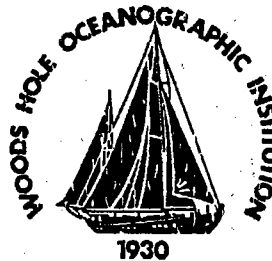


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Institution**



**W.H.O.I. CTD MicroVAX II Data Acquisition System Part II
Operator's Guide**

by

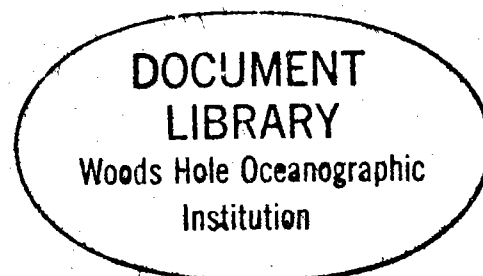
J.M. Allen

January 1992

Technical Report

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Grant Nos. OCE87-12087 and OCE90-05218.

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Woods Hole, Massachusetts 02543

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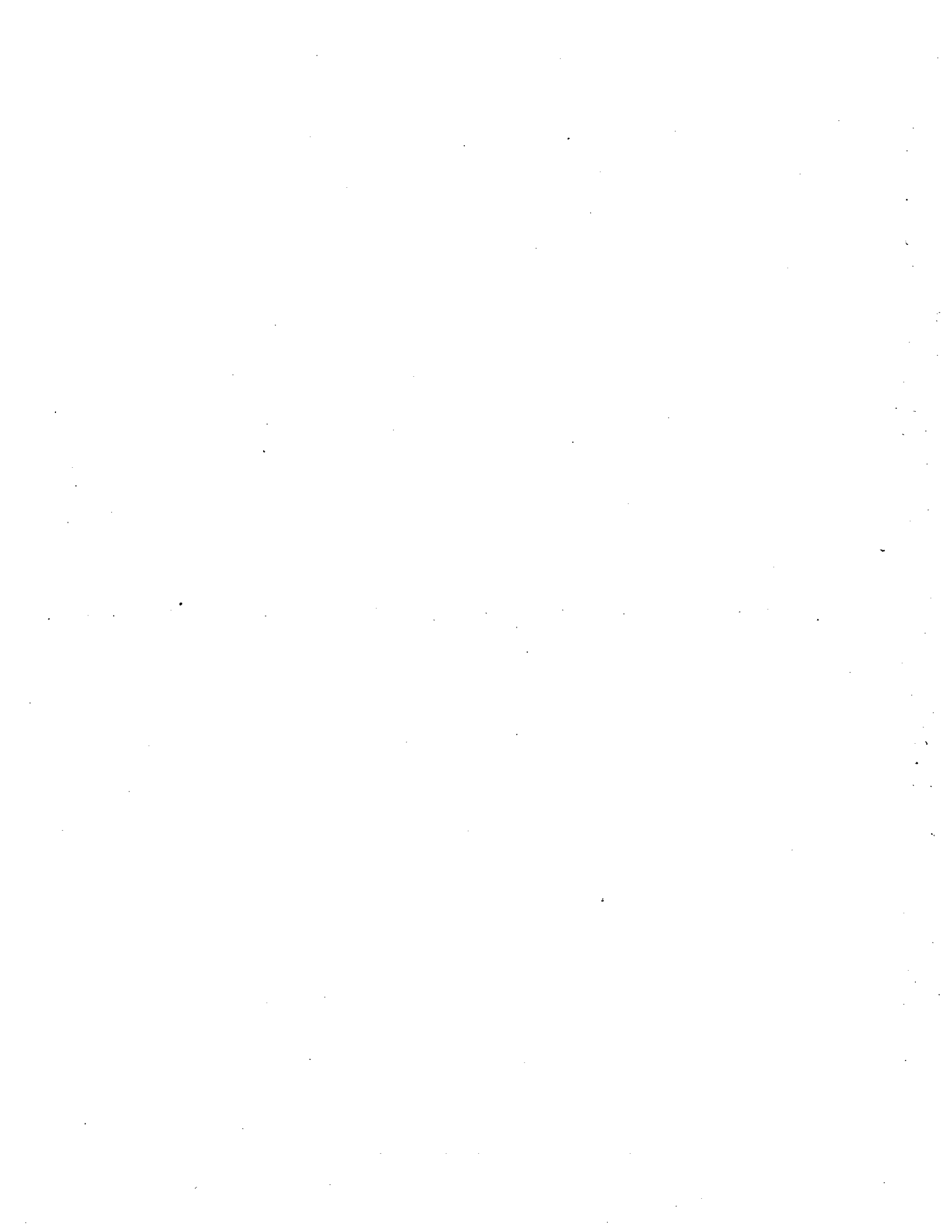
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**Robert C. Groman, Director
Information Systems Center**





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Related publications

WHOI CTD MicroVAX II Data Acquisition System Part I:	Installation Manual
WHOI CTD MicroVAX II Data Acquisition System Part III:	Reference Manual
WHOI CTD MicroVAX II Data Acquisition System Part IV:	Guide to Writing Programs to Access the Global Section
WHOI CTD MicroVAX II Data Acquisition System Part V:	Directory Structure, Source Code and DCL files

Acknowledgements

I would like to thank the University of Rhode Island Technical Services Group for their invaluable assistance in the development of the **AQUI89** CTD MicroVAX data acquisition system. In particular, Lorne Covington, Bill Fanning, Bill Hahn and Joe Lewkowicz were helpful in providing source code, information, and assistance.

Much of the **CTD78** portion of the code was modeled after the original **CTD78** acquisition system written for use on the HP 2100 series computer by George Power and modified later for an LSI/11 system by Tom Danforth. Mary Hunt designed and documented the **CTD78** disk data format.

Skip Little helped with many of the structural diagrams, and reviewed the documentation. Robert Millard assisted with technical details. Carol MacMurray and Maggie Cook were most helpful in testing the system on land and at sea and made many suggestions for improvements. Warren Sass helped to solve some of the more obscure bugs in the system.

1 Introduction

AQUI89 is a real-time shipboard Conductivity Temperature Depth profiler (CTD) data acquisition system used at the Woods Hole Oceanographic Institution to collect, preview and store (log) data from the WHOI/Brown Mark III CTD microprofiler (Brown and Morrison, 1978) on a MicroVAX II computer, running the VAX/VMS operating system, version 5.3. This manual describes **AQUI89** version 1.0.

AQUI89 is a modification of a system developed for the University of Rhode Island (URI) by Lorne Covington of the Technical Services group at the Graduate School of Oceanography (GSO). The URI system was designed to run on a VAXstation II workstation. **AQUI89** is intended to run on a MicroVAX II computer which is basically a subset of the VAXstation II, having less memory and no DEC graphics development unit.

The **AQUI89** system, as implemented on the microVAX II, allows a certain amount of time-shared processing to take place without interfering with the acquisition process. However, we strongly recommend that the microVAX II that is to be used for at sea data acquisition be completely dedicated to the acquisition process while data logging is in progress, since there is no adequate means at present to determine exactly how much extra processing can be done without interfering with the acquisition process.

The **CTD_GRAB**, **CTD_LOG**, **CTD_CONTROL** programs and most of the DCL command files were written by Lorne Covington and other members of the Technical Services Group at URI/GSO. The plotting and display routines, the **CTD78** formatting code and the documentation were written by Julie Allen, W.H.O.I. The archived data is stored in **CTD78** format (Millard, et.al, 1978).

Chapter 1 is an overview of the CTD data acquisition system. Chapter 2 contains a description of the **AQUI89** software. Chapter 3 is a step-by-step set of instructions for operating and testing the acquisition system. Chapter 4 outlines some particular features of **AQUI89** version 1.0.

The appendices contain information important to the operator and are referred to throughout this manual.

An overview of the CTD data acquisition system is shown in Figure 1. As the instrument package is lowered and raised through the water column, the serial FSK (frequency shift key) modulated data stream from the CTD underwater unit is transmitted up the instrument cable to the CTD deck unit where it is converted to serial RS232 format and sent to the MicroVAX II computer. The RS232 data are typically transmitted at 9600 baud.

The software allows for a variable number of bytes between frame synchs; it unpacks the byte string, and rearranges the data in **CTD78** format before archiving. This system uses frame synchs to detect a scan. The CTD scans are marked with a frame synch byte which alternates between 11110000B and the compliment 00001111B. The number of bytes in an observation can be obtained from the scale factor record, parameter **WDS_PER_SCAN** (Millard, et. al., 1978).

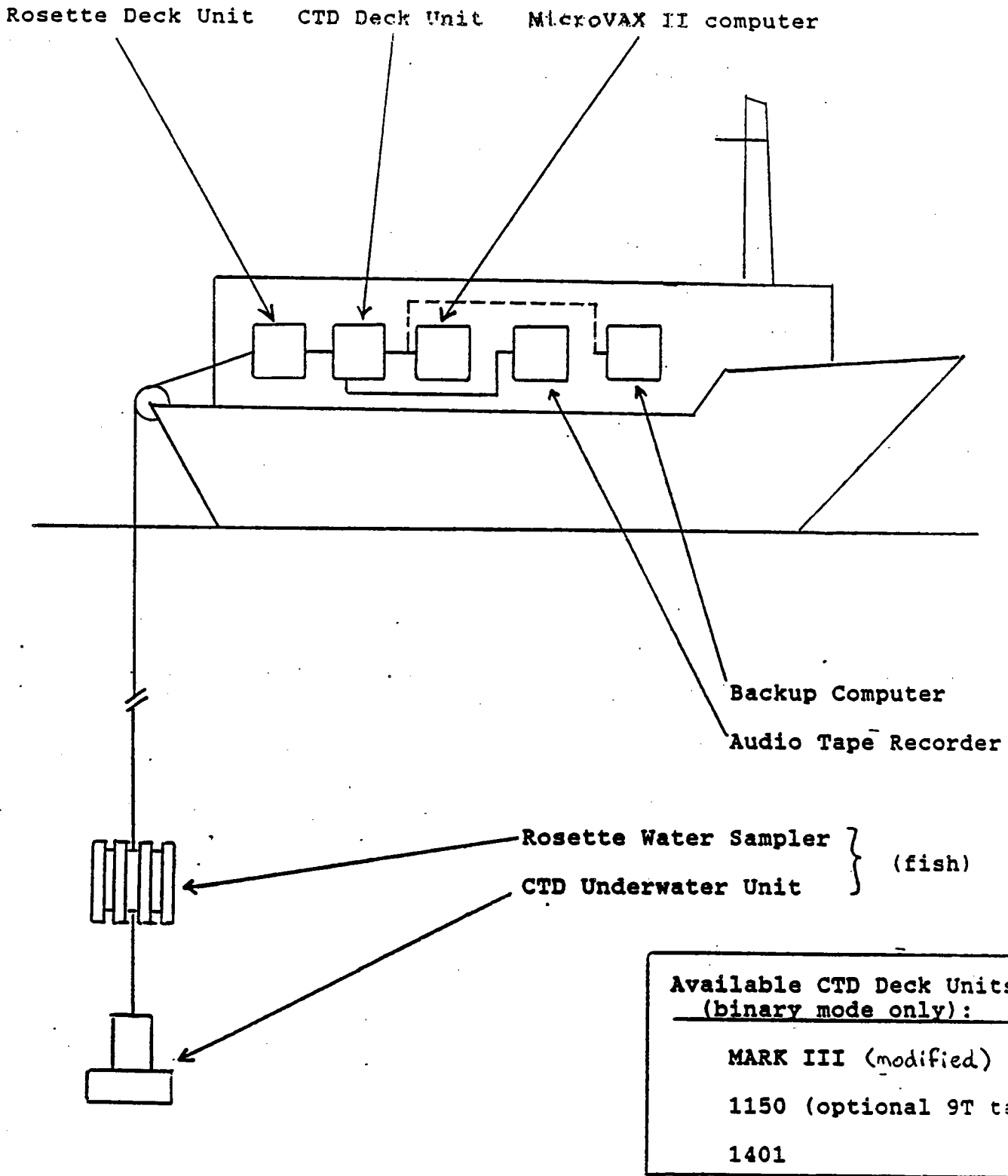


Figure 1: CTD Data Acquisition System Overview

A standard CTD instrument configuration would consist of records comprising the following bytes:

frame synch	1 byte
pressure	2 bytes
temperature	2 bytes
conductivity	2 bytes
signs	1 byte
dissolved oxygen current	2 bytes
dissolved oxygen temperature	1 byte

The above data configuration is variable; the **AQUI89** program is designed to accept any instrument configuration and scan rate. Other sensors may be added, although pressure, temperature and conductivity are assumed to always be present. The data scan rate is dependent on the number of variables being measured. The scan rate for instruments configured for 13 bytes or less is normally 31.25 scans/sec; for 14 to 26 bytes the scan rate is normally 16 scans/sec. The following equation is used to determine scan rate (srate):

$$\text{srate} = 1/5 \text{ kHz} * (\text{number of bytes} + 1) * 11 \text{ bits/byte} \leq \text{scan rate}$$

where: scan rate is either 31.25 scans/sec or 16 scans/sec and
11 bits/byte is figured as follows:

8 data bits
1 start bit
2 stop bits

The Rosette deck unit controls the Rosette water sampler by transmitting a signal down the instrument cable instructing the sampler to "fire" the next successive bottle.

Raw FSK data are recorded on audio tape cassettes which can be played back to the deck unit for post-processing in the event of system failure. When the older type 1150 CTD unit is used, raw data may also be recorded digitally on an off-line 9T magnetic tape. A backup computer system can be used to capture the RS232 data stream in parallel with the MicroVAX II system.

The RS232 data stream enters a time-sharing port on the MicroVAX II computer where the **AQUI89** software monitors, processes, and logs the data to 9T magnetic tape and/or disk storage in standard **CTD78** format (Millard, et. al, 1978).

The operator begins data acquisition by setting up a template file for each instrument. This file contains the laboratory calibrations (used to scale the raw data to physical units) for each sensor within the instrument, along with other cruise and instrument specific data. The template files can be modified at any time during a cruise, prior to a cast. The information contained in the template file includes the calibration data required to write the **CTD78** format scale factor record to the disk and/or tape archive file. Appendix A shows a typical **AQUI89** template file, explains its contents, and shows where the parameters used to calculate the various physical properties of seawater (Fofonoff and Millard, 1983) are stored in the **CTD78** scale factor record.

Before each instrument deployment (cast), the operator must specify a device name (e.g. msa0:) if logging to tape, the data filename and directory if logging to disk, the station and cast numbers, and the start position (latitude and longitude). Offline printing and plotting parameters may be entered at any time before or during a cast. A shared dynamic block of memory (a global section called **CTDGBL**) contains the data for the offline printing and plotting. The data in the global

section has been masked for the sign bit (section 5 of the **AQUI89** Programmer's Reference Manual) but is otherwise uncorrected. Depending on the size of the global section, all or (the most recent) part of a cast will be available in the global section.

The data interrupt which occurs during transmission of the signal to fire a water bottle is detected by the acquisition program which automatically "tags" the corresponding CTD data record. A record tag is indicated in the flags byte of the CTD data scan. When a record tag is detected, CTD data are extracted to separate ASCII disk file(s) for later merge with water data. The user may tag a scan manually via the command \$ **CTD TAG** (Section 3.2).

The logging program also automatically checks and reports the following data errors:

- frame synch
- no data
- range errors on pressure

Errors detected during acquisition are written to an ASCII disk file for bookkeeping purposes and marked in the **CTD78** data record quality word (Millard, et. al, 1978) where appropriate. Fatal errors are broadcast to the user terminals.

Offline processing includes the creation of 'real-time' plots of selected parameters (scaled to physical units) as well as listings of subsets of the data.

Time used in the system is based on the VAX/VMS system clock, which is normally set to GMT at system boot.

The user interface is friendly, with clear prompts and default options for most input. Help files and menus are used to facilitate data entry.

