USER MANUAL

for the

IPNS Data Acquisition System

R. K. Crawford – March 4, 1996

DRAFT -- DRAFT

Known Problems:

general -	need to modify boot instructions wherever they occur
Chapter 4 -	need to add pointers with numerical labels to figures need to add TYP LT and TYP FT plots
Chapter 5 -	need to update Table 5.1
Appendix C -	need to update this entire appendix

CONTENTS

CONTENTS

CONTENTS

CONTENTS

USING THIS MANUAL

This manual is intended as an introductory manual to guide IPNS users through the use of the IPNS data acquisition systems. It is specific to the operation of those instrument data acquisition systems which use Vaxstations as Instrument Computers.

Chapters 1 through 5 of this manual guide you through normal data acquisition operations of the system, while Chapter 6 describes a number of other useful commands. Many of the concepts used in Chapters 1 through 6 are defined in Appendix A, which provides an overview of how the data acquisition system operates on an IPNS instrument. You don't need to read this Appendix to get started using the system. However Appendix A should give you a better feel for what is going on in your instrument and for where your data "really" come from, and may prove to be useful in understanding some of the various options offered in Chapters 1-6.

Appendix B provides a list of the PNS system commands and will be generally useful. Several of the Chapters in this manual refer to the commands in specific sections of Appendix B. Appendices C, D, and E provide additional information which you may find helpful on occasion, but probably will not require often.

Throughout this manual, commands or other responses to be typed in by the user are shown in **boldface**. Required spaces in commands are indicated with the symbol $_\Delta$. Curly brackets { } are used to enclose portions of command lines which are optional.

CHAPTER 1

GETTING STARTED

1.1 WORKING WITH THE VAXSTATION

1.1.1 Terminal Operation

You can interact with one of the Vaxstations either via the Vaxstation terminal located near the Instrument Computer for the instrument you are using, via any remote terminal connected to the ETHERNET network, or from the Central Cluster or any of the other Vaxstation computers via the **SET$_\Delta$HOST** command. All of the Vaxstation terminals run the DECWINDOWS windowing software, allowing multiple windows to be open and active on the terminal at any given time. Each of these Vaxstation terminals has a mouse, which is used extensively to select windowing system options. In some of the following discussion, you will be asked to "click" the mouse on a given option. To do so, move the mouse until the cursor is on the desired option and that option is highlighted. Then press the mouse button which is under your right forefinger.

Occasionally one of the DECWINDOWS windows will "hang up" for no apparent reason, and will no longer accept input or provide output. If this happens, use the mouse to click on the CLEAR COMMUNICATIONS option in the window menu. If this doesn't clear things up, click on the QUIT menu option, and then create a new window.

1.1.2 Logging on to the System

The Vaxstation terminals are usually left logged in to the instrument account. If you want to use the Vaxstation terminal:

1. If the screen is blank (screen-saver mode), move the mouse to restore the screen display.

2. If you are prompted for Username, then if you wish to log into the instrument account input the name of the instrument. Then respond with the instrument password to the Password prompt. If you wish to log into another account. use the correct Username and Password for that account.

3. If the screen now has windows on it, check to make sure the name above the icon window (long, skinny window at the top) is the correct account name.

4. If it is not the correct account name, use the mouse to select and "click" on the Quit menu option in the session-manager window, and when the computer asks "Are you sure?", click on Yes. This should result in a clearing of the screen, followed by a prompt for Username. Now go back to step 2.

5. Check to see if one or more terminal-emulation (DECterm) windows are open. If not, select the Application menu in the session-manager window and click on the DECterm option. It will take about 20 seconds for a new DECterm window to be opened.

6. Click the mouse on the window you want to use. The currently-active window should have a red bar at the top. Make sure the DECterm window is currently active.

7. You are now ready to operate as though this were a normal terminal.

To log in from a remote terminal connected to a terminal server on the ETHERNET:

1. Type **C** followed by the node name of the instrument of interest. The node name is the full instrument name (GLAD, GPPD, HRMECS, LRMECS, POSY1, POSY2, SAD, SAND, SCD, or SEPD). For example, type **C$_\Delta$SAND<cr>**.

2. If you are prompted for Username, input the Username of the desired account (instrument name or other account name). Then respond to the Password prompt with the correct password for this account.

3. After a few seconds you should get a $ or other system prompt. At this point the system is ready to accept commands.

1.1.3 Operating the Instrument

The PNS system software provides the commands to operate the data acquisition system, display raw data, etc. A list of these commands is given in Appendix B. Those you will normally need to operate the instrument are described in greater detail in Chapters 2-6. If trouble occurs, Appendix D of this Users Manual provides procedures for identifying and rectifying many of the problems which might occur in the operation of the Vaxstation and the data acquisition software and hardware.

1.2 THE VAX/VMS OPERATING SYSTEM

The Instrument Vaxstations currently run VMS 5.3-1 (except for SEPD, which runs VMS 5.4-2) with DECWINDOWS, FORTRAN, and GKS. VMS provides a number of commands which are useful for file handling, etc. A list of these commands and descriptions of their functions can be obtained by typing **HELP**.

1.2.1 The **HELP** Command

To get a list of the VMS commands, type **HELP**. You will then be shown a list of commands and asked to select a specific command for further information. To obtain information on a specific VMS command, type **HELP**_Δ**command** instead of **HELP**, where "command" is the VMS command of interest (eg - **HELP**_Δ**COPY**, will provide information about the **COPY** command).

1.2.2 Logical Directory and Disk Assignments

In order to help provide flexibility in adapting to the requirements of the various instruments, the PNS system software on the Instrument Vaxstation systems makes extensive use of logical disk and directory assignments. The following assignments are made system-wide on each instrument Vaxstation when it is booted:

Table 1.1
Logical Assignments

logical disk name	use
UDISK1:	This disk contains the instrument login directory [(name)], where (name) is the full instrument name (eg - HRMECS). It also contains the data and instrument subdirectories [(name).DATA] and [(name).INST], which are usually given the further logical assignments of DATADIR: and INSTDIR: respectively - see below.

logical directory name	use
DATADIR:	Contains Run Files and some logging files (eg - temperature-logging). Normally assigned to UDISK1:[(name).DATA].

INSTDIR: Contains calibration files and other instrument-related files. Normally assigned to UDISK1:[(name).INST].

OBJTDIR: Contains generally useful object modules.

EXECDIR: Contains PNS system executable modules.

You can use UDISK1: instead of the specific device name (eg - DUB0:) in any VMS or PNS system command. Similarly, you can use DATADIR:, INSTDIR:, OBJTDIR:, or EXECDIR: instead of the corresponding specific device and directory names in any VMS or PNS command. Furthermore, PNS commands always assume that Run Files are in DATADIR:, whatever its current assignment. If you wish to use PNS commands to refer to Run Files in another directory, you must first logically assign this directory to DATADIR: (see the VMS **ASSIGN** or **DEFINE** commands).

1.3 COLLECTING DATA

1.3.1 General Procedure

In order to collect data on the instrument you will have to:

1.   Set up one or more Run Files using the **NEWRUN** command (see Chapter 2).

2.   Start one of these Runs or a series of Runs using the **START** and/or **SCHEDULE** commands (see Chapter 3).

3.   Stop data collection, when and if desired, using the **STOPRUN** command (see Chapter 3).

4.   To look at this raw data while it is being collected or after it has been collected, use the various display commands (see Chapter 4).

5.   If you will be using this computer to analyze the data, you can proceed to the analysis stage as soon as data collection is complete. Otherwise you will need to **COPY** the Run File to the computer to be used for analysis, or to **COPY** it to tape or other media for transport to other systems or for storage. (See Chapter 6.)

Chapters 2-6 will tell you how to do each of these steps.

1.3.2 Log Files

A log of data-collection-related activity is written to the file (name).LOG in the instrument login directory on the Instrument Vaxstation system, where (name) is the 4-character instrument name (GLAD, GPPD, HRCS, LRCS, PNE0, POSY, SAD1, SAND, SCD0, or SEPD). A new version of (name).LOG is created each time a Run or series of Runs is started with the START command. The version of (name).LOG associated with any currently active Runs is also accessible, so you can look at this to check progress or to check for errors in the current Runs.

Programs which interface with the temperature controllers can produce a log of the temperature readings (typically at one-minute intervals). This log is stored as an ASCII file DATADIR:(name)TEMP.LOG, where (name) is again the 4-character instrument name.

1.4 DATA ANALYSIS

Data analysis can be carried out either on the Instrument Vaxstation or on the IPNS Central microVax Cluster. See your instrument manager concerning the preferred computer system and the choices of data analysis software which are available.

1.5 DOCUMENTATION AND FURTHER READING

Several of the instruments have their own user manuals. Check with your instrument manager to see whether there is such a manual for your instrument. (If one exists, it is probably located close to the Instrument Vaxstation.)

User Manuals exist for the computer interface to the temperature controllers, and for a few other sample-environment control devices. These manuals should be located in this same binder, following this Data Acquisition System User Manual.

Manuals for the commercial NIM, CAMAC, and MULTIBUS hardware modules can be found in labeled filing cabinet drawers in the "terminal room" in Bldg. 399.

Operator manuals for the various models of Vaxstations can be found in Bldg. 399, either near one of the Instrument Vaxstations or else on the documentation shelves in the terminal room, or in the documentation shelves in the IPNS Main Control Room in Bldg. 360. Manuals for the VMS operating system and for FORTRAN and GKS can be found on the documentation shelves in the Bldg. 399 terminal room and in the Bldg. 360 Main Control Room.

A User Manual for the Central microVax Cluster is available. Copies may be obtained in the IPNS Office.

CHAPTER 2

RUN FILE SETUP

2.1 THE NEWRUN COMMAND

Run File setup is started by typing **NEWRUN**. The NEWRUN routine prompts for a variety of inputs. Most of these inputs have default values, which are shown in reverse video. The default value can be accepted by typing a carriage return. A title and user name are always required as input. You are also always given the chance to add or modify sample-environment parameters which are computer controlled (eg - angle settings, temperatures, etc). If you opt to use a default Run File to provide most of the setup information, these may be the only inputs required. If you do not use a default Run File, you will be guided through the selection of the parameters necessary to control the data acquisition for this Run.

2.1.1 Using A Default Run

Any previously defined Run File may be used as a default Run in setting up a new Run File. Just select the desired default Run number from the menu or enter the Run number of the Run File to be used as a default. If you wish to enter new histograming parameters, use a default Run number of 0.

2.1.2 Defining New Histogram Parameters

If the default Run number is set to 0, you will be required to define histogram parameters for the 2D detector (if any) and for each 1D detector or group of detectors on this instrument. For 2D detectors this involves selecting the number of X, Y, and T channels and the T (or l) range, while for 1D detectors this involves setting the time range and channel width for each detector group, selecting the corrections to be made to the incoming data such as time delay corrections or time-focusing, and selecting which detectors are to be grouped together on-the-fly. (See Sections 2.1.3 and 2.1.4 concerning time-focusing and grouping.)

2.1.3 Time-Focusing

The PNS system software and hardware permit "on-the-fly time-focusing" of data from standard non-position-sensitive detectors or from the charge-division-encoded linear-position-sensitive detectors. The quantity binned for detector or detector element number ID and time-of-flight (TOF) T is T*, where

$$T^* = TSC(ID) \times [T - CD] \tag{2.1}$$

The TSC table and the constant CD can be set up so that a given value of T* corresponds to a specific value of the variable of interest (eg - ordinary time-of-flight T, d-spacing D, energy E, etc.) no matter which detector ID within the time field is involved. The quantity actually stored in the histogram in MULTIBUS memory or in the Run File is always I(T*), the intensity as a function of T* for a group of IDs, so the PNS system software (and any data analysis software) must include routines to convert this to the desired physical units.

Appendix E describes how to set up the focusing used in several particular cases.

2.1.4 Detector Grouping

Grouping of 1D detectors is defined as the storage of spectra from more than one detector in the same area of memory so that the counts from different detectors are added together. This may require that some "time-focusing" corrections be made to the data before histograming.   Grouping of detectors has been decoupled from the definition of their time-spectra parameters except for the requirement that detectors to be grouped together must have the same time-spectra parameters. This allows a time-focused set of detectors to be split into several groups for histograming, if desired. Any detectors not specifically assigned to a group will have their events stored in separate time-spectra in memory. The input is terminated by a carriage return, so if no grouping is desired, the only input required for grouping would be a carriage return.

2.2 MODIFYING CONTROL PARAMETERS

If you want to select sample-environment control devices or modify sample-environment control parameters for a Run File that has already been set up, use the **CTLMOD** command. By default, this routine modifies the last Run File created, but you may enter the number of another Run File that you wish to modify. When you enter the routine you will be given a list of possible controlled devices which you can select. You will be prompted for appropriate device parameters for whatever device you select.

CHAPTER 3

ACQUIRING DATA

3.1 SCHEDULING AND STARTING RUNS

After a Run has been set up using the **NEWRUN** command (See Chapter 2), it may be started by the command

START

or

START$_\Delta$n

where n is the number of a previously set up Run that you wish to start. If you wish to modify the length of the cycle, the monitored variable, or the number of cycles, you may use the **SCHEDULE** command to do so, for example

SCHEDULE$_\Delta$40(8)/30M

will schedule Run 8 to collect data for 40 cycles of 30 minutes each. (Between cycles, data acquisition will be stopped and the current data will be saved to the Run File.) Other choices of monitor variable are 'P' for pulses, and 'C' for counts. If you choose to monitor counts you will be asked which detector and which channel of that detector you wish to monitor. (The total count for a 1D detector group is contained in channel 0.) Scheduling a Run or series of Runs means that you have defined the monitoring parameters and specified the order in which the Runs will be collected. The same functions can be performed by the **START** command and it must be remembered that the **START** command is performed last so will override previous scheduling if any scheduling parameters are included in the **START** command line. Both **SCHEDULE** and **START** will accept lists of Runs, so that you may schedule a series of Runs to execute consecutively. This feature is particularly useful if you are automatically changing samples or varying sample-environment parameters between Runs. Otherwise you will need to stop to change samples or temperature, etc. after each Run. If a list of Runs is enclosed in parentheses, the number of the active Run will change after each cycle until all cycles of all Runs listed have been completed. For example, the commands

SCHEDULE$_\Delta$**2(31)/108000P**
SCHEDULE$_\Delta$**3(32-34)/54000P**
SCHEDULE$_\Delta$**1(40)/108000P**
START$_\Delta$**40,31-34**

will result in collection of data in Run 40 for 1 cycle of 108000 pulses (108000 pulses is 1 hour at 30 Hz), then collection of data for 2 cycles of 108000 pulses each in Run 31, collection for 3 cycles of 54000 pulses each in Run 32, collection for 3 cycles of 54000 pulses each in Run 33, and finally collection for 3 cycles of 54000 pulses each in Run 34. Collection for each Run will utilize the histograming and control parameters set up for that Run with the **NEWRUN** command. On the other hand, the commands

SCHEDULE$_\Delta$**2(31-34)/108000P**
START$_\Delta$**31**

will result in collection for 1 cycle of 108000 pulses in Run 31, followed by collection for 1 cycle each in Runs 32 through 34, followed by collection of a second cycle of 108000 pulses in Run 31 and a second cycle each in Runs 32 through 34. This latter mode of operation with data collection alternating between Runs is designed to help average out any changing backgrounds, source performance, etc. (For example, one Run could have the sample changer position the sample in the beam and another Run could have the sample changer position an empty cell in the beam. Alternating between these Runs would then have the effect of collecting both sample and background data under as nearly similar conditions as possible.)

