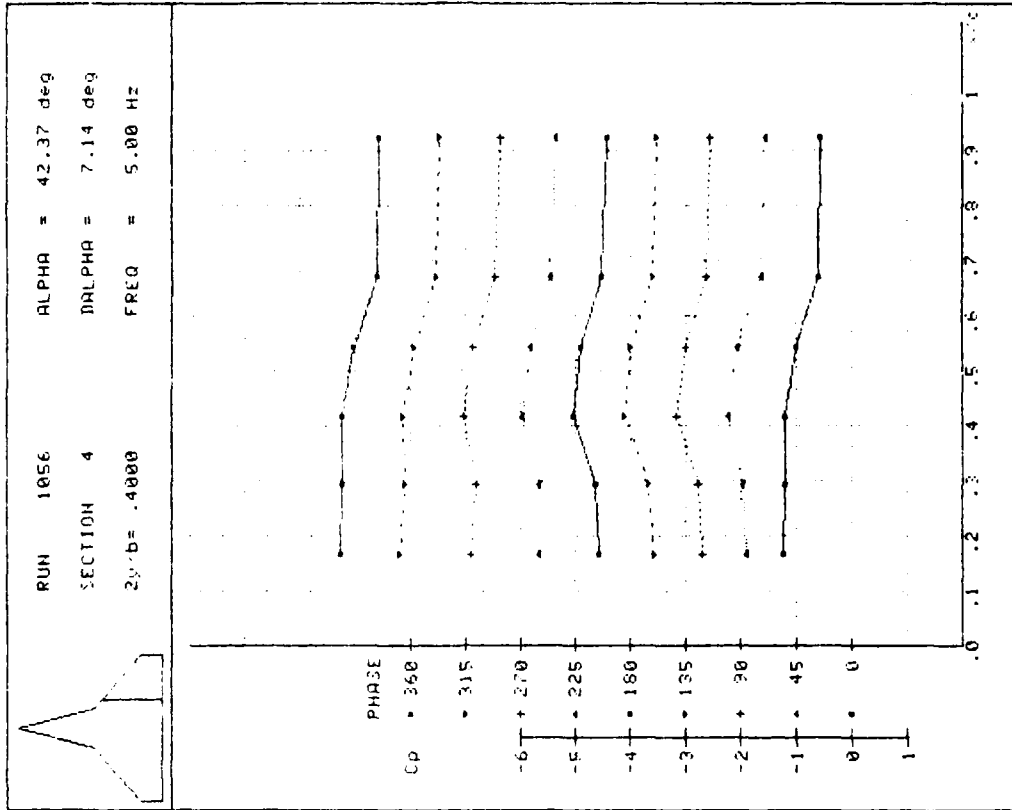


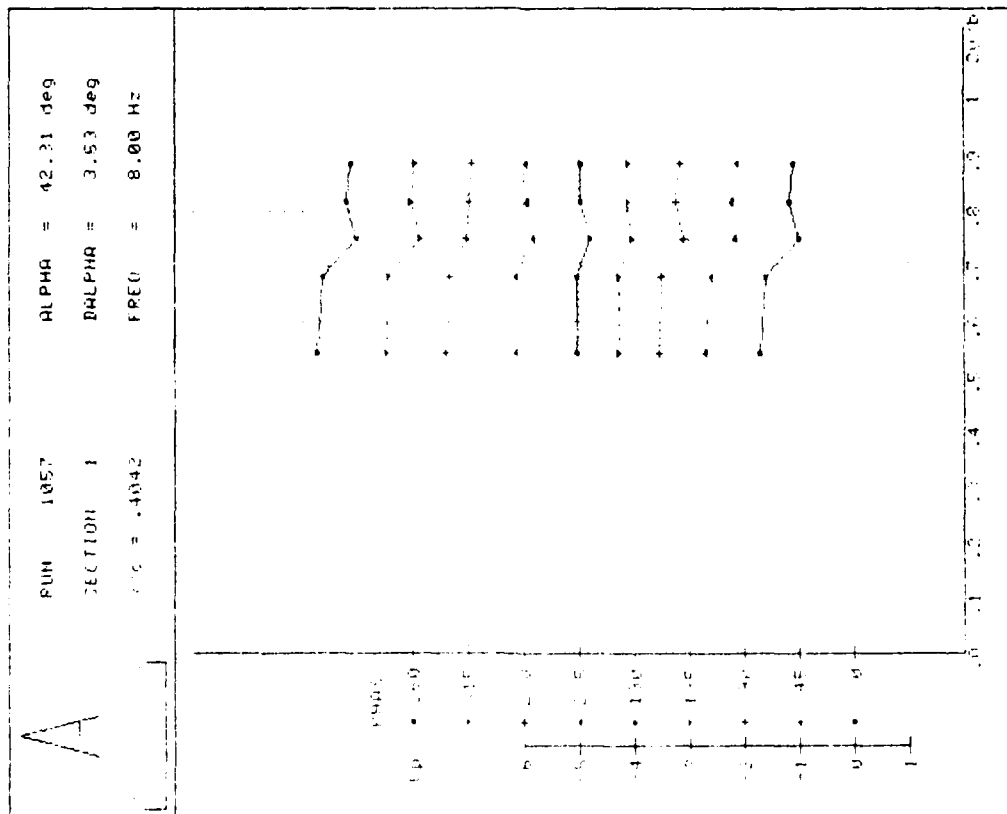
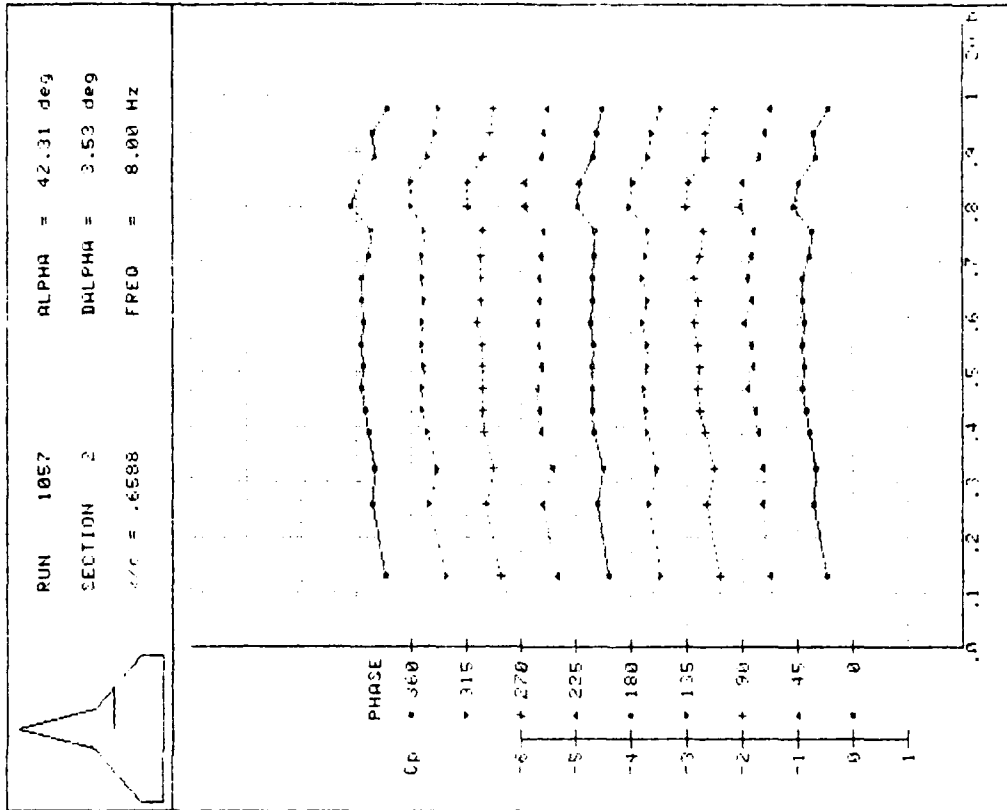


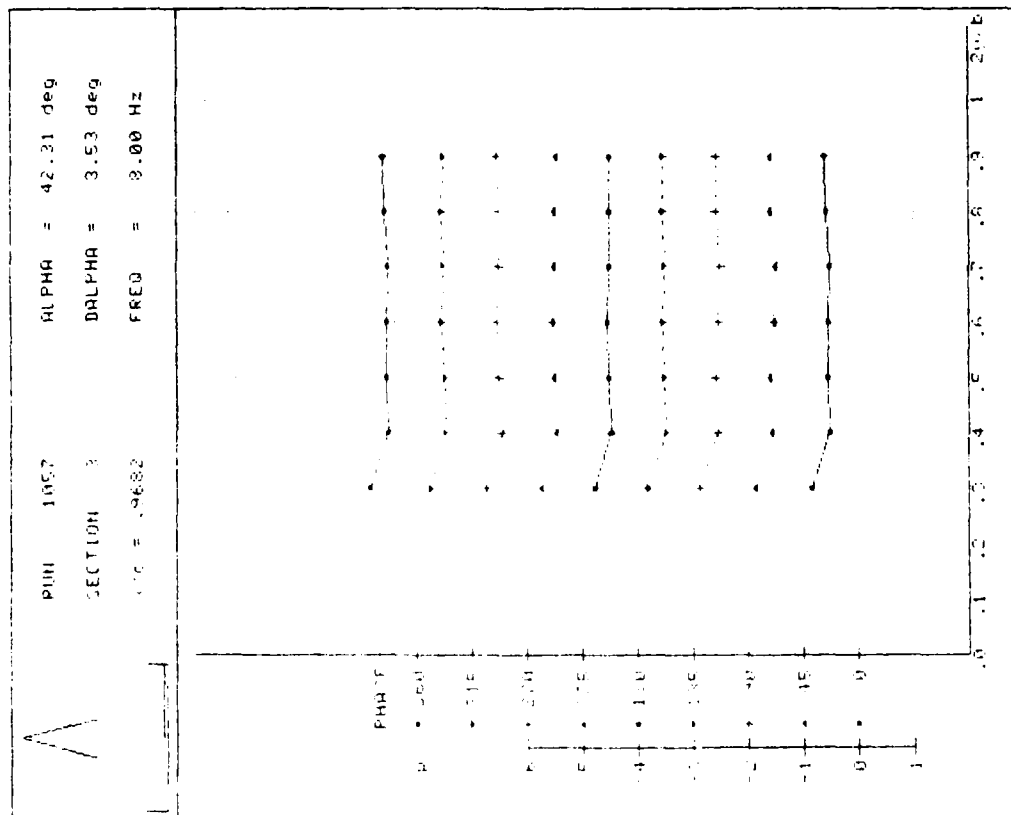
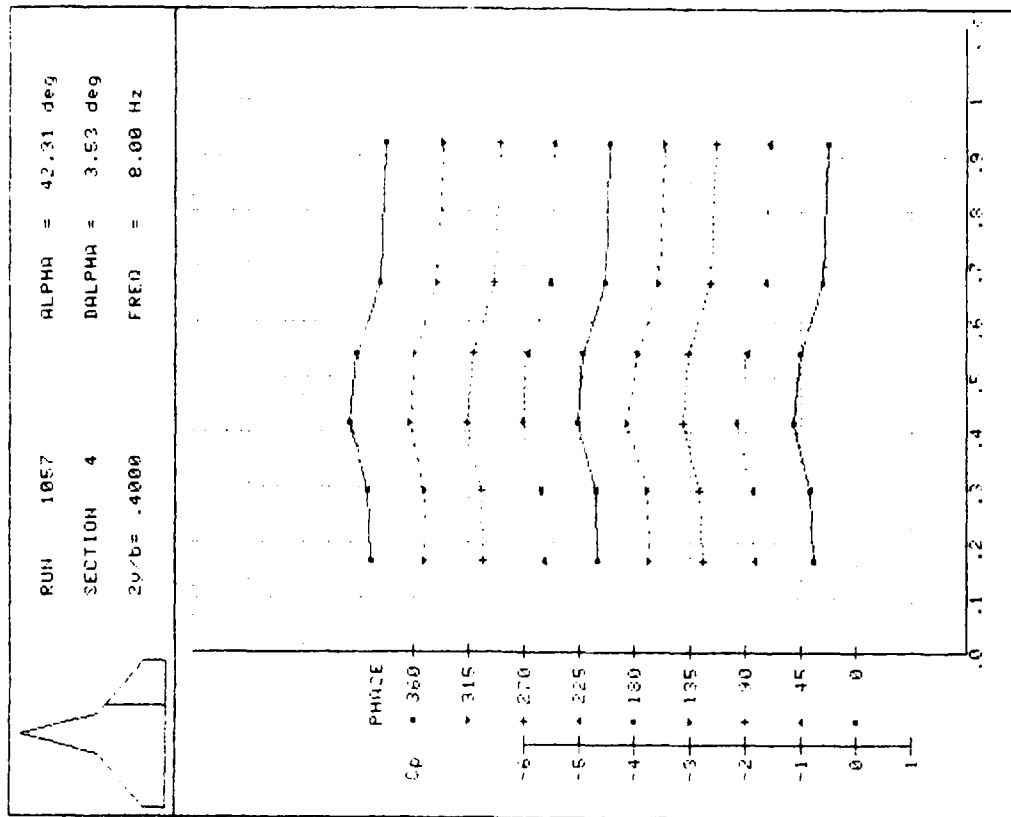


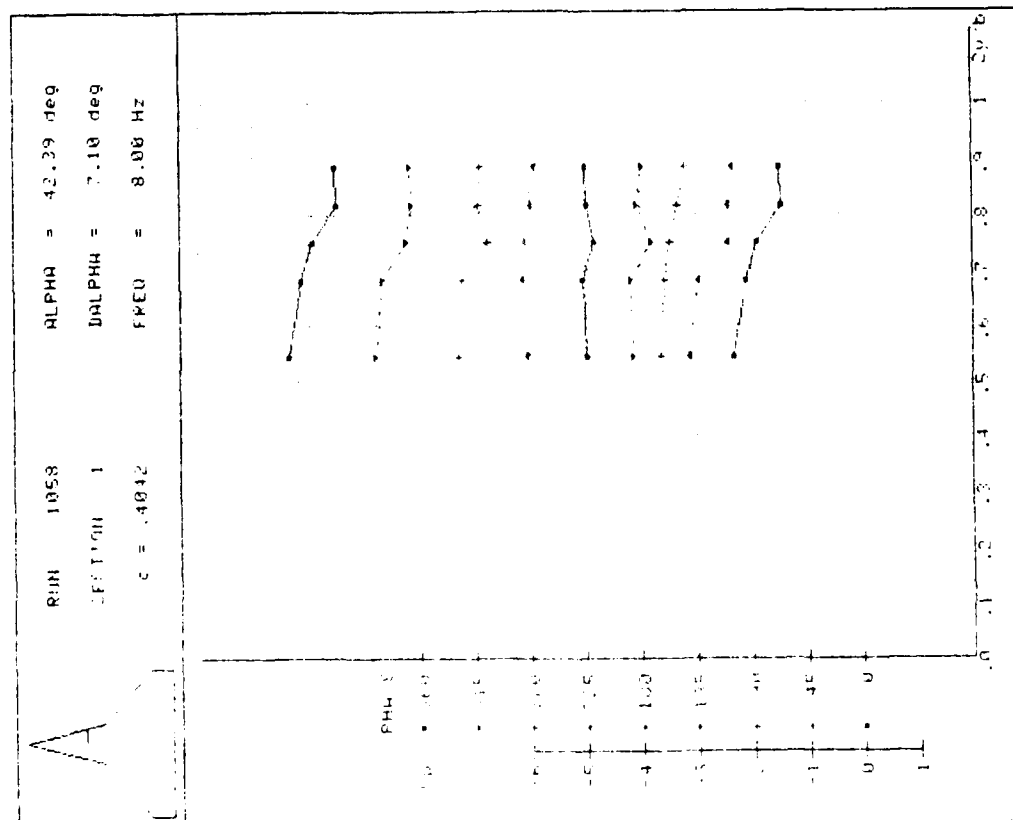
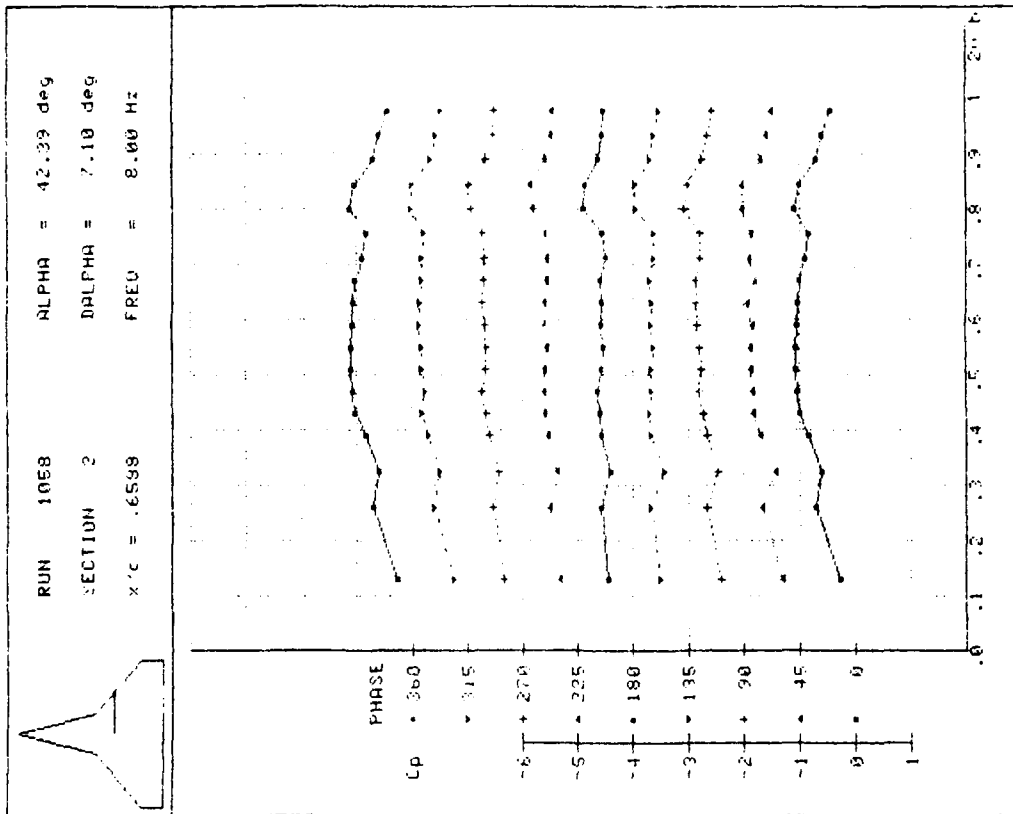


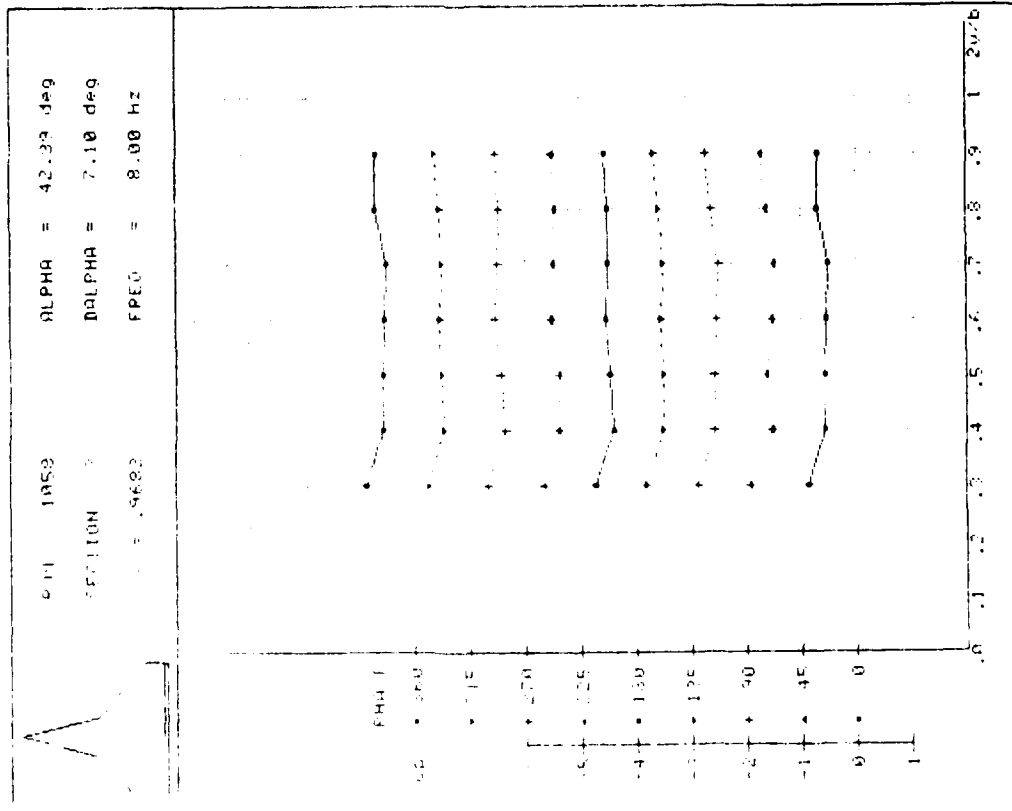
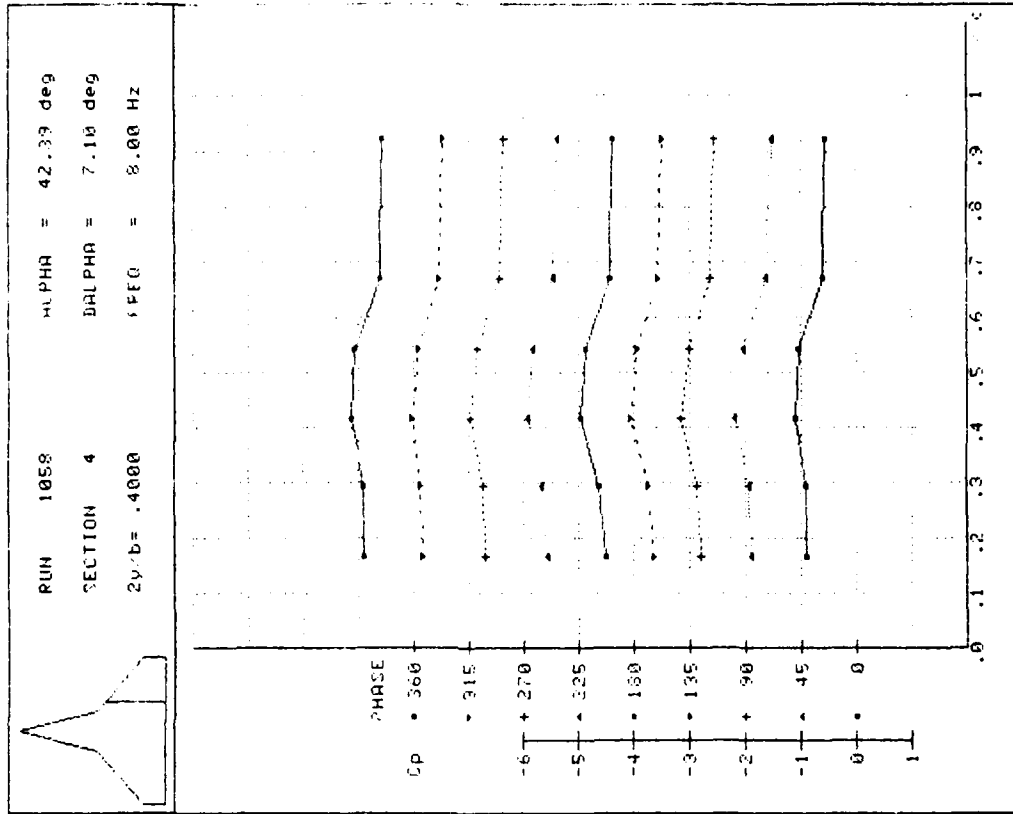


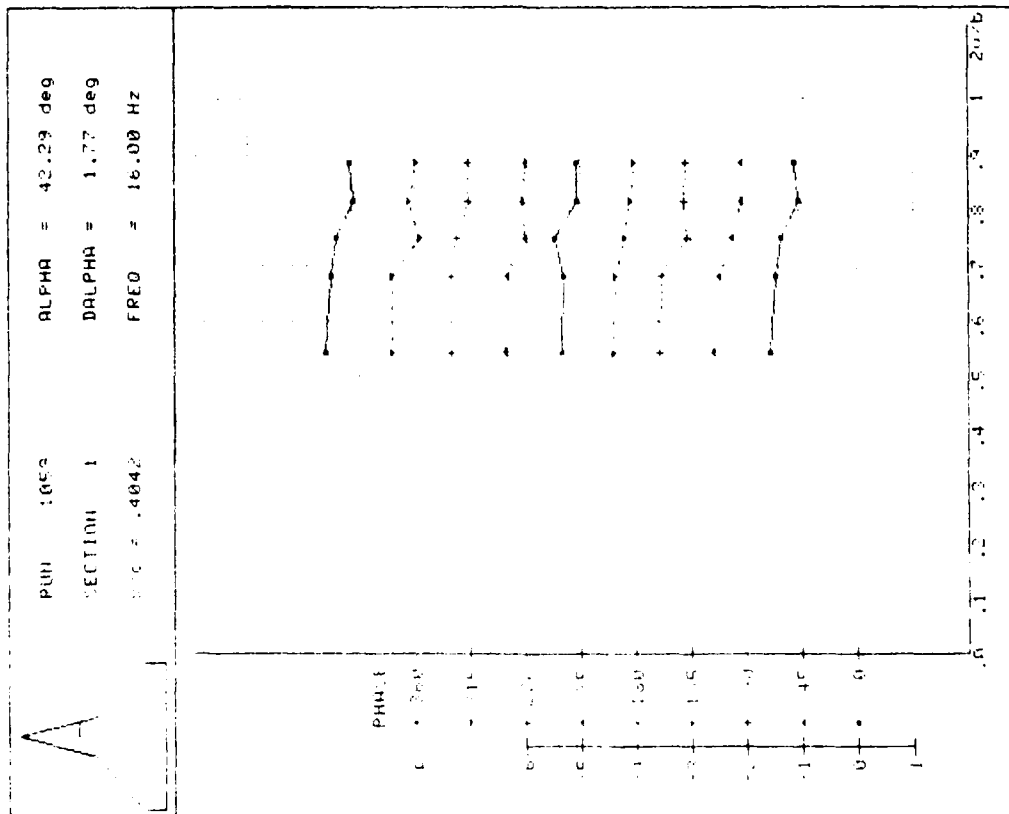
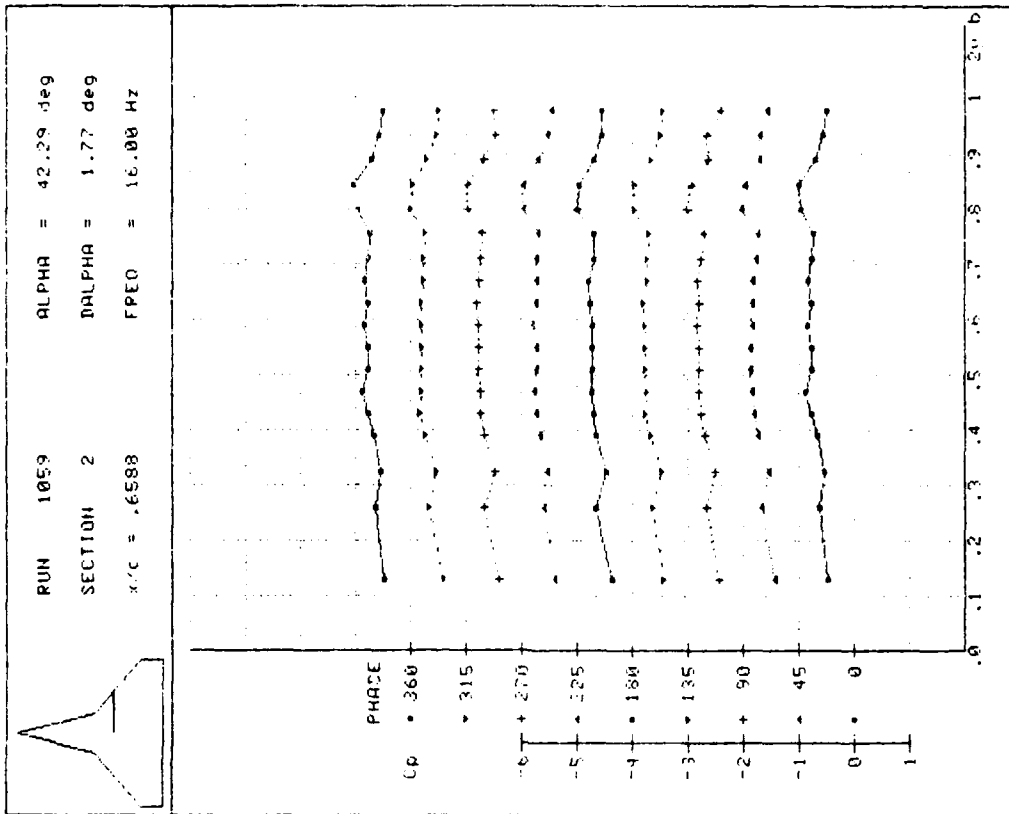


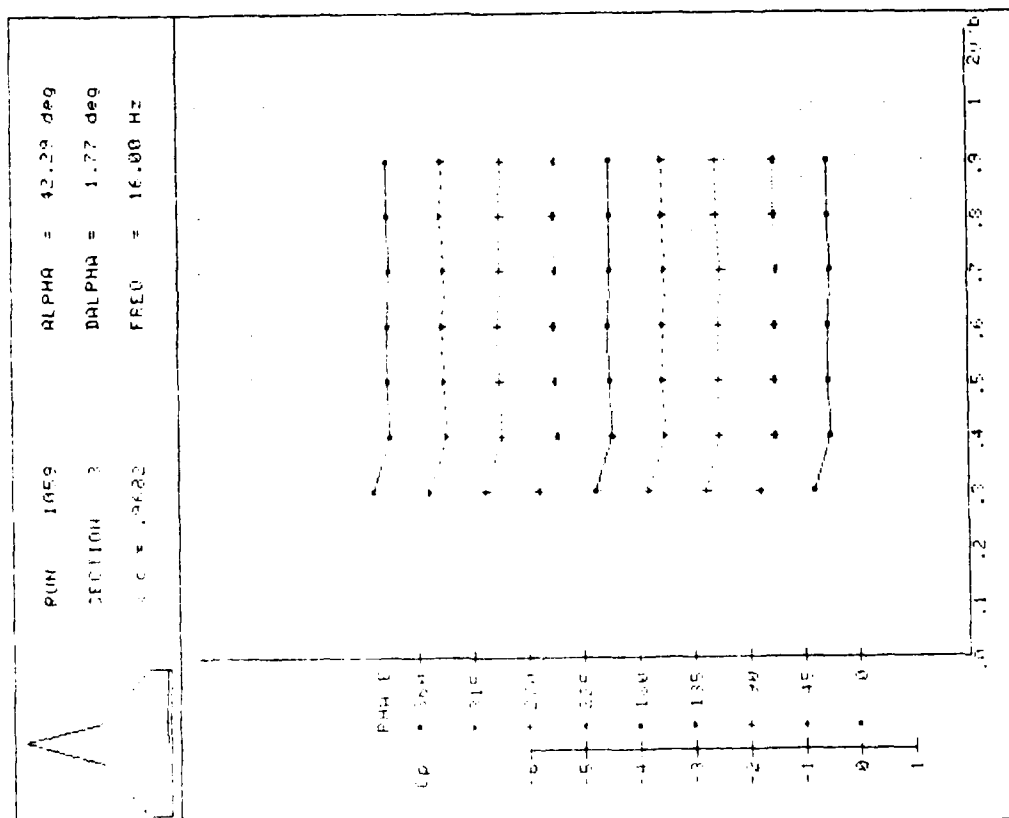
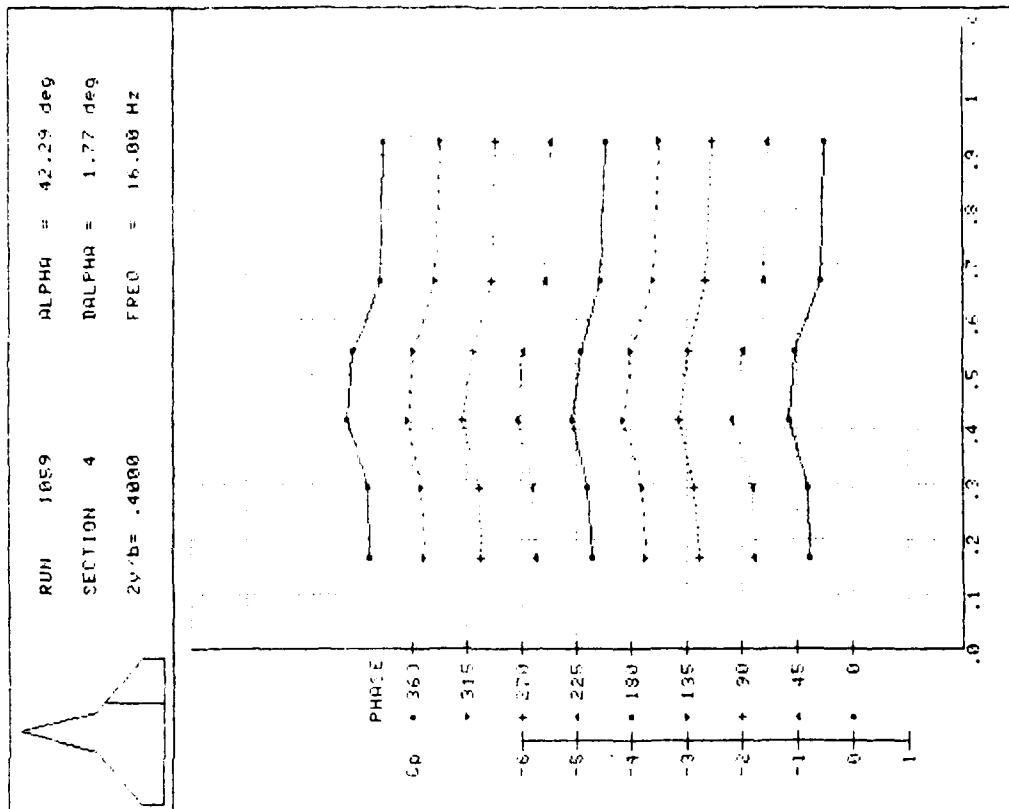




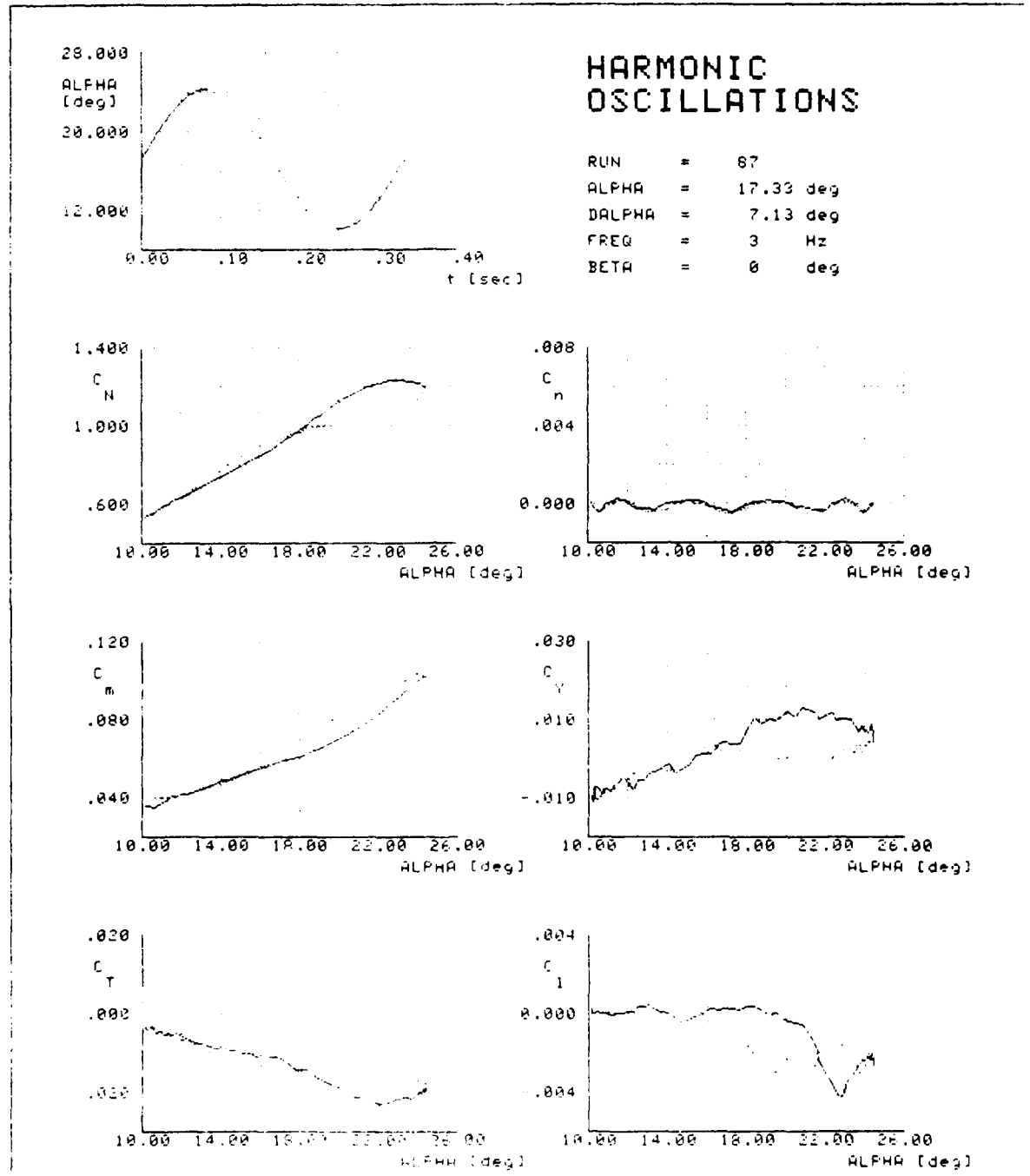


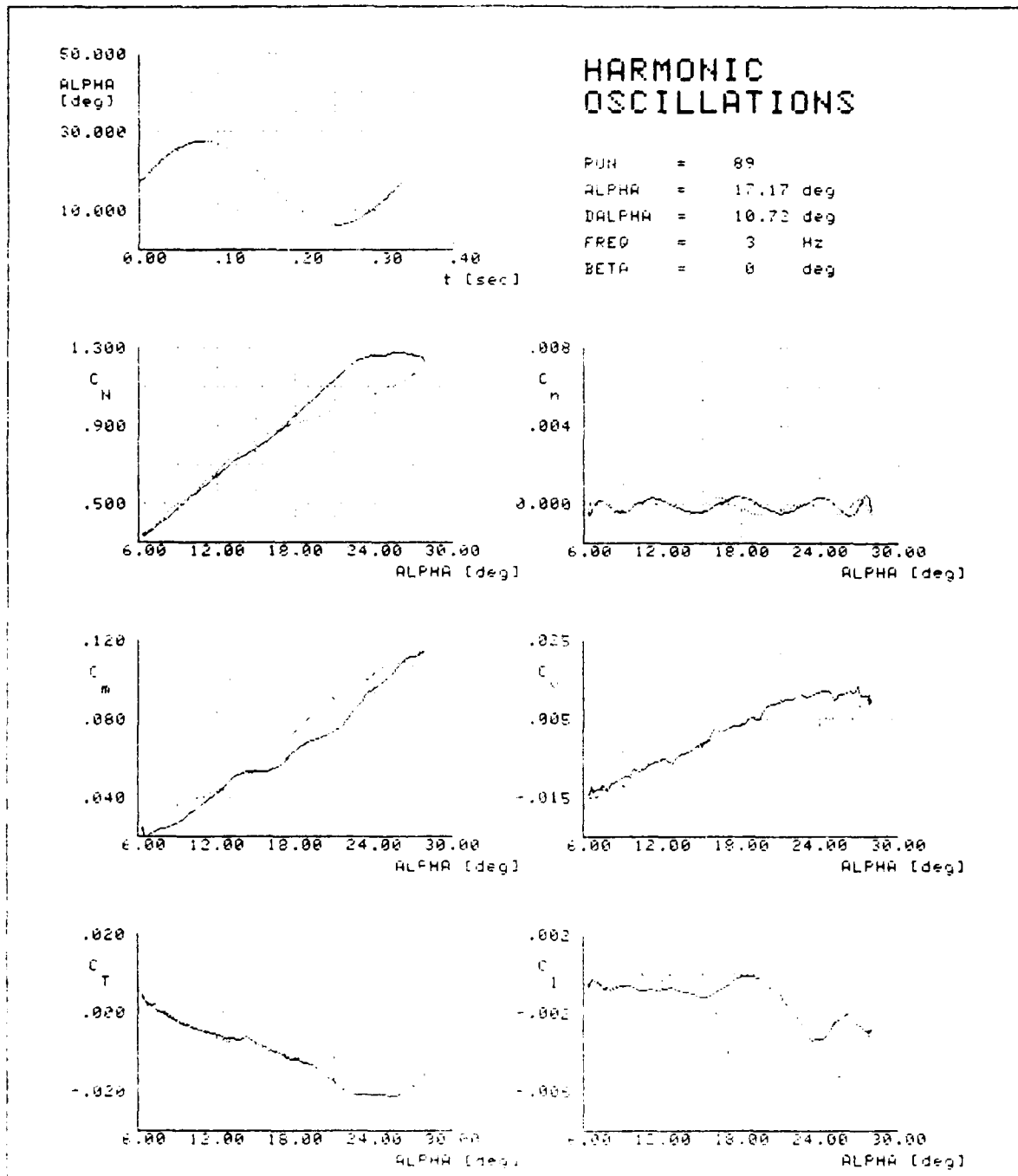


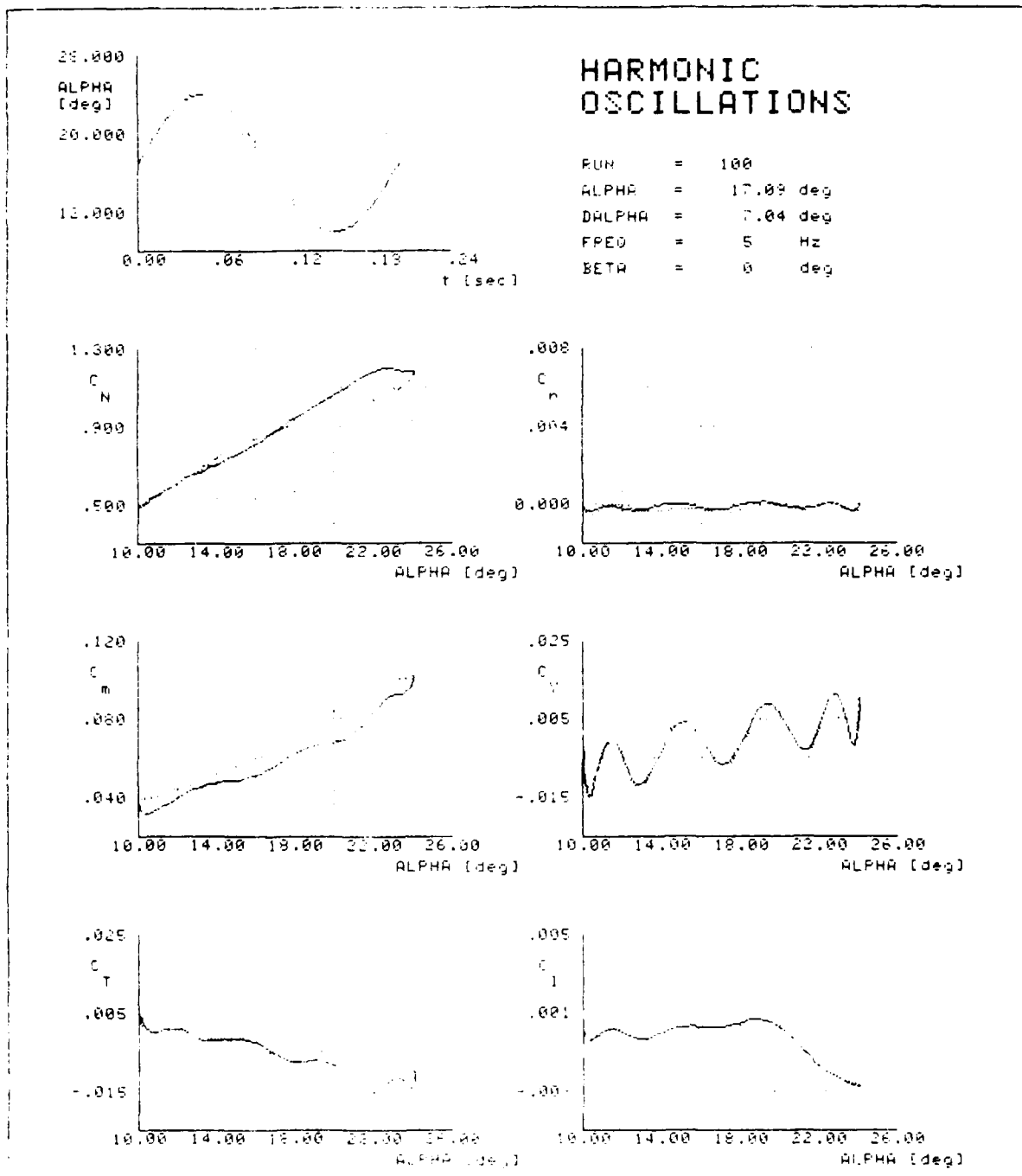


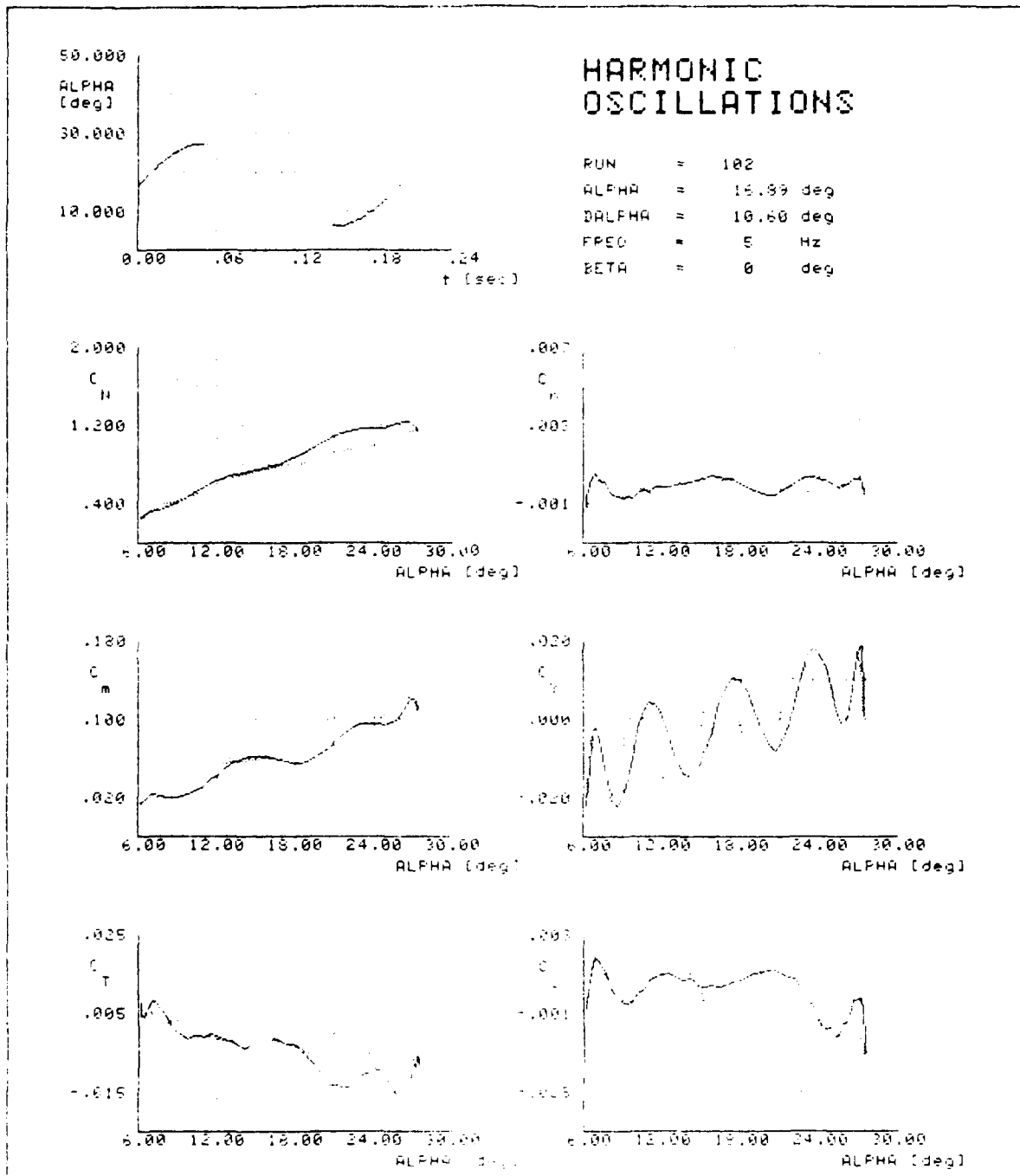


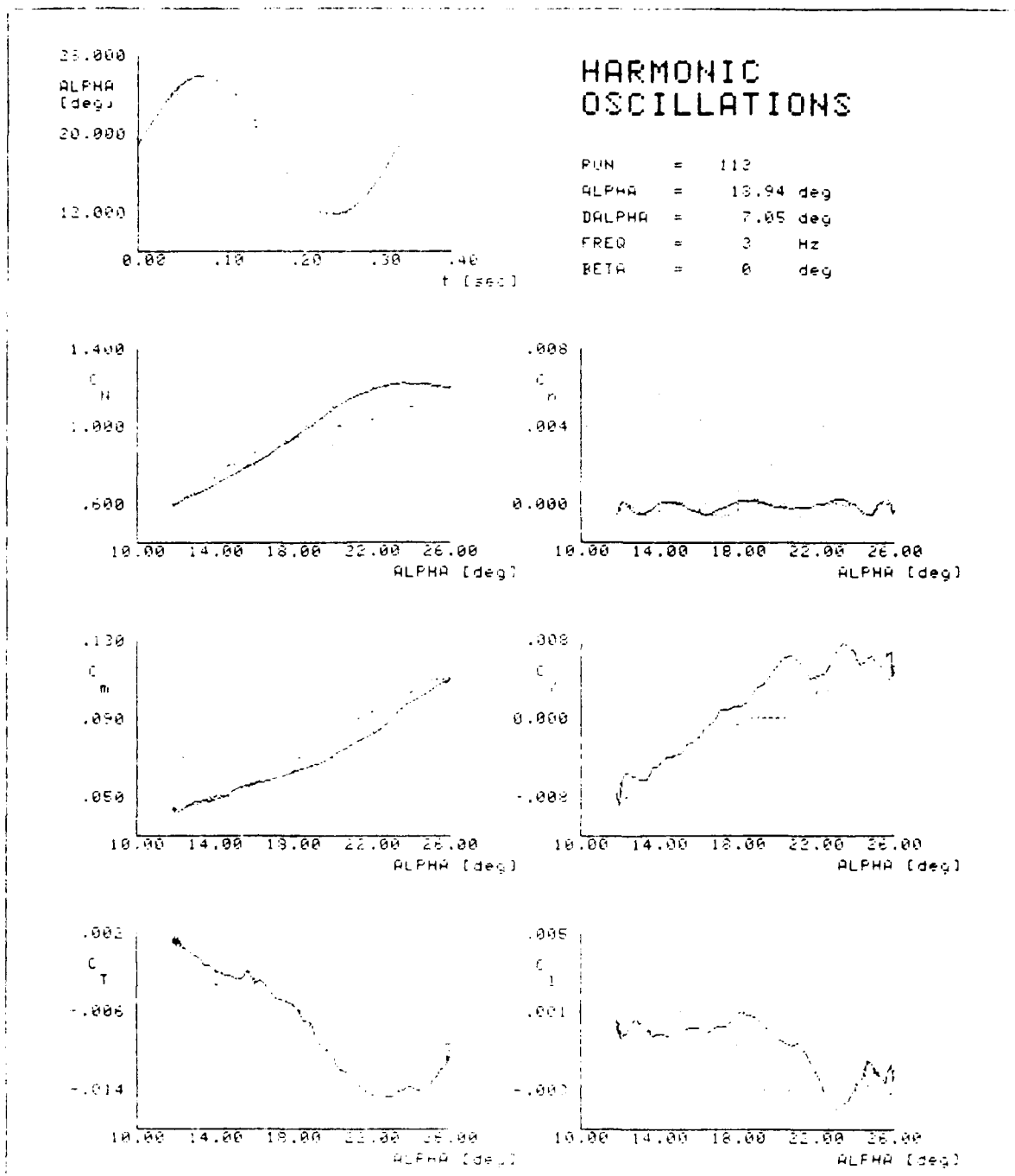
APPENDIX B
PLOTS OF TIME HISTORIES OF OVERALL LOADS FOR
CONTINUOUS OSCILLATING MODEL

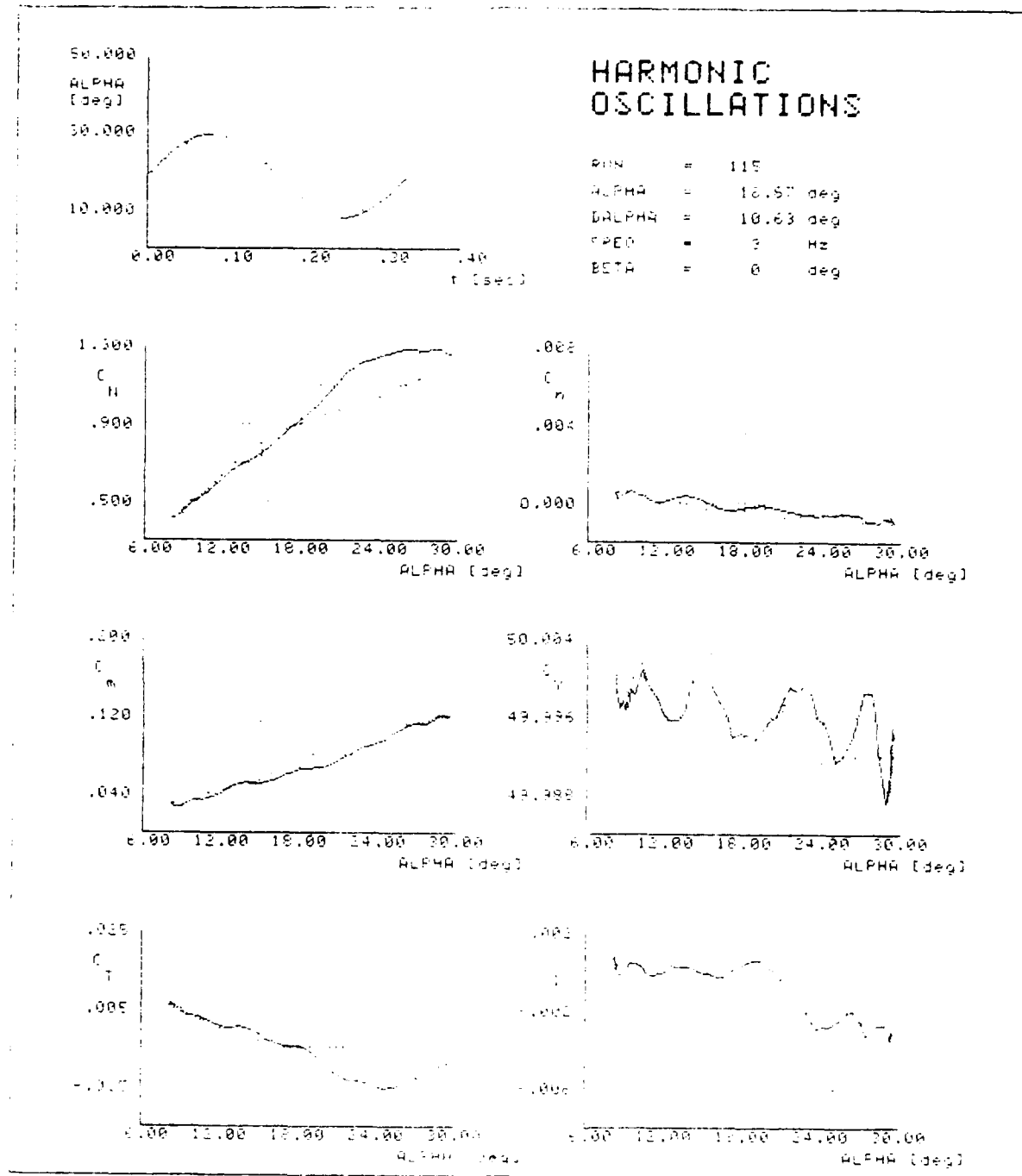


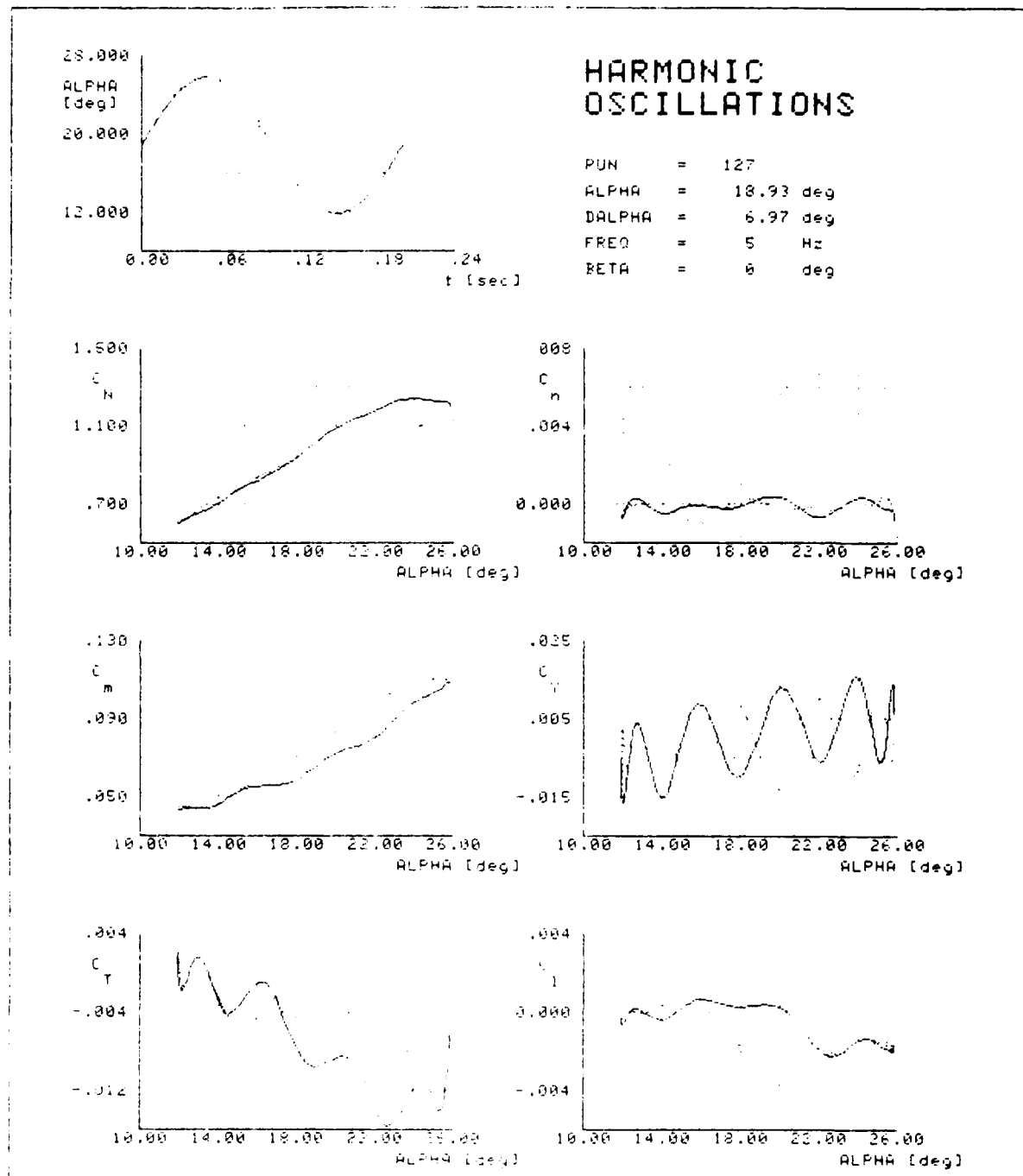


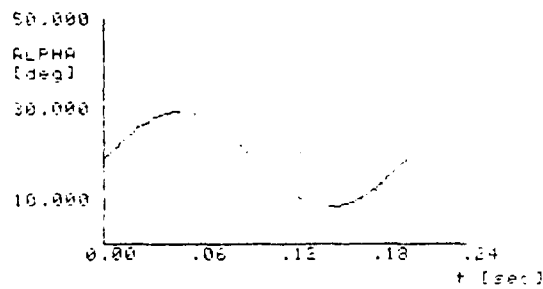






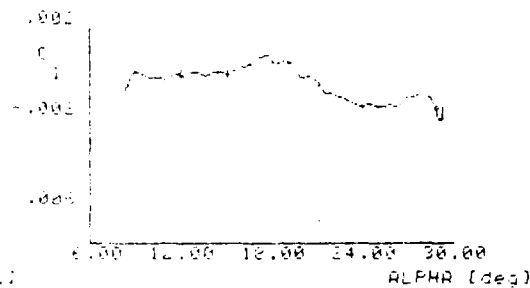
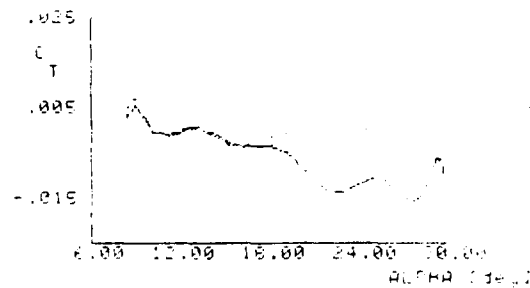
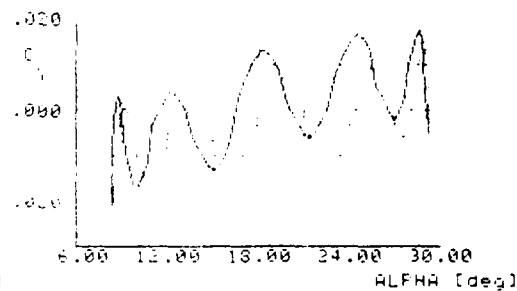
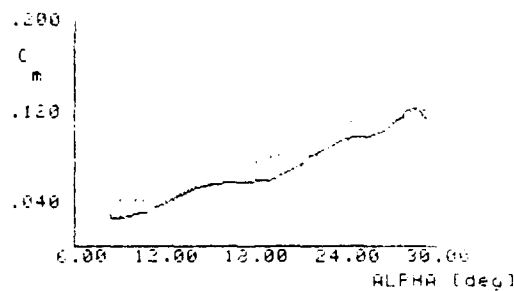
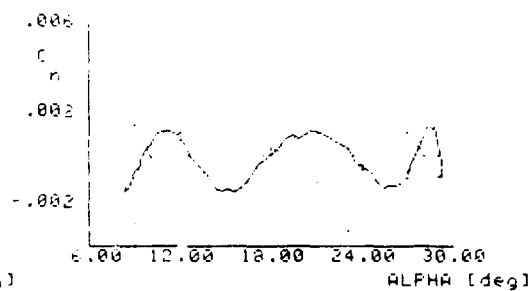
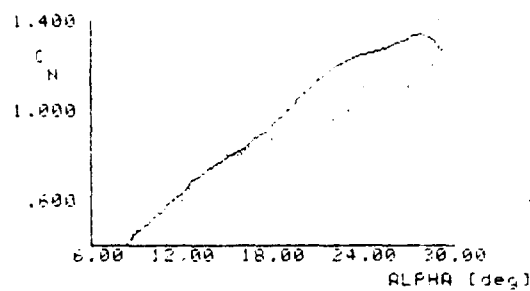