The documentation package for the **AQUI89** system consists of the following manuals:

- Part I Installation Guide
- Part II Operator's Guide
- Part III Reference Manual
- Part IV Guide to writing programs to access the **CTDGBL** global section
- Part V Source Code Manual

2 Software description

The **AQUI89** software is designed to operate under VAX/VMS version 5.3 and requires the following utilities:

- EDT** or **EVE** editor
- VAX/VMS Backup**

If program modification is necessary, the following VAX utilities may also be required (see **AQUI89** Programmer's Reference Manual):

- C compiler (version 2.4)
- FORTRAN compiler (version 4.5)
- Symbolic debugger (only on systems with at least 4mB of memory)

The **AQUI89** system consists of software modules which perform the following tasks:

installation
 initialization
 acquisition and data logging
 quality control
 bookkeeping

An overview of these modules is presented in figure 2. Some of the major programs in the **AQUI89** system include:

CTD_GRAB	detached	archives data from the CTD deck unit into a global section (CTD.COM.BUF)
CTD_LOG	detached	collects data from the global section (CTD.COM.BUF) and writes it to: global section (CTDGBL), CTD78 format tape and/or CTD78 format disk file.
CTD_CONTROL	interactive	passes commands to CTD_LOG
PLOT_CTD78	detached	controls the plotter in response to commands sent by the CTD78_PLOT interactive process
CTD78_PLOT	interactive	initiates plot setup and sends commands to the detached plotting process, PLOT_CTD78
CTD78_CONFIG	interactive	creates a configuration file from the CTD78 template file; allows CTD_LOG to process data from CTD instruments having different sensor configurations; called automatically by the START_AQUI command file
GET_SCAN	interactive	allows the user to look at selected scans in the current CTDGBL global section; data is scaled to physical units; CTD_LOG must be active
R_CTD78_DISK	interactive	allows the user to view portions of the CTD78 disk data file after completion of a logging session; CTD_LOG must be inactive
R_CTD78_TAPE	interactive	allows the user to view portions of the CTD78 magnetic tape file after completion of a logging session; CTD_LOG must be inactive
JOURNAL	detached	writes a journal file of significant events reported by CTD_GRAB and CTD_LOG ; usually disabled
SCAN_JOURNAL	interactive	reads and prints the journal file; not used for normal WHOI AQUI89 operation

Several VMS DCL command files are utilized during the initialization and operation of the **AQUI89** system. Flow diagrams illustrating how these are used appear in Figures 3-7. The command files are also listed in the **AQUI89** Source Code Manual, together with lists of the VMS logical names and VMS global symbols used by **AQUI89**.

2.1 Installation

The CTD data acquisition system is installed on a MicroVAX II via the VAX/VMS **BACKUP** facility, using a TK50 cartridge tape containing the latest release (**AQUI89** version 1.0). The details of the installation procedure are described in the **AQUI89** Installation Guide.