3.2 RESTARTING RUNS

If for some reason (eg - Vaxstation computer crash, software bug, etc.) the Run monitoring process RUNTIM_PROC is aborted while the MULTIBUS subsystem is still collecting data, a proper recovery can be effected by rebooting the Vaxstation (if necessary) and issuing the command

START/RESTART$_\Delta$**run**

where "run" is the current Run number.

3.3 STOPPING OR ABORTING RUNS.

A Run may be stopped before it completes its allocated number of cycles by the command

STOPRUN

The **STOPRUN** command causes the current data to be saved to the Run File. If you do not wish to save the data, but wish to stop data collection, you can type

QUITRUN

3.4 SAVING DATA

The data are only written from MULTIBUS memory to the Run File at the end of a cycle or when the Run is stopped with the **STOPRUN** command. Data are not saved when the Run is stopped with the **QUITRUN** command.

In order to conserve disk space, the system will keep only a small number (typically 3) of versions of a Run File on disk. If 3 versions are kept these would be the current version and the versions containing the data written out at the ends of the last two complete cycles. [Remember that each version of the Run File contains cumulative data for all cycles of that Run completed up to the time the data were saved in that version.] This would mean that if your cycle time were one hour you would only be able to inspect data for this Run back to two or three hours before the current data. This can be extended by increasing the cycle time or by keeping more versions of the Run File. The cycle time can be extended with the **SCHEDULE** or **START** commands, while the number of versions to be kept can be increased through the **KEEP** command. The **KEEP** command has the syntax

KEEP$_\Delta$**n**

where "n" is the number of versions of the Run File to be kept on the disk at any given time. Be careful to ensure adequate disk space before providing for the saving of a large number of versions of the Run File.

3.5 PROTECTING THE RUN FILE

When you are satisfied with the data you have acquired and want to ensure that the Run File does not get cleared or overwritten inadvertently, you can change the protection of this file with the VMS command

SET$_\Delta$**PROTECTION=(S:RWE,O:RWE,G:RWE,W:RWE)**$_\Delta$**DATADIR:(name)(number).RUN;***

where (name) is the 4-character instrument name (eg - HRCS or SCD0) and (number) is the 4-character Run number (eg - 0004 or 9382).

CHAPTER 4

DISPLAY OF RAW DATA

4.1 TYPES OF GRAPHIC DISPLAYS

At present there are four basic formats for graphic displays, and each of these formats can be used to display either "live" data (data from MULTIBUS memory) or "file" data (data taken from a Run File). This gives rise to the eight different "types" of displays. Some of these types can be used only for data from 1D detectors or from linear-position-sensitive detectors (LPSDs), some can be used only for 2D area detector data, and some can be used with data from more than one kind of detector. The **TYP** command is used to select one of these eight types. The eight display types and the kinds of detectors for which they are applicable are:

1. "File" display of time spectrum or detector sums using data from a Run File. (**TYP**$_\triangle$**F**). Can be used for 1D or LPSD data.

2. "Live" display of time spectrum or detector sums using data from MULTIBUS memory. (**TYP**$_\triangle$**L**). Can be used for 1D or LPSD data.

3. "File density" two-dimensional color density plot of one or more time-slices of data from a Run File. (**TYP**$_\triangle$**FD**). Can be used for 2D or a bank of LPSD data.

4. "Live density" two-dimensional color density plot of one or more time-slices of data from MULTIBUS memory. (**TYP**$_\triangle$**LD**). Can be used for 2D or a bank of LPSD data.

5. "File histogram" plot of an X, Y, or T trace through area-detector data from a Run File. (**TYP**$_\triangle$**FH**). Can be used only for 2D data.

6. "Live histogram" plot of an X, Y, or T trace through area-detector data from MULTIBUS memory. (**TYP**$_\triangle$**LH**). Can be used only for 2D data.

7. "File 3D" display of the time spectra of all segments of an LPSD, or of the sum over time for all segments for all detectors in a given LPSD bank, or of a single two-dimensional time-slice of area-detector data, based on Run File data. (**TYP**$_\triangle$**F3**). Can be used for 2D or LPSD data.

8. "Live 3D" display of the time spectra of all segments of an LPSD, or of the sum over time for all segments for all detectors in a given LPSD bank, or of a single two-dimensional time-slice of area-detector data, based on MULTIBUS data. (**TYP$_\triangle$L3**). Can be used for 2D or LPSD data.

4.2 DISPLAY FORMATS

4.2.1 Histogram Display Format for 1D Data

Figure 4.1 shows the display format used for "live" and "file" displays of 1D data (types L and F). Various features labeled on the figure and the sources for the values shown are discussed below.

1. Date and Time. For "live" displays these are the current date and time, while for "file" displays these are the date and time at which the data were last saved in the Run File (Run ending date EDT and time ETM from the Run File).

2. Instrument which collected the data being displayed (from INAME.DAT).

3. User Name (from Run File - first 12 characters only)

4. Run Number. This will be the current live Run number for "live" displays and will be the number of the Run File being displayed for "file" displays (from the **RUNN$_\triangle$n** command).

5. Version of Run File. 0000 means the most recent version is being used.

6. Run Title (from Run File - first 40 characters only).

7. Display Type. FILE, LIVE, 2D-F, 2D-L, 2H-F, 2H-L, L3-F, or L3-L (for types F, L, FD, LD, FH, LH, F3, L3, respectively).

8. Detector Identification Number. The time field displayed is the one into which detector ID was binned in histogram IH.

9. Histogram Number. Display is taken from this histogram.

10. Variable being Monitored. Possible values are:
    PULSES: number of T_0 trigger pulses is monitored
    CHN: id ch   number of counts in channel ch of the time field
                               containing detector id is monitored
    EL. TIM.   elapsed time (minutes) is monitored

11. Elapsed Cycle and Monitor Count. The number before the colon is the last cycle to have been completed. The number after the colon is the value of the monitored variable for the current cycle. (For "live" displays the cycle number is obtained from the process RUNTIM_PROC and the monitor count is obtained from the CAMAC Clock Module plus RUNTIM_PROC for pulses, from the MULTIBUS memory plus RUNTIM_PROC for counts in a given channel, and from the Vaxstation internal clock plus RUNTIM_PROC for elapsed time. For "file" displays, values are obtained from ICY and ELN taken from the Run File.) There may be some delay (up to 4-5 minutes) in updating "live" information after a cycle has changed.

12. Cursor Coordinates (not shown on hard-copy plots). When the cursor is being used, this region displays the X-coordinate followed by the Y-coordinate of the cursor on the screen, given in the current display units. Resolution is that corresponding to 1 pixel (roughly 1/400 of range for X, 1/320 of range for Y). Cursor coordinates are displayed only when the cursor is turned on.

13. Preset Cycle and Monitor Count. These are the number of cycles scheduled to be run (before the colon) and the monitor count per cycle (after the colon) (from Run File).

14. Y Units

15. Y Scale. The values shown are the minimum and maximum Y divided by the power of 10 shown.

16. X Units.

17. X Scale. The values shown are the minimum and maximum X divided by the power of 10 shown.
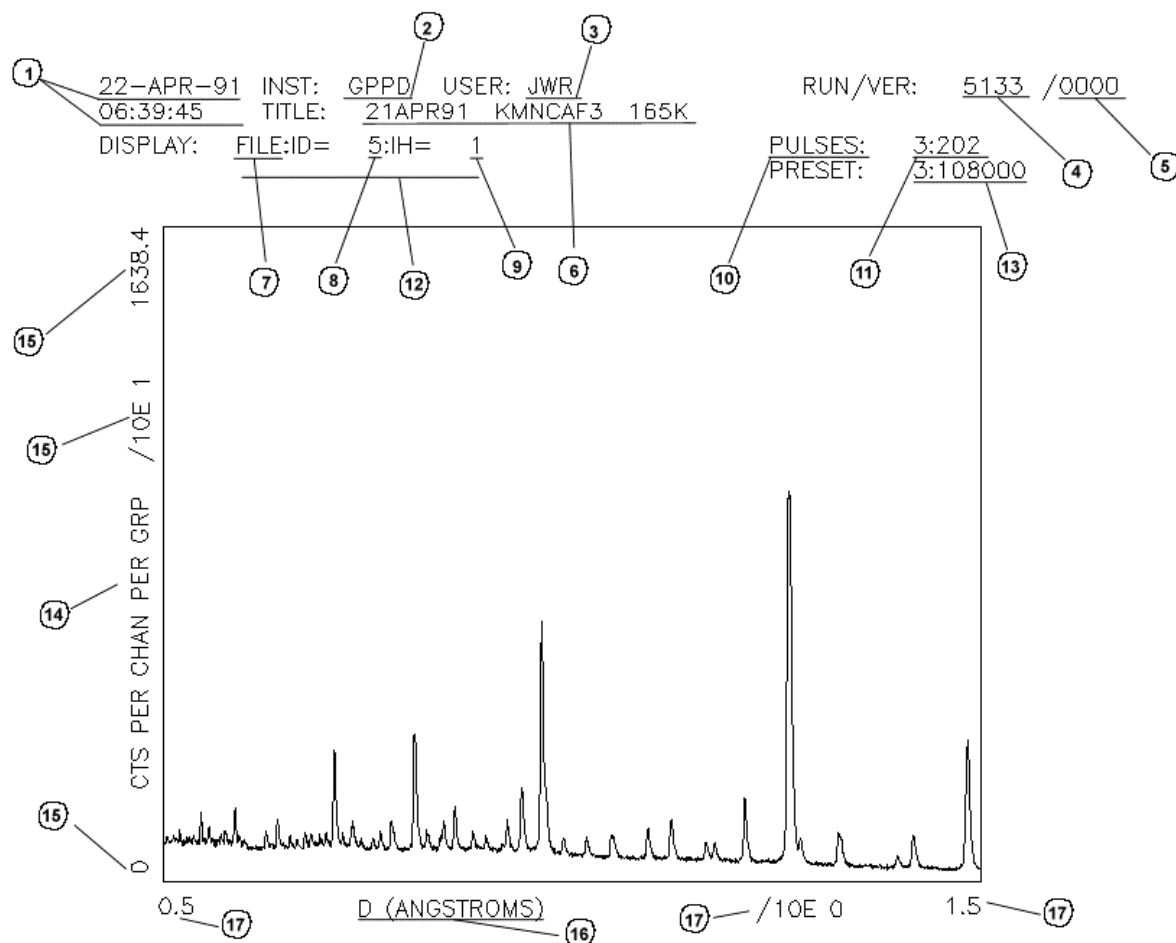
Figure 4.1. Typical time-spectrum from a 1D detector group on GPPD.

The display in Figure 4.1 was set up by the series of commands (on GPPD):

> **IH$_\Delta$1**
> **ID$_\Delta$5**
> **TYP$_\Delta$F**
> **RUNN$_\Delta$5133**
> **UNIT$_\Delta$D**
> **DX$_\Delta$.5,1.5**
> **DIS**

The **YSC** command was used to toggle to the "autoscale" mode. (It may not be necessary to use all of these commands, depending on the previous values for the plotting parameters, as the system remembers the last parameter values used.)

4.2.2 Density Display Format

Figure 4.2 shows the display format used for the "live density" and "file density" displays of 2D data from an area detector (types LD or FD). Figure 4.3 shows a similar display for a bank of LPSDs on GLAD (types LD or FD). the data display format shown is that used for Tektronix emulating devices. The different intensities would be indicated by different colors if the display were on the Vaxstation monitor. Those features not discussed in Figure 4.1 are labeled on Figures 4.2 and 4.3 and are discussed below:

1.   Histogram Number. Display is taken from this histogram.

2.   Time-slice Number. In the ADD mode (default), the density plot contains summed data from all the time-slices within the range listed. In the PAGE mode, the plot contains only data from the last time-slice indicated, and will cycle through time-slices one at a time.

3.   Cursor Coordinates (not shown on hard-copy plots). Units are detector position channels (eg - if the detector was binned in 64 x 64 position channels, the x and y cursor values will each run from 1 through 64).

4.   Color Levels. Each numerical value is the lowest intensity (counts/pixel) which will be given the "color" shown to its right. When plotting on a Tektronix terminal or hard-copy device, the color scale is replaced by the pseudo gray scale made up of different character symbols as shown here.

