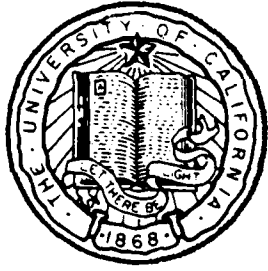


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MARINE PHYSICAL LABORATORY

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VERTICAL DIRECTIONALITY OF AMBIENT NOISE
AT 32° N AS A FUNCTION OF LONGITUDE:
Tape #86180

W. S. Hodgkiss and F. H. Fisher

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MPL TECHNICAL MEMORANDUM 387-E

MPL-U-32/86

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January 1988

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) MPL Technical Memorandum 387-E [MPL-U-32/86]		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION Marine Physical Laboratory	6b. OFFICE SYMBOL (if applicable) MPL	7a. NAME OF MONITORING ORGANIZATION Office of Naval Research Department of the Navy	
6c. ADDRESS (City, State, and ZIP Code) University of California, San Diego Scripps Institution of Oceanography San Diego, CA 92152		7b. ADDRESS (City, State, and ZIP Code) 800 North Quincy Street Arlington, VA 22217-5000	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Office of Naval Research	8b. OFFICE SYMBOL (if applicable) ONR	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER N00014-84-K-0097 and N00014-87-C-0127	
8c. ADDRESS (City, State, and ZIP Code) Department of the Navy 800 North Quincy Street Arlington, VA 22217-5000		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Vertical Directionality of Ambient Noise at 32°N as a Function of Longitude: Tape #86180			
12. PERSONAL AUTHOR(S) W. S. Hodgkiss and F. H. Fisher			
13a. TYPE OF REPORT tech memo	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) January 1988	15. PAGE COUNT 123
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
		ambient noise, MPL 27-element vertical array, vertical directionality	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
<p>Measurements have been made of the ambient noise field between 25 and 300 Hz with vertical arrays at 32°N (124°W, 136°W, and 150°W). This technical report contains the complete analysis results for the MPL 27-element vertical array Tape #86180. The tape was recorded at 32°N, 150°W (approximately 1700 nmi due west of San Diego) on 5 May 1986 beginning at 10:09 PDT. At that time, the wind speed was 10 kts.</p>			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL W. S. Hodgkiss		22b. TELEPHONE (Include Area Code) 619-534-1798	22c. OFFICE SYMBOL MPL

Vertical Directionality of Ambient Noise

at 32° N as a Function of Longitude:

Tape #86180

W.S. Hodgkiss and F.H. Fisher

Marine Physical Laboratory
Scripps Institution of Oceanography
San Diego, CA 92152

Abstract

Measurements have been made of the ambient noise field between 25 and 300 Hz with vertical arrays at 32° N (124° W, 136° W, and 150° W). This technical report contains the complete analysis results for the MPL 27-element vertical array Tape #86180. The tape was recorded at 32° N, 150° W (approximately 1700 nmi due west of San Diego) on 5 May 1986 beginning at 10:09 PDT. At that time, the wind speed was 10 kts.

I. Introduction

This technical report contains the complete analysis results for the MPL 27-element vertical array Tape #86180. The tape was recorded at 32° N, 150° W (approximately 1700 nmi due west of San Diego) on 5 May 1986 beginning at 10:09 PDT. At that time, the wind speed was 10 kts.

A complete description of the experiment and data analysis procedure is given in the summary technical report (TM-387-A). Here, a brief guide will be provided to the results documented in the various sections.

Section II (Preliminary Analysis) provides a preliminary look at the data quality from 4 hydrophones spaced approximately equally across the array for the first data segment (65536 points).

The results are ordered as follows:

- (1) Channel means (A/D counts).
- (2) Time series (A/D counts) for the first 1024 points of the first segment.
- (3) Time-varying mean (A/D counts, 64-point averages).
- (4) Time-varying power (A/D counts squared, 64-point averages) (channel means have been removed).
- (5) Power spectra (dB// μ Pa/ \sqrt Hz) (channel means have been removed).

Section III (Power Spectra) provides an extended preliminary look at the power spectra from all hydrophones in the array for the first data segment (65536 points). The results are ordered as follows:

- (1) Channel means (A/D counts).
- (2) Power spectra (dB// μ Pa/ \sqrt Hz) (channel means have been removed).

Section IV (Array Response: Waterfall, KB Window) provides waterfall plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape (dB// μ Pa/ \sqrt HzDeg). A Kaiser-Bessel window ($\alpha = 1.5$) was used to amplitude shade the array elements.

Section V (Array Response: Waterfall, Rect Window) provides waterfall plots of the time-evolving

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vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape ($\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$). A rectangular window was used to amplitude shade the array elements.

Section VI (Array Response: Panels, KB Window) provides multi-panel plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape ($\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$). A Kaiser-Bessel window ($\alpha = 1.5$) was used to amplitude shade the array elements.

Section VII (Array Response: Panels, Rect Window) provides multi-panel plots of the time-evolving vertical directionality of ambient noise for successive segments (65536 points) across the entire data tape ($\text{dB}/\mu\text{Pa}/\sqrt{\text{HzDeg}}$). A rectangular window was used to amplitude shade the array elements.

II. Preliminary Analysis.

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Channel #10

1 14.558151245117

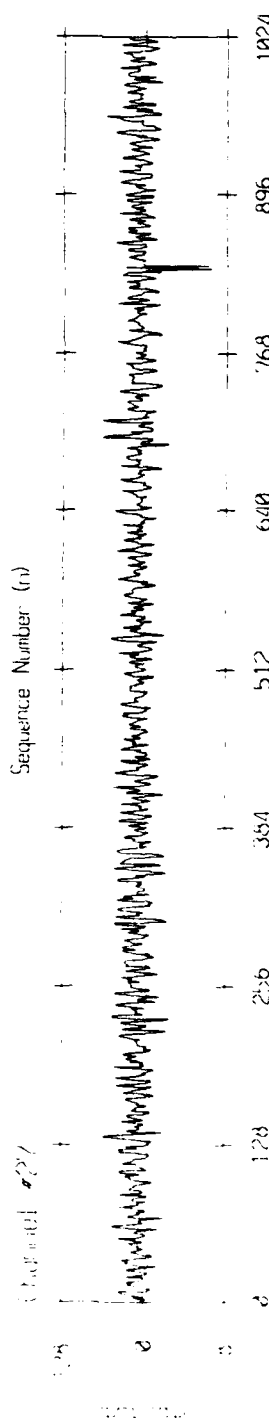
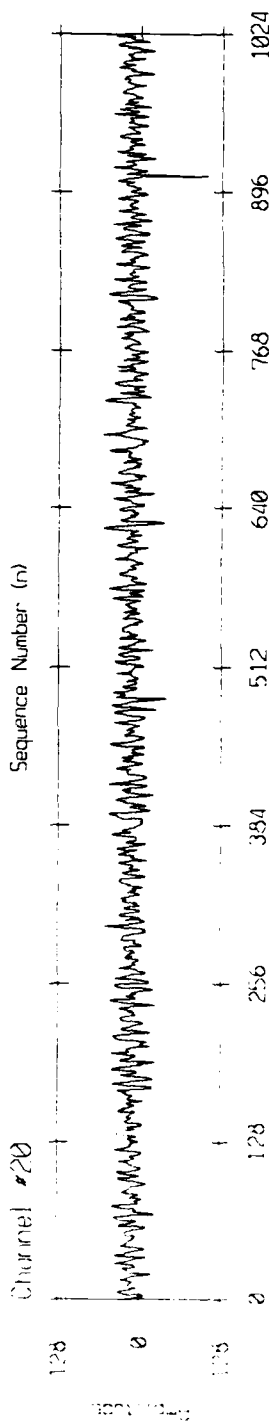
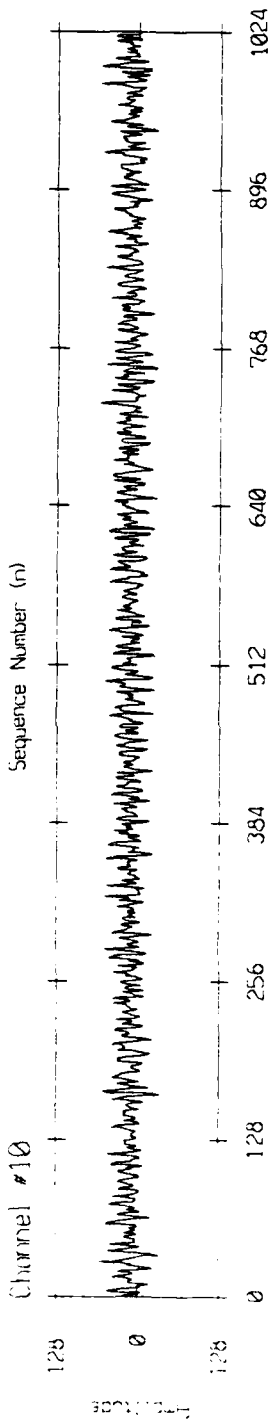
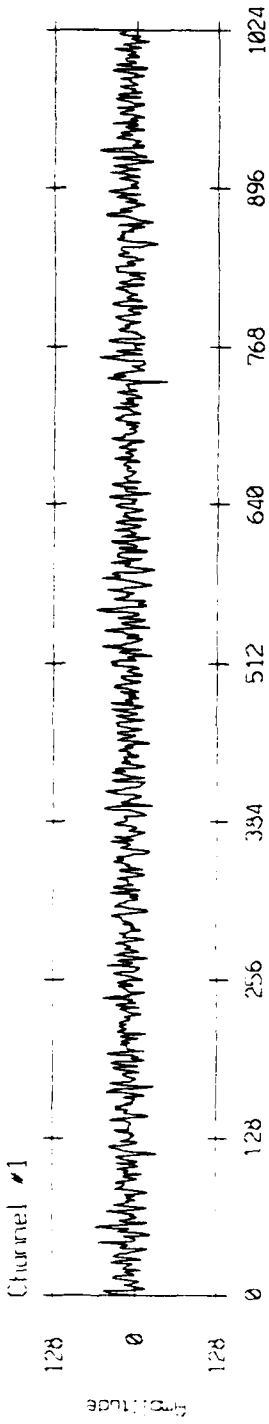
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1 13.688034057617

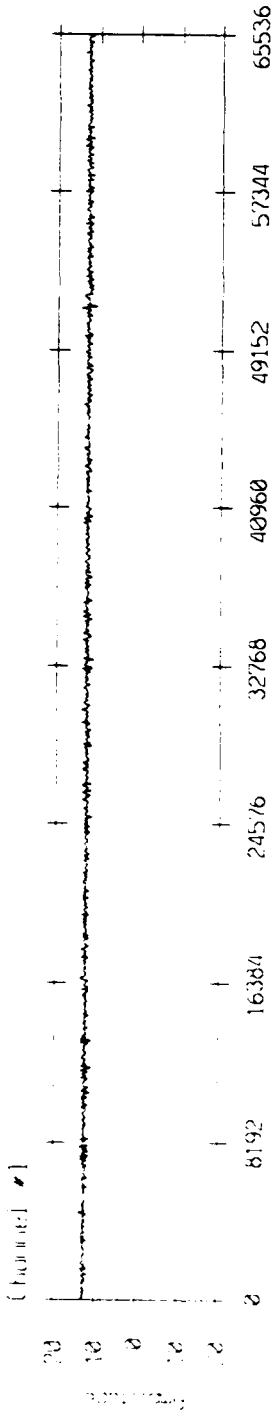
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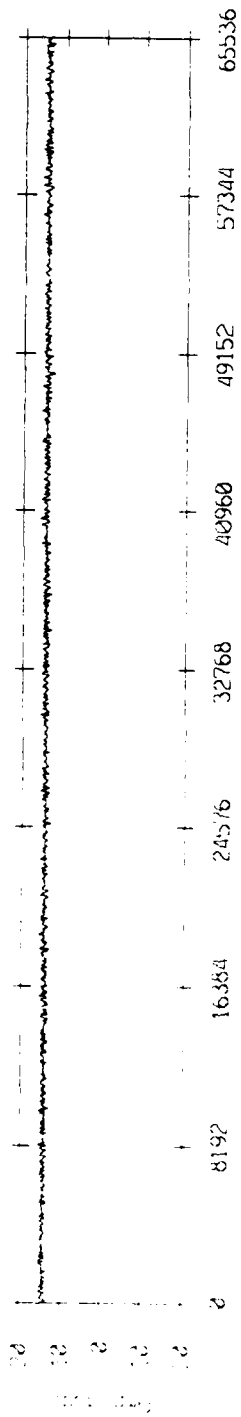
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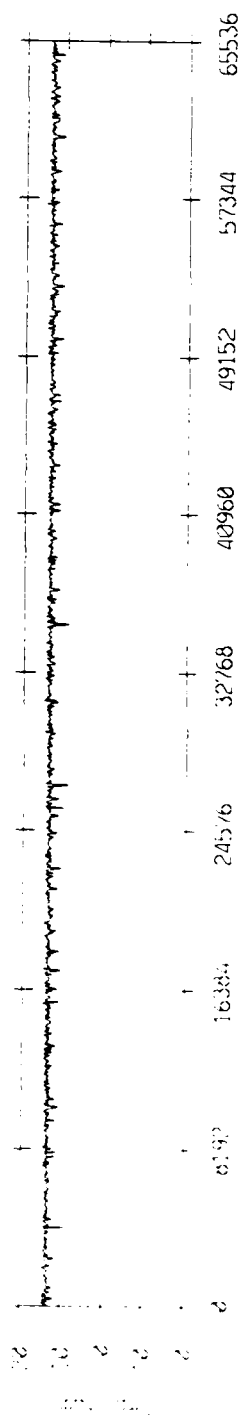
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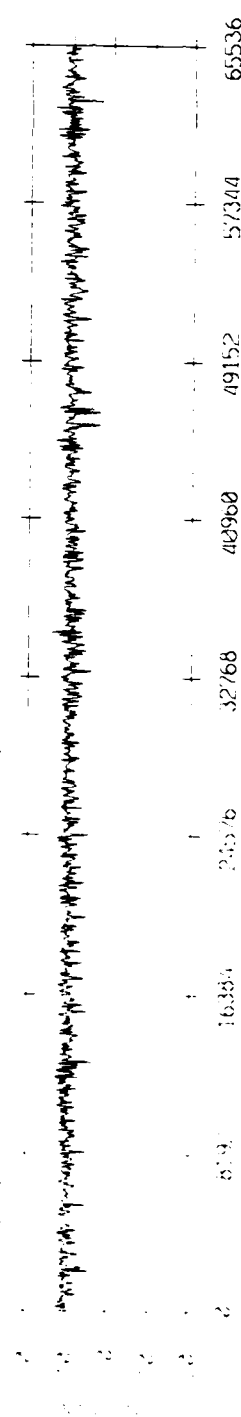
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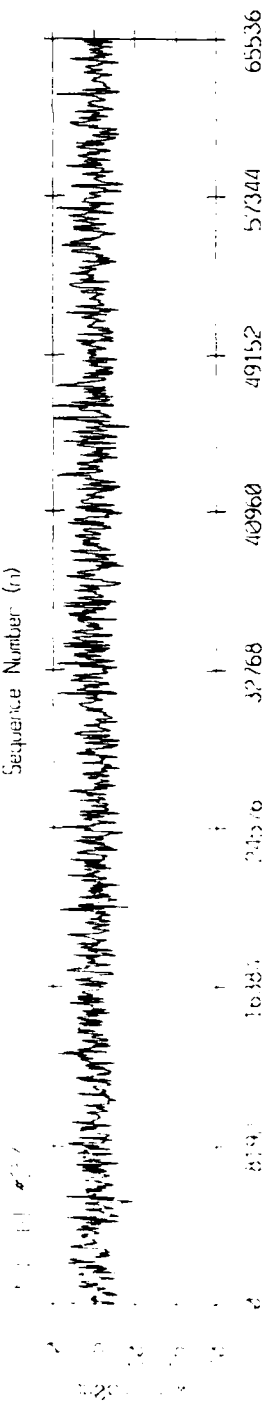
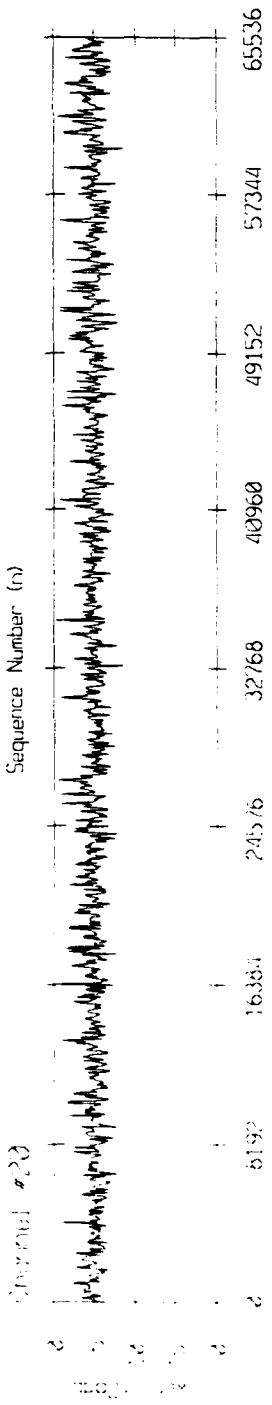
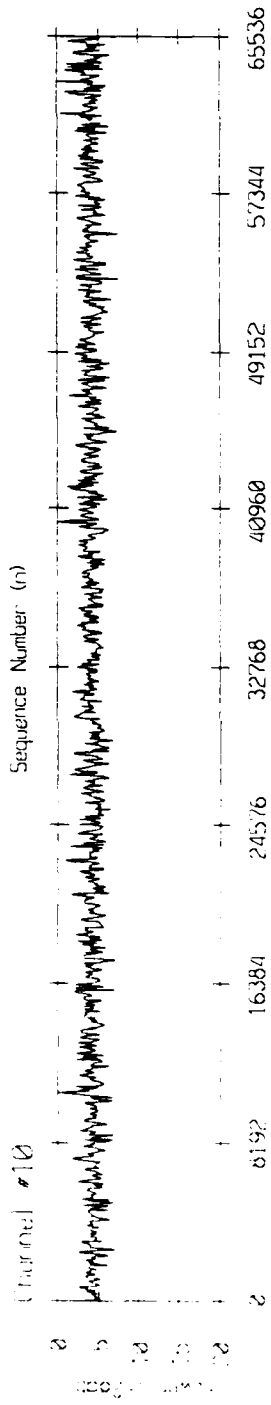
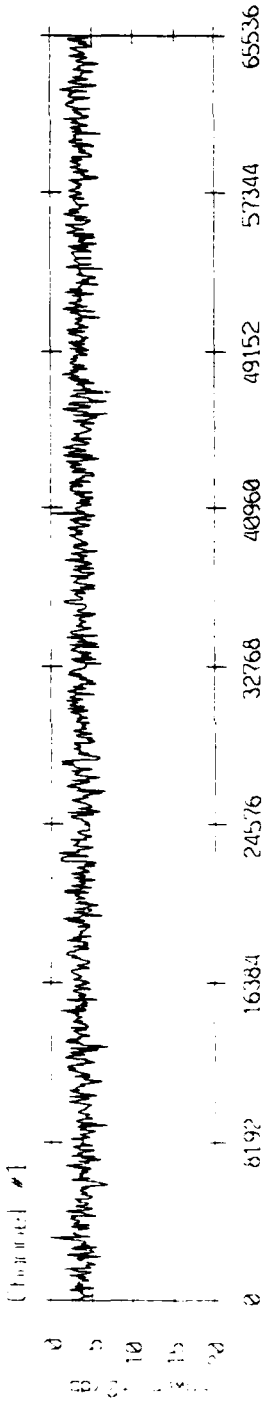
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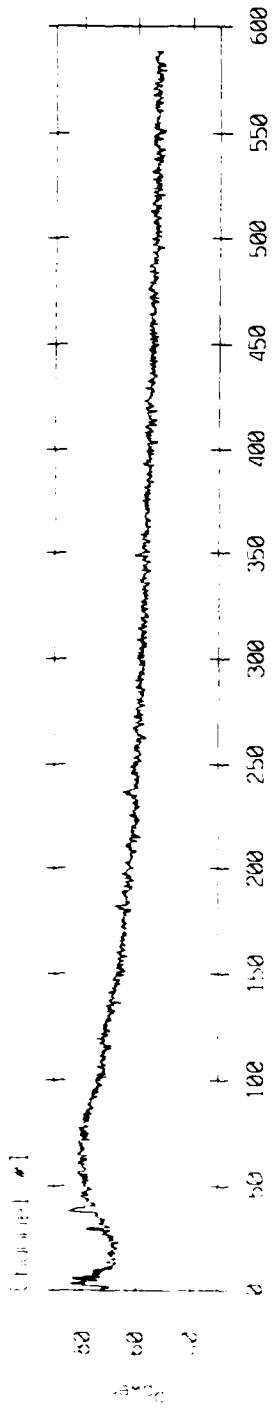
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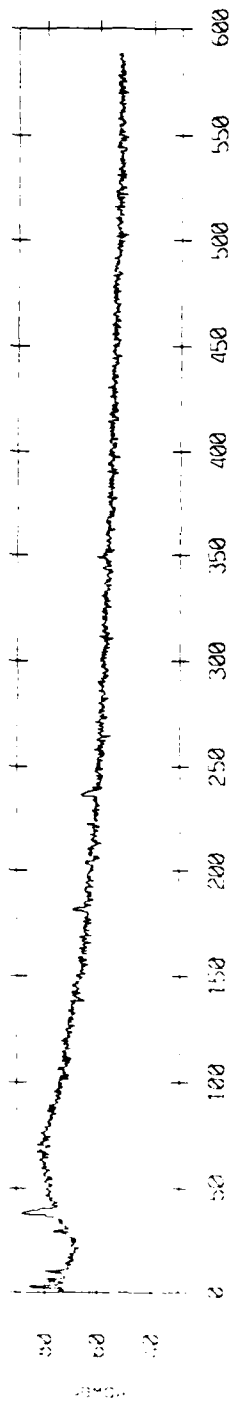
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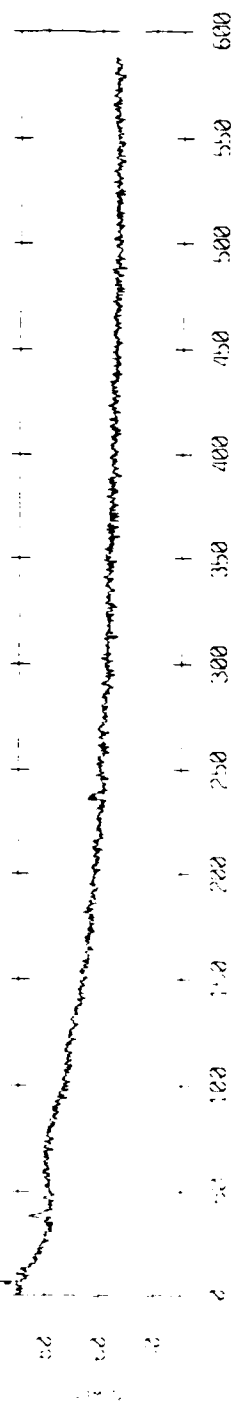
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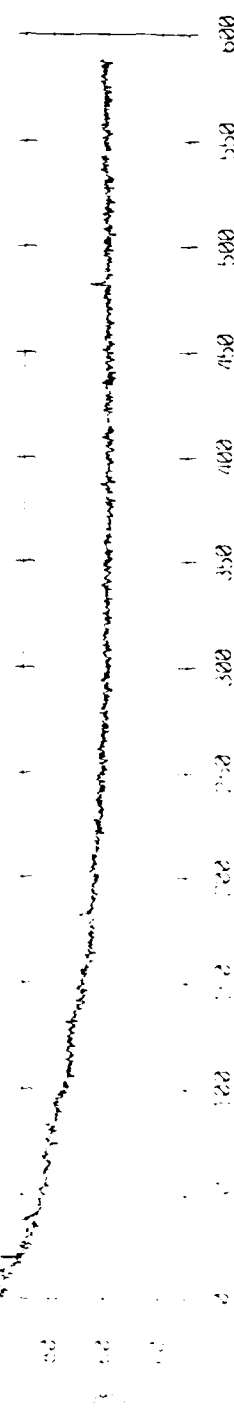
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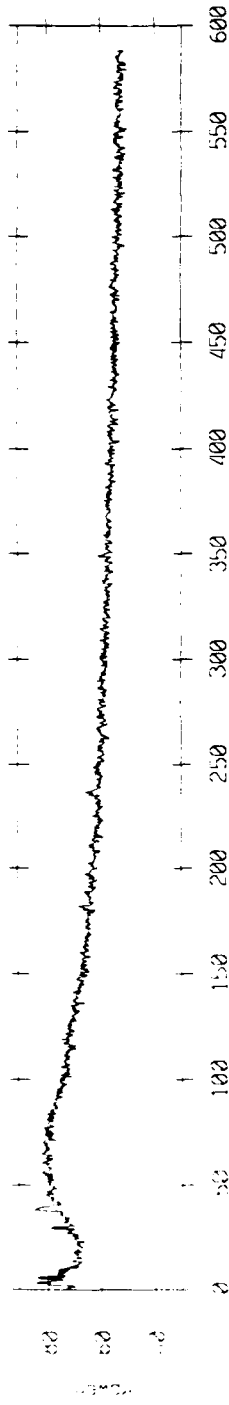


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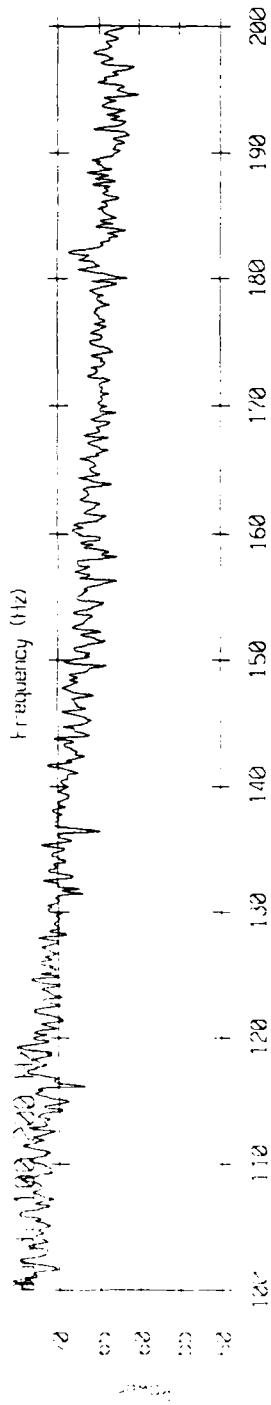


Power Spectrum 86180.1 Channel #1

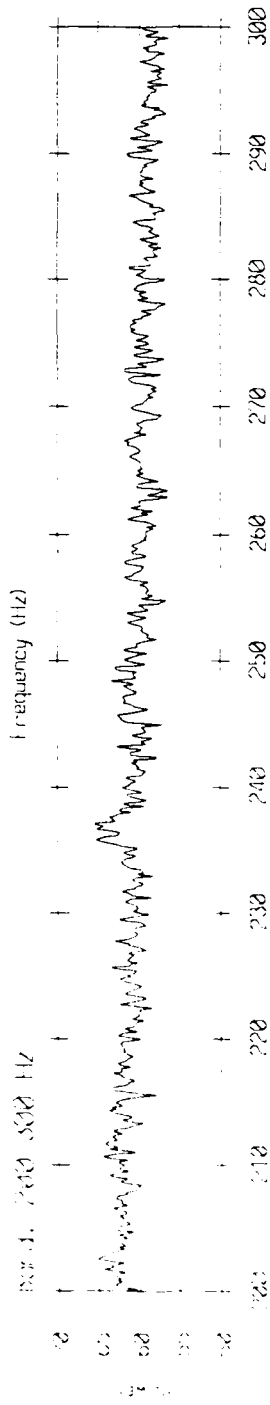
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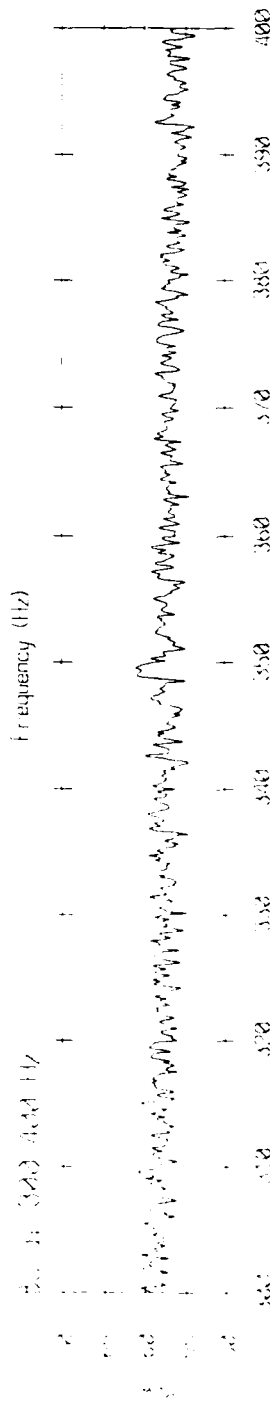
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Frequency (Hz)



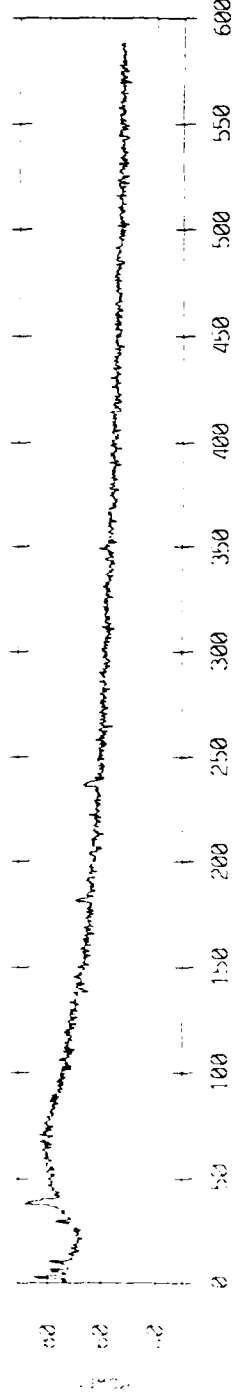
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Frequency (Hz)

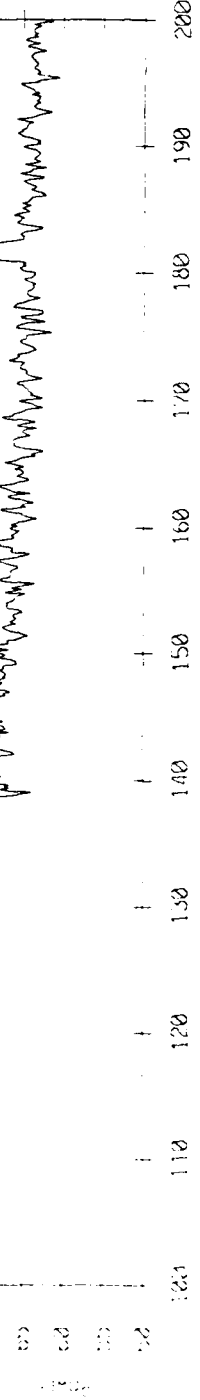
2000 Hz 1000 Hz 800 Hz Channel #10

2000 Hz



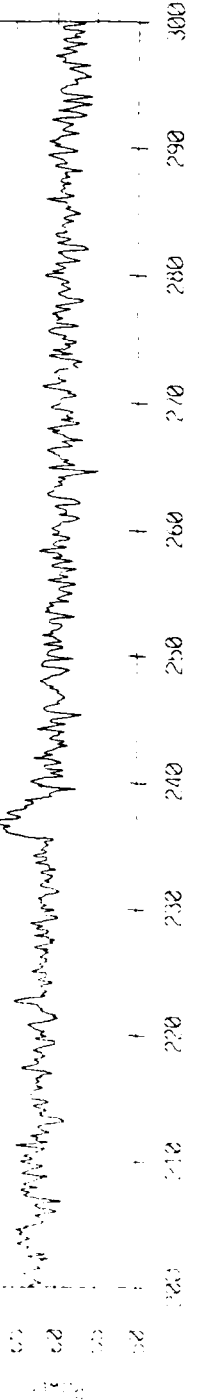
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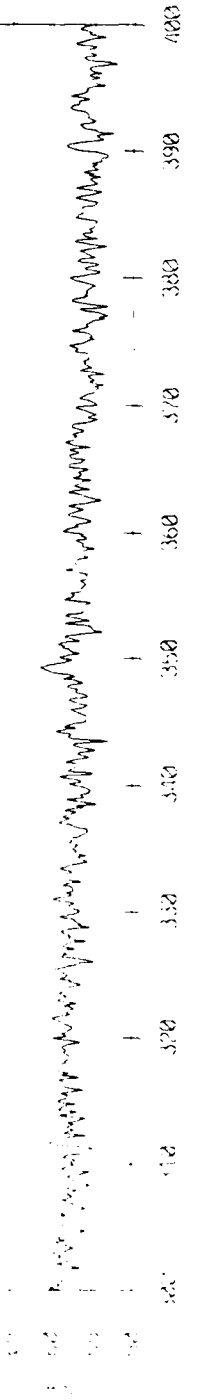
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2000 Hz



Frequency (Hz)

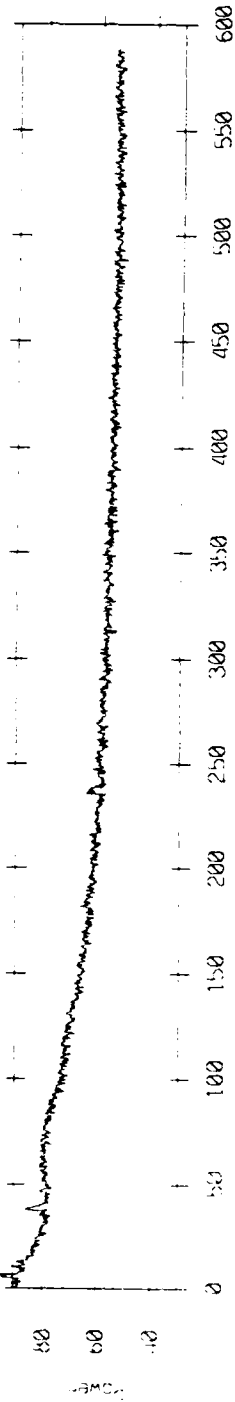
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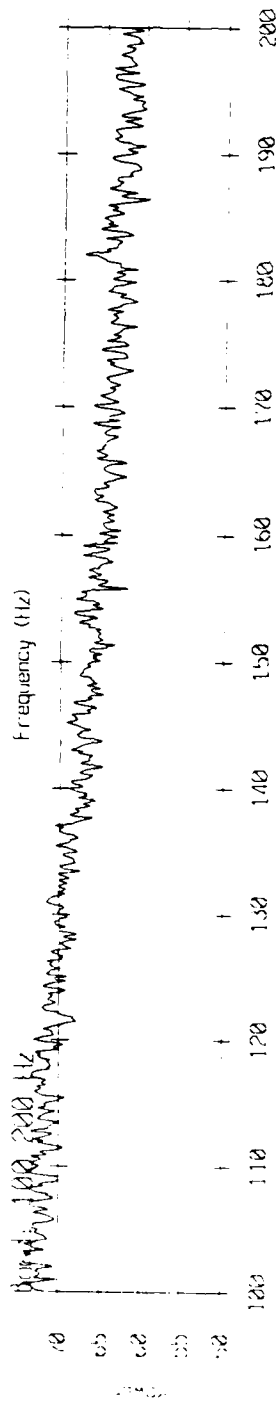
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Power Spectrum 86180.1 Channel #20

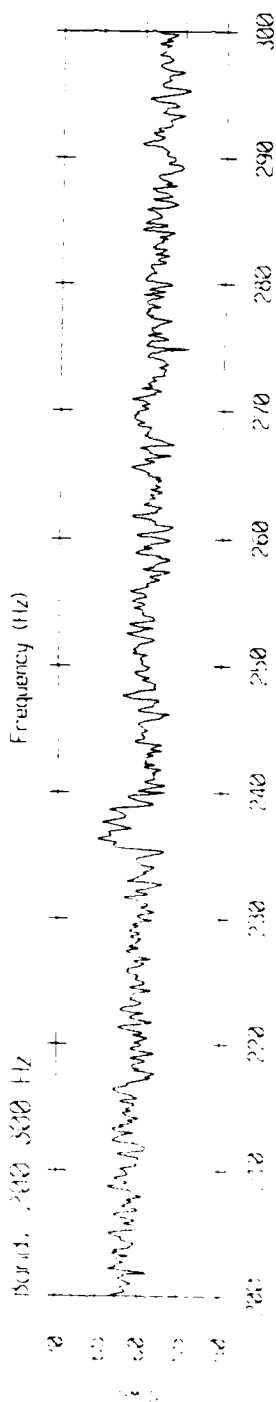
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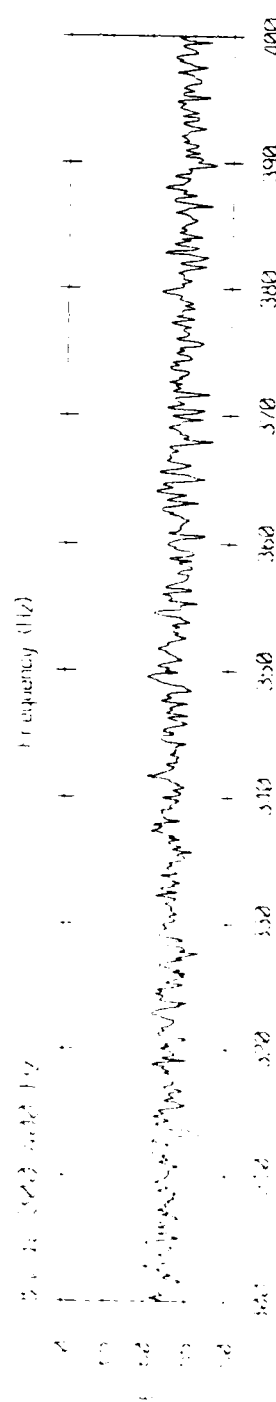
Frequency (Hz)



Frequency (Hz)

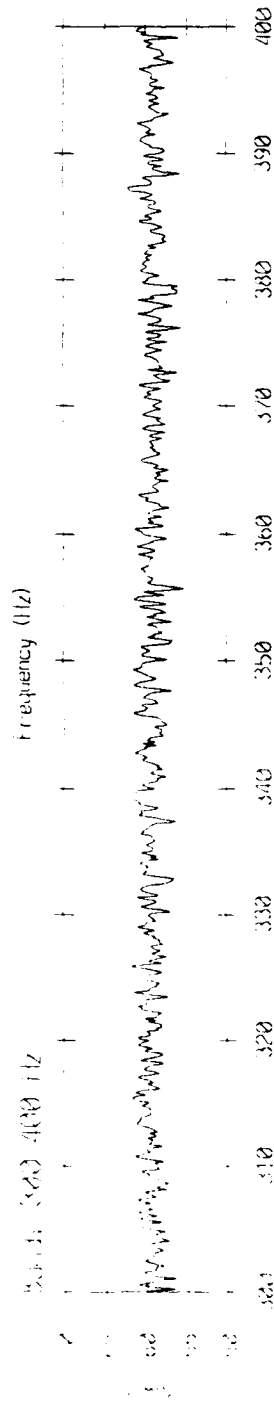
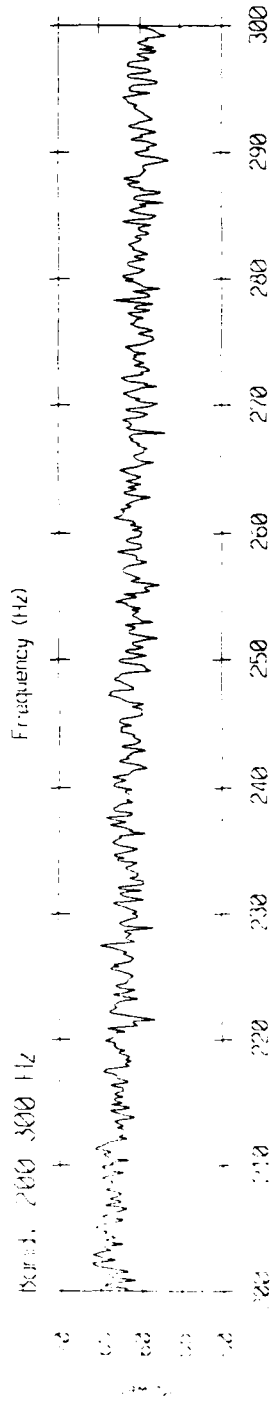
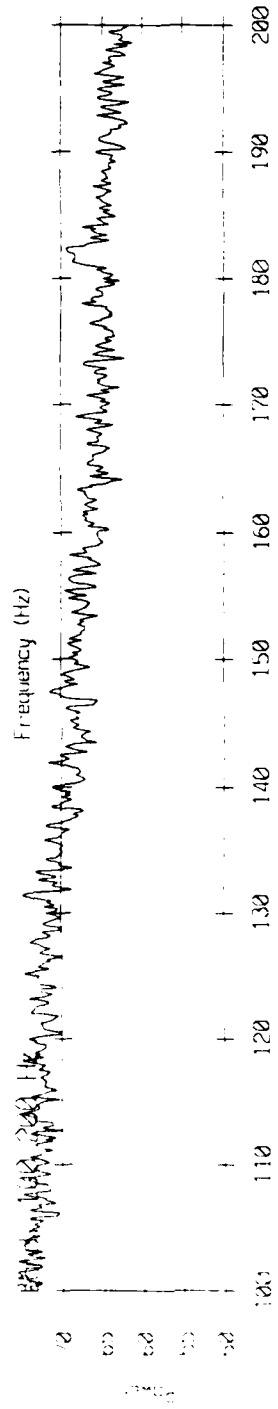
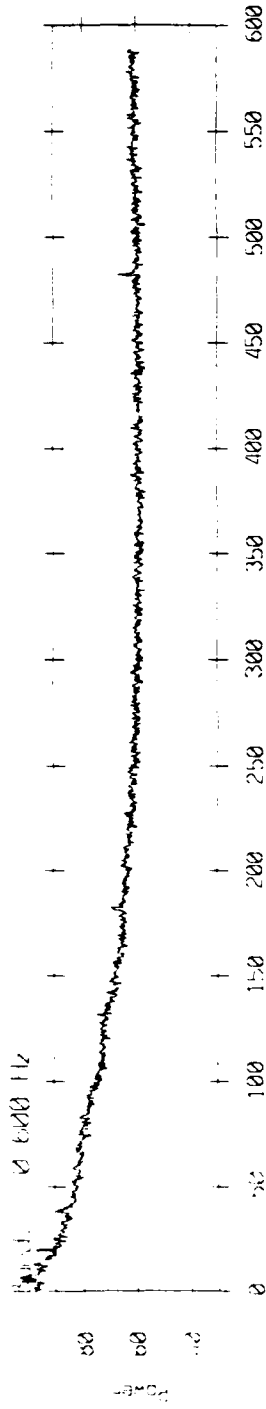


Frequency (Hz)



Frequency (Hz)

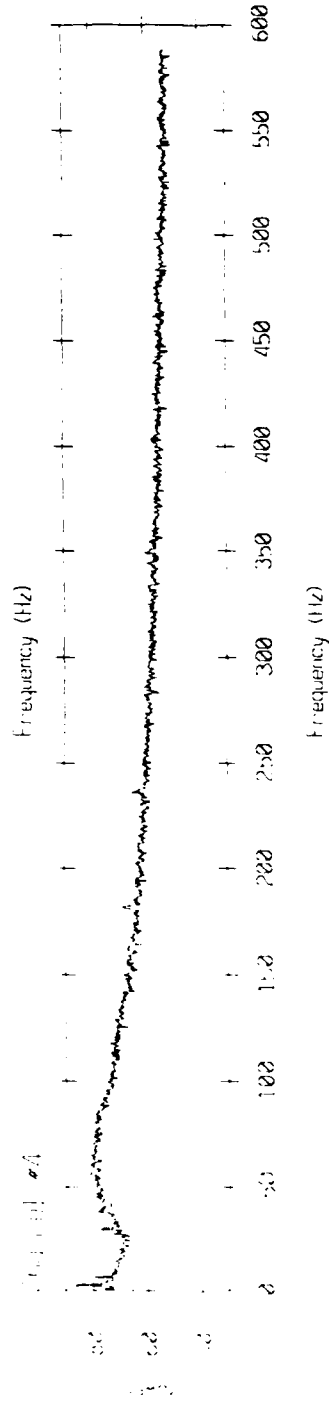
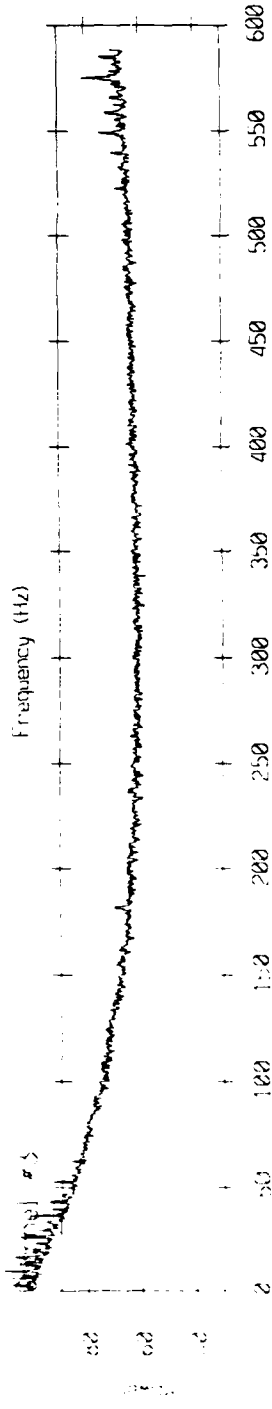
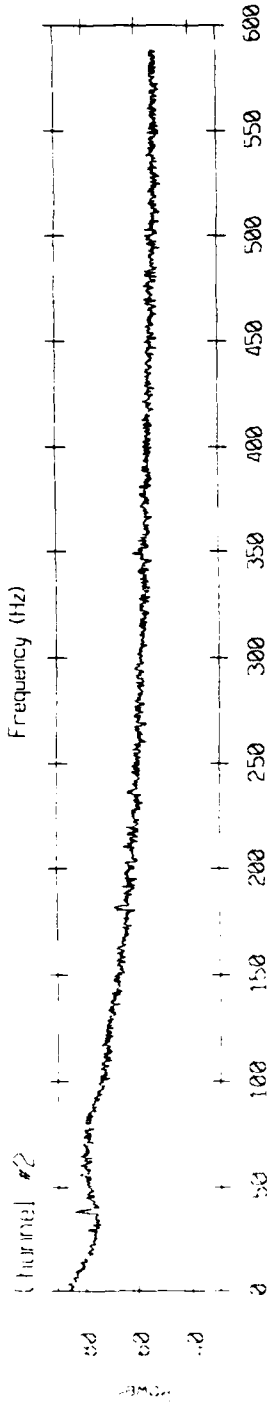
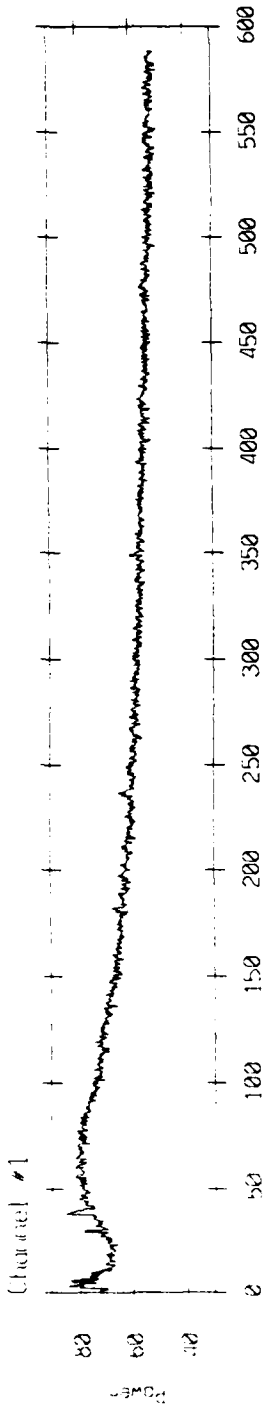
Power Spectrum 86180.1 Channel #27



III. Power Spectra.

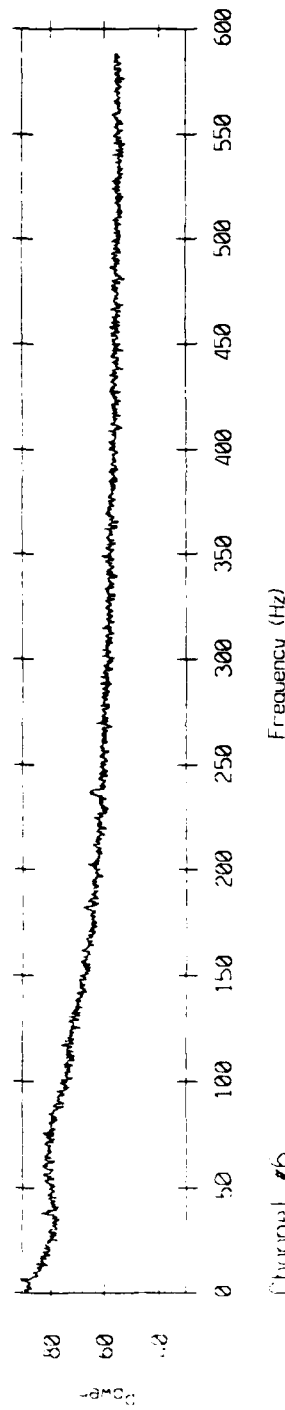
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1 10.013586205073