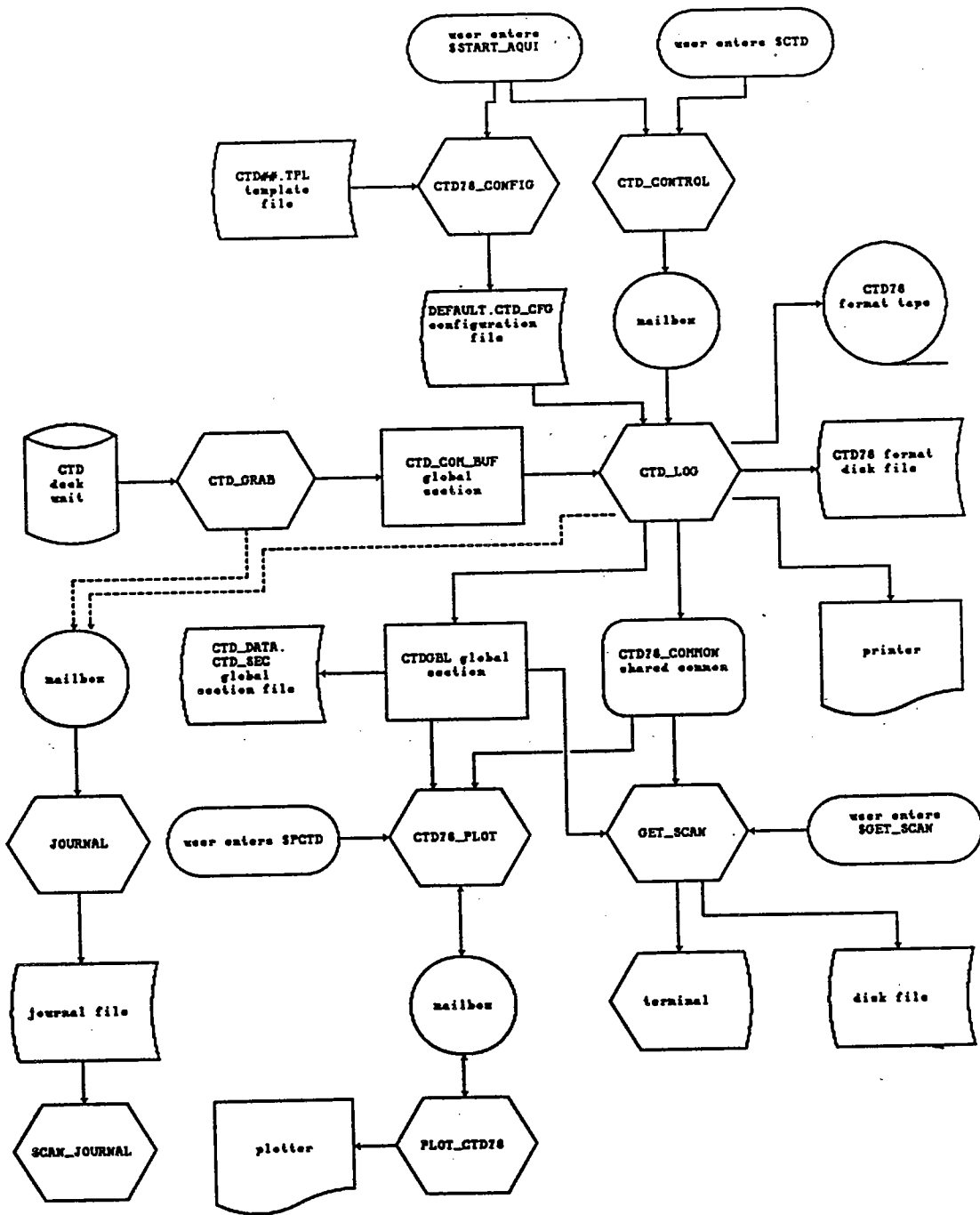


Figure 2: AQUI89 Software Overview

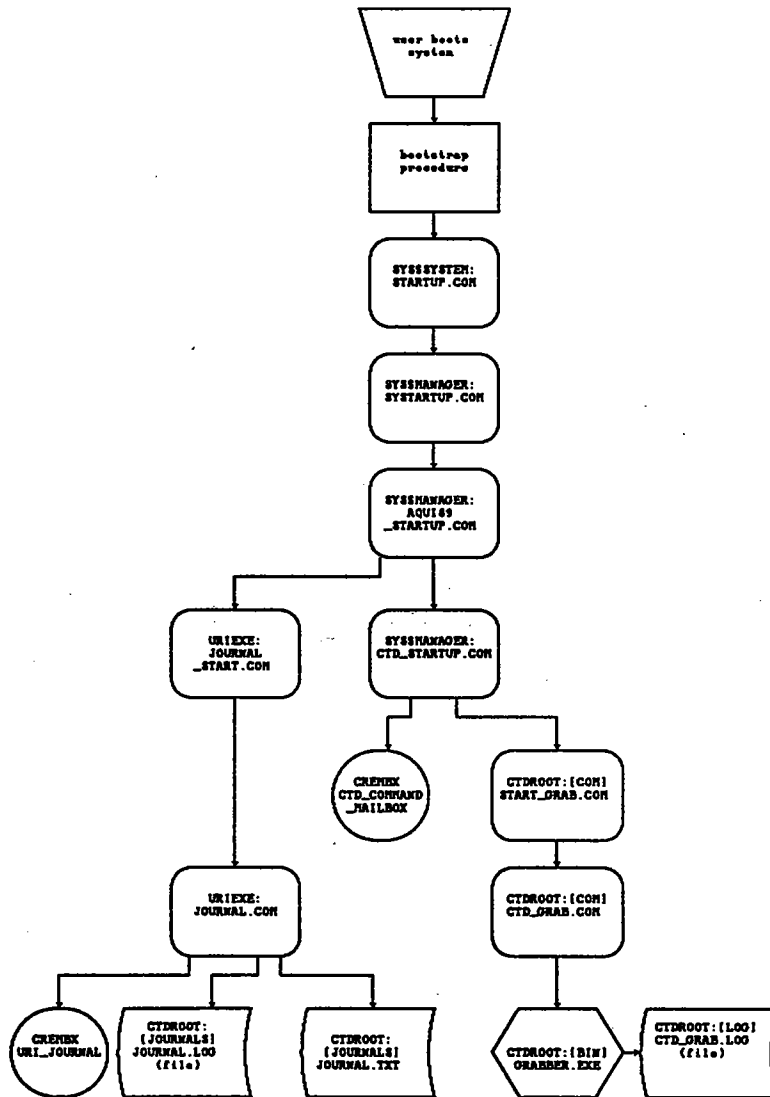


Figure 3: Start VMS, initiate CTD_GRAB and Journal

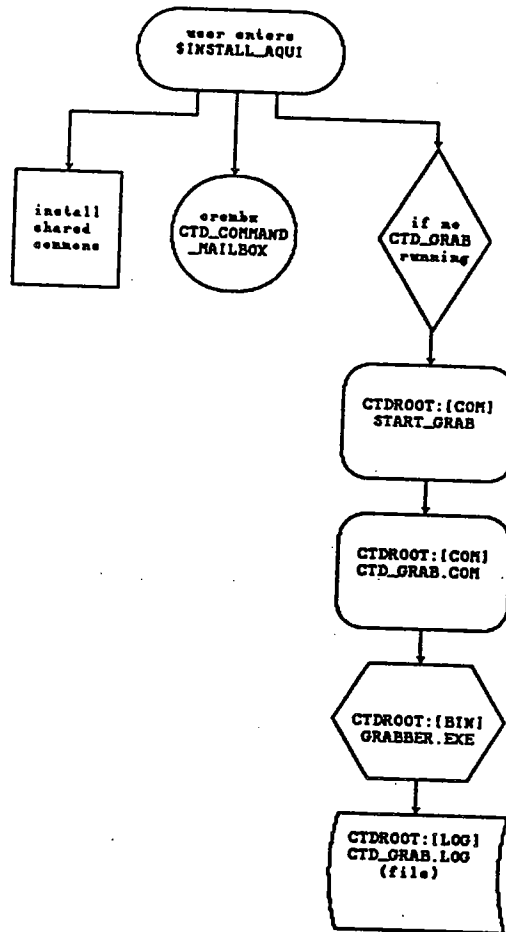


Figure 4: Install AQUI89 data acquisition system

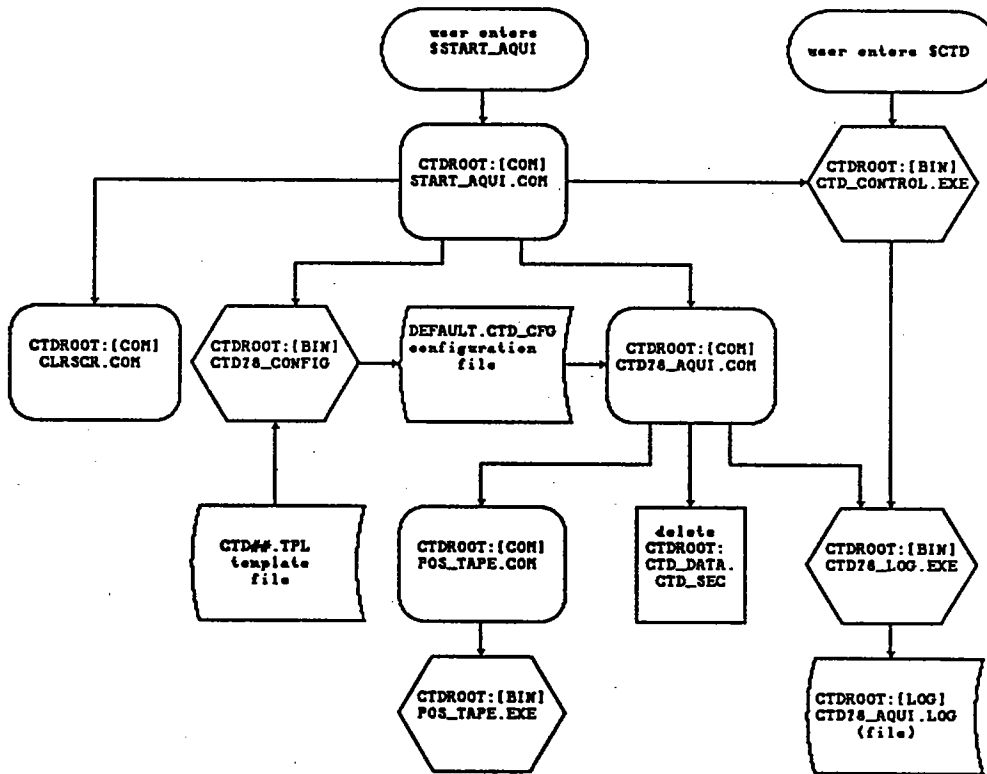


Figure 5: Initiate data logging process and control of data logging operations

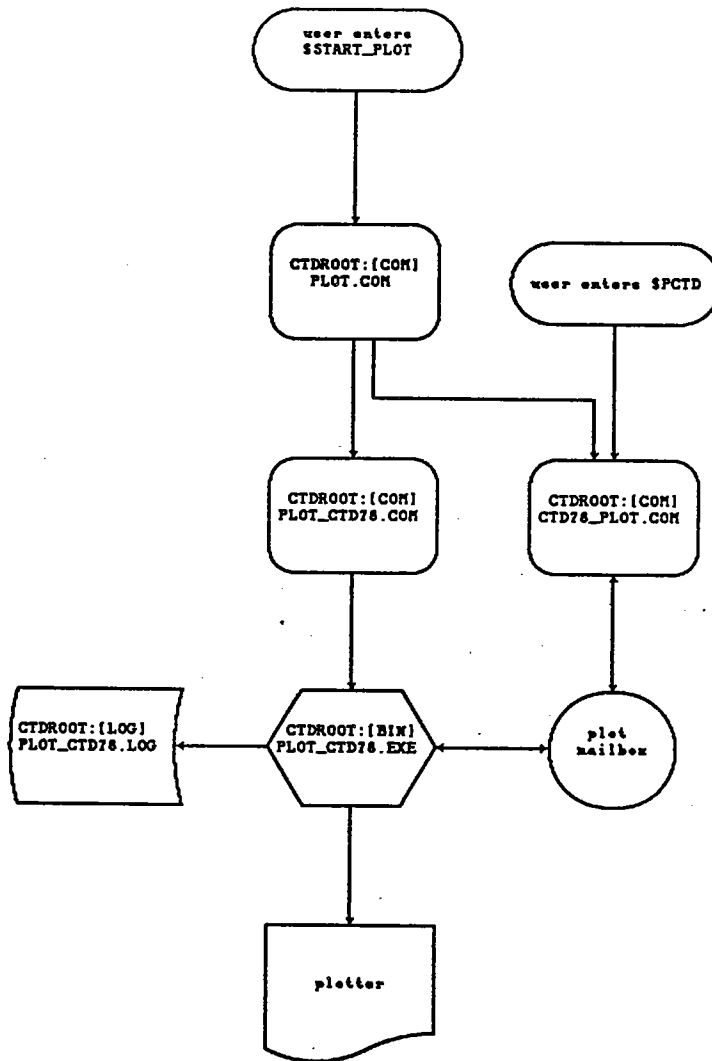


Figure 6: Initiate plotting operation

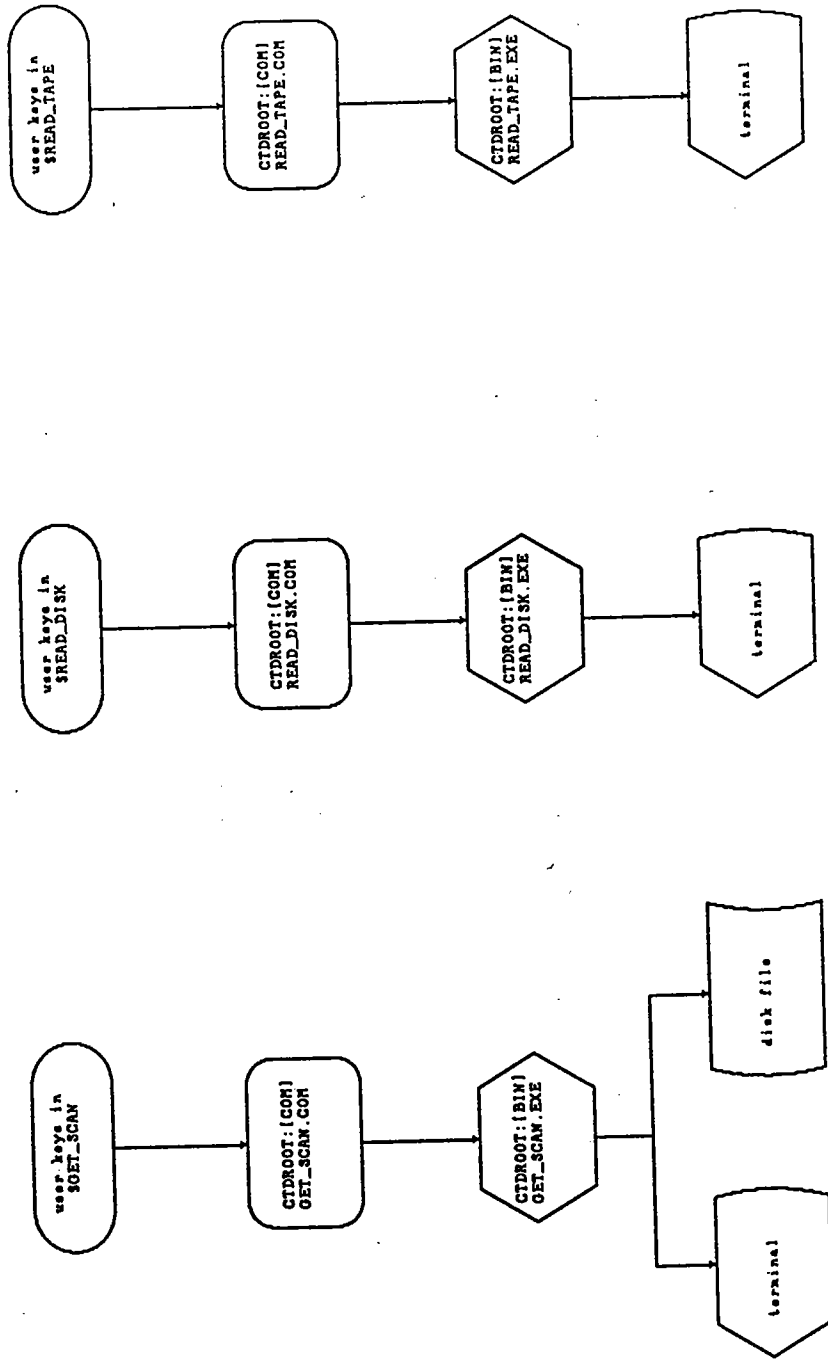


Figure 7: Initiate GET_SCAN, READ_DISK and READ_TAPE processes

2.2 Initialization

The acquisition program requires template files containing the cruise information and calibration parameters for each CTD instrument. These template files are in ASCII format and can be modified using the editor. The template files are identified by the instrument number (i.e. CTD01.TPL for instrument #1) and are located in the directory **USER:[CTD.AQUI.TEMPLATE]**.

2.3 Acquisition and data logging

The data acquisition portion of the software system consists of two detached processes, **CTD_GRAB** and **CTD_LOG**, and a user-interface, **CTD_CONTROL**.

CTD_GRAB - invoked at system startup or reboot
CTD_LOG - started for each cast
CTD_CONTROL - invoked for each command sent to **CTD_LOG**

The **CTD_GRAB** program runs as a detached process at VMS internal scheduling priority 5. **CTD_GRAB** issues read QIO (queued input/output operations) system calls to a terminal device and places the data received into a ring buffer in common memory (global section).

The **CTD_LOG** program also runs as a detached process, at the normal VMS internal scheduling priority of 4. **CTD_LOG** stores the data in a large common memory buffer (global section) for use by other programs. **CTD_LOG** also processes and arranges the data in **CTD78** format and writes the formatted data to disk, 9T magnetic tape, and the line printer. Commands sent to **CTD_LOG** (via program **CTD_CONTROL**) allow the operator to initialize and modify parameters in the header structure, start or stop printing of data scans and start, pause and stop logging of data to the specified archive devices (disk and/or tape). When **CTD_LOG** receives the **START** command, it reads the ring buffer and starts logging the 'oldest' data. For this reason, for normal operation, the CTD deck unit should be turned on before the **START** command is sent to **CTD_LOG**. Otherwise, there could be some data in the buffer from a previous cast which would get logged at the beginning of the current cast. For the standard WHOI CTD instrument (fish) configuration, with a scan rate of 31.25 scans/sec, it takes approximately 80 seconds to 'flush' the ring buffer. As a safety precaution, if the operator forgets to send the **START** command to the **CTD_LOG** process, logging will start automatically when a conductivity greater than 5 is detected (i.e. when the CTD instrument enters the water).

At the beginning of each cast, a command file is executed (**START_AQUI**) which queries the operator for the necessary information. This command file invokes the logging program (**CTD_LOG**) which logs data continuously. Once the logging process is active, the user may pass commands to the logging process in two ways:

A. type the command:

\$ CTD

after which the program prompts with:

CTD>

The user may then use the online help facility by typing:

CTD> HELP

or enter any other valid command(s):

CTD> STATION 15

```

CTD> CAST 1
CTD> SPOS 15 10.2N 140 33.8W
CTD> START
CTD> LOG
CTD> EPOS 15 10.3N 140 33.7W
CTD> EXIT

```

B. Commands may also be entered from DCL (note that commands with multiple parameters require double quotes):

```

$ CTD HELP
$ CTD STATION 15
$ CTD CAST 1
$ CTD SPOS "15 10.2N 140 33.8W"
$ CTD START
$ CTD LOG
$ CTD EPOS "15 10.3N 140 33.7W"

```

During the upcast, firing a water bottle causes a record tag to be written to the archive device. Record tags are marked in the data scan quality word (CTD78 format, Millard, et. al, 1978), bit 12; if bit 12 is set (= 1) then that scan was marked.

2.4 Quality control

The CTD.LOG process writes the CTD data scans to a global section which other processes may access (read-only) during acquisition. The quality control part of AQUI89 allows the operator to list and/or plot portions of the global section CTDGBL. The data in the global section is in the following format (assuming a standard CTD instrument sensor configuration of pressure, temperature, conductivity, oxygen current and oxygen temperature):

flags,pres,temp,cond,oxyc,oxyt

<u>variable</u>	<u>type</u>	<u>description</u>
flags	unsigned 8-bit integer	indicates cast direction, frame synch error and record tag
pres	signed 24-bit integer	pressure
temp	signed 24-bit integer	temperature
cond	unsigned 16-bit integer	conductivity
oxyc	unsigned 16-bit integer	oxygen current
oxyt	signed 16-bit integer	oxygen temperature

Depending on the size of the global section, a whole cast or the most recent portion of the cast will be available. If a small global section has been allocated, the data in the section will "wrap-around" when it is full, overwriting the oldest data. See section 3.7.3 of the AQUI89 Installation Guide for instructions if the size of the global section needs to be changed.

The data in the global section has been sign-bit masked but not converted to physical units. The

plotting and display programs read data from the global section; these programs scale the raw data to physical units and compute the other physical properties of sea water, using the parameters from the **CTD78** scale factor record.

2.4.1 Plotting

The plotting software consists of two programs: **CTD78_PLOT** and **PLOT_CTD78** (a detached process) which communicate via VMS mailboxes and Common Event Flags. The plotting programs read data from the global section and allow the user to interactively change plot parameters and replot any portion of the current cast that is contained in the global section.

The plotting programs, **CTD78_PLOT** and **PLOT_CTD78** (detached), run separately from the acquisition program. The **AQUI89** plot system includes a menu of derived and sensor parameters from which the user may select variables to be displayed in near 'real-time'. The plotting software version 1.0 runs on a 12" ZETA plotter. Depending on the size of the global section (i.e. whether or not the entire cast will fit in the global section), the user also has the option to replot with parameter and/or scale changes. The operator defines one independent variable and up to four dependent variables in the template file; the user is allowed to change plot parameters during acquisition.

If the global section (**CTDGBL**) is small and the plot interval is set too small, the plotter may not be able to keep up with the data and some data may not be plotted. This situation may be corrected by increasing the plot interval.

The plotting program maps to the global section that is created by **CTD_LOG**. Therefore, the plotting program can only be started after the **START_AQUI** command has been issued. The operator may initiate the plotting programs and draw plot axes before data acquisition begins. Note, however, that attempts to read from the global section (via plot commands **SCAN** or **LOOK**) will cause the plotting program to wait until there is data in the global section before responding.

2.4.2 Printing

There are two methods of looking at the CTD data during acquisition. To get a printed listing, specify the print option to the ctd command:

```
$ CTD
CTD> PRINT N      !where N is the scan increment
CTD> PRINT 100    !will print once every 100th scan
CTD> PRINT 1875   !will print every minute, assuming a scan_rate
                  ! of 31.25 scans per second
CTD> NOPRINT      !to stop output to line printer
or use the alternative method:
$ CTD PRINT N     !where N is the scan increment
$ CTD PRINT 100   !will print once every 100th scan
$ CTD PRINT 1875  !will print every minute, assuming a scan_rate
                  ! of 31.25 scans per second
$ CTD NOPRINT     !to stop output to line printer
```

If this print option has been chosen, the current values, in engineering units, of scan number, flag, pressure, temperature, salinity, conductivity, oxygen current, oxygen temperature and dissolved

oxygen are listed on the printer (assuming a 'standard' fish configuration).

The **GET_SCAN** program allows the user to examine scans anywhere in the global section from the beginning (unless the global section has wrapped around) to the current scan. **GET_SCAN** prints the data (scaled to physical units) to the user's terminal and has the option to also output to an ASCII file which can be printed if a hard copy is required:

\$ GET_SCAN

The printer is assigned to the **CTD_LOG** process during the entire cast and the normal VMS print queue is restarted in the command procedure **stop_aqui**. Therefore, hardcopy of the ASCII file produced by **GET_SCAN** can only be produced after the **CTD_LOG** process has terminated.

2.4.3 Error logging

During acquisition, informational messages, warnings and errors are reported to the display terminal and any other terminal on the system which has not been set to **/NOBROADCAST** mode. Frame synch errors, data gap and range errors are added to the quality word and recorded in the ASCII disk file:

CTDROOT:[DATA]ssssAccc.ERR (eg. 0029A002.ERR)

where **ssss** = station number (eg. 0029)
ccc = cast number (eg. 002)

The program checks and reports data errors for:

frame synch - sets bit 15 in the data quality word for that scan
no data - data gaps are filled with the value of the last good scan to preserve the time series
range errors - sets bit 0 in the data quality word if pressure jumps > 1 decibar (see Appendix

Data gaps are assumed by **CTD_LOG** to be caused by the signal transmitted to fire the Rosette water bottles. Therefore, when a data gap is detected, the following message is broadcast:

18-JAN-1989 12:58:2683: %CTDLOG-I-TAG, tagged scan 28869

2.5 Bookkeeping

During acquisition, ASCII disk files are written for bookkeeping purposes. On completion of a station, these files can be printed and logged for station archives and cruise reports. The following ASCII files are produced:

filename = **ssssAccc.***

where **ssss** = 4-digit station number (eg. 0053)
ccc = 3-digit cast number (eg. 001)

	(eg. station 53, cast 1)
station log file	CTDROOT:[LOG]CTD78_AQUILLOG
error file	CTDROOT:[DATA]0053A001.ERR
header record	CTDROOT:[DATA]0053A001.HED
water sample data (scaled)	CTDROOT:[DATA]0053A001.WSC
water sample data (raw)	CTDROOT:[DATA]0053A001.WRW
data file	CTDROOT:[DATA]0053A001.RAW

The station log file (*.LOG) contains all system messages and error messages from the logging session; the maximum pressure, scan number and CTD78 record number at maximum pressure are also recorded in the log file.

The error file (*.ERR) contains the errors logged during the session.

The header record (*.HED) is an ASCII file containing the scale factor record and header record information (Millard, et. al, 1978) that was written to tape (in binary format).

The water sample data files (*.WRW and *.WSC) contain the averaged data scans which are archived when a water bottle is triggered (causing a data interrupt which is interpreted as a water tag). The water sample files are in ASCII format and contain the average values for the data immediately prior to detection of the tag. The *.WRW file contains the uncorrected (raw) data; the *.WSC file contains the scaled (corrected) data.

Appendix H contains examples of log, header, error and water sample files.

3 Operation

The following describes the steps to initialize and log data using AQUIS9, assuming that VMS version 5.3 is operational on the MicroVAX. For instructions on how to restore the VMS operating system and utilities and modify standard sysgen parameters, see the AQUIS9 Installation Guide.

Following installation, the operator should:

- prepare the deck unit and associated equipment,
- initialize the tape (if necessary) and physically mount it (when archiving to tape)
- set up the plotter, if plotting
- enter the **START_AQUI** command before the CTD sensor is placed in the water; enter the station number, cast number and start position (latitude, longitude)
- specify whether or not a data listing is desired
- when the deck unit has been checked and adjusted, begin data logging; logging should commence before the CTD instrument goes in the water
- start the plotting process, if plots are desired
- monitor the cast with the **GET_SCAN** utility

3.1 Calibration

Calibration data are used to scale raw data into real engineering units. Before a cruise, calibrations are calculated for each instrument and entered into the template file for that instrument. Archive versions of the template files may be kept and the operator can change calibration values during a cruise if desired. See Appendix A and the CTD78 scale factor record (Millard, et. al, 1978) for structure and information content.

3.1.1 Template files

Before each cruise, a template file should be prepared for each CTD instrument to be used. The template files are located in the directory:

CTDROOT:[TEMPLATE]

The template file names are based on the instrument number:

CTDROOT:[TEMPLATE]CTD##.TPL !where ## is the instrument number

CTDROOT:[TEMPLATE]CTD09.TPL !template file for instrument #9

Since the template files are in ASCII format, they may be easily modified using the available VMS text editor.

3.1.2 Configuration files

A configuration file named **CTDROOT:[CONFIG]DEFAULT.CTD_CFG** is required for operation of **CTD_LOG**. This configuration file is automatically created (via program **CTD78_CONFIG**) from the WHOI **CTD78** template file immediately prior to starting the **CTD_LOG** detached process. For more information on configuration files, see section 3.6 and Appendix A of the **AQUI89** Programmer's Reference Manual.

