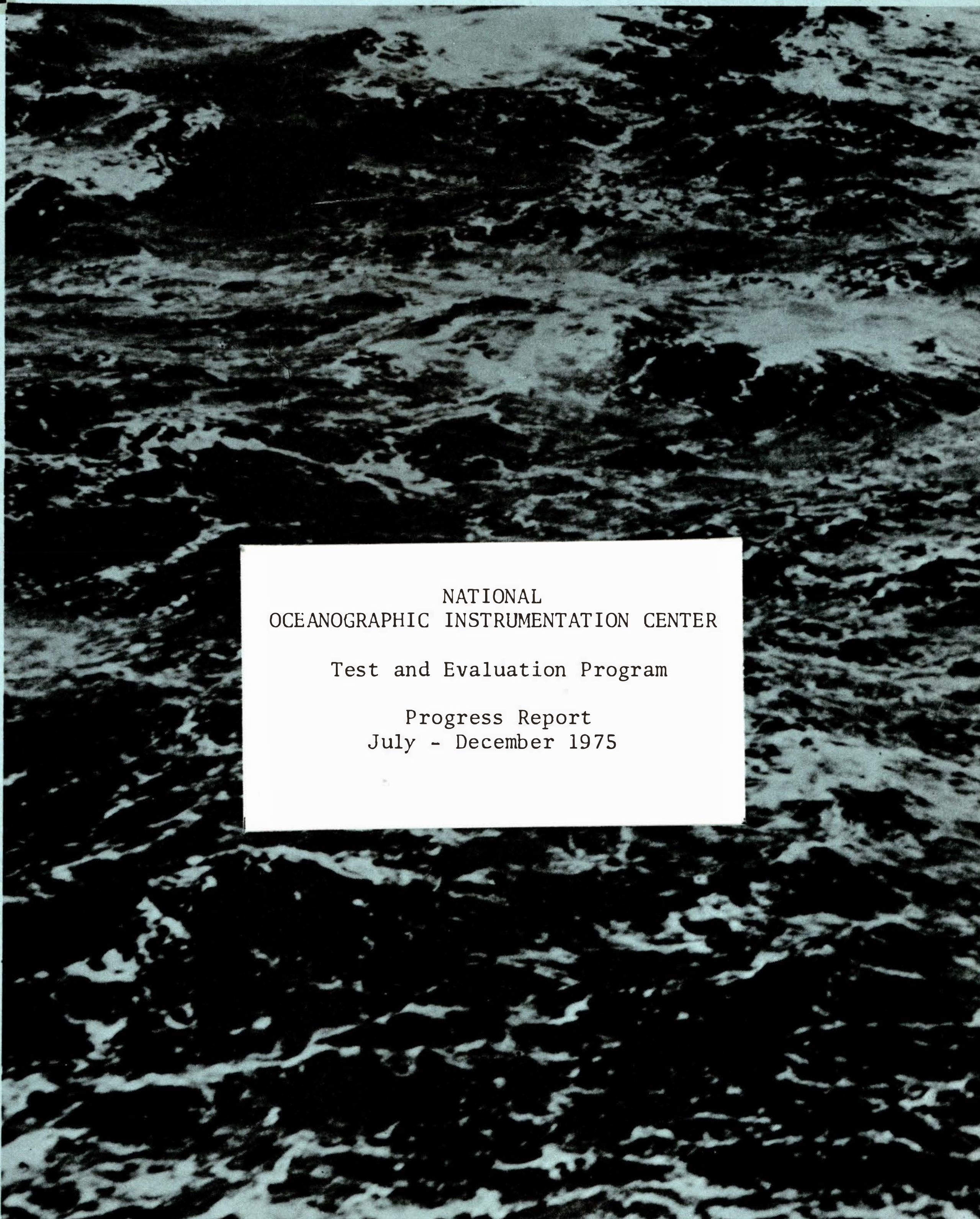
A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

National Oceanographic Instrumentation Center

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey



NATIONAL
OCEANOGRAPHIC INSTRUMENTATION CENTER

Test and Evaluation Program

Progress Report
July - December 1975

National
Oceanographic
Instrumentation
Center
WASHINGTON, D.C.

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OCEANOGRAPHIC INSTRUMENTATION CENTER

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AMERICAN REVOLUTION BICENTENNIAL 1776-1976

NOAA--S/T 76-2148

NATIONAL
OCEANOGRAPHIC INSTRUMENTATION CENTER

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Progress Report
July - December 1975

Approvals:

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Chief, Testing Division

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Chief, Evaluation Branch

January 1976

INTRODUCTION

The objective of the National Oceanographic Instrumentation Center's (NOIC) Test and Evaluation Program is to provide information on the state of marine instrument technology. This information can serve as a basis for decisions influencing positive direction of programs which utilize marine instruments and thus result in favorable changes.

The progress report provides summary descriptions of marine instrumentation undergoing test and evaluation at NOIC during the period from July 1, 1975 to December 31, 1975. The instrumentation are divided into the following four broad categories:

- Water Quality Instrumentation
- Conductivity/Salinity-Temperature-Depth Measuring Systems
- Ocean Fluid Dynamics (includes current meters and wave/tide instruments)
- Acoustic Instrumentation

The instruments covered in this report are of general interest to the entire marine science community and of specific interest to many programs. As indicated by the asterisks in the table of contents, the majority of the instruments tested are of specific interest to the Navy and their selection was based on requirements conveyed to NOIC by the Office of the Oceanographer of the Navy.

Should anyone desire additional information concerning the evaluation of the instruments listed in this report, please contact NOIC's Testing Division, Code C631, Rockville, Md. 20852 (Phone 202-426-9073 or 202-426-9075).

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WATER QUALITY INSTRUMENTATION

TESTING PROGRAM

Date: January 1, 1976

Project: Water Quality Instrumentation
Project Leader: B. Pijanowski

N — Navy **R** — Reimbursable
I — In-House **O** — Other

Task Description	FY'76												FY'77												Req'mt.
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
Water Quality Systems																									
Whitney/Montedoro Mark II	■	■																							N
InterOcean Model 513D	■	■	■	■	■	■																			N
NERA Systems EKOLOG 60-1, Mod 4							■	■	■	■	■	■													N
Martek Mark V								■	■	■	■	■	■												I
Horiba Model U-7								■	■	■	■	■	■												I
Dissolved Oxygen Meters																									
Beckman Fieldlab	■	■	■	■																					R
Delta Scientific Model 2010	■	■	■	■				■	■	■															R
Martek Mark V	■	■	■	■																					R
Yellow Springs Model 57	■	■	■	■				■	■	■															R
IBC Model 170-051	■	■	■	■				■	■	■															R
Rexnord Model 330	■	■	■	■				■	■	■															I

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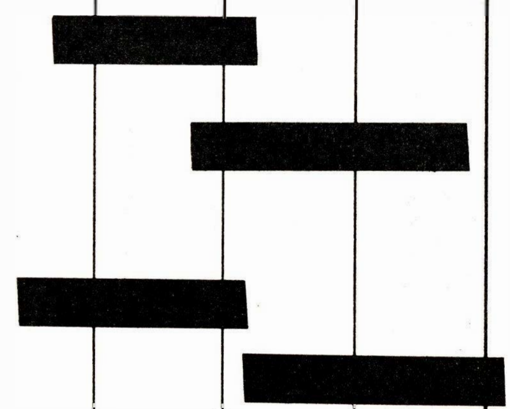
In-House Studies																									
D.O. Calibration Comparisons																									I/O
Ion Selective Electrode Evaluations																									I
EPA/Energy Related Projects																									
Laboratory Equipment																									R
Test Kit Evaluations																									R
Technique Evaluations																									R



WHITNEY/MONTEDORO CORPORATION MARK II PORTABLE WATER QUALITY MONITORING SYSTEM

A. Description

This system is designed to measure temperature, conductivity, dissolved oxygen, pH and Chloride ion concentration in situ to a depth of 100 meters. Temperature is measured by thermistor, conductivity by an inductive cell, dissolved oxygen by a pressure and temperature-compensated polarographic membrane sensor, pH by a pressure-compensated glass electrode and Chloride ion by a specific ion electrode. Output for all parameters is digital. Instrument specifications are listed in Table 1.

This is an improved version of the system originally tested in January 1972. According to the manufacturer, repairs and extensive modifications have been made.

B. Progress

No progress has been made with this system during the past six months. A faulty conductivity sensor was returned to the manufacturer in July and a repaired unit has not yet been received.

C. Future Plans

No further evaluation of this system is planned; test results obtained to date will be published.

INTEROCEAN MODEL 513D CTD-DO - pH SYSTEM

A. Description

This system is designed to measure temperature, conductivity, depth, dissolved oxygen and pH in situ to depths of 100 meters. Temperature is measured by thermistor, conductivity by an inductive cell, dissolved oxygen by a temperature-compensated polarographic sensor which is the Beckman Instrument Co. Fieldlab unit and pH is measured by a combination electrode with an Ag/AgCl reference. Output is digital for all parameters.

B. Progress

All planned tests have been completed on this system. Dissolved oxygen data for the system is shown in Figure 1; data for a new and improved sensor recently offered by InterOcean are shown in Figure 2. Design modifications have resulted in improved performance. Pressure effect on the pH sensor are shown in Figure 3. During the past six months, it was necessary to replace a dissolved oxygen sensor and two pH sensors because of failures.

SPECIFICATIONS FOR WATER QUALITY SYSTEMS

TABLE I	INTEROCEAN 513D	WHITNEY-MONTEDORO
Conductivity		
Range	0-65 mmho/cm	0.01 - 100 mmho/cm
	±0.05 mmho/cm	±0.05 mmho/cm
Accuracy	Inductive cell	Inductive cell
Sensor	t.c. - 10ms	(20°C,35°/oo Na Cl)*
Temperature		
Range	-5 to 45°C	0 to 40°C
	±0.05°C	±0.1°C
Accuracy	Thermistor Network	
Sensor	t.c. - 1.4s	Rt - 5s
Depth		
Range	0-100M	0-100M
	±1.M	±0.4M
Accuracy	25% overrange	165 psi max
	tc-50ms	
Sensor	Strain gauge bridge	Solid state *
Dissolved Oxygen		
Range	0-40 ppm	0-20 ppm
	±0.2 ppm	±0.2 ppm
Accuracy	Ag/Pt polarographic (Beckman)	Au/Ag polarographic
Sensor	t.c. - 10s *	Rt - 10s *
pH		
Range	2-14 pH	2-12 pH
	±0.1 pH	±0.05 pH
Accuracy	Combination Ag/AgCl (Beckman)	Combination Ag/AgCl pressure comp.
Sensor	t.c. - 200MS *	Rt - 10S.Max *
Power	External AC or DC +15V -15V	Internal Globe Gel Cells (2) 12V-rechargeable External 12V DC
Environmental Conditions	-5 to 50°C	

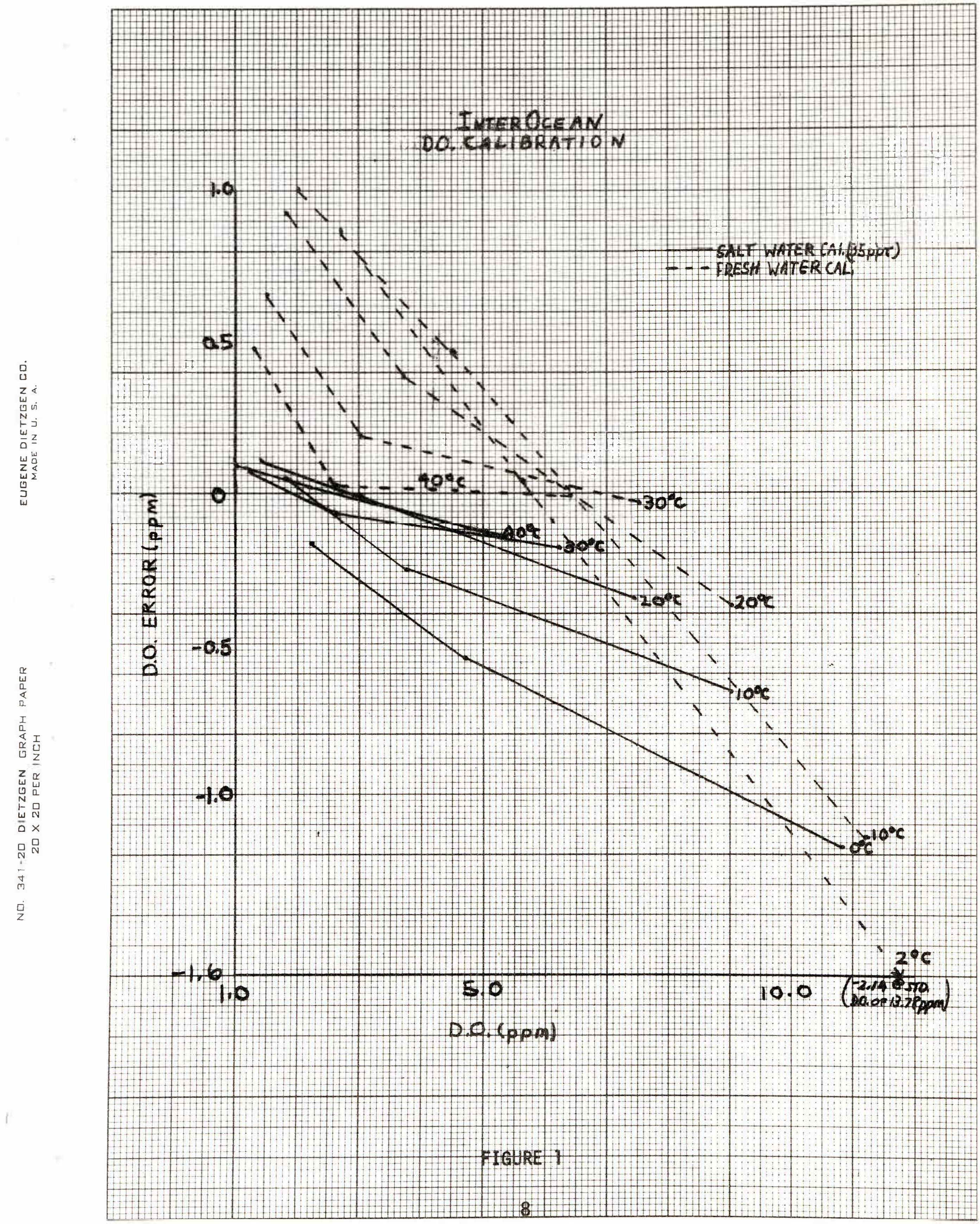
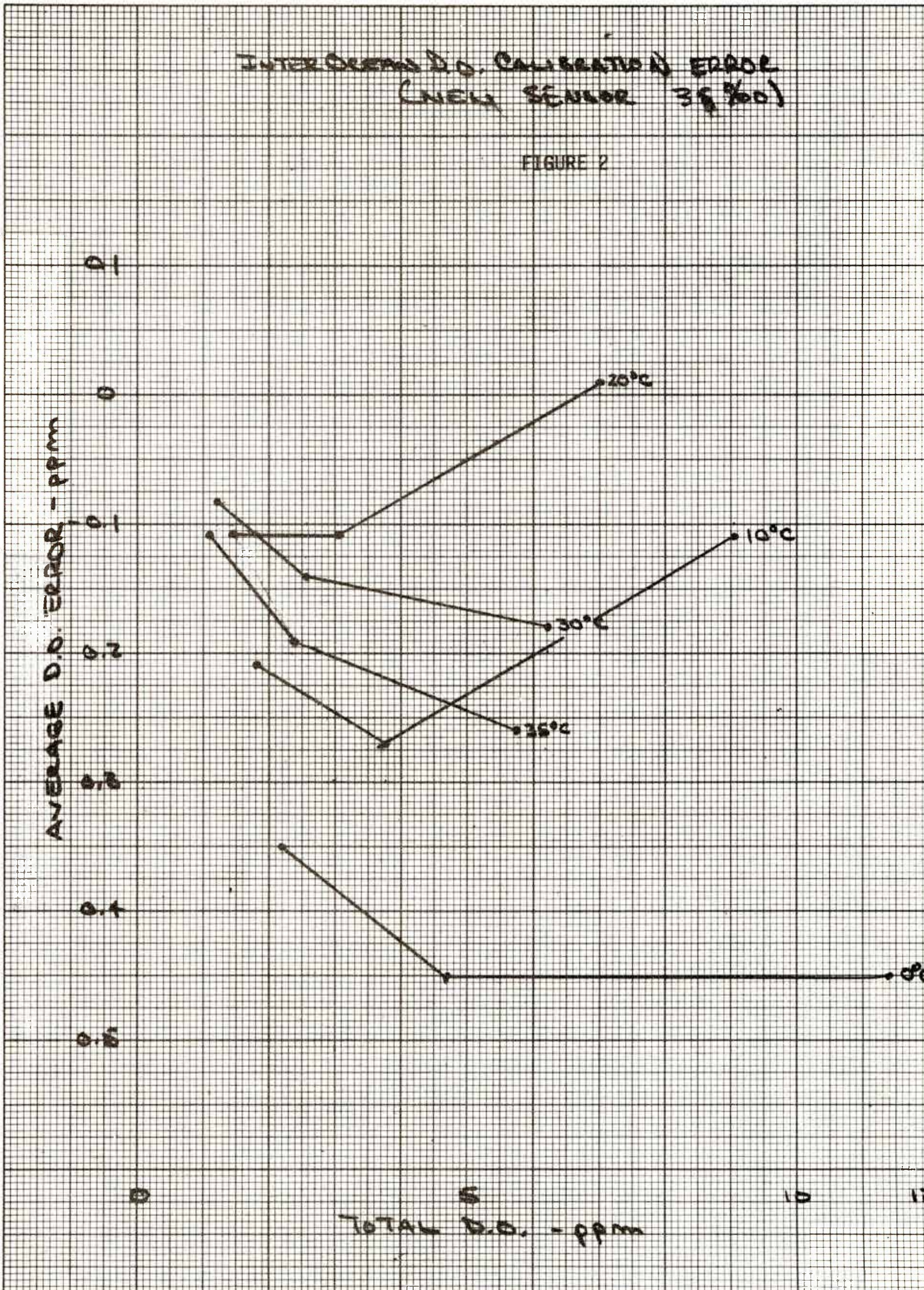

INTER OCEAN
D.O. CALIBRATION
SALT WATER CAL. (35ppt)
FRESH WATER CAL.
D.O. ERROR (ppm)
1.0
0.5
0
-0.5
-1.0
-1.6
1.0
5.0
10.0
D.O. (ppm)
40°C
30°C
40°C
30°C
20°C
20°C
10°C
10°C
0°C
2°C
(-2.14 @ STD. D.O. of 13.78 ppm)
NO. 341-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.