Power spectrum 86180.1

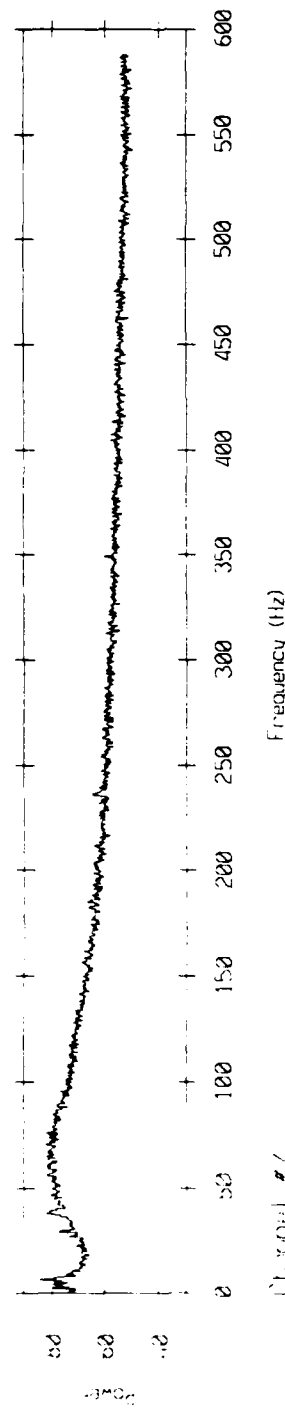


Power Spectrum - 86180.1

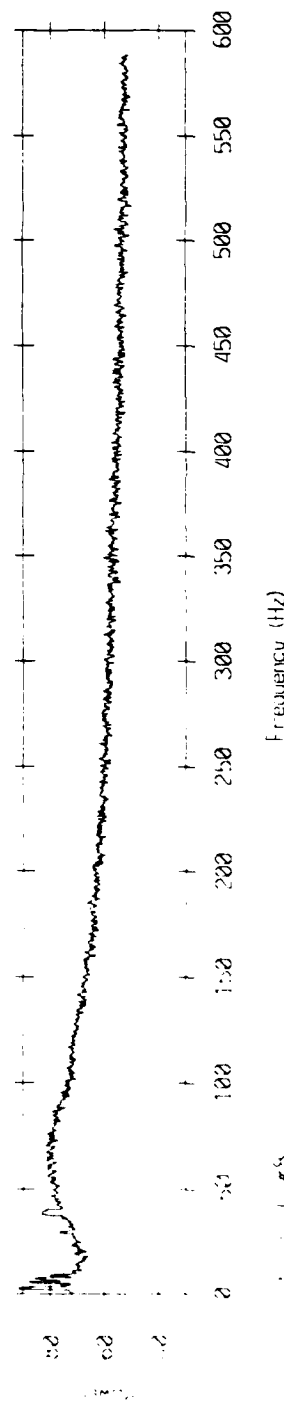
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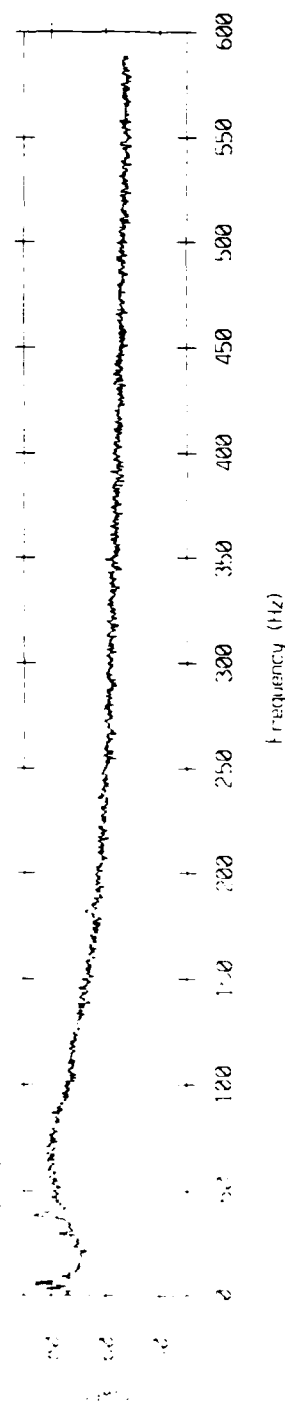
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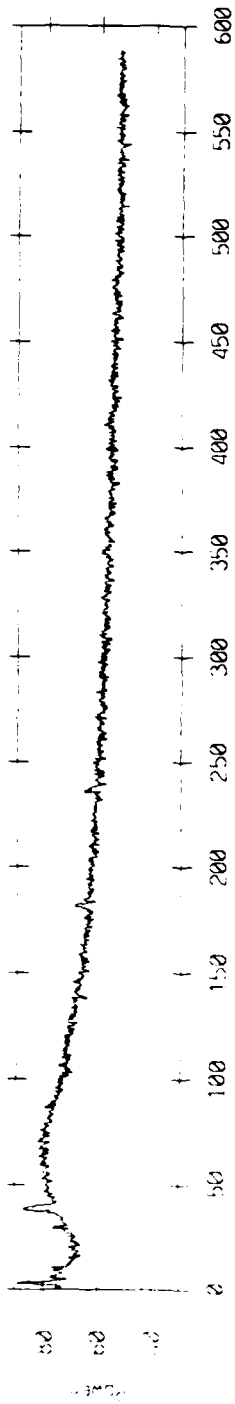


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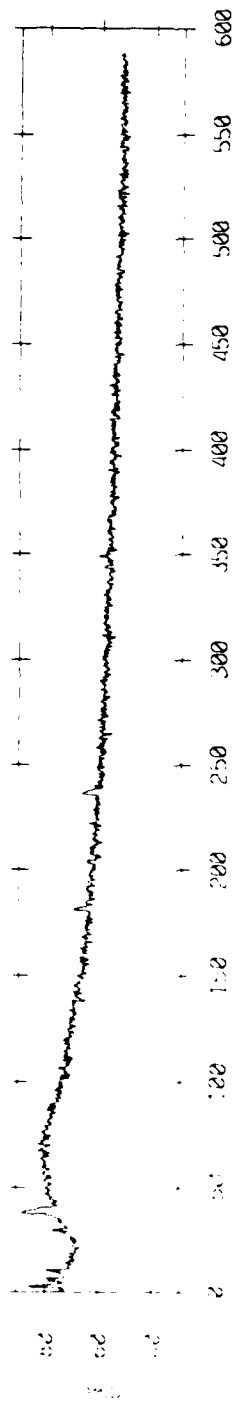
Power Spectrum - 86180.1

Channel #9



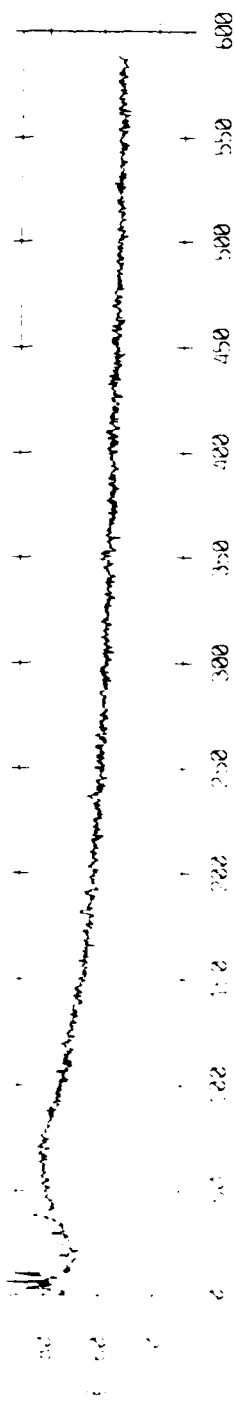
Channel #10

Frequency (Hz)



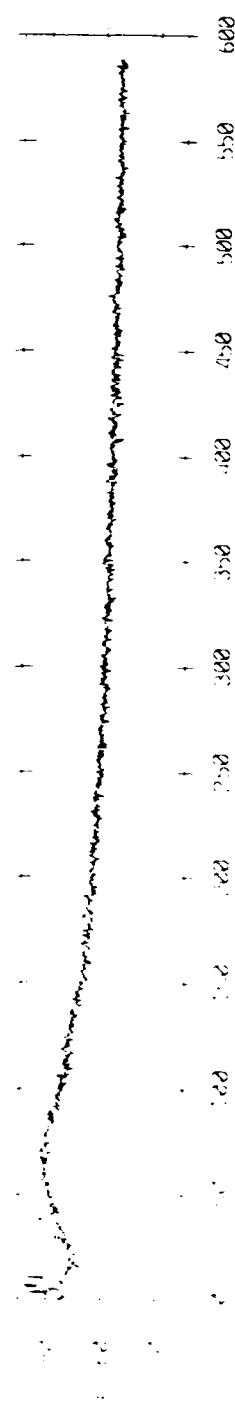
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Frequency (Hz)



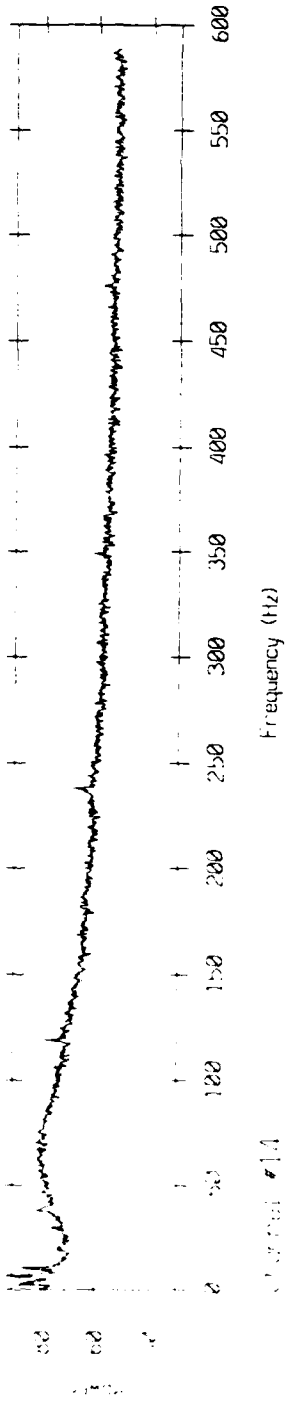
Channel #12

Frequency (Hz)

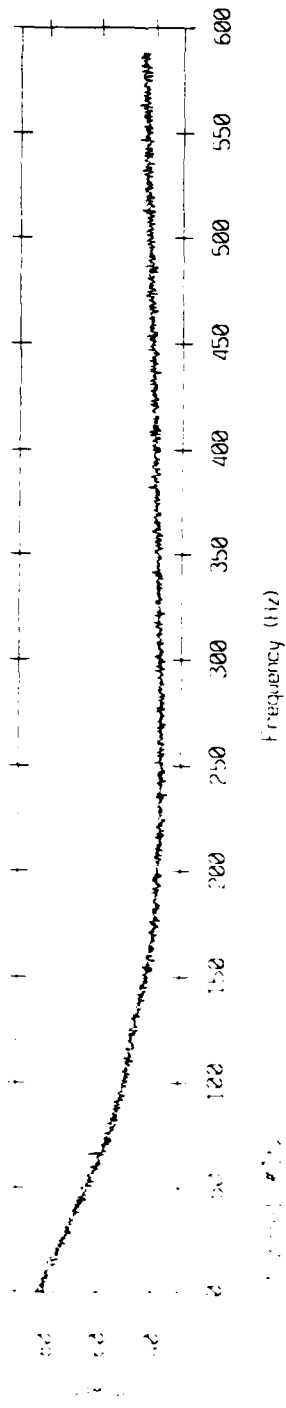


Power Spectrum 86180.1

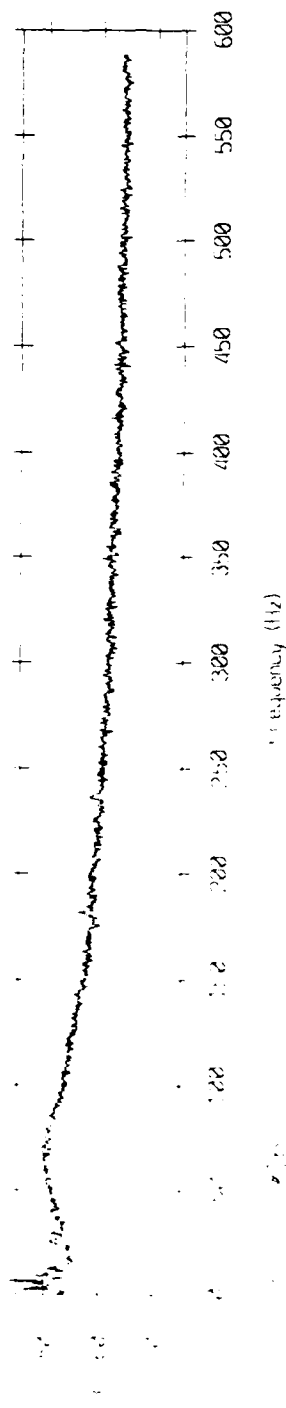
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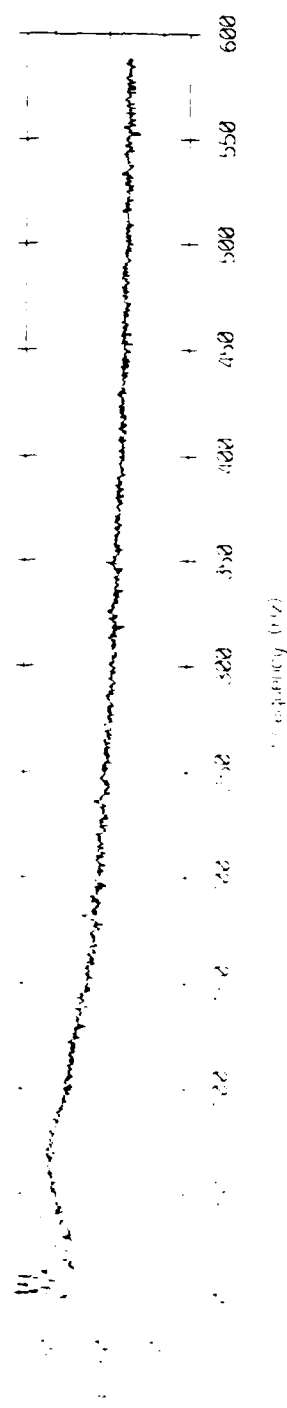
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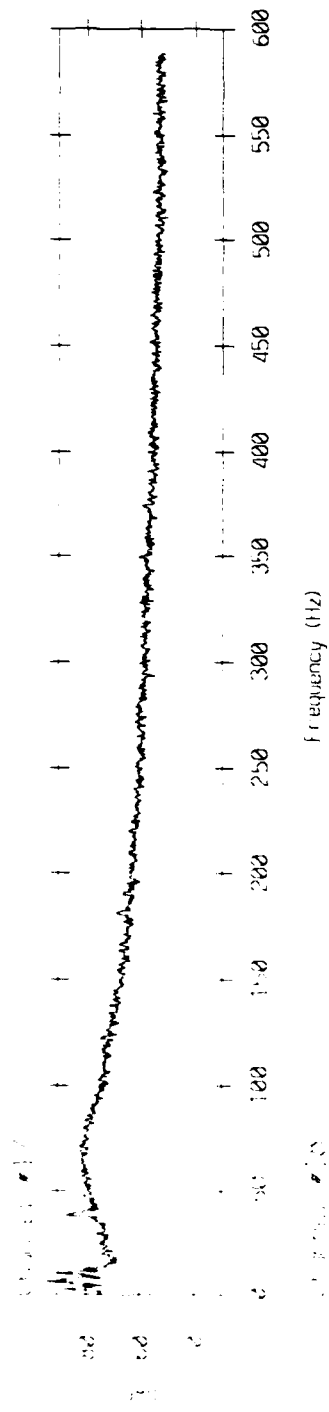
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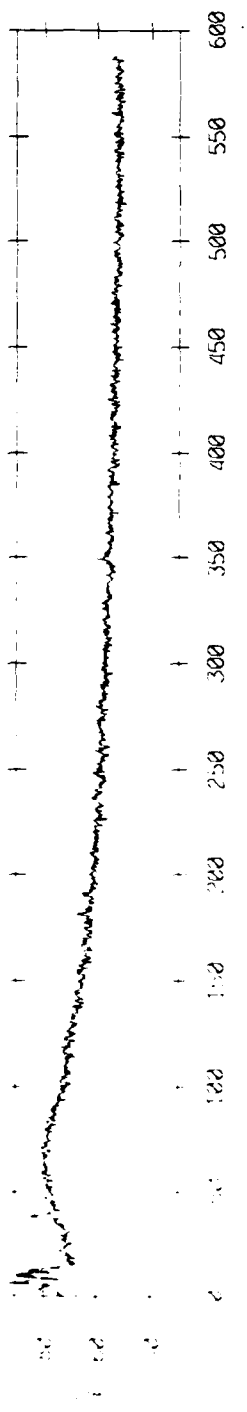
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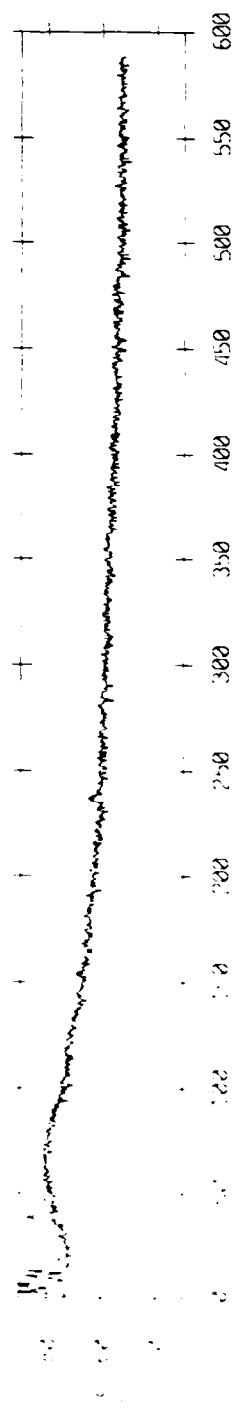
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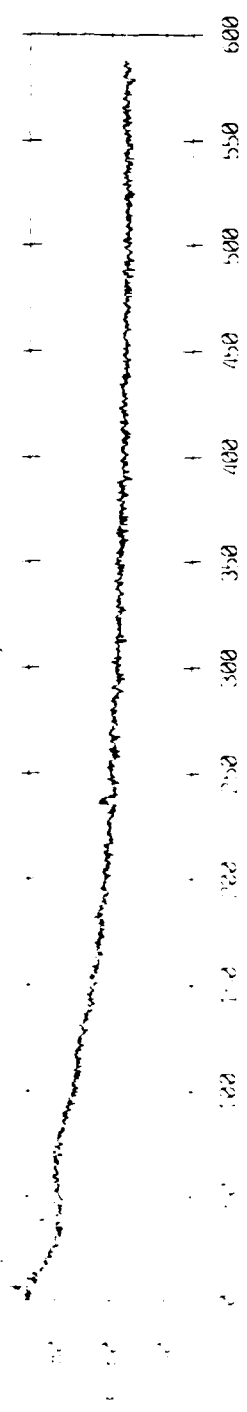
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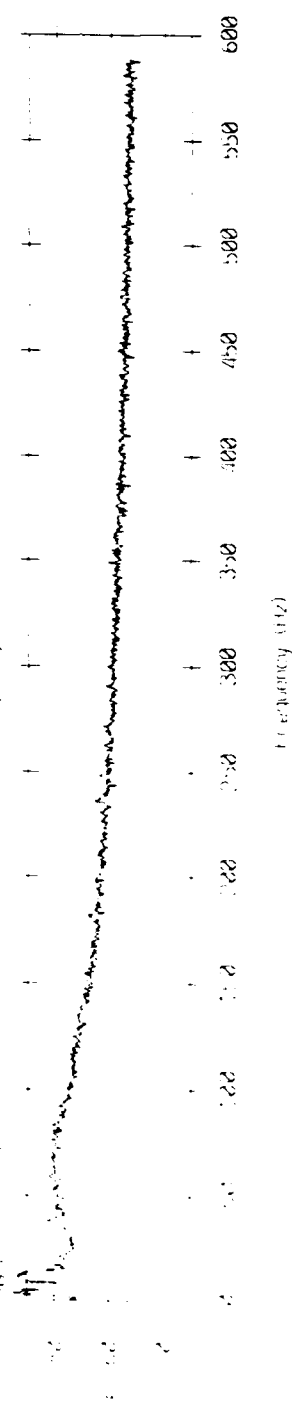
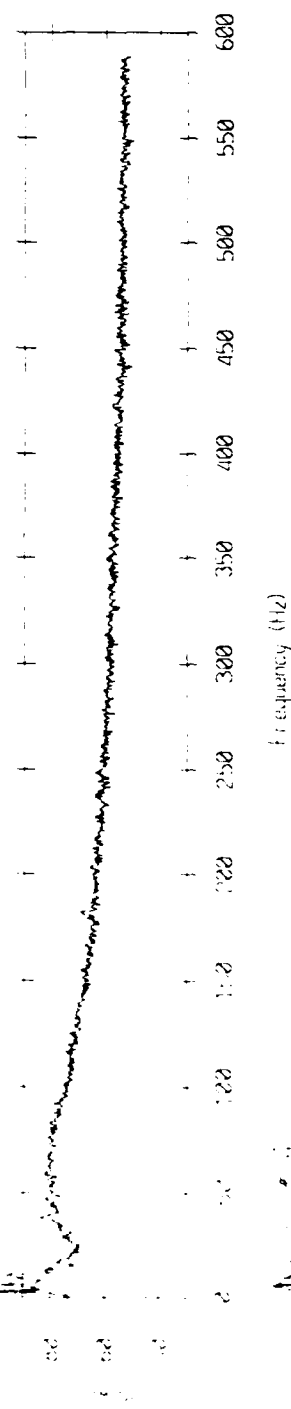
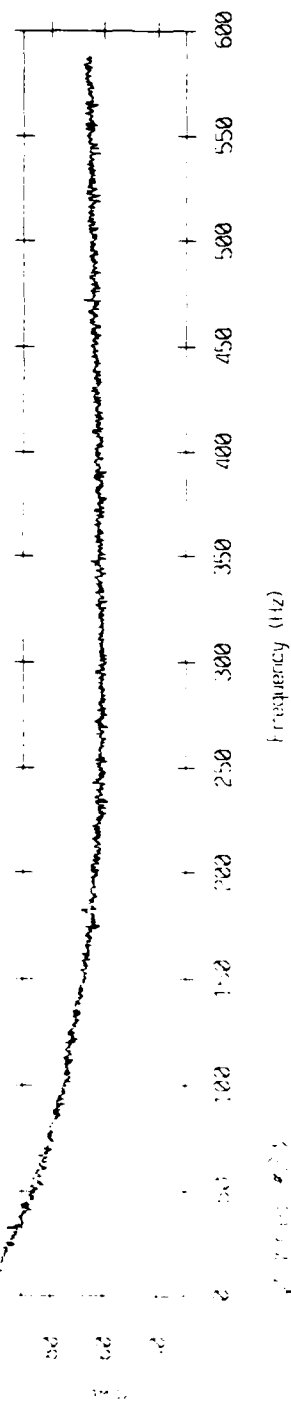
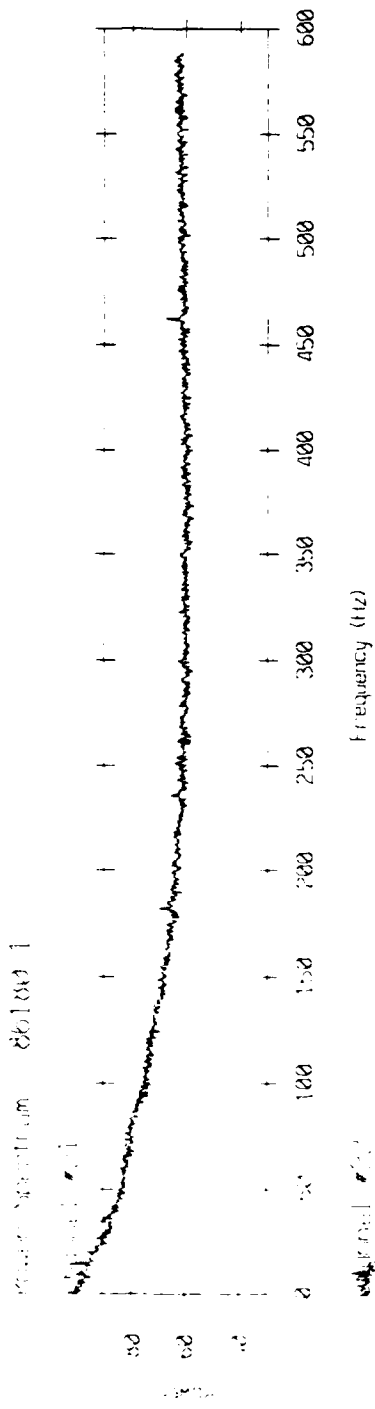
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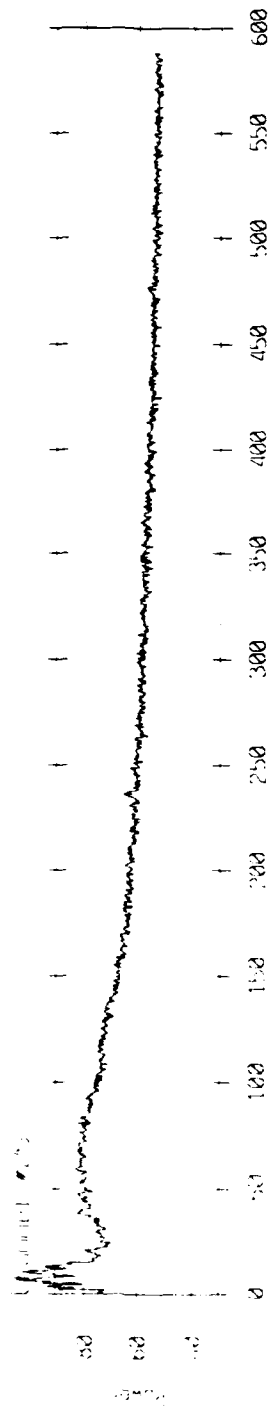
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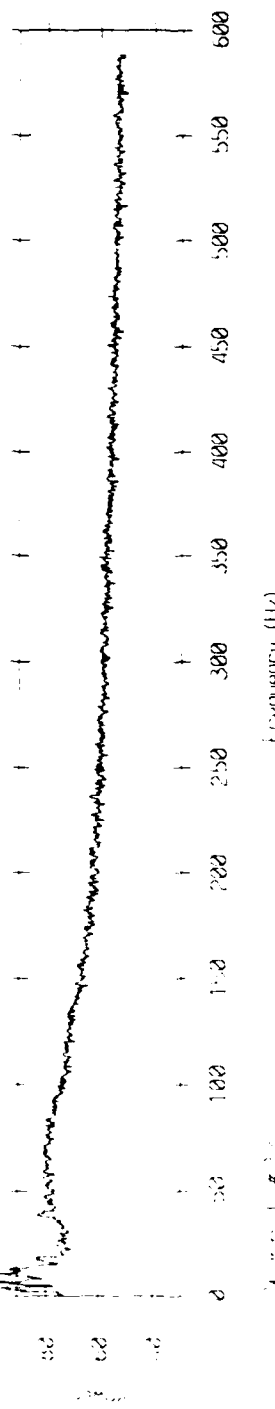
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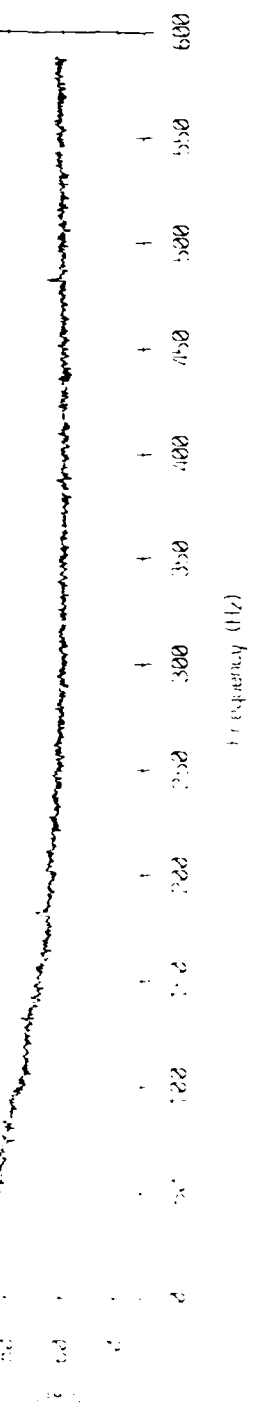
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Power Spectrum 861841

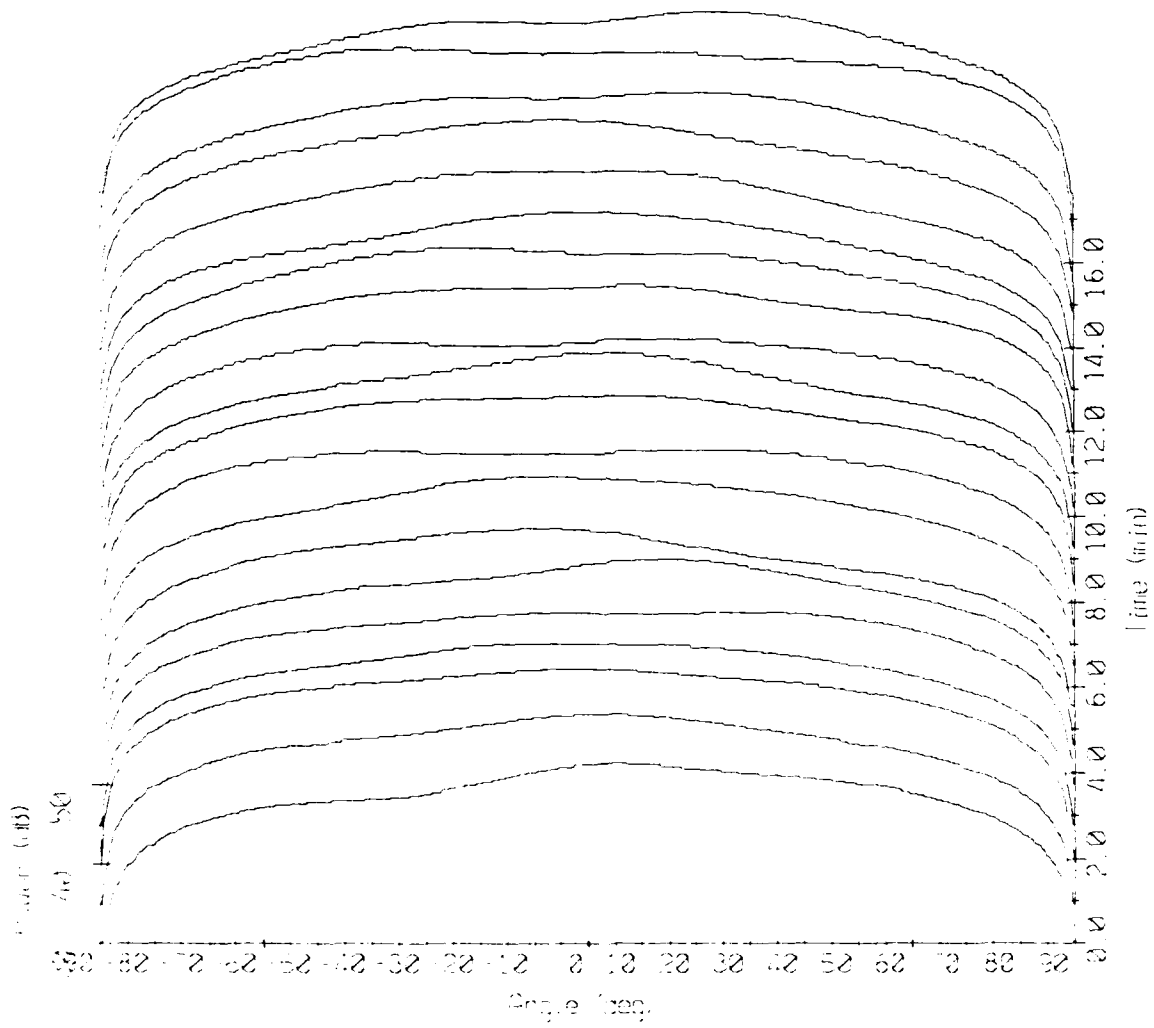


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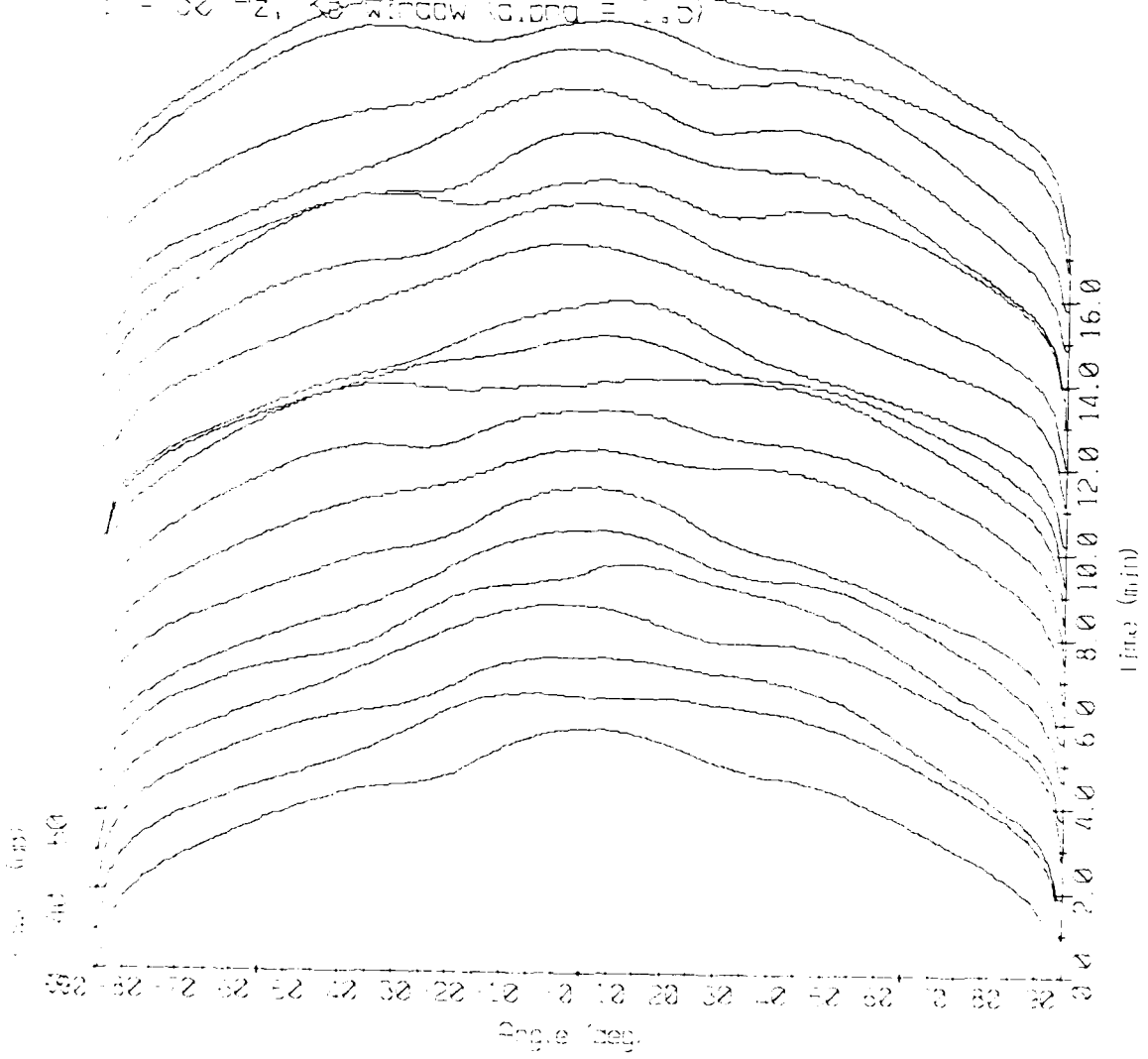


IV. Array Response: Waterfall, KB Window.

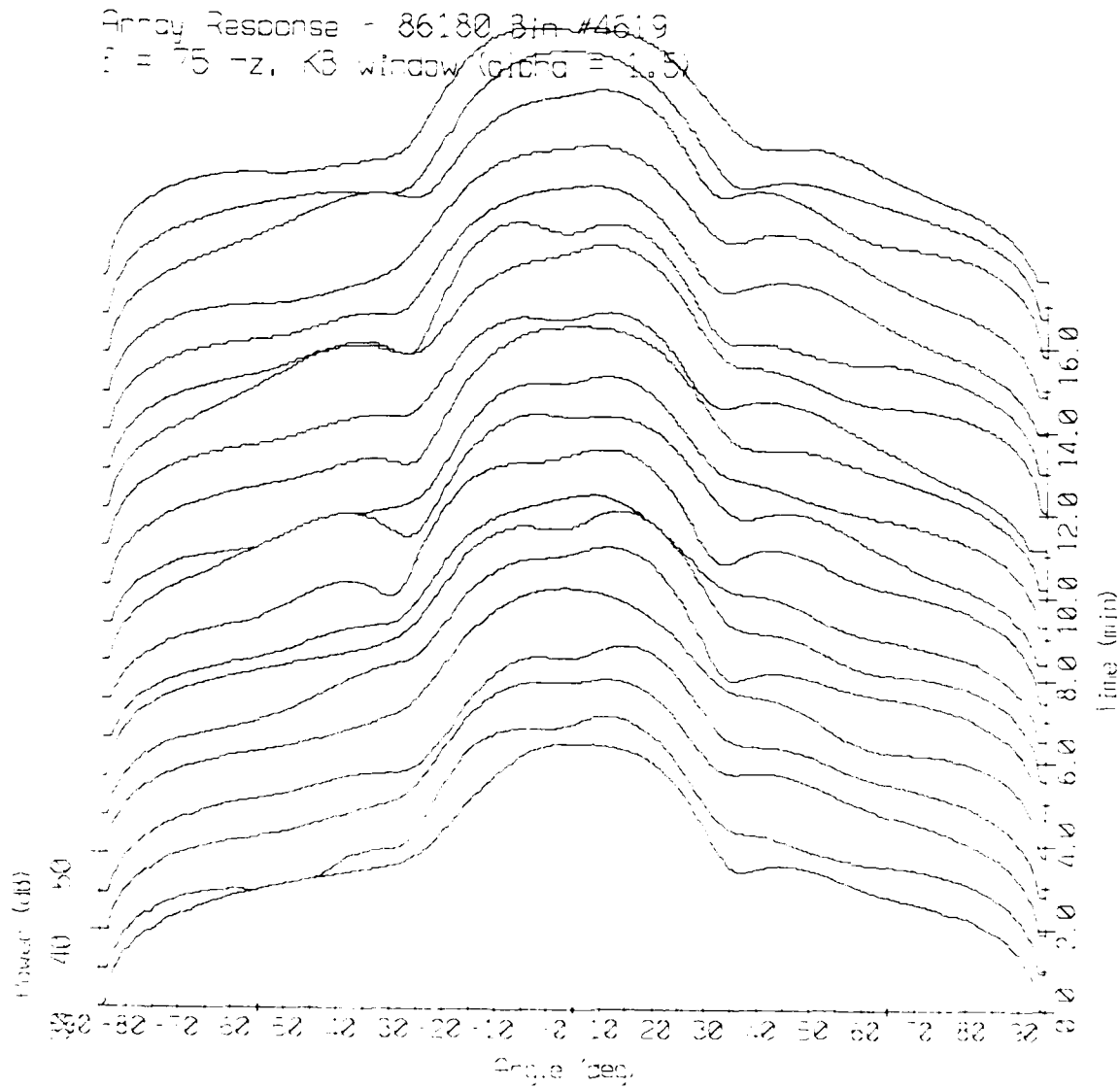
Energy Response - 86180 Bin #4271
 $\beta = 25$ Hz, $\Delta\beta$ window (alpha = 1.5)



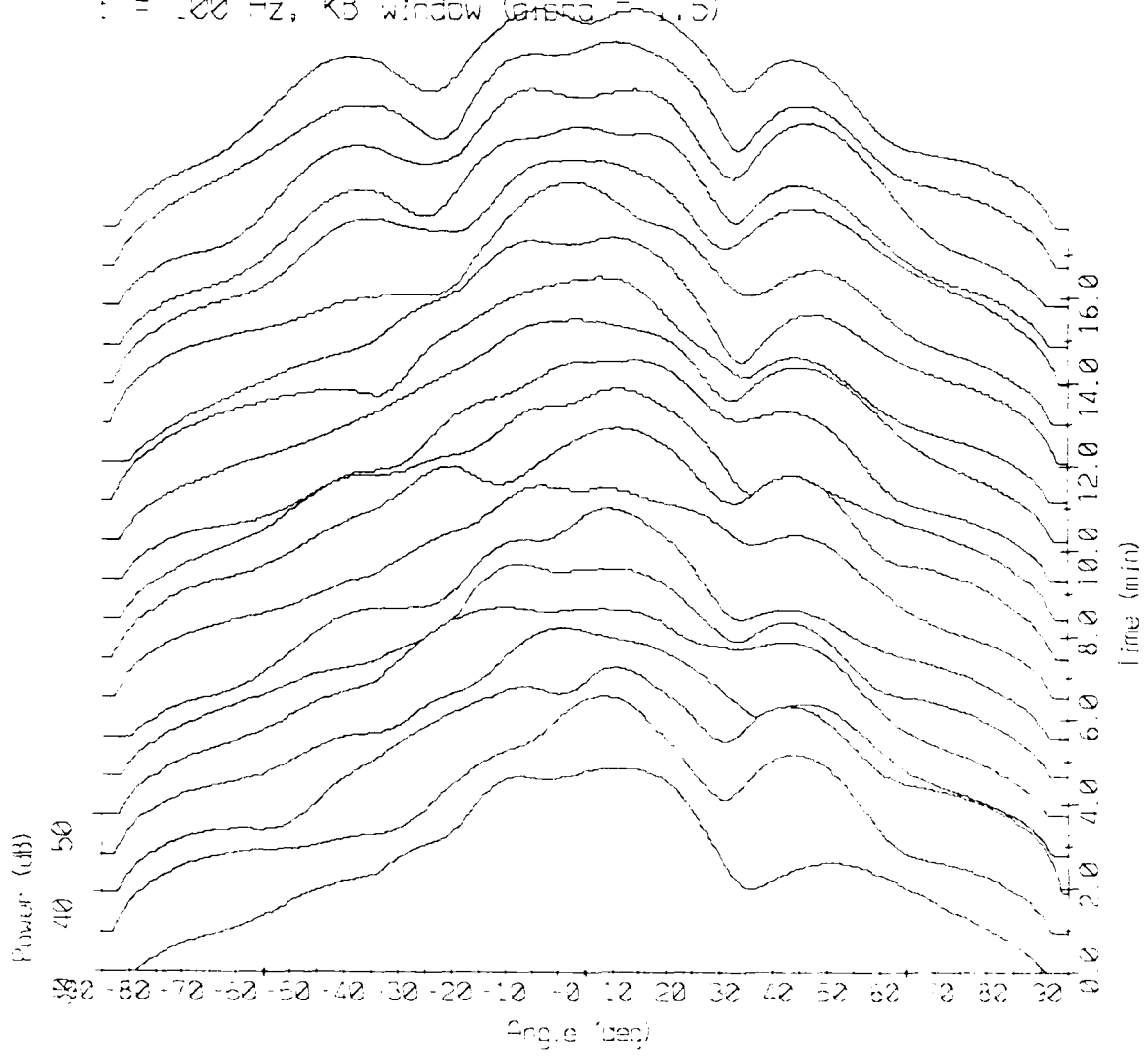
Condu Response - 86180 Bin #4445
2.4 50 Hz, 18 WINDOW (Angle = 1.5)



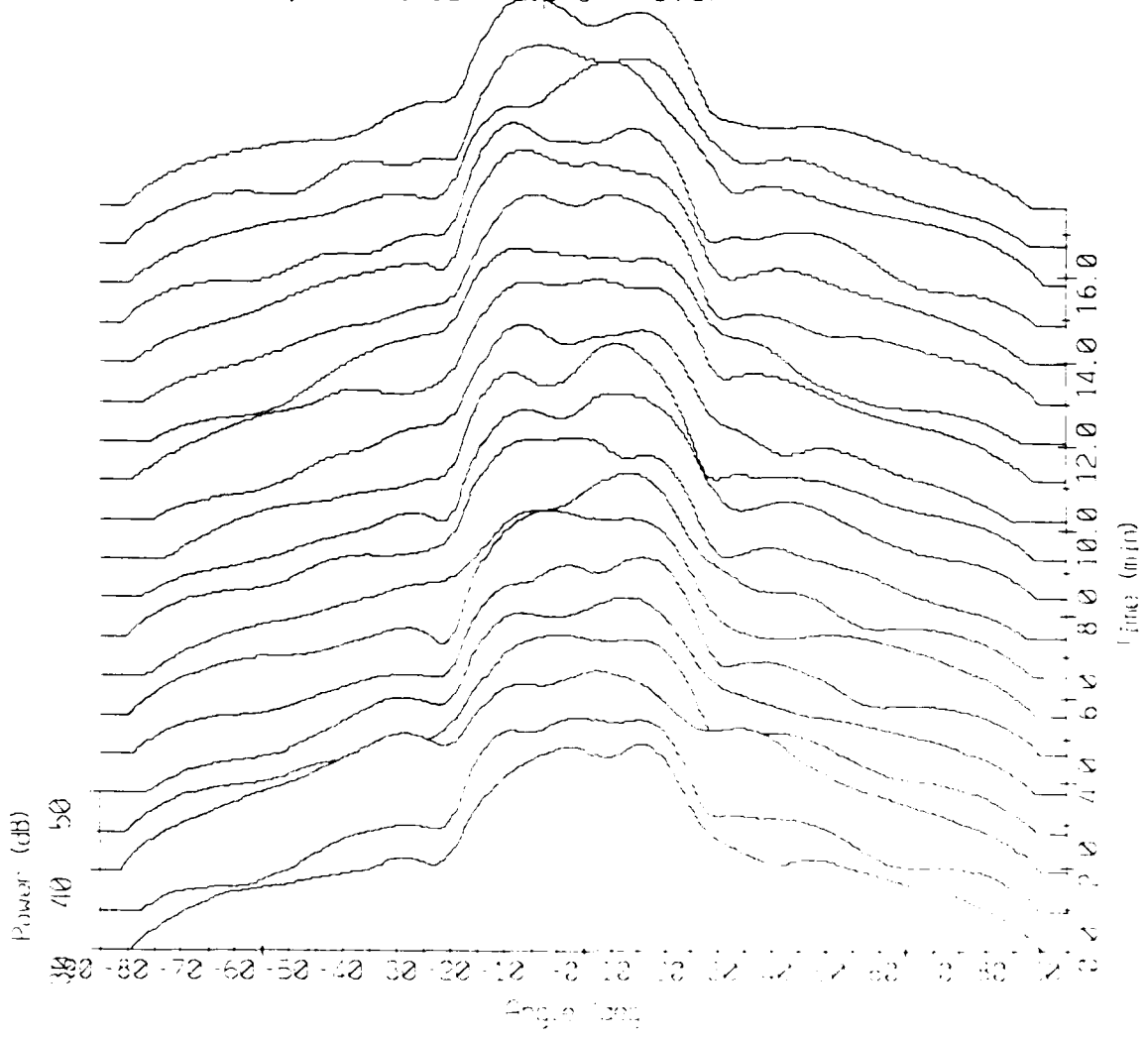
Amplitude Response - 86180 Bin #4619
 $\beta = 75$ Hz, KB window (alpha = 1.5)



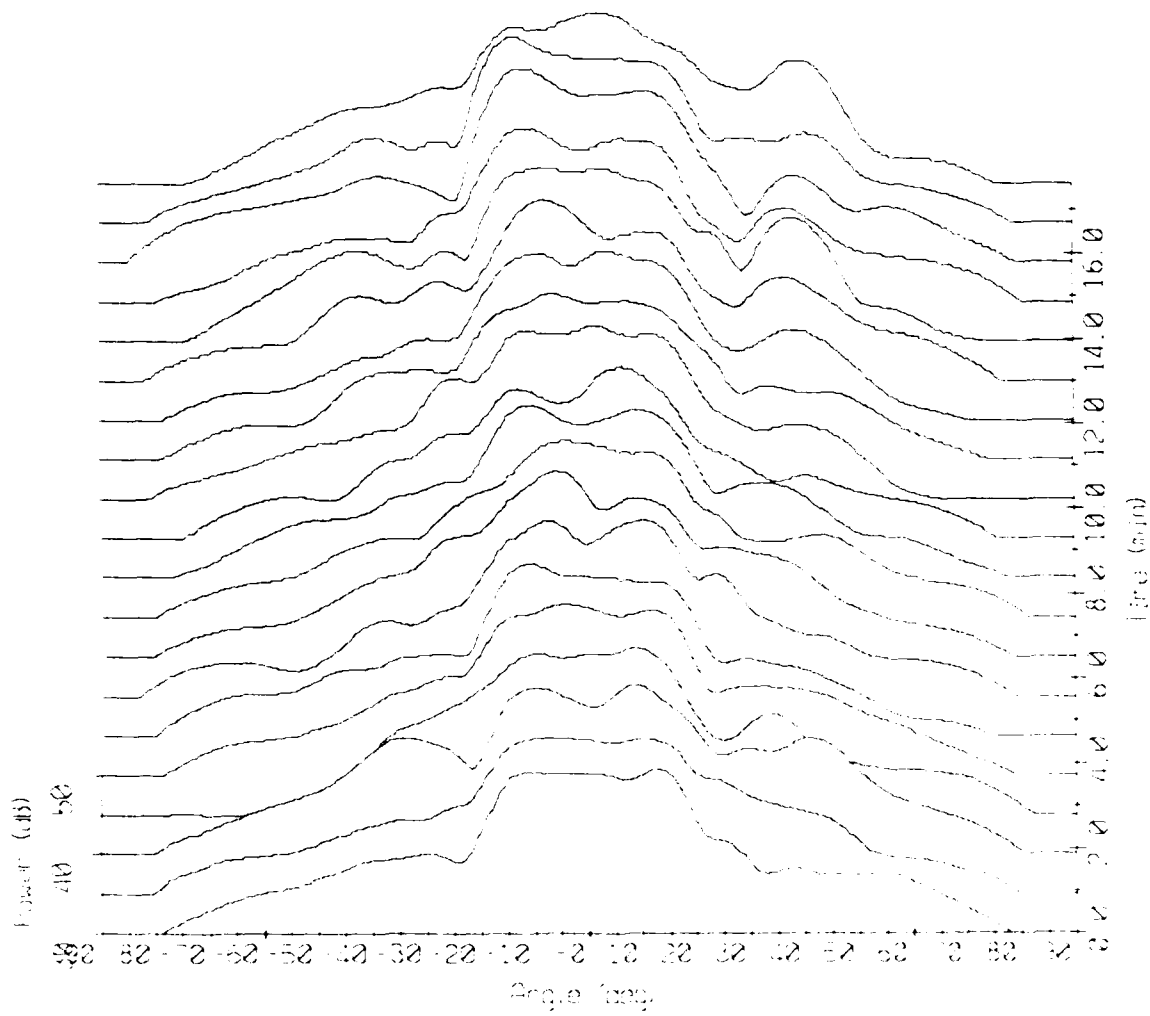
Array Response - 86180 Bin #4793
 $f = 100$ Hz, KB window (width = 1.5)



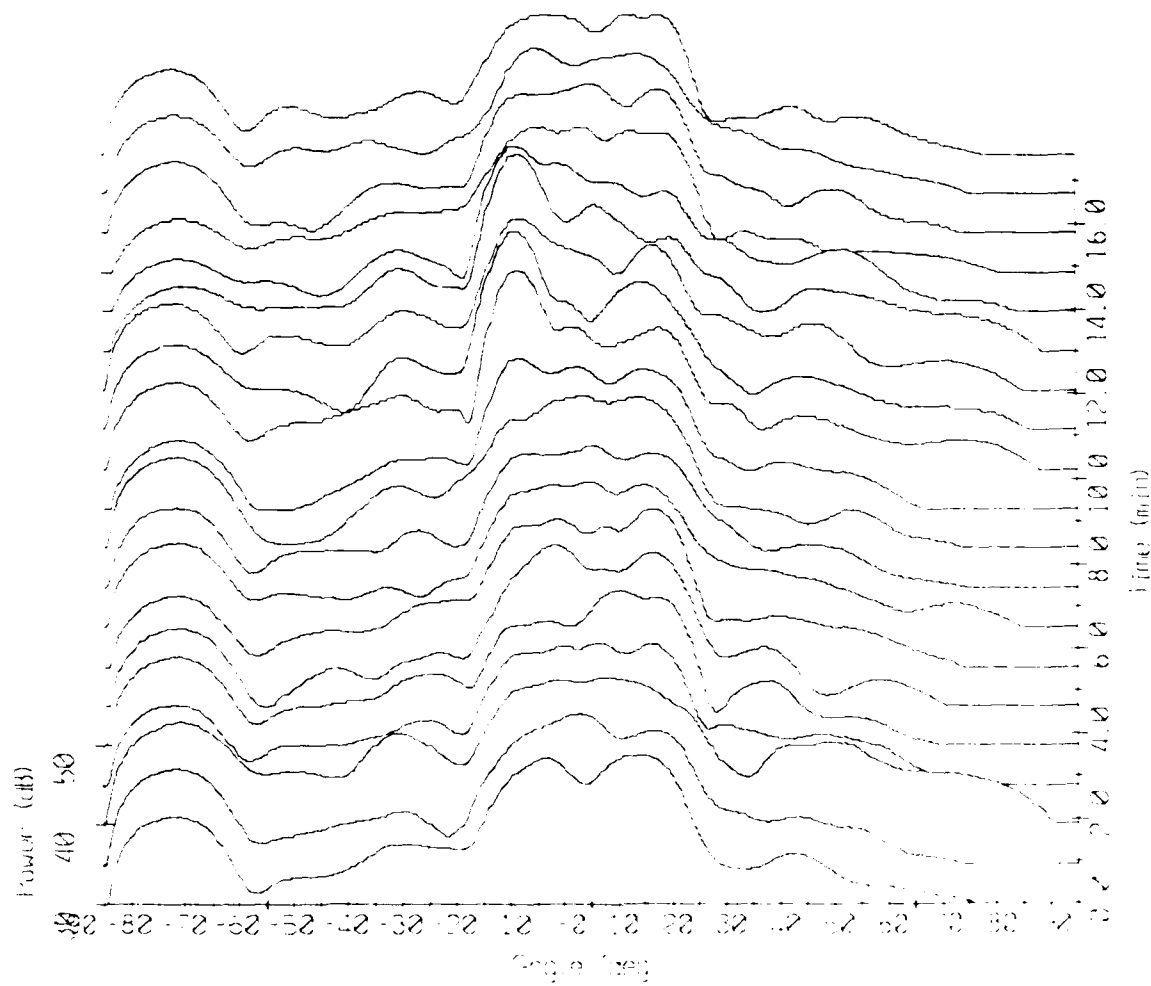
Array Response - 86180 Bin #4967
 $f = 125$ Hz, K8 window ($\alpha = 1.5$)