3.2 Data acquisition

If logging to disk file, first ensure that there is enough free disk space available. If free disk space falls below 1000 blocks while logging to disk, the disk data file will be closed; logging to tape will continue. The following banner message will appear on all of the user terminals:

```
30-DEC-1988 14:12:06.18: %CTD-W-SPACELOW, Disk space low.  
Disk files closed.
```

The **CTD78_AQUILOG** file will contain the following messages:

```
%WARNING: SPACELOW, Disk space low
```



```
-WARNING: SPACELOW, Disk files closed
Disk space has fallen below      1000 free blocks.
Closing disk data file at scan #    99572.
```

If you attempt to start `CTD_LOG` with disk space below 100 free blocks, `CTD_LOG` will abort with a message notifying the user that there is not enough disk space to log data:

```
30-DEC-1988 14:12:06.18: %CTD-W-NOSPACE, Not enough disk space to log data.
```

To calculate the amount of disk space required for a cast:

```
~disk space (blocks) = time (hours) * 3116 blocks/hour
assuming:  standard CTD instrument configuration (7 bytes of data)
            data sampling rate is 31.25 scans/sec
            1 block = 512 bytes
```

If logging data to 9T tape, and this is the first cast on the tape, the tape must first be initialized:

```
$ INIT MSAO: CTDAQU
```

If this is not the first cast on the tape, the `START_AQUI` command procedure will check to see if there is already data logged to the tape and automatically position the tape at the end of the last station (program `POS_TAPE`).

There is no check in the current release of `AQUI89` for magnetic tapes that run out. Appendix I contains information on how to determine the amount of CTD data that will fit on a 9T magnetic tape.

3.2.1 Initialization

At the beginning of each cruise, and again if the system has been rebooted, the command file `INSTALL_AQUI` must be run to set up the terminal ports and ensure that the shared commons have been installed:

```
$ INSTALL_AQUI
Port for plotter (tta3:):  TTA3:
Port for printer (tta2:):  TTA2:
Printer baud rate (9600):  9600
CTD78_COMMON installed
CTD78_PLOT_COM installed
%DCL-I-SUPERSEDE, previous value of CTD_REPORT_MAILBOX has been superseded
%DCL-I-SUPERSEDE, previous value of CTD_PRINTER has been superseded
CTD_GRAB up and running
$
```

Note that when `CTD_GRAB` is restarted via the `START_GRAB` command, the following message will sometimes appear and can be ignored:

```
15-MAY-1990 10:25:22.36 %CTDLOG-W-NOSCAN, error from ctd_scan()
15-MAY-1990 10:25:22.42 -CTDLOG-W-NOSCAN, GRESTART, GRABBER was restarted
```

The maximum amount of time for a cast will normally be set to 3 hours (180 minutes). If cast times are expected to exceed 3 hours, follow the instructions in the `AQUI89` Installation Guide,

section 3.7.3 Note that if a cast exceeds the maximum time allowed, the data in the global section will 'wrap-around' and the data scans that are overwritten will not be available to the printing or plotting programs. The logging of data to tape and/or disk will continue with no interruption; the archived data will not be affected.

3.2.2 Logging data

For each cast, the command **START_AQUI** must be used to start the program **CTD_LOG**, which runs as a detached process at the normal VMS internal scheduling priority of 4. At the beginning of each cast, the operator issues the **START_AQUI** command and provides the necessary parameters interactively:

```
$ START_AQUI
```

Appendix C shows an example of an **AQUI89** session.

To ensure that **CTD_LOG** is running, type:

```
$ SHOW SYSTEM
```

The process **CTD_LOG** should be running in **HIB** state:

Pid*	Process Name	State	Pri*	I/O*	CPU*	Page flts*	Ph.Mem*
00000021	CTD_LOG	HIB	7	111 0	00:00:07.49	4809	200

* your numbers will probably be different from the ones shown here

If the process does not start up properly, check the file

CTDROOT:[LOG]CTD78_AQUI.LOG for diagnostics.

3.2.3 Interactive control of AQUI89

This section describes the interactive control interface to the **CTD_LOG** program. Since most of the commands required to log data in **CTD78** format are entered via the **START_AQUI** command file, most of the information in this section will not be necessary under normal circumstances.

Once data logging has commenced, commands may be entered interactively via two methods:

```
$ CTD
```

after which the **CTD_CONTROL** process will issue the prompt:

```
CTD>
```

and wait for input. The following are the available **ctd** logging commands:

help - online help facility
data filename - where filename is the disk file name
print n - to begin printing every n data scans
noprint - halt printing
station n - enter station number for header
cast n - enter cast number for header
start_pos DDD MM.MMH DDD MM.MMH *
start - writes the header information to the archive device and bookkeeping files
log - start logging data
tag n - write record tag n to the archive device and bookkeeping files for bottle firing
pause - stops logging (time series is NOT preserved)
end_pos DDD MM.MMH DDD MM.MMH *
stop - stops logging for this cast and writes closing information to the archive device and bookkeeping files
exit - exit from interactive process, back to DCL

* latitude and longitude positions are denoted as: DDD MM.MMH

where DDD is degrees
 MM.MM is decimal minutes
 H is hemisphere (N or S for latitude, E or W for longitude)

A sample run might look like this (note that most of the following commands are automatically called when the command file **START_AQUI** is run):

```

$ CTD (to enter acquisition command level)
CTD> STATION 33 (identify station number)
CTD> CAST 1 (identify cast number)
CTD> DATA 0033A001.RAW (log to data file)
CTD> START_POS 34 15.ON 45 30.OW (start position)
CTD> PRINT 100 (start printing every 100 scans)
CTD> START (initialize and write headers to tape and disk)
CTD> LOG (start logging data)
CTD> TAG (tag a scan)
CTD> TAG (tag a scan)
CTD> PAUSE (stop logging temporarily)
CTD> LOG (resume logging)
.
.
CTD> TAG (tag a scan)
CTD> EXIT (exit to DCL)
$
  
```

Perform other DCL tasks here if you want - edit files, etc.

```

$ CTD (re-enter acquisition command level)
CTD> TAG (tag a scan)
CTD> NOPRINT (stop the printer)
CTD> PRINT 200 (print every 200 scans)
CTD> TAG (tag a scan)
CTD> PAUSE (stop logging temporarily)
CTD> LOG (resume logging)
.
.
CTD> END_POS 34 15.0N 45 30.0W (end position)
CTD> STOP (stop logging, write double EOF to tape)
CTD> KILL (stop the logging process)
CTD> EXIT (exit from acquisition command level to DCL)
$

```

The alternative method allows the operator to enter commands directly from the DCL command line:

```

$ CTD TAG
$ CTD NOPRINT
$ CTD PRINT 200
$ CTD TAG
$ CTD PAUSE
$ CTD LOG
.
.
$ CTD STOP

```

Note that the following error and informational messages will occur if the STOP_AQUI command is issued before any actual data logging occurs:

```

5-OCT-1989 14:39:00.61: %CTDLOG-E-CTD78ERR, Error reading disk header
5-OCT-1989 14:39:03.02: %CTDLOG-E-CTD78ERR, Error writing header to disk
5-OCT-1989 14:39:06.29: %CTDLOG-I-STOPPED, Station 60, Cast 0
5-OCT-1989 14:39:10.57: %CTDLOG-I-DEAD, Stopped.

```

3.2.4 Water sample data

When a water bottle is fired, the data interrupt is detected by the acquisition system and the data scan is tagged. The data scans immediately preceding the tag are extracted and used to compute averages which are output to the ASCII water sample files.

The NUM_WATER_SAMP values (defined in the template file) immediately prior to the tag are averaged for all parameters except dissolved oxygen current, which is averaged over 10 seconds (since oxygen current is only measured once each second).

The water sample files are as follows:

ssssAnnn.WRW !raw data (masked for sign bit)
ssssAnnn.WSC !data scaled to physical unit

where ssss = station number and
nnn = cast number.

Scans may be tagged without firing a bottle by sending the TAG command to CTD_LOG:

```
$ CTD
CTD> TAG
CTD> EXIT
$
or, simply:
$ CTD TAG
```

The following message will appear on the user's terminal following a TAG:

```
18-JAN-1989 12:58:2683: %CTDLOG-I-TAG, tagged scan 28869
```

3.2.5 Terminating data logging

At the end of a cast (before entering the command STOP_AQUI), the user should enter an end position (latitude and longitude):

```
$ CTD
CTD> EPOS 15 10.3N 140 33.8W
CTD> EXIT
or:
$ CTD EPOS "15 10.3N 140 33.8W"
To end a cast, type
$ STOP_AQUI
30-DEC-1988 12:32:02.30: %CTDLOG-I-STOPPED, Station 33, Cast 1
30-DEC-1988 12:32:11.18: %CTDLOG-I-DEAD, Stopped.
printer is not spooled - starting print queue
```

This command terminates the logging and plotting processes and restarts the print queue. Note: if there is a problem with the printer after executing the STOP_AQUI command, try restarting the print queue via the command:

```
$ START_PRINT_Q
```

To save disk space, the global section file USER:[CTD]CTD_DATA.CTD_SEC can be deleted any time after the acquisition process has been stopped.

3.2.6 Printing

During data acquisition, the print command may be invoked in two ways, and can be toggled on and off:

```
$ CTD          (get into CTD command mode)
CTD> PRINT N   (where N is the decimation interval)
CTD> NOPRINT   (to halt printing)
CTD> PRINT N   (to restart printing)
CTD> EXIT      (to exit to DCL)
$
```

or, using the alternative method:

```
$ CTD PRINT N   (where N is the number of scans to skip)
$ CTD NOPRINT   (to halt printing)
$ CTD PRINT N   (to restart printing)
```

If the print option has been invoked, scans will continue to be printed on the line printer until the NOPRINT command is sent. Appendix D shows a sample of printer output during a CTD cast.

To look at the data in the global section on a user terminal, type the command:

```
$ GET_SCAN
Output to a disk file as well as terminal (y/n)? N
current scan: 1523
Enter start, end, increment (0,0,0 to end): 700,1000,100
<<< data will appear here - see example in Appendix E >>>
Enter start, end, increment (0,0,0 to end): 0 0 0
$
```

Appendix E shows an example of using GET_SCAN during a logging session.

If data is output to a disk file as well as to the terminal, the ASCII file is:

```
CTDROOT:[DATA]CTD78_LIST.DAT.
```

3.2.7 Plotting

The plotting process is initiated via the command:

```
$ START_PLOT
%RUN-S-PROC_ID, identification of created process is 00000243
Waiting for plotting process to initialize...
PLOT.CTD78 up and running
%DCL-I-SUPERSEDE, previous value of FOR009 has been superseded
CTD_PLOT> HELP      !to print the following menu
You may abbreviate commands to 3 characters.
```

```

axes      - draw axes with current parameters
end       - finish current plot segment, reset origin
exit     - exit to DCL, no change in plotting status
help     - print this menu
list     - list the current plot setup parameters
look     - look at a given range of scans
mod.par  - modify plotting parameters, plotting stops
pause    - stop plotting temporarily
plot     - start plotting
rate     - change plot rate, plotting continues
scan     - get current scan number
stop     - stop detached plotting process

```

```
CTD_PLOT> EXIT
```

```
$
```

If a CTD78 plot session has been started and the user has returned to DCL (via the EXIT command), the command \$PCTD may be used to return to the CTD_PLOT prompt.

Appendix F illustrates an AQUI89 plotting session; figure 3.2.7 shows a sample AQUI89 plot.

In order to change pen color between the down and up casts, the operator must pause the plotter and manually change the pens. To do this, press the PAUSE button on the ZETA plotter to stop the plotter temporarily, make the required pen changes, moving the carriage if necessary, then press the RETURN button to return the carriage to its original position and press the PAUSE button again to resume plotting.

3.3 Diagnostics

If the CTD_GRAB and CTD_LOG processes are running, the following activities should be observed under normal operation:

- if logging to tape, tape moves every few seconds, when writing a CTD78 data record
- in the directory containing the archived disk data file (default CTDROOT:[DATA]), the file_name.dat for the current cast grows in size:


```
$ D FILE_NAME.RAW (to get size of data file)
```

 wait ~1 minute, then


```
$ D FILE_NAME.RAW (file size should be increasing)
```
- GET_SCAN will allow you to look at the data in the global section during acquisition. See Section 3.2.6 for operating instructions.
- during logging, you can double check that data is being transferred by typing:


```
$ SH SYS (to get the process id number for CTD_LOG)
```

```
$ SHO PROC/ID=pid/CONT
```

 The buffered I/O (BIO) and direct I/O (DIO) counts should both increase. The direct I/O increases will coincide with each tape write. To exit, type:


```
$ <CTRL> C (hold down the CONTROL key and press C)
```

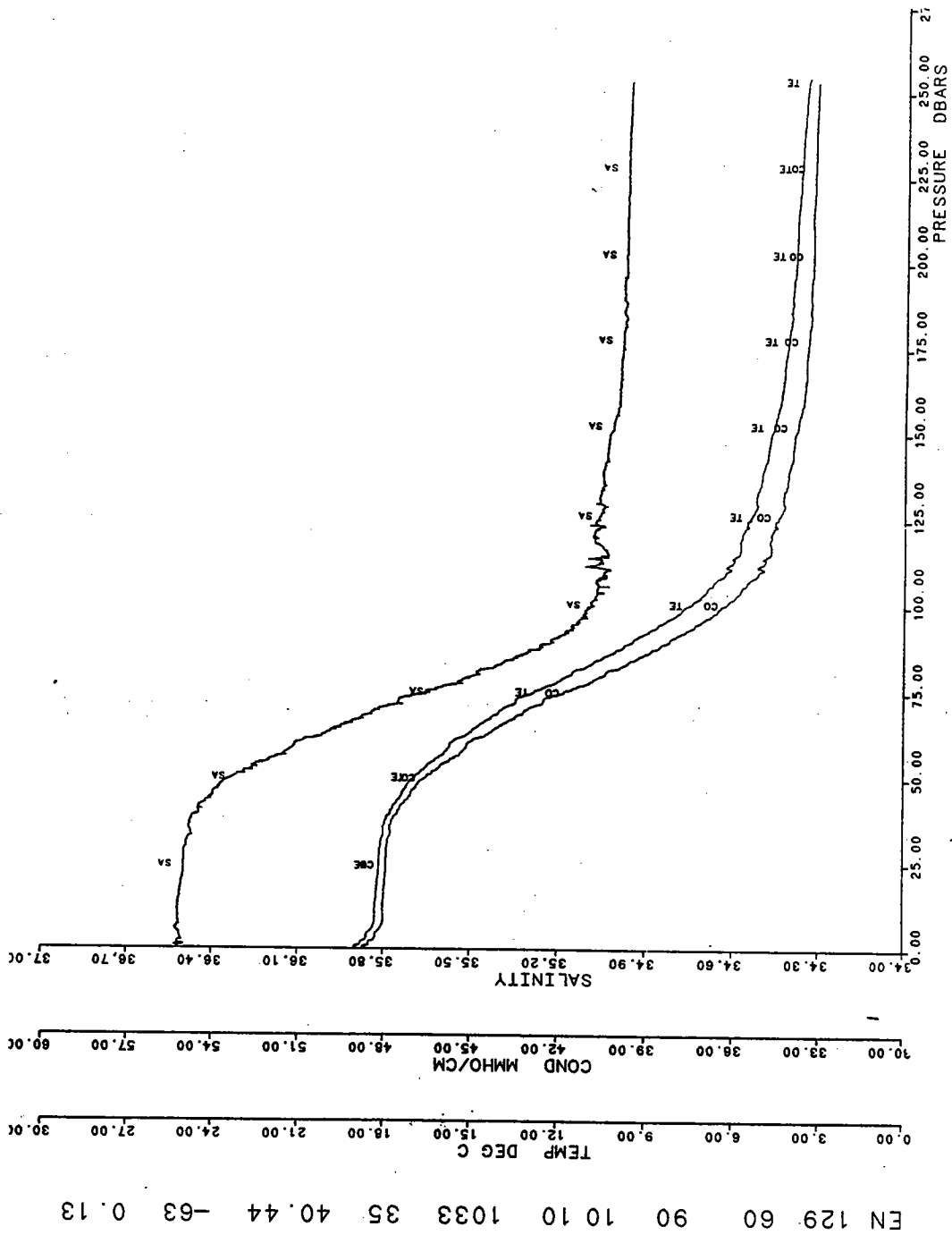


Figure 8: Sample AQU189 plot
29

If it appears that nothing is happening, try stopping the process (via **STOP_AQUI**) and starting it up again (via **START_AQUI**). If there is still a problem, check for diagnostic messages in the log file:

CTDROOT:[LOG]CTD78_AQUI.LOG

If all else fails, reboot the system and start over.

