WHOI-92-02

Woods Hole
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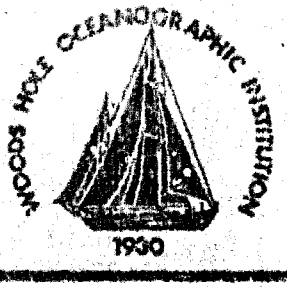
Institution



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

by

J.M. Allen

January 1992

Technical Report

Funding was provided by the National Science Foundation under
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Robert C. Groman, Director
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WHOI CTD MicroVAX II Data Acquisition System Part I:	Installation Manual
WHOI CTD MicroVAX II Data Acquisition System Part III:	Reference Manual
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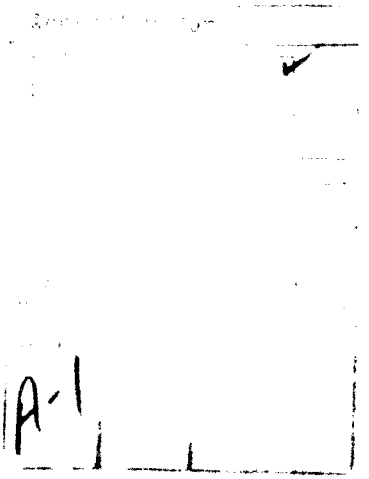
WHOI CTD MicroVAX II Data Acquisition System Part V:	Directory Structure, Source Code and DCL files



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 acquistion 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).

