APPENDIX B

(ERDLST MODIFICATIONS)

Prepared by
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COMPUTER SCIENCES CORPORATION

For

GODDARD SPACE FLIGHT CENTER

Under

Contract No. NAS 5-11790
Task No. 3101-02000

March 1973

EDRLST MODIFICATIONS

The Pioneer F/G Tape List Program has been modified for the following purposes: to print the subcom data in octal and to copy the EDR tape by option.

Deck Setup

Added to the JCL is the following set of DD cards:

```
//GO.FT11F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(NEW,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP,,OUT),VOL=SER=DUM2
```

The purpose of this data set is:

DD Name	Purpose of Data Set	Input/ Output	Device Type	Code
FT11F001	Backup EDR tape	Output	Tape	C

The meaning of the code is as follows:

C - Copy EDR tape onto backup tape

```
//PEDR EXEC LINKGO,REGION.GO=100K
//LINK.SYSLIB DD DSN=K3.ZIART.OGENERAL,DISP=SHR
//            DD DSN=K3.ZBRXB.SB001.OPIONEER,DISP=SHR
//GO.FT06F001 DD DCB=(BUFNO=4)
//GO.FT10F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(OLD,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP,,IN),VOL=SER=DUM1
//GO.FT11F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(NEW,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP,,OUT),VOL=SER=DUM2
//GO.SYSUDUMP DD SYSOUT=A
//GO.DATA5 DD *
 &INPUT DTAPE='E02102',QATT=T,LIMITS=1,1,QCOPY=T,DBUTP='Z-169'  &END
```

(Note the example of the additional parameters to NAMELIST. In this example, the decom tape residing in slot E02102 is copied onto the tape residing in slot Z-169.)

Figure 1. General Deck Setup for Executing the Pioneer F/G EDR Tape List Program (EDRLST)

Input/Output Tape

The backup EDR tape is formatted the same as the EDR tape. (Refer to Section 6.3.3.1 for the format. Its location is specified by namelist input parameter DBUTP.)

Cards

Added to the NAMELIST name INPUT are the following:

QCOPY = T - If a backup EDR tape is to be made.
F - If no backup EDR tape is to be made.

(Default = F)

DBUPTP = The location (tape slot) or symbol identifying the EDR backup tape (See DTAPE, Section 6.3.3.2).

(Default = blank)

PRINTED REPORTS

(Refer to Section 6.3.3.3 for a detailed description of the Printed Reports)

International Business Machines Corporation

6611 Kenilworth Avenue
Riverdale, Maryland 20840

January 24, 1972

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. Peter Bracken

Subject: Pioneer Data Processing System

Gentlemen:

The attached memoranda describe our understanding of the current requirements for the Pioneer Data Processing System.

Very truly yours,

G. J. Palfi

G. J. Palfi

Date: January 19, 1972

Organization: Scientific Data Analysis

Dept. & Bldg.: KE-2/Goddard

Telephone Ext.:

IBM

Subject: Meeting with Dr. Teegarden concerning the Pioneer Data Processing System

Reference:

To: G. J. Palfi

Attendees:
Mr. Pete Bracken (NASA)
Mr. Talcott Brooks
Mr. Ted Smith
Dr. Bonnard Teegarden (NASA)

A meeting was held with Dr. Bonnard Teegarden on January 14, 1972 to resolve some issues concerning the PHA Summarizer and the PHA Summary Plot program of the Pioneer Data Processing System. As a result of the meeting and subsequent telephone conversations, the following decisions were made:

PHA Summarizer

1. Each file on a Summary tape will contain data from a time interval that will be constant for the entire flight. The begin and end time of the interval will be rounded to the nearest quarter of an experiment cycle (64 frames). It was not decided what the time interval would be (perhaps 5 – 20 days), but Dr. Teegarden said he would decide that at a later date.

2. Each file on a Summary tape will consist of a header record followed by one or more data records. The first record (header record) of each file will contain at least the following information:

   a. Start and End time of Summary

   b. Attitude information to be used in conjunction with the sector identification. Dr. Teegarden said he would later decide what attitude information was required.

   c. Number of events and total time (excluding the time during data dropout) for each event type during the summarized interval.

3. The second and remaining records of the file (the data records) will consist of entries that contain the frequencies, in each of 4 priority modes, of events that have the same event type, amplitudes, R value, and sector values. It should be noted that these entries are determined by:

   (a) sorting all events from the PHA tape according to the following fields in decending order and from left to right:

   ETTA--- AB--- BC---CRSSSPP

   where E = 1 for HET
   = 0 for LET
   TT = 00 for $A_1 \overline{A_2}$ BC III
   = 01 for A_2BCIII
   = 10 for $(A_2 K_1 + A_1 (CI)\ \overline{BC III}$
   = 11 for $A_1 BK_2 \overline{C III}$
   A, B, C = Amplitudes for detectors A, B and C respectively
   R = 0 CII threshold not exceeded
   = 1 CII threshold is exceeded
   SSS = 0-7 Sectors 1-8 respectively
   PP = 0-3 Priorities 1-4 respectively

   and (b)

   summing events with identical E thru S fields according to the 4 priority modes. These 4 frequencies along with fields E thru S will comprise an entry in the data record.

4. Summaries generated for a time interval other than the constant time interval mentioned in 1 above will be written on a unique tape. The format of this unique tape will be identical to the normal Summary tape.

PHA Summary Plots

1. The PHA Summary Plots will be produced on a 128 by 128 grid. They will express the frequency of occurrence of the various data point readouts of two Pulse Height Analyzers for a range of possible readouts of the third Pulse Height Analyzer. The plots will be generated using compression factors which will allow the plotting range of Pulse Height Analyzer readouts to be increased at the expense of the resolution of individual readouts. The following table shows the correspondence of compression factor with range of readouts plotted. The ability to plot all possible combinations of two Pulse Height Analyzers within a detector will be incorporated.

Compression Factor	Range of PHA Readouts Plotted	Resolution Readouts/Plotted Point
1	0 - 127	1
2	0 - 255	2
4	0 - 511	4
8	0 - 1023	8
16	0 - 2047	16
32	0 - 4095	32

2. The program will have the ability to plot the data for one or more event types, either in separate plots or on the same plot. When plots are desired from only one summary period, any or all of the possible plots can be produced by performing multiple passes through the data for the summary period. When plots are desired from multiple summary periods, only a limited number of plots can be produced in one pass through the summary data due to main core storage limitations. The program can plot multiple summary periods either all on one plot or each on a separate plot.

3. The plot data can be screened before entering the plot grid. This screening can be based on the range at the third Pulse Height Analyzer readout, the sector information associated with each data point, or the priority mode in effect during data occurrence. In the case of the HET data, the status of the CI-CII threshold bit will provide an additional screening criteria.

In addition, screening can be performed through the correlation of readouts from two Pulse Height Analyzers. This can be accomplished by checking one PHA value against that derived from a function based on its correspondence with another PHA value. The incorporation of this technique might become so involved as to eliminate its feasibility within the time period at the PHA Summary Plot Program.

Unresolved Issues

In order for the Pioneer Summarizer Specifications to be completed the following items must be resolved by Dr. Teegarden:

1. The time interval to be summed during normal production.
2. The attitude information required in the header record on the Summary tape.
3. The procedure required to verify that the equipment counting the events/second (rates) is working correctly. To verify this, the PHA readouts will be analyzed to approximate the number of particles counted and then compared to the rates readout. It is not clear at this time whether such a procedure can be defined and thus may not be included in the PHA Summarizer.

Prepared by: Talcott K. Brooks
T. K. Brooks

Ted R. Smith
T. Smith

Date: January 20, 1972
From (location or mail address): Scientific Data Analysis
Dept. & Bldg.: KE 2/Goddard
Telephone Ext.:

IBM

Subject: Meeting with Dr. Teegarden concerning the Pioneer Data Processing System

Reference: Memo dated January 19, 1972 — Same subject

To: George Palfi

Attendees: Dr. Bonnard Teegarden (NASA)
Mr. Ted Smith

A meeting was held with Dr. Teegarden on January 20, 1972 to discuss the unresolved issues mentioned in the memo referenced above. The objective was to obtain a "best guess" as to what general statistics and attitude information was required in the header record on the summary tape and to further define the time interval to be used during normal production of the Pioneer PHA Summarizer. As a result of the meeting the following decisions were made:

1. The time interval to be summed for a normal production run (hereafter referred to simply as the "summary interval") will be an even multiple of full days beginning at the first second of a day. The summary interval is expected to be between 5 and 20 days and will be changed infrequently (i.e., once or twice) during the life of the satellite. A summary interval will not overlap with any other summary interval in the production data base.

2. The header record will contain at least the following information:

   a. The start and end time of the summary interval.

   b. The attitude information to be used in conjunction with the sector identification. This information will be copied from the first record (i.e., experiment cycle) of the summary interval on the Pioneer PHA tapes and will include:

      1.) Roll attitude timer
      2.) Spin Period

3.) Roll pulse/roll index phase error
4.) Roll attitude time

c. The total of the rates data (i.e., the number of events that occurred) during the summary interval as a function of the event type.

d. The total time that the rates data was accumulated for during the summary interval as a function of the event type.

e. The total time that the PHA data (includes both good and null events) was accumulated for during the summary interval.

f. The total number of PHA readouts that resulted in null events as a function of the priority.

3. The information that will be printed by the Pioneer PHA Summarizer for the summary interval will include the following:

a. The number of events that occurred per second as a function of the event type.

b. The possible error in events/second described in a. above. This will be printed as a function of the event type where:

$$\text{error} = \pm \frac{\text{events/second}}{\sqrt{\text{number of events}}}$$

c. The number of rates readouts as a function of the event type.

Prepared by: Ted P. Smith
T. P. Smith

Date: January 20, 1972

From (location and address):

Dept. & Bldg.: KE4/Goddard

Telephone Ext.:

IBM

Subject: Specifications for the Pioneer Data Reduction System

Reference:

To: File

Attendees:
Dr. Bonnard J. Teegarden
Mr. Pete Bracken
Mr. Don Stillwell
Mr. Charles Dickman
Mr. George Palfi
Mr. Joseph Novitsky
Mr. Talcott Brooks
Mr. Ted Smith

A meeting was held to discuss the design specifications for the Pioneer Data Reduction System. The following items were discussed:

1) The specifications for the Pioneer D. R. S. should include a discussion of the various operational modes for creating the PHA and RATES data bases and the utilization of only three tape drives for a single production run.

2) The Daily Data Quality Summary Report should include the following additional information:

   (a) Hourly averages of the PHA Event Rates data
   (b) Times associated with bit rate and format changes and the corresponding bit rate and format indicators.
   (c) Null events (all three detector readouts equal zero) will not be included in the number of event types for priority mode.

3) Don Stillwell will contact JPL or ARC concerning data overlap elimination.

4) The time assigned to the data on the PHA and RATES tape will be the actual sampling time.

J. A. Novitsky

Final Documentation for the

Pioneer F/G GSFC/CRT Data Reduction System

June 1972

Prepared by

J. A. Novitsky

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for

Goddard Space Flight Center
Contract No. NAS 5-11874
Greenbelt, Maryland

ABSTRACT

This document contains a detailed description of the Pioneer F/G GSFC/CRT Data Reduction Program (PIODRP) and the supplemental programs which comprise the Pioneer F/G GSFC/CRT Data Reduction System.

PIODRP has as its main input the Pioneer Experimenter Data Record (EDR) tapes received from Ames Research Center in Moffett Field, California and its main output the Pulse Height Analysis (PHA) tapes and the Events per second (RATES) tapes. The PHA and RATES tapes contain the GSFC/CRT experiment data in a readily accessible format for subsequent analysis programs.

TABLE OF CONTENTS

Section 1

INTRODUCTION

1.1 System Description

The Pioneer F/G GSFC/CRT Data Reduction System consists of three programs which aid in the reduction and analysis of the Pioneer F/G GSFC/CRT experiment data. Included in this system is the Pioneer F/G Data Reduction Program (PIODRP) which creates the PHA, RATES and CATALOG tapes, the Pioneer F/G Data Reduction System Catalog Maintenance Program (DRSMNT) which performs various maintenance functions on the Pioneer F/G DRS Tape Catalogs, and the Pioneer F/G EDR Tape List Program (EDRLST) which provides a formatted listing of the data contained on a Pioneer F/G GSFC/CRT EDR tape.

There are seven types of data sets referenced in this system. The first two, which apply to all three programs, are the parameter cards, which specify the processing options requested by the user, and the printed reports, which provide the user with all the necessary information required for normal data processing. The third type of data set is the DRS Tape Catalog (1-4) and the DRS Tape Catalog Pointer, initialized by DRSMNT and updated by PIODRP. This data set provides the system with information about the PHA, RATES and CATALOG tapes previously created and the blank PHA and RATES tapes currently available to the system. The last four data sets

utilized by the system are the EDR tapes (contain all Pioneer F/G data input to the system), the PHA tapes (generated by PIODRP and contain all the GSFC/CRT PHA data), the RATES tapes (generated by PIODRP and contain all the GSFC/CRT RATES data) and the CATALOG tapes (generated by PIODRP and contain all the Logistics and Command information).

The relationship between the three programs and the data sets is shown in Figure 1.1. The solid lines show the flow of data through the system and the dotted lines indicate an optional flow of data.

PIODRP reads parameter cards to determine the processing options requested and the EDR tapes to process. The latest version of the DRS Tape Catalog is then searched, provided Quick-Look processing was not requested, to determine what tapes are currently available for saving the data being processed. If the new data needs to be merged with data previously processed and the data merge option was specified, the tapes (PHA and/or RATES) containing the old data are copied and the new data is merged onto new tapes (PHA and/or RATES). At the end of each run a Processing Messages Report, a Data Quality Summary Report, a FILE/LOGISTICS/HISTORY Catalog Report and a Current Status Report are generated. These reports provide a history of the EDR tapes processed, the abnormal conditions encountered, the quality of the GSFC/CRT experiment data processed and a status report of all tapes available to the system.

DRSMNT is used to perform the following five basic functions on the DRS Tape Catalog:

1. Initialize and list all four Tape Catalogs and the Tape Catalog Pointer.

2. Add blank tapes (PHA and/or RATES) to the latest version of the Tape Catalog indicated by the Tape Catalog Pointer and provide a listing of the Tape Catalog before and after update.

3. Modify the Tape Catalog Pointer and provide a listing of the Tape Catalog to which it points before and after update.

4. List the contents of a specified Tape Catalog.

5. Restore and list a specified Tape Catalog from the appropriate backup tape.

DRSMNT reads parameter cards to determine what function is requested. The DRS Tape Catalogs or the DRS Tape Catalog Pointer are updated as requested and a listing of all the Tape Catalogs affected by the update is generated.

EDRLST provides a formatted listing of selected data from a GSFC/CRT EDR tape. EDRLST reads parameter cards to determine the EDR tapes and the amounts of data to list. One or more tapes may be listed in each run and each tape must be specified on a separate parameter card.

1.2 System Design Specifications and Assumptions

The following assumptions and considerations were included in the system design:

a. After each production run of PIODRP, a new/updated version of the DRS Tape Catalog is created. To facilitate this continual updating of the Tape Catalog and to provide the capability of rerunning a job that ran to completion but was in error, the four latest versions of the Tape Catalog are kept on the disk. Also, a tape backup of the four latest Tape Catalogs is maintained by PIODRP on the associated primary and backup CATALOG tapes. When a Tape Catalog on disk is destroyed, DRSMNT may be used to restore it from the appropriate backup tape.

b. It is assumed that each EDR tape processed by PIODRP will contain data for only one day and the start and stop times of the data provided in the Logistics data (file 1) is an accurate indication of the experiment data contained in file four of the EDR tape.

c. The processing of subsequent EDR tapes in the same run of PIODRP is based on the restriction that all EDR tapes must be submitted for processing in time-ordered sequence. All tapes not in time-ordered sequence for the current run are rejected by PIODRP and an appropriate message is written in the Processing Messages Report.

d. The PHA and RATES tapes are created in a one pass system rather than a two pass system to eliminate duplication of the setup functions inherent to a Data Reduction System, the computer time required to process the same data a second time and the tapes required for the intermediate storage of the experiment data.

e. A Quick-Look option has been provided in PIODRP to allow for the processing of the most recent GSFC/CRT EDR tapes available onto temporary PHA and/or RATES tapes. The temporary data tapes are supplied to PIODRP via the OPTION group of parameter cards and only the blank tapes required for the new PHA and/or RATES tapes can be supplied (the data processed in the Quick-Look mode cannot be merged or added to data previously processed). The DRS Tape Catalogs are not referenced when Quick-Look processing is requested, therefore all EDR tapes processed in this manner must be reprocessed in their proper chronological sequence by PIODRP in the normal (not Quick-Look) mode.

   The Quick-Look option provides the capability to process all the Pioneer F/G EDR tapes and create the PHA and RATES tapes in the most efficient manner possible. That is, new data is always added after previously processed data and the unnecessary copying of old PHA and RATES tapes for the purpose of merging new data with previously processed data is eliminated.

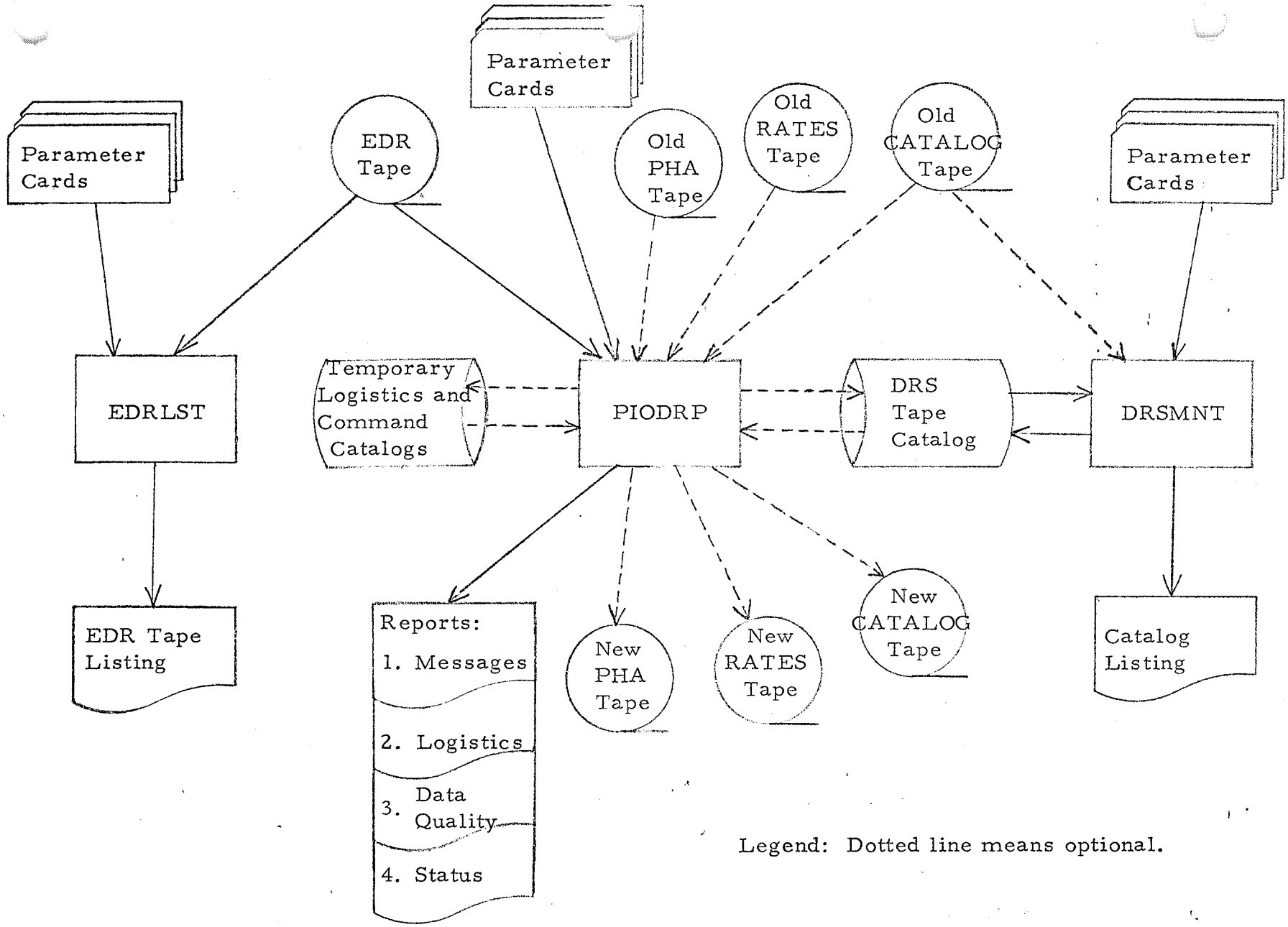


Figure 1.1 Flow of Data through the Pioneer F/G GSFC/CRT Data Reduction System

Section 2

DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Many of the following terms have several meanings; however, only the definition pertinent to this report is given.

Absolute File - All the data (Logistics, Command, Attitude and Experiment) processed from a particular EDR tape in same run of PIODRP.

Absolute File Number - A number assigned to each absolute file (consists of data for an entire day) of data processed by PIODRP. Each file processed is assigned an absolute file number one larger than the previous file; therefore, each file is uniquely identified.

Album - One complete sampling of the GSFC/CRT experiment data. An album consists of the following:

1 Album = 4 pages (each page represents 1/4 of an experiment cycle).

256 frames/tape
A

1 Page = 2 snapshots (each snapshot represents 1/8 sample of RATES information unless sector sync not inhibited and redundant rate readouts occur).

512 frames/tape
B

1 Snapshot = 32 frames (Format A)/64 frames (Format B).

Catalog Pointer - A disk data set which contains the character (1, 2, 3, or 4) indicating which of the four Tape Catalogs is the most recent (see section 5).

CATALOG Tape - Tape(s) containing all the time-ordered Logistics, Command and Attitude information related to the Pioneer F/G missions (see section 5).

Events per second (RATES) Tape - Tape(s) containing all the time-ordered events per second information from the GSFC/CRT experiment (see section 5).

Experiment Data Record (EDR) Tape - Input tape received from Ames Research Center in Moffett Field, California (see section 5).

Pulse Height Analysis (PHA) Tape - Tape(s) containing all the time-ordered pulse height analysis information from the GSFC/CRT experiment and the corresponding events per second information (see section 5).

Relative Modified Julian Day (RMJD) - Date assigned to each day of data referenced from day 0 to launch year, 1972 (Modified Julian Day 41316).

Tape Catalog - A disk data set which contains pointers to all the tapes used by the D.R.S. along with certain control information (see section 5).