3.3.1 Data files

This section describes the data files that are created by **AQUI89** and their location on the disk.

The directory **CTDROOT:[DATA]** (or the directory specified in **START_AQUI**) will contain the following files:

(eg. for station 23, cast 1)

0023A001.RAW - binary file in **CTD78** disk file format, if logging to disk
0023A001.ERR - ASCII file of error information - frame synch errors
0023A001.HED - ASCII file of header information
0023A001.WRW - ASCII file of tagged scans (raw)
0023A001.WSC - ASCII file of tagged scans (scaled)

The files containing tagged scans are for merging with water sample data if desired. Values are an average of the **num-water_samp** (default=5) good scans preceeding the tag.

After the **STOP_AQUI** command has been issued, the **CTD78** disk data file may be reviewed using the program **R_CTD78_DISK**, invoked via the command:

```
$ READ.DISK
```

```
Enter file to read: CTDROOT:[DATA]0023A001.RAW
```

Appendix G shows an example of this program.

4 Notes on AQUI89 Version 1.0

AQUI89 version 1.0 contains some special features which are described in this section.

The binary data that is output to the 9 track magnetic tape in **CTD78** format is written to emulate an HP 16-bit word configuration, i.e. every two bytes on the VAX are swapped in order.

The conductivity calculation (subroutine **CON**) uses a parameter (**ALPHA**) from the **CTD78** scale factor record (attribute_1 of conductivity). This parameter is a negative number (default = -6.5e-6) in the **CTD78** scale factor record and the equation used is:

$$\text{COND} = \text{COND} * (1.0 + \text{ALPHA} * (\text{TEMP} - \text{CTZ}) + \text{BETA} * (\text{PRES} - \text{CPZ}))$$

In the URI portion of the code and in the configuration file **CTDROOT:[CONFIG]DEFAULT.CTD_CFG**, the parameter **ALPHA** is positive (default = 6.5e-6). The default value is defined in the file:

```
CTDROOT:[URISRC.LIBS]CTD_VARIABLES.H
```

(parameter **COND_TEMP_COEFF**). The equivalent equation used is:

$$\text{COND} = \text{COND} * (1.0 - \text{ALPHA} * (\text{TEMP} - \text{CTZ}) + \text{BETA} * (\text{PRES} - \text{CPZ}))$$

The results produced are the same, but the user should note carefully that the parameters are signed correctly in the **CTD78** scale factor record (negative) and in the configuration file (positive). If this is not the case, the conductivity values listed using the **CTD PRINT** command (uses **ALPHA** from the configuration file) will not agree with the conductivity values from the **GET_SCAN** command (uses **ALPHA** from the **CTD78** scale factor record), and at least one of them will be wrong!

In version 1.0 of **AQUI89**, the configuration file is a binary file. It should only be modified by running the program **CTD78_CONFIG**, which creates the default configuration file from a template file.

There is a URI program, **CTD_CONFIG**, which allows the user to create a new configuration file but this program must be run on a VT100 terminal in order for the drop-down menus to work properly. Users of **AQUI89** should not find it necessary to run this program.

4.1 Known bugs

There is one known bug in the system that occurs infrequently. The **CTD_LOG** process will appear to start normally, but before data logging begins, the following message will appear:

```
.  
. .  
% RUN-S-PROC_ID, identification of created process is 00000071  
Waiting for AQUI process to initialize...  
16-OCT-1990 10:58:37.72 CTDLOG-I-NEW, starting ...  
16-OCT-1990 10:59:17.58 CTDLOG-I-DEAD, stopped.  
% SYSTEM-W-NONEXPR, nonexistent process  
\00000071\  
  
CTD_LOG up and running  
  
Station number:
```

The **CTD_LOG** process receives commands from the **CTD_CONTROL** process via a system-wide mailbox, **CTD_CONTROL_MAILBOX**. If an extra **STOP_AQUI** command (or an extra **CTD STOP**) is issued, then the extra **STOP** command is stored in the command mailbox until the next time the **CTD_LOG** process is active. The **STOP** command is then the first command read from the mailbox, which causes the **CTD_LOG** process to immediately abort. A **CLEAR_MBX** command has been added to the **START_AQUI** command procedure to clear the system mailbox of any commands before the **CTD_LOG** process is initiated.

If this bug still occurs, there are three options to try:

- type the command: **CLEAR_MBX**
- type the command: **START_AQUI** again, assuming that the mailbox has now been flushed empty

- reboot the system

Appendices

A Template file

This appendix includes a listing of a sample template file, a description of the variables and an explanation of the special parameters stored in the template files.

A.1 Sample template file

Template file: CTDROOT:[TEMPLATE]CTD09.TPL

```

CTD09          !template file for CTD instrument # 9
      32       !project code
      114      !cruise number
OC          !ship code (OC = Oceanus)
      9       !CTD instrument number
      7       !words/scan
      3125    !scan rate
      10000   !time unit frequency
      7       !# variables per data scan
      34      !descriptor length
      5       !# float values
      5       !number of scans for water sample file
              !operator last name

v# descript  units  id lag win qual  res  sensor  yr mo da
1 pressure  decibars  PR   0   0   17  38965   90 7 11
2 temp      deg Cel    TE   0   0   17  14279   90 7 11
3 cond      millimhos CO   3   0   16   C86   90 7 11
4 sign wd   SW        3   0   -8    0     0 0 0
5 oxy c     microamps OC  156  0   12    0     0 0 0
6 oxy t     deg Cel    OT  156  0   9     0     0 0 0
7 quality   QU        0   0   0     0     0 0 0

v# sb wrd  sb msk  lsb wrd  lsb msk  dig per  data msk
1   4      1      0          0          1      177777
2   4      2      0          0          1      177777
3   0      0      0          0          1      177777
4   0      0      0          0          1       377
5   0      0      0          0         32       7777
6   4      4      0          0         32       377
7   0      0      0          0          1      177777

v# attribute 1  attribute 2  slope  bias  sens lag
1  0.933999E-08 -0.102206E-12  0.998763E-01 -0.178000E+02  0.000000E+00
2  0.282170E-11  0.000000E+00  0.499916E-03 -0.554621E-02  0.250000E+00
3  0.650000E-05  0.150000E-07  0.998550E-03 -0.995867E-02  0.000000E+00
4  0.280000E+01  0.300000E+04  0.100000E+01  0.000000E+00  0.000000E+00

```

```

5 -0.360000E-01  0.115000E-03  0.302000E-02  0.000000E+00  0.000000E+00
6  0.500000E+00  0.000000E+00  0.128000E+00  0.000000E+00  0.000000E+00
7  0.000000E+00  0.000000E+00  0.100000E+01  0.000000E+00  0.000000E+00

```

Plot setup parameters

```

1.0000          !plot factor
100            !plot interval
100            !print interval
1124           !scan # for start of plotting
5              !number of plot variables
id axis label  start val  end val  units/in first dif annot int p cs
PR PRESSURE DBARS      0.0000 4500.0000 250.0000  0.0000  0.0000  0
TE TEMP DEG C          0.0000  30.0000   3.0000  0.0000  1.0000  1 -1
CO COND MMHO/CM       30.0000  60.0000   3.0000  0.0000  1.0000  1 -1
SA SALINITY           33.0000  36.0000   0.3000  0.0000  1.0000  1 -1
OX OXYGEN              0.0000   6.0000   0.6000  0.0000  1.0000  1 -1

```

A.2 Variable descriptors

Variable descriptor items in the template file	
Descriptor	Meaning
v#	relative position of the given variable in the scan
descript	variable label
units	physical units of variable
id	two-character ASCII tag for variable - must be unique
lag win	lag correction window
qual	quality flag
res	total number of bits for the variable, including sign bit and least significant bits (if any) with the following conventions: > if the item is a sensor variable, length is positive > if a non-sensor variable (sign word or lsb word), length is negative > if program-supplied, (quality word), length set to 0 but is actually 16 bits.
sensor	identification number of the sensor
yr	calibration date - year
mo	calibration date - month
da	calibration date - day
sb wrd	sign bit word - the location within the data scan of the sign bit word for this variable (=0 if no sign bit)
sb msk	sign bit mask - defines where in the sign bit word the sign bit for this variable is located. (=0 if no sb word)
lsb wrd	least significant bits word - the location within the data scan of the least significant bits word (=0 if no lsb word)
lsb msk	least significant bits mask - defines where in the least significant bits word any least significant bits for the variable are located (=0 if variable has no significant bits)
dig per	digitizing period - number of scans between actual data samples for this variable (eg. dig per = 32 for oxygen current means data updated every second, at 31.25 Hz)
data msk	data mask - defines which bits in the magnetic tape word (always 16 bits) actually contain data
attribute 1	used for 2nd order corrections
attribute 2	used for 3rd order corrections
slope	slope to be applied to data
bias	bias (offset) to be applied to data
sens lag	sensor lag - time constant of sensor

plot setup parameters	
id	two-character ASCII tag for variable (must be unique)
axis label	20-character ASCII string for plot axis label
start val	start data value, in physical units
end val	end data value, in physical units
units/inch	number of physical units per inch on plot
first dif	first difference check (not implemented in AQUI89 version 1.0)
annot int	annotation interval (inches)
p	plot type blank = independent variable l = line p = point s = Calcomp centered symbol
cs	Calcomp centered symbol (if plot type = s) 0 = square 1 = circle 2 = triangle 3 = plus (+) 4 = cross (x) 5 = diamond

A.3 Calculation parameters

The template file contains the conductivity cell geometry factors used to calculate salinity; salinity is used in the calculation of various physical properties of sea water (Fofonoff and Millard, 1983). These parameters are read from the template file at run time and stored in the shared common; they are also written to the CTD78 format scale factor record (Millard, et. al, 1978) on tape and/or disk. The parameters are stored as follows:

Conductivity constants (Fofonoff, et al, 1974)		
variable	position	default
alpha (variable cona in subroutine con)	attribute_1 (conductivity)	-6.5e-6
beta (variable conb in subroutine con)	attribute_2 (conductivity)	1.5e-8
T (variable ctz in subroutine con)	attribute_1 (sign word)	2.8
P (variable cpz in subroutine con)	attribute_2 (sign word)	3000.0

Oxygen calculation (Owens and Millard, 1985)		
variable	position	default
Pc (variable oxpc in subroutine oxyg)	attribute_2 (oxygen current)	0.000115
Tc (variable oxtc in subroutine oxyg)	attribute_1 (oxygen current)	-0.036
C1 (variable oxcl in subroutine oxyg)	attribute_2 (oxygen temperature)	0.0
C2 (variable oxcl in subroutine oxyg)	attribute_1 (oxygen temperature)	0.5

B Ranges for CTD variables

Variable	Units	Resolution	Oceanic Minimum	Range Maximum
PRES	decibars	xxxx.x	0.0	6500.0
TEMP	Celcius	-xx.xxxx	-2.0	30.0
COND	MMHO/CM	xx.xxx	30.0	60.0
SALT	PPS78	xx.xxxx	2.0	42.0
OXYG	ML/L	xx.xx	0.0	10.0
OXCU	M AMP	x.xxx	0.0	3.0
OXTM	Celcius	-xx.x	-2.0	30.0

C Sample logging session

```
*****
*
*      Welcome to MicroVMS V5.3      *
*
*      This is a CTD GROUP MicroVax  *
*      CTD03 SYSTEM                  *
*
*****
```

Username: CTD_AQUI

Password:

Last interactive login on Friday, 23-FEB-1990 08:40

Last non-interactive login on Thursday, 28-DEC-1989 15:29

23-FEB-1990 08:44:22

\$ init msa0: ctdaq

\$ start_aqui

%DCL-I-SUPERSEDE, previous value of USER_TERM has been superseded

```
*****
*
*      CTD Data Acquisition System *
*
*
*****
```

killing the print queue

%DCL-I-ALLOC, _CTD03\$TTA2: allocated

Enter the CTD instrument number: 1

%DCL-I-SUPERSEDE, previous value of TEMPLATE_FILE has been superseded

CTDROOT:[TEMPLATE]CTD01.TPL

Creating configuration file...

*** configuration file created: CTDCFG:DEFAULT.CTD_CFG

Logging to mag tape? (y/n): y

Enter mag tape device (eg. msa0:): msa0:

%DCL-I-SUPERSEDE, previous value of CTD_MOUNT_DEVICE has been superseded

Mount tape on MSA0:, type <ret> when ready:

Logging to disk file? (y/n): y

Default data directory is CTDROOT:[DATA]

Output disk files to default data directory? (y/n): y
%DCL-I-SUPERSEDE, previous value of DATA_DIR has been superseded
...Mailbox CTD_COMMAND_MAILBOX is empty.
%RUN-S-PROC_ID, identification of created process is 00000029
Waiting for AQUI process to initialize...
23-FEB-1990 08:45:25.48: %CTDLOG-I-NEW, Starting ...

CTD_LOG up and running

Station number: 60
Cast number: 0
Logging to disk file: CTDROOT:[DATA]0060A000.RAW
Start latitude degrees (DD): 35
Start latitude minutes and hemisphere (MM.MMH): 40.44n
Start longitude degrees (DDD): 63
Start longitude minutes and hemisphere (MM.MMH): 0.13w
23-FEB-1990 08:46:19.51: %CTDLOG-I-START, Station 60, Cast 0
Starting data acquisition...

When ready, put CTD in water.
At the \$ prompt, type CTD LOG to start logging data.

Enter the command STOP_AQUI to terminate the
cast and perform post-cast operations.
23-FEB-1990 08:46:22.86: %CTDLOG-I-POS, Start Lat: 035 40.44N Lon: 063 00.13W
\$ ctd log
23-FEB-1990 08:47:02.33: %CTDLOG-I-LOGGING, Station 60, Cast 0
\$ ctd print 1875
23-FEB-1990 09:00:00.40: %CTDLOG-W-MAXCAST, maximum specified cast duration reached.
23-FEB-1990 09:00:02.64: -CTDLOG-W-BADSEC, global section data is now corrupted.
\$
23-FEB-1990 09:43:17.51: %CTDLOG-I-TAG, tagged scan 76486
23-FEB-1990 09:44:49.60: %CTDLOG-I-TAG, tagged scan 78391
23-FEB-1990 09:47:51.51: %CTDLOG-I-TAG, tagged scan 82458
23-FEB-1990 09:50:47.25: %CTDLOG-I-TAG, tagged scan 86350
23-FEB-1990 09:53:34.98: %CTDLOG-I-TAG, tagged scan 90121
23-FEB-1990 09:56:24.72: %CTDLOG-I-TAG, tagged scan 93848
23-FEB-1990 09:59:11.40: %CTDLOG-I-TAG, tagged scan 97564
23-FEB-1990 10:01:59.14: %CTDLOG-I-TAG, tagged scan 101294
23-FEB-1990 10:04:39.98: %CTDLOG-I-TAG, tagged scan 104875
23-FEB-1990 10:07:21.26: %CTDLOG-I-TAG, tagged scan 108482
23-FEB-1990 10:10:06.75: %CTDLOG-I-TAG, tagged scan 112137
23-FEB-1990 10:12:48.84: %CTDLOG-I-TAG, tagged scan 115759
23-FEB-1990 10:15:45.52: %CTDLOG-I-TAG, tagged scan 119663
23-FEB-1990 10:18:38.48: %CTDLOG-I-TAG, tagged scan 123532
23-FEB-1990 10:21:26.02: %CTDLOG-I-TAG, tagged scan 127265

23-FEB-1990 10:24:23.64: %CTDLOG-I-TAG, tagged scan 131222
 23-FEB-1990 10:27:56.36: %CTDLOG-I-TAG, tagged scan 136039
 23-FEB-1990 10:30:39.94: %CTDLOG-I-TAG, tagged scan 139678
 23-FEB-1990 10:33:28.28: %CTDLOG-I-TAG, tagged scan 143431
 23-FEB-1990 10:36:25.57: %CTDLOG-I-TAG, tagged scan 147372
 23-FEB-1990 10:39:12.96: %CTDLOG-I-TAG, tagged scan 151096
 23-FEB-1990 10:42:01.92: %CTDLOG-I-TAG, tagged scan 154904
 23-FEB-1990 10:43:48.81: %CTDLOG-I-TAG, tagged scan 157114

\$ stop_aqui

23-FEB-1990 10:46:30.62: %CTDLOG-I-STOPPED, Station 60, Cast 0

23-FEB-1990 10:46:34.76: %CTDLOG-I-DEAD, Stopped.

