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היחידה למחקר ופיתוח אלקטרואופטי
ELECTRO - OPTICS RESEARCH & DEVELOPMENT UNIT

ACOUSTIC SOUNDING SYSTEM FOR LONG RANGE PROPAGATION IN MIDDLE EAST SURROUNDINGS

First Intern Report

Item 0001



19950217 119

January 1995

Report No.: 5364/845

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REPORT DOCUMENTATION PAGE		FORM APPROVED OMB No. 0704-0188	
1.AGENCY USE ONLY(Leave blank)	2.REPORT DATE 31 Jan 1995	3.REPORT TYPE AND DATES Interim 1 Nov 94 to Jan 95	
4.TITLE AND SUBTITLE Acoustic Sounding system for long range propagation in Middle East surroundings		5.FUNDING NUMBERS N68171-94-C-9152	
6.AUTHOR(S) Dr. L. B. Salem, Dr. Z. Zlotnick			
7.PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Technion Research & Development Foundation EORD Division, Technion city 32000 Haifa, Israel		8.PERFORMING ORGANIZATION AGENCY REPORT NUMBER 5364/845	
9.SPONSORING, MONITORING AGENCY NAME(S) AND ADDRESS(ES) Mr. Jerry C. Comati, Environmental Sciences Branch, European Research Office, USARDSG-UK, 223 Old Marylebone Road, London, NW1 5TH, England		10.SPONSORING, MONITORING AGENCY REPORT NUMBER	
11.SUPPLEMENTARY NOTES First Interim Report			
12a.DISTRIBUTION/AVAILABILITY STATEMENT Unlimited		12b.DISTRIBUTION CODE	
13.ABSTRACT(MAXIMUM 200 WORDS) The current report briefly covers the activities carried out during the first interim period. One of the tasks performed was the design and development of the Acoustic Directive Receiver Antenna(ADRA). The main parts of the ADRA namely the microphone array the data acquisition and data processing units have been developed The ADRA is unitwise functional. A second task performed was the design and development of the Acoustic Power Source (APS) based on standard exponential horn type elements. The horns and associated drivers were selected based on their performance in the low frequency range (50-1000 Hz). Procurement orders for the APS components have been placed.			
14. SUBJECT TERMS acoustics, propagation, phased array, beamforming		15.NUMBER OF PAGES: 10	
		16.PRICE CODE	
17.SECURITY CLASSIFICATION OF REPORT Unclassified	18.SECURITY CLASSIFICATION OF THIS PAGE -	19.SECURITY CLASSIFICATION OF ABSTRACT -	20.LIMITATION OF ABSTRACT Same As Report

Title Page

1. Title of Research Project : Acoustic Sounding System for long range propagation in Middle east Surroundings.
2. Name of Principal Investigator : Dr. Z. Zlotnick, Dr. L.B. Salem.
3. Name of Contractor : EORD, Technion, Haifa, ISRAEL.
4. Contract Number: N68171-94-C-9152
5. Report Number: First Interim Report, Item 0001.
6. Report Period : November 1994 - January 1995
7. Statement: " The Research reported in this document has been made possible through the support and sponsorship of the U.S. Government through its European Research Office of the U.S. Army. This report is intended only for the internal management use of the Contractor and U.S. Government."

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Unannounced	<input type="checkbox"/>
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Availability Codes	
Dist	Avail and / or Special
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First Interim Report

This report briefly describes the design and development activities carried out during the first interim period. The activities concern the two main components of the acoustic field measurement system namely the Acoustic Power Source (APS) and the Acoustic Directive Receiver Antenna (ADRA).

1. The Acoustic Power Source -APS

- 1.1 The APS is designed as a linear array that produces a strong effective acoustic beam in a direction broadside to the array ($\phi=0$). The azimuthal and elevational scans of this beam will be accomplished by mechanically rotating the linear array.
- 1.2 The array is based on standard acoustic sources of the exponential horn type. Following an extensive search, the acoustic horns from Atlas/ Soundolier (USA) were selected based on the acoustic power radiated by these sources in the 40-400Hz spectral region. The maximum power radiated by these horns are in the 125-1000 Hz region.
- 1.3 The APS is designed to be portable and can be positioned in any outdoor location where the atmospheric propagation properties are to be investigated. In accordance with the goals of the current research program the APS is designed to work in the following two modes:

1. The CW mode

In this mode of operation acoustic power will be radiated in 1/3 octave frequency bands. Atmospheric attenuation, wavefront distortion and phase changes for a particular acoustic propagation channel will be studied as a function of frequency. Signal analysis in this mode is based on beamforming .