5.   Direction on detector or detector bank.

6.   Edges of detector or detector bank, as viewed from the sample.

7.   Bank Number. Display is based on this bank of LPSDs.

8.   Time-range. In the ADD mode (default), the density plot contains summed data from all the time channels having centers within the range listed. In the PAGE mode the plot also contains summed data from all time channels having centers within the range listed, but the listed time range is much smaller than that specified by the **ZLIM** command, and is stepped through the full range specified by **ZLIM**.
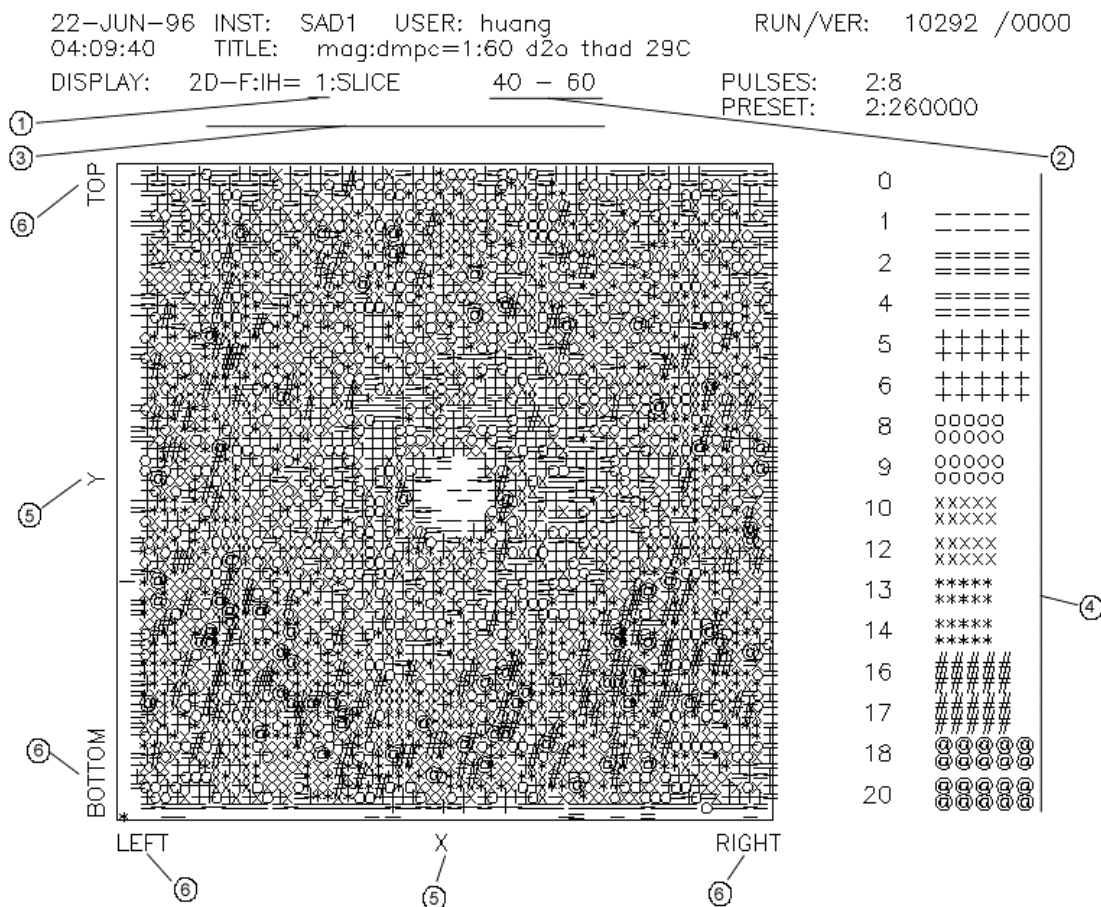
Figure 4.2. Typical "color-density" plot from the area detector on SAD.

The display in Figure 4.2 was created with the following set of commands (on SAD):

      IH$_\triangle$1

      TYP$_\triangle$FD

      RUNN$_\triangle$10292

      ZLIM$_\triangle$40,60

      DIS

The **YSC** command was used to toggle to the "autoscale" mode. (It may not be necessary to use all of these commands, depending on the previous values for the plotting parameters.) Data were binned in 64 x 64 position channels for this Run, so this is the pixel resolution shown in the plot.
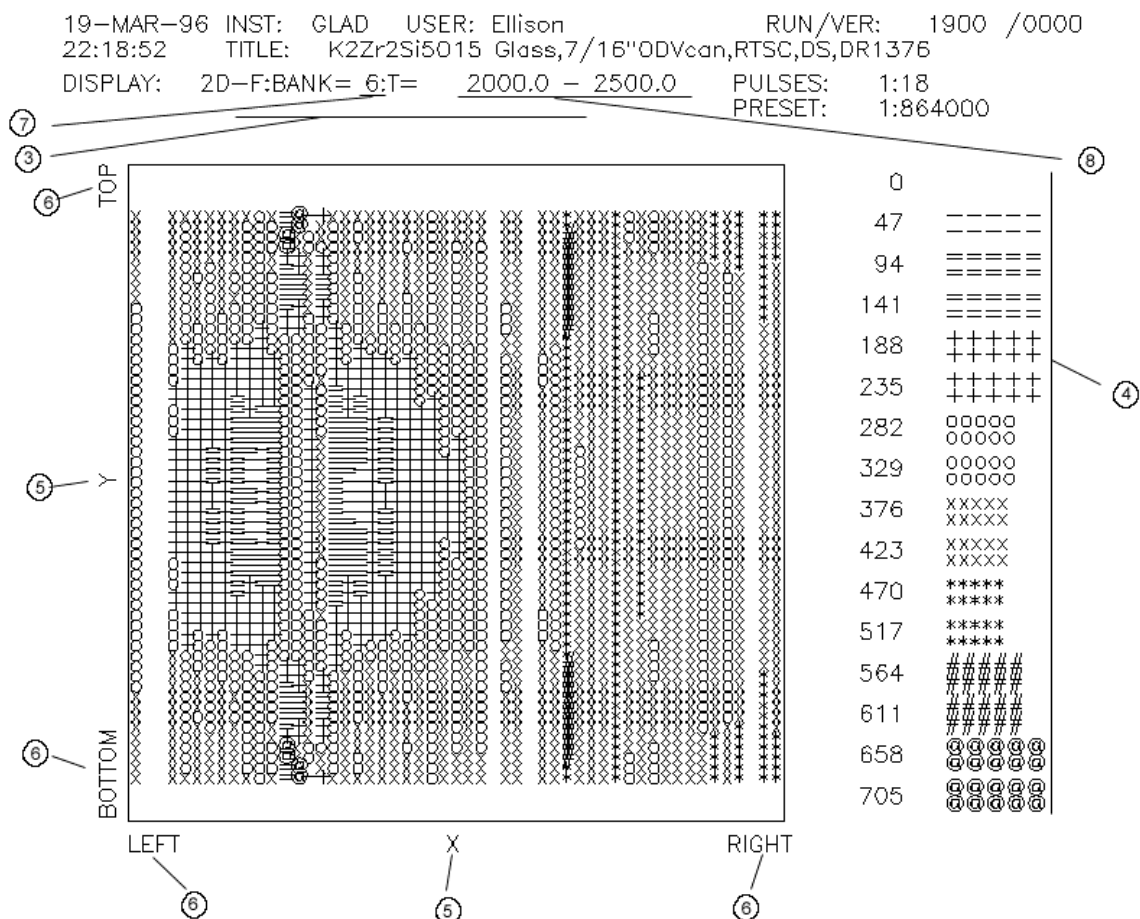
Figure 4.3. Typical "color-density" plot summed over a range of times for one LPSD detector bank on GLAD. Each LPSD appears as a vertical column. As can be seen, one of the LPSDs was "dead" for this Run.

The display in Figure 4.3 was created with the following set of commands (on GLAD):

       TYP$_\triangle$FD
       RUNN$_\triangle$1900
       ID$_\triangle$6,5,32
       ZLIM$_\triangle$2000,2500
       DIS

The **YSC** command was used to toggle to the "autoscale" mode. (It may not be necessary to use all of these commands, depending on the previous values for the

plotting parameters.)   Data were binned in 64 position channels for each LPSD, and there were 47 LPSDs in this bank (LPSD number 33 was "dead" during this Run). Thus each LPSD contributes a vertical column of 64 pixels in this display.
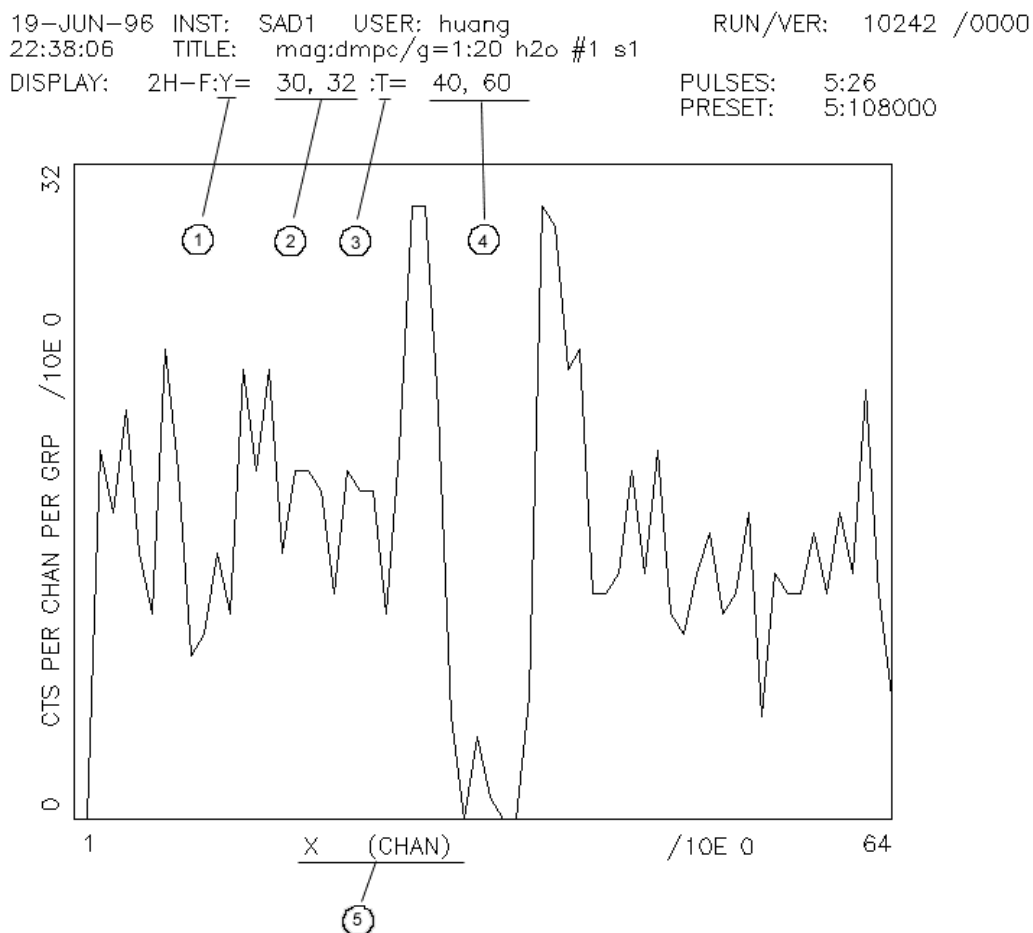
Figure 4.4. Histogram plot of a "cut" in the x-direction through the data of Figure 4.2.

4.2.3 Histogram Display Format for 2D Data

    Figure 4.4 shows a display of a "cut" in the x-direction across the 2D data of Figure 4.2 (types LH and FH). Those features not discussed in Figures 4.1-4.3 are labeled on Figure 4.4 and are discussed below:

    1.   First "Fixed" Coordinate. In this case the "y" coordinate was held fixed for this plot.

2.   Range of First Fixed Coordinate. In this case data were summed for y values ranging from 27 through 29 (units of channels).

3.   Second "Fixed" Coordinate. In this case the "t" coordinate was held fixed for this plot.

4.   Range of Second Fixed Coordinate. In this case data were summed for t values ranging from 40 through 60 (units of channels).

5.   Independent Coordinate and Units.

The display in Figure 4.4 was created with the following set of commands (on SAD):

TYP$_\Delta$FH
RUNN$_\Delta$10242
HST$_\Delta$X
YPT$_\Delta$30,32
TPT$_\Delta$40,60
DX$_\Delta$1,64
DIS

The **YSC** command was used to toggle to the "autoscale" mode. (It may not be necessary to use all of these commands, depending on the previous values for the plotting parameters.)

4.2.4 3-Dimensional Display Format

Figure 4.5 shows the display format used for the "live 3D" and "file 3D" displays of data from an LPSD. Those features not discussed in Figures 4.1-4.4 are labeled on Figure 4.5 and are discussed below:

1.   Run File Name and Version.

2.   Detector Bank and LPSD Number Within this Bank.

3.   Range for Intensity Scale.

4.   First Independent Variable. "TIME" means time-of-flight.

5.   Range for First Independent Variable. Units are microseconds.

6.   Second Independent Variable.

7.   Range for Second Independent Variable. Units are LPSD segment numbers.
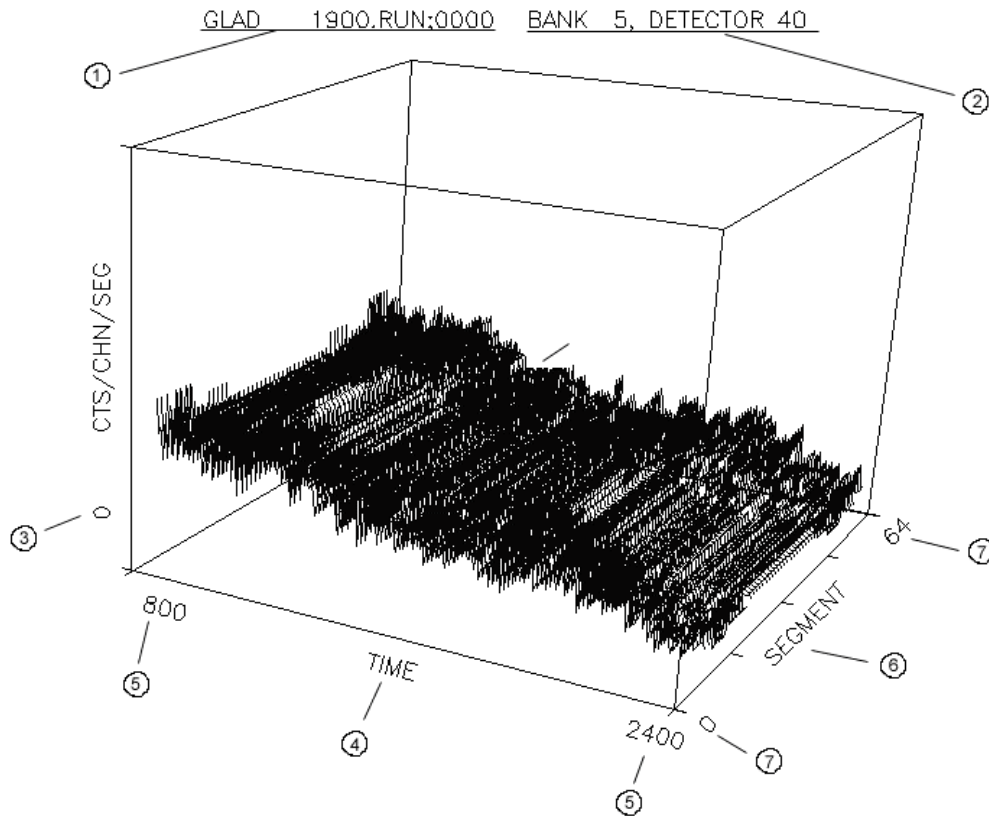
Figure 4.5. "3D" plot of data from one of the LPSDs for the Run shown in Figure 4.3.

The display in Figure 4.5 was created with the following set of commands (on GLAD):

TYP$_\Delta$F3
RUNN$_\Delta$1900
ID$_\Delta$5,40,32
UNIT$_\Delta$T
DX$_\Delta$800,2400
VIEW$_\Delta$8,-12,6
YMAX 500

YSC
DIS

The **YSC** command was used to toggle to the "manual scale" mode. (It may not be necessary to use all of these commands, depending on the previous values for the plotting parameters.)

4.3 DISPLAY COMMANDS

A number of display commands change values of specific display parameters, but these changes do not affect the display until the **DIS** command is issued. The **DIS** command is used to create a display using the current value of the display parameters. If this command is issued on one of the Vaxstation terminals a new window will be opened for the graphics display if one does not already exist. If a graphics window already exists, the **DIS** command will cause the display within this window to be updated to reflect the current values of the display parameters.