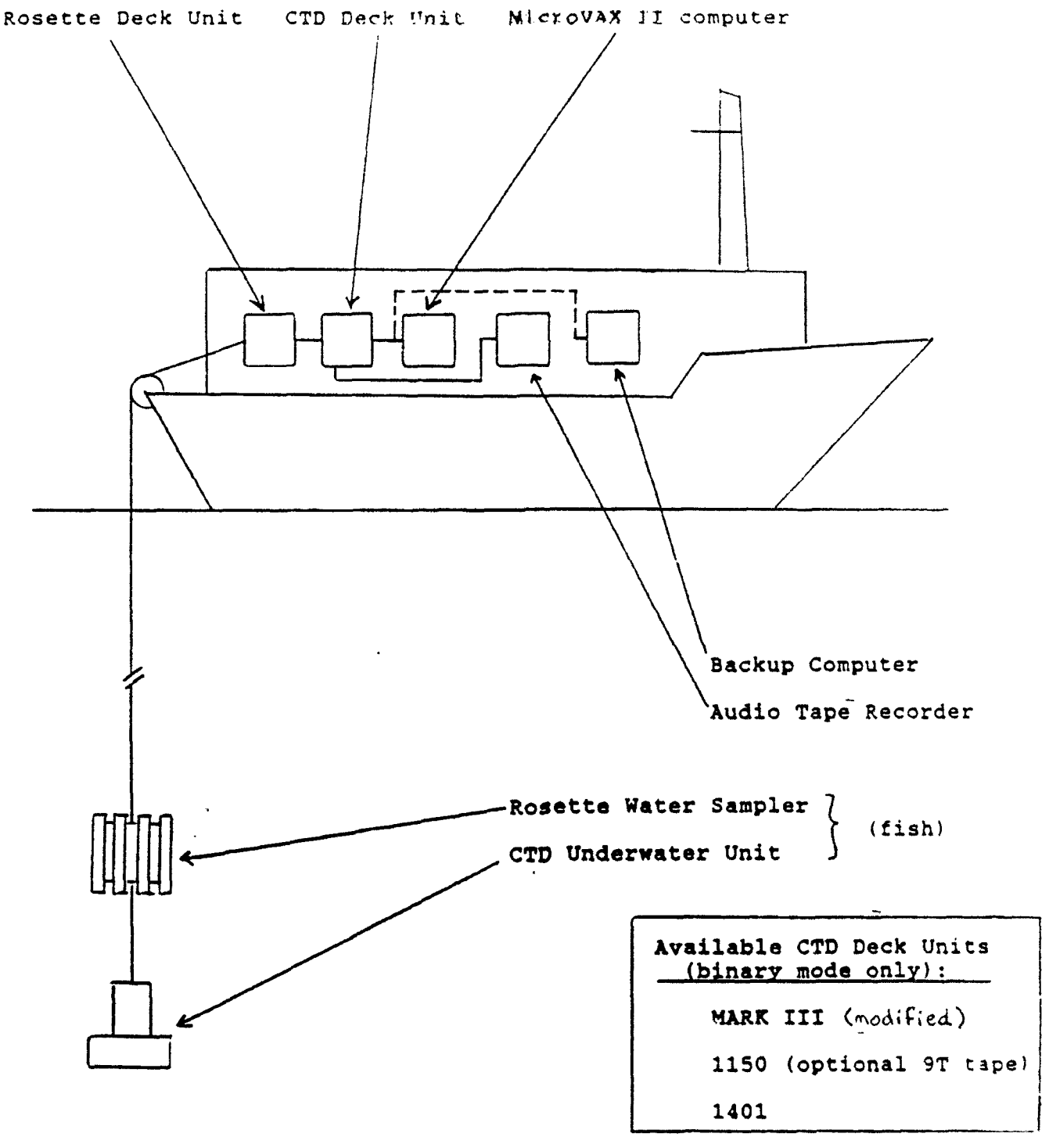


Figure 1: CTD Data Acquisition System Overview

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):

srate = 1/5 kHz * (number of bytes + 1) * 11 bits/byte <= 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 and 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.

