

FINAL OPERATIONS REPORT

AUSTRALIA MARINE SEISMIC SURVEY

B 69B

BASS BASIN

FOR

ESSO STANDARD OIL (AUSTRALIA) LIMITED

BY

WESTERN GEOPHYSICAL COMPANY OF AMERICA

PARTY 80

OCTOBER 1969.

OK-011

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I. SUMMARY

A continuous reflection seismic survey using the AQUAPULSE* system was conducted in the Bass Strait, offshore Tasmania and Victoria.

Operations commenced on October 3, 1969 and were completed on October 14, 1969. Refer to Plate I for detailed location of survey lines.

II. GENERAL INFORMATION

A. Contractors

The survey was conducted by Western Geophysical Company of America, 8100 Westpark Drive, Houston, Texas, and 514 Miller Street, Cammeray, New South Wales, Australia. Positioning control was provided by Offshore Navigation, Incorporated, 5728 Jefferson Highway, New Orleans, Louisiana, and 202 Roma Arcade, 413-417 New South Head Road, Double Bay, New South Wales, Australia.

B. Base of Operations

Headquarters were set up in Devonport, Tasmania. Good port facilities and a daily air service for supplies were available. Radio communications were established with the "Marchart 3" from Devonport.

C. Weather

Moderate to rough seas persisted throughout most of the survey. A total of 5 days were lost when recording had to be terminated due to excessive cable noise.

D. Surveying Technique

The Shoran XR Extended Range system was employed for positioning control. The mobile equipment used included a track plotter, digital print-out system and dual directional antennae. Four Shoran base stations were used, located at the following sites: Foster North, Deal Island, Walker's Lookout and Cape Waterhouse. A complete description of the Shoran system and the fixed base station sites is included in a separate report to be submitted by Offshore Navigation Incorporated.

E. Chronology

October 3, 1969: Commenced recording; Lines 11 and 10 completed.
Recording on line 12.

October 4, 1969: Completed lines 12 and 14. Recording on line 13.

October 5-6, 1969: "Marchart 3" docked at Devonport. No production due to rough seas.

October 7, 1969: Underway to prospect. No production.

October 8, 1969: Boat on prospect. No production due to instrument trouble and cable noise.

October 9, 1969: Completed lines 13 and 15.

October 10, 1969: "Marchart 3" docked at Devonport. No production

due to rough seas.

October 11, 1969: Boat returned to prospect.
Recorded line 9 complete.

October 12, 1969: Recorded lines 8, 6, and 7
complete.

October 13, 1969: Completed lines 4, 3, 5, 2.
Recording on line 1.

October 14, 1969: Completed line 1.
Bass program completed.

III. RECORDING OPERATIONS

A. Survey Vessel

M.V. "Marchart 3" - 101 foot, steel hull, twin-screw vessel of Australian registry, powered by two Caterpillar D343 365 h.p. marine diesel engines, capable of 11 knots cruising speed. Equipped with a Decca 202 Radar, Elac fathometer and Mariner ship-to-shore radio.

B. Instrumentation

Digital Recorder - SDS 1010, 30 channel, 9 track, IBM compatible $\frac{1}{2}$ inch E.P.R.Co. format, binary gain controlled amplifiers.

On-board Display - Raytheon Precision Depth Recorder, driven by output of trace 22, through a playback amplifier.

Magnetometer - Ship board, Varian Proton Marine Model V4937.

Magnetometer-diurnal drift - Located on Walker's Lookout Shorean base station, Model V4937A.

Fathometer - Elac Model DENEb, 2200 fathom range.
Sonar Forward Scanner - Honeywell Model S-1600-A3.
Tape Transport - Potter dual tape deck.
Sample Rate - 2 milliseconds.
Monitor Records - Read-after-write wiggle trace recorded on direct write paper every 30 files.

C. Detector Cable

A neutrally-buoyant, oil-filled streamer cable equipped with 4 depth detectors positioned ahead of the seismic detector groups 24, 17, 9 and 1. In addition, 4 water break detectors were positioned at the head of seismic detector groups 24, 17, 9 and 1. During operation the cable was under continuous tension to at an average depth of 45 feet throughout the survey. Each seismic detector group consisted of 32 geophones in a tapered noise cancelling array. A 5290 foot cable configuration was used providing a group centre spacing of 230 feet. Refer to Plate II for a detailed diagram of the streamer cable, AQUAPULSE gun array and navigation antennae - gun array - cable relationship.

D. Recording Technique

With the AQUAPULSE system four Model B "guns" in a rectangular array were towed at a subsea depth of 20-25 feet. A gun pulse monitoring system was provided by the use of 4 MP8B Geospace geophones. The gas, air pressures and fill-time were as specified by ESSO; oxygen 60 p.s.i., air 45 p.s.i., propane 16-18 p.s.o., fill-time 1.3 seconds. Under continuous

tow operations a metered oxygen, air and propane mixture was fired electrically at intervals such that a minimum of three pulses per 230 feet, or 68.87 pulses per mile were recorded. Shotpoint locations were preplotted with a 460 feet interval.

IV. DATA PRESENTATION

A. Field

A variable density section was made by recording the output of group 22 on the Raytheon Precision Depth Recorder. Wiggle trace, read-after-write monitors were produced by a Dry-Write camera every 5 shot points. This monitor displayed data from the 24 seismic data channels, time break and individual gun pulse signatures.

B. Processing

The digital tapes were air expressed to Geophysical Services International in Sydney for processing.

C. Post Plotting

The Post Plotting was carried out by Engineering Computer Services Limited, of 48 Chandos Street, St. Leonards, Sydney. Maps were produced using the Gerber 522 plotting system on the Australian Transverse Mercator Projection at a scale of 1:100,000.

V. KEY FIELD PARTY PERSONNEL

A. Esso Standard Oil (Australia) Limited

<u>Name</u>	<u>Position</u>
A. Martens	Client Representative
W. R. Stone	Client Representative

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B. Western Geophysical Company of America

<u>Name</u>	<u>Position</u>
V. Smith	Supervisor
B. Kolozs	Operations Manager
R. Stansbury	Coordinator
J. Goodin	Assistant Coordinator
A. Shirley	Instrument Supervisor
J. Hammond	Gun Captain

C. Offshore Navigation, Incorporated

<u>Name</u>	<u>Position</u>
I. Easterbrook	Party Chief
G. Owen	Mobile Operator
D. Woody	Mobile Operator

VI. STATISTICAL SUMMARY

Line length measured by computing the number of Shoran intervals on line and adding half an interval on the last Shoran position.