2. The Burst mode

In order to investigate atmospheric layer structure, wind and turbulence effects on acoustic propagation the APS will work in the modulated acoustic pulse mode. Signal analysis in this mode is based on time domain beamforming and Doppler effects.

2 The Acoustic Directive Receiver Antenna (ADRA)

2.1 The acoustic antenna consists of a circular array of 12 microphones equally spaced along the circumference. A linear vertical array of 4 microphones projects above the circular plane at its center. This structure enables one to determine the direction of an acoustic source. All microphones used are of measurement quality of type ACO 7046. The antenna is modularly constructed and the dimensions of the circle diameter and the vertical section can be changed from 2m to 8m. In the appendix a picture of the 3-D Acoustic Antenna is included.

2.2 The data acquisition and analysis module is based on a PC system and has the following features:

1. Ability to select a segment of raw data from a long recording and for any channel.
2. FFT and PSD calculations for the selected segment.
3. Selecting a characteristic frequency and calculating the bearing of the acoustic source based on a multibeam beamforming algorithm.

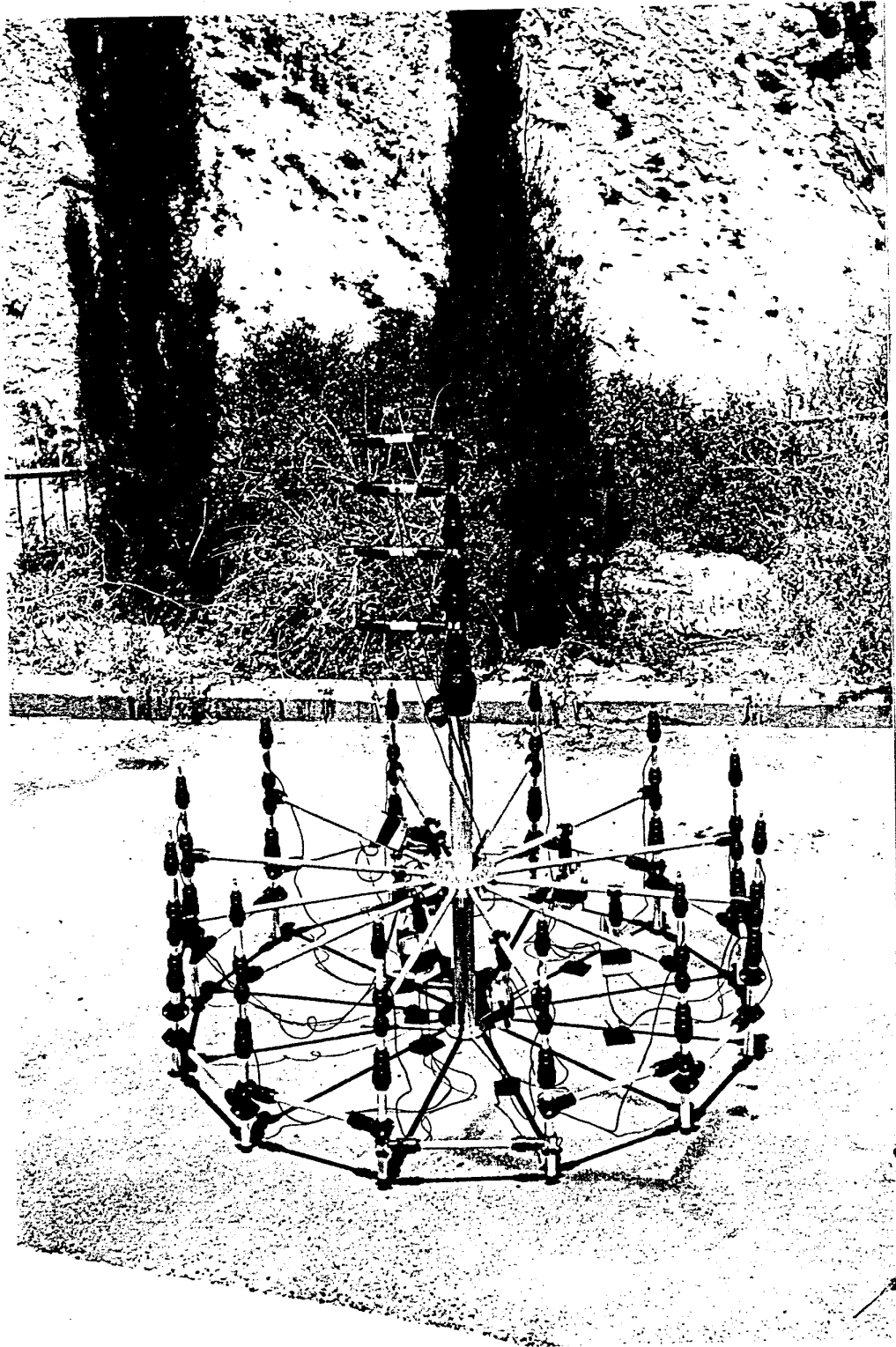
2.3 A typical example of results obtained from a vehicle are given in the Appendix. The appendix includes graphs of the SPL as a function of time, the calculated PSD and a beamformation for two selected frequencies.