VAX/VMS V4.4 on node CTDO3 23-FEB-1990 10:46:47.64 Uptime 0 21:51:25

Pid	Process Name	State	Pri	I/O	CPU	Page flts	Ph.Mem
00000010	NULL	COM	0	0	0 20:51:07.28	0	0
00000011	SWAPPER	HIB	16	0	0 00:00:03.58	0	0
00000042	CTD_AQUI_RTA1	CUR	4	1105	0 00:01:21.87	4432	321
00000033	CTD_AQUI	HIB	7	1618	0 00:00:15.24	2586	284
00000014	JOB_CONTROL	HIB	9	452	0 00:00:02.85	127	243
00000015	ERRFMT	HIB	9	839	0 00:00:07.57	69	90
00000016	OPCOM	LEF	8	114	0 00:00:01.50	1163	62
00000017	Journal	LEF	5	1541	0 00:00:37.72	12707	123
00000018	CTD_GRAB	CEF	9	14305	0 00:00:32.46	3155	200
0000001A	NETACP	HIB	10	65	0 00:00:15.13	265	180
0000001B	REMACP	HIB	8	41	0 00:00:00.25	73	42

printer is not spooled - starting print queue

\$ lo

CTD_AQUI logged out at 23-FEB-1990 10:53:05.23

D Sample printer output

01079 Data Acquisition

Station: 219

Cast: 0

Page 1

Mon Mar 16 04:37:01 1991 (no nav data)

Data: NONE Section: NONE

Exam	Flag	Pres	Temp	Cond	Salt	OxyC	OxyT	Oxy	Prte	RedT	Flt1	FltY	Thsn
002000	----ST	27.7	19.302	49.320	36.2768	2.300	20.2	5.958	387.5	3675.000	-46.3	-40.4	-1168.8
002040	----ST	27.9	19.669	49.264	36.2778	2.372	20.4	5.925	387.5	3675.000	-46.3	-40.4	-1168.8
002100	----ST	28.5	19.909	49.512	36.3025	2.372	20.4	5.917	387.5	3675.000	-46.3	-40.4	-1168.8
002140	----ST	29.1	19.993	49.464	36.2700	2.369	20.2	5.910	387.5	3675.000	-46.6	-40.4	-1168.8
002180	----ST	29.7	20.055	49.579	36.3105	2.378	20.2	5.917	387.7	3647.000	-46.6	-40.4	-1168.8
002220	----ST	30.3	20.085	49.631	36.3276	2.378	20.2	5.911	387.7	3647.000	-46.6	-40.4	-1168.8
002260	----ST	30.8	19.899	49.351	36.2575	2.390	20.2	5.983	387.7	3647.000	-46.6	-40.4	-1168.8
002300	----ST	30.4	19.778	49.290	36.3119	2.390	20.2	6.008	387.7	3675.000	-46.3	-40.4	-1168.8
002340	----ST	30.5	19.909	49.325	36.2274	2.395	20.4	5.979	387.7	3647.000	-46.6	-40.4	-1168.8
002380	----ST	30.6	19.879	49.264	36.2025	2.389	20.2	5.986	387.7	3673.000	-46.3	-40.4	-1168.8
002420	----DN	30.3	19.118	48.987	36.2978	2.405	20.2	6.199	388.3	3677.000	-46.6	-40.5	-1168.8
002460	----DN	30.1	18.949	48.807	36.2880	2.297	20.2	5.970	389.3	3679.000	-46.6	-40.5	-1168.8
002500	----DN	30.5	18.941	48.410	36.2987	2.219	20.0	5.803	389.5	3707.000	-47.0	-41.0	-1231.6
002540	----DN	30.9	18.986	48.359	36.2916	2.174	19.8	5.723	389.3	3679.000	-47.0	-41.0	-1231.6
002580	----DN	31.3	18.816	48.285	36.2882	2.134	19.6	5.655	388.5	3679.000	-47.0	-40.6	-1168.8
002620	----DN	32.5	18.807	48.288	36.2953	2.113	19.5	5.645	387.3	3679.000	-46.6	-40.6	-1168.8
002660	----DN	30.6	18.775	48.268	36.2874	2.125	19.3	5.711	384.3	3647.000	-46.3	-40.4	-1164.6
002700	----DN	30.8	18.682	48.152	36.2822	2.081	19.1	5.632	382.7	3647.000	-46.3	-40.6	-1168.8
002740	----DN	30.7	18.584	48.041	36.2463	2.016	19.1	5.510	381.3	3643.000	-46.3	-40.5	-1168.8
002780	----DN	31.3	18.625	48.117	36.2679	2.054	19.1	5.617	379.7	3637.000	-46.2	-40.4	-1168.8
002820	----DN	236.2	18.594	48.096	36.2684	2.056	18.9	5.656	378.3	3615.000	-46.1	-40.4	-1168.8
002860	----DN	257.8	18.494	47.963	36.2355	1.989	18.8	5.520	376.9	3605.000	-45.5	-39.8	-1164.6
002900	----DN	236.1	18.357	47.800	36.2100	1.925	18.8	5.384	375.7	3611.000	-45.5	-39.8	-1168.8
002940	----DN	299.5	18.264	47.695	36.1949	1.862	18.7	5.249	374.3	3583.000	-45.5	-39.5	-1168.8
002980	----DN	329.0	18.141	47.350	36.1785	1.838	18.7	5.219	373.1	3583.000	-45.5	-39.8	-1227.4
003020	----DN	340.3	18.044	47.449	36.1637	1.804	18.6	5.165	371.7	3581.000	-45.5	-39.8	-1231.6
003060	----DN	361.5	17.895	47.275	36.1379	1.777	18.4	5.142	371.9	3583.000	-45.5	-39.8	-745.7
003100	----DN	387.2	17.716	47.079	36.1186	1.764	18.3	5.165	370.9	3581.000	-45.5	-39.8	-745.7
003140	----DN	417.2	17.518	46.852	36.0861	1.729	18.2	5.129	369.7	3551.000	-45.4	-39.8	-745.7
003180	----DN	445.9	17.341	46.653	36.0597	1.690	18.2	5.066	368.1	3551.000	-45.1	-39.8	-745.7
003220	----DN	477.8	17.142	46.426	36.0278	1.666	18.0	5.063	366.5	3551.000	-45.1	-39.5	-758.2
003260	----DN	509.7	16.951	45.961	35.9575	1.604	17.8	4.989	364.7	3549.000	-44.8	-39.5	-762.4
003300	----DN	537.3	16.726	45.456	35.8820	1.524	17.5	4.857	362.7	3519.000	-44.8	-39.4	-758.2

E Sample terminal output

The GET_SCAN program allows the user to view data in the global section during acquisition. This program must map to the CTDGBL global section and therefore can only run if the CTD.LOG process is active.

\$ get_scan

Output to a disk file as well as terminal (y/n)? n

maximum # scans in global section: 18750

Global section has wrapped around 3 times.

Scans 1 - 39563 have been overwritten.

current scan: 58313 Logging time (secs): 1866.016

Logging time: 0:31: 6.02

Enter start, end, increment (0,0,0 to end): 50000 60000 1000

scan num	PR	TE	CO	OC	OT	SA	OX	PT	SV	DE	
50000	D	2534.73	3.549	33.199	0.643	4.35	34.967	5.879	3.3	1506.8	2501.2
51000	D	2598.12	3.451	33.130	0.634	4.22	34.960	5.886	3.2	1507.5	2563.4
52000	D	2663.33	3.362	33.072	0.628	4.10	34.955	5.919	3.1	1508.2	2627.3
53000	D	2728.83	3.324	33.061	0.619	4.10	34.953	5.895	3.1	1509.2	2691.5
54000	D	2793.73	3.241	33.009	0.613	3.97	34.949	5.925	3.0	1509.9	2755.1
55000	D	2857.83	3.191	32.987	0.607	3.97	***	Lost scan error	***		
56000	D	2922.44	3.132	32.956	0.598	3.97	34.943	5.905	2.9	1511.6	2881.2
57000	D	2986.94	3.106	32.958	0.592	3.84	34.944	5.922	2.9	1512.6	2944.3
58000	D	3050.84	3.042	32.922	0.586	3.71	34.940	5.945	2.8	1513.4	3006.9
59000	D	3113.44	3.020	32.925	0.577	3.58	34.939	5.927	2.8	1514.4	3068.1
60000	D	3176.54	2.976	32.907	0.571	3.58	34.937	5.926	2.7	1515.3	3129.9

Global section has wrapped around 3 times.

Scans 1 - 41250 have been overwritten.

current scan: 60000 Logging time (secs): 1920.000

Logging time: 0:32: 0.00

Enter start, end, increment (0,0,0 to end): 0 0 0

FORTRAN STOP

\$

\$ get_scan

Output to a disk file as well as terminal (y/n)? n

maximum # scans in global section: 18750

Global section has wrapped around 8 times.

Scans 1 - 140349 have been overwritten.

current scan: 159099 Logging time (secs): 5091.168
Logging time: 1:24:51.17

Enter start, end, increment (0,0,0 to end): 158000 159000 100

scan num	PR	TE	CO	OC	OT	SA	OX	PT	SV	DE
158000 U	182.19	18.223	47.968	1.712	16.90	36.509	5.309	18.2	1521.2	180.8
158100 U	182.69	18.223	47.969	1.700	17.02	36.510	5.256	18.2	1521.2	181.3
158200 U	183.39	18.223	47.968	1.670	17.15	36.509	5.147	18.2	1521.2	182.0
158300 U	183.19	18.222	47.968	1.682	17.15	36.510	5.184	18.2	1521.2	181.8
158400 U	180.79	18.223	47.968	1.700	17.28	36.510	5.222	18.2	1521.1	179.4
158500 U	175.89	18.230	47.974	1.727	17.28	36.511	5.301	18.2	1521.1	174.5
158600 U	169.40	18.252	48.001	1.749	17.28	36.516	5.357	18.2	1521.0	168.1
158700 U	163.81	18.270	48.021	1.758	17.28	36.519	5.378	18.2	1521.0	162.5
158800 U	100.27	18.274	48.022	1.785	17.41	*** Range error ***				
158900 U	151.82	18.270	48.012	1.779	17.41	36.517	5.417	18.2	1520.8	150.7
159000 U	145.92	18.271	48.010	1.773	17.41	36.516	5.394	18.2	1520.7	144.8

Global section has wrapped around 8 times.
Scans 1 - 140349 have been overwritten.

current scan: 159099 Logging time (secs): 5091.168
Logging time: 1:24:51.17

Enter start, end, increment (0,0,0 to end): 140500 150000 500

scan num	PR	TE	CO	OC	OT	SA	OX	PT	SV	DE
140500 U	1130.66	5.835	34.740	0.698	5.12	35.028	4.776	5.7	1492.8	1119.4
141000 U	1096.84	6.333	35.211	0.683	5.25	35.061	4.562	6.2	1494.2	1086.0
141500 U	1062.02	6.705	35.572	0.667	5.25	35.099	4.387	6.6	1495.1	1051.6
142000 U	1027.91	7.239	36.048	0.649	5.38	35.096	4.164	7.1	1496.6	1017.9
142500 U	993.60	7.917	36.700	0.622	5.50	35.136	3.875	7.8	1498.7	984.0
143000 U	981.09	8.186	36.942	0.580	5.63	35.131	3.564	8.1	1499.5	971.7
143500 D	954.59	8.662	37.400	0.589	5.89	35.157	3.532	8.6	1500.9	945.5
144000 U	920.88	9.362	38.117	0.583	6.14	35.232	3.383	9.3	1503.0	912.2
144500 U	888.07	10.078	38.854	0.610	6.14	35.306	3.447	10.0	1505.1	879.7
145000 U	854.96	10.603	39.401	0.622	6.40	35.365	3.422	10.5	1506.5	847.0
145500 U	821.86	11.324	40.182	0.655	6.66	35.466	3.488	11.2	1508.6	814.3
146000 U	790.46	12.018	40.936	0.686	7.04	35.558	3.524	11.9	1510.6	783.2
146500 U	782.66	12.244	41.170	0.707	7.42	35.576	3.571	12.1	1511.3	775.5
147000 D	782.76	12.225	41.162	0.707	8.19	35.586	3.507	12.1	1511.2	775.6
147500 U	753.45	13.092	42.132	0.764	8.58	35.712	3.645	13.0	1513.8	746.6
148000 U	722.75	13.642	42.742	0.815	8.83	35.786	3.787	13.5	1515.2	716.2
148500 U	691.36	14.157	43.353	0.864	9.22	35.891	3.896	14.1	1516.5	685.2
149000 U	660.66	14.855	44.150	0.945	9.73	35.994	4.108	14.8	1518.3	654.8

scan num	PR	TE	CO	OC	OT	SA	OX	PT	SV	DE
149500 U	629.56	15.455	44.791	1.015	10.24	36.040	4.263	15.4	1519.7	624.0
150000 U	598.37	15.926	45.372	1.066	10.62	36.145	4.357	15.8	1520.8	593.2

Global section has wrapped around 8 times.
Scans 1 - 140349 have been overwritten.

current scan: 159099 Logging time (secs): 5091.168
Logging time: 1:24:51.17

Enter start, end, increment (0,0,0 to end): 0 0 0
FORTRAN STOP
\$

F Sample AQUI89 plotting session

\$ START_PLOT

%RUN-S-PROC_ID, identification of created process is 0000001E
Waiting for plot process ot initialize...

PLOT_CTD78 up and running

CTD_PLOT> LIS

Current plot/print setup parameters

Plot factor: 1.0

Plot interval: 10

Start plotting at scan # 1

Number of plot variables: 3

id	axis label	start val	end val	units/in	first dif	annot	int	p	cs
PR	PRESSURE DBARS	0.0000	4500.0000	250.0000	0.0000	0			0
TE	TEMPERATURE DEG C	0.0000	30.0000	3.0000	0.0000	1	1		-1
SA	SALINITY	34.0000	37.0000	0.3000	0.0000	1	1		-1

CTD_PLOT> LOO

Current scan number is 2351

Enter start,end,inc for scans to examine (0,0,0 to end): 700 1000 100

scan num	pres	temp	cond	oxy c	oxy t	oxyg	ptmp	sal	svel	depth
700 D	4.2	18.993	48.705	1.887	19.584	5.237	18.993	36.520	1520.4	4.2
800 D	4.1	18.993	48.705	1.891	19.584	5.245	18.993	36.520	1520.4	4.1
900 D	3.9	18.993	48.705	1.872	19.712	5.178	18.993	36.520	1520.4	3.9
1000 D	4.1	18.994	48.705	1.894	19.584	5.253	18.993	36.520	1520.4	4.1

Current scan number is 2788

Enter start,end,inc for scans to examine (0,0,0 to end): 0 0 0

CTD_PLOT> MOD

Plotting setup menu

h: print this menu
i: specify the independent variable
d: specify a dependent variable
r: remove a plot variable
p: specify a plot factor
s: specify plot sample interval
l: list the active plot variables and parameters
n: change the start scan number
q: quit (done)

Enter option: i (modifying the axis limits for pressure)

Available variable IDs:

PR TE CO OC OT SA PT DE ST SV OX

Enter id for independent variable: PR

Enter axis label (max 20 chars): PRESSURE DBARS

Enter start value, end value, units/inch: 0,5000,250

Enter 1st difference maximum (0 = no check): 0

Enter option: d (adding a dependent variable - CO)

Available variable IDs:

PR TE CO OC OT SA PT DE ST SV OX

Enter id for dependent variable: CO

Enter axis label (max 20 chars): COND MMHO/CM

Enter start value, end value, units/inch: 30,60,3

Enter 1st difference maximum (0 = no check): 0

Enter annotation interval (inches): 1

Enter plot type (p=point,l=line,s=symbol): l

Enter option: d (adding a dependent variable - OX)

Available variable IDs:

PR TE CO OC OT SA PT DE ST SV OX

Enter id for dependent variable: OX

Enter axis label (max 20 chars): OXYGEN

Enter start value, end value, units/inch: 0,6,.6

Enter 1st difference maximum (0 = no check): 0

Enter annotation interval (inches): 1

Enter plot type (p=point,l=line,s=symbol): s

Enter CALCOMP symbol number: 3

Enter option: r (removing a variable - SA)

Enter id for plot variable to remove: SA

Enter option: p

Enter plot factor (1.0): 1

Enter option: s

Enter plot interval (10): 100

Enter print interval (100): 100

Enter option: l

Current plot/print setup parameters

Plot factor: 1.000000

Plot interval: 100

Start plotting at scan # 1

Number of plot variables: 4

id	axis label	start val	end val	units/in	first dif	annot	int	p	cs
PR	PRESSURE DBARS	0.0000	4500.0000	250.0000	0.0000	0.0000	0	0	
TE	TEMP DEG C	0.0000	30.0000	3.0000	0.0000	1.0000	1	-1	
CO	COND MMHO/CM	30.0000	60.0000	3.0000	0.0000	1.0000	1	-1	
OX	OXYGEN	0.0000	6.0000	0.6000	0.0000	1.0000	s	3	

Enter option: q

Initialization of plot/print parameters complete
Plot parameters have been modified, enter
the command AXES and PLOT to begin the next plot.