One interval equals .0871 of a mile.

Centre of AQUAPULSE gun array to centre of group 24
= 769 and 760 feet.

Record length = 5 seconds.

<u>Line</u>	<u>S.P. - S.P.</u>	<u>Chargeable Shot-point Intervals</u>	<u>Statute Miles</u>
1	3160-3389	229½	19.990
2	2921-3159	238½	20.773
3	2647-2782	135½	11.802
4	2451-2646	195½	17.028

<u>Line</u>	<u>S.P. - S.P.</u>	<u>Chargeable Shot-point Intervals</u>	<u>Statute Miles</u>
5	2783-2920	137½	11.976
6	1938-2152	214½	18.683
7	2153-2450	297½	25.912
8	1691-1872		
	1867A-1872A		
	1873-1937	246½	21.470
9	1472-1690	218½	19.031
10	295-473	178½	15.547
11	1-294	293½	25.564
12	474-769		
	764A - 769A		
	770-807	333½	29.048
13	1012-1102		
	1103-1209		
	1102A-1012A		
	1210-1215	203½	17.72
14	808-926		
	920A-926A		
	927-1011	203½	17.725
15	1222-1471	249½	21.731
	TOTALS	<u>3375½</u>	<u>294.000</u>

055010

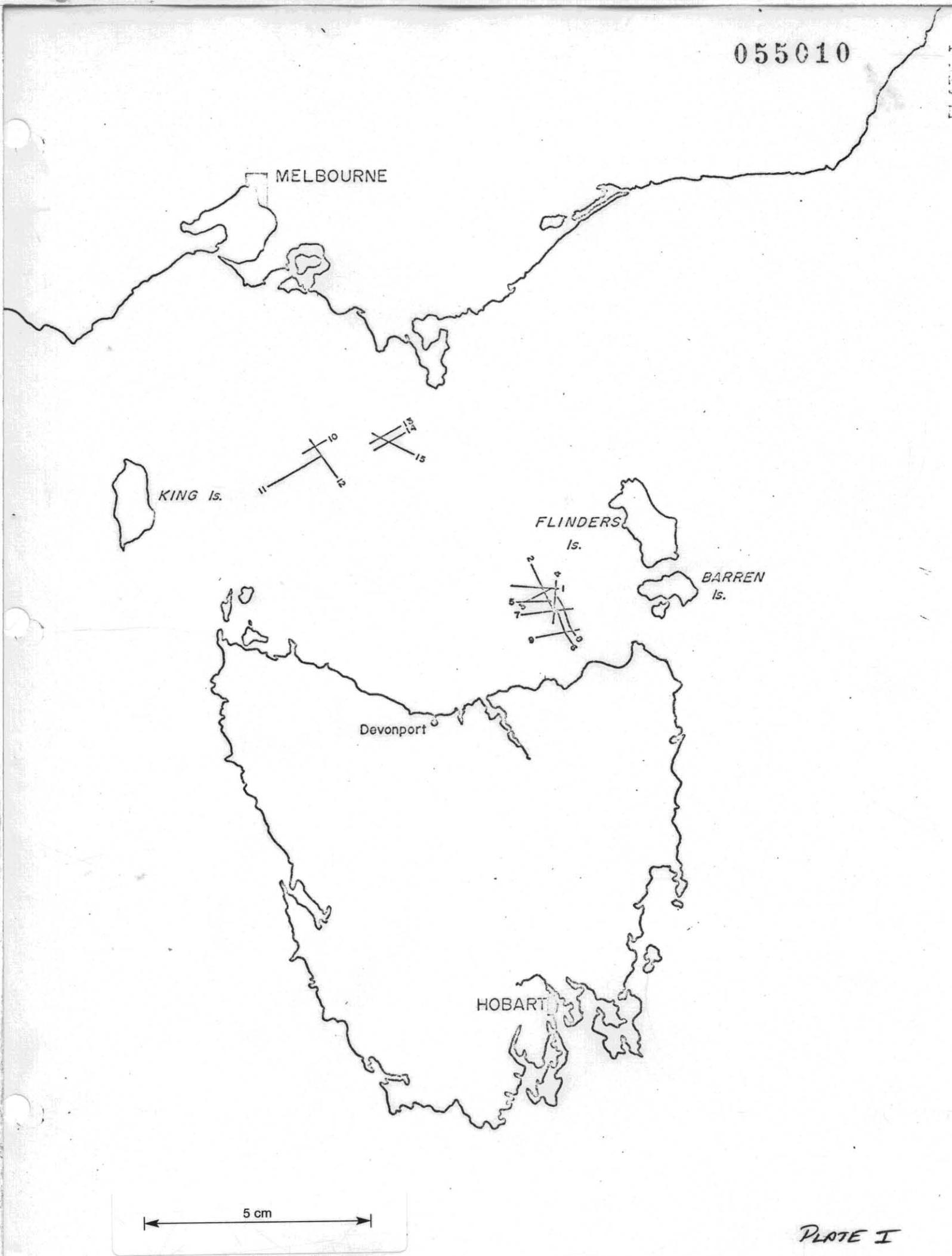


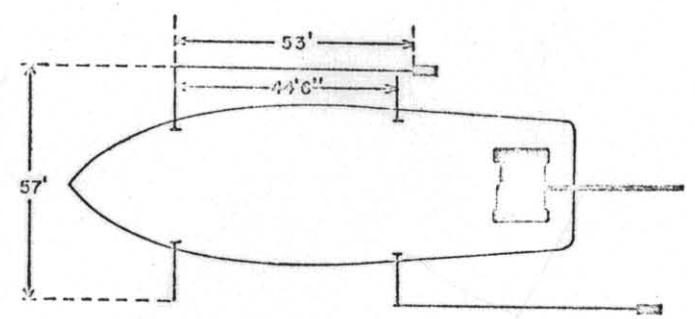
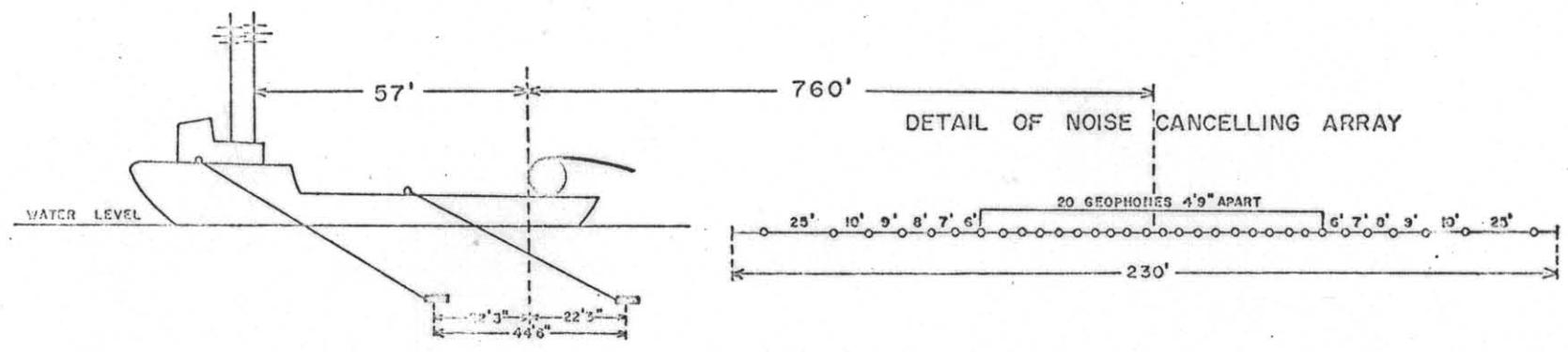
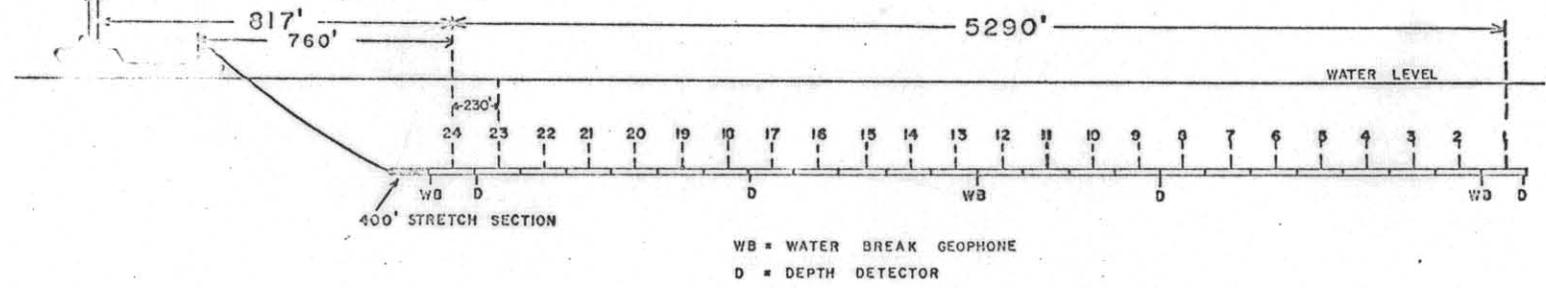
PLATE I

B69B.

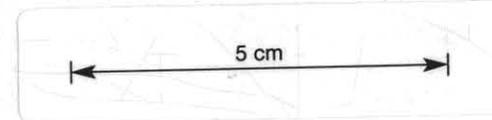
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DIAGRAM OF 5290 Ft. STREAMER CABLE

The Stepback From The Centre
Of The Ship to Centre of Crp. 24
is 760' for Lines 1, 2, 4 and 5 Only.



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DIVISION OF LITTON INDUSTRIES



GENERAL DESCRIPTION and SPECIFICATIONSDFR-300 BINARY GAIN SEISMIC SYSTEM (HIGH GAIN)1. General Information1.0 Function

1.0.0 The DFR-300 Binary Gain Seismic System accepts data directly from the seismic sensors, conditions the data, and causes the conditioned data to be recorded on digital tape. At the option of the operator, either an analog oscillograph monitor record can be recorded in the read-after-write mode concurrently with the digital recording, output from the amplifiers can be monitored directly, or else selected files can be played back at some later time.

1.0.1 The basic 9-track format is described in Savit, "A proposed standard format for nine-track digital tape", published in Geophysics, v 31, n 4, 1966.

1.1 Physical Description

1.1.1 The recording system consists of seven sections as follows:

1. Input and Test Panel
2. Binary-Gain Input Amplifiers