*** Note: On the DECWINDOWS terminal (Vaxstation console), all graphics commands are entered into a DECterm text window. However, when graphics are operated from a remote terminal in Tektronix mode, graphics commands can be entered into the graphics window (terminal in graphics mode) as well. ***

For a listing of the display commands and their functions, see Section B.5.

4.4 REMOTE GRAPHICS

The graphical displays discussed in this Chapter can also be obtained on remote graphics terminals. Only terminals running DECWINDOWS or terminals emulating a Tektronix 4014 (or equivalent) are supported at present (January, 1992), but other types are expected to be supported in the near future.

There are several minor problems relating to remote graphics on the Tektronix-emulating terminals.

1.   Once a display is running on such a terminal, graphics commands must be typed into the display screen. What you type in is not displayed until you hit the **<return>** key at the end of the command. Because of the way in which the VMS terminal driver handles commands input in this manner, it is fairly common for one or more of the letters you type in to be lost, resulting in an unintelligible command. This problem is much more common with "live" displays than with "file" displays. If this problem occurs, type the command in again slowly. Keep repeating this until you get the system to accept your command.

2.   Cursor operation on the Tektronix-emulating terminals is not very satisfactory.

3.   If you are operating a remote terminal over a phone line, or are operating it at
a low baud rate for any other reason, you may wish to consider using the
IPT$_\triangle$**n** command to plot every nth point rather than plotting every point. This
can speed up some of the types of plots considerably.

4.5 INTEGRATING REGIONS OF DATA

The **INTEGRATE** command works in conjunction with the currently displayed plot.
If a histogram plot is being displayed (types L,F,LH,FH), then the command

INTEGRATE$_\triangle$**x$_1$,x$_2$**

returns the sum of the graphed data between x_1 and x_2 (x_1 and x_2 in the current units).
For types LH and FH, this integral includes all data within the region specified by x_1,x_2
and the ranges of the other two variables (x,y,or t) specified for the current plot.

If a 2D density plot is being displayed (types LD and FD), then the command

INTEGRATE$_\triangle$**x$_1$,x$_2$,y$_1$,y$_2$**

returns the sum of the graphed data lying within the box with opposite corners at x_1,y_1
and x_2,y_2 (doesn't work for GLAD LD and FD plots yet). This integral includes all data
within the time range specified on the current plot. y_1 and y_2 must be entered for this
plot type.

NOTE: you must be displaying a plot in order to use the **INTEGRATE** command.

CHAPTER 5

CONTROL OF SAMPLE ENVIRONMENT

5.1 OVERVIEW OF SAMPLE-ENVIRONMENT DEVICE CONTROL SOFTWARE

You can interact with the sample-environment control software for each device via two programs, the NEWRUN program which treats all devices in a consistent manner, and the device interface program which may be different for different devices. The device interface program allows you to access most or all of the device parameters, while the NEWRUN program allows access to only a limited subset of the parameters for this device. It is only this latter subset which can be changed automatically from Run-to-Run (eg - SET POINT, UPPER LIMIT, and LOWER LIMIT are the only parameters which can be changed automatically for the temperature controllers).

Before doing anything with the device, you may want to change some of the non-automatically-controlled device parameters. This can be done at any time before starting the Run which is to use these parameters - even after this Run has been set up. To do this, the device interface program for this specific device is invoked (eg - with the command **TEM** if the device is the DISPLEX temperature controller or the MICRICON furnace temperature controller). This program will then lead you through the changing of device parameters, and allow you to exit without any actual communication with the device. See Sections 5.2 and B.6 for the commands used to access the device control programs for specific devices. The user manuals for specific devices may provide further information.

Once all the device parameters have been set to their desired values, this process should not have to be repeated very often. Most of these parameters will retain their same values from Run-to-Run for a number of Runs. The **NEWRUN** and **CTLMOD** commands allow you to set those parameters which will be different for each Run. This can be done in either of two ways:

1. By answering **Y** when the computer prompts

    CONTROL PARAMETERS (Y/N) ?

    while you are setting up a Run with the **NEWRUN** command.

2. After the Run has been set up, by entering the command

    CTL$_\Delta$run-number

where run-number is the number of the Run for which control parameters are to be entered. This method can be used either to make the initial entry of control information for this Run (provided the Run has never been started), or to change previously entered control information for this Run (provided the device name(s) and the number of devices are not changed). Previously entered control information can be changed even for a Run which has been started and stopped.

In either case, the program will display a list of the allowed devices for this instrument, ask you for the name(s) of the device(s) you wish to use, and for each device you specify will prompt you for the values of those device parameters which may be changed automatically from Run-to-Run. The names of the devices to be used and these new parameter values will be stored in the Run File, and will then automatically be used, along with the other device parameters, the next time this Run is started.

If the device is one which is to be monitored during a Run, this will be done automatically without your intervention. In this case data acquisition will be suspended whenever the appropriate measured value(s) for this device (eg - sample temperature if the device is a temperature controller) are outside the specified limits, and will be resumed whenever these value(s) get back inside these limits.

Once control information has been entered in the Run File, this information can be displayed using the command

PRUN$_\Delta$**CONTROL**$_\Delta$**run_list**

This information is also displayed as part of the **PRUN**$_\Delta$**HEADER** or **PRUN**$_\Delta$**RUN** commands (see Section 6.1).

For detailed information on control of specific devices, consult the individual device control manuals or contact your instrument manager.

5.2 AVAILABLE DEVICES

Table 5.1 shows the sample-environment-control devices which have been interfaced to the computer. This Table also shows which instruments can use each type of device, and the device-specific command required to operate the device.

Table 5.1
Computer-Interfaced Sample-Environment-Control Devices

Device	Instruments	Command
Displex refrigerator	GLAD,GPPD,HRMECS, LRMECS,POSY1,SAD, SAND,SCD,SEPD	**TEM*TUR**
Furnaces (Micricon controller)	GLAD,GPPD,HRMECS, LRMECS,SAD,SCD,SEPD	**TEM*TUR**
Furnaces (Micristar controller)	GLAD,GPPD,HRMECS, LRMECS,SAD,SCD,SEPD	**TEM*TUR**
Furnaces (LFE controller)	GLAD,GPPD,HRMECS, LRMECS,SAD,SCD,SEPD	**TEM*TUR**
Sample changers (Jacob's ladder)	GLAD**,**GPPD,POSY2,SEPD	**SAM*PLE**
Sample changers (stepping motor)	GLAD,SAD	**CHA*NGER**
Sample orienters (stepping motor)	GPPD,HRMECS,LRMECS, POSY1,SCD,SEPD	**STE*P**
Sample orienters (linked to collimators)	POSY2	**SETANG**
Magnetic field	POSY1	**MAG*NET**

Letters following the asterisk "*" in a command may be omitted if desired.

CHAPTER 6

OTHER USEFUL COMMANDS

6.1 PRINTING RUN FILE INFORMATION

Various types of information from the Run File or from the MULTIBUS or CAMAC subsystems can be printed to the screen or to a file with the **PRUN** command. This command takes the form

PRUN{/option}$_\triangle$**object**$_\triangle$**run_list**

The options include **/LIVE** to print data from the MULTIBUS memory rather than from the Run File, **/VERS=version_number** to print data from other than the highest version number of a Run File, **/HIST=histogram_number** to select which histogram the data are to be taken from, and **/OUTPUT=output_file** to direct that the output go to the file "output_file". If no options are specified, the **PRUN** command will take data from histogram IH=1 in the most recent version of a Run File, and will direct the printout to the terminal screen.

The objects indicating the portion of the Run File to be printed are: **TITLE**, **STATUS**, **CONTROL**, **HEADER**, **RUNS**, **DATA**, **MESSAGE**, and **DISCRIMINATORS**. **RUNS** and **DATA** both output the data, but **RUNS** includes Run File Header information as well. These two will ask you what range of the data (detector ID and time range) you want printed. Whenever the Header is printed the total count recorded in the sum-channel for each 1D detector group will be printed. For instruments with 2D detectors the time-slice sums for the area detector will be printed as well.

The run_list entry on the command line is the list of Run numbers that are to be printed. This list can contain a single Run number, a list of Run numbers separated by commas, a pair of Run numbers separated by dashes, or combinations of these. When a dash is used, information is printed for all Runs with numbers lying between and including the two separated by the dash. A run_list must be provided if the data are being taken from one or more Run Files. However, if the **/LIVE** option is specified the run_list need not be specified, and will be ignored if it is specified. In this case the printout will be for a single Run only, this being the Run which is currently active for data acquisition, and as much of the information as possible will be taken from the MULTIBUS and CAMAC subsystems rather than from the Run File.

The following are examples of valid **PRUN** commands:

PRUN/LIVE△**HEADER**

PRUN△**TITLES**△**1134,1140-1170**

PRUN/OUTPUT=[SEPD.PRINT]RUNSTAT.LIS△**STATUS**△**124-200**

PRUN△**CONTROL**△**2013**

PRUN△**DATA**△**1498**

NOTE: When the requested Run File does not exist, a message to that effect is printed and when the requested Run number is greater than the highest Run number for the instrument the printing terminates. Overflows are corrected automatically in both the individual channel content printout and in the sum printout.

If the **/OUTPUT** option is used to direct the output to a file, this file can then be printed using one of the print queues (see Section 6.6 and Appendix C).

6.2 MODIFYING RUN FILE INFORMATION

Sometimes you may wish to change the Run title after the Run has been set up with **NEWRUN**. This and various other entries in the Run File can be modified with the command

MODRUN△**runfile**

where runfile is the file name of the file to be modified (eg - SEPD0245.RUN). This file is assumed to be in the logical directory DATADIR:. The MODRUN program will then guide you through the various parameters you can change in this Run File, and will prompt you for input when necessary.

6.3 DELETING RUN FILES

The **REMOVE** command provides a "clean" way to delete Run Files. This would typically be done if some of the Run Files contain only junk and you want to reuse the Run numbers, or if the Run Files have been archived and you want to delete them to free up disk space. The command is

REMOVE$_\triangle$run_list

The run_list entry is the list of Run numbers for Run Files that are to be deleted. This list can contain a single Run number, a list of Run numbers separated by commas, or a pair of Run numbers separated by dashes, or combinations of these. When a dash is used, all Runs with numbers lying between and including the two separated by the dash are deleted. All versions of all Run Files identified by the run_list are deleted.

Be extremely careful in using this command. Be absolutely sure the Runs you are deleting contain only junk or have been copied successfully to another disk or to tape. Once Run Files have been deleted in this manner, there may be no way to recover them.

6.4 PURGING RUN FILES

The PNS system software normally keeps more than one version of each Run File in the directory DATADIR:, in order to permit recovery of most of the data when some types of errors occur. Once data collection is complete for a given Run and you are sure the last version of the Run File is good, you can use the command

PURGE$_\triangle$DATADIR:runfile

where runfile is the Run File name (eg - SEPD1972.RUN). If you want to purge more than one Run File at a time, you can use the "wildcard" symbol * for part of the Run File name. For example

PURGE$_\triangle$DATADIR:SEPD197*.RUN

would purge SEPD Run Files for Runs 1970 through 1979.

6.5 LISTING RUN FILES

All versions of all Run Files for your Instrument may be listed on the terminal screen with the command

LIST

The output will include file size and creation time and date for each Run File.

6.6 HARDCOPY PRINTING AND PLOTTING

Most of the IPNS printers and plotters are attached to terminal servers which are accessible from most of the IPNS Vaxstations. To print a file or to plot a graph on one of these devices, use the command

PRINT/QUEUE=queue_name{/options}$_\Delta$file_name

The options control some of the printing features. For example, to plot a Tektronix graphics file on a plotter capable of handling this type of graphics, use the options

/FORM=TEK/PASSALL

No options are required for the printing of most text files or of postscript text or graphics files.

Appendix C shows the various print and plot queues which are available and indicates where the corresponding devices are located and the type of graphics file each device can plot. Appendix C also provides some shorthand commands which may be used to print or plot while automatically including the appropriate options.

6.7 COPYING FILES TO TAPE OR OTHER MEDIA

6.7.1 Disk-to-Disk Transfer

The VMS **COPY** command can be used to transfer files (Run Files or any other files) to other directories on the disks on the Vaxstation, or on the disks on other computers connected to the network. For example, the command

COPY$_\Delta$DATADIR:SEPD1844.RUN$_\Delta$DUA0:[SCRATCH]

would copy the Run File SEPD1844.RUN from the logical directory DATADIR: to the directory [SCRATCH] on disk DUA0:. The directory [SCRATCH] must have been created previously. The command

COPY△**DATADIR:SEPD1844.RUN**△**ANLPNS"username password"::UD1:[SCR]**

would copy this same file to the directory [SCR] on disk UD1: on node ANLPNS. The "username" and "password" in this command must be for an account which is valid on node ANLPNS.

6.7.2 Transfer to 8-mm Tape Cassette

Each of the Instrument Vaxstations has an 8-mm cassette tape drive for backup and archiving of Run Files and other files. To load a tape in this drive, push the button on the front of the drive. When the door opens, insert the tape cassette and gently push the door closed until it latches. The tape drive will automatically go through several steps, and the green light on front will turn on when loading is complete. Do not issue any commands involving the tape drive until this green light is on.

These 8-mm tape drives are accessed just like any other tape drive, using the **INITIALIZE**, **MOUNT**, **BACKUP**, **COPY**, **DISMOUNT**, etc. commands. Use the **HELP** command or consult the appropriate VMS documentation (in the 360 terminal area or in the 399 terminal area) if you are unsure about how to use any of these commands.

The 8-mm tape drives have different device names on different instruments, since the device name depends on the type of controller used and on whether or not there is another tape drive (TK50 or TK70) on the system. Device names for the 8-mm drives are usually MUA0:, MUB0:, or MKA500:. Use the **SHOW**△**DEVICE**△**M** command to see which device is present on your instrument system. The TK50 and TK70 drives also use the device name MUA0: and if there is one of these drives on your system it will have this device name. If you are in doubt about the device name for the 8-mm drive, ask your instrument manager or try mounting a tape cassette in this drive using different device names until you find the one that works.

6.7.3 Transfer to Other Media

The IPNS Central Cluster of computers provides access to several 9-track reel-to-reel tape drives. To use these, you must first transfer your files to a directory on a disk in the cluster. Then see the User Manual for the cluster, or ask IPNS computer personnel for directions about how to use the tape drives.

It is also possible to transfer files to either 5-1/4" or 3-1/2" floppy disks. This can be done on the PC in the small room connected to the IPNS division office. Follow the instructions in the User Manual for the cluster, or ask IPNS computer personnel.