Last scan plotted: 0
Current scan number is 33559

CTD_PLOT> AXE !note that axes may be plotted prior to data
logging but the CTD_LOG detached process must
be running before any plotting may begin

CTD_PLOT> PLO !starting a new plot

Plot options:

0 plot from current scan
1 plot from beginning of cast
N plot from scan number N

Enter plot option: 1000

CTD_PLOT> EXIT !exit the interactive plot process, return to
DCL

\$ <<< do anything here - edit files, etc. >>>

\$ PCTD !to return to interactive plot process

CTD_PLOT> PAUSE !plotting will be temporarily interrupted, key in
the PLO command to continue plotting or the END
command to finish the current plot

CTD_PLOT> RAT
Current plot interval is 10 scans
Enter new plot interval (scans): 100

CTD_PLOT> SCA
Current scan number is 40442

CTD_PLOT> PLO

Plot options:

c: continue plotting from current scan (gap)
p: continue from where pause started (no gap)

Enter option: C

CTD_PLOT> END

CTD_PLOT> STO

Background plotting process terminated,
Type EXIT to return to command level.

CTD_PLOT> EXI

\$ (returned to DCL)

G Reading a CTD78 disk data file

```
$ sddata
$ read_disk
Enter data filename: 0060a001.raw
%DCL-I-SUPERSEDE, previous value of SYS$INPUT has been superseded
Print station header? (y/n): y
```

```
Station header:
words per scan:      7
station #:          60
cast #:             1
ship code: EN
Print scale factor record? (y/n): y
```

```
Scale factor record:
keyword:            -4
number of variables: 7
descriptor length: 34
words per scan:    7
number of float values: 5
```

```
variable,id,attr_1,attr_2,slope,bias
```

```
1 PR 0.933999E-08 -.102206E-12 0.998763E-01 -.178000E+02
2 TE 0.282170E-11 0.000000E+00 0.499916E-03 -.554621E-02
3 CD -.650000E-05 0.150000E-07 0.998550E-03 -.995867E-02
4 SW 0.280000E+01 0.300000E+04 0.100000E+01 0.000000E+00
5 OC -.325000E-01 0.139500E-03 0.302000E-02 0.000000E+00
6 OT 0.750000E+00 0.000000E+00 0.128000E+00 0.000000E+00
7 QU 0.000000E+00 0.000000E+00 0.100000E+01 0.000000E+00
```

```
Read data records? (y/n): y
Convert raw data to physical units? (y/n): y
```

```
Reading data header records and data records
```

```
Enter record number to read (0 to end): 1
Data records start at record #3
Enter record number to read (0 to end): 3
```

```
Data header record at record #      3
Enter record number to read (0 to end): 4
```

Data record, irec # 4: 146 scans
Enter start,end,inc scans: 1 146 40

scan #	PR	TE	CO	SW	OC	OT
1	4.1	18.994	48.704	0.00	1.935	19.1
41	4.2	18.995	48.704	0.00	1.937	19.1
81	3.9	18.994	48.704	0.00	1.934	19.3
121	4.2	18.993	48.702	0.00	1.934	19.1

Enter record number to read (0 to end): 200
Data record, irec # 200: 146 scans
Enter start,end,inc scans: 1 146 20

scan #	PR	TE	CO	SW	OC	OT
1	1058.6	6.883	35.708	0.00	0.732	12.9
21	1059.7	6.874	35.707	0.00	0.732	12.7
41	1065.0	6.827	35.624	0.00	0.729	12.7
61	1061.7	6.776	35.596	0.00	0.729	12.7
81	1063.0	6.754	35.581	0.00	0.732	12.7
101	1064.1	6.753	35.583	0.00	0.732	12.7
121	1065.4	6.742	35.573	0.00	0.732	12.7
141	1066.8	6.720	35.561	0.00	0.735	12.6

Enter record number to read (0 to end): 600
Errsns # 36 on unit 11
Attempt to read beyond end-of-file
Enter record number to read (0 to end): 584
Data record, irec # 584: 146 scans
Enter start,end,inc scans: 1 146 20

scan #	PR	TE	CO	SW	OC	OT
1	4186.1	2.343	32.674	0.00	0.472	2.8
21	4185.4	2.343	32.677	0.00	0.471	2.8
41	4185.5	2.342	32.673	0.00	0.474	2.8
61	4185.5	2.343	32.671	0.00	0.474	2.6
81	-6494.3	-32.762	65.433	255.00	12.375	-32.7
101	-6494.3	-32.762	65.433	255.00	12.375	-32.7
121	-6494.3	-32.762	65.433	255.00	12.375	-32.7
141	-6494.3	-32.762	65.433	255.00	12.375	-32.7

Enter record number to read (0 to end): 0
FORTRAN STOP
<<< Note: last four records output represent the default data values
used to fill the CTD78 disk data file records >>>

\$
\$ read_disk
Enter data filename: 0060a001.raw
%DCL-I-SUPERSEDE, previous value of FOR011 has been superseded
%DCL-I-SUPERSEDE, previous value of SYS\$INPUT has been superseded

Print station header? (y/n): y

Station header:

words per scan: 7

station #: 60

cast #: 1

ship code: EN

Print scale factor record? (y/n): y

Scale factor record:

keyword: -4

number of variables: 7

descriptor length: 34

words per scan: 7

number of float values: 5

variable,id,attr_1,attr_2,slope,bias

1 PR 0.933999E-08 -.102206E-12 0.998763E-01 -.178000E+02

2 TE 0.282170E-11 0.000000E+00 0.499916E-03 -.554621E-02

3 CO -.650000E-05 0.150000E-07 0.998550E-03 -.995867E-02

4 SW 0.280000E+01 0.300000E+04 0.100000E+01 0.000000E+00

5 OC -.325000E-01 0.139500E-03 0.302000E-02 0.000000E+00

6 OT 0.750000E+00 0.000000E+00 0.128000E+00 0.000000E+00

7 QU 0.000000E+00 0.000000E+00 0.100000E+01 0.000000E+00

Read data records? (y/n): y

Convert raw data to physical units? (y/n): n

Reading data header records and data records

Enter record number to read (0 to end): 584

Data record, irec # 584: 146 scans

Enter start,end,inc scans: 1. 146 20

scan #	PR	TE	CO	SW	OC	OT
1	42002.	4693.	32731.	0.	157.	22.
21	41995.	4692.	32729.	0.	156.	22.
41	41996.	4693.	32730.	0.	156.	22.
61	41996.	4693.	32729.	0.	157.	21.
81	-65535.	-65535.	65535.	255.	4096.	-256.
101	-65535.	-65535.	65535.	255.	4096.	-256.
121	-65535.	-65535.	65535.	255.	4096.	-256.

141 -65535. -65535. 65535. 255. 4096. -256.
Enter record number to read (0 to end): 0
FORTRAN STOP
<<< Note: last four records output represent the default data values
used to fill the CTD78 disk data file records >>>
\$

H Sample output files from AQU189 logging session

H.1 Log file

This appendix shows a sample log file created during a re-run of ENDEAVOR 129 Station 60. The AQU189 program was run using analog cassette tapes played through the CTD deck unit, to simulate a real CTD cast.

The maximum size of the global section was set to 10 minutes, so that this log file would illustrate the messages that occur when the global section wraps-around.

```
$ if .not.f$trnlrm("WHOI_VERIFY") then set noverify !stop syslogin.com printing
%DCL-W-SKPDAT, image data (records not beginning with "$") ignored
%SET-I-NEWLIMS, new working set: Limit = 149 Quota = 298 Extent = 298
  "USER_TERM" = "__CTD03$OPAO:" (LNM$GROUP_000300)
  "CTD_MOUNT_DEVICE" = "MSAO:" (LNM$GROUP_000300)
  "DATA_DIR" = "CTDROOT:[DATA]" (LNM$GROUP_000300)
%MOUNT-I-MOUNTED, CTDAQU mounted on _MSAO:
Enter tape device (msa0:):
channel #          176 assigned to tape.
Only 80 bytes read, must be a new tape!
*** NEW TAPE ***
Writing EOF to tape...
Rewinding tape...
FORTRAN STOP
  "TEMPLATE_FILE" = "CTDROOT:[TEMPLATE]CTD01.TPL" (LNM$GROUP_000300)
%DCL-I-SUPERSEDE, previous value of ERROR_CODE has been superseded
```

```
CTD_LOG X4.01 - Background CTD Data Conversion and Logging Task
University of Rhode Island Graduate School of Oceanography
Nov 29 1989 16:10:03
```

```
Fish scan 10 bytes long.
Data scan 13 bytes long.
Max data capacity 18750 scans, or 10 minutes at 31.25 scans/sec.
Logging data in WHOI CTD78 format.
```

```
Logging 6 variables:
Status Flags
Pressure
Temperature
Conductivity
Oxygen Sensor Current
Oxygen Sensor Temperature
```

```
*** subroutine init_ctd78 ***
(ctd78_trnlrm) logical name CTD_MOUNT_DEVICE is assigned to: MSAO:
```

```

(read_template) plot parameters
num_plot_var:      5
Command: CTD_LOG001 0060A000.RAW Status: 1
Command: Status: 1
Command: CTD_LOG026 60 Status: 1
Command: Status: 1
Command: CTD_LOG027 0 Status: 1
Command: Status: 1
Command: CTD_LOG011 Status: 1
Command: Status: 1
*** subroutine start_cast_ctd78 ***
%INFO: START, Station 60, Cast 0
Command: CTD_LOG024 35 40.44N 63 0.13W Status: 1
Command: Status: 1
%INFO: POS, Start Lat: 035 40.44N Lon: 063 00.13W
%INFO: LOGGING, Station 60, Cast 0
*** subroutine start_log_ctd78 ***
(write_tape_h) channel # 416 assigned to tape.
*** subroutine write_scan_ctd78 ***
Command: CTD_LOG013 Status: 1
Command: Status: 1
%INFO: LOGGING, Station 60, Cast 0
Command: CTD_LOG004 1875 Status: 1
Command: Status: 1
Wrapping around on global section at scan #: 18750
%WARNING: MAXCAST, maximum specified cast duration reached.
-WARNING: BADSEC, global section data is now corrupted.
Wrapping around on global section at scan #: 37500
Wrapping around on global section at scan #: 56250
Wrapping around on global section at scan #: 75000
%INFO: TAG, tagged scan 76486
(write_scan) tagged scan # 76486 flags = 54 record tag = 1
Subroutine write_tag_78, version of 20 December 1989
%INFO: TAG, tagged scan 78391
(write_scan) tagged scan # 78391 flags = 6 record tag = 2
%INFO: TAG, tagged scan 82458
(write_scan) tagged scan # 82458 flags = 54 record tag = 3
%INFO: TAG, tagged scan 86350
(write_scan) tagged scan # 86350 flags = 23 record tag = 4
%INFO: TAG, tagged scan 90121
(write_scan) tagged scan # 90121 flags = 6 record tag = 5
Wrapping around on global section at scan #: 93750
%INFO: TAG, tagged scan 93848
(write_scan) tagged scan # 93848 flags = 7 record tag = 6
%INFO: TAG, tagged scan 97564
(write_scan) tagged scan # 97564 flags = 6 record tag = 7
%INFO: TAG, tagged scan 101294
(write_scan) tagged scan # 101294 flags = 6 record tag = 8

```

```

%INFO: TAG, tagged scan 104875
(write_scan) tagged scan #      104875 flags =      6 record tag =      9
%INFO: TAG, tagged scan 108482
(write_scan) tagged scan #      108482 flags =      6 record tag =     10
%INFO: TAG, tagged scan 112137
(write_scan) tagged scan #      112137 flags =      6 record tag =     11
Wrapping around on global section at scan #: 112500
%INFO: TAG, tagged scan 115759
(write_scan) tagged scan #      115759 flags =      6 record tag =     12
%INFO: TAG, tagged scan 119663
(write_scan) tagged scan #      119663 flags =      7 record tag =     13
%INFO: TAG, tagged scan 123532
(write_scan) tagged scan #      123532 flags =      7 record tag =     14
%INFO: TAG, tagged scan 127265
(write_scan) tagged scan #      127265 flags =      6 record tag =     15
%INFO: TAG, tagged scan 131222
(write_scan) tagged scan #      131222 flags =      6 record tag =     16
Wrapping around on global section at scan #: 131250
%INFO: TAG, tagged scan 136039
(write_scan) tagged scan #      136039 flags =      7 record tag =     17
%INFO: TAG, tagged scan 139678
(write_scan) tagged scan #      139678 flags =      6 record tag =     18
%INFO: TAG, tagged scan 143431
(write_scan) tagged scan #      143431 flags =      6 record tag =     19
%INFO: TAG, tagged scan 147372
(write_scan) tagged scan #      147372 flags =      7 record tag =     20
Wrapping around on global section at scan #: 150000
%INFO: TAG, tagged scan 151096
(write_scan) tagged scan #      151096 flags =      6 record tag =     21
%INFO: TAG, tagged scan 154904
(write_scan) tagged scan #      154904 flags =      7 record tag =     22
%INFO: TAG, tagged scan 157114
(write_scan) tagged scan #      157114 flags =      7 record tag =     23
Command: CTD_LOG012  Status: 1
Command:  Status: 1
*** subroutine end_cast_ctd78 ***
(end_cast) start position:
latitude:    35.67
longitude:  -63.00
(end_cast) number of data records in CTD78 disk file:      1090
(end_cast) total # of records in CTD78 disk data file:     1100
Total number of scans logged:      159099
Total number of errors:             3734
Total number of sync errors:        0
Total number of scans lost:         3121
Total number of range errors:       613
Total number of scans tagged:       23
(end_cast) end position:

```

latitude: 0.00
No end longitude recorded.

maximum pressure: 5695.26
at scan #: 85877
CTD78 record #: 596

minimum pressure: 0.0
at scan #: 1
CTD78 record #: 4

header.max_pres: 5695.26
header.min_pres: 0.00

(end_cast) number of scans outstanding: 105

%INFO: STOPPED, Station 60, Cast 0

Command: CTD_LOG030 Status: 1

*** subroutine cleanup_ctd78 ***

Command: Status: 1

Unmapped section memory from 9A600H to D87FFH.

Ciao.