2.2 Abbreviations

ARC	Ames Research Center, Moffett Field, California
ARIPPHEC	Roll Pulse/Roll-Index Pulse Phase Error
ASPNPDC	Spin Period
BPI	Bytes Per Inch
DASD	Direct Access Storage Device
DRS	Data Reduction System
DSS	Deep Space Station

EBCDIC	Extended Binary Coded Decimal Interchange Code
EDR	Experimenter Data Record
GMT	Greenwich Mean Time (UT)
GSFC/CRT	Goddard Space Flight Center/Cosmic Ray Telescope
HET	High Energy Telescope
LET	Low Energy Telescope
LSB	Least Significant Bit
MF	Main Frame
MS	Milliseconds
MSB	Most Significant Bit
PHA	Pulse Height Analysis
RAT	Roll Attitude Timer
RTLT	Round Trip Light Time
SCID	Subcommutator Identification
SPF	Spin Period Flag
SPSG	Spin Period Sector Generator
TLM	Telemetry
UT	Universal Time (GMT)

Section 3

OBJECTIVES AND REQUIREMENTS

3.1 Objectives

a. The major objective of this system is to process the Pioneer EDR tapes received from Ames Research Center in Moffett Field, California and generate tapes containing the GSFC/CRT experiment data and related spacecraft information in a readily accessible format for subsequent analysis programs.

b. The function of the Tape Catalog and CATALOG tapes is to render the system self-sustaining and thus reduce the amount of manual intervention required for normal data processing.

3.2 Operational Requirements

The following data sets are needed as input to PIODRP:

a. Experiment Data Record (EDR) tape(s)

b. Old CATALOG tape(s)

c. Old Pulse Height Analysis (PHA) tape(s)

d. Old Events per second (RATES) tape(s)

e. Tape Catalog indicated by the Catalog Pointer

f. Parameter cards indicating the processing options and the EDR tapes to process.

The following data sets and reports are generated by PIODRP:

a. New Pulse Height Analysis (PHA) tape(s)

b. New Events per second (RATES) tape(s)

c. Updated CATALOG tape(s)

d. Updated Tape Catalog and Catalog Pointer

e. Daily Data Quality Summary Report

f. Appropriate error messages

g. Current Status of D.R.S. Report.

3.3 Functional Requirements

The following functions are performed by the Pioneer F/G GSFC/CRT D.R.S.

a. Read and unpack the EDR tapes

b. Save pertinent information from EDR file 1 (logistics), file 2 (command) and file 3 (attitude) on CATALOG tape

c. Check time continuity of data records in EDR file 4 (experiment data)

d. Establish experiment synchronization

e. Compute and assign to the data the start time of the actual accumulation interval for the data

f. Decompress the logarithmic compressed RATES data

g. Process the PHA and RATES data into a condensed and accessible format for the PHA and RATES tapes

h. Merge new data with data previously processed

i. Create automatic backups for all Tape Catalogs used by the D.R.S.

j. Produce data quality summary reports

k. Provide an easy re-run capability

l. Dynamically assign all PHA and RATES tapes

m. Generate a time-ordered data base for the PHA and RATES data and provide the capability for selective retrieval of the data.

Section 4

PROGRAM DESCRIPTIONS

4.1 Executive Routines

4.1.1 Pioneer F/G Data Reduction Program (PIODRP)

The Pioneer F/G Data Reduction Program (PIODRP) reads the Pioneer F/G EDR tapes and creates time-ordered PHA, RATES and CATALOG tapes which contain all the Pioneer F/G GSFC/CRT experiment data and related spacecraft information. PIODRP also maintains two permanent disk data sets. The first disk data set is the DRS Tape Catalog which provides PIODRP with the necessary information related to all the tapes available to the program. The second disk data set is the time-ordered FILE/LOGISTICS/HISTORY catalog which provides PIODRP with a permanent history of all the EDR tapes processed.

PIODRP begins by initializing all program options which may be specified on the first parameter card for each production run to their default values. The first parameter card containing the NAMELIST name OPTION is then read and the program proceeds to initialize the remaining program variables. Appropriate checks are then made to determine if the satellite data (F/G) specified for processing is correct and the job is terminated when the satellite identification specified is incorrect. Next, a check is made to determine if Quick-Look processing is requested for the current run and, if so, the tape labels supplied via the OPTION group of cards, identifying the blank PHA

and/or RATES tapes available for use during the current run, are transferred to the appropriate arrays in the common area DRSTAP. Also, the processing control indicators contained in the common area DRSTAP, initialized when the DRS Tape Catalog is accessed during normal processing, are initialized to zero for Quick-Look processing. PIODRP then proceeds to write the Beginning of Job message and process the requested EDR tapes in exactly the same manner as a normal production run.

When Quick-Look processing is not requested, the DRS Tape Catalog Pointer data set is read and a check is made to assure that the correct satellite (F/G) data set was accessed. The job is terminated when the incorrect satellite (F/G) data set is supplied to PIODRP via the Job Control Language. The unit numbers for the input and output DRS Tape Catalogs are then computed, using the value of the DRS Tape Catalog Pointer as the base. The Tape Catalog to be updated at the end of the current run is then read, a check is made to assure that the correct satellite (F/G) data set was accessed and the job is terminated when the data set is incorrect. The labels of the CATALOG tapes to be updated at the end of the current run are retained and the latest version of the Tape Catalog, which provides PIODRP with the current status of all tapes available, is read. A check is made to assure that the correct satellite (F/G) data set was accessed and the job is terminated when the data set is incorrect. PIODRP then writes the Beginning of Job message and begins the processing of the requested EDR tapes.

Before each EDR tape is processed, PIODRP calls the generalized routine REMTIM to determine if sufficient time (CPU and I/O) remain for the job to process at least one EDR tape, create the CATALOG

tapes if necessary and end the job normally. When insufficient time remains for the job, PIODRP writes out a message indicating the job is being prematurely terminated due to insufficient time, performs the necessary functions to end the job normally, writes the End of Job message and terminates the job.

When sufficient time remains for PIODRP to continue processing EDR tapes, an attempt is made to read a NAMELIST card with the name EDRTAP containing the label of the EDR tape to process and the processing options to be used when processing the specified tape. If one is not available, PIODRP performs the necessary functions to end the job normally, writes the End of Job message and terminates the job.

When an EDR tape to be processed is supplied to PIODRP via the EDRTAP group of cards, the tape is mounted and positioned to file one and the pertinent logistics information is obtained by calling the routine UPKLOG. The routine EDRCAT is then invoked to determine if the data on this EDR tape follows all data previously processed for the current job. If the data does not follow all data previously processed for the current job, the EDR tape is rejected and PIODRP attempts to read the next EDRTAP group of cards as before.

After an EDR tape is accepted for processing, PIODRP then processes the Command and Attitude information, contained in files two and three respectively, if requested. This information is processed from the appropriate files and written into separate temporary sequential data sets maintained on a 2314 DASD. After all EDR tapes have been processed for the current job, the Command and Attitude catalog information on disk is merged with the previously processed data on the CATALOG tape by the routine ENDCAT (entry point in EDRCAT).

Next, the experiment data contained in file four of the EDR tape is processed and the PHA and RATES information is added to the appropriate tape data set when requested.

When processing the experiment data, several quality and validity checks are performed on each data record by the routine EDRCHK. These checks are performed in order of priority and whenever a data record fails a particular check, it is discarded. Statistics are maintained for all data records discarded and this information is printed in the Data Quality Summary Report after the processing for an entire EDR tape is completed. The first check to be performed determines whether the data record contains any good data or consists entirely of padded data. Appropriate checks are then made to determine whether the experiment power is "on" or "off". Next a check is performed to validate the time assigned to the data record and assures continuity with the times assigned to the preceding records. Finally, experiment synchronization is determined for all good records (records with correct time assigned, experiment power on and good experiment data).

After a data record has successfully passed the preceding checks, the experiment data, consisting of the Pulse Height Analysis (PHA) data and the Events per second (RATES) data, is formatted and added to the appropriate tape data sets in a time-ordered fashion by the routine PHAOUT and RATOUT respectively. PIODRP then acquires the next data record and repeats the above process of validating the data and producing the appropriate output records. After the last data record for a particular EDR tape has been processed, the Data Quality Summary Report is printed by the routine EDRSUM. PIODRP then determines whether there is another EDR tape to process and if so, repeats the above process of validating the date assigned to the

data, generating the appropriate catalog entries, and processing the experiment data. If no more EDR tapes are to be processed, the routine ENDCAT is invoked, if necessary, to print the FILE/LOGISTICS/HISTORY Catalog Report and generate the updated version of the CATALOG tapes. The Current Status Report is then written by the routine DRSRPT, the Tape Catalog is updated to reflect the data processed, the End of Job message is written and the job is terminated.

4.1.2 Pioneer F/G Data Reduction System Catalog Maintenance Program (DRSMNT)

The Pioneer F/G Data Reduction System Catalog Maintenance Program (DRMNT) is used to initialize, update, modify, list and restore the Pioneer DRS Tape Catalogs. Only the data sets associated with one satellite (F/G) may be accessed in the same run and only one unique function is performed by DRSMNT for a particular run.

DRSMNT determines the maintenance function requested by reading the first data card. This data card also identifies the satellite (F/G) data sets for which the particular maintenance function is to be performed. After the function indicator and the satellite identification character (F/G) are verified, DRSMNT reads as many subsequent data cards as necessary to acquire all the information required to perform the requested maintenance function.

When performing the various maintenance functions, DRSMNT recognizes several abnormal conditions and writes a self-explanatory message identifying the abnormal condition and indicating the action taken by the program. These messages provide an indication of all the data rejected by the program and they also provide a detailed explanation when a particular job is abnormally terminated.

When DRSMNT is requested to update the Tape Catalog Pointer, it must also restore the FILE/LOGISTICS/HISTORY catalog data set maintained on disk from the appropriate CATALOG tape. This CATALOG tape is the one associated with the Tape Catalog indicated by the Tape Catalog Pointer after the update function has been performed by DRSMNT. The CATALOG tape is mounted and positioned to file two, and the FILE/LOGISTICS/HISTORY catalog is read from the CATALOG tape and placed into the disk data set.

After a particular maintenance function has been performed by DRSMNT, a Current Status Report is written which reflects the status of all the Tape Catalogs affected by the current run and the current value of the Tape Catalog Pointer. After this report is written, DRSMNT writes an appropriate End of Job message and terminates the job.

4.1.3 Pioneer F/G EDR Tape List Program (EDRLST)

The Pioneer F/G EDR Tape List Program is used to list the Pioneer GSFC/CRT EDR tapes. The logistics, command and attitude data, contained in files one through three respectively, is always listed and the experiment data, contained in file four, may be listed by either record number or time period. One or more EDR tapes may be listed in the same production run and a maximum of 20 pairs consisting of start and stop record numbers or time periods may be specified for each tape.

EDRLST begins by initializing all program variables which may be specified on the NAMELIST card INPUT to their default values. Then the first parameter card containing the NAMELIST name INPUT

and specifying the EDR tape to list is read. The specified EDR tape is mounted and files one through three, containing the logistics, command and attitude data respectively, are read and the pertinent information is interpreted and listed on the first page of printout associated with the EDR tape.

Next, the EDR tape is positioned to file four and all records requested to be printed on the associated INPUT group of cards are read and listed. After all data records for this EDR tape have been listed, EDRLST initializes the program variables and attempts to read another INPUT group of cards specifying the next EDR tape to list. If another INPUT group of cards is available, EDRLST mounts the specified tape and list the requested data as before. If no more EDR tapes are to be listed, the End of Job message is written and the job is terminated.

4.2 Subroutines

4.2.1 UPKLOG

This routine unpacks the pertinent logistics information contained in file one of a Pioneer F/G GSFC/CRT EDR tape. UPKLOG processes the logistics data from the buffer containing the logistics data record into the common area LOGREC.

The calling sequence is:

CALL UPKLOG (MBUFAD)

where MBUFAD is the address of the buffer containing the logistics data record.

4.2.2 UPKCMD

This routine unpacks all the command information from one command record contained in file two of a Pioneer F/G GSFC/CRT EDR tape. UPKCMD processes the command data from the buffer containing the command data record into the common area CMDREC.

The calling sequence is:

CALL UPKCMD (MBUFAD)

where MBUFAD is the address of the buffer containing the command data record.

4.2.3 EDRCAT/EDREND/NEWCAT/ENDCAT

The routine handles the FILE/LOGISTICS/HISTORY catalog which is maintained of a 2314 DASD with a backup copy on file two of the CATALOG tape. Also, this routine generates the updated version of the CATALOG tape, when requested, at the end of each production run of PIODRP. This routine consists of four entry points which are invoked by the main data reduction program, PIODRP, to perform the following specific functions.

The first enty point, EDRCAT, is invoked at the beginning of processing of an EDR tape to determine if the EDR tape is to be processed in the current run. That is, all EDR tapes must be submitted in the proper time-ordered sequence for a particular run. Also, all EDR tapes processed in a particular run, when data merge has not been specified, must contain data that follows all data previously processed. EDRCAT also sets-up a pointer to the location where the catalog entry to be created for the EDR tape is to be inserted in the FILE/LOGISTICS/HISTORY catalog.

When Quick-Look processing is specified for a particular run, EDRCAT does not reference the permanent FILE/LOGISTICS/HISTORY catalog. All catalog entries created for the current Quick-Look run are processed on the temporary catalog and are discarded at the termination of the run.

When data merge is specified for a particular run, EDRCAT first determines whether the data being processed needs to be merged with previously processed data. If no merge is necessary, EDRCAT processes the catalog entries created for the current run in the same manner as when data merge is not specified. That is, all entries are inserted after the last catalog entry contained in the permanent FILE/LOGISTICS/HISTORY catalog and no reference is made to the temporary catalog data set. When the data being processed needs to be merged with the data previously processed, EDRCAT copies the permanent data set onto the temporary data set until the location to insert the new catalog entry is determined. This procedure will continue on each subsequent entry to EDRCAT and eventually the new updated version of the FILE/LOGISTICS/HISTORY catalog will reside on the temporary catalog data set.

The calling sequence is:

CALL EDRCAT (&N)

where N is the statement number to return to when the EDR tape is rejected when it is not in time-ordered sequence with previously processed EDR tapes.

The second entry point is EDREND. The entry point is invoked by PIODRP after the processing of an EDR tape has been completed. EDREND inserts the catalog entry created for the EDR tape into its

proper time-ordered location in the FILE/LOGISTICS/HISTORY catalog. EDREND also saves the Absolute File Numbers assigned to the first and last catalog entries created in the current run. These Absolute File Numbers are utilized by the entry point ENDCAT when generating the FILE/LOGISTICS/HISTORY Catalog Report.

The calling sequence is:

CALL EDREND.

The entry point NEWCAT is invoked by PIODRP when the value of the Tape Catalog Pointer is overridden for a particular production run by the value specified for NUMCAT which is supplied on the OPTION group of cards. The purpose of this entry point is to restore the permanent FILE/LOGISTICS/HISTORY catalog from the appropriate backup CATALOG tape before the processing of EDR tapes begins for the the current production run.

The calling sequence is:

CALL NEWCAT.

The entry point ENDCAT is invoked by PIODRP after the processing of EDR tapes for the current run has been completed. ENDCAT first determines if the last catalog entry processed by EDREND was inserted with previously processed data and, if so, it proceeds to finish the copying of the permanent catalog data set onto the temporary data set. If the generation of the CATALOG tapes is specified for current run EDREND mounts the appropriate CATALOG tapes and writes the first file of information onto them. Next, the new updated version of the FILE/LOGISTICS/HISTORY catalog is read and the FILE/LOGISTICS/HISTORY Catalog Report is generated. If the new version of the catalog

resides on the temporary data set, it is copied onto the permanent data set provided Quick-Look processing was not requested. The catalog entries generated when Quick-Look processing is specified are discarded. Also, the new version of the catalog is written onto the CATALOG tapes when requested. Finally, the command data processed for the current run is merged with the Command catalog contained on file three of the CATALOG tape when requested.

The calling sequence is:

CALL ENDCAT (NUMCMD, NCMTAP)

where NUMCMD is the number of command data records written into the temporary disk data set by PIODRP

NCMTAP is the CATALOG tape sequence number (0-no previous CATALOG tape, 1-previous CATALOG tape).

4.2.4 EDRCHK

This routine performs a quality check on each data record contained in file four of a Pioneer GSFC/CRT EDR tape. EDRCHK first invokes the routine UPKFMT to determine the format of the data record. Then the continouous data indicator, HCONT, is set equal to one indicating that the data record contains data which is continuous with the data contained in the preceding data record (EDRCHK always assumes that the data records are continuous and it attempts to prove otherwise). If the first data record for a run is being processed, EDRCHK invokes the routine DRPMES to write out the time (MS of day), bit rate and format associated with the record. Also, HCONT is set equal to zero to indicate that the data contained in the record is not continuous with any previous data (no previous data processed) and EDRCHK then saves the format, mode, bit rate, DSS and the spin period roll reference

indicator assigned to the data record and proceeds to validate the data contained in the data record.

When the data record being processed is not the first data record for a run, EDRCHK compares the bit rate, format, mode and DSS assigned to the current data record to the corresponding values assigned to the previous data record. When an inconsistency is encountered with one or more of the four values, DRPMES is invoked to write an appropriate message indicating the previous and current values of the item updated and the associated time (MS of day) assigned to the data record. Also, HCONT is set equal to zero to indicate that the data is not continuous with the data previously processed. EDRCHK then saves the format, mode, bit rate, DSS and the spin period roll reference indicator assigned to the current data record and proceeds to validate the data contained in the record.

The first quality check performed by EDRCHK on a data record is to determine if the data contained in the record is entirely padded. If no good data is contained in the record, the appropriate statistics counter is incremented by one and the program takes the alternate return. When a data record contains some good data, the routine GETPAG is invoked to determine the amount of good (non-padded) data and also to determine whether the experiment is operating (power "on"). If the experiment power is "off" for the entire data record, GETPAG will take an alternate return and, consequently, EDRCHK will also take an alternate return, skipping the data record. Next, the time assigned to the data record is verified by invoking the routine TIMCHK. If the time is in error (time backup occurs), the data record is skipped. Finally, proper experiment synchronization is determined for the data contained in the data record by invoking the routine SYNCHK. If the experiment data is not in proper synchronization, the data record is skipped.

After a data record has been verified, EDRCHK moves all the associated header information from the common area DATREC into the common area RECSTA. The appropriate statistics counters are incremented, the switch indicating that a data record has been skipped is set to the FALSE condition and the program returns.

The calling sequence is:

CALL EDRCHK (&N)

where N is the statement number to return to when a data record is to be skipped.

4.2.5 GETPAG

This routine determines how many pages can be processed from a data record. Each Format A data record contains a maximum of six pages and each Format B data record contains a maximum of five pages. A page contains the data for a fourth of an experiment cycle and consists of 64 frames of data in Format A and 128 frames of data in Format B. The subcom data, particularly word E-1,29 which is the GSFC/CRT experiment power indicator, which is readout once each 64 frames for either format, appears once each page for Format A and twice each page for Format B. Therefore, the processing of Format A data is done on a page basis and the processing of Format B data is done on a half-page basis.

GETPAG first checks the format of the data record and then performs the pad and power check on the appropriate data. All pages which are entirely padded are excluded from further processing. Only pages at the beginning and end of a data record are excluded. The start and stop page indicators, HPGS and HPGE, contained in the

common area RECSTA are then set to point to the first and last non-padded page in the data record, respectively. Next, the power indicator contained in the subcom data word E-1,29 is examined for a value greater than eight for each page/half-page remaining to be processed. All pages/half-pages which fail the power check are excluded from the beginning and end of the good block of pages by making the necessary adjustments to the start and stop page indicators. If the entire data record contains data when the experiment power is "off", the data record is skipped.

After EDRCHK determines the status of the data contained in the data record, the appropriate statistics counters are incremented, the number of good consecutive pages of data, if any, is computed and the program returns. If the data record is to be skipped, the program takes the alternate return.

The calling sequence is:

CALL GETPAG (&N)

where N is the statement number to return to when a data record is to be skipped.

4.2.6 TIMCHK

This routine is used to compare the time assigned to the first page of data that is to be processed from a particular data record to the time that is expected to be assigned to this data. The expected time is computed from the times assigned to the data processed from the preceding data record.

TIMCHK first computes the frame time for the data contained in the data record. Then the start of the actual accumulation interval for the first PHA event contained in the first page of data to be processed from the data record is computed. If this is the first data

record for a particular run, the time expected for the page of data which should follow the last page processed from the current record is computed. This time is computed by invoking the routine ADDPAG which is supplied all the necessary information for computing this time in the calling sequence. After the time expected to be assigned to the subsequent data processed is computed, the program returns.

When the data record being processed is not the first data record for a run, TIMCHK invokes the routine COMPAG, an entry point in ADDPAG, to compare the time assigned to the first page of data being processed from the record to the expected time. If the times are in agreement to within a tolerance of one frame, TIMCHK computes the expected time for subsequent data as before and returns. When a positive time jump occurs that is greater then the time for one frame of data, HCONT is set equal to zero to indicate that the current data being processed is not continuous with previously processed data. TIMCHK then computes the expected time for subsequent data as before and returns.

When a negative time jump occurs that is greater than the time for one frame of data and no more pages are to be processed from the data record, TIMCHK skips the data record by taking the alternate return. When more pages are to be processed, the time of the next page of data contained in the record is computed by invoking the routine ADDPAG. The necessary data record status indicators contained in the common area RECSTA are then updated to reflect the new start page, start time and the number of pages to process from the record. TIMCHK then makes the time comparison as before and repeats the above process of eliminating entire pages of data due to time-backups until either the entire data record is skipped or a portion of the data record is accepted for processing.

The calling sequence is:

CALL TIMCHK (&N)

where N is the statement number to return to when a data record is to be skipped.

4.2.7 SYNCHK

This routine is used to determine the experiment status for all pages of data contained in a Format A data record. SYNCHK first initializes all entries of the arrays HURSEQ and HSRSEQ contained the common area RECSTA to a negative one. These arrays are used to save all the rate sequence I.D.'s associated with a maximum of six pages of experiment data. Each page requires two consecutive entries in the arrays and the entries associated with a particular page are always fixed (i.e., the first page utilizes the first two entries, etc.).

SYNCHK then unpacks all good rate sequence I.D.'s contained in the subcom data word, E-1,30 associated with each page of data being processed from the data record by invoking the routine UPKSEQ. The unsectored and sectored rate sequence I.D.'s are placed in the corresponding entries of HURSEQ and HSRSEQ, respectively. When an unsectored rate sequence I.D. is encountered that is not an even number, the data record is skipped. Also, the data record is skipped when no rate sequence I.D.'s are available and the data contained in the record is not continuous with the data previously processed. If no rate sequence I.D.'s are available and the data is continuous with the data previously processed, the rate sequence I.D.'s are assigned values based on the rate sequence I.D.'s associated with the previous data.

Next, SYNCHK computes all missing unsectored rate sequence I.D.'s which are missing because of padded data or because the GSFC/CRT experiment did not supply them. In the latter case, the GSFC/CRT experiment supplies only one set of rate sequence I.D.'s for each 64 frames, which is a page of data in Format A. The rate sequence I.D.'s supplied are contained in the subcom data word E-1,30 which appears once each 64 frames. Therefore, the second set of rate sequence I.D.'s, required to identify the second set of unsectored and sectored rates contained in a page of data, must always be computed for Format A.