APPENDIX A

IPNS DATA ACQUISITION SYSTEM OVERVIEW

A.1 NEUTRON SCATTERING AT IPNS

At IPNS, protons are accelerated in the RCS accelerator and used to produce neutrons from a target by the spallation process. Since the protons are extracted from the accelerator in sharp pulses, usually at the rate of 30 pulses per second, the neutrons are produced in the target also in sharp pulses. These neutrons are slowed down in moderators close to the target, and then emerge over a very short time period (ranging from a few microseconds to a few hundred microseconds, depending on the neutron energy). Each of these pulses emerging from a moderator contains neutrons of all energies. Since the time "T_0" at which these neutrons leave the moderator is so well known, the energies of the neutrons detected in the detectors of the IPNS instruments can be determined by measuring the time-of-flight (TOF) of these neutrons over the known distance from moderator to sample to detector. All IPNS instruments use this TOF technique, and a "T_0" signal for each pulse is distributed from the accelerator system to all the instruments to serve as a reference starting time for the TOF measurements.

Each of the IPNS instruments has its own data acquisition system which carries out the acquisition and storage of TOF data from all the detectors in the instrument. These data acquisition systems are as nearly identical as possible, with each system having nearly identical sets of electronics hardware (described in Section A.2) and each system operating a standard software package for interfacing with the user. This standard software package (described in Section A.3) is referred to as the PNS system software throughout this manual.

In addition to the data acquisition systems for each instrument, there is a "Central Cluster" of computers (mostly microVaxes) available for use for data analysis, access to mass storage devices, access to more sophisticated graphics software and hardware, access to networks, etc. This Central Cluster is described in a separate manual, and is not discussed in any detail here.

A.2 DATA ACQUISITION SYSTEM HARDWARE OVERVIEW

Each IPNS instrument has its own independent data acquisition system. Each such system consists of a DEC Vaxstation Instrument Computer, coupled to the instrument MULTIBUS and CAMAC subsystems (see Figure A.1). The CAMAC subsystem contains modules which condition and/or encode (digitize) the signals coming from the detector preamplifiers or other specialized detector electronics. The fully-digitized events, each consisting of both position and time-of-flight information, are then passed on to the MULTIBUS subsystem which bins them in histograms in MULTIBUS memory. The Vaxstation serves as an interface between the CAMAC and MULTIBUS subsystems and the user and handles Run setup, data file storage and archiving, graphics, etc. The Vaxstation can also be used for data analysis. The Vaxstation is connected to a DECNET/ETHERNET network which can be used to access the IPNS Central microVax Cluster. This Central Cluster of computers can also be used for data analysis.
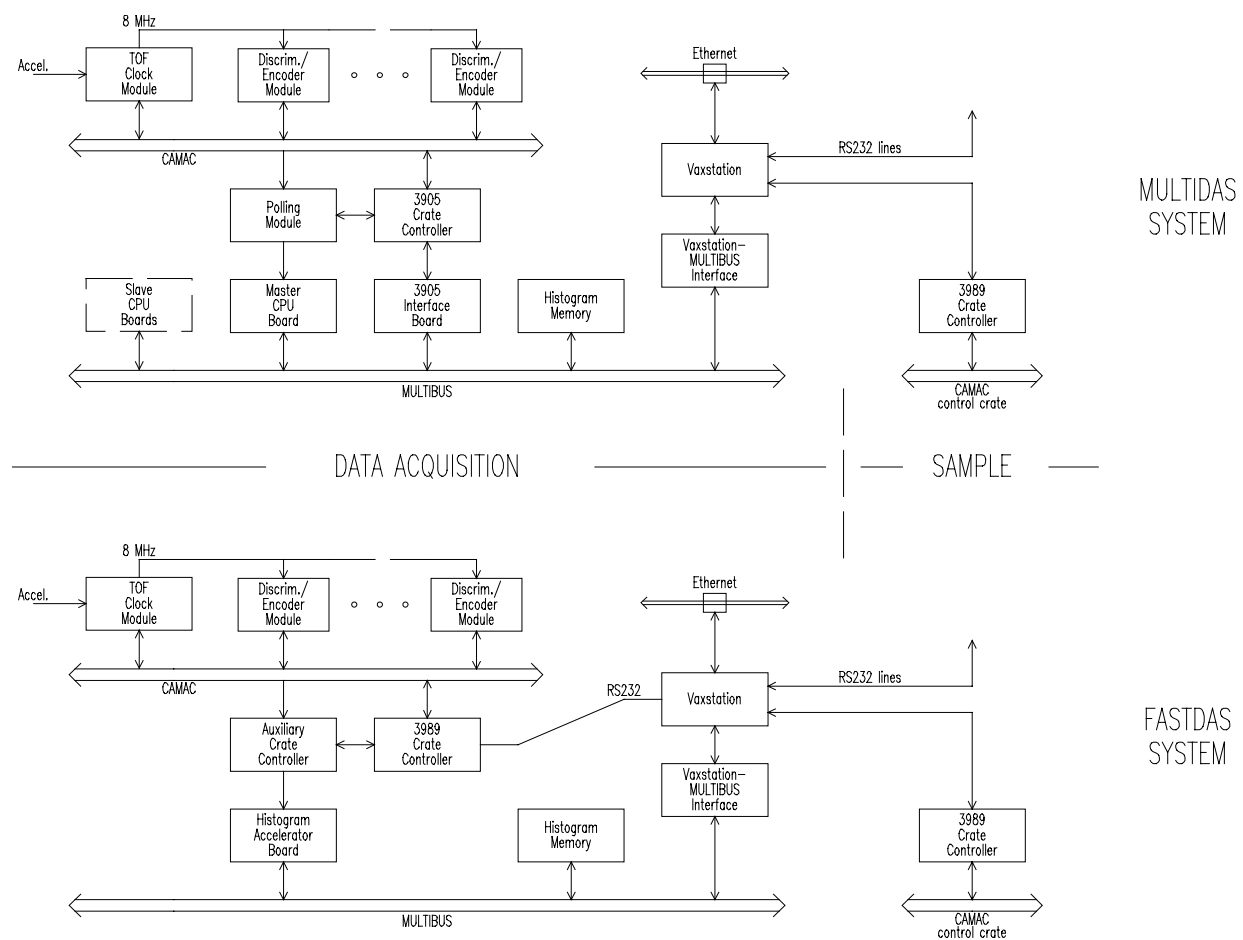

Figure A.1. Schematic diagram of the IPNS Data Acquisition System hardware.

Over the history of IPNS, the MULTIBUS subsystem has been based on two different types of microcomputers to carry out the histograming process. The original systems were each based on a single Zilog Z8001 CPU, packaged on a Central Data model B1017 computer board. In 1986, all IPNS instruments were changed over to use National N32016 microcomputer (CPU) boards, operating in a multiple-parallel-processor configuration (MULTIDAS). The MULTIDAS systems were designed as multiprocessor systems, with each system having one master CPU board and 0-3 slave CPU boards. The functionality of the MULTIDAS is essentially the same as that with the old Z8001 CPU boards, but internal details of operation are somewhat different and the MULTIDAS systems provide an order of magnitude increase in histograming speed relative to that of the Z8001 systems. More recently, the functionality of the MULTIDAS systems has been largely duplicated in a hardware FASTDAS Histogram Accelerator Board, resulting in the FASTDAS histograming system. The Histogram Accelerator Board is also located in the MULTIBUS crate, replacing the N32016 CPU boards, and provides an additional order of magnitude increase in histograming speed over that of the MULTIDAS systems. Currently (January, 1992) FASTDAS is used only on the GLAD instrument, while all the other instruments use the MULTIDAS microcomputer-based systems.

A.2.1 CAMAC and MULTIBUS Subsystems

A schematic layout of the CAMAC and MULTIBUS subsystems and their connections to the Vaxstation are shown in Figure A.1 for both the MULTIDAS and FASTDAS configurations.   Signals from the detectors (via signal conditioning electronics such as preamps, etc.) arrive at "discriminator/encoder modules" in the CAMAC crate. Several different types of discriminator/encoder modules are used to handle the signals from the different types of detectors (standard 1D detectors, two different types of linear-position-sensitive detectors, and several types of 2D (area) position-sensitive detectors). Once a discriminator/encoder module has accepted and encoded an event, the digitized position-time data word is stored in a buffer in or connected to the discriminator/encoder module. A "master TOF clock module" handles time-of-flight timing and synchronization for all the discriminator/encoder modules on a given instrument. This timing is synchronized to the accelerator pulses by a "T_0" signal which is distributed from the accelerator to all the instruments.

In the MULTIDAS systems a Kinetic Systems model 3905 CAMAC Crate Controller and associated MULTIBUS interface board provide an interface between the CAMAC and MULTIBUS subsystems, and a CAMAC "Polling Module" scans to see which buffers need to be emptied. The master CPU board then transfers the position-time data from the CAMAC buffer to a second buffer in the MULTIBUS subsystem. If this is data from an area detector, it is placed in the 2D raw data buffer, located in MULTIBUS-accessible memory on the master CPU board. If it is not area detector data, it is placed in a 1D raw data buffer located in MULTIBUS-accessible memory on

the lowest number slave CPU board in which the 1D raw data buffer has sufficient room. If there are no slave boards in the system, or if the 1D raw data buffer is full on all slave boards, the data are placed in the 1D raw data buffer on the master board.

Since the slave processors in MULTIDAS systems spend no time on the transfer of the raw data, each slave spends full time processing the data in its 1D raw data buffer to determine which locations to increment to form a histogram in MULTIBUS memory. This histograming process is governed by tables which had previously been set up on the Vaxstation. These tables are set up when you use the **NEWRUN** command (See Chapter 2), and are stored in the Run File. (See Section A.3.1 for a discussion of "Runs" and "Run Files".) When the Run is started, these tables are downloaded to the MULTIBUS CPU boards. Instead of completing the histograming process, each slave CPU stores the histogram memory addresses it has calculated to be incremented in a buffer in its own on-board memory. When the master CPU is not handling raw data transfers, it scans these "histogram address" buffers on the slave boards, increments the contents of each address it finds there, and resets pointers to indicate this buffer space is again available. If not involved with raw data transfers or incrementing the contents of addresses determined by the slaves, the master then histograms the data, if any, in its own 1D or 2D raw data buffers. This master/slave operation is transparent to all outside systems, for which it makes no difference (other than overall time-averaged histograming rates) whether the instrument has one or more slave boards or only a single master CPU board. The number of CPU boards installed on a given instrument is thus based only on the maximum time-averaged data rate expected for that instrument.

In the FASTDAS system (GLAD only), all of the functions of the Polling Module and all the time-critical functions of the CAMAC Crate Controller are carried out by a CAMAC Auxiliary Crate Controller. This Auxiliary Crate Controller scans to see which CAMAC buffers contain any data, and transfers any data found to its own very-deep internal buffer. Data from this Auxiliary Crate Controller buffer are transferred on demand to the Histogram Accelerator Board in the MULTIBUS crate. This Histogram Accelerator Board uses the histograming tables in its on-board memory to calculate the histogram address to be incremented for each event, and also carries out the incrementing of the contents of these addresses in MULTIBUS histogram memory. These histograming tables are generated when the **NEWRUN** command is used for GLAD, and are downloaded when the Run is started. A slow, reliable main CAMAC crate controller communicates directly with the Vaxstation via RS232 terminal communication, to provide for initialization of the CAMAC modules, etc.

The table-driven histograming schemes used in the MULTIDAS and FASTDAS systems allow a wide degree of flexibility in the choice of histograming parameters while maintaining as much hardware and software compatibility as possible across all the different IPNS instruments. The structure of these tables is largely irrelevant to the general user, since the tables are set up automatically by the Vaxstation software based upon specific choices of default parameters (set up by the instrument manager) and on the dialog with the user initiated by the **NEWRUN** command.

A.2.2 Vaxstation (Instrument Computer) Subsystem

Several different models of DEC Vaxstation or MicroVAX are used on the IPNS instruments. Throughout this manual these are all generically referred to as Vaxstations. At present (March, 1996) these include Vaxstation 3600 (upgraded from Vaxstation-II) (HIPD,LRMECS,POSY1,QENS), Vaxstation 3200 (HRMECS,POSY2), MicroVAX 3400 (SCD), MicroVAX 3500 (SAD), Vaxstation 3520 (GLAD,SAND), MicroVAX 3900 (CHEX), MicroVAX 3600 (GPPD), and a Vax 4000-200 configured as a Vaxstation (SEPD). A development/spare system using a MicroVAX 3900 (SPARE1) is also available. Each of these has at least 16 MB of RAM and a large disk (1000-2000 Mbytes) for storage of Run Files and of calibration and other instrument-related files. This disk is given the logical name UDISK1:, and the instrument login account is always located on this disk. Some of the instruments have a second disk which contains the VMS system software while on other instruments the VMS system software is stored on UDISK1: along with all the other files. The PNS system software, data analysis software, reduced data files, etc. are stored on one or the other of the disks, depending on space requirements.

All Instrument computers are connected to a DECNET/ETHERNET network which allows easy communication among the instrument computers, with the IPNS Central Cluster of MicroVAX and DEC Alpha computers which is available for data analysis, with a variety of printers, plotters, terminals and other peripheral equipment, and with outside networks such as BITNET and INTERNET.

A.2.3 Control of Sample-Environment Equipment

A variety of sample-environment equipment has been interfaced for computer-controlled operation. This includes temperature controllers for both low and high temperatures, several different types of sample changers, sample positioners and orienters, and magnetic field. Check with your instrument manager to see which equipment is available for each instrument. The PNS system software contains provisions for monitoring sample-environment variables (eg - temperature) during data acquisition and stopping data acquisition whenever the monitored variable is out of the allowed range.

The number of different types of possible hardware interfaces for such equipment has been deliberately restricted, in order to minimize the number of different types of hardware and software interfacing which must be dealt with and to maximize the interchangeability of equipment between instruments. All of the sample-environment-equipment which has been interfaced to the instrument computers has been interfaced either via a CAMAC module in the control CAMAC crate (this is a separate CAMAC

crate connected directly to the Vaxstation - see Figure A.1), or via RS232 serial lines using standard VMS terminal communication. To date, all of the temperature controllers have been interfaced via RS232, while all other equipment has been interfaced via CAMAC.

A.3 PNS SYSTEM SOFTWARE

The PNS system software consists of a suite of programs on the instrument computer which interface with the data acquisition hardware. These programs take care of all the data acquisition functions including setting-up the necessary tables for histograming, starting and stopping data acquisition, display of data, control of sample environment, etc. Appendix B of this manual contains a list of these commands, and some of them are described in greater detail in Chapters 2-7 of this manual.

All of the instrument computers run the same PNS system software. Although there are a few instrument-specific programs, most of the PNS system programs are common to all instruments, with the different functionality required by different instruments being dictated by a number of instrument control files which are maintained by the instrument managers or other IPNS personnel.