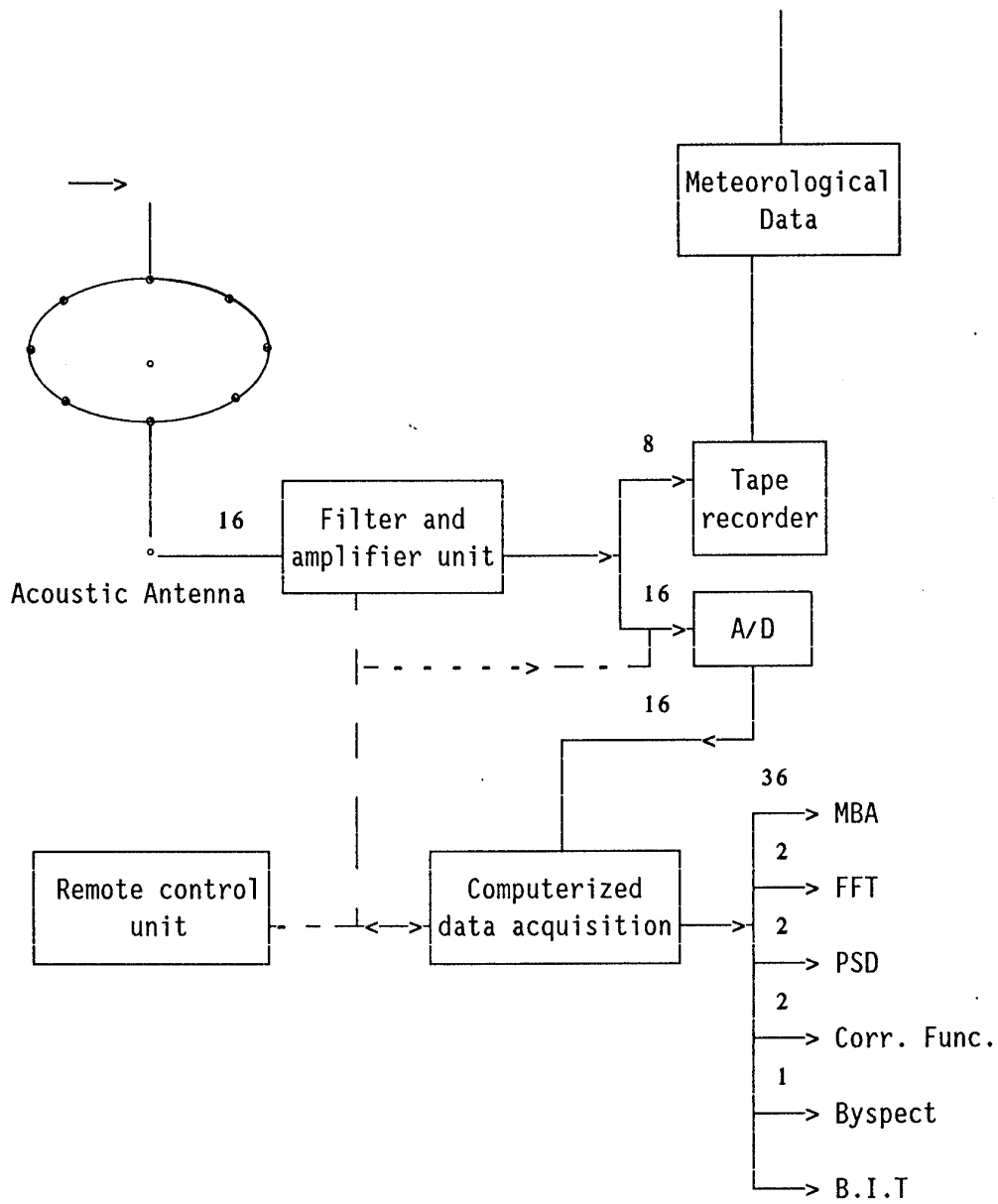
3. The next stages of the research

The following are the main tasks we plan to perform in the next stages of the research:

1. Receiving the APS elements and testing them.
2. Constructing the APS and mapping its radiation pattern.
3. Integration of the ADRA and APS units.
4. Computer simulation of long range acoustic transmission.