After all the unsectored rate I.D.'s have been determined, SYNCHK examines two separate bits in the first and last good HET Tag Words available in the data record. These checks are made to determine whether the experiment is operating in the High or Low Power Mode and to determine whether the sectored rates are being accumulated with Sectored Sync Inhibited or Sectored Sync Not-Inhibited. The data record is skipped when SYNCHK is unable to examine at least one HET Tag Word because of bad data quality or when a change in state is noted for the accumulation of the sectored rates. When the experiment is found to be operating in the High Power Mode, the experiment power mode indicator, HIGHPW, is set equal to one. HIGHPW is set equal to zero when the experiment is operating in the Low Power Mode.

Next, SYNCHK computes all missing sectored rate sequence I.D.'s which are missing because of padded data or because the GSFC/CRT experiment did not supply them. When sectored sync is Inhibited, the computation of the missing sectored rate sequence I.D.'s is identical to the computation for the unsectored rate sequence I.D.'s. However, when sectored sync is Not-Inhibited, it cannot be assumed that the sectored rate sequence I.D.'s are updated systematically.

In this mode of accumulation, the sectored rate sequence I.D.'s can only be updated at the time in the TLM frame when unsectored rates are being readout and a prescribed number of spacecraft rolls have been completed. Therefore, the least significant bit of the sectored rate sequence I.D., provided in the HET Tag Words (total of 4) which were accumulated when the sectored rates were being readout, must be inspected to determine the value of the sectored rate sequence I.D. the corresponding sectored rates were accumulated under when the sectored rate sequence I.D. is missing.

When sectored sync is Not-Inhibited, all pages of data at the beginning and/or end of the block of data being processed from a data record are eliminated from further processing if the required sectored rate sequence I.D.'s cannot be determined. When pages of data are discarded by SYNCHK, the record status indicators, contained in the common area RECSTA, are updated to reflect the new start and/or end page and time and the number of pages to process from the record is changed accordingly.

Finally, SYNCHK determines the HET priority sequence for the first page of data to be processed from the data record. This priority sequence is a function of the first unsectored rate sequence I.D. associated with the page.

The calling sequence is:

CALL SYNCHK (&N)

where N is the statement number to return to when a data record is to be skipped.

4.2.8 SYNFMB

This routine is used to determine the experiment status for all pages of data contained in a Format B data record. SYNFMB is invoked by SYNCHK after the arrays HURSEQ and HSRSEQ have been initialized. The logic flow for SYNFMB is identical to that of SYNCHK (see section 4.2.7) with a few minor differences. These differences are a result of the difference in the amount of data readout in the two formats. Since one page of data for Format B requires 128 frames rather than the 64 as in Format A, the GSFC/CRT experiment supplies both sets of rate sequence I.D.'s required to identify all the rates data contained in a page of data. Also, due to the smaller amount of PHA data available in Format B, the HET Tag Words containing the true status of the least significant bit of any sectored rate sequence I.D. that is missing due to pad are not available for inspection. Therefore, when sector sync is Not-Inhibited, no attempt is made to compute the missing sectored rate sequence I.D.'s. All pages of data at the beginning and/or end of the block of data being processed from a data record are eliminated from further processing when the required sectored rate sequence I.D.'s are not available.

The calling sequence is:

CALL SYNFMB (&N)

where N is the statement number to return to when a data record is to be skipped.

4.2.9 PHAOUT/PHAEND

This routine is used to format all the PHA data to be processed from a data record into a PHA tape data record. Refer to section 5.1.2 of this document for a detailed description of the data contained in a PHA tape data record.

The main entry point in this routine is PHAOUT which is invoked by PIODRP whenever the PHA data is to be processed from a data record. The first time PHAOUT is invoked for a run, the array SVRT is initialized. This array is utilized for the processing of all the RATES data which is associated with the PHA data being processed. PHAOUT then proceeds to process the required data from the data record.

PHAOUT processes the data for both Format A and Format B data records in a similar manner. Only the data associated with the pages specified by the data record status indicators HPGS and HPGE, which identify the first and last pages of the consecutive pages in the record required for processing, are processed. The data is processed a page at a time until all the required data in the data record is processed.

The processing of a page of data begins with the associated subcom data words for the page. Then the required RATES data is located and processed. Finally, all the PHA data associated with the page is processed. After this process is repeated for each page of data required for processing in the data record, the program returns.

On each subsequent entry to PHAOUT, the data contained in the current data record, which belongs in the previous PHA data record processed, is processed when necessary. The previous PHA data record processed is then added to the PHA tape data base by invoking the routine WRTPHA. Then the current data record is processed as before.

The calling sequence is:

CALL PHAOUT

The second entry point in this routine is PHAEND. This entry point is invoked by PIODRP at the end of a job to complete the processing of the last PHA data record that was processed by PHAOUT. The appropriate data entries in the last PHA data record are padded, when necessary, and the record is added to the PHA tape data base by invoking the routine WRTPHA.

The calling sequence is:

CALL PHAEND.

4.2.10 WRTPHA/ENDPHA

This routine is invoked by PHAOUT/PHAEND whenever a PHA data record is to be added to the PHA tape data base. WRTPHA adds a PHA data record to its proper time-ordered position within the PHA tape data base. All data which overlaps previously processed data is discarded on a page basis unless the replace option was specified for the data being processed. When the replace option is specified and overlap occurs, the previously processed data is replaced by the new data.

The main entry point in this routine is WRTPHA. On the first entry to WRTPHA for a run, various program variables are initialized. WRTPHA then checks if data merge was specified for the run. If data merge was not specified, a check is made to determine if a previously processed PHA tape exists. When no previous PHA data has been processed, the first available blank PHA tape is mounted, the PHA data record is written onto it and the program returns. When a previous PHA tape exist, a check is made to determine if the last PHA tape has less than 2100 feet of tape utilized. If less than 2100

feet of tape is used, the new data is added to the end of the last PHA tape and the program returns. If more than 2100 feet of tape is used, the first available blank PHA tape is mounted, the PHA data record is written onto it and the program returns.

When data merge is specified for a run, WRTPHA determines the previously processed PHA tape, if any, that needs to be copied so that the new data may be merged with the old data. When an old PHA tape needs to be copied, the tape is mounted for input, the entry for the tape in the Tape Catalog is deleted and an old PHA data record is read from it. The appropriate checks are then made to assure that the new PHA data record is merged with the old PHA data record in the proper time-ordered fashion. As many old PHA data records as necessary are read from the old PHA tape, when attempting to merge the new data record with the old data. All data processed in this manner is written onto a new PHA tape. After the new PHA data record is added to the PHA tape data base, the program returns.

On subsequent entries to WRTPHA, a check is made to determine if an old PHA tape is currently being copied. If an old PHA tape is mounted, the program merges the new data with the old data as before. When no old PHA tape is currently being copied, a check is made to determine if the last PHA data record processed was inserted before the data contained on an old PHA tape or if it was added after all other data. If the last data record was added after all other data, WRTPHA first verifies that the current record follows the last record and it then adds the new record to the new PHA tape being created. When the last PHA data record processed was inserted before an old PHA tape, a check is made to determine if the current record still needs to be inserted before the same old PHA tape. If this is so, WRTPHA first verifies that the current record follows the last record and it

then adds the new record to the new PHA tape being created. When the current record being processed is not to be inserted as the previous data record, WRTPHA either copies in the old PHA tape where the data is being inserted and merges the new data with the old as before or it unloads the new PHA tape being created and locates the appropriate location to insert or merge the new data record with the previously processed data as before.

As new and old PHA data records are written onto a new PHA tape, WRTPHA continuously monitors the amount of space being utilized on the tape. When the number of feet utilized exceeds 2200 feet, WRTPHA unloads the current output PHA tape, makes the appropriate entries for the tape in the Tape Catalog and mounts the next available blank PHA tape. When no blank PHA tapes are available, the job is terminated.

The calling sequence is:

CALL WRTPHA.

The second entry point in this routine is ENDPHA. The entry point is invoked by PHAEND at the end of a job to add the last PHA data record processed to the PHA tape data base. ENDPHA sets the end of job switch to the TRUE condition and processes the data record in the same manner as WRTPHA does. Before ENDPHA returns, it assures that the data on any old PHA tape currently being copied is completed copied onto a new PHA tape. It then unloads the last new PHA tape created, makes the appropriate entries for the tape in the Tape Catalog and returns.

The calling sequence is:

CALL ENDPHA.

4.2.11 RATOUT/RATEND

This routine is used to format all the RATES data to be processed from a data record into a RATES tape data record. Refer to section 5.1.3 of this document for a detailed description of the data contained in a RATES tape data record.

The function and method for RATOUT/RATEND is identical to the routine PHAOUT/PHAEND which processes the PHA data from a data record (see section 4.2.9). However, RATOUT does not attempt to process any PHA data but it does process all the RATES data required to be processed from the data record.

The calling sequences are:

CALL RATOUT and CALL RATEND.

4.2.12 WRTRAT/ENDRAT

This routine is invoked by RATOUT/RATEND whenever a RATES data record is to be added to the RATES tape data base. The function and method for WRTRAT/ENDRAT is identical to the routine WRTPHA/ENDPHA (see section 4.2.10) which adds a PHA data record to its proper time-ordered position within the PHA tape data base.

The calling sequences are:

CALL WRTRAT and CALL ENDRAT.

4.2.13 DRPMES

This routine is invoked by various routines in the Pioneer Data Reduction Program for the purpose of writing an informative message or an error message whenever a program error or an unusual condition is encountered within the routine. Information related to the particular message is passed to DRPMES via the calling sequence.

After DRPMES is invoked by a routine, it writes the appropriate message and, provided the message code passed in the calling sequence had a positive value, it returns to the invoking routine. If the message code had a negative value when DRPMES was invoked, the job is terminated with a dump having the positive value of the message code as the completion code.

The calling sequence is:

CALL DRPMES (DPROG, MESCOD, MESAGE)

where DPROG is the name of the routine generating the message

MESCOD is the message code

MESAGE is an array containing information related to the message when necessary.

4.2.14 EDRSUM/EDRINT

The entry point EDRSUM is invoked by PIODRP for the purpose of writing the Data Quality Summary Report for each EDR tape processed. The necessary totals are computed from the related statistics counters in the common area EDRSTA and the required report is generated.

The entry point EDRINT is invoked by PIODRP for the purpose of initializing all the statistics counters in the common area EDRSTA to zero.

The calling sequences are:

CALL EDRSUM and CALL EDRINT.

4.2.15 DRSRPT

This routine is invoked by PIODRP at the end of each production run to write the Current Status Report. This report provides information

concerning all PHA and RATES tapes generated and/or copied in the current run, the current status of all tapes currently available to the Pioneer Data Reduction System and indicates which Tape Catalog is the latest.

The calling sequence is:

CALL DRSRPT (NCAT)

where NCAT is the value of the latest Tape Catalog.

4.2.16 LOGDEC

This routine is invoked by PHAOUT and RATOUT for the purpose of decompressing the logarithmic compressed RATES information on the EDR tapes. The RATES readouts on the EDR tapes are in the form of a logarithmic compression (five bit characteristic and a seven bit mantissa). These readouts are decompressed by placing a one in the high order position of the mantissa, left justifying it in a register, and then shifting right the number of bits specified by the characteristic. The result is then shifted eight bits to the right to right justify it in the register. An uncertainty factor is then computed using the following formula:

$$1/2\ (2^{(16-N)}-1)$$

where N is the five bit characteristic. This uncertainity factor is added to the result and finally, the result is incremented by one.

The calling sequence is:

CALL LOGDEC (HRDOUT, MRATE)

where HRDOUT is the logarithmic compressed RATES readout

MRATE is the decompressed RATES value.

4.2.17 PKHET

This routine is invoked by PHAOUT for the purpose of packing all the information associated with one HET PHA event into three consecutive halfwords (48 bits) in the PHA data record common area PHANEW. Refer to section 5.1.2 of this document for a detailed description of the HET PHA data contained in a PHA tape data record.

PKHET loads the three HET PHA readouts (12 bits of data each) associated with the HET Tag Word (12 bits of data) passed to PKHET via the calling sequence from their corresponding locations on the EDR tape, which is a function of the EDR data record format (A or B), into three general registers. PKHET then determines whether the HET event is a NULL event. A NULL event is one in which all three HET PHA readouts are zero. When a NULL event is being processed, PKHET sets the null return switch and processes the event in the same manner as a good event. If a NULL event is not being processed, PKHET then checks each HET PHA readout for the reset condition. A reset condition is one in which all 12 bits of the readout are set equal to one. Any readout which is in the reset condition is set equal to zero. All other readouts are incremented by one and PKHET then proceeds to pack the three readouts and the corresponding information from the associated HET Tag Word and the common area PHAEVT into the 48 bit configuration for a PHA event (see section 5.1.2).

After the HET PHA event has been processed, PKHET checks the null return switch to determine if a NULL event has been processed. If a NULL event was processed, PKHET turns on the bit indicating a NULL event and takes the alternate return. If a NULL event was not processed, PKHET takes the normal return.

The calling sequence is:

CALL PKHET (HETTAG, HETEVT, &N)

where HETTAG is the Tag Word associated with the HET PHA event

HETEVT is the first of three consecutive halfwords into which the packed HET PHA event is to be placed

N is the statement number to return to when a NULL event is processed.

4.2.18 PKLET

This routine is invoked by PHAOUT for the purpose of packing all the information associated with one LET PHA event into three consecutive halfwords (48 bits) in the PHA data record common area PHANEW. Refer to section 5.1.2 of this document for a detailed description of the LET PHA data contained in a PHA tape data record.

The function and method for PKLET is identical to the routine PKHET which processes one HET PHA event (see section 4.2.17). However, PKLET processes one LET PHA event which consists of three LET PHA readouts and the associated LET Tag Word.

The calling sequence is:

CALL PKLET (LETTAG, LETEVT, &N)

where LETTAG is the Tag Word associated with the LET PHA event

LETEVT is the first of three consecutive halfwords into which the packed LET PHA event is to be placed

N is the statement number to return to when a NULL event is processed.

4.2.19 UPKFLG

This routine is used to upack the data word in each Pioneer GSFC/CRT EDR data record which contains the four flags for the satellite position parameters. The data word consists of four eight bit flags for the ARIPPHEC, SPF, ASPNPDC and RAT, respectively.

The calling sequence is:

CALL UPKFLG (MFLG, HFLG1, HFLG2, HFLG3, HFLG4)

where MFLG is the data word containing the four flags
HFLG1 is the RAT flag.
HFLG2 is the ASPNPDC flag
HFLG3 is the SPF flag
HFLG4 is the ARIPPHEC flag.

4.2.20 UPKFMT

This routine is used to unpack the data word in each Pioneer GSFC/CRT EDR data record which contains the mode and data format indicators. The mode and data format indicators are two data values, three bits and five bits respectively, packed to form, eight bits right justified in the data word.

The calling sequence is:

CALL UPKFMT (MODFMT, HMODE, HFMT)

where MODFMT is the data word containing the mode and data format indicators
HMODE is the mode indicator
HFMT is the format indicator.

4.2.21 UPKSEQ

This routine is used to unpack the subcom data word E-1,30 which contains the unsectored and sectored rate sequence I.D.'s. The unsectored and sectored rate sequence I.D.'s are two data values, three bits each, packed to form, six bits right justified in the data word.

The calling sequence is:

CALL UPKSEQ (HRTSEQ, HUSEQ, HSSEQ)

where HRTSEQ is the data word E-1,30 containing the unsectored and sectored rate sequence I.D.'s

HUSEQ is the unsectored rate sequence I.D.

HSSEQ is the sectored rate sequence I.D.

4.2.22 UPKSPN

This routine is used to unpack the data word in each Pioneer GSFC/CRT EDR data record which contains the spin period flag. This data word consists of two data values, the SPSG roll reference and the SPSG mode. The two data values, one bit and two bits respectively, are packed to form, three bits right justified in the data word.

The calling sequence is:

CALL UPKSPN (MSPF, HSRR, HSMOD)

where MSPF is the data word containing the SPSG roll reference and the SPSG mode

HSRR is the SPSG roll reference

HSMOD is the SPSG mode.

4.2.23 UPKTIM

This routine is used to unpack the data word in each Pioneer GSFC/CRT EDR data record which contains the Data Quality Indicator and the time (MS) assigned to each frame of data. The Data Quality Indicator and the time are two data values, three bits and 29 bits respectively, packed to form a 32 bit data word.

The calling sequence is:

CALL UPKTIM (MSDQI, MSTM, HDQI)

where MSDQI is the data word containing the Data Quality Indicator and the time

MSTM is the time (MS) assigned to the corresponding frame of data

HDQI is the Data Quality Indicator assigned to the corresponding frame of data.

4.3 Generalized Subroutines

4.3.1 ADDPAG/COMPAG/MSPAGE

The entry point ADDPAG is used to add a time increment to a base time, supplied via the calling sequence, for the number of pages requested. The time increment used is dependent on the format (A, A/D, B or B/D) and the bit rate (16-2048) and is expressed in terms of milliseconds per page.

The calling sequence is:

CALL ADDPAG (IMS1, HDY1, HPGS, HFMT, HBITR, IMS2, HDY2)

where IMS1 is the time of day (MS) to which the increment is to be added

HDY1 is the RMJD to which the increment is to be added

HPGS is the number of pages for which the increment is to be added

HFMT is the format that is to be used in determining the increment

HBITR is the bit rate that is to be used in determining the increment

IMS2 is the time of day (MS) after the increment is added

HDY2 is the RMJD after the increment is added.

The entry point COMPAG is used to compare the time assigned to one page of data to the time assigned to another page of data.

The calling sequence is:

CALL COMPAG (MSP1, HDP1, MSP2, HDP2, MTDIF)

where MSP1 is the time of day (MS) assigned to the first page of data

HDP1 is the RMJD assigned to the first page of data

MSP2 is the time of day (MS) assigned to the second page of data

HDP2 is the RMD assigned to the second page of data

MTDIF is the time difference between the two pages expressed in milliseconds.

The entry point MSPAGE is used to provide the time in terms of milliseconds for a page of data. This time is dependent on the format (A, A/D, B or B/D) and bit rate (16-2048) of the page of data.

The calling sequence is:

CALL MSPAGE (HFM, HBR, MSP)

where HFM is the format of the page

HBR is the bit rate of the page

MSP is the time in terms of milliseconds for the page.

4.3.2 - CONVMD/CNVDAT

The subroutine CNVMJD contains another entry point called CNVDAT. CNVMJD converts a day count based on January 0, 1972 to a date of the form month/day/year. CNVDAT converts a date of the form month/day/year or day/year to a consecutive day count based on day zero being January 0, 1972.

CNVMJD first calculates the year associated with the day count and then the day count is decremented to day of year. The month is calculated by table look-up, accounting for years. Finally, day of year is decremented to day of month.

CNVDAT first initializes the day count to the days to be converted. Then the year is converted to an index by subtracting the base year, 72, and the day count increased by the number of days of the year. If the desired month is less than two, the calculation is complete. Otherwise, the day count is incremented by the number of days to the month, accounting for leap years.

The calling sequences are:

CALL CNVMJD (HRMJD, HMON, HDY, HYR)

and

CALL CNVDAT (HMON, HDY, HYR, HRMJD)

where HRMJD is a Relative Modified Julian Day

HMON is the month of year

HDY is the day of month (for CNVDAT it may also be the day of year if HMON=0)

HYR is the two digit year.

4.3.3 CONTIM

This routine is used to convert milliseconds into hours/minutes/seconds where seconds may be either floating point or fixed point with thousandths of seconds. The milliseconds are converted to hours, the remainder to minutes, and that remainder to seconds by taking advantage of Assembler Language division which makes available both quotient and remainder. The form of the desired seconds is determined by the presence and value of a fifth parameter. If this parameter is present and has a negative value, the seconds are stored in consecutive halfwords, starting with that pointed to by the fourth parameter, as seconds and thousandths of second. Otherwise, seconds are stored in full word floating point format.

The calling sequence is:

CALL CONTIM (MILSEC, HOUR, MINUTE, SECOND, TYPE)

where MILSEC is the full word containing the milliseconds to be converted

HOUR is the derived hours

MINUTE is the derived minutes

SECOND is the derived seconds

TYPE is an optional parameter defining the form of seconds.

4.3.4 QBIT

QBIT is a bit manipulator routine which performs one of three functions on the desired bit. It can set the bit either ON, i.e., "1", of OFF, i.e., "0", or it can test the desired bit for its ON-OFF status.

QBIT can be invoked as a subroutine, through the CALL statement, for setting a bit ON or OFF, or it can be referenced as a function, through an assignment statement, for detecting the status of a bit, which it returns in general purpose register zero.

The loaction of the desired bit is calculated to the byte and a mask generated to reference the bit within the byte. The desired operation is reached by performing a series of branch on count (BCT) based on the operation code. The bit is set ON by OR'ing the desired byte with the mask. The bit is set OFF by AND'ing the desired byte with the one's compliment of the mask. The status of the bit is determined by testing under mask (TM) the desired byte against the mask: If the bit was OFF, GPR#0 is zeroed; if the bit was ON, GPR#0 is loaded with a one.

The calling sequence is:

CALL QBIT (CODE, LOC, BIT)

where CODE indicates the desired QBIT operations
=1: set designated bit on
=2: set designated bit off
=3: test designated bit

LOC is the variable on which the desired bit operation is performed

BIT is the bit position within the variable on which the desired operation is performed.

4.3.5 DTIME/FTIME

This routine has two entry points, DTIME and FTIME. The entry point DTIME obtains the date, which is in packed decimal form, from the OS/360 control program. This date is of the form YYDDDC where:

YY is the last two digits of the year

DDD is the day of the year

C is a sign character that allows the date to be unpacked and printed directly.

The entry point FTIME obtains the time of day, based on a 24-hour clock, in packed decimal form, from the OS/360 control program. This time is of the form HHMMSSth where:

HH is hours
MM is minutes
SS is seconds
t is tenths of seconds
h is hundreds of seconds.

The calling sequences are:

CALL DTIME (IYR, IDY) and CALL FTIME (ITIM)

where IYR = YY
IDY = DDD
ITIM = HHMMSS.

4.3.6 FMOVE

Refer to the "Space and Earth Science Computing Center User's Guide".

4.3.7 FTIO (MOUNT/POSN/FREAD/FWRITE/UNLOAD)

Refer to the "Space and Earth Science Computing Center User's Guide".

4.3.8 DAIO (DREAD/DWRITE)

Refer to the "Space and Earth Science Computing Center User's Guide".

4.3.9 REMTIM

Refer to the "Space and Earth Science Computing Center User's Guide".

Section 5

INPUT AND OUTPUT FORMATS

5.1 Tapes

5.1.1 GSFC/CRT EDR Tapes

5.1.1.1 Description

The GSFC/CRT EDR tapes are 9-track 800 BPI tapes which contain the Pioneer GSFC/CRT experiment data and related spacecraft information. Each tape contains four files, separated by end-of-file indicators and a double end-of-file indicator signifying tape end. Files one through four contain the logistics, command, attitude and experiment data, respectively. Each tape contains data for an entire day (time 0 to time 2400) based on ground receipt time, that is, the time the data was received at a particular tracking station.