3. Master Control Panel
4. Magnetic Tape Unit
5. Playback Amplifiers
6. Camera
7. Power Converter

1.2 Input and Test Panel

1.2.1 Included with the input and test panels are bridling switches, cable leakage and continuity tester, precision oscillator and attenuator, group selector switch, and voltage test meter. Test panels include means to terminate the amplifier inputs with a 500 ohm load, a feature used in certain test procedures.

1.3 Binary-Gain Amplifiers

1.3.1 For each amplifier there is provided a hum balance circuit, adjustable high-cut, low-cut, and alias filters, and preamplifier-gain and D.C. offset trim pots.

1.3.2 Amplifier gain is adjusted automatically in 6 db steps; the system always attempts to maintain the signal level between one-fourth and one-half of full scale. To prevent signal clipping and distortion, it is urgent to reduce gain if the signal bursts out above half scale so downward gain-ranging may take place on every alternate scan. At a 1 ms sample rate, the attack rate is 3000 db/sec. On the other hand, in the case of a varying data signal which is crossing zero many times per second, it is apparent that some of the sample values of the signal would fall below the one-quarter scale set-point which triggers the gain increase, yet the signal peaks would be above the trigger level and the existing gain level should be continued. A means is provided to delay the gain increase until all samples fall below the trigger level. This operation is accomplished by examining all samples of a given channel for a time period which is set by a 3-position release-rate switch, having the positions, fast, medium, and slow (30, 40, 60 ms, nominal or 200, 150, 100 db/second). The release rate is an expression of the speed, in decibels per second, at which an amplifier is capable of increasing gain to follow a declining seismic signal. As soon as all samples are below the lower set point for an examination period, the gain is increased by 6 db at the next scan. Thus, with a 30 ms examination period, the gain could be increased 6 db every 30 ms or at a rate of 200 db/sec. Provision of three release rates permits the operator to select the one best suited to the data being received.