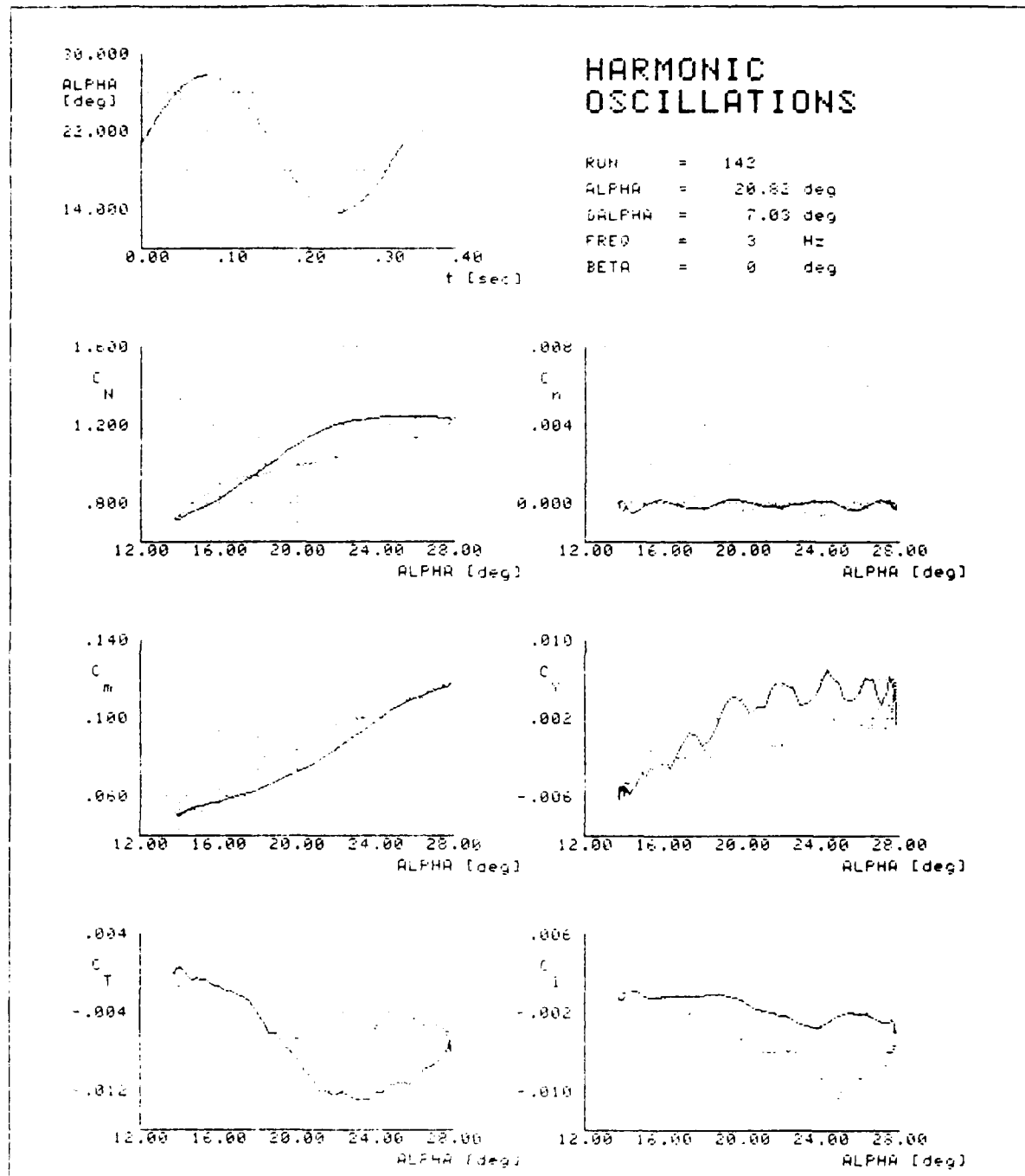


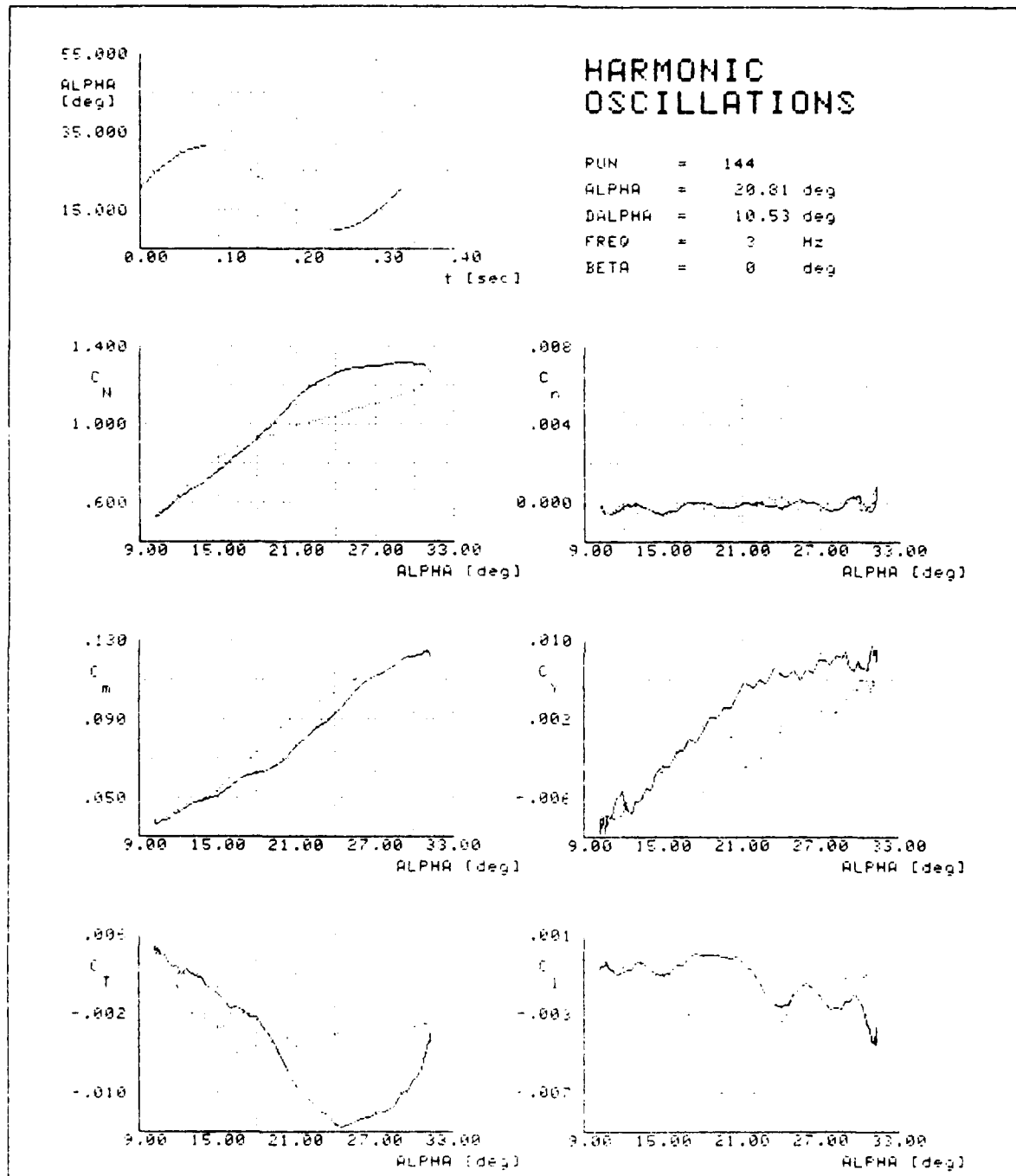


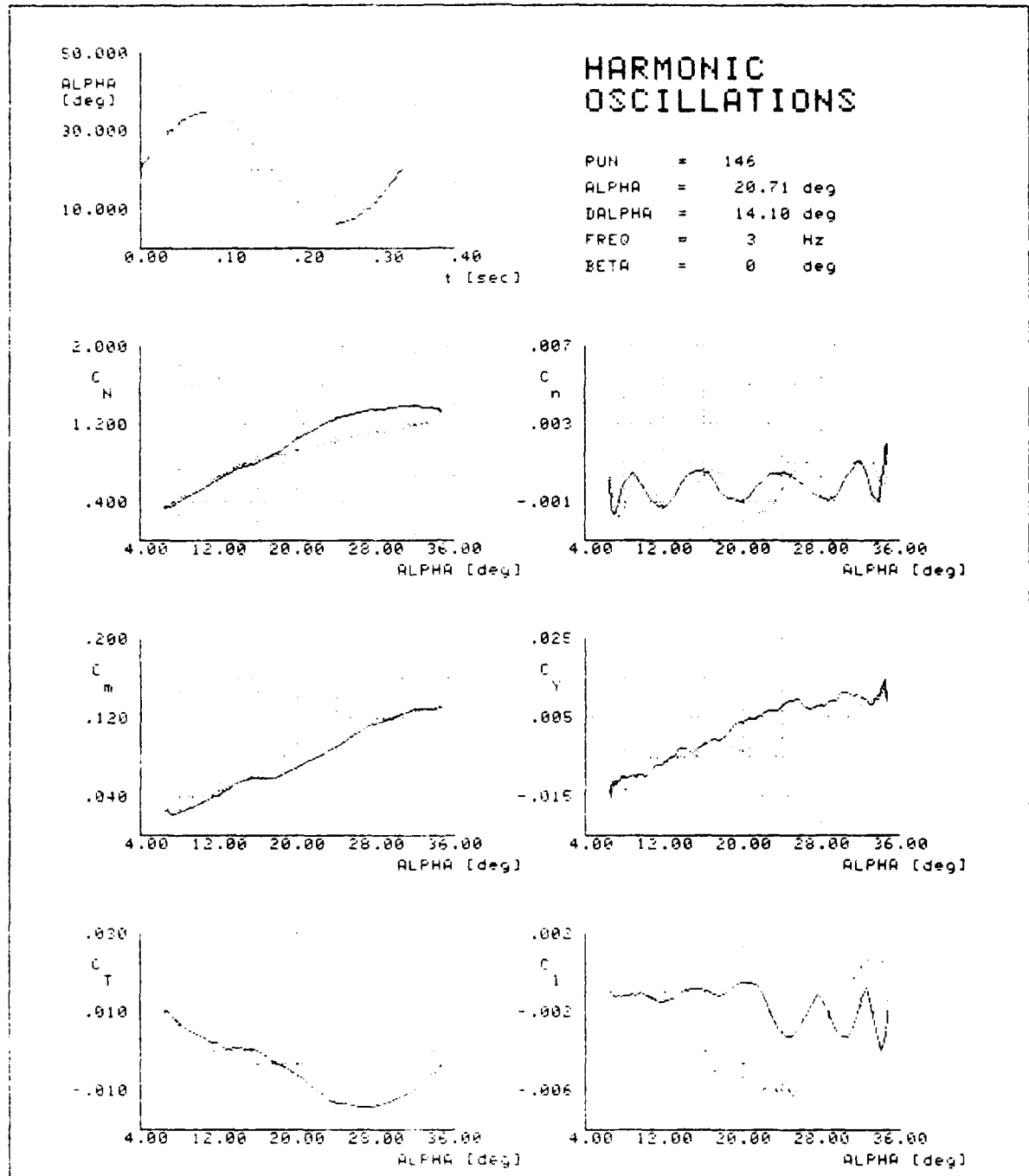
HARMONIC OSCILLATIONS

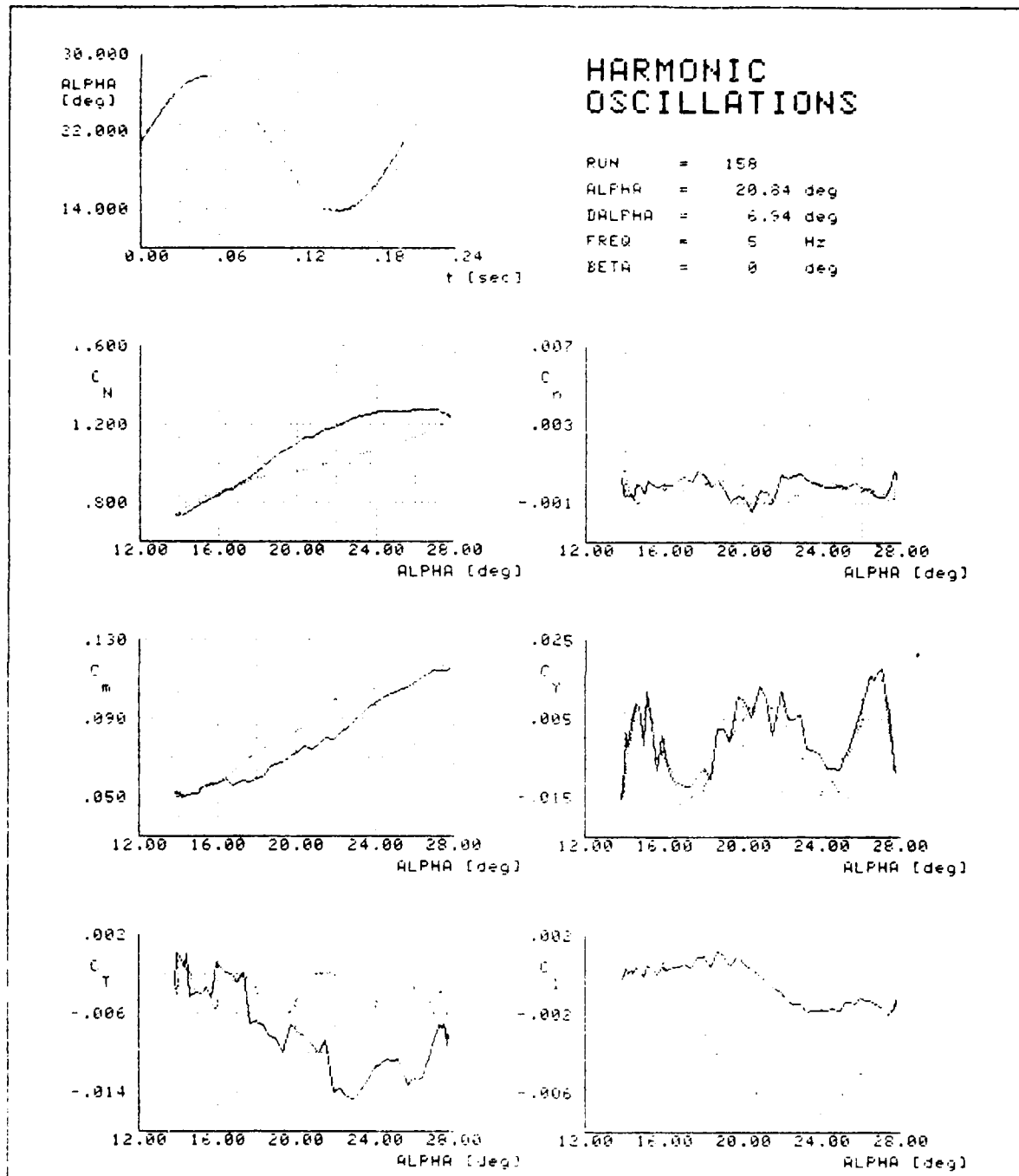
PUN = 129
 ALPHA = 18.68 deg
 DIALPHA = 10.45 deg
 FREQ = 5 Hz
 BETA = 0 deg

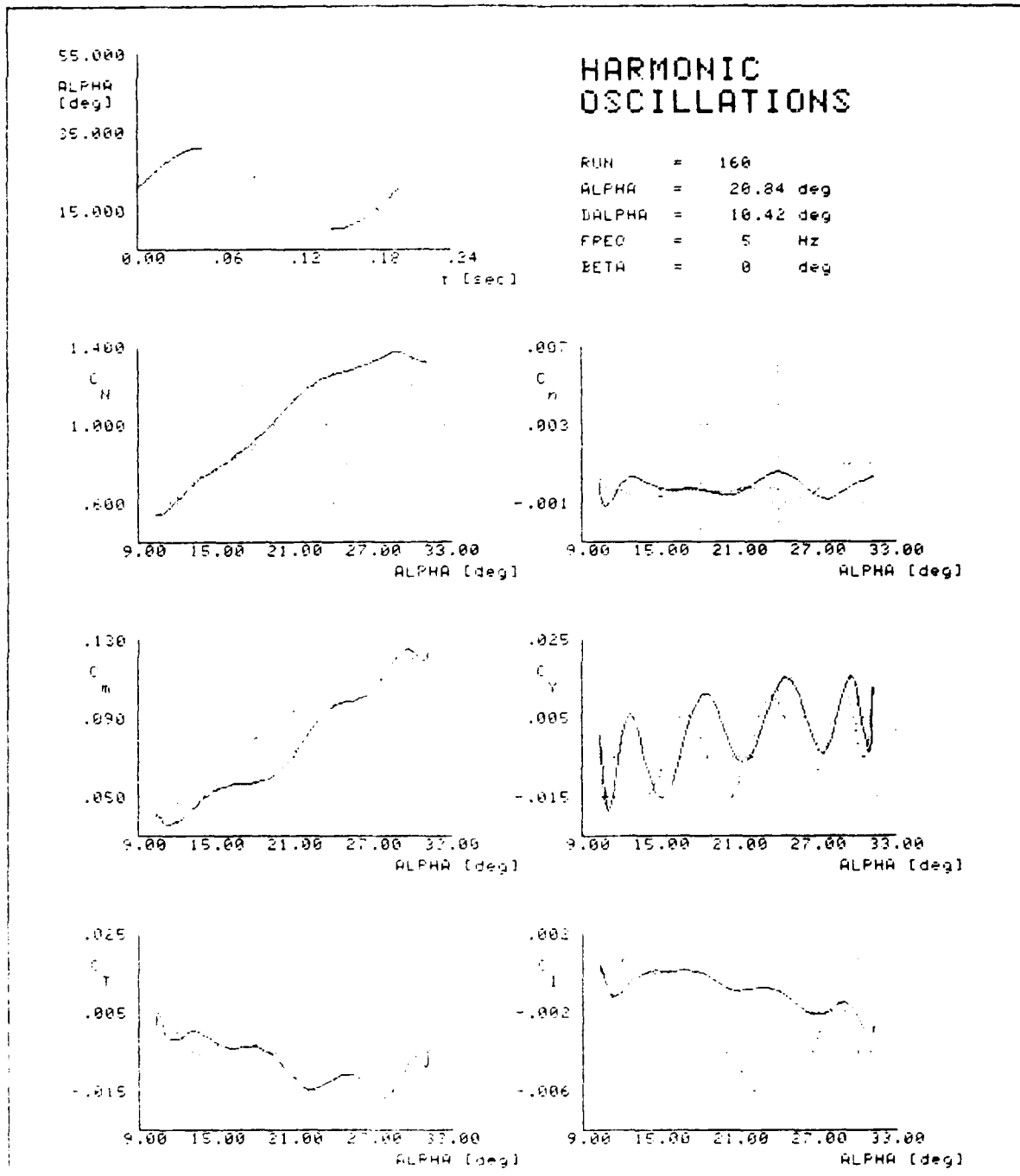


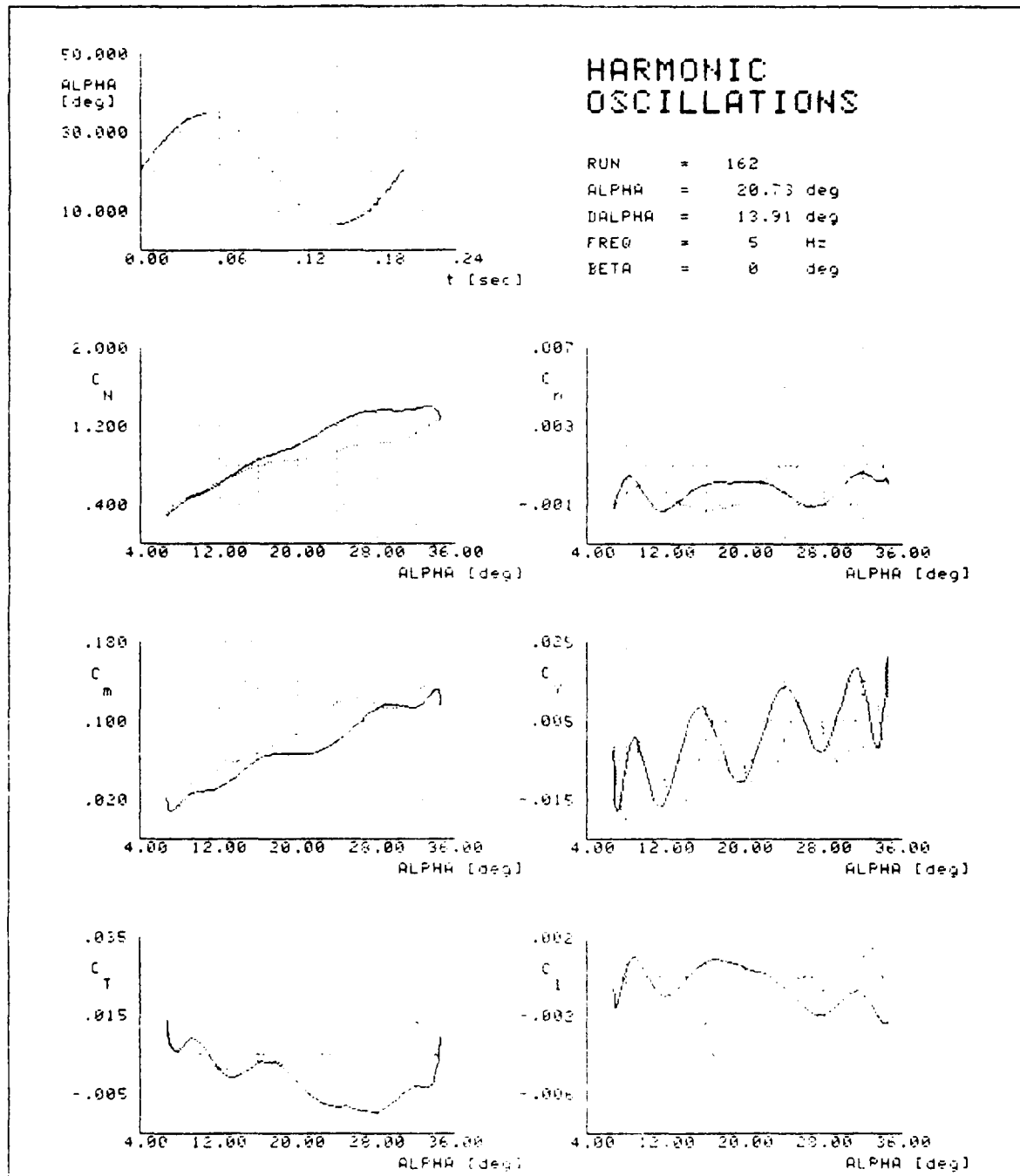


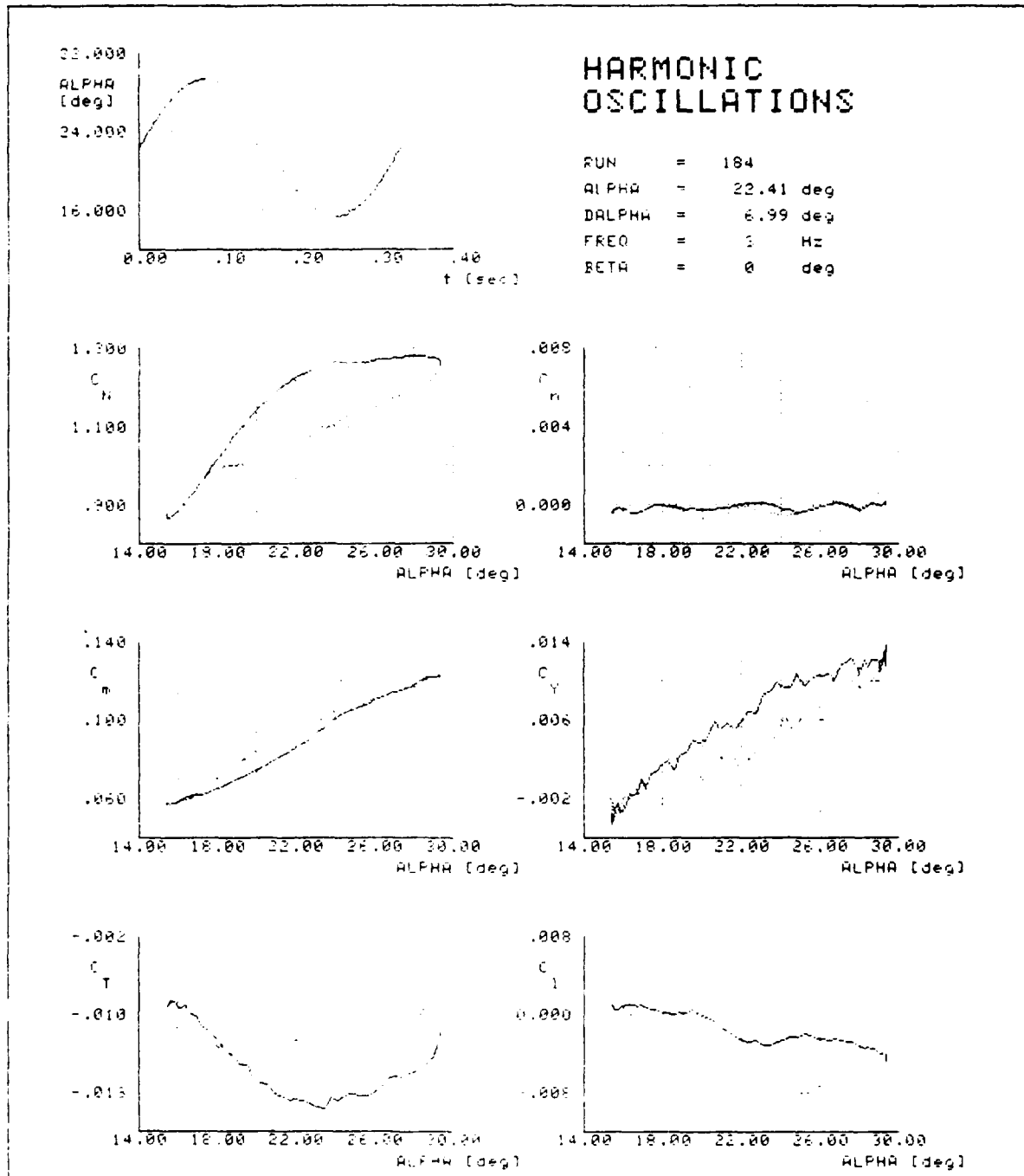


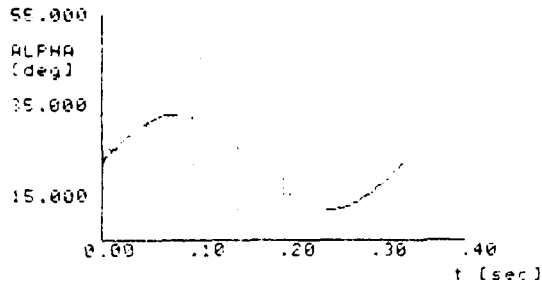






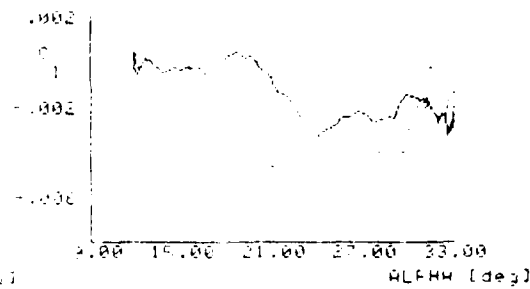
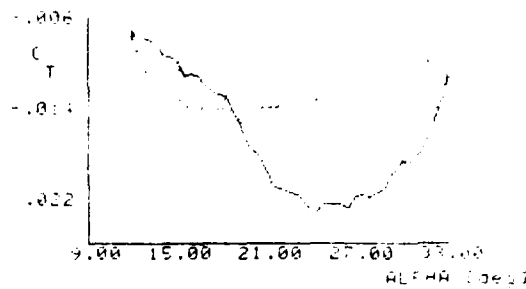
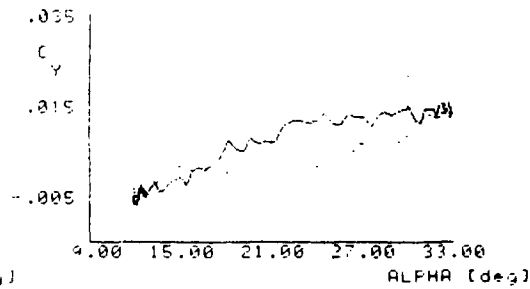
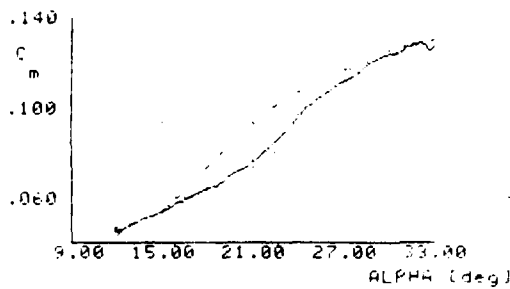
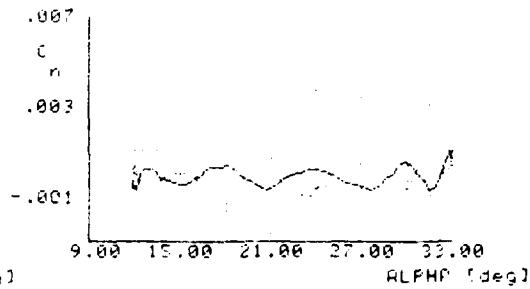
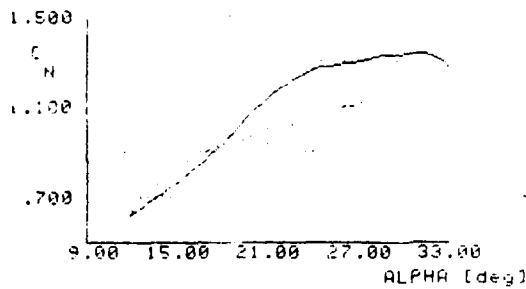


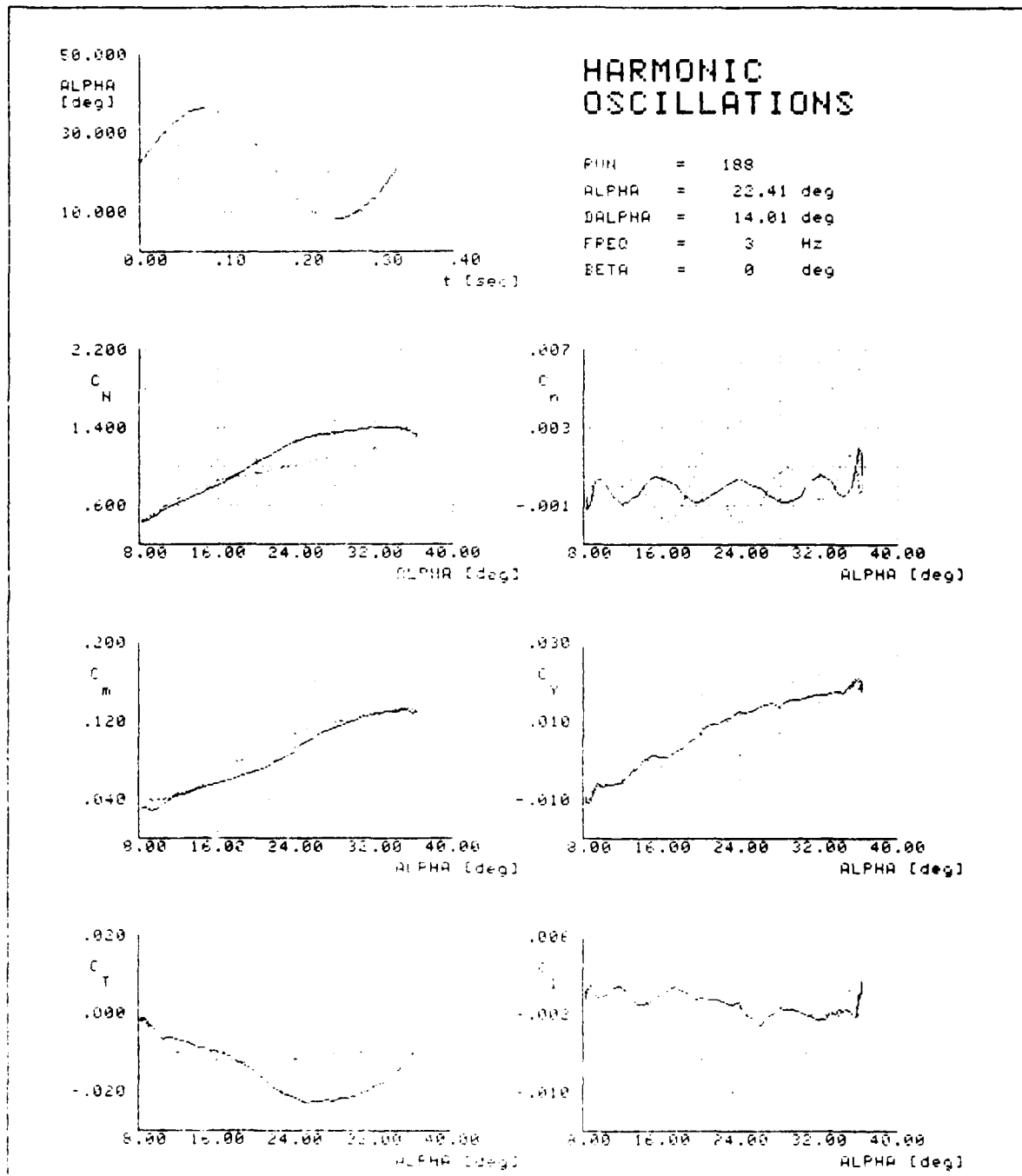


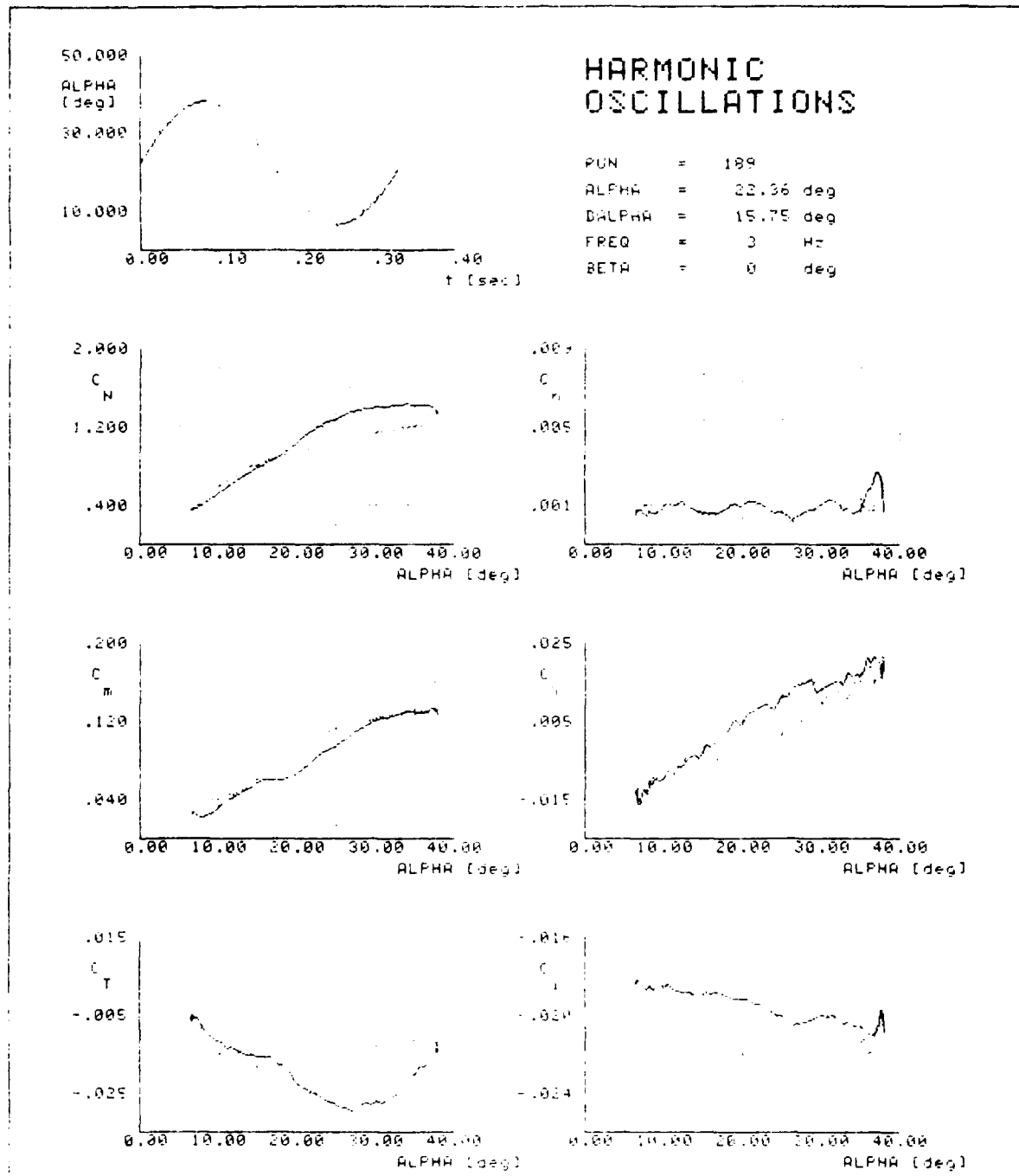


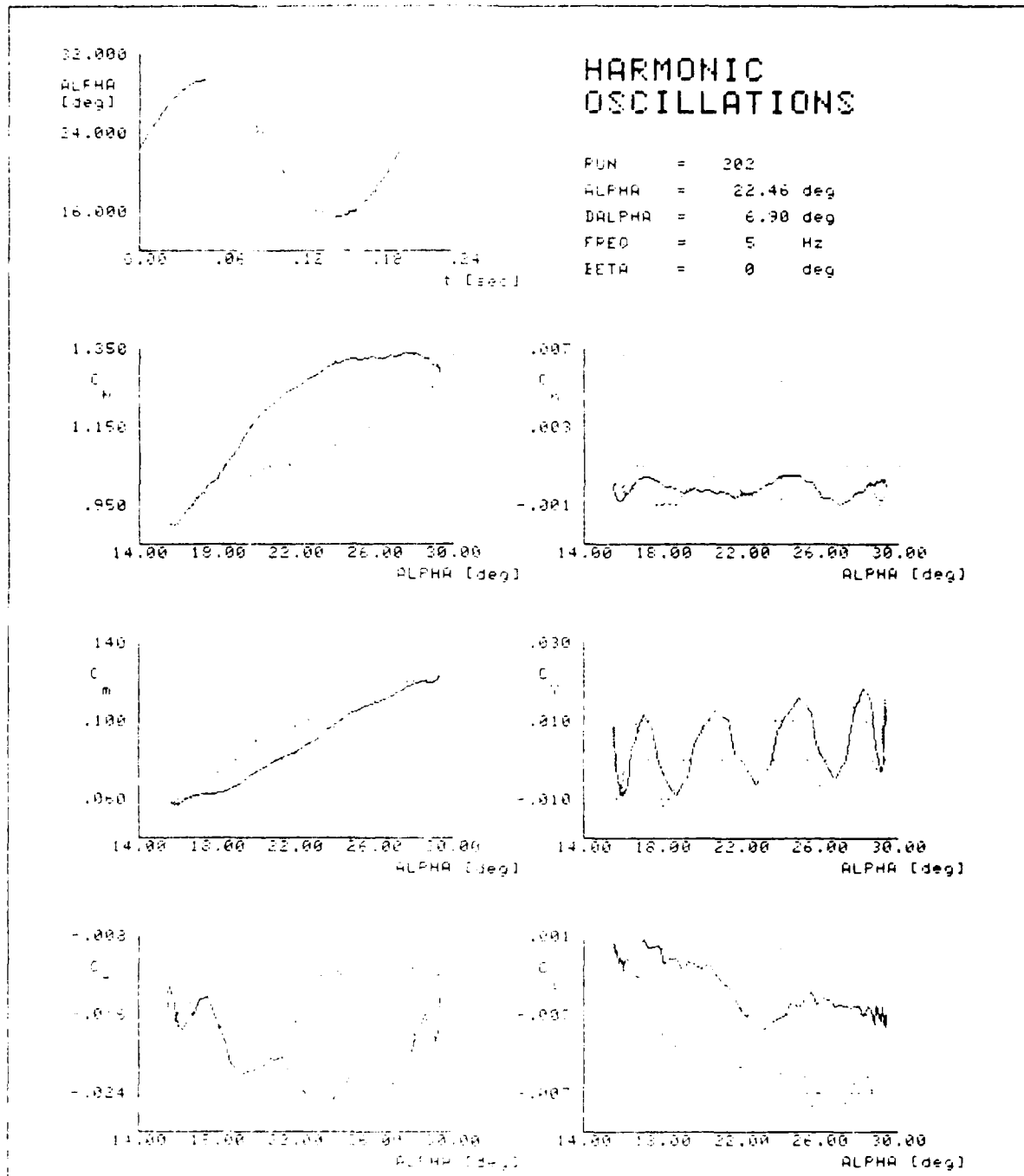
HARMONIC OSCILLATIONS

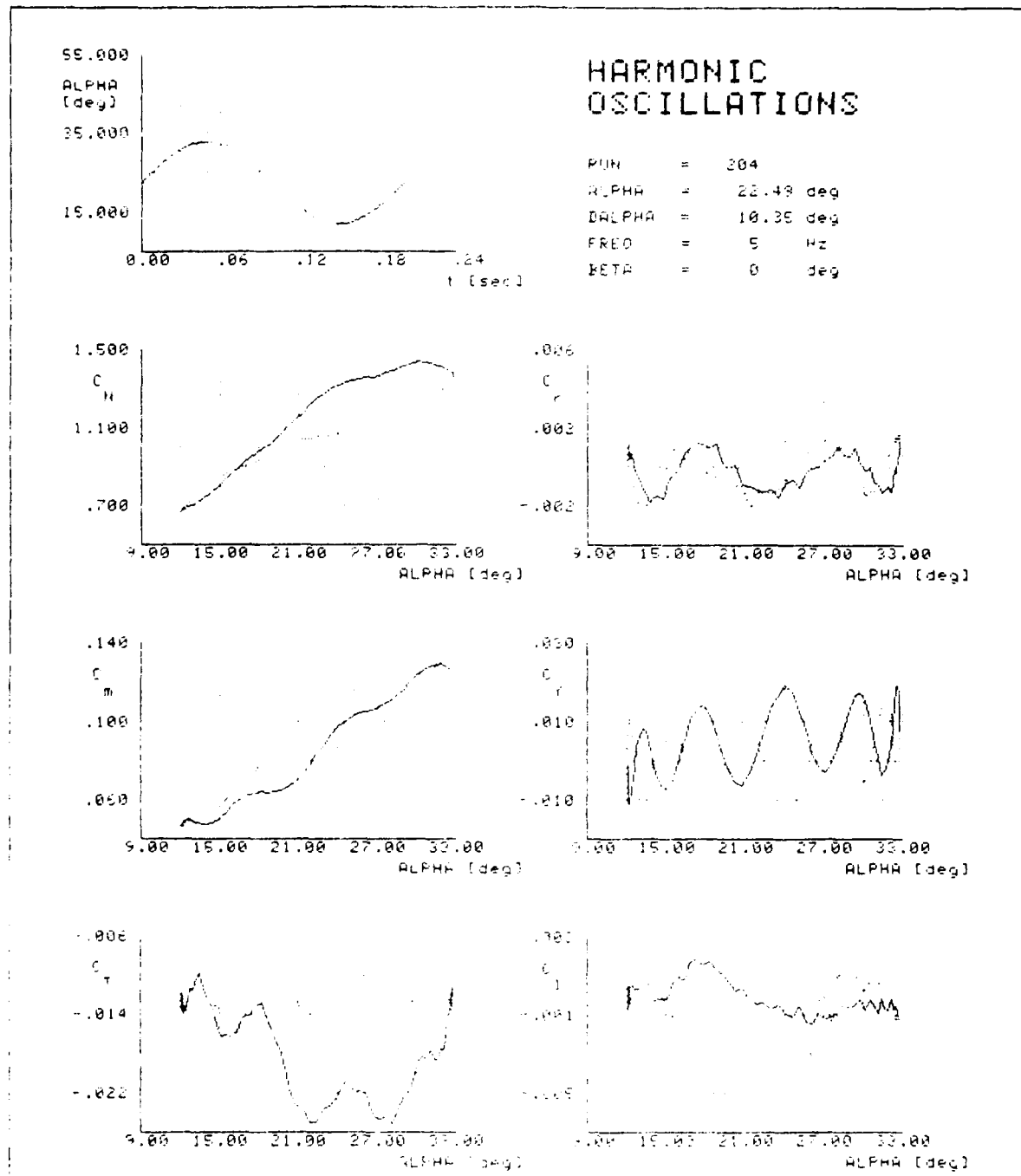
RUN = 196
ALPHA = 22.42 deg
DALPHA = 10.48 deg
FREQ = 3 Hz
BETA = 0 deg

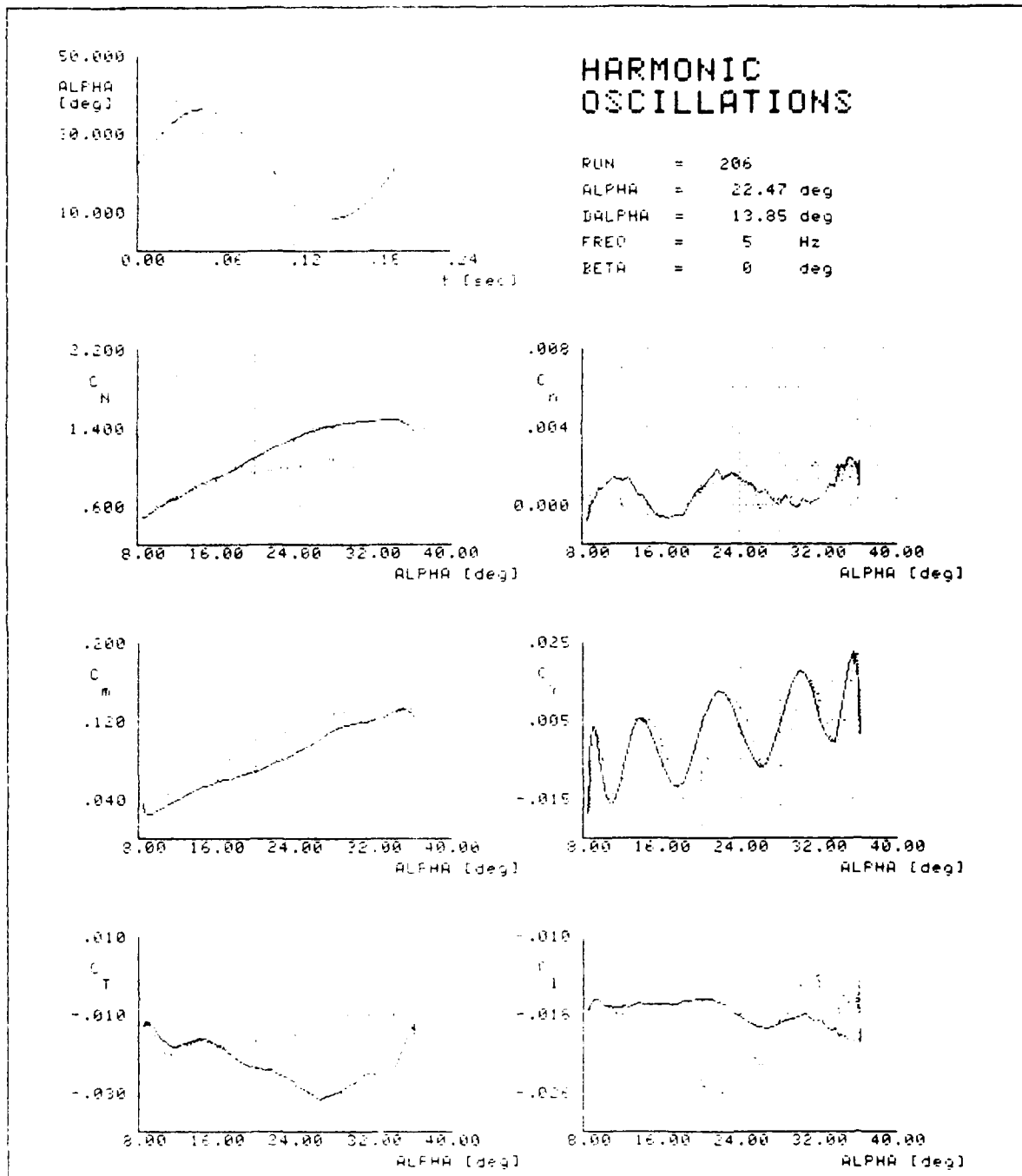


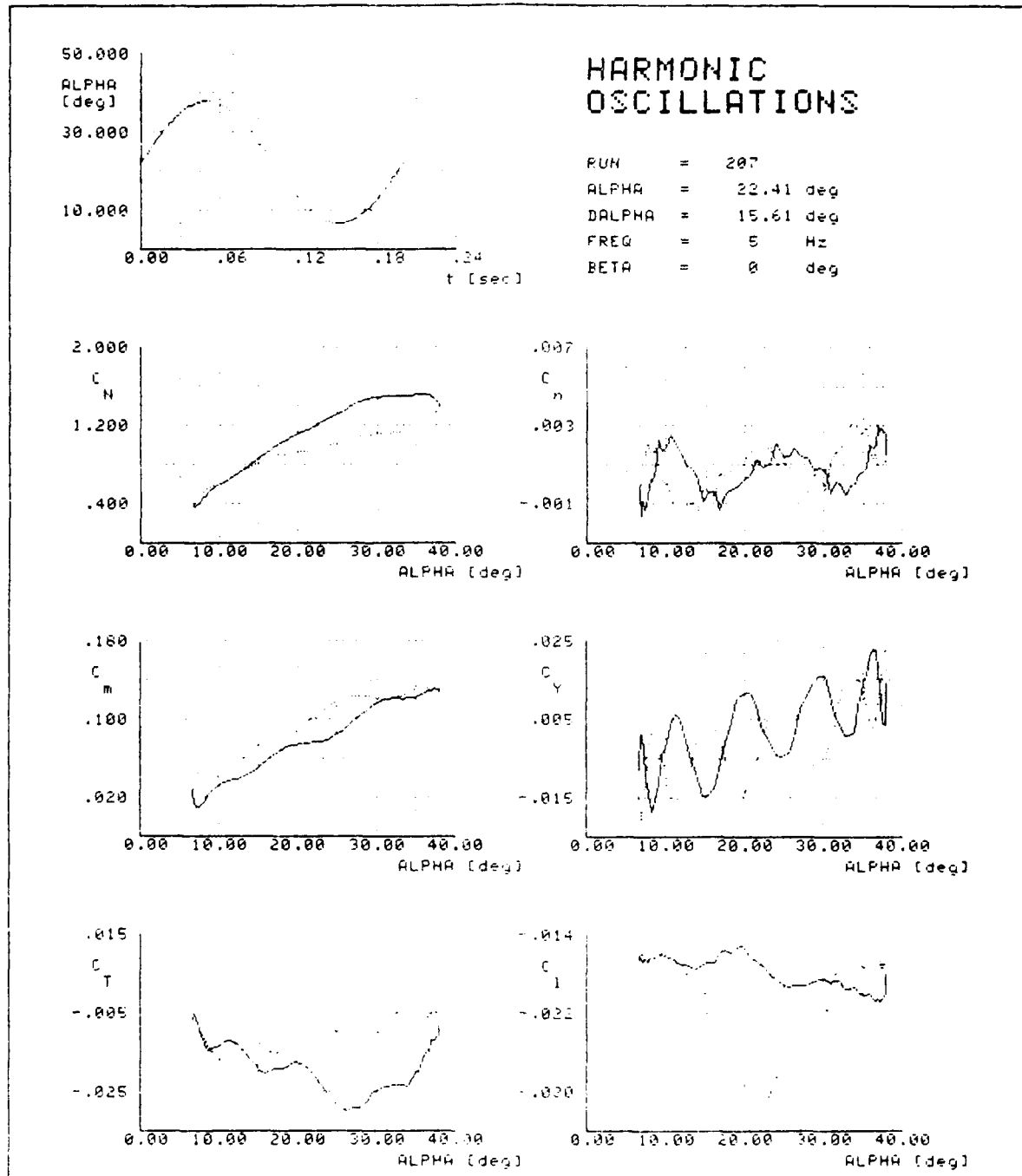


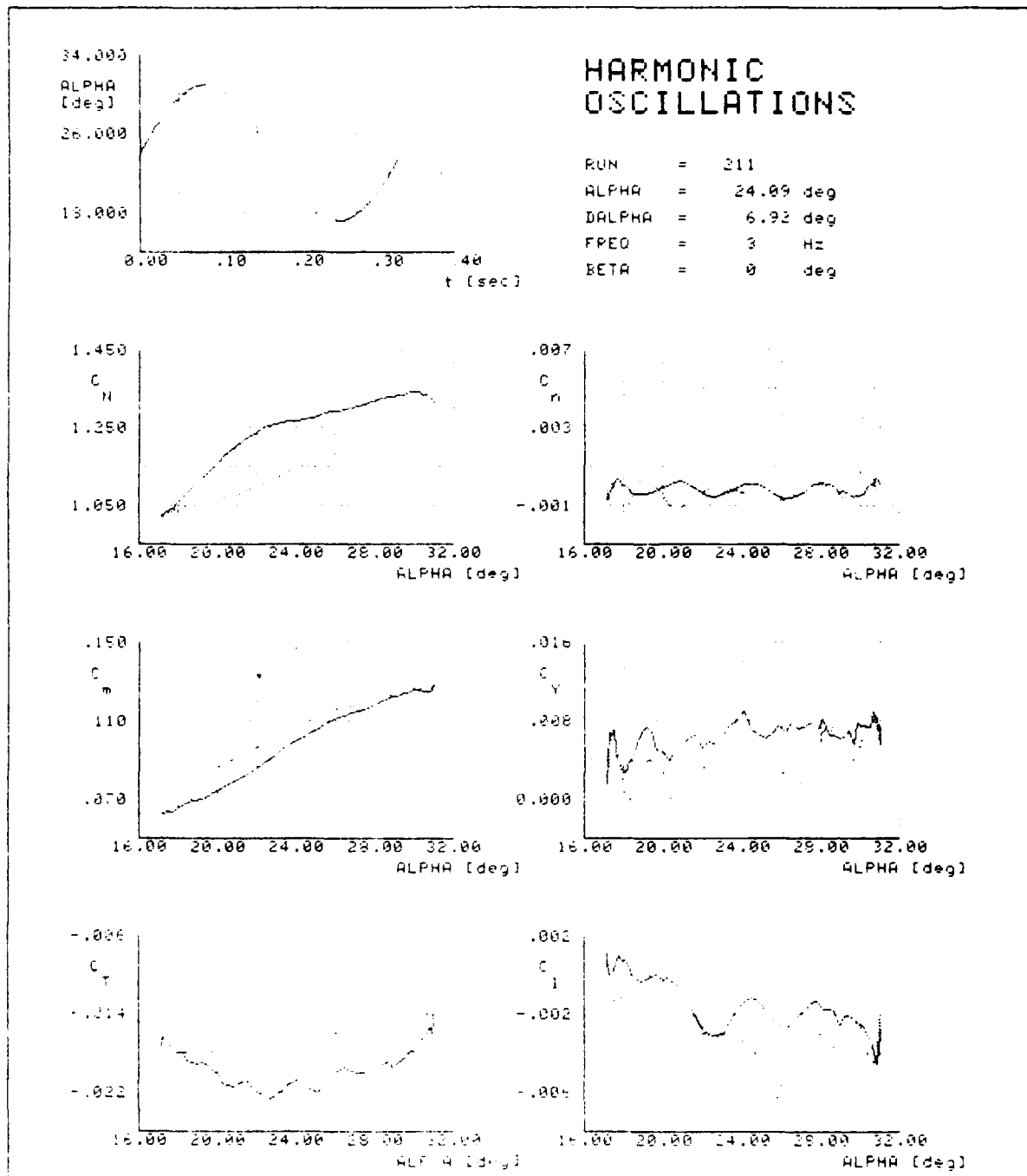


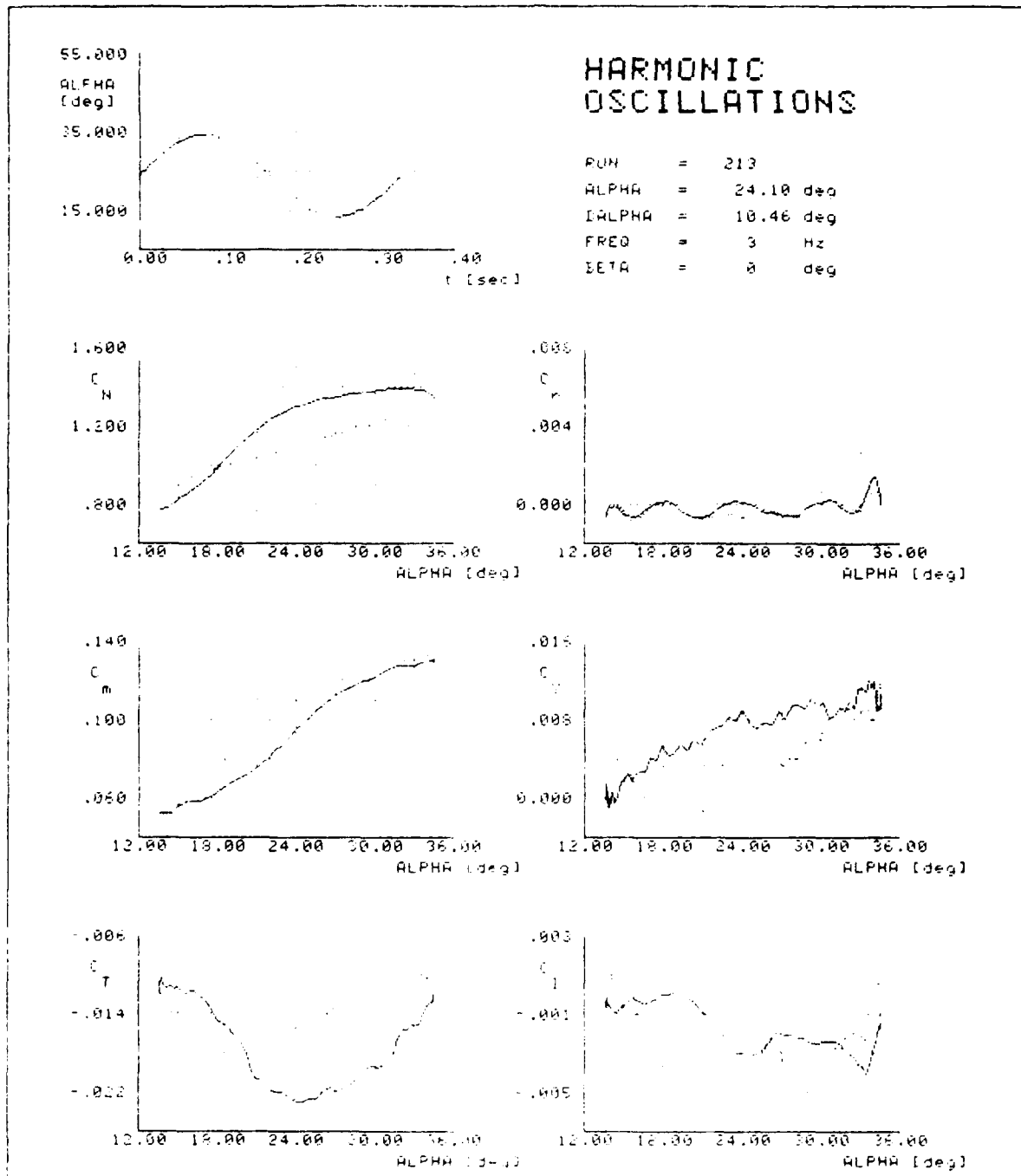


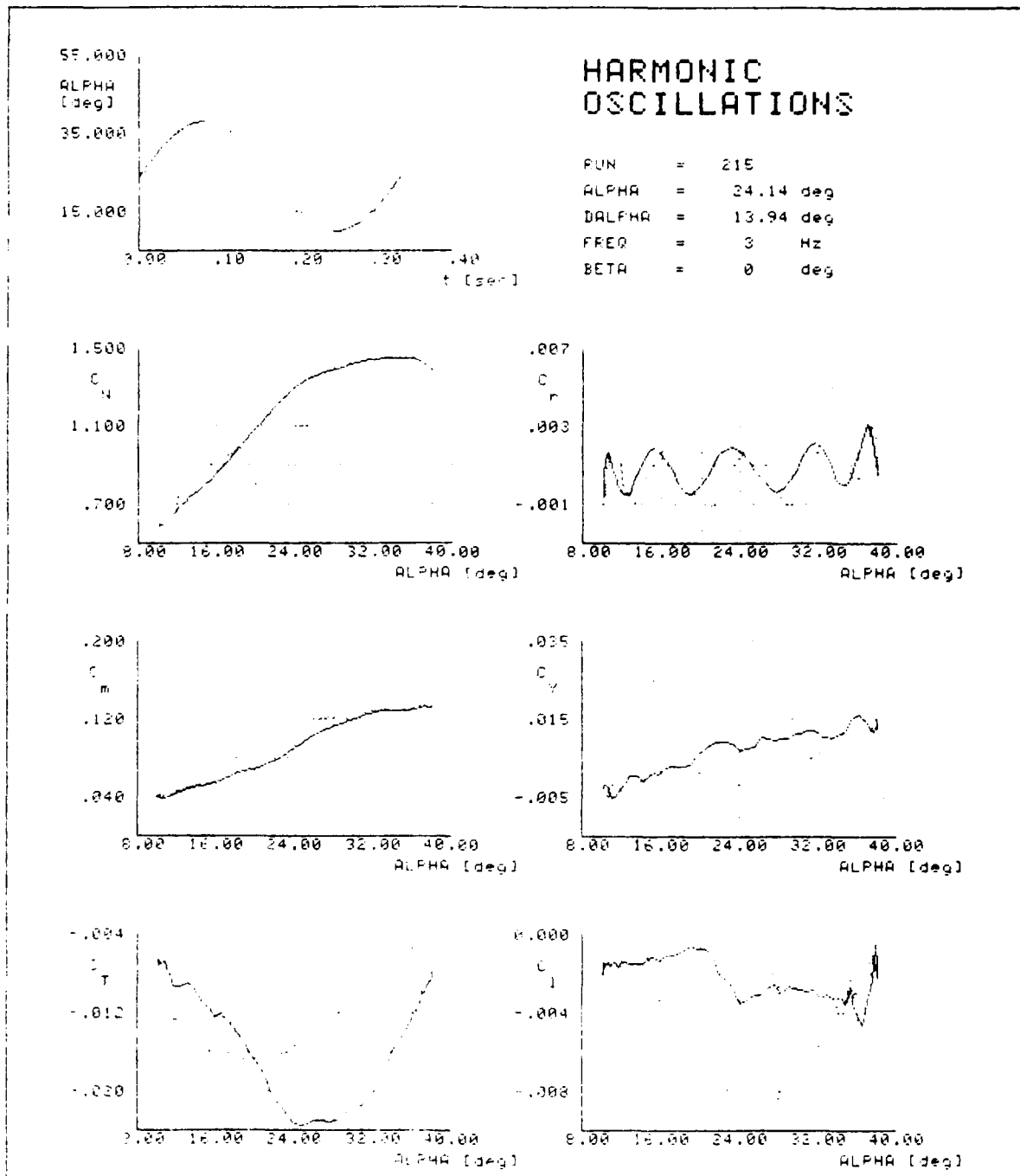


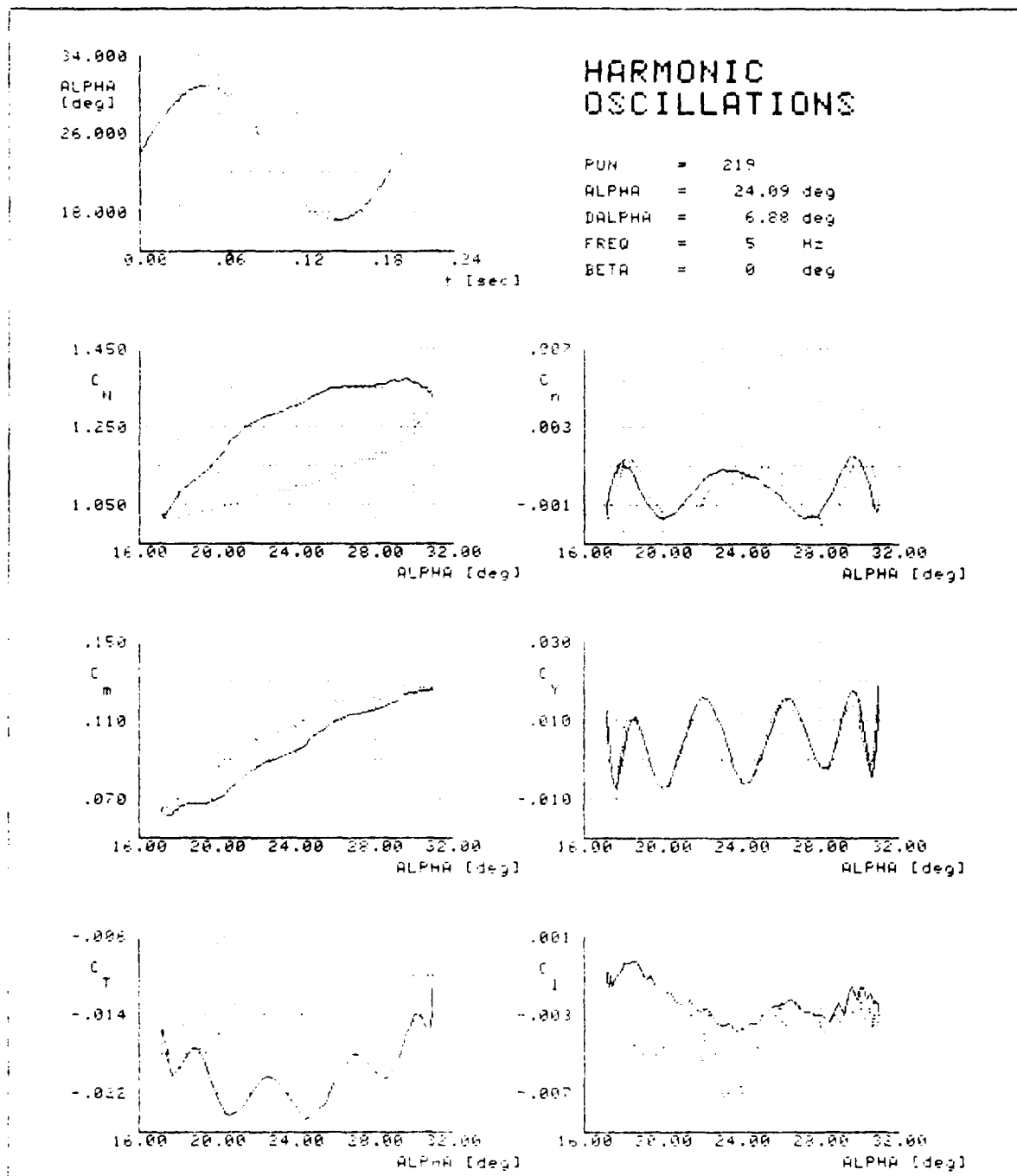


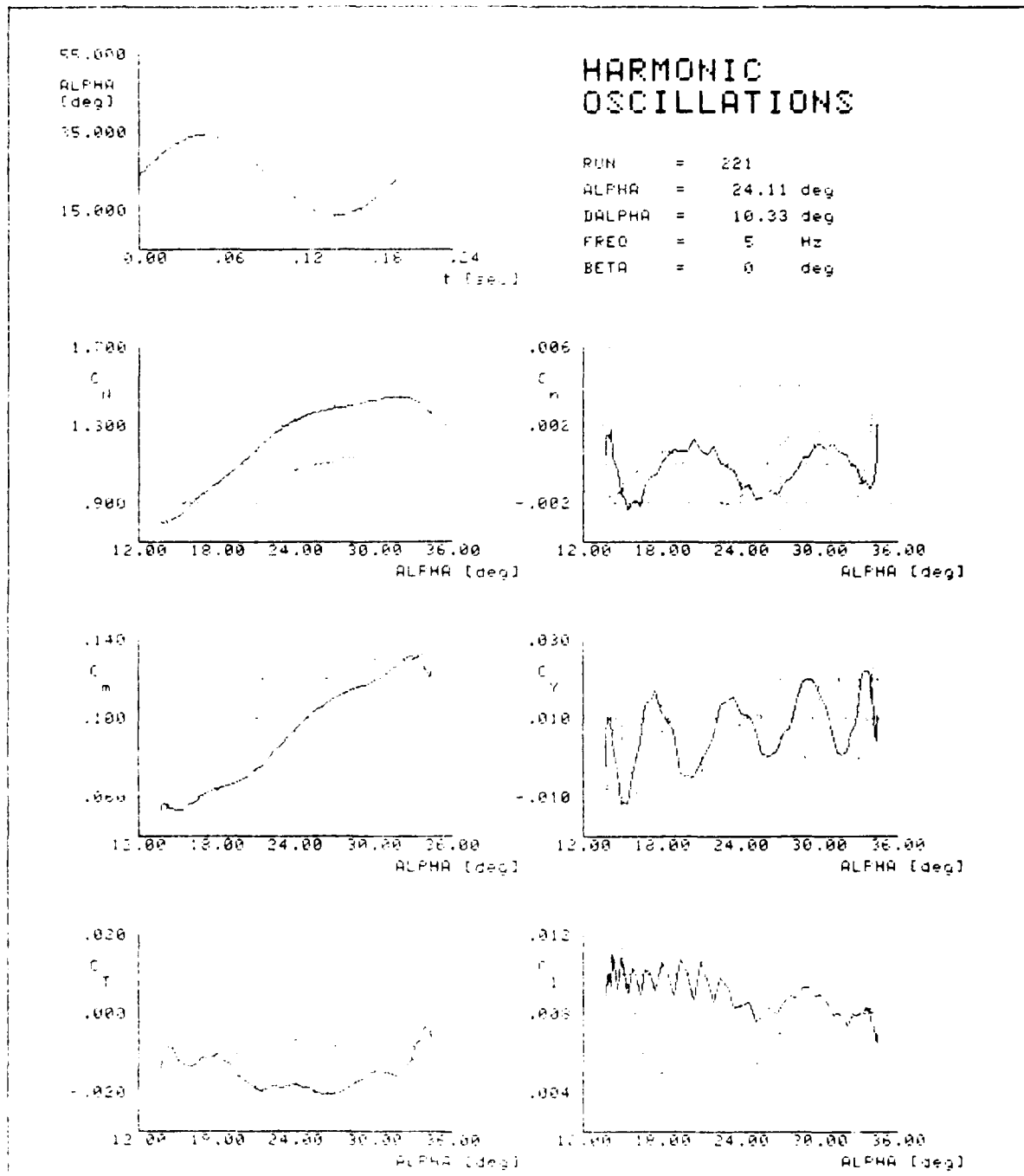


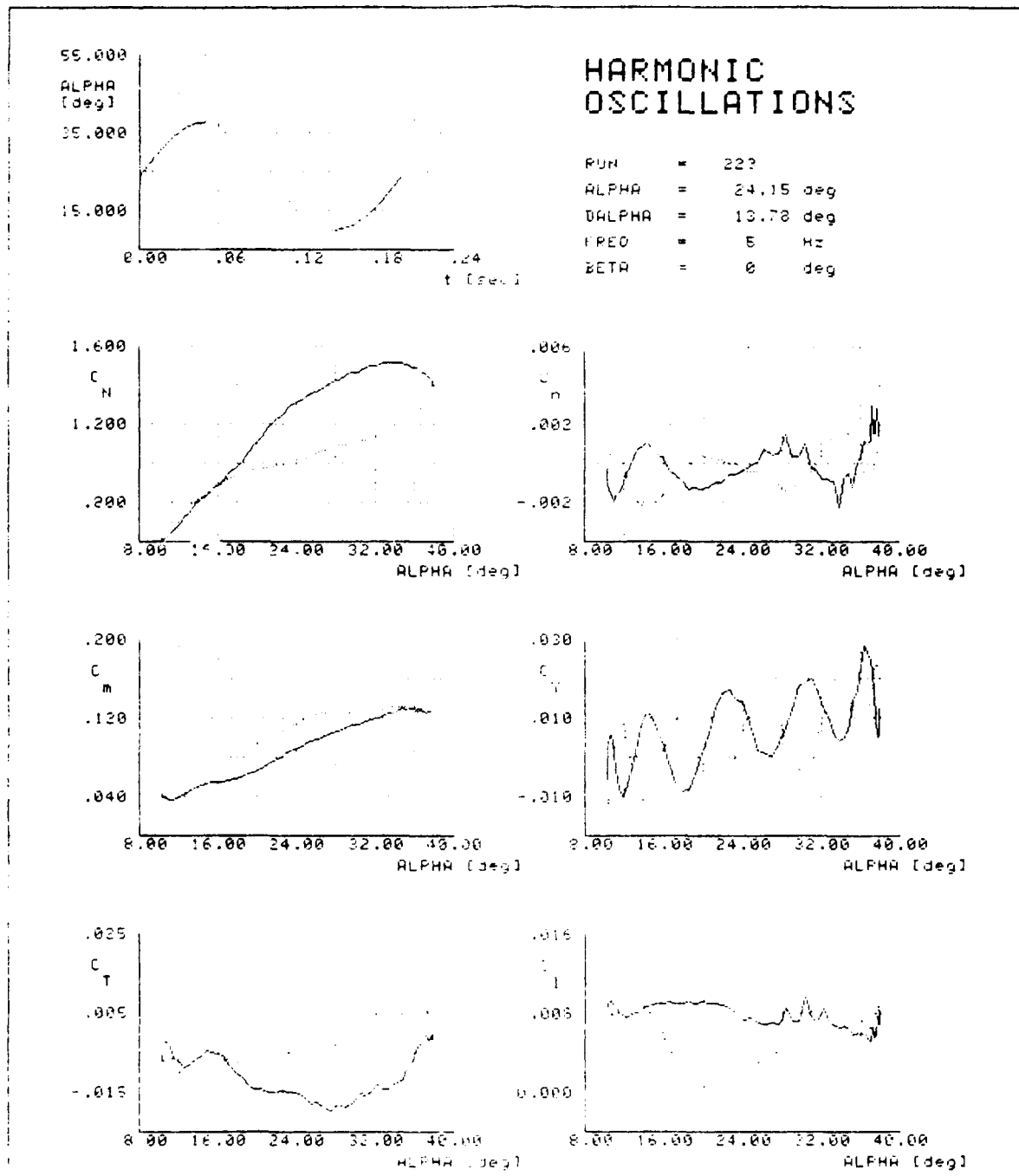


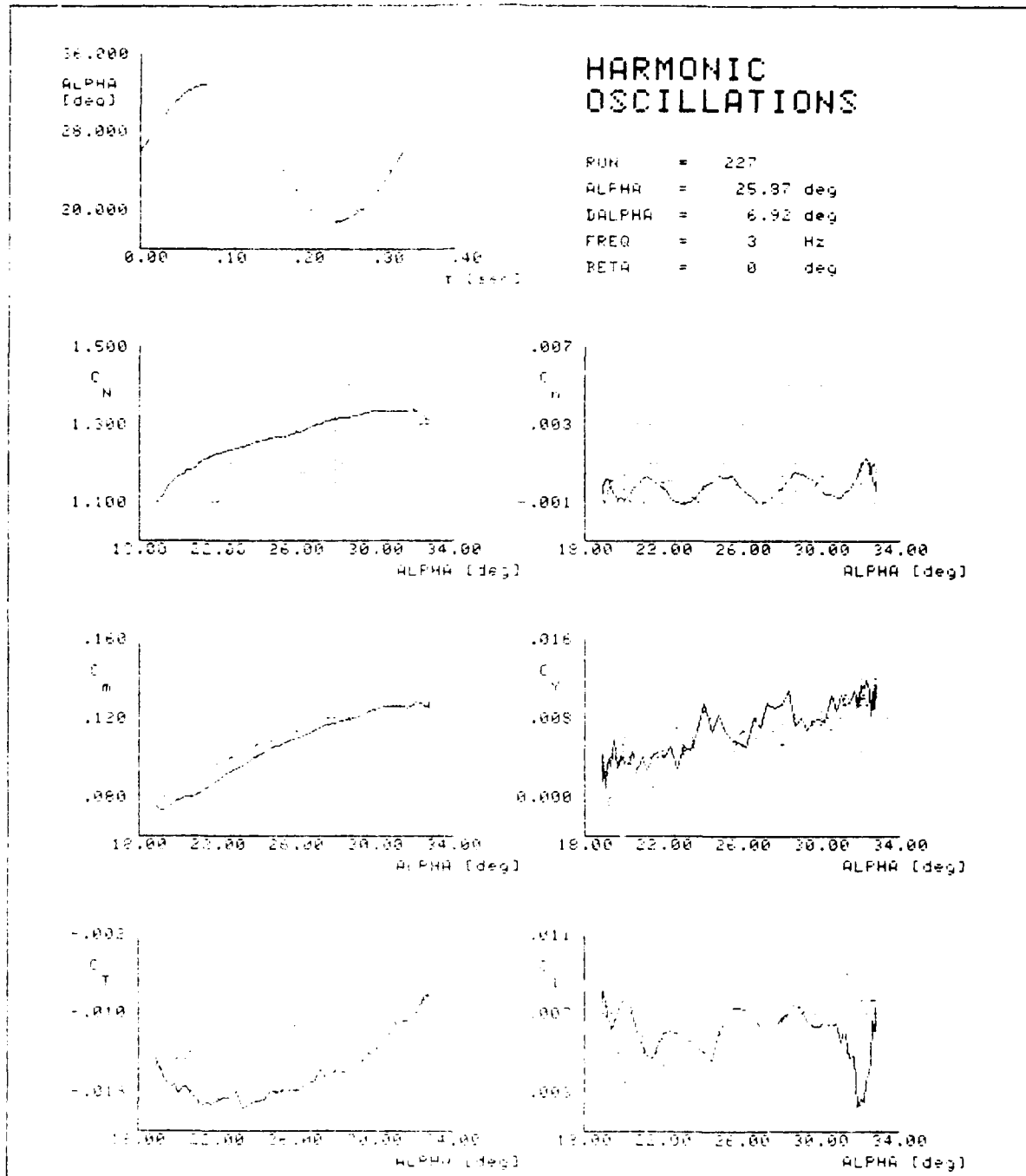


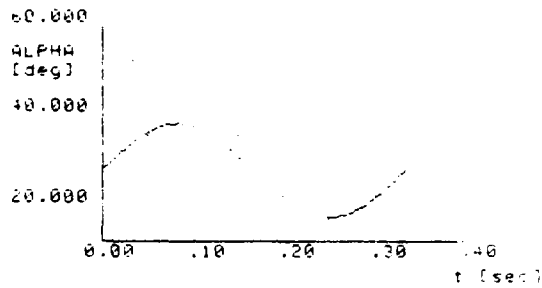






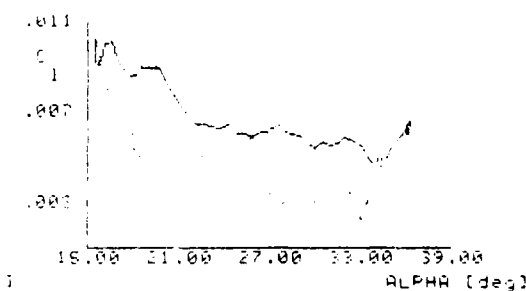
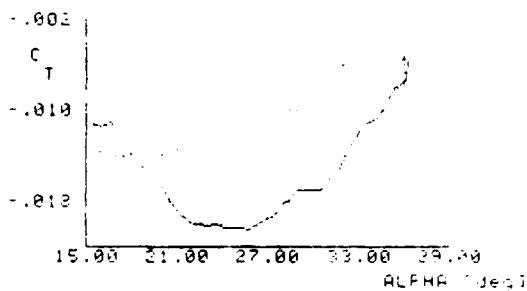
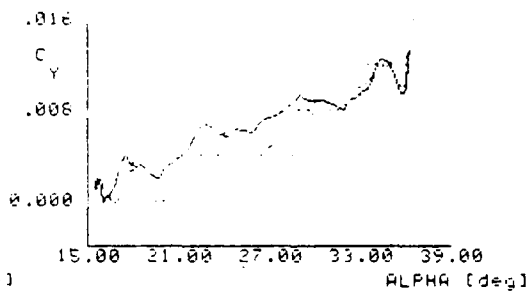
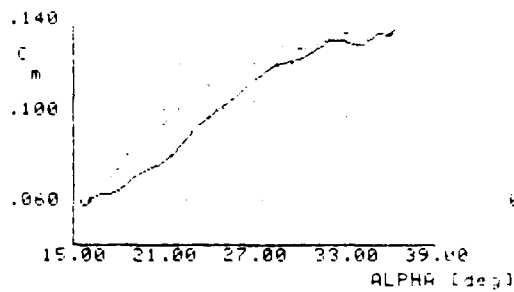
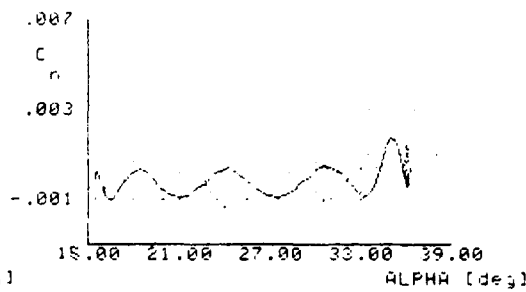
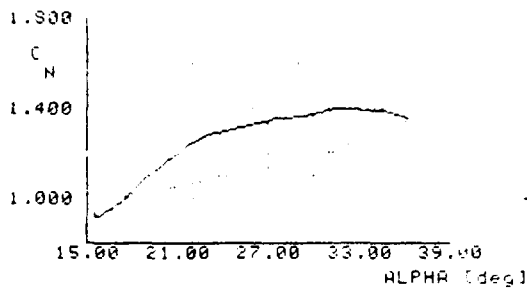