5.1.1.2 Logistics Data

The Logistics Data is contained in file one of the EDR tape and consists of one physical record of 480 EBCDIC characters. The format is as follows:

Characters	Content
1-13+Space	PIONEER F EDR
15-16+Space	Number of acquisitions

Characters	Content
18-29+Space	ACQUISITIONS
31-38+Space	GSFC/CRT
40-45+Space	S/C ID
47-48+Space	Spacecraft number
50-58+Space	GENERATED
60-67+Space	mm/dd/yy
69-79+Space	REGENERATED
81-88+Space	mm/dd/yy
90-95+Space	ddd/yy (time of data)
97-104+Space	DSIF NO.
106-120	List of DSS that tracked during the EDR time period.
121-133+Space	TLM BIT RATES
135-240	List of all the bit rates contained on this EDR tape. The entries consist of four characters separated by commas.
241-251+Space	TLM FORMATS
253-360	List of all formats contained on this EDR tape. The entries consist of five characters separated by commas.
361-365+Space	MODES
367-380	List of all modes contained on this EDR tape. The entries consists of three characters separated by commas.
381-390+Space	START TIME
392-396+Space	hh/mm
398-406+Space	STOP TIME
408-412+Space	hh/mm
414-430+Space	TAPE SEQUENCE NO.
432-433	Tape sequence number
434-480	Blanks

5.1.1.3 Command Data

The Command Data is contained in file two of the EDR tape and consists of one or more physical records of 1200 EBCDIC characters. Each physical record consists of ten logical records of 120 EBCDIC characters which contain five commands each. The format of each command is as follows:

Characters	Content
1-3+Space	DDD - Day of year of command verification
5-6+Space	HH - Hour of command expected verification time
8-9+Space	MM - Minutes of command expected verification time
11-12+Space	SS - Seconds of command expected verification time
14-18+Space	CCCCC - Command memonic
20	Flag - V = Command verified N = Command not verified C = Command unverifiable
21-22	Blanks.

The format of each logical record is as follows:

Characters	Content
1-8	Indicates the total number of commands if logical record one. Contains blanks for remaining logical records.
9-30	First command in logical record
31-52	Second command in logical record
53-74	Third command in logical record
75-96	Fourth command in logical record
97-118	Fifth command in logical record
119-120	Blanks.

5.1.1.4 Attitude Data

The Attitude Data is contained in file three of the EDR tape is currently being defined by the Pioneer Project Personnel at Ames Research Center.

5.1.1.5 GSFC/CRT Experiment Data

The GSFC/CRT Experiment Data is contained in the file four of the EDR tape and consists of one or more physical records containing the spacecraft and experiment information in binary representation. Each physical record of 5204 bytes consists of 21 full words (4 bytes) of header information followed by the experiment data in one of two formats (A or B). All 21 full words of header information are full word integer unless otherwise stated.

5.1.1.5.1 Fixed Words in Header

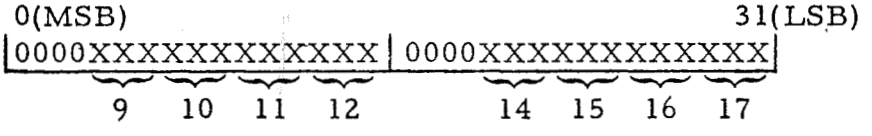
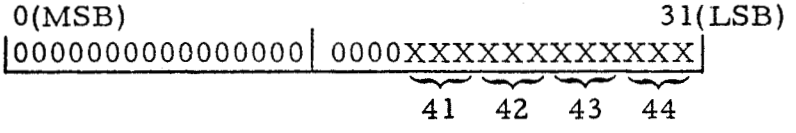
Word	Content
1	Time of day in MS for first non filler data word
2	Day of year
3	Time correction flag (0=no correction, 7=suspect time or corrected time)
4	Bits 4 and 5 from engineering word C-431 (0=error, 1=locked on star, 2=Sum B sensor, 3=Sum A sensor).
5	Signal to noise ratio (Floating Point-One million equals pad)
6	Deep space station which was tracking
7	Bit rate at which data record was taken
8	Eight bits, right justified, comprised of a three bit Mode value (most significant bits) and five bit Format value (least significant bits) were: Mode = 000/001 - real time =100/101 - telemetry store = 010/011 - memory readout

Word	Content
	Format = 0100? - Format A = 0000? - Format B = 11000 - Format A/D = 10000 - Format B/D
9	Round Trip Light Time (RTLT) given in total milliseconds
10	Extended Frame Counter
11	Star Delay, Counter in Data Numbers (conversion algorithm to be defined by ARC)
12	Four eight bit flags for RAT, ASPNPDC, SPF, ARIPPHEC, respectively. RAT is contained in the most significant eight bits and ARIPPHEC is contained in the least significant eight bits. The flag values are: (0=OK, 1=old value, 2=missing value, and 3=corrected value).
13	Roll attitude timer (Floating Point-One million equals pad)
14	Spin Period (Floating Point-One millison equals pad)
15	Three bits, right justified, comprised of a one bit Spin Period Sector Generator roll reference value (most significant bit) and a two bit Spin Period Sector Generator mode (least significant bits) were: SPSG roll reference = 0-0° roll reference = 1-180° roll reference SPSG mode = 00 - Non-spin averaging = 01 - ACS = 10 - Spin averaging
16	Roll Pulse/Roll-Index Pulse Phase Error (Floating Point-One million equals pad)
17	GMT in MS of RAT (a negative one indicates the value is missing)
18	DC Bus Voltage (Floating Point-One million equals pad)

Word	Content
19	DC Bus Current (Floating Point-One million equals pad)
20	Power status indicator for the GSFC/CRT experiment and the GMT of the indicator where: Bit 5 = 0 Power is off = 1 Power is on Bits 6-32 = GMT of power indicator (a negative one indicates the value is missing)
21	Spacecraft Platform Temperature (Floating Point-One million equals pad)

5.1.1.5.2 GSFC/CRT Experiment Data for Format A

The GSFC/CRT experiment data is assigned 12 MF (9, 10, 11, 12, 14, 15, 16, 17, 41, 42, 43, 44) data words (3 bits each) for Format A. These data words are readout 128 times for a Subcom sequence and each Format A data record contains three Subcom sequences. The GSFC/CRT data words appear on the EDR tape along with the subcom information (E-1, 24 to E-1, 30) which are readout twice each Subcom sequence as follows:

22	Data Quality Indicator and GMT of SCID 0. Bit 1 (most significant) of Word 22 is the fill indicator (0 - indicates data, 1 - indicates pad). Bits 2 and 3 are dependent on Bit 1. If Bit 1 equals 0, then Bits 2 and 3 are the Data Quality Indicator (00 - data is bad, 01 - two indicators are bad, 10 - one indicator is bad, 11 - data is good). If Bit 1 equals 1, then Bit 2 will indicate the extent of pad (0 - at least this frame of data is filled with pad and data resumes in this physical record, 1 - the rest of this physical record is filled with pad). Bits 4-32 contain the GMT of SCID0 when the frame is not padded).
23	
24	

Word	Content
25-90	Repeat Words 22-24 for SCID 1-22
91	Data Quality Indicator and GMT of SCID 23 (see Word 22)
92	Same as Word 23
93	0(MSB) 31(LSB) |00000000000XXXXXX| 0000XXXXXXXXXXXX| S/CE-1,24 41 42 43 44
94-111	Repeat Words 91-93 for SCID 24-29 (contains S/CE-1, 25 - S/CE-1,30 respectively)
112-312	Repeat Words 22-24 for SCID 30-63
214-405	Repeat Words 22-213 for SCID 64-127
406-1173	Repeat Words 22-405 for 2 additional Subcom sequences (SCID 0-127)
1174-1301	Filler - all bits on

213

5.1.1.5.3 GSFC/CRT Experiment Data for Format B

The GSFC/CRT experiment data is assigned four MF (14, 15, 16, 17) data words (3 bits each) for Format B. These data words are readout 128 times for a Subcom sequence and each Format B data record contains five Subcom sequences. The GSFC/CRT data words appear on the EDR tape along with the subcom information (E-1,24 to E-1,30) which are readout twice each Subcom sequence as follows:

Word	Content
22	Data Quality Indicator and GMT of SCID 0. (see Word 22 section 5.1.1.5.2)
23	0(MSB) 31(LSB) |0000000000000000| 0000XXXXXXXXXXXX| 14 15 16 17

Word	Content
24-67	Repeat Words 22-23 for SCID 1-22
68	Data Quality Indicator and GMT of SCID 23 (see Word 22)
69	0(MSB) 31(LSB) |0000000000XXXXXX| 0000XXXXXXXXXXXX| S/CE-1,24 14 15 16 17
70-81	Repeat Words 68-69 for SCID 24-29 (contains S/CE-1,25 - S/CE-1,30 respectively)
82-149	Repeat Words 22-23 for SCID 30-63
150-277	Repeat Words 22-149 for SCID 64-127
278-130T	Repeat Words 22-277 for 4 additional Subcom sequences (SCID 0-127)

5.1.2 PHA Tapes

5.1.2.1 Description

The PHA tapes are 9-track 1600 BPI tapes with standard OS/360 labels written in the binary mode and odd parity. The data set name is PIOPHA. They contain variable length blocked records with a maximum buffer length (BLKSIZE) of 7624 bytes and a maximum logical record length (LRECL) of 1524 bytes. These tapes contain the time-ordered Pioneer GSFC/CRT Pulse Height Analysis (PHA) data, corresponding events per second (RATES) data and related spacecraft information. Each logical record contains selected spacecraft information and all the PHA data and associated RATES data for one or more pages (each page represents a fourth of an experiment cycle). Each PHA event for the HET and LET requires 3 halfwords (48 bits) and these bits are organized in the 3 halfwords for the HET and LET events as follows:

	0(MSB)	15(LSB)
Halfword 1	METTAAAAAAAAAAAA	
Halfword 2	BBBBBBBBBBBBCCCC	
Halfword 3	CCCCCCCCRSSSQPPN	

where: M = 0 Good data

= 1 Missing/padded data

E = 0 LET event

= 1 HET event

TT = 00 $A_1\overline{A}_2$BCIII (HET) / DIDIIEDF (LET)

= 01 A_2BCIII (HET) / DIDIIF (LET)

= 10 (A_2K_1+A_1CI)B$\overline{CIII}$ (HET) / (No LET)

= 11 $A_1BK_2\overline{CIII}$ (HET) / (No LET)

A, B, C = Amplitudes from detectors A, B, and C respectively

R = 0 CII threshold not exceeded
= 1 CII threshold is exceeded
} HET only

SSS = 0-7 Sectors 0-7 respectively

Q = 0 Priority indicators valid

= 1 Priority indicators questionable

PP = 0-3 Priorities 0-3 (HET) / 0-1 (LET)

N = 0 Good event

= 1 Null event

5.1.2.2 Logical Record Format

Displacement	Type	Description
0	I*4	Time of day (MS) for first page contained in record.

Displacement		Type	Description
4	2	I*4	Time of day (MS) for page which is expected to immediately follow the last page in this record.
8	3	I*2	Day (RMJD) for first page contained in record.
10	6	I*2	Day (RMJD) for page which is expected to immediately follow the last page in this record.
12	4	I*2	Absolute File Number.
14	8	I*2	Time correction flag (0 - no correction, 7 - suspect time or corrected time)
16	5	I*2	Number of pages (1/4 experiment cycle) included in record (maximum of 6 for Format A and 5 for Format B)
18	10	I*2	Bit rate (1-16, 2-32, 3-64, 4-128, 5-~~256~~ 256, 6-512, 7-1024, 8-2048)
20	6	I*2	Format (1-A, 2-A/D, 3-B, 4-B/D)
22	12	I*2	Mode (0 or 1 - real time, 2 or 3 - memory readout, 4 or 5 - telemetry store)
24	7	I*2	DSS identification
26	14	I*2	Extended frame counter (ESC Subcom ID)
28	8	I*2	RAT flag (Roll attitude timer) (0 - good value, 1 - old value, 2 - missing value, 3 - corrected value)
30	16	I*2	ASPNPDC flag (Spin period) (see RAT flag for description)
32	9	I*2	SPF flag (Spin period flag) (see RAT flag for description)

Displacement		Type	Description
34	18	I*2	ARIPPHEC flag (Roll pulse/Roll-index pulse phase error) (see RAT flag for description)
36	19	R*4	Roll attitude timer (RAT) (One million equals pad)
40	11	R*4	Spin period (ASPNPDC) (One million equals pad)
44	12	R*4	Roll pulse/Roll-index pulse phase error (ARIPPHEC) (One million equals pad)
48	13	I*2	Spin Period Sector Generator (SPSG) roll reference (0 = 0^{o}, 1 = 180^{o})
50		I*2	Spin Period Sector Generator (SPSG) mode (0 - Non-Spin averaging, 1 - ACS, 2 - Sping averaging)
52	14	I*4	Roll attitude time (MS of RAT) (a negative one indicates value is missing)
56	15	R*4	DC Bus Voltage (One million equals pad)
60		R*4	DC Bus Current (One million equals pad)
64		R*4	Spacecraft Platform Temperature (One million equals pad)
68		R*4	Signal to noise ratio (SNR) (One million equals pad)
72	19	I*2	Bits 4 and 5 from engineering word C-431. (0=error, 1=locked on star, 2=Sum B sensor, 3=Sum A sensor)
74		I*2	Star Delay Counter in Data Numbers (conversion algorithm to be defined by ARC)
76	20	I*2	Day (RMJD) of RAT
78		I*2	Sectored Rates indicator (0-Not Inhibited, 1-Inhibited)
80	21	I*2	All the Subcom data associated with the first page of data contained in the record. Refer to Tables 5.1 and 5.2 for a description of the Subcom data for Format A and Format B respectively.

Displacement	Type	Description
N1	I*4	All the rates data associated with the first page of data contained in record. The rates data associated with each page appears in eight consecutive words as follows: (1)HET Rate R1 - $(A_2K_1+A_1CI)B\overline{CIII}$ (2)HET Rate R1 - $(A_2K_1+A_1CI)B\overline{CIII}$ (3)HET Rate R2A - $A_1\overline{A}_2BCIII$ (4)HET Rate R2B - $A_1BK_2\overline{CIII}$ (5)HET Rate R3A - A_2BCIII (6)LET Rate R11A - DI DII $\overline{F}$ (7)LET Rate R11B - DI DII $\Sigma\overline{DF}$ (8)Computed HET Rate R1 - (R6B+R7A+ R7B+R8A+R8B) All rates which fail the Trend Check will be indicated by a negative rate value. Whenever a rate with the value of zero fails the Trend Check, it will be indicated by the value, -21000000. Padded rates will be indicated by the value, -20,000,000. N1 = 96 - Format A = 112 - Format B
N2	I*2	All the PHA data associated with the first page of data contained in record. Each PHA entry, comprised of a HET and LET event, has a unique time associated with it and appears in three consecutive words as follows: 0 (MSB) 31 (LSB) (1) |HET - 1 | HET - 2| (2) |HET - 3 | LET - 1| (3) |LET - 2 | LET - 3| Padded data is indicated by a negative first halfword for an HET or LET event. There are 16 PHA entries, comprised of an HET and LET event, per page for Format A and 8 PHA entires per page for Format B. N2 = 128 - Format A = 144 - Format B

Displacement	Type	Description
N3		All the Subcom, Rates and PHA data for the second page of data contained in the record (see description of first page). N3 = 320 - Format A = 240 - Format B
N4		Third page of data N4 = 560 - Format A = 400 - Format B
N5		Fourth page of data N5 = 800 - Format A = 560 - Format B
N6		Fifth page of data N6 = 1040 - Format A = 720 - Format B
1280		Sixth page of data (Format A only)

5.1.3 RATES Tape

5.1.3.1 Description

The RATES tapes are 7-track 800 BPI tapes with standard OS/360 labels written in the binary mode and odd parity with coversion. The data set name is PIORAT. They contain variable length blocked records with a maximum buffer length (BLKSIZE) of 8704 bytes and a maximum logical record length (LRECL) fo 1740 bytes. These tapes contain the time-ordered Pioneer GSFC/CRT Events per second (RATES) data and related spacecraft information. Each logical record contains selected spacecraft information and all the RATES data for one or more pages (each page represents one fourth of an experiment cycle). All rates which fail the Trend Check will be indicated by a negative rate value.

Whenever a rate with the value of zero fails the Trend Check, it will be indicated by the value, -21000000. Padded rates data will be indicated by the value, -20000000.

5.1.3.2 Logical Record Format

Displacement	Type	Description
0	I*4	Time of day (MS) for first page contained in record.
4	I*4	Time of day (MS) for page which is expected to immediately follow the last page in this record.
8	I*2	Day (RMJD) for first page contained in record.
10	I*2	Day (RMJD) for page which is expected to immediately follow the last page in this record.
12	I*2	Absolute File Number
14	I*2	Time correction flag (0 - no correction, 7 - suspect time or corrected time)
16	I*2	Number of pages (1/4 experiment cycle) included in record (maximum of 6 for Format A and 5 for Format B).
18	I*2	Bit rate (1-16, 2-32, 3-64, 4-128, 5-256, 6-512, 7-1024, 8-2048)
20	I*2	Format (1-A, 2-A/D, 3-B, 4-B/D)
22	I*2	Mode (0 or 1 - real time, 2 or 3-memory readout, 4 or 5 - telemetry store)
24	I*2	DSS identification
26	I*2	Extended frame counter (ESC Subcom ID)
28	I*2	RAT flag (Roll attitude timer) (0-good value, 1-old value, 2-missing value, 3-corrected value)
30	I*2	ASPNPDC flag (Spin period) (see RAT flag for description)
32	I*2	SPF flag (Spin period flag) (see RAT flag for description)

Displacement	Type	Description
34	I*2	ARIPPHEC flag (roll pulse) Roll-index pulse phase error) (see RAT flag for description)
36	R*4	Roll attitude timer (RAT) (One million equals pad)
40	R*4	Spin period (ASPNPDC) (One million equals pad)
44	R*4	Roll pulse/Roll-index pulse phase error (ARIPPHEC) (One million equals pad)
48	I*2	Spin Period Sector Generator (SPSG) roll reference (0=0°, 1=180°).
50	I*2	Spin Period Sector Generator (SPSG) mode (0-Non-Spin averaging, 1-ACS, 2-Spin averaging)
52	I*4	Roll attitude time (MS of RAT) (-1 indicates value is missing)
56	R*4	DC Bus Voltage (One million equals pad)
60	R*4	DC Bus Current (One million equals pad)
64	R*4	Spacecraft Platform Temperature (One million equals pad)
68	R*4	Signal to noise ratio (SNR) (One million equals pad)
72	I*2	Bits 4 and 5 from engineering word C-431. (0=error, 1=locked on star, 2= Sum B sensor, 3=Sum A sensor)
74	I*2	Star Delay Counter in Data Numbers (conversion algorithm to be defined by ARC)
76	I*2	Day (RMJD) of RAT
78	I*2	Sectored Rates indicator (0=Not Inhibited, 1=Inhibited)
80	I*2	All the Subcom data associated with the first page of data contained in the record. Refer to Tables 5.1 and 5.2 for a description of the Subcom data for Format A and Format B respectively.

Displacement	Type	Description
N1	I*4	All the rates data associated with the first page of data contained in record. Each page consists of 4 sets (2 sectored and 2 unsectored) of 16 rates which are uniquely identified by the corresponding rate sequence I.D.'s appearing in the associated set of Subcom data. The rates data associated with each page appears in 64 consecutive words as follows: 1 - Sectored Rate (First set) ⋮ 16 - Sectored Rate (First set) 17 - Unsectored Rate (First set) ⋮ 32 - Unsectored Rate (First set) 33 - Sectored Rate (Second set) ⋮ 48 - Sectored Rate (Second set) 49 - Unsectored Rate (Second set) ⋮ 64 - Unsectored Rate (Second set) Refer to Table 5.3 to determine the rates data associated with each unsectored and sectored rate sequence I.D. Note: Redundant sectored rates data occurs whenever the corresponding sectored rate sequence I.D. is not updated from previous value. N1 = 100 - Format A (26) = 112 - Format B (29)
N2		All the Subcom and Rates data for the second page of data contained in the record (see description of first page). N2 = 356 - Format A = 368 - Format B

Displacement	Type	Description
N3		Third page of data N3 = 632 - Format A = 656 - Format B
N4		Fourth page of data N4 = 908 - Format A = 944 - Format B
N5		Fifth page of data N5 = 1184 - Format A = 1232 - Format B
1460		Sixth page of data (Format A only)

5.1.4 CATALOG Tapes

5.1.4.1 Description

The CATALOG tapes are 9-track 1600 BPI tapes with standard OS/360 labels written in the binary mode and odd parity. The data set name is PIOCAT. They contain variable length blocked records with a maximum buffer length (BLKSIZE) of 7292 bytes and a maximum logical record length (LRECL) of 7288 bytes. These tapes contain a backup copy of the associated DRS Tape Catalog on the first file, and files two through four contain the time-ordered Logistics, Command and Attitude information related to the Pioneer F/G missions, respectively.

The Logistics, Command and Attitude data sets (separate CATALOG tape files) are treated as three separate catalogs. Within each catalog, the information associated with an Absolute File (all the data for a particular day processed from the same EDR tape) is stored in sequential groups of records (one or more). A unique number is assigned to each absolute file called the Absolute File Number and is used to identify the

catalog information associated with each absolute file on the CATALOG tape. For each absolute file processed through PIODRP, there is one associated FILE/LOGISTICS/HISTORY catalog entry, and one or more associated Command and Attitude catalog entries (logical records) on the CATALOG tape, containing the same Absolute File Number. However, when the same or second EDR tape for a particular day is processed by PIODRP, redundant Command and Attitude entries are not maintained on the CATALOG tape. Only the most recent entry processed is maintained.

5.1.4.2 Backup DRS Tape Catalog

The backup DRS Tape Catalog is contained in file one of the CATALOG tape and consists of one physical record of 5540 bytes. The format is identical to the DRS Tape Catalog on disk (see section 5.2.2).

5.1.4.3 FILE/LOGISTICS/HISTORY Catalog

The FILE/LOGISTICS/HISTORY catalog is contained in file two of the CATALOG tape and consists of one or more physical records of 7284 bytes. This data set serves as the backup for the FILE/LOGISTICS/HISTORY catalog maintained in a permanent disk data set and the format is identical (see section 5.2.3).

5.1.4.4 Command Catalog

The Command catalog is contained in file three of the CATALOG tape and consists of one or more physical records of 608 bytes. The format is identical to the temporary Command information on disk (see section 5.2.5) except that the array containing the day of year of each of the commands is deleted.