FIGURE 1


INTEROCEAN D.O. CALIBRATION ERROR
(NEW SENSOR 35‰)
FIGURE 2
AVERAGE D.O. ERROR - ppm
0.1
0
0.1
0.2
0.3
0.4
0.5
20°C
10°C
30°C
35°C
0°C
0
5
10
12
TOTAL D.O. - ppm

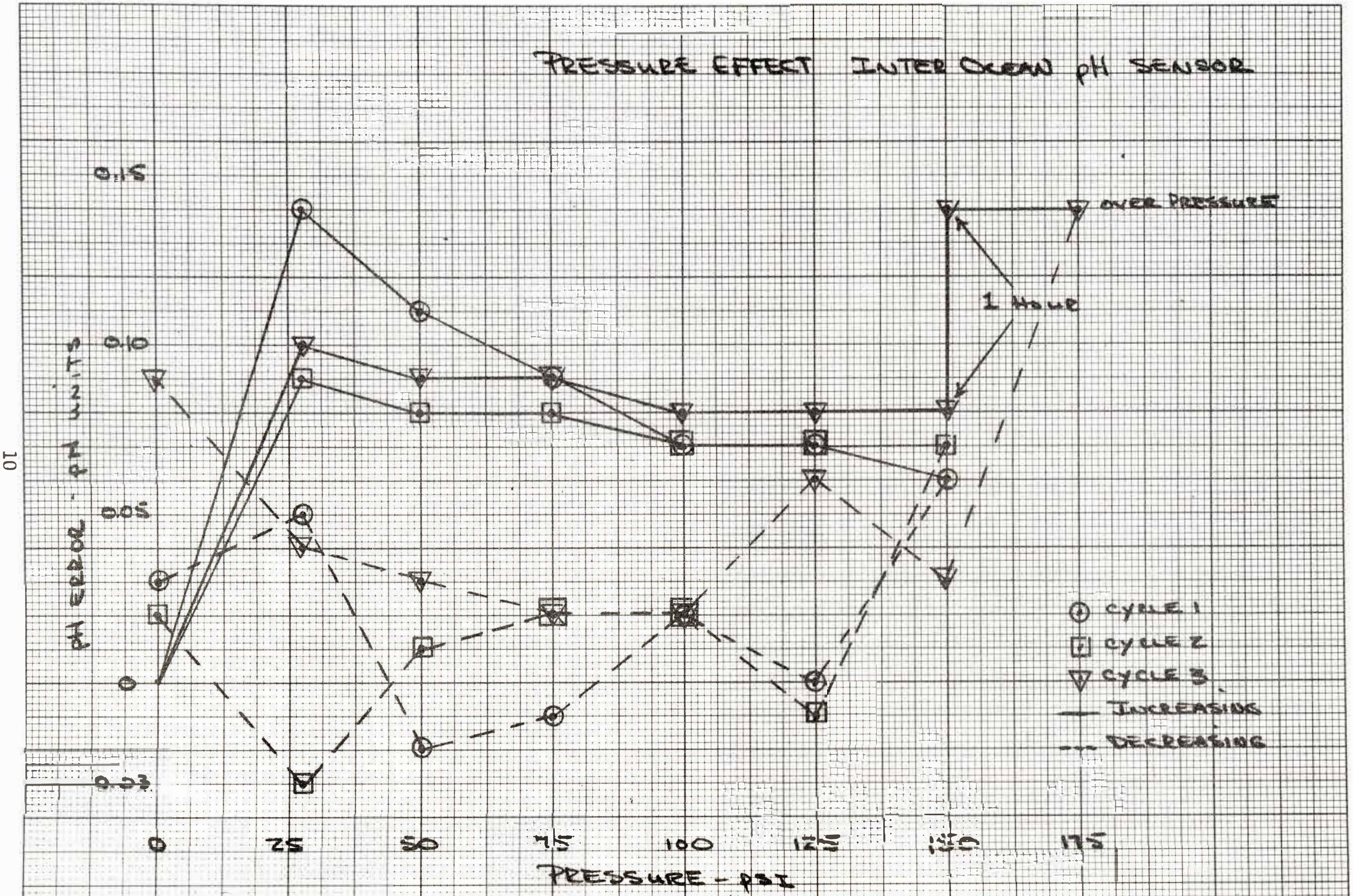

PRESSURE EFFECT INTER OCEAN pH SENSOR
pH ERROR - pH UNITS
0.15
0.10
0.05
0
0.03
0
25
50
75
100
125
150
175
PRESSURE - PSI
OVER PRESSURE
1 HOUR
CYCLE 1
CYCLE 2
CYCLE 3
INCREASING
DECREASING

FIGURE 3

C. Future Plans

No further testing is planned. An IFS will be published.

NERA SYSTEMS EKOLOG 60-1 MOD 4 WATER QUALITY MONITOR

A. Description

This system is composed of a Hydrolab Surveyor Model 6D Water Quality unit interfaced with a portable data acquisition system manufactured by NERA Systems, Inc. The data collection rate is programmable and data is recorded on a cassette tape recorder. Data on the tapes can be reduced in conjunction with software available on the G. E. time sharing computer through remote terminals. The entire unit is operated by a 12V automotive battery and with the exception of the underwater unit is housed in a watertight carrying case.

B. Progress

No progress has been made on this system during the past six months due to late delivery by NERA. The unit to be tested is composed of a Hydrolab Surveyor belonging to NOIC and a data acquisition unit on loan from NERA. The NOIC Hydrolab unit has been updated and modified to accommodate the NERA system. NERA is still in the process of interfacing the systems together.

C. Future Plans

Complete test and evaluation of the data collection system is planned when it is delivered by NERA.

MARTEK MARK V WATER QUALITY SYSTEM

A. Description

This system is designed to measure temperature, conductivity, dissolved oxygen and pH to depths of 30 meters. Automatic temperature compensation is included for the dissolved oxygen and pH sensors. Digital output is provided by an LED display and continuous analog and digital signals for recording are available. An AC/DC power supply unit offers optional operation from internal rechargeable batteries, AC, or an external 12 volt DC power source.

B. Progress

Procurement of the system has been initiated.

C. Future Plans

Complete test and evaluation is planned.

HORIBA MODEL U-7 WATER QUALITY CHECKER

A. Description

This system is an inexpensive unit designed to measure temperature, conductivity, dissolved oxygen, pH and turbidity to a depth of 5 feet. Output is a digital display; no output signals are provided for recorder operation. The unit can be powered by AC or rechargeable DC batteries.

B. Progress

The manufacturer has agreed to lend NOIC a unit for evaluation. Formal correspondence has been generated to accomplish this.

C. Future Plans

Complete test and evaluation for all parameters except turbidity is planned.

DISSOLVED OXYGEN INSTRUMENTS

A. Description

All instruments measure dissolved oxygen in water. The following instruments were evaluated:

Beckman Fieldlab
Delta Scientific Model 2010-00
Martek Mark V
Yellow Springs Model 57
International Biophysics Corp. Model DOA 170-051
Rexnord (Weston & Stack) Model 330

The specifications for the above instruments are listed in Table 2.

B. Progress

All tests have been completed and six separate IFS reports have been completed. Dissolved oxygen performance data for three different temperatures in fresh and salt water are summarized in Figures 4 through 9. Temperature calibration errors for those systems which provide a direct temperature readout are summarized in Figure 10.

C. Future Plans

Limited field testing in the Potomac River is planned for all of the units except the Beckman Fieldlab and Martek Mark V.

SPECIFICATIONS FOR DISSOLVED OXYGEN METERS

TABLE II	BECKMAN FIELDLAB	DELTA SCIENTIFIC MODEL 2010-00	INTERNATIONAL BIOPHYSICS CORP. DOA 170-051	MARTEK DDO	YELLOW SPRINGS MODEL 57	REXNORD MODEL 330 (WESTON & STACK)
Dissolved Oxygen Range	0-25 ppm	0-20 ppm	0-20 ppm	0-20 ppm	0-20 ppm	0-15 ppm
Accuracy	±0.2 ppm	Not Specified	0-100% O_2 ±2% reading	0-.4 atm (O_2) 0-200% sat. ±1% F.S.	±0.1 ppm	±1% F.S.
Sensor	Ag/Pb polarographic	Ag/Au Polarographic	Ag/Au Polarographic	Ag/Au Polarographic	Ag/Au Polarographic	Pt/Pb polarographic
Temperature	0-100°C ±0.1°C	no readout (thermistor)	(no readout)	-5 to 50°C	-5 to 45°C ±0.7°C	0-50°C ±0.5°C
Power Requirements	AC or rechargeable NiCd batteries	Batteries	Batteries 4 D Cells	115 AC or DC - rechargeable	Batteries 2 C Cells 5 C NiCd for stirrer	4 D Cells 4AA Cells for Stirrer
Depth Limit	600 ft.	300 ft.	Not Specified	200 meters	250 ft.	300 ft.
Temp/Press.	Manual Temperature Compensation	Automatic Temperature & pressure Compensation	Automatic Temperature Compensation	Automatic Temperature Compensation	Automatic Temperature Compensation Manual Salinity Compensation	Automatic Temperature Compensation
Stirrer	Not required	Optional	None	Provided	Optional	Optional
Price	$700	$925	$450	$800	$850	$665

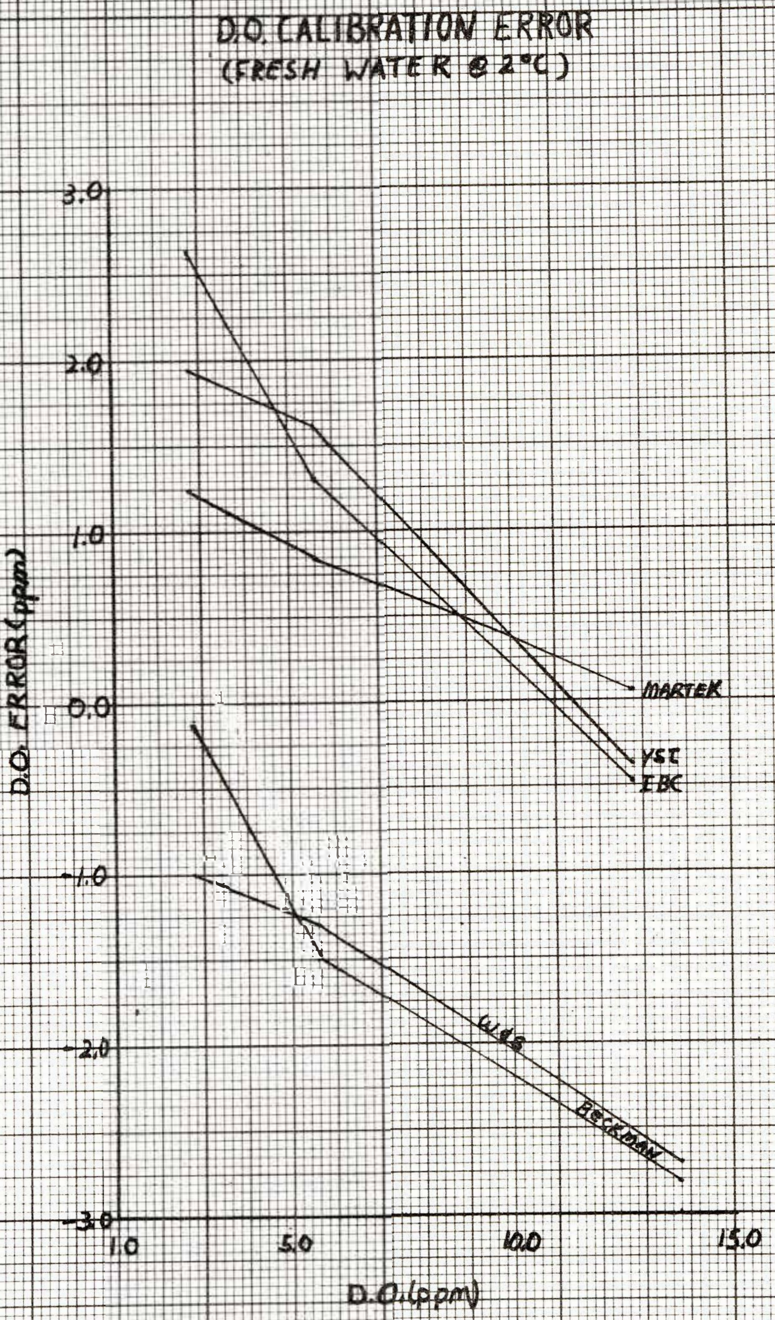


FIGURE 4

EUGENE DIETZGEN CO.
MADE IN U. S. A.

NO. 341-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

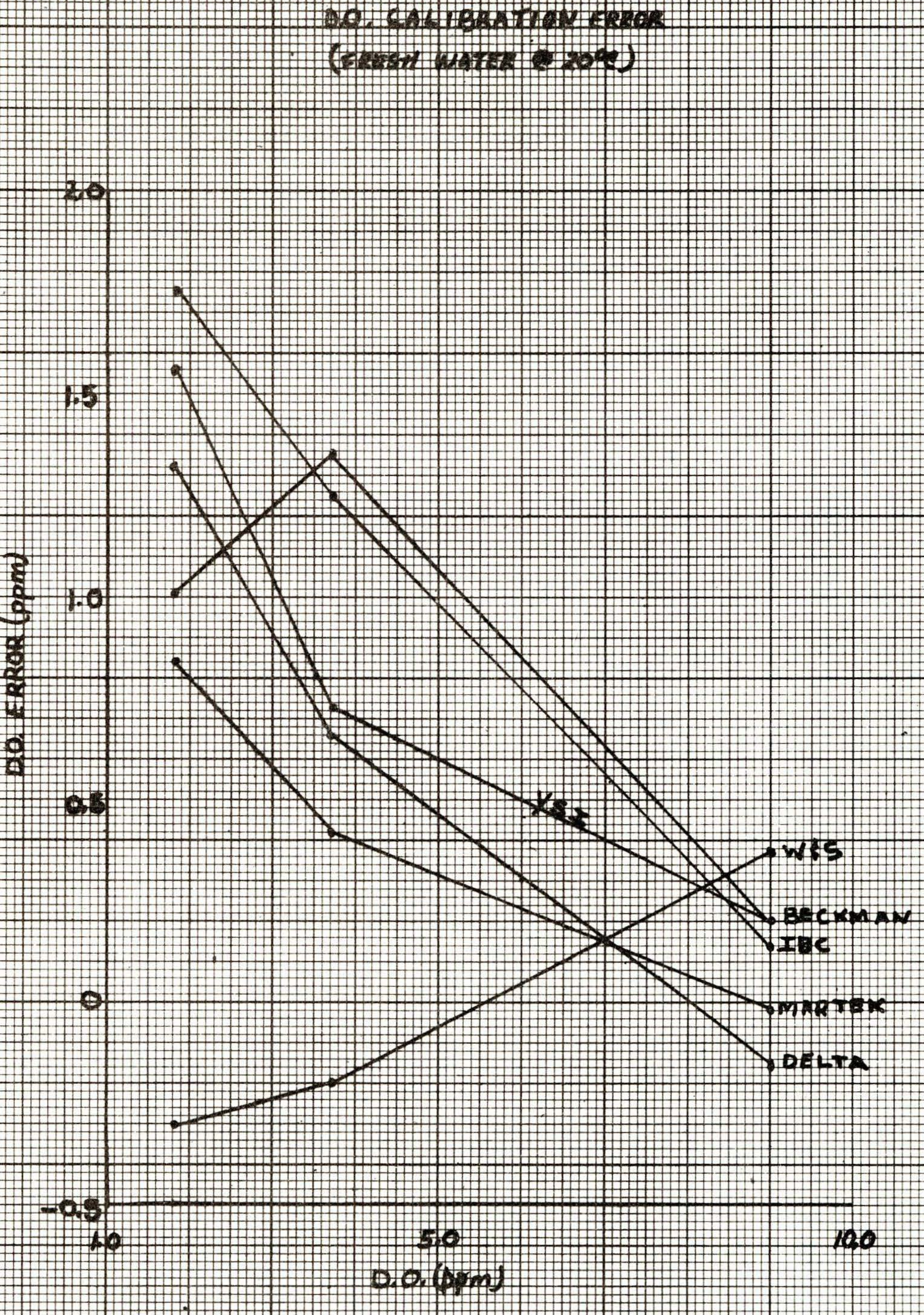

D.O. CALIBRATION ERROR
(FRESH WATER @ 20°C)
D.O. ERROR (ppm)
2.0
1.5
1.0
0.5
0
-0.5
1.0
5.0
10.0
D.O. (ppm)
YSI
W&S
BECKMAN
IBC
MARTEK
DELTA