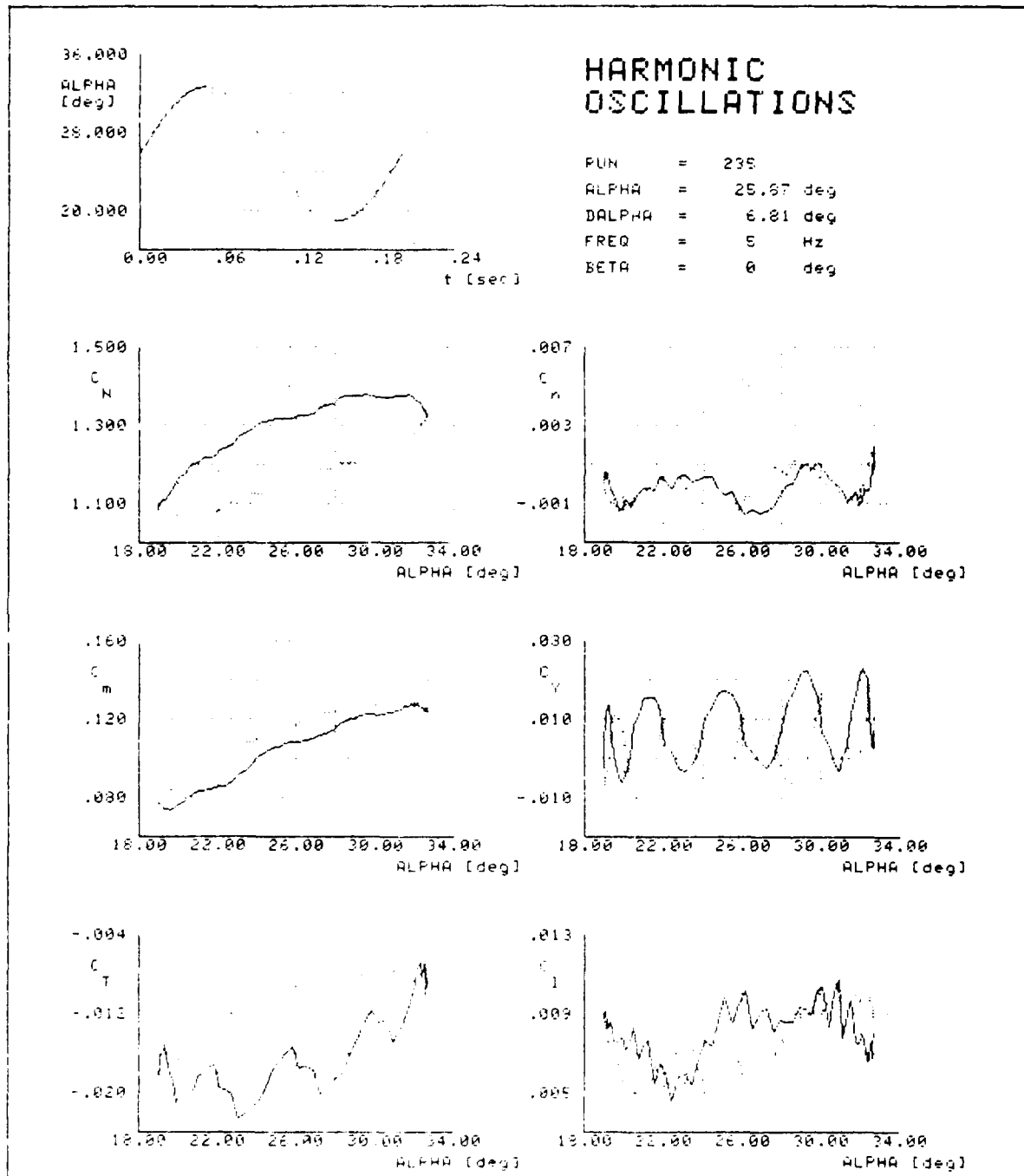


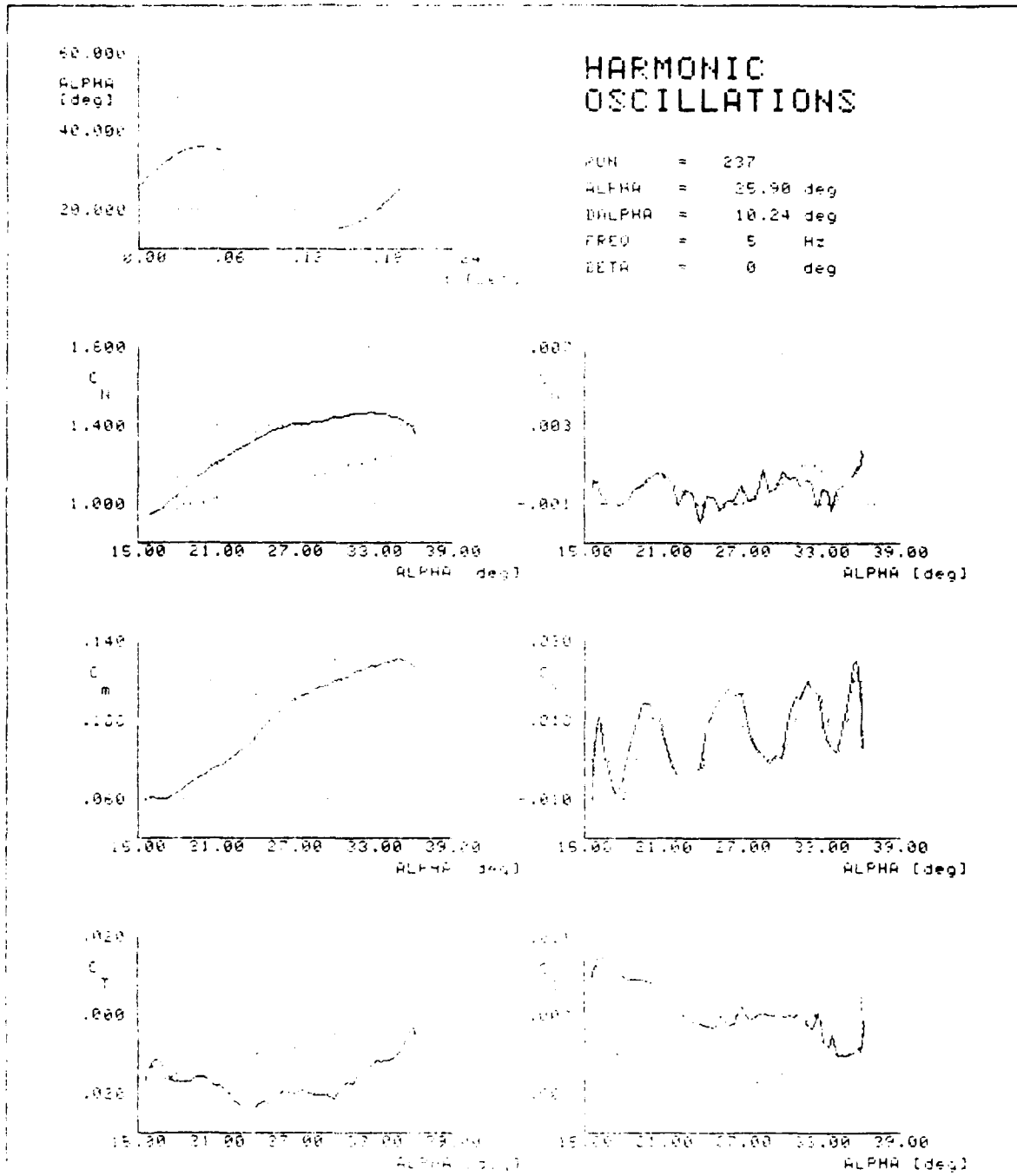


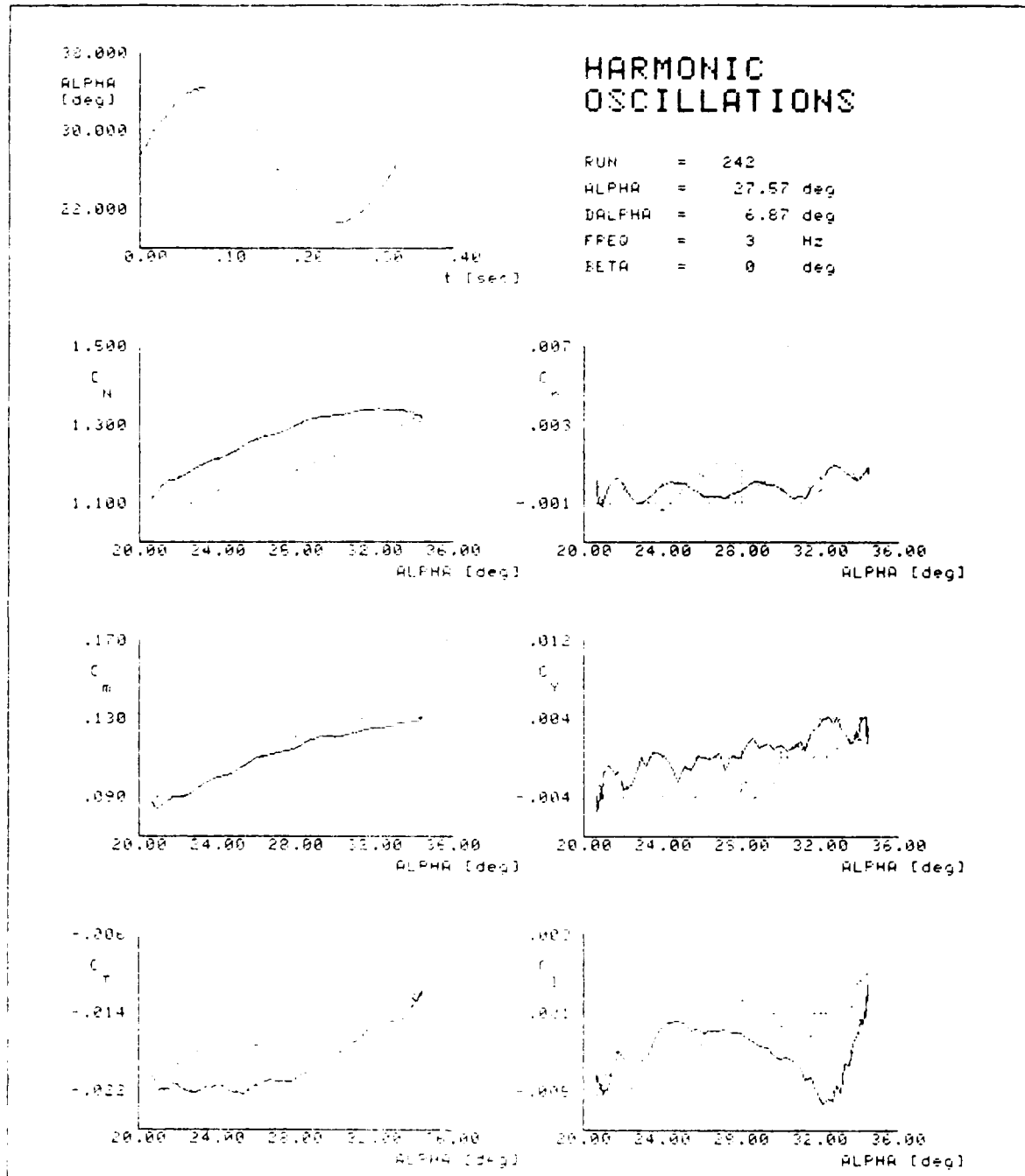
HARMONIC OSCILLATIONS

RUN = 229
 ALPHA = 25.39 deg
 DIALPHA = 10.36 deg
 FREQ = 3 Hz
 BETA = 0 deg









60.000

ALPHA

(deg)

40.000

20.000

0.00 .10 .20 .30 .40

1 sec

HARMONIC OSCILLATIONS

PUN = 344

ALPHA = 27.57 deg

DELTA ALPHA = 10.35 deg

FREQ = 3 Hz

BETA = 0 deg

1.400

1.250

1.050

19.00 21.00 27.00 33.00 39.00

ALPHA (deg)

0.000

0.000

0.000

0.000

19.00 21.00 27.00 33.00 39.00

ALPHA (deg)

1.300

1.150

0.950

19.00 21.00 27.00 33.00 39.00

ALPHA (deg)

0.050

0.050

0.050

0.050

19.00 21.00 27.00 33.00 39.00

ALPHA (deg)

0.040

0.040

0.040

0.040

19.00 21.00 27.00 33.00 39.00

ALPHA (deg)

0.040

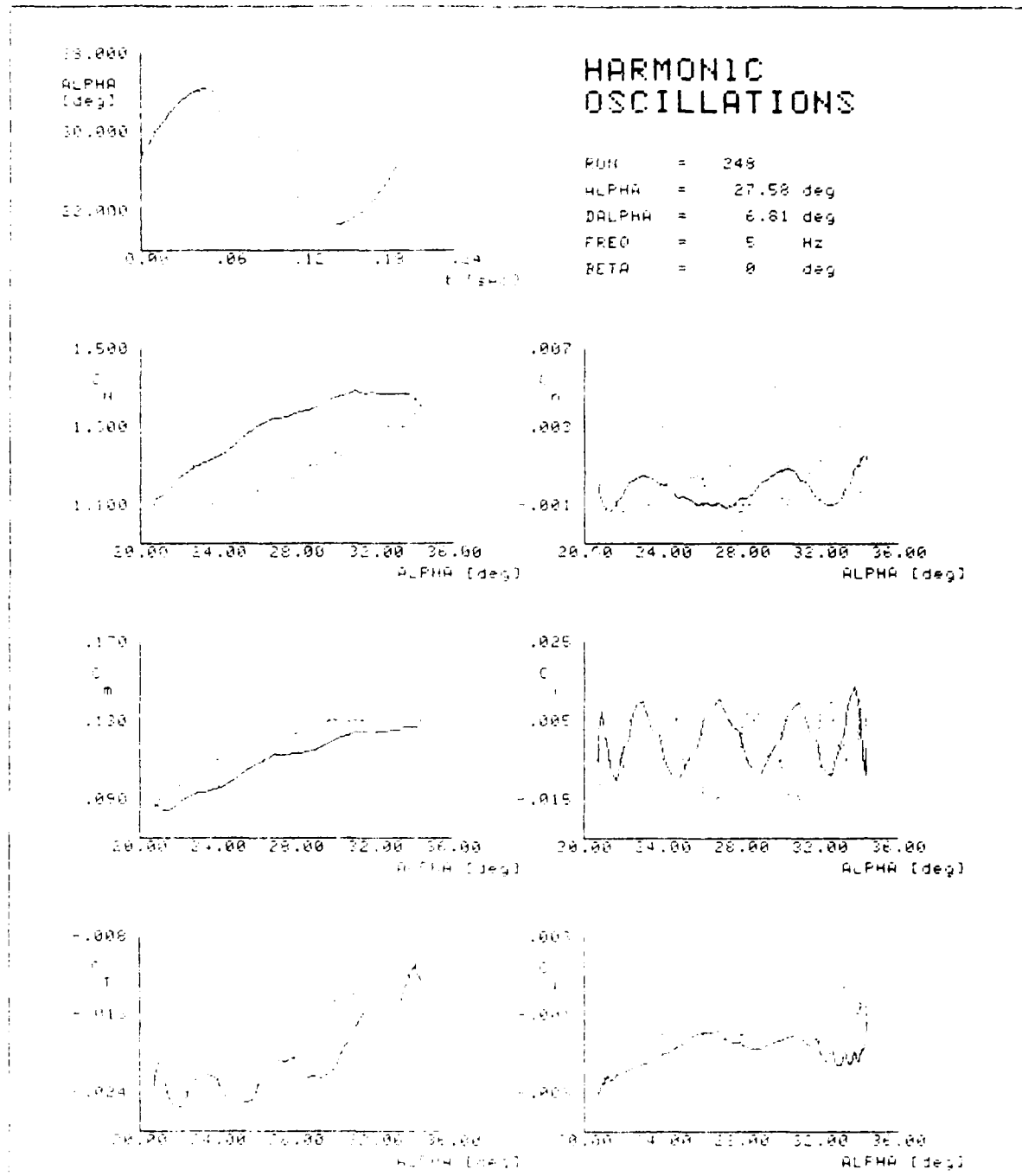
0.040

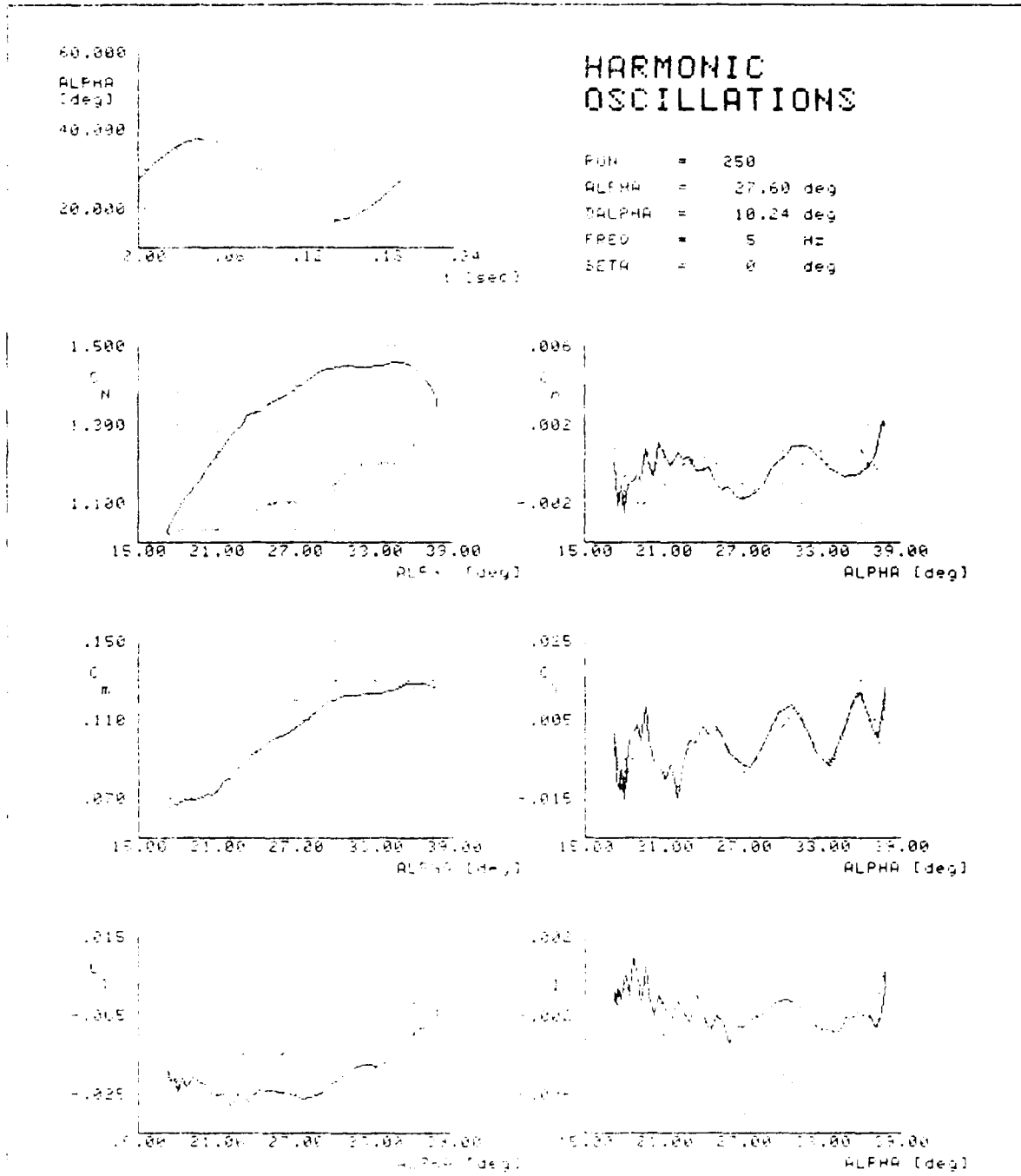
0.040

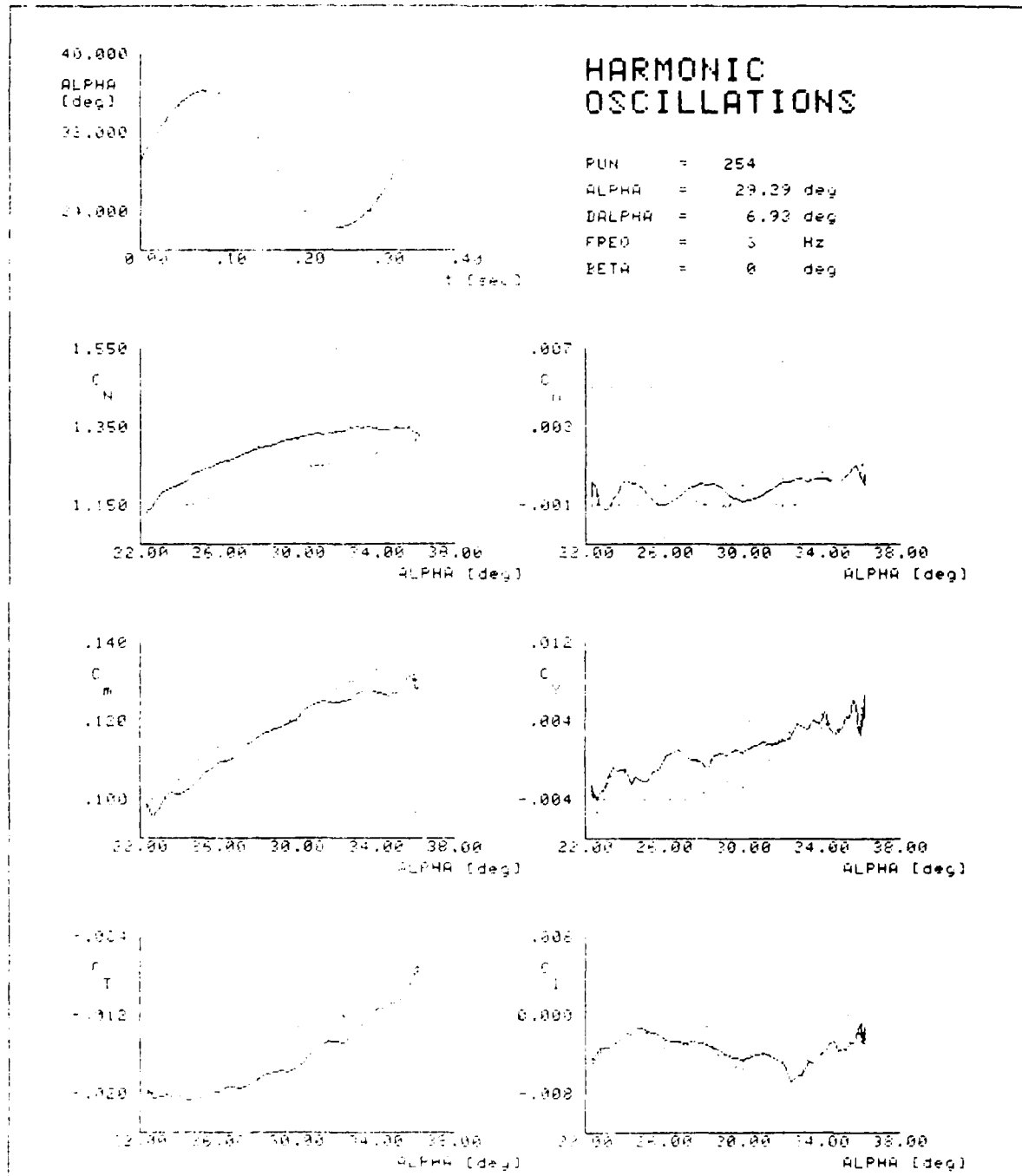
0.040

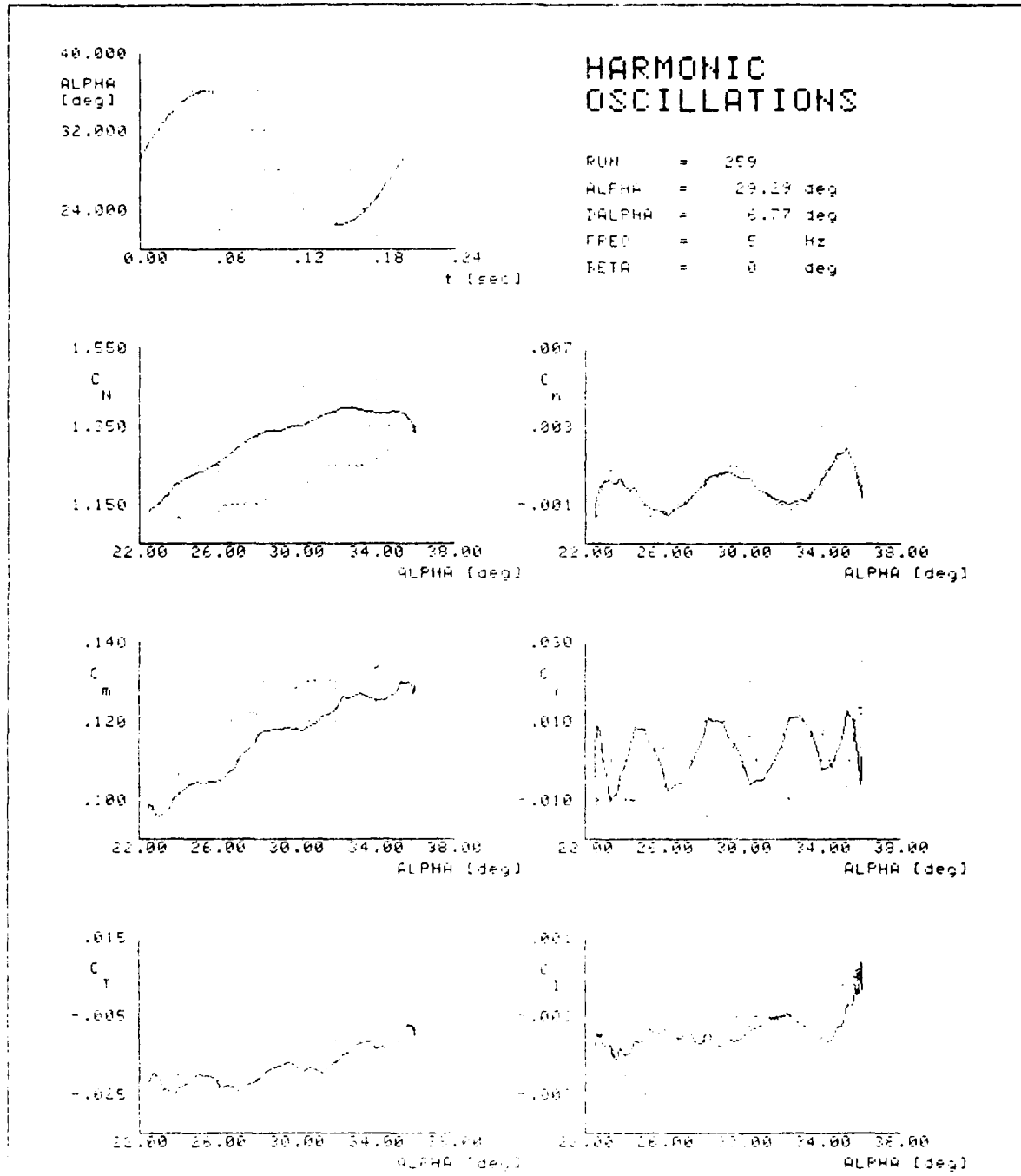
19.00 21.00 27.00 33.00 39.00

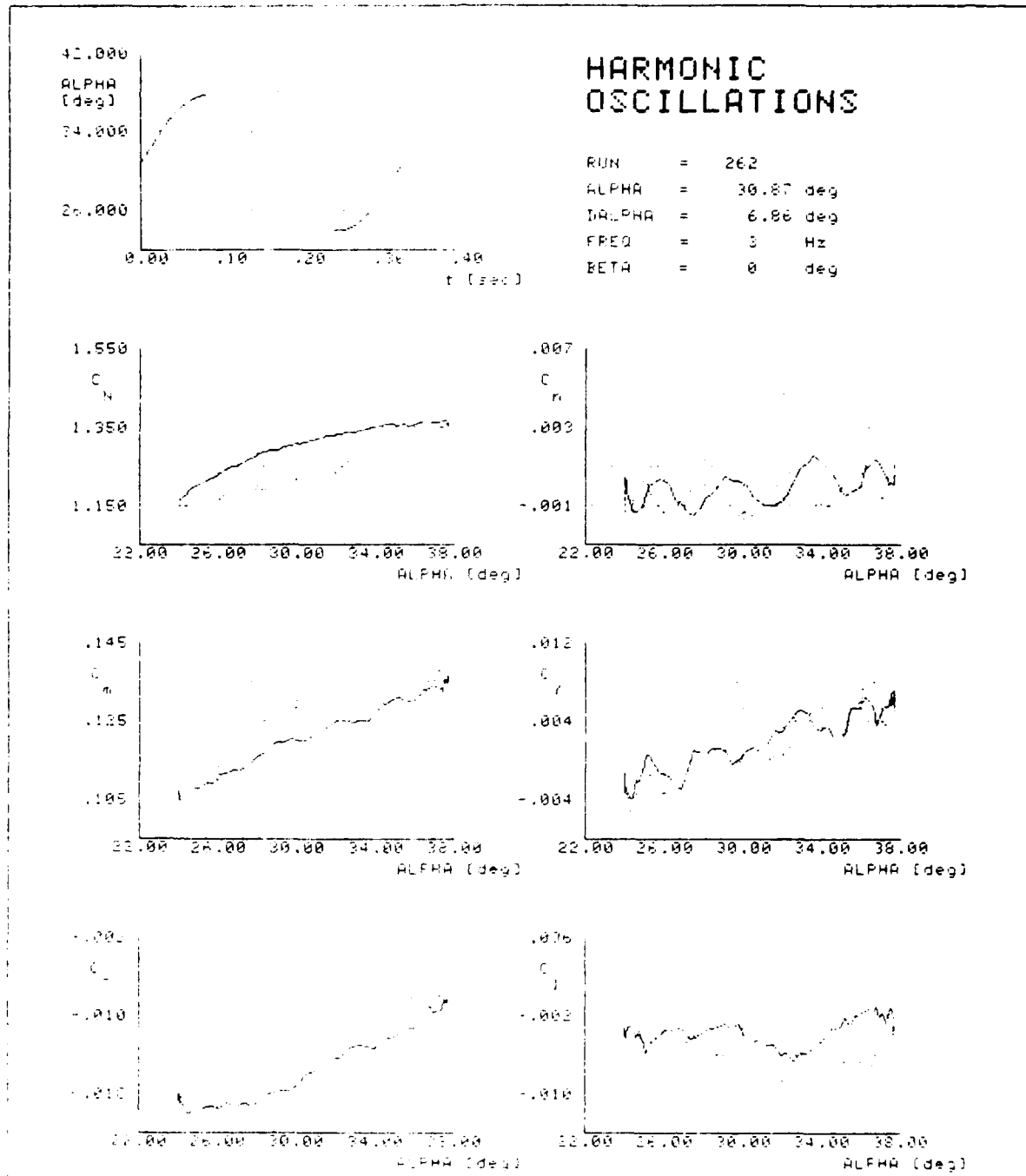
ALPHA (deg)

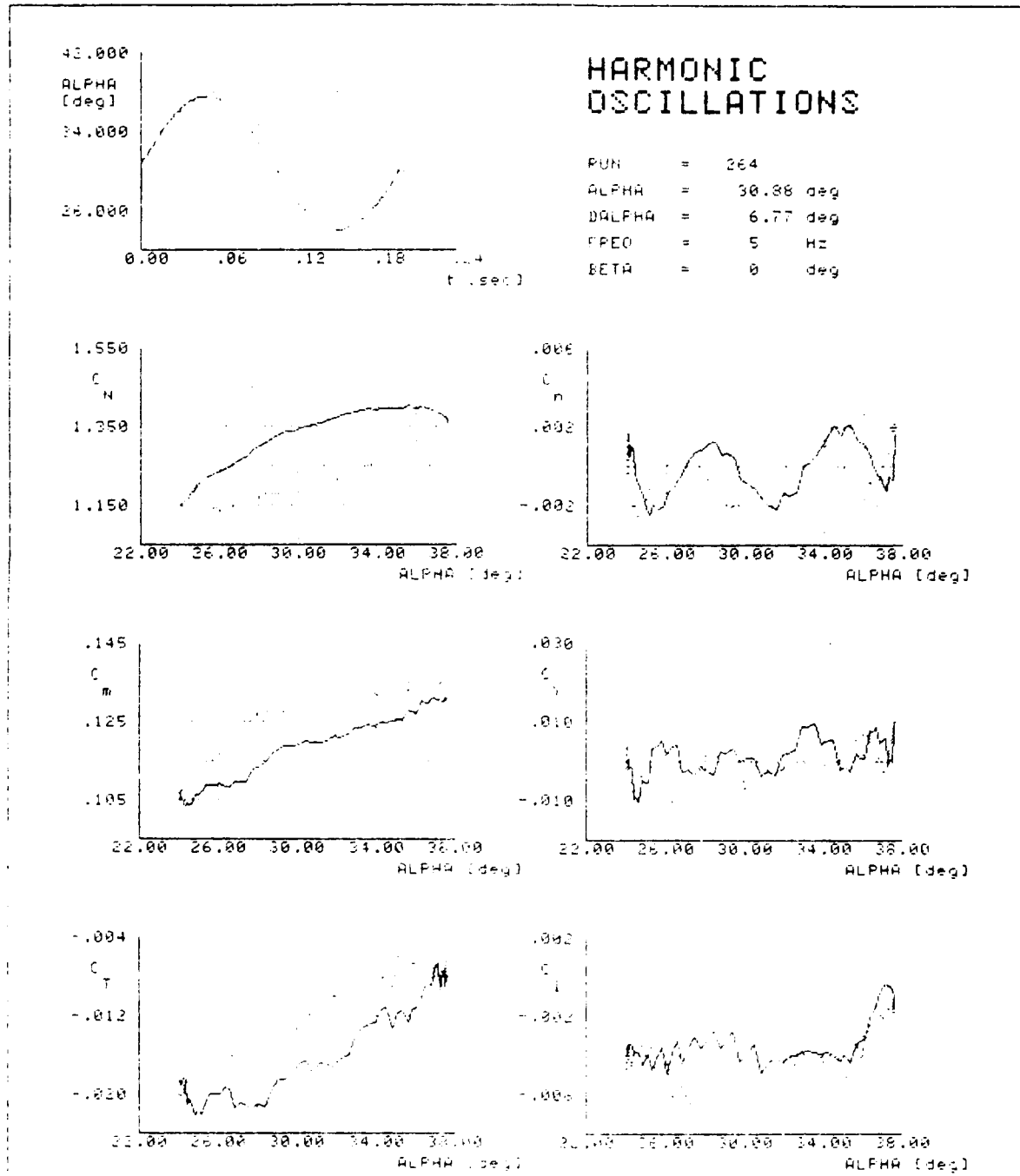


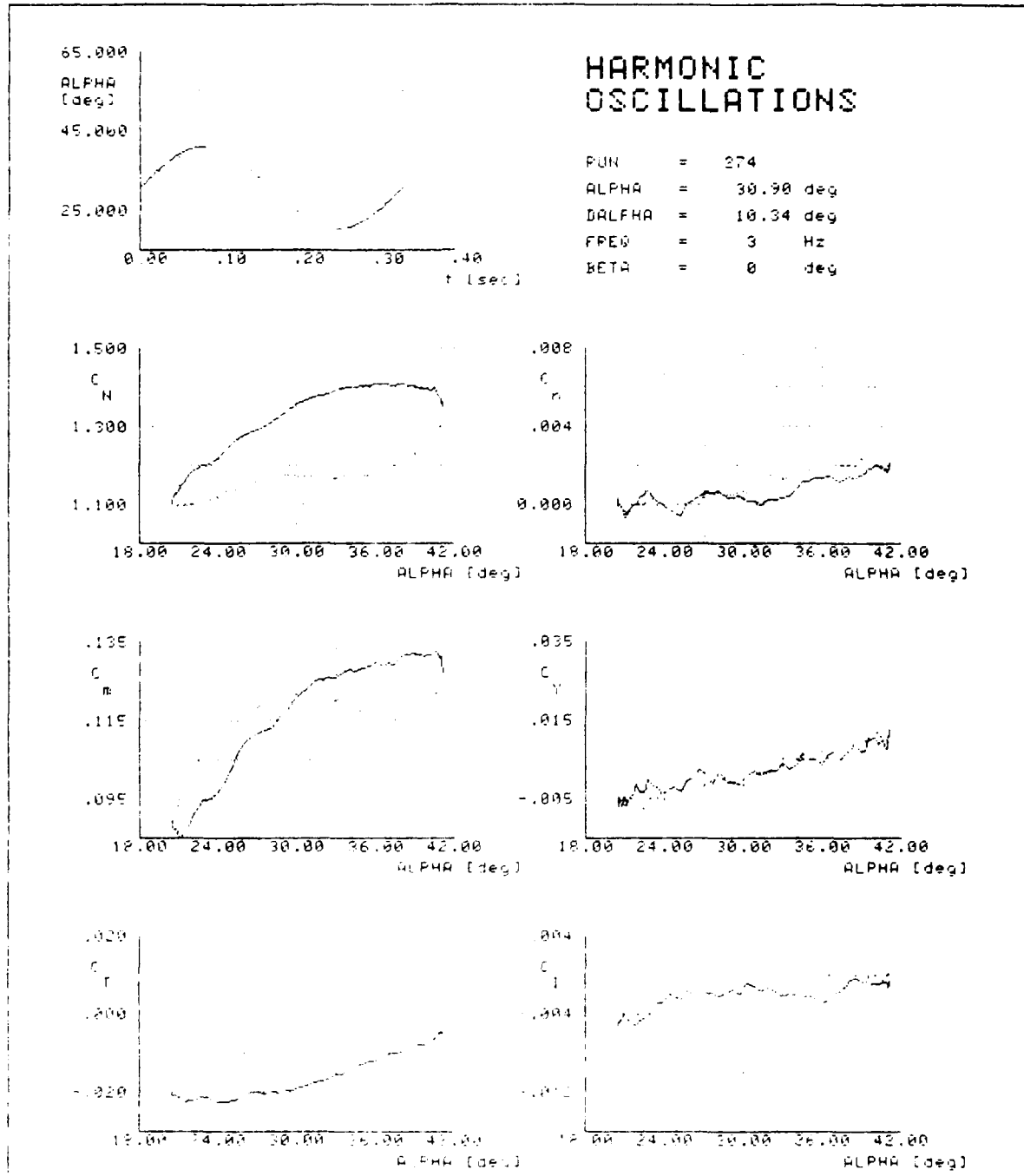


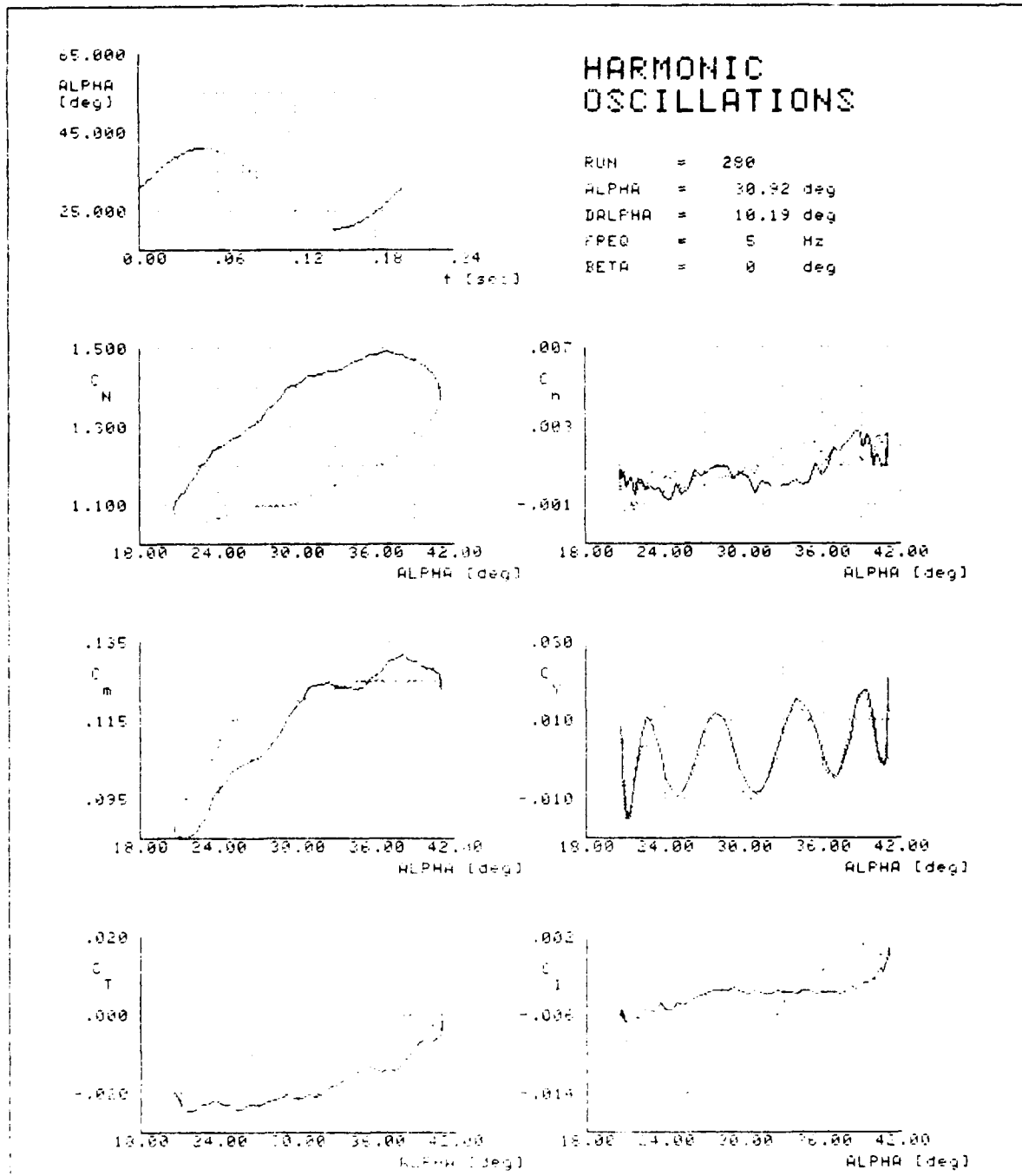


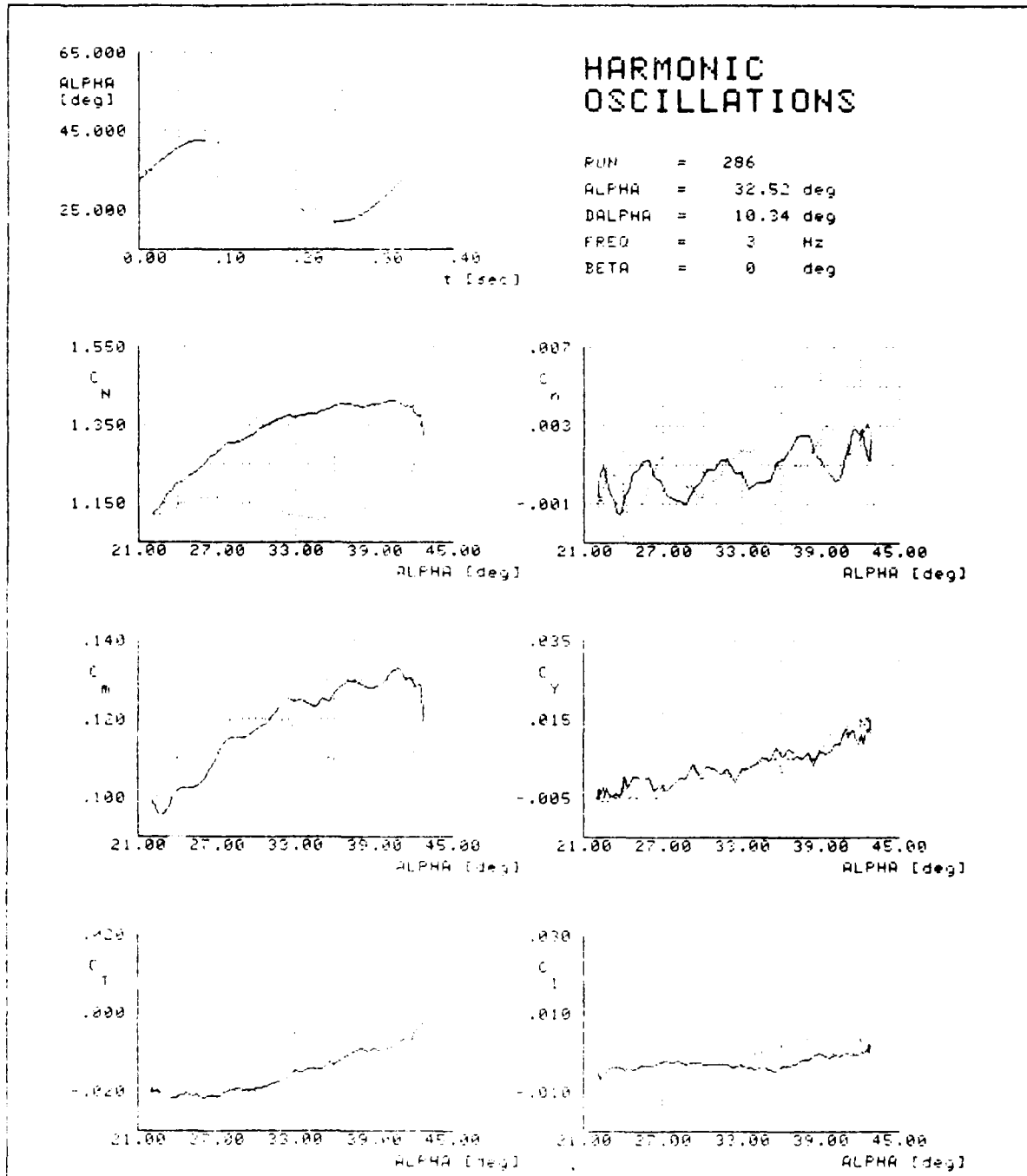


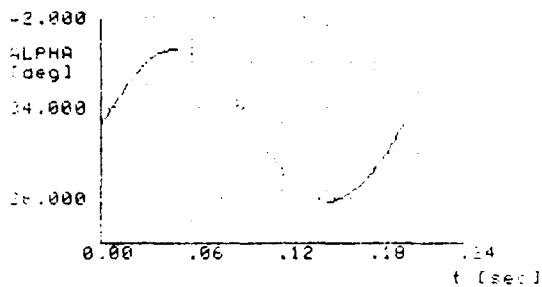






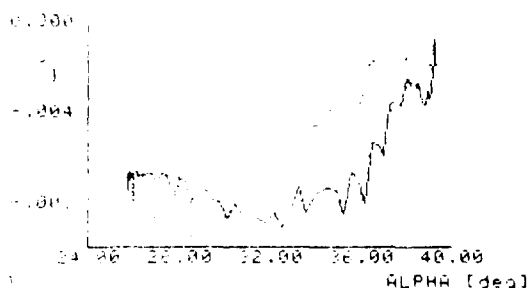
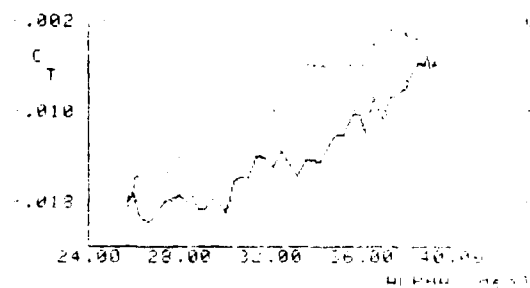
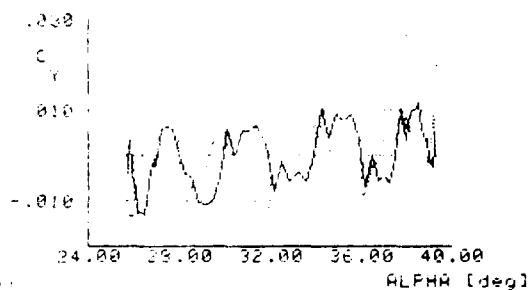
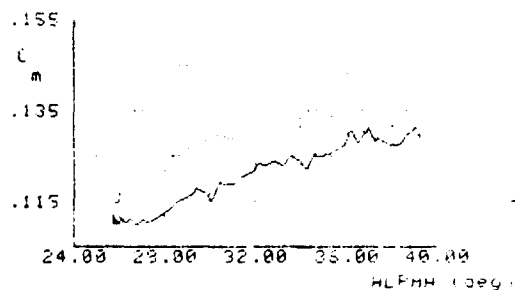
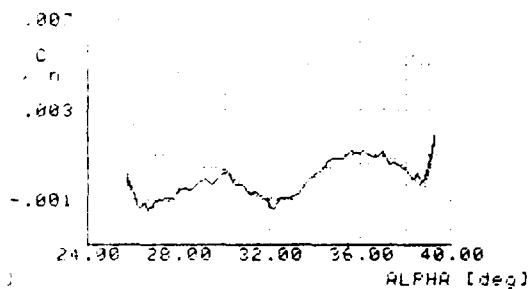
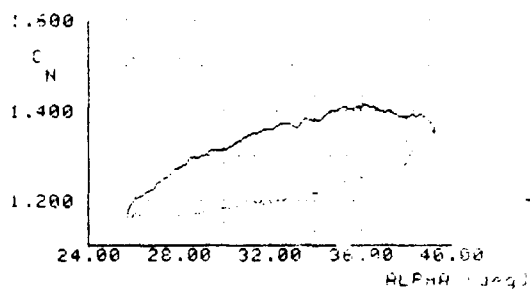


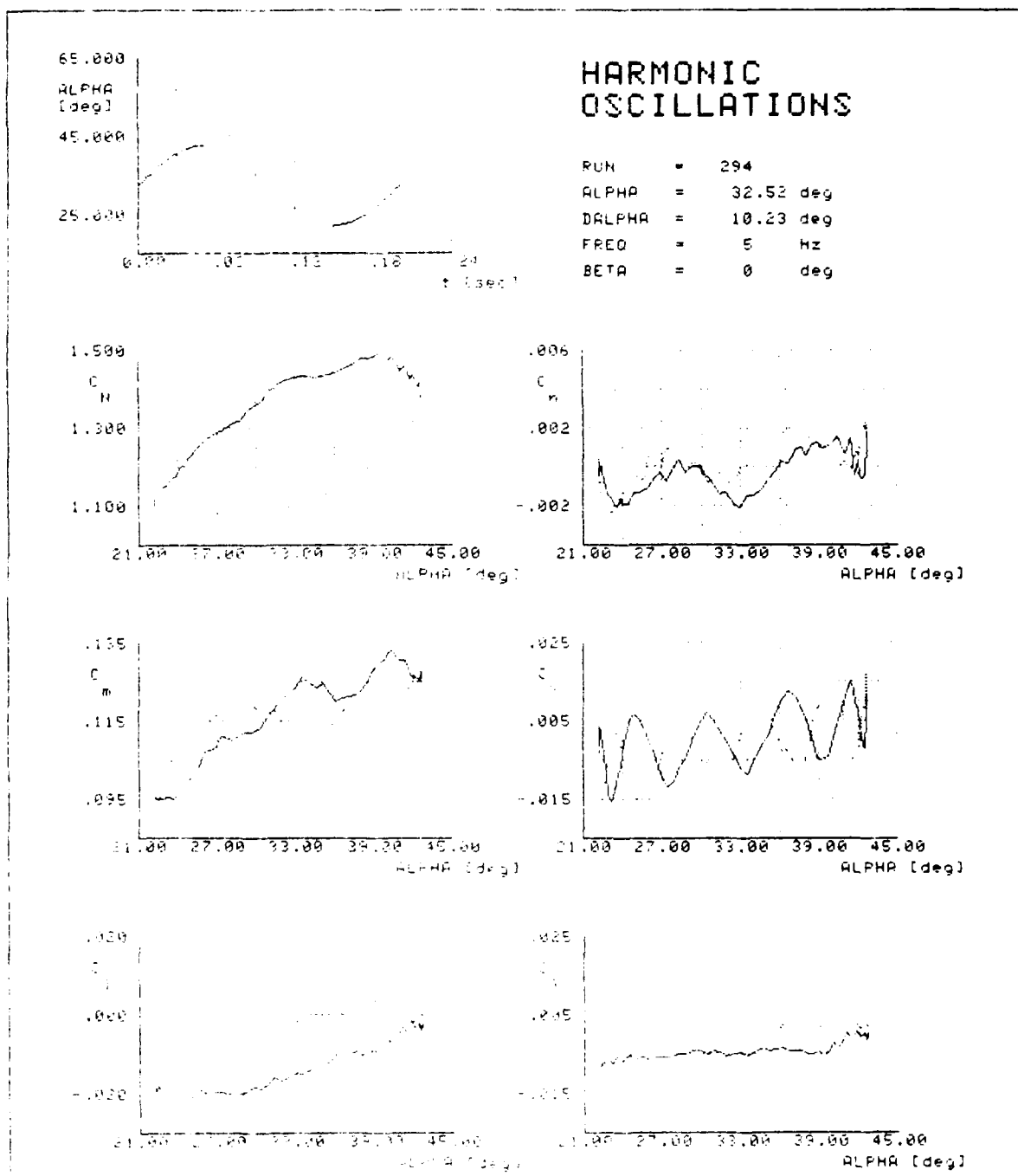


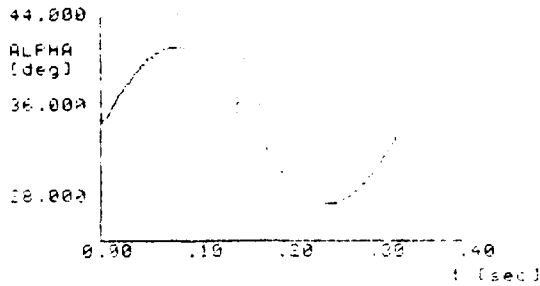


HARMONIC OSCILLATIONS

PUN = 291
ALPHA = 32.55 deg
DALPHA = 6.76 deg
FREQ = 5 Hz
BETA = 0 deg

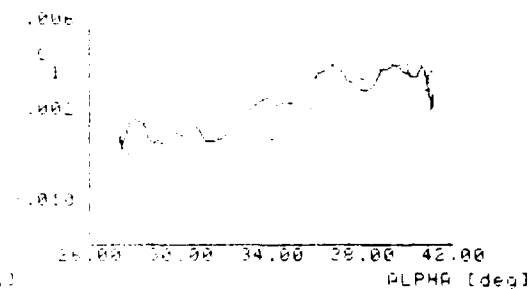
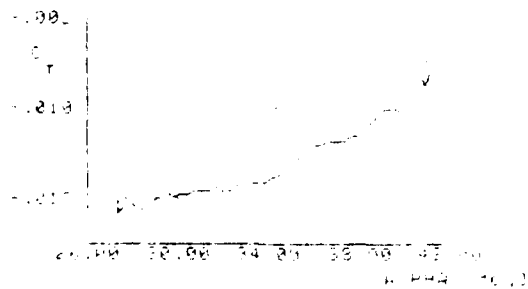
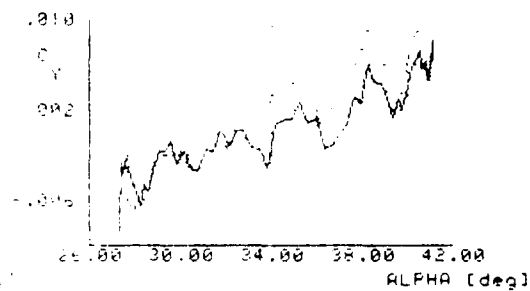
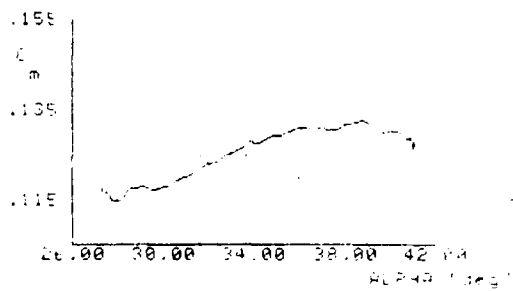
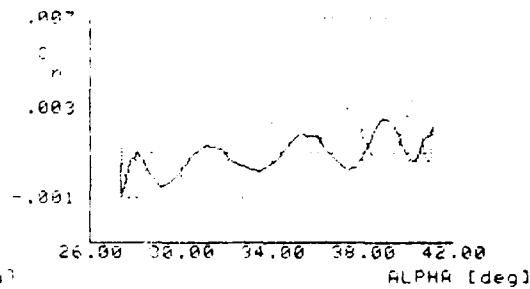
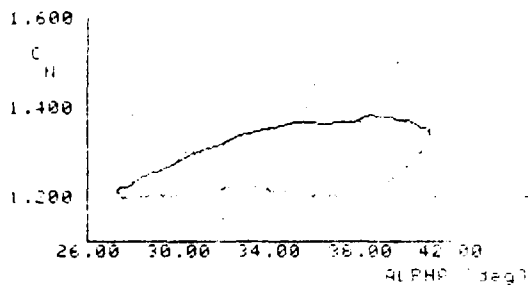


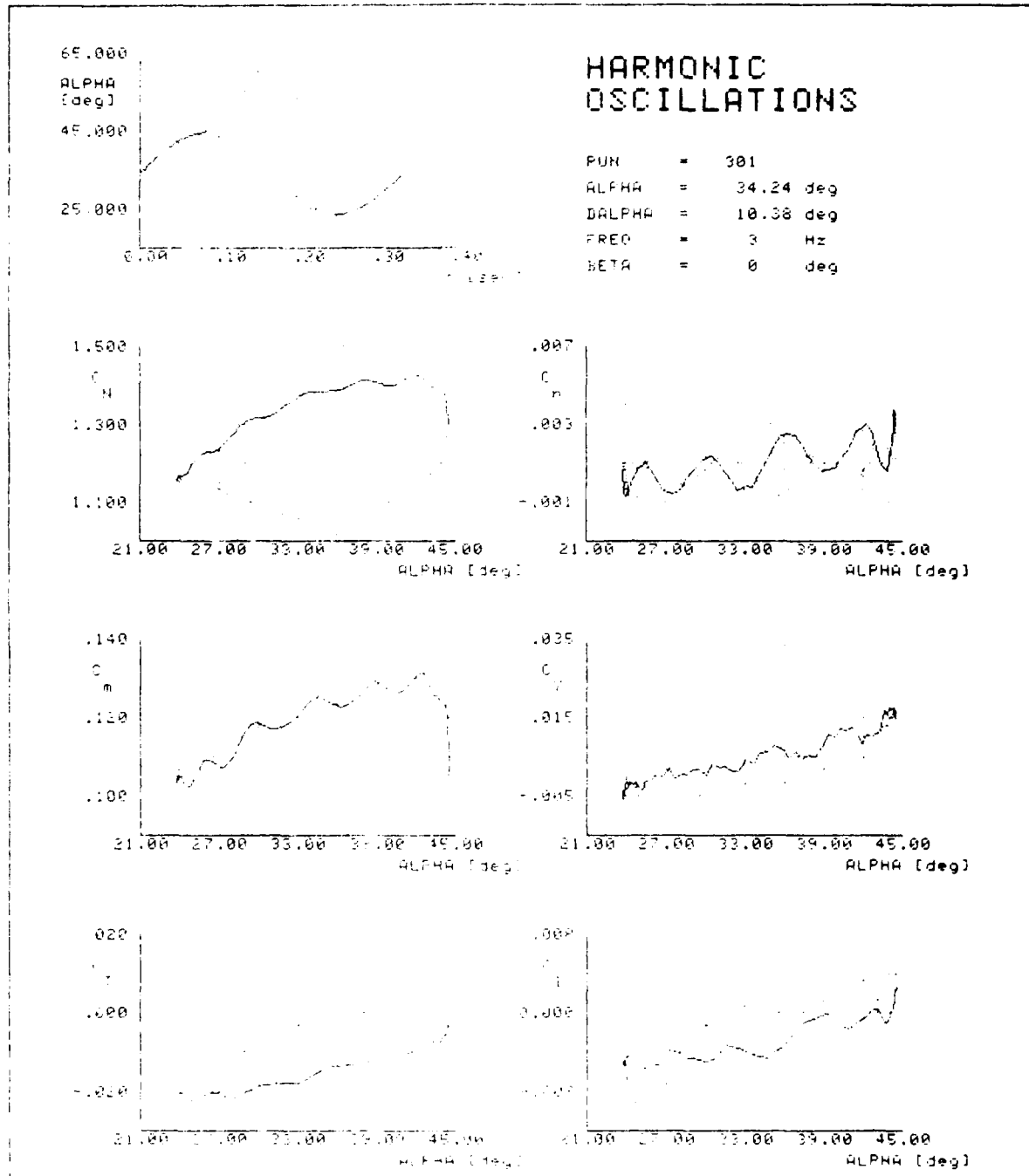


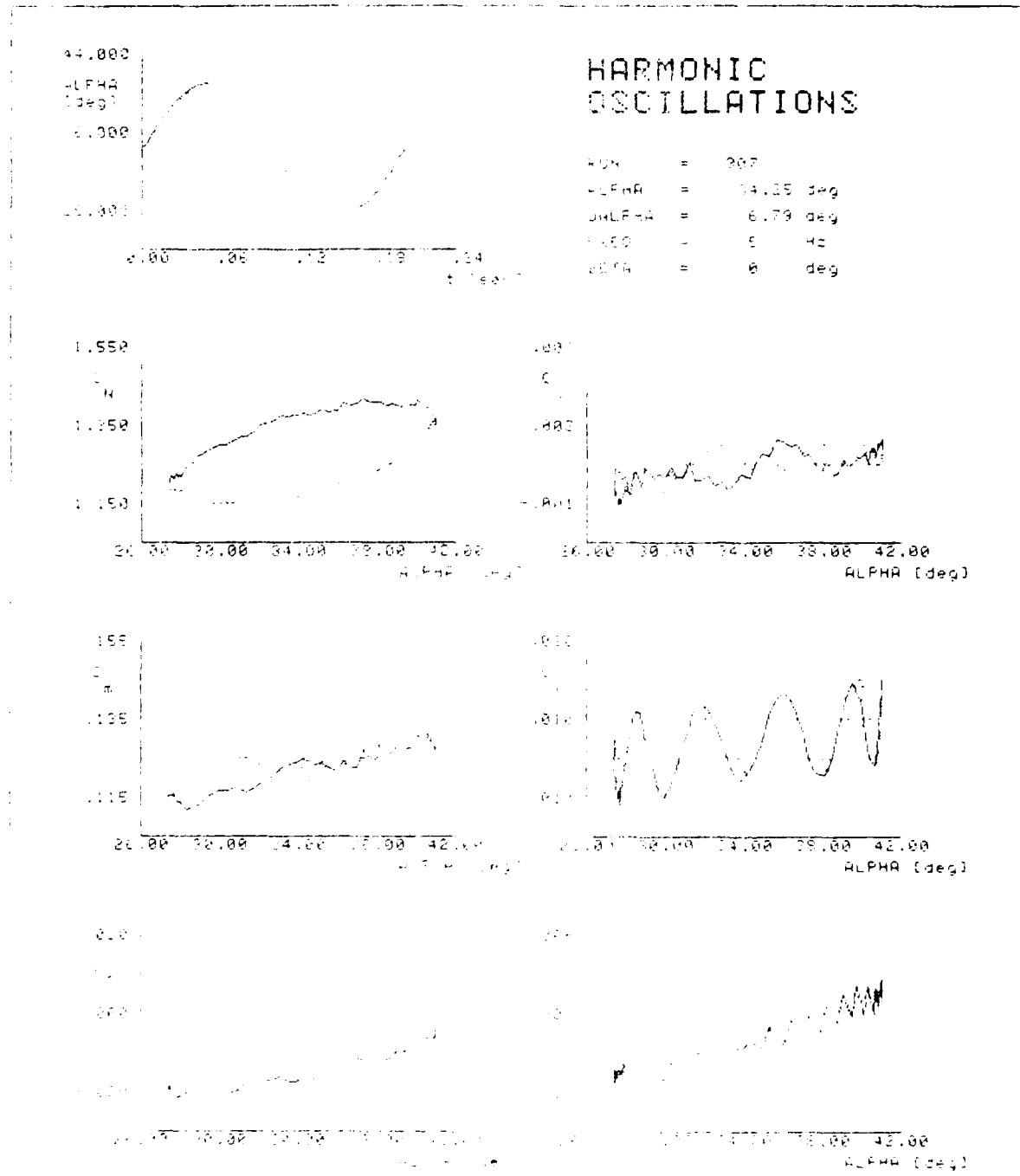


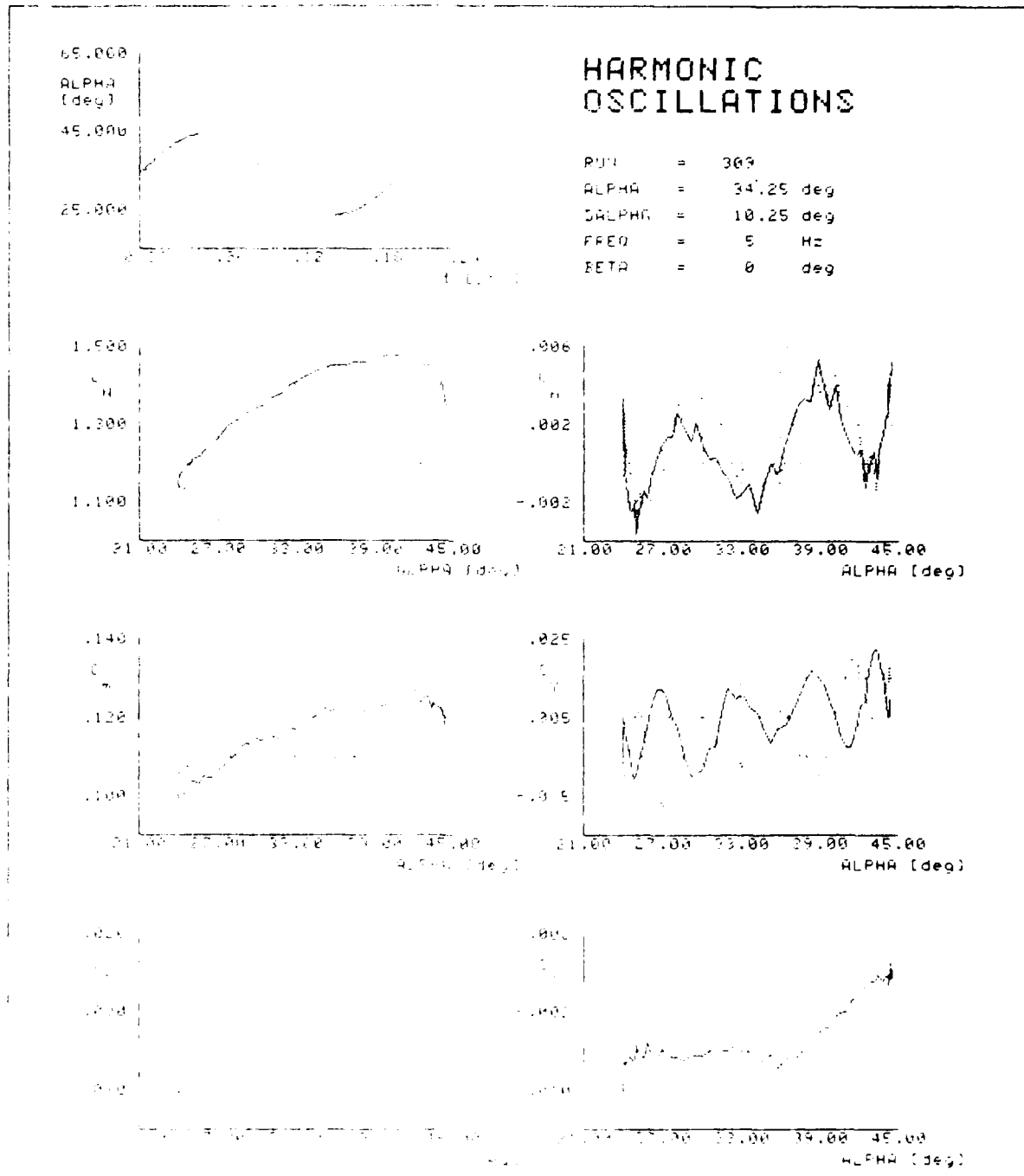
HARMONIC OSCILLATIONS

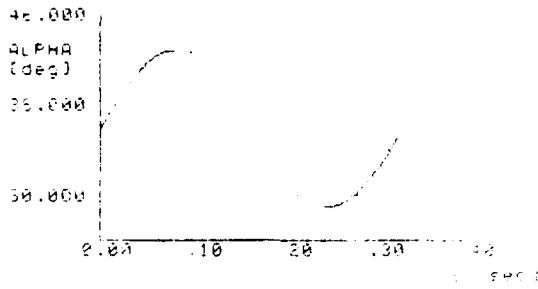
RUN = 299
ALPHA = 34.23 deg
DALPHA = 6.69 deg
FREQ = 3 Hz
BETA = 0 deg