5.1.4.5 Attitude Catalog

The Attitude catalog is contained in file four of the CATALOG tape. The format of the Attitude information will be defined after the Pioneer Project Personnel at Ames Research Center adequately define the Attitude information to be contained in file three of the Pioneer EDR tapes.

5.2 Disk Data Sets

5.2.1 DRS Tape Catalog Pointer

The DRS Tape Catalog Pointer is a permanent disk data set (one track on a 2314 DASD) containing one unblocked record with a fixed length of 80 bytes. The record contains the character (1, 2, 3, or 4) in the first byte and the character (F or G) in the second byte. This data set indicates which of the four DRS Tape Catalogs is the latest version (see section 5.2.2) and is updated each time a new version of the DRS Tape Catalog is created.

5.2.2 DRS Tape Catalog

5.2.2.1 Description

The DRS Tape Catalog is a permanent disk data set (one track on a 2314 DASD) containing one unblocked record with a fixed length of 5540 bytes. It provides the DRS with pertinent information about the PHA, RATES and CATALOG tapes previously created and the blank tapes currently available to the system. This provides the system with the capability to locate data previously processed and dynamically assign all new PHA and RATES tapes. The four latest versions of the Tape

Catalog are maintained on the disk to facilitate the continual updating of the catalog and to provide a rerun/recover capability. Each time PIODRP is run, the latest version of the Tape Catalog, indicated by the Catalog Pointer (see section 5.2.1), is read from the disk, updated to reflect the data processed, and written onto the disk replacing the most outdated version.

5.2.2.2 DRS Tape Catalog Format

Displacement	Variable	Type	Description
0	IDSAT	I*4	Pioneer identification (F/G) character in high order byte followed by three blank characters.
4	HPHATP	I*2	Total number of PHA tapes
6	HRATTP	I*2	Total number of Rates tapes
8	DPHATP(100)	R*8	PHA tape labels
808	MSPHAS(100)	I*4	PHA tape start time (MS)
1208	MSPHAE(100)	I*4	PHA tape end time (MS)
1608	HDPHAS(100)	I*2	PHA tape start date (RMJD)
1808	HDPHAE(100)	I*2	PHA tape end date (RMJD)
2008	HPHAFT(100)	I*2	Amount of space (feet) used on PHA tape
2208	DRATTP(100)	R*8	Rates tape labels
3008	MSRATS(100)	I*4	Rates tape start time (MS)
3408	MSRATE(100)	I*4	Rates tape end time (MS)
3808	HDRATS(100)	I*2	Rates tape start date (RMJD)
4008	HDRATE(100)	I*2	Rates tape end date (RMJD)
4208	HRATFT(100)	I*2	Amount of space (feet) used on Rates tape
4408	DBLNKP(50)	R*8	Labels of blank tapes for use as PHA tapes

Displacement	Variable	Type	Description
4808	DBLNKR(50)	R*8	Labels of blank tapes for use as Rates tapes
5208	DCATLG(2,2)	R*8	CATALOG tape labels DCATLG(I, J): I = 1 - Backup DRS Tape Catalog and FILE/LOGISTICS/HISTORY catalog tape label = 2 - Command and Attitude catalog tape label J = 1 - Primary tape = 2 - Backup tape
5240	HPHABK	I*2	Number of blank PHA tapes
5242	HRATBK	I*2	Number of blank Rates tapes
5244	LSTAFN	I*4	Last Absolute File Number assigned to data
5248	LSTLOG	I*4	Last track number used for FILE/LOGISTICS/HISTORY catalog
5252	NUMLOG	I*4	Last entry in last track used for FILE/LOGISTICS/HISTORY catalog
5256	DTRJTP(10)	R*8	Trajectory tape labels
5336	MSTRJS(10)	I*4	Trajectory tape start time (MS)
5376	MSTRJE(10)	I*4	Trajectory tape end time (MS)
5416	HDTRJS(10)	I*2	Trajectory tape state date (RMJD)
5436	HDTRJE(10)	I*2	Trajectory tape end date (RMJD)
5456	NUMTRJ	I*4	Total number of Trajectory tapes
5460	MYSPR1	I*4	Spare
5464	DPHAS	R*8	Absolute value of tape label assigned as first tape in PHA block of tapes
5472	DPHAE	R*8	Absolute value of tape label assigned as last tape in PHA block of tapes
5480	DRATS	R*8	Absolute value of tape label assigned as first tape in RATES block of tapes

Displacement	Variable	Type	Description
5488	DRATE	R*8	Absolute value of tape label assigned as last tape in RATES block of tapes
5496	MYSPR2(11)	I*4	Spares

5.2.3 FILE/LOGISTICS/HISTORY Catalog

5.2.3.1 Description

The FILE/LOGISTICS/HISTORY catalog is a permanent disk data set which provides a permanent time-ordered history of all the EDR tapes processed by PIODRP. This data set consists of one or more unblocked records with a fixed length of 7294 bytes. Each record occupies one track on a 2314 DASD (maximum of 15 tracks) and contains 182 entries of 40 bytes each. Each entry contains all the information associated with a particular EDR tape processed by PIODRP.

5.2.3.2 FILE/LOGISTICS/HISTORY Catalog Entry Format

Displacement	Variable	Type	Description
0	MSLOGS	I*4	Start time of EDR data coverage (MS)
4	MSLOGE	I*4	End time of EDR data coverage (MS)
8	HLGAFN	I*2	Absolute File Number assigned to data contained on EDR tape
10	HLRMJD	I*2	Start date of EDR data coverage (RMJD)
12	HLMJDE	I*2	End time of EDR data coverage (RMJD)
14	HEDRNO	I*2	EDR tape sequence number
16	HEDRG	I*2	Date EDR was generated by ARC (RMJD)

Displacement	Variable	Type	Description
18	HEDRRG	I*2	Date EDR was regenerated by ARC (RMJD)
20	HPROCD	I*2	Date EDR was processed by PIODRP (RMJD)
22	HTLREC	I*2	Total number of records contained on EDR tape
24	HGDREC	I*2	Total number of good records processed from EDR tape
26	HQULHG	I*2	High limit for Data Quality Indicator used when accepting data from EDR tape
28	HQULLW	I*2	Low limit for Data Quality Indicator used when accepting data from EDR tape
30	HDTPRC	I*2	Data processed indicator. Bits 16 (least significatn bit), 15 and 14 indicate whether PHA, RATES and Command data have been processed (0-not processed, 1-processed)
32	HLOGSP(4)	I*2	Spares

5.2.3.3 FILE/LOGISTICS/HISTORY Catalog Record Format

Displacement	Variable	Type	Description
0	NUMNEW	I*4	Total number of entries in record
4	LOGFLN(10,82)	I*4	Array containing the time-ordered catalog entries (maximum of 182 for record) (see section 5.2.3.2)

5.2.4 Temporary FILE/LOGISTICS/HISTORY Catalog

The temporary FILE/LOGISTICS/HISTORY catalog consists of one or more unblocked records with a fixed length of 7294 bytes. Each

record occupies one track on a 2314 DASD (maximum of 15 tracks) and contains 182 entries of 40 bytes each. Each entry contains all the information associated with a particular EDR tape processed by PIODRP. The format of this data set is identical to the permanent FILE/LOGISTICS/HISTORY catalog (see section 5.2.3) and it is utilized by PIODRP when data is being merged with previously processed data.

5.2.5 Temporary Command Catalog

5.2.5.1 Description

The temporary Command catalog is utilized by PIODRP for storing the command data during a production run. This data is then merged with the Command catalog (file three of the CATALOG tape) at the end of each production run of PIODRP. The data set consists of one or more unblocked records with a fixed length of 708 bytes. PIODRP requests enough 2314 DASD space to accommodate a maximum of 200 records for each production run.

5.2.5.2 Disk Command Catalog Record Format

Displacement	Variable	Type	Description
0	HNUMCM	I*2	Total number of commands contained in record (maximum of 50)
2	HCMAFN	I*2	Absolute File Number assigned to date
4	HCRMJD	I*2	Date of commands (RMJD) (all commands belong to the same day)
6	HCMLFT	I*2	Total number of commands belonging to same day and assigned the same Absolute File Number that appear in succeeding records (all commands over 50)

Displacement	Variable	Type	Description
8	DCMMND(50)	A*8	Array containing at the most 50 commands. Each command consists of 8 EBCDIC characters and appears as follows: 1 2 3 4 5 6 7 8 CCCCC F where: CCCCC - Command memonic F - Command flag (V-command verified, N-command not verified, C-command unverifiable)
408	MSCMD(50)	I*4	Array containing the time (MS) of each of the commands
608	HDYCMD(50)	I*2	Array containing the day of year of each of the commands

5.3 Cards

5.3.1 Parameter Cards

Refer to section 6 of this document for a format description of the parameter cards read by each of the three programs which comprise this system.

5.4 Printouts and Reports

Refer to section 6 of this document for a detailed description of the printed reports generated by each of the three programs which comprise this system.

Displacement	Type	Description[1]
0	I*2	Bilevel (E-1, 24)
2	I*2	Elect. Temp. (E-1, 25)
4	I*2	Housekeeping (E-1, 26)
6	I*2	Calibration Voltage (E-1, 27)
8	I*2	Detector Temperature (E-1, 28)
10	I*2	Sec. Voltage (E-1, 29)
12	I*2	Unsectored rate sequence I.D. (identifies first set of unsectored rates for page)
14	I*2	Sectored rate sequence I.D. (identifies first set of sectored rates for page)
16	I*2	Unsectored rate sequence I.D. (identifies second set of unsectored rates for page)[2]
18	I*2	Sectored rate sequence I.D. (identifies second set of sectored rates for page)[2]

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1 Padded data is indicated by a negative one (-1) for a particular Subcom word. However, the unsectored and sectored rate sequence I.D.'s will always be present.

2 The unsectored and sectored rate sequence I.D.'s for the second set of rates data contained in a page for Format A are not readout by the GSFC/CRT experiment. However, they are provided by the D.R.S. to identify the rates data contained in each page of data on the RATES Tape. They are not included with the Subcom data on the PHA tape.

Table 5.1. Subcom Data for Format A

Displacement	Type	Description[1]
0	I*2	Bilevel (E-1, 24)
2	I*2	Elect. Temp. (E-1, 25)
4	I*2	Housekeeping (E-1, 26)
6	I*2	Calibration Voltage (E-1, 27)
8	I*2	Detector Temperature (E-1, 28)
10	I*2	Sec. Voltage (E-1, 29)
12	I*2	Unsectored rate sequence I.D. (identifies first set of unsectored rates for page)
14	I*2	Sectored rate sequence I.D. (identifies first set of sectored rates for page)
16	I*2	Bilevel (E-1, 24)
18	I*2	Elect. Temp. (E-1, 25)
20	I*2	Housekeeping (E-1, 26)
22	I*2	Calibration Voltage (E-1, 27)
24	I*2	Detector Temperature (E-1, 28)
26	I*2	Sec. Voltage (E-1, 29)
28	I*2	Unsectored rate sequence I.D. (identifies second set of unsectored rates for page)
30	I*2	Sectored rate sequence I.D. (identifies second set of sectored rates for page)

[1] Padded data is indicated by a negative one (-1) for a particular Subcom word. However, the unsectored and sectored rate sequence I.D.'s will always be present.

Table 5.2. Subcom Data for Format B

Table 5.3. RATES data associated with each unsectored and sectored rate sequence I.D.

Rate Sequence I.D.		Unsectored or Sectored Rate
Unsectored	Sectored	
XX	0	Sectored rate S1A(1 of 2)-$A_1\overline{A}_2$ BCI$\overline{\text{CIII}}$ (1-8)
		Sectored rate S2A(1 of 1)-$SI_5\overline{\text{SII}}\ \overline{\text{SII}}_a\ \overline{\text{SIII}}$ (1-8)
0	XX	Unsectored rate R1(1 of 8)-(A_2K_1+A_1 CI)B$\overline{\text{CIII}}$
		Unsectored rate R2A(1 of 4)-$A_1\overline{A}_2$BCIII
		Unsectored rate R3A(1 of 4)-A_2BCIII
		Unsectored rate R4A(1 of 4)-A_2BK_2CI $\overline{\text{CII}}$
		Unsectored rate R5A(1 of 4)-A_2BK_2CI CII $\overline{\text{CIII}}$
		Unsectored rate R6A(1 of 4)-$A_1\overline{A}_2$B$\overline{\text{CI}}$
		Unsectored rate R7A(1 of 4)-$A_1\overline{A}_2$BCI CII $\overline{\text{CIII}}$
		Unsectored rate R8A(1 of 4)-A_2BK_1CI $\overline{\text{CII}}$
		Unsectored rate R9A(1 of 2)-B
		Unsectored rate R10A(1 of 1)-DI_1
		Unsectored rate R11A(1 of 4)-DI DII $\overline{\text{F}}$
		Unsectored rate R12A(1 of 4)-DI DII E_1 $\overline{\text{F}}$
		Unsectored rate R13A(1 of 4)-DI DII E_2 $\overline{\text{F}}$
		Unsectored rate R14A(1 of 1)-DI $\overline{\text{SII}}$ $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$
		Unsectored rate R15A(1 of 2)-$SI_1\overline{\text{SII}}\ \overline{\text{SII}}_a\ \overline{\text{SIII}}$
		Unsectored rate R16A(1 of 2)-SI SII_1 $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$
XX	1	Sectored rate S1B(1 of 2)-$A_2BK_1\overline{\text{CIII}}$ (1-8)
		Sectored rate S2B(1 of 1)-$SI_6\overline{\text{SII}}\ \overline{\text{SII}}_a\ \overline{\text{SIII}}$ (1-8)
1	XX	Unsectored rate R1 (2 of 8)
		Unsectored rate R2B(1 of 4)-A_1BK_2 $\overline{\text{CIII}}$
		Unsectored rate R3B(1 of 4)-A_2BK_2 $\overline{\text{CI}}$

Table 5.3 (continued)

Rate Sequence I.D.		Unsectored or Sectored Rate
Unsectored	Sectored	
		Unsectored rate R4B(1 of 4)-A_1 Unsectored rate R5B(1 of 4)-A_2 Unsectored rate R6B(1 of 4)-$A_1\overline{A}_2$B CI $\overline{\text{CII}}$ Unsectored rate R7B(1 of 4)-A_2BK_1 $\overline{\text{CI}}$ Unsectored rate R8B(1 of 4)-A_2BK_1 CI CII $\overline{\text{CIII}}$ Unsectored rate R9B(1 of 2)-CI Unsectored rate R10B(1 of 1)-DI_2 Unsectored rate R11B(1 of 4)-DI DII Σ D $\overline{\text{F}}$ Unsectored rate R12B(1 of 4)-DI DII Σ DE_3 $\overline{\text{F}}$ Unsectored rate R13B(1 of 4)-DI DII ΣD E_4 $\overline{\text{F}}$ Unsectored rate R14B(1 of 1)-DII $\overline{\text{SII}}$ $\overline{\text{SII}}$ $\overline{\text{SIII}}$ Unsectored rate R15B(1 of 2)-SI_2 $\overline{\text{SII}}$ $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$ Unsectored rate R16B(1 of 2)-SI SII_2 $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$
XX	2	LET 1 Sectored rate S1C(1 of 2)-DI $\underline{\text{DII}}$ $\overline{\text{F}}$ (1-8) Sectored rate S2C(1 of 1)-SI_7 $\overline{\text{SII}}$ $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$ (1-8) LET 2
2	XX	Unsectored rate R1(3 of 8) Unsectored rates R2A-R8A(2 of 4) Unsectored rate R9C(1 of 2)-CII Unsectored rate R10C(1 of 1)-DI_3 Unsectored rates R11A-R13A(2 of 4) Unsectored rate R14C(1 of 1)-E_1 Unsectored rate R15C(1 of 2)-SI_3 $\overline{\text{SII}}$ $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$ Unsectored rate R16C(1 of 2)-SI SII_3 $\overline{\text{SII}}_a$ $\overline{\text{SIII}}$

Table 5.3 (continued)

Rate Sequence I.D.		Unsectored or Sectored Rate
Unsectored	Sectored	
XX	3	LET 1 Sectored rate S1D(1 of 2)-DI DII E_1 $\overline{F}$ (1-8) Sectored rate S2D(1 of 1)-SI_8 $\overline{SII}$ $\overline{SII_a}$ $\overline{SIII}$ (1-8) LET 2
3	XX	Unsectored rate R1(4 of 8) Unsectored rates R2B-R8B(2 of 4) Unsectored rate R9D(1 of 2)-CIII Unsectored rate R10D(1 of 1)-DI_4 Unsectored rates R11B-R13B(2 of 4) Unsectored rate R14D(1 of 1)-F Unsectored rate R15D(1 of 2)-SI_4 $\overline{SII}$ $\overline{SII_a}$ $\overline{SIII}$ Unsectored rate R16D(1 of 2)-SI SII_4 $\overline{SII_a}$ $\overline{SIII}$
XX	4	HET Sectored rate S1A(2 of 2) (1-8) Sectored rate S2E(1 of 1)-$\overline{SI}$ SII_5 $\overline{SII_a}$ $\overline{SIII}$ (1-8) LET 2
4	XX	Unsectored rate R1(5 of 8) Unsectored rates R2A-R8A(3 of 4) Unsectored rate R9A(2 of 2) Unsectored rate R10E(1 of 1)-DI_5 Unsectored rates R11A-R13A(3 of 4) Unsectored rate R14E(1 of 1)-SI Unsectored rate R15A-R16A(2 of 2)
XX	5	HET Sectored rate S1B(2 of 2) (1-8) Sectored rate S2F(1 of 1)-$\overline{SI}$ SII_6 $\overline{SII_a}$ $\overline{SIII}$ (1-8) LET 2
5	XX	Unsectored rate R1(6 of 8) Unsectored rate R2B-R8B(3 of 4) Unsectored rate R9B(2 of 2) Unsectored rate R10F(1 of 1)-DI_6 Unsectored rates R11B-R13B(3 of 4) Unsectored rate R14F(1 of 1)-SII Unsectored rate R15B-R16B(2 of 2)

Table 5.3 (continued)

Rate Sequence I.D.		Unsectored or Sectored Rate
Unsectored	Sectored	
XX	6	SET 1 Sectored rate S1C(2 of 2) (1-8) Sectored rate S2G(1 of 1)-$\overline{SI}$ SII_7 $\overline{SII_a}$ $\overline{SIII}$ (1-8) SET 2
6	XX	Unsectored rate R1(7 of 8) Unsectored rates R2A-R8A(4 of 4) Unsectored rate R9C(2 of 2) Unsectored rate R10G(1 of 1)-DI_7 Unsectored rates R11A-R13A(4 of 4) Unsectored rate R14G(1 of 1)-SIII Unsectored rates R15C-R16C(2 of 2)
XX	7	SET 1 Sectored rate S1D(2 of 2) (1-8) Sectored rate S2H(1 of 1)-$\overline{SI}$ SII_8 $\overline{SII_a}$ $\overline{SIII}$ (1-8) SET 2
7	XX	Unsectored rate R1(8 of 8) Unsectored rates R2B-R8B(4 of 4) Unsectored rate R9D(2 of 2) Unsectored rate R10H(1 of 1)-DI_8 Unsectored rates R11B-R13B(4 of 4) Unsectored rate R14H(1 of 1)-SII_a Unsectored rates R15D-R16D(2 of 2)

Section 6

USER'S GUIDES

6.1 Pioneer F/G Data Reduction Program (PIODRP)

6.1.1 Purpose

The purpose of the Pioneer F/G Data Reduction Program (PIODRP) is to read the Pioneer F/G EDR tapes and create time-ordered PHA, RATES and CATALOG tapes which contain all the GSFC/CRT experiment data and related spacecraft information for the life of the Pioneer F/G Satellite missions. For further detail, refer to sections 1 and 2 of this document.

6.1.2 Deck Setup

The main program for the Pioneer F/G Data Reduction Program, PIODRP, and all the required subroutines have been placed in two library data sets called:

K3.ZIJAN.SB001.OPIONEER

and

K3.ZIART.OGENERAL

which currently reside on the S/360 75J disk packs K3USR2 and K3USR1, respectively. The general setup of the Job Control Language (JCL) needed to execute the program from the program library is shown in Figure 6.1.

```
//PDRS EXEC LINKGO,REGION.GO=270K
//LINK.SYSLIB DD DSN=K3.ZIART.OGENERAL,DISP=SHR
//             DD DSN=K3.ZIJAN.SB001.OPIONEER,DISP=SHR
//LINK.SYSLIN DD *
  INCLUDE SYSLIB(PIODRP)
  ENTRY PIODRP
//GO.FT06F001 DD DCB=(BUFNO=1)
//GO.FT10F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(OLD,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP),VOL=SER=DUM1
//GO.FT11F001 DD DSN=PIOPHA,UNIT=(2400-9,,DEFER),DISP=(MOD,KEEP),
// DCB=(RECFM=VB,LRECL=1524,BLKSIZE=7624),VOL=SER=DMYPH1
//GO.FT12F001 DD DSN=PIOPHA,UNIT=AFF=FT11F001,DISP=(NEW,KEEP),
// DCB=(RECFM=VB,LRECL=1524,BLKSIZE=7624),VOL=SER=DMYPH2
//GO.FT13F001 DD DSN=PIOPHA,UNIT=(2400-9,,DEFER),DISP=(OLD,KEEP),
// VOL=SER=DMYPH3
//GO.FT14F001 DD DSN=PIORAT,UNIT=(2400-7,,DEFER),DISP=(MOD,KEEP),
// DCB=(RECFM=VB,LRECL=1740,BLKSIZE=8704,TRTCH=C,DEN=2),
// VOL=SER=DMYRT1
//GO.FT15F001 DD DSN=PIORAT,UNIT=AFF=FT14F001,DISP=(NEW,KEEP),
// DCB=(RECFM=VB,LRECL=1740,BLKSIZE=8704,TRTCH=C,DEN=2),
// VOL=SER=DMYRT2
//GO.FT16F001 DD DSN=PIORAT,UNIT=(2400-7,,DEFER),DISP=(OLD,KEEP),
// DCB=DEN=2,VOL=SER=DMYRT3
//GO.FT17F001 DD DSN=PIOCAT,UNIT=AFF=FT10F001,DISP=(OLD,KEEP),
// VOL=SER=DMYCT1
//GO.FT18F001 DD DSN=PIOCAT,UNIT=AFF=FT11F001,DISP=(NEW,KEEP),
// DCB=(RECFM=VB,LRECL=7288,BLKSIZE=7292),VOL=SER=DMYCT2
//GO.FT19F001 DD DSN=PIOCAT,UNIT=AFF=FT13F001,DISP=(NEW,KEEP),
// DCB=(RECFM=VB,LRECL=7288,BLKSIZE=7292),VOL=SER=DMYCT3
//GO.FT20F001 DD DSN=K3.ZIJAN.SB001.PIOFPLOG,DISP=OLD
//GO.FT21F001 DD UNIT=2314,SPACE=(7294,15),DCB=BLKSIZE=7294
//GO.FT22F001 DD UNIT=2314,SPACE=(708,200),DCB=BLKSIZE=708
//GO.FT30F001 DD SYSOUT=A,DCB=*.FT06F001
//GO.FT31F001 DD SYSOUT=A,DCB=*.FT06F001
//GO.FT32F001 DD SYSOUT=A,DCB=*.FT06F001
//GO.FT33F001 DD SYSOUT=A,DCB=*.FT06F001
//GO.FT40F001 DD DSN=K3.ZIJAN.SB001.PIOFDRSP,DISP=OLD
//GO.FT41F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS1,DISP=OLD
//GO.FT42F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS2,DISP=OLD
//GO.FT43F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS3,DISP=OLD
//GO.FT44F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS4,DISP=OLD
//GO.SYSUDUMP DD SYSOUT=A
//GO.DATA5 DD *
```

Figure 6.1 General Deck Setup for Executing the Pioneer F Data Reduction Program (PIODRP)

The program was designed so that the JCL need not be changed from one production run to the next for a particular satellite. However, the data set names (DSNAME) for all the permanent disk data sets must be unique for each satellite (F/G). Only the parameter cards, which specify the processing options and identify the EDR tapes to be processed, must be updated each run. However, to make more efficient use of the computer, it is advisable to remove Data Definition (DD) cards for tapes which will not be used during a particular job. By doing so, unnecessary tape drives are not allocated for the job. DD cards for data sets on disk that will not be used, however, need not be removed since disk drives are shared by other jobs.