FIGURE 5

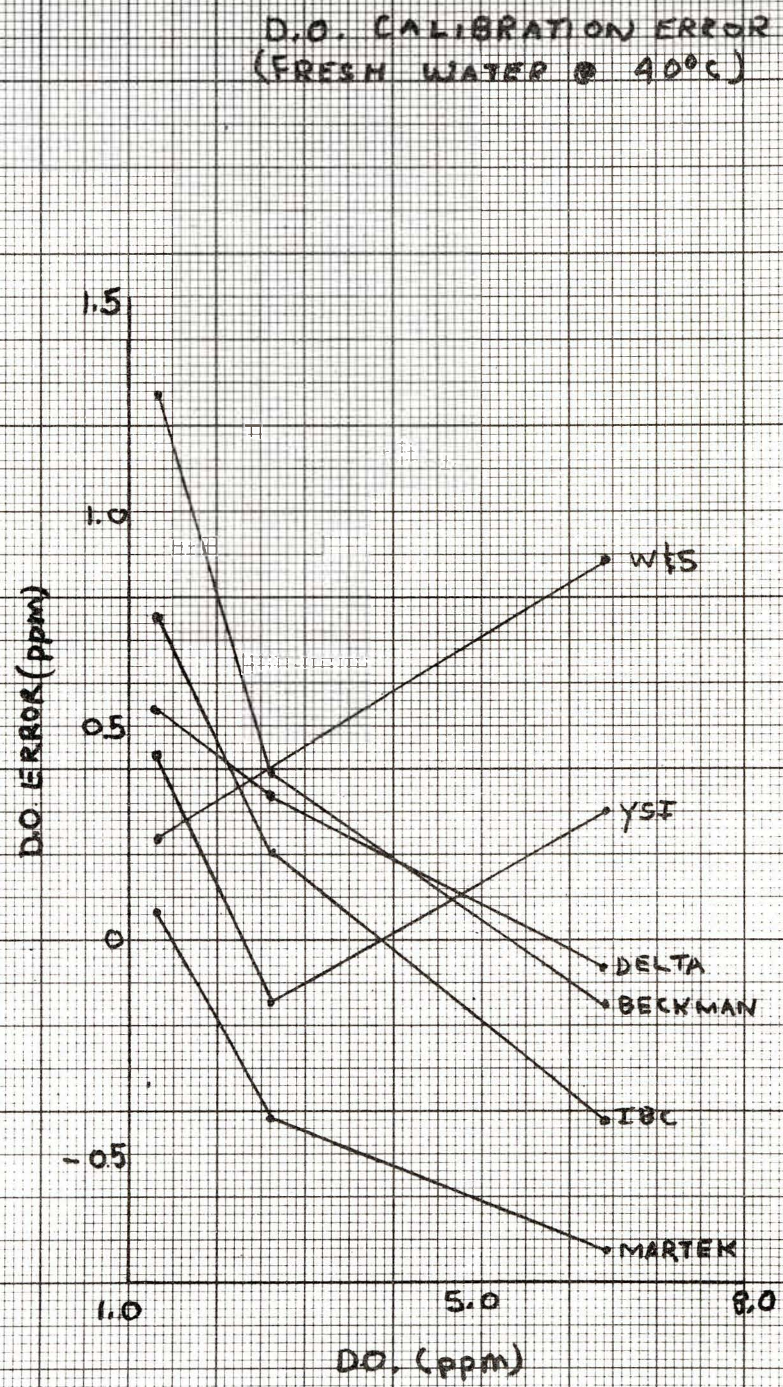
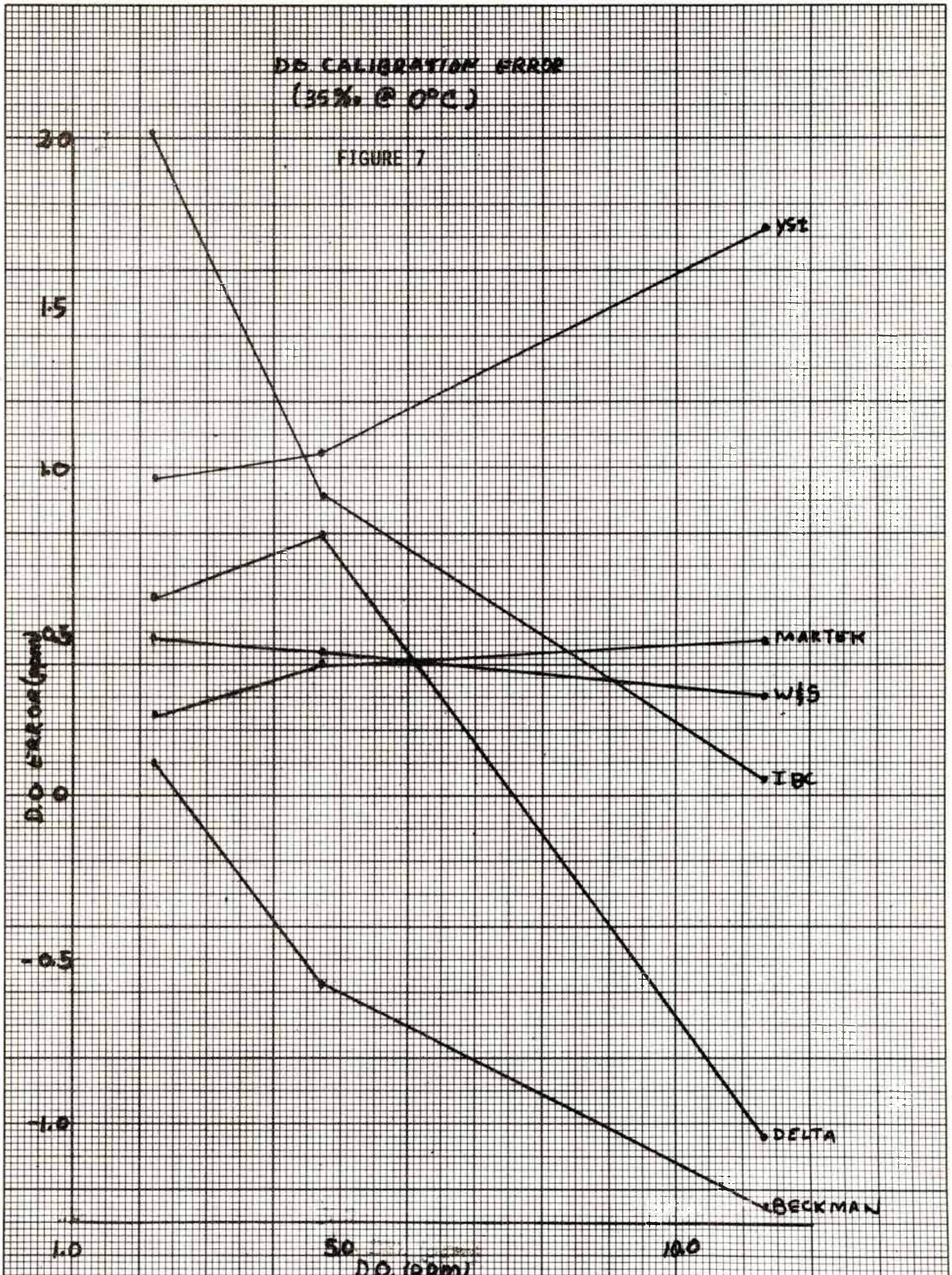

D.O. CALIBRATION ERROR
(FRESH WATER @ 40°C)
1.5
1.0
0.5
0
-0.5
D.O. ERROR (ppm)
W&S
YSI
DELTA
BECKMAN
IBC
MARTEK
1.0
5.0
8.0
D.O. (ppm)

FIGURE 6



DO CALIBRATION ERROR
(35‰ @ 0°C)
FIGURE 7
2.0
1.5
1.0
0.5
0
-0.5
-1.0
D.O. ERROR (ppm)
YSI
MARTEK
W&S
IBC
DELTA
BECKMAN
1.0
5.0
10.0
D.O. (ppm)

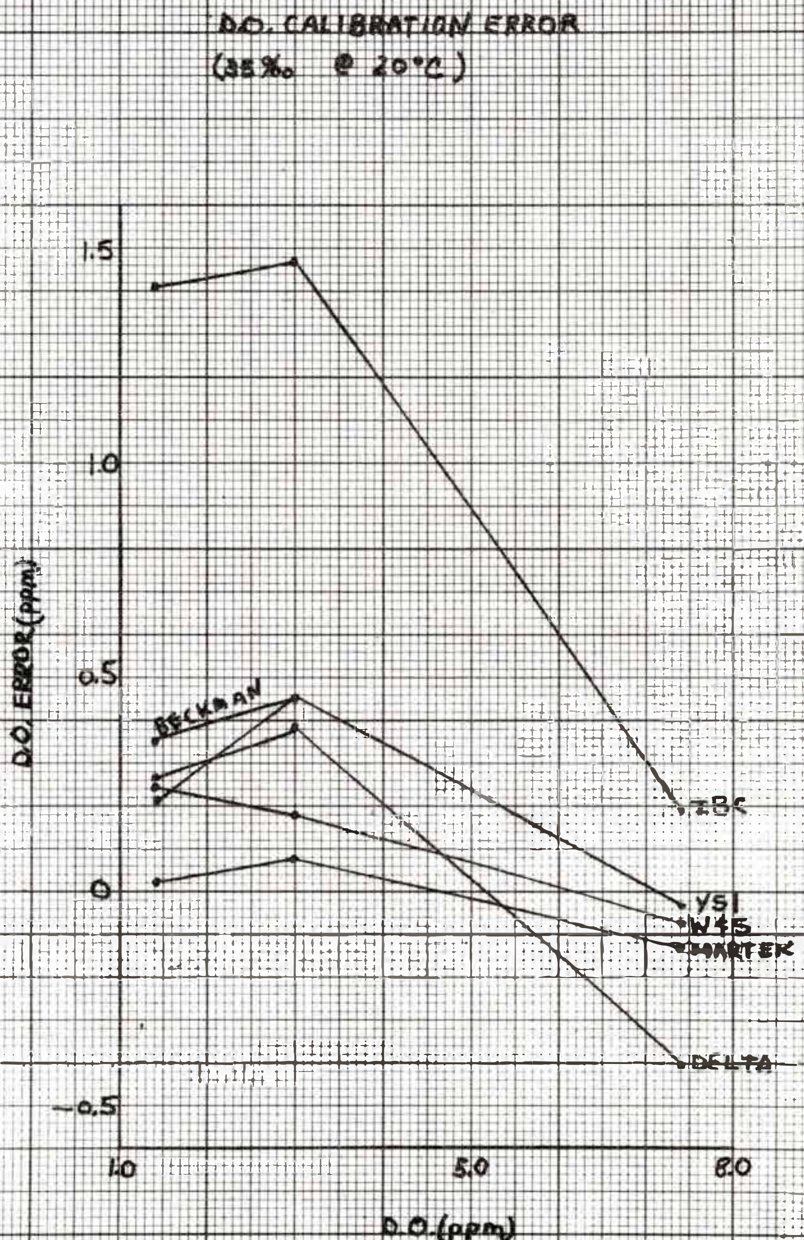

D.O. CALIBRATION ERROR
(35‰ @ 20°C)
D.O. ERROR (ppm)
1.5
1.0
0.5
0
-0.5
BECKMAN
IBC
YSI
W45
MARTEK
DELTA
1.0
5.0
8.0
D.O. (ppm)

FIGURE 8

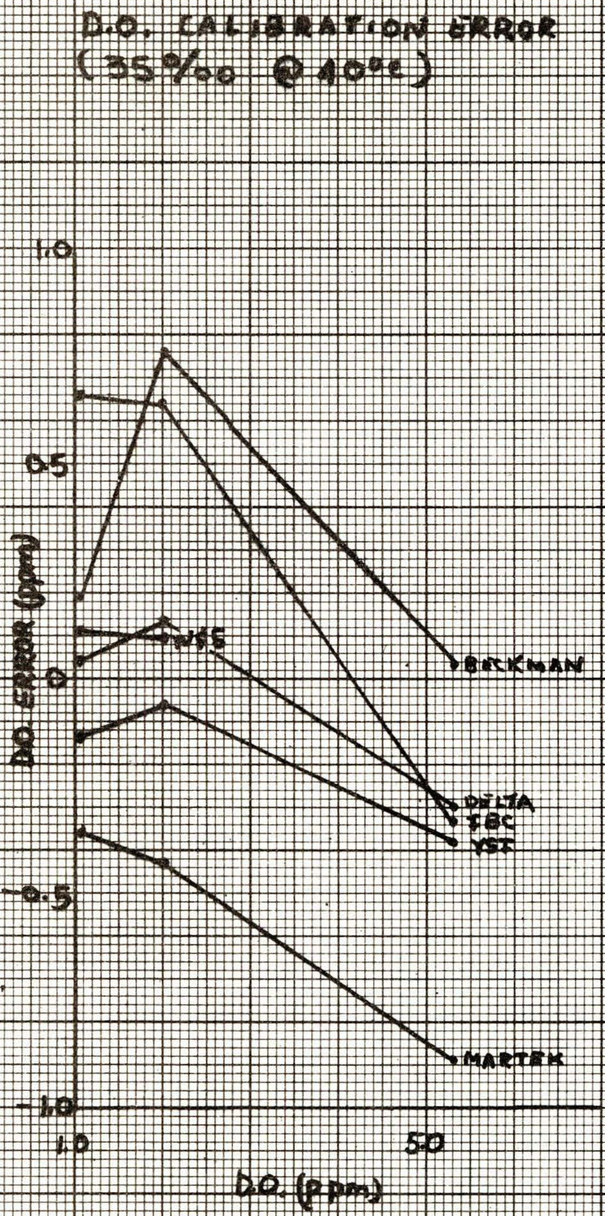
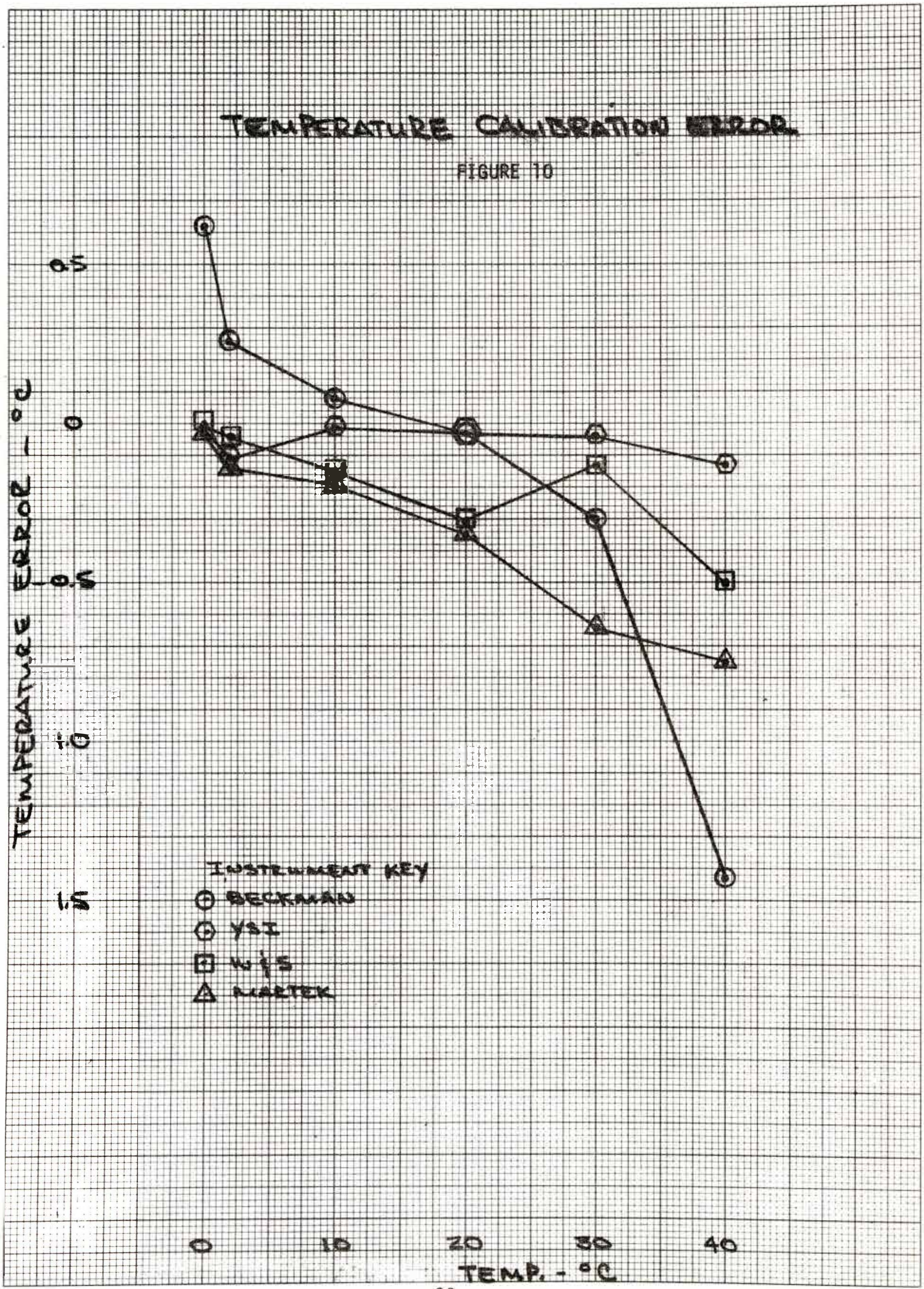

D.O. CALIBRATION ERROR
(35‰ @ 40°C)
1.0
0.5
0
-0.5
-1.0
D.O. ERROR (ppm)
YSS
BECKMAN
DELTA
EBC
YSI
MARTEK
1.0
5.0
D.O. (ppm)

FIGURE 9


TEMPERATURE CALIBRATION ERROR
FIGURE 10
0.5
0
-0.5
1.0
1.5
TEMPERATURE ERROR - °C
INSTRUMENT KEY
BECKMAN
YSI
W/S
MARTEK
0
10
20
30
40
TEMP. - °C

IN-HOUSE PROJECTS

DISSOLVED OXYGEN CALIBRATION COMPARISONS

A. Description

This project involves comparing various techniques available for calibration of dissolved oxygen systems. The techniques under consideration are: the Winkler, a wet chemical analytical procedure, a gas chromatographic technique and various air saturation procedures. It is expected that the results of these comparisons will provide a basis for recommending specific field calibration procedures as well as aid in the development of valid testing procedures for dissolved oxygen systems.

B. Progress

Some tests have been run; however, problems with facilities and standardizing experimental procedures have not been completely solved. Preliminary data has not yet been reduced.

C. Future Plans

Comparison testing will continue on a time-available basis until sufficient data is accumulated.

ION SELECTIVE ELECTRODE EVALUATIONS

A. Description

Many ion selective electrodes are being advertised for application in the marine environment; however, it is suspected that most of these can be used under only very limited conditions. This project involves the evaluation of several types of electrodes that may have in-situ applications. These electrodes will be evaluated for performance in fresh and salt waters, both clean and polluted. A list of the electrodes to be evaluated follows. They will all be used in conjunction with an Orion Model 801A Digital pH Meter.

Sodium ion:

glass membrane - Beckman
Thomas
Fisher
Corning
Markson
solid state - Orion

Potassium ion:

glass membrane	-	Thomas Markson
liquid ion-exchange	-	Orion

Calcium ion: Orion
Magnesium ion: Orion
Chloride ion:

solid state	-	Orion Sensorex Beckman Markson Corning Chemtrix
liquid ion-exchange	-	Orion

B. Progress

Procurement has been initiated on the selected sensors.

C. Future Plans

Complete test and evaluation is planned in clean and polluted fresh, brackish, and sea water.

EPA/ENERGY-RELATED PROJECTS

LABORATORY EQUIPMENT

A. Description

As a result of energy-related funds provided by EPA, several major pieces of equipment were added to the Water Quality Instrumentation Laboratory to serve as reference and standard techniques for future evaluations.

B. Progress

The following instrumentation is in varying stages of procurement:

Atomic Absorption Spectrophotometer-Perkin Elmer 503
UV-VIS Spectrophotometer-Perkin Elmer 200
Fluorometer-Turner Designs
Spectrophotometer-Bausch & Lomb Minispec. 20
pH Meter-Orion 801A

C. Future Plans

No additional procurements are planned since all funds have been expended.

TEST KIT EVALUATIONS

A. Description

At the request of EPA, a series of test kits for water quality measurements will be evaluated for use in fresh and sea water. A partial listing of the parameters for which test kits are available follows:

Ammonia	Phosphate
Copper	Salinity
Iron	Sulfate
Manganese	Zinc
Nitrate	Chloride
Dissolved Oxygen	Cyanide

B. Progress

Procurement has been initiated for representative test kits from the two major manufacturers, Hach Chemical Company and LaMotte Chemical Products Company.

C. Future Plans

Complete evaluations for the kits are planned.