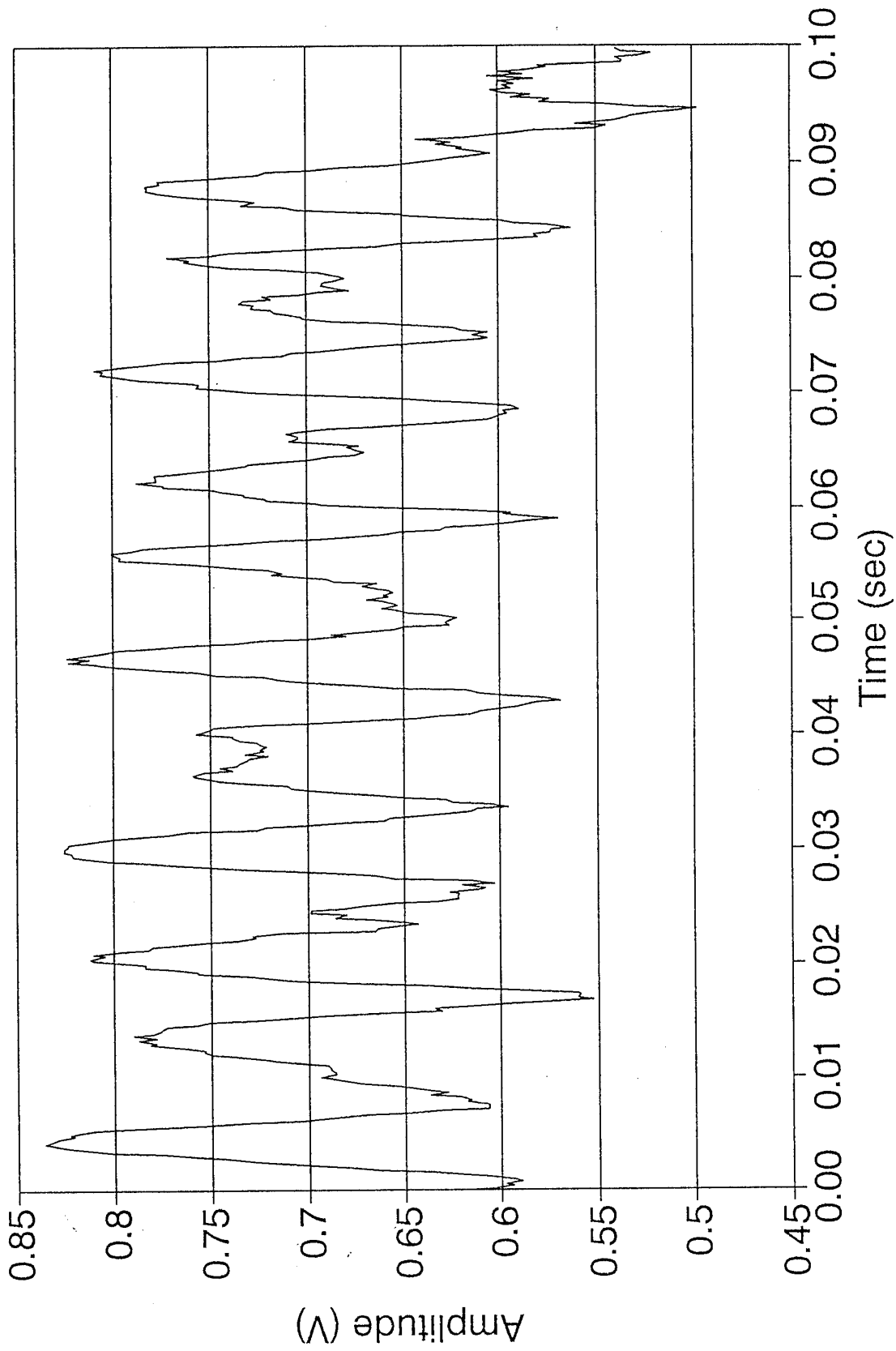
APPENDIX 1



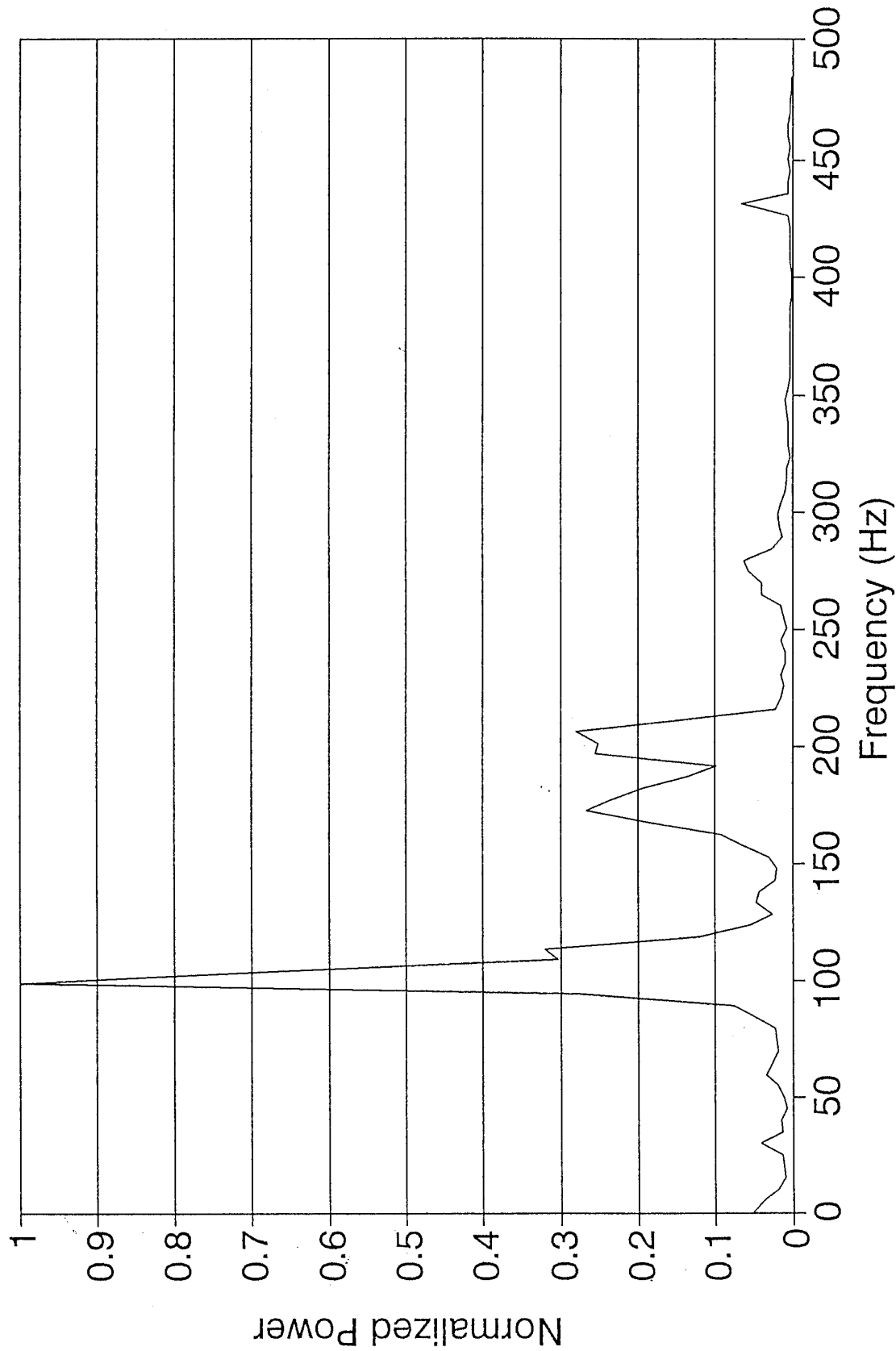