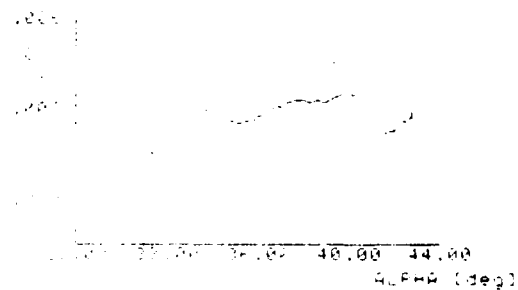
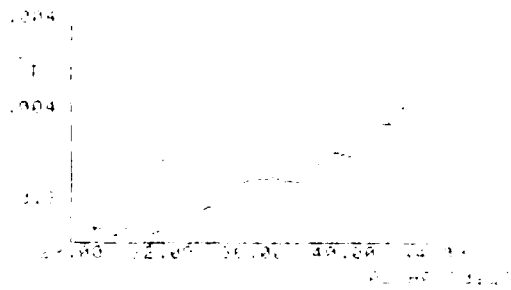
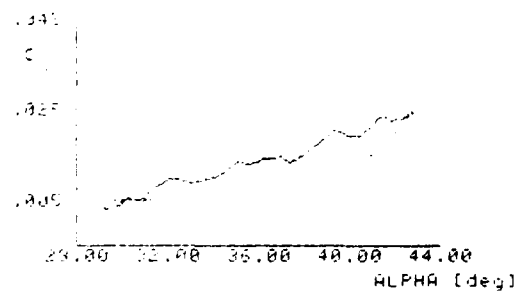
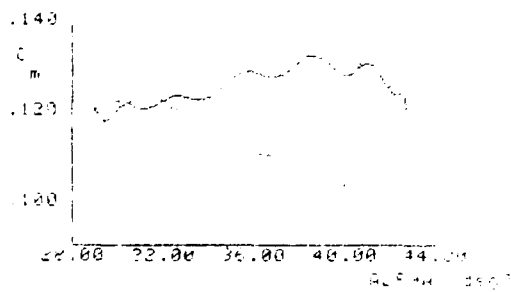
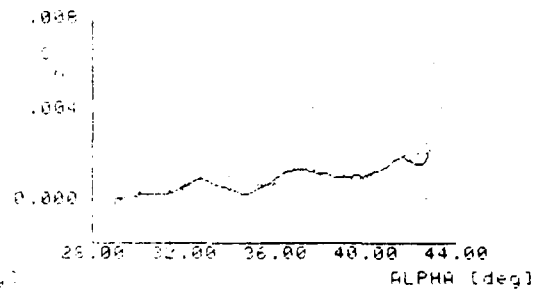
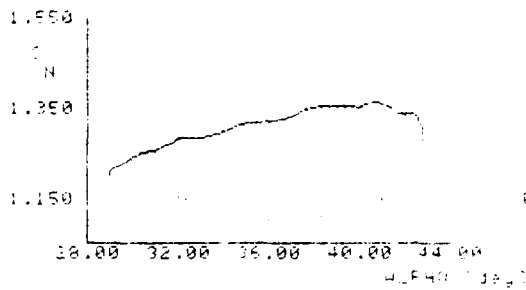


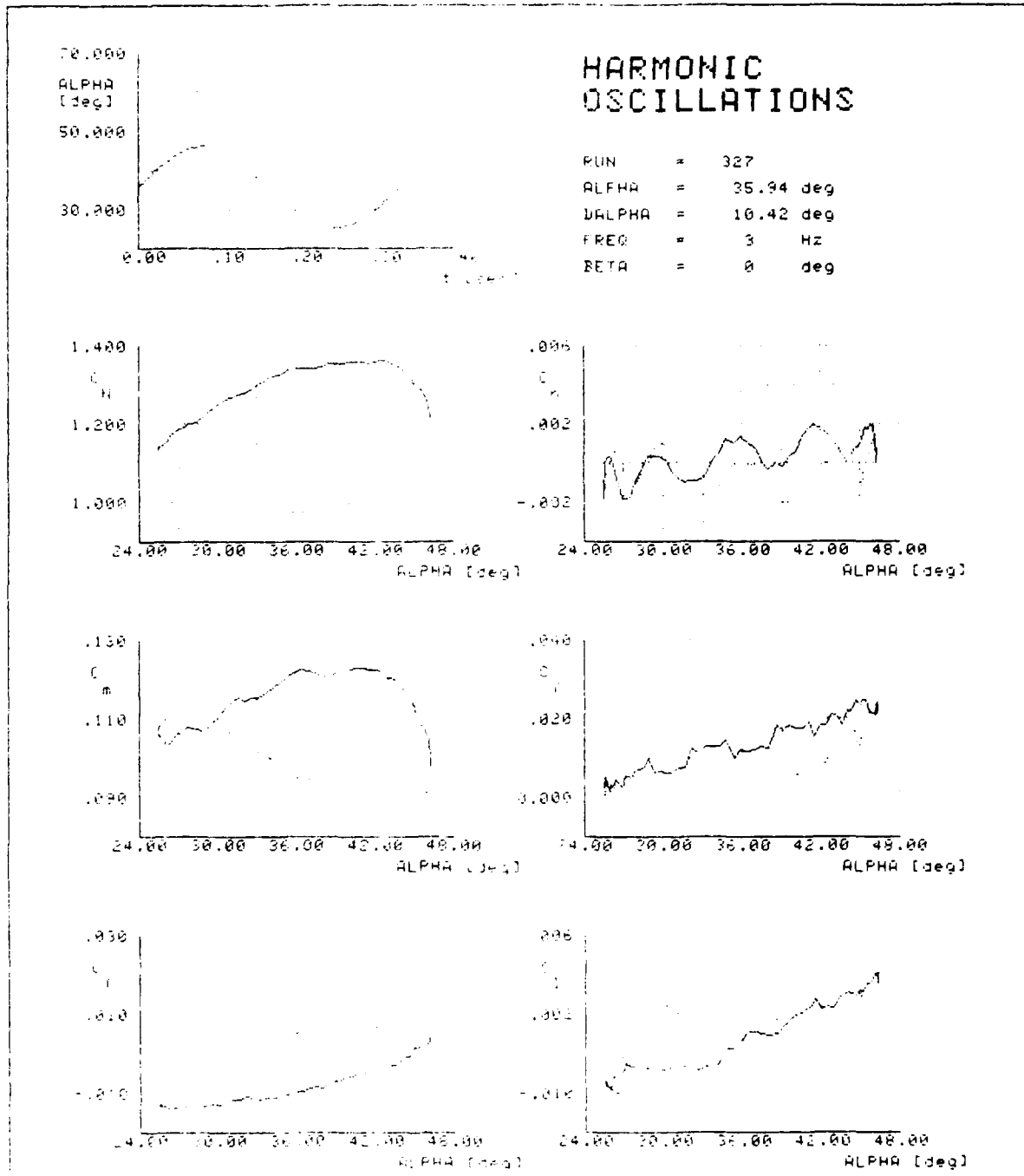


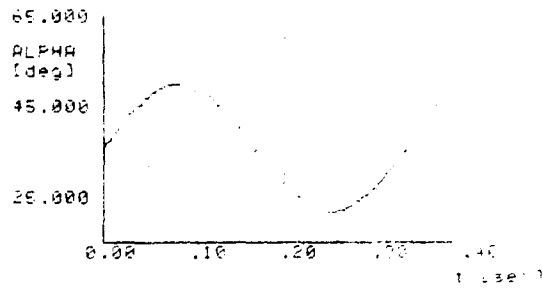


HARMONIC OSCILLATIONS

ω_N = 305
 α_{LPHR} = 35.94 deg
 $\Delta\alpha_{LPHR}$ = 6.90 deg
 ω_{PO} = 3 Hz
 β_{LPH} = 0 deg

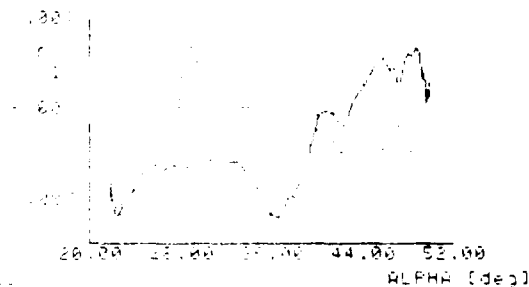
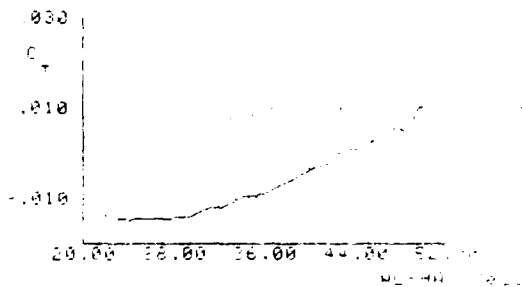
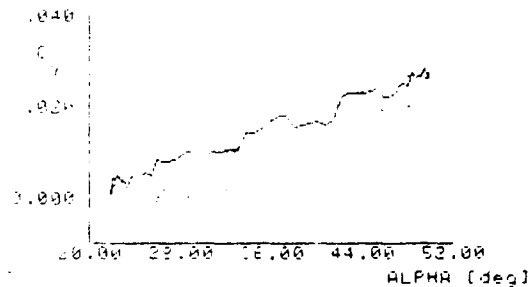
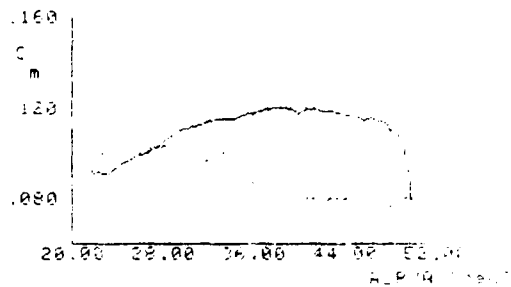
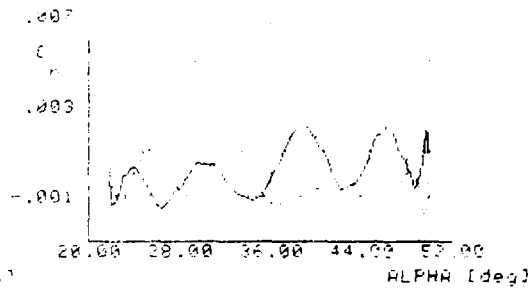
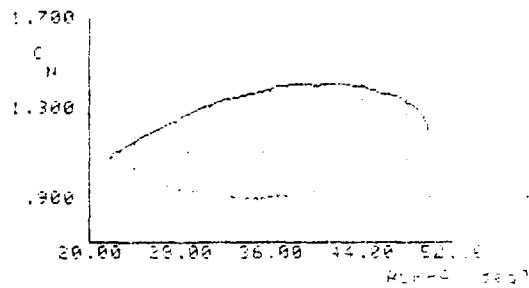


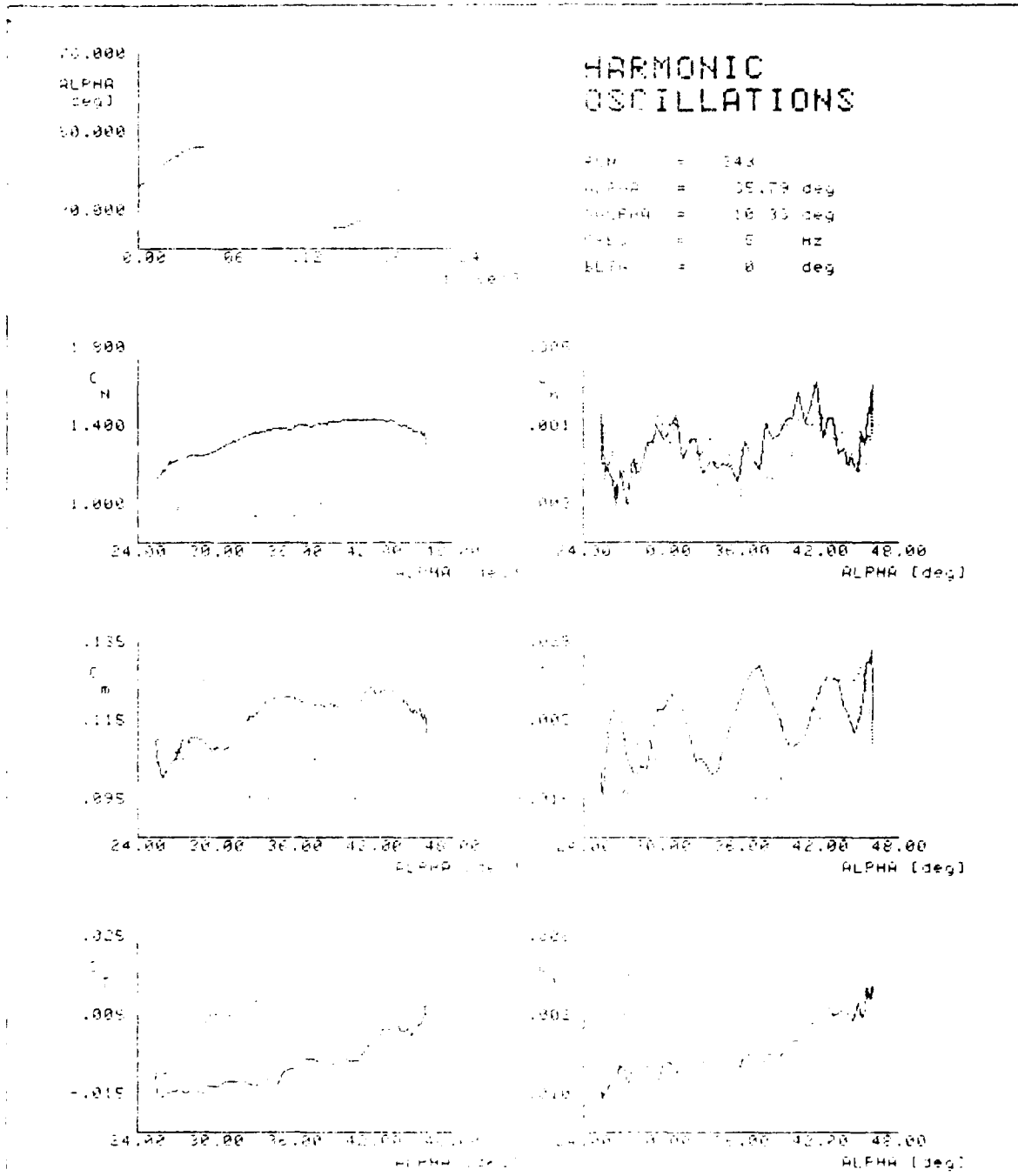


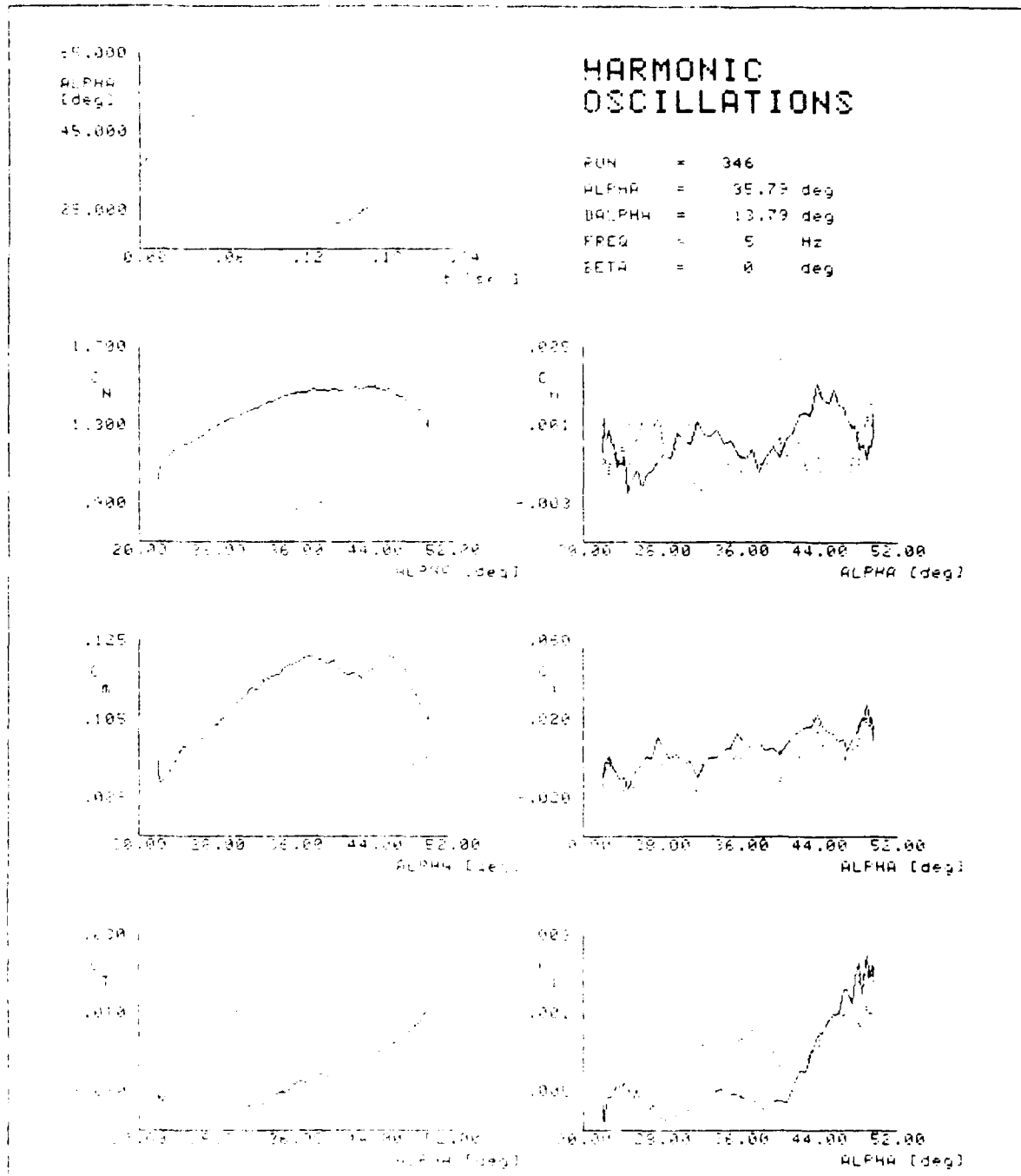


HARMONIC OSCILLATIONS

RUN = 329
 ALPHA = 15.95 deg
 DIALPHA = 14.02 deg
 FREQ = 3 Hz
 PSID = 0 deg







40.000

ALPHA
[deg]

40.000

40.000

ALPHA [deg]

HARMONIC OSCILLATIONS

SGN = 370
 CPHA = 37.46 deg
 LCPH = 7.97 deg
 FSC = 3 Hz
 SGN = 0 deg

1.500

C

H

1.300

1.100

ALPHA [deg]

1.000

C

H

1.000

1.000

ALPHA [deg]

1.150

C

H

1.100

1.050

ALPHA [deg]

1.012

C

H

1.004

1.004

ALPHA [deg]

1.012

C

H

1.004

1.004

ALPHA [deg]

1.000

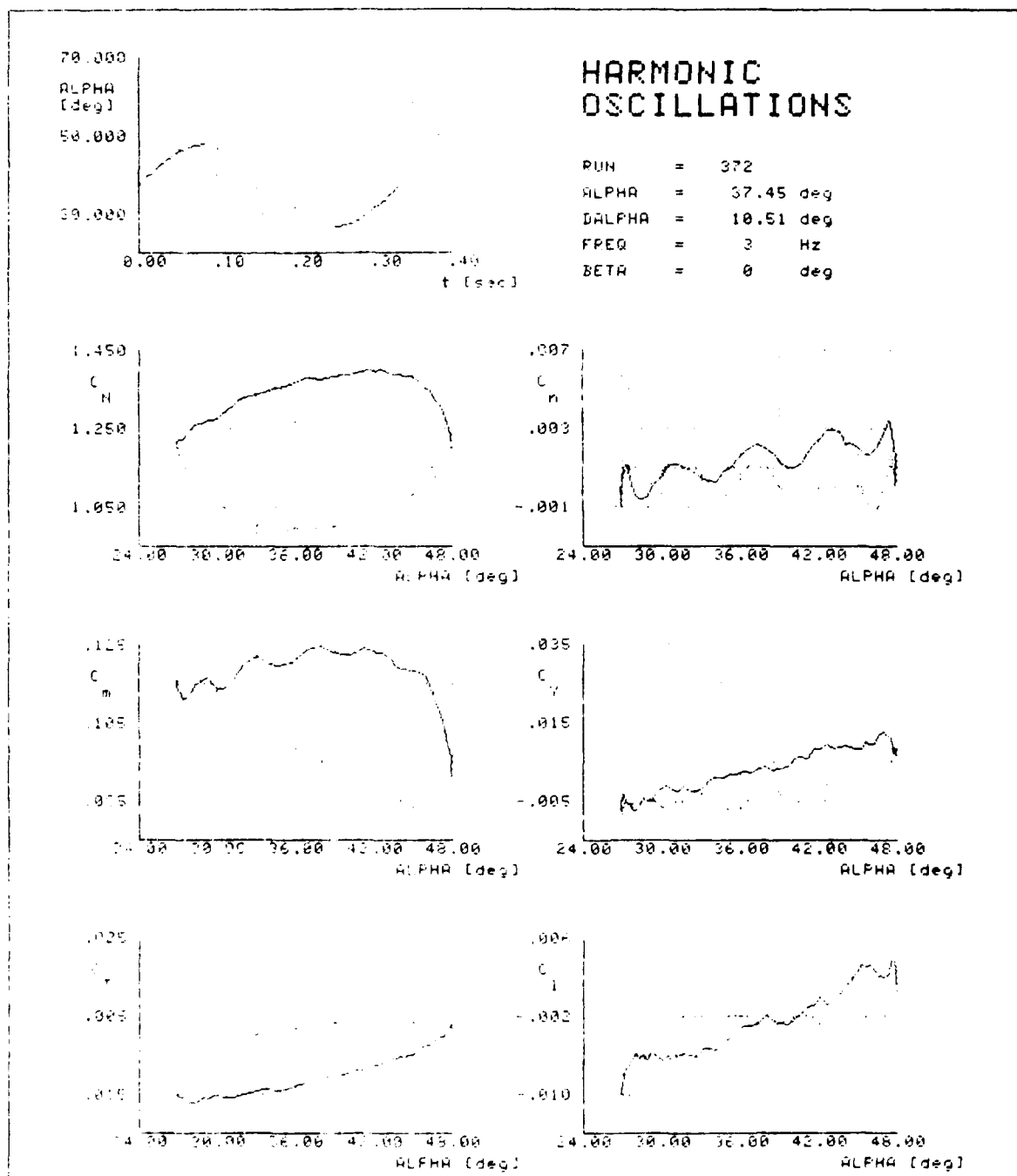
C

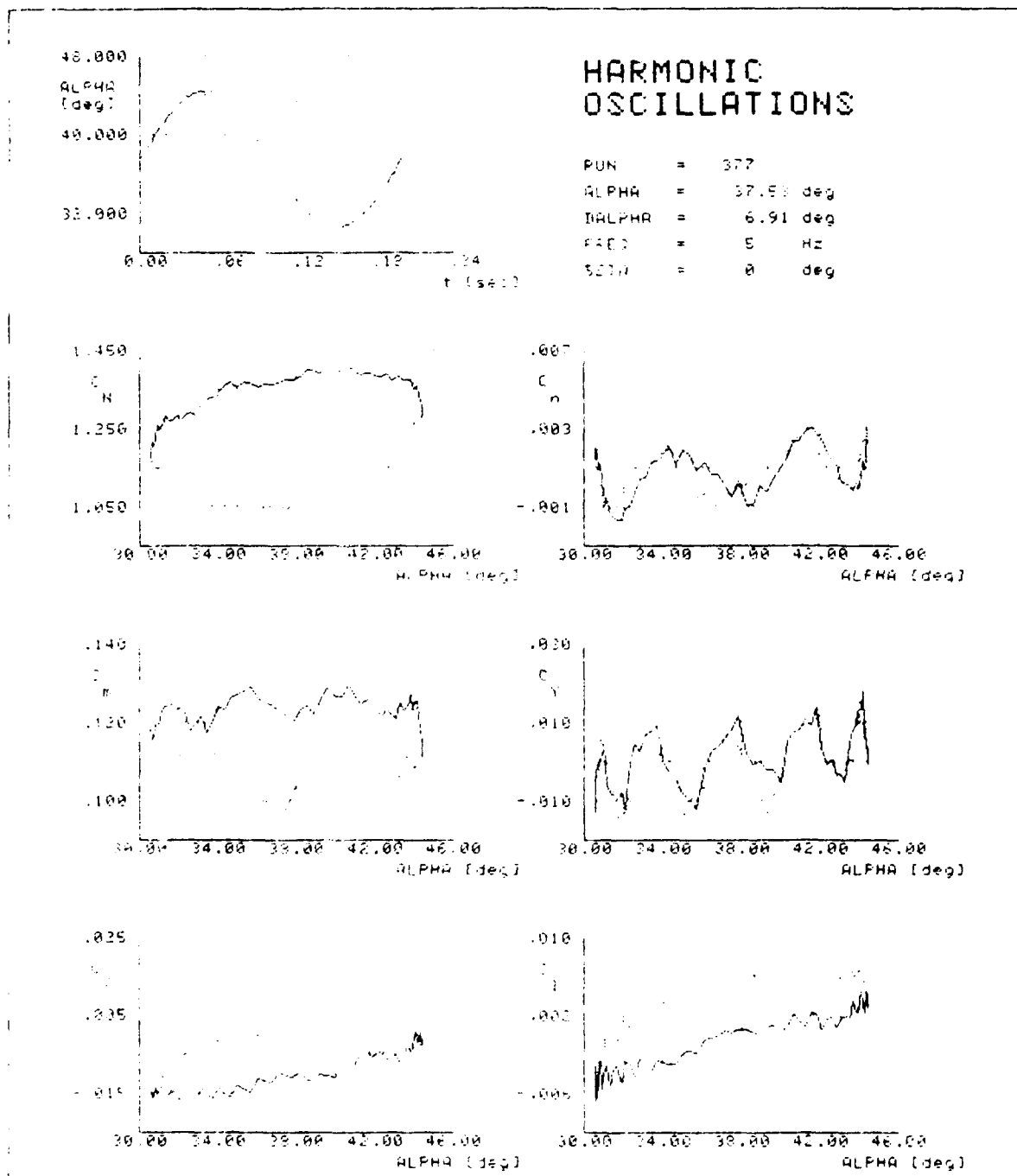
H

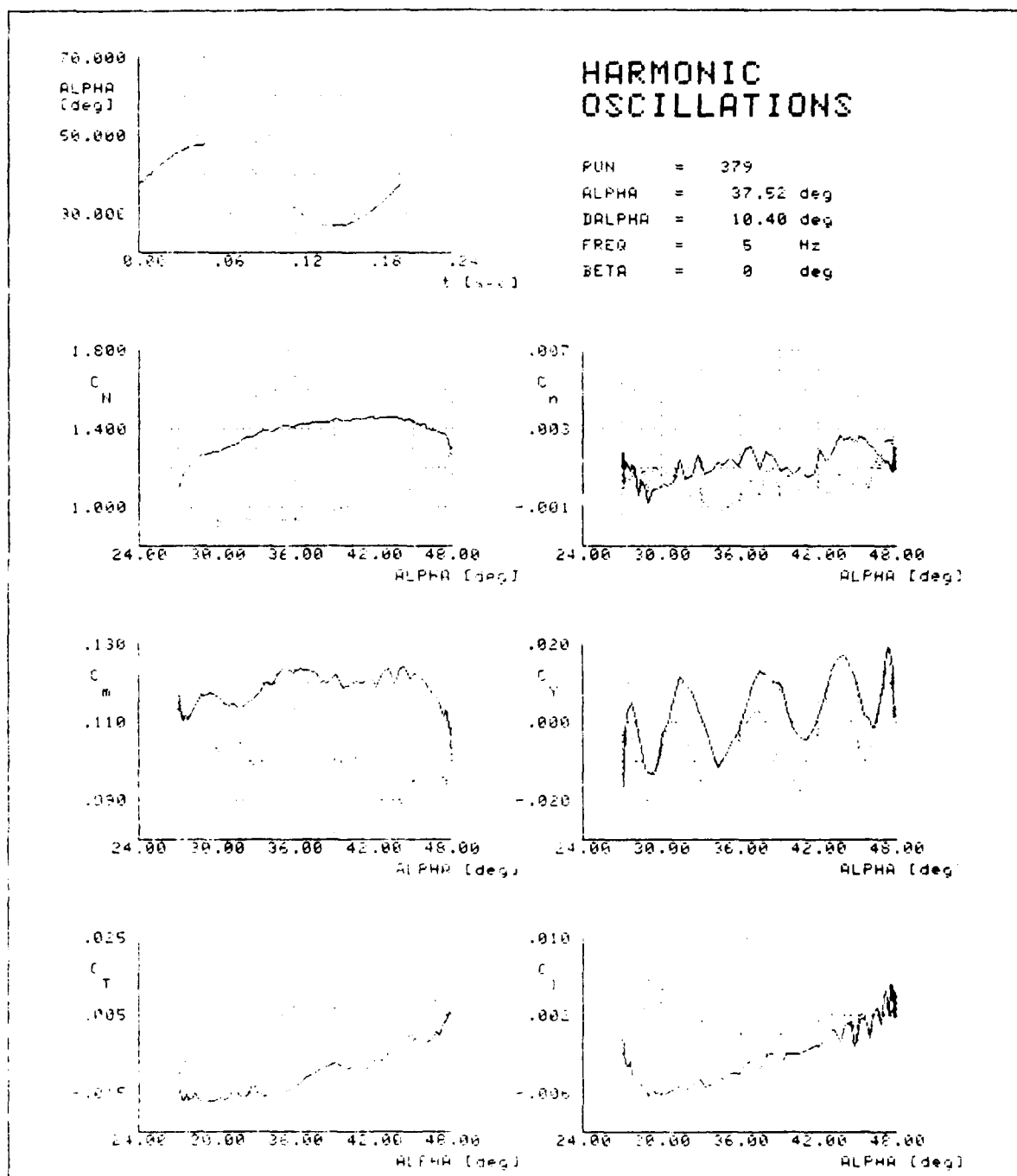
1.000

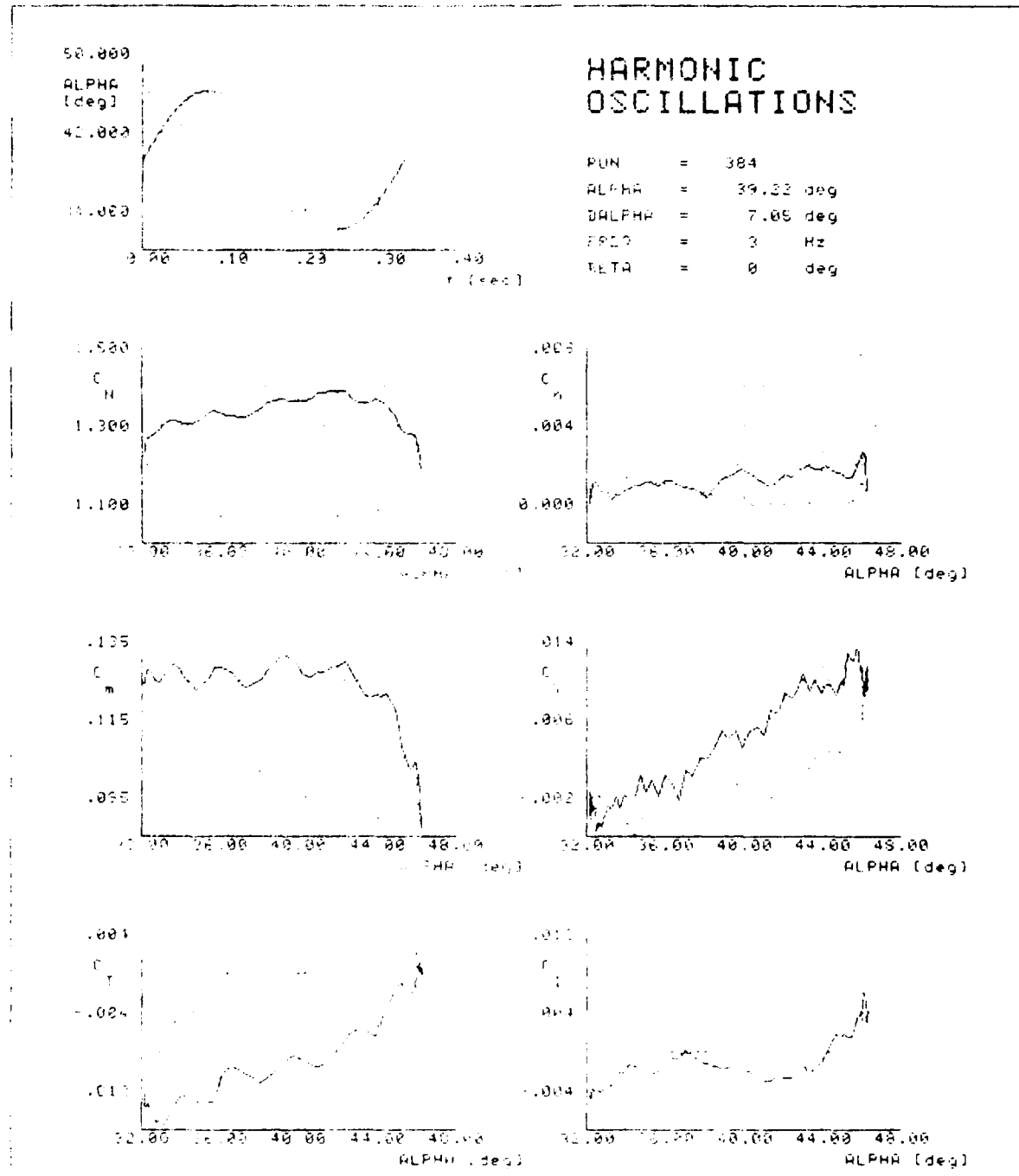
1.000

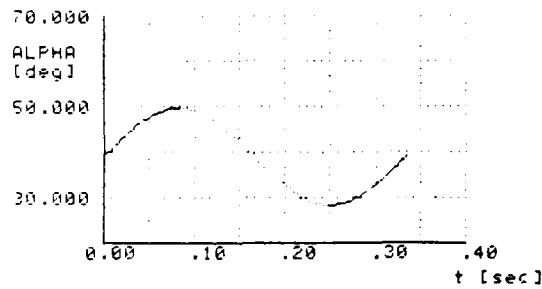
ALPHA [deg]





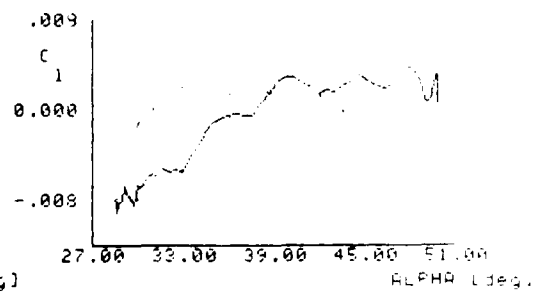
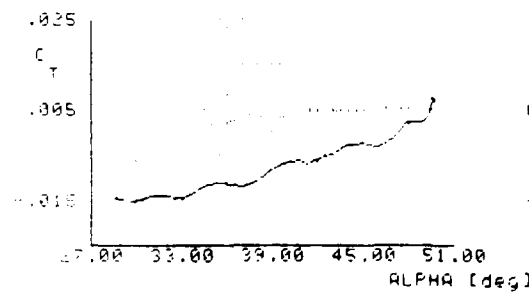
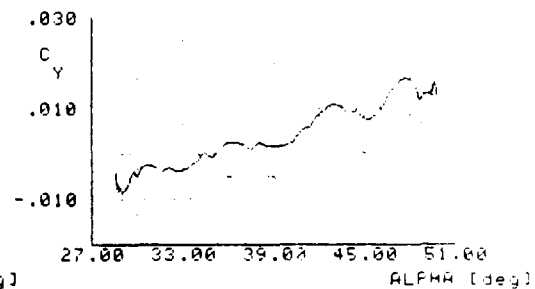
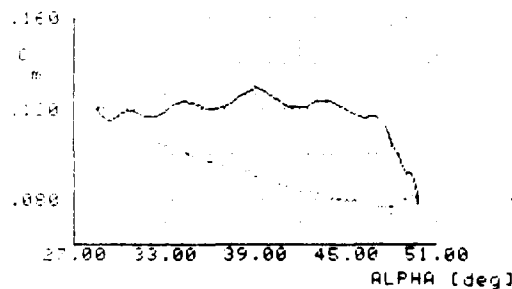
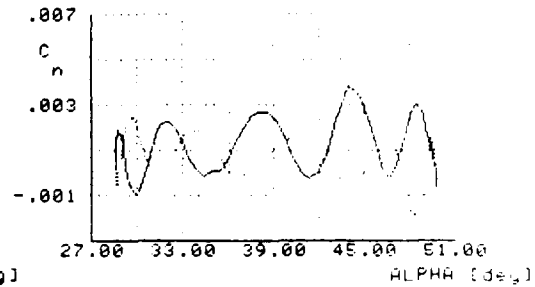
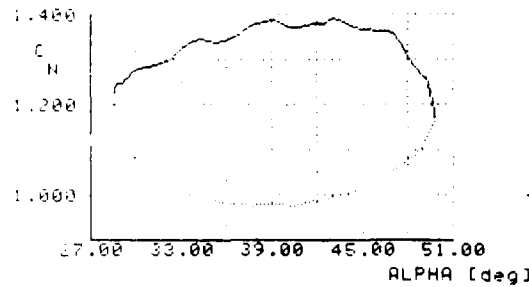




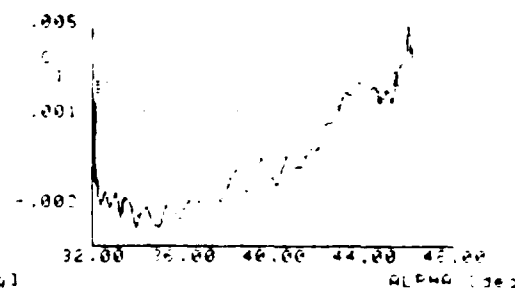
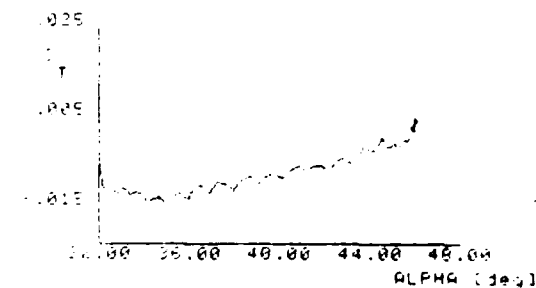
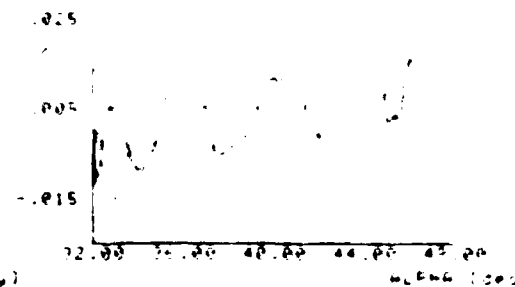
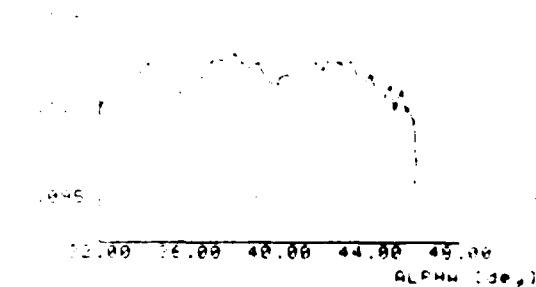
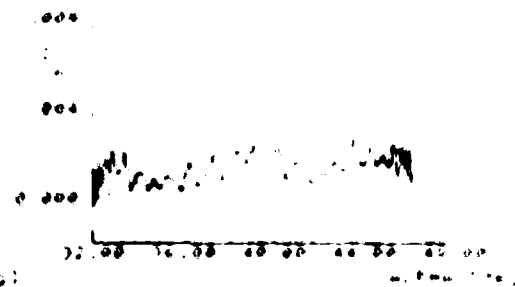
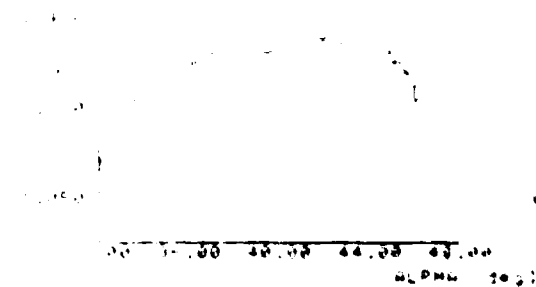
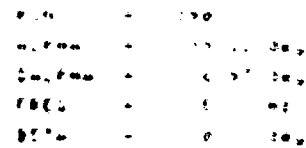
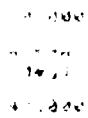


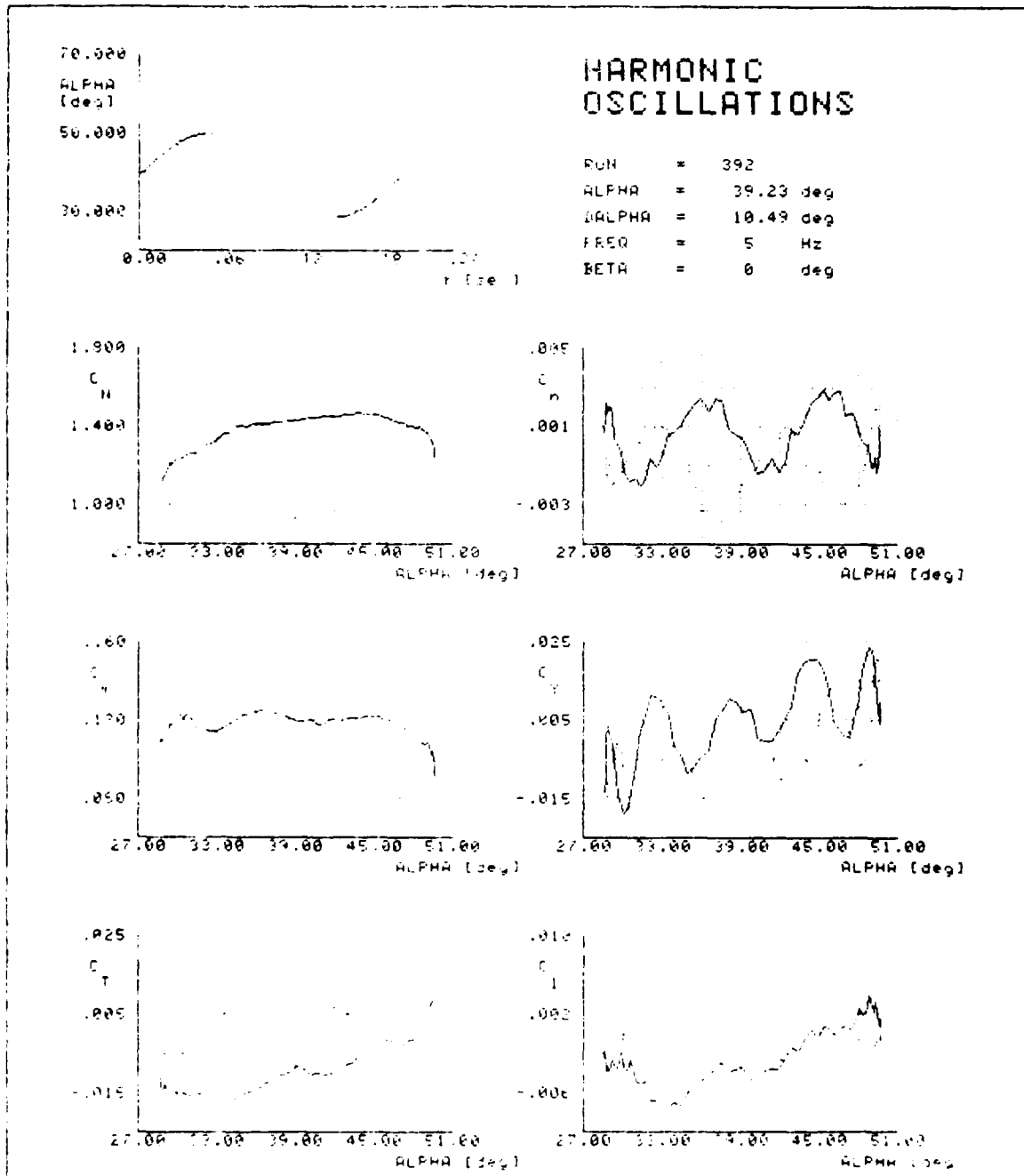
HARMONIC OSCILLATIONS

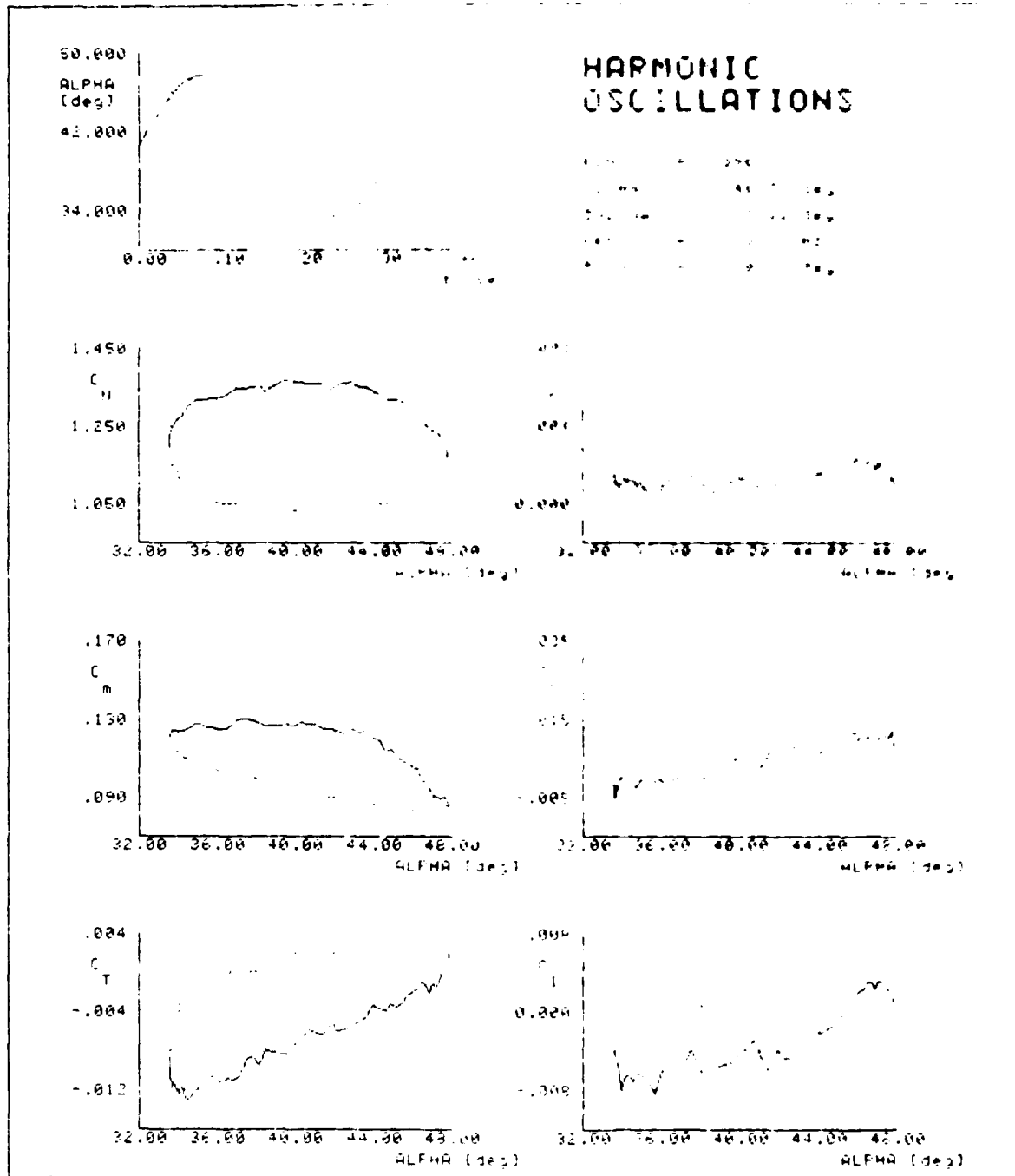
RUN = 386
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DALPHA = 10.59 deg
FREQ = 3 Hz
BETA = 0 deg

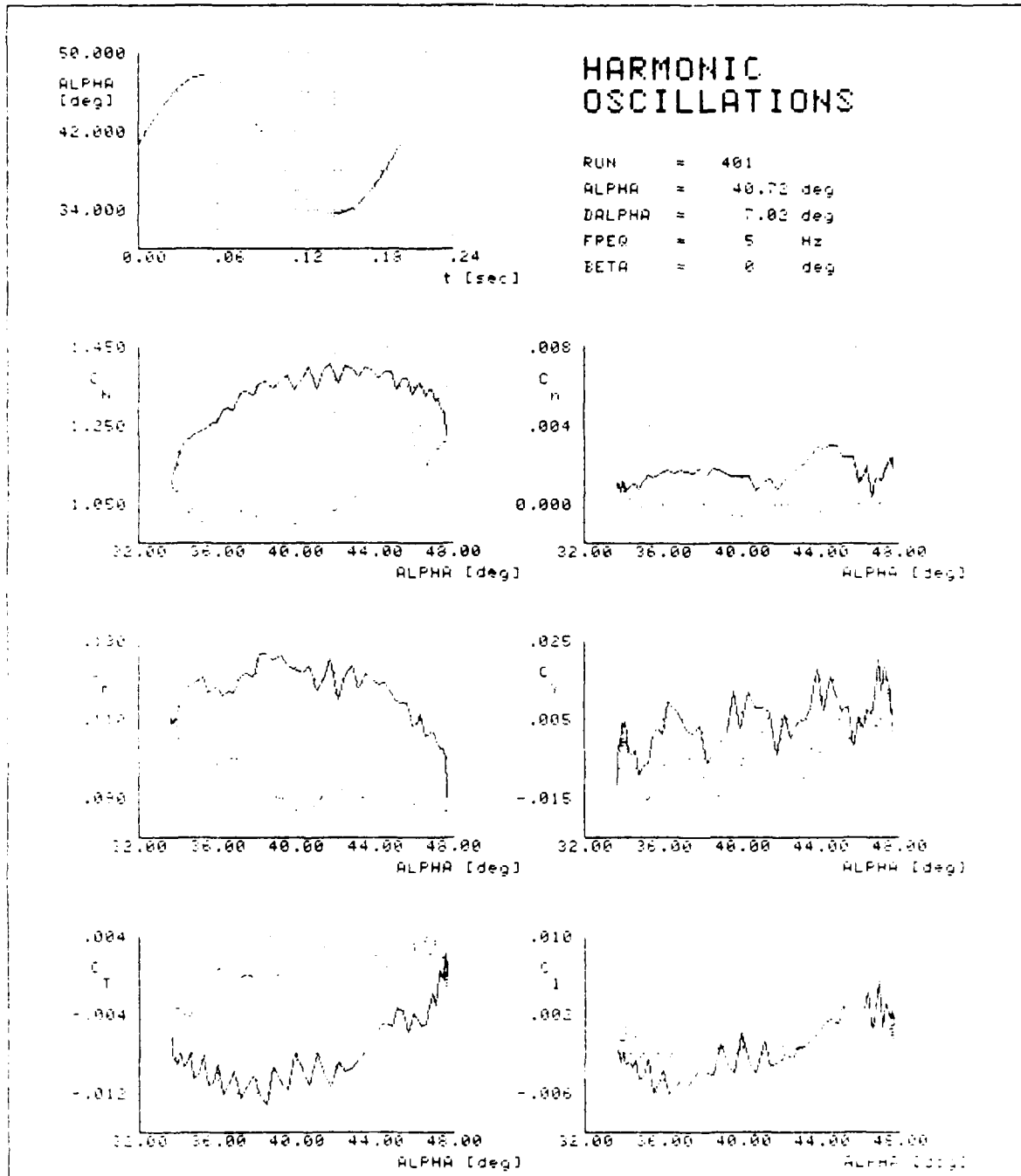


HARMONIC OSCILLATIONS









52.000

ALPHA

(deg)

44.000

36.000

28.000

20.000

12.000

4.000

0.000

-8.000

-16.000

-24.000

-32.000

-40.000

-48.000

-56.000

-64.000

-72.000

-80.000

-88.000

-96.000

-104.000

-112.000

-120.000

-128.000

-136.000

-144.000

-152.000

-160.000

-168.000

-176.000

-184.000

-192.000

-200.000

-208.000

-216.000

-224.000

-232.000

-240.000

-248.000

-256.000

-264.000

-272.000

-280.000

-288.000

-296.000

-304.000

-312.000

-320.000

-328.000

-336.000

-344.000

-352.000

-360.000

-368.000

-376.000

-384.000

-392.000

-400.000

-408.000

-416.000

-424.000

-432.000

-440.000

-448.000

-456.000

-464.000

-472.000

-480.000

-488.000

-496.000

-504.000

-512.000

-520.000

-528.000

-536.000

-544.000

-552.000

-560.000

-568.000

-576.000

-584.000

-592.000

-600.000

-608.000

-616.000

-624.000

-632.000

-640.000

-648.000

-656.000

-664.000

-672.000

-680.000

-688.000

-696.000

-704.000

-712.000

-720.000

-728.000

-736.000

-744.000

-752.000

-760.000

-768.000

-776.000

-784.000

-792.000

-800.000

-808.000

-816.000

-824.000

-832.000

-840.000

-848.000

-856.000

-864.000

-872.000

-880.000

-888.000

-896.000

-904.000

-912.000

-920.000

-928.000

-936.000

-944.000

-952.000

-960.000

-968.000

-976.000

-984.000

-992.000

-1000.000

-1008.000

-1016.000

-1024.000

-1032.000

-1040.000

-1048.000

-1056.000

-1064.000

-1072.000

-1080.000

-1088.000

-1096.000

-1104.000

-1112.000

-1120.000

-1128.000

-1136.000

-1144.000

-1152.000

-1160.000

-1168.000

-1176.000

-1184.000

-1192.000

-1200.000

-1208.000

-1216.000

-1224.000

-1232.000

-1240.000

-1248.000

-1256.000

-1264.000

-1272.000

-1280.000

-1288.000

-1296.000

-1304.000

-1312.000

-1320.000

-1328.000

-1336.000

-1344.000

-1352.000

-1360.000

-1368.000

-1376.000

-1384.000

-1392.000

-1400.000

-1408.000

-1416.000

-1424.000

-1432.000

-1440.000

-1448.000

-1456.000

-1464.000

-1472.000

-1480.000

-1488.000

-1496.000

-1504.000

-1512.000

-1520.000

-1528.000

-1536.000

-1544.000

-1552.000

-1560.000

-1568.000

-1576.000

-1584.000

-1592.000

-1600.000

-1608.000

-1616.000

-1624.000

-1632.000

-1640.000

-1648.000

-1656.000

-1664.000

-1672.000

-1680.000

-1688.000

-1696.000

-1704.000

-1712.000

-1720.000

-1728.000

-1736.000

-1744.000

-1752.000

-1760.000

-1768.000

-1776.000

-1784.000

-1792.000

-1800.000

-1808.000

-1816.000

-1824.000

-1832.000

-1840.000

-1848.000

-1856.000

-1864.000

-1872.000

-1880.000

-1888.000

-1896.000

-1904.000

-1912.000

-1920.000

-1928.000

-1936.000

-1944.000

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-1992.000

-2000.000

-2008.000

-2016.000

-2024.000

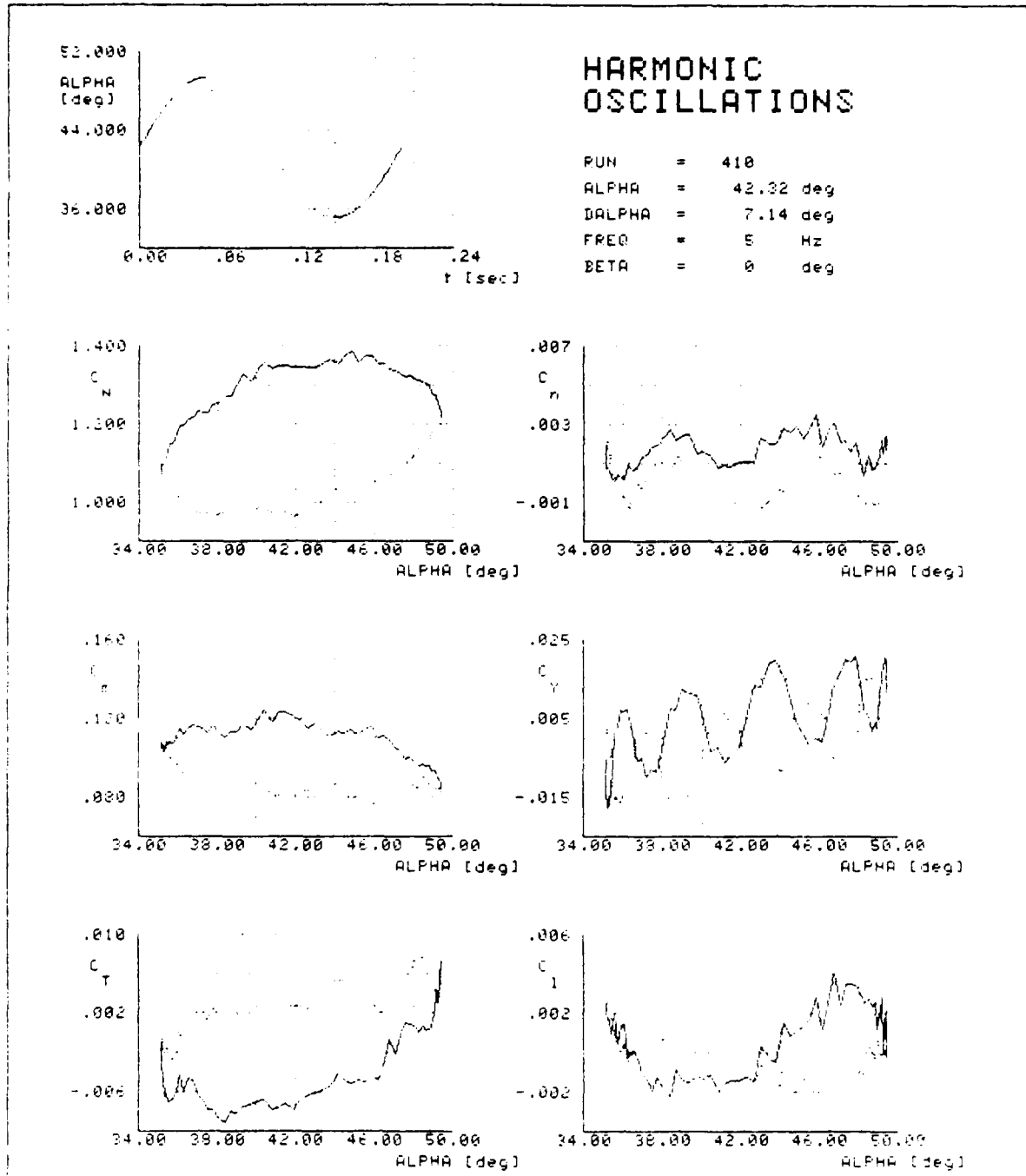
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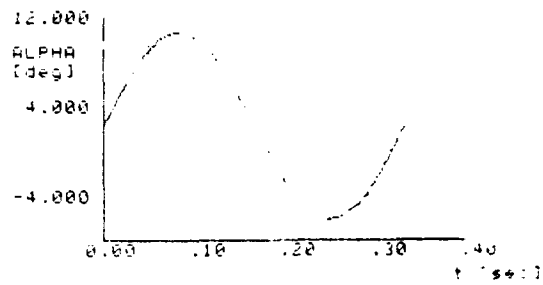
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-2048.000

-2056.000

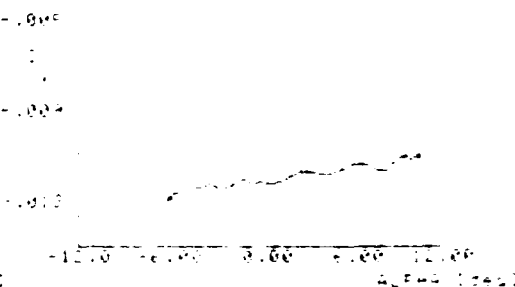
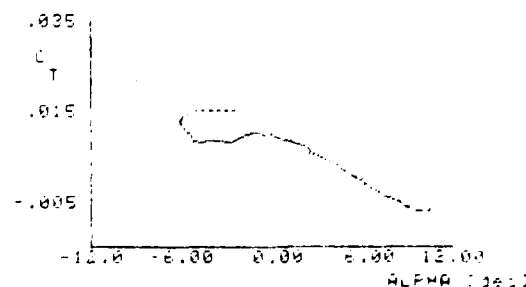
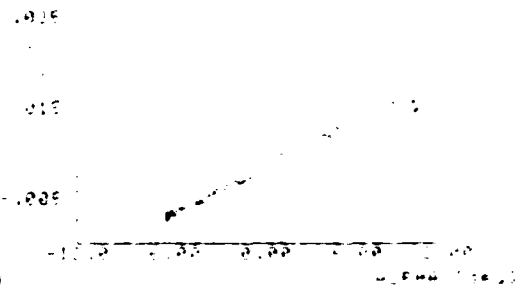
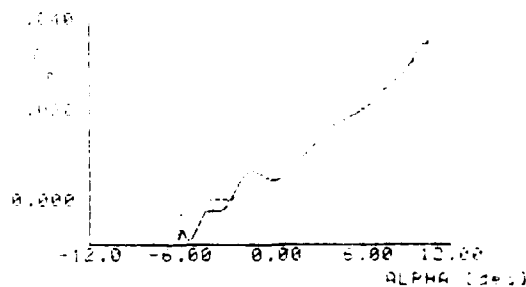
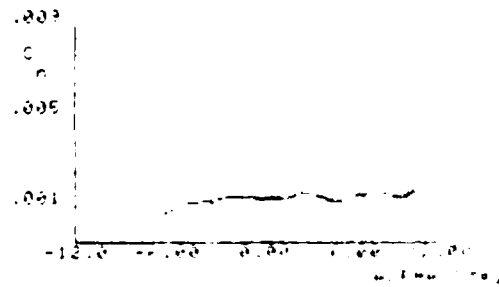
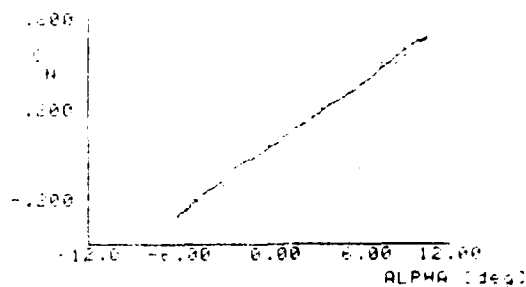
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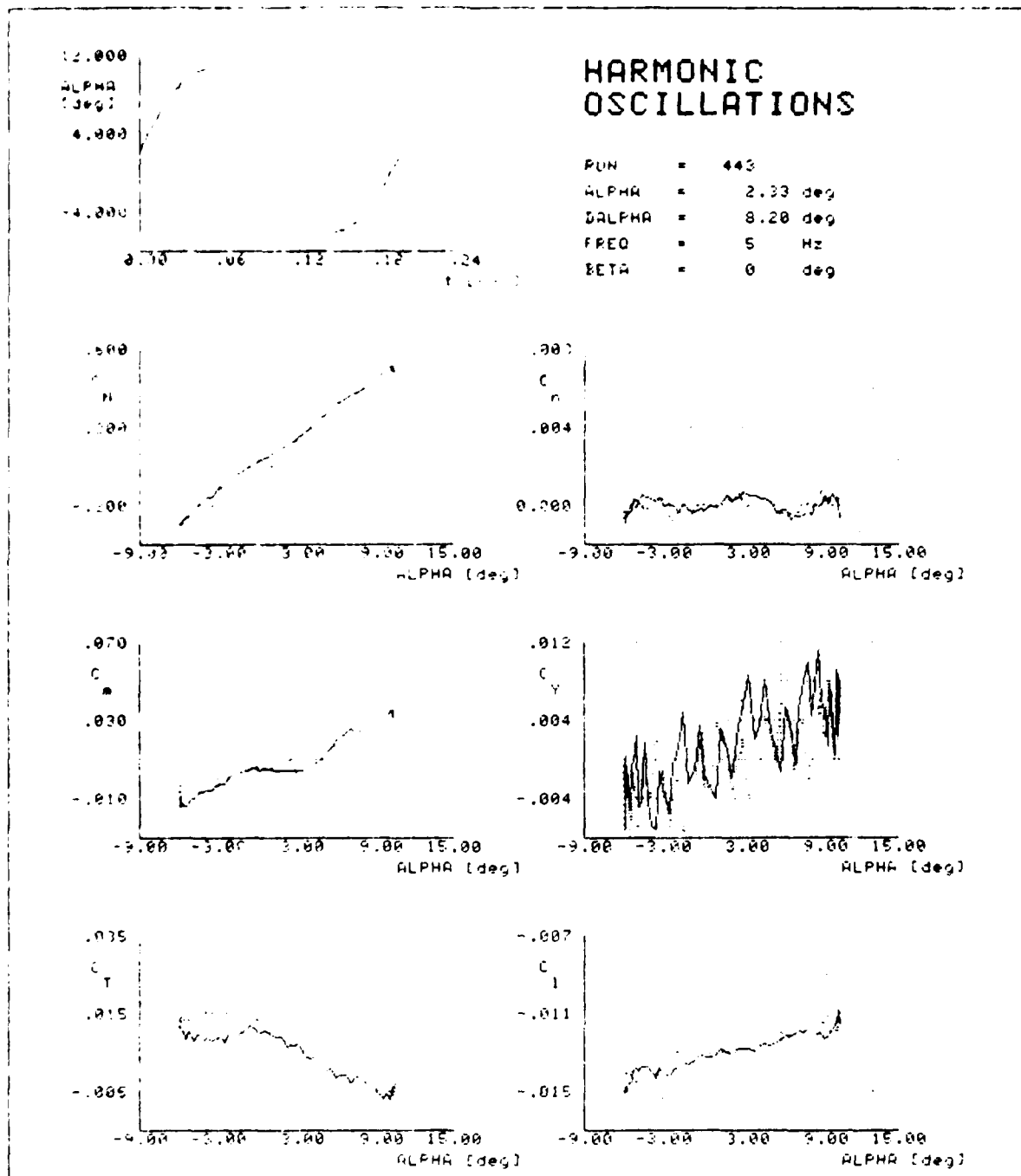