CONDUCTIVITY/SALINITY-TEMPERATURE-DEPTH MEASURING SYSTEMS (C/STDs)

TESTING PROGRAM

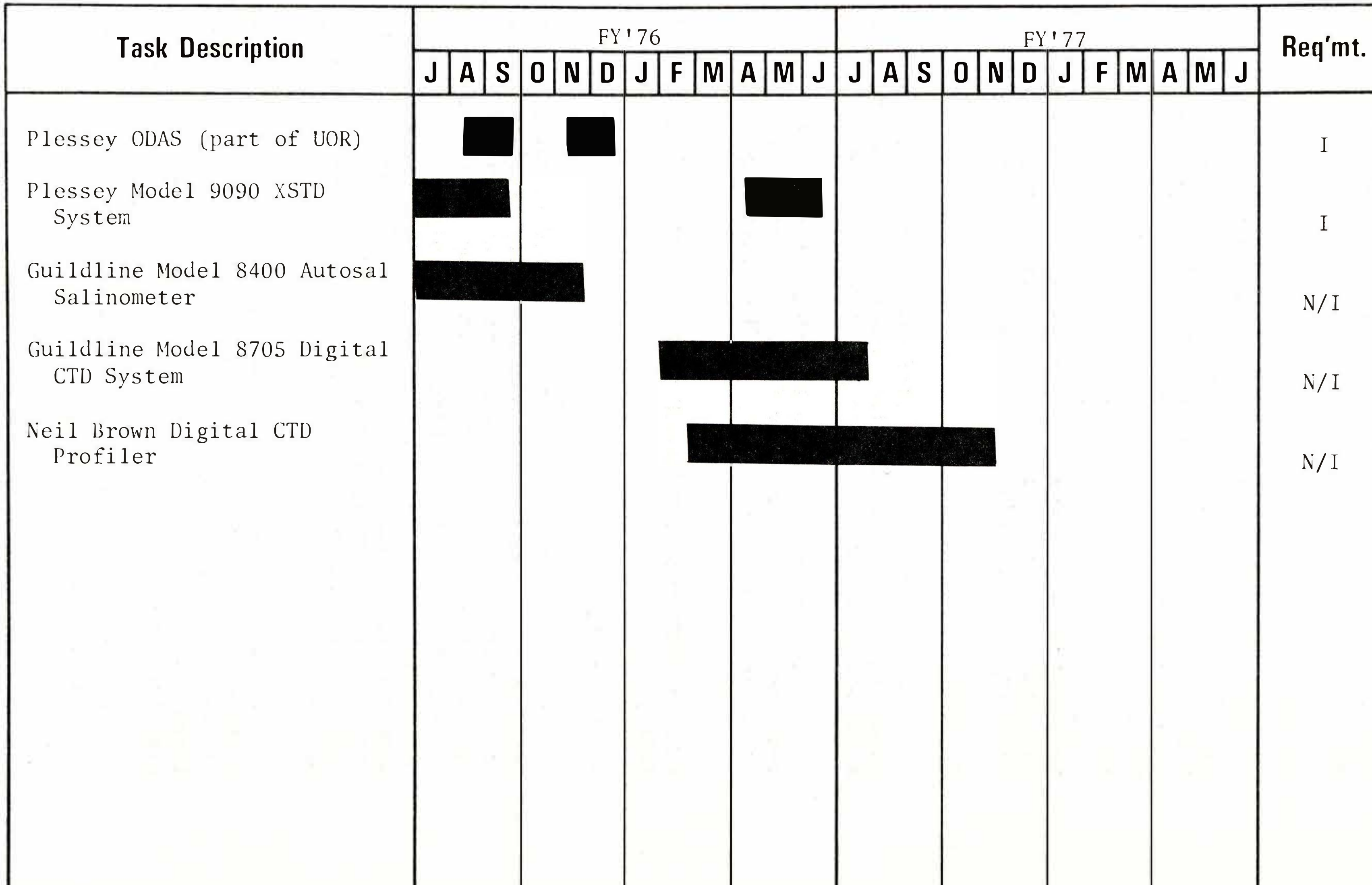
Date: January 1, 1976

Project: C/STD Instrumentation

Project Leader: J. Boyd

N — Navy R — Reimbursable

I — In-House O — Other



WESTINGHOUSE ELECTRIC CORPORATION/NOAA DATA BUOY OFFICE OCEAN SENSOR

A. Description

The Westinghouse Electric Corporation (WEC) Ocean Sensor (OS) was developed for the NOAA Data Buoy Office's Engineering Experimental Phase. The OS is mounted on a data buoy hull or to a mooring line at various depths. The OS consists of a pressure housing, electronics, and transducers. The sensor, after interrogation from a Sensor Deck Unit (SDU), converts oceanographic environmental measurements into telemetering signals that are transmitted through the SDU to an Ocean Platform System. The OS contains the electronics and transducers required to obtain measurements for conductivity, temperature, and pressure.

B. Progress

A NOIC Technical Report (Informal) was written covering in detail the test and evaluation findings on the Ocean Sensor. A summary of the test results are shown in Table 3.

Possible repeat tests on the conductivity sensor if refinements are made to improve performance accuracy; the disposition on the sensor will be made by the NOAA Data Buoy Office.

PLESSEY MODEL 9090 EXPENDABLE SALINITY-TEMPERATURE-DEPTH SYSTEM (XSTD)

A. Description

The Model 9090 XSTD System is designed to obtain economical Temperature and Salinity or Sound Velocity profiles from the ocean environment. The system consists of inexpensive expendable probes that measure conductivity and temperature and simultaneously transmit this data over a wire link to shipboard processing equipment that provides real time output functions of conductivity, temperature, and cast duration for digital binary magnetic recording. The processor also provides computed salinity or sound velocity and temperature as a function of depth for analog graphic recording.

The probe is designed for operation to depths of 750 meters over temperature and salinity range of -2 → 35°C and 30 → 40 ppt. It can be deployed from existing, hand-held, deck-mounted, or through-hull launchers, since it is mechanically interchangeable with the Expendable Bathythermograph (XBT).

In addition to the processor, the shipboard equipment also includes an analog multipen recorder and an optional incremental,

Table III

WEC Ocean Sensor
Test Results Summary
S/N 023

Performance Parameter \ OS Channel	Temperature (°C)	Conductivity (mho x 10^{-3}/cm)	Pressure (decibars)	Equivalent Error in Computed Salinity From T, C, & P (ppt)
Nonrepeatability	±0.010	±0.179	±1.43	±0.179
Nonlinearity	±0.005	±0.014	±0.02	±0.015
Temperature Effect (±20°C)	Combined with nonlinearity	≈0.009 mho x 10^{-3}/ C° (±0.184)	≈-0.191 decibars/°C (±3.8)	±0.184
Stability	±0.012 (8 months)	Not Tested	Not Tested	
Overange Effects	Within Nonrepeatability	±0.224	±1.26	
Slope — WEC	0.01°C/count	0.015 mmho/cm/ count	1.2258 decibars/ count	
Slope — NOIC (Error FR)	0.0099963°C/ count (±0.008)	0.014902 mmho/cm/ count (±0.201)	1.2253 decibars/ count (±0.13)	
Inaccuracy (RSS) (Design, Acceptable Goals)	±0.016 (±0.01, ±0.06)	±0.257 (±0.015, ?)	±4.06 (±2.4, ±4.9)	±0.258 (±0.01, ±0.03)
Inaccuracy (RSS) With Temperature Corrections Applied	±0.016	±0.180	±1.43	±0.181

$\frac{\partial S}{\partial T} = \frac{\partial S}{\partial G} = 1000 \frac{\partial S}{\partial P} = 1$ where S is salinity (ppt)
T is temperature (°C)
G is conductivity (mho x 10^{-3}/cm)
P is pressure (decibars)

digital magnetic tape cassette recorder. Information stored on tape is processed through a tape processor which can be purchased as peripheral equipment with the XSTD System. The company also offers a tape-processing service by mail.

B. Progress

Operational performance tests were completed as planned in the laboratory and in the field. A NOIC Technical Report (Informal) was written covering in detail the test and evaluation findings on the system. An abstract of the report is given below.

This report describes and presents data from operational laboratory and field tests on a Plessey Environmental Systems Model 9090 Expendable Salinity/Temperature/Depth (XSTD) System. The equipment consisted of one Model 9090 Deck Unit which was comprised of a signal processor and analog plotter and 28 XSTD probes. Laboratory tests on the Deck Unit consisted of checking the accuracy and stability of its various electrical operational functions using simulation techniques for electrical data signals; it was checked under both programmable conditions, i.e., analog computation for salinity and for sound velocity. Overall RSS errors for the processor's temperature, salinity, sound velocity, and depth signals were determined to be (in equivalent parameter units) ±0.33°C, ±0.29 ppt, ±2.0 m/S and ±5.6 m, respectively. Electrical measurements and temperature and conductivity calibration measurements were made on the XSTD probes by using a specially-designed probe tester; average probe operating conditions were 41.2 VDC at 4.2 mA; average temperature and conductivity calibration errors are also given. Field tests of the system consisted of 20 XSTD probe launchings at sea. Probe data collected on the system's plotter from 14 on station launches were compared at discrete points to Nansen bottle salinity and reversing thermometer data; 139 points were compared, 69 temperature and 70 salinity. Of these, 31 (51.4%) of the temperature comparisons were within ±0.2°C, and 31 (44.9%) of the salinity comparisons were within ±0.2 ppt.

C. Future Plans

Participate with Office of Fleet Operations, National Ocean Survey, NOAA, in field testing more XSTD probes to assess performance of latest production runs. Tests will probably be performed on the NOAA ship, MT. MITCHELL, in late winter or early spring, 1976.

GUILDLINE MODEL 8400 AUTOSAL LABORATORY SALINOMETER

A. Description

This instrument is designed for laboratory use which measures and displays the conductivity ratio of an unknown water sample with respect to standard Copenhagen water. A square-wave potential comparator technique is used to continuously compare the resistance of a cell filled with a sample salinity solution at constant known temperature with an integral reference resistor initially adjusted to the cell resistance when filled with standard water at the same temperature. A four-electrode conductivity cell is used to sense the conductance. Readout is both digital display and BCD output.

B. Progress

Completed the laboratory test and evaluation. A draft of a NOIC Technical Bulletin was written covering in detail the test and evaluation findings on the instrument. In summary, the instrument did meet the manufacturer's specified conductivity ratio measurement accuracy of ±3 ppm in equivalent salinity.

C. Future Plans

The instrument will be used as a NOIC laboratory working standard for conductivity ratio (salinity) measurements of saline solutions.

GUILDLINE MODEL 8705 (MARK IV) DIGITAL OCEANOGRAPHIC DATA COLLECTION SYSTEM

A. Description

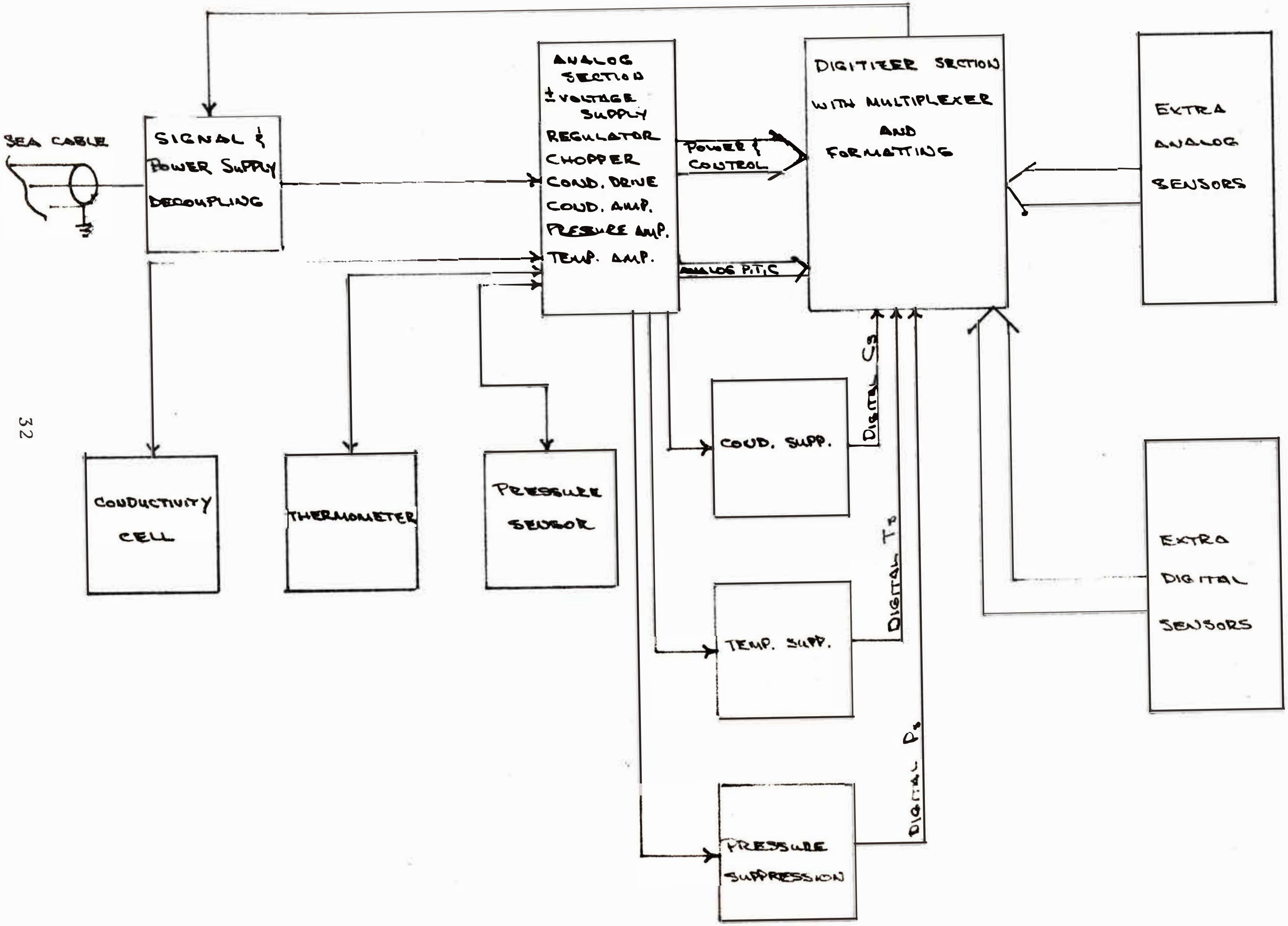
The system is designed to provide in-situ digital measurements of conductivity, temperature, and pressure (depth) utilizing pulse amplitude techniques of data transmission over a possible length of 6,000 meters of single-conductor cable.

The basic Mark IV System consists of an underwater probe and shipboard deck unit. The underwater unit consists of a lightweight aluminum pressure case which internally contains the associated electronics for the sensors, digitizer, multiplexer and data transmission circuits. A block diagram of tiis circuitry is shown in Figure 11.

The CTD sensors are located in a cage which is mounted on the pressure case.

Figure 11

DIGITAL CTD PROBE BLOCK DIAGRAM



Data obtained by the underwater unit is derived simultaneously for all three parameters which is then stored and transmitted sequentially to the surface by bi-polar pulses.

The associated shipboard unit circuits process the information to produce 16-bit binary readings and decodes these to decimal with illuminated displays for each parameter.

The underwater probe is designed for ease of field maintenance without disturbance of calibrated accuracy. Modular construction is used throughout each circuit function and is finished in the form of interchangeable plug-in circuit boards and sensors which can be independently calibrated. The conductivity cell is an electrode type which is known to have much reduced proximity or "area" effect associated with induction-type cells.

Response time of all sensors are specified by the manufacturer to be better than 50 millisecnnds at a drop rate of 1.5 meters per second. The manufacturer's specified parameter measurement ranges and accuracies for the unit to be tested at the Center are given below:

Measurement Ranges

Conductivity	28 to 40 ppt in equivalent salinity
Temperature	$-2° \rightarrow 40°C$
Pressure	5,000 meters

Accuracies

Conductivity	±0.01 ppt in equivalent salinity
Temperature	±0.01°C
Pressure	±0.15% FS

B. Progress

A special interface adaptor was designed and built which will enable data from the deck unit to be inputted and recorded on the NOIC Data Collection System. A Fortran computer subprogram was written that will recombine the sensor output data (12 bit bytes) and produce a sensor data file which adapts in format to the NOIC C/STD Software Package.

C. Future Plans

Perform six months of laboratory performance and environmental tests on the system beginning mid-January, 1976.

NEIL BROWN CTD SYSTEM (MK III)

A. Description

General

The system is designed to provide high resolution, high speed and high accuracy conductivity, temperature and pressure data suitable for classical deep ocean hydrographical observations as well as specialized microstructure studies.

The basic system consists of two components - the underwater unit and the shipboard unit. The underwater unit consists of three (3) sensors with their interface circuits, oscillator, digitizer, multiplexer, data formatter and data transmission circuits. C, T & P sensor outputs are digitized to 16 bit "words" 30 times per second and transmitted serially to the shipboard unit in Teletype format using frequency shift-keyed (FSK) modulation. The particular FSK modulation parameters used permits reliable recording of the signal from the underwater unit using an unmodified inexpensive audio tape recorder. Data subsequently replayed from the recorder is indistinguishable from the original as far as the shipboard unit is concerned. This feature provides very inexpensive and effective backup capability in the event that a shipboard computer is not available for any reason.

The shipboard unit consists of a demodulator, digital display and D to A converters. The signal from the underwater unit is demodulated and the resulting serial digital output can be inputted directly to a computer (e.g. Hewlett-Packard 2116 or 2100) via a standard Teletype I/O card. Additional decoding logic provides parallel outputs for computers requiring parallel inputs (e.g. IBM 1800). This logic also provides BCD outputs to the display modules and the D to A channels. The manufacturer's system specifications are as follows:

1. Ranges

Pressure	Full scale ranges of 650, 1600, 3200 and 6500 meters
Temperature	0 → ±32°C
Conductivity	20 → 65 mmhos

2. Accuracy

	Short term	3 months
Temperature	±0.003°C	±0.005°C

2. Accuracy (cont'd)

	Short term	3 months
Conductivity	±0.003 mmhos	±0.005 mmhos
Pressure	±0.075% of F.S.	±0.1% F.S.

Accuracy includes linearity, hysteresis, temperature effects in all cases.

3. Resolution

Temperature	±0.0005°C
Conductivity	±0.001 mmhos
Pressure	±0.0015% of F.S.

4. Sampling Rate

Each parameter is sampled 30 times per second. However, a special version of the instrument would be available at a later data which would sample at up to 100 times per second. The standard unit of course can be set for lower sampling rates if desired.

Sensors

Temperature - Temperature is measured using a precision platinum-resistance thermometer (response time 250 mS) and a miniature high speed thermistor probe (30 mS). The thermistor circuit output voltage is automatically and precisely nulled in an electronically-balanced bridge using an electronic servo having a response time equal to that of the platinum thermometer. Slowly changing thermistor resistance including those due to thermistor calibration drift results in zero output from the bridge. However, rapid changes in temperature result in a momentary unbalanced output from the thermistor bridge which is equal and opposite to the lag in the platinum thermometer. Hence, the sum of these sensor outputs is the same as would be expected if the platinum thermometer were operating alone and had a time constant of 30 mS instead of its 250 mS value. Thus temperature is sensed with the excellent stability and linearity of the platinum thermometer and speed of miniature thermistors without paying the penalty of thermistor calibration drift.

Since the thermistor and conductivity cell are within 5 mm of each other, the very high speed temperature sensing virtually eliminates the serious problem of "salinity spikes" that are typical of other systems.

Conductivity - Conductivity is measured using a 4-electrode (platinum) conductivity cell having a length of 8 mm and an inside diameter of 2 mm. The 4-electrode cell has excellent stability and is not sensitive to changes in electrode polarization impedance as is the case for the simple 2-electrode cell.

The 4-electrode cell is analogous to a 4-terminal resistor in that the cell resistance is defined by measuring the ratio of the open circuit coltage at the "voltage electrodes" to the current applied at the "current electrodes". The resistance defined in this way is completely independent of the polarization impedance which occurs at the electrode-electrolyte interface.