Block diagram of the ADRA

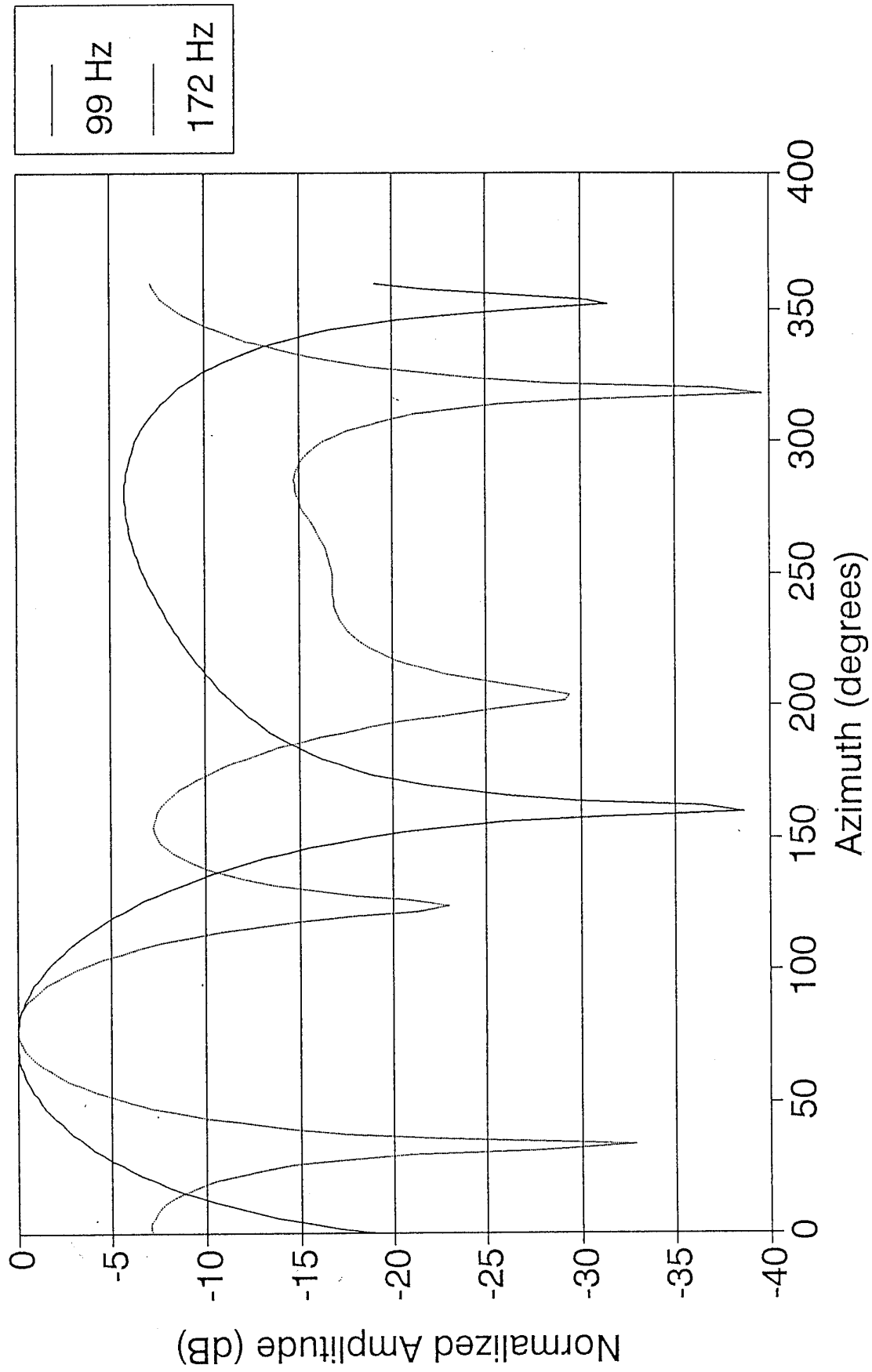
Raw signal of GMC vehicle



Power Spectral Density of GMC vehicle



Acoustical Radiation Pattern



Acoustical Radiation Pattern