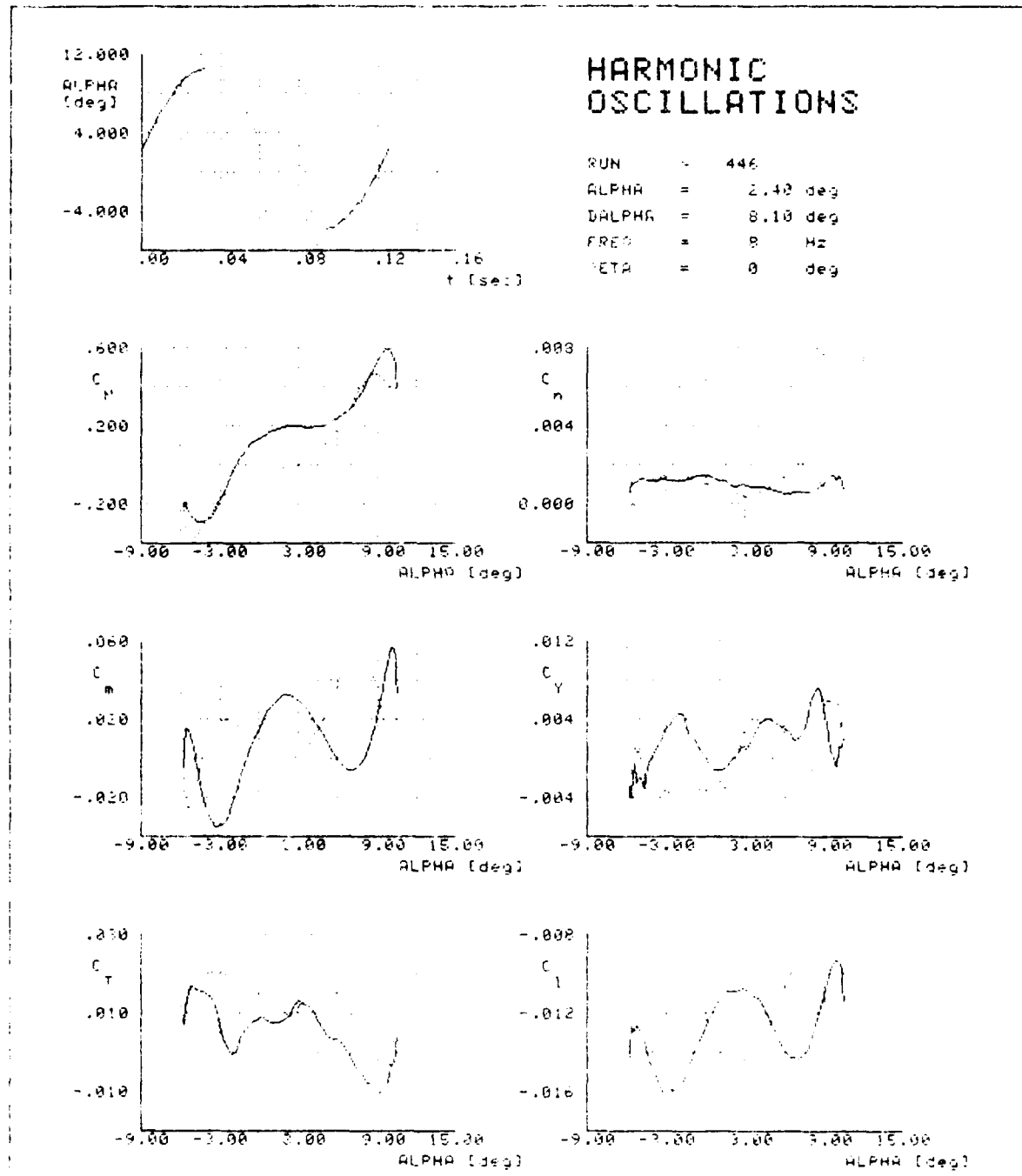


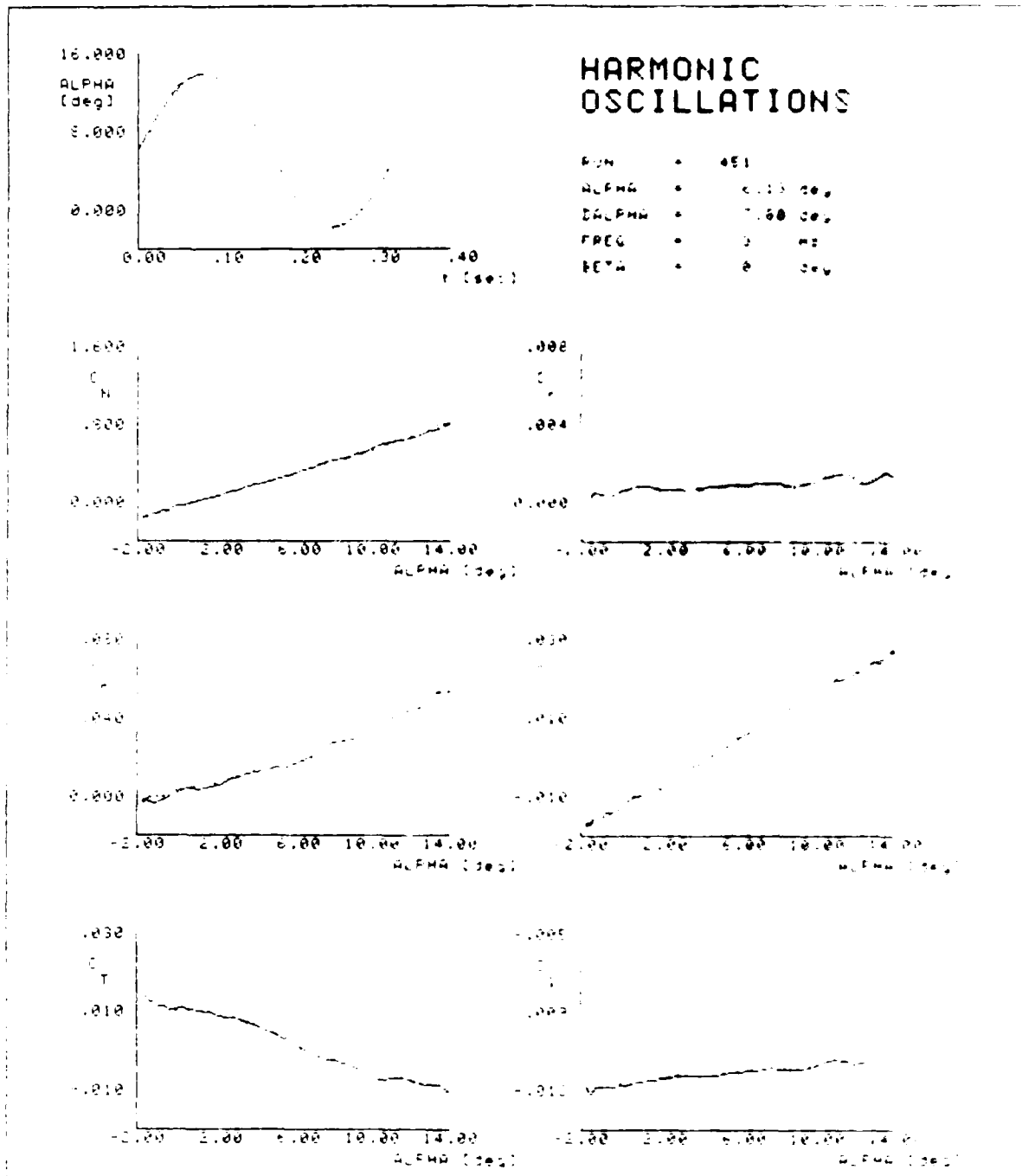
HARMONIC OSCILLATIONS

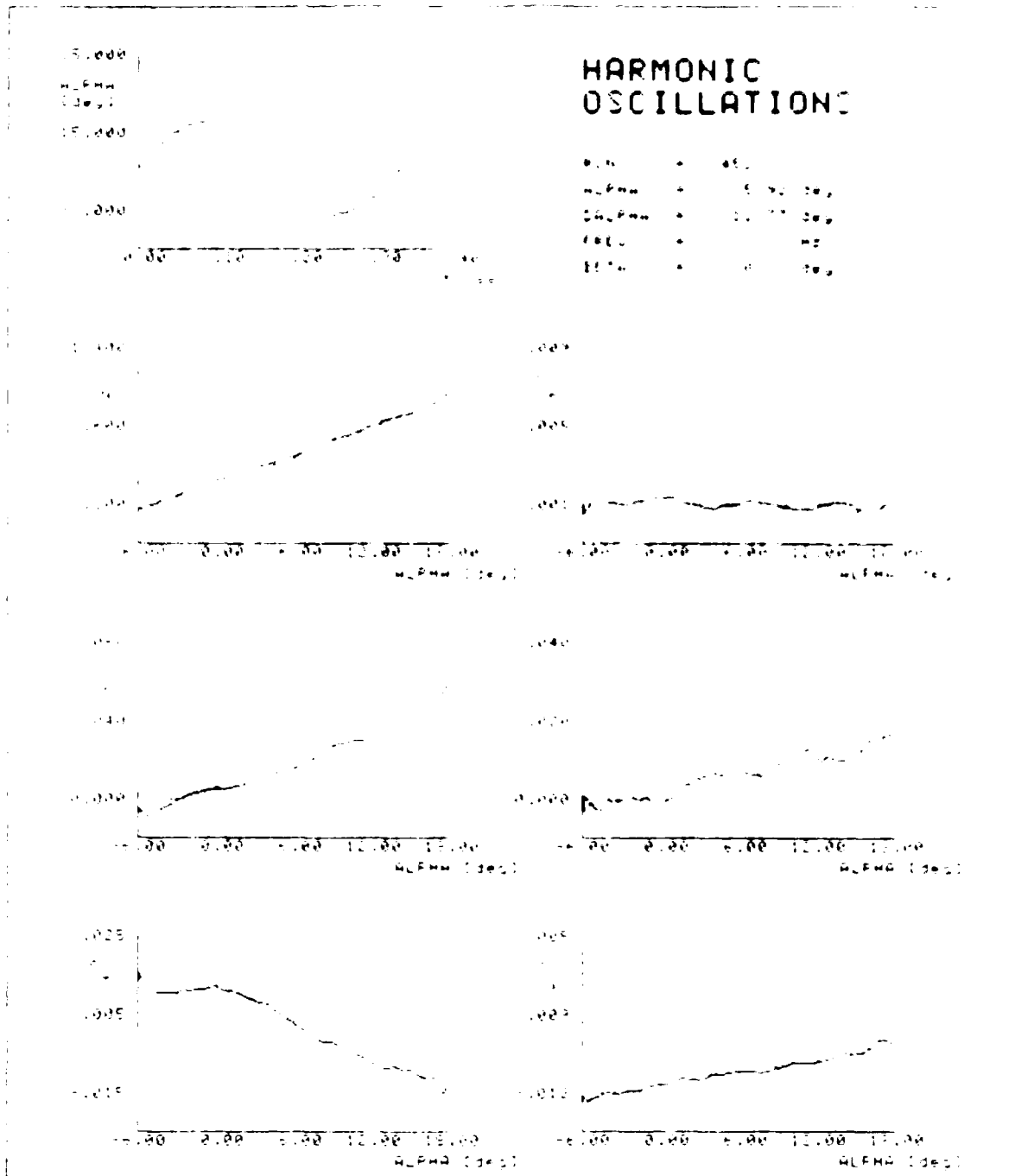
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BETA = 1.57 deg
FREQ = 0 Hz
BETA = 1.57 deg

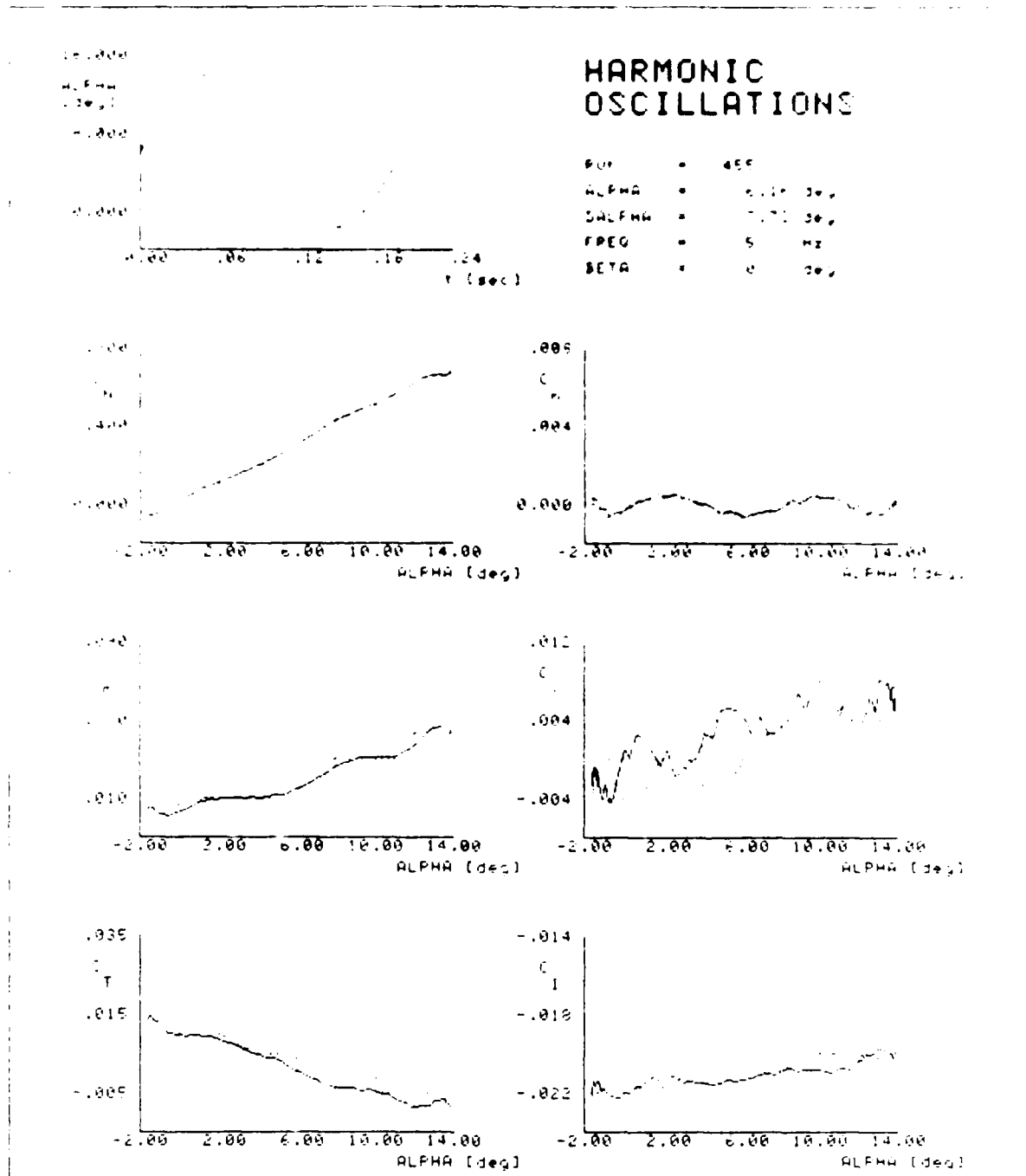


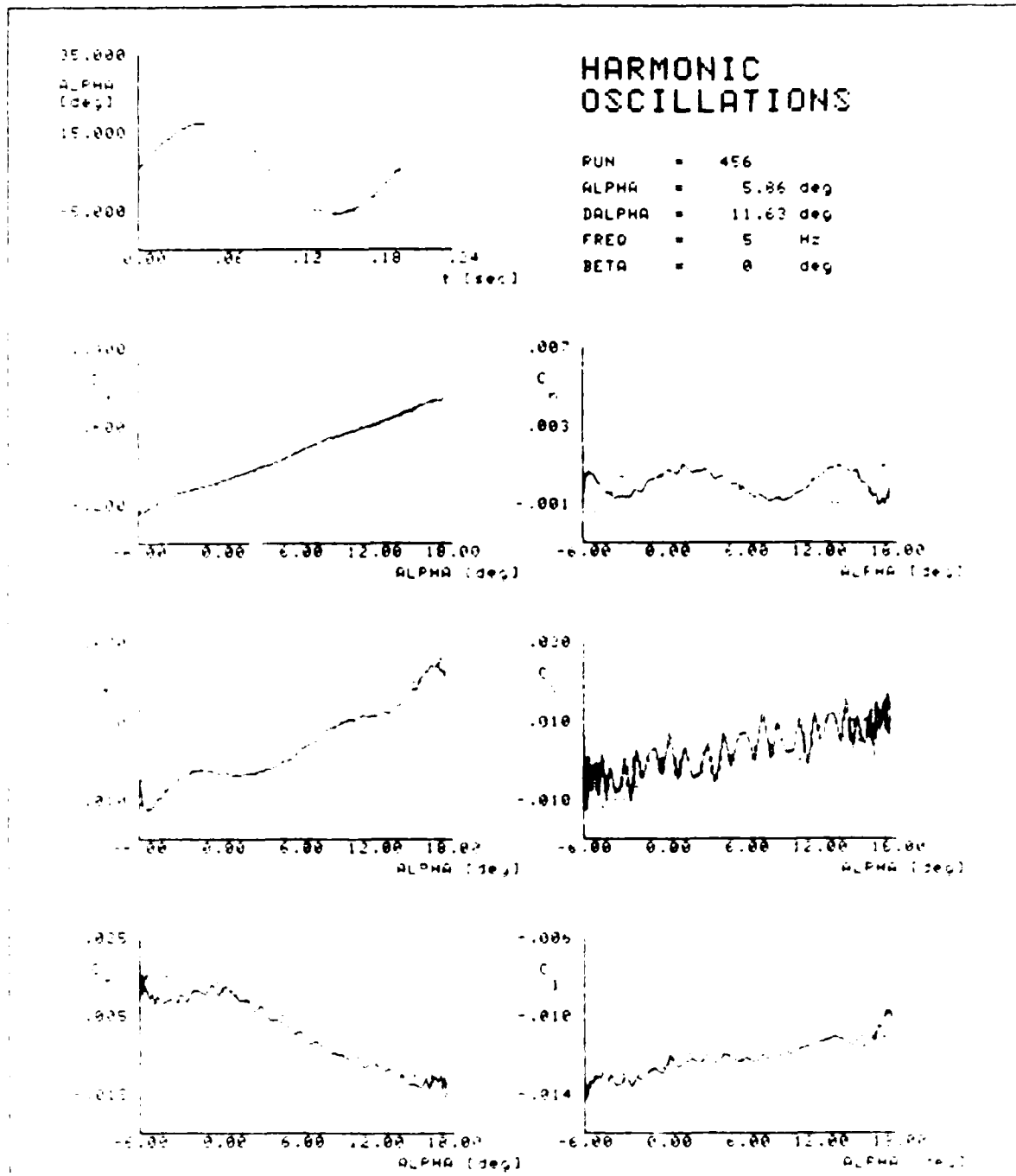


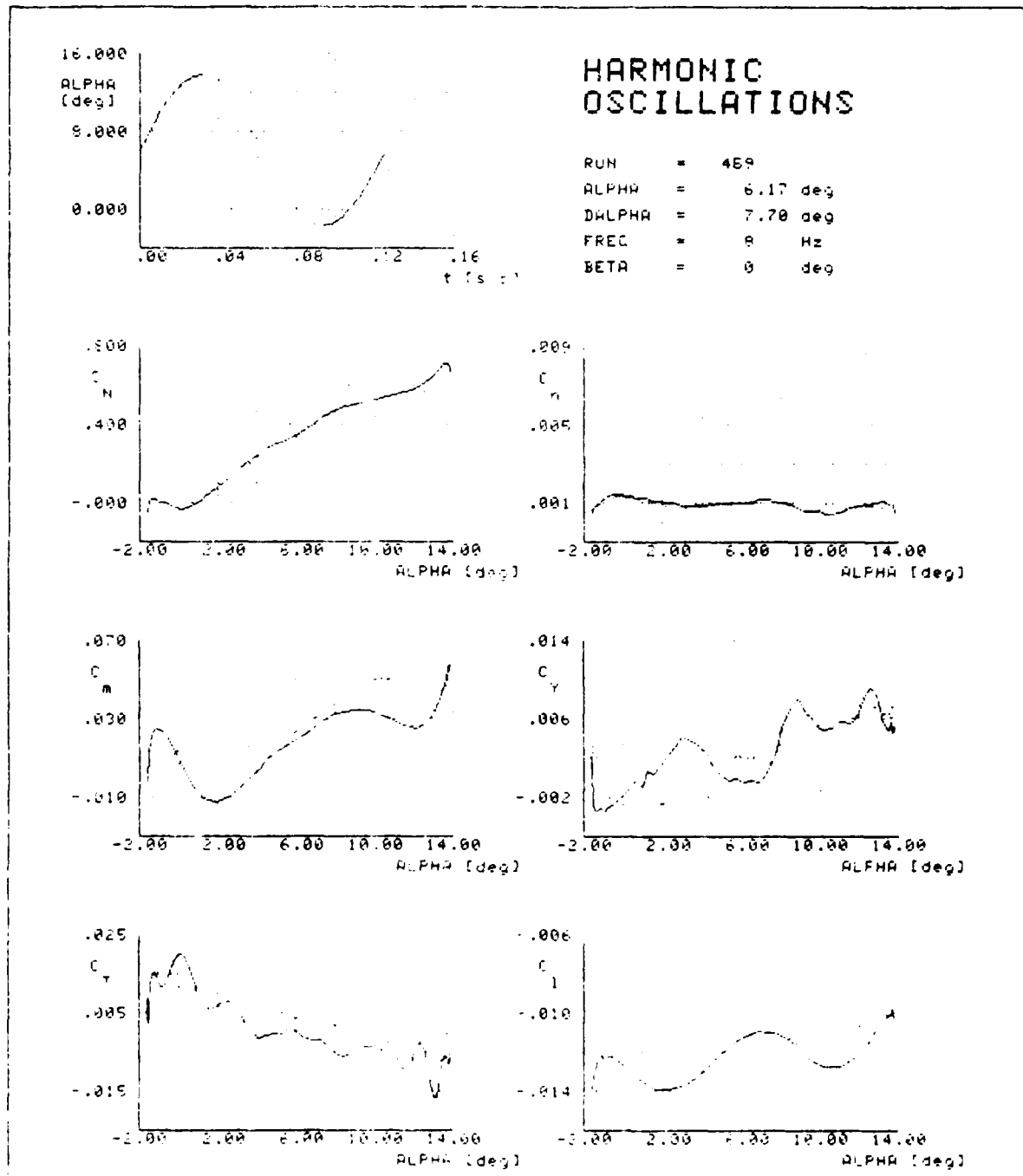


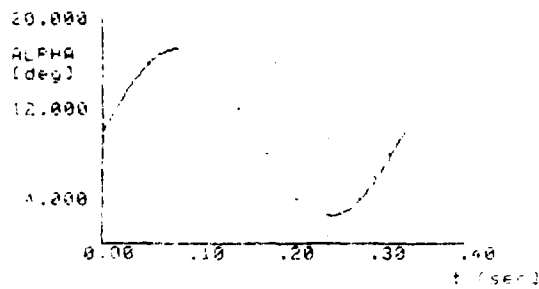






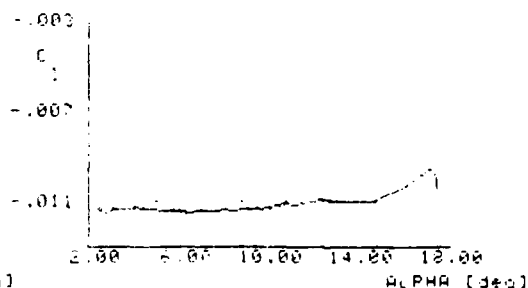
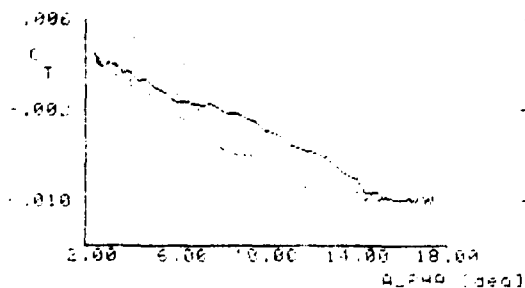
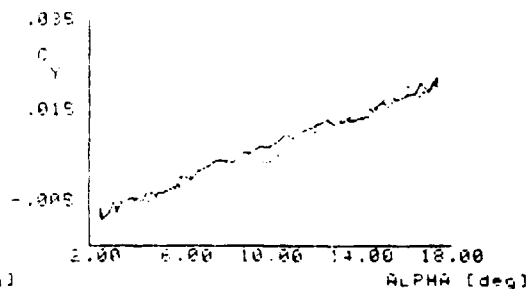
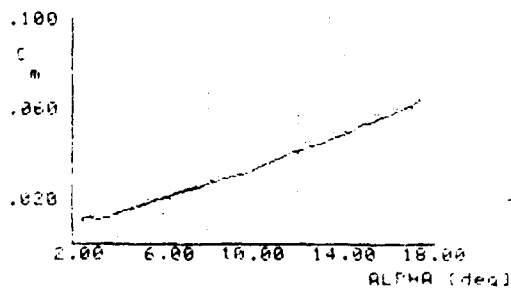
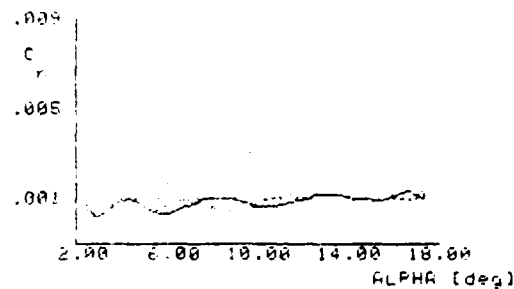
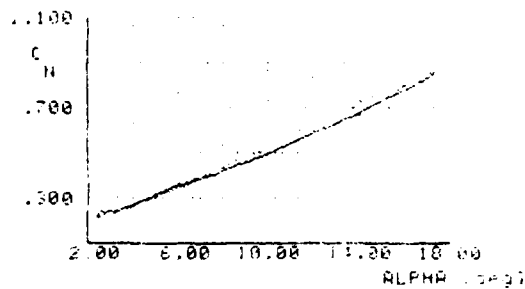


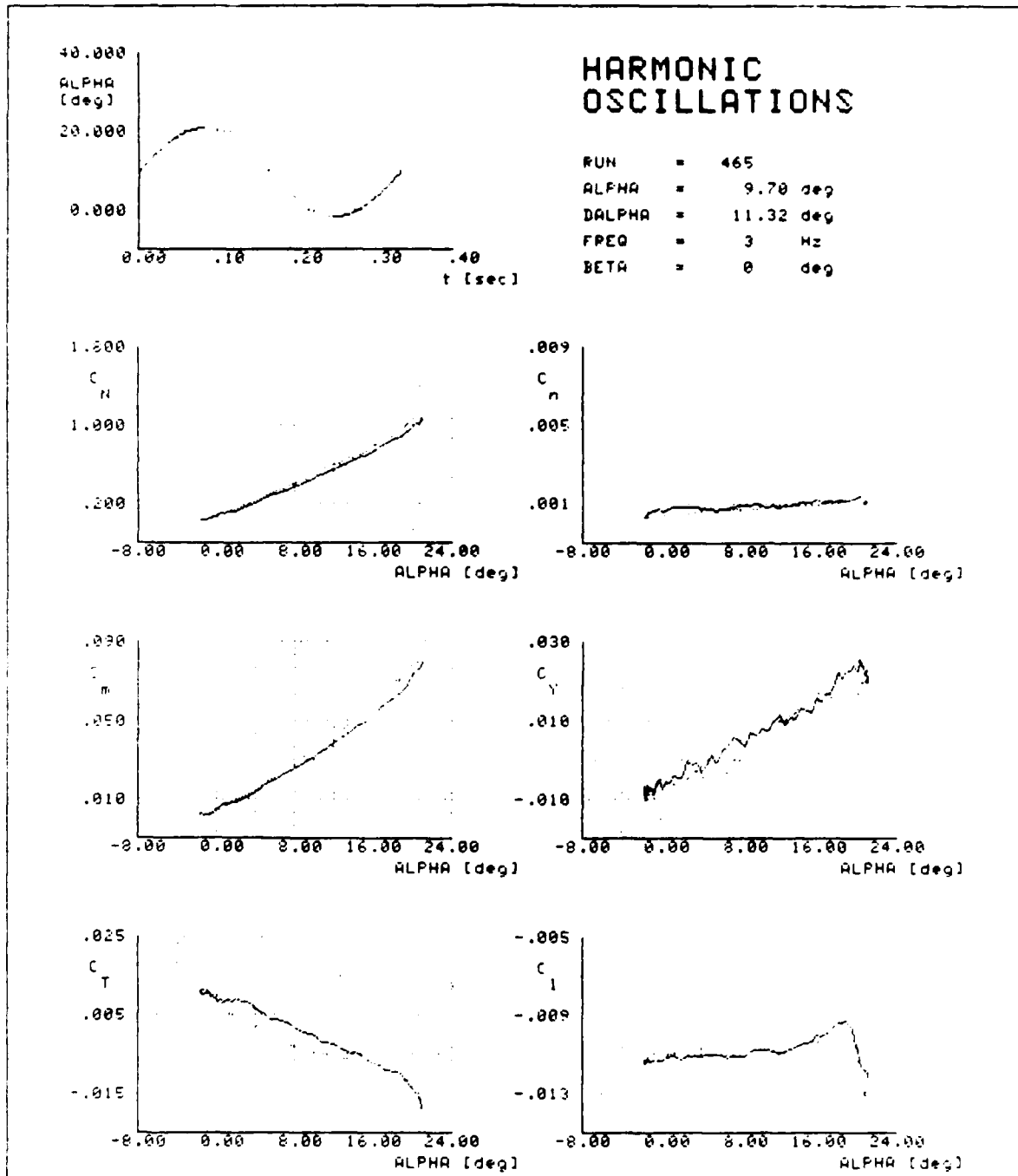


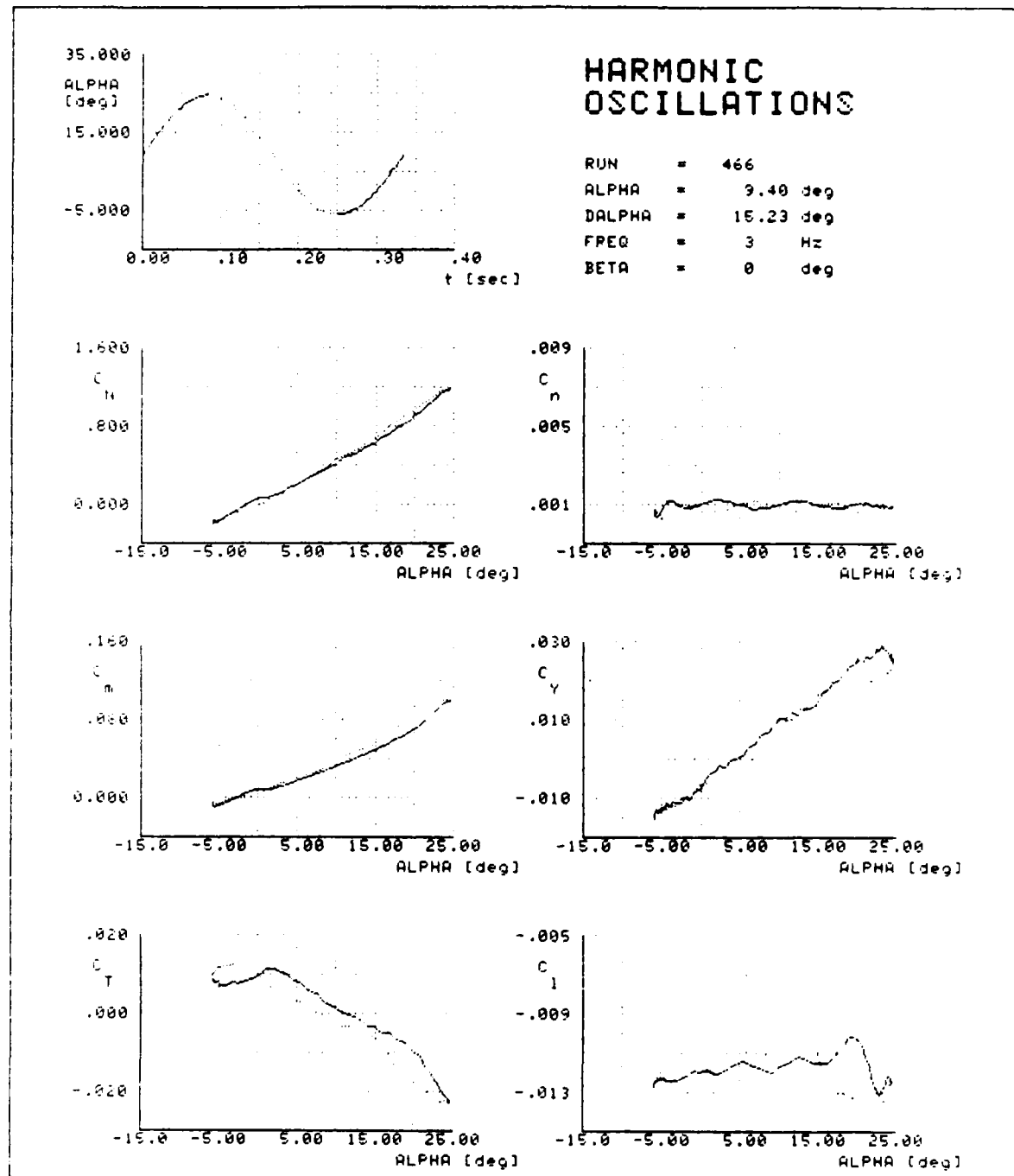


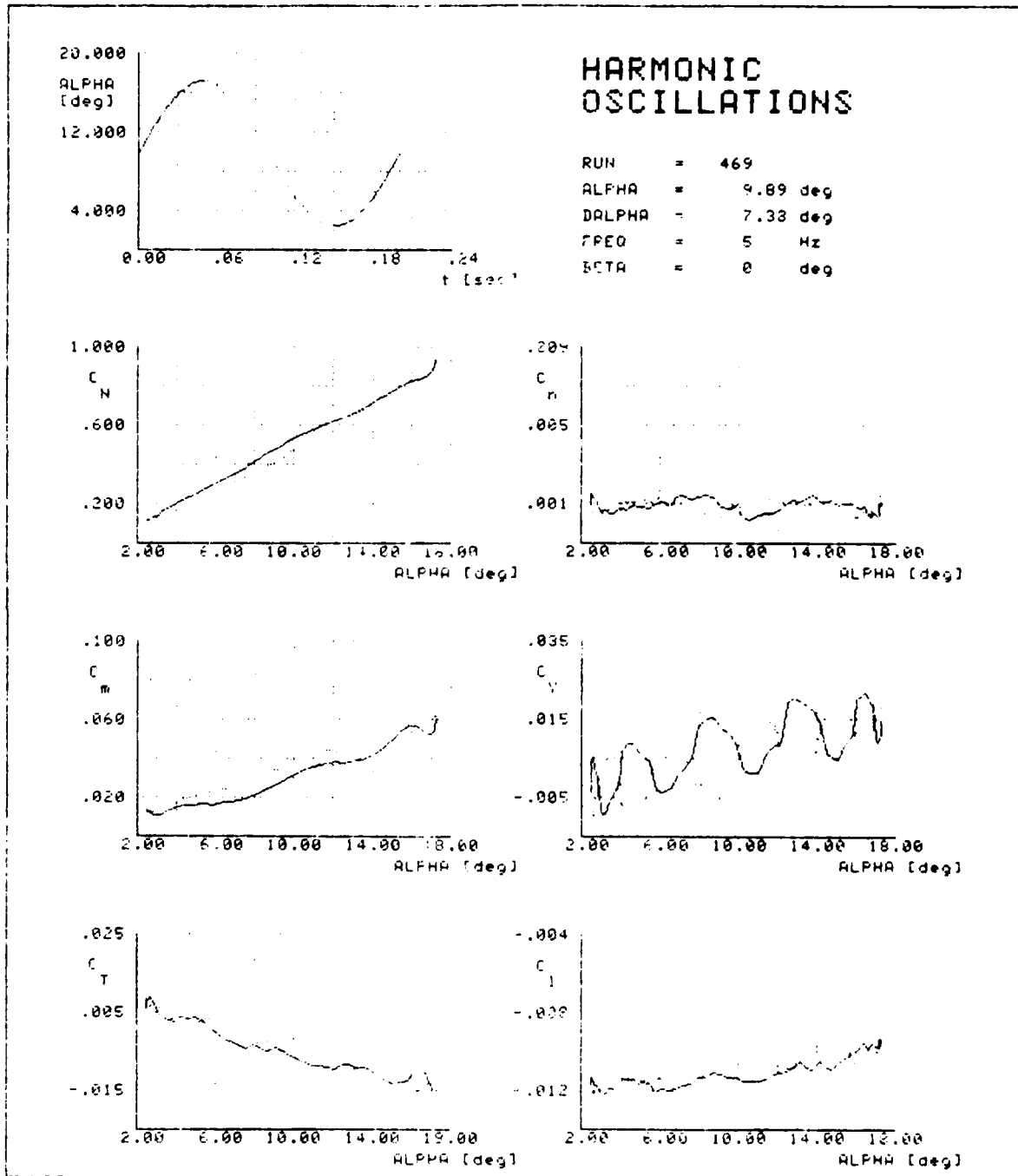
HARMONIC OSCILLATIONS

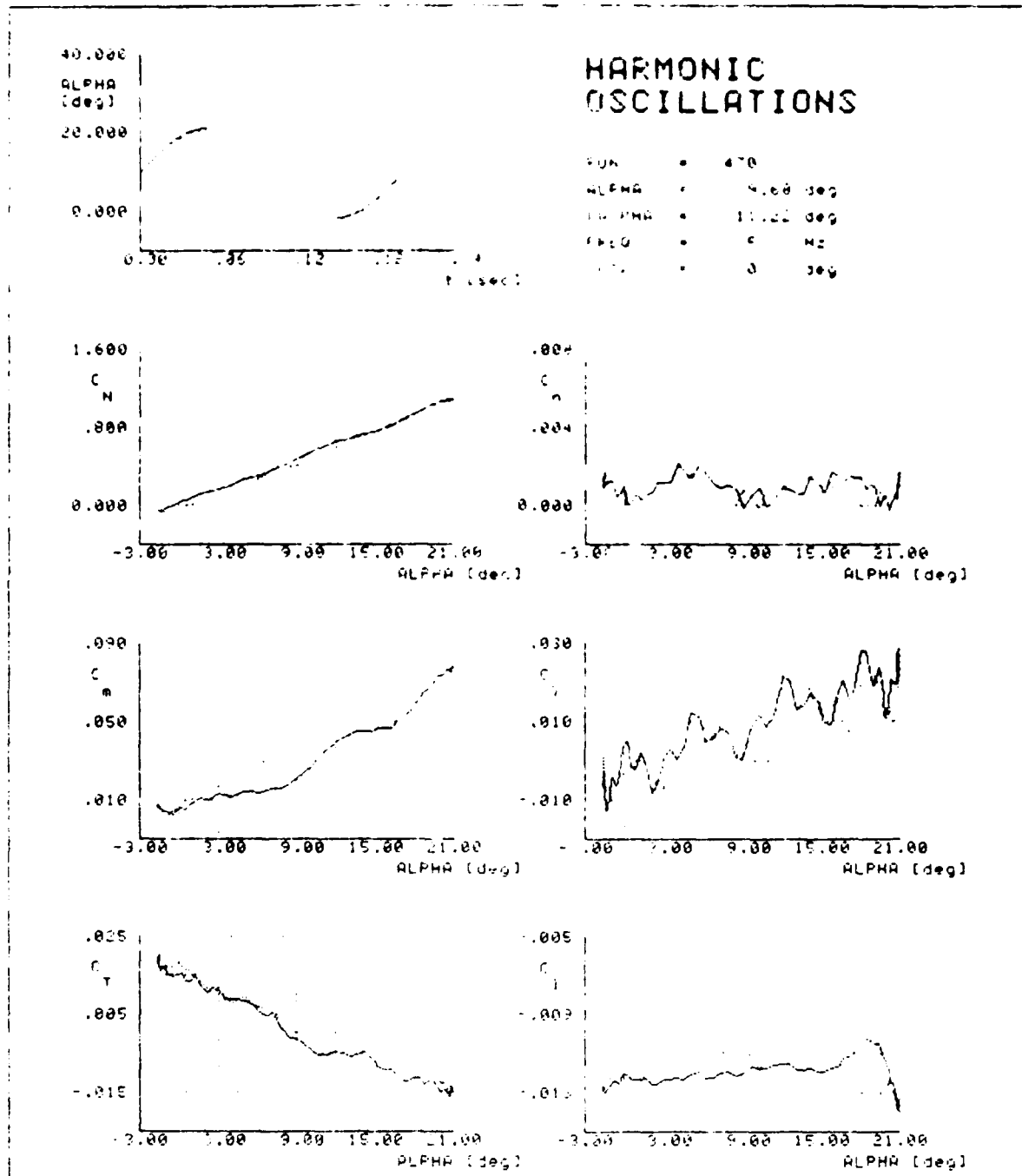
$\omega_N = 464$
 $\alpha = 9.95 \text{ deg}$
 $\alpha_{\text{max}} = 7.46 \text{ deg}$
 $\omega = 3 \text{ Hz}$
 $\alpha = 0 \text{ deg}$

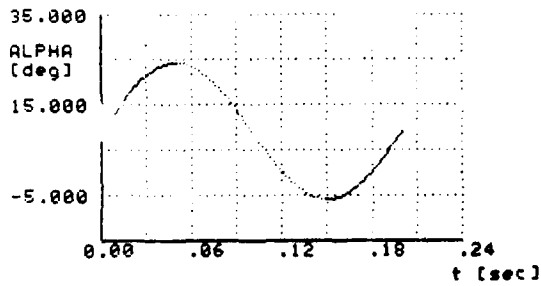






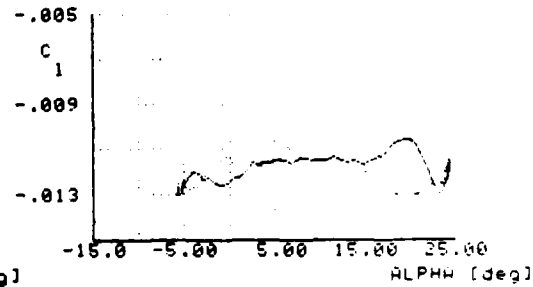
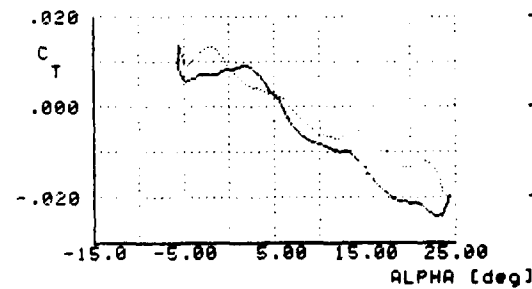
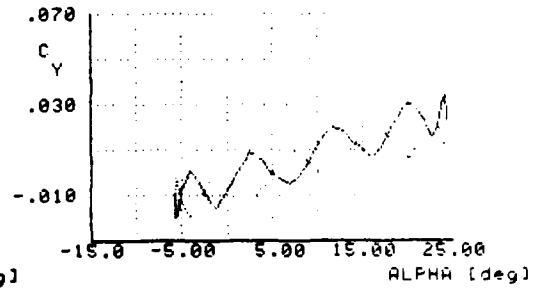
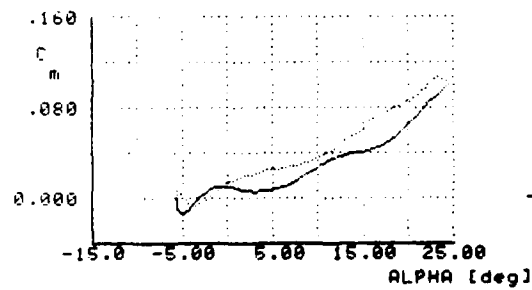
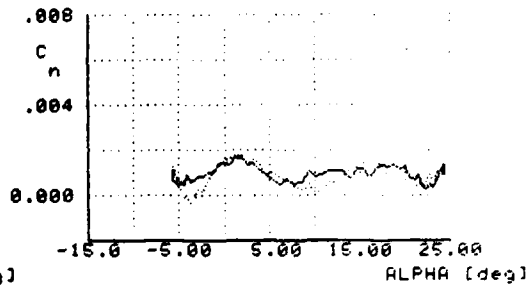
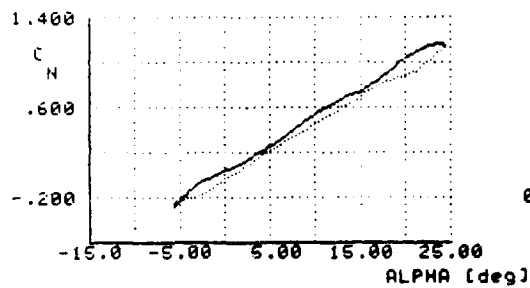


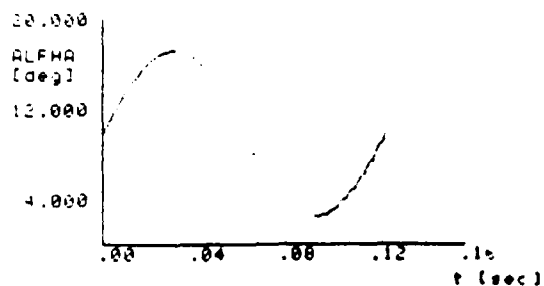




HARMONIC OSCILLATIONS

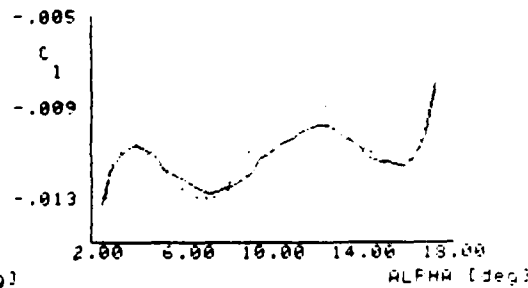
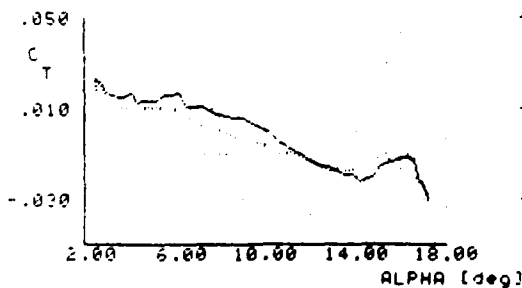
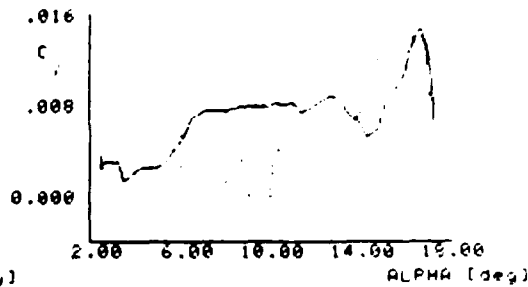
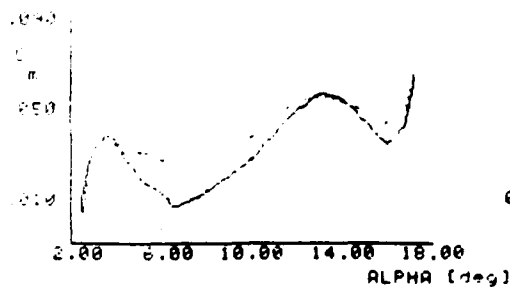
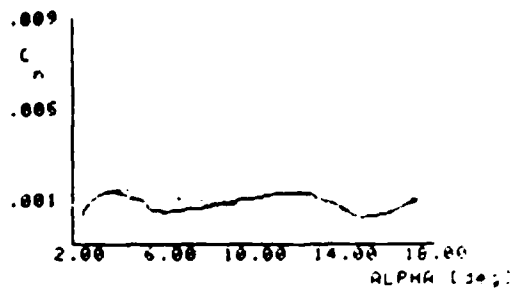
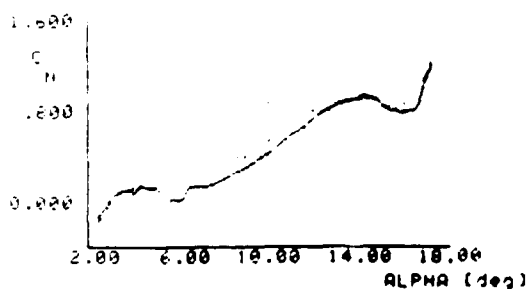
RUN = 471
 ALPHA = 9.42 deg
 DALPHA = 15.03 deg
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 BETA = 0 deg

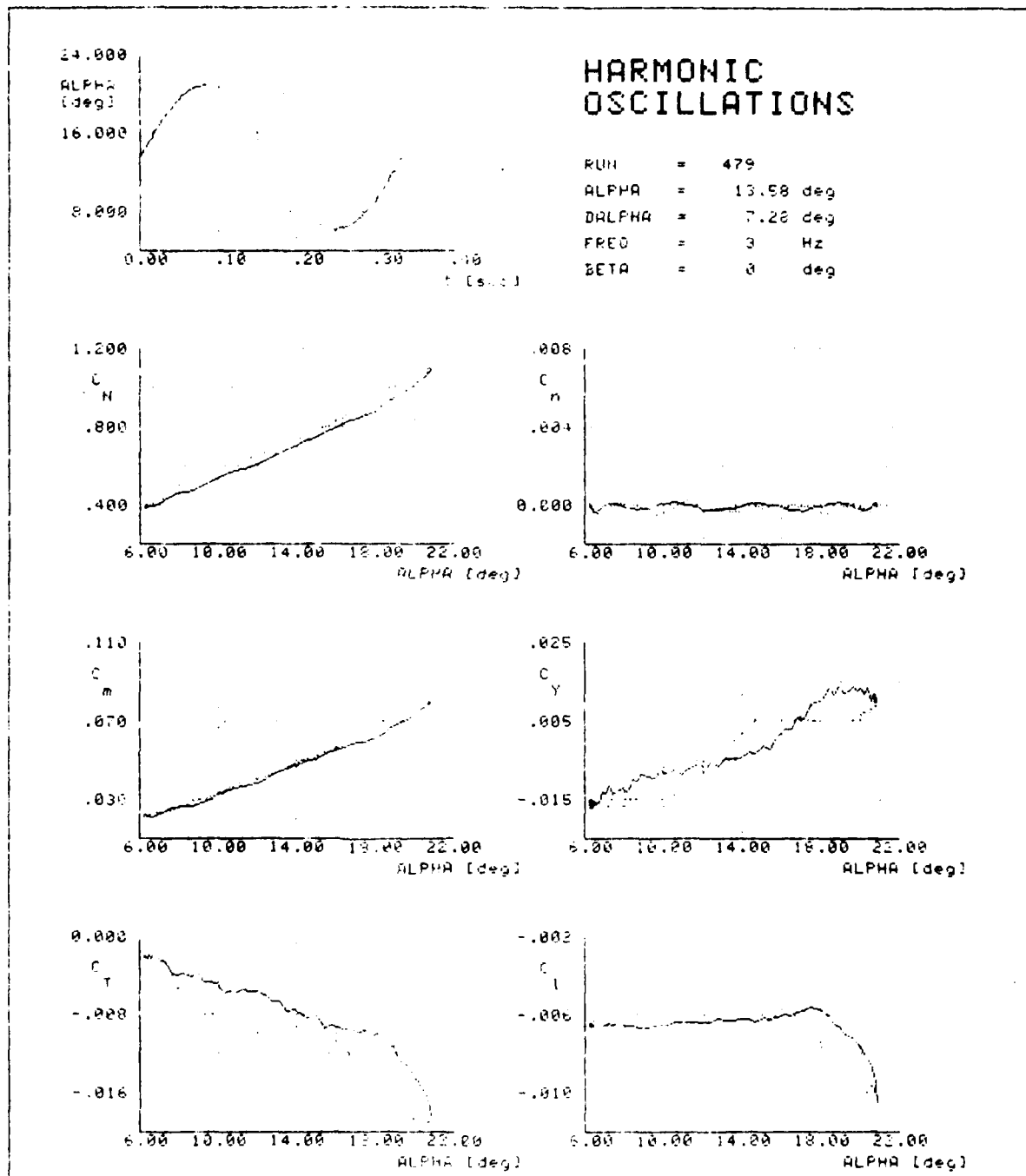


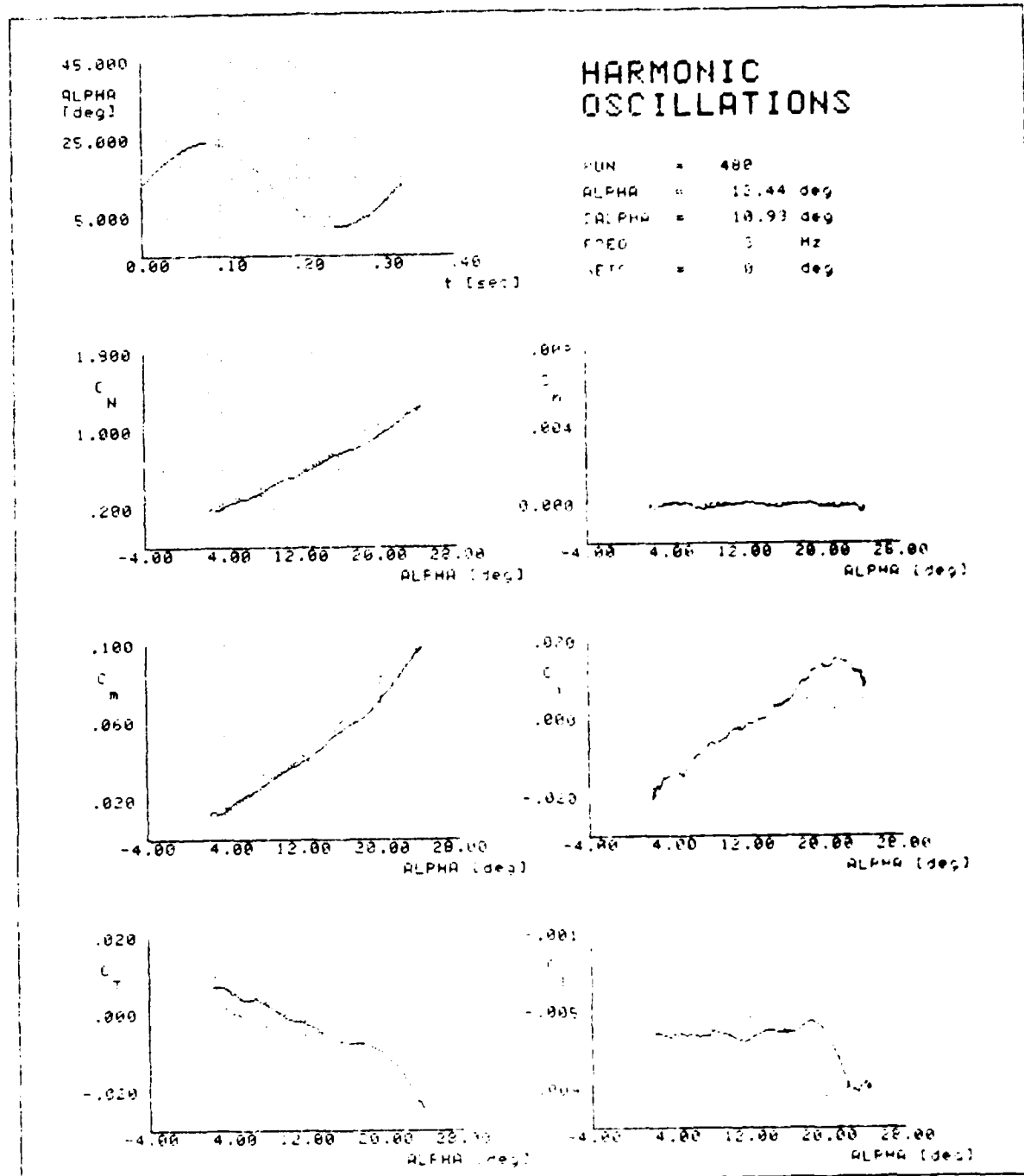


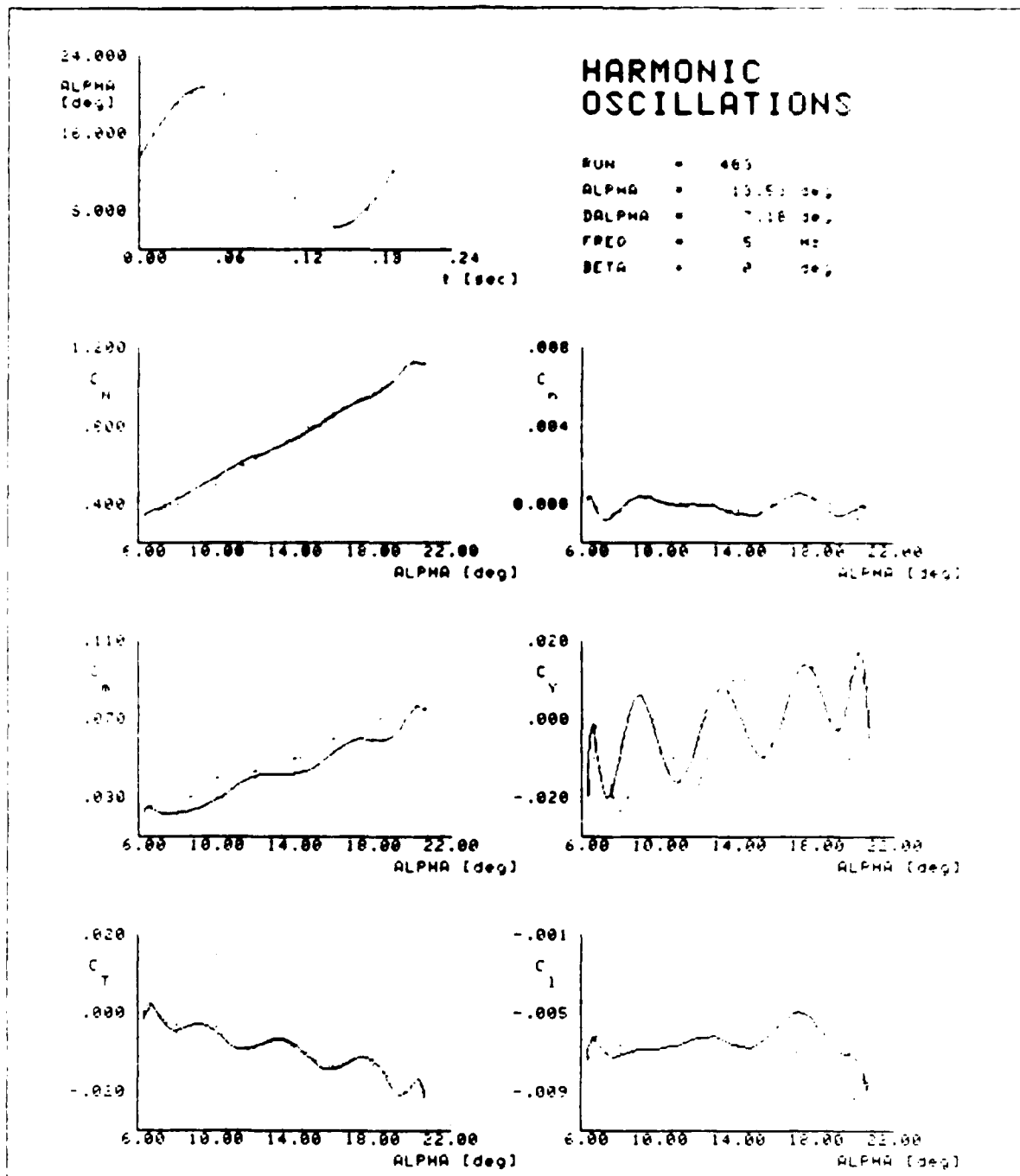
HARMONIC OSCILLATIONS

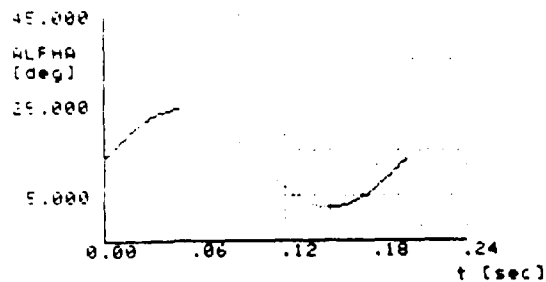
RUN = 474
 ALPHA = 5.66 deg
 DALPHA = 7.26 deg
 FREQ = 6 Hz
 BETA = 0 deg





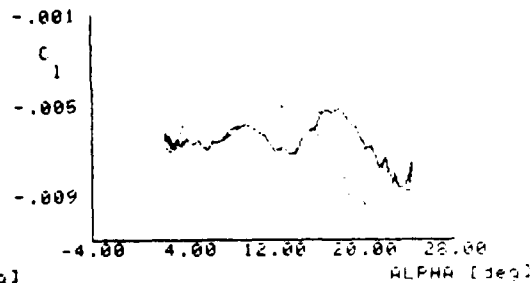
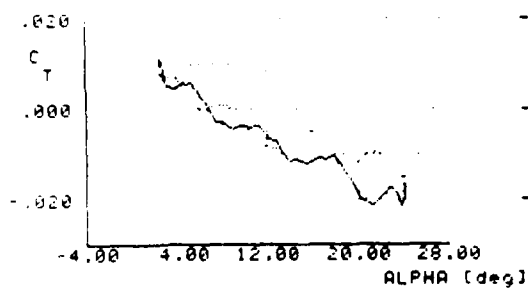
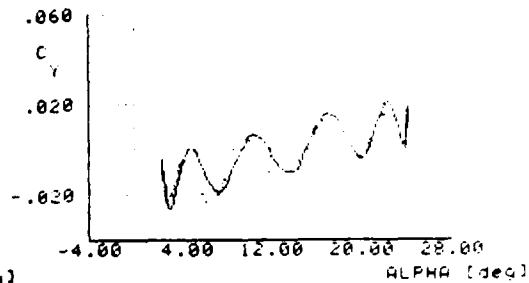
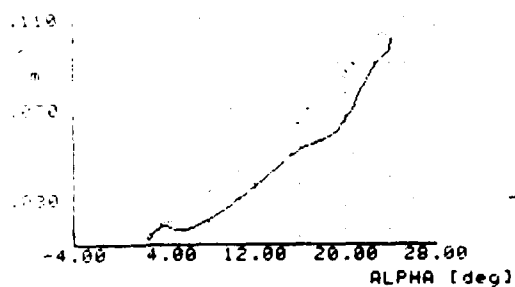
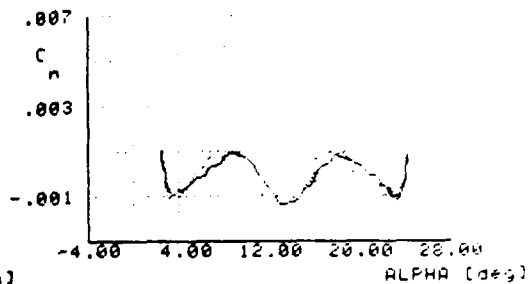
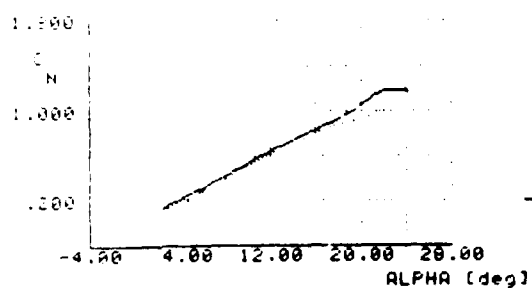


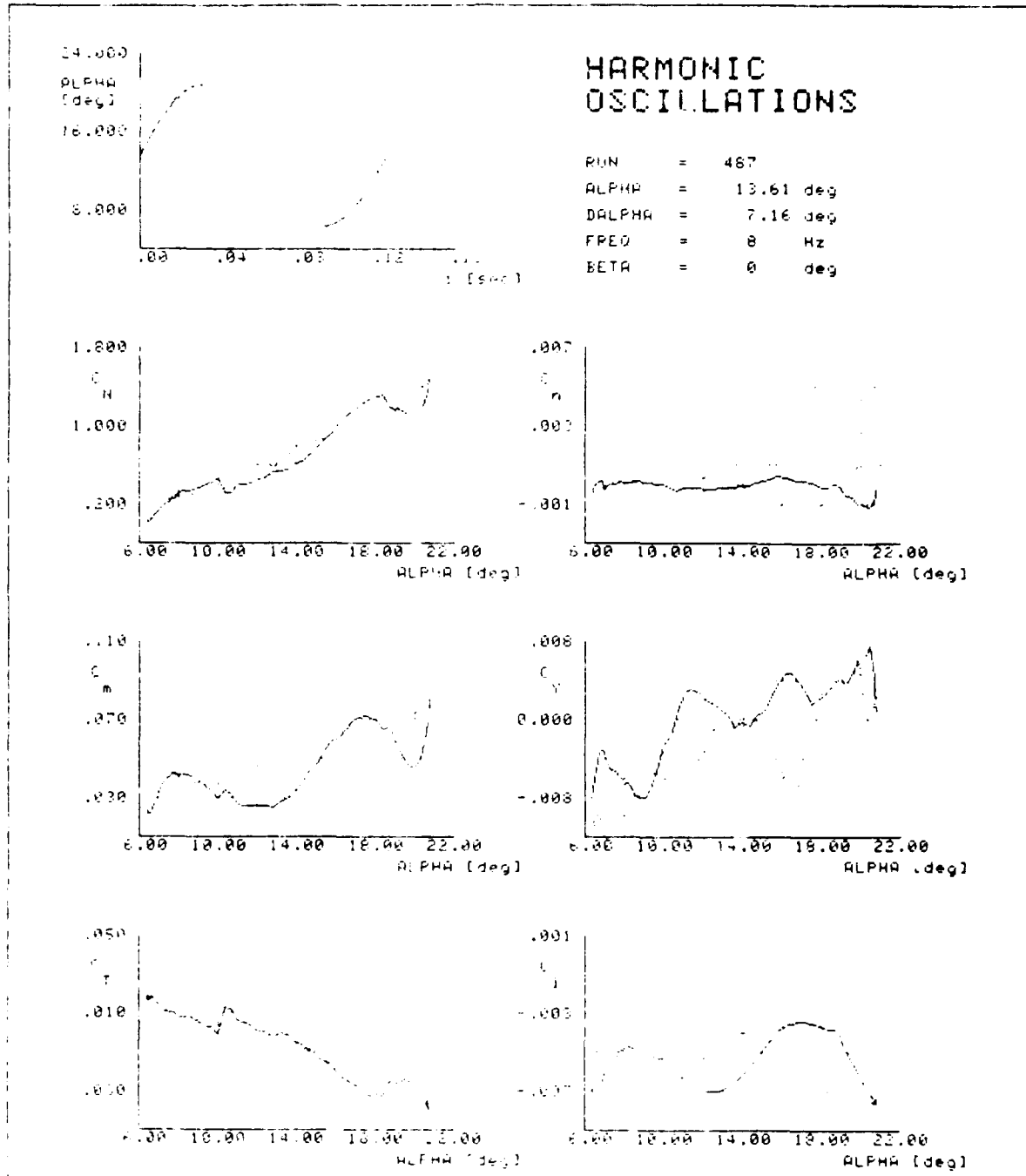


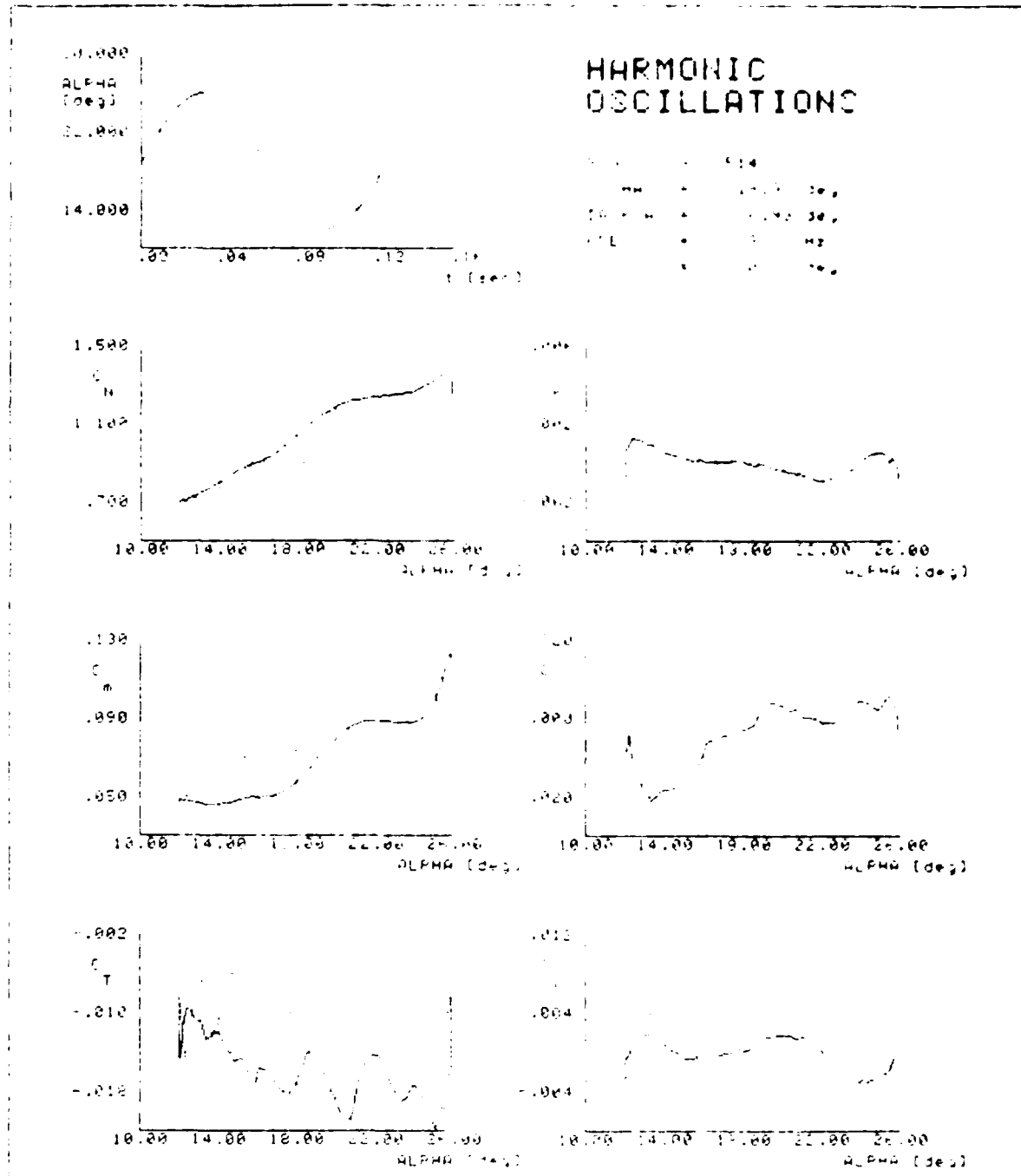


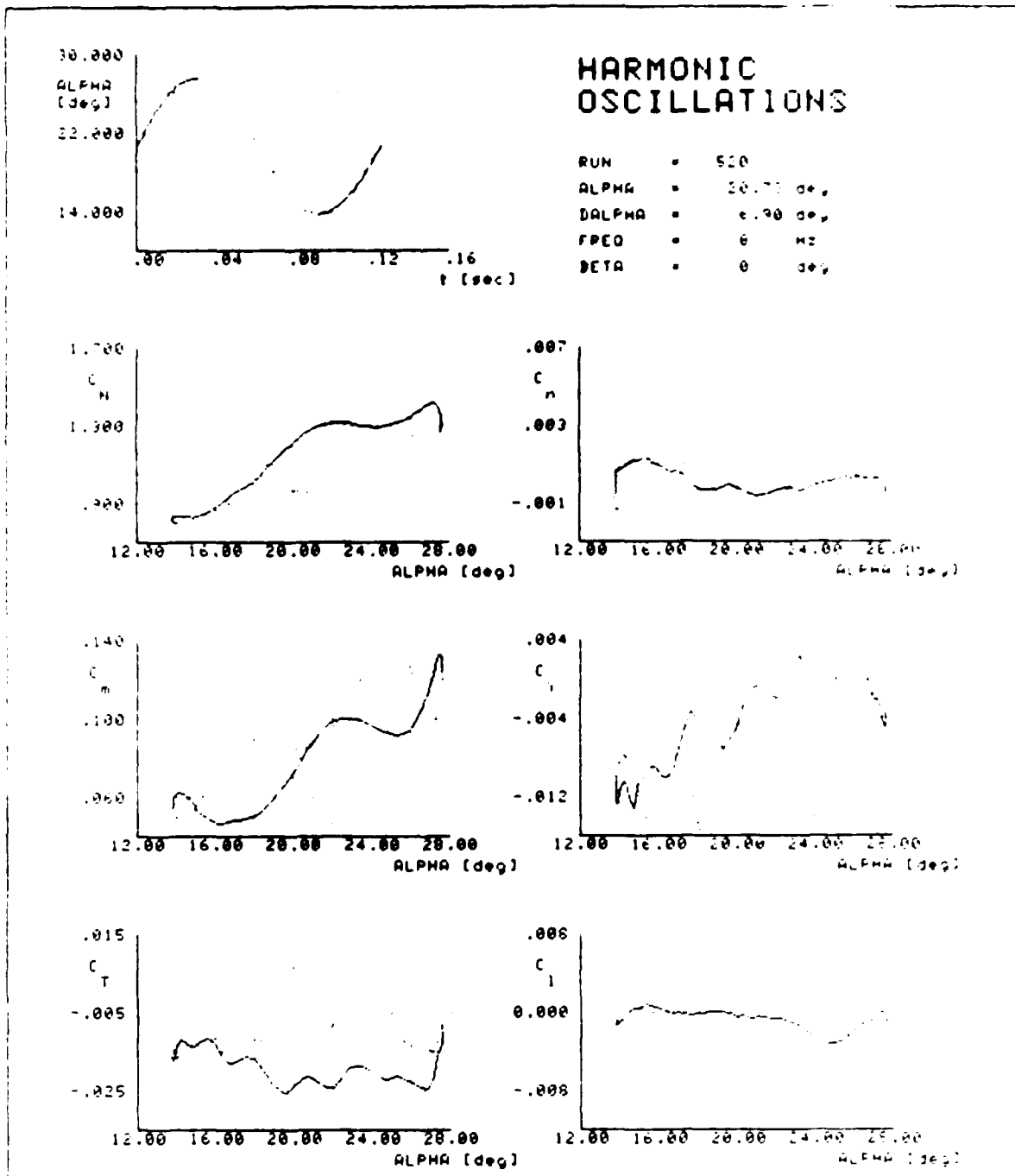
HARMONIC OSCILLATIONS

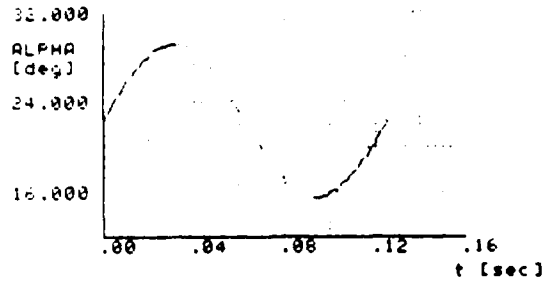
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 ALPHA = 13.44 deg
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 FREQ = 5 Hz
 BETA = 0 deg