One of the important advantages of this cell is the fact that it can be drastically scaled down in size for microstructure measurements without significantly reducing its accuracy. The inductively-coupled conductivity sensor used very widely in the past cannot be scaled down without introducing unacceptable errors. Furthermore, the signal-to-noise ratio of the 4-electrode cell is several orders of magnitude better than the inductively-coupled sensor.

Pressure - Pressure is measured using a strain-gage pressure transducer. At the present time, the best accuracy available is ±0.05%. However, as better transducers are available, they will be incorporated into the system.

B. Progress

Develop specifications for interface adaptor to input and record sensor data on the NOIC Data Collection System and specifications for a Fortran computer subprogram that will recombine the sensor output data (16 bit bytes) and produce a sensor data file which adapts in format to the NOIC C/STD Software Package.

C. Future Plans

Perform six months of performance and environmental tests on the system beginning early March, 1976.

PLESSEY UNDULATING OCEANOGRAPHIC RECORDER'S OCEANOGRAPHIC DATA ACQUISITION SYSTEM

A. Description

The Oceanographic Data Acquisition System (ODAS) was designed specifically to measure and record environmental parameters while mounted in a vehicle being towed behind a ship at a fixed depth (8 → 100 meters) or undulating in a triangular pattern within the same depth interval. It is completely self-contained with sensors, measuring and control electronics, a reel-to-reel incremental digital tape record for data storage, and two (2) separate rechargeable NiCad battery pack assemblies for system power. Presently, it is equipped with three (3) sensors (capable of handling up to eight (8) sensors), a temperature, conductivity and pressure sensor. Temperature is sensed with a thermistor, conductivity with a five (5) electrode cell, and pressure with a strain-gauge bridge. System specifications are ±0.1°C, ±0.1°/₀₀, and ±5 meters for the temperature, salinity (conductivity), and depth (pressure) measurements, respectively. Each sensor measurand signal is converted to a 10-bit binary number and recorded on the digital tape recorder. Sampling is switch selectable from 2 per minute to 30 per hour with a recording duration capability of 6 to 24 hours, respectively.

B. Progress

Calibration tests were performed on the ODAS sensors during the period September 2-25, 1975. Successful calibrations were obtained on the temperature and pressure sensors. However, problems were encountered with the conductivity sensor. These are elaborated below.

1. After an initial conductivity calibration cycle (varying temperatures in 5°C intervals from 35°C → 0°C → 35°C in a 35 ppt salinity bath) was performed, the sensor data exhibited nonreproducible measurements. Electrical tests on the sensor revealed leakage resistances existed between the cell's electrodes due to water penetrating the inside of the sensor assembly.

2. When a second conductivity calibration was attempted, a ground loop was determined to be established between the ODAS and ODAS Tape Translator Unit which caused unstable conductivity sensor readings. The second calibration was performed with the ODAS operating independently in the self-recording mode. However, the ODAS data recorded on tape could not be translated because of a malfunction in the ODAS's tape recorder.

The ODAS was returned November 19, 1975, for conductivity sensor recalibration (third attempt). A full calibration cycle (as described) was performed (November 19-20) with the ODAS package not submerged. A half calibration cycle (35°C → 0°C) was performed on November 24 and on December 1, 1975 with the package submerged. The November 24th test data was erratic because a dummy plug was mistakenly not installed on the ODAS. This caused exposure of electrical connections to the bath salt water, thus interfering with the operation of the conductivity sensor. However, the full and half cycle calibration data still indicated that the measurement performance of the conductivity sensor was nonreproducible and unstable.

C. Future Plans

The above was a reimbursable project with the Engineering Development Laboratory (EDL), NOS, NOAA. Future tests, if any, on this system will be undertaken as requested by EDL.

OCEAN FLUID DYNAMICS INSTRUMENTATION

TESTING PROGRAM

Date: January 1, 1976

Project: Ocean Fluid Dynamics

Project Leader: G. Appell

N — Navy
I — In-House
R — Reimbursable
O — Other

Task Description	FY'76: J	A	S	O	N	D	J	F	M	A	M	J	FY'77: J	A	S	O	N	D	J	F	M	A	M	J	Req'mt.
Current Meters																									
Naval Underseas Center (NUC) "Open" Electromagnetic																									N
ENDECO Type 105 Tethered (impellor)																									N
General Oceanics Model 6011 Inclinometer																									N
CERC-Ducted Meters																									R
NDBO Support																									I
Turbulence Study																									O/I
Dynamic Test Techniques																									I/N
Wave Instruments																									
Western Marine Electronics Model SLM 15W																									I/N
Kelk Model P116 Wave Gauge																									I
Tide Instruments																									
National Ocean Survey (NOS) Tide Instrument Studies																									I

NAVAL UNDERSEAS CENTER (NUC)"OPEN" ELECTROMAGNETIC CURRENT METER

A. Description

The "open" electromagnetic current meter (EMCM) was developed by Jack Olson of NUC for measurements of currents in a near shore, dynamic environment. The current meter is a solid state, no moving part instrument designed to measure simultaneously two orthogonal components of water current velocity utilizing Faraday's principle of electromagnetic induction. It differs from the design of other EMCM transducers by the "open" configuration. This refers to the usage of two Helmholtz coils to generate the magnetic field with the placement of the measuring electrodes within the two parallel coils allowing the water to flow through the transducer, hence the "open" terminology. This type of transducer design is not subject to boundary layer changes as are the solid transducers.

B. Progress

Tests have been completed and an NOIC Technical Bulletin is in preparation.

C. Future Plans

Tests are planned in the spring of 1976 on an improved instrument that Jack Olson is developing.

ENDECO TYPE 105 SELF-CONTAINED TETHERED CURRENT METER (TCM)

A. Description

The Endeco Type 105 Tethered Current Meter attaches to a mooring line by a five-foot long tether line. The resilient tether and the neutral buoyancy of the instrument is designed to allow mooring cable motions to occur without their effects to be transmitted to the instrument.

The instrument senses current speed with an impellor and direction with a magnetic compass and alignment of the sensor into the flow. Data is recorded on 16 mm tri-x film magazine.

B. Progress

An instrument has been received from the Naval Underwater Systems Center (NUSC) and preparations are being made for testing.

C. Future Plans

Tests are scheduled to begin in January, 1976.

GENERAL OCEANICS MODEL 6011 INCLINOMETER CURRENT METER

A. Description

This type of current meter has no moving parts and measures current by sensing the magnitude and direction of tilt of its own housing. The instrument mounts to a special tether and swivel attached to the mooring that allows the housing to lean with the current that is to be measured. Internal tape recording (replaced film recording of model 2010) of an accelerometer output yield the angle of inclination and two Hall-effect sensors yield magnetic north orientation.

B. Progress

None.

C. Future Plans

Tests are planned to begin in March of 1976.

TURBULENCE STUDY

A. Description

A study of the effect of flow stream turbulence on the output of various water speed measuring transducers was initiated by NOIC. The program developed as a result of calibration differences on various transducers obtained between turbulent and nonturbulent facilities and vibration effects discovered on EMCM transducers. The study consists of: (1) determining turbulent scales in the environment, (2) generating grid turbulence and mechanical simulated turbulence and determining course and effect relationships on various transducer outputs and, (3) determine natural facility turbulence levels.

B. Progress

Initial investigations have been completed on a variety of electromagnetic transducers with grid-induced turbulence in the NOIC Submerged Jet Facility. Indications are that transducer output gain can increase by as much as 30% depending on the scale and intensity of turbulence levels.

C. Future Plans

Tests will continue with different scales and intensities of turbulence. Mechanical tests are being devised to determine scale and frequency dependencies. Investigations of facilities and insitu turbulence levels will also be performed.

CURRENT METER DYNAMIC RESPONSE STUDY

A. Description

The dynamic response characteristics of a current speed and direction sensor may severely limit its in-situ measurement capabilities. For example, it has been found that platform/ mooring motions introduce significant errors in the average current vector measured by current meters supported by moorings. Also, the imperfect dynamic response characteristics inherent in current meters present additional measurement deficiencies for near surface current determinations (wave-water particle region).

Historically, almost all current meter performance evaluations conducted in the laboratory have been under steady flow conditions. Unfortunately, these conditions are not very representative of the typical in-situ environment. Therefore, in July 1972, NOIC initiated a program to develop realistics dynamic test standards for current meters.

B. Progress

A dynamic test fixture capable of simultaneously imparting two degrees of freedom (simulating longitudinal, lateral, vertical/horizontal elliptical, vertical orbital motion) is being fabricated under contract to the Naval Ship Research and Development Center (NSRDC). This fixture, to be used on the NSRDC tow carriage, will be capable of testing full size current meters at up to 4 foot peak-to-peak amplitudes (adjustable) and from 12 to 3 second periods. It is envisioned that once this fixture has been completed and validated it will be utilized for current meter dynamic investigations.

C. Future Plans

Completion of fabrication of the dynamic test fixture is scheduled for mid-January, 1976. Validation of the fixture will commence when the fabrication is completed.

WESTERN MARINE ELECTRONICS MODEL SLM15W WAVE HEIGHT LEVEL MONITOR

A. Description

The Western Marine Electronics Model SLM15W is a variation of a device used to measure level of stored liquids. It has all solid state electronics and contains circuits for measurement of the transit time interval of sound from the transducer down to the ocean surface.

The electronics sends a series of pulses to the ceramic piezoelectric transducer, which are transformed into acoustical pulses. The echoes received from the ocean surface by the same transducer are detected and amplified. The electronics then produce a DC voltage and current output proportional to wave height. The modified unit being tested is a prototype. Transmitted pulses are specified as modulation of 12 kHz carrier with 12 degree beam width. Range of measurement is from 3 feet to 23 feet from the transducer.

B. Progress

Tests have been completed, and an Instrument Fact Sheet is in preparation. Based upon the similarity of the Western Marine Electronics Model SLM-9 to the Model SLM-15W evaluated, no testing will be performed on the SLM-9.

C. Future Plans

None.

NATIONAL OCEAN SURVEY (NOS) TIDE INSTRUMENT STUDIES

A. Description

The Fischer and Porter Company, Model 1550, Level Recorder, is in extensive use by NOS. This tide gauge uses a stilling well with a float mechanically linked to coded disks. The disk code is punched into paper tape at preselected time intervals obtained from a timer in the instrument. Resolution is 0.01 foot for a rated range of 50 feet.

B. Progress

None.

C. Future Plans

NOS Oceanographic Division is studying state of the art in tide instruments to determine if an off-the-shelf instrument or special design might be incorporated into their survey systems. NOIC is planning to do appropriate tests for NOS when requirements arise.

KELK MODEL P121 GAGE WAVE HEIGHT SENSOR (also called the ZWARTZ Gage)

A. Description

The wave staff consists of concentric pipes serving as a coaxial transmission line for electromagnetic square waves created by a tunnel-diode oscillator. Frequency of oscillation is dependent on amount of exposed wave staff, since the staff is part of the oscillator circuitry. The frequency is converted to an analog voltage as a measure of wave height by electronics, Part No. 11690, provided. The wave height sensor comes in both an aluminum housing (for fresh water) and a copper housing (for salt water).

B. Progress

The manufacturer has offered NOIC a gage with a copper housing for testing purposes. Preliminary planning is being conducted.

C. Future Plans

Start evaluation in the summer of 1976.

ACOUSTIC INSTRUMENTATION

TESTING PROGRAM

Date: January 1, 1976

Project: Acoustic Instrumentation

Project Leader: K. Berstis

N — Navy **R** — Reimbursable
I — In-House **O** — Other

Task Description	FY'76												FY'77												Req'mt.
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
Digital Depth Trackers																									
Edo Western Model 261C																									N
Raytheon Model PDD-200C																									N
Innerspace Technology																									
Model 410																									N
Model 408																									N
Marine Resources Model 096R Acoustic Release/Transponder																									N
Klein Associates Model 400 Side Scan Sonar																									N
Raytheon Model DSF-600 Fathometer																									I

DEEP WATER DIGITAL DEPTH TRACKERS (EDO MODEL 261C DIGITRAK, RAYTHEON MODEL PDD-200C, AND INNERSPACE TECHNOLOGY MODEL 408)

A. Description

A description of each tracker will be given in the next six-month update.

B. Progress

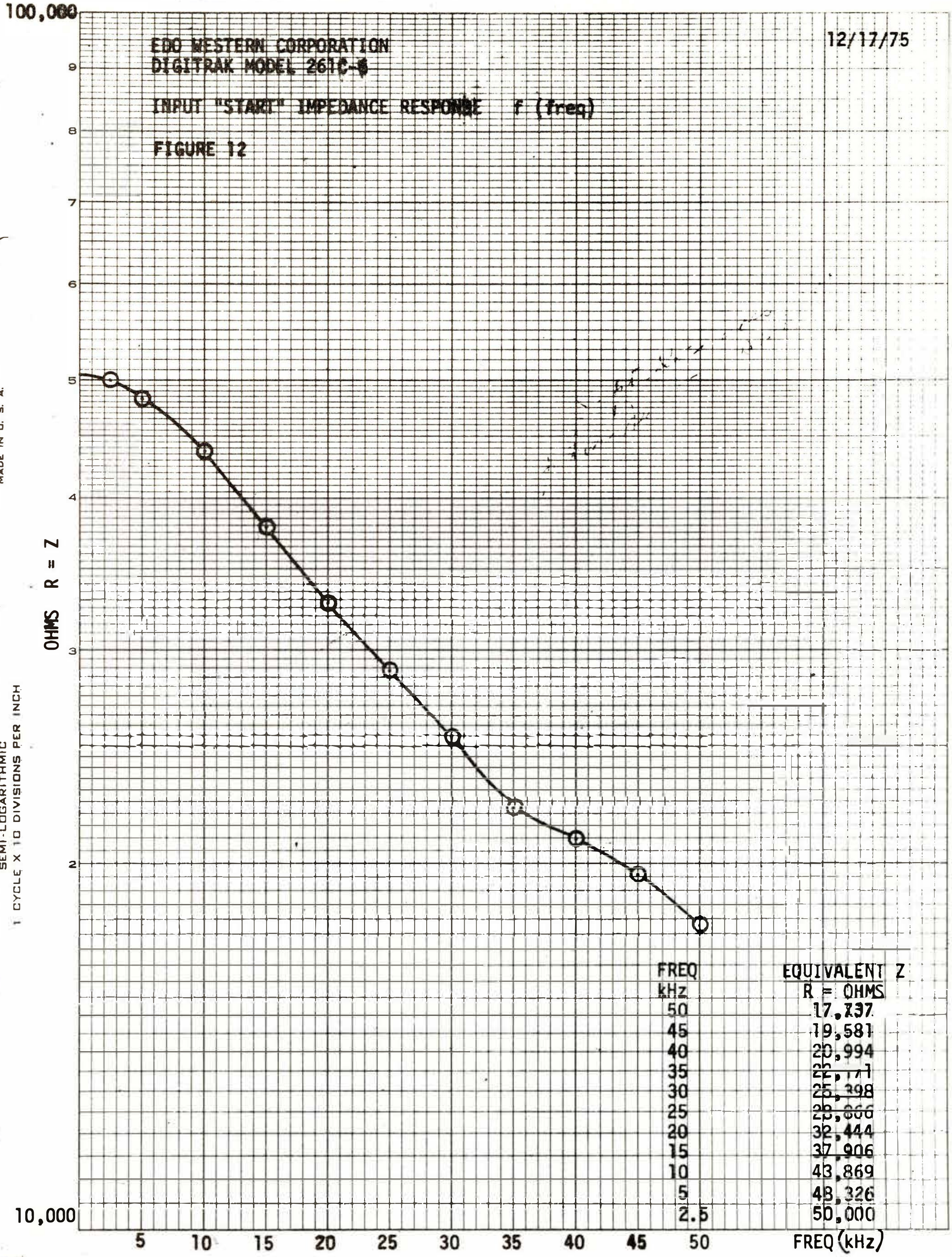
To speed the evaluation of the three deep water digital depth trackers, an interface will be designed so that most of the laboratory evaluation tests can be conducted simultaneously on all three trackers. To determine what type of analog interfacing is required, several evaluation tests will be completed sequentially on each tracker. These tests are noted on the task completion table shown below. The digital interface will consist of a microprocessor-controlled parallel to serial converter and a Digi-Data seven track incremental tape recorder. The IBM compatible output data recorded will be processed either in a MIDAS system or be reformatted by the microprocessor controller to be processed on a H-P computing counter. This interface will also be used as the primary data acquisition system during the field test evaluation of the three trackers.