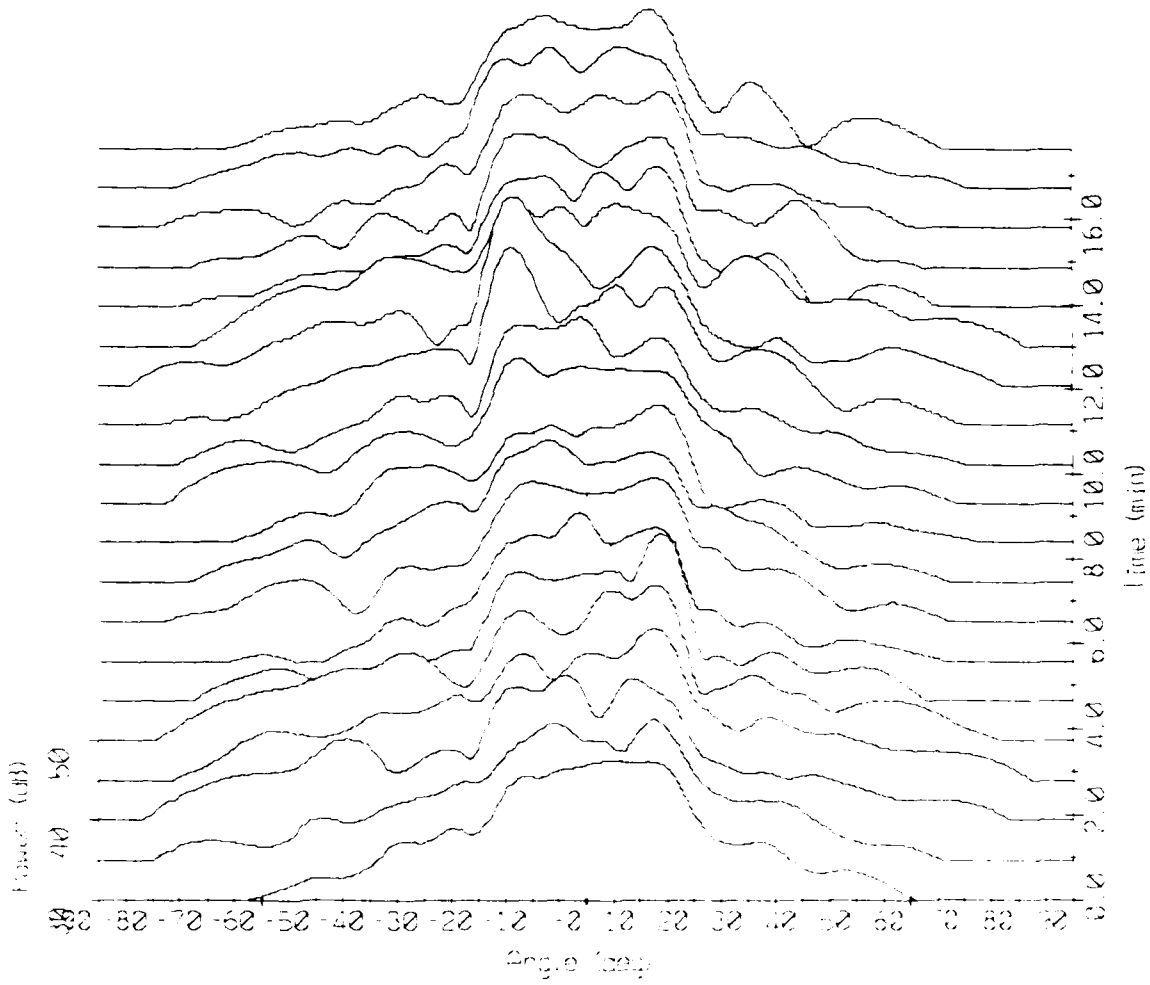
Array Response - 86180 Bin #5141
 $\beta = 1.50$ -z, $\Delta\theta$ window (alpha = 1.5)



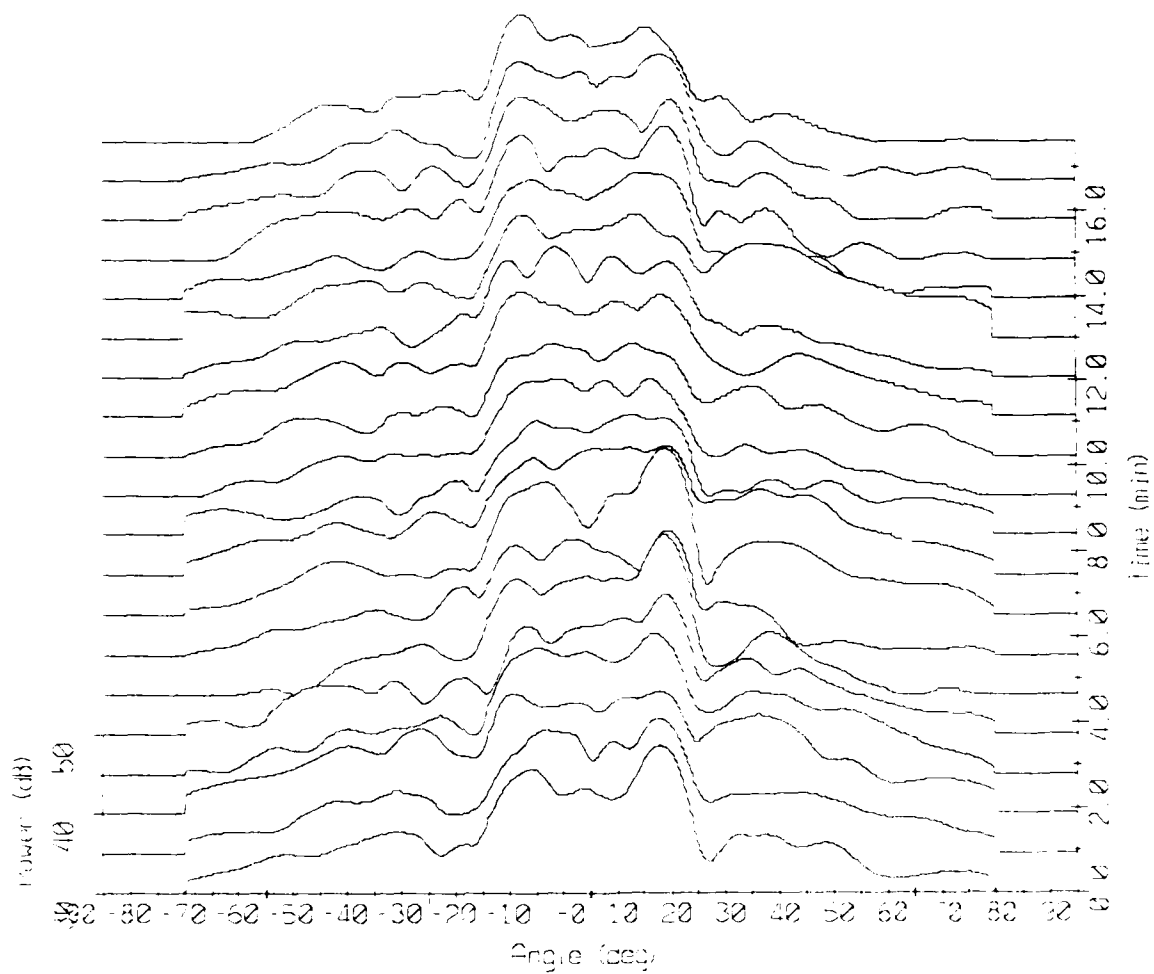
Array Response - 86180 Bin #5316
 $\beta = 1.75$ -z, K8 Window (alpha = 1.5)



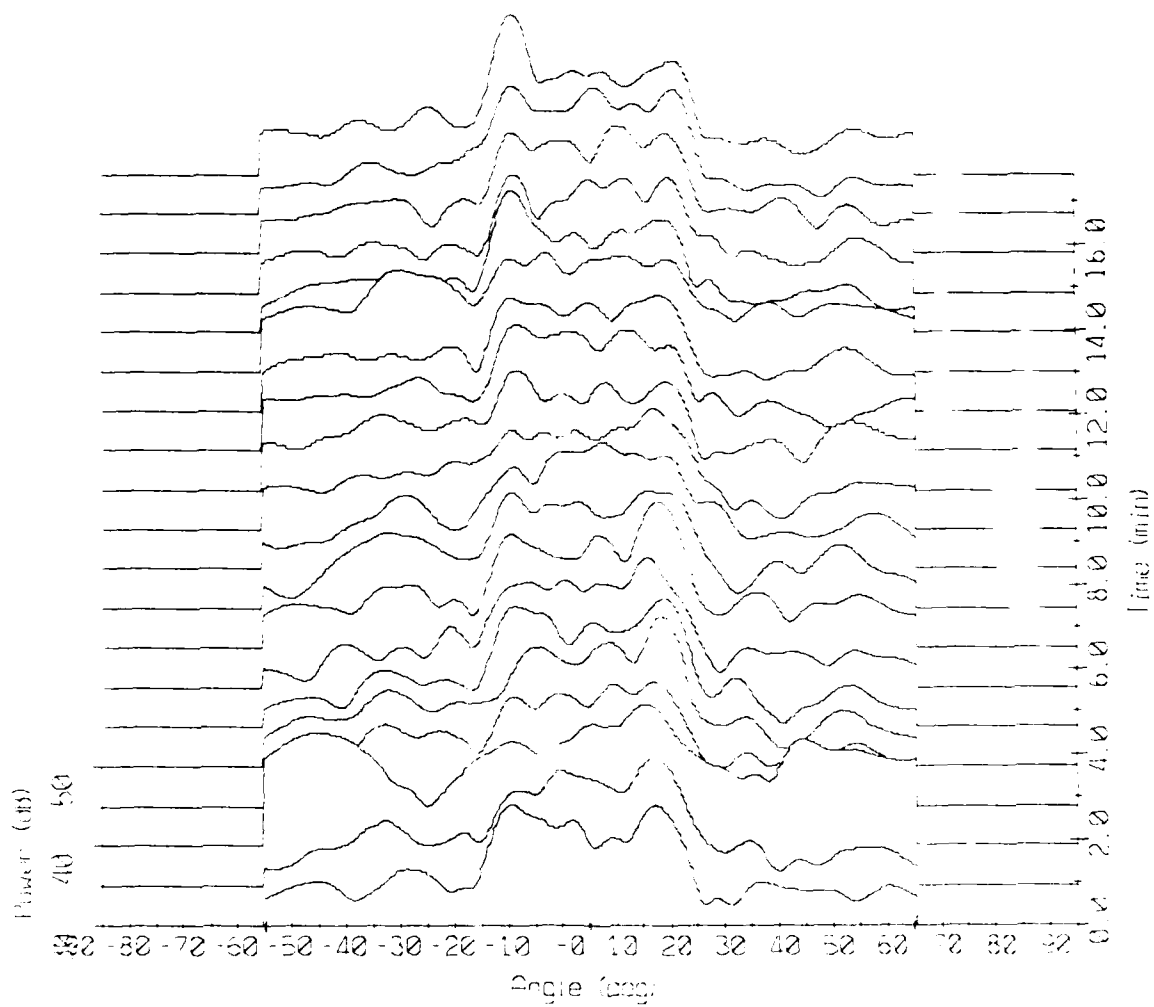
Array Response - 86180 Bin #5490
 $\tau = 200$ -z, K3 window (alpha = 1.5)



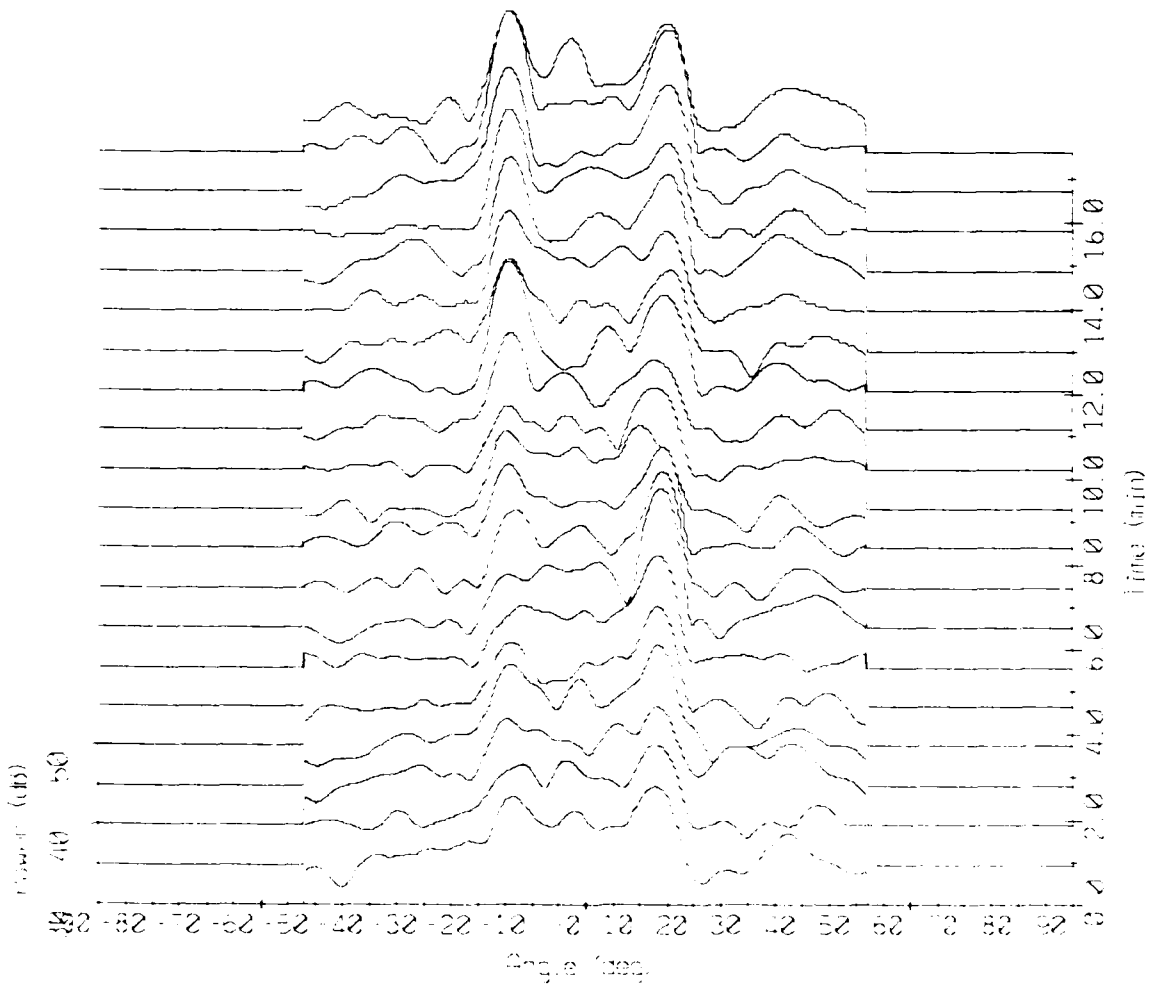
Acoustic Response - 86180 31- #5664
 $f = 225$ Hz, ΔB window (alpha = 1.5)



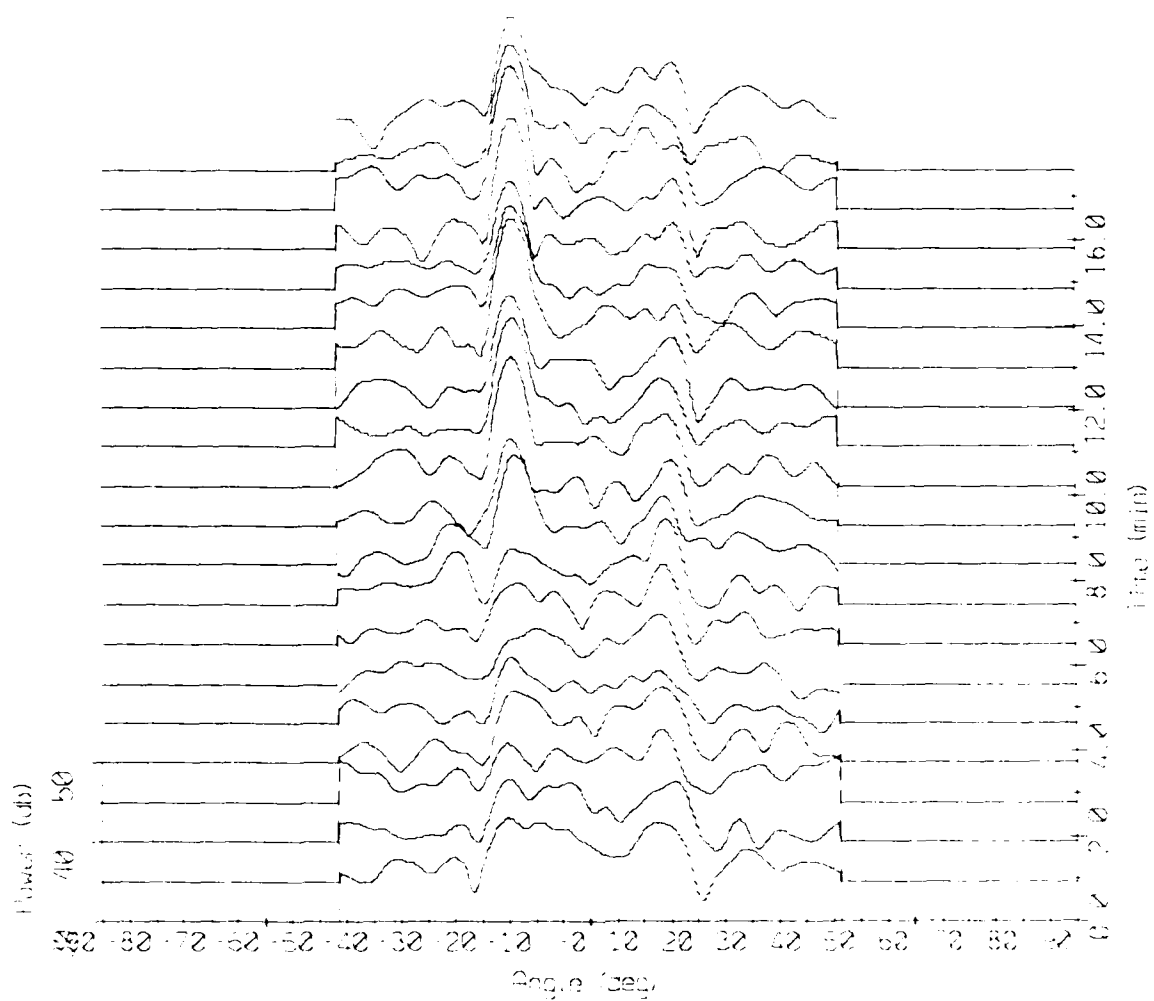
Energy Response - 86182 3in #5832
 $\lambda = 250 \text{ nm}$, $\Delta\lambda$ window (alpha = 1.5)



Energy Response - 86180 Bin #6012
 $f_c = 275$ Hz, Δf window (alpha = 1.5)

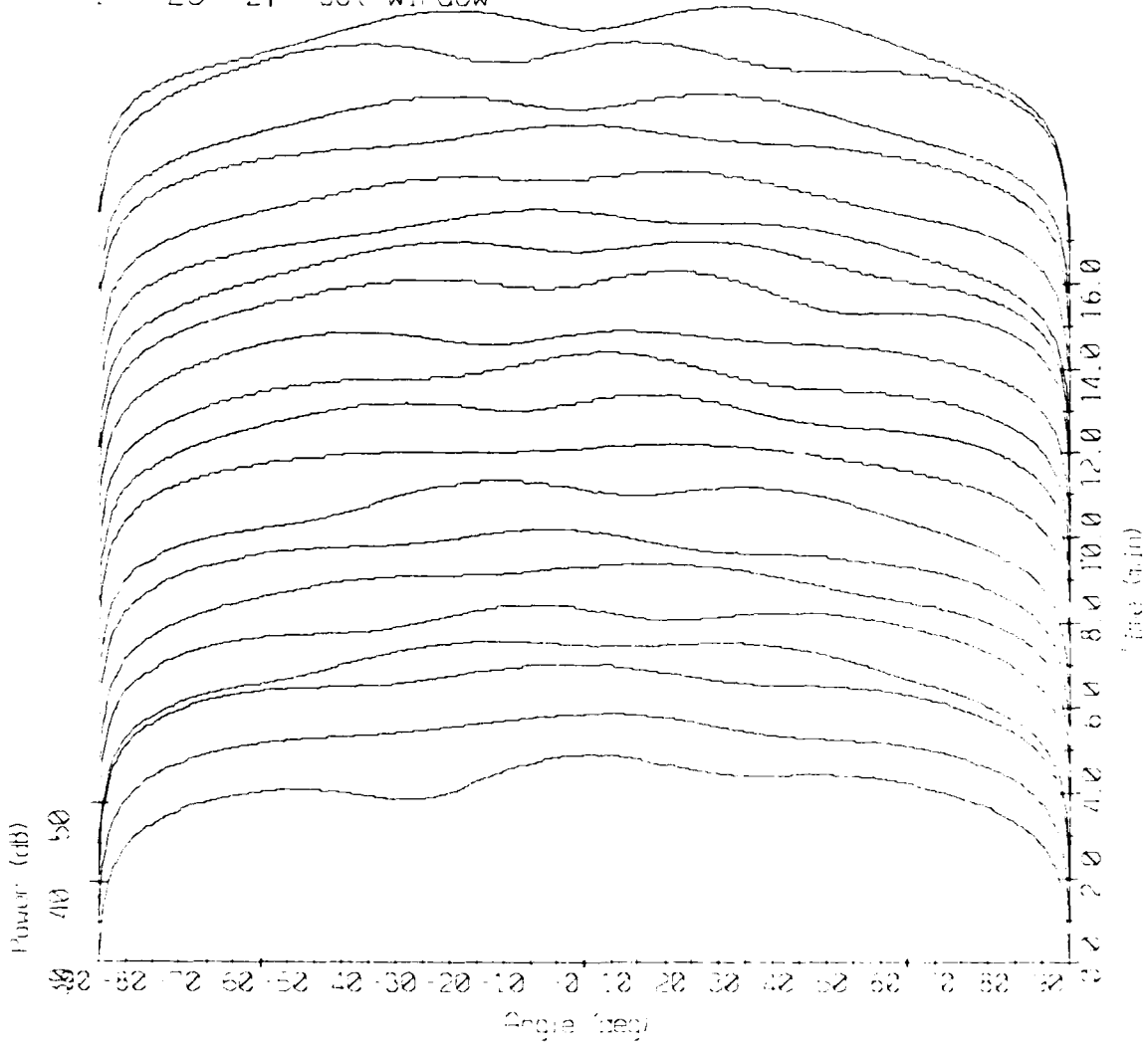


Power Response - 86180 314 #6186
f = 320 Hz, K window (alpha = 1.5)

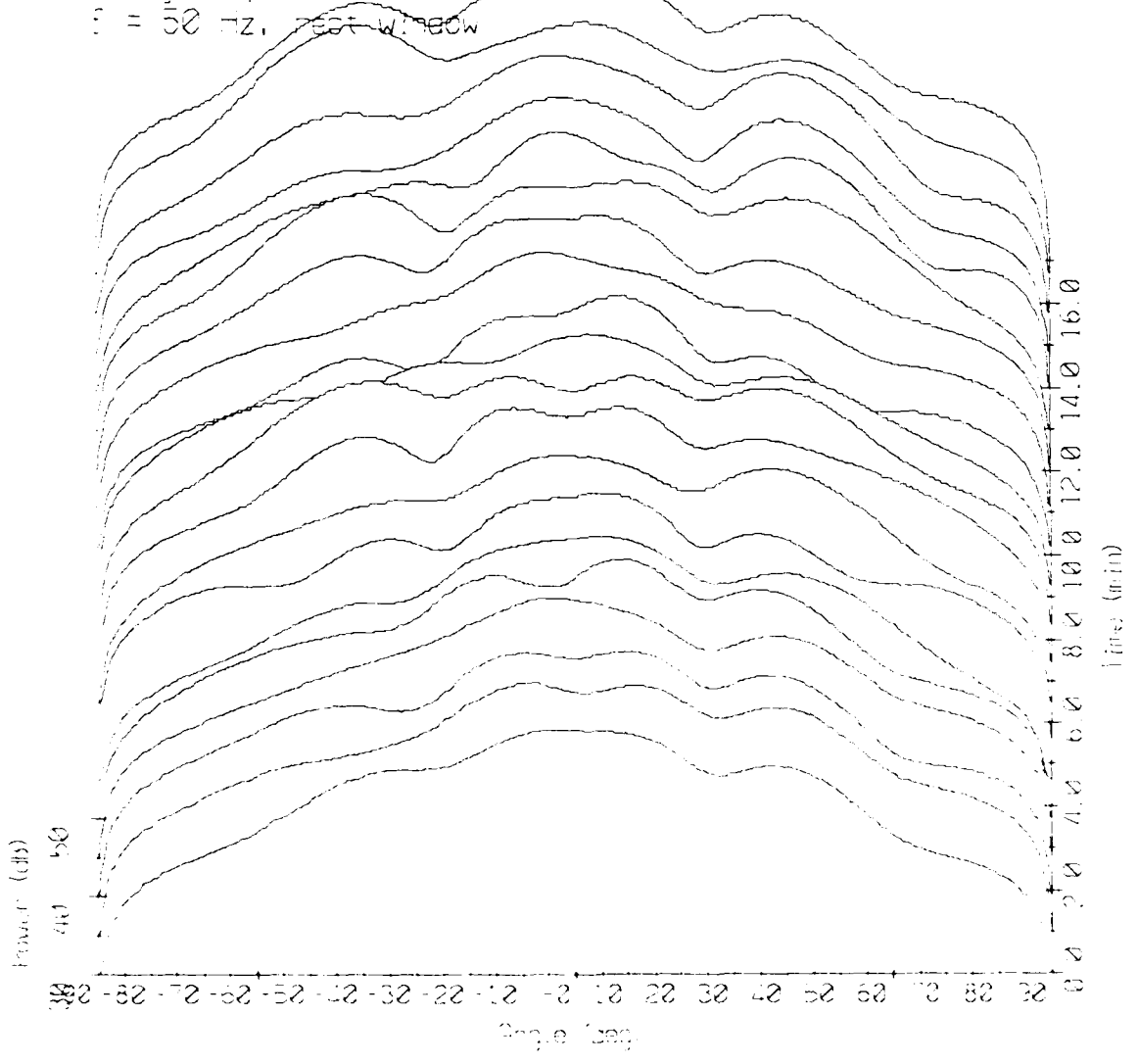


V. Array Response: Waterfall, Rect Window.

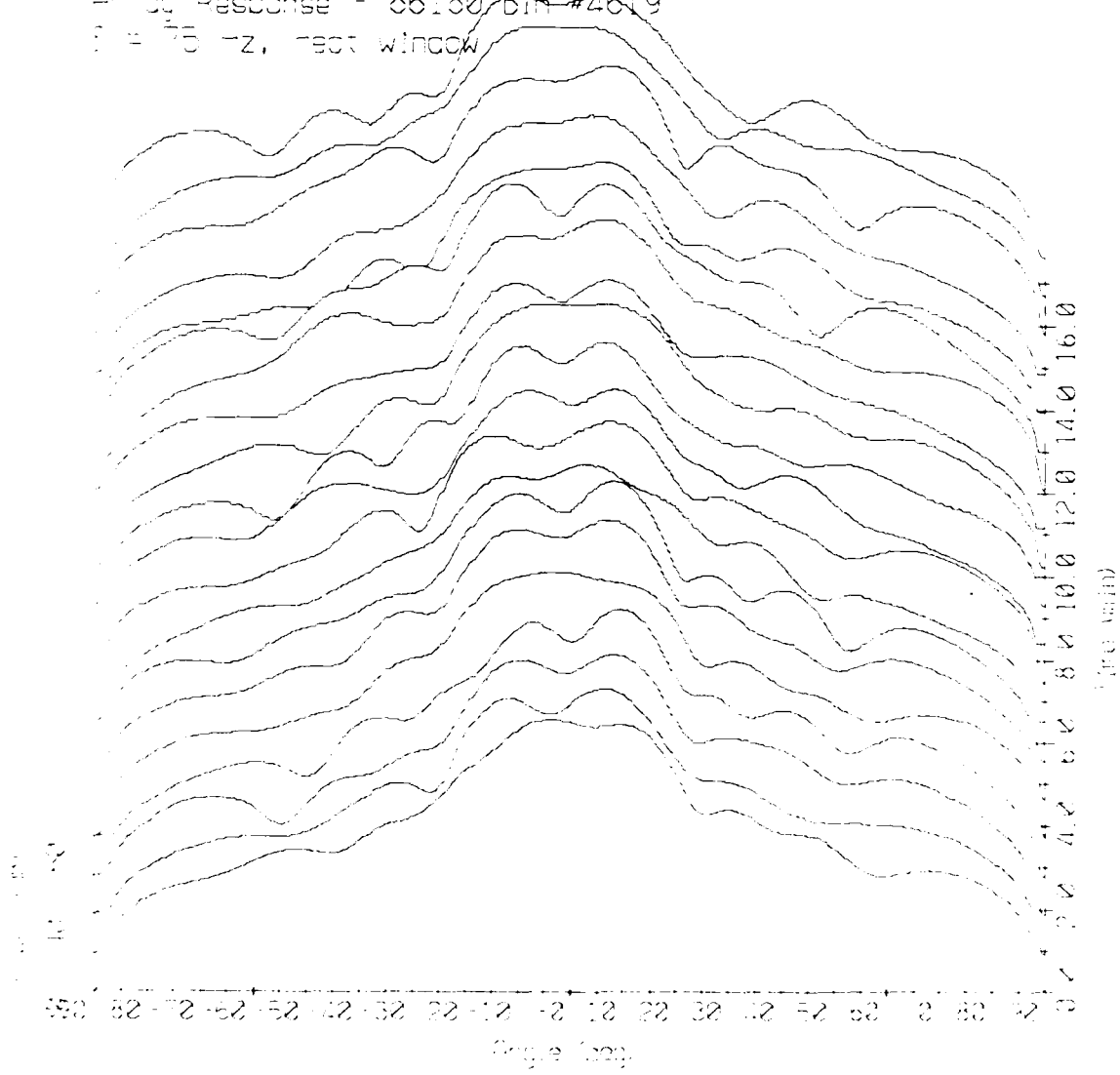
Array Response - 86180 Bin #4271
 $f = 25$ Hz, next window



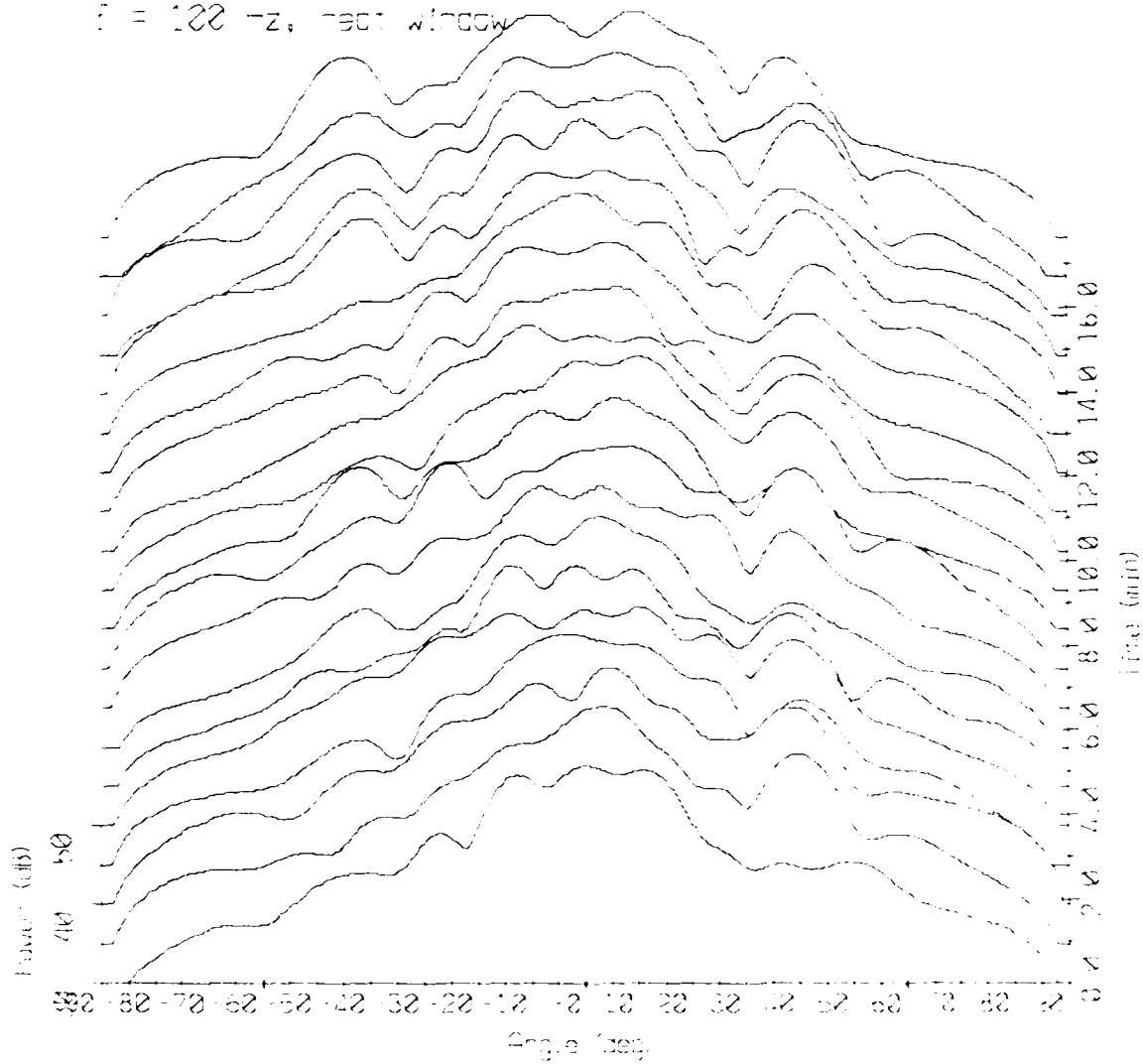
Array Response - 86180 Bin #4445
 $\Delta = 50$ Hz, Test Window



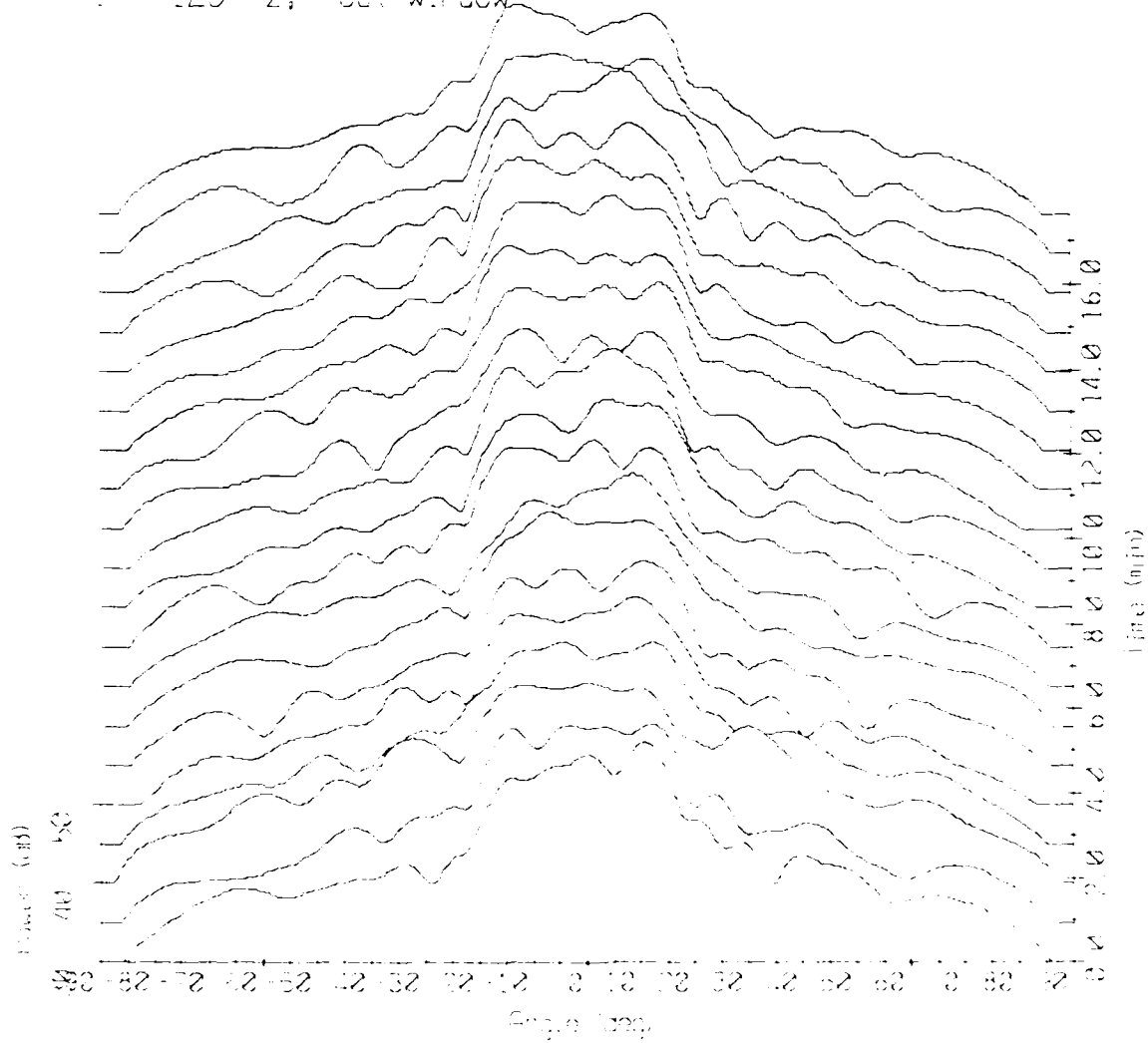
Angu Response - 86180 Bin #4519
F = 75 Hz, rect window



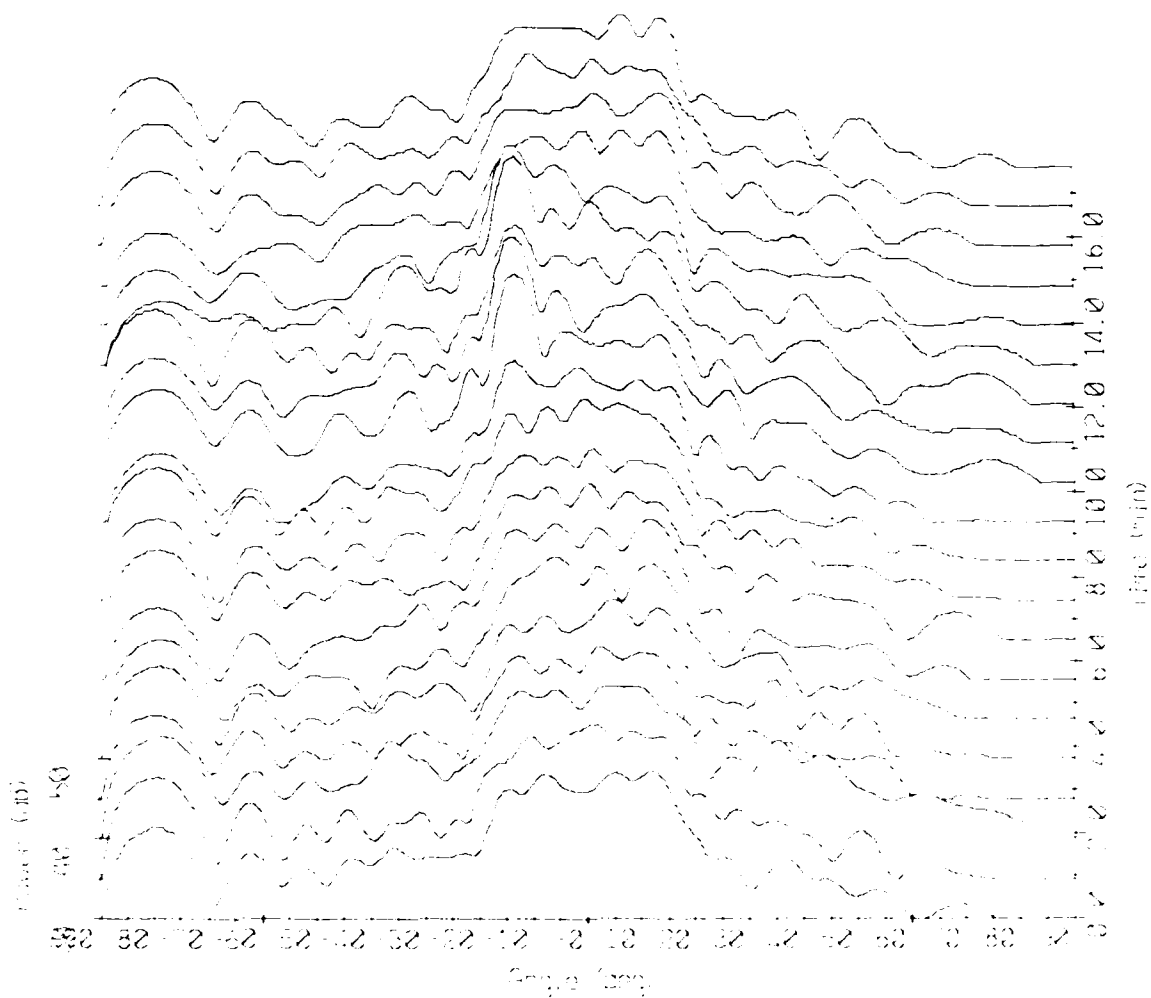
Acoustic Response - 86180 Bin #4793
N = 120 Hz, 1901 window



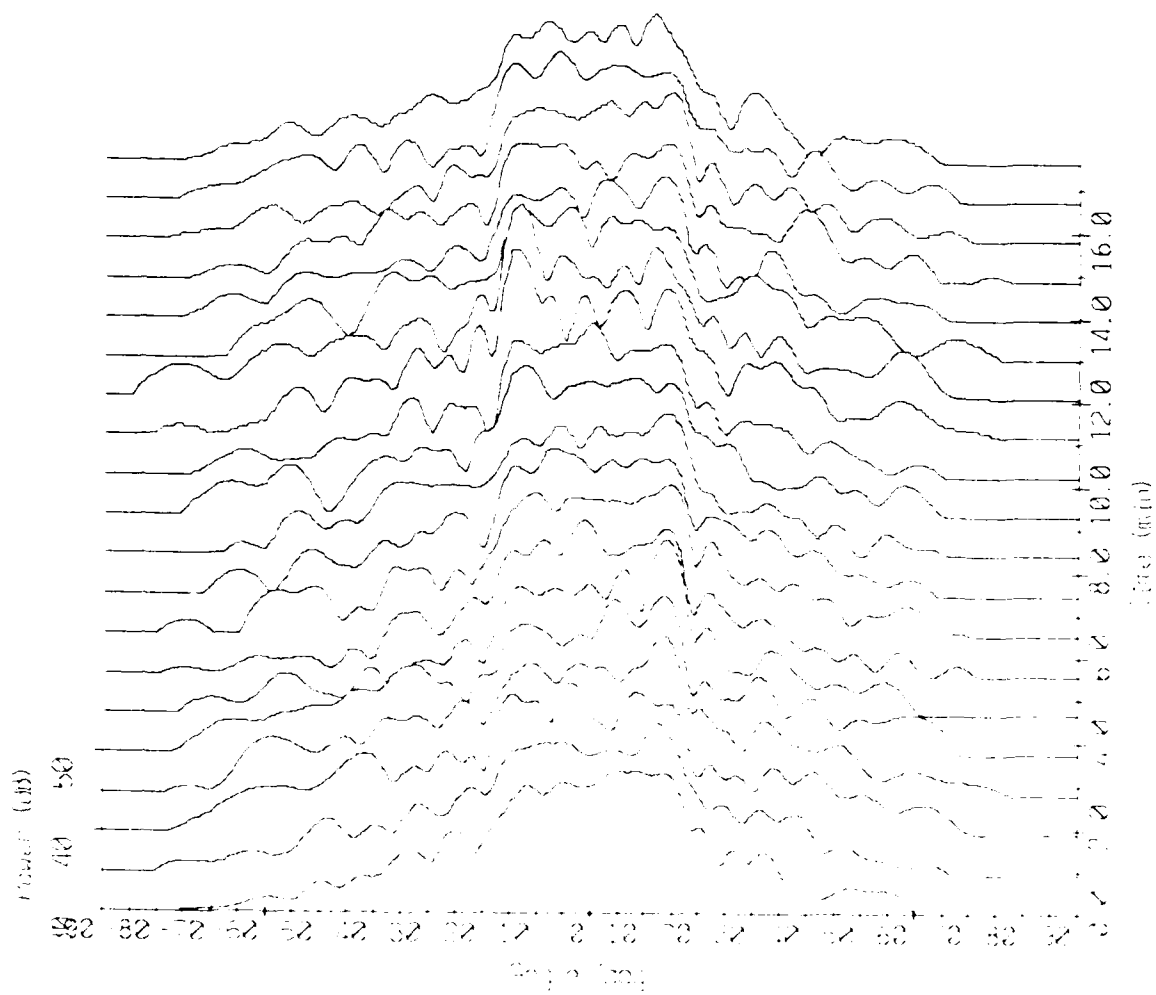
Acq. Response - 86180 Bin #4967
 $\Delta f = 125$ Hz, rect. window



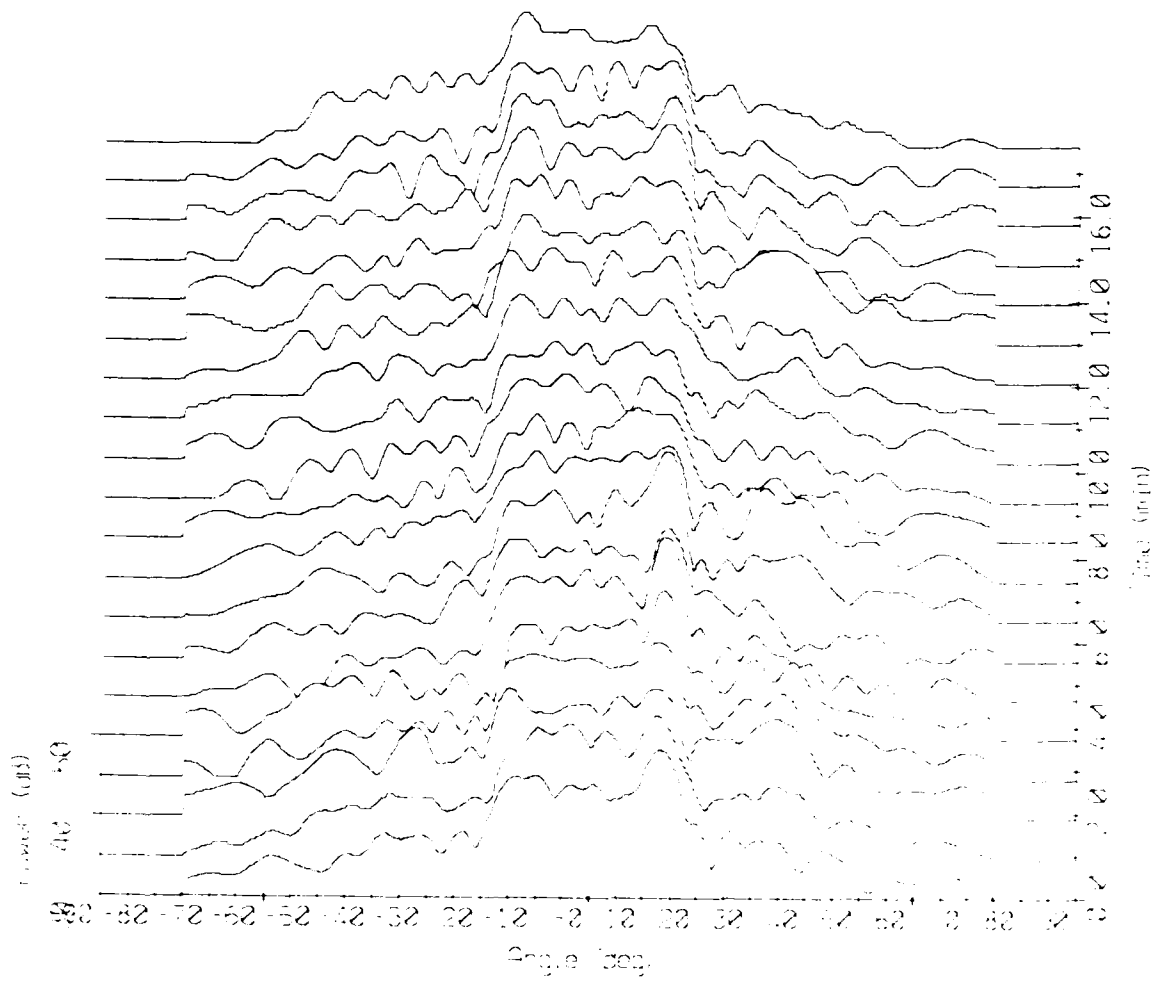
Band Response - 36180 Bin #5316
BW = 175 Hz, rect. window