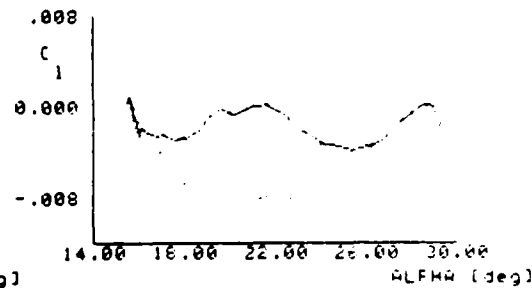
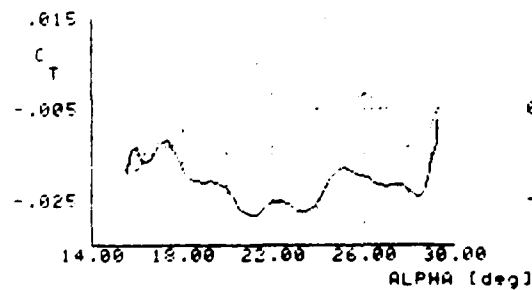
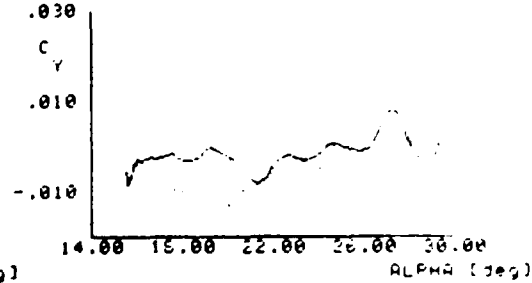
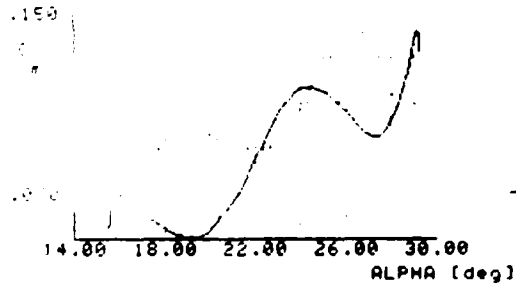
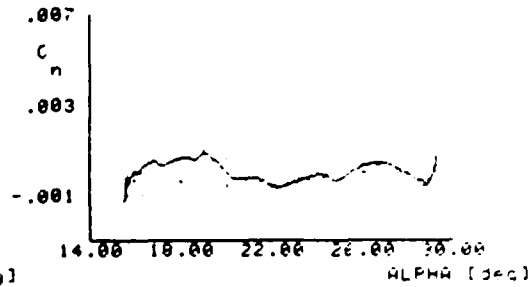
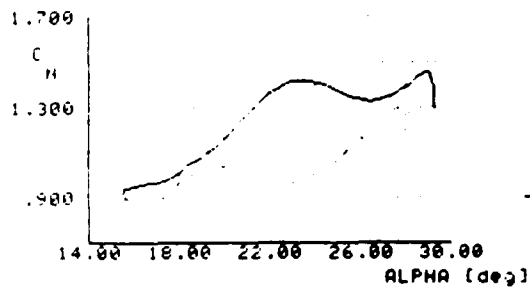


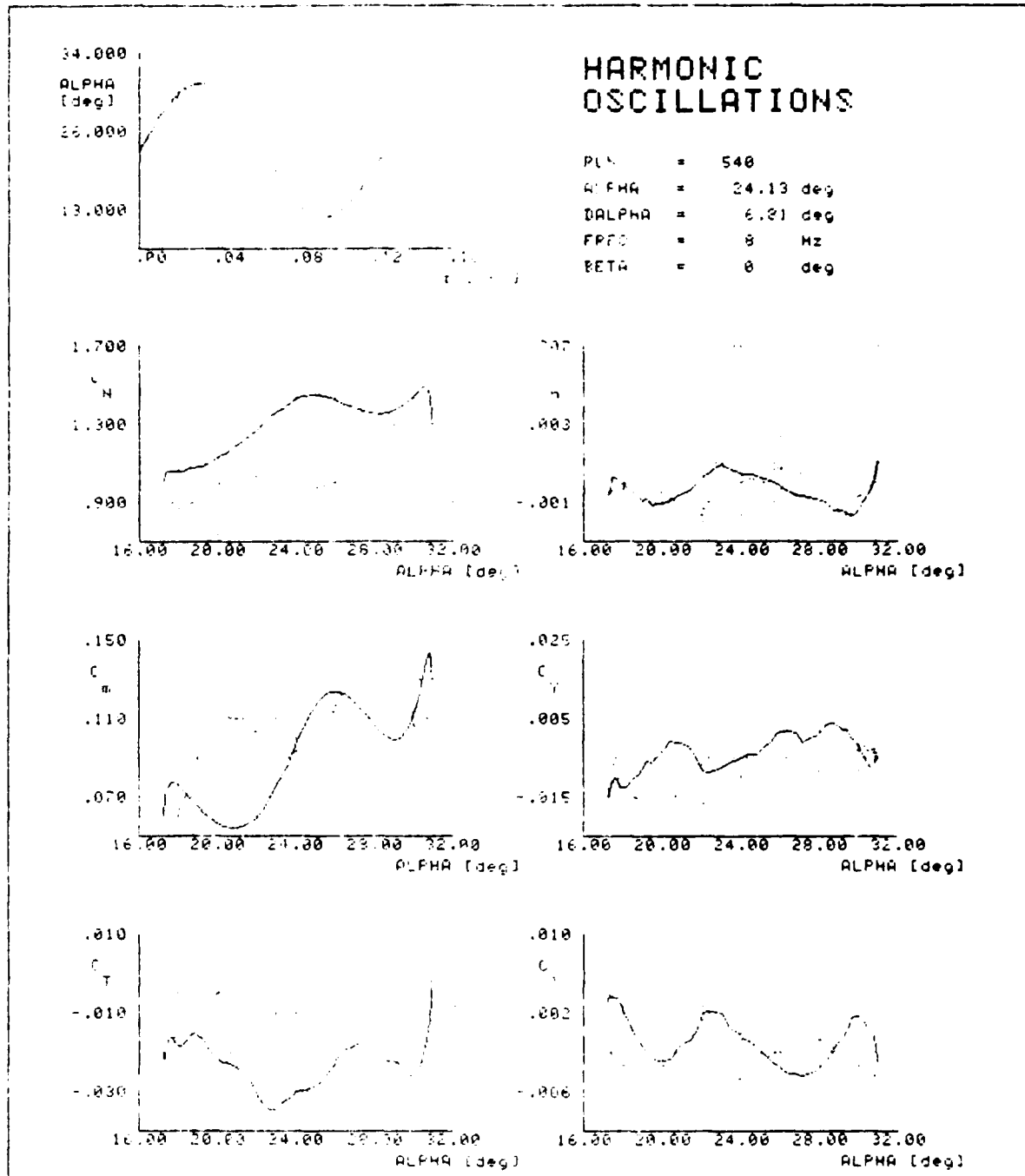


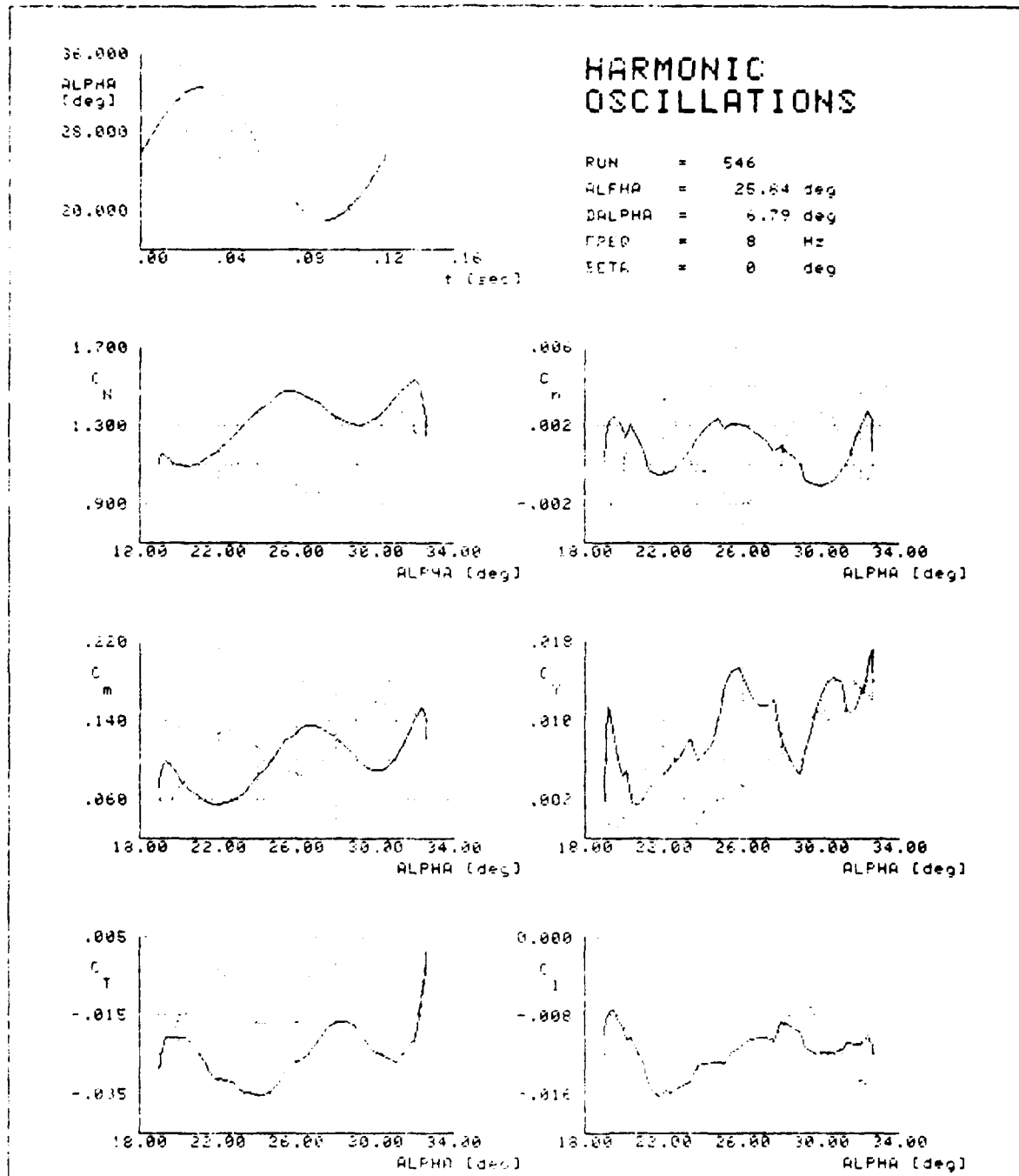


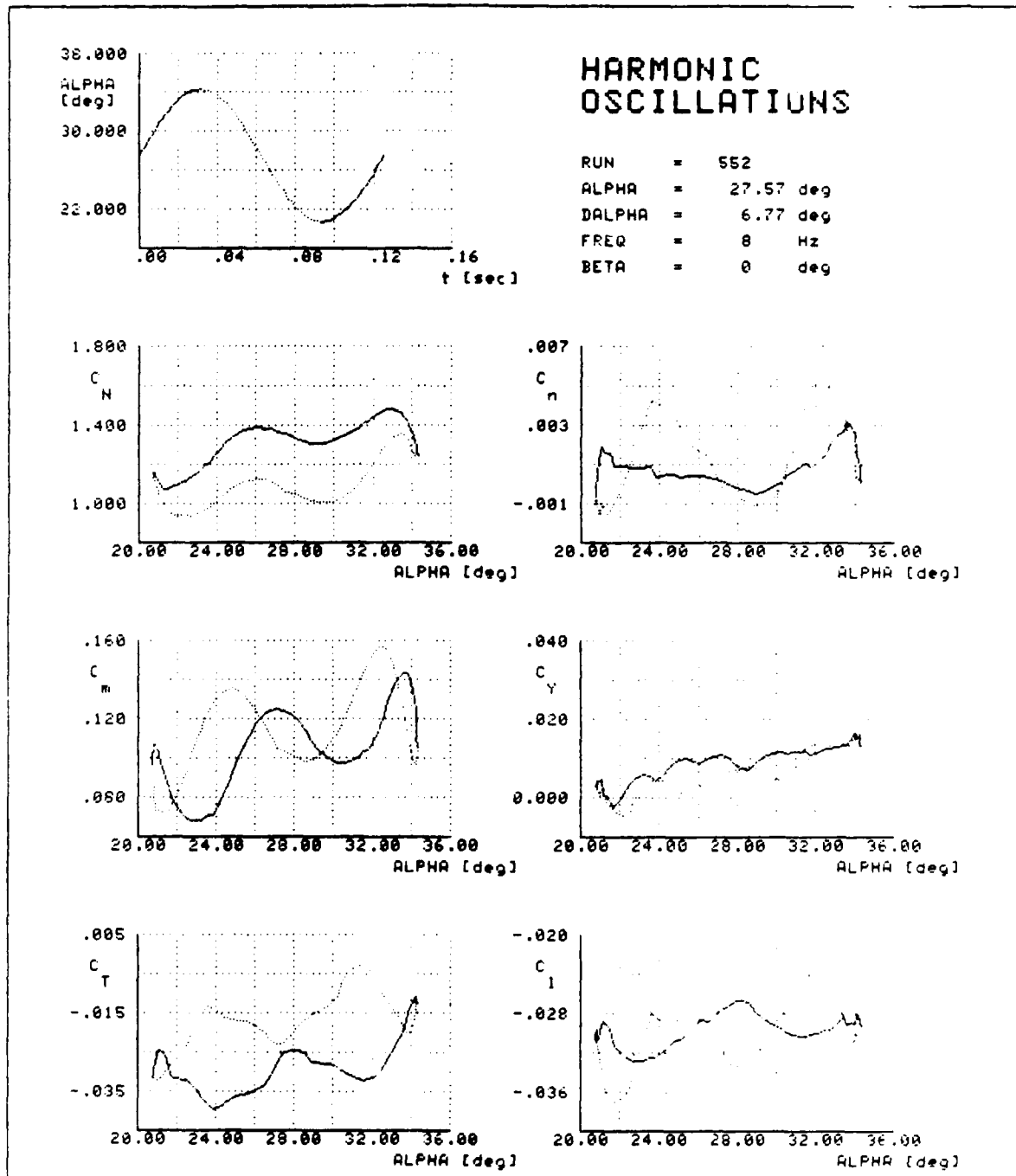
HARMONIC OSCILLATIONS

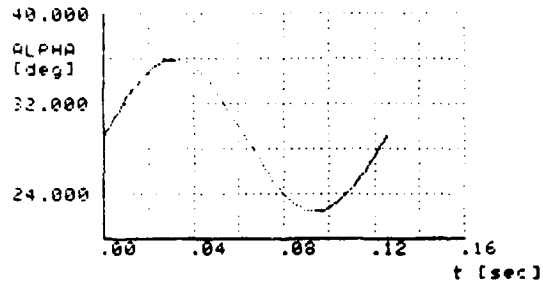
RUN = 532
 ALPHA = 22.44 deg
 DALPHA = 6.66 deg
 FREQ = 8 Hz
 BETA = 0 deg





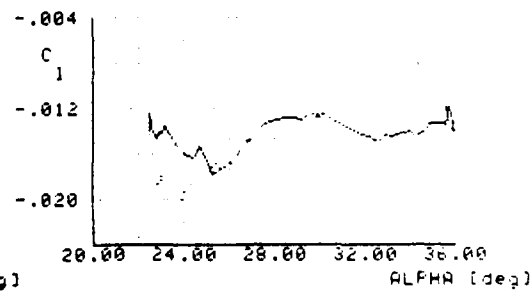
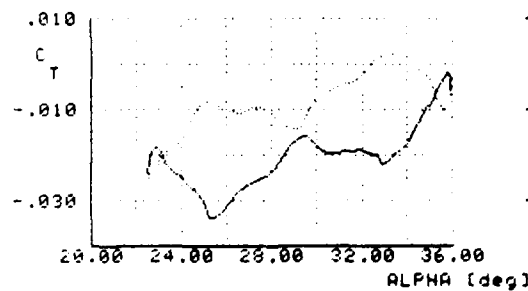
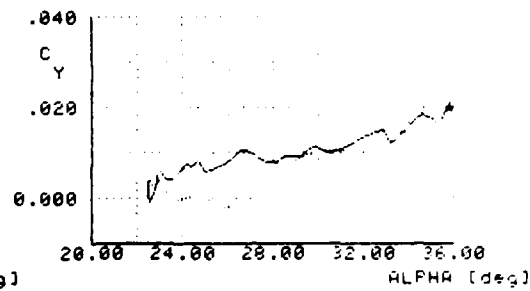
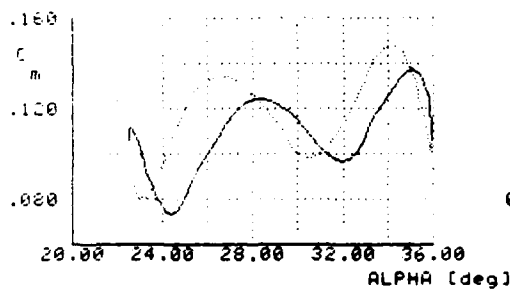
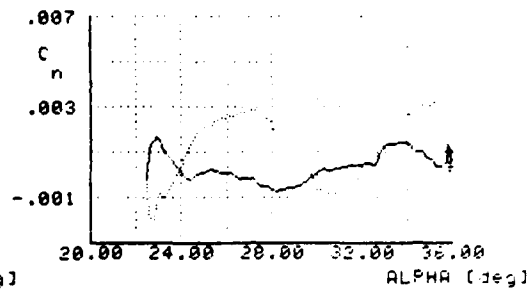
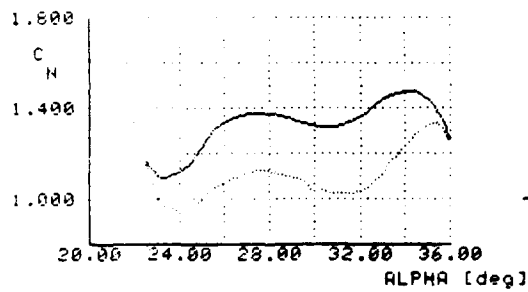


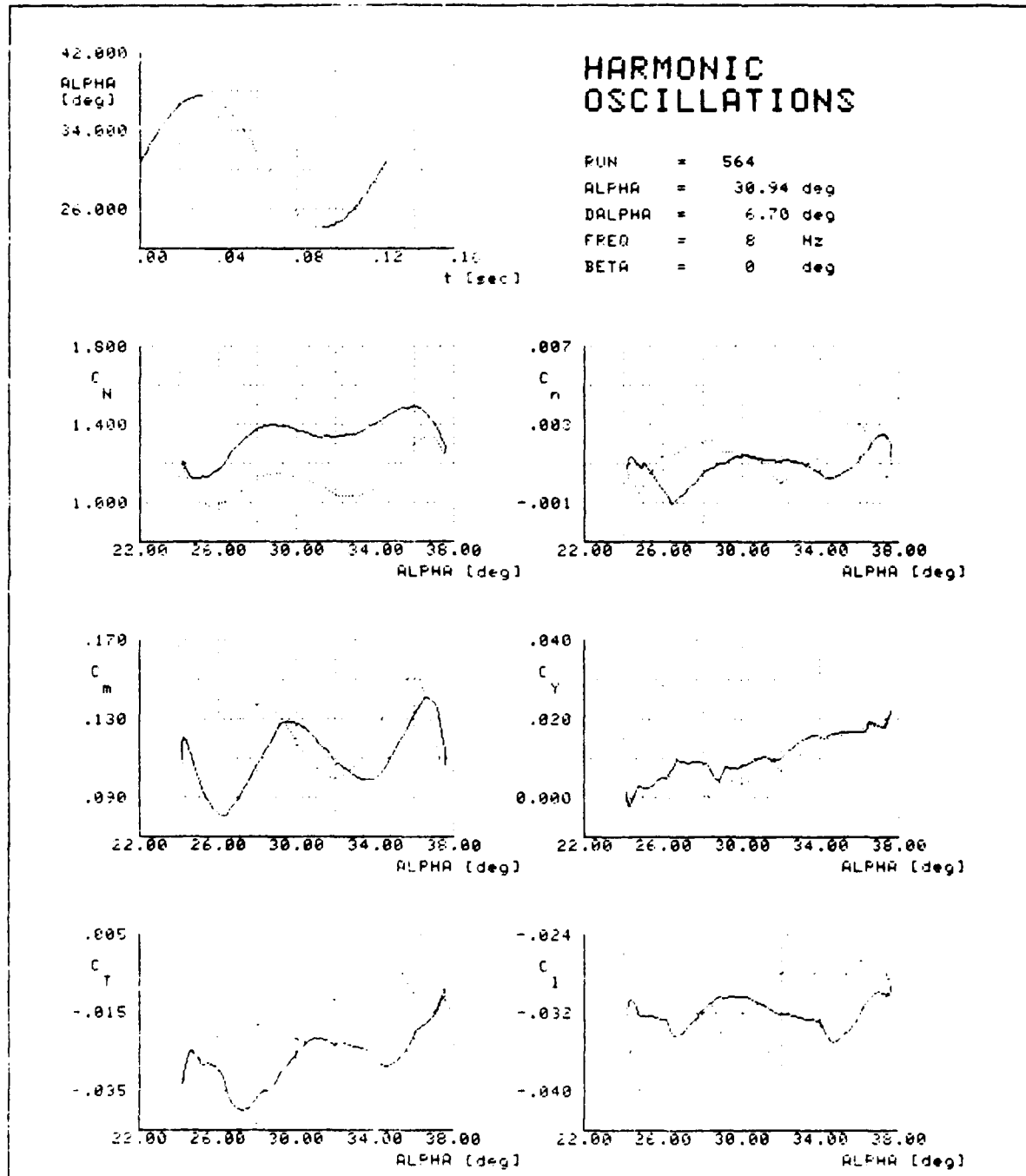


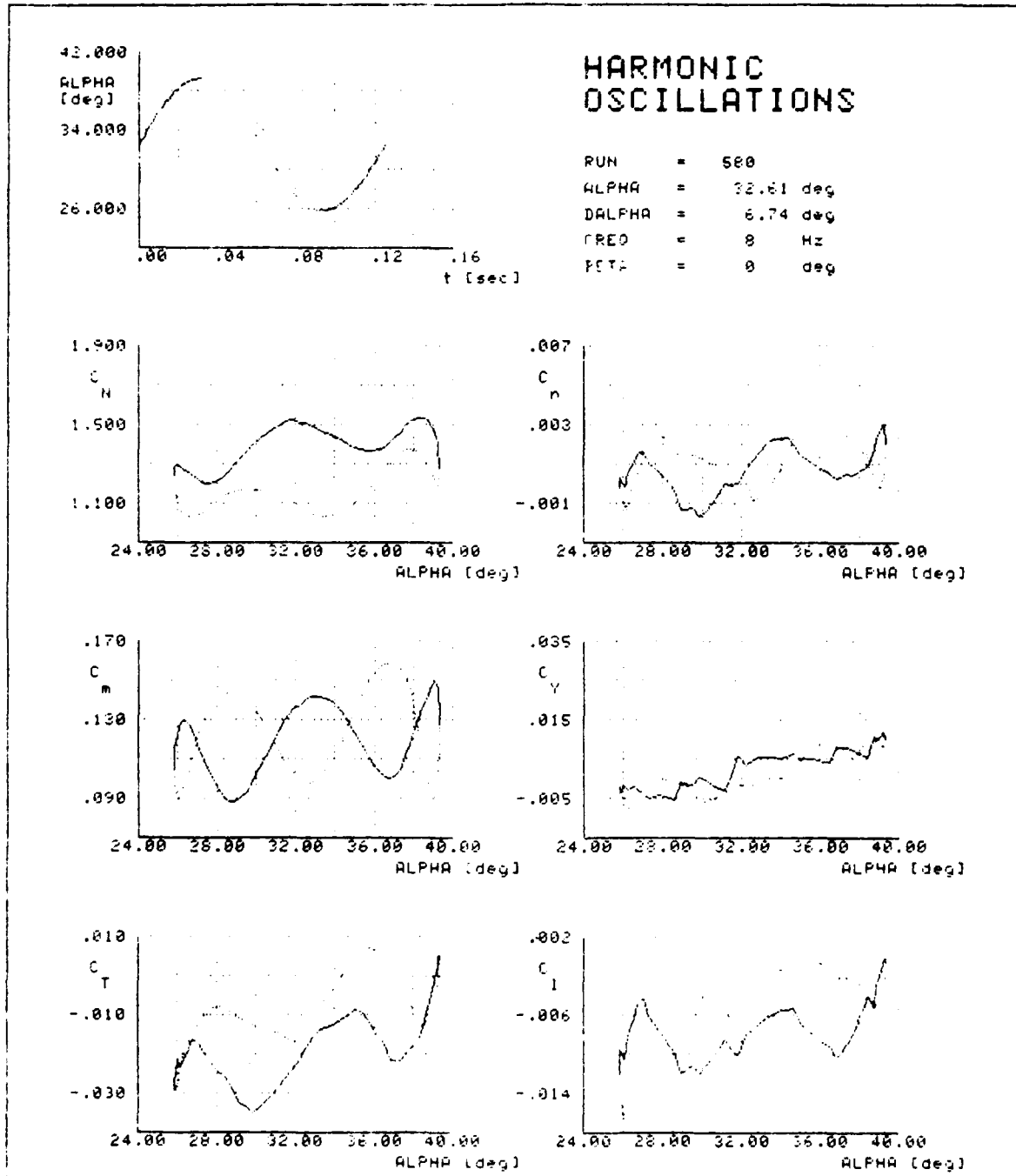


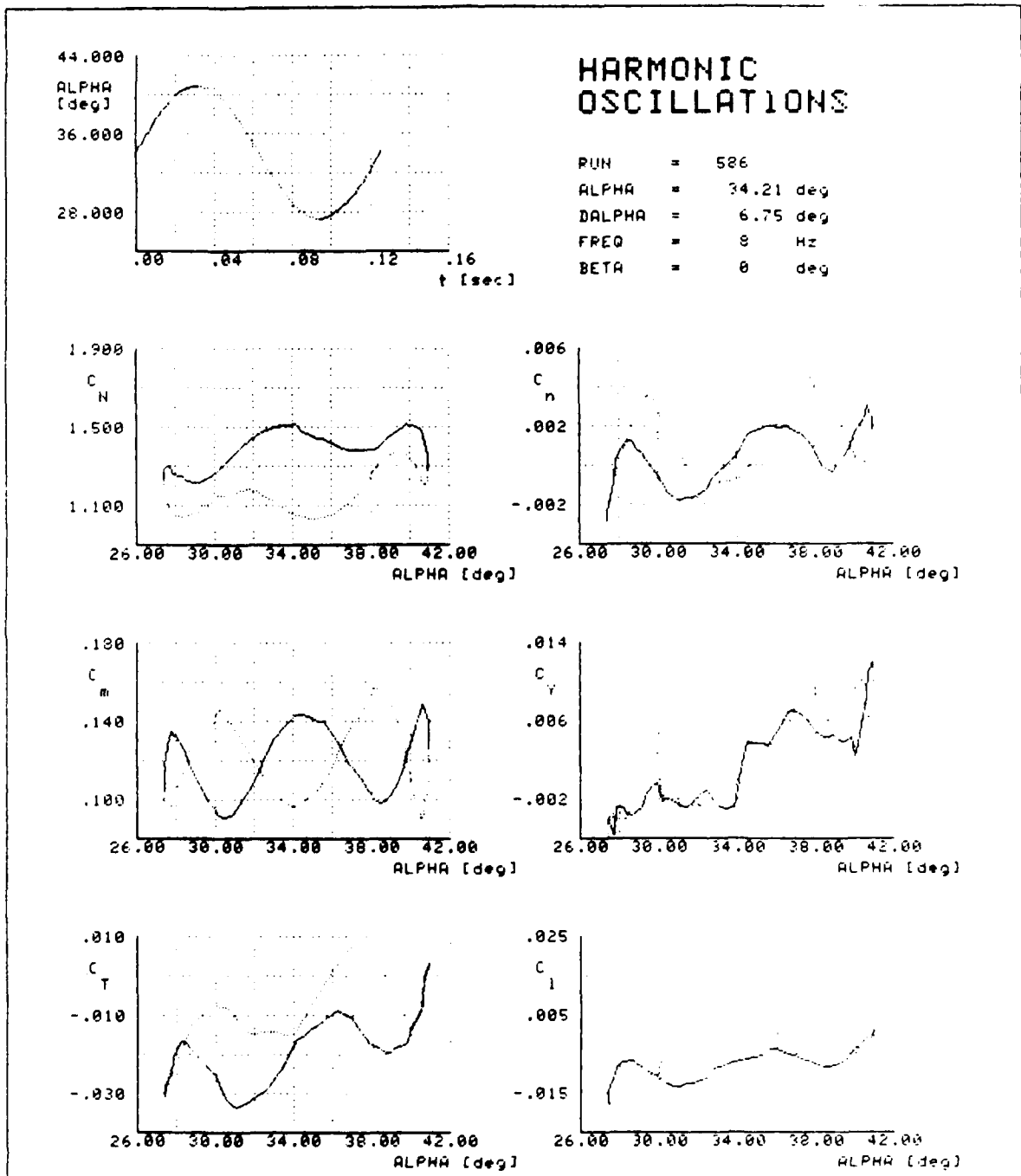
HARMONIC OSCILLATIONS

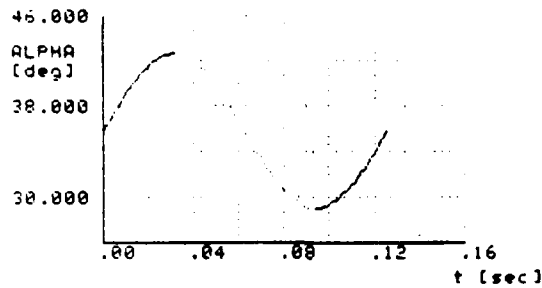
RUN = 558
ALPHA = 29.25 deg
DALPHA = 6.74 deg
FREQ = 8 Hz
BETA = 0 deg





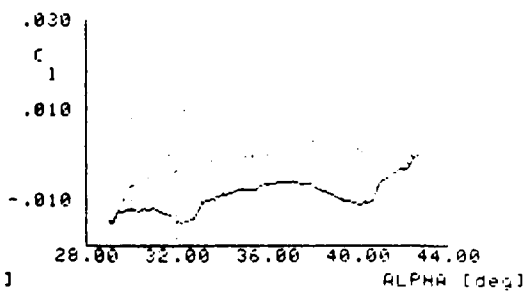
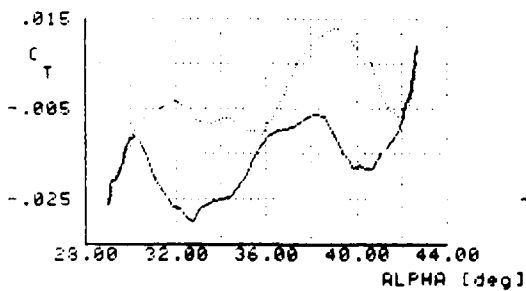
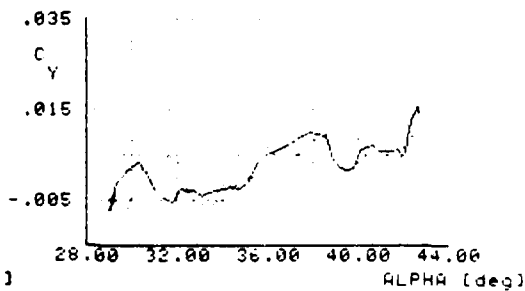
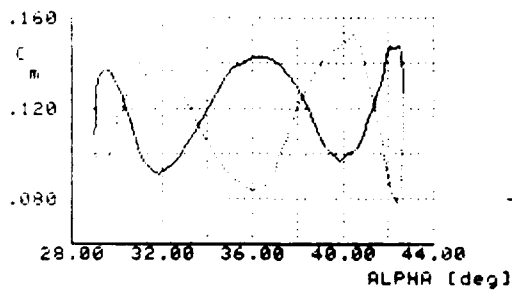
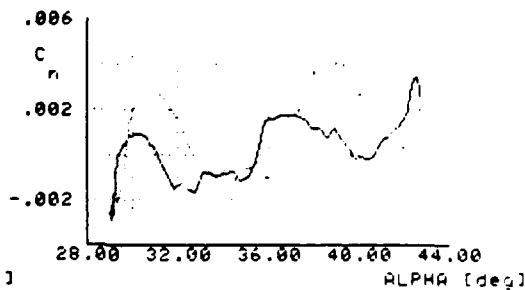
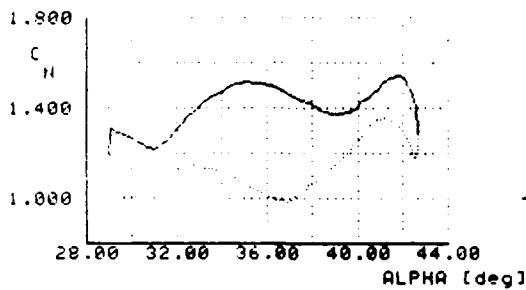


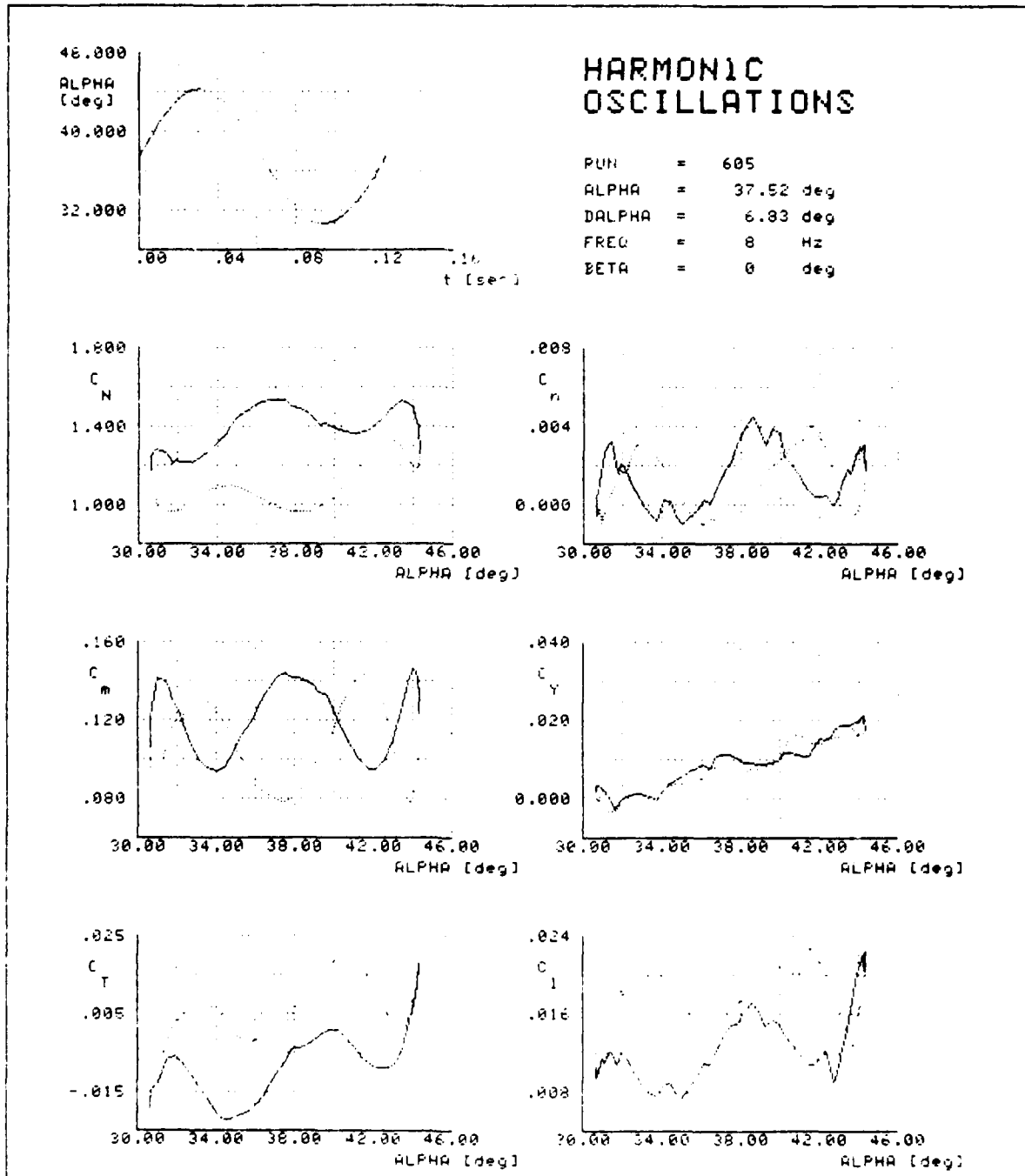


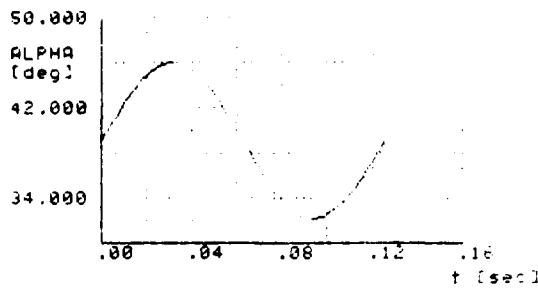


HARMONIC OSCILLATIONS

RUN = 597
ALPHA = 35.88 deg
DALPHA = 6.88 deg
FREQ = 8 Hz
BETA = 0 deg

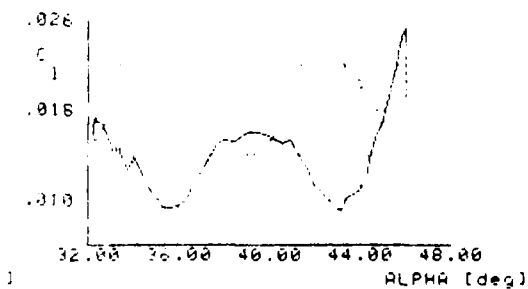
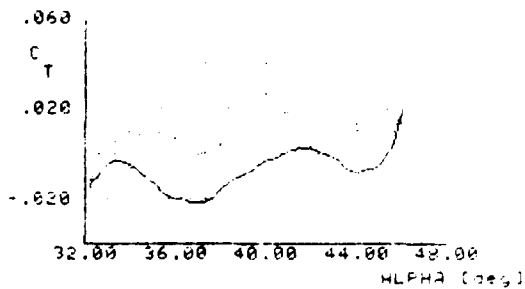
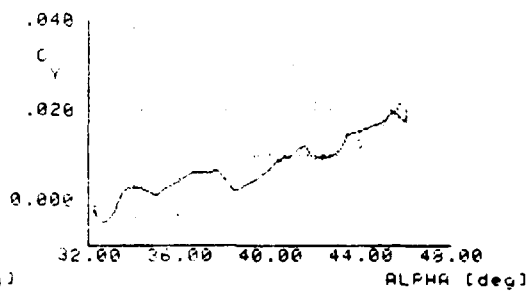
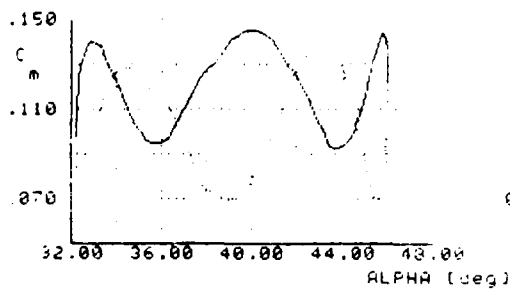
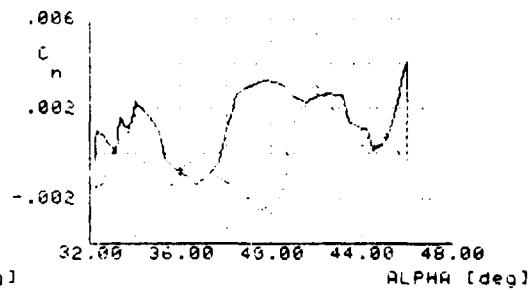
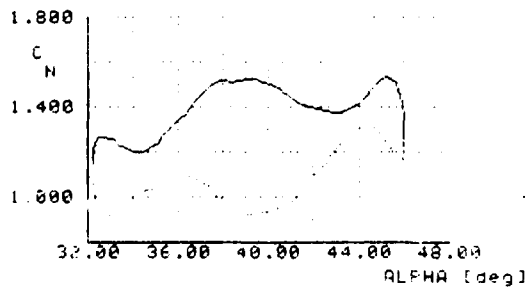


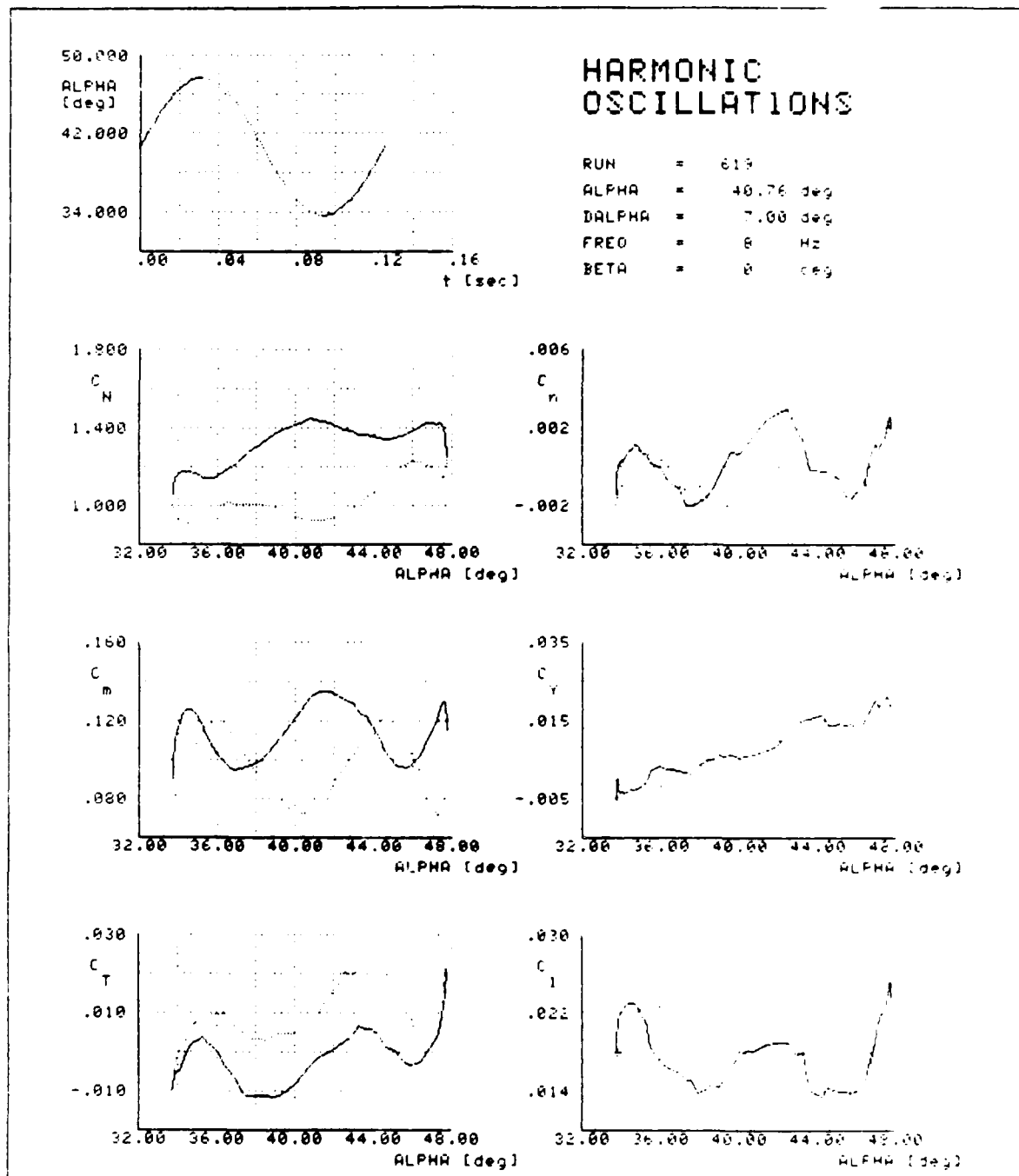


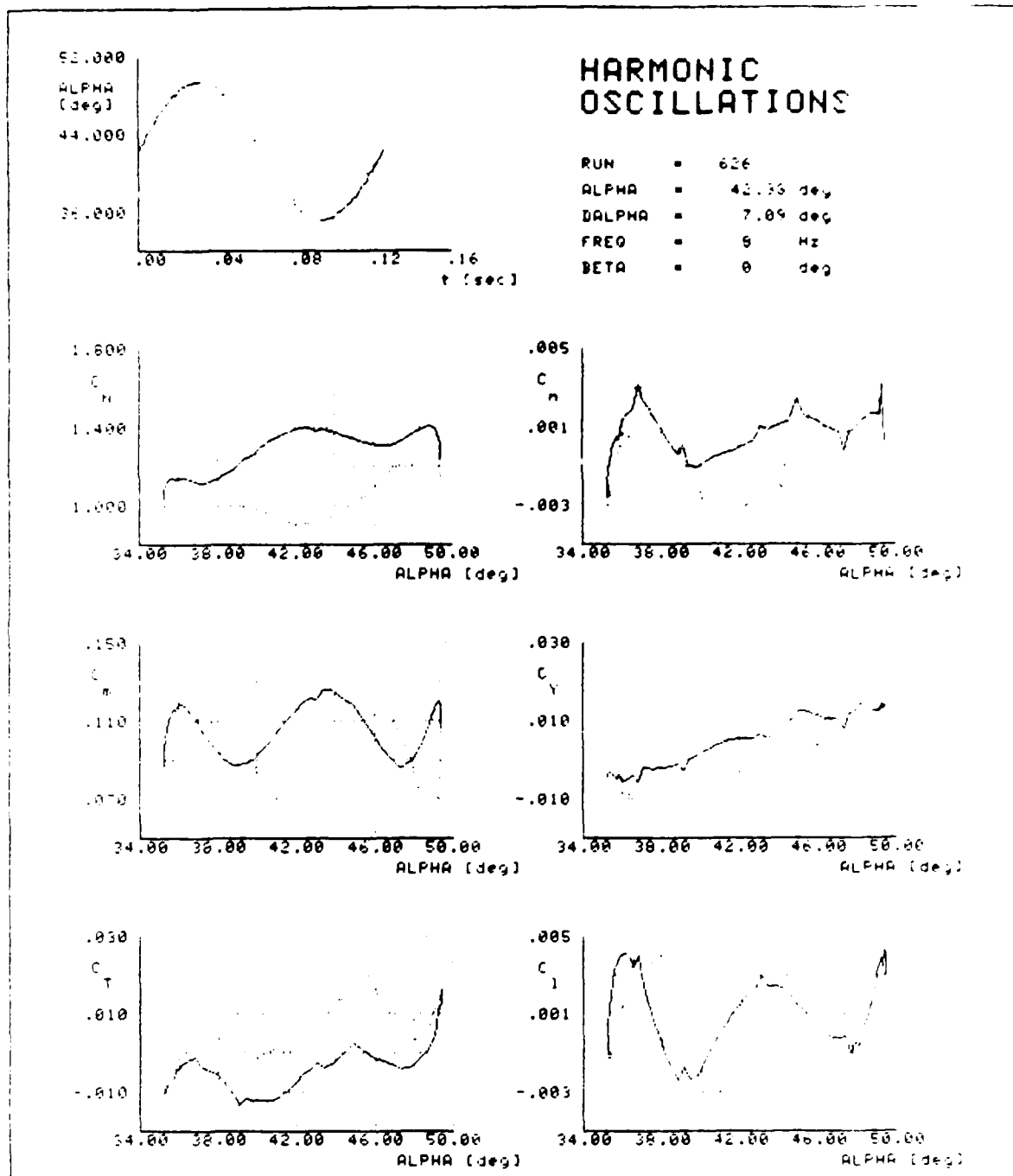


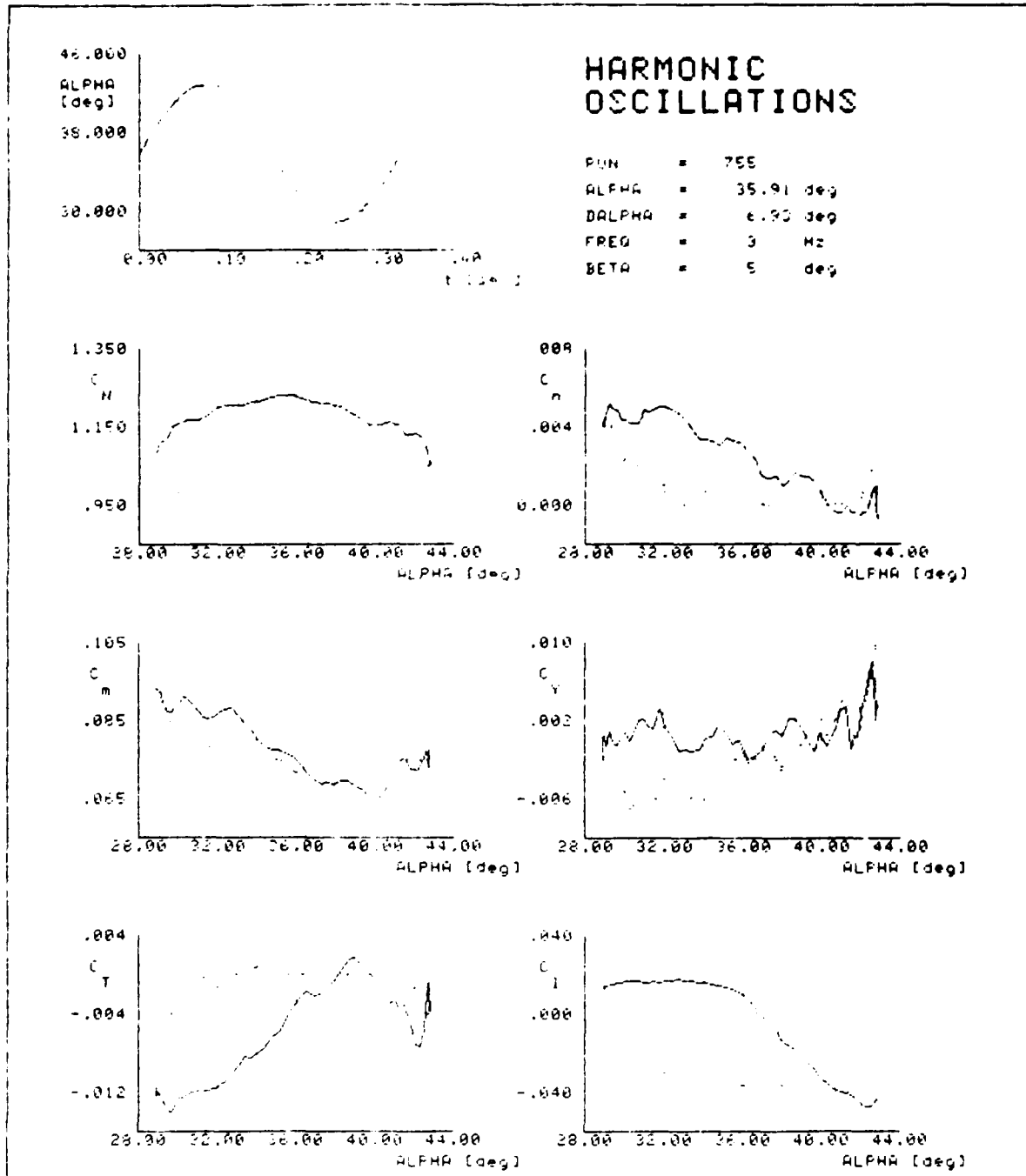
HARMONIC OSCILLATIONS

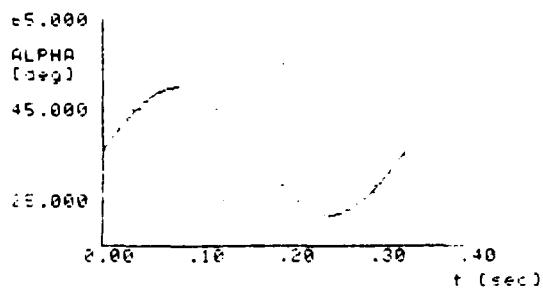
RUN = 612
ALPHA = 39.15 deg
DALPHA = 6.90 deg
FREQ = 8 Hz
ETA = 0 deg





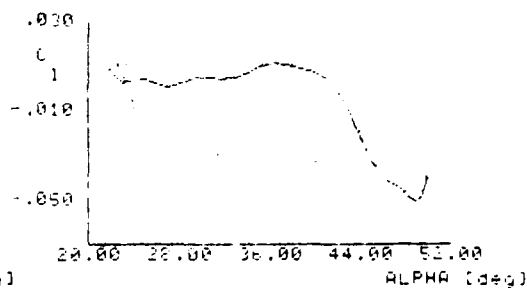
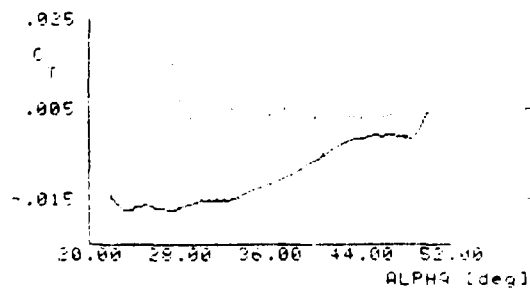
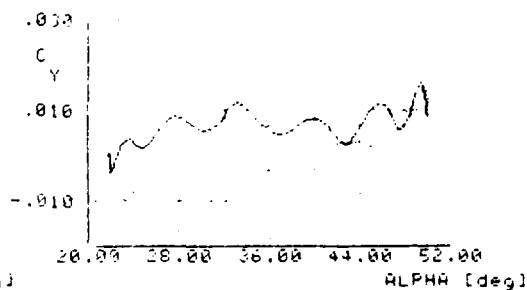
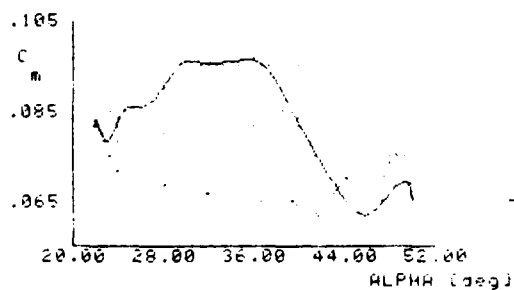
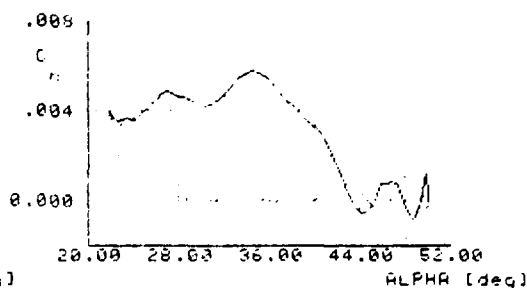
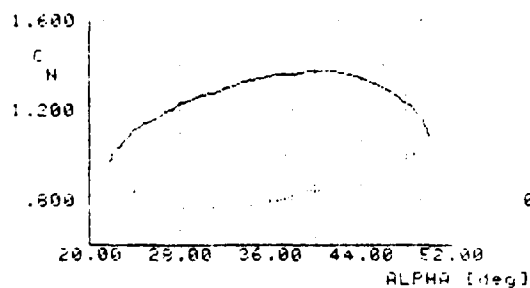


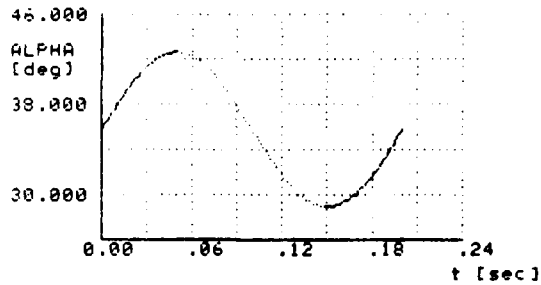




HARMONIC OSCILLATIONS

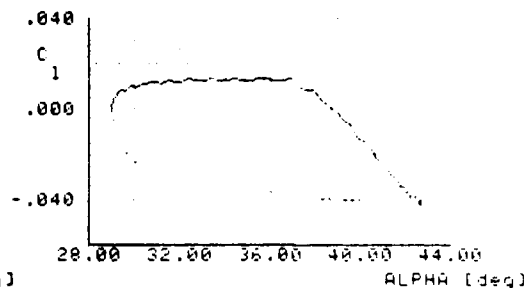
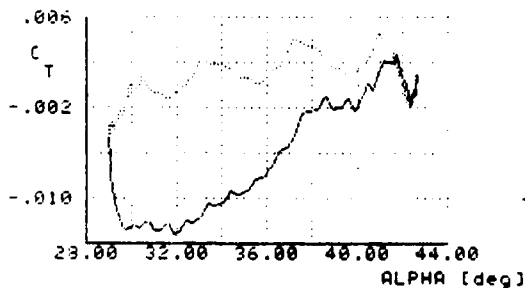
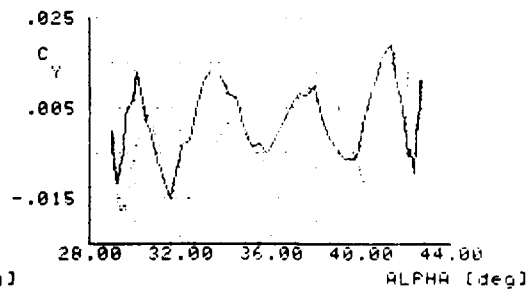
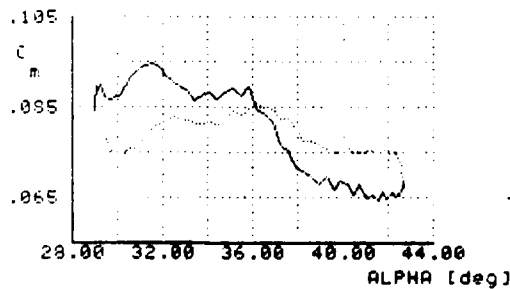
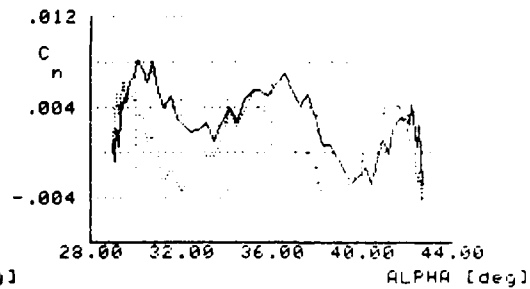
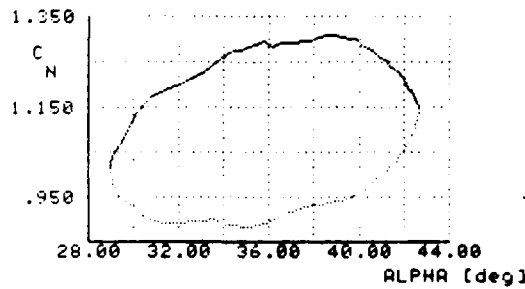
RUN = 756
 ALPHA = 36.01 deg
 DIALPHA = 14.02 deg
 FREQ = 7 Hz
 BETA = 5 deg

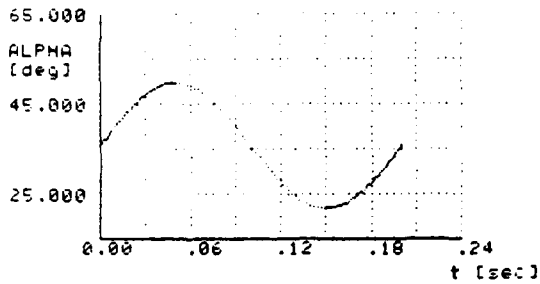




HARMONIC OSCILLATIONS

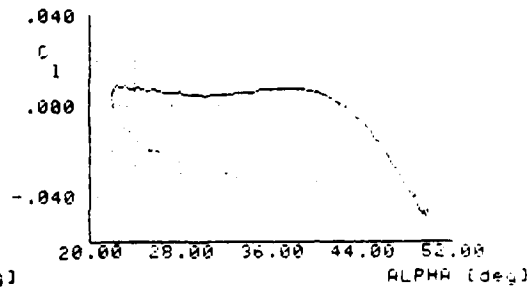
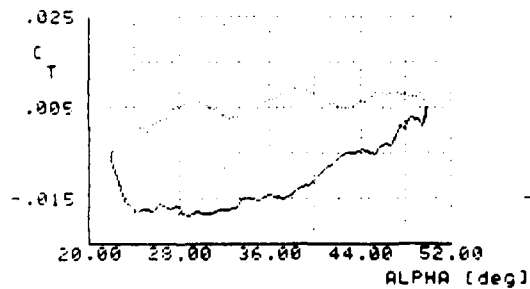
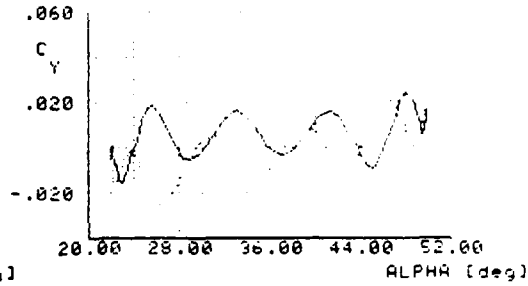
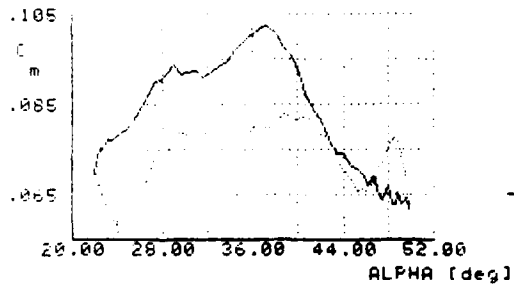
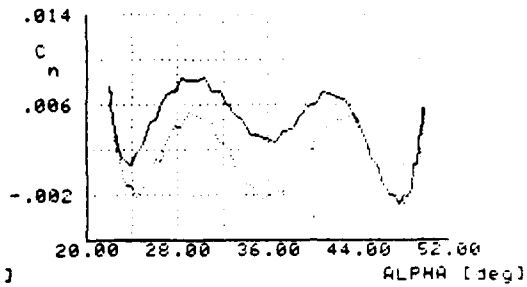
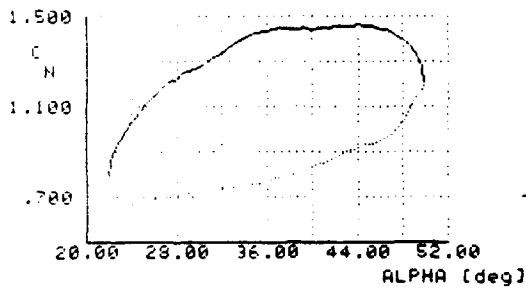
RUN = 758
ALPHA = 35.86 deg
DALPHA = 6.82 deg
FREQ = 5 Hz
BETA = 5 deg