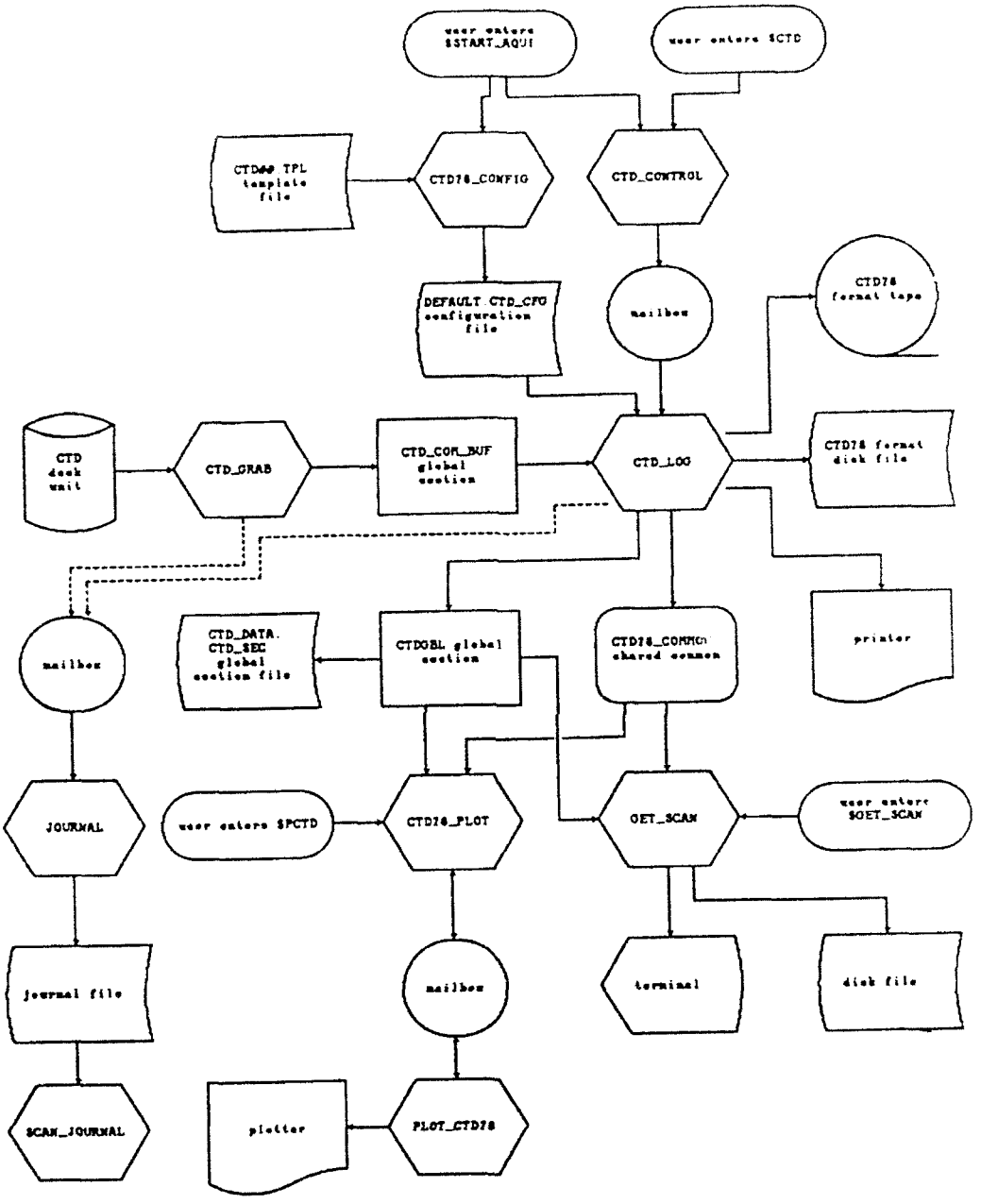


Figure 2: AQUI89 Software Overview

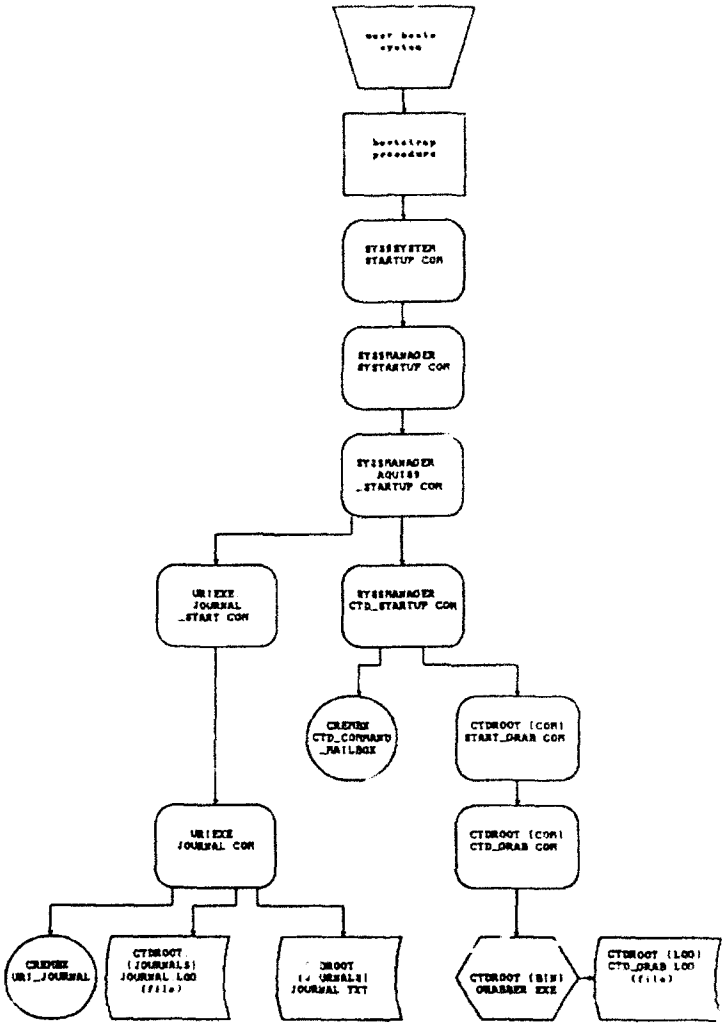


Figure 3: Start VMS, initiate CTD_GRAB and Journal

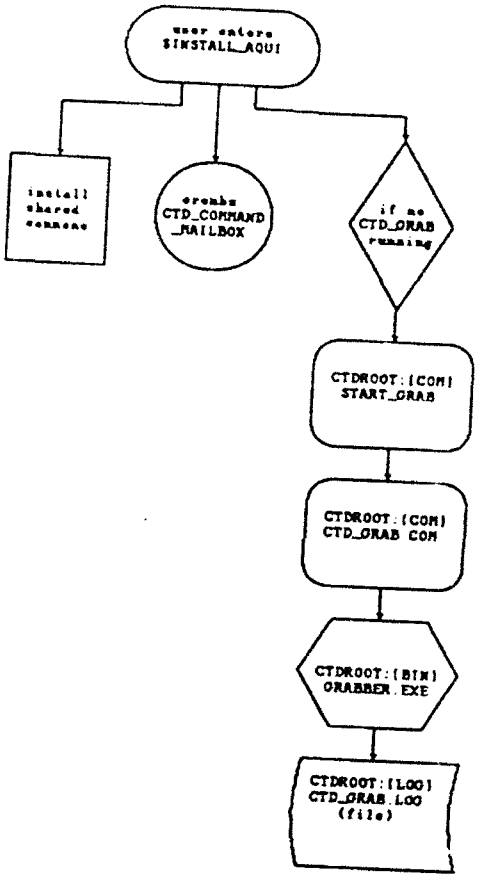


Figure 4: Install AQUI89 data acquisition system

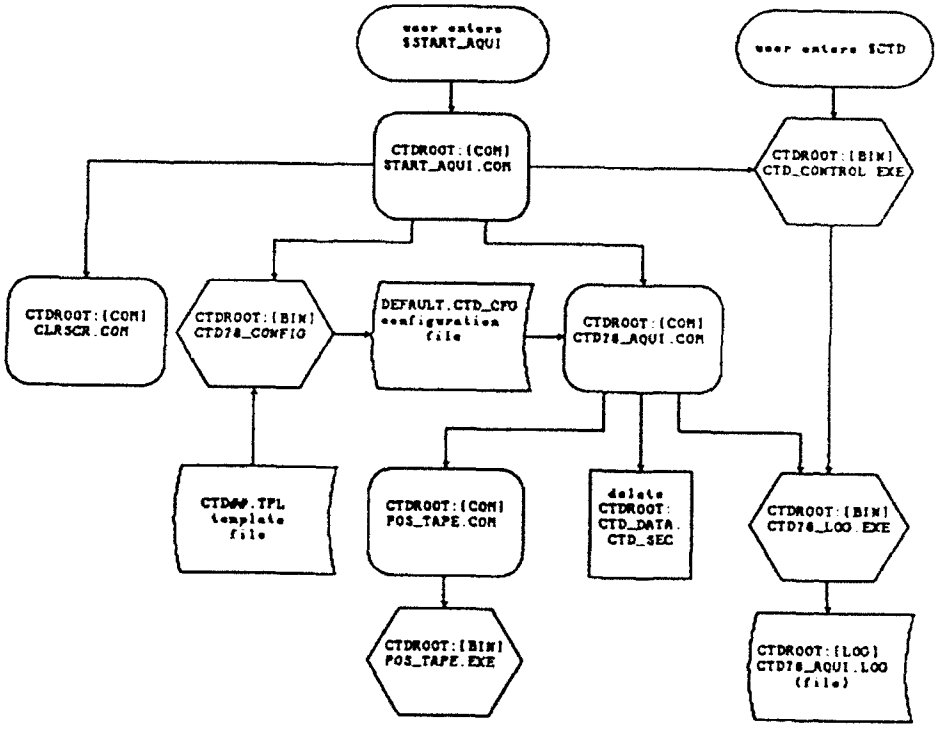


Figure 5: Initiate data logging process and control of data logging operations