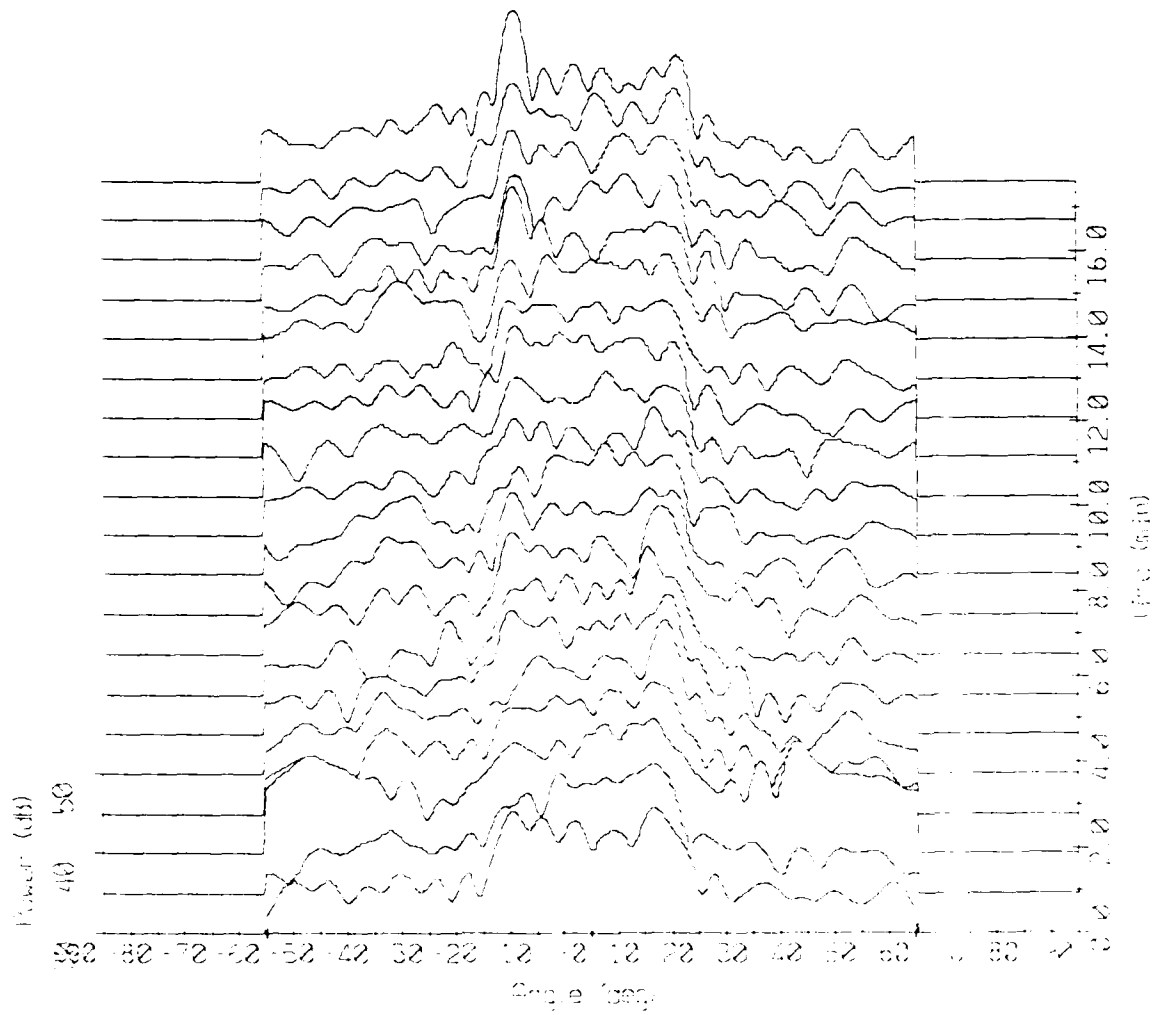
Array Response - 86180 Bin #5490
 $\Delta f = 200$ Hz, rect window



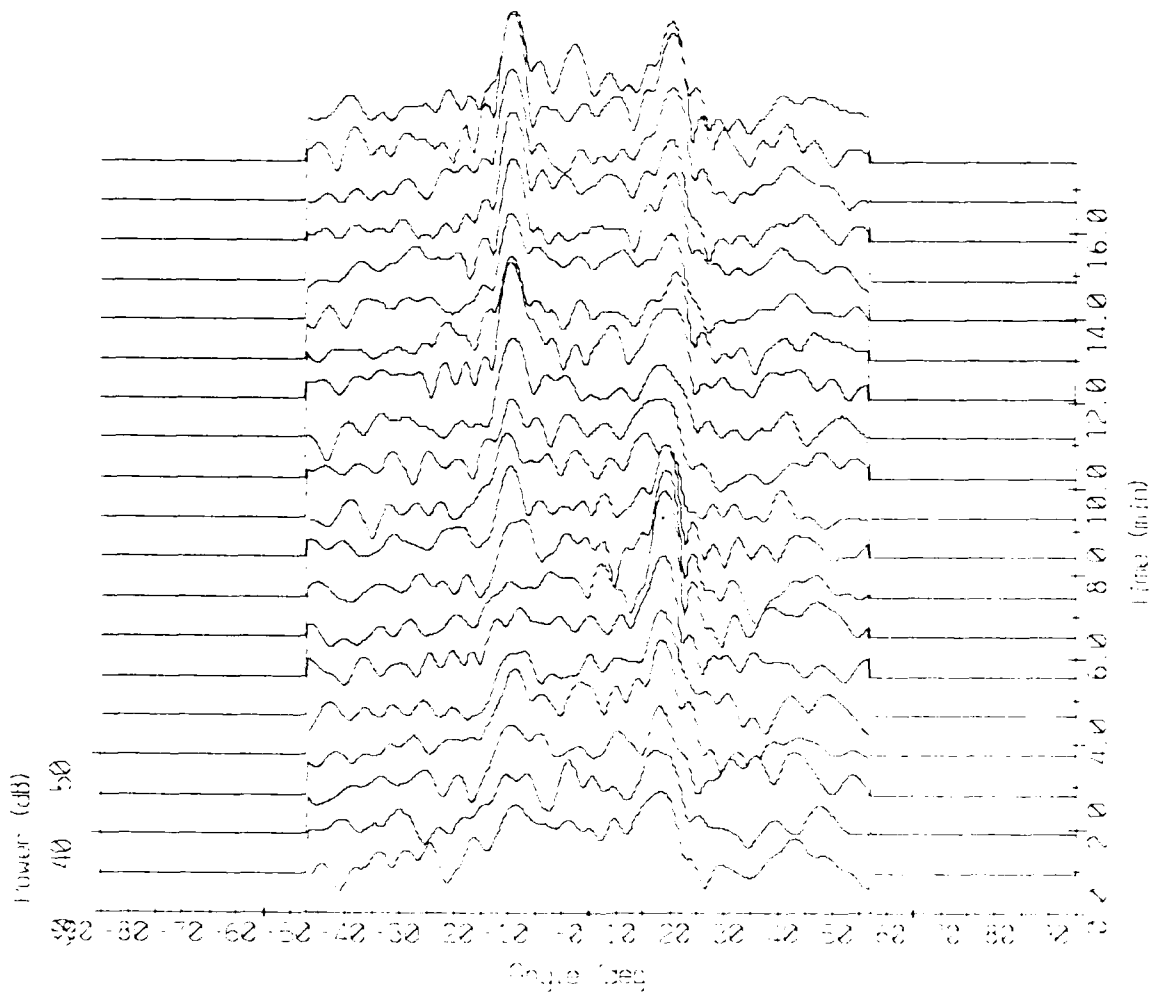
Array Response - 86180 Bin #5664
 $f = 225$ Hz, next window



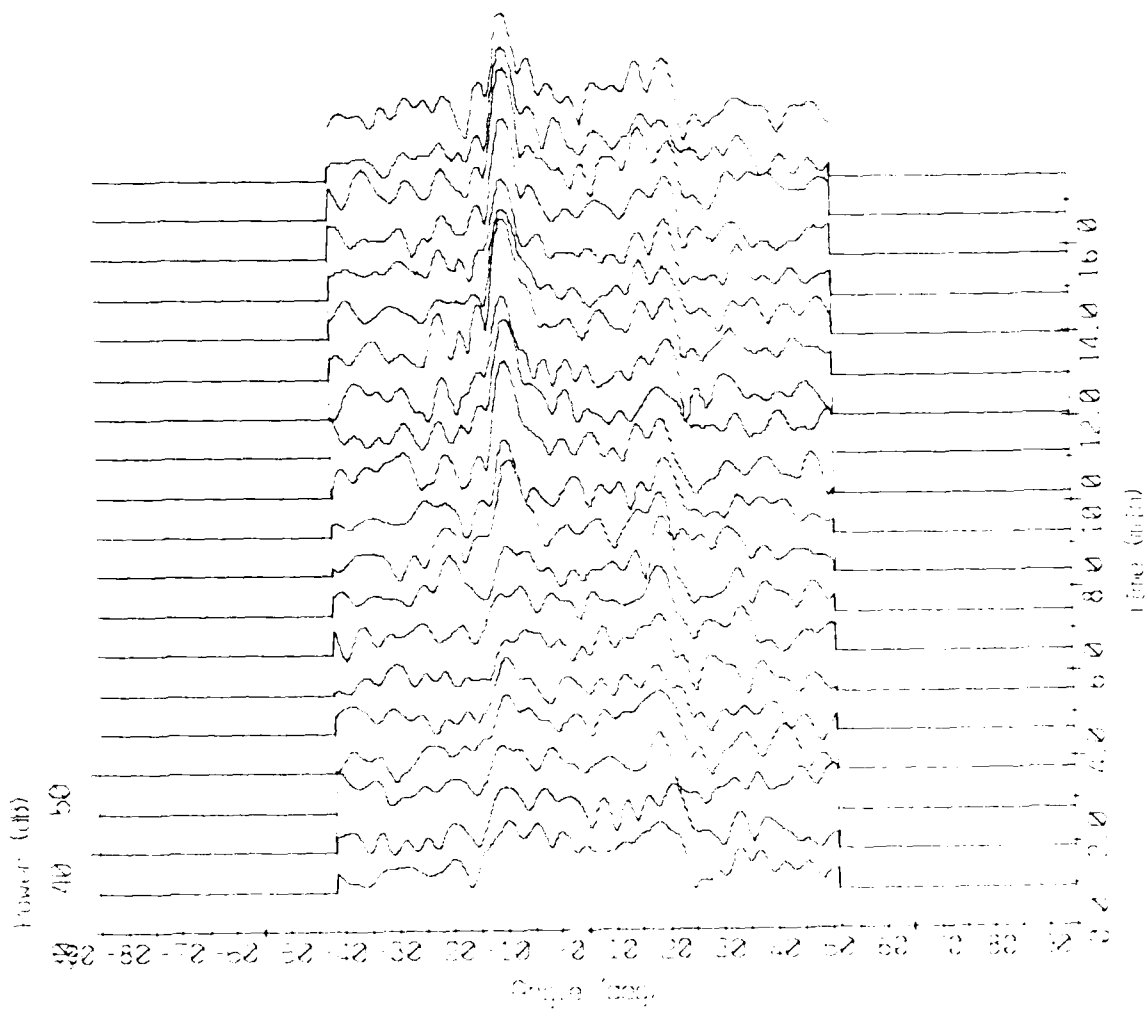
Energy Response - 86180 Bin #5832
f = 250 Hz, rect window



Array Response - 36180 Bin #6212
 $f = 275$ Hz, rect window



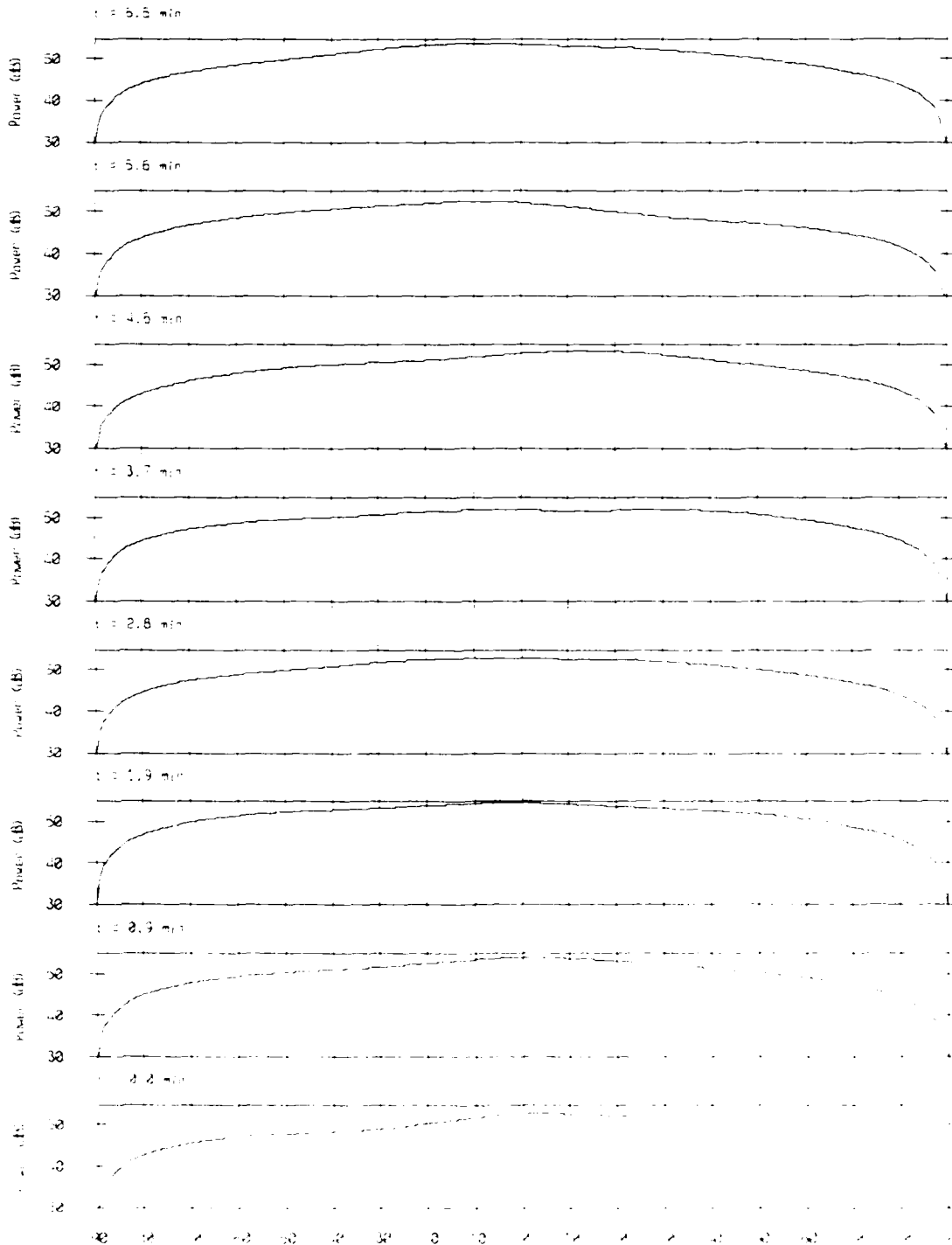
Power Response - 36180 Bin #6186
 $\Delta f = 300$ Hz, rect. window



VI. Array Response: Panels, KB Window.

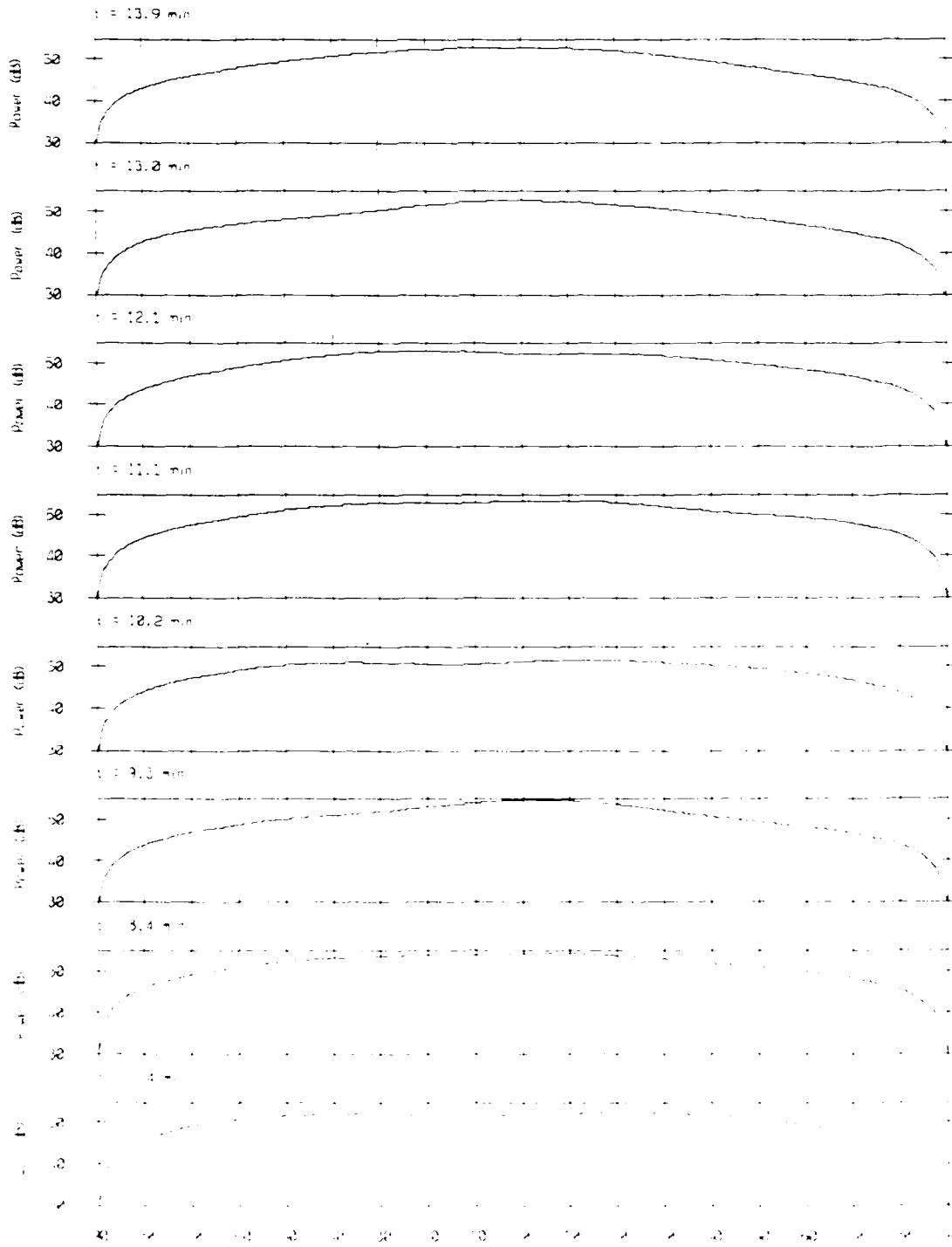
Ampl. Response - 86180 3:1 #4271

$f = 25$ Hz, ΔB window (average = 1.5)



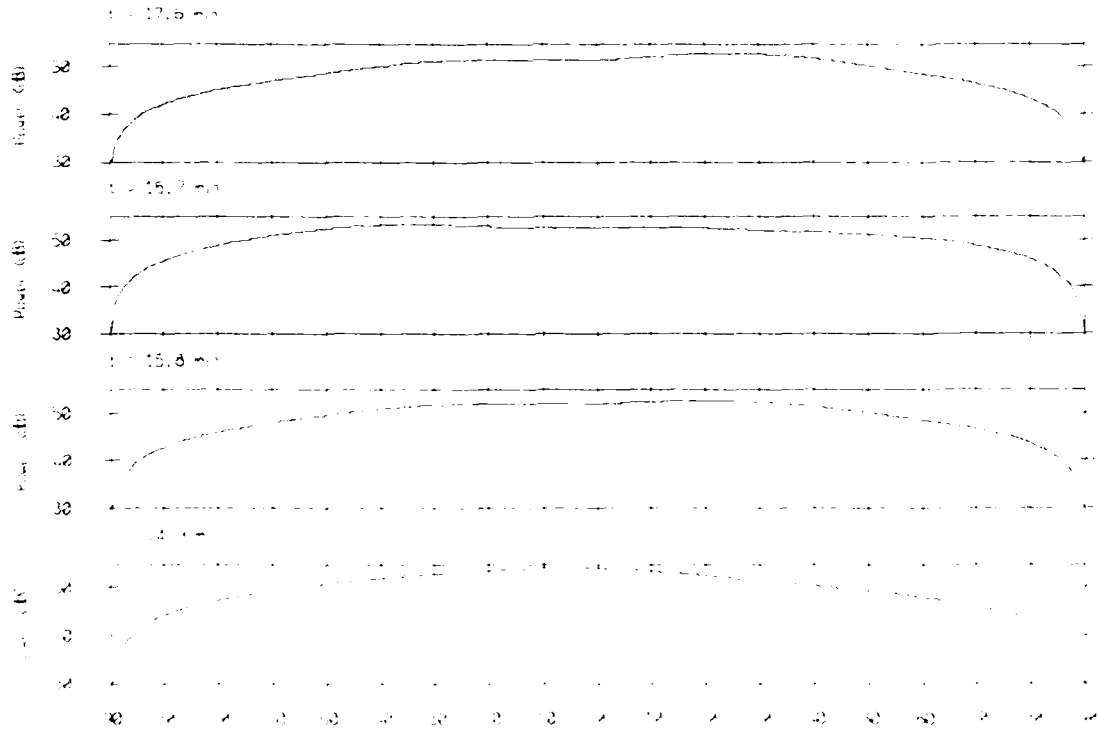
Array Response - 86180 Bin #4271

$f = 25$ Hz, Δf window (s.dnc = 1.5)



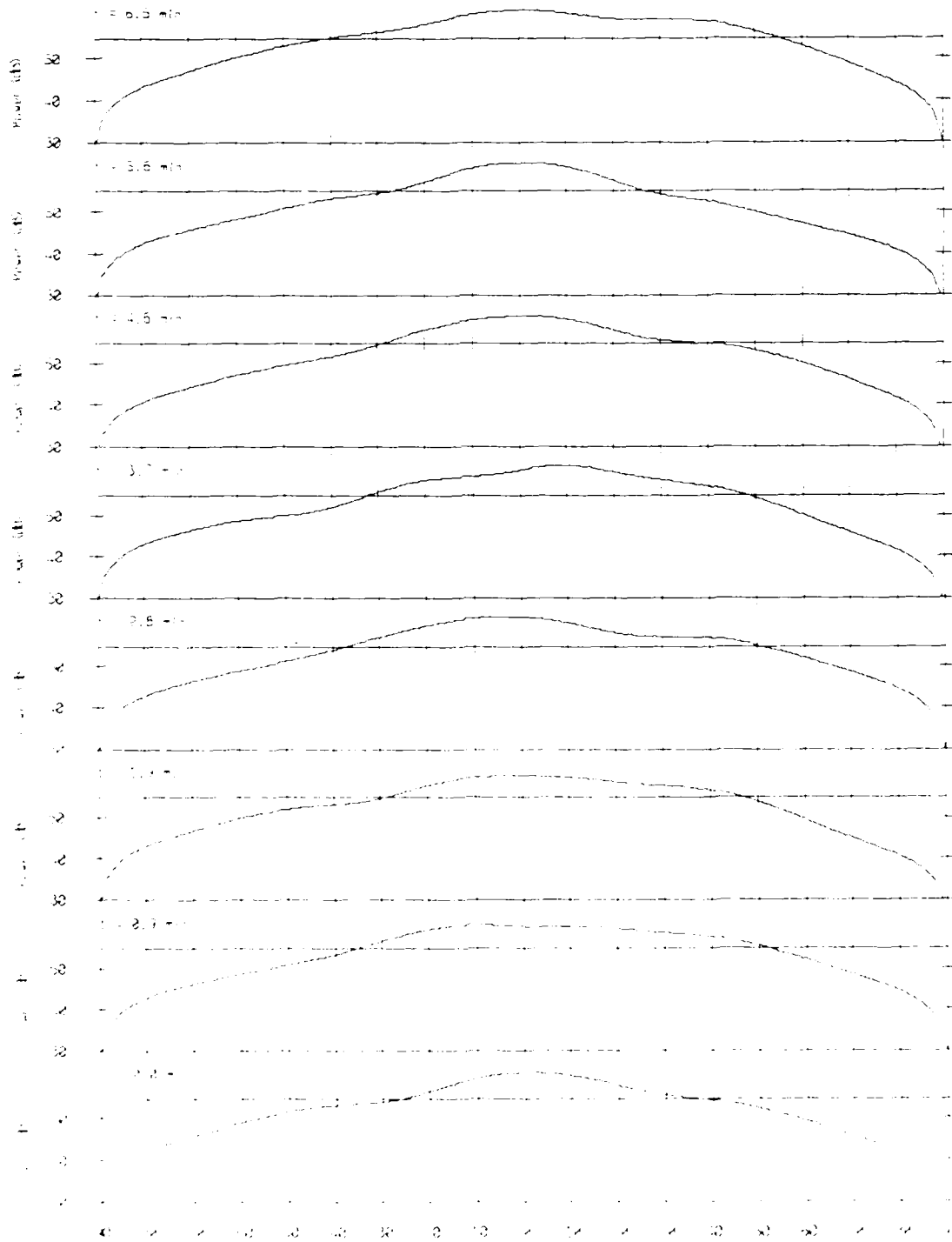
Array Response - 86180 3in #4271

$f = 25$ Hz, ΔB window (alpha = 1.5)



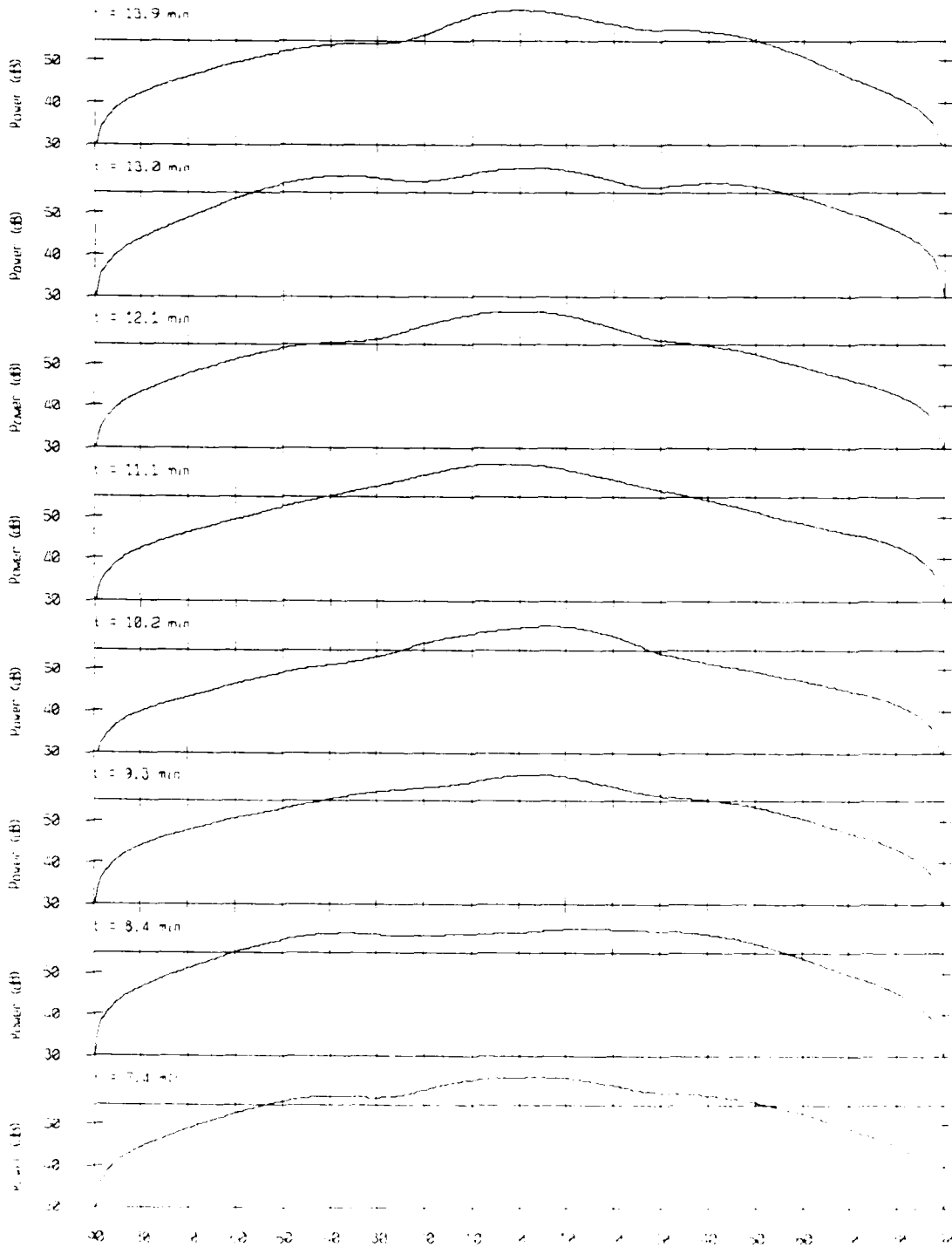
Array Response - 86180 31r #4445

$f = 50$ Hz, ΔB window (sigma = 1.5)



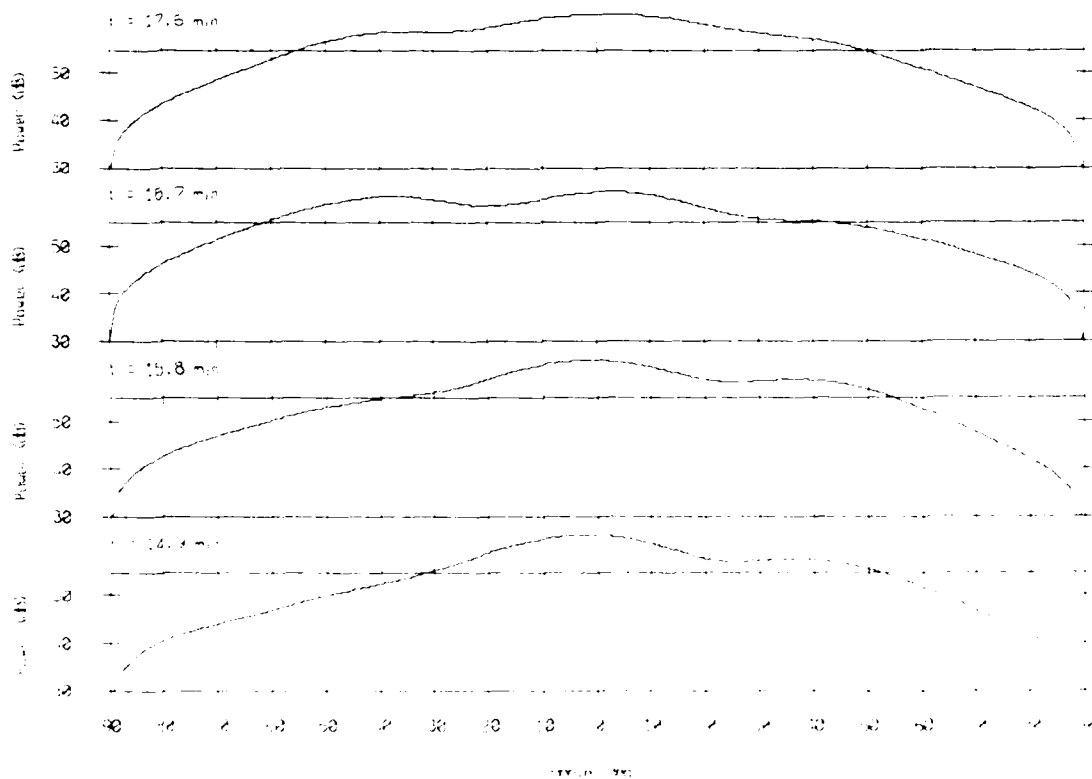
Acoustic Response - 86180 Bin #4445

$f = 50$ Hz, ΔB window (alpha = 1.5)

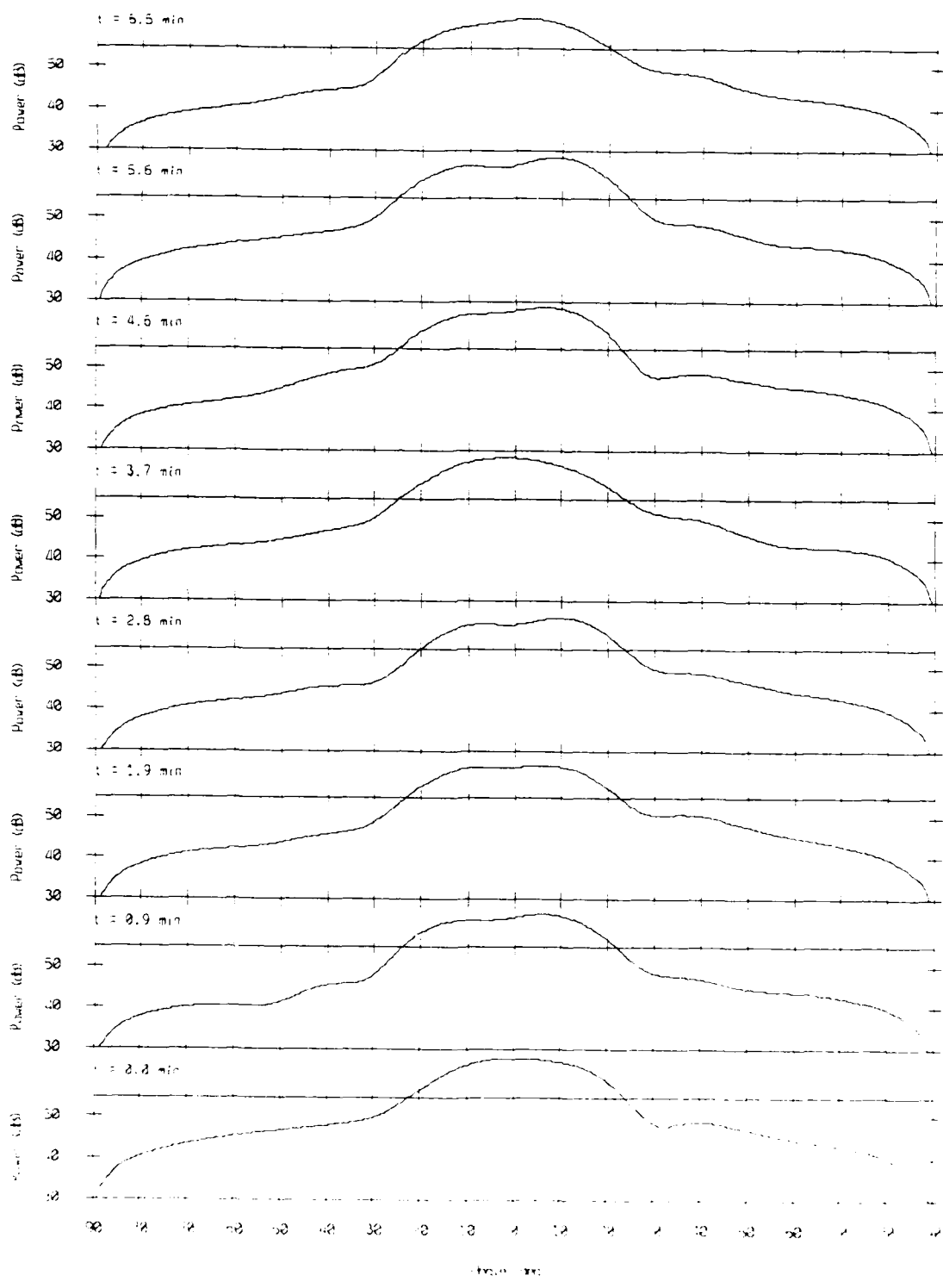


Array Response - 86180 31r #4445

$f = 50$ Hz. $\Delta\theta$ window (elans) = 1.5)

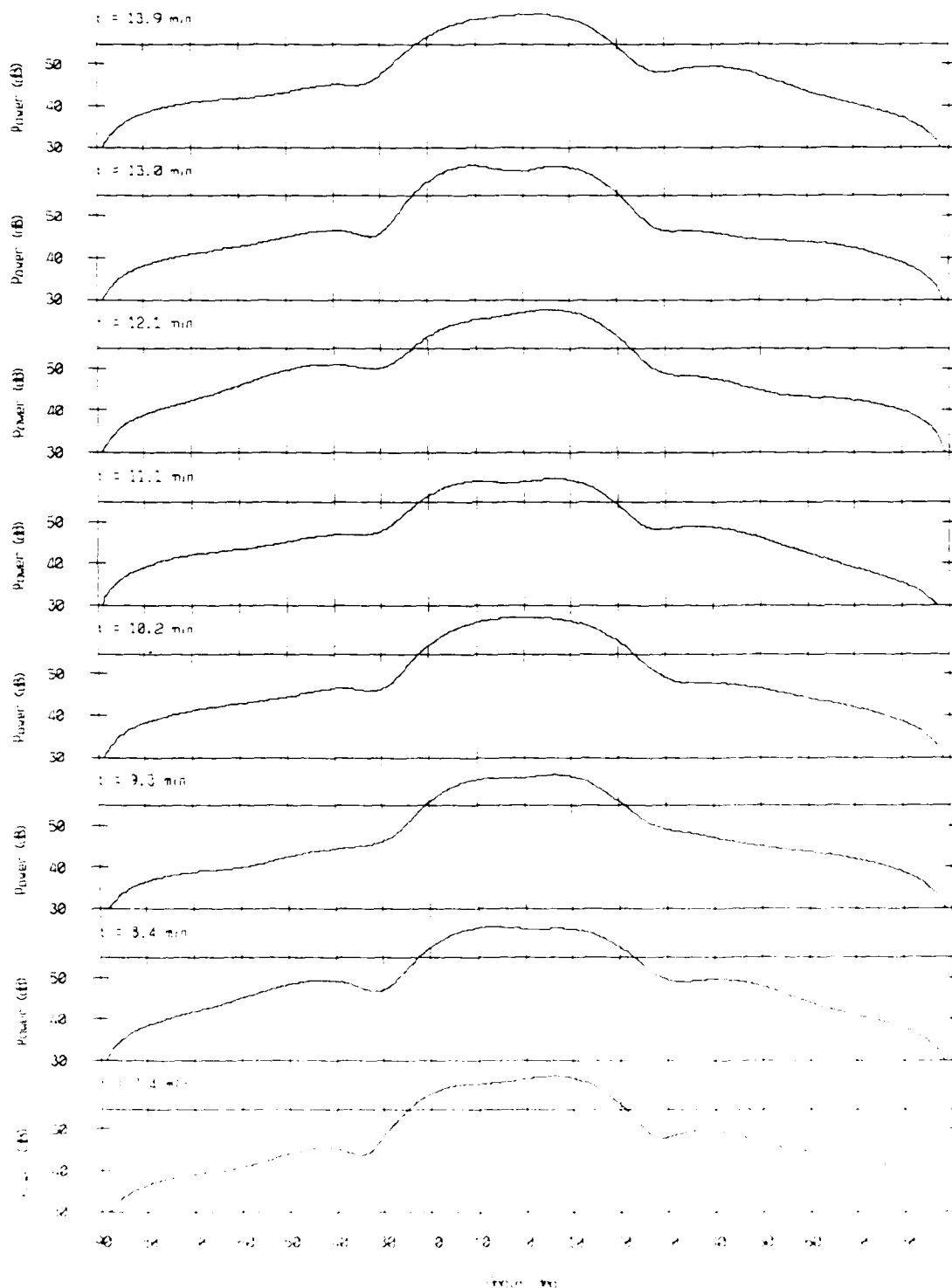


Pondy Response - 86180 Bin #4619
 $f = 75$ Hz, ΔB window (alpha = 1.5)

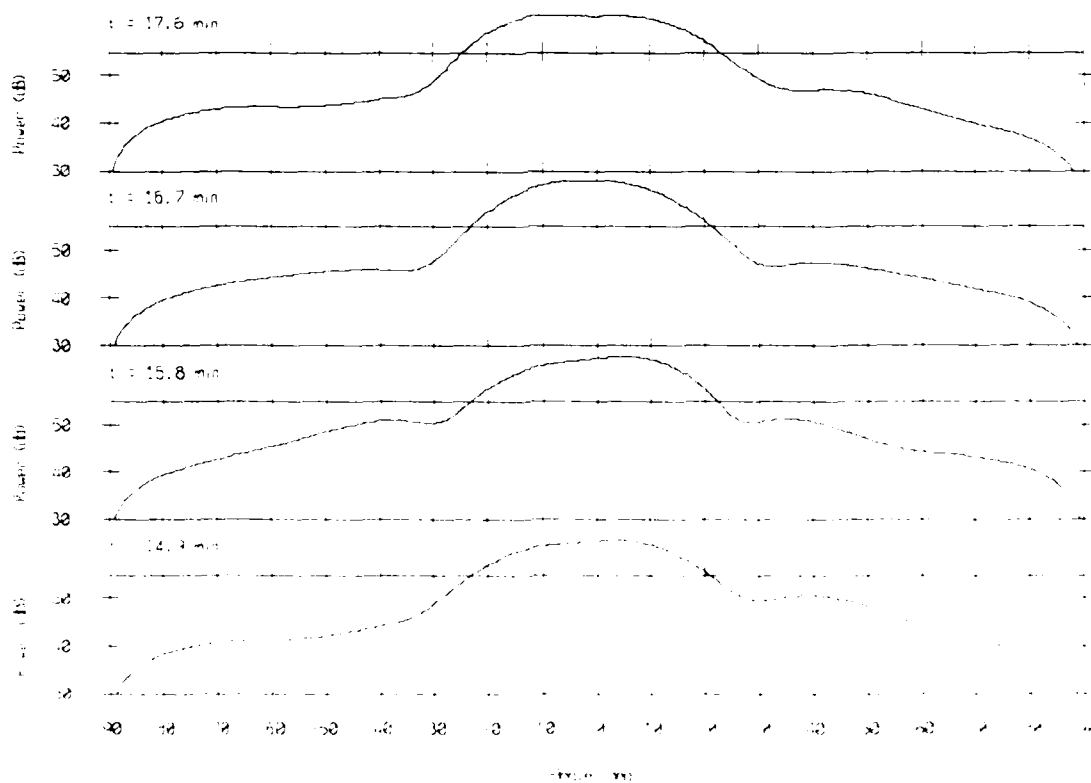


Array Response - 86180 3in #4619

f = 75 Hz, <B window (sigma = 1.5)

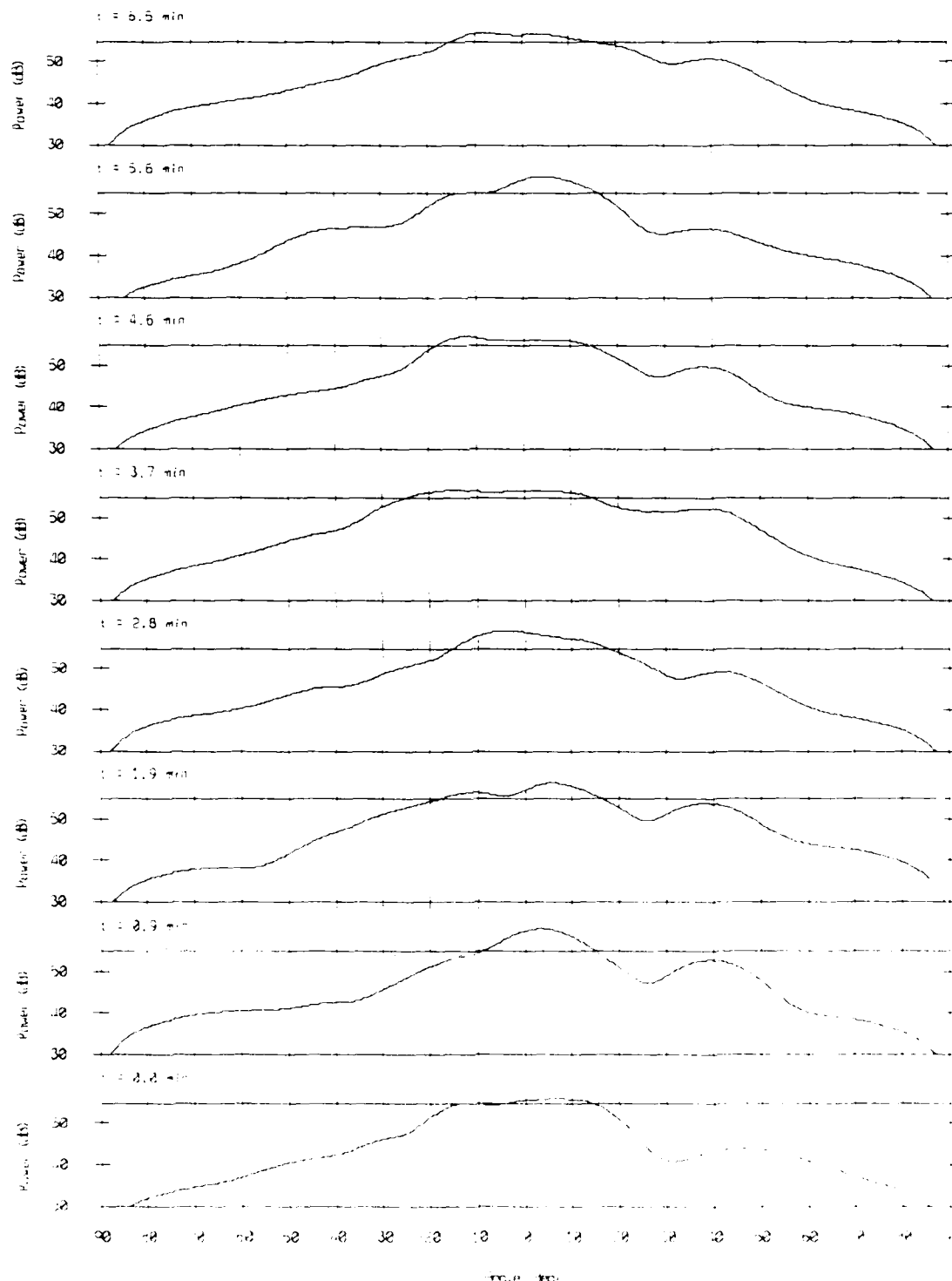


Array Response - 86180 Bin #4619
 $f = 75$ Hz, ΔB window (alone) = 1.5)



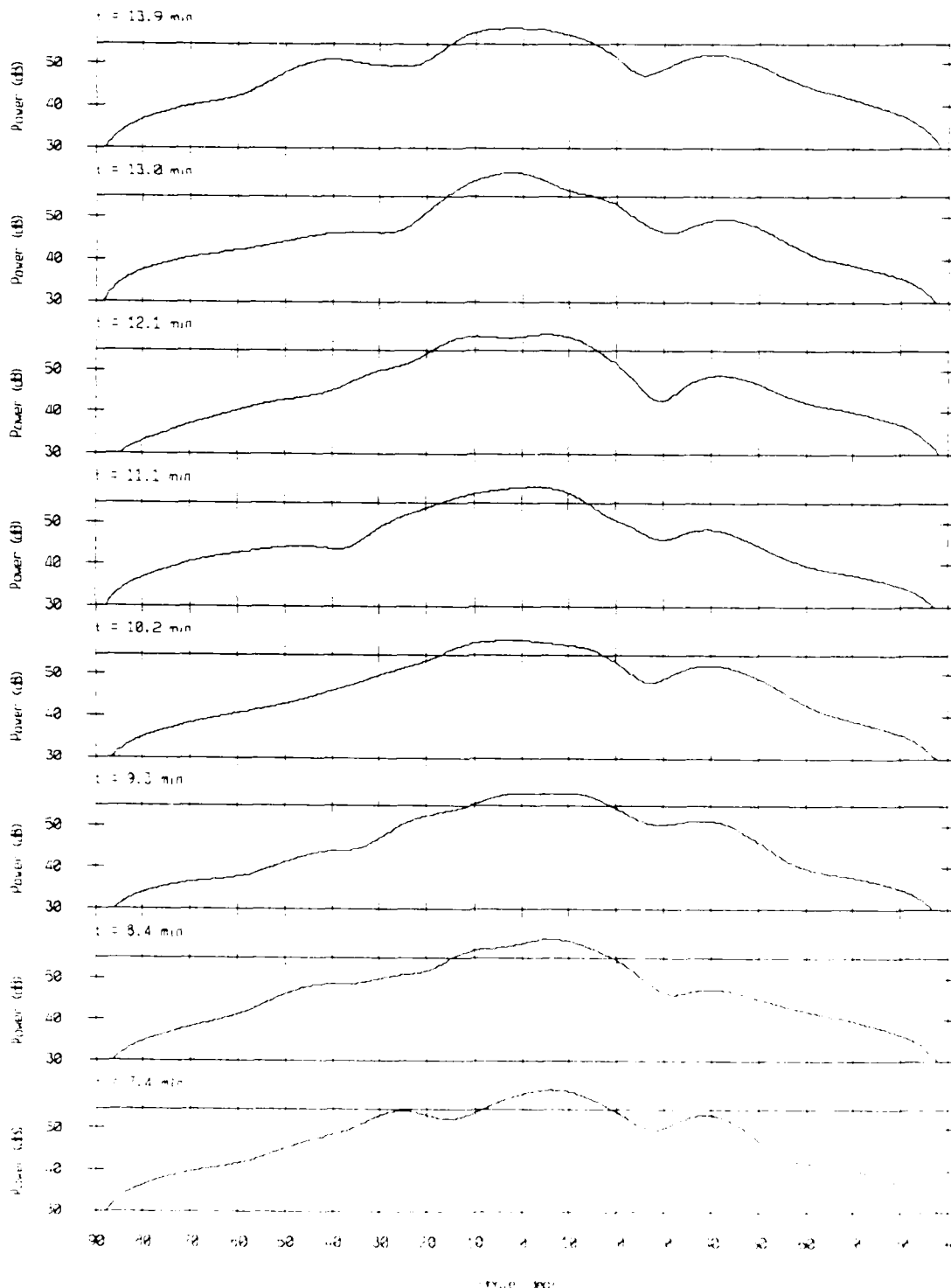
Acoustic Response - 86180 3in #4793

$f_c = 120$ Hz, Δf window (octave) = 1.5



Array Response - 86180 Bin #4793

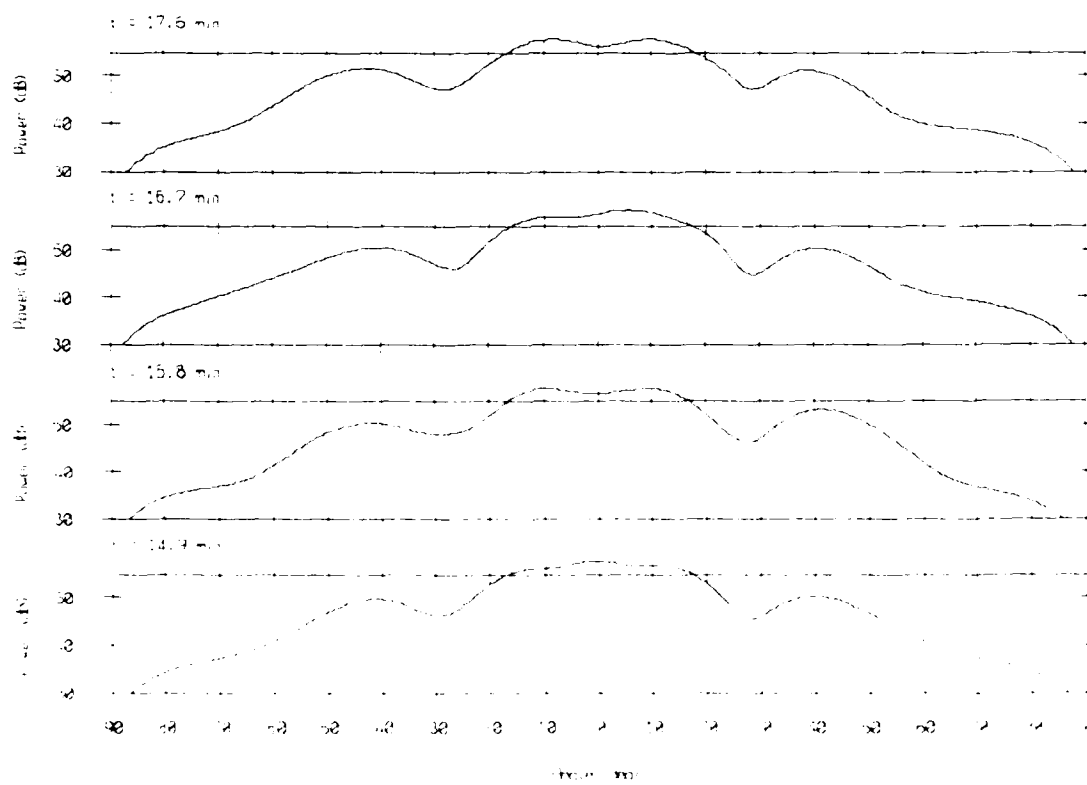
$\Delta f = 100$ Hz, KB window (alpha = 1.5)