Several concepts are fundamental to the use of this software. These include the concepts of 'Runs' and 'Run Files', 'histograms, detector 'IDs', 'grouping' of detectors, and 'time-focusing' of detectors. These concepts are discussed in Sections A.3.1 through A.3.5 below.

A.3.1 The 'Run' Concept

The PNS system software for the data acquisition systems is organized around the concept of an individual 'Run'. A 'Run' is defined as a data acquisition operation of the system with a single distinct set of instrument parameters. Examples of a single Run might be:

1. Collect data with one particular set of histogram channel widths and grouping of detectors and one particular sample temperature. Stop when a preset monitor count is reached.

2. Collect data from an area PSD with one particular set of histogram channel widths for one particular orientation of stepping motors. Stop when a preset monitor count is reached.

A repeat of example 1 with everything the same but the sample temperature would be considered to be a separate Run. Similarly, a repeat of example 2 with different

stepping motor settings would be considered to be a separate Run. A repeat of either example with different histogram channel widths would also be considered to be a separate Run. Each separate Run is assigned a 'Run number'. All the parameters used to set up a Run (parameters controlling data histogram organization, sample and instrument parameters, etc.), other pertinent parameters (times of data acquisition start and stop, title of the Run, user name, etc.), and the raw histogram data collected during that Run are all gathered into one 'Run File' identified with that Run number, with a different Run File being used for each Run. Run Files have the file name (name)(number).RUN, where (name) is a 4-character version of the instrument name (GLAD, GPPD, HRCS, LRCS, PNE0, POSY, SAD1, SCD0, or SEPD) and (number) is the Run number (4-digit ASCII). Run Files are stored in the logical directory DATADIR:.

The Run File also contains the tables necessary for the MULTIBUS subsystem to properly histogram the incoming data. As much as possible of this information is obtained automatically. When you set up a Run with the **NEWRUN** command, you have the option of taking most of the set up information from one of several default Run Files which have previously been set up, or of providing your own input for the setup parameters. Such setup parameters might include minimum and maximum times and channel widths for the time-spectra, which detectors should be grouped together on-the-fly, etc. In either case, you have the option to select automatic control of one or more sample-environment parameters such as temperature, sample position, etc.

When a Run is started, information from the Run File is used to control the operation of the instrument, and data collected during this Run are periodically saved into a new version of the Run File at the end of each 'cycle' and/or when the Run is stopped. (The length of a cycle is arbitrary and can be defined in terms of the number of T_0 pulses from the accelerator, elapsed time, or number of events in a given channel.) The data in histogram memory and in the Run File are always cumulative over all the cycles of that Run. At the completion of the Run, the Run File contains a complete record of the instrument configuration and the data collected for that configuration.

A.3.2 The 'Histogram' Concept

The time-of-flight data are collected into 'histograms' in MULTIBUS memory. Each histogram contains 1D time spectra (with each channel containing the data accumulated from a range of TOF values for a given group of detectors, and consecutive channels containing consecutive TOF ranges for this same detector group) or 2D spectra (with each channel containing the data accumulated from a range of x and y positions on the detector and for a range of TOF values, and with all such channels for the same range of TOF values being associated as a "time-slice") or a combination of these two. Each event can be binned in only one of the different spectra in such a histogram.

However, the PNS system software permits the collection of multiple histograms within the framework of a given Run. These multiple histograms can be either 'concurrent' or 'sequential'. Concurrent histograms are collected concurrently, with each event being allowed to be binned in time spectra within each of the concurrent histograms. This allows, for example, one histogram to be set up with the actual channel widths and TOF ranges of interest for the experiment, while another histogram is organized with channel widths and time ranges which are appropriate for monitoring detector noise, background, etc.

Sequential histograms are collected by allowing the system to switch the binning from one region of MULTIBUS memory to another. Such switching can be done very rapidly, and is intended to be used for following the real-time evolution of the sample (eg - relaxation of a cyclically perturbed sample). Each event can be binned in at most one of the sequential histograms. Each of the sequential histograms has the same histograming parameters (channel widths, etc.).

Each histogram, either concurrent or sequential, within a Run is given a histogram number IH, which ranges from 1 to the number of histograms in the run. This histogram number is used to define which histogram is to be accessed for graphics displays, data analysis, etc.

A.3.3 'Monitored Variables' and 'Cycles'

The PNS system software organizes data collection into 'cycles'. The length of each cycle is determined in terms of the 'monitored variable'. Monitored variables can be elapsed time, measured in minutes; number of accelerator T_0 synchronizing pulses received (only those received while data acquisition is active are counted), measured in pulses; or the total counts accumulated in a particular channel in histogram memory. Thus a cycle could be set up to run for 15 minutes, for 27000 pulses (which is also 15 minutes of 30 Hz operation, but may actually take longer than 15 minutes), or it could be set up to run until 10000 counts were accumulated in a beam monitor sum channel, etc.

When a Run is started it is scheduled to run for a certain number of cycles with a certain monitored variable, and the **START** command will show you the currently scheduled values (default is 720 cycles of 108000 pulses each - this is 30 days running at 30 Hz). At the end of each cycle data acquisition is stopped briefly and the accumulated data are saved to the current version of the Run File on the disk. As soon as the data have been saved, data acquisition begins on the next cycle, and a new version of the Run File is created to be ready to receive the data from the next save (data in histogram memory or in the Run File are always cumulative over all the cycles completed). When the last scheduled cycle is completed, the PNS system software checks whether another Run is scheduled, and if so starts it. If there are no more Runs scheduled, data acquisition is terminated. The **STOPRUN** command can be used to

stop data acquisition at any time before the scheduled number of cycles has been completed.

A.3.4 The Detector Identification Number 'ID'

For standard detectors and for linear-position-sensitive detectors which are charge-division encoded (GLAD,SAND), the fundamental position variable treated by the data acquisition system is the detector identification number 'ID'. The standard 1D-detector discriminator/encoder modules (models D109 or D109B) in the CAMAC system can each accept input from 8 detectors. In the MULTIDAS system each of these inputs is assigned an ID, which is encoded as part of the raw data for each event coming from that detector. ID assignments proceed in sequence according to the input within the module and the crate and slot in which the module is located, with the first input in slot 1 of crate 1 being ID number 1, the first input in slot 2 of crate 1 being ID number 9, the first input in slot 1 of crate 2 being ID number 161, etc. [Each crate can hold discriminator/encoder modules in slots 1-20, so there are 160 IDs per crate.] If there is no discriminator/encoder module in a given slot, 8 IDs are still reserved for that slot.

The charge-division-encoded linear-position-sensitive detectors (LPSDs) are currently (January, 1992) used only on GLAD, with the FASTDAS system. The LPSD discriminator/encoder modules (models D114 and D115) in the CAMAC subsystem can each accept input from 4 LPSDs, and can encode positions within each of these LPSDs into 64 segments. Hence in the FASTDAS (GLAD) system there are 256 IDs assigned per CAMAC slot, with segment 1 of input 1 in slot 1 of crate 1 being ID number 1, Segment 1 of input 2 in slot 1 of crate 1 being ID number 65, segment 1 of input 1 in slot 2 of crate 1 being ID number 257, etc. Unlike the MULTIDAS case where IDs are assigned consecutively, in the FASTDAS system the first ID assigned in crate 2 is 8193 (2^{13}+1) while the last ID assigned in slot 20 of crate 1 is 5120 (20x256), so there is a set of IDs between 5120 and 8193 which are never used. Similarly, the first ID assigned in crate 3 is 16385 ($2x2^{13}$+1), etc. If a standard discriminator/encoder module (D109B) is used in the FASTDAS system, as is done for the GLAD beam monitors, its 8 inputs are assigned the first 8 IDs associated with that slot.

In both the MULTIDAS and FASTDAS systems, all histograming of events from such detectors is based on the ID and the time-of-flight (TOF) encoded for each event. The tables which control all aspects of the histograming (channel width, time-focusing, grouping of detectors, etc.) are all formulated in terms of these two variables. A set of calibration tables, also formulated in terms of these two variables, allows the mapping of ID to scattering angle, ID and TOF to d-spacing or other relevant variable, etc. These calibration tables have been set up by the instrument manager for your particular instrument, and permit the NEWRUN program to set up the Run in terms of physically meaningful variables regardless of in what order the detectors are actually connected

into the modules in the CAMAC crates (so long as the calibration tables are correct for the detectors as connected).

Because GLAD has a large number (eventually more than 400) of such LPSDs, the number of individual IDs to keep track of is quite large. Thus the PNS system software provides a mapping for GLAD so that the user can refer to specific LPSD segments (IDs) in a more intuitive manner. The GLAD LPSDs are mounted in the instrument in banks. GLAD can accommodate 10 such banks. These bank locations are numbered 1 through 10 clockwise (viewed from above) starting at the highest angle on the SCD side of the instrument and running through 0 angle and back to the highest angle on the QENS side of the instrument. LPSDs within each bank are numbered 1 through the number of LPSDs that bank will hold (ranging from 38 to 53), with the numbering again proceeding in a clockwise (viewed from above) direction. Segments within each LPSD are numbered 1 through 64, from the top down. The PNS system software and the GLAD analysis codes use this bank,detector,segment numbering scheme to point to the desired ID so that the system can still function internally in terms of the IDs as defined above. This mapping is set up by the instrument manager or by other IPNS personnel, so you should never have to worry about individual ID numbers on GLAD.

2D position-sensitive detectors and rise-time-encoded linear-position-sensitive detectors which are encoded as 2D position-sensitive detectors with only 1 element in the y-direction (POSY1,POSY2) are not assigned IDs. Their histograming is handled by an entirely different algorithm.

A.3.5 'Grouping' and 'Time-Focusing'

'Grouping' of standard 1D detectors or of the segments in LPSDs is defined as the storage of spectra from more than one detector ID in the same area of memory so that the counts from different detector IDs are added together. This is commonly used to combine the results from several detectors which are physically close together, so that the results appear as though they were from a single larger detector. Data may or may not be 'time-focused' before grouping.

'Time-focusing' of the data from several detectors means performing computations on the raw data position and time-of-flight information as the data arrive (on-the-fly) so that the events from several detectors can be combined in a physically meaningful way before they are histogramed. The PNS system software allows on-the-fly focusing of the detectors in the powder diffractometers (GPPD,SEPD), in order to convert the time-of-flight to a modified time-of-flight which is proportional to the sample d-spacing (spacing between the crystalline planes) before data from the different detectors are grouped together. The PNS system software also allows on-the-fly focusing of the detectors on the chopper spectrometers (HRMECS,LRMECS) to correct for differences in path length before grouping.

The setup procedures for both grouping and time-focusing are described in detail in Chapter 2.

APPENDIX B

SUMMARY OF PNS COMMANDS

Portions of the command verb after the * may be omitted. Commands are listed alphabetically within a given category. Unless otherwise noted, all commands apply to both FASTDAS (GLAD) and microprocessor (all other instruments) systems.

NOTE: Do not use the "=" sign in any of these VAX commands, except as explicitly shown in these notes. The VAX treats "=" as "assign", which can lead to many problems. If you do use "=" by accident, log out and log back in to reinitialize the variables.

B.1 RUN FILE SETUP AND DELETION

CTL*MOD$_\Delta$run
Put ancillary equipment control parameters in the Run File for Run number "run", or modify the control parameters already in this Run File.

DRUN$_\Delta$run
Set default Run number "run" to copy for Run setup. Run is a decimal Run number - omit to see current value - set to 0 to allow full setup. Use of the value input by **DRUN** is governed by the flags set in (name)NEWR.MSK (see Chapter 3). Default Run number is also accessible in the **NEWRUN** command.

NEW*RUN
Run setup routine. Input to this routine is menu-driven or in question-answer mode.

REMOVE$_\Delta$runlist
Deletes all versions of the Run Files for the Run numbers specified in "runlist" and corrects the maximum Run number used if the Run File for the previous maximum Run number is deleted. Runlist can contain a single Run number, individual Run numbers separated by commas, a sequence of Run numbers specified by giving the first and last number in the sequence separated by a dash, or any combination of these.

B.2 SCHEDULING, STARTING, AND STOPPING OF RUNS

KEEP△numver

Set number of versions of the Run File to keep. Numver is in decimal - omit to see current value.

QUITRUN

Stop Run and don't save data.

SCHE*DULE△command-line

Run scheduling. The command line contains one or more lists of Run numbers separated by dashes or commas, and associated scheduling information. Run numbers separated by dashes will be interpreted as a list containing these Run numbers and all consecutive numbers between them. To schedule the number of cycles to be used for these Runs, surround the Run list with parentheses ( ) and precede the parentheses with the number of cycles (no intervening blanks). To indicate the length of cycle and the monitored variable, follow the Run list or the right-parenthesis) with a slash / and then a number indicating the cycle length followed by either M (for minutes of elapsed time), P (for pulses), or C (for counts in a channel). Again there must be no intervening blanks. If the number of cycles, the cycle length, or the monitored variable are omitted, default values are used. See Chapter 3 for examples of command-line syntax.

STAR*T△command-line

Start Run (also includes scheduling). The command line syntax is the same as for the **SCHEDULE** command, but any scheduling input as part of the **START** command line supersedes any corresponding previous scheduling.

START/RESTART△runnumber

Start Run without downloading all tables or data. Used to recover data from the MULTIBUS memory after a system malfunction. NOTE: USE THIS COMMAND ONLY TO RECOVER FROM AN ABNORMAL EXIT FROM THE RUN, AND THEN ONLY IF YOU TRUST THE DATA REMAINING IN MULTIBUS MEMORY. IF DATA HAVE PREVIOUSLY BEEN PROPERLY SAVED WITH A **STOPRUN** COMMAND, USE **START** INSTEAD OF **START/RESTART**.

STOPRUN

Stop Run and save data. Note: save takes several minutes on GLAD - don't issue any other commands until it is complete.

B.3 PRINTING AND MONITORING RUN-RELATED INFORMATION

LIST
List Run Files for this instrument.

PRUN{/options}$_\Delta$NOUN$_\Delta$runlist
Prints Run information. Options: **/LIVE**, **/VERS=version**, **/HIST=histogram**, **/OUTPUT=filename**. Nouns: **TITLE**, **STATUS**, **CONTROL**, **HEADER**, **RUNS**, **DATA**, **MESSAGE**, **DISCRIMINATORS**. If output is not specified, it goes to terminal. See Chapter 6 for examples of the command line syntax.

RDP*LS{/L}
Read current contents of T_0 pulse counter in clock module. The **/L** option causes all output to go to the (name).LOG file in the login account.

S2DS{/options}$_\Delta$runlist
Prints area-detector and monitor sums for area detector instruments. Options: **/LIVE**, **/VERS=version**, **/OUTPUT=filename**. If output is not specified, it goes to terminal.

STATUS
Initiates a display of status of various instrument parameters (eg - beam monitor counts, gate open or closed, instrument vacuums, etc).