1.3.3 Each amplifier unit includes one preamplifier and two paralleled post-amplifiers. The preamplifier has a gain of 40 for systems 105 and all systems with serial number 108 and later. The output of the post-amplifiers is applied to the system multiplexer and also to the analog camera when switched to the noise monitor mode. Of the two post-amplifiers, post-amplifier 1 has selectable gains of 1 and 256; post-amplifier 2 has selectable gains of 16 and 4096. The choice of one of the two gains and one of the two post-amplifiers is a function of the gain-control unit selecting the particular amplifier. In the noise monitor mode, the amplifier gain is forced to X163,840.

1.4 Logic Control Chassis

1.4.1 The Logic Control chassis contains the master control panel multiplexer, buffer amplifier, gain control unit, A/D and D/A converters, and control logic. Early gain controls for the amplifiers are mounted on the master control panel. The tape drive is included in this chassis unless a 10" tape drive is specified, in which case the tape is mounted in a third rack. An optional dual drive is available for continuous operations.

1.4.2 The analog outputs of the amplifier units are time-multiplexed by the amplifier multiplexer, whence each analog signal is fed to the buffer amplifier. The buffer amplifier serves both as

an impedance matcher between the multiplexer and the A/D converter and as an element of the binary gain amplification scheme. Binary signals from the control unit select any one of four buffer-amplifier gains of 1, 2, 4, or 8. The selected buffer-amplifier gain, combined with one of the four gains in the post-amplifiers, result in 15 binary gain steps from 1 to 32,768.

1.4.3 The Gain Control Unit originates a 4-bit gain code to select the gain of one of the two post amplifiers and to control the gain of the buffer amplifier. In general, when the analog value being digitized falls below one-quarter scale, the gain control unit increases the gain code by 1. When the value exceeds one-half scale, the gain control unit decrements the gain code by 1. These values are acquired by decoding the digital outputs of the A/D converter.

1.4.4 The Input Control Unit controls flow of data from the A/D converter, gain control unit, file counter, time counter and other sources to the input bus. This unit sequences and formats the data words into two 8-bit bytes, generates the parity bit, and writes the data on tape via the tape write unit.

1.4.5 The A/D converter is a 14-bit-plus-sign binary converter with complement output for negative numbers. It is controlled by a single start line originating in the input control unit. A trigger pulse on this line for each seismic channel starts the entire conversion sequence. The bit circuits continuously track the analog signal; then, after a particular analog signal has settled, the start signal initiates the sequential clamping of the bit circuits. In this way the precise digital value is achieved very rapidly by successive approximation. The digital output levels are applied to the input bus and are also used to control the gain control units.

1.4.6 -The D/A converter accepts the magnitude bits furnished by the A/D converter as well as the 4-bit gain code from the gain control unit. It uses both of these--as mantissa and exponent--in a floating point representation to generate an analog signal with three significant features: (1) The analog output contains the full dynamic range of the system in a form capable of representation on a recording oscillograph. (2) The gain steps that would ordinarily be visible when the system moves from one gain code to another are removed. (3) The average value of the analog signal is normalized by digital and analog AGC, around a manually set playback level, so that rapid changes such as burst-outs are readily visible. The final result is a camera record on which both the average signal value and the reflections are clearly visible for the entire length of the file. On high-gain models, the gain change blips can be displayed at the operator's option.

1.5 Magnetic Tape Unit

1.5.1 The Magnetic Tape Unit is a field tape transport accommodating 9-track tape, $\frac{1}{2}$ -inch wide, on 8- $\frac{1}{2}$ or 10 inch reels. Direction of tape motion, startup and shutdown are controlled by the system control unit on the basis of the mode selected; tape speed depends upon the sampling rate selected.

1.5.2 A beginning-of-tape sensor determines when first recording may commence, and the end-of-tape sensor warns of the approach of the tape end. If the EOT marker is sensed while a file is being recorded, recording will continue past the EOT mark until the file is completed but no further recording can be done on that reel. It should be noted that this capability is possible because the EOT marker is located 65 feet from the actual end of tape. The tape transport is interlocked with a number of system and transport conditions so that it can operate only when all conditions are ready.

1.5.3 Use of the seismic recording system may involve interlaced recording or playback operations; therefore, a special type of file protection system is provided. This over-write protection uses the electronic detection of data on the tape to inhibit writing. An advance-to-end-of-data control allows the system operator to automatically reposition the tape at the end of the previously recorded data. As a result, it is possible to record a file, replay it or another file, and go ahead with more recording with no chance of inadvertently over-writing data.

1.5.4 In addition to the electronic data-detector-write-inhibitor, conventional write-ring protection is provided. This feature assures the operator that previously recorded data cannot possibly be damaged. If desired, the erase head and electronic file protector can be disabled when recording in the continuous forward mode and, in this case, file protection is available only via the write-ring file protect.

1.5.5 The write logic generates IBM-compatible odd vertical parity which is recorded on tape along with the data. Parity errors are displayed by means of indicator-lights; whenever an excess of parity errors occurs, an audible and visible alarm is activated. The usual EOF characters are generated automatically after the recording has been completed; a manual EOF switch is also available.

1.5.6 A special switch is provided to write a block of all 1's. This block, of indefinite length, is used to check skew.

1.6 Playback Amplifiers

1.6.1 Camera displays can be made in playback mode, either read-after-write during a recording or read only at a later time, or in noise monitor mode.

1.6.2 When the noise-monitor mode is entered, signals are taken from the output of post-amplifier 2 and are fed to the camera. In this mode, the gain is forced to X163,840.

1.6.3 In the direct playback mode only the mantissa is displayed with no reference to the gain code. In this mode the transients due to gain changes are readily visible.