FREQUENCY

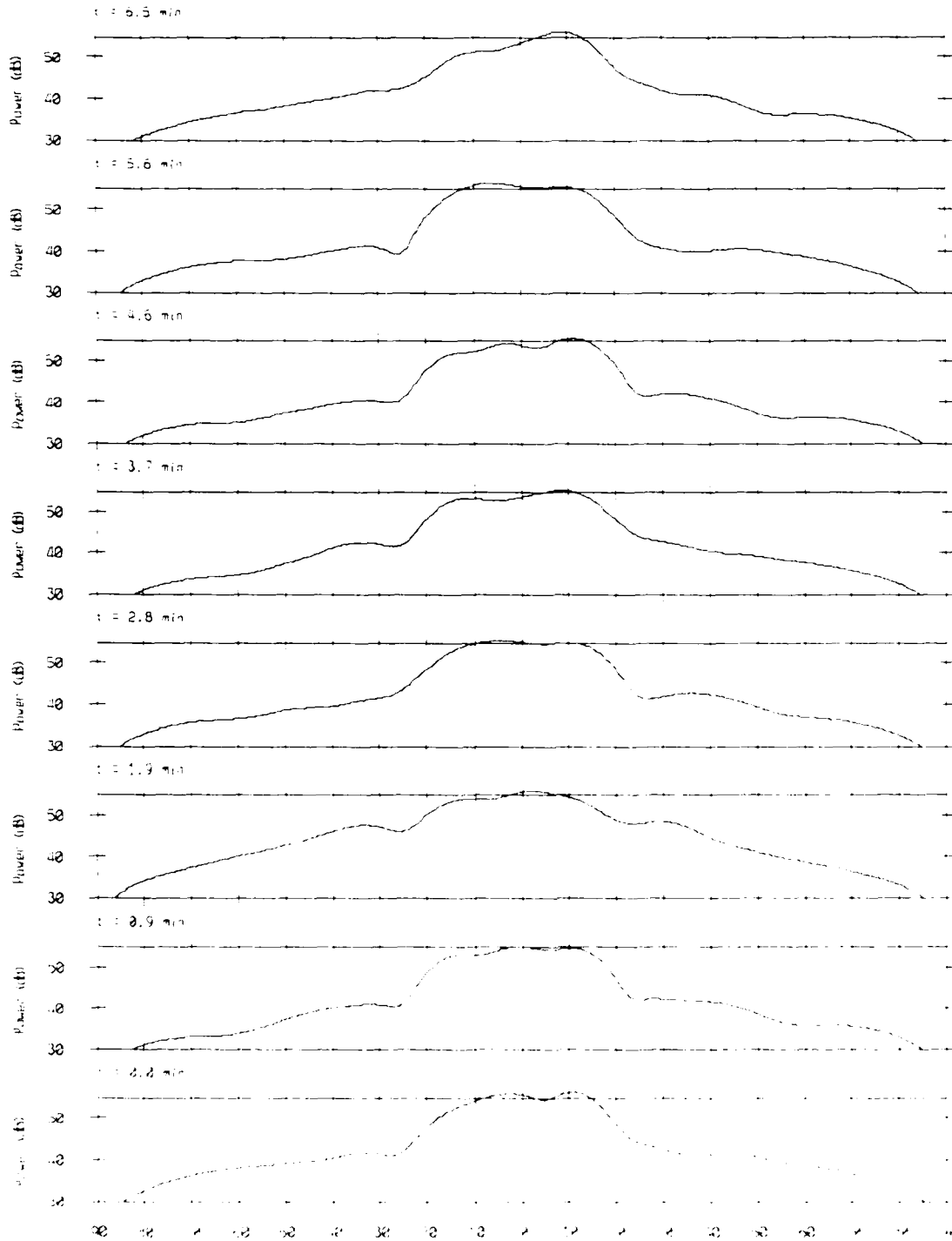
Array Response - 86180 3:~ #4793

$f = 120$ Hz, ΔB window (along) = 1.5



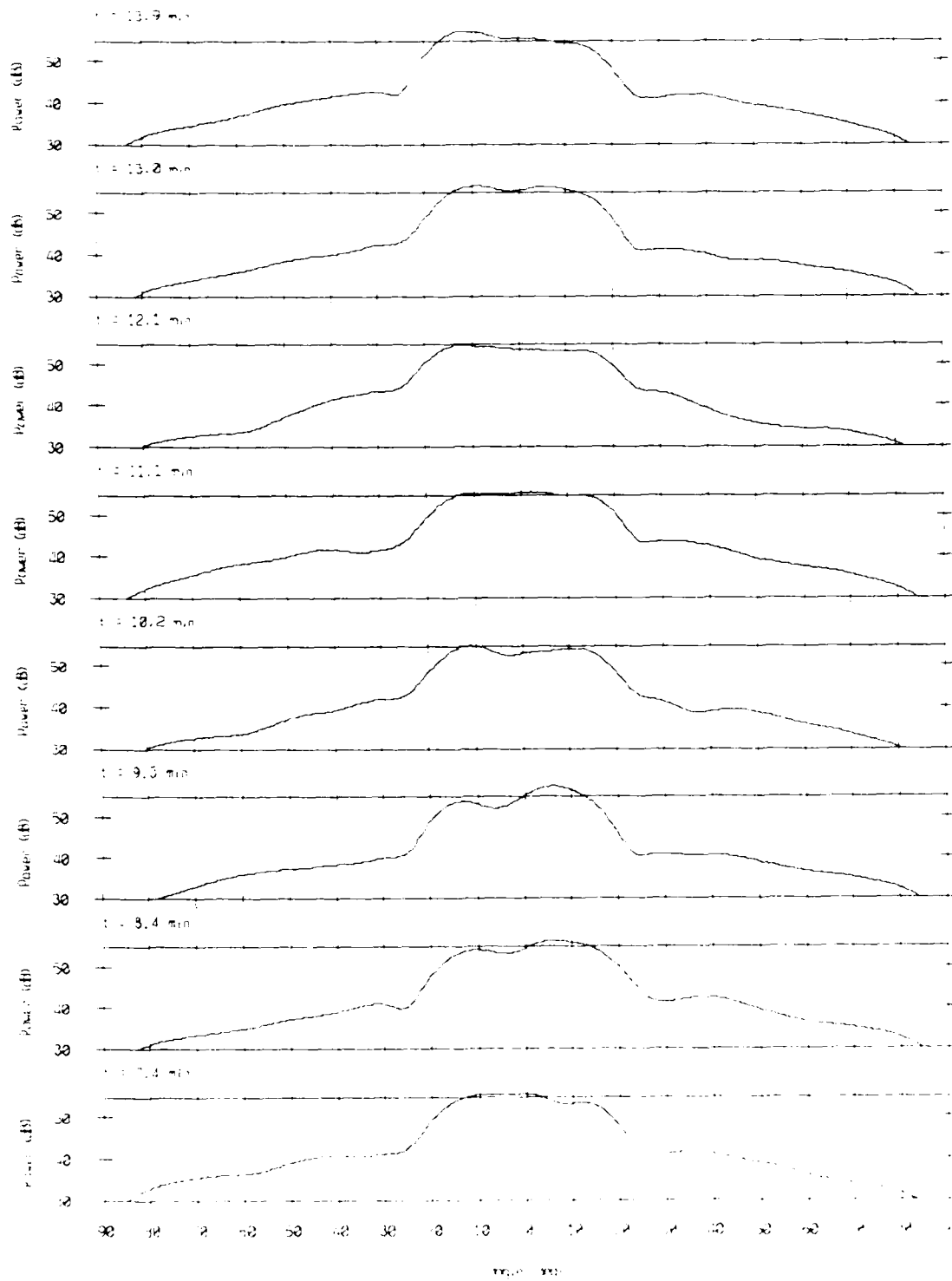
Random Response - 86180 3in #4967

$f = 125$ Hz, Δf window (tolerance) = 1.5



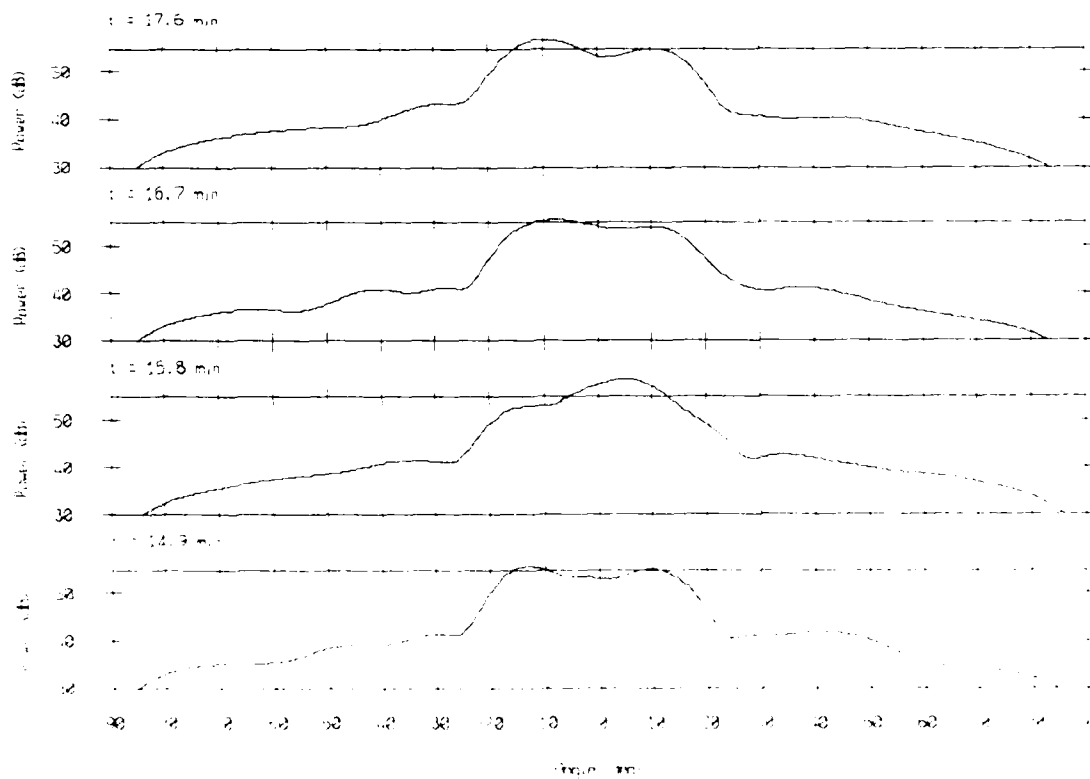
Power Response - 85182 314 #4967

f = 125 Hz, 48 window, 3.0 sec = 1.5



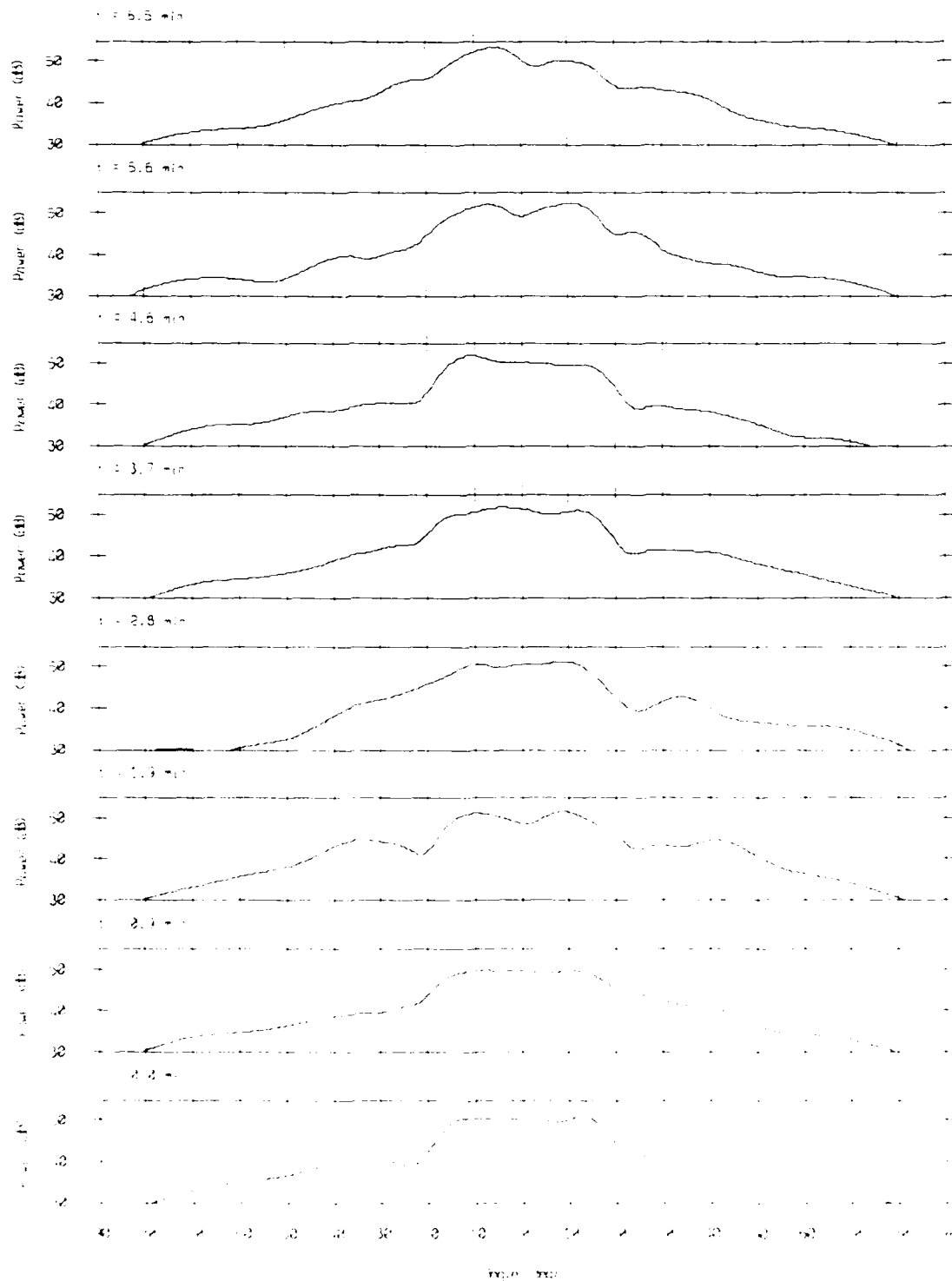
Acoustic Response - 86180 31r #4967

$f = 125$ Hz, ΔB window (dB) = 1.5



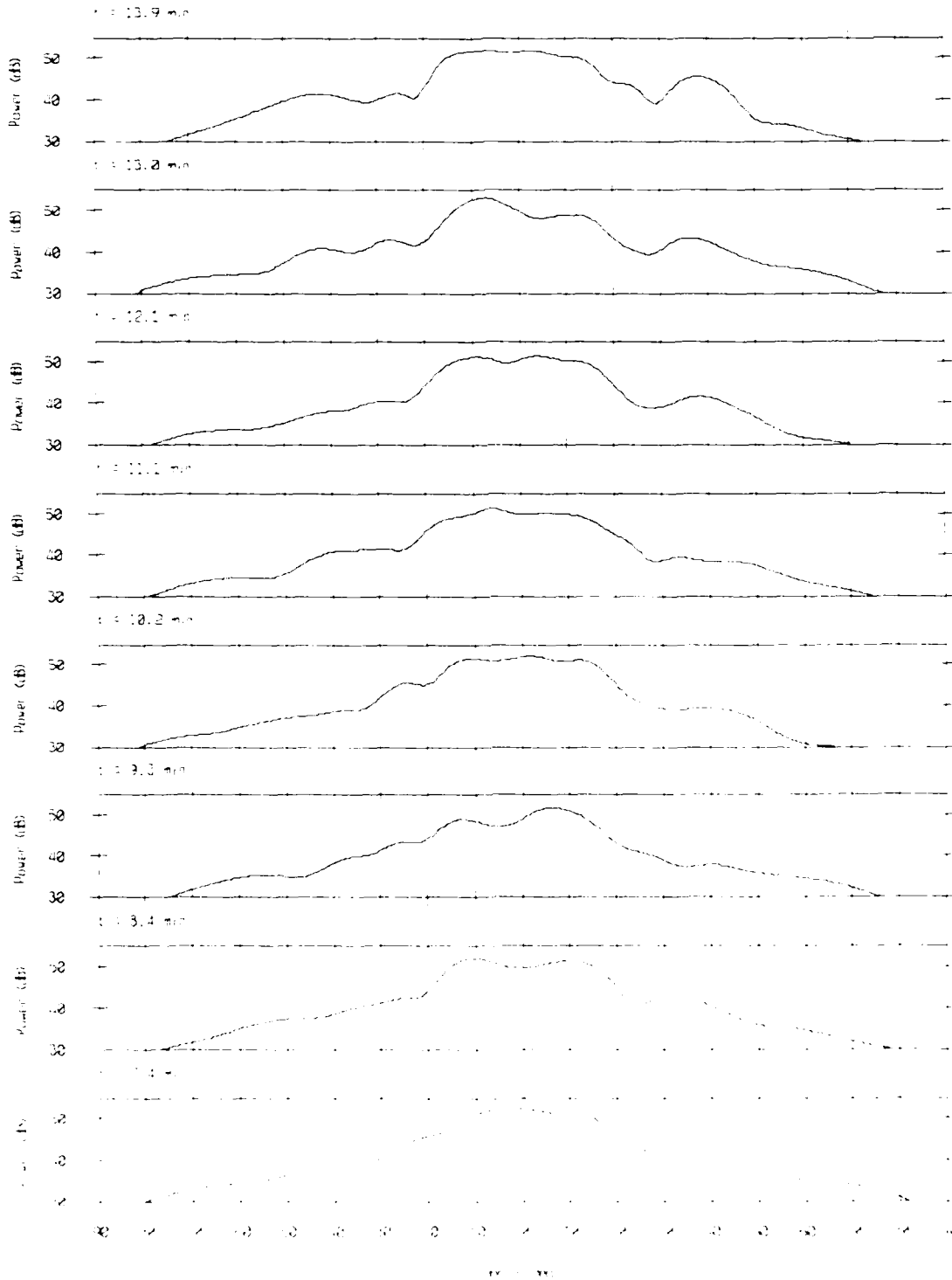
Energy Response - 86180 3in #5141

$\beta = 150$ Hz, ΔB window (alpha = 1.5)



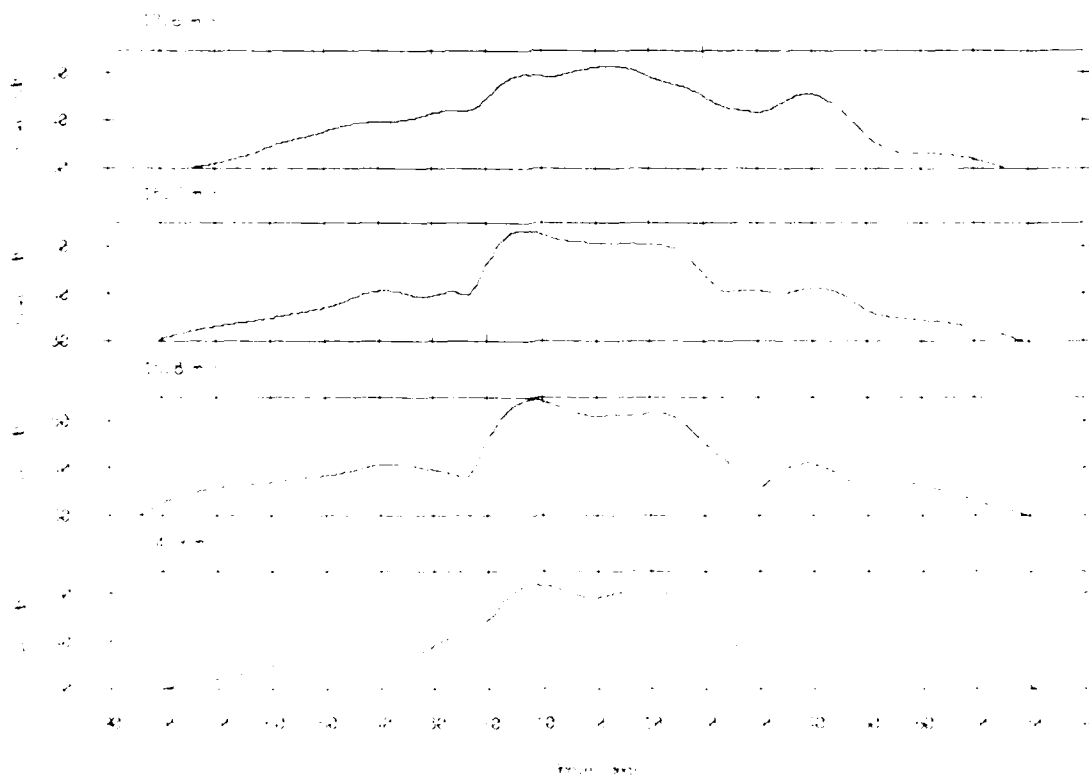
Body Response - 86180 3in #5141

$f = 150$ Hz, Δf window (alpha = 1.5)



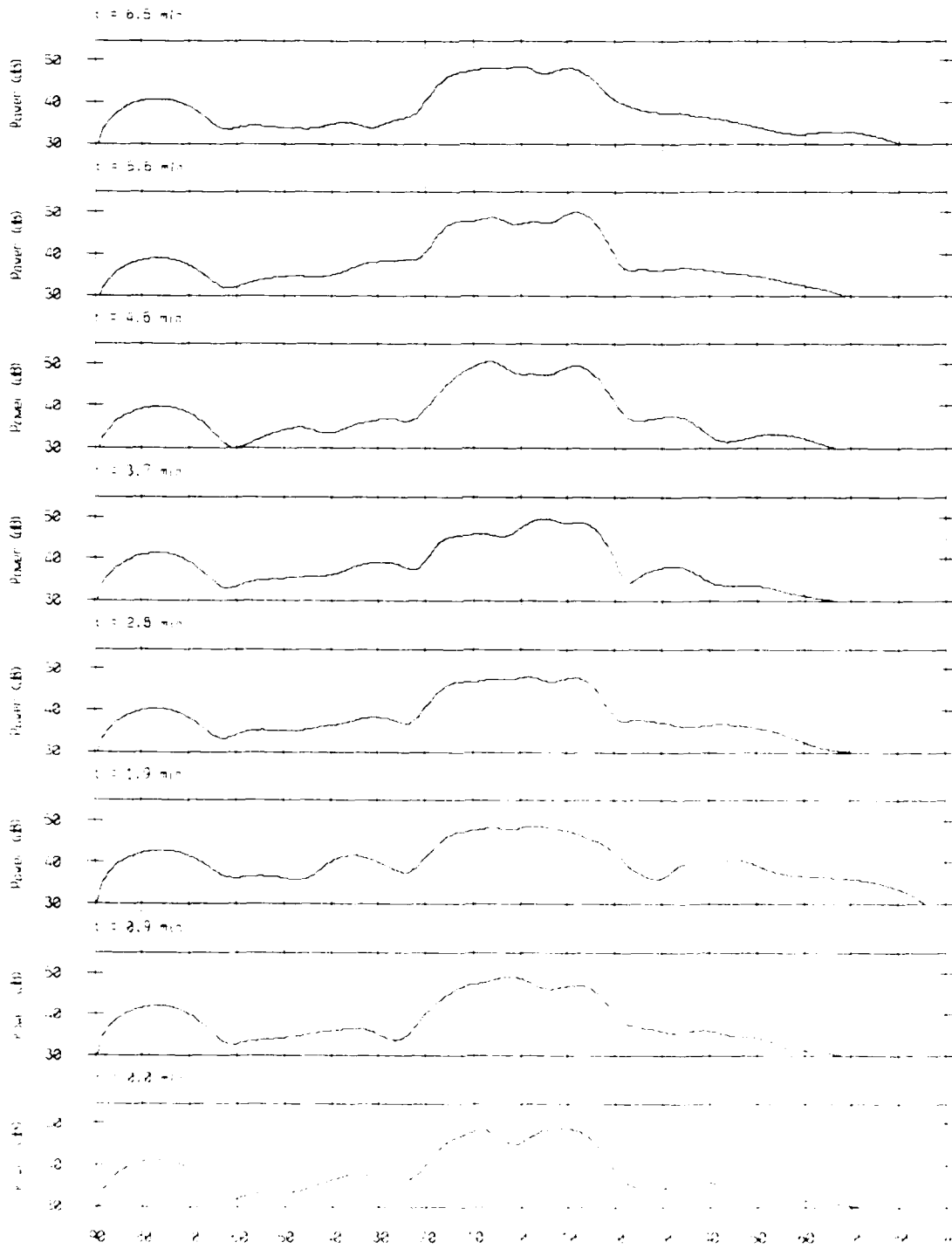
Amplitude Response - 86180 Bin #5141

$f = 150$ Hz, ΔB window (alpha = 1.5)



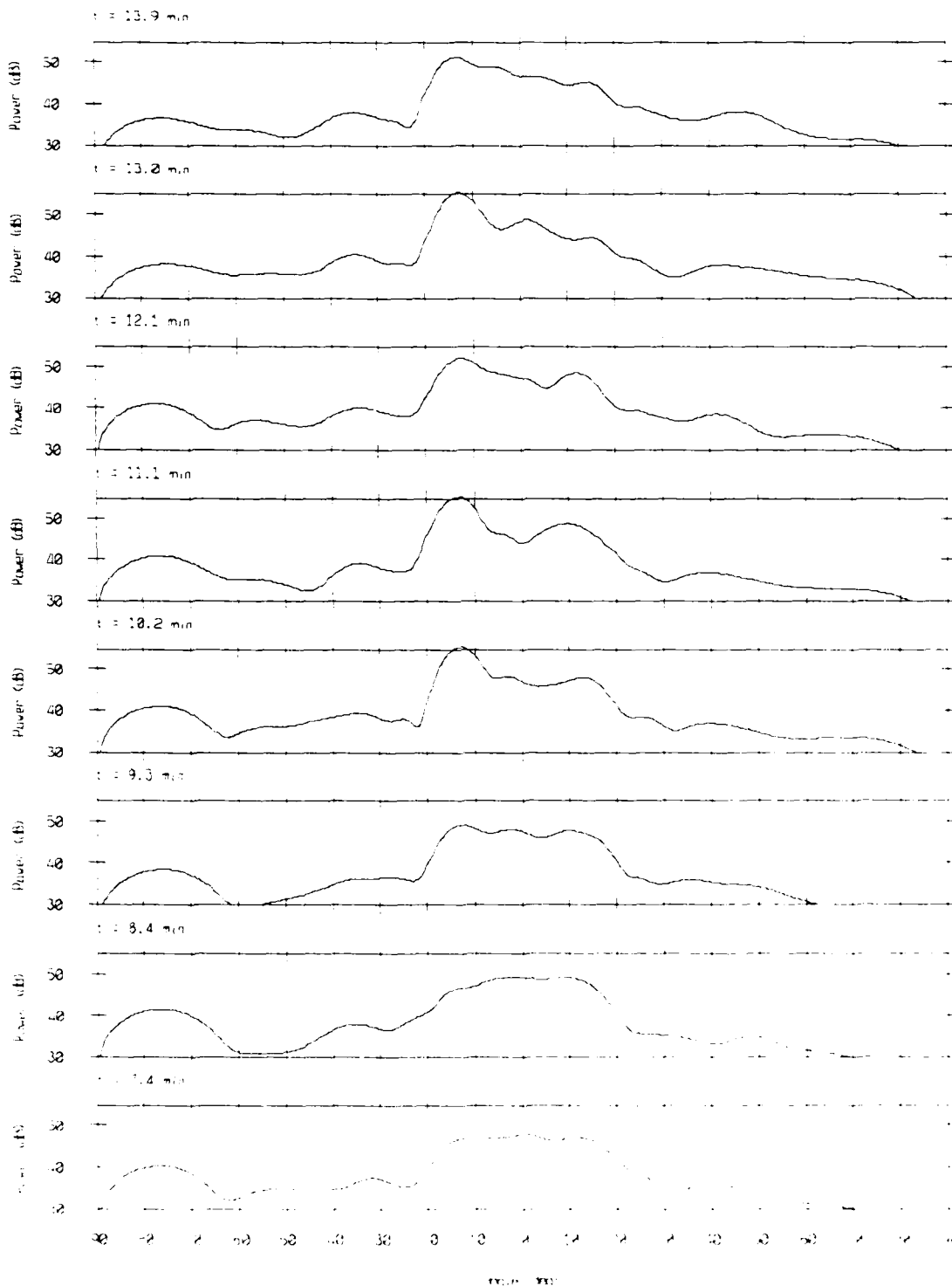
Array Response - 86180 3in #5316

$\beta = 175$ -z, $\Delta\theta$ window (slant) = 1.5.



Array Response - 86180 Bin #5316

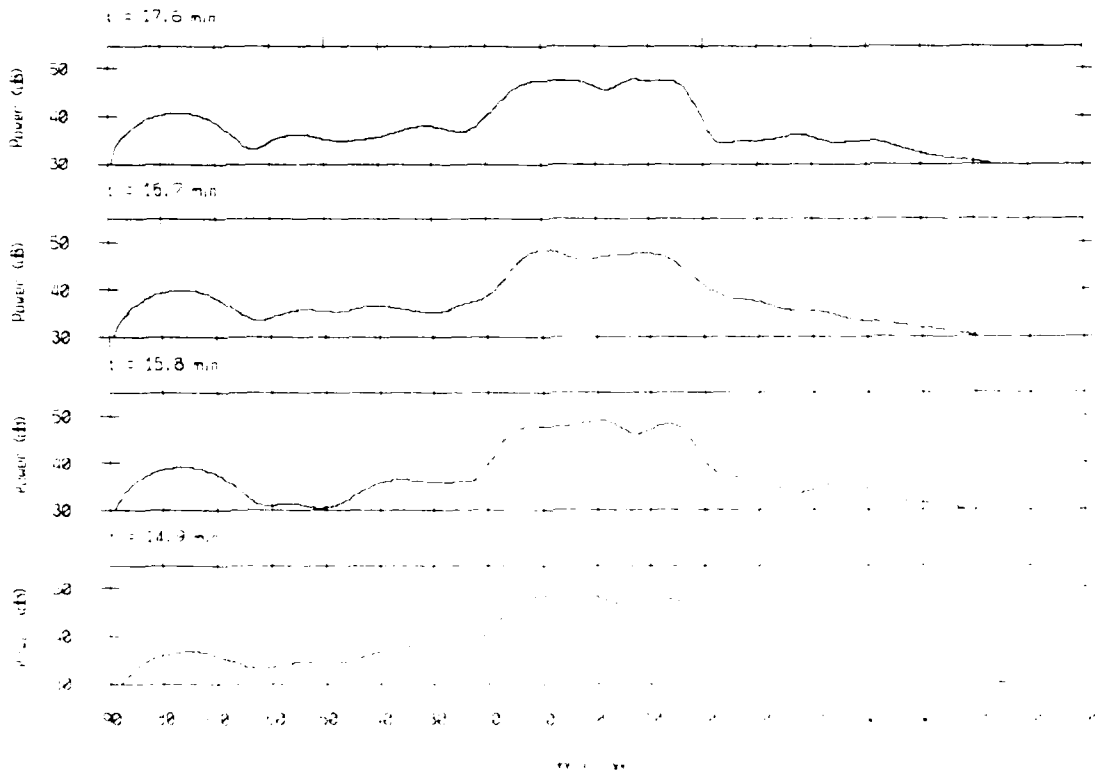
$f = 175$ Hz, ΔB window (alpha = 1.5)



Time (min)

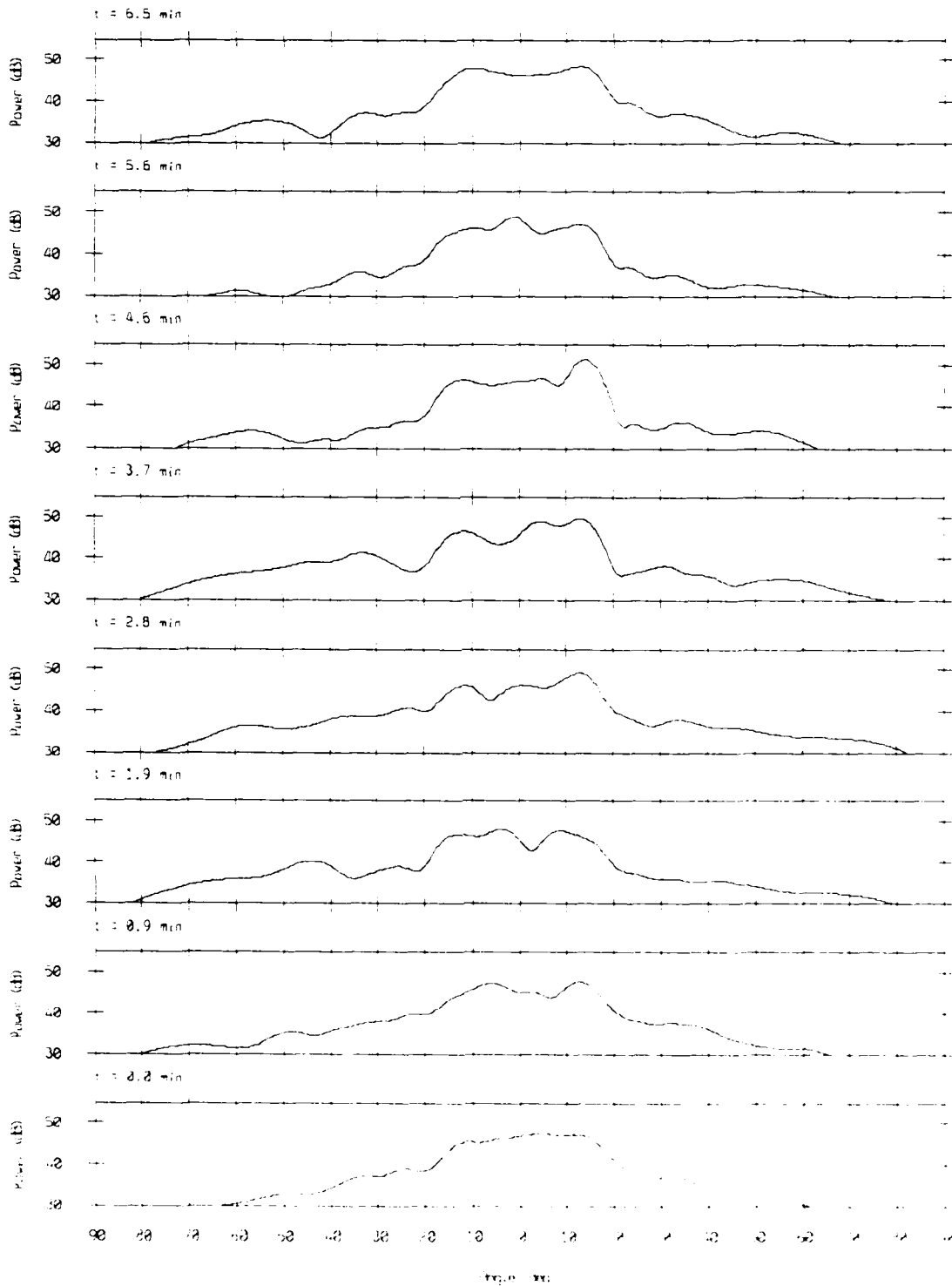
Array Response - 86180 Bin #5316

$f = 175$ Hz, KB window (alone = 1.5)



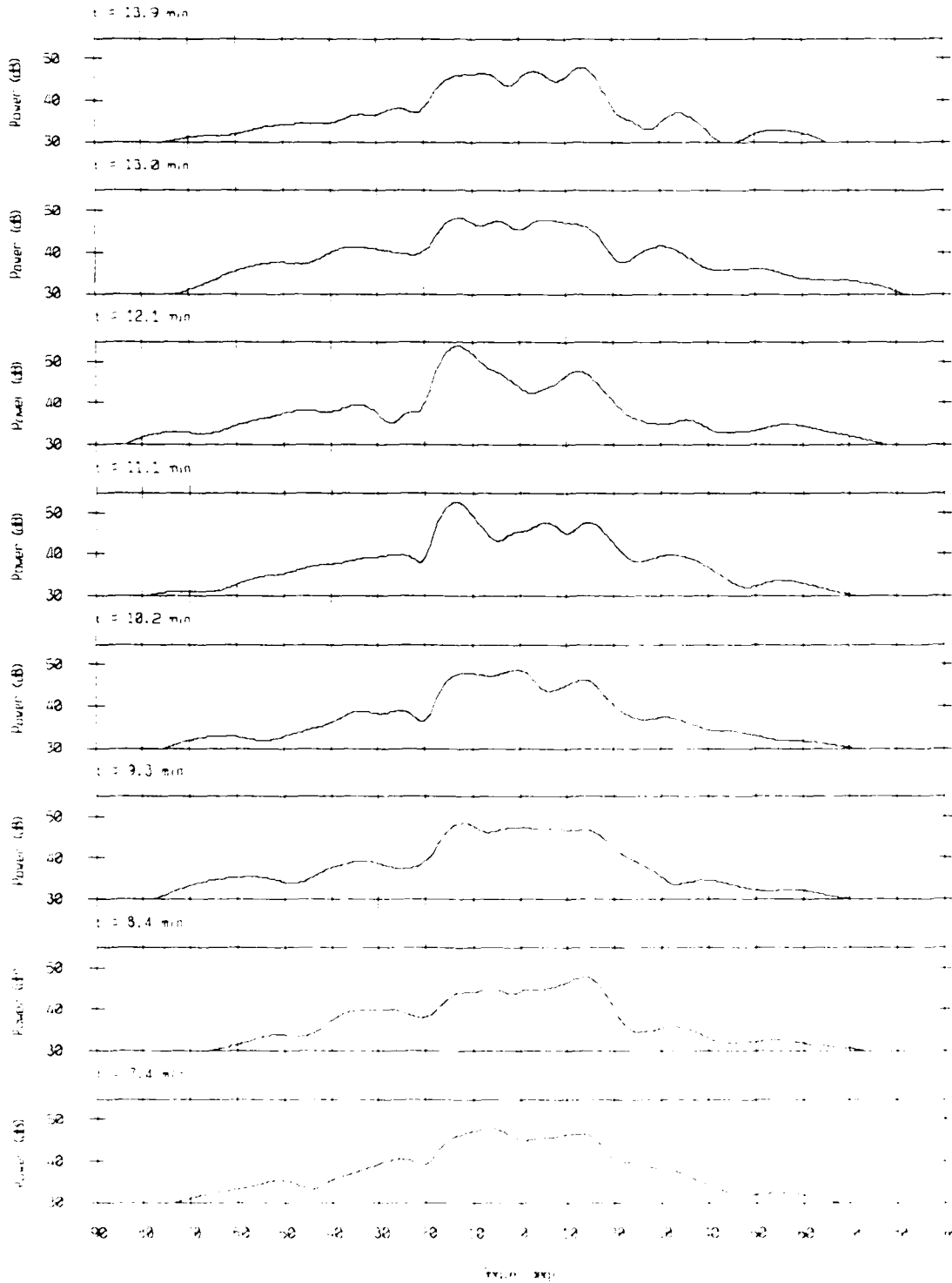
Array Response - 86180 Bin #5490

$f = 200$ Hz, ΔB window (alpha = 1.5)

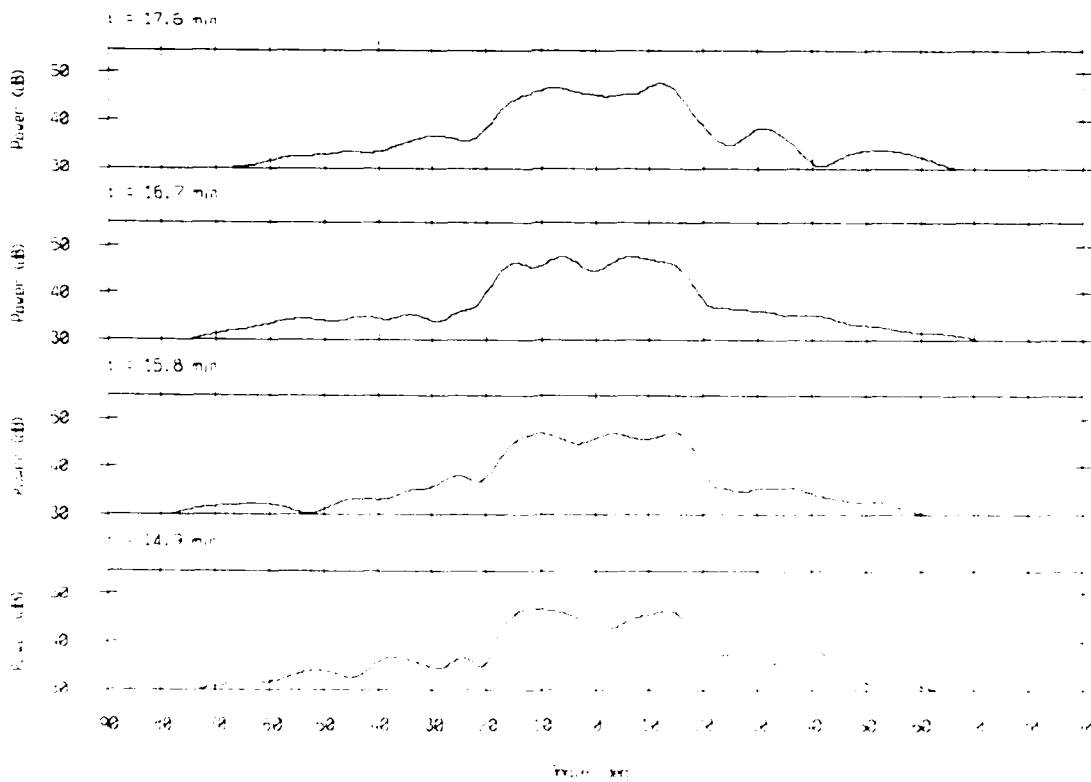


Array Response - 86130 Bin #5490

f = 220 Hz, window (alpha = 1.5)

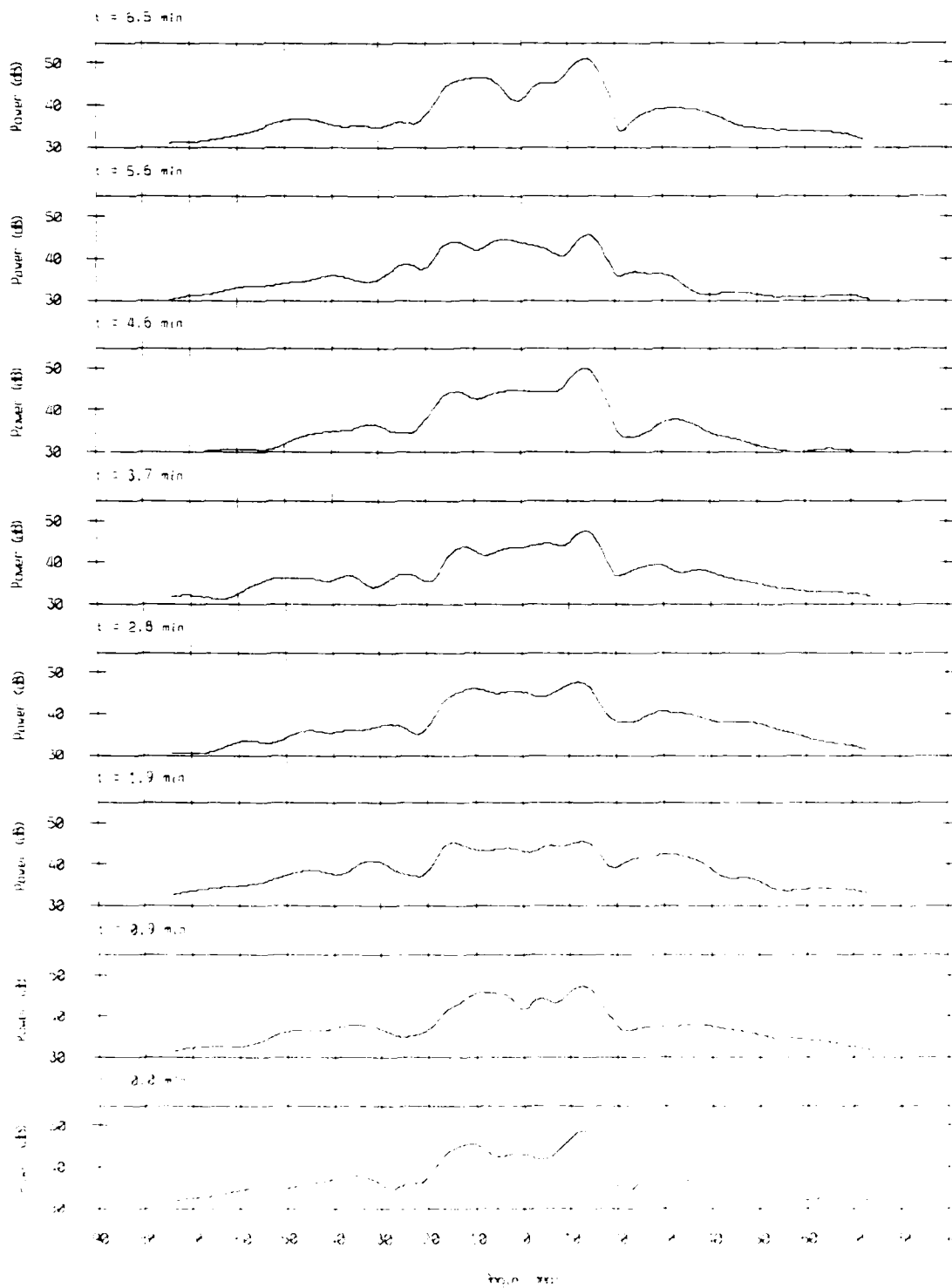


Array Response - 86180 Bin #5490
 $f = 200$ Hz, ΔB window (alpha = 1.5)



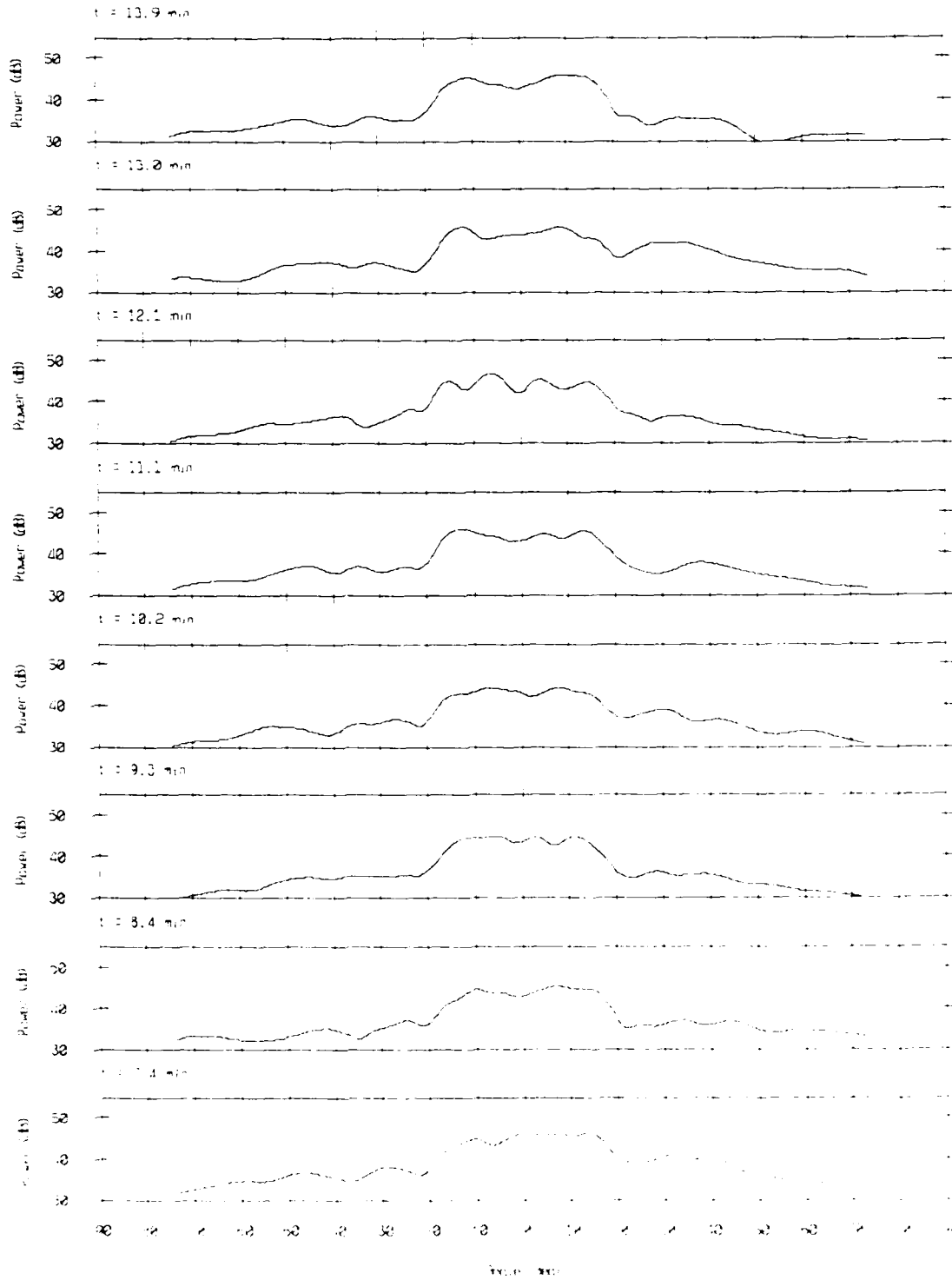
Array Response - 86180 Bin #5664

$f = 225$ Hz, KB window (alpha = 1.5)



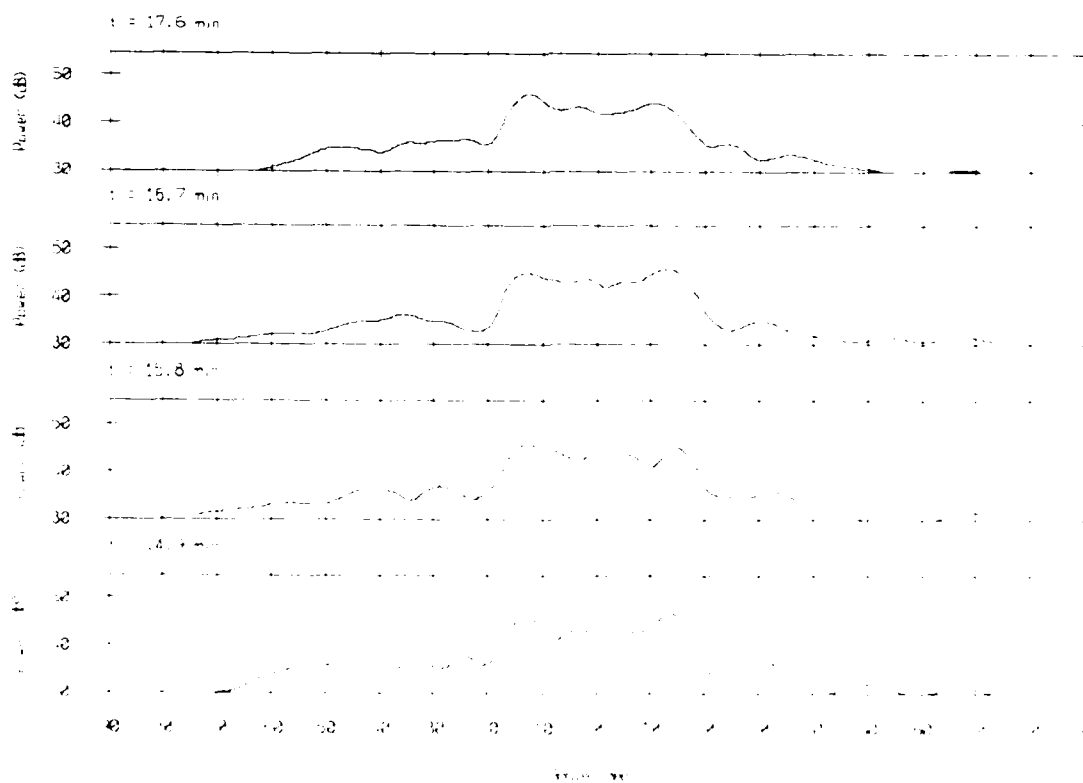
Arndy Response - 86180 Bin #5664

$f = 225$ Hz, Δf window (align = 1.5)