B.4 MANIPULATION OF RUN FILES

MODRUN$_\Delta$runfile
Allows modification of some of the header portions of a Run File, and also allows modification of overflow information in the Run File.

B.5 GRAPHICAL DISPLAY OF DATA

*** Note: On the DECWINDOWS terminal (Vaxstation console), all graphics commands are entered into a text window. However, when graphics are operated from a remote terminal in Tektronix mode, graphics commands can be entered into the graphics window (terminal in graphics mode) as well. ***

See Chapter 4 for examples of the use of the graphics commands.

CVS
Exit display mode.

DEXIT
Same as **CVS**.

DIS
Initiate display.

DPLOT
Produces a Tektronix graphics file PGPLOT.TK14 containing the current plot. You must be displaying a plot to use this command.

DPLOT△PS
Produces a Postscript graphics file PGPLOT.PS containing the current plot in landscape format. You must be displaying a plot to use this command.

DPLOT△PSP
Produces a Postscript graphics file PGPLOT.PS containing the current plot in portrait format. You must be displaying a plot to use this command.

DPLOT△PSC
Produces a color Postscript graphics file PGPLOT.PS containing the current plot in landscape format. You must be displaying a plot to use this command.

DPLOT△PSCP
Produces a color Postscript graphics file PGPLOT.PS containing the current plot in portrait format. You must be displaying a plot to use this command.

DPLOT△EZ
Produces an ASCII file PGPLOT.EZ of the data used for the currently displayed plot (eg - in TYP FH, HST X, the y column in the file would contain area detector data summed from ypoint_min to ypoint_max and tpoint_min to tpoint_max, and the x column would contain the corresponding x in the current units). The file is in EASYPLOT format.

DPLOT△LX
Produces a LJ250 180-dpi graphics file PGPLOT.LJ containing the current plot in landscape format. You must be displaying a plot to use this command.

DX△xmin△xmax
Set x limits for display.

GRAFW*INDOW△option
Sets the size of the graphics window on a Decwindows terminal. If option is omitted, the current setting is reported. Currently allowed values for option are LARGE and SMALL, but other options will be added in the future.

HOLD
Causes the LD and L3 type plots to "hold" for viewing at the end of the next plotting pass, rather than immediately repeating the plot with new data.

Plotting is then resumed with the "**RESUME**" command (or the "**PAGE**" command if page mode plotting is being resumed).

HST$_\triangle$hstdir
Set direction for 1D plot thru 2D data. Hstdir is X, Y, or T. Not for GLAD.

ID$_\triangle$id   (instruments other than GLAD)
Set detector id for display.

ID$_\triangle$bank,detector,segment   (GLAD)
Select bank, detector, and segment for display.

IH$_\triangle$ih
Set histogram number for display.

INTEGRATE$_\triangle$x1,x2{,y1,y2}
For 1D plots (types L,F,LH,FH) this command returns the sum of the graphed data between x1 and x2 (x1 and x2 in the current units). For these type plots, y1 and y2 need not be entered, and will be ignored if entered. For types LH and FH, this integral includes all data within the region specified by x1,x2 and the ranges of the other two variables (x,y,or t) specified for the current plot. For 2D density plots (types LD and FD), this command returns the sum of the graphed data lying within the box with opposite corners at x1,y1 and x2,y2. This integral includes all data within the time range specified on the current plot. y1 and y2 must be entered for this plot type. NOTE: you must be displaying a plot in order to use the **INTEGRATE** command.

IPT$_\triangle$ipt
Set point-plotting parameter for display. Every iptth point will be plotted. (Primarily useful to speed up 3D plots over phone lines or to allow a plot to span the full range of a spectrum containing more than 8000 channels.)

NORMALIZE
Toggles the y variable between counts per detector (or segment) and counts per group, for display types where these normalizations are applicable..

PAGE
Causes the LD and FD type plots to "page" through the time-slices one at a time,rather than summing them.   "**RESUME**" will return to the summing mode.

PRE*VIEW
Show current display parameter settings.

RES*UME

"Resumes" the normal graphics operation in the LD, FD, L3, or F3 plotting types (after operation has been altered by the "**HOLD**" or "**PAGE**" commands). If page mode plotting has been stopped with the "**HOLD**" command, it should be restarted with "**PAGE**" rather than with "**RESUME**", as "**RESUME**" will return it to summation mode instead and the limits will be altered.

RUNHCPY

This invokes a display program which works outside the framework covered by these other display commands. **RUNHCPY** allows superposition of several IDs from the same Run, and is set up through menus. Plot files can be produced for QMS, HP, LN03 or POSTSCRIPT printers (POSTSCRIPT may not work yet). NOT CURRENTLY IMPLEMENTED.

RUNN*UM$_\Delta$runn

Set Run number for a file display. RUNN is an integer Run number.

TERMINAL

Specify terminal you are using for display. If the terminal type is currently set as either type 1 (Vaxstation) or type 2 (HDS terminal - Tektronix mode), the system will automatically select type 1 if you log in on the Vaxstation or type 2 if you log in remotely. (Type 2 will work for other kinds of Tektronix graphics terminals, but screen handling may not be correct.) You can use the **TERMINAL** command to select a terminal type higher than 2 (eg - to get the correct screen handling on a Mac with Versaterm), but if you do so please set the terminal type back to 1 or 2 when you are done, so terminal-setting will be back in the automatic mode. *** If you have any question about the current terminal type setting, use the **PRE** command to check this.

TPT$_\Delta$tpoint_min{,tpoint_max}

Set tpoint for 1D plot thru 2D data. Tpoint is in channels. The plot will be of a sum of data over the range tpoint_min to tpoint_max. If tpoint_max is not specified, it is set equal to tpoint_min. Not for GLAD.

TYP$_\Delta$type

Set type of plot. Valid types are F, L, FD, LD, FH, LH, F3, L3. F3 and L3 are available on GLAD for units T or S, and on area-det instruments for unit T.

UNIT$_\Delta$unit

Set units for display. Only units T and S are valid with types F3 and L3 (only T for area-detectors).

VERSION$_\Delta$vernum

Set the version number for file plots. Vernum is a 4 or fewer digit ASCII number. A value of 0 results in plotting from the highest version number

available for this file. The version number is reset to 0 for live plots, and defaults to 0 in most other cases unless specifically set.

VIEW$_\triangle$xvue,yvue,zvue
Set view point for F3 and L3 plot types. Xvue, yvue, zvue are specified in a coordinate system in which the plot area dimensions are 4.x4.x3. and the z-axis (intensity data axis) is vertical. The viewpoint should be set well outside this plot box.

XPT$_\triangle$xpoint_min{,xpoint_max}
Set xpoint for 1D plot thru 2D data. Xpoint is in channels. The plot will be of a sum of data over the range xpoint_min to xpoint_max. If xpoint_max is not specified, it is set equal to xpoint_min. Not for GLAD.

YLOG
Toggles between a linear and logrithmic color-density scale for intensities in the LD, FD, LT, and FT types of displays.

YMAX$_\triangle$ymax
Set maximum data value for display. Applies to manual scaling only.

YMIN$_\triangle$ymin
Set minimum data value for display. Applies to manual scaling only.

YPT$_\triangle$ypoint_min{,ypoint_max}
Set ypoint for 1D plot thru 2D data. Ypoint is in channels. The plot will be of a sum of data over the range ypoint_min to ypoint_max. If ypoint_max is not specified, it is set equal to ypoint_min. Not for GLAD.

YSC
Toggle between manual and autoscaling.

ZLIM$_\triangle$zmin$_\triangle$zmax
Sets time-slice limits for LD and FD plots.

B.6 CONTROL OF SAMPLE-ENVIRONMENT EQUIPMENT

BARCAL
Operates the calibration bar and collects position spectra on GLAD.

BEA*MSTOP
Operates the beamstops and the transmission monitor on SAND.

CHA*NGER
Operates the sample changer on SAD.

OFF*ON

Switches a logic level in the 3082 CAMAC Output Register.

RDT*EMP{/L}

Reads the temperature of a displex, cryostat, or furnace. The **/L** option causes all output to go to the (name).LOG file in the login account.

SAM*PLE

Operates the SEPD, GPPD and GLAD Jacob's Ladder room temperature sample changers, and the POSY2 sample changer.

SETANG

Drives stepping motors for POSY2 collimators and sample table. All motions are correlated.

STE*P

General purpose stepping motor drive program.

STOPLOG

Stops the stand-alone temperature logging which was previously started by the **TLOG** command.

TEM*TUR

Control program for the displex and furnace temperature controllers.

TLOG

Stand-alone temperature logging program for the displex and furnace temperature controllers.

TRA*NSMON

Positions the SAD transmission monitor.

B.7 UTILITY MULTIBUS AND CAMAC COMMANDS

CAMAC $_\triangle$B$_\triangle$crate,slot

CAMAC block transfer. Crate, slot are in decimal; results in hex.

CAMAC$_\triangle$C$_\triangle$crate,slot,subadr,function,(data){/opt}

CAMAC function, including read and write. Options specify data or result type: **D**(decimal), **O**(octal), **I**(inverted): default is hex. Crate, slot, subadr, and function are in decimal.

CAMAC$_\triangle$R$_\triangle$crate,slot,subadr{/opt}
CAMAC read. Options specify result type: **D**(decimal), **O**(octal), **I**(inverted): default is hex. Crate, slot, subadr are in decimal.

CAMAC$_\triangle$W$_\triangle$crate,slot,subadr,data{/opt}
CAMAC write. Options specify data type: **D**(decimal), **O**(octal), **I**(inverted): default is hex. Crate, slot, subadr are in decimal.

CLEAR$_\triangle$MEM$_\triangle$strtadd,endadd
Clear MULTIBUS memory. Strtadd, endadd are hex addresses.

CLEAR$_\triangle$PLS
Clear T_0 pulse counter in clock module.

DCS$_\triangle$crate,slot,input-list=dismin,dismax
Set discriminators in the CAMAC discriminator/encoder module (D109 or D109B) in this crate and slot.

DISC*RIMINATORS$_\triangle$idlist=dismin,dismax
Set discriminators in CAMAC discriminator/encoder modules (D109 or D109B) and in the file INSTDIR:(name).DIS. **DISC*RIMINATORS/OUTPUT=filename** causes a printout of the discriminator settings into the file "filename" with no other action.

MBMAP
Read MULTIBUS mapping table.

MBR{/options}$_\triangle$strtadd$_\triangle$endadd
Read data from specified MULTIBUS region. Options include **/LONGWORD**, **/INCREMENT=increment**, **/BIT3** (**/BIT3** is required if the BIT3 interface is used on this instrument). Strtadd and endadd are in hex. Increment is in decimal bytes. Default for data is hex.

B.8 HELP

PHELP
Displays a list of PNS system commands (those given in this Appendix) and describes their functions.

APPENDIX C

PRINT, PLOT, AND BATCH QUEUES

C.1 PRINT AND PLOT QUEUES

Table C.1 shows the devices currently available to be used in print and plot queues on the instrument Vaxstations. These devices and their locations change frequently, so Table C.1 may not stay up to date. Contact your instrument manager if you have problems.

Table C.1
Printer and Plotter Queues and Devices

Queue	Device Type	Graphics	Device Location
375T	LN03 laser	TK14	trailer in 375
399_LN03	LN03 laser	TK14	399 big room
AST	AST laser	ps	????
B223_LASER	Talaris laser	TK14	223
B223_PRINTER	Printronix line	- - -	223
BEV	LN03 laser	TK14	360 Bev's office
CI600	CI600 line	- - -	360 computer room
DIANE	DP laser	ps	360 main office
HP	HP pen-plot (color)	HPGL	- - -
HP360	HP pen-plot (color)	HPGL	360 terminal area
LJ250	LJ250 ink-jet (color)		360 terminal area
LPA0	Printronix line	- - -	399
NPB	LN03 laser	TK14	360 terminal area
TALARIS	Talaris laser	TK14	399 terminal room
TALLY	Tally dot-matrix	- - -	399

The following two sections list some "shorthand" commands that can be used for printing or plotting on some of these devices.

C.1.1 Printing

These commands are used to spool files to be printed on various printers. THESE ARE NOT FOR PLOT FILES!!! [NOTE: Some of these queues may not be available on your particular Vaxstation.]

PRQ*MS$_\Delta$files
> Queue specified files for printing on the QMS (TALARIS) laser printer in Bldg. 399. [QUEUE=TALARIS]

PR223$_\Delta$files
> Queue specified files for printing on the printer in Bldg. 223. [QUEUE=B223_PRINTER]

PRNPB$_\Delta$files
> Queue specified files for printing on the NPB LN03 laser printer in Bldg. 360. [QUEUE=NPB]

PR375$_\Delta$files
> Queue specified files for printing on the LN03 laser printer in the trailer in Bldg. 375. [QUEUE=375T]

PRLN399$_\Delta$files
> Queue specified files for printing on the LN03 laser printer in Bldg. 399. [QUEUE=399_LN03]

PR399$_\Delta$files
> Queue specified files for printing on the Printronix printer in Bldg. 399. [QUEUE=LPA0]

PR360$_\Delta$files
P360$_\Delta$files
> Queue specified files for printing on the CI600 printer in Bldg. 360. [QUEUE=CI600]

PRTALLY$_\Delta$files
PTALLY$_\Delta$files
> Queue specified files for printing on the Tally printer in Bldg.. [QUEUE=TALLY]

C.1.2 Plotting

These commands are used to spool plot files to various plotters.
[NOTE: Some of these queues may not be available on your particular Vaxstation.]

PLQ*MS$_\Delta$files
> Queue specified files for plotting on the QMS (TALARIS) laser printer in Bldg. 399. Files must be Tektronix graphics files set up for the TALARIS printer. [QUEUE=TALARIS]

PL223$_\Delta$files

   Queue specified files for plotting on the QMS (TALARIS) laser printer in Bldg. 223. Files must be Tektronix graphics files set up for the TALARIS printer. [QUEUE=B223_LASER]

PLNPB$_\Delta$files

   Queue specified files for plotting on the NPB LN03 laser printer in Bldg. 360. Files must be Tektronix graphics files set up for the LN03 printer. [QUEUE=NPB]

PL375$_\Delta$files

   Queue specified files for plotting on the LN03 laser printer in the trailer in Bldg. 375. Files must be Tektronix graphics files set up for the LN03 printer. [QUEUE=375T]

PLN399$_\Delta$files

   Queue specified files for plotting on the LN03 laser printer in Bldg.. Files must be Tektronix graphics files set up for the LN03 printer. [QUEUE=399_LN03]

PLHP$_\Delta$files
PLHP399$_\Delta$files

   Queue specified files for plotting on the HP pen plotter in Bldg.. Files must be HP plotting files set up for the HP plotter. [QUEUE=HP]

PLHP360$_\Delta$files

   Queue specified files for plotting on the HP pen plotter in Bldg. 360. Files must be HP plotting files set up for the HP plotter. [QUEUE=HP360]

PLJ250$_\Delta$files

   Queue specified files for plotting on the LJ250 color ink jet printer in Bldg. 360. Files must be LJ250 plotting files set up for this printer. [QUEUE=LJ250]

C.2 BATCH QUEUES

   Several batch queues are started when the Instrument Vaxstation is booted. Each Instrument Vaxstation has the following batch queues started in this manner:

Queue	Priority	CPU Limit	Max Jobs
FAST	4	3 min	2
MEDIUM	3	25 min	3
LONG	2	2 hours	2
(name)	2	unlimited	2

where (name) is the full instrument name.