1.6.4 Playback AGC capability is partly analog and partly digital. The digital part removes the transients due to gain changes by bit-shifting and applies gain control to all channels so that the maximum average signal is at a preset level. Differences of amplitude level between channels are then removed by analog AGC applied to individual channels. Burstouts are preserved in their true relationship to the signal envelope level at the point where they occurred. The rate at which the average envelope level is followed in the reconstruction of the signal is adjusted by a three-position AGC rate switch. In addition to the AGC rate, the level at which the average envelope is controlled can also be adjusted. If, for example, the level is reduced, a relatively large burstout capability is provided. To prevent the AGC action from forcing the amplifier to maximum gain when no data signal is present, the AGC preset control is provided to limit the amount of gain control before trip.

1.6.5 Fixed-gain playbacks can be made by locking out the AGC action so that the effective gain is set by the preset switch. It should be noted that if the Preset gain, as set for playback, is greater than the Early gain, as set for record, all signals will be automatically bit-shifted by the amount of the difference, but if the settings are the same, no bit-shifting will occur. For certain test purposes it is desirable to make specified bit-shifts without regard to the early gain setting used at recording time. To accomplish this end, Unit 105, 108 and later models have been equipped with a special function switch providing the option of normal AGC preset, or the capability of shifting the data bits, on playback, by specified fixed amounts regardless of the Early gain setting used during recording.

1.6.6 On playback, the data can be filtered at the option of the operator. Three-position, high- and low-cut filters are provided, with provision to switch the filters out if desired.

1.6.7 Many units have a time accumulator. To monitor its functioning, the least significant bits of the time word are selected and displayed on trace 25 of the camera recording. The signal will appear as a saw-tooth wave with a period of 2048 ms. The time-word display appears on an auxiliary trace.

1.6.8 In addition to the time accumulator display, the time break event is shown as follows. At the beginning of the recording, a DC offset is applied to trace 25. At the moment that the time

break is sensed, the offset is removed and the trace returns to normal in the form of a step function. The amplitude of the time-break signal must exceed 1/4 scale for this feature to function.

1.7 Camera

1.7.1 A multi-trace, direct-writing camera is a permanent part of the system. Ordinarily, camera input is fed from the read-after-write heads on the magnetic tape recorder unless the system is in the noise monitor or tape bypass mode. Camera start may be set to coincide with either the recording or playback cycles. For test purposes, the tape can be bypassed so that incoming signals can be played directly into the camera.

1.8 Power Converter Unit

1.8.1 The Power Converter Unit converts 12-volt battery power to thirteen, DC output voltages to operate the units of the 1010 system. Five shielded outputs are used where the maintenance of analog accuracy is critically important. Seven regulated voltages are used principally for digital purposes. An unregulated voltage is used for indicators and relays, and the battery voltage is used directly for motors and heaters.

1.9 Block Diagram

1.9.1 A simplified block diagram is illustrated in Figure 1.

2.3 Multiplexer, A/D converter

Input	±10 v from seismic amplifier
Number of inputs	30
Noise	±0.6 mv peak referred to ±10 v peak at input to A-D
Coding error	± $\frac{1}{2}$ least significant bit
Negative numbers	1's complement
Linearity	Better than 0.01%
Slope error	Better than 0.01%
Zero error	Better than 0.01%
Conversion time	12 μ s

2.4 D/A Converter

Code input	Binary, 1's complement
Number of bits	10 bits, including sign
Accuracy	±0.2%

2.5 Magnetic Tape Unit

Speeds	20, 40, 80 ips
Speed tolerance	±2% long term
Direction	bi-directional
Tape width	$\frac{1}{2}$ " (0.498 ±0.002)
Recording	IBM compatible
Packing density	800 bpi
Tracks	9
Track spacing	ASI standard
Tape sensing	Photo-reflective IBM compatible; both BOT and EOT