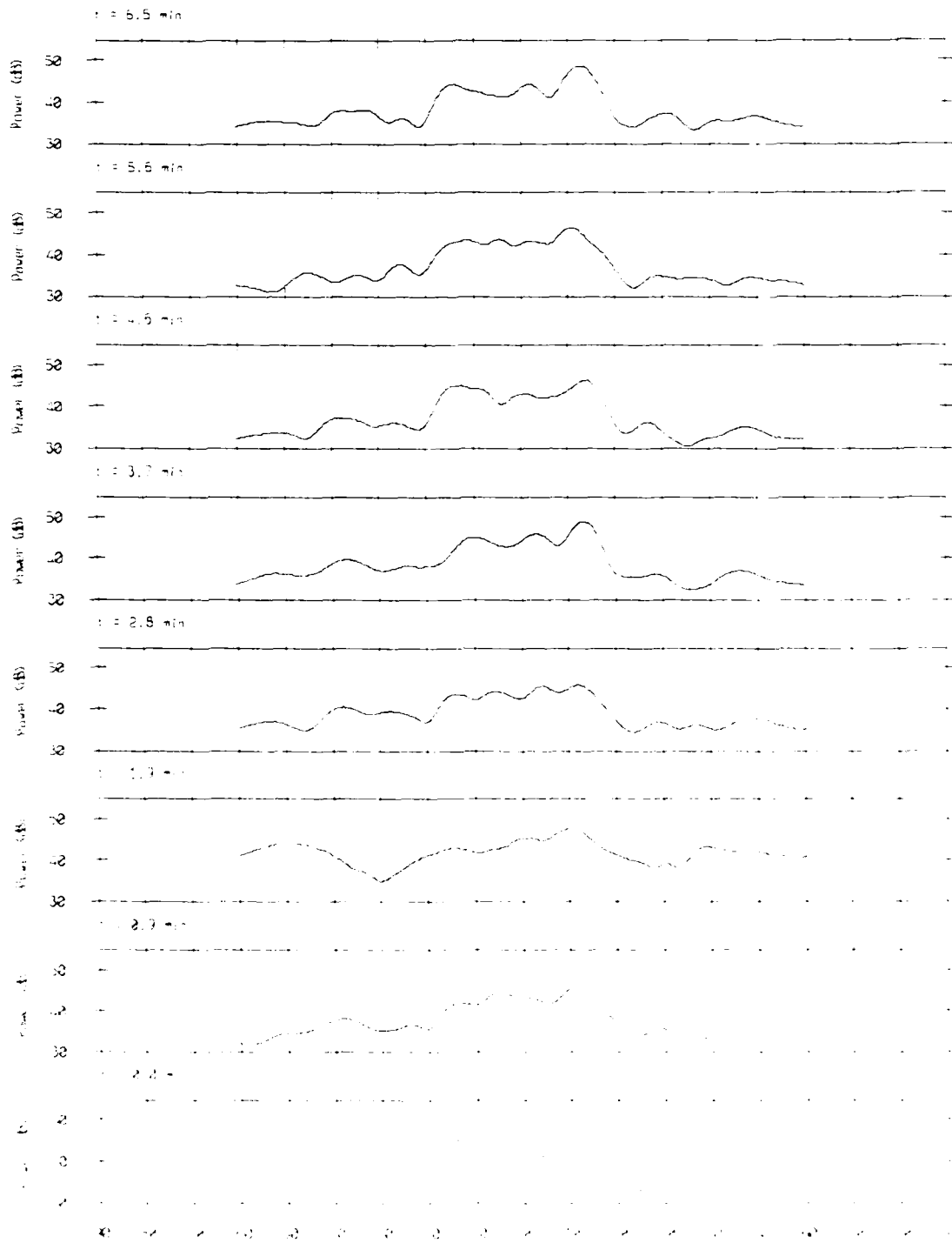
Array Response - 86180 3in #5664

$f = 225$ Hz, KB window (alpha = 1.5)



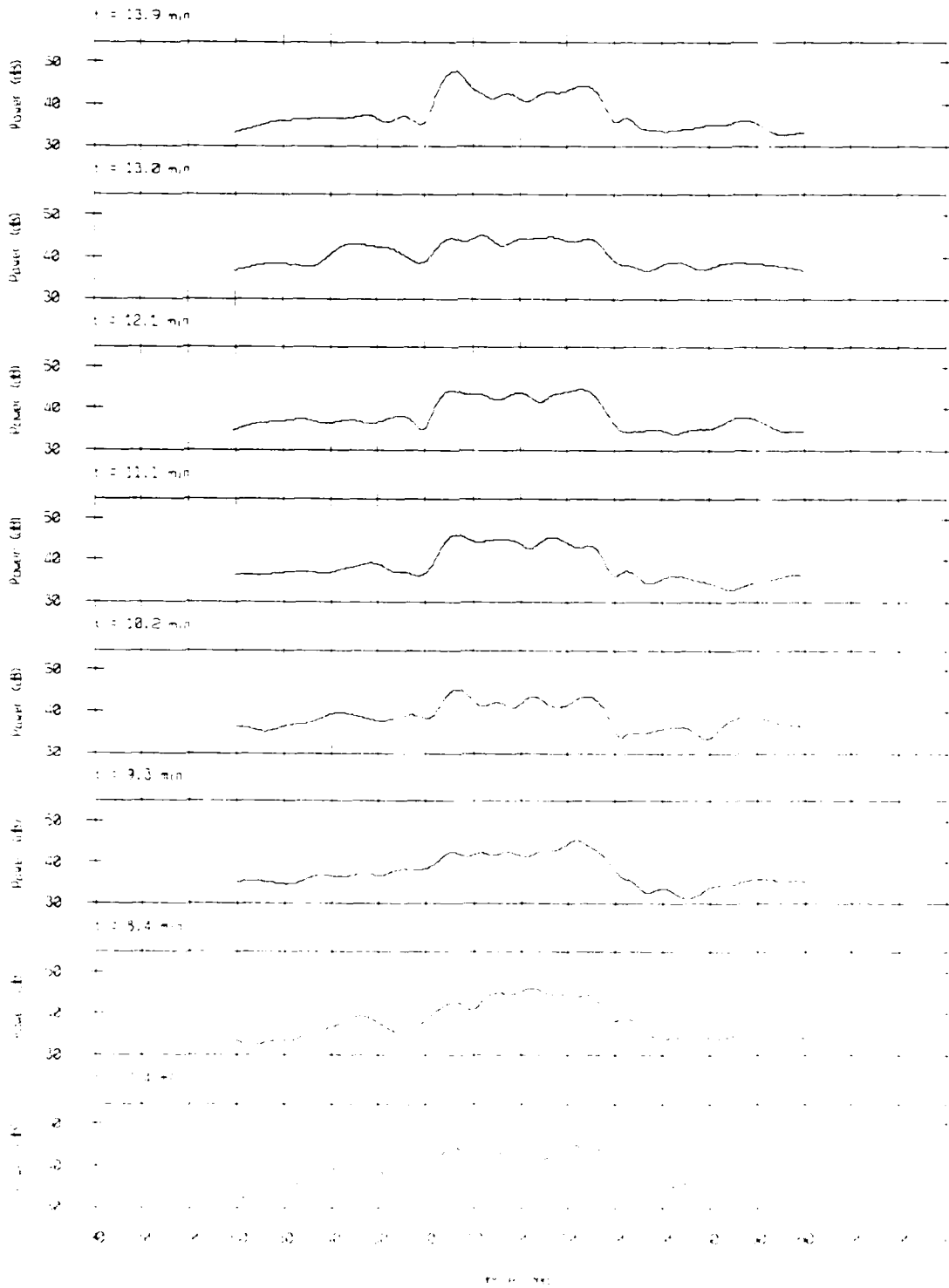
Array Response - 86180 Bin #5832

$\Delta f = 250$ Hz, Δt window (alone) = 1.5s



Array Response - 86180 Bin #5832

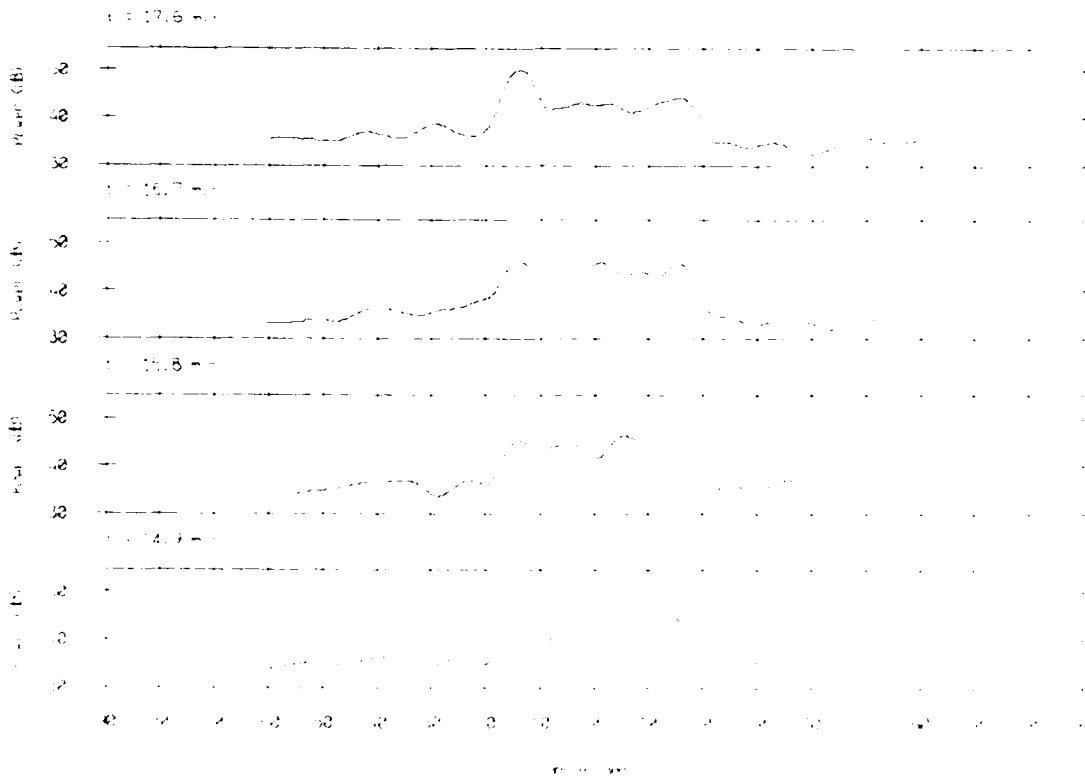
f = 250 Hz, <B window (alpha = 1.5)



Time (min)

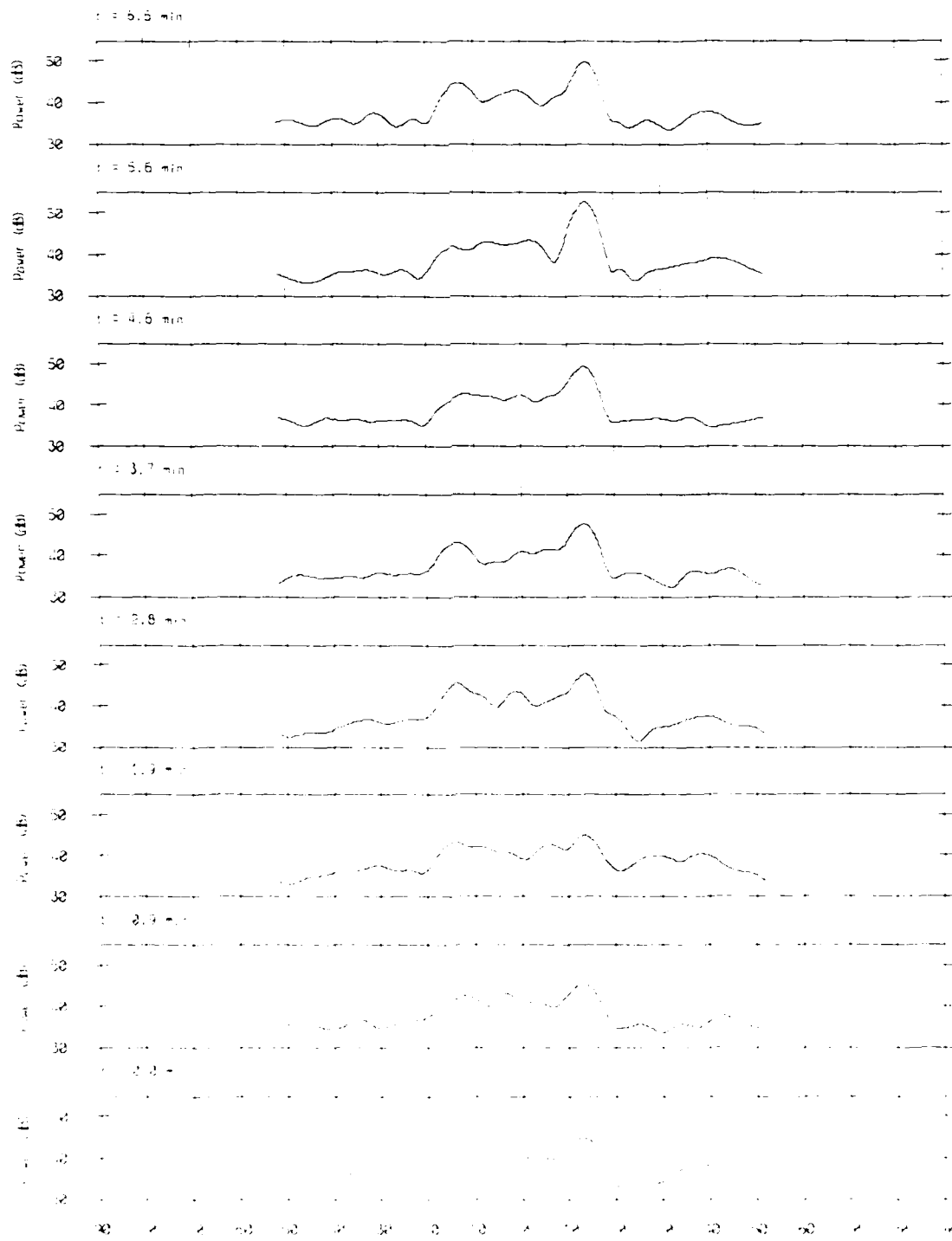
Prod. Response - 86182 Bin #6332

$f = 252$ Hz, Δf window (bins) = 16



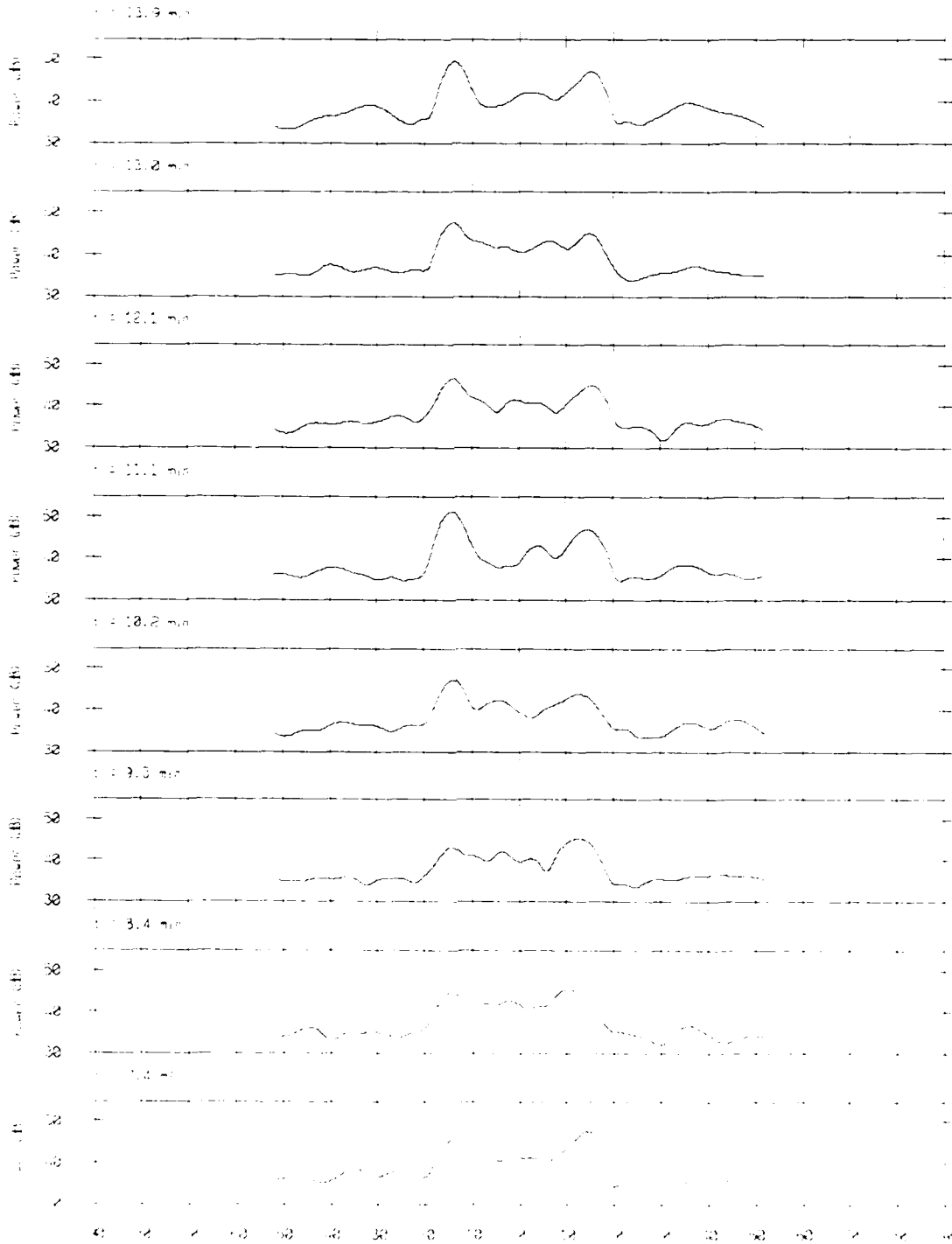
Array Response - 86180 3In #6012

$f = 275$ Hz, ΔB window (alpha = 1.5)



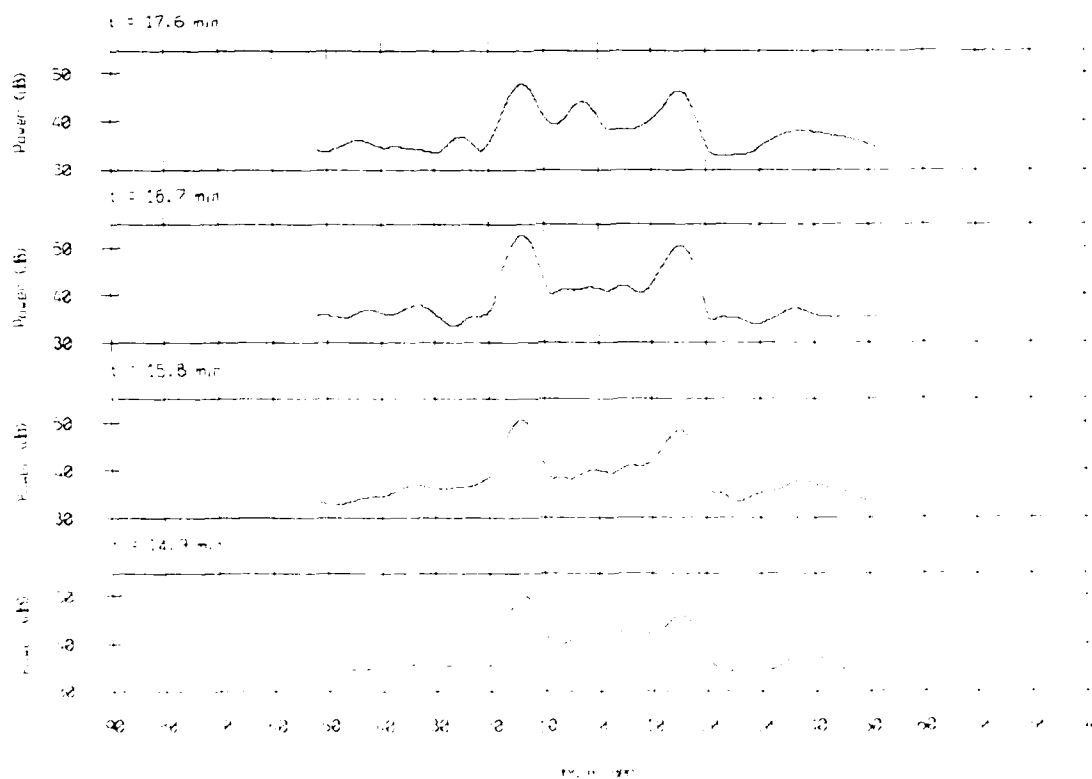
Array Response - 86180 Bin #6012

$f_c = 275$ Hz, Δf window (alone) = 1.5

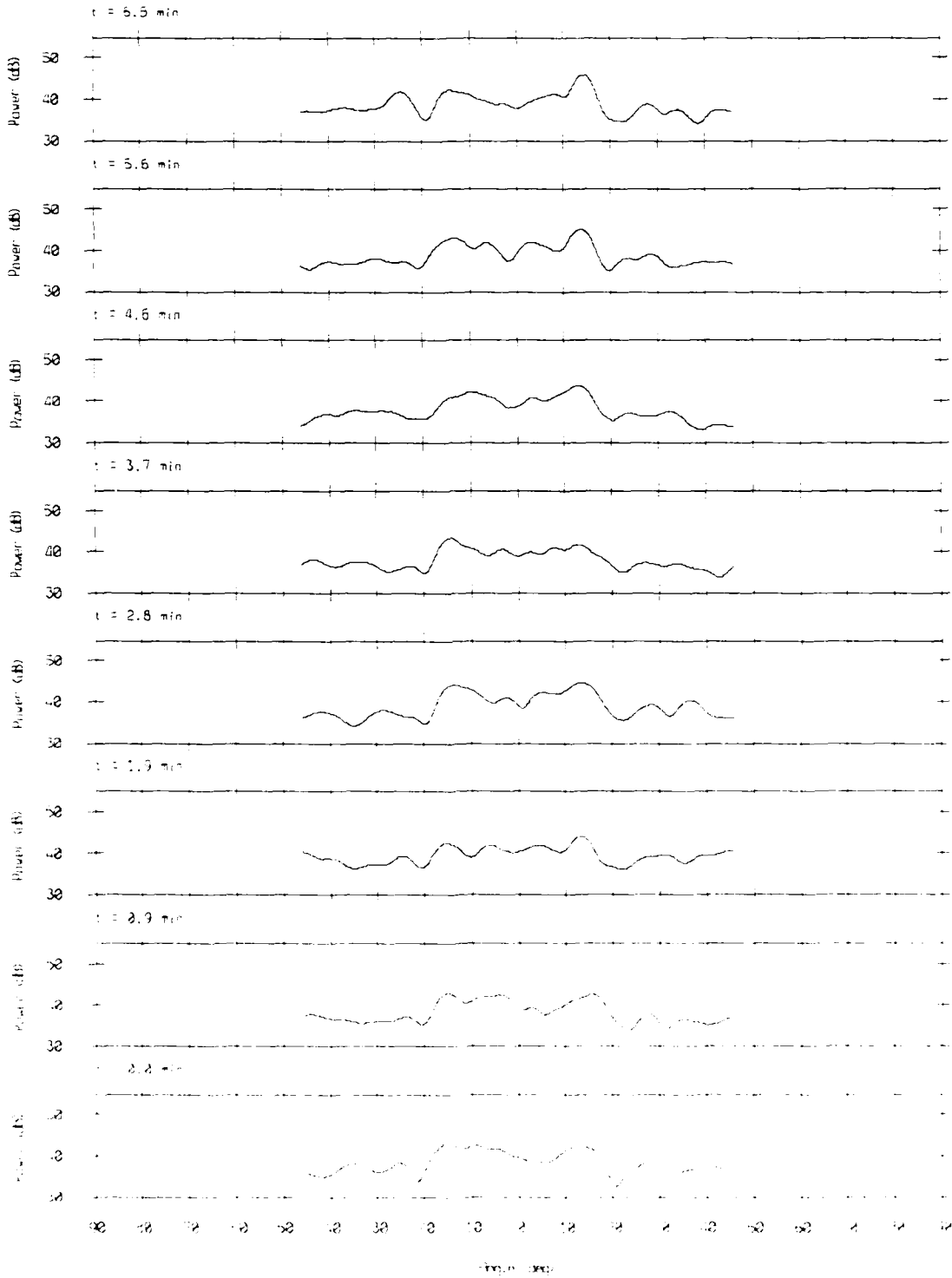


Array Response - 86180 3in #6012

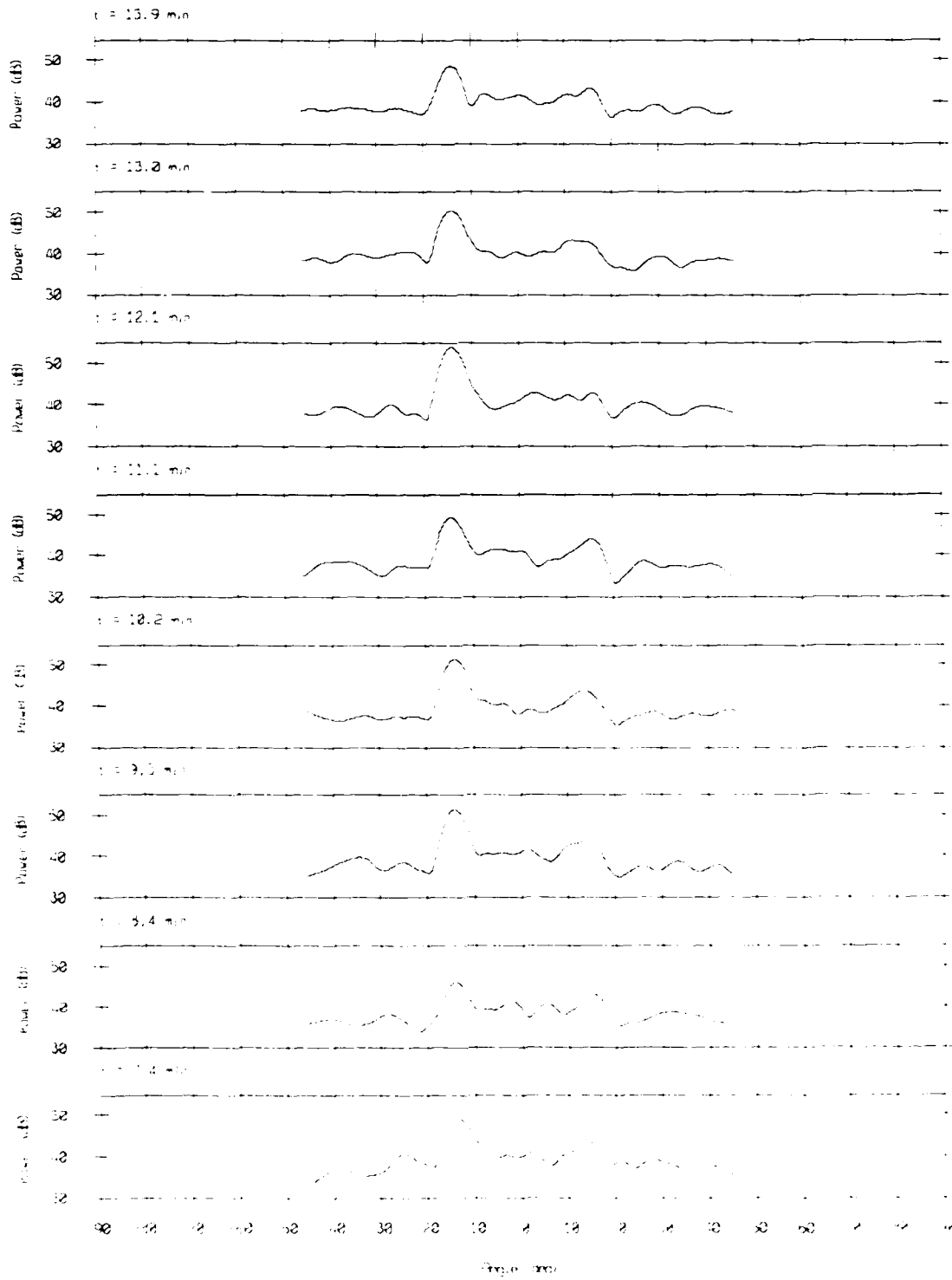
f = 275 Hz, KB window (alpha = 1.5)



Array Response - 86180 Bin #6186
 $f = 300$ Hz, KB window ($\alpha = 1.5$)

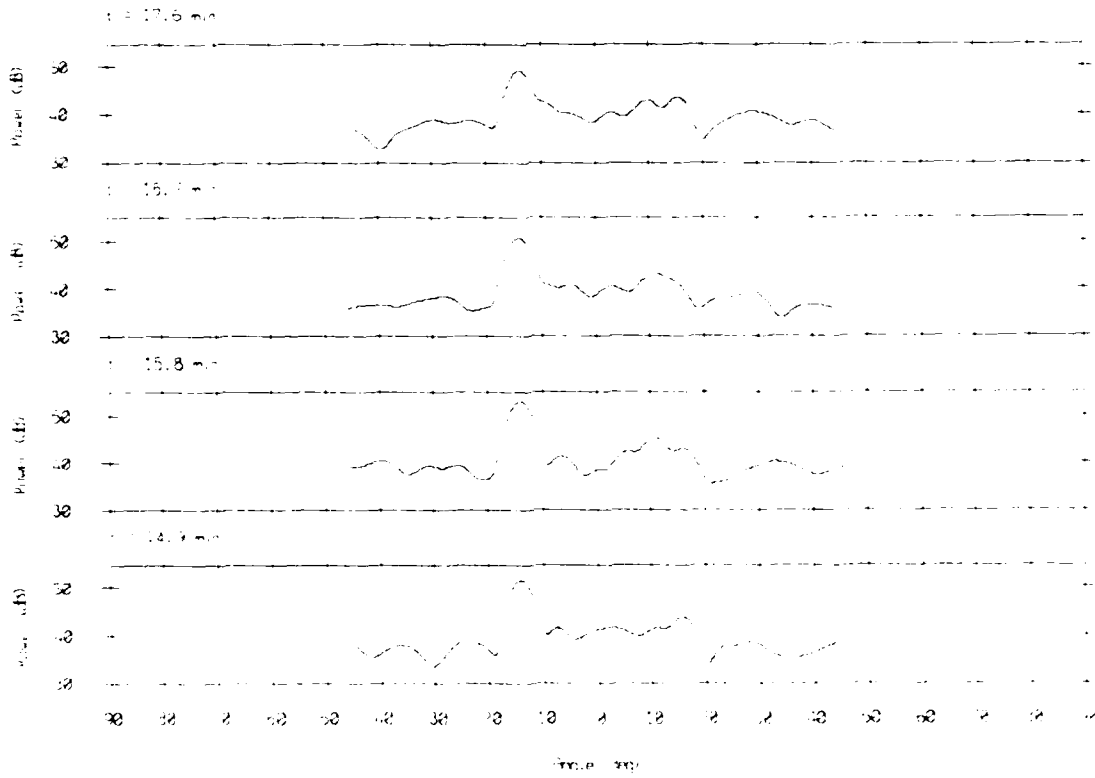


Array Response - 86180 Bin #6186
 $f = 300$ Hz, KB window (alpha = 1.5)



Array Response - 86180 Bin #6186

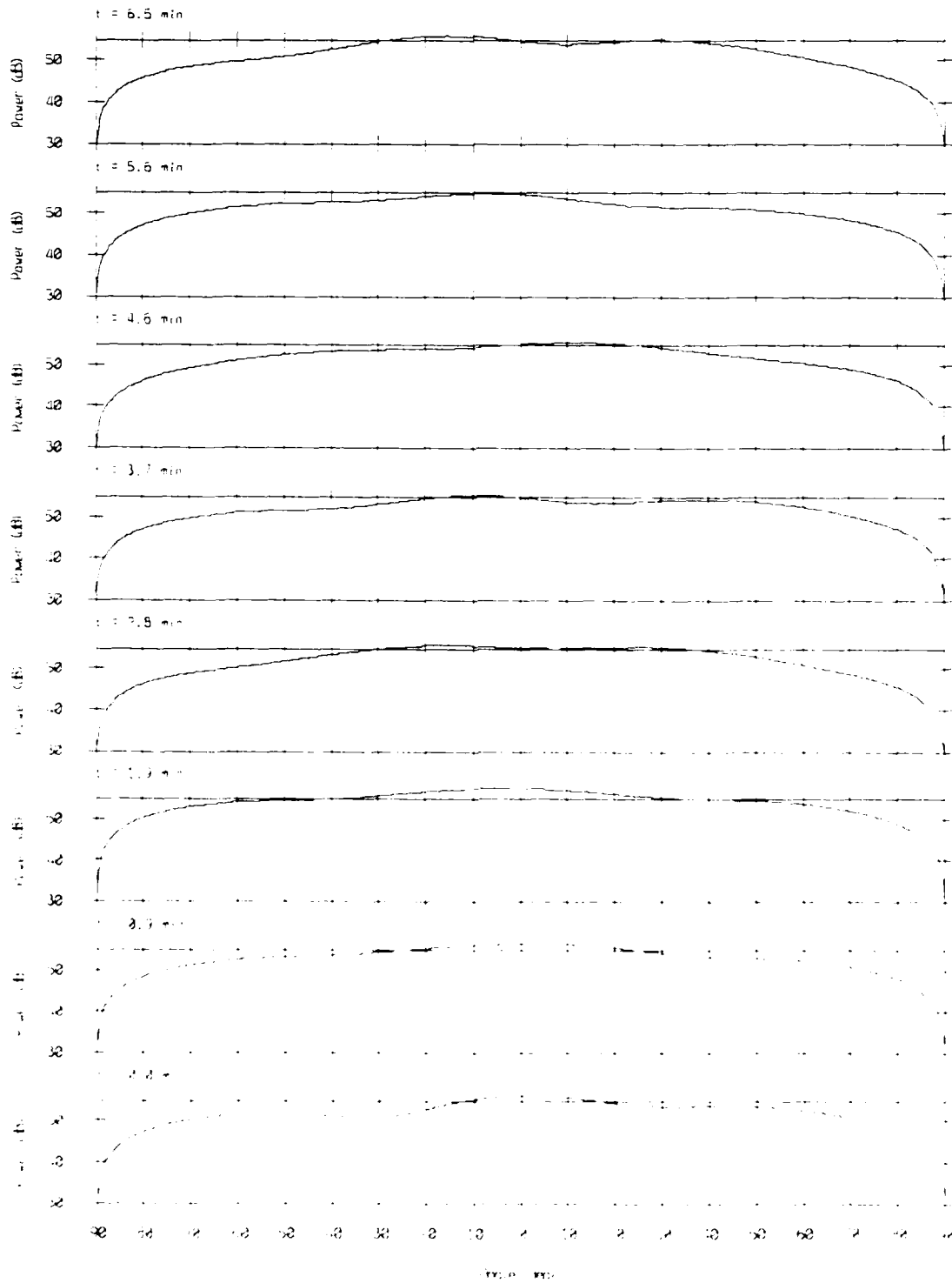
$f = 300$ Hz, KB window (pitch = 1.5)



VII. Array Response: Panels, Rect Window.

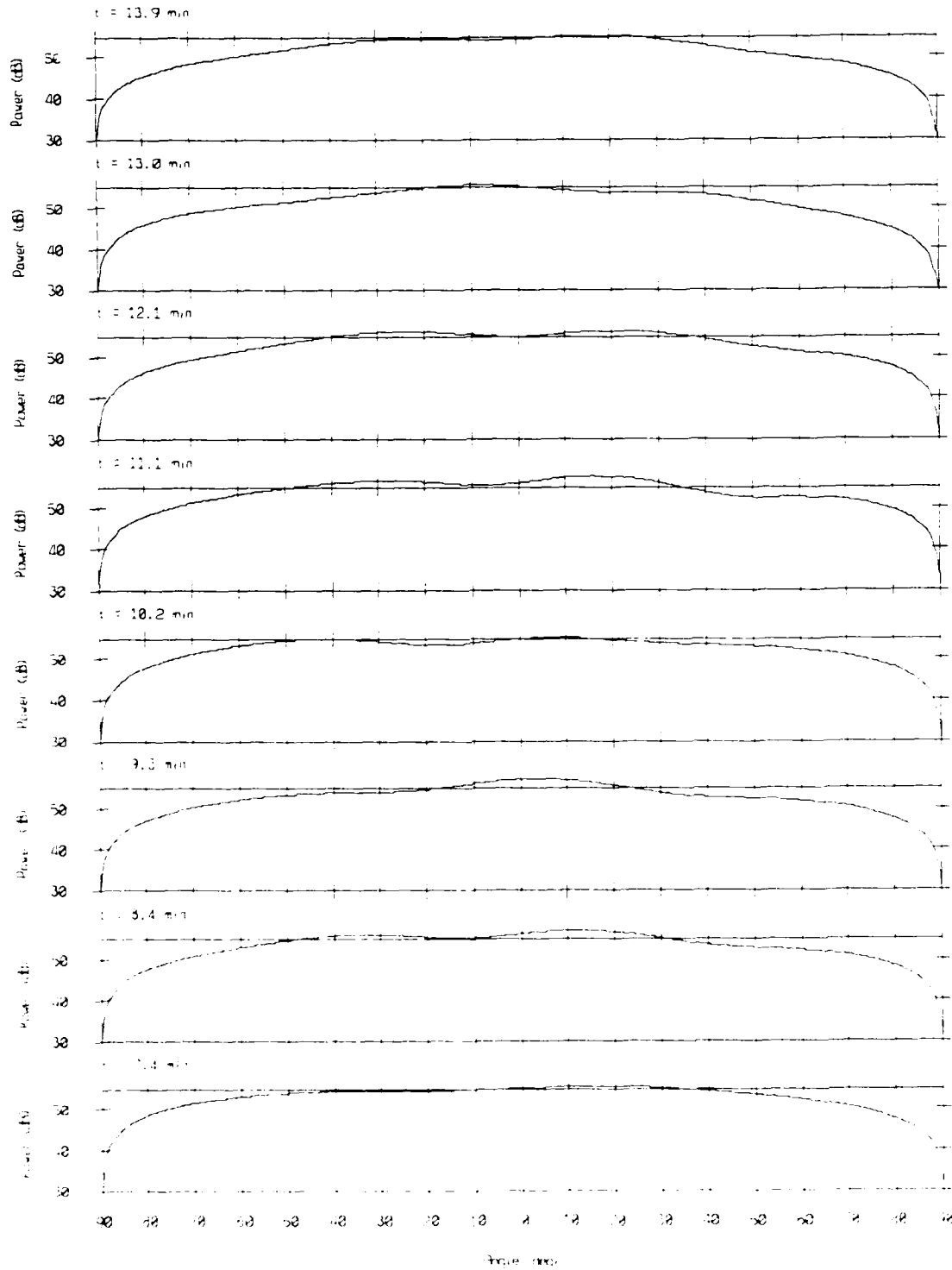
Array Response - 86180 Bin #4271

$f = 25$ Hz, rect window



Array Response - 86180 3in #4271

$\Delta = 25$ Hz, rect window



Array Response - 86180 Bin #4271

$f = 25$ Hz, next window

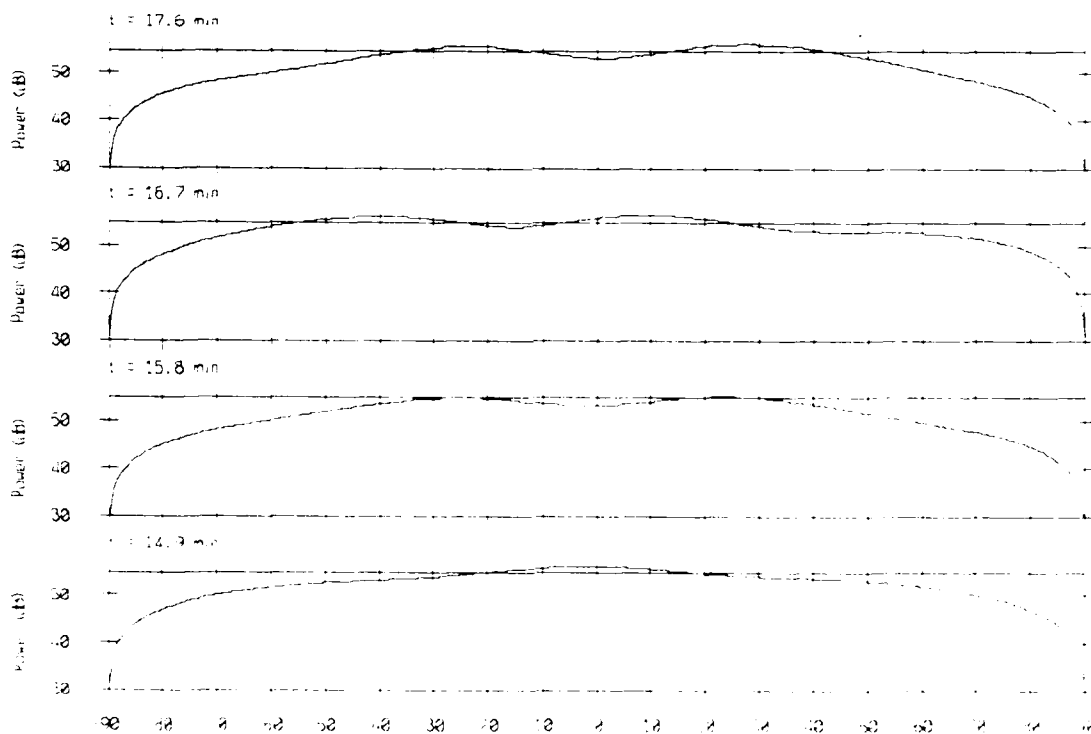
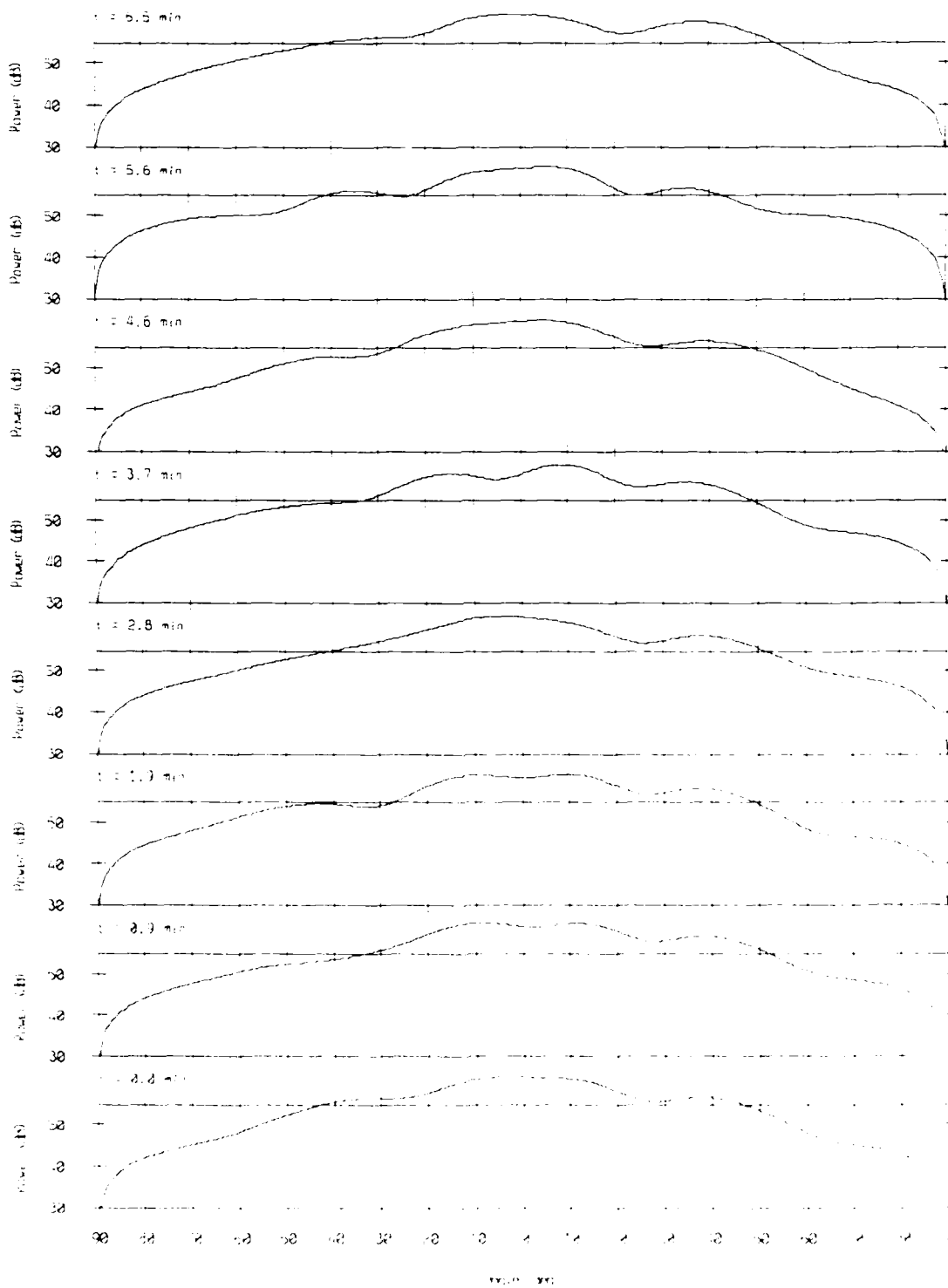


FIGURE 100

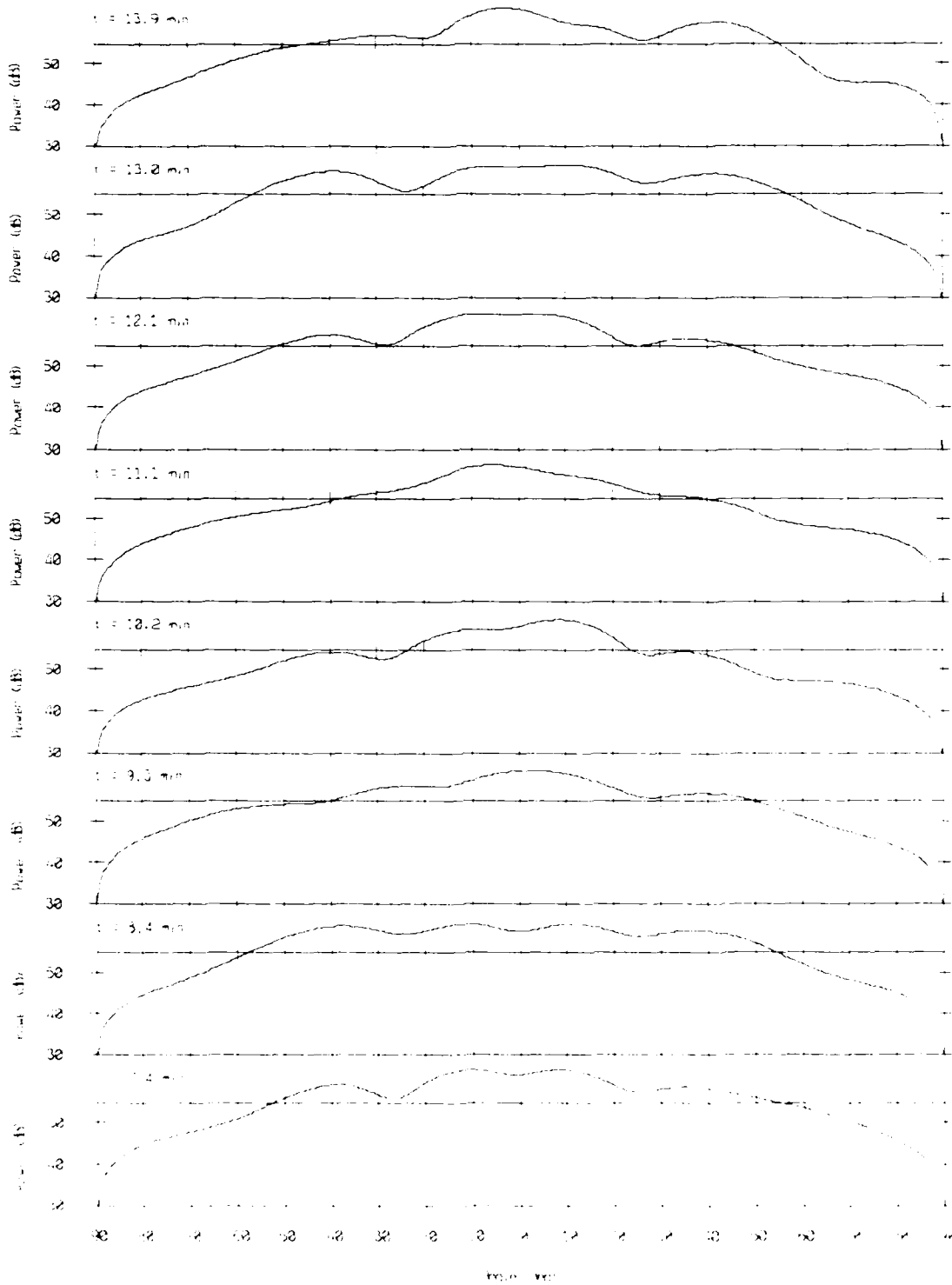
Array Response - 86180 3in #4445

$\Delta = 50$ Hz, rest window



Array Response - 86180 Bin #4445

$\Delta = 50$ Hz, rect window



Array Response - 86180 Bin #4445

$f = 50$ Hz, next window

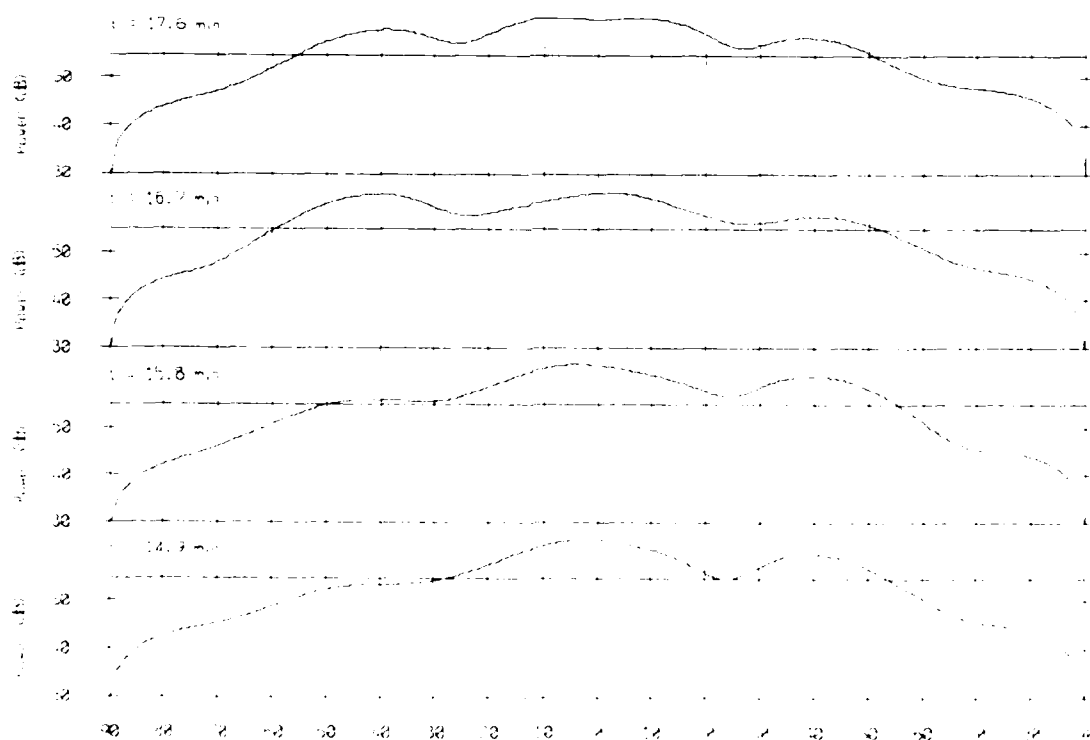
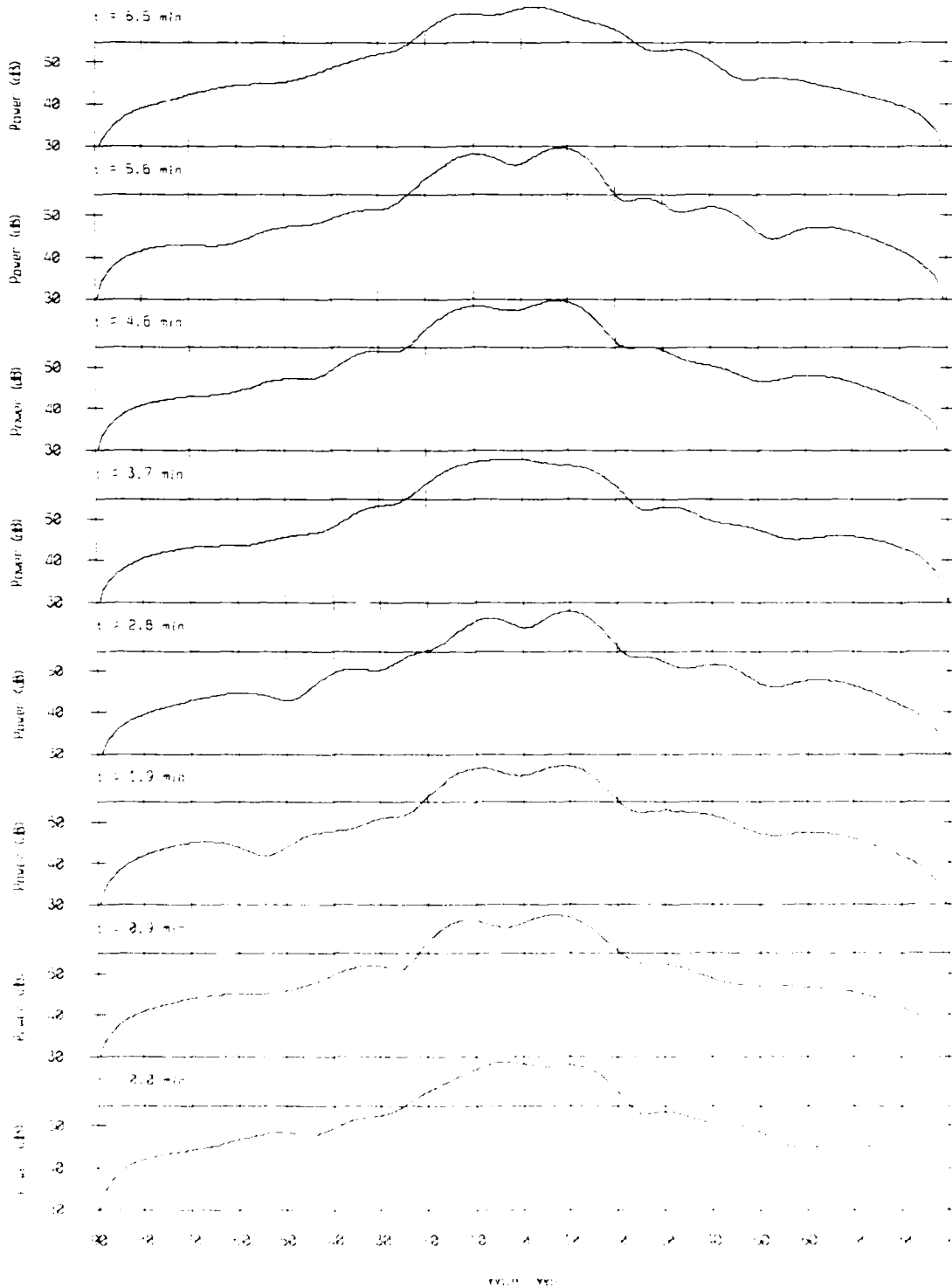