The program requires 270K bytes of main storage and approximately one minute of CPU time and 1.5 minutes of I/O time (I/O time includes one minute for tape mount charge) for each EDR tape processed. The DD cards required for PIODRP are shown in Figure 6.1 and the following table shows the purpose of each data set and indicates when it is required.

DD Name	Purpose of Data Set	Input/ Output	Device Type	Code
FT06F001	Error Message (No Data Cards)	Output	Printer	A
FT10F001	EDR Tape	Input	Tape	A
FT11F001	PHA Tape	Output	Tape	P/C
FT12F001	PHA Tape	Output	Tape	P/C
FT13F001	PHA Tape	Input	Tape	PM/C
FT14F001	RATES Tape	Output	Tape	R
FT15F001	RATES Tape	Output	Tape	R
FT16F001	RATES Tape	Input	Tape	RM
FT17F001	CATALOG Tape	Input	Tape	C/U

DD Name	Purpose of Data Set	Input/ Output	Device Type	Code
FT18F001	CATALOG Tape (Primary)	Output	Tape	C
FT19F001	CATALOG Tape (Backup)	Output	Tape	C
FT20F001	Logistics Catalog (Permanent)	Input/ Output	Disk	A
FT21F001	Logistics Catalog (Temporary)	Input/ Output	Disk	M
FT22F001	Command Catalog (Temporary)	Input/ Output	Disk	N
FT23F001	ATTITUDE CATALOG (TEMPORARY)	I/O	DISK	
FT30F001	Processing Messages	Output	Printer	A
FT31F001	Data Quality Summary Report	Output	Printer	A
FT32F001	FILE/LOGISTICS/HISTORY Rpt	Output	Printer	A
FT33F001	Current Status Report	Ouput	Printer	A
FT40F001	DRS Tape Catalog Pointer	Input/ Output	Disk	A
FT41F001	DRS Tape Catalog 1	Input/ Output	Disk	A
FT42F001	DRS Tape Catalog 2	Input/ Output	Disk	A
FT43F001	DRS Tape Catalog 3	Input/ Output	Disk	A
FT44F001	DRS Tape Catalog 4	Input/ Output	Disk	A
SYSUDUMP	Abend Dumps	Output	Printer	A
DATA5	Parameter Cards	Input	Card Reader	A

The meaning of code is as follows:

A - Always required.

C - Required if a CATALOG Tape is to be generated.

P - Required if a PHA Tape is to be generated.

PM - Required if a PHA Tape is to be generated and data merge is specified.

R - Required if a RATES Tape is to be generated.

RM - Required if a RATES Tape is to be generated and data merge is specified.

U - Required if the DRS Tape Catalog Pointer is specified on the Namelist Card/OPTION/

M - Required if data merge is specified.

N - Required if Command data is specified to be processed.

6.1.3 Input/Output

6.1.3.1 Tapes

There are four types of tapes utilized by PIODRP. The first type is the Pioneer GSFC/CRT EDR tapes which contain the GSFC/CRT experiment data and related spacecraft information. These tapes are 9-track, odd parity and the recording density is 800 BPI. Each tape consists of four files of data having fixed length records with a different record length for each file. Files one through four contain the logistics, command, attitude and experiment data, respectively. The tape contains undefined records with a maximum blocksize of 5204 bytes.

The second type of tape is the PHA tape that is created and read by PIODRP. These tapes are 9-track with standard OS/360 labels and the data set name (DSNMAE) is PIOPHA. The tapes are written in the binary mode and odd parity at a recording density of 1600 BPI. The tapes contain variable length blocked records with a maximum logical record length of 1524 bytes and a maximum physical record length of 7624 bytes.

The third type of tape is the RATES tape that is created and read by PIODRP. These tapes are 7-track with standard OS/360 labels and the data set name (DSNAME) is PIORAT. The tapes are written

in the binary mode and odd parity with conversion at a recording density of 800 BPI. The tapes contain variable length blocked records with a maximum logical record length of 1740 bytes and a maximum physical record length of 8704 bytes.

The fourth type of tape is the CATALOG tape that is created and read by PIODRP. These tapes are 9-track with standard OS/360 labels and the data set name (DSNAME) is PIOCAT. The tapes are written in the binary mode and odd parity at a recording density of 1600 BPI. The tapes contain variable length blocked records with a maximum logical record length of 7288 bytes and a maximum physical record length of 7292 bytes.

For a detailed format description of all the tapes utilized by PIODRP, refer to section 5.

6.1.3.2 Cards

Parameter cards follow the last DD card in the program setup and are of two types:

a. Processing options (OPTION) card

b. Input EDR tape (EDRTAP) cards.

All cards are read using the NAMELIST convention of FORTRAN IV. The first column in each card must be blank. The second column in the first card of a group of data cards associated with the same NAME-LIST name must contain an ampersand (&), immediately followed by the NAMELIST name (OPTION/EDRTAP). The name is followed by a blank and then a series of data items separated by commas. The end of the data group is indicated by the characters "&END".

The first data group for each run must be the OPTION group of cards. This group is used to specify various program variables and options to be used throughout the current run. All program variables and options which may be specified in this group are listed below along with their associated purpose and the standard default value they assume whenever they are not specified. The underlined keywords and equal sign must be written exactly as shown.

IDRUN= 'F' If Pioneer F EDR tapes are to be processed.
'G' If Pioneer G EDR tapes are to be processed.

(Default - The job is terminated with a user completion code of 47.)

NQLHIG= The high limit for the Data Quality Indicator to be used when accepting data this run. The Data Quality Indicator may have the following values:

0 - Data is bad (no sync)
1 - At least two quality indicators are bad (data is suspect).
2 - At least one quality indicator is bad (data is suspect).
3 - All quality indicators are good (data is good).

(Default = 3)

NQLLOW= The low limit for the Data Quality Indicator to be used when accepting data this run (see NQLHIG for possible values).

(Default = 2)

HCPUTM= The CPU time in minutes needed to process one EDR tape and terminate the job normally which includes the generation of the CATALOG tape when specified (see QCTLGT).

(Default = 2 min)

HIOTM= The I/O time in minutes needed to process one EDR tape and terminate the job normally which includes the generation of the CATALOG tape when specified (see QCTLGT).

(Default = 2 min if CATALOG tape not being created and 5 min if CATALOG tape is being created.)

QMERGE= T If data processed this run is to be merged with data processed previously.
F If data processed this run is to be added after all data processed previously.

(Default = F)

QPHATP= T If PHA tapes are to be created this run.
F If PHA tapes are not to be created this run.

(Default = T)

QRATTP= T If RATES tapes are to be created this run.
F If RATES tapes are not to be created this run.

(Default = T)

QCTLGT= T If CATALOG tapes are to be created this run.
F If CATALOG tapes are not to be created this run.

(Default = T)

QCMMND= T If command data is to be processed this run.
F If command data is not to be processed this run.

(Default = T)

QPRTID= T If the entire FILE/LOGISTICS/HISTORY catalog is to be printed at the end of the run.
F If only the updated section of the catalog is to be printed.

(Default = F)

QATT= T If attitude data is to be processed this run.
F If attitude data is not to be processed this run.

(Default = T)

NUMCAT= The sequence number of the DRS Tape Catalog to be read. This number +40 is the FORTRAN logical unit from which the Catalog will be read.

(Default - The DRS Tape Catalog will be read from the last unit on which the latest version of the DRS Tape Catalog was written by PIODRP. This Catalog is pointed to by the DRS Tape Catalog Pointer on disk.)

QLOOK= T If Quick-Look processing is to be performed this run. The DRS Tape Catalogs and the current FILE/LOGISTICS/HISTORY catalog are not referenced for this type of processing. Also, the command data and CATALOG tapes are not processed.

F If normal processing is to be performed this run.

(Default = F)

DTPPHA= Labels of tapes to be used for PHA tapes when Quick-Look processing is specified (see QLOOK). A maximum of 10 tape labels may be supplied. Each tape label must be enclosed in apostraphes and be separated from the previous one by a comma.

(Default - Blank PHA tapes will be used from the latest version of the DRS Tape Catalog.)

DTPRAT= Labels of tapes to be used for RATES tapes when Quick-Look processing is specified (see QLOOK). A maximum of 10 tape labels may be supplied. Each tape label must be enclosed in apostraphes and be separated from the previous one by a comma.

(Default - Blank RATES tapes will be used from the latest version of the DRS Tape Catalog.)

One or more NAMELIST groups with the name EDRTAP must follow the OPTION group of cards. These cards are used to identify the EDR tapes to be processed this run and these tapes must be submitted in time sequence. The form of the data items within this group is given below along with the standard default value they assume whenever they are not specified. The underlined keywords and equal sign must be written exactly as shown.

DTSLOT= The loaction (tape slot) or symbol identifying the EDR tape to be processed. The tape slot or symbol may contain a maximum of six characters and must be enclosed in apostrophes. This symbol appears on the operator's console whenever the EDR tape is to be mounted.

(Default - None. The EDR tape must always be identified.)

DTLABL= The label or identifying symbol for the EDR tape being processed. This label may contain a maximum of six characters and must be enclosed in apostrophes. This label appears in all the printed reports generated by PIODRP which are associated with this EDR tape.

(Default - Assumes the value of DTSLOT when not specified.)

QREPLC= T If the PHA and RATES data processed from this EDR tape is to replace all PHA and RATES data processed previously for the same time period.

F If the PHA and RATES data processed from this EDR tape is not to replace all PHA and RATES data processed previously for the same time period.

(Default = F)

Note: When data replace is specified (QREPLC=T) for a particular EDR tape, the tape must either be the last tape processed in the run or all subsequent EDR tapes to be processed must also have data replace specified. Also, data merge must be specified (QMERGE=T) on the OPTION group of cards.

6.1.3.3 Printed Reports

PIODRP provides four types of printed reports at the end of each production run; a Processing Messages Report, a Data Quality Summary Report, a FILE/LOGISTICS/HISTORY Catalog Report, and the Current Status Report. Each page of a report contains the following standard header information:

a. Type of report.

b. Name of the spacecraft and experiment.

c. Date of run (MM/DD/YY).

d. Page number.

6.1.3.3.1 Processing Messages Report

The Processing Messages Report provides a history of all the EDR tapes processed and the errors (abnormal conditions) encountered. Each message produced has a standard format (reading left to right) as follows:

a. Time the message was generated (HHMMSS).

b. Name of the routine generating the message.

c. Label of the EDR tape being processed.

d. Tape sequence number for current run.

e. Number of file being processed from EDR tape.

f. Number of record being processed.

g. Message content.

All Processing Messages generated by PIODRP are self-explanatory and provide the following information:

a. Indications of all abnormal conditions encountered during processing.

b. Reasons for discarding data either on a record basis or an entire EDR tape.

c. First message generated list all the pertinent processing options specified for run.

d. The last message generated either provides the total EDR tapes mounted and the total EDR tapes rejected (normal End of Job) or provides the reason the job was abnormally terminated with a user dump.

6.1.3.3.2 Data Quality Summary Report

The Data Quality Summary Report provides an indication of the quality and status of the Pioneer GSFC/CRT experiment data processed. A Data Quality Summary Report is generated for each EDR tape processed and contains the following information:

a. EDR tape label (source of data).

b. Absolute File Number assigned to data.

c. Start time of data coverage (MM/DD/YY - HH/MM/SS.SSS).

d. End time of data coverage (MM/DD/YY - HH/MM/SS.SSS).

The following information is provided for each data format (A, A/D, B, B/D) along with an over-all total:

a. Total records processed.

b. Number of good records.

c. Number of records discarded due to pad.

d. Number of records discarded due to sync errors.

e. Number of records discarded due to time errors.

f. Number of records discarded with power off.

g. Number of records when GSFC/CRT experiment was operating in low power mode (no PHA data).

h. Number of records when GSFC/CRT experiment was operating with Sector Sync I hibited.

i. Number of records when the SPSG (Spin Period Sector Generator) roll reference was 180°.

j. Number of good pages processed (PHA/RATES).

k. Number of pages discarded due to pad (this number does not include item c).

l. Number of pages discarded with power off (this number does not include item f).

m. Number of pages discarded due to time errors (this number does not include item e).

n. Number of pages discarded dur to sync errors (this number does not include item d).

o. Number of pages of PHA data discarded due to overlap with data previously processed (not provided as a function of format).

p. Number of pages of RATES data discarded due to overlap with data previously processed (not provided as a function of format).

The following information is provided for each PHA event priority mode (0-3 for HET and 0-1 for LET) along with an over-all total:

a. Number of good PHA events as a function of type (0-3 for HET and 0-1 for LET).

b. Number of Null PHA events.

c. Total number of PHA events (this number does not include Null events).

Finally, the total number of PHA events (HET and LET) discarded as a function of the following data quality criteria is provided along with an over-all total:

a. All Bad - data is bad (no sync).

b. Two Bad - at least two quality indicators are bad (data is suspect).

c. One Bad - at least one quality indicator is bad (data is suspect).

d. Padded - all or part of the data necessary for a PHA event is padded.

6.1.3.3.3 FILE/LOGISTICS/HISTORY Catalog Report

The FILE/LOGISTICS/HISTORY Catalog Report provides a permanent history of all the EDR tapes processed by PIODRP and provides a permanent record of the data processed from each tape. This report contains the following information for each EDR tape processed:

a. Absolute File Number assigned to data.

b. Start time of data (MM/DD/YY - HH/MM/SS.SSS).

c. End time of data (MM/DD/YY - HH/MM/SS.SSS).

d. EDR sequence number.

e. Date EDR was generated (MM/DD/YY)

f. Date EDR was regenerated (MM/DD/YY).

g. Date EDR was processed by PIODRP (MM/DD/YY).

h. Total records processed.

i. Total good records.

j. High limit of the Date Quality Indicator used for accepting data.

k. Low limit of the Data Quality Indicator used for accepting data.

l. Record of the data processed from this EDR tape (PHA/RATES/COMMANDS).

6.1.3.3.4 Current Status of D.R.S. Report

This report provides the current status of all tapes available to the Pioneer Data Reduction System. This report provides the following information at the end of each production run of PIODRP:

a. Total number of good PHA and RATES tapes currently in the system.

b. Total number of blank PHA and RATES tapes currently available to the system.

c. First and last tapes assigned to the PHA and RATES block of tapes.

d. Current versions of the primary and backup CATALOG tapes and a record of the data sets contained on them.

e. List of all blank PHA and RATES tapes currently available to the system.

f. List of all PHA and RATES tapes created in the current run.

g. List of all PHA and RATES tapes copied in the current run.

h. List of all GOOD PHA and RATES tapes giving the start and end times and the amount of tape (feet) used on each.

i. Last Absolute File Number assigned to data.

j. Last track and last entry on the track used by the FILE/LOGISTICS/HISTORY catalog.

k. Current value of the D.R.S. Tape Catalog Pointer (1, 2, 3 or 4) indicating which Tape Catalog is the latest.

6.1.3.4 Abnormal Conditions

PIODRP recognizes several abnormal conditions and terminates a run with a user dump when they are encountered. Normally, all

user dumps with a completion code that is less than 50 will be explained by the last printed message in the Processing Messages Report. For user dumps 001-and 002 when this does not apply, and all user dumps with a completion code that is greater than 50, refer to the User Abends section of the "IBM System/360 General I/O Package" written by Alan R. Thompson.

After the error condition is corrected, the job may be resubmitted without any other changes to the deck. However, when data merge was not specified (QMERGE=F) for the job which abnormally terminated, (i.e., with a user or system completion code) the job must be resubmitted with data merge specified (QMERGE=T). This is necessary to prevent the PHA and RATES tapes from containing any duplicate and/or unwanted data.

If an error is detected by the user after one or more production runs has executed successfully, (job was not abnormally terminated with a dump) the error may be corrected and the job may usually be resubmitted by setting NUMCAT (on OPTION group cards) to a Tape Catalog prior to the error. However, this may not be done if more than two production runs have been run since the error.

6.2 Pioneer F/G Data Reduction System Catalog Maintenance Program (DRSMNT)

6.2.1 Purpose

The purpose of the Pioneer F/G Data Reduction System Catalog Maintenance Program (DRSMNT) is to initialize, modify, update and/or list the contents of the Pioneer D.R. S. Tape Catalogs.

6.2.2 Deck Setup

The main program for the Pioneer F/G Data Reduction System Catalog Maintenance Program, DRSMNT, and all the required subroutines have been placed in two library data sets called:

K3.ZIJAN.SB001.OPIONEER

and

K3.ZIART.OGENERAL

which currently reside on the S/360 75J disk pack K3USR2 and K3USR1, respectively. The general setup of the Job Control Language (JCL) needed to execute the program from the program library is shown in Figure 6.2.

The program was designed so that the JCL need not be changed from one production run to the next for a particular satellite. However, the data set names (DSNAMES) for all the permanent disk data sets must be unique for each satellite (F/G). Only the parameter cards, which specify the function to be performed, identify the appropriate satellite (F/G) and provide the necessary input data, must be updated each run. However, to make more efficient use of the computer, it is advisable to remove the Data Definition (DD) cards for the CATALOG tape which will not be used during a particular job. By doing so, an unnecessary tape drive is not allocated for the job. DD cards for data sets on disk that will not be used, however, need not be removed since disk drives are shared by other jobs.

The program requires 100K bytes of main storage and approximately .5 minutes of CPU time and .5 minutes of I/O time to perform any function requested. The DD cards required for DRSMNT are shown in Figure 6.2 and the following table shows the purpose of each data set and indicates when it is required.

```
//PDRS EXEC LINKGO,REGION.GO=100K
//LINK.SYSLIB DD DSN=K3.ZIART.OGENERAL,DISP=SHR
//             DD DSN=K3.ZIJAN.SB001.OPIONEER,DISP=SHR
//LINK.SYSLIN DD *
  INCLUDE SYSLIB(DRSMNT)
  ENTRY DRSMNT
//GO.FT06F001 DD DCB=(BUFNO=1)
//GO.FT10F001 DD DSN=PIOCAT,UNIT=(2400-9,,DEFER),DISP=(OLD,KEEP),
// VOL=SER=DMYCAT
//GO.FT20F001 DD DSN=K3.ZIJAN.SB001.PIOFPLOG,DISP=OLD
//GO.FT40F001 DD DSN=K3.ZIJAN.SB001.PIOFDRSP,DISP=OLD
//GO.FT41F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS1,DISP=OLD
//GO.FT42F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS2,DISP=OLD
//GO.FT43F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS3,DISP=OLD
//GO.FT44F001 DD DSN=K3.ZIJAN.SB001.PIOFDRS4,DISP=OLD
//GO.SYSUDUMP DD SYSOUT=A
//GO.DATA5 DD *
```

Figure 6.2 General Deck Setup for Executing the Pioneer F Data Reduction System Catalog Maintenance Program (DRSMNT)

DD Name	Purpose of Data Set	Input/ Output	Device Type	Code
FT06F001	Processing Messages	Output	Printer	A
FT10F001	CATALOG Tape	Input	Tape	U/R
FT20F001	Logistics Catalog (Permanent)	Output	Disk	U
FT40F001	DRS Tape Catalog Pointer	Input/ Output	Disk	A
FT41F001	DRS Tape Catalog 1	Input/ Output	Disk	A
FT42F001	DRS Tape Catalog 2	Input/ Output	Disk	A
FT43F001	DRS Tape Catalog 3	Input/ Output	Disk	A
FT44F001	DRS Tape Catalog 4	Input/ Output	Disk	A
SYSUDUMP	Abend Dumps	Output	Printer	A
DATA5	Parameter Cards	Input	Card Reader	A

The meaning of code is as follows:

A - Always required.

U - Required if the DRS Tape Catalog Pointer is being updated.

R - Required if a DRS Tape Catalog (1-4) is being restored from the CATALOG tape.

6.2.3 Input/Output

6.2.3.1 Tapes

There is only one tape utilized by DRSMNT. This tape is the CATALOG tape created by PIODRP. This tape is 9-track with a standard OS/360 label and the data set name (DSNAME) is PIOCAT. The tape is written in the binary mode and odd parity at a recording density of

1600 BPI. The tape contains variable length blocked records with a maximum logical record length of 7288 bytes and a maximum physical record length of 7292 bytes.

For a detailed format description of the CATALOG tape utilized by DRSMNT, refer to section 5.

6.2.3.2 Cards

The parameter cards follow the last DD card in the program setup and must be supplied to the program as shown in the following table.

Card Number	Columns	Format	Variable Name	Field Description
1	1	I1	MODE	Maintenance function requested. MODE=1 - Initialize and list all four DRS Tape Catalogs and the DRS Tape Catalog Pointer. MODE=2 - Add blank tapes (PHA and/or RATES) to the latest Tape Catalog indicated by the Tape Catalog Pointer. MODE=3 - Modify the Catalog Pointer and generate a listing of the Catalog to which it points before and after update. MODE=4 - List the contents of a specified tape catalog. MODE=5 - Restore a specified Tape Catalog from a specified backup tape.