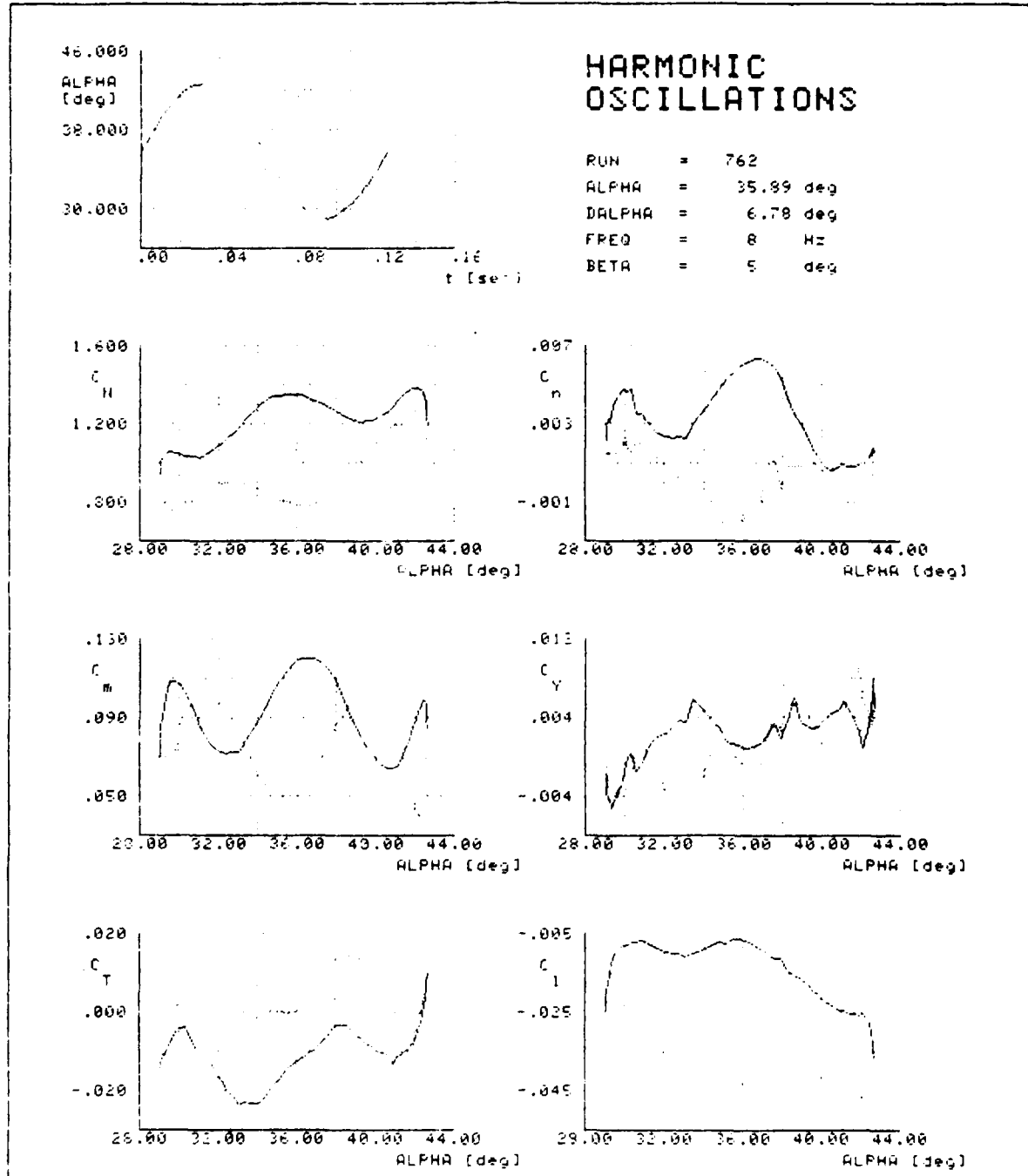


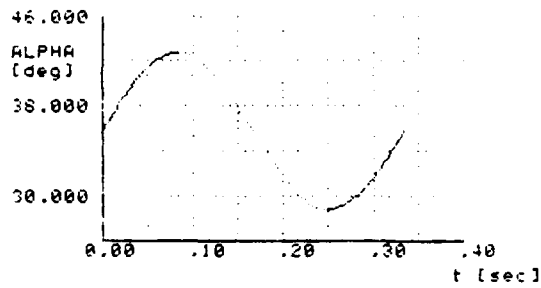


HARMONIC OSCILLATIONS

RUN = 759
 ALPHA = 36.00 deg
 DALPHA = 13.89 deg
 FREQ = 5 Hz
 BETA = 5 deg

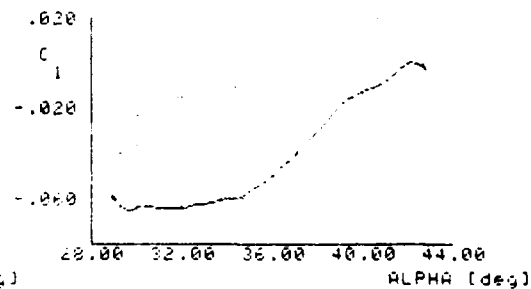
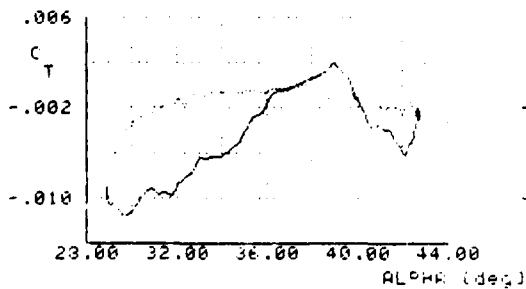
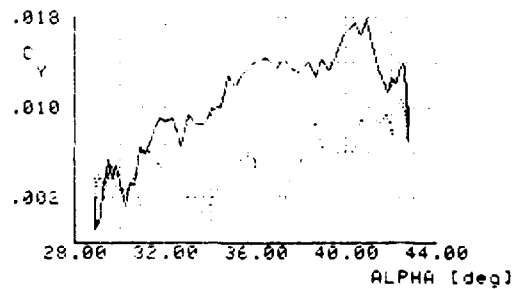
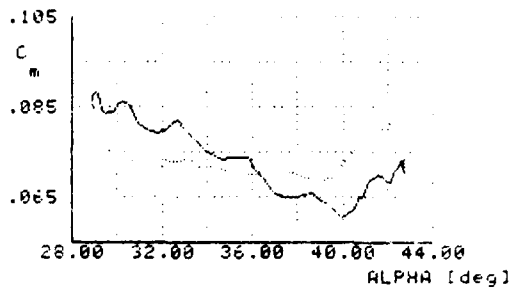
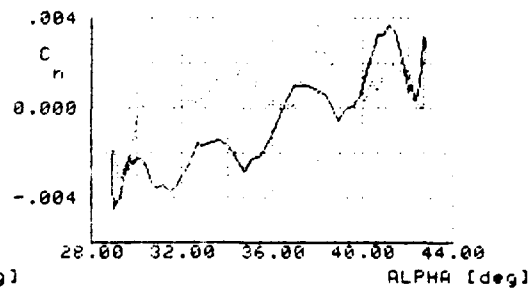
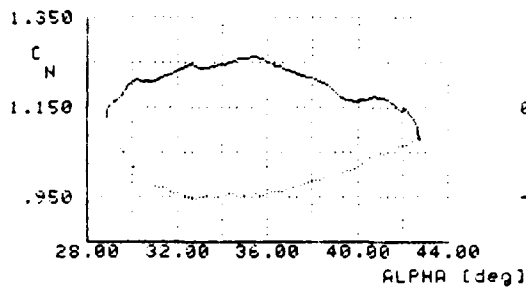


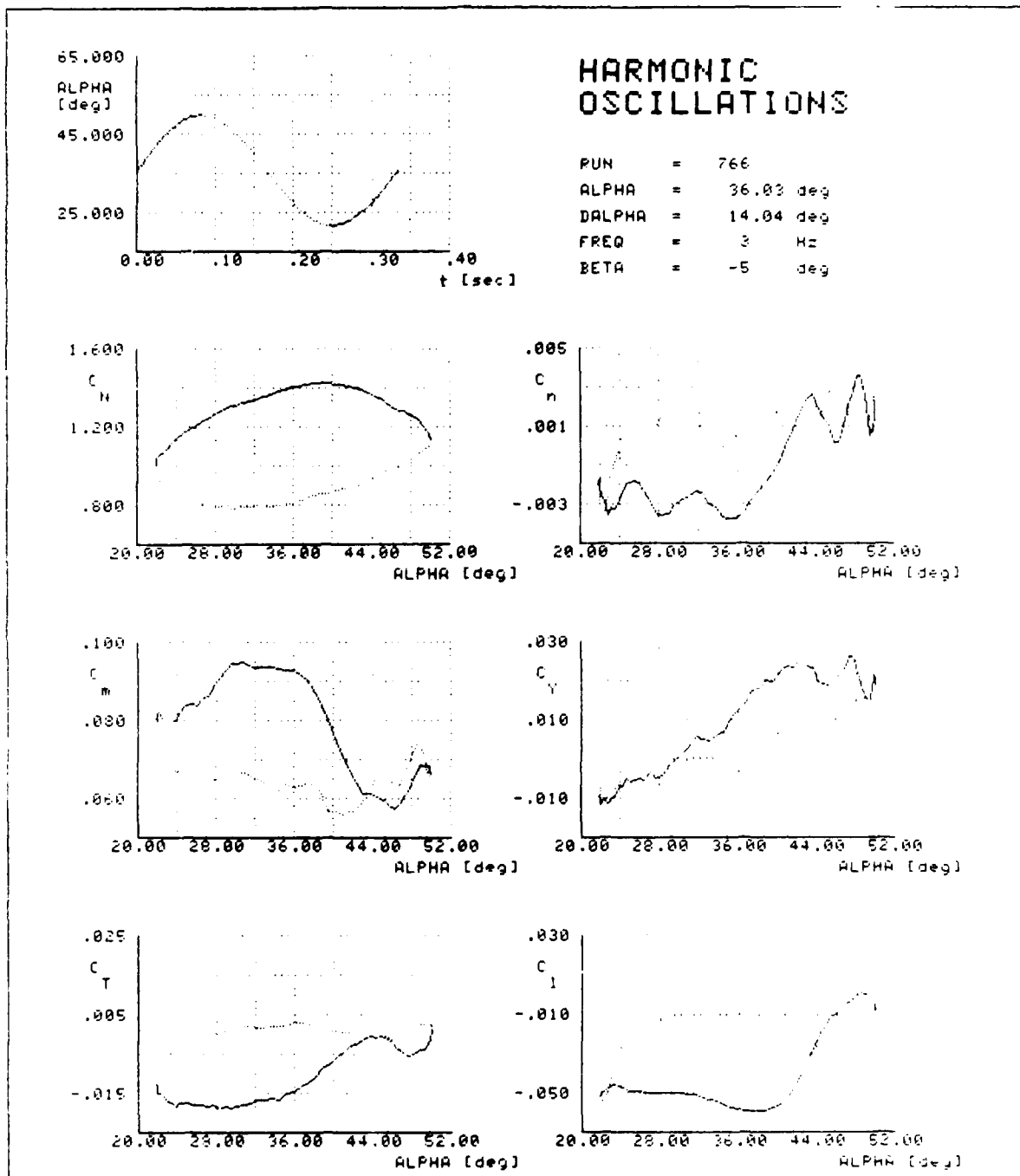


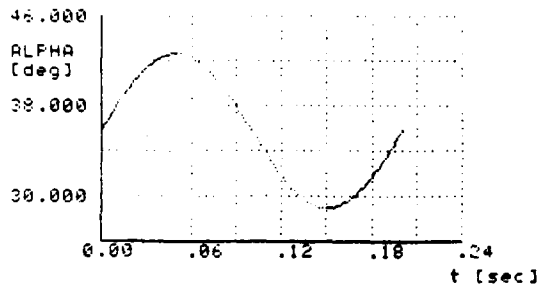


HARMONIC OSCILLATIONS

RUN = 765
ALPHA = 35.86 deg
DALPHA = 6.91 deg
FREQ = 3 Hz
BETA = -5 deg

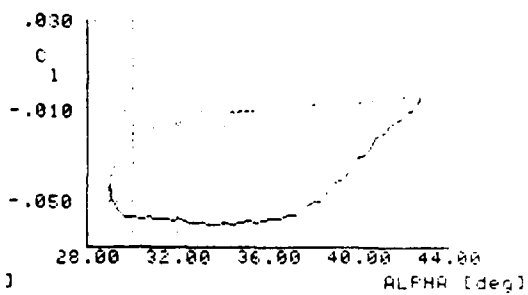
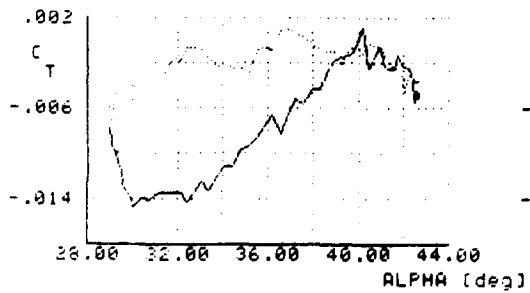
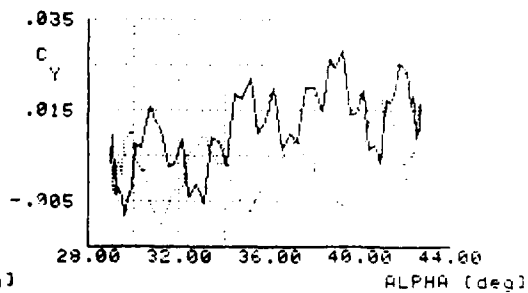
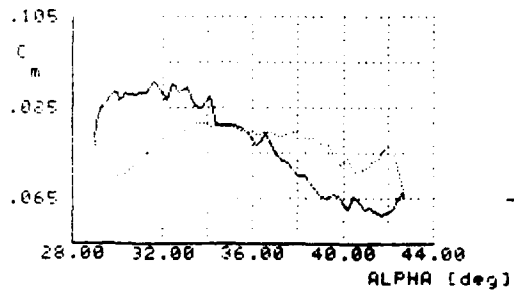
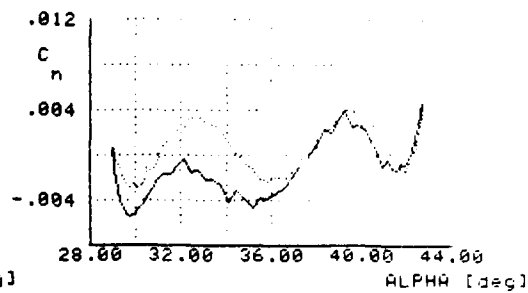
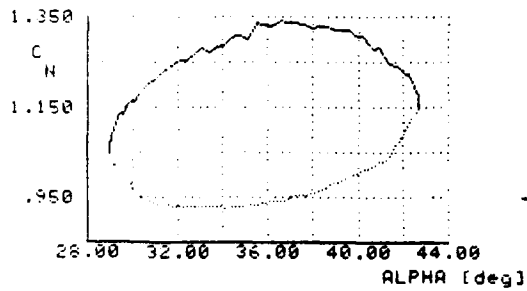


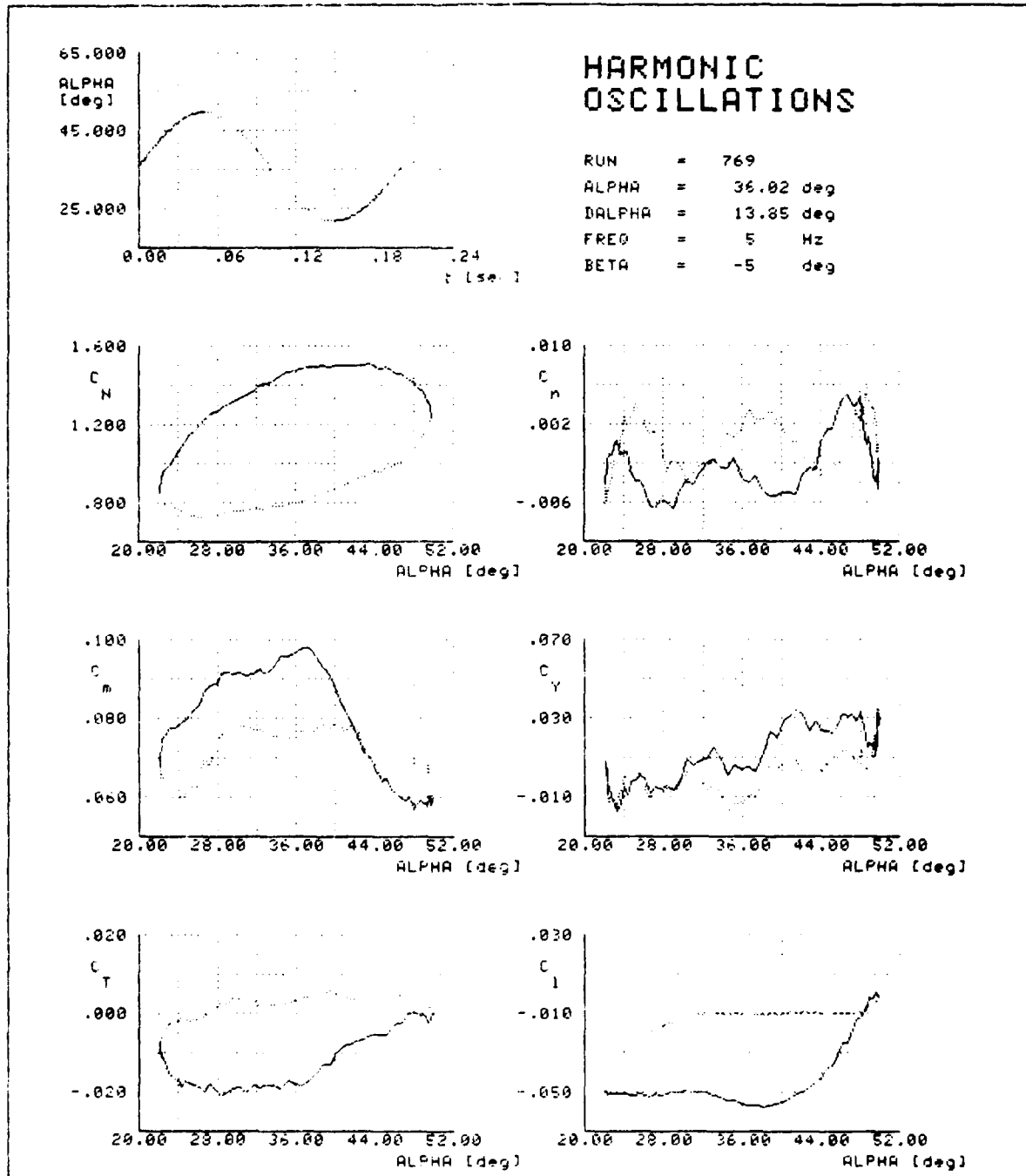


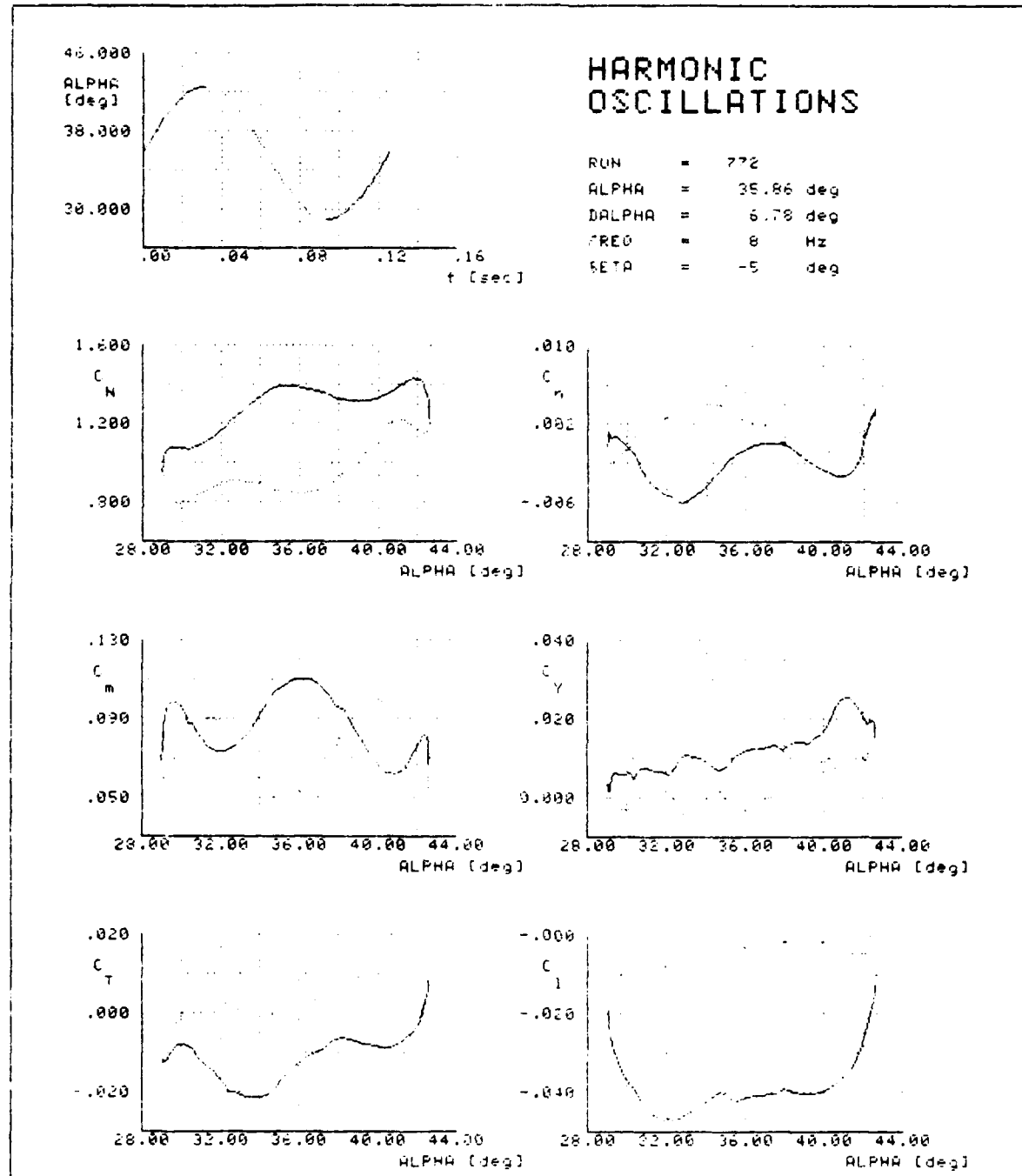


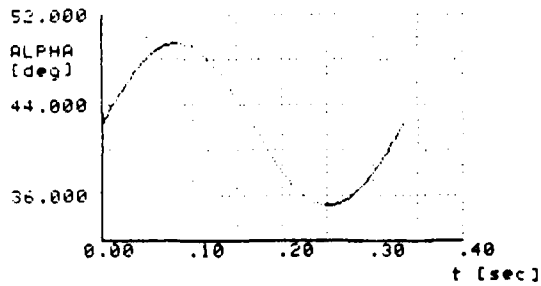
HARMONIC OSCILLATIONS

RUN = 768
 ALPHA = 35.89 deg
 DALPHA = 6.83 deg
 FREQ = 5 Hz
 BETA = -5 deg



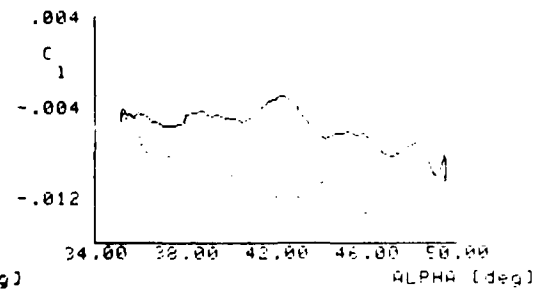
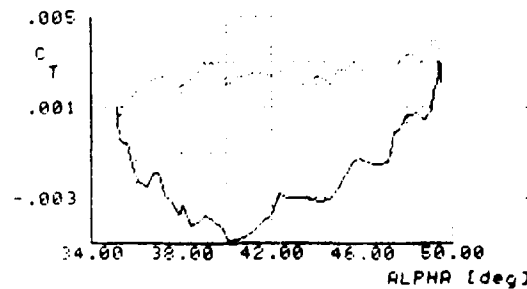
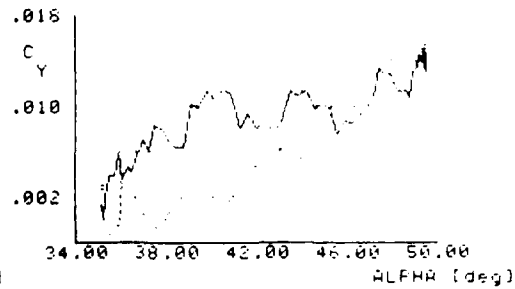
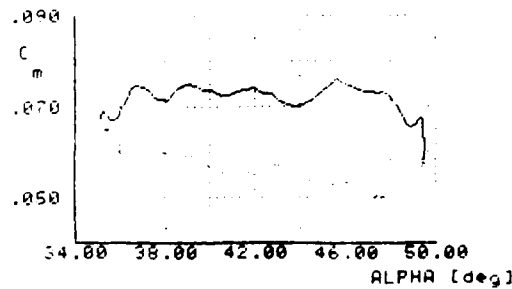
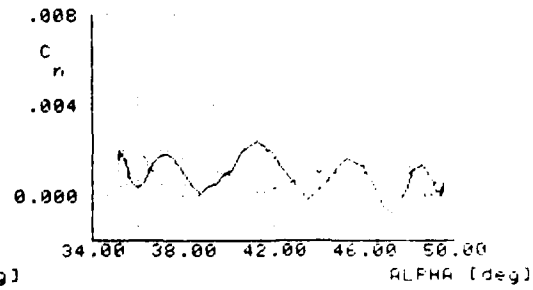
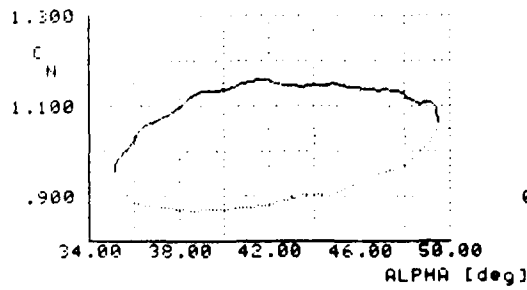


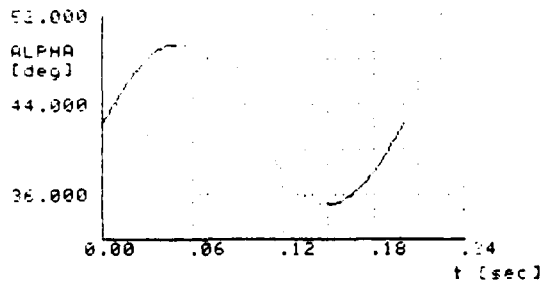




HARMONIC OSCILLATIONS

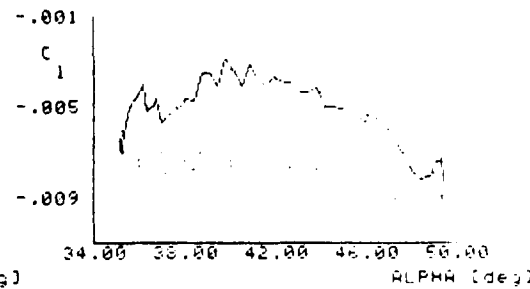
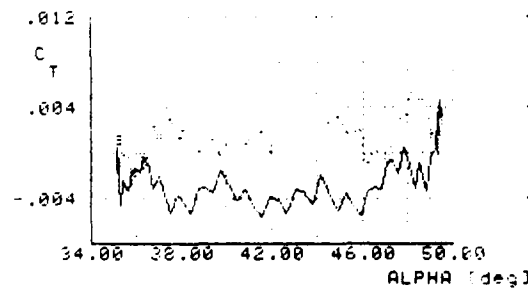
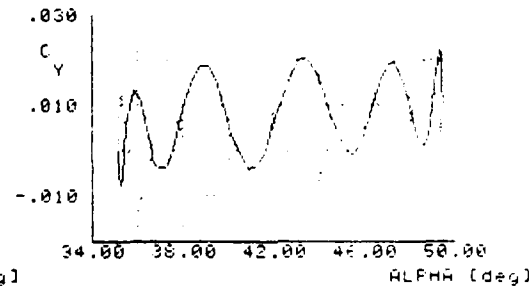
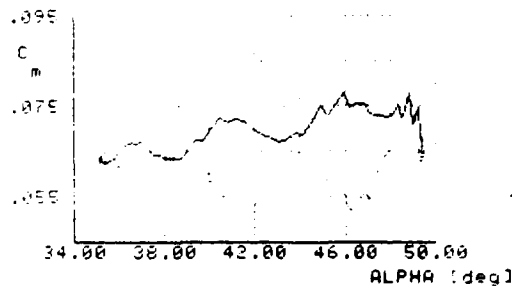
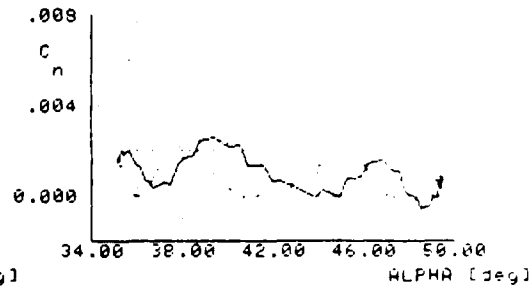
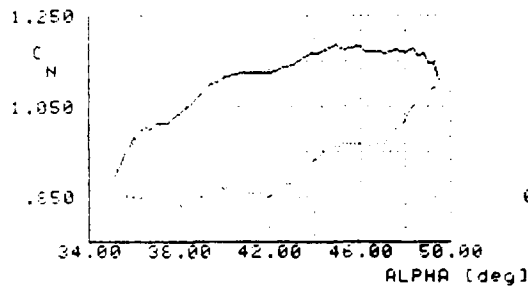
RUN = 775
ALPHA = 42.38 deg
DALPHA = 7.20 deg
FREQ = 3 Hz
BETA = -5 deg

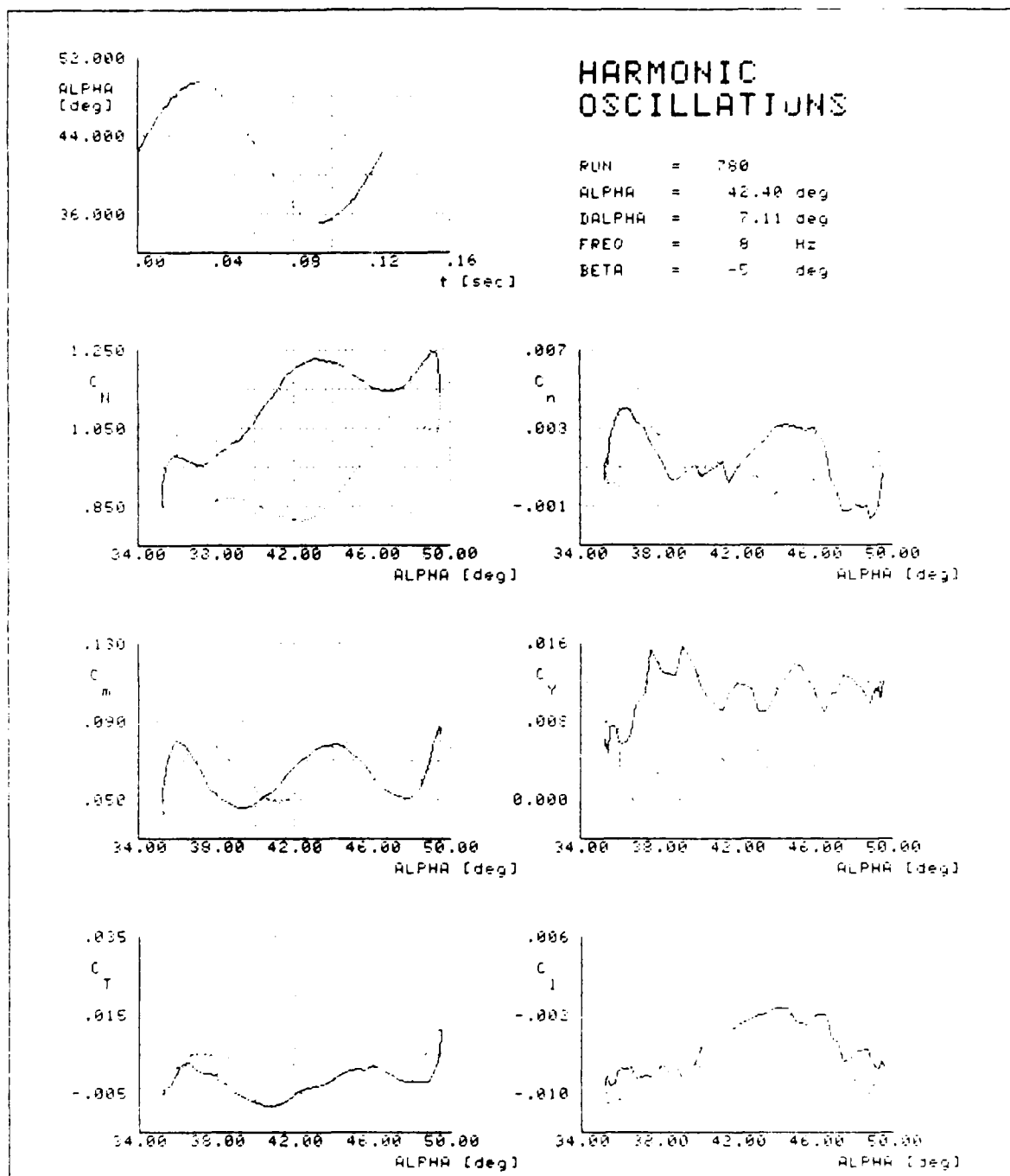


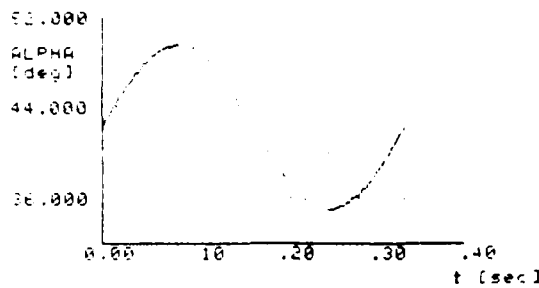


HARMONIC OSCILLATIONS

RUN = 777
 ALPHA = 42.36 deg
 DALPHA = 7.14 deg
 FREQ = 5 Hz
 BETA = -5 deg

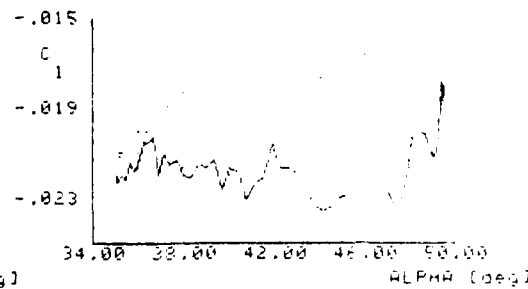
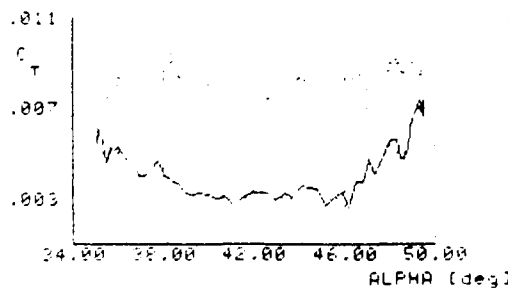
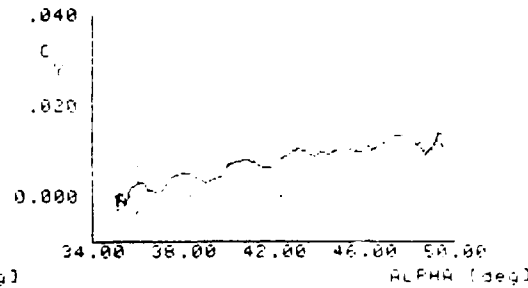
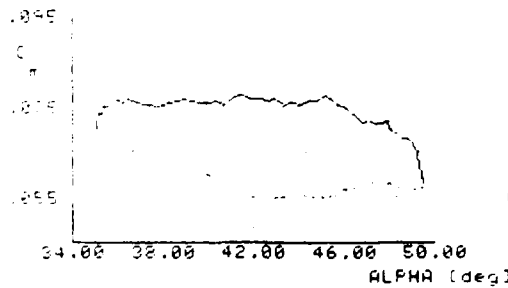
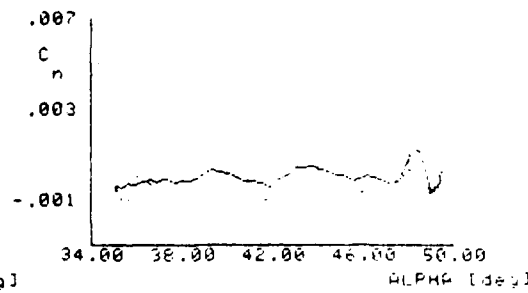
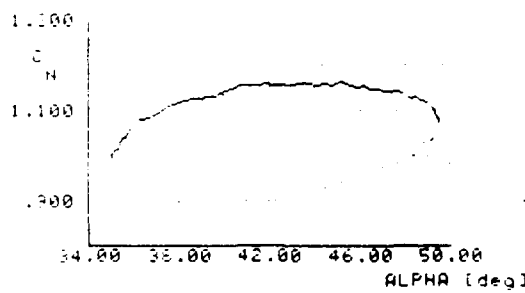


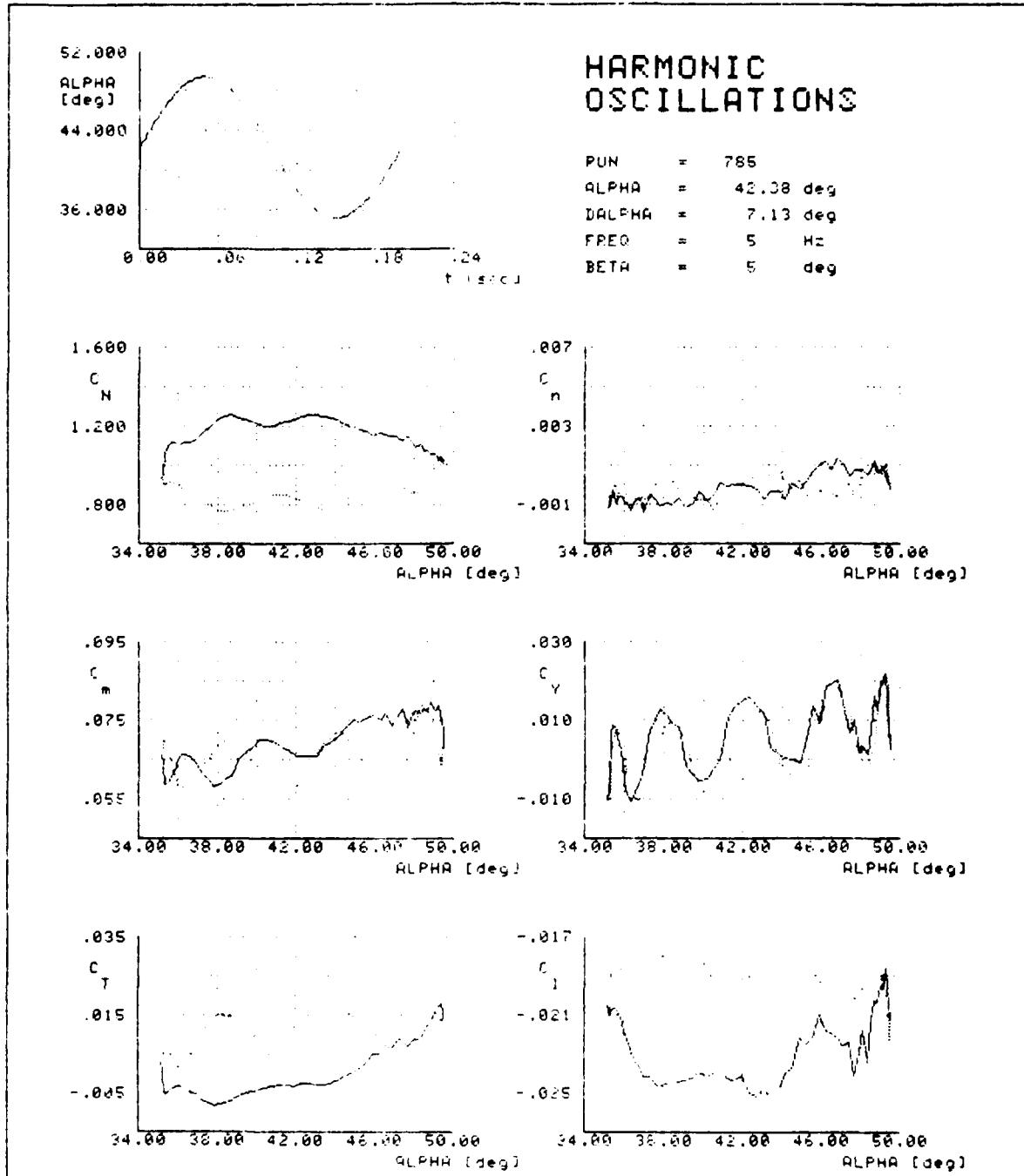


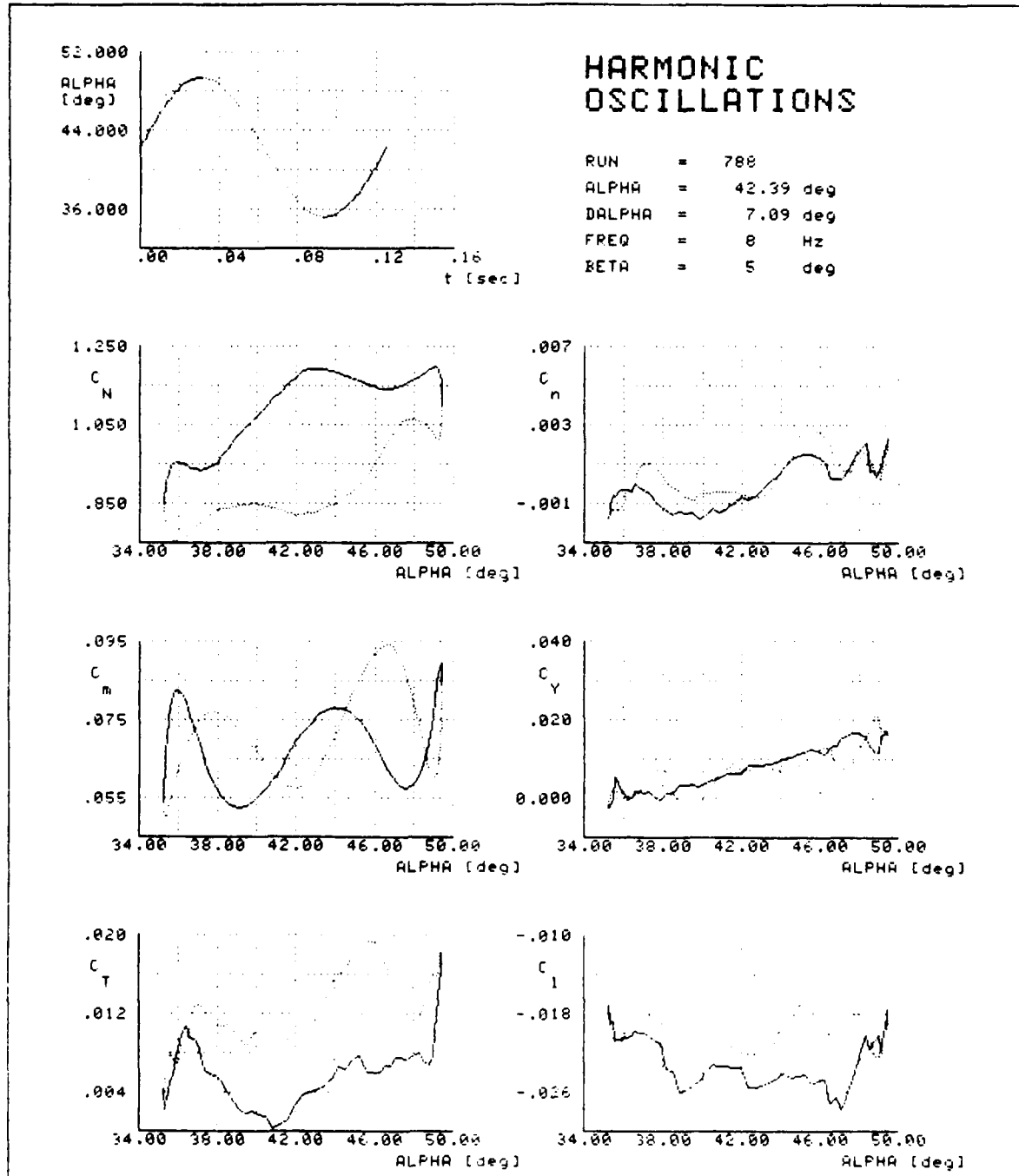


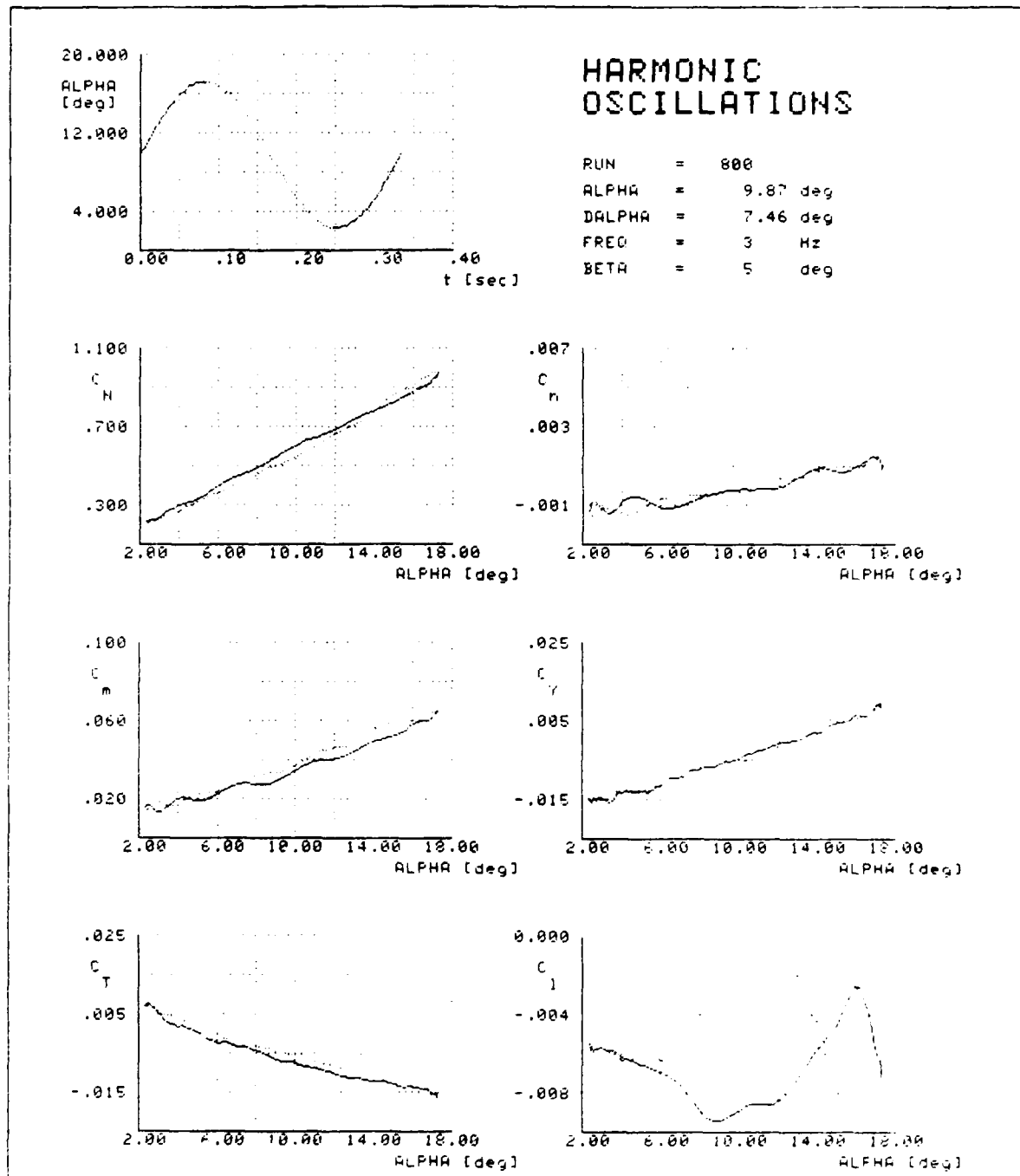
HARMONIC OSCILLATIONS

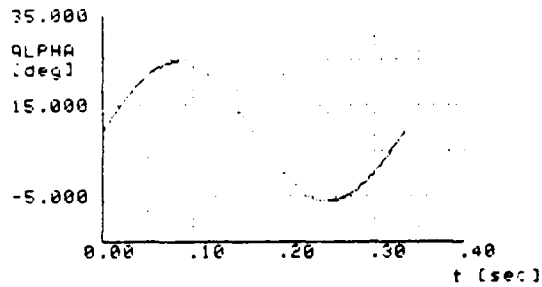
RUN = 703
ALPHA = 42.31 deg
DALPHA = 7.22 deg
FREQ = 3 Hz
BETA = 5 deg





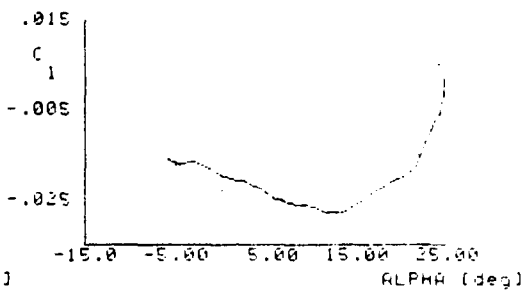
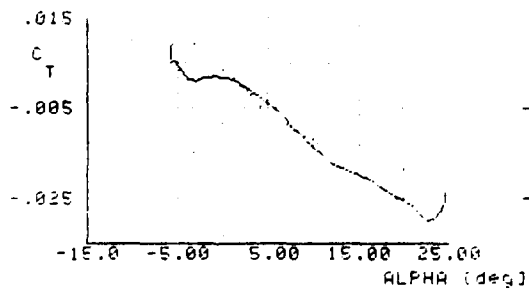
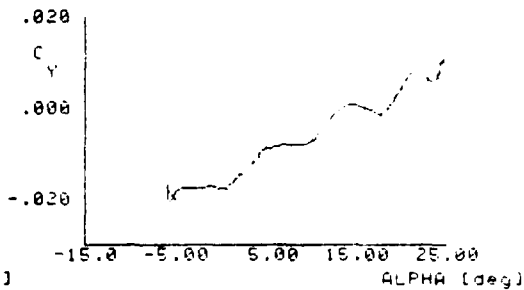
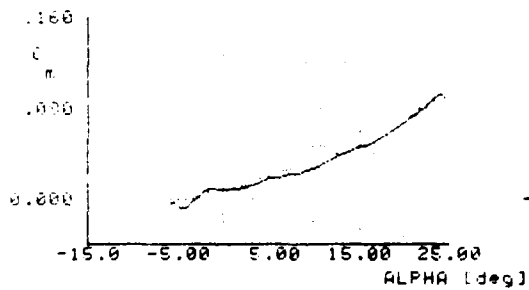
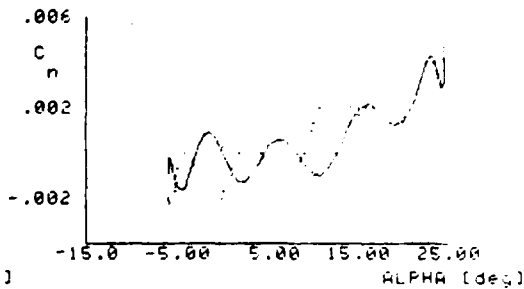
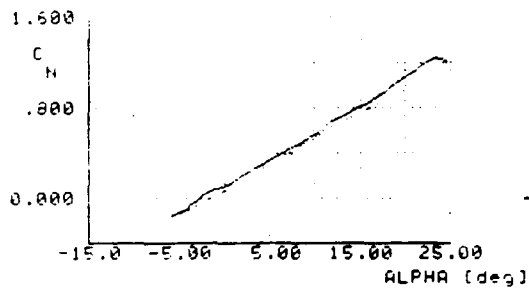


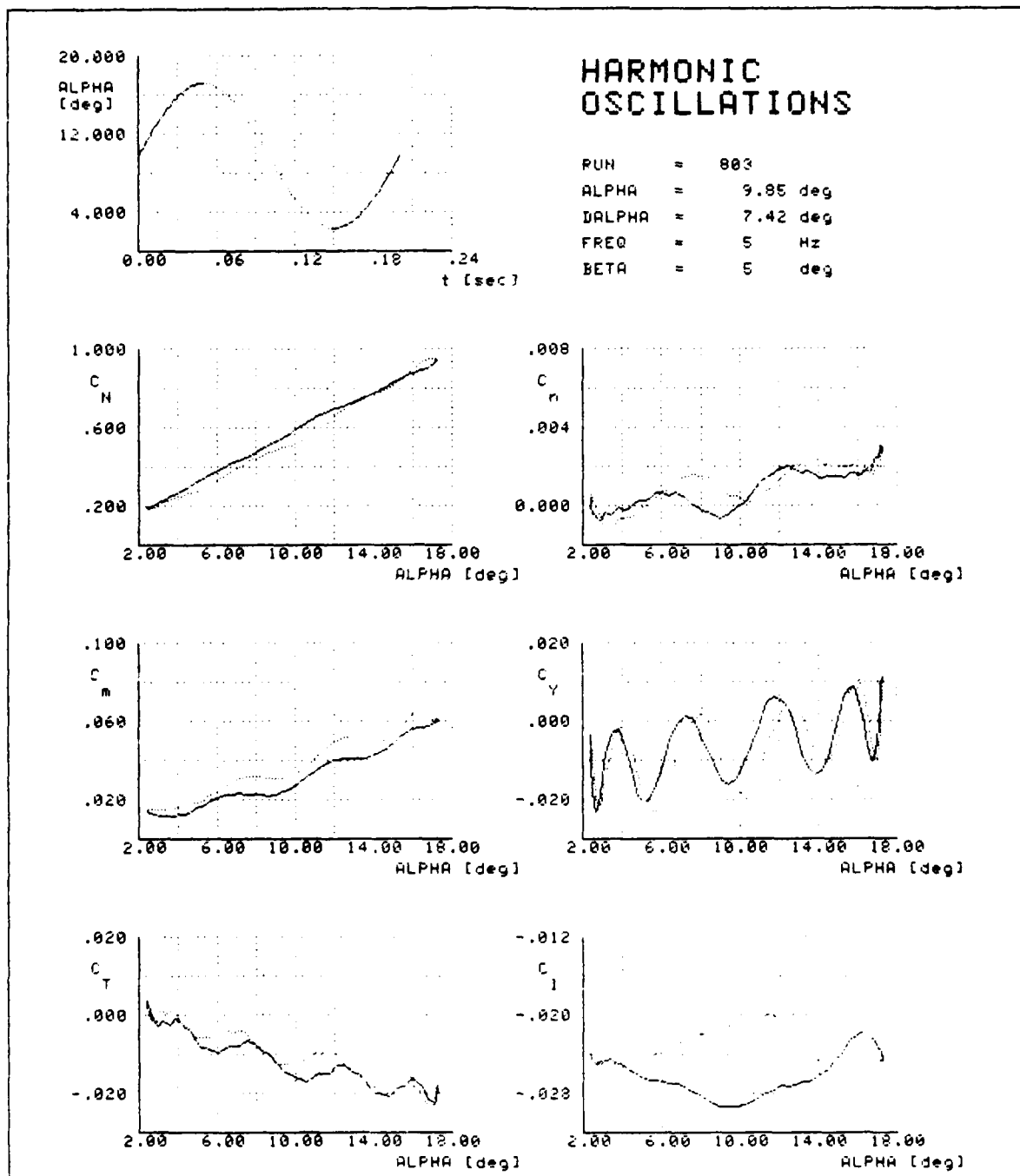


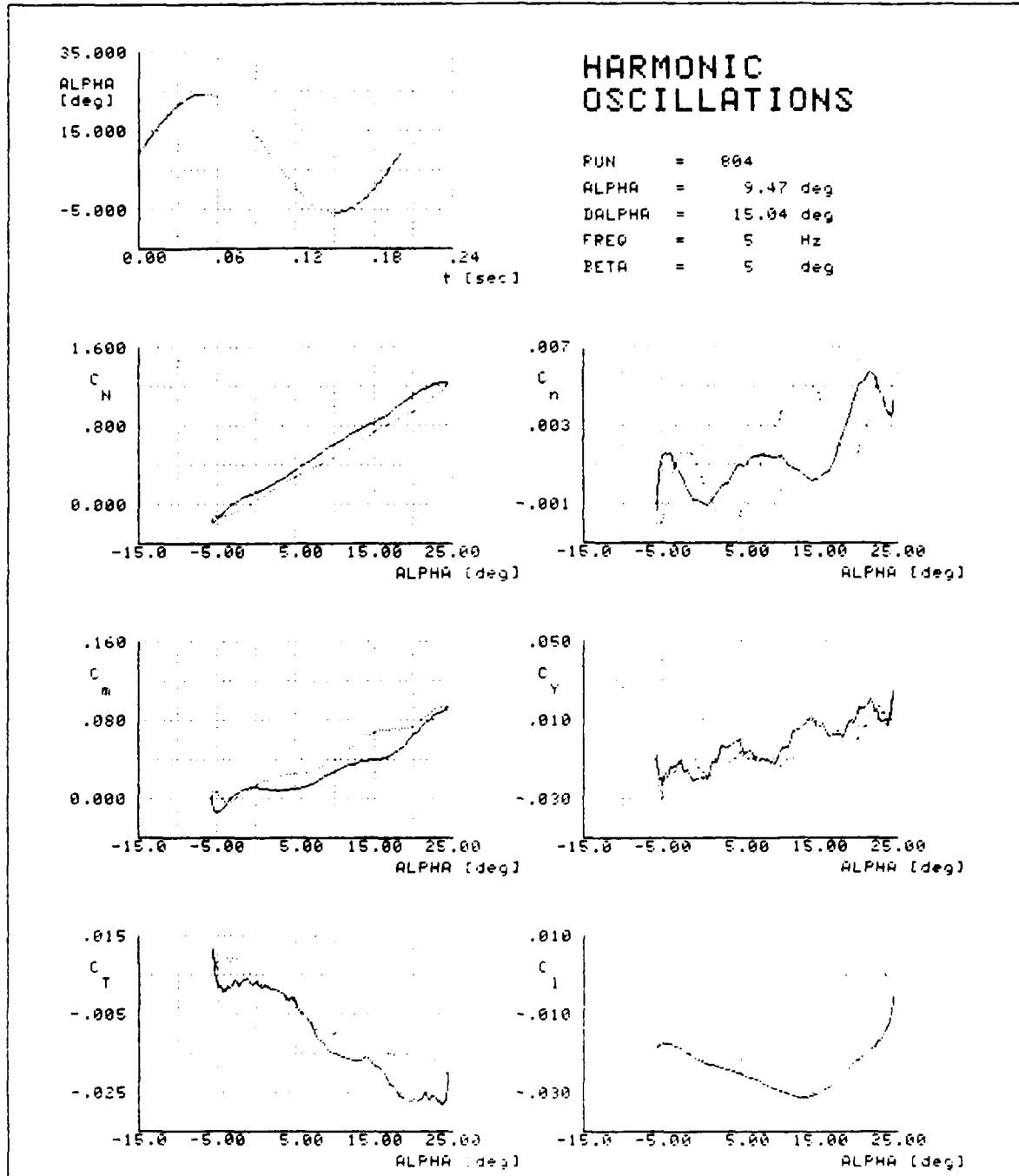


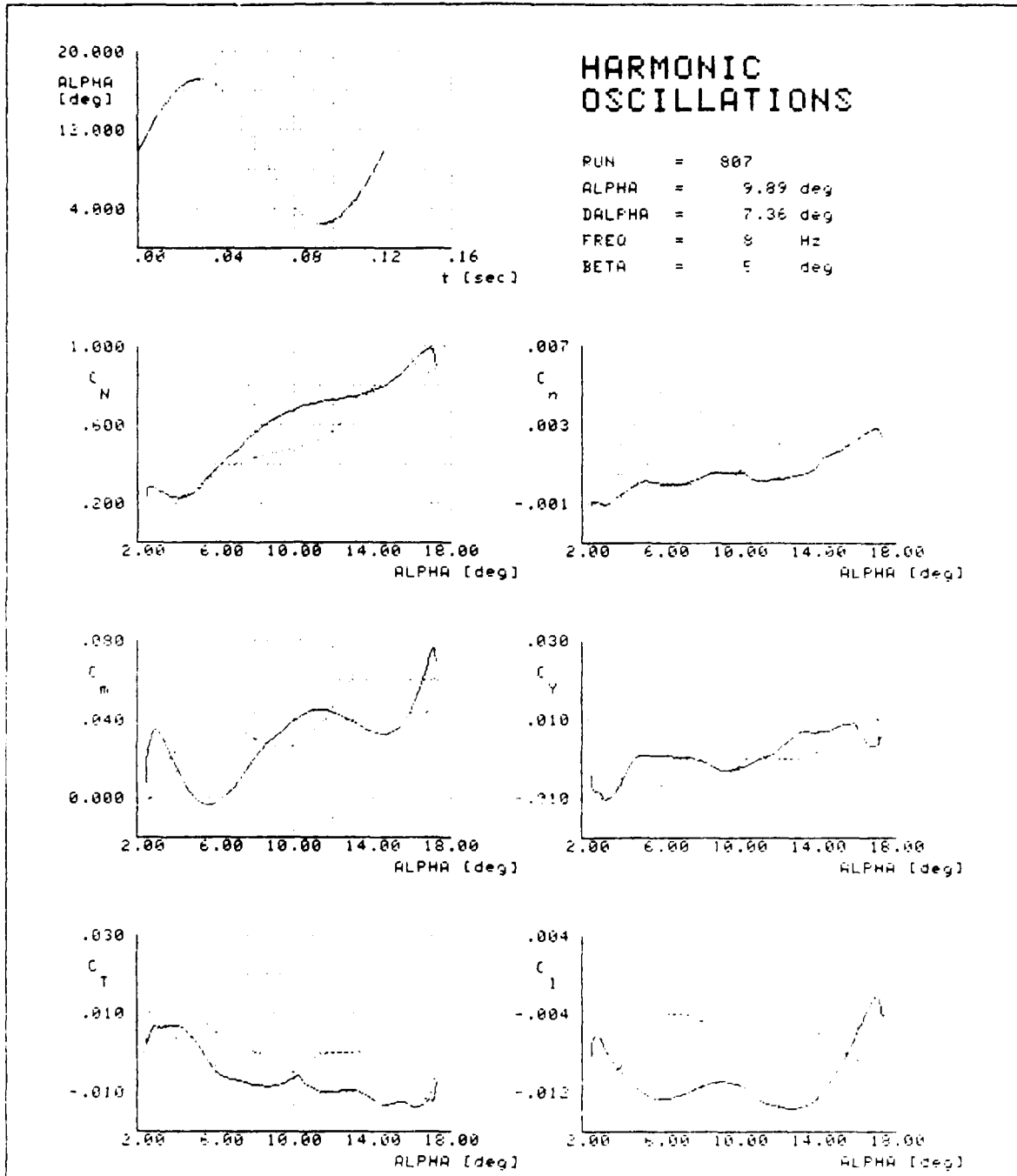
HARMONIC OSCILLATIONS

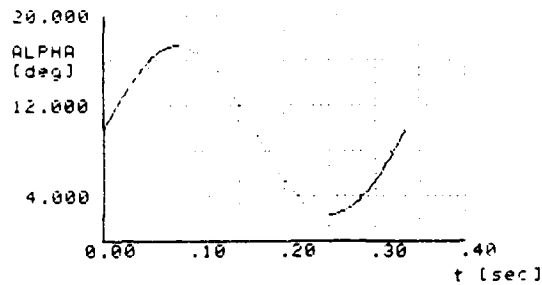
RUN = 801
ALPHA = 9.44 deg
DALPHA = 15.26 deg
FREQ = 3 Hz
BETA = 5 deg





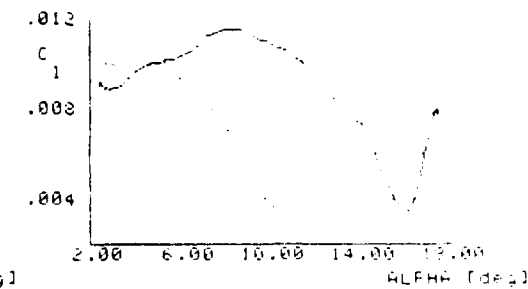
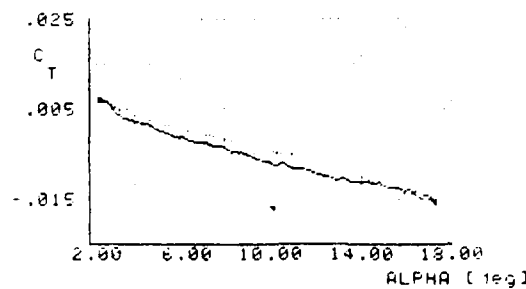
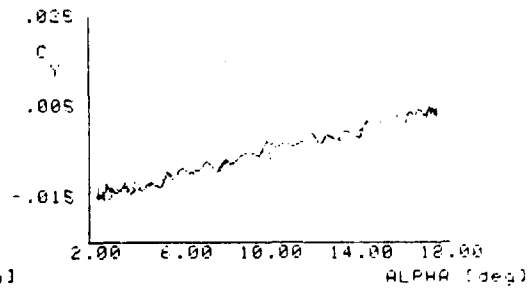
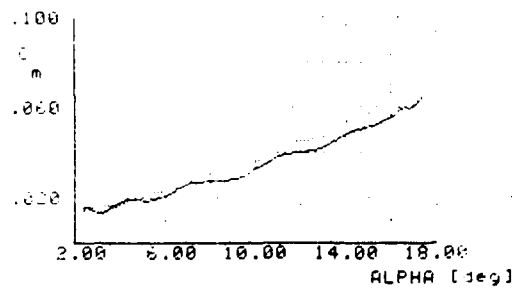
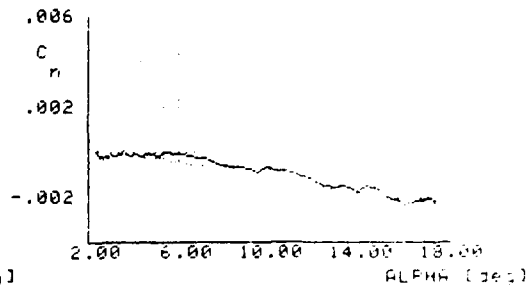
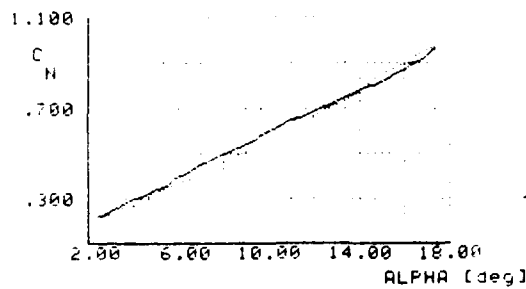


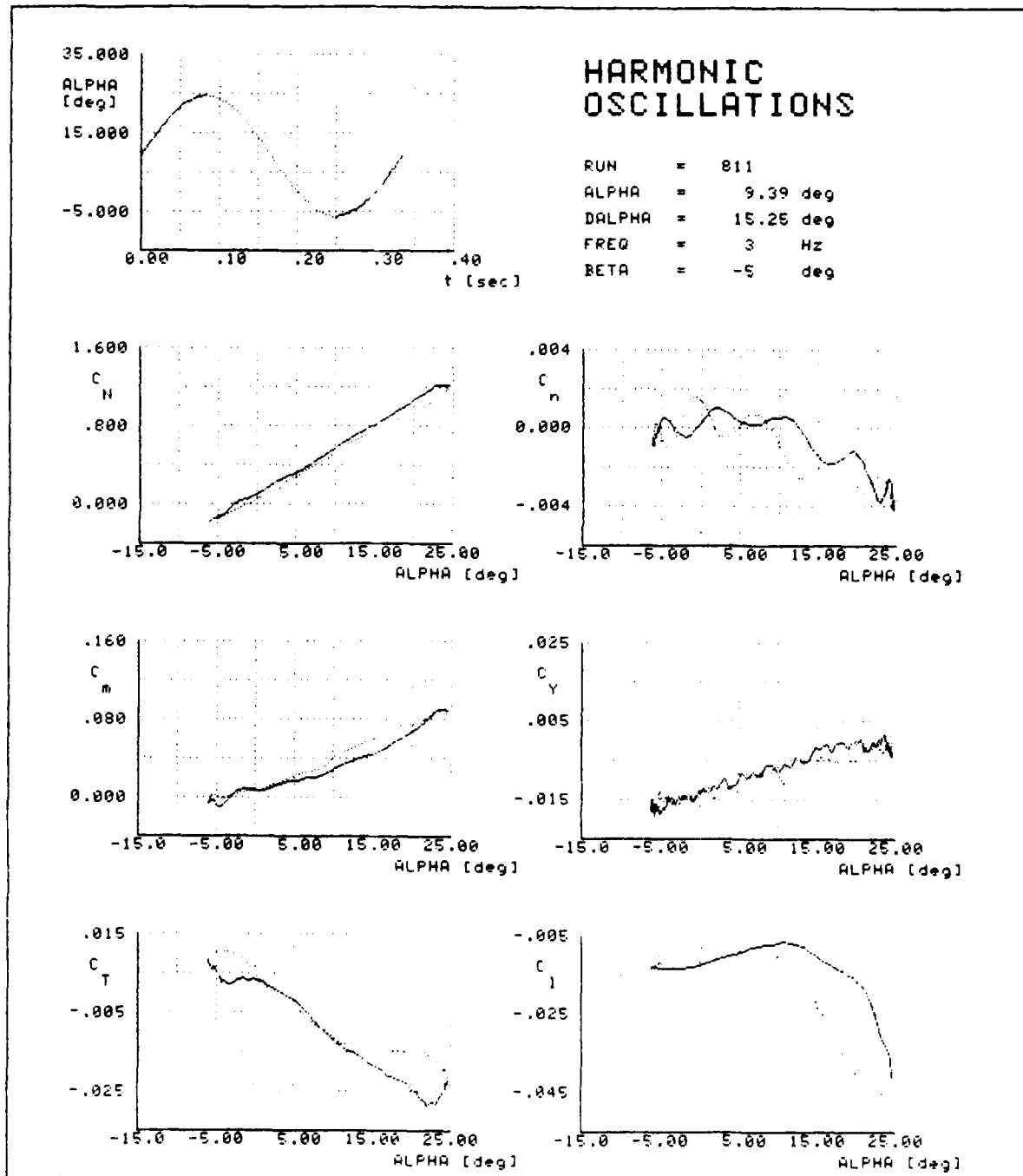


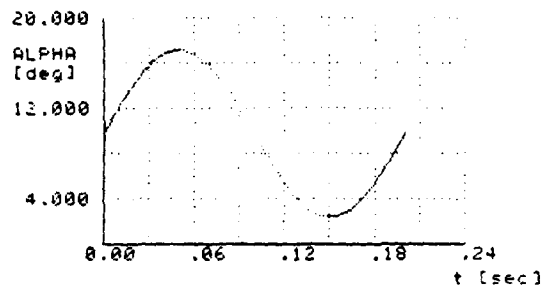


HARMONIC OSCILLATIONS

RUN = 810
ALPHA = 9.90 deg
DALPHA = 7.48 deg
FREQ = 3 Hz
BETA = -5 deg

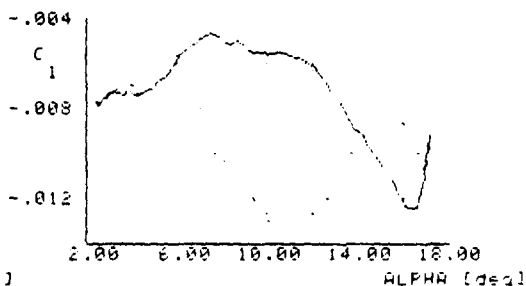
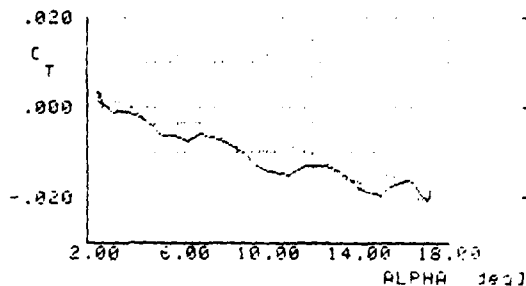
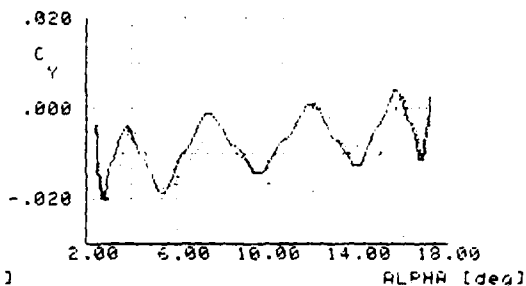
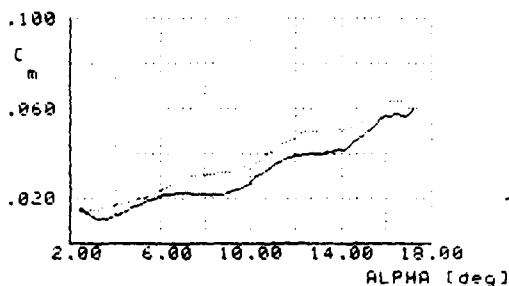
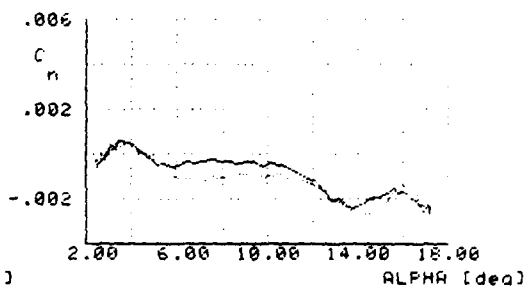
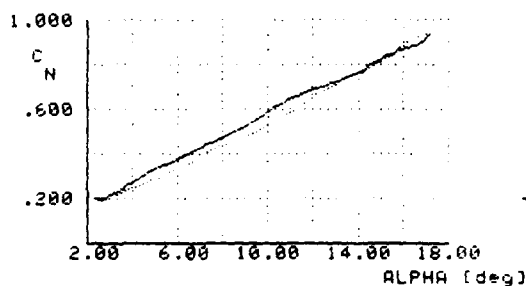