Task Completion Table

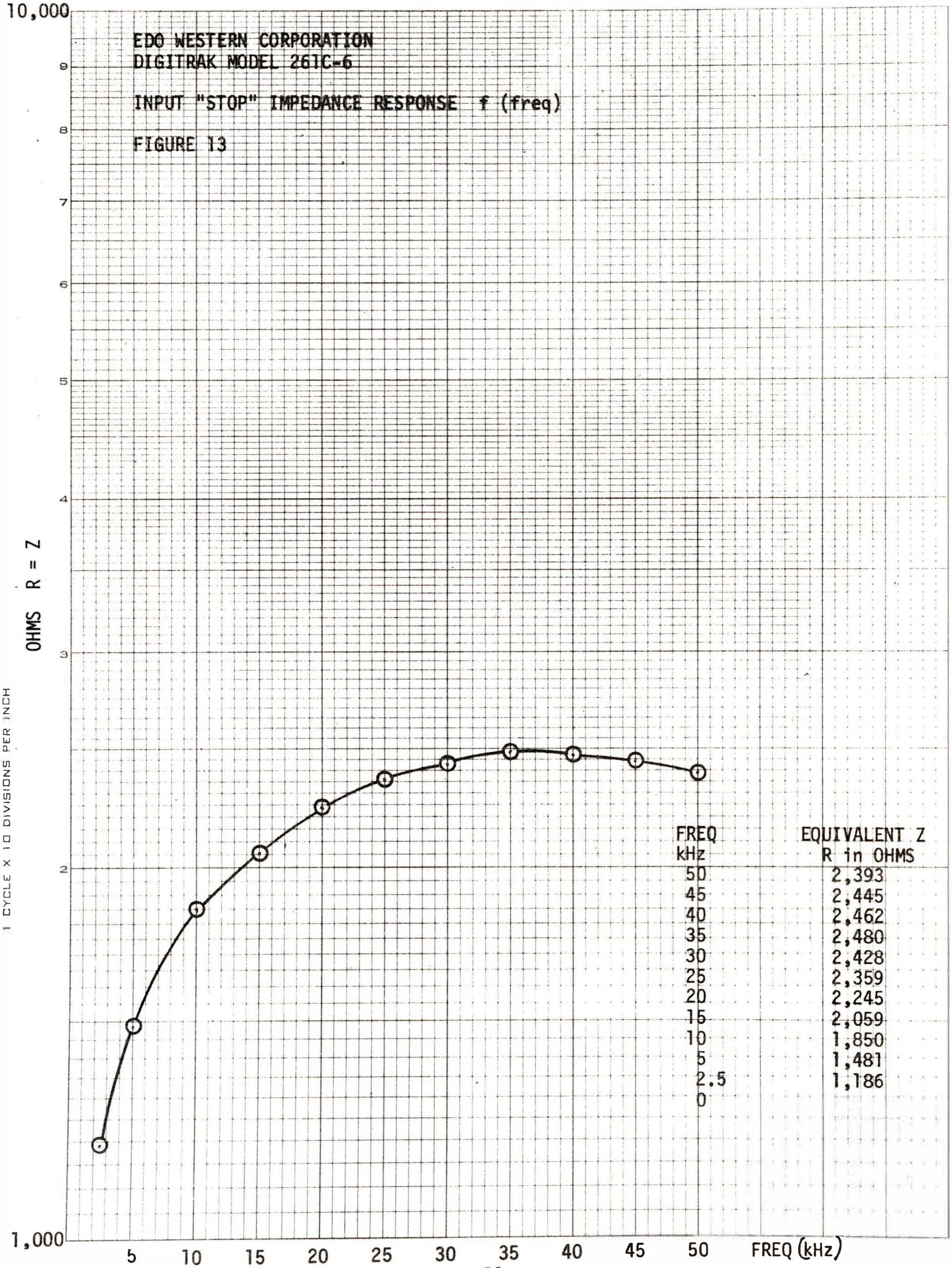
	11/15/75	12/15/75	1/15/76	2/15/76
1. Pre-Interface Evaluation Tests[1]				
Edo Western 261C	*			
Raytheon PDD-200C		Δ		
Innerspace 408				
2. Analog Interface Designed				
3. Digital Interface Designed				

[1]manufacturer's checkout procedure
receiver input impedance
receiver frequency response
nominal threshold
*task complete
Δ evaluation tests in progress

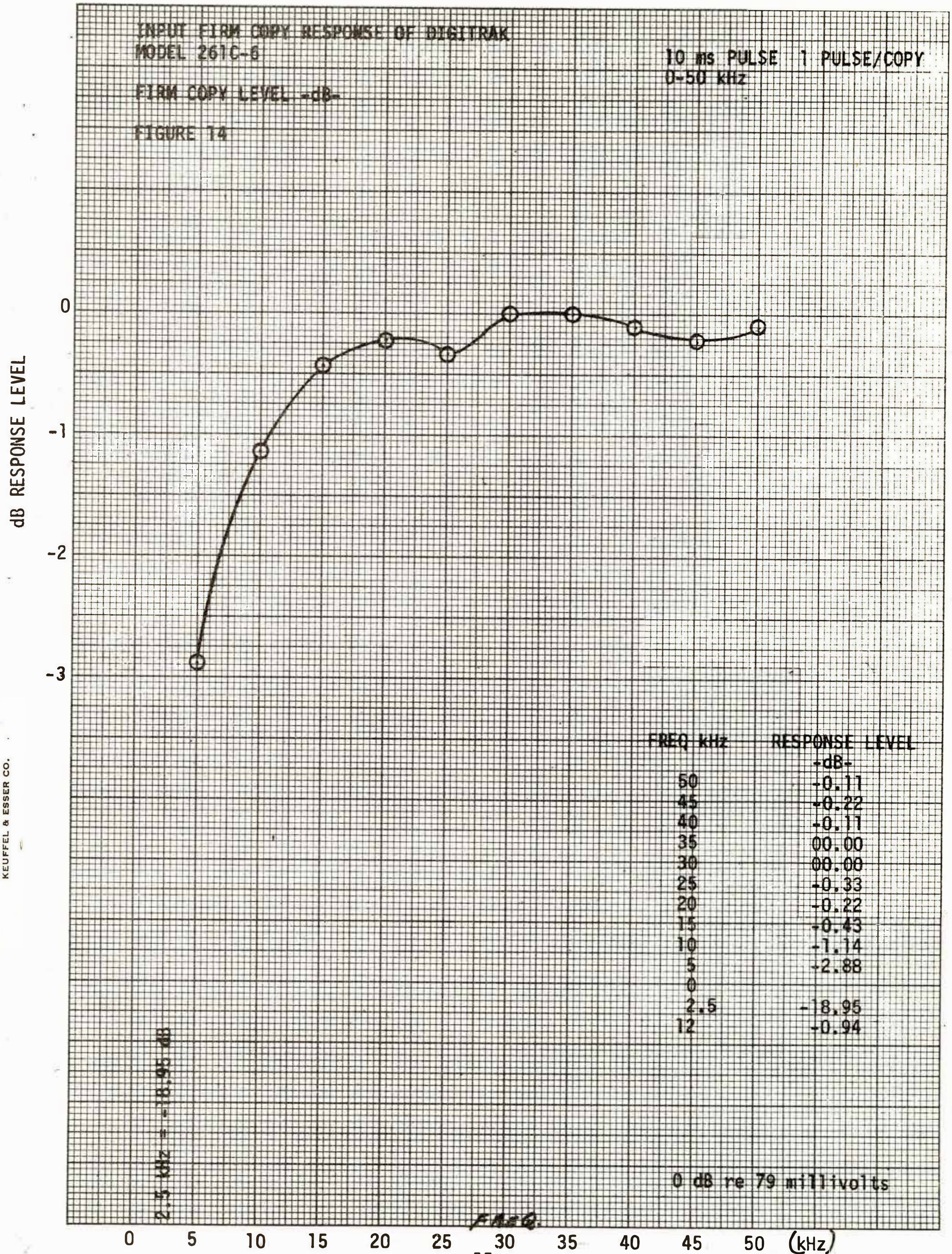
The test data available to date for these trackers is shown in Figures 12 thru 21.



FREQ kHz	EQUIVALENT Z R = OHMS
50	17,737
45	19,581
40	20,994
35	22,171
30	25,398
25	28,866
20	32,444
15	37,906
10	43,869
5	48,326
2.5	50,000



FREQ kHz	EQUIVALENT Z R in OHMS
50	2,393
45	2,445
40	2,462
35	2,480
30	2,428
25	2,359
20	2,245
15	2,059
10	1,850
5	1,481
2.5	1,186
0	

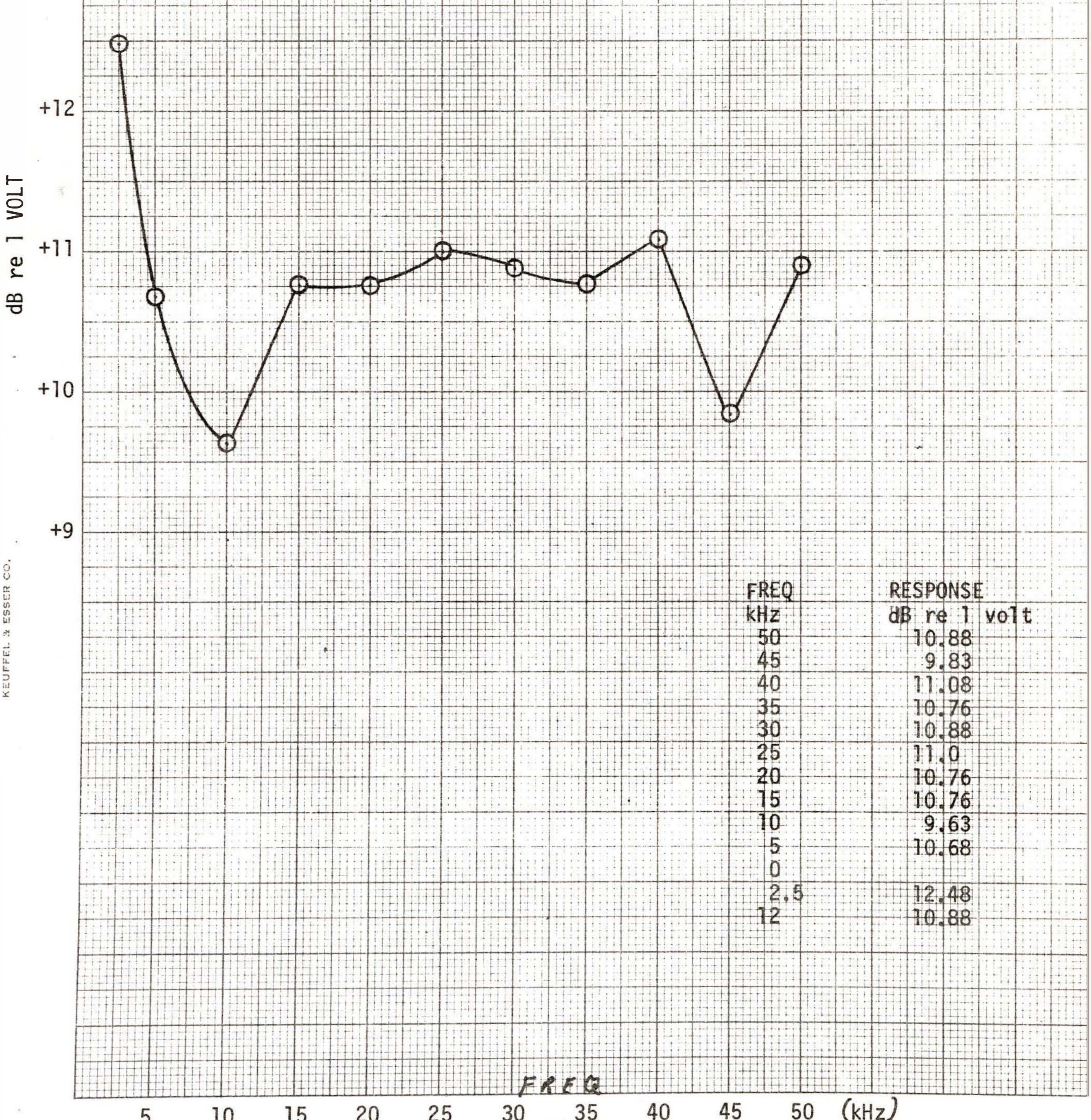


INPUT FIRM COPY RESPONSE OF DIGITRAK
MODEL 261C-6
FIRM COPY LEVEL -dB-
FIGURE 14
10 ms PULSE 1 PULSE/COPY
0-50 kHz
dB RESPONSE LEVEL
0
-1
-2
-3
FREQ kHz
RESPONSE LEVEL -dB-
50 -0.11
45 -0.22
40 -0.11
35 00.00
30 00.00
25 -0.33
20 -0.22
15 -0.43
10 -1.14
5 -2.88
0
2.5 -18.95
12 -0.94
2.5 kHz = -18.95 dB
0 dB re 79 millivolts
FREQ.
0 5 10 15 20 25 30 35 40 45 50 (kHz)

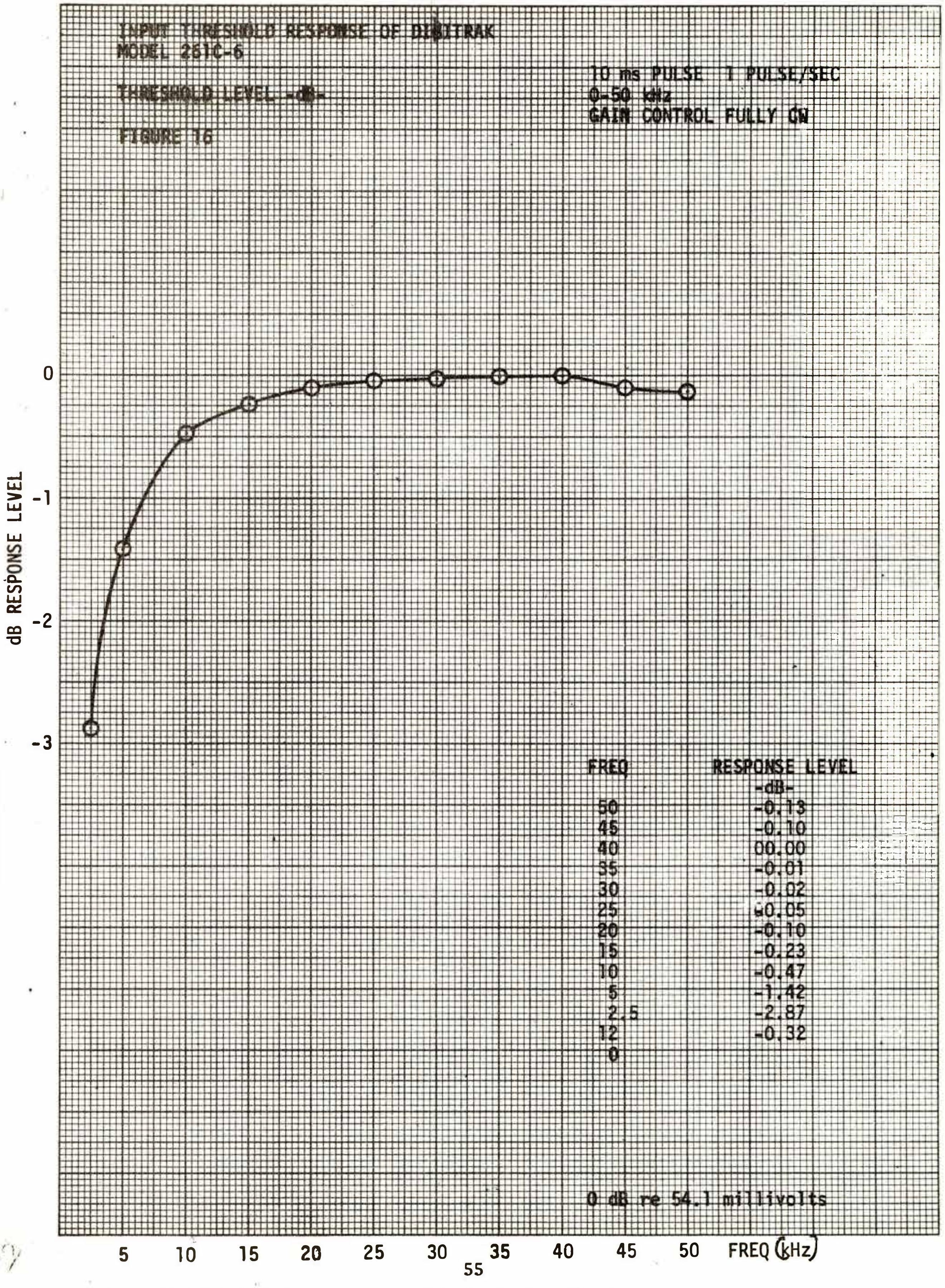
INPUT THRESHOLD RESPONSE OF DIGITRAK MODEL 261C-6

GAIN CONTROL FULLY CCW

FIGURE 15



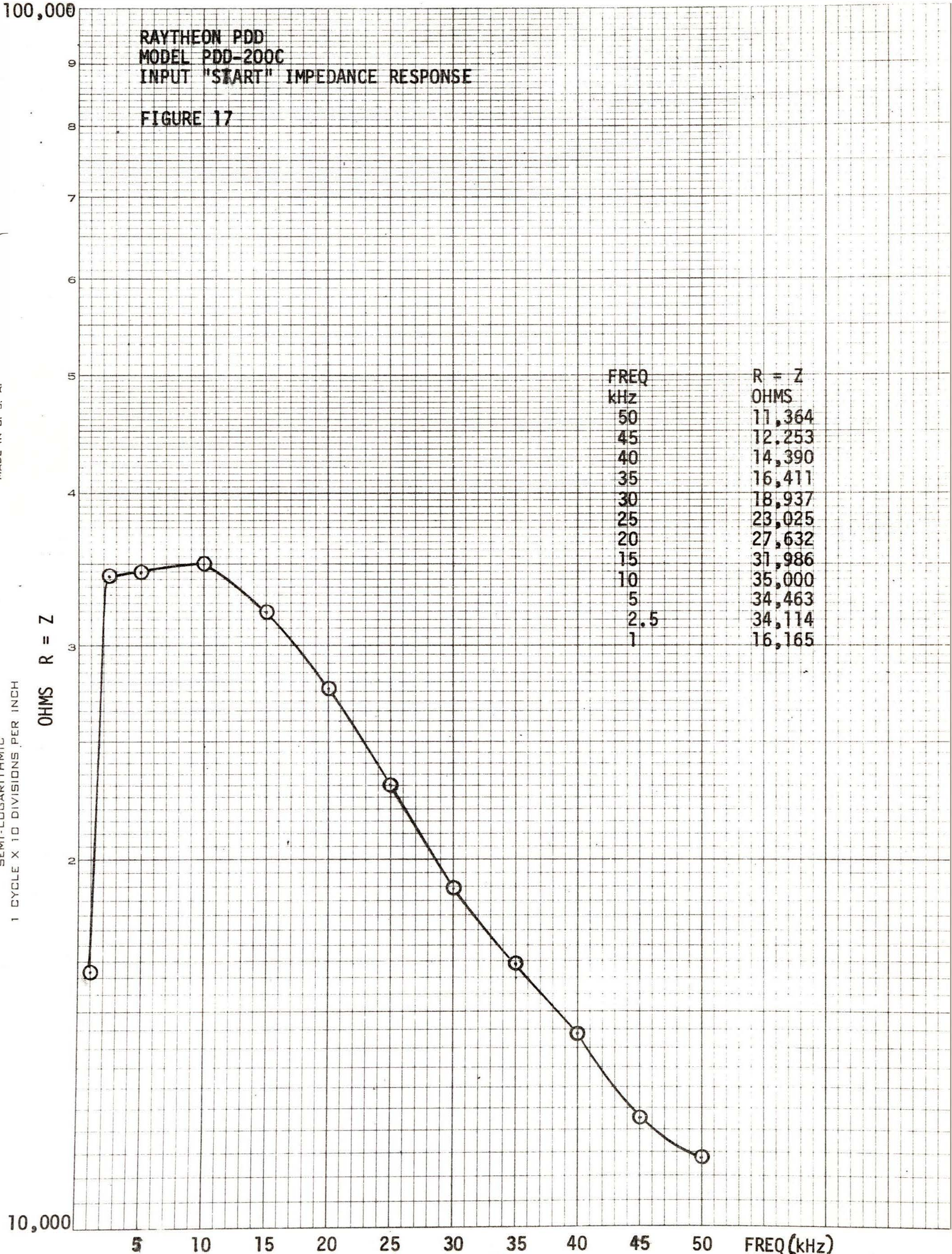
FREQ kHz	RESPONSE dB re 1 volt
50	10.88
45	9.83
40	11.08
35	10.76
30	10.88
25	11.0
20	10.76
15	10.76
10	9.63
5	10.68
0	
2.5	12.48
12	10.88