FIG. 10

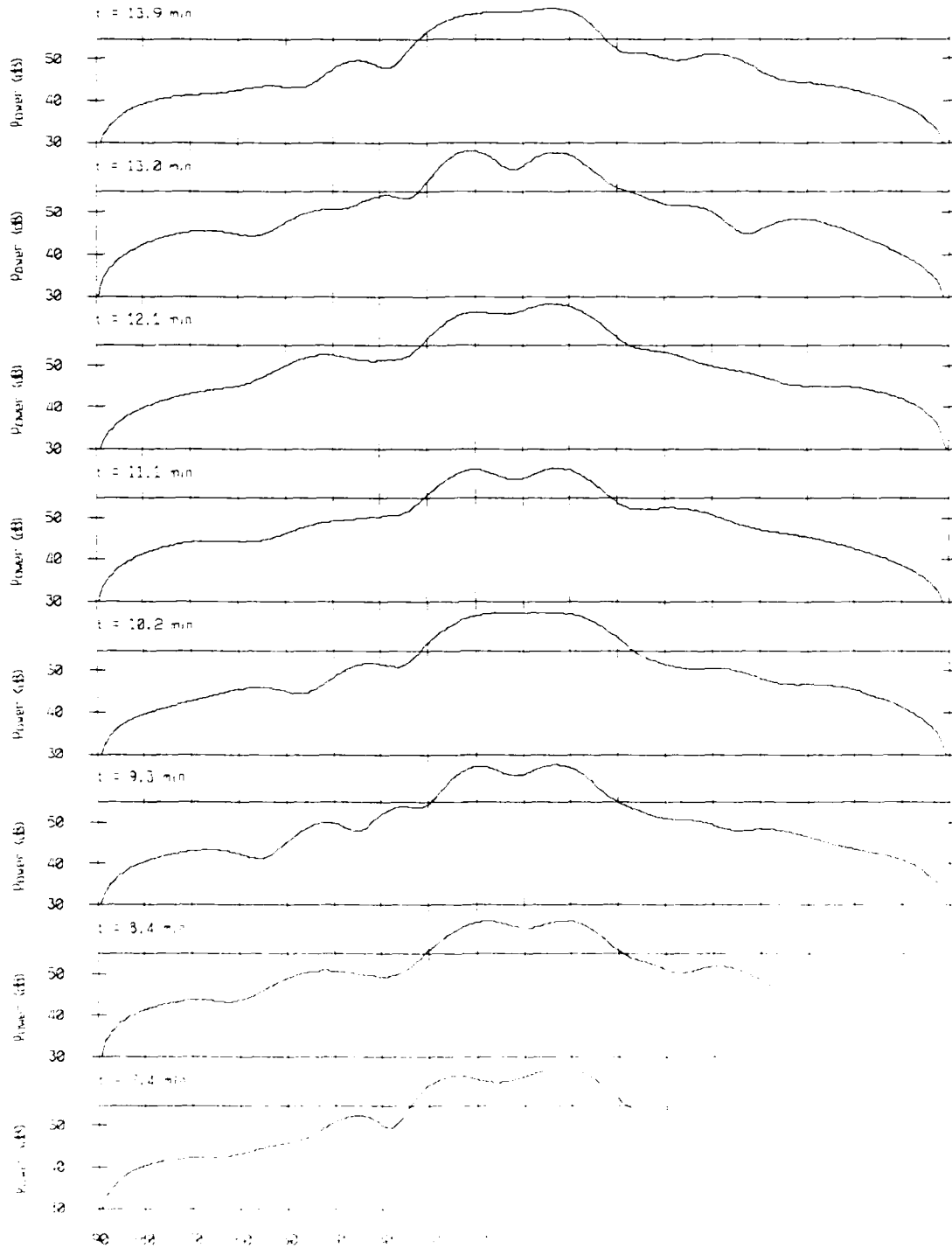
Array Response - 86180 Bin #4619

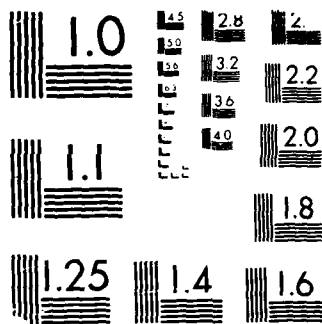
$\Delta = 75$ Hz, next window



Array Response - 86180 Bin #4619

$f = 75$ Hz, rect window

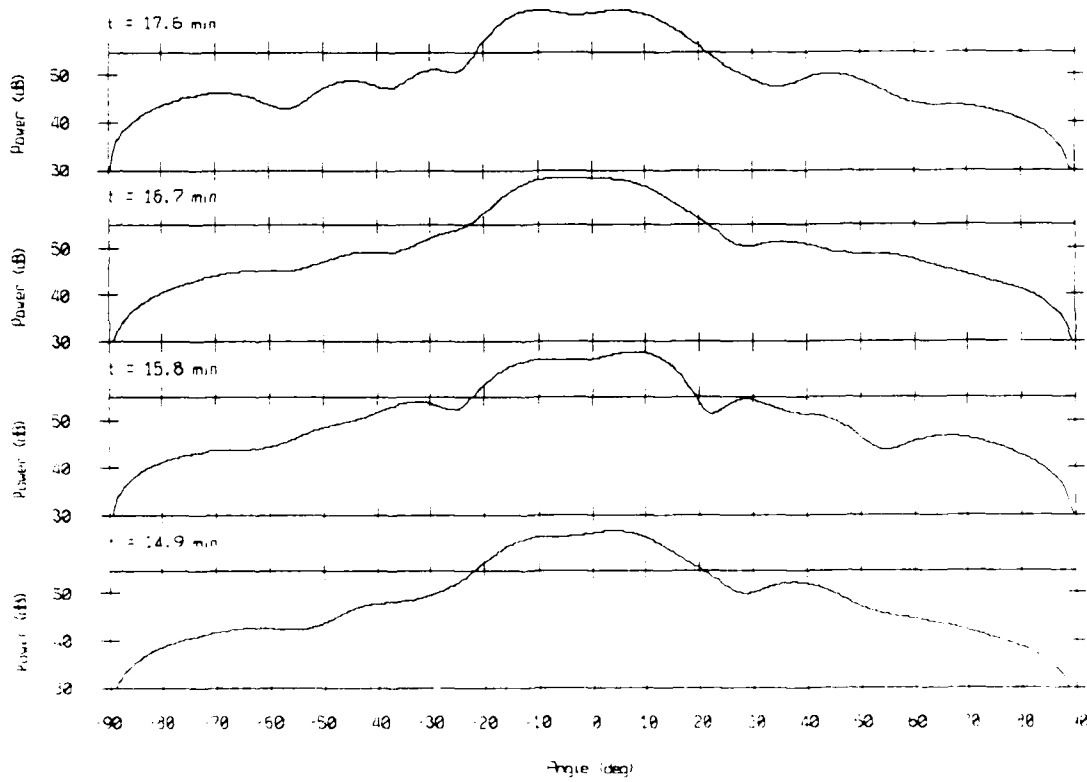




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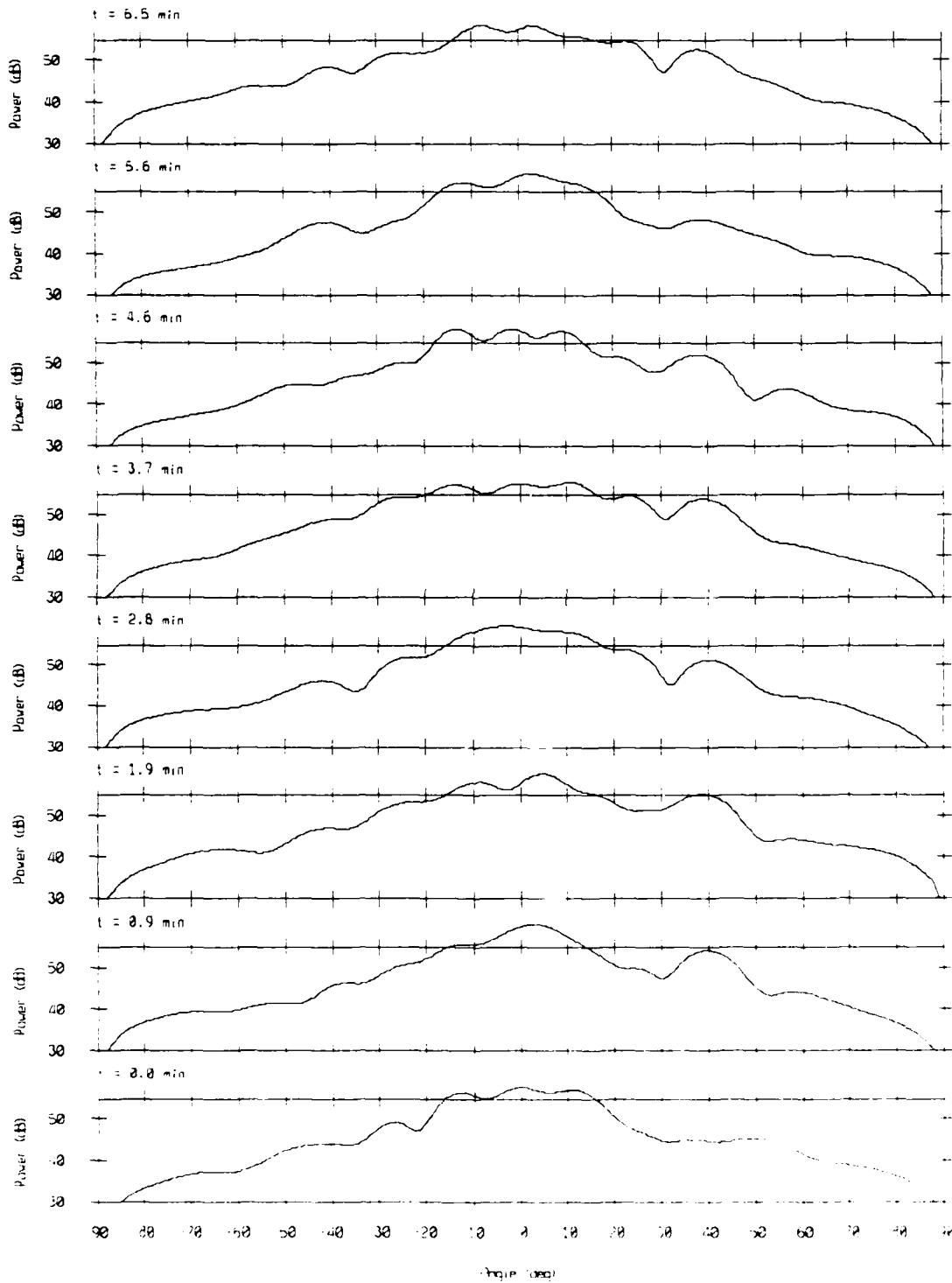
Array Response - 86180 Bin #4619