Read direction

3 speeds forward, 1 speed
reverse

File protection

Electronic and/or write-ring
file protection

Erase head

Reels

8 $\frac{1}{2}$ " or 10" compatible with
IBM hubs and snap-off locks

2.6 Filter Amplitude Response Curves

2.6.1 Refer to Figures 2 and 3.

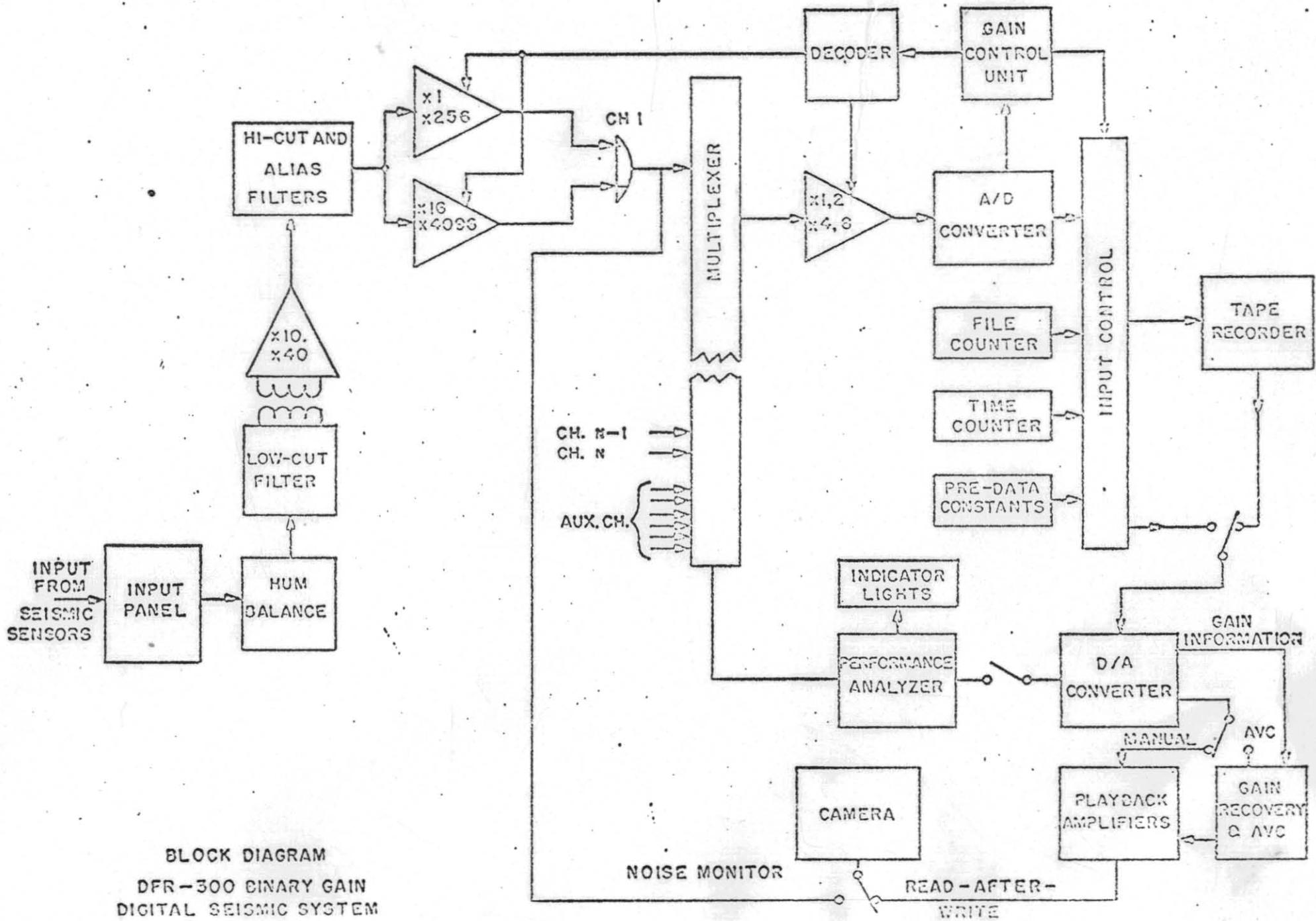


Figure 1

BLOCK DIAGRAM
DFR-300 BINARY GAIN
DIGITAL SEISMIC SYSTEM

5 cm

AMPLITUDE RESPONSE

055021

SDS BINARY GAIN AMPLIFIER

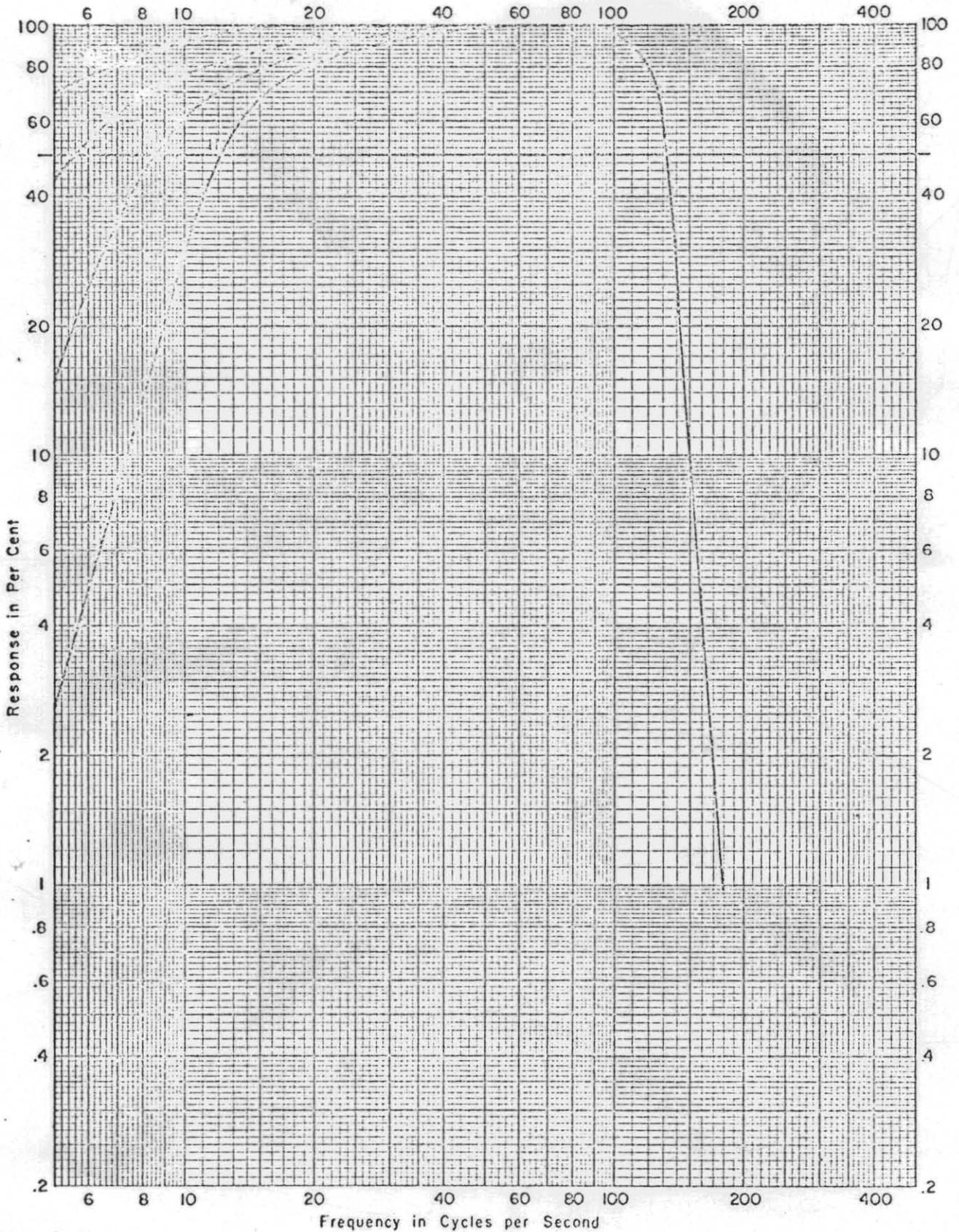
AMPLIFIER ONLY

SERIES DFR-300

HIGH CUT FILTERS-OUT

LOW CUT FILTERS

ALIAS FILTER -2MS



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FIGURE 2.