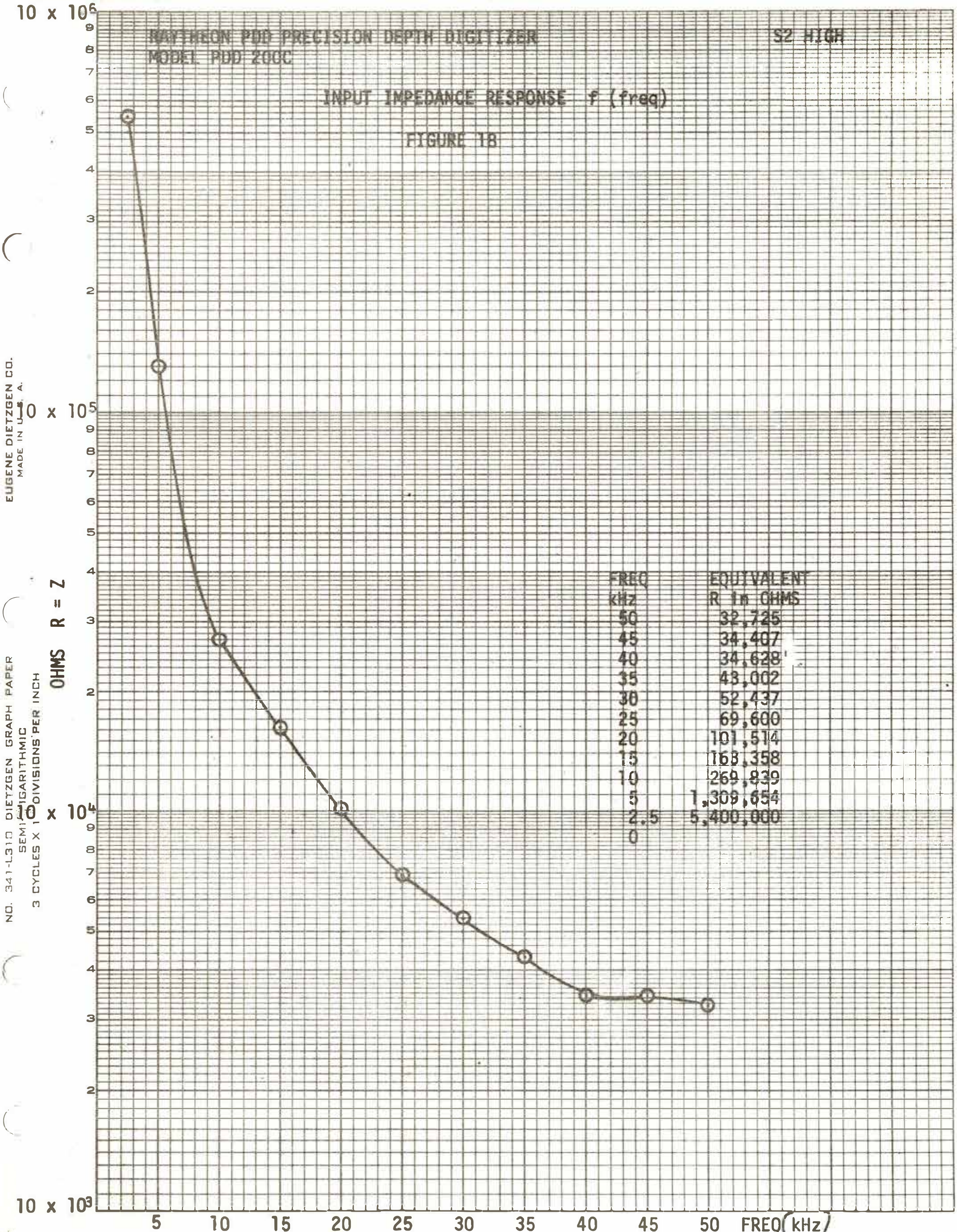
FREQ	RESPONSE LEVEL -dB-
50	-0.13
45	-0.10
40	00.00
35	-0.01
30	-0.02
25	-0.05
20	-0.10
15	-0.23
10	-0.47
5	-1.42
2.5	-2.87
12	-0.32
0	

RAYTHEON PDD
MODEL PDD-200C
INPUT "START" IMPEDANCE RESPONSE

FIGURE 17



FREQ kHz	R = Z OHMS
50	11,364
45	12,253
40	14,390
35	16,411
30	18,937
25	23,025
20	27,632
15	31,986
10	35,000
5	34,463
2.5	34,114
1	16,165

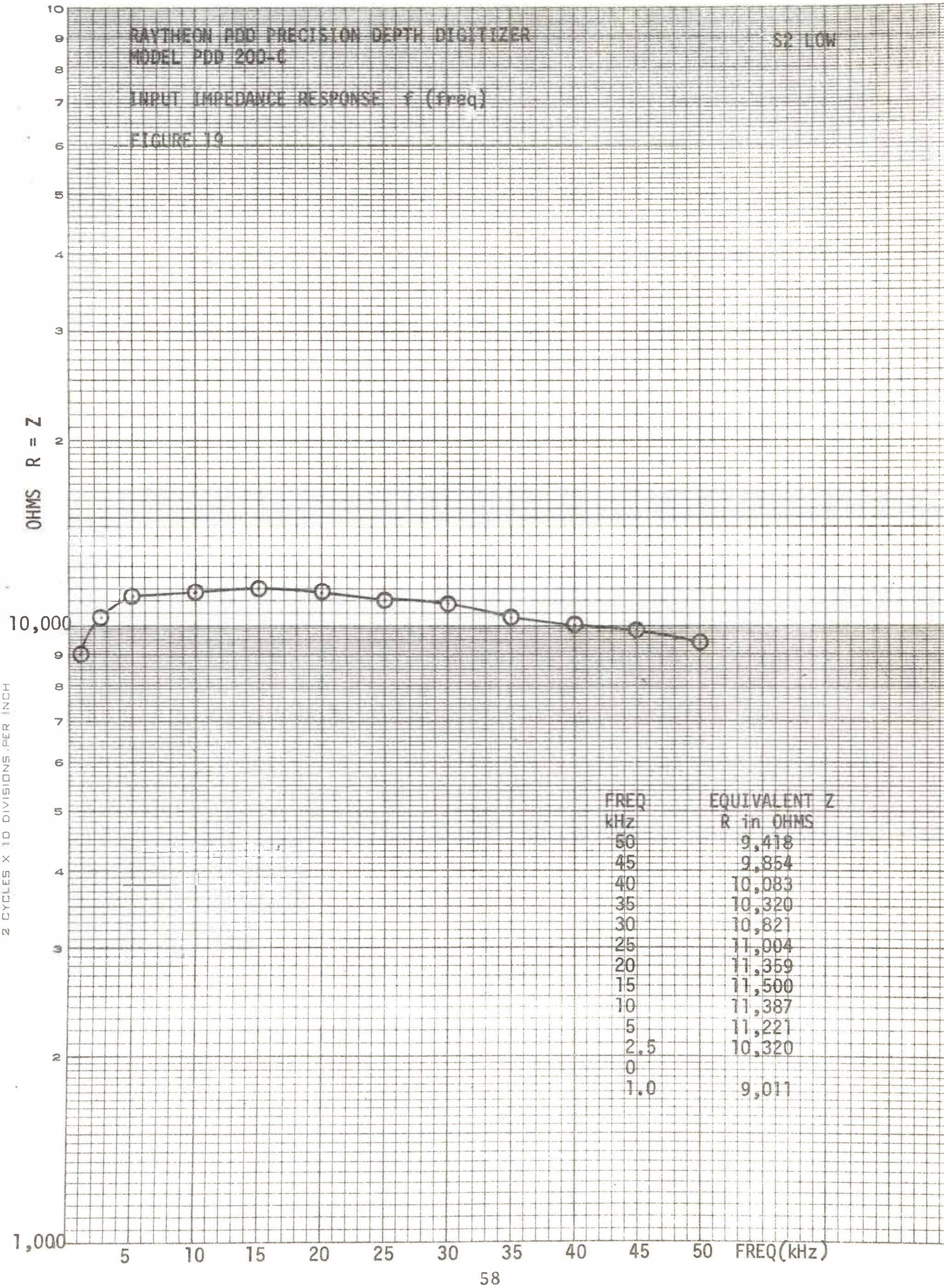


FREQ kHz	EQUIVALENT R in OHMS
50	32,725
45	34,407
40	34,628
35	43,002
30	52,437
25	69,600
20	101,514
15	163,358
10	269,839
5	1,309,654
2.5	5,400,000
0	

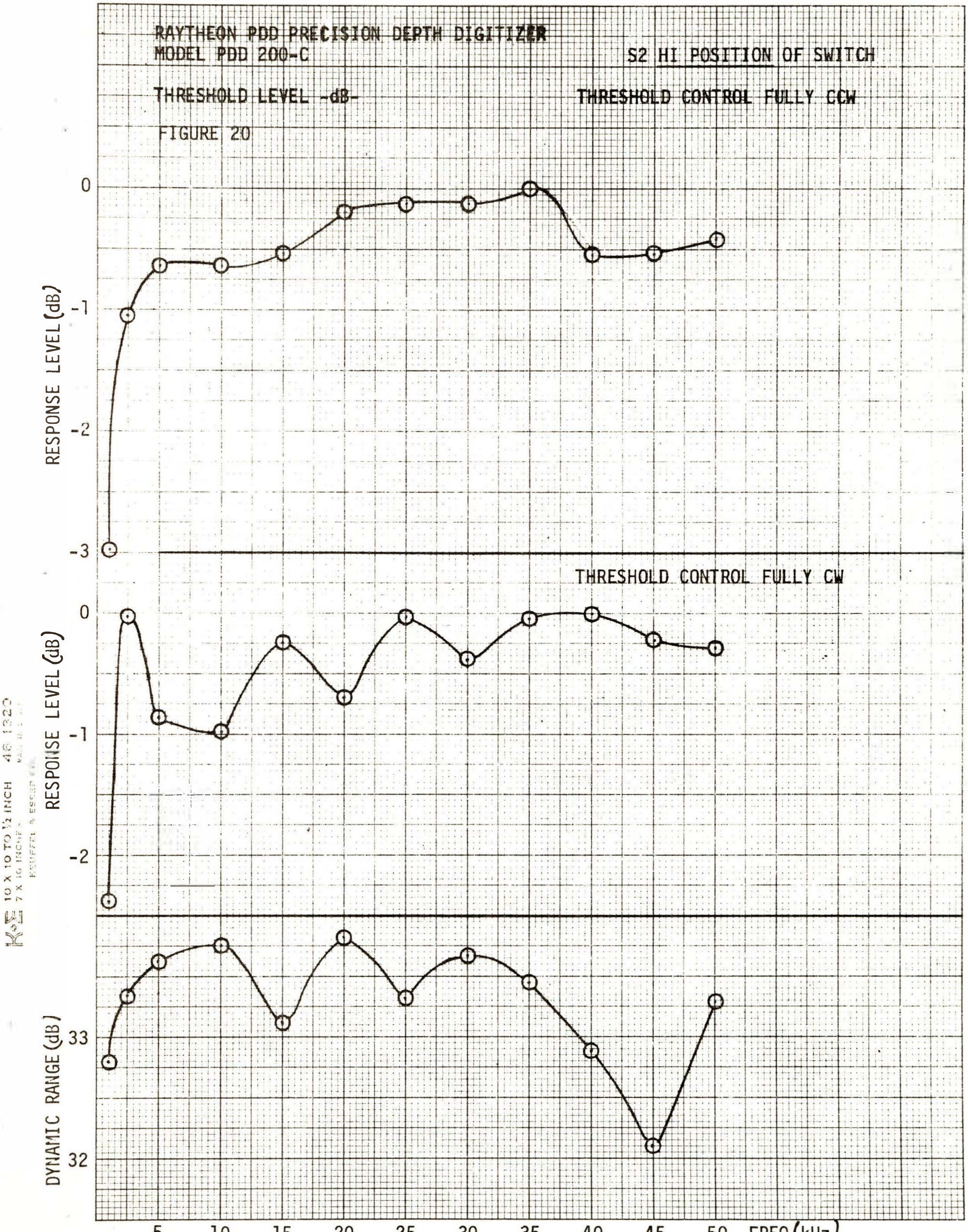
RAYTHEON PDD PRECISION DEPTH DIGITIZER
MODEL PDD 200-C

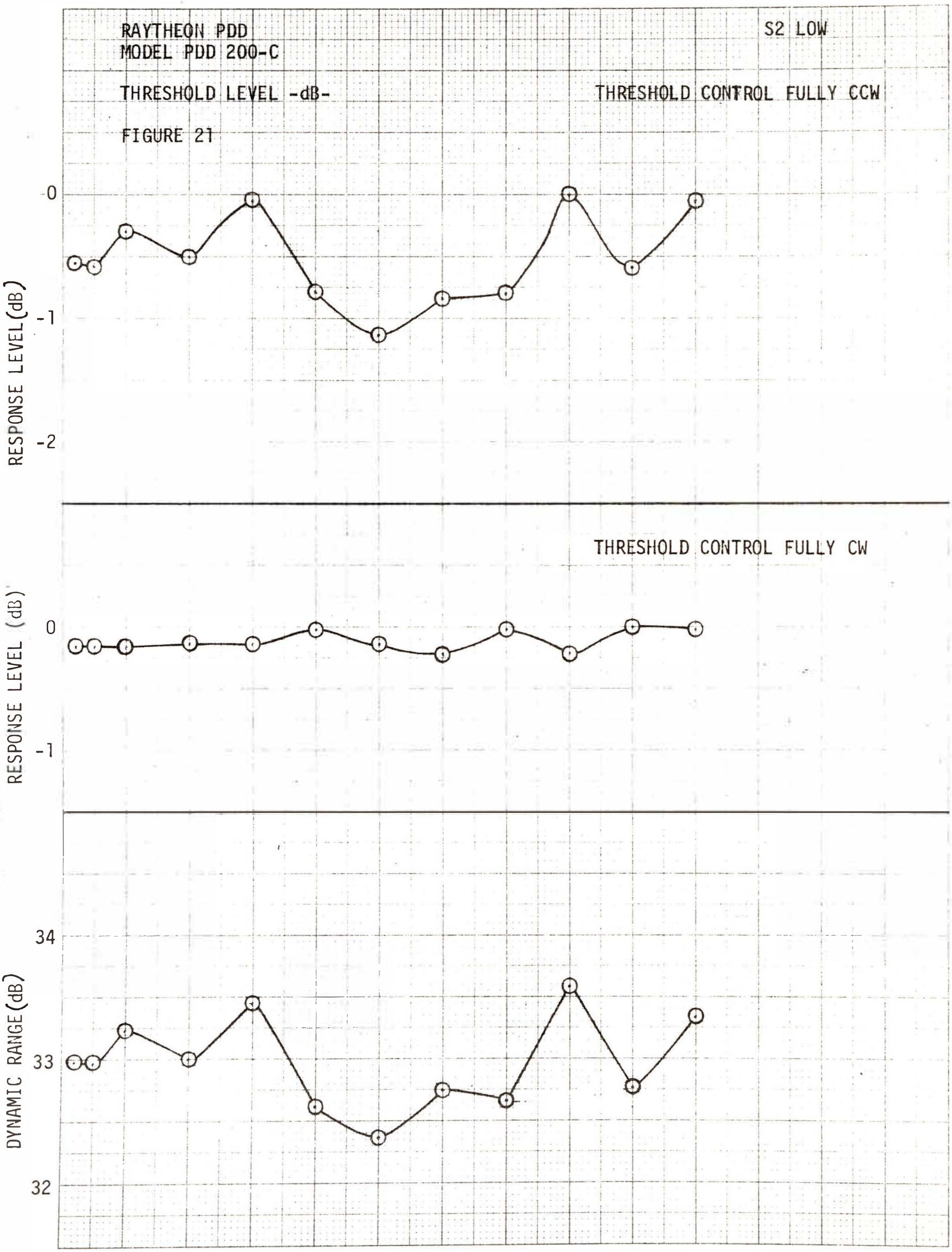
INPUT IMPEDANCE RESPONSE f (freq)

FIGURE 19



FREQ kHz	EQUIVALENT Z R in OHMS
50	9,418
45	9,854
40	10,083
35	10,320
30	10,821
25	11,004
20	11,359
15	11,500
10	11,387
5	11,221
2.5	10,320
0	
1.0	9,011


RAYTHEON PDD PRECISION DEPTH DIGITIZER
MODEL PDD 200-C
S2 HI POSITION OF SWITCH
THRESHOLD LEVEL -dB-
THRESHOLD CONTROL FULLY CCW
FIGURE 20
RESPONSE LEVEL (dB)
0
-1
-2
-3
THRESHOLD CONTROL FULLY CW
RESPONSE LEVEL (dB)
0
-1
-2
DYNAMIC RANGE (dB)
33
32
5
10
15
20
25
30
35
40
45
50
FREQ (kHz)
10 X 10 TO ½ INCH 46 1320
7 X 10 INCHES
KEUFFEL & ESSER CO.


RAYTHEON PDD
MODEL PDD 200-C
S2 LOW
THRESHOLD LEVEL -dB-
THRESHOLD CONTROL FULLY CCW
FIGURE 21
RESPONSE LEVEL (dB)
0
-1
-2
THRESHOLD CONTROL FULLY CW
RESPONSE LEVEL (dB)
0
-1
DYNAMIC RANGE (dB)
34
33
32
5
10
15
20
25
30
35
40
45
50
FREQ (kHz)

C. Future Plans

The laboratory evaluation of the three trackers is scheduled to be completed in June 1976. An Instrument Fact Sheet will be written for each tracker summarizing the laboratory tests. A joint NOIC/NAVOCEANO field test is tentatively planned for all trackers after the laboratory evaluation. A report will be written summarizing the field test results.