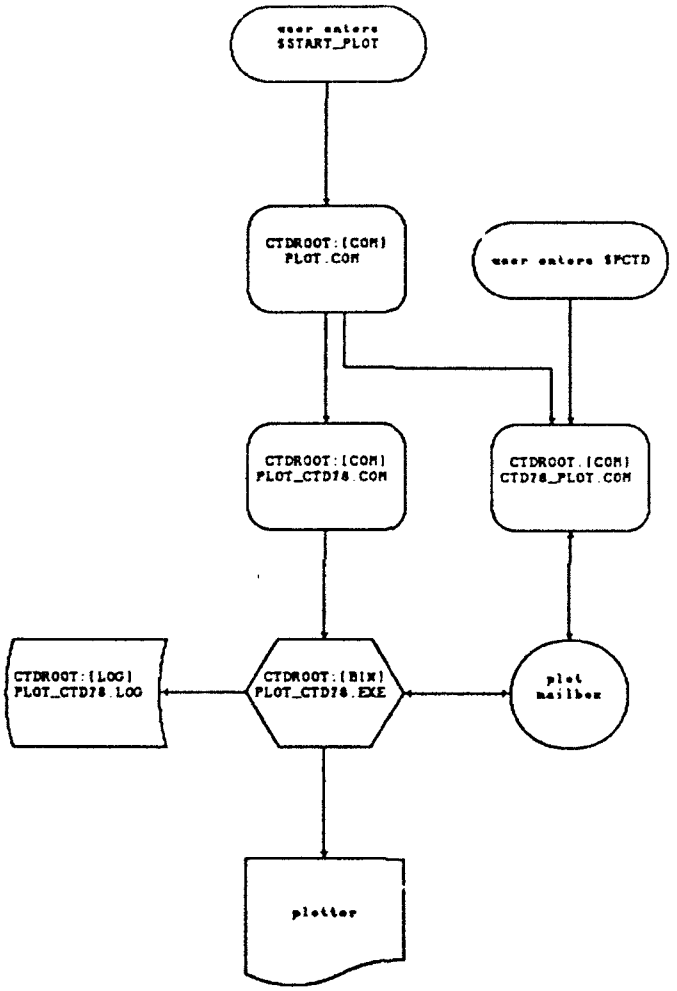


Figure 6: Initiate plotting operation

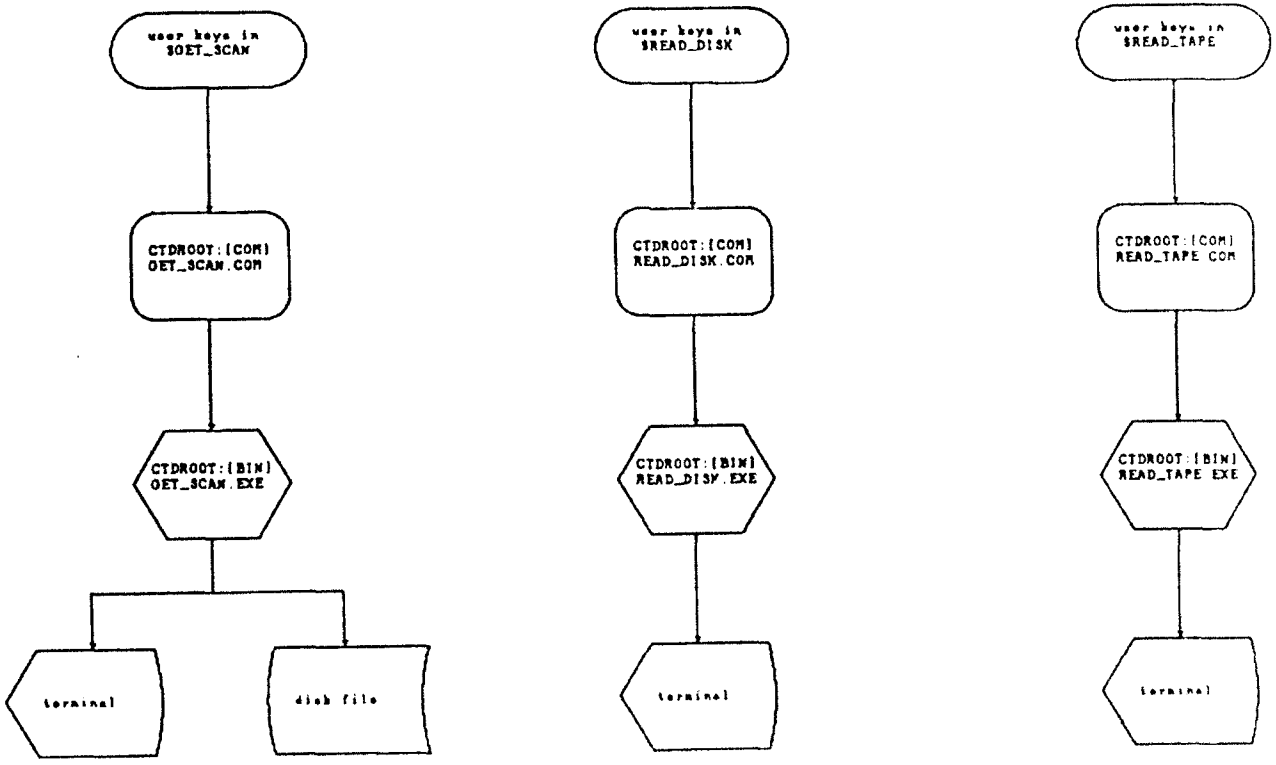


Figure 7: Initiate GET_SCAN, READ_DISK and READ_TAPE processes

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

variable	type	description
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 se
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_AQUI.LOG**
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 **AQUI89**, 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 **AQUI89** 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_AQUI.LOG** 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 MSA0:  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 15.0N 45 30.0W   (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 preceeding 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)