Card Number	Columns	Format	Variable Name	Field Description
	2	A1	IDCAT	Pioneer (F/G) identification. F - Perform maintenance function for Pioneer F Tape Catalogs. G - Perform maintenance function for Pioneer G Tape Catalogs.
(Cards '2 to N1+4' must have following format when MODE=1 is specified on Card 1)				
2	1-2	I2	NUMPHA	Number of blank PHA tapes to be placed in the DRS Tape Catalogs (must be greater than zero and less than 51).
	5-6	I2	NUMRAT	Number of blank RATES tapes to be placed in the DRS Tape Catalogs (must be greater than zero and less than 51).
	11-16	A6	DPHAST	First tape assigned to PHA block of tapes.
	21-26	A6	DPHAEN	Last tape assigned to PHA block of tapes.
	31-36	A6	DRATST	First tape assigned to RATES block of tapes.
	41-46	A6	DRATEN	Last tape assigned to RATES block of tapes.
3	1-6	A6	DTAP(1)	Blank PHA tape number 1
	9-14	A6	DTAP(2)	Blank PHA tape number 2
	17-22	A6	DTAP(3)	Blank PHA tape number 3
	25-30	A6	DTAP(4)	Blank PHA tape number 4
	33-38	A6	DTAP(5)	Blank PHA tape number 5
	41-46	A6	DTAP(6)	Blank PHA tape number 6
	49-54	A6	DTAP(7)	Blank PHA tape number 7

Card Number	Columns	Format	Variable Name	Field Description
	57-62	A6	DTAP(8)	Blank PHA tape number 8
	65-70	A6	DTAP(9)	Blank PHA tape number 9
	73-78	A6	DTAP(10)	Blank PHA tape number 10
4-N	(same as card 3)			Repeat card 3 for Blank PHA tapes 11-50 if necessary.
N+1	(same as card 3)			Blank RATES tapes 1-10.
N+2 to N1	(same as card 3)			Blank RATES tapes 11-50 if necessary.
N1+1	1-6	A6	DCATLG(1, 1)	Primary CATALOG tape for backup Tape Catalog 1 and the FILE/LOGISTICS/ HISTORY catalog associated with Tape Catalog 1.
	9-14	A6	DCATLG(1, 2)	Backup CATALOG tape for backup Tape Catalog 1 and the FILE/LOGISTICS/ HISTORY catalog associated with Tape Catalog 1.
	17-22	A6	DCATLG(2, 1)	Primary CATALOG tape for the Command and Attitude catalogs associated with Tape Catalog 1.
	25-30	A6	DCATLG(2, 2)	Backup CATALOG tape for the Comma nd and Attitude catalogs associated with Tape Catalog 1.
N1+2	(same as card N1+1)			Primary and backup CATALOG tapes associated with Tape Catalog 2.
N1+3	(same as card N1+1)			Primary and backup CATALOG tapes associated with Tape Catalog 3.
N1+4	(same as card N1+1)			Primary and backup CATALOG tapes associated with Tape Catalog 4.

Card Number	Columns	Format	Variable Name	Field Description
(Cards '2 to N' must have following format when MODE=2 is specified on Card 1.)				
2	1-2	I2	NUMPHA	Number of blank PHA tapes to be added to the latest DRS Tape Catalog (this number can be zero).
	5-6	I2	NUMRAT	Number of blank RATES tapes to be added to the latest DRS Tape Catalog (this number can be zero).
3-N	(same as card 3 when MODE=1)			Blank PHA and/or RATES tapes to be added to the latest DRS Tape Catalog (when both PHA and RATES tapes are added, the RATES tapes must follow the PHA tapes and they must begin on a new parameter card).
(Card '2' must have following format when MODE=3 is specified on Card 1.)				
2	1	I1	NCAT	Value to be assigned to the DRS Tape Catalog Pointer indicating the latest version to the Tape Catalog (must be a value from 1 to 4).
(Card '2' must have following format when MODE=4 is specified on Card 1.)				
2	1	I1	NCAT	Number specifying the DRS Tape Catalog to list. A value of zero defaults to the latest version of Tape Catalog indicated by the Tape Catalog Pointer (must be a value from 0 to 4).
(Card '2' must have following format when MODE=5 is specified on Card 1.)				

Card Number	Columns	Format	Variable Name	Field Description
2	1	I1	NCAT	Number specifying the DRS Tape Catalog to restore (must be a value from 1 to 4).
	6-11	A6	DCLGTP	CATALOG tape containing the appropriate backup Tape Catalog (must always be specified on data card).

6.2.3.3 Printed Reports

DRSMNT provides one printed report at the end of each production run. This report is divided into two sections; the first section contains the processing messages which indicate all abnormal conditions encountered and the action taken by the program and the second section is the Current Status Report. Each page of the report contains the following standard header information:

a. Type of report.

b. Name of the spacecraft.

c. Date of run (MM/DD/YY).

d. Page number.

There are three categories of messages generated by DRSMNT and all are self-explanatory. The first category is the group of messages which list all PHA and RATES tapes rejected by the program. These messages should be investigated for possible errors with the parameter cards. The second category is the group of messages which begin with "JOB TERMINATED" and provide an explicit reason for the abnormal termination of the job. All messages in this group must be investigated and the abnormal condition corrected before the job is resubmitted. The third category is the group of messages which signify the normal "end of job" and these always follow the Current Status report.

The contents of the Current Status report generated by DRSMNT is identical to the Current Status report generated by PIODRP (refer to section 6.1.3.3.4). However, all the DRS Tape Catalogs affected by the current maintenance run are listed by DRSMNT.

6.2.3.4 Abnormal Conditions

DRSMNT recognizes several abnormal conditions and terminates a run without a dump whenever they occur. The last message printed by the job will always indicate the abnormal condition encountered. This condition must be corrected before the job is resubmitted. When a job is terminated abnormally with a user completion code, refer to the User Abends section of the "IBM System/360 General I/O Package" written by Alan R. Thompson.

6.3 Pioneer F/G EDR Tape List Program (EDRLST)

6.3.1 Purpose

The purpose of the Pioneer F/G EDR Tape List Program is to provide a formatted listing of selected data from one or more Pioneer F/G EDR tapes.

6.3.2 Deck Setup

The main program for the Pioneer F/G EDR Tape List Program, EDRLST, and all the required subroutines have been placed in two library data sets called:

K3.ZIJAN.SB001.OPIONEER

and

K3.ZIART.OGENERAL

which currently reside on the S/360 75J disk packs K3USR2 and K3USR1, respectively. The general setup of the Job Control Language (JCL) needed to execute the program from the program library is shown in Figure 6.3. No change to this JCL setup is required from one production run to the next. Only the parameter cards, which specify the EDR tapes and the amount of data to list, must be updated each run.

The program requires 100K bytes of main storage and approximately .5 minutes of CPU time and .5 minutes of I/O time to list 100 records from a particular EDR tape. The DD cards required by EDRLST are shown in Figure 6.3 and the following table shows the purpose of each data set and indicates when it is required.

DD Name	Purpose of Data Set	Input/ Output	Device Type	Code
FT06F001	Formatted Data Listing	Output	Printer	A
FT10F001	EDR Tape	Input	Tape	A
SYSUDUMP	Abend Dumps	Output	Printer	A
DATA5	Parameter Cards	Input	Card Reader	A

The meaning of code is as follows:

A - Always required.

6.3.3 Input/Output

6.3.3.1 Tapes

There is only one tape utilized by EDRLST. This tape is the Pioneer F/G EDR tape which contains the GSFC/CRT experiment data and related spacecraft information. This tape is 9-track, odd parity with a recording density of 800 BPI. Each tape consists of four files of

```
//PEDR EXEC LINKGO,REGION.GO=100K
//LINK.SYSLIB DD DSN=K3.ZIART.OGENERAL,DISP=SHR
//             DD DSN=K3.Z1JAN.SB001.OPIONEER,DISP=SHR
//LINK.SYSLIN DD *
  INCLUDE SYSLIB(EDRLST)
  ENTRY EDRLST
//GO.FT06F001 DD DCB=(BUFNO=4)
//GO.FT10F001 DD DSN=EDRIN,UNIT=(2400-9,,DEFER),DISP=(OLD,KEEP),
// DCB=(RECFM=U,BLKSIZE=5204,DEN=2),LABEL=(,BLP),VOL=SER=DUM1
//GO.SYSUDUMP DD SYSOUT=A
//GO.DATA5 DD *
```

Figure 6.3 General Deck Setup for Executing the Pioneer F/G EDR Tape List Program (EDRLST)

data having fixed length records with a different record length for each file. Files one through four contain the logistics, command, attitude and experiment data, respectively. The tape contains undefined records with a maximum blocksize of 5204 bytes.

For a detailed format description of the Pioneer F/G EDR tape utilized by EDRLST, refer to section 5.

6.3.3.2 Cards

The parameter cards follow the last DD card in the program setup and are read using the NAMELIST convention of FORTRAN IV. The first column in each card must be blank. The next six columns of the first card of a group of cards must contain the characters "&INPUT", followed by a blank. The blank is followed by data items separated by commas. The end of a group of cards is signaled by the characters "&END". One or more groups of cards, each identifying a unique EDR tape, may be submitted each run.

Each group of cards, with the NAMELIST name INPUT, identifies an EDR tape to list and specifies the amount of data to list. The form of the data items within this group is given below along with the standard default value they assume whenever they are not specified. The underlined keywords and equal sign must be written exactly as shown.

DTAPE= The location (tape slot) or symbol identifying the EDR tape to be listed. The tape slot or symbol may contain a maximum of six characters and must be enclosed in apostrophes. This symbol appears on the operator's console whenever the EDR tape is to be mounted.

(Default - None. The EDR tape must always be identified.)

DALIAS= The label or identifying symbol for the EDR tape being processed. This label may contain a maximum of six characters and must be enclosed in apostrophes. This label appears in all the listings generated by EDRLST which all associated with this EDR tape.

(Default - Assumes the value of DTAPE when not specified.)

LSTRCN= 0 If the records on the EDR tape are to be listed by record number.
1 If the records on the EDR tape are to be listed by time period (MS of day).

(Default = 0)

LIMITS= Pairs of start and end record sequence numbers or time periods (MS of day) that are to be listed from the EDR tape specified via the "DTAPE" keyword. A maximum of 20 pairs (2 entires) may be supplied and each entry must be separated from the previous one by a comma. Both entries of a pair must be supplied even if only one record is desired. The pairs must be supplied in sequence and the end entry of a pair must always be larger than or equal to the start entry. Only the data contained in the first three files of the EDR tape is listed when only one pair is supplied with both entries set equal to zero.

(Default - Only the data contained in the first three files of the EDR tape is listed.)

QATT= T If the Attitude information contained in file 3 of the EDR tape is to be listed.
F If the Attitude information is not to be listed.

(Default = T).

6.3.3.3 Printed Reports

The primary output from EDRLST is the listing of the first three files of data contained on the EDR tape, followed by the listing of the specified data records contained in file four. The first three files of data (logistics, commands and attitude) are printed on one page followed

by four pages for each full data record from file four. When a data record does not contain all good data, the following message will be printed after the last good frame of data.

***** REMAINDER OF RECORD ALL PAD *****

The listing generated by EDRLST for all four files of data on an EDR tape are self-explanatory. Also, all messages generated by EDRLST are self-explanatory except for the following message:

ERROR ENCOUNTERED:FILE-XX REC-XXX STATUS INFORMATION FOLLOWS:

This message indicates that an error occurred during a read operation and the pertinent information describing the error is provided in the following line of printout. A detailed description of the status information is provided in the I/O Errors section of the "IBM System/360 General I/O Package" written by Alan R. Thompson.

6.3.3.4 Abnormal Conditions

When a job is terminated abnormally with a user completion code, refer to the User Abends section of the "IBM System/360 General I/O Package" written by Alan R. Thompson.

CSC

Specifications for the

Pioneer F GSFC/CRT Pulse Height Analysis Summarizer System

February 1972

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ABSTRACT

This document outlines the design specifications of the Pioneer F GSFC/CRT Pulse Height Analysis (PHA) Summarizer Program (PPHASP) and briefly defines the supplemental programs which comprise the Pioneer F GSFC/CRT PHA Summarizer System. PPHASP has as its main input the PHA tape produced by the Pioneer F GSFC/CRT Data Reduction Program (PIODRP). PIOPSP computes the frequency of identical PHA events as a function of the priority and generates PHA Summary tapes in a condensed and readily accessible format for subsequent analysis programs.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 System Description

The Pioneer F GSFC/CRT Pulse Height Analysis Summarizer System (PPHASS) consists of three programs and the data sets referenced by these programs. The three programs, each consisting of an executive routine and some subroutines, collectively aid in the reduction and processing of the Pioneer F GSFC/CRT Pulse Height Analysis (PHA) data and the corresponding Rates data.

The Pioneer F GSFC/CRT PHA Summarizer Program (PPHASP) is the primary processing program which accomplishes the major function of the system (i.e., to create a data set containing PHA event summaries in time ascending order for the life of the Pioneer F Satellite). The other two programs, the Pioneer F Summary Catalog Maintenance program (PSUMCM) and the Pioneer F Summary Tape List program (PSUMTL), are utility programs which provide functions to assist in maintaining and listing the data sets created by PPHASP.

There are five types of data sets referenced in this system. The two secondary types are the parameter cards, which provide the processing options desired by the user, and the printed reports, which indicate the current processing status. The three primary types are the PHA tapes (generated by the Pioneer F GSFC/CRT Data Reduction Program (PIODRP)), the PHA Summary tapes (generated by PPHASP), and the Catalogs which provide the system with information about (1) the tapes previously created and (2) the unused tapes currently available to the system.

The DRS Tape Catalog is generated by PIODRP and contains status information about all the PHA tapes. The PHA Summary Catalog is generated by PPHASP and contains status information of all the PHA Summary files and tapes. Using the Catalogs, the system can locate PHA or Summarized PHA data previously processed and can dynamically assign tapes to be used for storing currently processed PHA data. The system's Catalog facility eliminates much of the burden on the personnel responsible for production.

The relationship between the three programs and the data sets is shown in Figure 1. The solid arrows show the flow of data through the system. The dotted arrows indicate an optional flow of data.

PPHASP will read parameter cards to determine the time during which the PHA data is to be summarized. The DRS Tape Catalog (stored on disk) will then be searched to determine which PHA tape contains the data for the specified time interval. The data for the time interval will be read from the PHA tape, summarized by computing the frequency of identical PHA events as a function of the priority, on a PHA summary tape. The PHA Summary Catalog will be updated to record the time interval of the new summary, the label of the tape that the summary was stored on, the file on the tape that contains the summary, and the total number of records written on the tape. If the new summary needs to be merged onto an existing PHA Summary tape, then that tape will be copied and the new summary merged. At the end of each run, a Processing Messages Report, a PHA Summary Report and a Current Status Report will be printed. The Processing Messages Report will provide a history of all PHA tapes and records processed and the errors (abnormal conditions)

encountered during processing. The PHA Summary Report will provide statistics on all the data processed for each summary. The PHA Summary Catalog Report will provide the current status of all PHA Summary tapes and unused tapes available to the system.

PSUMTL will be used to print the data stored on a PHA Summary tape. PSUMTL will read parameter cards to determine the labels of the tapes, the sequence number of the files, and (optionally) the sequence numbers of the records that contain the PHA Summarized data to be printed. The PHA Summary tape will then be read and a formatted listing of all pertinent information for the time interval will be provided.

PSUMCM will be used to perform the following five basic functions on the PHA Summary Catalog:

1. Initialize the Catalog
2. Add unused (blank) tapes to a tape queue in the Catalog
3. Save the latest version of the Catalog on a tape or cards
4. Restore this Catalog from a tape or from cards
5. List the Catalog

PSUMCM will read parameter cards to determine what function is requested. The PHA Summary Catalog will be updated as requested and a report, providing the new status of all tapes within the PHA Summary Catalog, will be printed. Optionally, the Catalog will be copied onto tape or cards.

1.2 System Design Specifications and Assumptions

The following assumptions and considerations are included in the system design:

a. Each time the PPHASP is executed, a new/updated version of the PHA Summary Catalog will be created. To facilitate this continual updating of the Catalog and to provide the capability of rerunning a job that ran to completion but was in error, the four latest versions of the Catalog will be kept on direct access storage devices. Two versions of the Catalog will be kept on one disk pack and two on another. This will provide for recovery in case one disk pack is destroyed.

Also, in case both disk packs are destroyed or it becomes desirable to restart production using a Catalog no longer available on disk, an option will be available with PSUMCM to store to or restore from tape, a copy of the latest Catalog. It is expected that the Catalog will be stored onto tape periodically (perhaps after every hour of computer time used during production).

Finally, as a last resort, PSUMCM will provide the capability to punch the latest version of the Catalog from disk or tape onto cards and then to restore from cards to disk. In this manner, the latest version can be punched, manually updated, and then restored.

b. It is assumed that during standard production of PPHASP, the data on the PHA tapes will usually be processed in time ascending order, the time interval of the data to be summed (hereafter referred to as the summary interval) will not be less than 2 full days, nor more than 20 full days, and the summary interval will be changed infrequently during the life of the satellite. A summary interval will not overlap with any other summary interval but one or more summaries may be replaced with a summary whose time interval totally encompasses the time intervals of the replaced summaries.

It is also assumed that special processing will be desirable where the summary interval may be shorter than a day and data from one day may be included in one or more summaries (i.e., the summary intervals may overlap).

Finally, it is assumed that merging of two or more summaries produced during standard production will be desirable.

Based on these assumptions, PPHASP will allow either standard processing or special processing to be requested during a production run. During standard processing, PPHASP will assure that the summary interval does not overlap with the summary interval of an existing summary on a standard PHA Summary tape and will add to an existing tape if any space is available, (the latter reduces the number of tapes required for standard production). During special processing, no check

for overlap will be made, and the summaries for this production run will be written sequentially onto a new special PHA Summary tape.

Merging of summaries from standard PHA Summary tapes will be accomplished by the Pioneer F GSFC/CRT PHA Merge program and will be discussed in the documentation for that program.

To support the three types of processing the PHA Summary Catalog is logically divided into three sections. Each section will consist of entries of information about the summaries contained on each PHA Summary tape for the type of tape (i.e., standard, special, or merge). The Catalog is designed to support up to a total of 160 tapes and 700 summaries.

c. It is assumed that of all the non-null PHA events, less than 10% will be from the Low Energy Telescope (LET). Therefore to simplify coding, testing, and documentation, High Energy Telescope (HET) events and LET events will be in the same format on a PHA tape and on a PHA Summary tape. This may cause an increase of up to 4% in PHA Summary tapes required over the non-standard format method.

Also to simplify coding, testing, and documentation, HET and LET events will be sorted together. This will cause a slight increase in sort time (perhaps 6% in PPHASP, but it eliminates the need to sort these events (according to HET and LET) in PIODRS. Also, less main storage is required for PPHASP using this method.

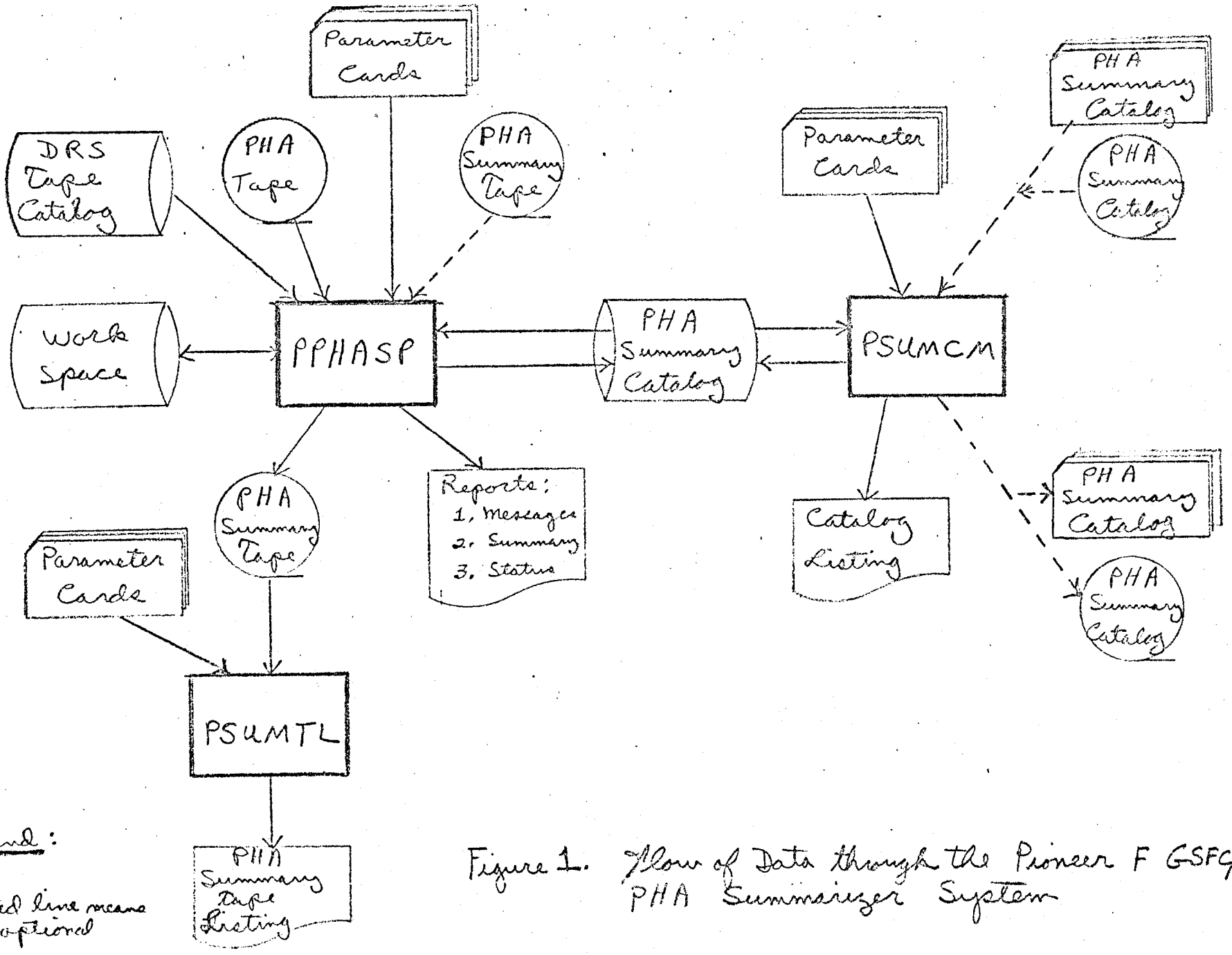


Figure 1. Flow of Data through the Pioneer F GSFC/CRT PHA Summarizer System

2. DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Many of the following terms have several meanings; however, only the definition pertinent to this report is given.

Absolute File Number -- A number assigned to each file of experiment data (consisting of data for an entire day) processed by the Pioneer F GSFC/CRT Data Reduction Program (PIODRP). Each file processed is assigned an absolute file number one larger than the previous file; therefore, each file is uniquely identified.

Album -- One complete sampling of the GSFC/CRT experiment data. An album consists of the following:

1 Album = 4 pages (each page represents a unique priority sequence)

1 Page = 2 snapshots (each snapshot represents 1/8 sample of Rates information)

1 Snapshot = 32 Frames (Format A)/64 Frames (Format B)

DRS Tape Catalog -- A data set which contains information about the PHA and Rates tapes created by PIODRP and the unused tapes currently available to the system (see section 5.2.2).

DRS Tape Catalog Pointer -- A data set which contains the character (1, 2, 3, or 4) indicating which of the four DRS Tape Catalogs is the most recent version (see section 5.2.1).