INNERSPACE TECHNOLOGY MODEL 410 DIGITAL DEPTH TRACKER

A. Description

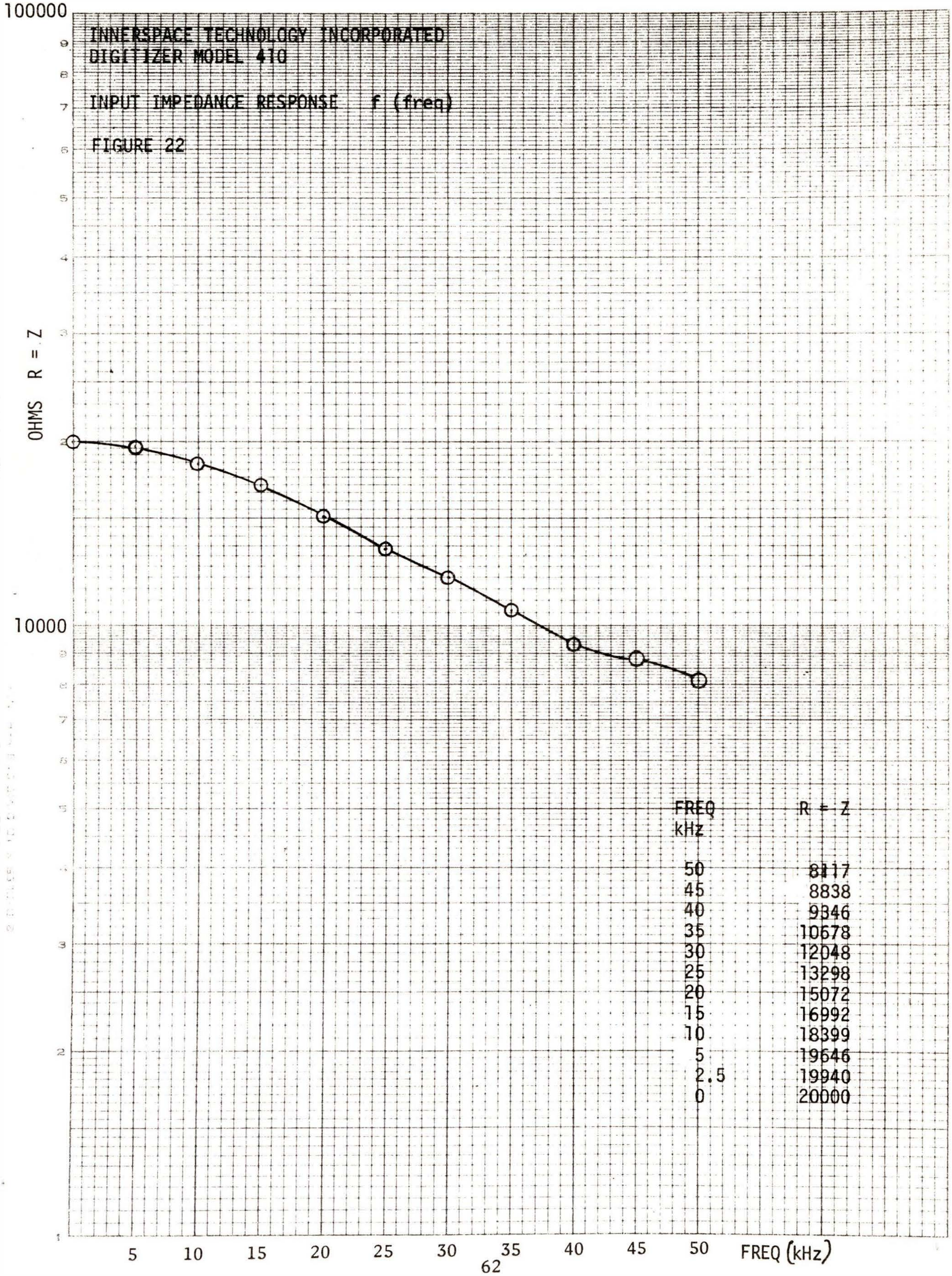
The Model 410 Digitizer provides a four-digit visual display on water depth in feet or fathoms (meters optional) when interfaced with survey-type echo sounders. A binary-coded decimal (BCD) output of depth information is provided for recording on magnetic tape, paper tape or digital printer. The unit displays a depth range from 2.0 - 999.9 with a timing accuracy of ±0.1 which is maintained by a precision crystal oscillator and is independent of the echo sounder's mechanical timing. The digitizer may be operated in a direct mode in which the first return after the outgoing transmission is digitized. In the range-gated mode, a gate is digitally positioned symmetrically about the bottom and tracks the bottom automatically. The gate width can be manually selected from six different widths and eliminates the possibility of tracking mid-water false replies. In the auto mode, the digitizer will track a reply within the range gate; however, if the bottom should change faster than the width of the range gate, the digitizer will automatically switch to the direct mode and reacquire the bottom after a selected number of missed replies.

B. Progress

The evaluation of the Model 410 is approximately 35% complete as of December 31, 1975. The bandwidth and input impedance tests have been completed for the receiver channel in the digitizer. In addition, the dynamic range for the start and stop channel has also been determined. The threshold data has been reduced indicating that the sensitivity control has an effective range of only 4 dB (0.355 volts rms control at maximum clockwise - 0.565 volts rms control at maximum counterclockwise) in reducing the threshold sensitivity of the input signal. Also as the input sensitivity is decreased, the average range error at threshold per 100 samples increased approximately linearly from +0.05 meters to +0.46 meters. The test data are shown in Figures 22 thru 25.

C. Future Plans

The laboratory evaluation of the Model 410 tracker is scheduled



FREQ kHz	R = Z
50	8117
45	8838
40	9346
35	10678
30	12048
25	13298
20	15072
15	16992
10	18399
5	19646
2.5	19940
0	20000

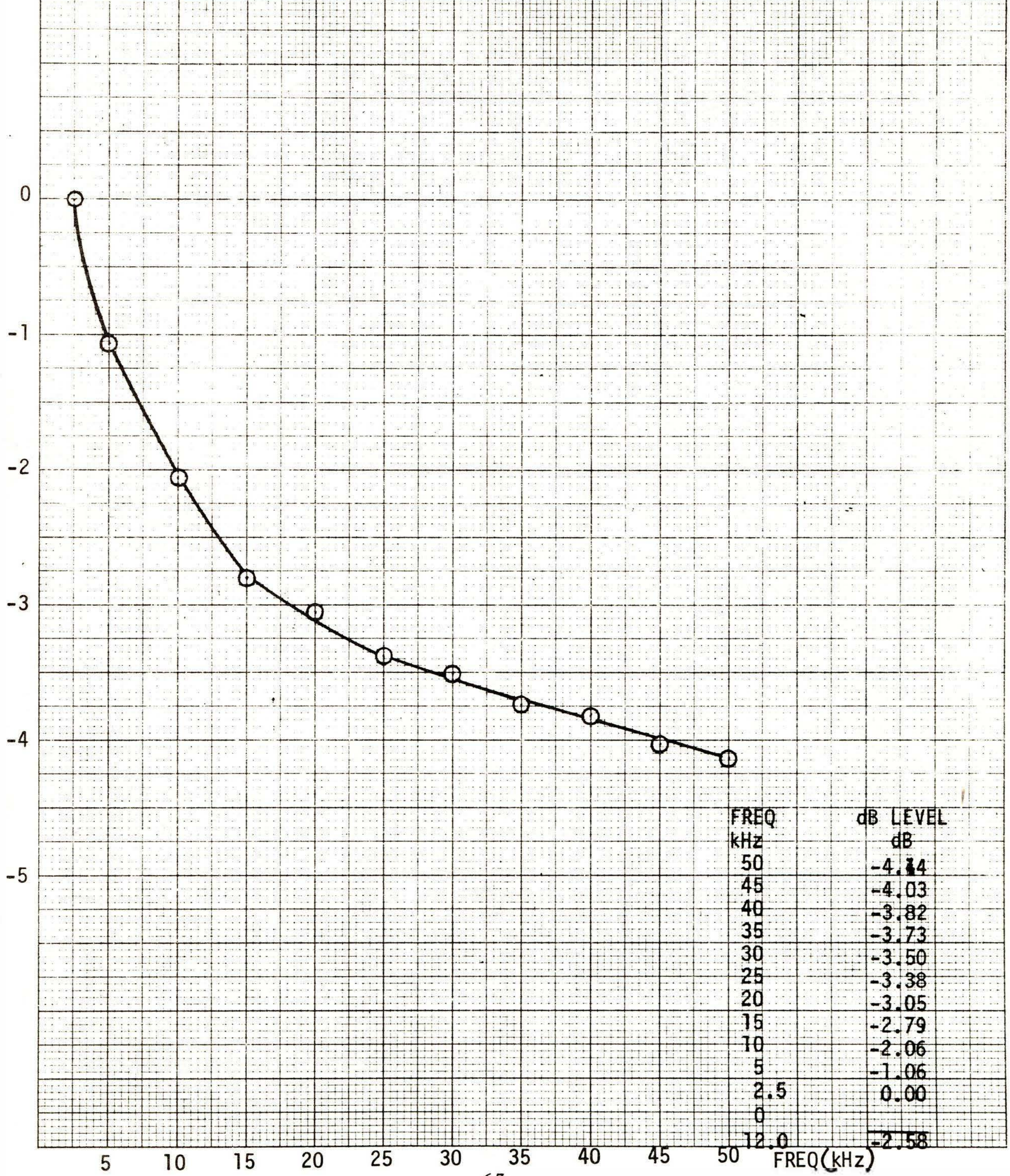
INNERSPACE TECHNOLOGY
DIGITIZER MODEL 410

GAIN CONTROL FULLY CCW
0.5 ms PULSE (START & STOP)
1 PULSE 1 SEC

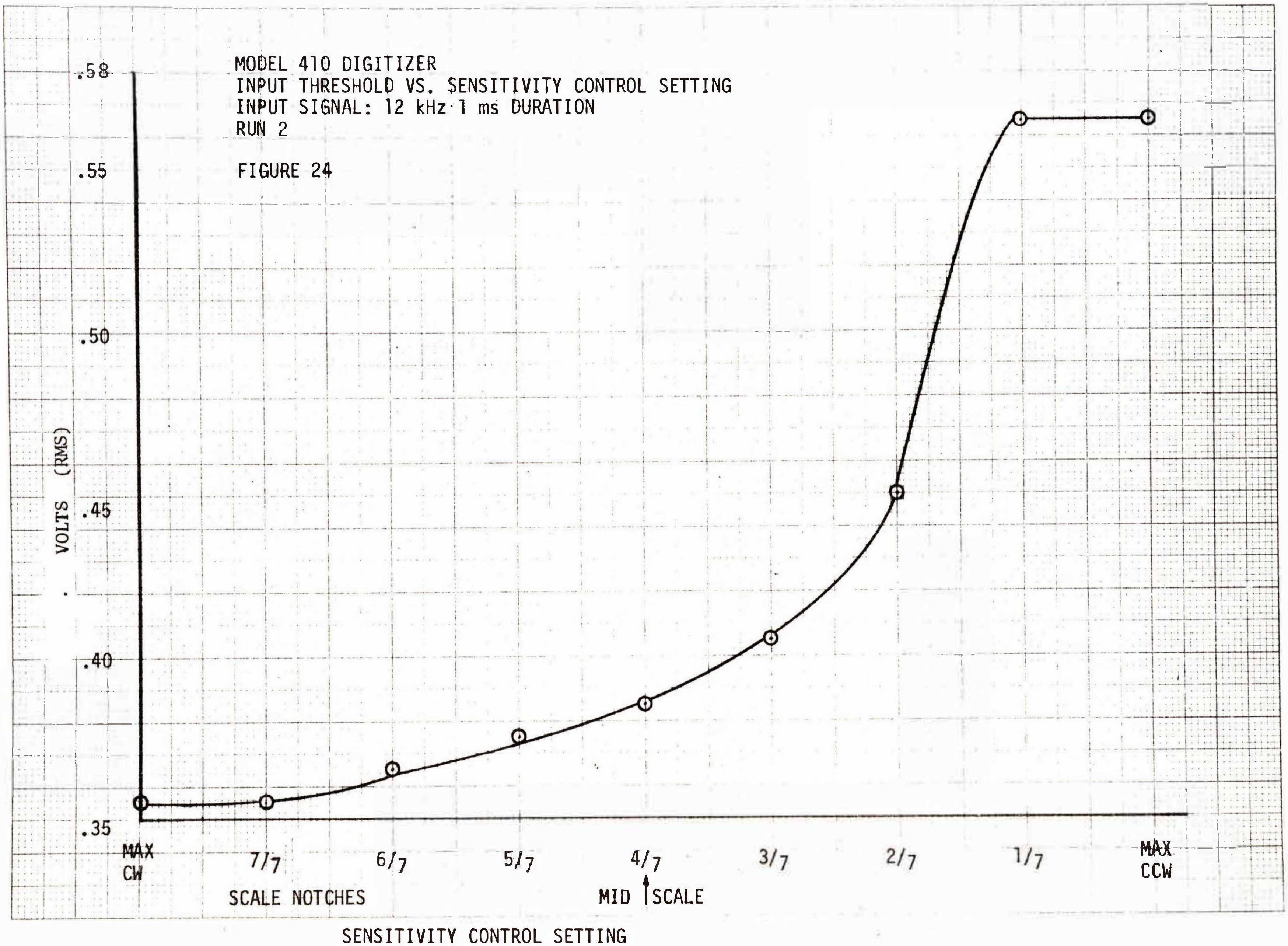
INPUT THRESHOLD RESPONSE

DATA LAMP OBSERVATION (FOR THRESHOLD RESPONSE)

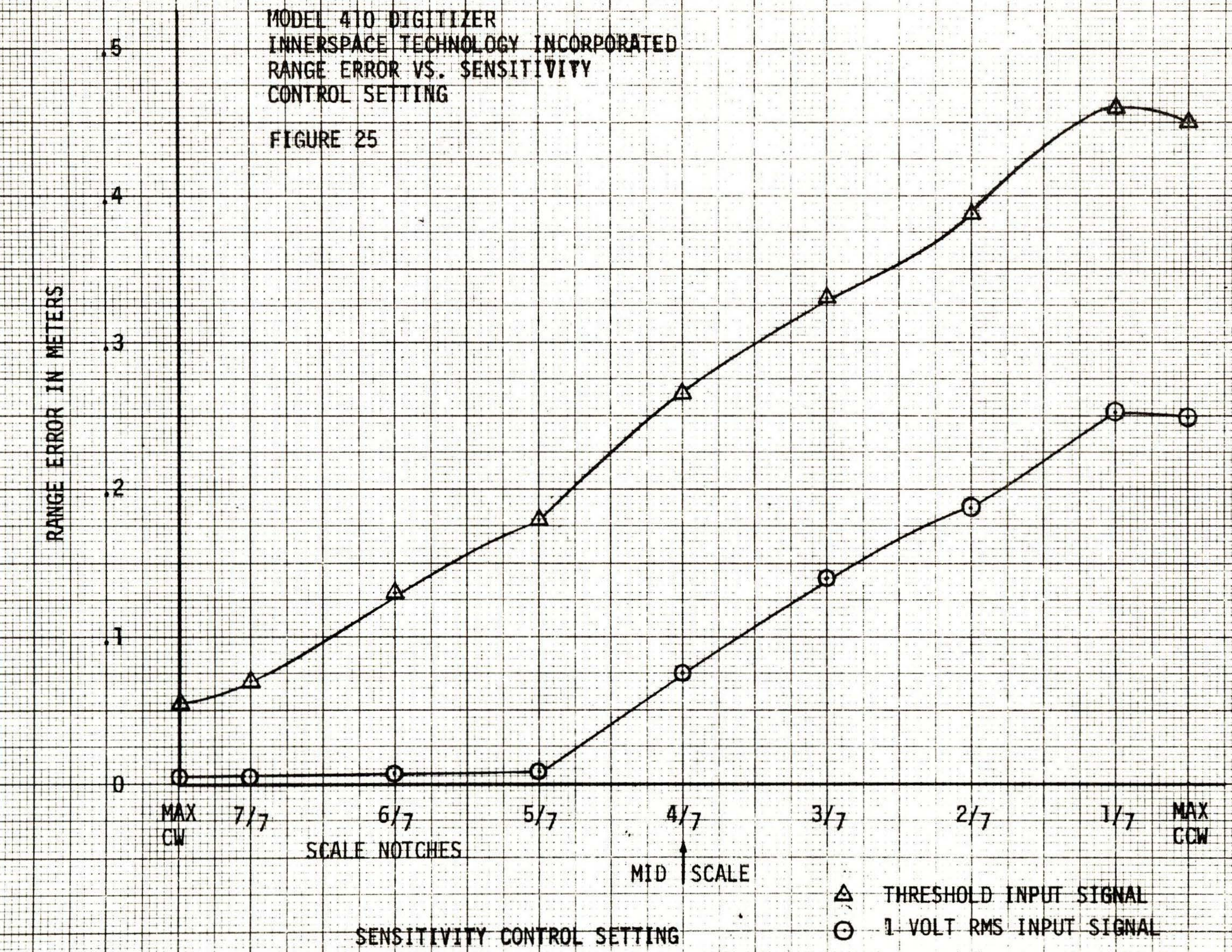
FIGURE 23



FREQ kHz	dB LEVEL dB
50	-4.14
45	-4.03
40	-3.82
35	-3.73
30	-3.50
25	-3.38
20	-3.05
15	-2.79
10	-2.06
5	-1.06
2.5	0.00
0	
12.0	-2.58



MODEL 410 DIGITIZER
INPUT THRESHOLD VS. SENSITIVITY CONTROL SETTING
INPUT SIGNAL: 12 kHz 1 ms DURATION
RUN 2
FIGURE 24
.58
.55
.50
.45
.40
.35
VOLTS (RMS)
MAX CW
7/7
6/7
5/7
4/7
3/7
2/7
1/7
MAX CCW
SCALE NOTCHES
MID SCALE
SENSITIVITY CONTROL SETTING


MODEL 410 DIGITIZER
INNERSPACE TECHNOLOGY INCORPORATED
RANGE ERROR VS. SENSITIVITY
CONTROL SETTING
FIGURE 25
RANGE ERROR IN METERS
.5
.4
.3
.2
.1
0
MAX CW
7/7
6/7
5/7
4/7
3/7
2/7
1/7
MAX CCW
SCALE NOTCHES
MID SCALE
SENSITIVITY CONTROL SETTING
THRESHOLD INPUT SIGNAL
1 VOLT RMS INPUT SIGNAL

to be completed in February, 1975. An Instrument Fact Sheet will be written summarizing the laboratory tests. A field test will then be planned to evaluate the tracker to its specified depth capability with varying bottom conditions.

MARINE RESOURCES MODEL 096R DEEP SEA ACOUSTIC RELEASE TRANSPONDER

A. Description

The transponder consists of a pressure housing with outboard transducer and activation magnet and in-board electronics and battery pack. In the Interrogation Mode, the unit responds to a 13 kHz-10 msec pulse and replies with a 13 kHz-15 msec pulse. Instead of 13 kHz, the receiver frequency can be specified as 11, 11.5 or 12.5 kHz. The release mode is activated by modulating the interrogation frequency with a square wave (100% modulation) and 50% duty cycle. The square wave modulation rate is 136.5 Hz but can also be specified as 123.0 Hz or 151.4 Hz. When the release command is received, an electrical potential is applied to the trip-wire holding a double arm, captive-link release mechanism. The potential produces electrolytic deposition of the trip wire onto a return cathode and after approximately 3.5 minutes, the wire is etched away, freeing the arms and link to which the anchor line is attached. During the period while the trip-wire is under electrolytic decomposition, the unit will reply to interrogation with a double pulse (0.5 sec spacing).

B. Progress

The evaluation of this release was completed in September. The IFS has been written and is in the process of being published and distributed.

C. Future Plans

A Technical Bulletin will be written summarizing the field test intercomparison results of the Marine Resources and the AMF acoustic release systems.

KLEIN ASSOCIATES SIDE SCAN SONAR (MODEL 400)

A. Description

The Model 400 Side Scan Sonar System consists of a dual channel recorded subsystem that displays both channels of bottom data and a towing subsystem comprising a towfish containing the transducers and electronics, a recovery device, and a depressor. The towed underwater unit sends out pulsed, high frequency signals that are beamed to either side of the fish perpendicular to the direction of travel.

The transducer beam patterns are narrow in the horizontal and wide in the vertical plane to optimize insonification of the ocean bottom. On either side of the towfish, the key pulses from the recorder control the transmission of acoustic signals in the towfish, and the return signals are processed in the recorder resulting in a permanent strip-chart recording of both channels. The recovery device prevents the towfish from hitting the bottom when the survey vessel is stopped and raises the towfish and depressor to the surface if the towline is severed. The depressor compensates for the increased cable drag as the survey vessel speed is increased by maintaining the depth of the towfish constant. Applications for the side scan sonar include geologic and sand ripple study, bathymetry and hydrography, mineral search, cable and pipeline location, engineering surveys, and underwater archeology.

B. Progress

One of four Naval Oceanographic Office's (NAVOCEANO) Model 400 systems has been sent to the manufacturer for updating and repairs. The repairs are estimated to be completed on February 15, 1976.

C. Future Plans

The evaluation of this system has been rescheduled to start after completion and updating of the system by the manufacturer.