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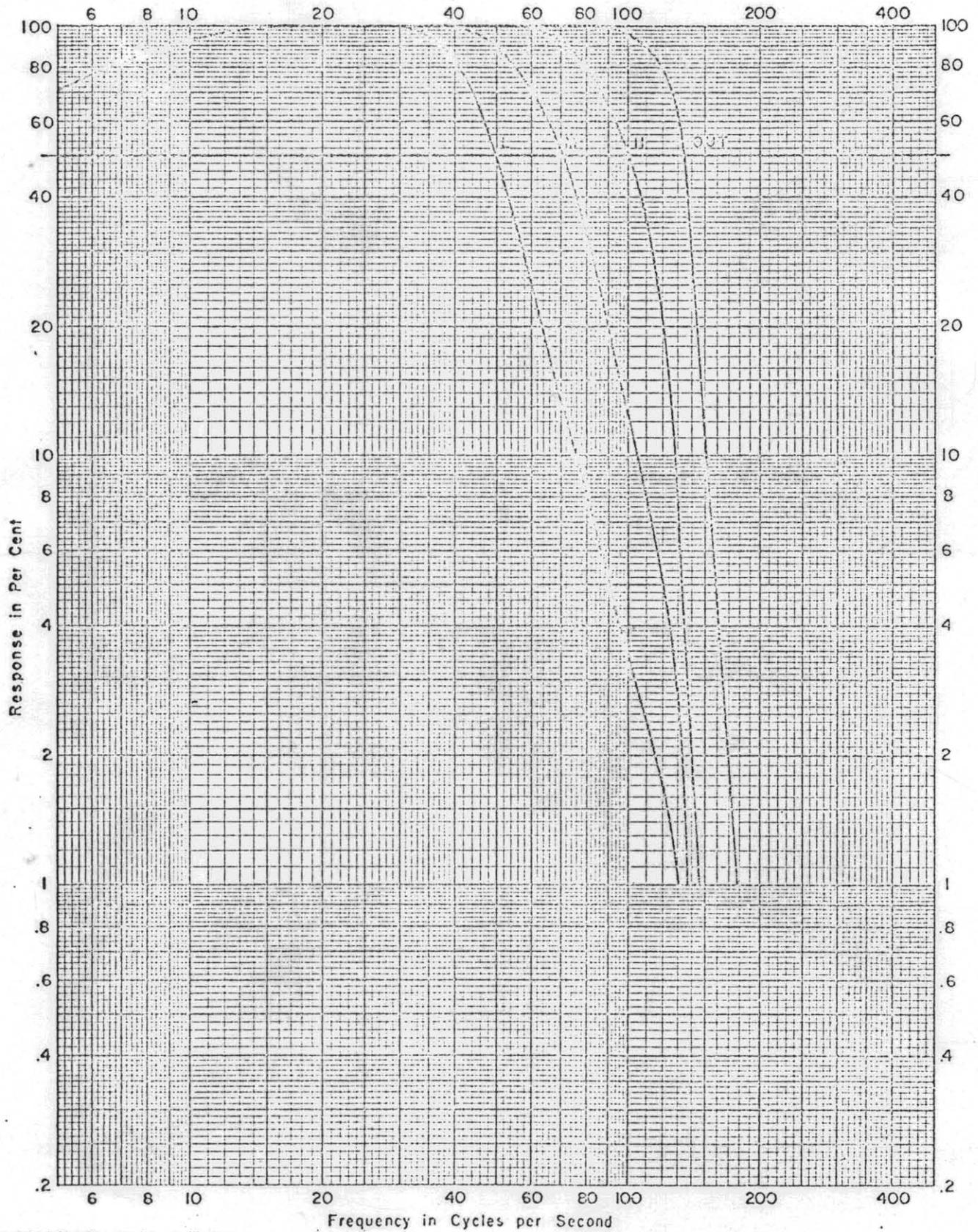
5 cm