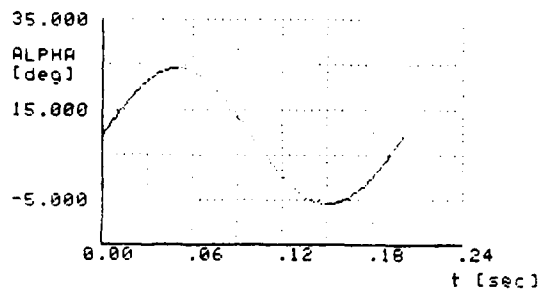




HARMONIC OSCILLATIONS

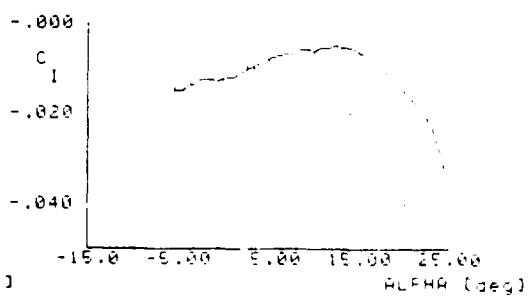
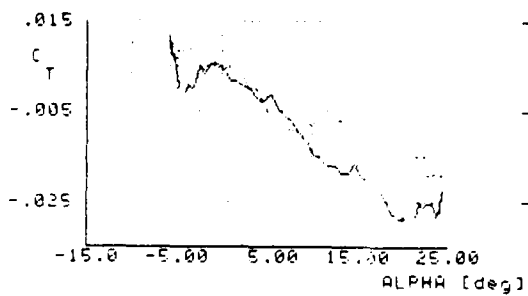
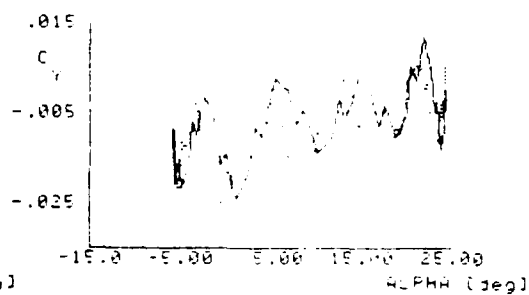
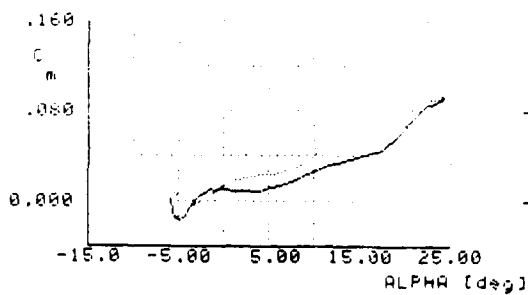
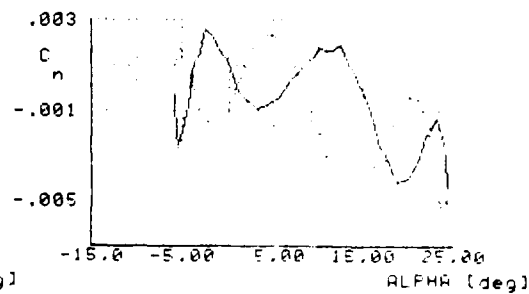
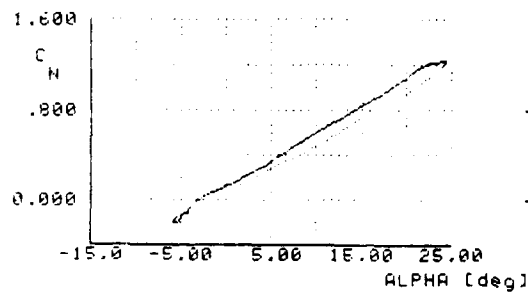
RUN = 813
 ALPHA = 9.86 deg
 DALPHA = 7.37 deg
 FREQ = 5 Hz
 BETA = -5 deg

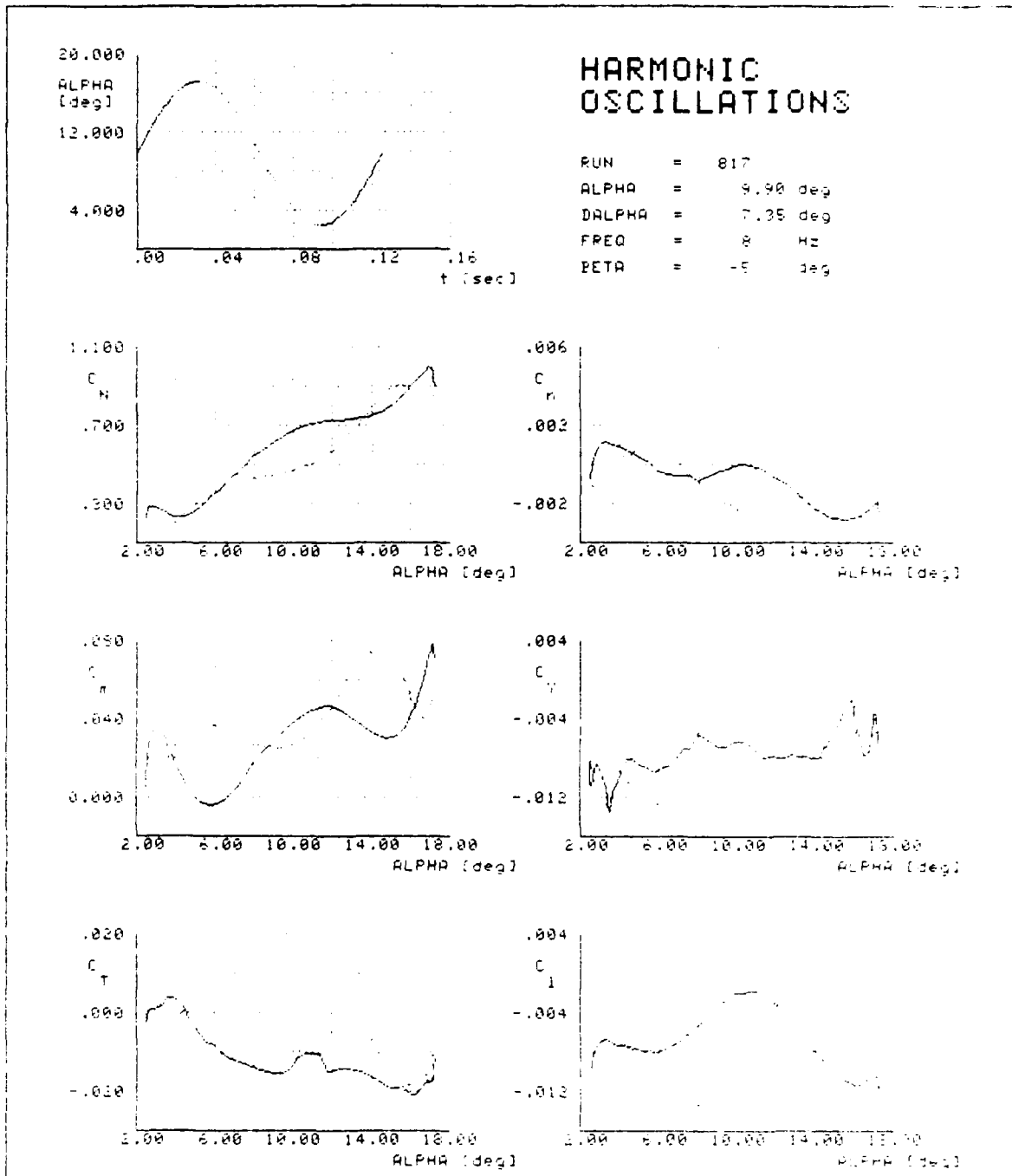


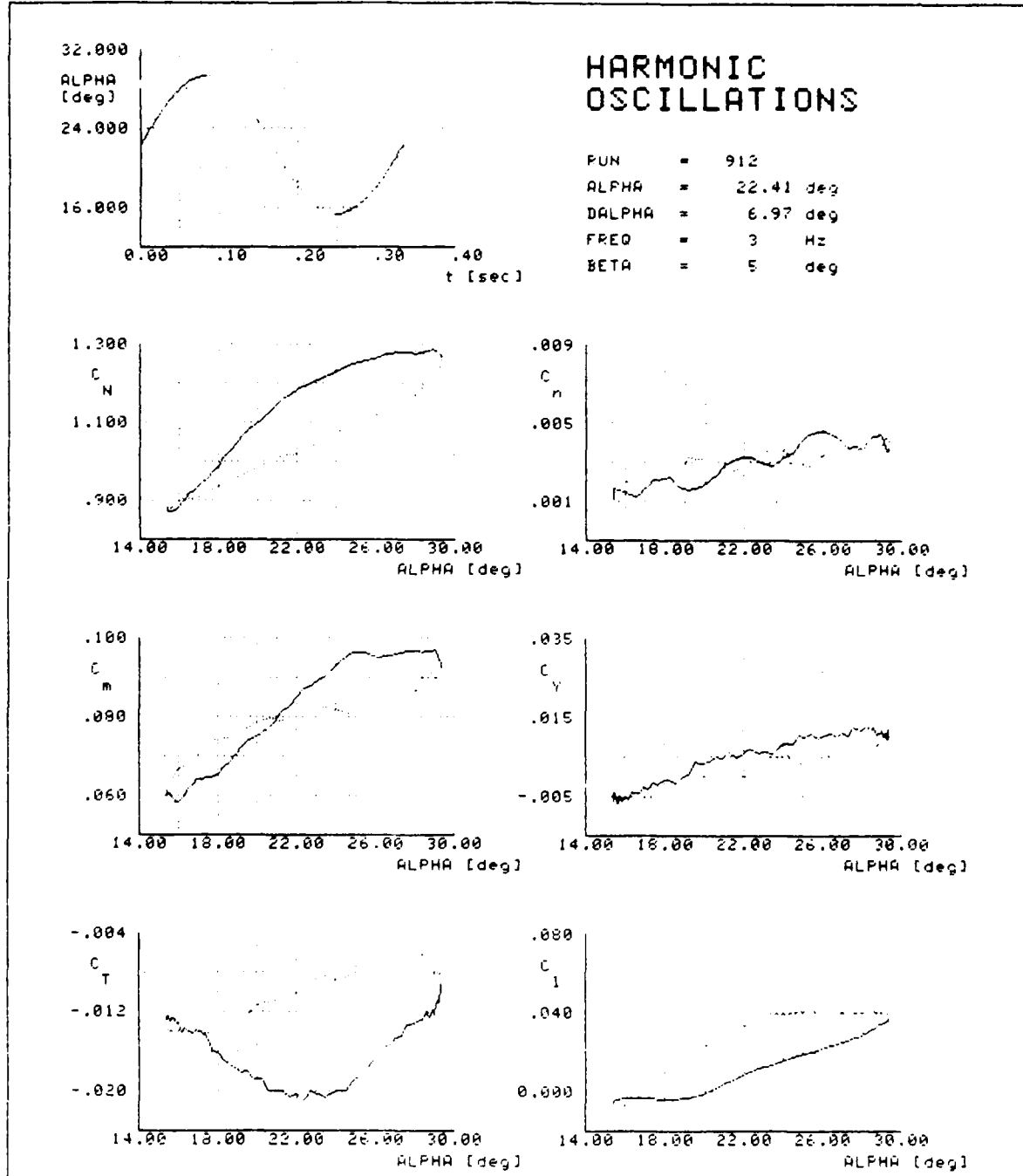


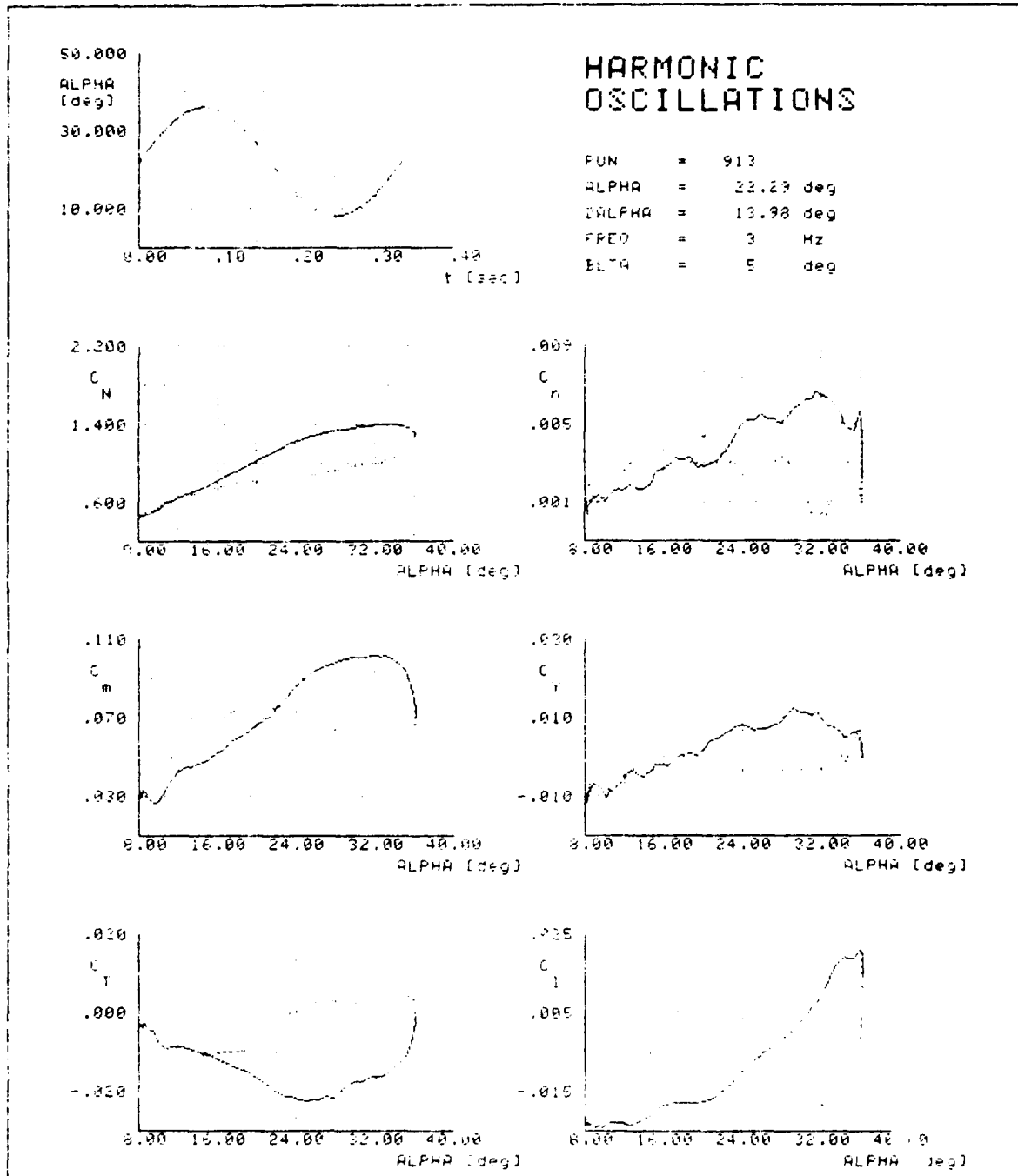
HARMONIC OSCILLATIONS

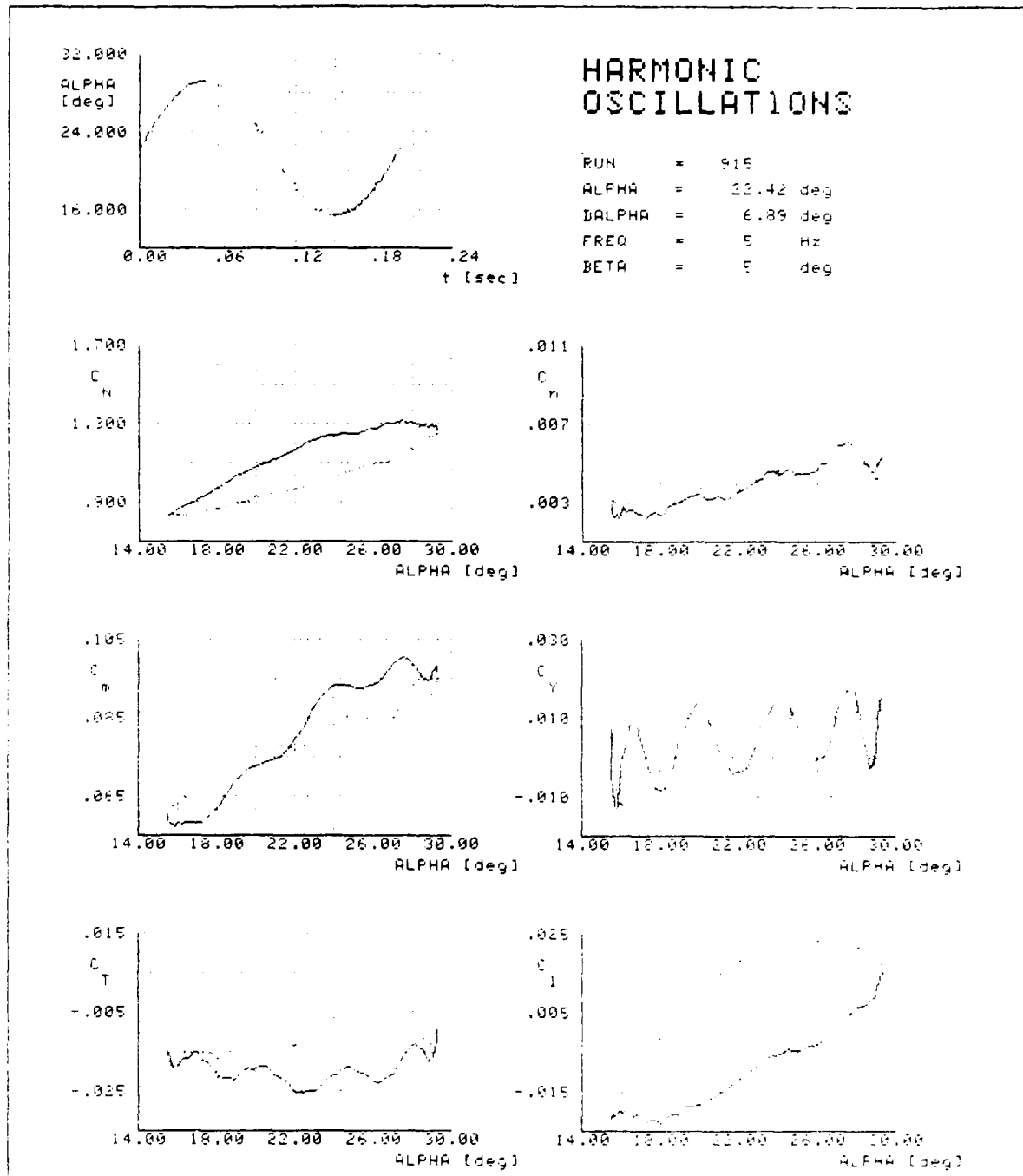
RUN = 014
 ALPHA = 9.39 deg
 DALPHA = 15.06 deg
 FREQ = 5 Hz
 BETA = -5 deg

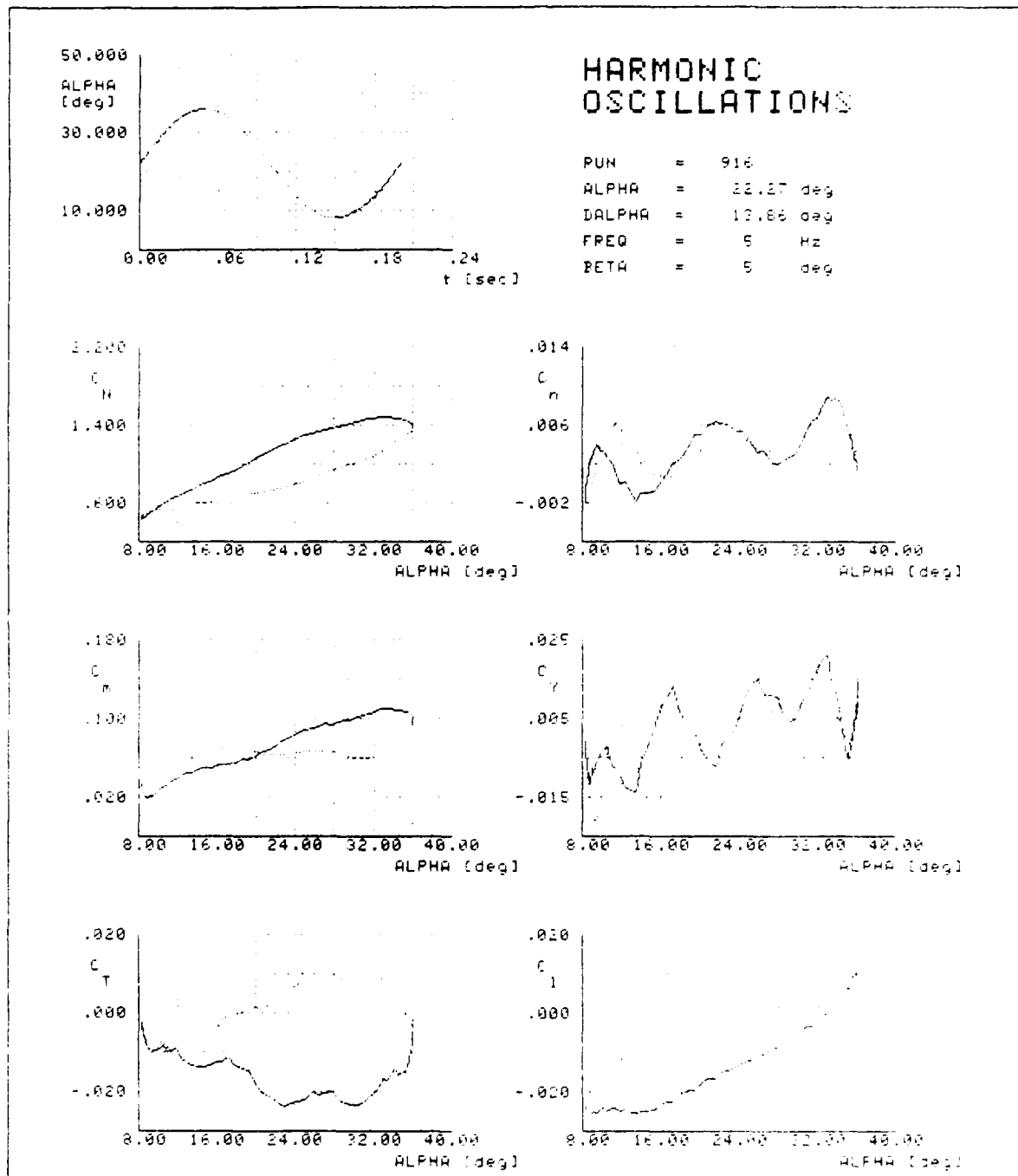


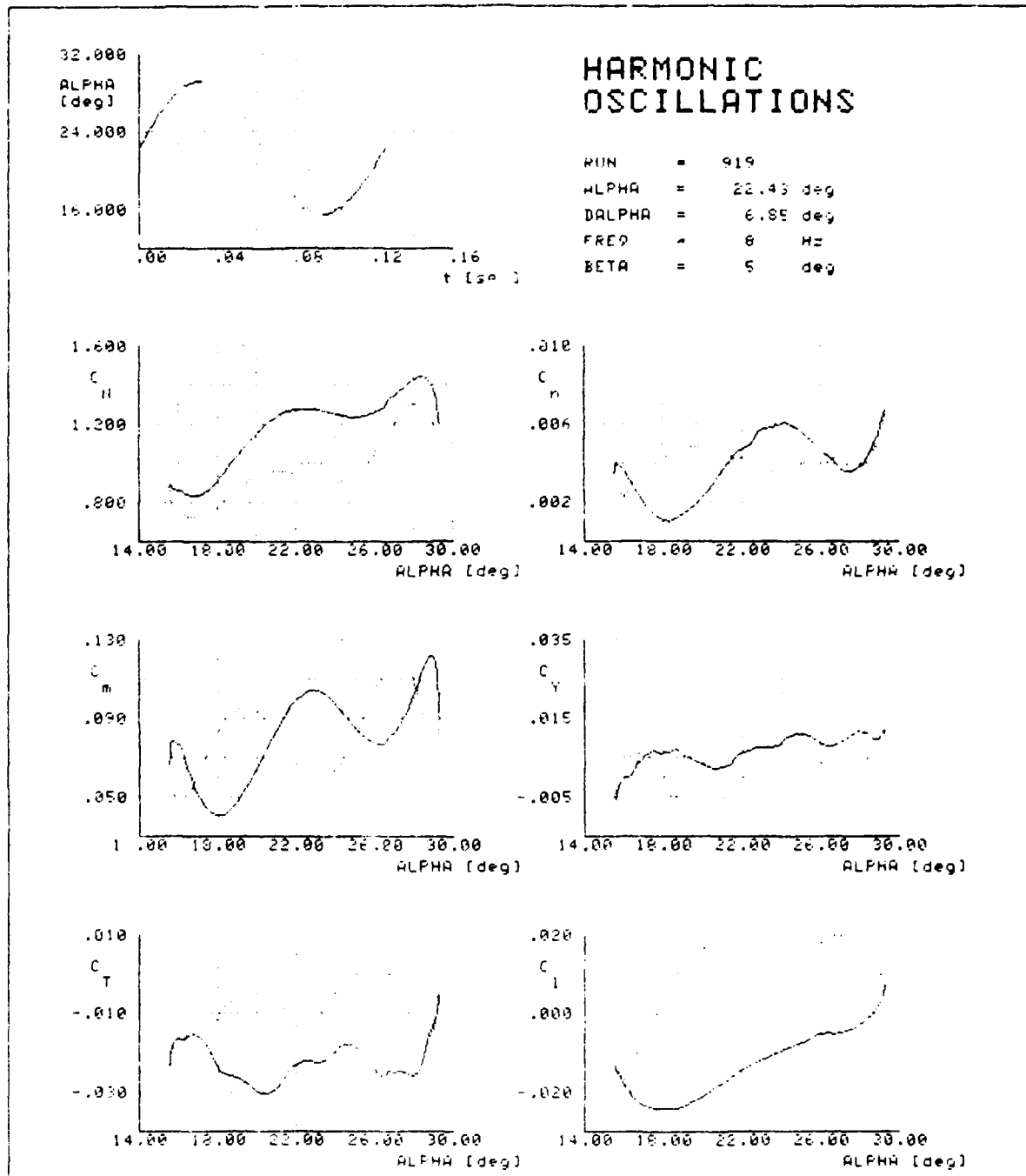


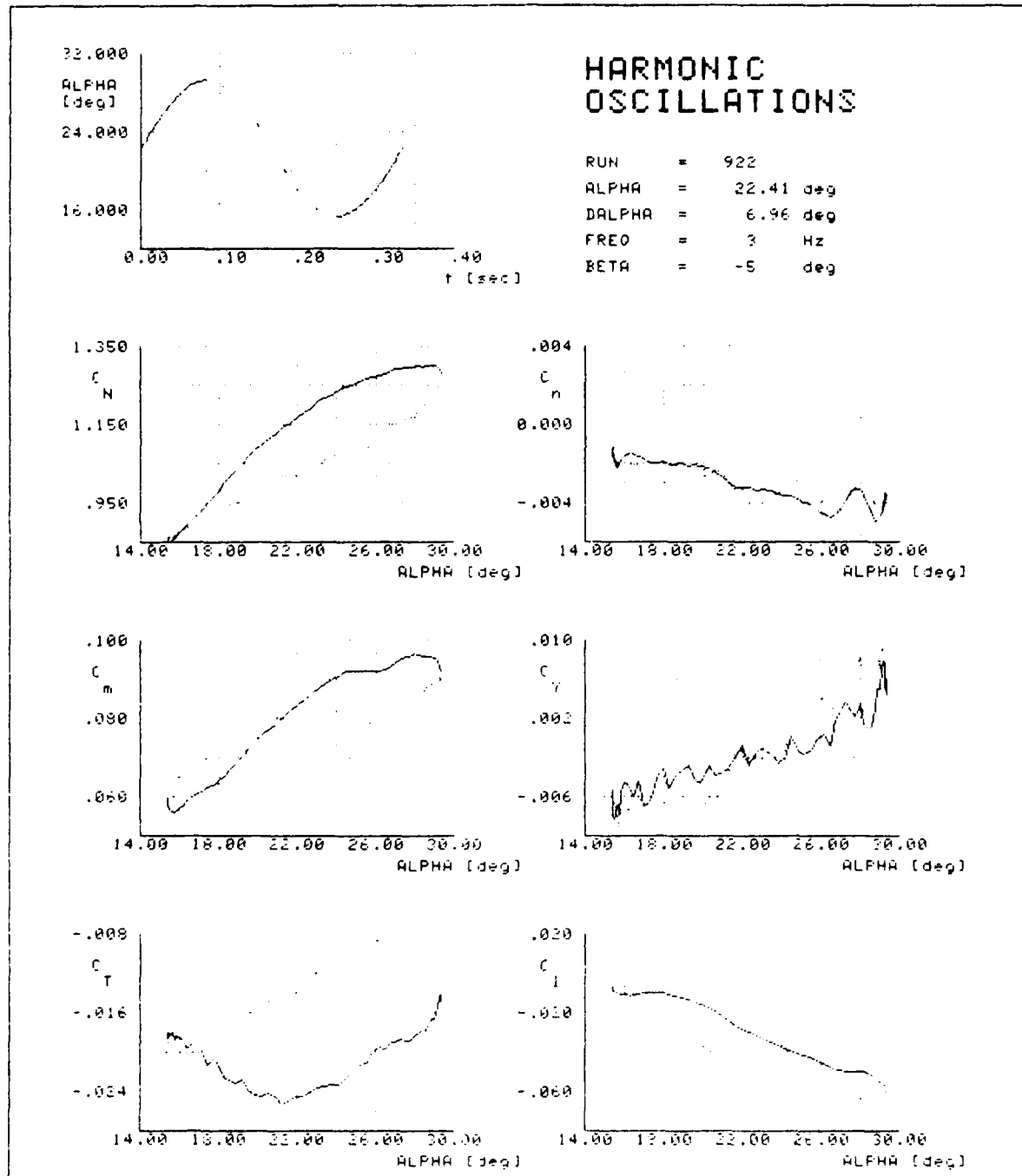


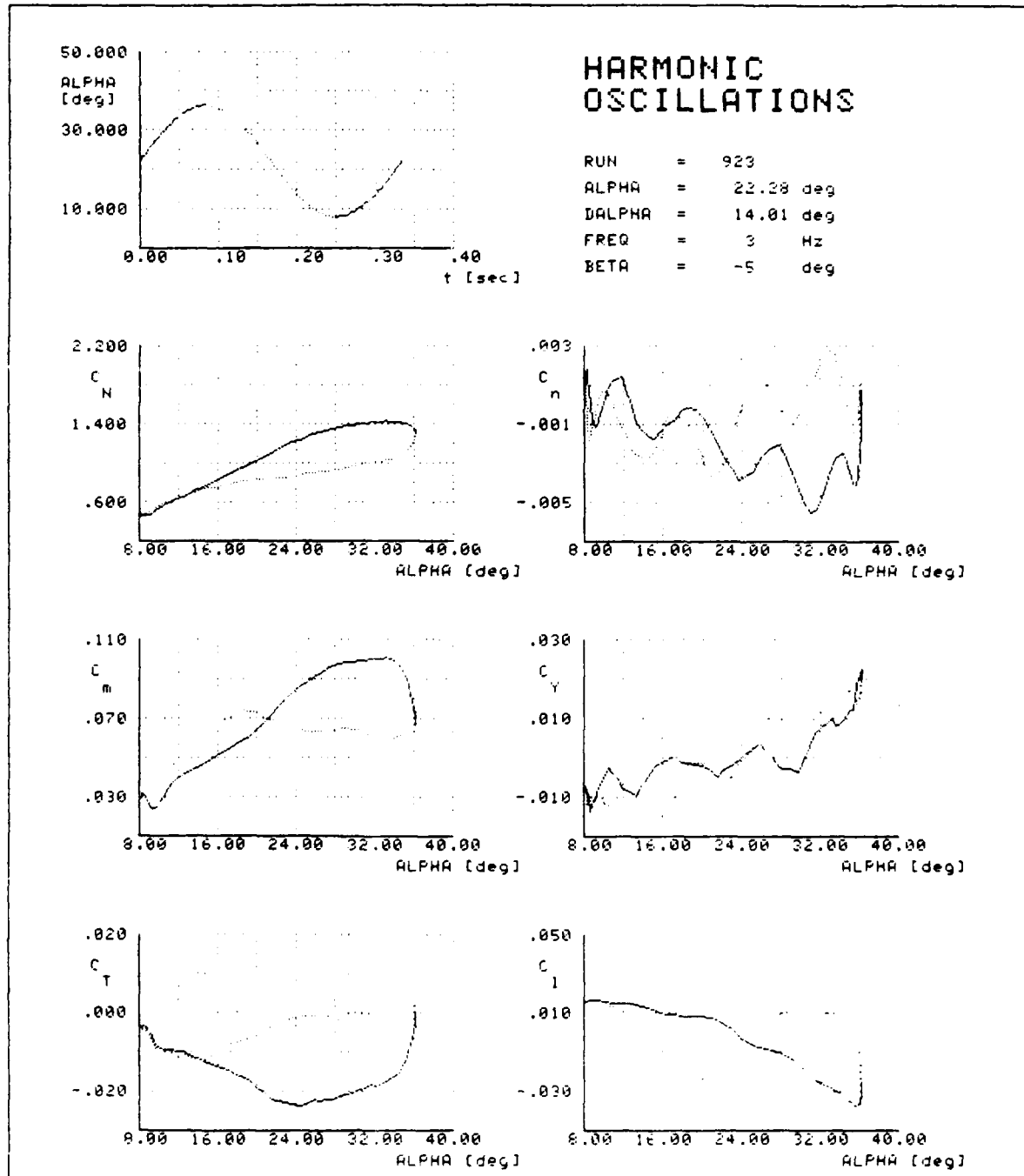


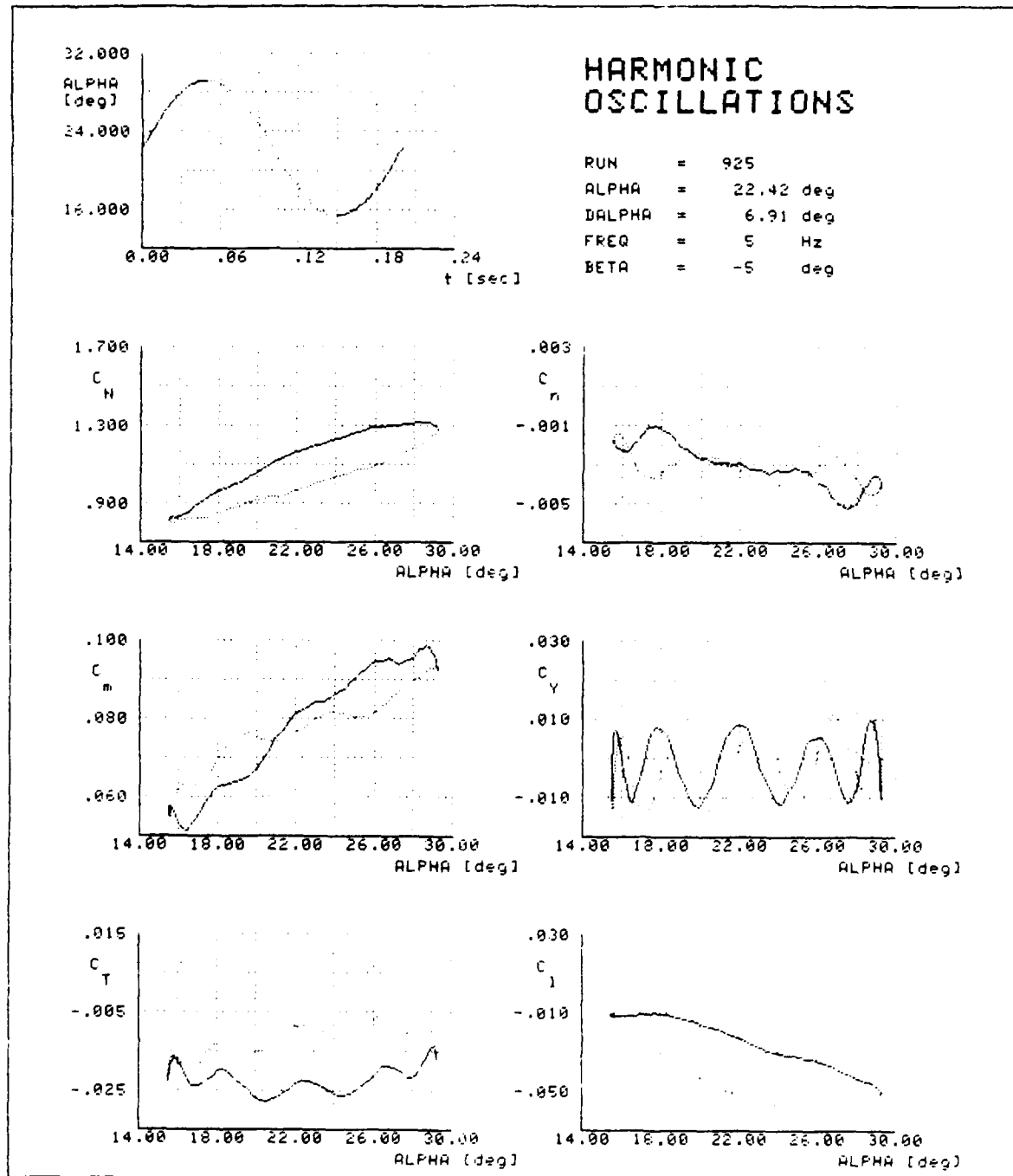


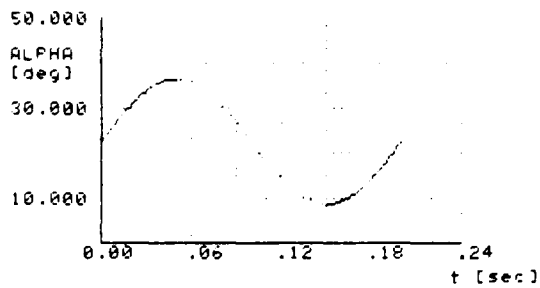






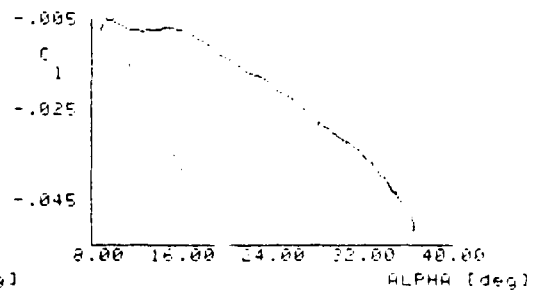
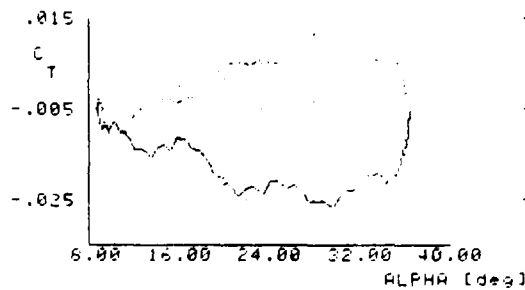
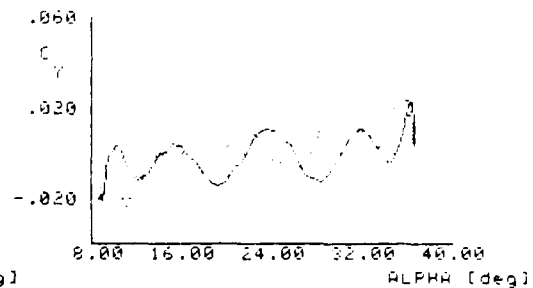
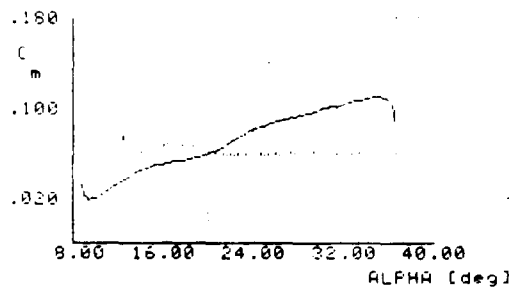
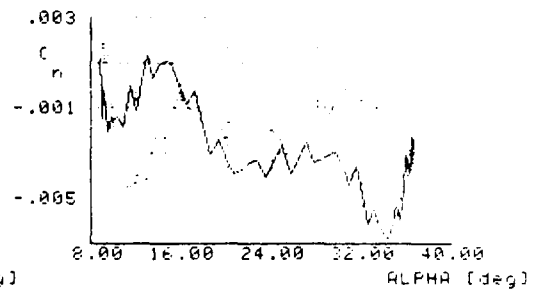
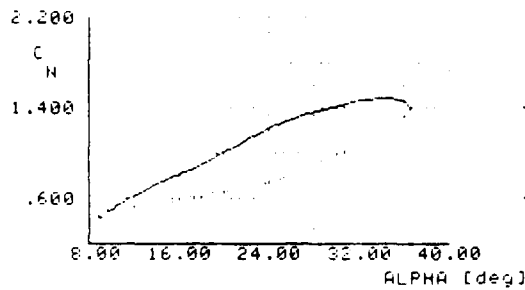


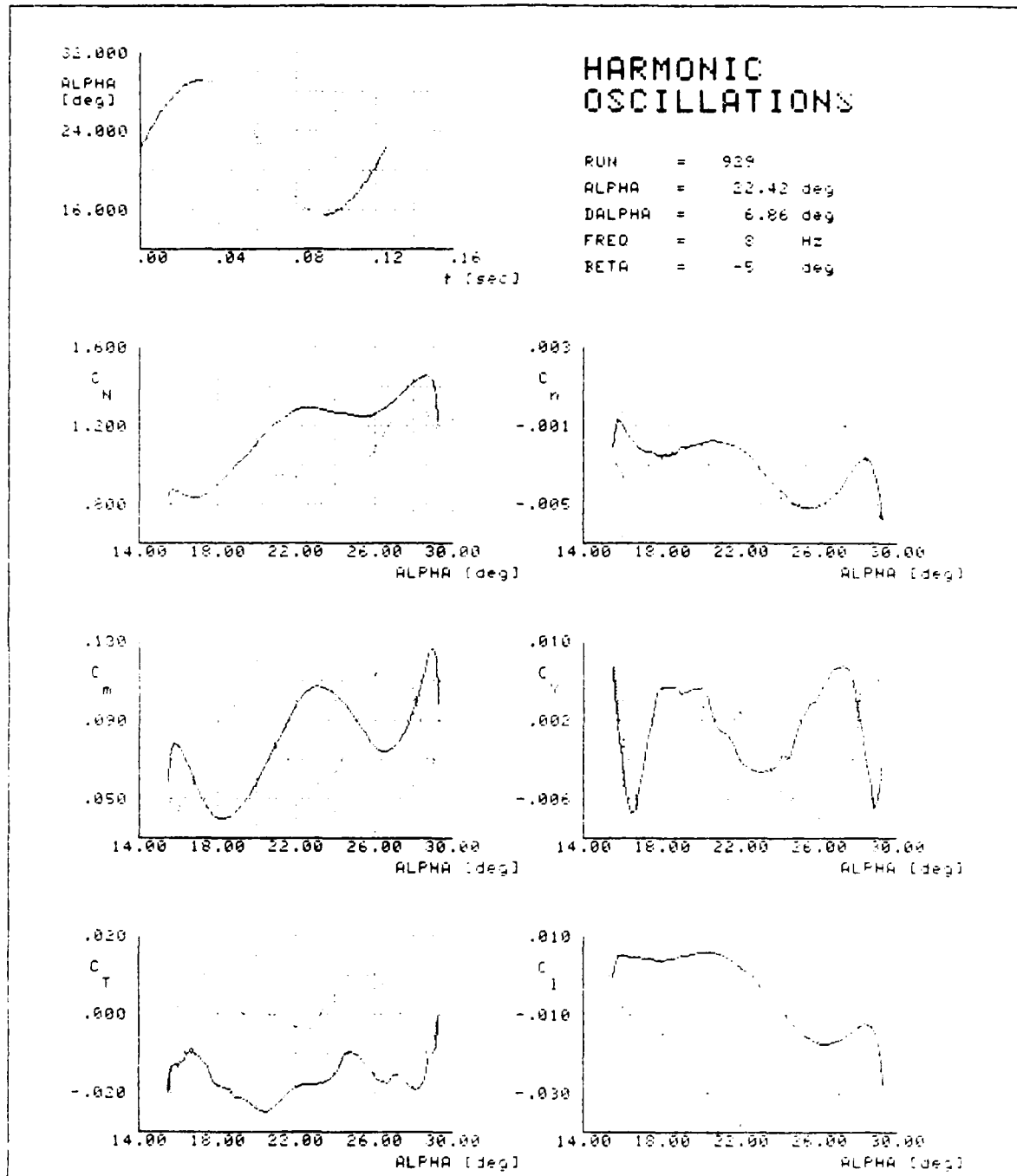


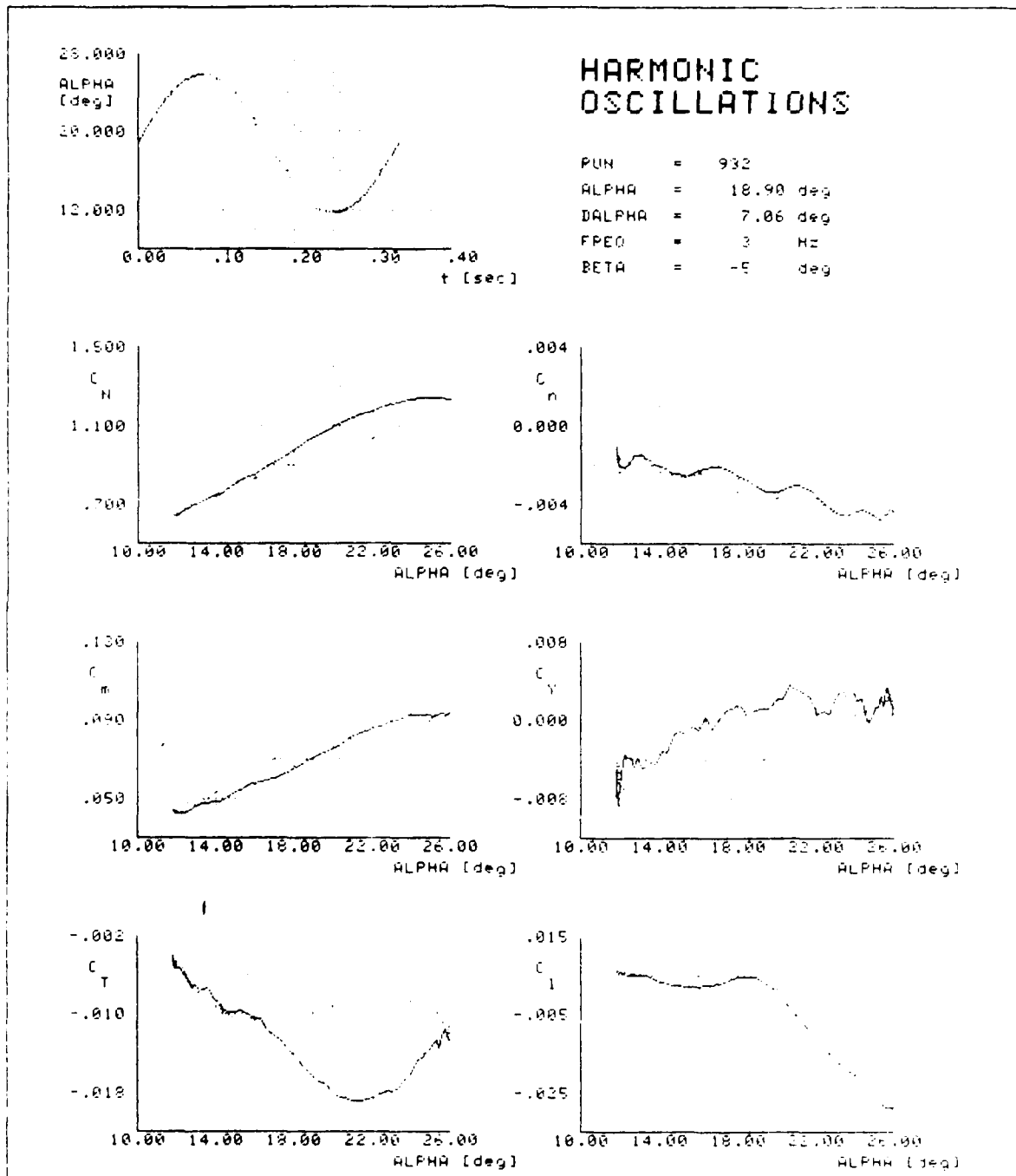


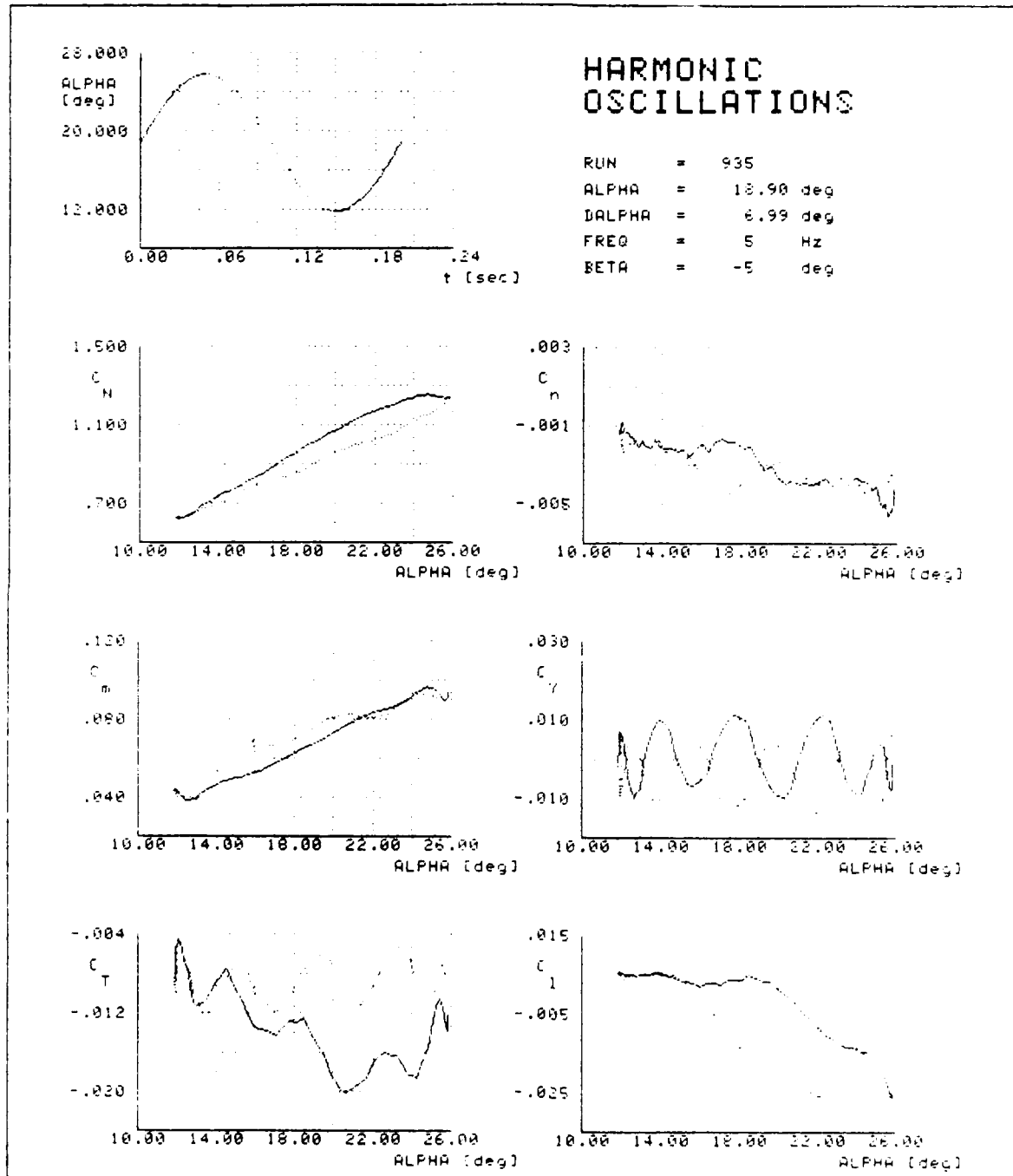
HARMONIC OSCILLATIONS

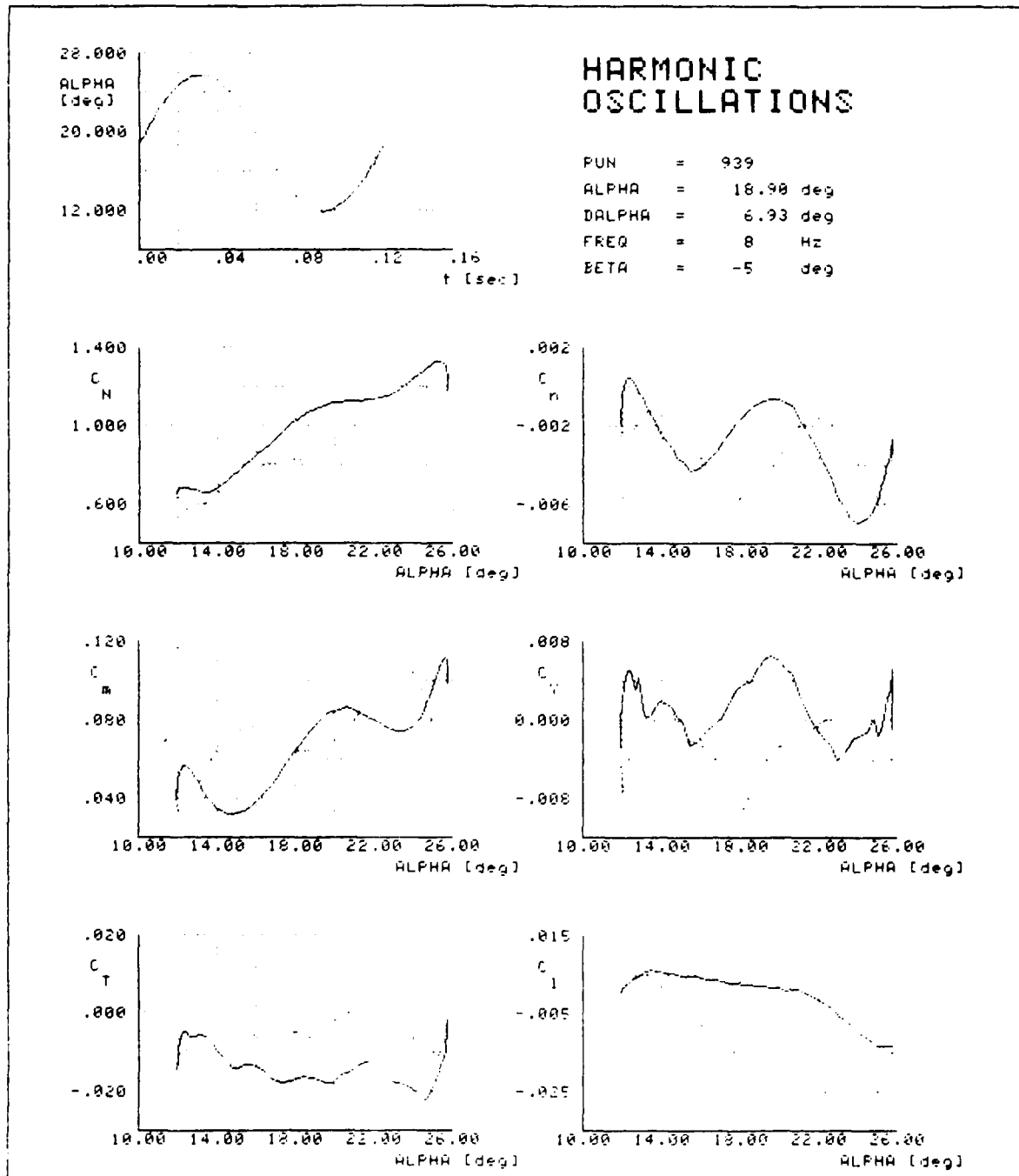
RUN = 926
ALPHA = 22.82 deg
DALPHA = 13.84 deg
FREQ = 5 Hz
BETA = -5 deg

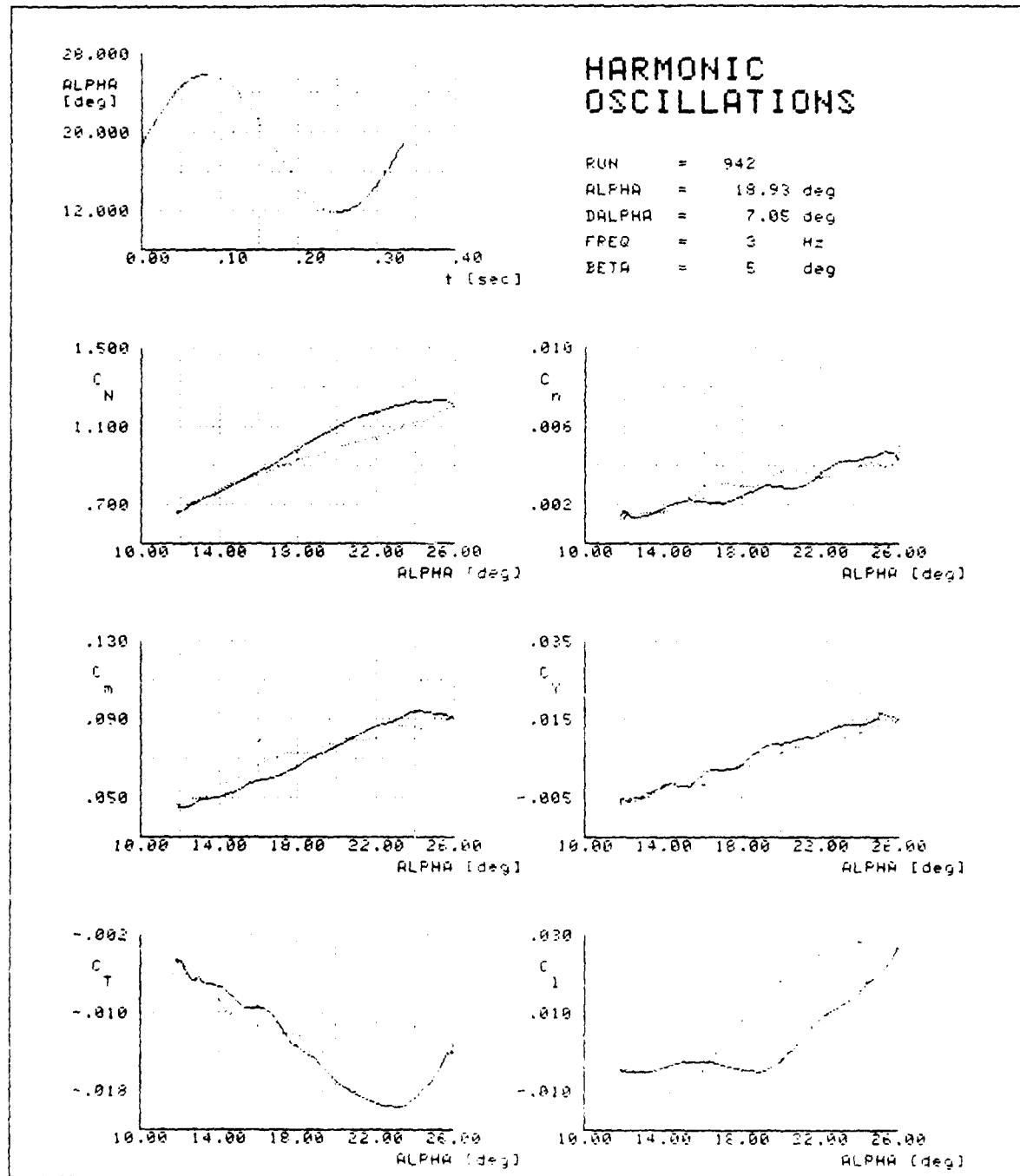


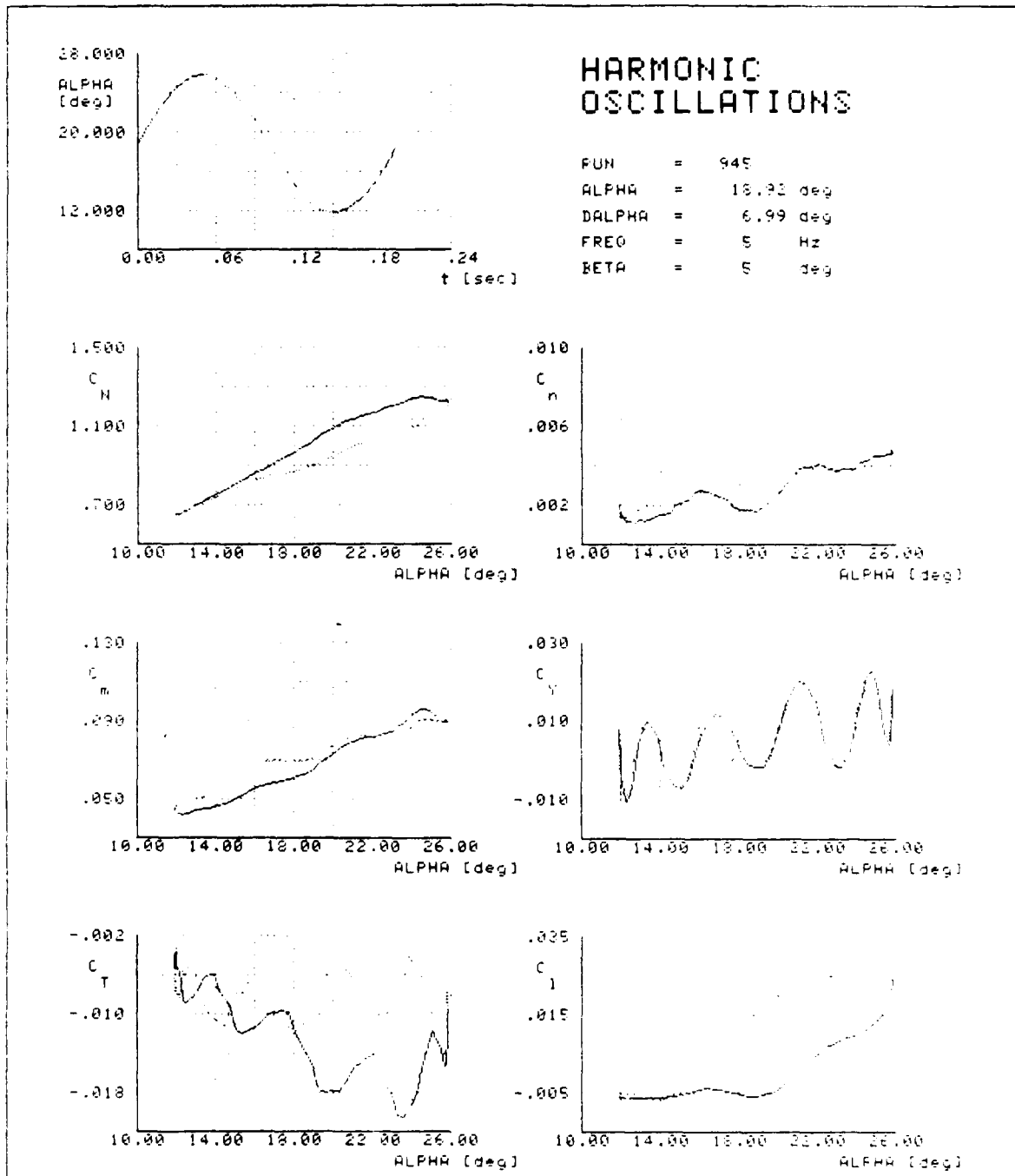


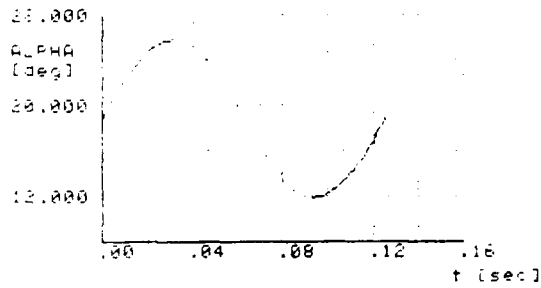






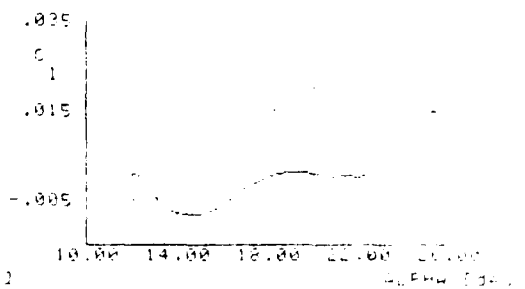
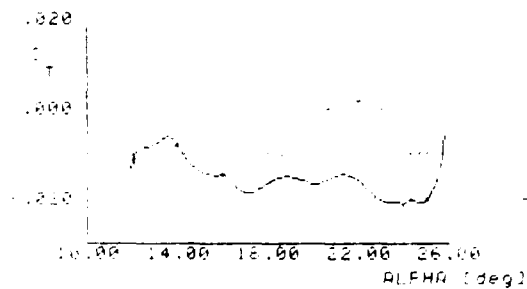
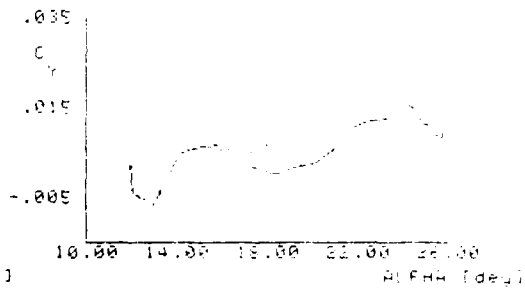
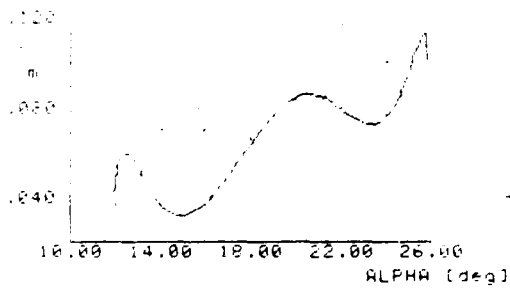
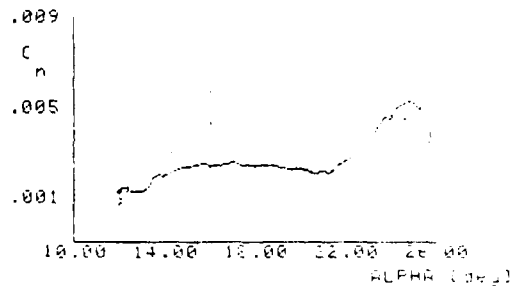
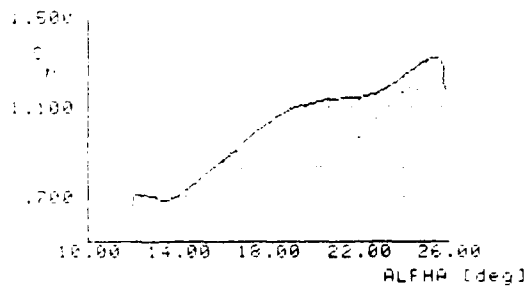






HARMONIC OSCILLATIONS

RUN = 949
ALPHA = 18.92 deg
DALPHA = 6.92 deg
FREQ = 6 Hz
BETA = 5 deg



END

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