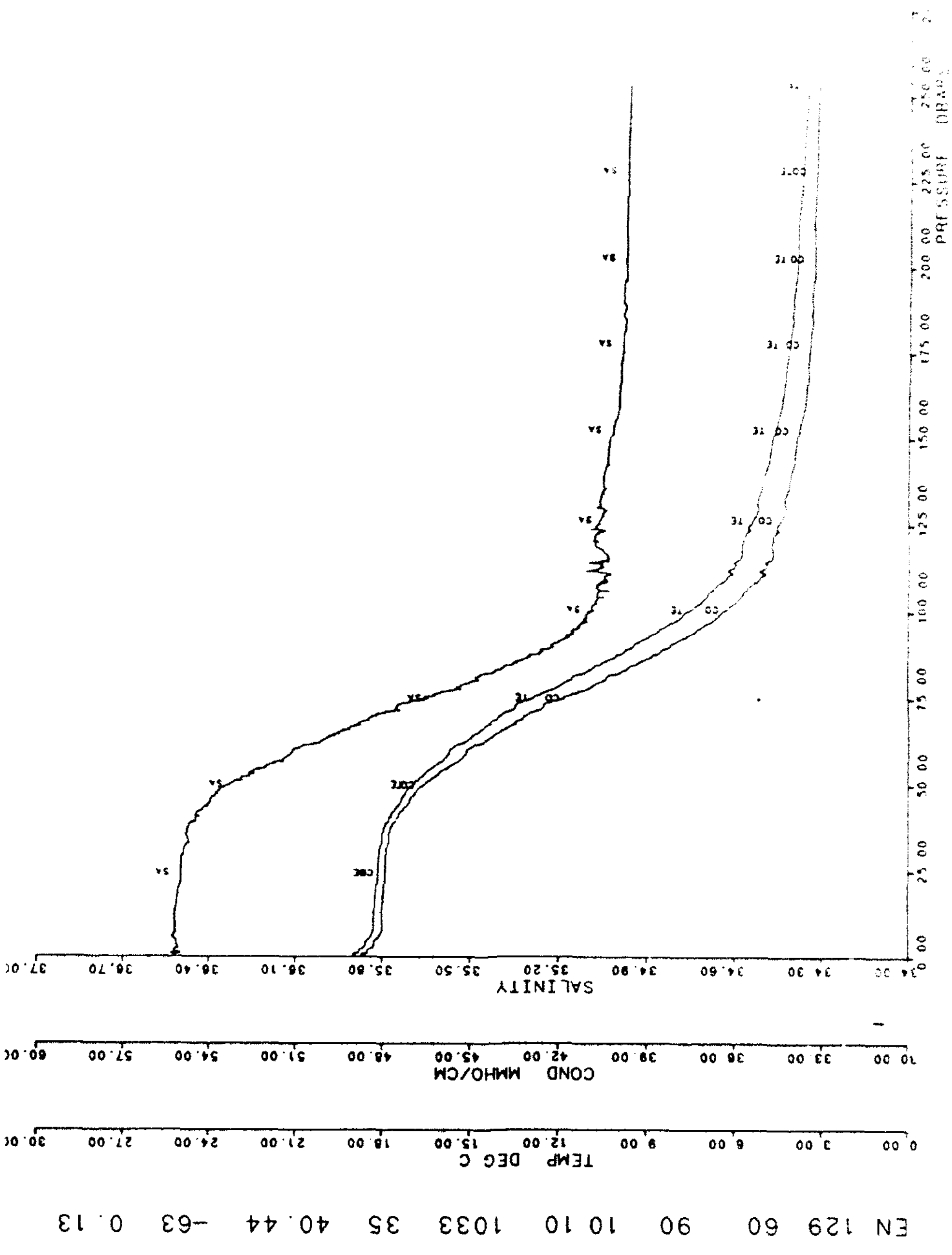


Figure 8: Sample AQUI89 plot

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:

COND = COND * (1.0 + ALPHA * (TEMP - CTZ) + BETA * (PRES - 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:

COND = COND * (1.0 - ALPHA * (TEMP - CTZ) + BETA * (PRES - 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 lab
units	physical unit 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 oxc1 in subroutine oxyg)	attribute_2 (oxygen temperature)	0.0
C2 (variable oxc2 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: ctdaqu
$ 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 08:47:02.38: %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 CTD03 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

[illegible] Page 1

[illegible] Cast: 0

[illegible] (no nav data)

[illegible] NONE

Scan	Flag	Pres	Temp	Cond	Salt	OxyC	OxyT	[illegible]	[illegible]	PedT	[illegible]	Tilt	Tnsn
[illegible]	----ST	[illegible]	19.332	49.330	36.2768	2.330	20.2	5.953	387.5	3675.000	-46.3	-40.4	-1168.8
[illegible]	----ST	27.9	19.369	49.264	36.2778	2.372	20.4	5.925	387.5	3675.000	-46.3	-40.4	-1168.8
[illegible]	----ST	28.5	19.309	49.512	36.3625	2.372	20.4	5.917	387.5	3675.000	-46.3	-40.4	-1168.8
[illegible]	----ST	[illegible]	19.953	49.464	36.2700	2.359	20.2	5.910	387.5	3675.000	-46.6	-40.4	-1168.8
[illegible]	----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
[illegible]	----ST	30.3	20.065	49.631	36.3276	2.378	20.2	5.911	387.7	3647.000	-46.6	-40.4	-1168.8
[illegible]	----ST	30.6	19.849	49.351	36.2575	2.390	20.2	5.983	387.7	3647.000	-46.6	-40.4	-1168.8
[illegible]	----ST	30.4	19.779	49.290	36.3119	2.390	20.2	6.008	387.7	3675.000	-46.3	-40.4	-1168.8
[illegible]	----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
[illegible]	----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
[illegible]	----DN	[illegible]	19.113	48.537	36.2978	2.405	20.2	6.199	388.3	3677.000	-46.6	-40.5	-1168.8
[illegible]	----DN	57.1	18.949	48.807	36.2980	2.297	20.2	5.970	389.3	3679.000	-46.6	-40.5	-1168.8
[illegible]	----DN	72.5	18.741	48.410	36.2987	2.219	20.0	5.803	389.5	3707.000	-47.0	-41.0	-1231.6
[illegible]	----DN	86.7	18.556	48.357	36.2716	2.174	19.8	5.723	389.3	3679.000	-47.0	-41.0	-1231.6
[illegible]	----DN	[illegible]	18.857	48.345	36.2894	2.134	19.6	5.655	388.5	3679.000	-47.0	-40.6	-1168.8
[illegible]	[illegible]	113.4	18.816	48.285	36.2882	2.125	19.5	5.665	387.3	3679.000	-46.5	-40.5	-1168.8
[illegible]	----DN	129.5	18.307	48.298	36.2353	2.113	19.5	5.645	385.7	3647.000	-46.3	-40.4	-1164.5
[illegible]	----DN	150.5	18.775	48.258	36.2874	2.125	19.3	5.711	384.3	3647.000	-46.3	-40.3	-1150.4
[illegible]	----DN	173.0	18.682	48.152	36.2822	2.081	19.1	5.652	382.7	3647.000	-46.3	-40.6	-1168.8
[illegible]	[illegible]	195.7	18.584	48.041	36.2463	2.016	19.1	5.510	381.3	3643.000	-46.3	-40.5	-1168.8
[illegible]	----DN	213.4	18.525	48.117	36.2679	2.054	19.1	5.617	379.7	3637.000	-46.2	-40.4	-1168.8
[illegible]	----DN	236.2	18.394	48.096	36.2684	2.056	18.9	5.656	378.3	3615.000	-46.1	-40.4	-1168.8
[illegible]	----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
[illegible]	----DN	[illegible]	18.357	47.808	36.2100	1.925	18.8	5.384	375.7	3611.000	-45.5	-39.8	-1168.8
[illegible]	----DN	[illegible]	18.264	47.695	36.1949	1.862	18.7	5.249	374.3	3583.000	-45.5	-39.5	-1168.8
[illegible]	----DN	324.0	18.141	47.558	36.1785	1.838	18.7	5.219	373.1	3583.000	-45.5	-39.8	-1227.4
[illegible]	----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
[illegible]	----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
[illegible]	----DN	[illegible]	17.716	47.079	36.1186	1.764	18.3	5.165	370.9	3581.000	-45.5	-39.8	-745.7
[illegible]	----DN	[illegible]	17.510	46.852	36.0861	1.729	18.2	5.129	369.7	3551.000	-45.4	-39.8	-745.7
[illegible]	----DN	[illegible]	17.341	46.653	36.0597	1.690	18.2	5.066	368.1	3551.000	-45.1	-39.8	-745.7
[illegible]	----DN	[illegible]	17.142	46.426	36.0278	1.666	18.0	5.063	366.5	3551.000	-45.1	-39.5	-758.2
[illegible]	----DN	[illegible]	16.751	45.961	35.9575	1.604	17.8	4.789	364.7	3549.000	-44.8	-39.5	-762.4
[illegible]	[illegible]	[illegible]	16.326	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 acquistion. 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):    1941.000
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:
?R  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 l -1
CO      COND  MMHO/CM      30.0000   60.0000    3.0000     0.0000     1.0000 l -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 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): 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 AQUI89 logging session