CTD_AQUI job terminated at 23-FEB-1990 10:46:38.35

Accounting information:

Buffered I/O count:	528	Peak working set size:	200
Direct I/O count:	1843	Peak page file size:	1838
Page faults:	250443	Mounted volumes:	1
Charged CPU time:	0 00:40:34.47	Elapsed time:	0 02:01:27.95

H.2 Header file

```

SHIP EN CRUISE 129 STATION 60 DATA VERSION 0
START 35 40.44 N 63 0.13 W AT 846 90/ 2/23
END 0 0.00 N 0 0.00 E AT 1046
WIND = 0 DEPTH = 0 POS. = STA. TYPE = CL
W/SCN = 7 SRATE = 3125 FREQ = 10000 INST. NO. = 1
EDIT DATE 0/ 0/ 0 QUAL = 0 WAT. SAM. = 0
PMIN = 0 PMAX = 5695
SHIP = EN CRUISE = 129 STATION = 60
ID ATTR. 1 SLOPE ENG. BIAS T.CONST. ATTR. 2
PR 0.933999E-08 0.998763E-01-0.178000E+02 0.000000E+00-0.102206E-12
TE 0.282170E-11 0.499916E-03-0.554621E-02 0.250000E+00 0.000000E+00
CO-0.650000E-05 0.998550E-03-0.995867E-02 0.000000E+00 0.150000E-07
SW 0.280000E+01 0.100000E+01 0.000000E+00 0.000000E+00 0.300000E+04
OC-0.360000E-01 0.302000E-02 0.000000E+00 0.000000E+00 0.115000E-03
OT 0.500000E+00 0.128000E+00 0.000000E+00 0.000000E+00 0.000000E+00
QU 0.000000E+00 0.100000E+01 0.000000E+00 0.000000E+00 0.000000E+00

```

Plot setup parameters

```

1.0000 !plot factor
20 !plot interval
100 !print interval
5 !number of plot variables

```

id	start	end	scale	firstannot	plot	calcomp	
PR	0.0000	5000.0000	250.0000	0.0000	0.0000		0
TE	0.0000	30.0000	3.0000	0.0000	1.0000	1	-1
CO	30.0000	60.0000	3.0000	0.0000	1.0000	1	-1
SA	34.0000	37.0000	0.3000	0.0000	1.0000	1	-1
OX	0.0000	6.0000	0.6000	0.0000	1.0000	1	-1

H.3 Error file

The error file contains the cumulative errors recorded during a deployment. The values listed are the cumulative number of scans that have been flagged for each CTD78 data record. The errors recorded are:

bad frame synch - the number of bytes between frame synch bytes is not correct

lost data - missed data scans, filled with last good scan to ensure time series

range errors - check for variables within the allowable range (defined in configuration file); also checks for pressure jumps

Note that if the number of errors exceeds 32768, the counter variables (integer*2) are reset to zero to avoid an integer overflow error.

*** error file -- EN 129 ***

Errors are cumulative - recorded for each CTD78 data record

ctd78 disk record #	bad frame synch	lost	range data	total errors	errors
1	0		2	0	2
2	0		2	0	2
3	0		2	2	4
4	0		2	2	4
5	0		2	2	4
6	0		2	2	4
7	0		6	4	10
8	0		8	4	12
9	0		8	4	12
10	0		10	4	14
11	0		10	4	14
12	0		10	4	14
13	0		10	4	14
14	0		10	4	14
15	0		10	4	14
16	0		10	8	18
17	0		14	8	22
18	0		16	8	24
19	0		16	8	24
20	0		18	12	30
21	0		20	12	32
22	0		20	12	32
23	0		24	12	36

24	0	24	16	40
25	0	26	16	42
.
.
.
1074	0	2892	606	3498
1075	0	2896	606	3502
1076	0	2904	607	3511
1077	0	2929	607	3536
1078	0	2935	607	3542
1079	0	2941	609	3550
1080	0	2958	609	3567
1081	0	2971	611	3582
1082	0	2981	611	3592
1083	0	2989	611	3600
1084	0	3001	613	3614
1085	0	3013	613	3626
1086	0	3030	613	3643
1087	0	3045	613	3658
1088	0	3059	613	3672
1089	0	3075	613	3688

H.4 Raw water sample file

The values listed in the water sample files are averages of the num_water_samp values (defined in the template file) immediately preceding the record tag. The column labeled Tag # is the sequential number of the record tag. The column BT# is set to zero; this column can be edited with the actual bottle numbers post-cast. The column labeled dTP/dt is set to 0.00 if there is no measured Titanium pressure temperature.

When a CTD instrument is configured for more than the 'standard' 7 variables per scan, the water sample file may extend beyond 80 columns. To view the files on the screen, do the following:

```
$ wide          (sets the terminal screen width to 132 characters)
$ ty 0060a000.wrw
$ unwide (sets the terminal screen width back to 80 characters)
```

```
*** Water sample data -- EN 129 ***
```

```
Records tagged during acquisition -- Raw data
```

```
Station: 60 Cast: 0
```

Sta #	Tag #	BT#	Scan #	CTD Pres	CTD Temp	CTD Con	CTD OXCur	CTD OTMP	dT/dt Du/s	doc/dt Du/s	dTP/dt Du/s
60	1	0	29590	43305.60	4672.00	32764.00	153.74	21.0	0.00038	0.00000	0.00
60	2	0	33123	42001.80	4693.67	32730.40	155.90	21.0	0.00126	0.00000	0.00
60	3	0	37812	40002.60	4822.00	32723.00	160.69	20.0	0.00000	0.00155	0.00
60	4	0	41825	37997.60	4957.00	32716.00	166.46	20.0	0.00000	0.00002	0.00
60	5	0	45001	35994.20	5190.00	32754.20	171.35	21.0	0.00000	-0.00110	0.00
60	6	0	48993	33996.00	5510.00	32831.60	177.24	21.0	-0.00049	0.00002	0.00
60	7	0	52098	31999.60	5909.00	32943.20	184.39	22.0	0.00000	0.00000	0.00
60	8	0	56238	29994.00	6234.00	33020.00	189.53	23.0	0.00000	-0.00001	0.00
60	9	0	60034	27982.60	6542.33	33088.00	197.48	24.0	0.00046	0.00002	0.00
60	10	0	63895	25998.20	6958.00	33205.00	205.87	26.0	-0.00081	0.00000	0.00
60	11	0	67730	23999.80	7359.00	33315.00	213.81	27.0	0.00000	0.00001	0.00
60	12	0	71099	21995.80	7661.00	33375.80	221.00	29.0	0.00000	0.00000	0.00
60	13	0	75816	20004.20	7974.33	33442.00	227.79	30.0	-0.00063	-0.00003	0.00
60	14	0	79221	18006.40	8343.00	33527.00	232.71	31.0	0.00001	-0.00005	0.00
60	15	0	83010	16003.80	9007.00	33759.00	237.43	32.0	-0.00002	-0.00112	0.00
60	16	0	87492	14013.80	10101.00	34211.00	238.91	35.0	0.00000	0.00012	0.00
60	17	0	90128	11997.80	11582.00	34820.80	231.56	39.0	-0.00001	0.00006	0.00
60	18	0	94957	9995.20	16387.33	37005.00	201.72	43.0	0.00044	-0.00007	0.00
60	19	0	98632	8008.80	24472.67	41222.20	233.09	59.0	0.00033	-0.00006	0.00
60	20	0	102880	5993.40	32319.33	45714.40	354.17	88.0	-0.00027	-0.00002	0.00
60	21	0	106374	3996.80	35807.00	47750.40	478.85	114.0	-0.00001	-0.00013	0.00
60	22	0	110933	2008.20	36455.00	48045.00	568.91	132.0	0.00000	0.00020	0.00
60	23	0	114293	1001.80	36679.00	48133.00	597.48	140.0	0.00000	0.00006	0.00

where:

Sta # = station number
BT # = bottle number (set to zero)
Pres = average pressure
Con = average conductivity
OTMP = average oxygen temperature

Tag # = record tag number
Scan # = tagged scan number
Temp = average temperature
OXcur = average oxygen current

dT/dt = rate of change of temperature (deg C/sec)
 doc/dt = rate of change of oxygen current (m/sec)
 dTP/dt = rate of change of Titanium pressure temperature (TP)
(this value is set to 0.0 if TP is not measured)

H.5 Scaled water sample file

The values for salt and oxygen listed in the water sample file are the derived, not the measured, values.

*** Water sample data -- EN 129 ***

Records tagged during acquisition -- Data scaled to physical units

Station: 60 Cast: 0

Sta #	Tag #	BT#	Scan #	CTD Pres	CTD Temp	CTD Con	CTD OXCur	CTD OTMP	Salt psu	oxygen ml/l
60	1	0	29590	4316.6	2.332	32.715	0.464	2.7	34.5898	5.903
60	2	0	33123	4186.1	2.341	32.673	0.471	2.7	34.8964	5.876
60	3	0	37812	3985.9	2.405	32.666	0.485	2.6	34.9026	5.895
60	4	0	48825	3785.1	2.473	32.659	0.503	2.6	34.9072	5.925
60	5	0	45001	3584.5	2.589	32.697	0.517	2.7	34.9155	5.889
60	6	0	48993	3384.4	2.749	32.774	0.535	2.7	34.9257	5.892
60	7	0	52098	3184.4	2.949	32.886	0.557	2.8	34.9359	5.902
60	8	0	56238	2983.5	3.111	32.962	0.572	2.9	34.9449	5.849
60	9	0	60034	2782.1	3.265	33.030	0.596	3.1	34.9535	5.876
60	10	0	63895	2583.3	3.473	33.147	0.622	3.3	34.9634	5.881
60	11	0	67730	2383.2	3.673	33.257	0.646	3.5	34.9742	5.882
60	12	0	71099	2182.5	3.824	33.317	0.667	3.7	34.9802	5.846
60	13	0	75816	1983.1	3.981	33.383	0.688	3.8	34.9870	5.811
60	14	0	79221	1783.0	4.165	33.468	0.703	4.0	34.9882	5.721
60	15	0	83010	1582.6	4.497	33.700	0.717	4.1	35.0068	5.597
60	16	0	87492	1383.4	5.044	34.151	0.722	4.5	35.0536	5.330
60	17	0	90128	1181.7	5.785	34.760	0.699	5.0	35.0774	4.843
60	18	0	94957	981.3	8.188	36.942	0.609	5.5	35.1302	3.756
60	19	0	98632	782.6	12.230	41.154	0.704	7.6	35.5718	3.548
60	20	0	102880	581.1	16.154	45.640	1.070	11.3	36.1837	4.265
60	21	0	106374	381.5	17.899	47.674	1.446	14.6	36.4699	4.921
60	22	0	110993	182.8	18.223	47.968	1.718	16.9	36.5092	5.328
60	23	0	114293	82.3	18.335	48.056	1.804	17.9	36.5232	5.365

where:

Sta # = station number

BT # = bottle number (set to zero)

Temp = average temperature

OXcur = average oxygen current

Salt = salinity 1978 PSS

Tag # = record tag number

Pres = average pressure

con = average conductivity

OTMP = average oxygen temperature

oxygen = oxygen content

I Determining space on 9T magnetic tape

To determine the amount of data that will fit on a 1200' 9T magnetic tape at 1600 bpi:

given: inter-record gaps = 0.75"
1200' tape = 14400" tape

CTD78 tape header record =	180 bytes
CTD78 station file header record =	180 bytes
CTD78 scale factor record =	2064 bytes
CTD78 data records =	2064 bytes
CTD78 file trailer record =	180 bytes

The header information will require ~4.6"

tape header	.75" + 180/1600 = 0.8625"
station file header	.75" + 180/1600 = 0.8625"
scale factor record	.75" + 2064/1600 = 2.04"
file trailer	.75" + 180/1600 = 0.8625"

	4.6275"

There will be approximately 14300" left for data records:

$14400"/\text{tape} - 4.6"/\text{headers} = \sim 14300"/\text{data}$

Since data records require ~2.04" per record, this gives:

$14300"/2.04"/\text{record} = 7010 \text{ CTD78 data records}/\text{tape}$

For a standard fish configuration (10 bytes) collected at a data rate of 31.25 scans/sec, a 1200' tape could hold approximately 9 hours of CTD data:

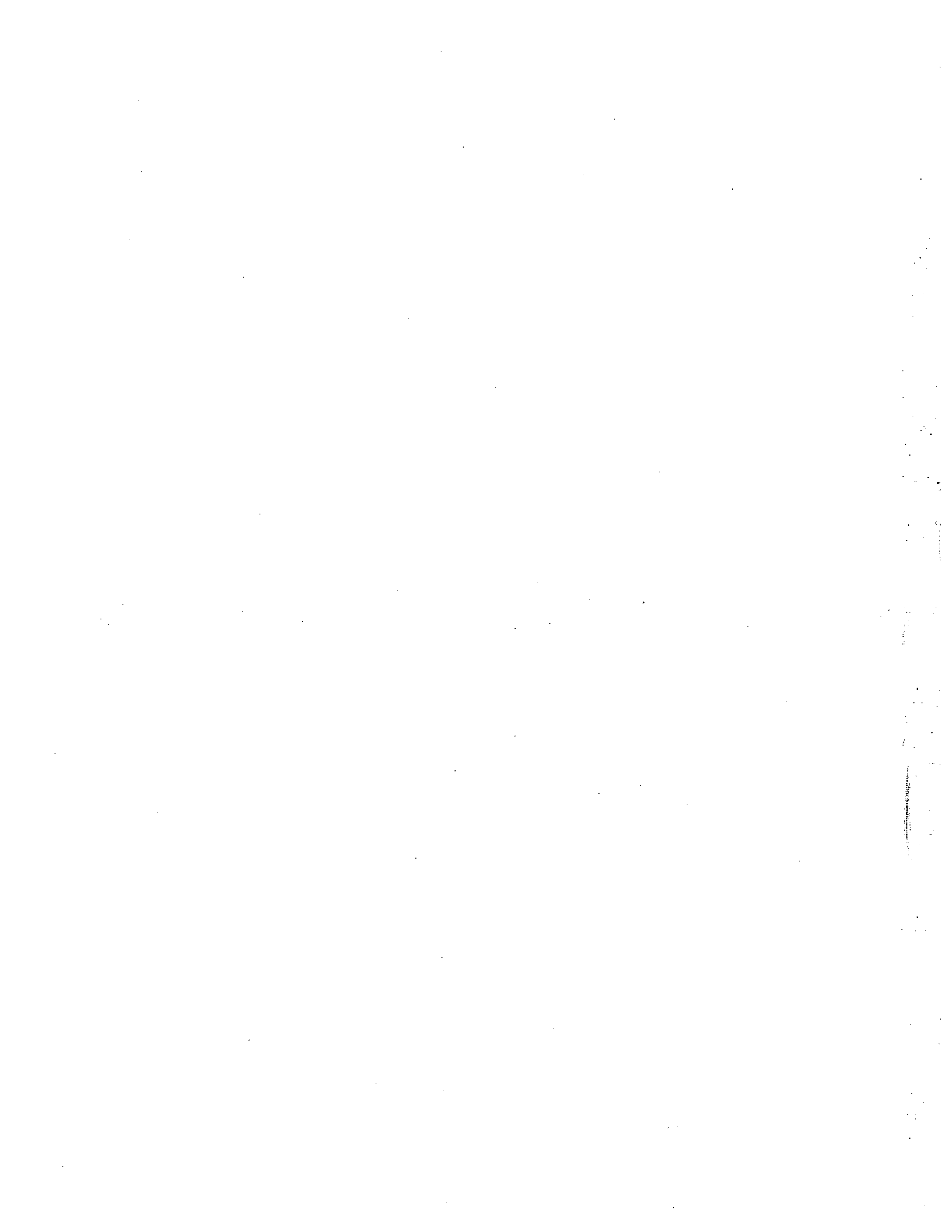
$7010 \text{ records} * 146 \text{ scans}/\text{record} = 1023460 \text{ scans}$

$1023460 \text{ scans} / 31.25 \text{ scans}/\text{sec} = \sim 32750 \text{ seconds}$

= ~9 hours

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