$f = 75$ Hz, rect window



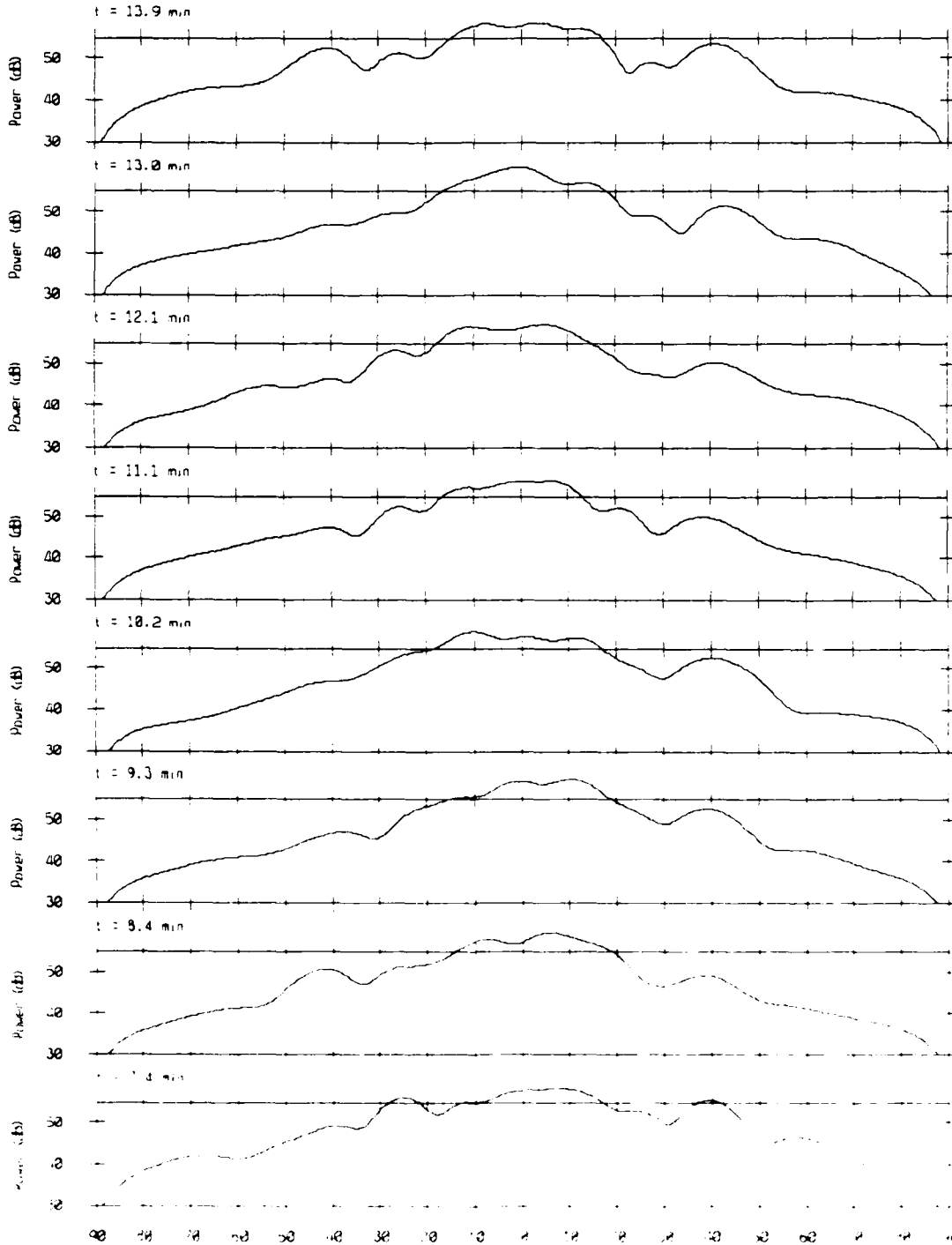
Array Response - 86180 Bin #4793

f = 100 Hz, rect window



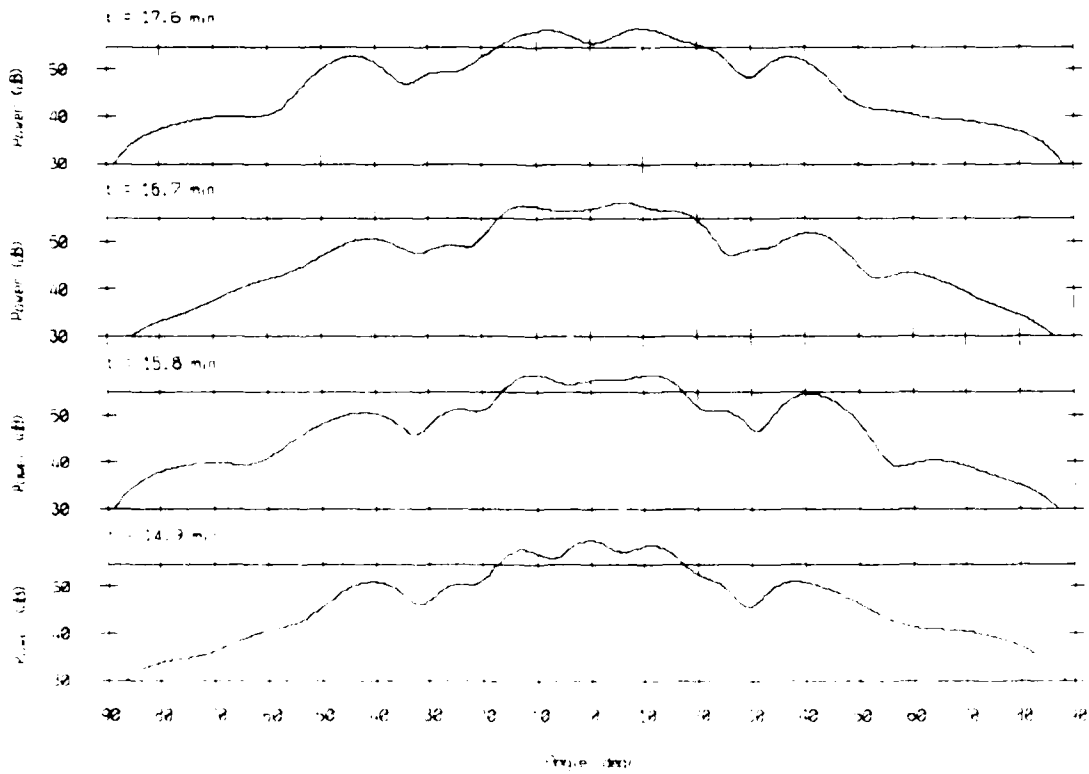
Array Response - 86180 Bin #4793

f = 100 Hz, rect window



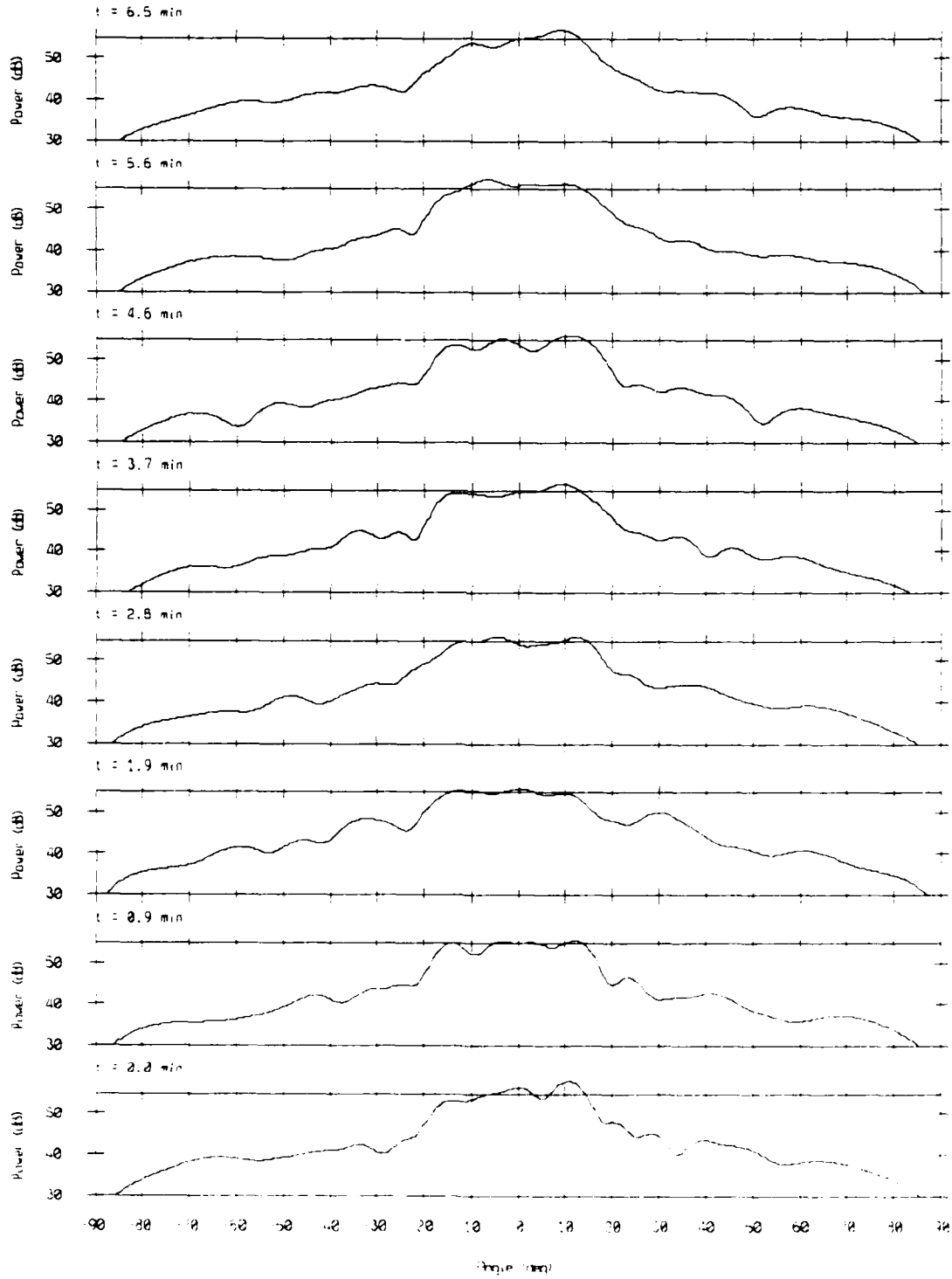
Array Response - 86180 Bin #4793

$f = 100$ Hz, rect window



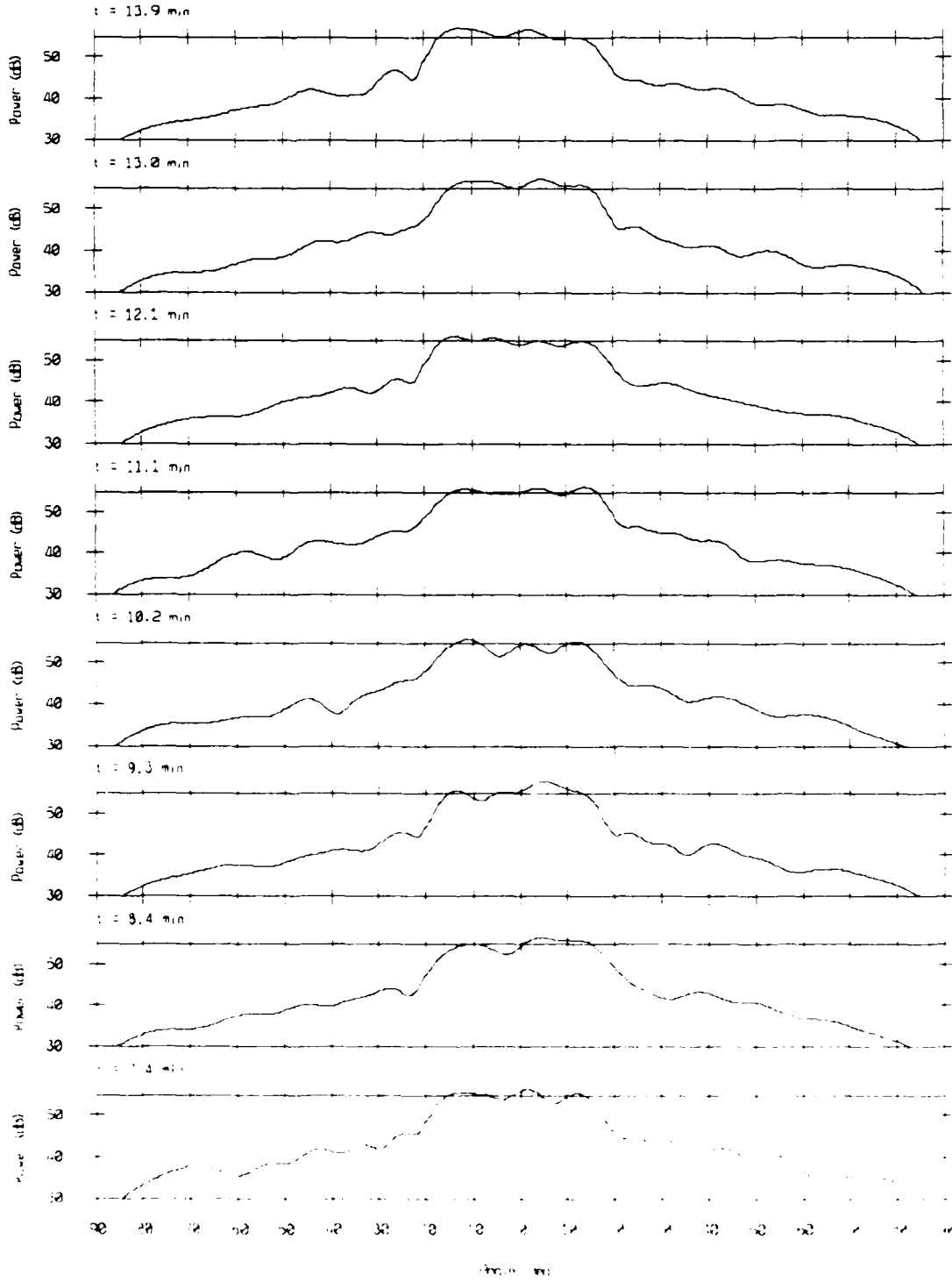
Array Response - 86180 Bin #4967

$f = 125$ Hz, rect window



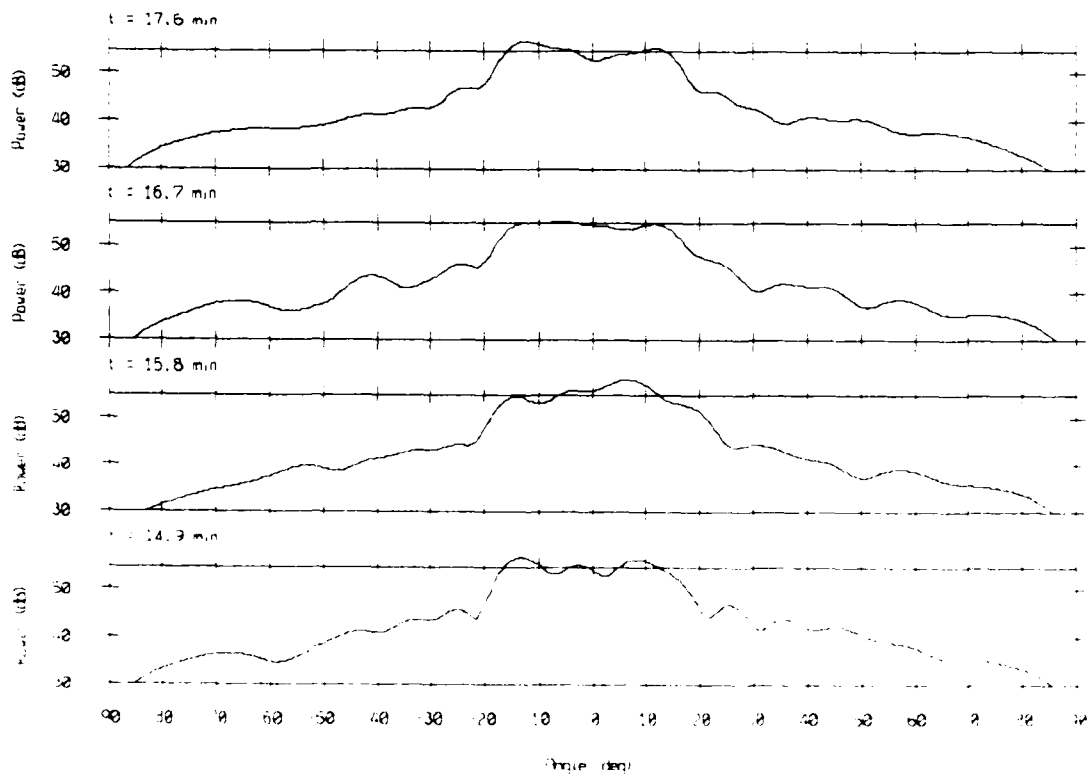
Array Response - 86180 Bin #4967

$f = 125$ Hz, rect window



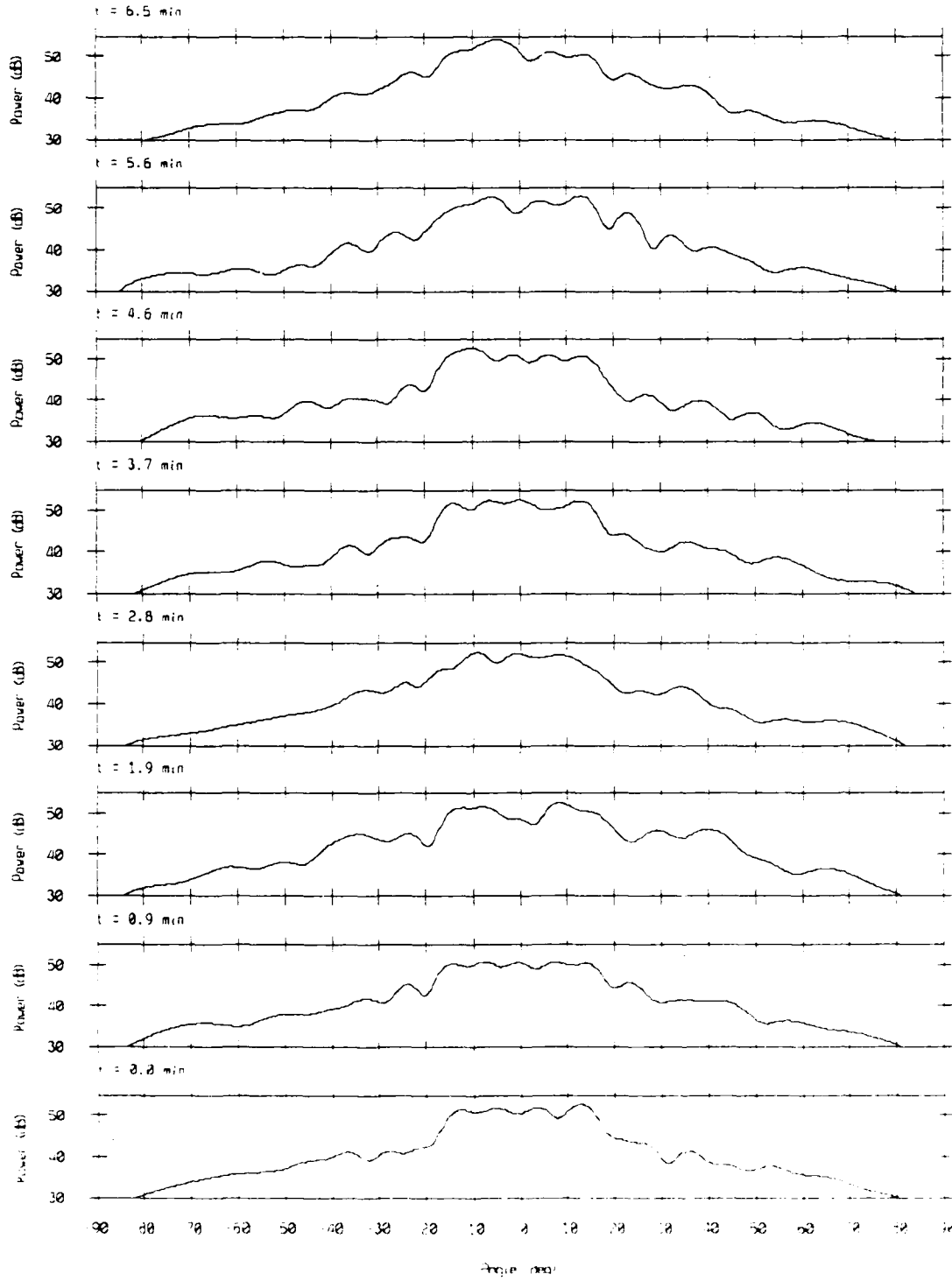
Array Response - 86180 Bin #4967

$\Delta f = 125$ Hz, rect window



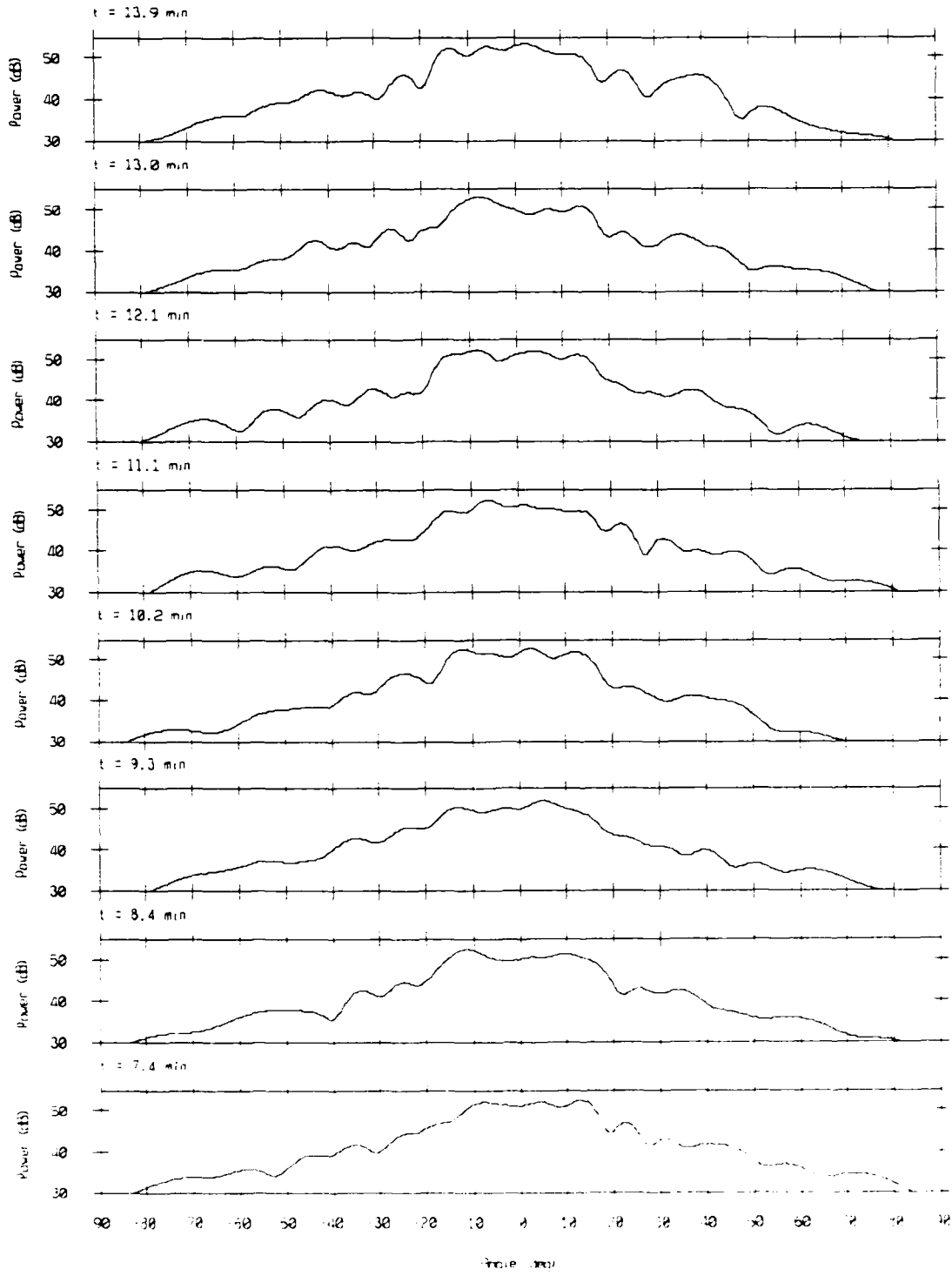
Array Response - 86180 Bin #5141

$\Delta f = 150$ Hz, rect window



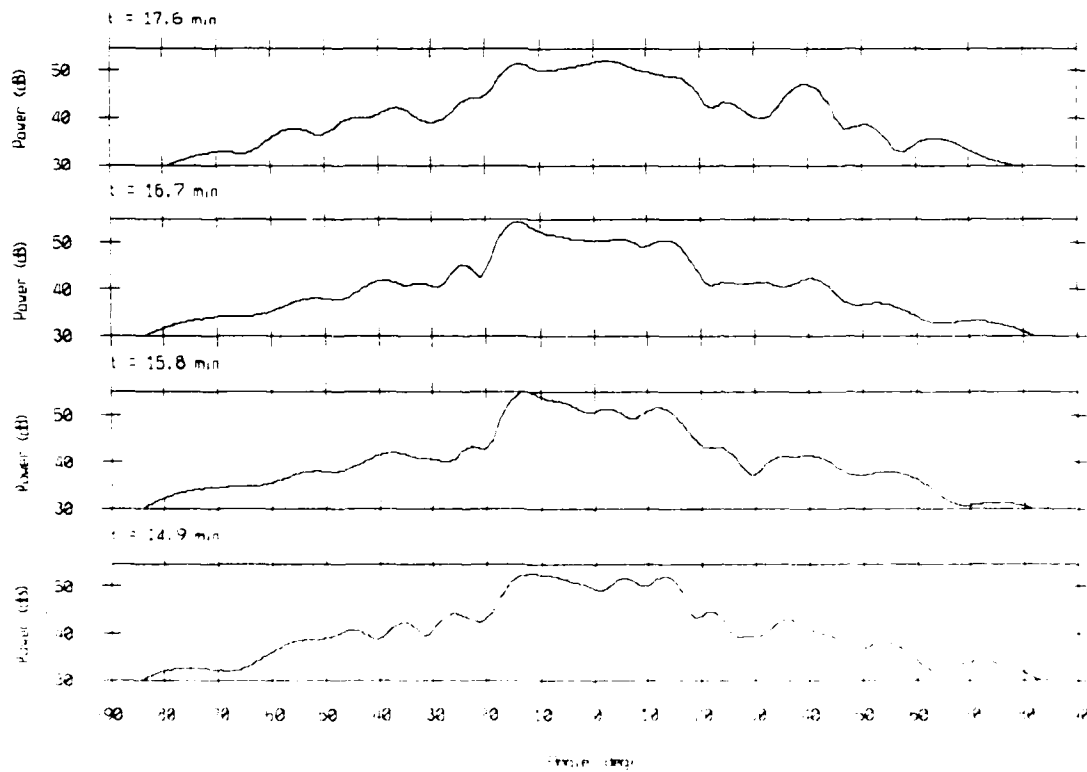
Array Response - 86180 Bin #5141

$f = 150$ Hz, rect window



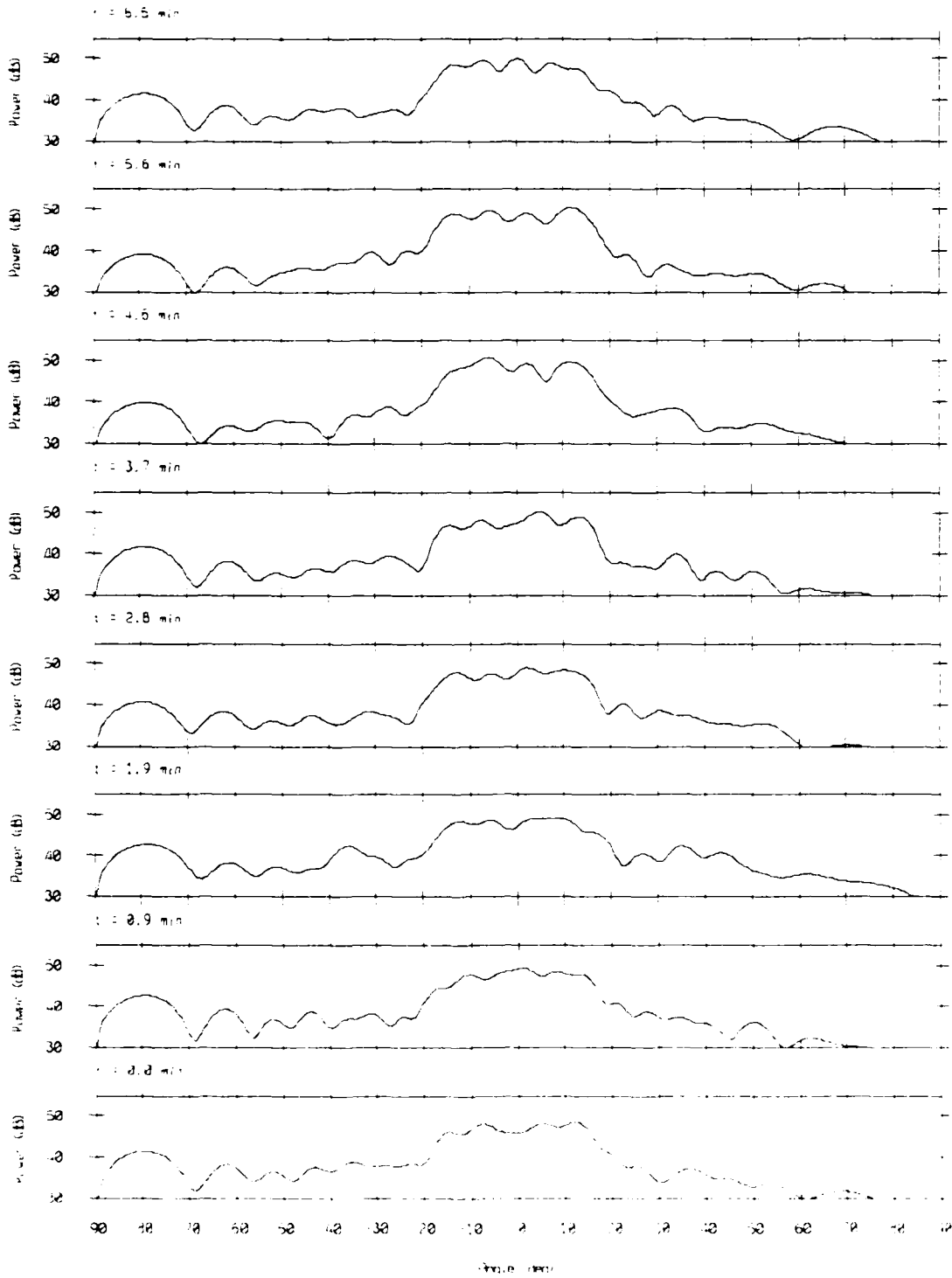
Array Response - 86180 Bin #5141

$f = 150$ Hz, rect window



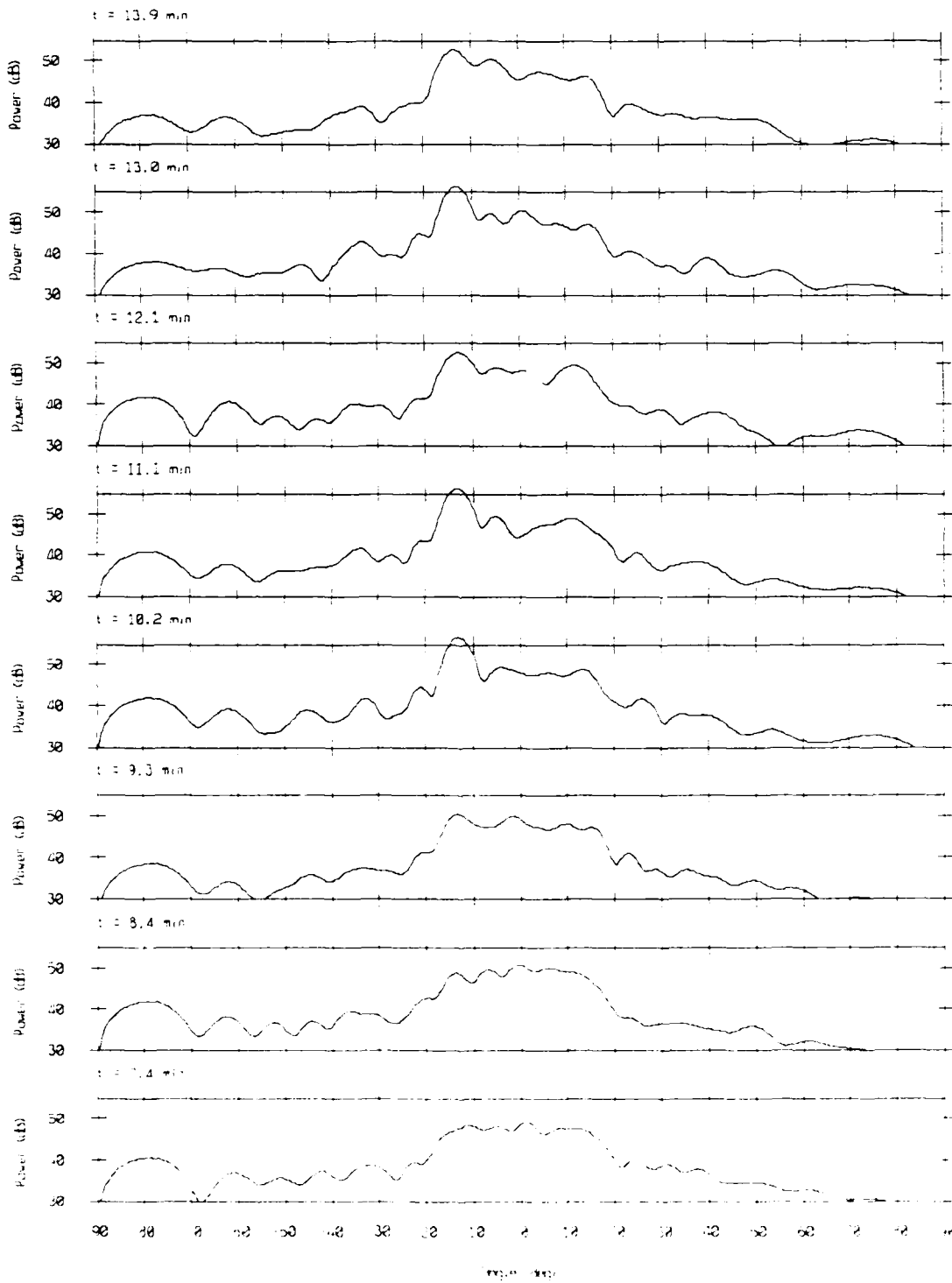
Array Response - 86180 Bin #5316

$\Delta = 175$ Hz, next window



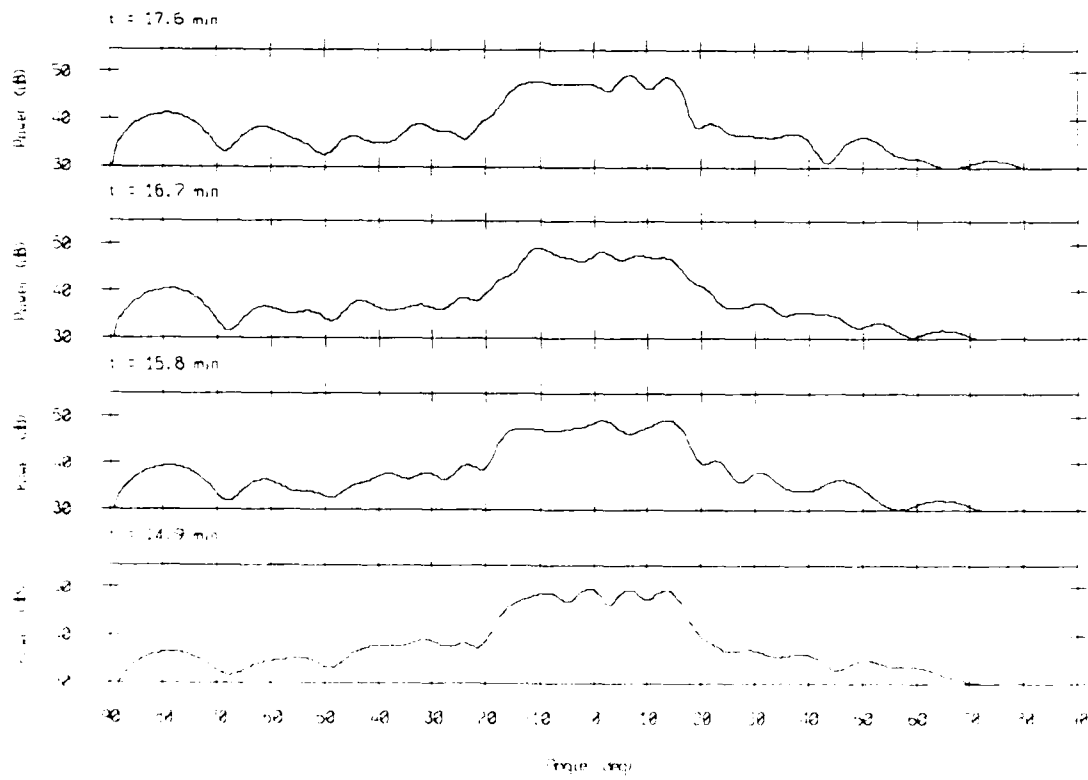
Array Response - 86180 Bin #5316

f = 175 Hz, rect window



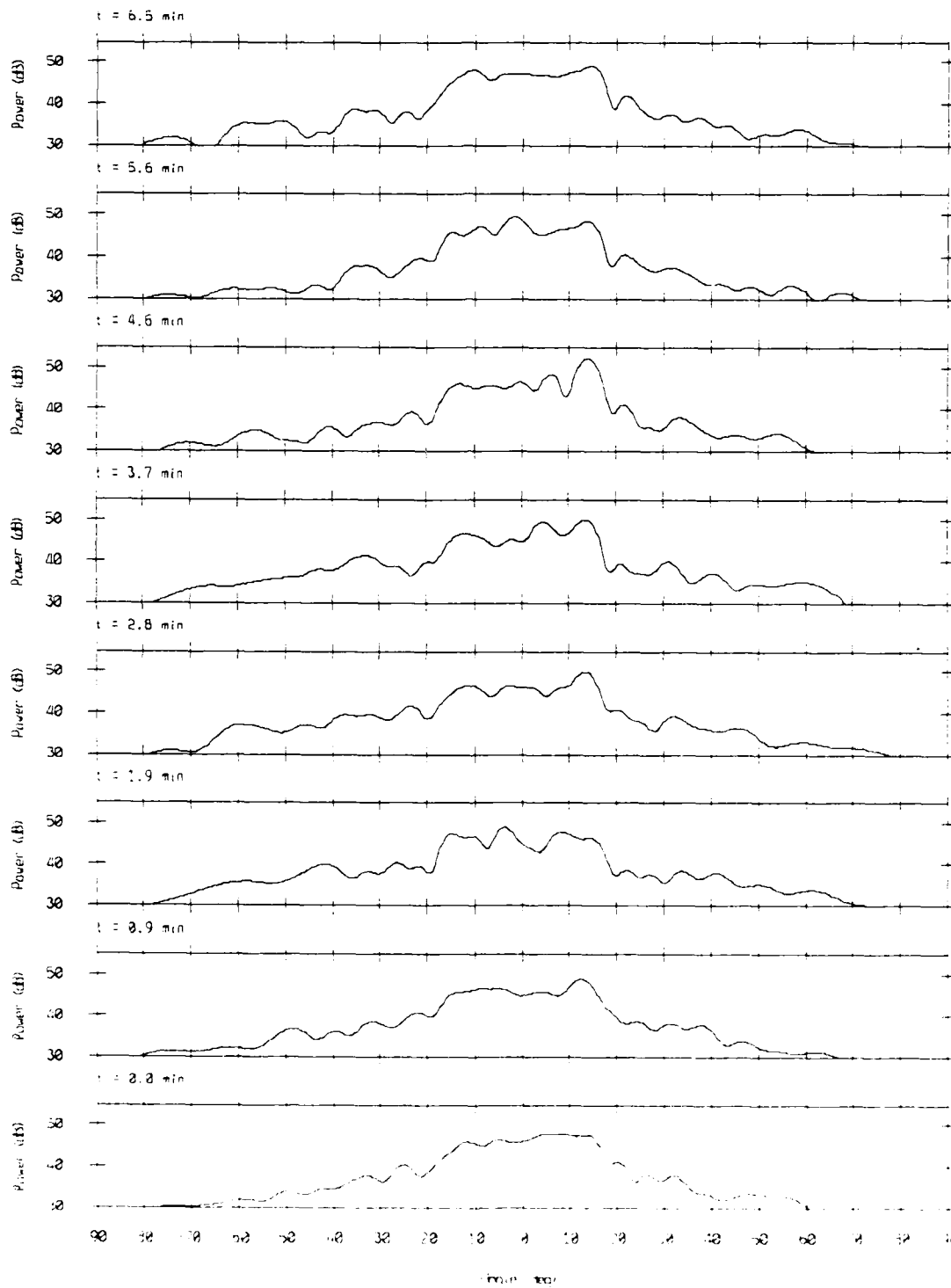
Array Response - 86180 Bin #5316

$f = 175$ Hz, rect window



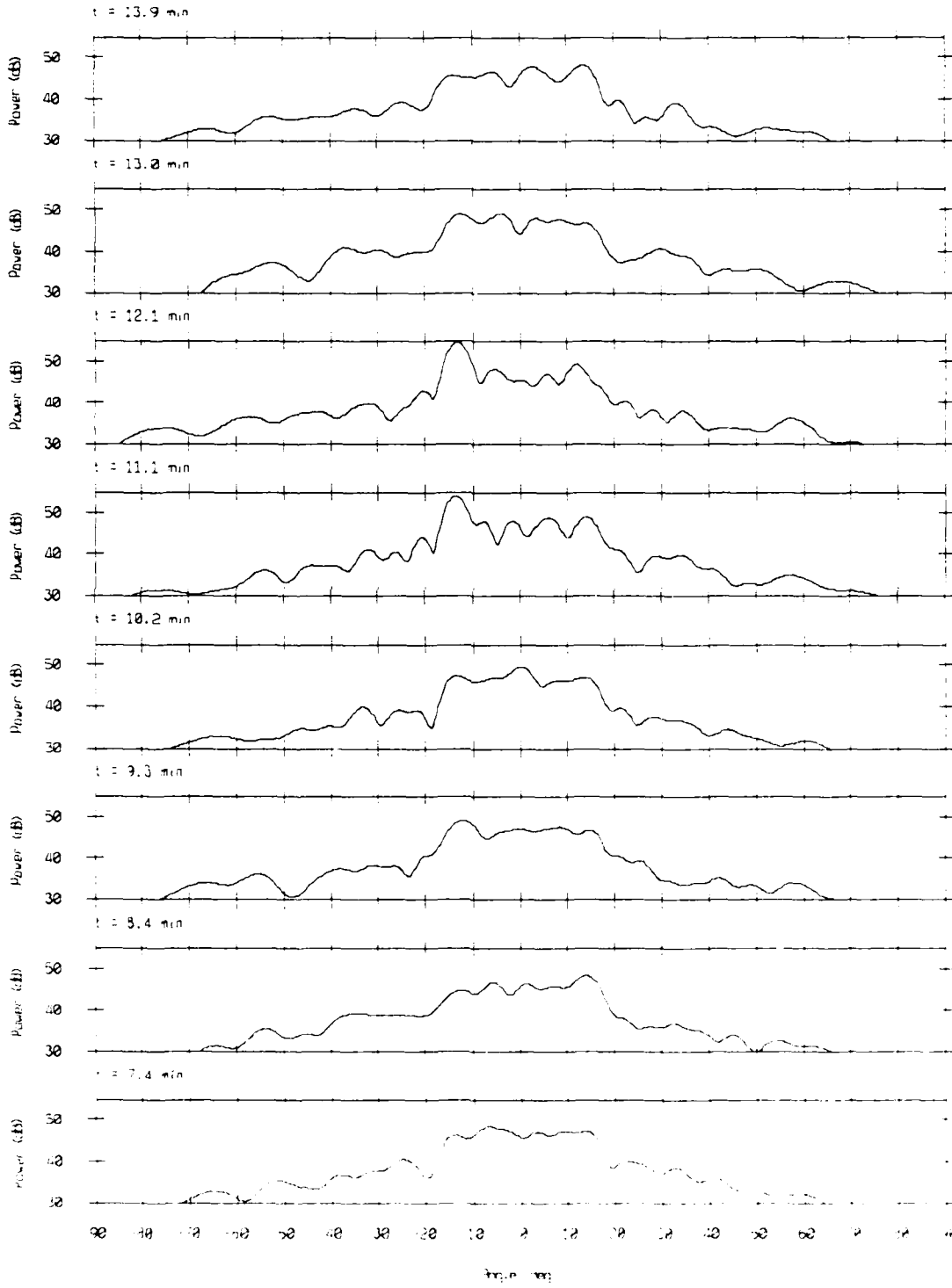
Array Response - 86180 Bin #5490

$f = 200$ Hz, rect window



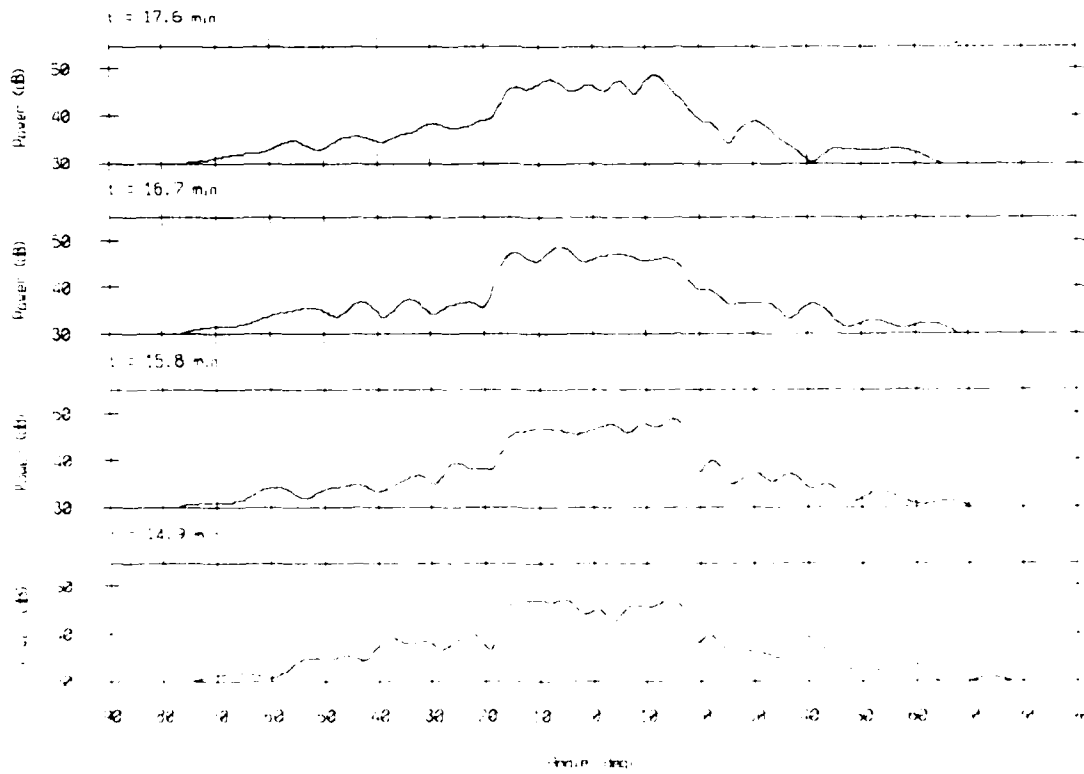
Array Response - 86180 Bin #5490

$\Delta f = 200$ Hz, rect window



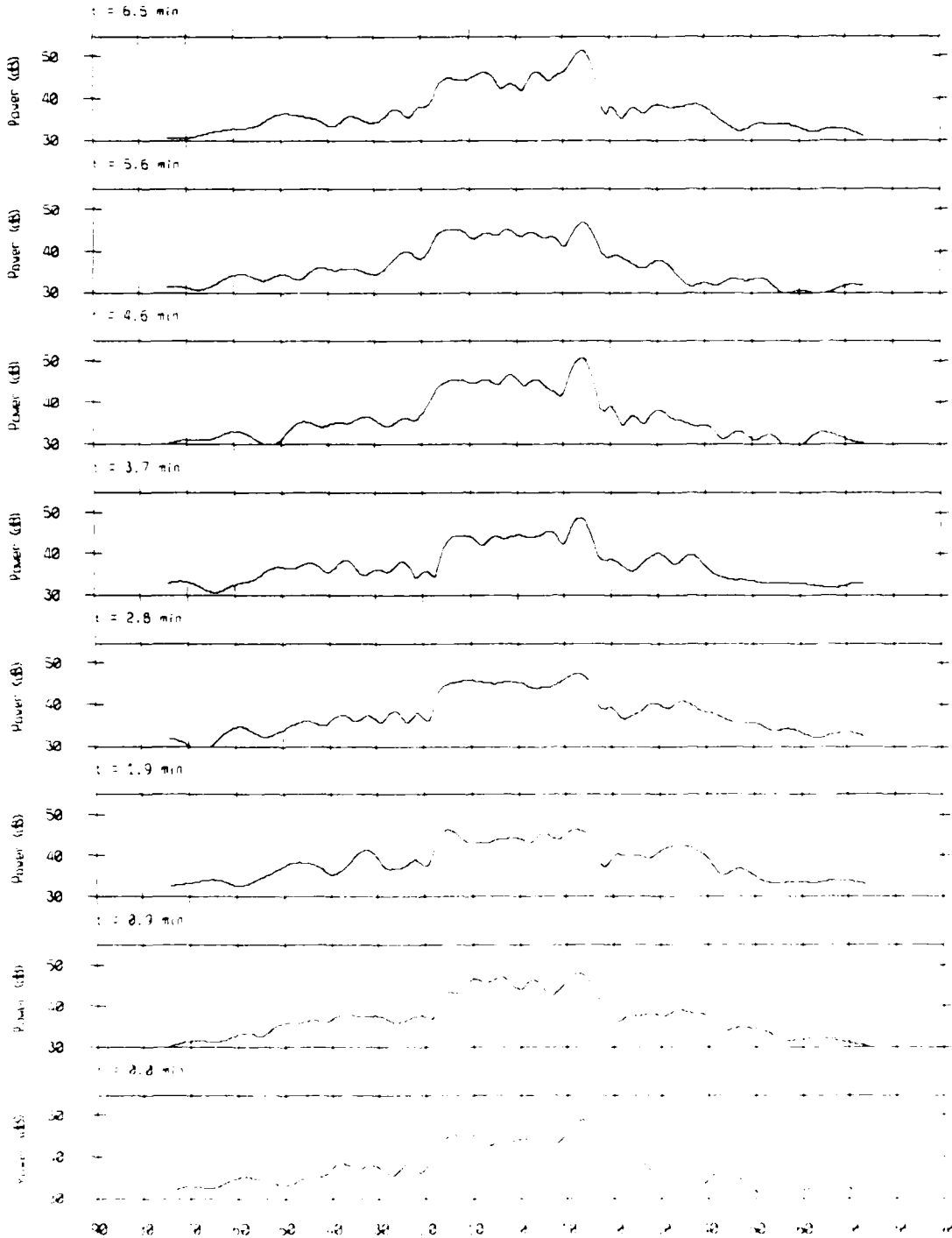
Array Response - 86180 Bin #5490

f = 200 Hz, rect window



Array Response - 86180 Bin #5664

$f = 225$ Hz, rect window



Array Response - 86180 Bin #5664

$f = 225$ Hz, rect window

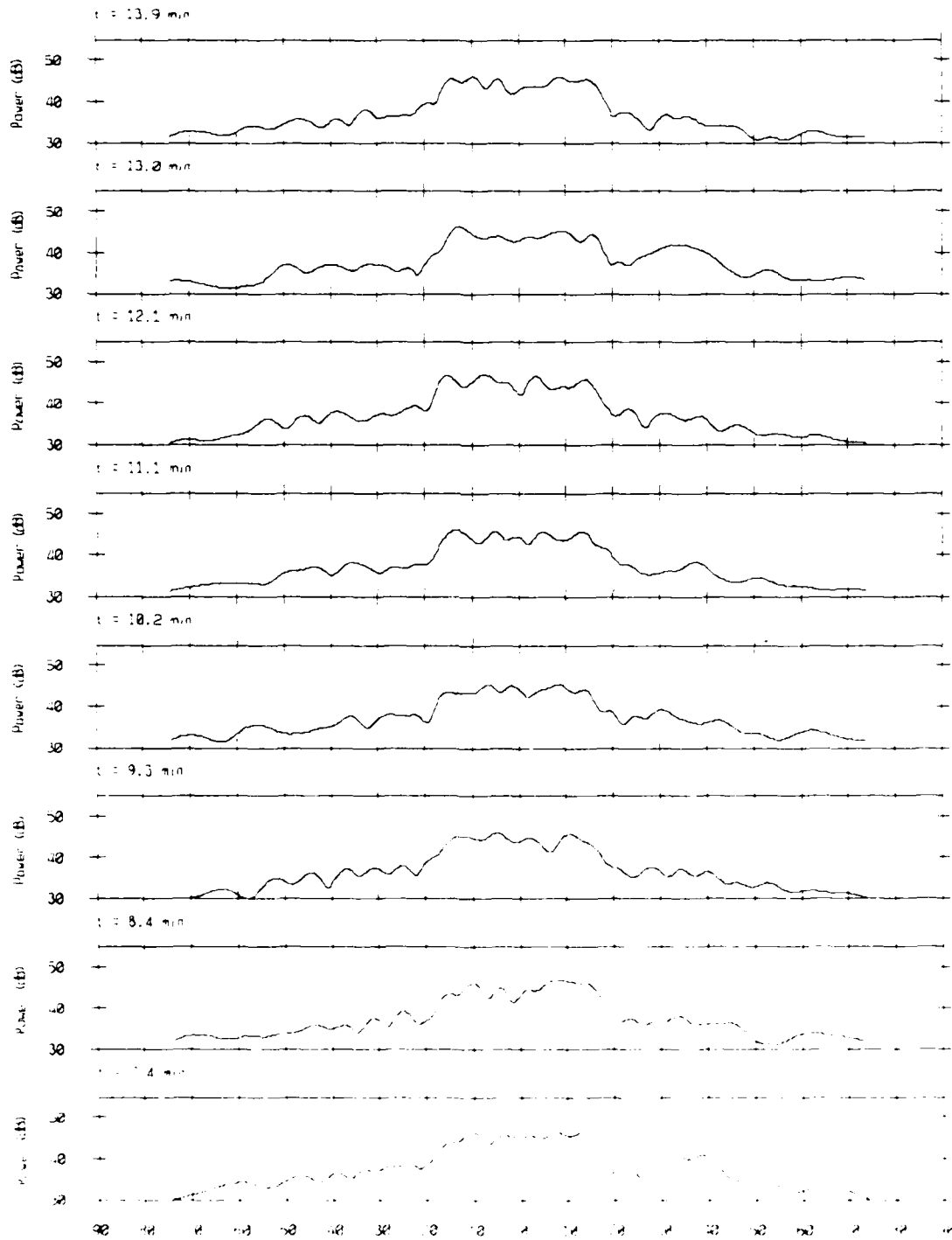
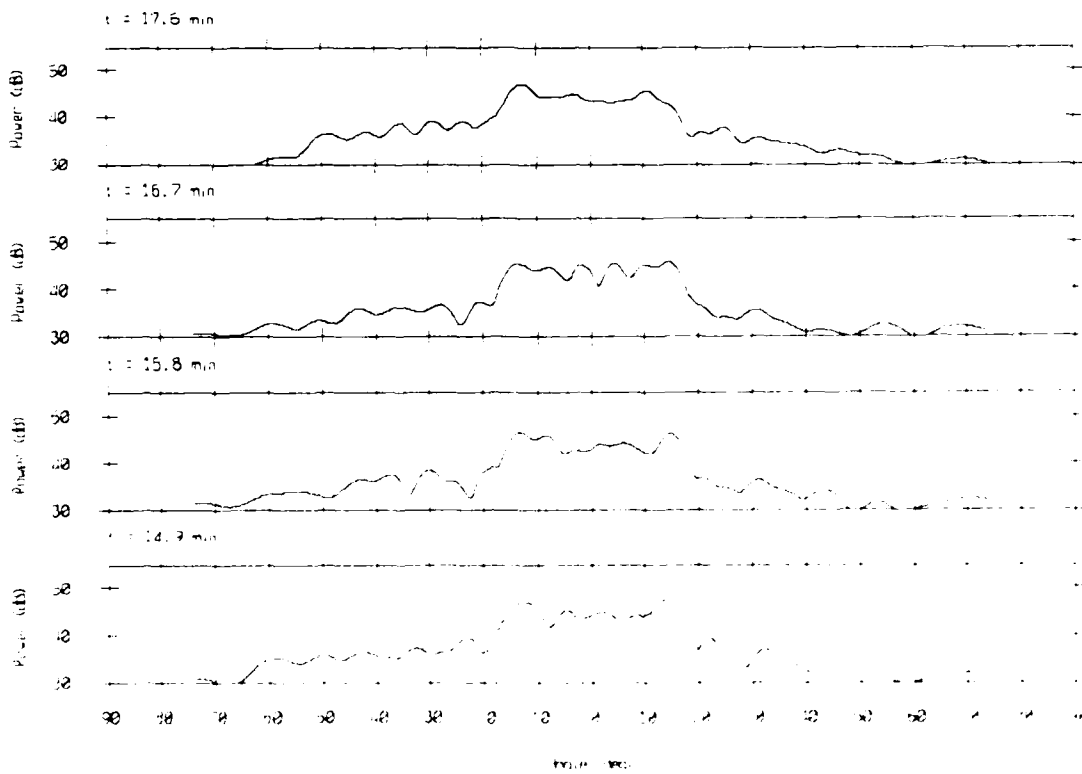


FIGURE 10

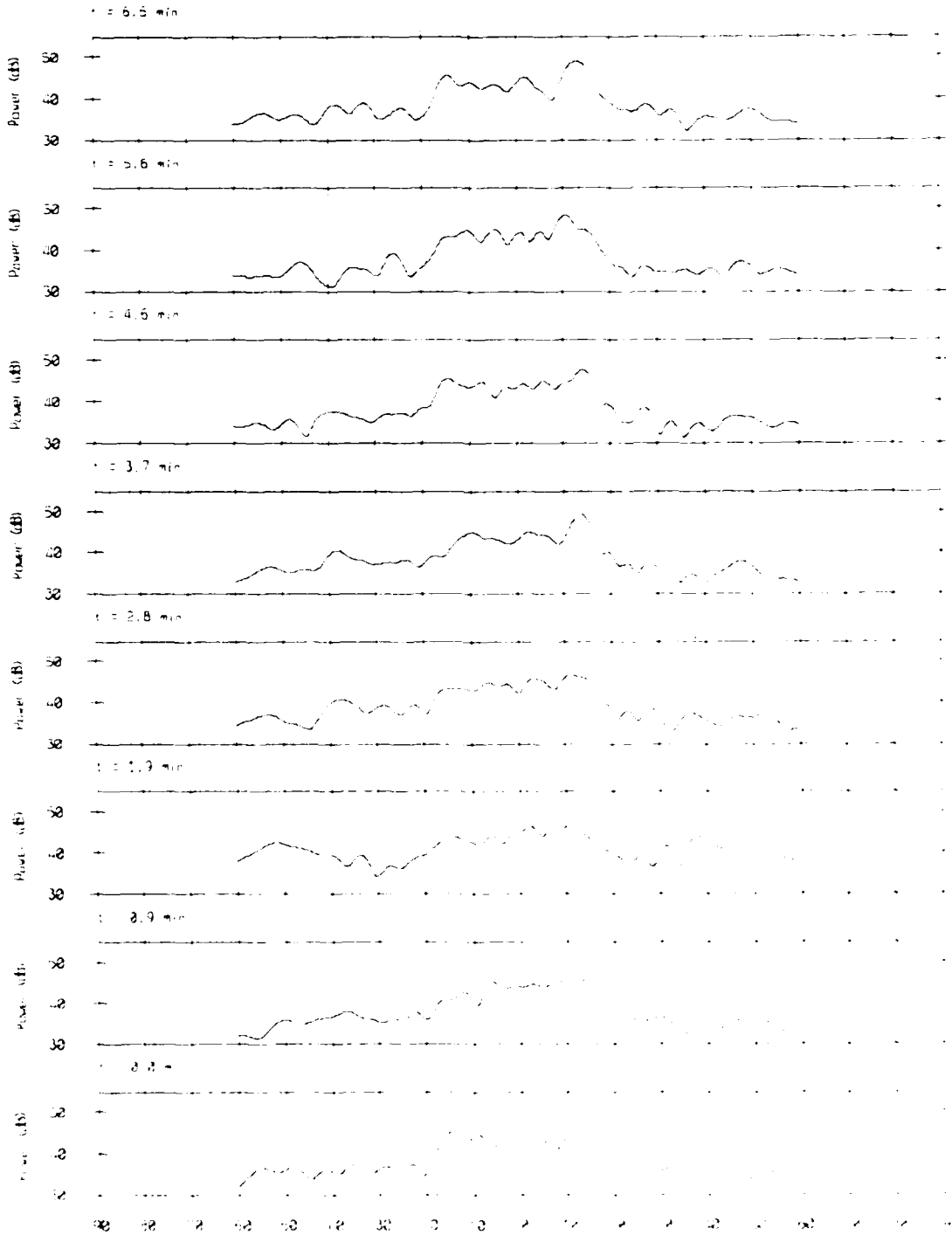
Array Response - 86180 Bin #5664

$f = 225$ Hz, rect window



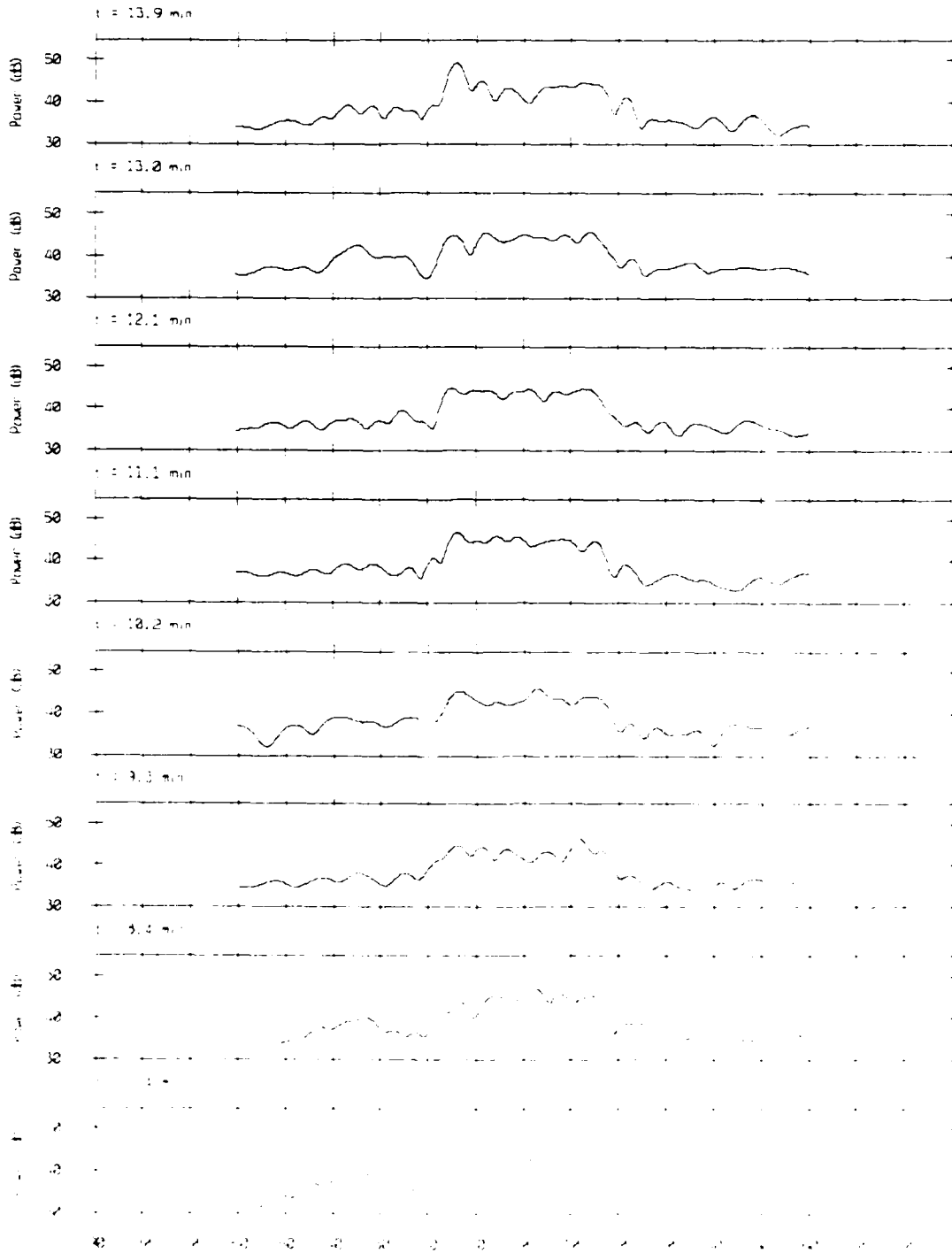
Array Response - 86180 Bin #5832

$f = 250$ Hz, rect window



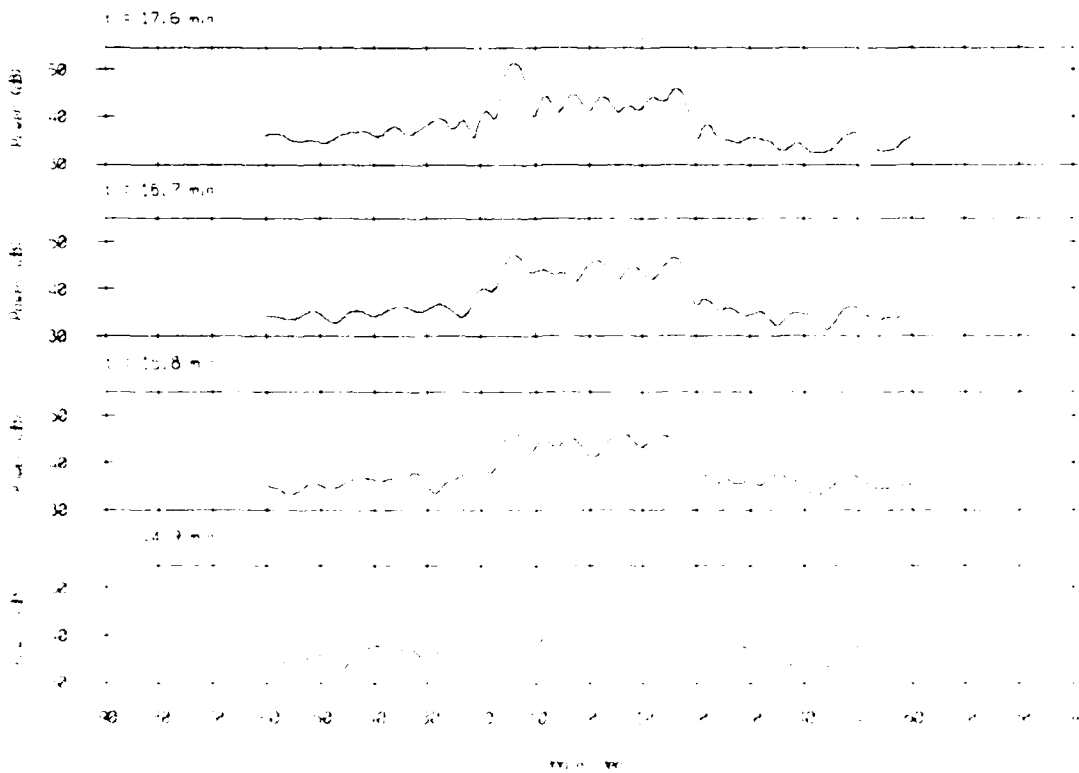
Array Response - 86180 Bin #5832

f = 250 Hz, rect window



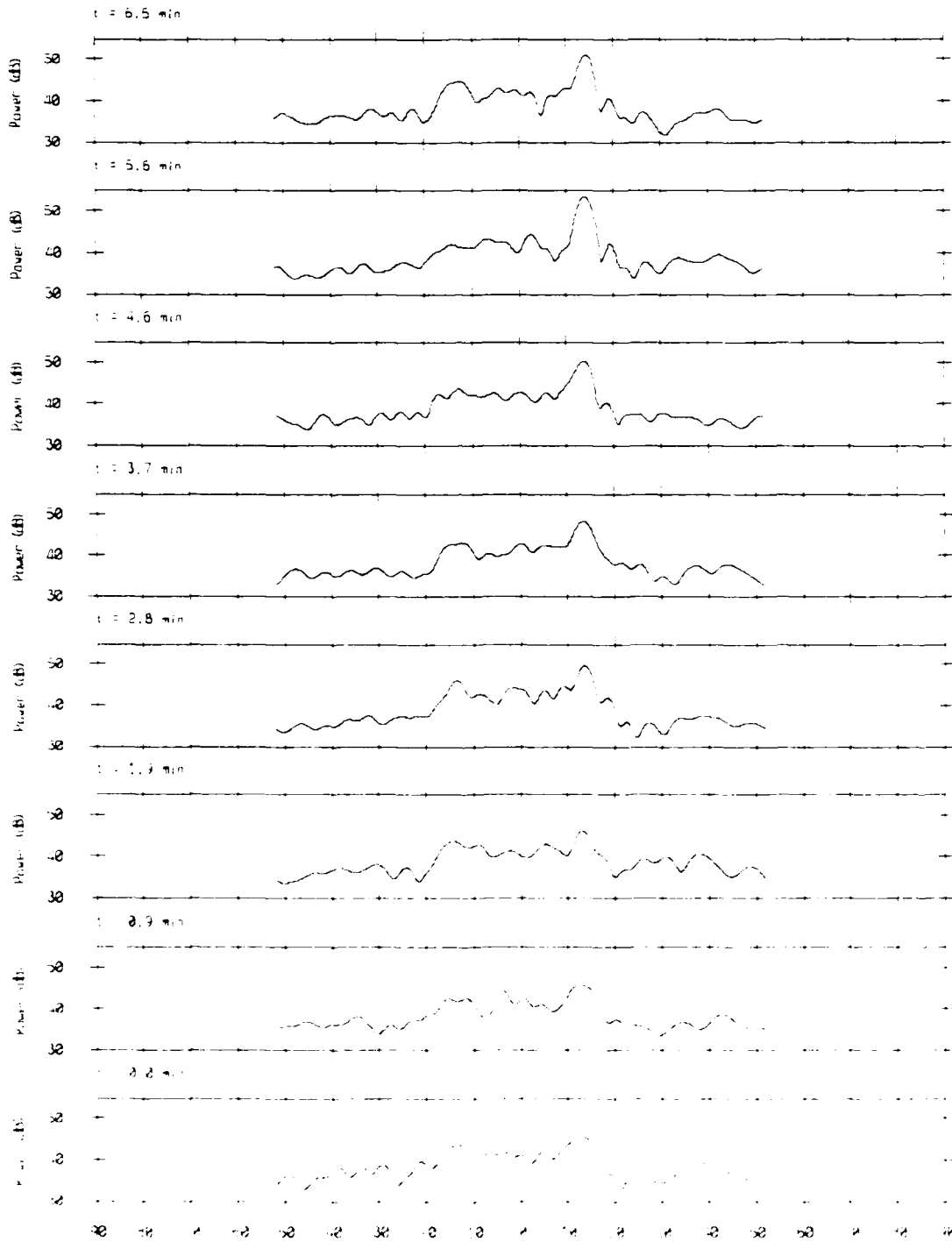
Array Response - 86180 Bin #5832

$f = 250$ Hz, rect window



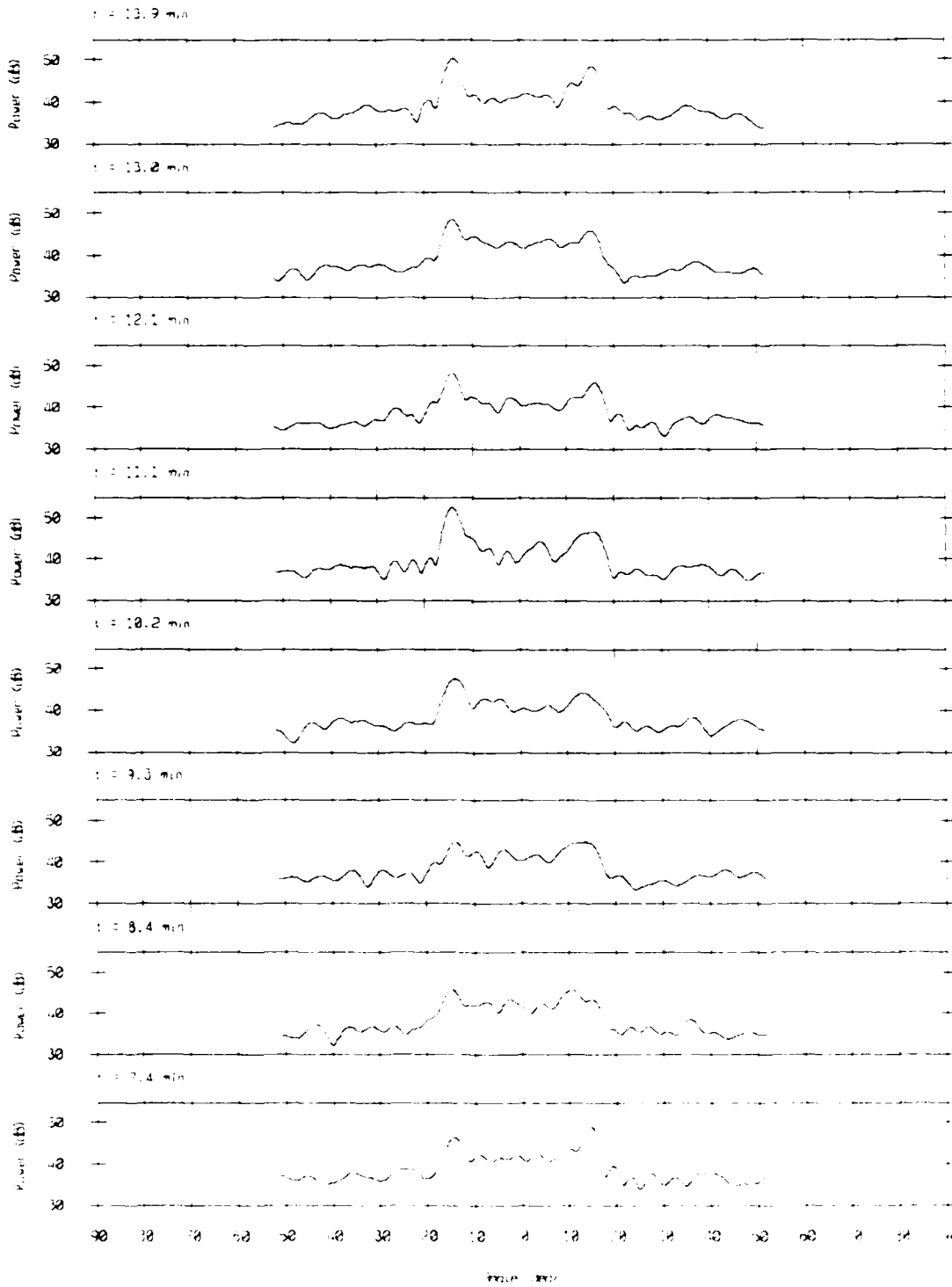
Array Response - 86180 Bin #6012

$\Delta f = 275$ Hz, rect window



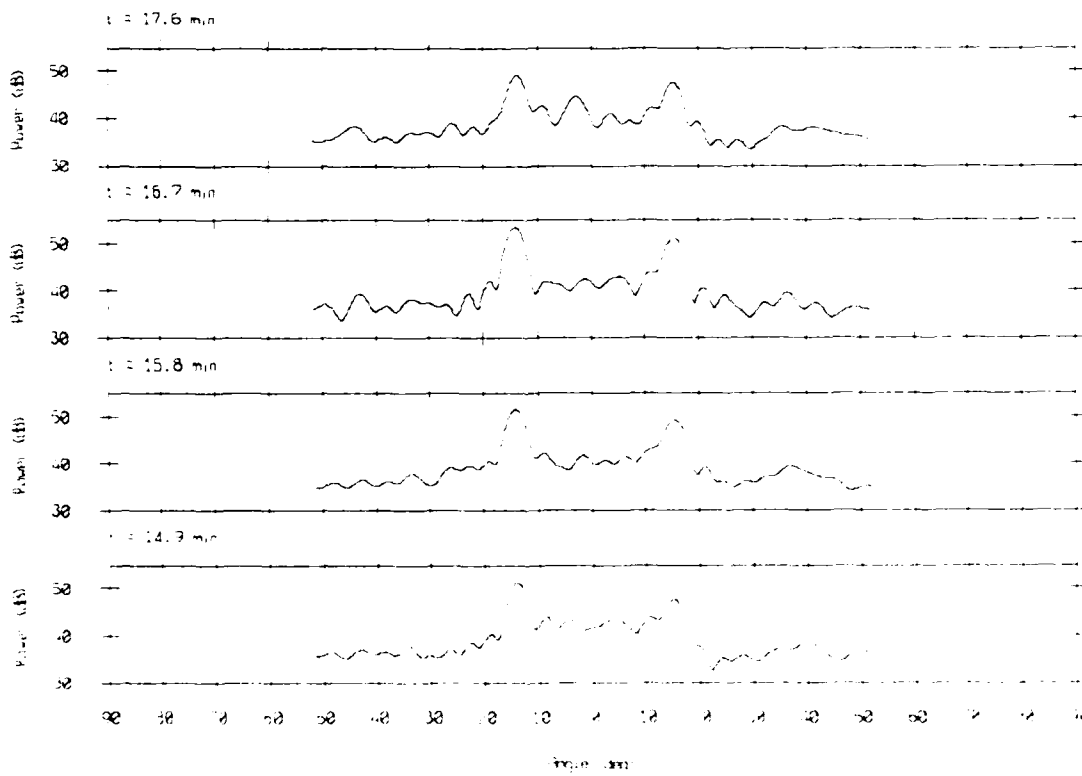
Array Response - 86180 Bin #6012

$f = 275$ Hz, rect window



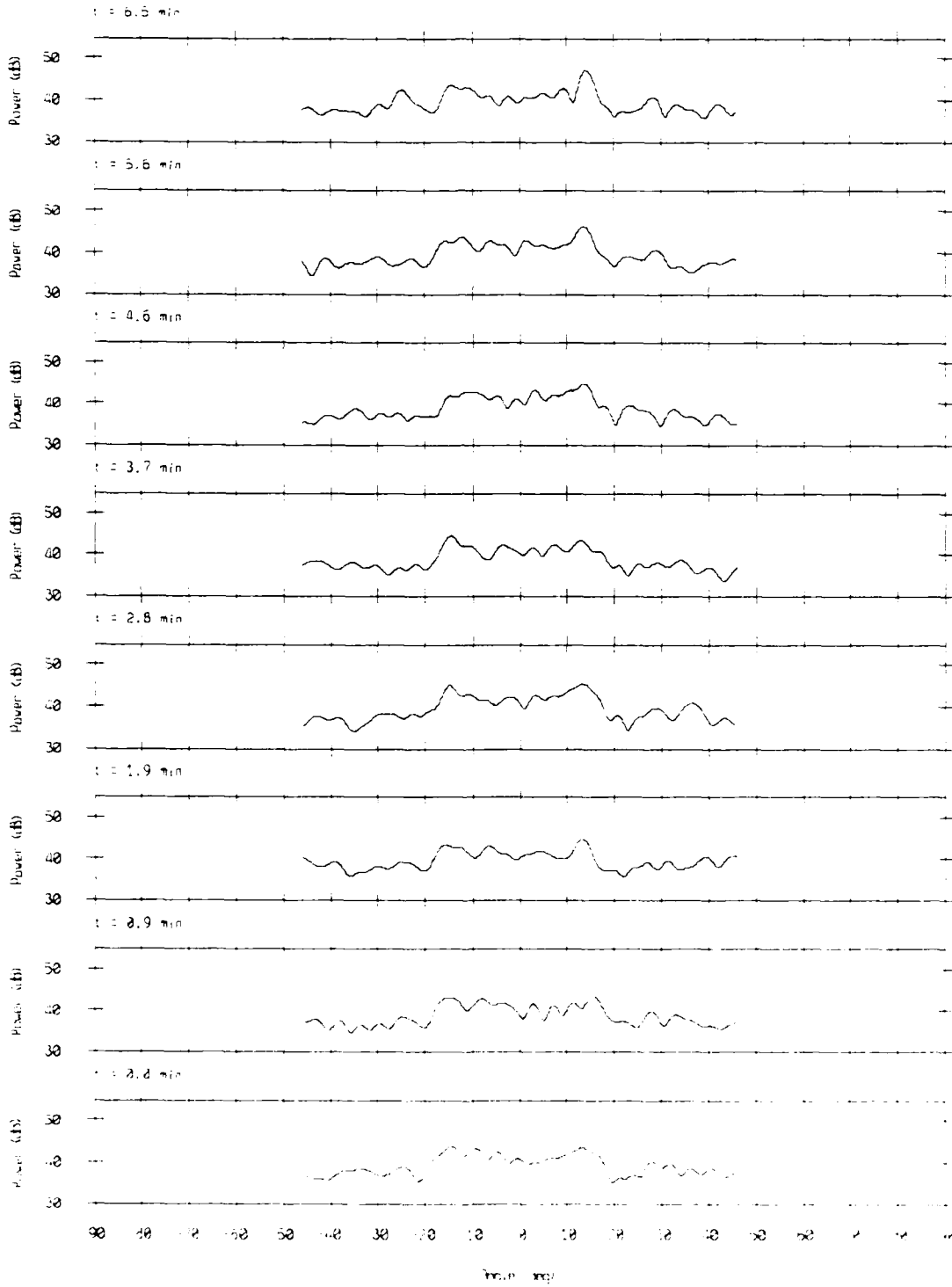
Array Response - 86180 3in #6012

f = 275 Hz, rect window



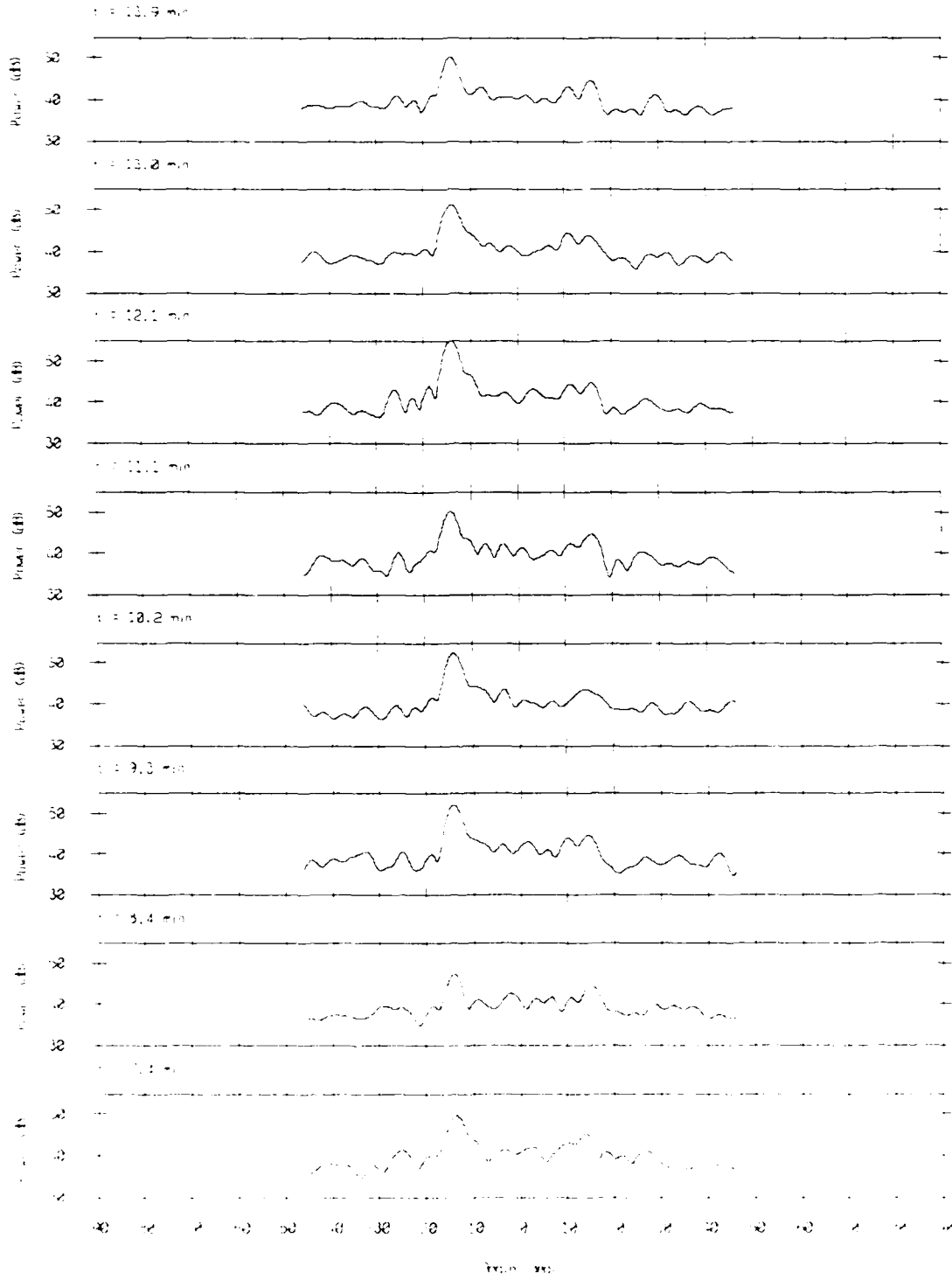
Array Response - 86180 Bin #6186

$\Delta = 300$ Hz, rect window



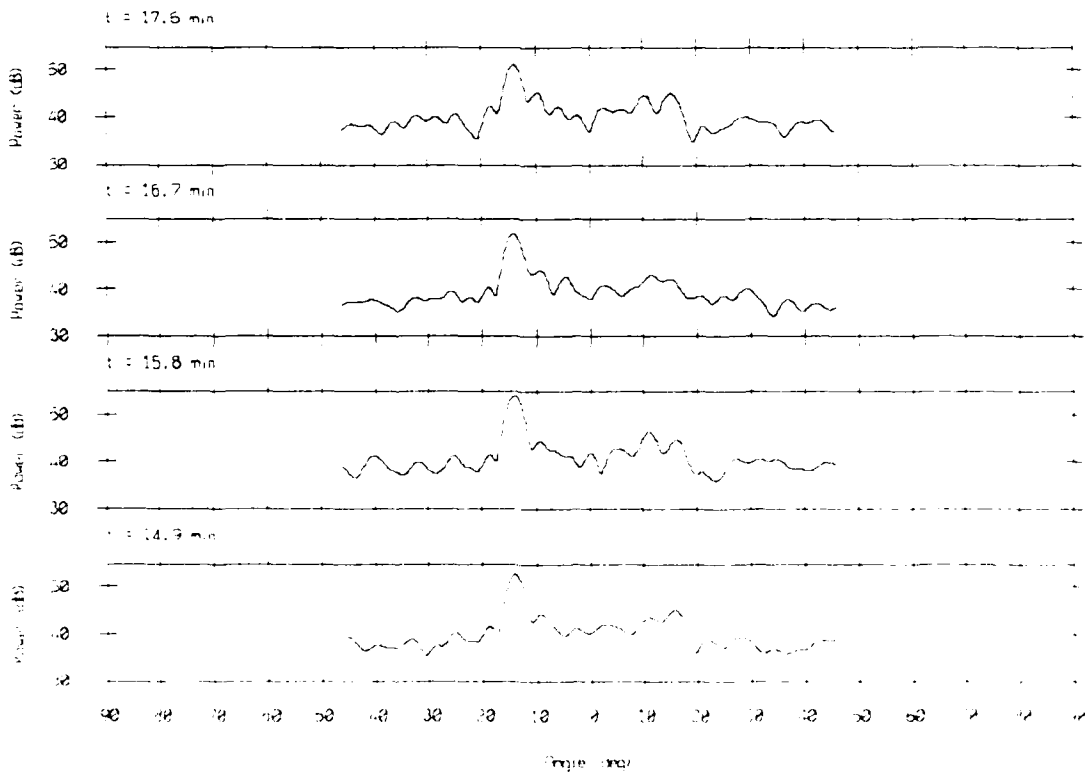
Andy Response - 86180 3in #6186

$\Delta = 300$ Hz, rect window



Array Response - 86180 Bin #6186

$f = 300$ Hz, rect window



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