H.1 Log file

This appendix shows a sample log file created during a re-run of ENDEAVOR 129 Station 30. The AQUI89 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$trnlnm("WHOI_VERIFY") then set noverify  'stop syslogin.com printing
%DCL-W-SKPDAT, image data (records not beginning with "$") ignored
%SET-I-NEWLIMS, new working set:  Limit = 149  Quota = 298  Extent = 298
   "USER_TERM" = "__CTD03$OPA0:" (LNM$GROUP_000300)
   "CTD_MOUNT_DEVICE" = "MSA0:" (LNM$GROUP_000300)
   "DATA_DIR" = "CTDROOT:[DATA]" (LNM$GROUP_000300)
%MOUNT-I-MOUNTED, CTDAQU mounted on _MSA0:
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_trnlnm) logical name CTD_MOUNT_DEVICE is assigned to: MSA0:
```

```
(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_sca . 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 data	range errors	total 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 preceeding 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	Tag #	= record tag number
BT #	= bottle number (set to zero)	Scan #	= tagged scan number
Pres	= average pressure	Temp	= average temperature
Con	= average conductivity	OXcur	= average oxygen current
OTMP	= average oxygen temperature		

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"/tape - 4.6"/headers = ~14300"/data

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

14300"/2.04"/record = 7010 CTD78 data records/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 records * 146 scans/record = 1023460 scans

1023460 scans / 31.25 scans/sec = ~32750 seconds

= ~9 hours

References

Brown, N.L. and G.K. Morrison, 1978, W.H.O.I./Brown Conductivity, Temperature and Depth Microprofiler, Woods Hole Oceanographic Institution Technical Report, WHOI-78-23

Fofonoff, N.P. and R.C. Millard Jr., 1983, Algorithms for computation of fundamental properties of seawater, UNESCO technical papers in marine science 44, 53 pp.

Fofonoff, N.P., Hayes, S.P., and Millard, R.C., 1974, WHOI/Brown CTD microprofiler: methods of calibration and data handling, Woods Hole Oceanographic Institution Technical Report, WHOI-74-89.

Millard, R.C., A. Blumer and N. Galbraith, 1978, A Digital Tape Format for Woods Hole Institution CTD Data, Woods Hole Oceanographic Institution Technical Report, WHOI-78-43, 36 pp.

Owens, W.B. and R.C. Millard, Jr., 1985, A new algorithm for CTD oxygen calibration, Journal of Physical Oceanography, 15, pp. 621-631.

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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 on a MicroVAX II computer, running the VAX/VMS operating system, version 5.3. This manual contains the instructions for operation of the AQUI89 data acquisition system version 1.0.

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