055022

AMPLITUDE RESPONSE

SDS BINARY GAIN AMPLIFIER
SERIES DFR-300
HIGH CUT FILTERS

AMPLIFIER ONLY
LOW CUT FILTER - OUT
ALIAS FILTER - 2MS

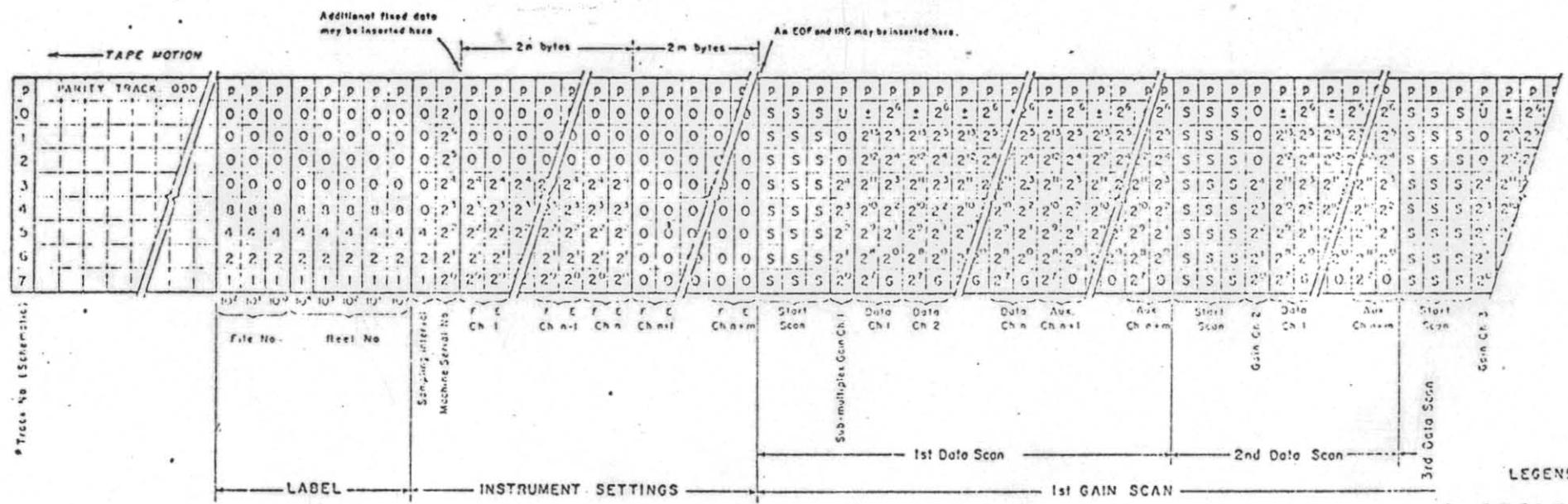


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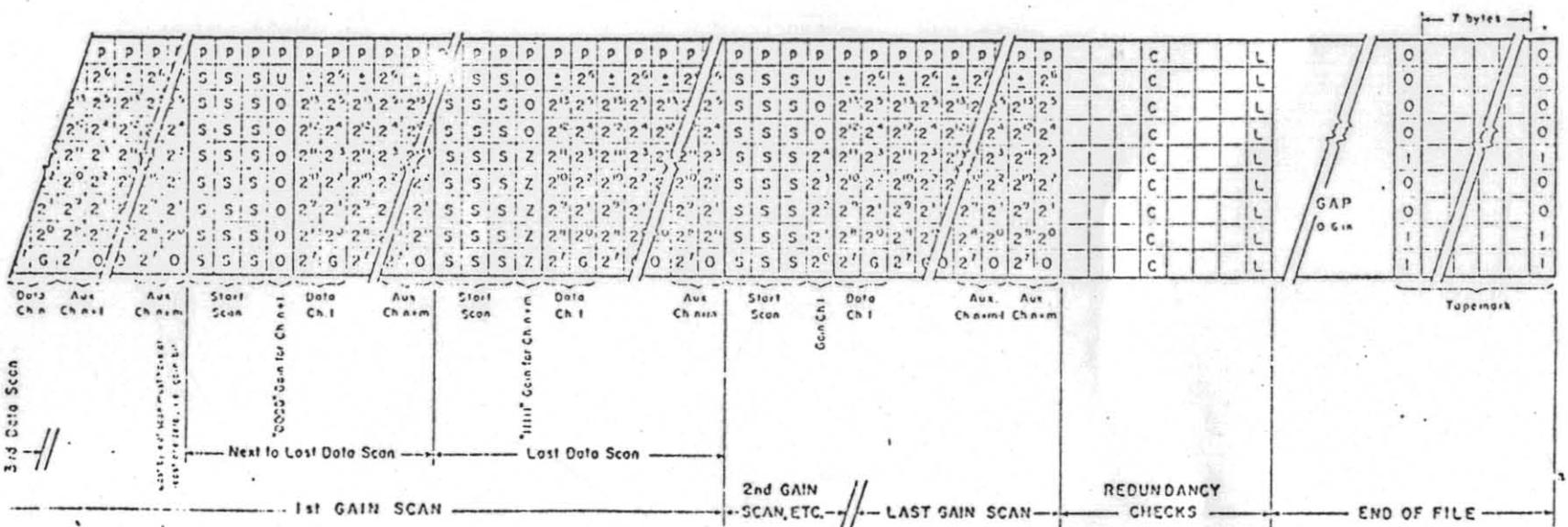
FIGURE 3.

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9-TRACK DIGITAL RECORDING FORMAT



* The actual order on the tape is, from top to bottom, 4, 5, 0, 1, 2, 6, 3, 7, 8.



LEGEND

- C = Cyclic Redundancy Check
- D = Data Channel Indicator
- E = Early Gain
- F = Fixed Gain
- G = Gain Change Indication
- L = Longitudinal Redundancy Check
- m = Number of Auxiliary Channels
- n = Number of Data Channels
- p = Parity Bit (odd)
- S = Start of Scan Code
- U = Upward Gain Change Indicator
- Z = End of Gain Scan
- 2ⁿ = Data Bit

APPENDIX 6ACCURACY OF NAVIGATION CONTROL

Good atmospheric conditions prevailed throughout the Bass B69B survey and there was no problem in obtaining strong signals at the desired ranges.

The four Shoran base stations were located adjacent to 1st or 2nd order Land and Survey Department trig points, all of which had been occupied for previous surveys.

There was no reason to suspect mis-placing of the stations from the results of the 3-way fix taken during the survey.

<u>Fix 3</u>	<u>Station</u>	<u>Range Reading</u> (miles)
October 18	Deal Island	51.897
	Walker's Lookout	40.670
	Waterhouse (Offset)	45.247

The coordinates of the boat's position when the fix was taken, were computed by pairing the range values and were presented in yards on the Australian TM zone 7 as follows:

Deal - Walker	525805 E	1040899 N
Deal - Waterhouse	525822 E	1040899 N
Walker - Waterhouse	525806 E	1040894 N

COMMENT

From the results of the 3-way fix computations, it was seen that the boat's position indicated by pairing ranges from Deal Island and Walker's Lookout, was displaced by

only 5 yards from the position indicated by pairing the ranges from Walker's Lookout and Waterhouse Cape. The paired readings from Deal Island and Waterhouse Cape placed the boat within 20 yards of the other positions. However, too much weight should not be given to this fix as a measure of accuracy since the boat was in a bad angle position relative to these two stations. (See diagram.)

The overall accuracy of the system as indicated by this 3-way fix, is much higher than normally encountered or expected due to varying range errors inherent with the XR Shoran system even at ranges of 40-50 miles. The results do however confirm that with good atmospheric conditions such as prevailed during the Bass survey and which promoted strong and distinct signal transmission, better interpretations of the received signal and therefore more accurate positioning can be expected.

NORTH ↑

1,040,950

900

850

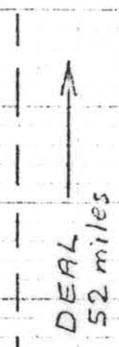
1,040,800

525,750

800

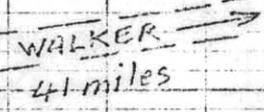
525,850

3-WAY FIX #3



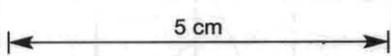
Deal-Walker

Deal-Waterhouse



Waterhouse
-Walker

WATERHOUSE
45 miles



055027

5 cm

1,150,000

DEAL ISLAND

1,100,000

1,050,000

NORTH

WALKER'S LOOKOUT

3-WAY FIX LOCATION

1,000,000

950,000

500,000

550,000

600,000

EAST