APPENDIX D

TROUBLESHOOTING AND TESTING

D.1 BASIC TROUBLESHOOTING PROCEDURE

The most common problems with the IPNS data acquisition systems have been user mistakes, problems in communication between computer and MULTIBUS or between MULTIBUS and CAMAC, and problems with the computers themselves, including problems with IPNS software and problems with DECWINDOWS. The following subsections are designed to lead you through tests to establish the source of the problem and to provide some steps to recover from the problem if possible.

D.1.1 DECWINDOWS

The most frequent problem with DECWINDOWS is the window "hanging up" for no apparent reason. To clear this up, first try the "Clear Communications" option in the window menu. If that doesn't work, use the "Quit" option in the window menu to kill the window, and then start another DECterm session. If that doesn't work, use the "Quit" option from the Session Manager window to kill all windows, and then log back into the system. If this doesn't work, then it's probably time to reboot the computer (see Section D.2).

Another DECWINDOWS problem is that occasionally the terminal will switch into the "operator console" mode with all or partially black screen and small white lettering indicating some type of operator message. To get out of this mode and back to the DECWINDOWS mode, use **<ctrl>F2** once or twice.

D.1.2 Computer

If a Vaxstation is hung up so you can't do anything on the terminal, reboot it. However, if you can do anything from any terminal on the Vaxstation, first try either the options to clear DECWINDOWS given in Section D.1.1 above or the "clear MULTIBUS communications" option below, to see if this solves the problem. If it doesn't, then you will have to try rebooting. If rebooting doesn't solve the problem (either type of computer), try turning off the power, waiting 20 sec, and then turning the power back on and booting.

If any of these result in a running computer with the problems cleared up, then use the **START/RESTART** command to restart any Runs that were running (if you are sure the data in the MULTIBUS weren't corrupted), or use **START** to start the Runs from the point at which they were last saved to the Run File. **START/RESTART** includes any data in the MULTIBUS memory, and can be used to save this data if the failure mode did not affect MULTIBUS operation (eg - MULTIBUS kept collecting data after the computer hung up).

If these procedures don't result in a running computer (fails to boot properly) then contact your instrument manager or other IPNS personnel.

D.1.3 Communication with MULTIBUS (not for GLAD)

If the computer is running, then communication with the MULTIBUS can be checked using the **MBMAP** command. This should result in a display of some of the mapping information used by the microcomputer CPU boards. Numbers displayed should be meaningful (most numbers should be same for all instruments, so check on a working instrument for comparison. If **MBMAP** doesn't work (error message, hangs up, or returns faulty numbers) then there is a MULTIBUS communication problem.

If there are no MULTIBUS communication problems then skip to Section D.1.4. Otherwise go through the following sequence. If at any point the communication problem clears up (as indicated by **MBMAP**) then skip the rest of the sequence and go to "MULTIBUS communication clear:".

Check software:

Try pressing the RESET button on the MULTIBUS and then using **MBMAP** again. If this doesn't work, then try rebooting the computer, which reinitializes the communication software. After pressing the RESET button, the Run must be started again with the **START** or **START/RESTART** command (you may have to use **QUITRUN** first).

If **MBMAP** still doesn't work after reinitializing the communication software or rebooting, then there is probably a hardware problem. Contact your instrument manager or other IPNS personnel.

MULTIBUS communication clear:

If there are no other problems, start any Runs that were running (use **START/RESTART** only if you are <u>absolutely sure</u> MULTIBUS data were not corrupted,

or if you arrange to save older versions of the current Run File and start a new Run immediately to make sure that any potentially corrupted data don't contaminate good data already in the Run File or good data collected after this fix).

D.1.4 Communication with CAMAC

Once communication with the MULTIBUS is OK, check the communication with the data acquisition CAMAC crate or crates. This is most easily done with a Dataway Display Module in some slot n (which slot is unimportant) in the crate to be tested (crate c, with c=1 for the first data acquisition crate). Communication with this crate can then be checked by writing to and reading from this module with the commands

Vaxstation

CAMAC$_\triangle$W$_\triangle$c,n,0,FFFFFF   Should light all lights in the right column
                                                                                      on the dataway display.
CAMAC$_\triangle$R$_\triangle$c,n,0   Should respond with FFFFFF.

In multiple-crate systems (only HRMECS at the moment) all crates should be checked.

If there is no Dataway Display Module available, communication with crate 1 can be roughly checked by reading the pulse counter in the CAMAC TOF Clock Module, clearing it, and reading it again.

Vaxstation

RDP   Should respond with the current number
                                                                                      of pulses (or with some large number if
                                                                                      the power has been turned off).

CLEAR$_\triangle$PLS
RDP   Should respond with 0.

If the first reading gives a non-zero number of pulses and the second reading gives zero, then CAMAC communication is probably working OK. However, if the first reading returns zero pulses this is not a good test, since communication problems sometimes result in a return of zero pulses.

If CAMAC communication seems OK, skip to Section D.1.5. Otherwise contact your instrument manager or other IPNS personnel.

D.1.5 Data Acquisition

Once all the communication works, try acquiring data.

System won't acquire data:

If the system will not acquire data, make sure all the cables are connected and that the Polling Module switches are set to poll all modules (except on GLAD which has no Polling Module). If the system still won't acquire data, contact your instrument manager or other IPNS personnel.

Errors while acquiring data:

Even for systems which appear to collect data OK, there is another more subtle communication error which sometimes causes problems (systems other than GLAD). This involves transfers of the raw data from the FIFO buffers in the CAMAC modules to the buffer memory on the microcomputer board. Occasionally these transfers will go to the wrong memory locations on the microcomputer board, resulting in overwriting of the histograming tables, overflow tables, histogram data, or the microcomputer program itself. Symptoms include obviously spurious data, hangup of the microcomputer and hence of data acquisition and/or communication with CAMAC, spurious overflow information, or spurious FIFO overflow indications (look at the file (name).LOG on the instrument computer).

If the problem occurs only infrequently, it may be difficult to tell if you have cured it unless you can run a very long test. However, if it occurs only infrequently, you can probably live with it.

Sometimes this problem can be cleared up merely by starting the Run over again. If this doesn't solve the problem adequately, contact your instrument manager or other IPNS personnel.

To be safe, data from cycles in which such a failure occurred should be discarded or at least isolated so it doesn't contaminate good data. In practice, however, such data is frequently still usable.

D.1.6 Control of Sample-Environment

If you are having a problem controlling sample-environment (temperature, sample positioning, etc.), first check the particular device manual to make certain you are using it properly. Go through any troubleshooting procedures which may be listed there. If this doesn't solve the problem, contact your instrument manager or other IPNS personnel.

D.2 BOOTING/REBOOTING THE VAXSTATION

Occasionally you may need to reboot the Vaxstation to clear up problems. To start the boot process, just press the HALT or RESTART button (RESTART initializes more of the system hardware and causes more system checks to be run) on the front of the Vaxstation (make sure it is on the Vaxstation box itself and not an expansion box). When the system is shut down, you may be prompted to use the console to reboot the system. To do this, press the HALT button again. The system will then go through several system checks and finally prompt with

>>>

to which you should respond **B**$_\Delta$**DUA0** which means boot from disk DUA0 (except on SEPD, where you should respond **B**$_\Delta$**DIA0** since the system disk is DIA0). In special cases it may be desirable to boot from a disk other than DUA0 (or DIA0). In this case replace DUA0 in the response with the desired disk name. The system should then proceed through the boot process (requires 7-10 minutes) with no further intervention. When the boot process is over, the Vaxstation console terminal will prompt you to input a Username and Password (see above).

APPENDIX E

TIME-FOCUSING DETAILS

The sections below describe the focusing used in several particular cases. In all of these examples, < > implies an unweighted arithmetic average over all values of ID within the time-field being focused, L_1 is the source-sample distance, L_2 the sample-detector distance, and $L = L_1 + L_2$. The constants h and m are Planck's constant and the neutron mass respectively.

E.1 POWDER DIFFRACTOMETERS

E.1.1 D-Spacing D

The PNS system software allows on-the-fly focusing of the detectors in the diffractometers, in order to convert the time-of-flight T to a modified time-of-flight T* which is proportional to d-spacing, before data from the different detectors are grouped together. This focusing involves the application of Equation (2.1) to each event "on-the-fly" before the event is binned into a histogram. When a Run is set up on a diffractometer using the **NEWRUN** command:

1. The user is asked if the detectors in a given time field are to be focused. If the answer is Yes, then any detectors from this time field which are grouped together will be focused according to equations (E.1) and (E.2).

2. The user sets up the histograming parameters as usual, but the time ranges specified for histograming are in terms of T* rather than T.

3. For focused detector groups, NEWRUN calculates the average total path length $<L> = \Sigma L/N$ and the average scattering angle $<2\theta> = \Sigma 2\theta/N$ where N is the number of detectors in the group. NEWRUN then generates the TSC table which is used to scale all sample-to-detector flight times to correspond to this fixed final path length and scattering angle according to the equation:

$$TSC(ID) = <L(ID)> \sin(<\theta(ID)>) / [L(ID) \sin(\theta(ID))] \qquad (E.1)$$

The d-spacing D can be calculated for each I(T*) channel according to:

$$D = \{h/[2m<L(ID)> \sin(<\theta(ID)>)]\} \, T^* \qquad (E.2)$$

4.   Values of <L> and <θ> can be printed out after the Run has been set up, by using the **PRUN**_Δ**HEADER** command.

E.1.2 Momentum Transfer Q

This type of focusing is also valid only for elastic scattering, and the correct focusing is given by focusing for D. (Focusing directly for Q does not work with the existing algorithm for T* because Q is not linear in T.) The formula for Q is then:

$$Q = 2\pi/\{h/[2m<L(ID)> \sin(<\theta(ID)>)] T^*\} \tag{E.3}$$

E.2 CHOPPER SPECTROMETERS

The PNS system software allows on-the-fly focusing of the detectors on the chopper spectrometers to correct for differences in path length before grouping. This results in a focusing of the neutron energy E. When a Run is set up using the **NEWRUN** command:

1.   The user inputs the fixed incident energy EIN (and possibly the final energy EOUT). For the chopper spectrometers, EIN must be non-zero and EOUT must be zero.

2.   Depending on the default settings in the (name)NEWR.MSK file, the user may be prompted to input a fixed time delay T_1. The dialog may go something like this:

Do you want to enter Time Delay(s): **Y**
Do you want Emission-Time Delay Corrections? **N**
Do you want to enter different delays for each detector? **N**
T0 Delay in Microseconds?: **T_1**
       [enter T_1 as a positive decimal number of microseconds; the value to
       use will be discussed below]
Will you be focusing any of the detector groups? **Y**
       [enter N here if none of the detector groups will be focused for this Run]

3. The user sets up the histograming parameters as usual, but the time ranges specified for histograming take on the different meanings given in Table E.1, depending on the situation:

Table E.1
Time-Focusing and TOF Times for Chopper Spectrometers

Answer to last question above	Answer to "is this field focused"	Value to input for T_1	Meaning of TOF times
N	No	0	moderator-to-detector flight time minus "chopper-delay"
N	No	"chopper-delay"	true moderator-to-detector flight time
Y	No	"chopper-delay"	moderator-to-detector flight time minus chopper-delay
Y	Yes	"chopper-delay"	sample-to-detector flight time

The correct value to use for the "chopper-delay" is the time difference between when the neutrons (of the incident energy EIN) leave the moderator and when the TOF clock starts counting (arrival of the T_0' pulse). This is not quite the same as the timing difference between the T_0 and T_0' pulses. Empirically, the correct number is roughly 104 microseconds.

4. The NEWRUN program calculates a fixed time T_2 which is either the negative of the T_1 value input above (in units of clock pulses) or else is the time (in clock pulses) at which neutrons of energy EIN reach the sample. The calculation of T_2 is controlled by the time-focus and constant-time-delay flag bits in the TTYPE table which are also calculated by NEWRUN. The value of T_2 is stored as the INTEGER*4 variable HTD in the Run File, and is accessible with a 3-argument Run File subroutine call. It is this T_2 value which is finally used as CD in the time-focusing equation (2.1). The values for the time-focus and constant-time-delay bits and for T_2 are given in Table E.2

Table E.2
Time-Focusing and Run File Parameters for Chopper Spectrometers

Answer to last question above	Answer to "is this field focused"	Time-focus bit	Constant-time-delay bit	T_2
N	No	0	0	0
N	No	0	1	$-8*T_1$
Y	No	0	0	$-8*T_1 +$ $8*L_1/\text{sqrt}(EIN/5.22707E+6)$
Y	Yes	1	1	$-8*T_1 +$ $8*L_1/\text{sqrt}(EIN/5.22707E+6)$

5.   For focused detector groups, NEWRUN also calculates the average final path length $<L_2> = \Sigma L_2/N$ where N is the number of detectors in the group. If $<L_2>$ is greater than 3.0 meters, $<L_2>$ is set to 4.0 meters; otherwise $<L_2>$ is set to 2.5 meters. NEWRUN then generates the TSC table which is used to scale all sample-to-detector flight times to this fixed final path length.

$$TSC(ID) = <L_2 \, (ID)> / L_2 \, (ID) \qquad\qquad (E.4)$$

The energy E can then be calculated for each I(T*) channel according to:

$$E = (<L_2 \, (ID)> / T^*)^2 / 2m \qquad\qquad (E.5)$$

6.   Values of EIN and $<L_2>$ can be printed out after the Run has been set up, by using the **PRUN$_\Delta$HEADER** command.

Once such an energy-focused Run has been set up, this Run File can be used to provide the default histograming information for setting up additional Runs, even if these Runs do not use the same value of EIN. In this case, the user inputs the new value for EIN when prompted by NEWRUN, and NEWRUN uses this value to calculate and store a new value for T_2. No other input is needed.

[Note: If EIN is different, this new focusing will be correct except for a minor error due to the fact that neutrons of a different energy leave the moderator at a slightly different time.]

When data are being displayed then if the display unit is T the displayed times have the same meaning as in Table E.1. If the display unit is E, the energy scale refers to the neutron final energy in all cases. [This energy scale will be correct only if correct values were entered for EIN and T_1 for this Run.]