Merge Processing – The process of combining two or more summaries residing on standard PHA Summary tapes that were created by PPHASP during standard processing. Merge Processing will be performed by the Pioneer F GSFC/CRT PHA Merge Program.

Null Event -- A PHA event which contains zero amplitudes for all three detector readouts.

PHA Event – Information describing the passage of a particle through the detectors of the High Energy or Low Energy Telescope. Each event consists of three halfwords of information described in section 5.1.1.

PHA Summary Catalog – A data set which contains information about the PHA Summary tapes created by PPHASP, and the unused tapes currently available to the system. The Catalog is logically divided into 3 sections, one for each type (standard, special or merge) of PHA Summary tapes produced (see section 5.2.4).

PHA Summary Catalog Pointer -- A data set which contains the character (1, 2, 3 or 4) indicating which of the four PHA Summary Catalogs is the most recent version (see section 5.2.3).

PHA Summary Tapes – Tapes containing summaries of the PHA events from the GSFC/CRT experiment in time ascending order for the life of the Pioneer F satellite. There are three types of PHA Summary tapes; standard, special and merge. These tapes have identical formats and are created during standard processing, special processing and merge processing, respectively. (see section 5.1.2).

PHA Tapes - Tapes containing all the time ordered pulse height analysis information and correspond Rates information from the GSFC/CRT experiment (see section 5.1.1).

Rates Data - The total number of particles per second detected during an accumulation period for a particular PHA event type.

Relative Modified Julian Day (RMJD) - Date assigned to each day of data referenced from day 0 of launch year, 1972 (Modified Julian Day 41316).

Relative Modified Julian Day and Fraction of Day (RMJDF) - The RMJD plus the fraction of a day stored in floating point format.

Special Processing - The process of computing the frequencies of identical PHA events as a function of the priority for a summary interval, and generating special PHA Summary tapes consisting of summaries that are in time ascending order (according to the start time of the summary interval) with possible overlap of summaries between tapes. During special processing, summaries are not replaced by, inserted in, or added to existing special PHA Summary tapes. No overlap of summaries will exist within a special PHA Summary tape.

Standard Processing - The process of computing the frequencies of identical PHA events as a function of the priority for a summary interval, and generating standard PHA summary tapes consisting of

summaries that are in time ascending order (according to the start time of the summary interval) without overlap between summaries. During standard processing, summaries may be replaced by, inserted in, or added to existing standard PHA Summary tapes.

Summary - A block of data containing the frequencies of identical PHA events detected as a function of the priority for a specific interval of time. This interval of time is referred to as the summary interval.

Zero Event - A dummy PHA event whose 3 halfwords contain all zeroes. This type of event is used to indicate the last event of a group of events during processing.

2.2 Abbreviations

BPI	Bytes Per Inch
DASD	Direct Access Storage Device
GSFC/CRT	Goddard Space Flight Center/Cosmic Ray Telescope
HET	High Energy Telescope
LET	Low Energy Telescope
LSB	Least Significant Bit
MS	Milliseconds
MSB	Most Significant Bit
PHA	Pulse Height Analysis
RTLT	Round Trip Light Time

3. OBJECTIVES AND REQUIREMENTS

3.1 Objectives

The following objectives were included in the system design:

a. The primary objective of the system should be to generate PHA Summary tapes in a readily accessible format for subsequent analysis programs.

b. The three programs of the system should be modular and flexible in design for ease of documentation and modification. Modularity and flexibility is best obtained through the design of an executive routine.

The purpose of the executive routine is to invoke the modules which perform the major functions of the program and to maintain all areas common to and accessed by the dependent subroutines. The overall system logic is therefore incorporated into one small contiguous amount of code written in a universally understood compiler language (FORTRAN). Therefore anyone desiring to understand the program can get a good insight into the problem through the study of the executive.

All subroutines invoked by the executive, immediately return control to the executive after execution. A subroutine does not pass control to another subroutine except when it requires a service that is performed by a completely generalized and separately documented subroutine (e.g., IBM System/360 General I/O package prepared by Alan R. Thompson).

Therefore the subroutines are primarily dependent upon the executive and can be changed or deleted with little or no effect to the other subroutines.

c. To allow special processing (and perhaps standard processing) to be performed during the prime shift, the amount of main storage and execution time required should not exceed 300K and 5 minutes (for both CPU and I/O) respectively. All disk and tape I/O functions and data handling functions (e.g., sorting and summing) are coded in assembler language in an attempt to meet this objective. The amount of execution time required, however, is completely dependent on the summary interval used and the number of summaries produced during a PPHASP production run.

d. The operation of the program should be easy to learn and use by both programmers and non-computer oriented personnel, and manual intervention should be kept to a minimum to reduce the chance of a human error. To help meet these objectives, the data on the input cards will be in a simple but flexible format (using the FORTRAN NAMELIST facility) and a Catalog facility (mentioned earlier) will allow the system to be self-sustaining and eliminate much burden on the production personnel submitting the runs.

3.2 Operational Requirements

The system is designed to operate in an environment with the following hardware:

a. One IBM S/360 - 370 with 300K bytes or more of main storage available to the user.

b. Three IBM 9-track tape drives with the capability of writing at a density of 1600 bytes per inch.

c. Two IBM 2314 Direct Access Storage Devices.

d. One IBM card reader/punch

e. One IBM printer

The following data sets will be generated or referenced by the system:

a. PHA tapes

b. DRS Tape Catalog Pointer (1 track on an IBM 2314)

c. DRS Tape Catalog (2 tracks each on two IBM 2314's)

d. PHA Summary tapes

e. PHA Summary Catalog Pointer (1 track on an IBM 2314)

f. PHA Summary Catalog (2 tracks each on two IBM 2314's)

g. Temporary storage (400 tracks on an IBM 2314).

h. Printed reports

i. Parameter cards.

3.3 Functional Requirements

The following functions will be performed by the system:

a. Search the PHA Catalog for the proper tape based on the summary interval requested.

b. Read the PHA tapes.

c. Move attitude information from the PHA tape to the header record on the PHA Summary tape.

d. Summarize and gather statistics on the Rates data from the PHA tape.

e. Gather statistics on the PHA data.

f. Eliminate null events.

g. Sort and summarize the PHA data.

h. For standard production, assure that no summary interval overlaps with another and merge new summaries onto a tape containing previously processed summaries.

i. Produce summary and error message reports.

j. Provide an easy re-run capability via the PHA Summary Catalog facility.

k. Dynamically assign and record all PHA Summary tapes generated.

l. Generate a time-ordered data set for the summaries (both standard and special) and, via the Catalog facility, provide the capability for selective retrieval of the summaries.

4. PROGRAM DESCRIPTION

4.1 Executive Routine

The Pioneer F GSFC/CRT PHA Summarizer Program (PPHASP) will be used to process the PHA tapes and generate time-ordered PHA Summary tapes. Before this program can be submitted for the first production run, disk space must be allocated for the PHA Summary Catalog Pointer and PHA Summary Catalogs, and these data sets must be initialized.

A production run will begin with PPHASP reading from a card, general information that will indicate the options desired for the run. On the card the user will be able to specify

(a) the type of processing to be used (standard/special)

(b) the labels of the PHA tapes that contain the summary intervals to be processed. If not specified, the DRS Tape Catalog will be searched for the tapes.

(c) which PHA Summary Catalog is to be used for this production run. If not specified, the PHA Summary Catalog pointed to by the PHA Summary Catalog Pointer will be used.

(d) whether the current PHA Summary Catalog is to be printed in its entirety or only the updated section (standard/special).

After the option card has been read, the DRS Tape Catalog Pointer and then the DRS Tape Catalog will be read into main storage. The Pioneer Summary Catalog Input (PSCATI) routine will then be called to read into main storage the PHA Summary Catalog.

Following the option card, will be summary cards containing information describing the time interval(s) during which the PHA and corresponding Rates data are to be summarized. PPHASP will read one card to determine a summary interval and will check to see whether labels, of PHA tapes to be processed, were supplied as an option. If there were, the first tape will be mounted. Otherwise, the DRS Tape Catalog will be searched for the tape containing the data for the summary interval and that tape will be mounted.

After mounting of a PHA tape, records will be read. If the time of the data on the record is within the requested summary interval, the record will be processed. If the time of the data on the record is after the end time of the summary interval, the current summary will be ended.

Each record is logically divided into 5 pages for format B and 6 pages for format A. The begin and end time of the summary interval requested will be rounded off to the nearest page. Therefore, only some of the pages of the first and last record of a summary interval may be processed (i.e., the pages of the first and last record outside the summary interval will not be processed). Also, the attitude information of the first page and the time of the first and last page for a summary interval will be stored into the header record of a summary file.

Each record of the summary interval will be processed by the Pioneer Data Extract routine (PXTRCT). This routine will first summarize and gather

statistics on the Rates data for the record. The summed Rates data and statistics will be totaled into the header record in main storage for the current summary. The routine will then extract the non-null events and will place them in an array to latter be sorted. It will also gather statistics on the PHA data and compute totals in the header record for the current summary.

Records will be read and processed by PXTRCT until the sort array becomes full or no more records exist on the PHA tapes for this summary interval. If an end-of-tape is detected on a PHA tape while trying to read a record, another PHA tape containing data from the summary interval, will be mounted. If no succeeding PHA tape contains any data for the summary interval, an end-of-summary will be indicated to PXTRCT.

After the Sort array is full or the end-of-summary indicator is set, the Pioneer Sort routine (PSORT) will be called to sort the PHA events in descending numerical order according to various fields within the PHA data. Following the sort, the Pioneer Summarizer routine (PSUM) will be called to summarize the PHA events from the Sort array into a Sum array and to maintain a running total of the number of non-null events for the current summary as a function of the event type and the priority mode. Upon return from PSUM, PPHASP will call PMERG to merge the newly summarized events with any previously summarized events residing on a temporary disk data set. If after PSUM processing the sort array was not empty (i.e., the Sum array was not large enough to contain all the events summarized from the sort array) PSUM2 and MPERG2 will be called to complete processing of the events from the Sort array.

When the end-of- summary indicator is detected, the results on disk are summarized PHA events sorted in descending numerical order according to the fields within the data. If special processing was requested, the Pioneer Summary Catalog Add routine (PSCATA) will be called to write the header record (in main storage) and all data recrods (in the temporary disk data set) for the summary onto the next file of the mounted blank tape. If no tape is mounted, PSCATA will obtain the label of a blank tape from the PHA Summary Catalog and the tape will be mounted. After the summary is written onto the blank tape, PSCATA will add an entry to the special section of the PHA Summary Catalog for the summary just processed.

If an end-of-summary is indicated and standard processing was requested, then the standard section of the PHA Summary Catalog will be searched by the Pioneer Summary Catalog Search routine (PSCATS) to see if any overlap will be created by the addition of the new summary, or to see if any summaries can be totally replaced by the new summary. If overlap will exist, then an error message will be written and the production job terminated. If a standard PHA Summary tape containing one or more summaries can be totally replaced by the current summary, the standard PHA Summary tape will be copied onto a blank tape, eliminating the replaced summaries and inserting the new summary. If only insertion is required (i.e., no replacement is necessary), then the standard PHA Summary tape will be copied and the new summary inserted. If replacement or insertion is not necessary, the new summary will be added to an existing standard PHA Summary tape without copying.

PPHASP will use the Pioneer Summary Catalog Copy routine (PSCATC) to copy a summary from the standard PHA Summary tape to the blank tape

and the Pioneer Summary Catalog add routine (PSCATA) to write the current summary from the temporary disk data set to the blank tape. These two routines, besides copying data to the blank tape, will update the Catalog to reflect the summary written and will mount a new blank tape if the current one becomes full. In addition, PSCATC will delete all entries in the standard section of the Catalog that make reference to the standard PHA Summary tape that was copied.

After the current summary is processed, the PHA Summary Report will be printed and another card will be read to determine the time interval for the next summary. If the time interval overlaps with a previous time interval, an error message will be printed and another card will be read. If there are no more cards to read, then the production job will be terminated. Job termination includes the copying of all remaining summaries from a mounted standard PHA Summary tape (if one is mounted for input) to an output tape. The PHA Summary Catalog will be updated to reflect this copying and the Pioneer Summary Catalog Output routine (PSCATO) will be called to write the Catalog to disk, to update the Catalog Pointer, and to print the Current Status Report. This report will list the current Catalog or the updated section (standard or special) of the Catalog as specified by the user.

4.2 Subroutines

4.2.1 Pioneer Merge

The Pioneer Merge routine (PMERG) will be called to combine newly sorted PHA events with previously summarized events residing on the temporary disk data set.

At first entry to this routine for a summary, there will be no existing events on disk with which to merge. Thus the events in the Sum array need only be written onto the disk. After the first entry to this routine, merging will be required. Two temporary disk data sets will be utilized in a flip-floping manner. Summarized events will be read from one data set, while the merged summarized events are written onto the other. At the next entry, the roles of the disk data sets will be reversed.

PMERG will begin by first reading a record from the temporary disk data set. The first entry in the disk record (a disk event) and the first entry in the Sum array (a new event) will then be compared. If the disk event is of higher magnitude, it will be moved to the output area and the event in the next disk entry will receive the same consideration. If the new event is of higher magnitude, it will be moved to the output area and the next new event (the next entry in the Sum array) will then be compared to the disk event. If the new event and the disk event are of equal magnitude, the frequencies will be added together and the event (with the summed frequencies) will be moved to the output area.

When the output area becomes full, it will be written onto the disk. When the last entry of a disk record has been moved to the output area, another

record will be read. When the Sum array is empty, control will be returned to the executive routine via an alternate return. The alternate return will be a request for the remaining summarized events from the Sort array. When the new event and the disk event are of equal magnitude and are the zero event processing is complete and a normal return will be made to the executive routine.

PMERG2 is an entry point in PMERG which will be called if the Sum array was not large enough to contain all the events summarized from the Sort array (i.e., an alternate return was taken from PMERG). PSUM2 (an entry point within PSUM) and PMERG2 will therefore be called to complete the processing of the remaining events in the Sort array. Upon entry PMERG2 will continue to merge the remaining disk events with the events in the newly filled Sum array. Again, if the Sum array becomes empty before both the disk event and the new event equal the zero event, an alternate return will be made to the executive routine.

4.2.2 Pioneer Message

The Pioneer Message routine (PMESGE) will be called whenever an error or informative message is to be written. This routine will provide a standard format for all message written and will tag all messages with the time of day, the label of the PHA tape being processed, the number of the record being processed, and the sequence number of the summary interval being processed.

4.2.3 Pioneer Summary Catalog Facility

The Pioneer Summary Catalog Facility (PSCATF) will be used to perform

all the necessary input, output, and update operations on the PHA Summary Catalog. PSCATF will consist of six routines, each with a separate entry point in the facility.

The first entry point, PSCATI, will read in the Catalog from disk. It will first determine which version of the Catalog is to be read and then will read the Catalog into main storage.

The last entry point, PSACTO, will print the current Catalog (or a section of it), write the current Catalog in main storage onto the disk data set, and update the Catalog Pointer on disk to point to the new version of the Catalog.

Another entry point, PSCATD, will delete all entries in the PHA Summary Catalog that make reference to a particular PHA Summary tape. This routine will be used when a PHA Summary tape has been copied because of replaced or inserted summaries.

Entry points PSCATC and PSCATA will copy or add summaries to the PHA Summary data set. PSCATC will read the header record into main storage from the mounted input tape. If an end-of-tape is detected, the tape will be unloaded and an alternate return will be made to the executive routine. Otherwise control will be transferred to PSCATA.

PSCATA will check to see if enough space exists on the output tape for the new summary. If there is not enough space, the output tape will be unloaded and another blank tape will be mounted. The records will then be read from the input unit (specified in the calling sequence) and written onto the output unit. When all the records of the summary have been written, an entry will be added to the Catalog to reflect the status of the summary (i.e., the time

interval of the summary and the label of the tape which contains the summary). PSCATA will be used by PPHASP to copy summary records from an input tape to an output tape and from the temporary disk data set to an output tape.

Finally, PSCATS will search a section (i.e., standard or special) of the Catalog for the label of the PHA Summary tape that contains the first summary for the time interval specified in the calling sequence. The label of the tape, the sequence number of the entry in the Catalog that contains information for the first summary of the time interval, the sequence number of the entry in the Catalog that contains information for the last summary of the time interval, and the sequence number of the file on the tape that contains the first summary for the time interval, will be returned to the executive routine. If a tape label is passed in the calling sequence, then searching of the Catalog will be performed only for that tape. If the time interval specified is not on a PHA Summary tape, an alternate return will be made to the executive routine and the tape label and the file sequence number (returned in the calling sequence) will specify where a new summary for the time interval should be inserted.

4.2.4 Pioneer Sort

The Pioneer Sort routine (PSORT) will be written in the 360 Assembler Language and will perform a binary sort on the events stored in the SORT array. The last event in the array will be the zero event.

Initially, the low order bit of each event in the Sort array (filled by the PXTRCT routine) will be examined. If this bit is a Ø, the entry will be moved to the first available location at the bottom of the work array, otherwise to the first available location at the top of the work array. Let us refer to the

upper and lower portion of the work array as the 1-array and the Ø-array, respectively. Now the next low order bit for each entry will be examined, beginning at the top of the 1-array taking each entry in descending order, unitl the 1-array has been exhausetd; then, beginning at the bottom of the Ø-array taking each entry in ascending order. As before, if this bit is a Ø, the entry will be moved to the first available location at the bottom of the Sort array. The data will be moved back and forth between the Sort array and the work array until all bits have been examined.

After the last bit is examined and all data moved accordingly, the Ø-array will be inverted in the Sort array and the sort will be complete. Control will then be returned to the executive routine.

4.2.5 Pioneer Summarizer

The Pioneer Summarizer routine (PSUM) will examine the array of PHA events sorted by PSORT and will produce summary entries that contain the frequencies, in each of 4 priority modes, of events that have the same M through Q fields (refer to section 2.1 for a definition of a PHA event). PSUM will also keep a running total of the number of good PHA events (i.e., non-null events) for the current summary interval as a function of the event type and the priority mode. These totals will be stored in the header record of the summary file. PSUM will be written in the 360 Assembler Language.

Processing will begin with the moving of the the M through Q fields from the first event in the Sort array to halfword 1, 2, and 3, respectively, of an entry in the Sum array. Halfwords 4, 5, 6 and 7 will be set to zero. The priority mode indicator will then be extracted from the first event in the Sort array

and from each succeeding event with identical M through Q fields. The number of identical events with identical priority mode inidcators will be accumulated and (1) stored in halfwords 4, 5, 6 and 7 of the current entry in the Sum array, and (2) added to the individual priority totals for each of the event types for the current summary interval. The halfwords 4, 5, 6 and 7 of the Sum array will therefore contain the frequencies for the priority order 4, 3, 2 and 1, respectively.

PSUM will then extract the next unused event (i.e., the first event in the Sort array that was not used in the previous sum) and repeat the process. When the Sum array becomes full or the zero event is reached, control will be returned to the executive routine.

PSUM2 is an entry point in PSUM which will be called if PSUM returned to the executive, with a full Sum array, before the zero event was reached in the Sort array. It will be called, after the PMERG routine completes its processing, to continue the summing procedure by storing the next summarized event into the beginning of the Sum array. As in PSUM, when the Sum array becomes full or the zero event is reached, control will be returned to the executive routine.

4.2.6 Pioneer Data Extract

The Pioneer Data Extract routine (PXTRCT) will move the non-null PHA events from the PHA record to the Sort array and will sum all the Rates data according to the event type. Statistics will be gathered and stored, along with the summed Rates data, in the header record of the summary file.

Although PXTRCT will process one record per call, the basic unit used is a page. Each PHA record contains 6 pages in format A or A/D and 5 pages in format B or B/D. The executive routine will specify through the calling sequence, the pages that are to be processed from the current record for the summary interval. Normally, all pages of a record will be processed except when the record is the first or last record of a summary interval. In this case, processing will begin and end with the closest page within the limits of the summary interval.

Upon entry, PXTRCT will extract all of the Rates data for a page and accumulate, as a function of the event type, the number of events that occurred and the total time that the Rates data was accumulated for during the summary interval. These totals will be stored in the header record of the summary file.

The PHA data for a page will then be extracted, one event at a time; and if it is not a padded or null event, the data will be moved to the Sort array. The total number of PHA readouts that resulted in null events as a function of the priority mode and the total time that the PHA events (both good and null events) were accumulated for during the summary interval, will also be stored in the header record of the summary file.

When all pages of a record are processed, control is returned to the executive routine. When the Sort array becomes full or an end-of-summary is indicated, an alternate return will be taken. Upon return, the entry after the last PHA event in the sort array will contain all zeroes. This will be the zero event and will signify the logical end of the sort array.

5. INPUT AND OUTPUT FORMATS

5.1 Tapes

5.1.1 PHA Tapes

The PHA tapes will be 9-track 1600 BPI tapes which contain the time-ordered Pioneer GSFC/CRT Pulse Height Analysis (PHA) data, corresponding events per second (Rates) data and related spacecraft information. Each logical record will contain selected spacecraft information and all the PHA data and associated Rates data for one or more pages (each page represents a fourth of an experiment cycle). Each PHA event for the HET and LET will require 3 halfwords (48 bits) and these bits will be organized in the 3 halfwords for the HET and LET events as follows:

	0(MSB) 15(LSB)
Halfword 1	METTAAAAAAAAAAAA
Halfword 2	BBBBBBBBBBBBCCCC
Halfword 3	CCCCCCCCRSSSQPPN

where: M = 0 Good data

= 1 Missing/padded data

E = 0 LET event

= 1 HET event

TT =00 $A_1\overline{A}_2$ BCIII (HET) / DIDIII$\overline{F}$ (LET)

=01 A_2BIII (HET) / DIDII$\overline{DF}$ (LET)

=10 $(A_2K_1+A_1CI)B\overline{CIII}$ (HET)

=11 $A_1BK_2\overline{CIII}$ (HET)

A, B, C = Amplitudes from detectors A, B, and C respectively

R = 0 CII threshold not exceeded)
= 1 CII threshold is exceeded)HET only
)

SSS = 0-7 Sectors 1-8 respectively

Q = 0 Priority indicators valid
= 1 Priority indicators questionable

PP = 0-3 Priorities 1-4 (HET) / 1-2 (LET)

N = 0 Good event
= 1 Null event

5.2.2 Logical Record Format

Word	Contents
1	Time of day (MS) for first PHA event which is comprised of an HET and LET event.
2	Halfword 1 – Day of data (RMJD) Halfword 2 – Absolute File Number
3	Halfword 1 – Number of pages (1/4 experiment cycle) included in record (maximum of 6 for Format A and 5 for Format B) Halfword 2 – Bit rate (1-16, 2-32, 3-64, 4-128, 5-256, 6-512, 7-1024, 8-2048)
4	Halfword 1 – Format (1-A, 2-A/D, 3-B, 4-B/D) Halfword 2 – Mode (0 or 1 - real time, 2 or 3-memory readout, 4 or 5- telemetry store)
5	Halfword 1 – Time correction flag (0 - no correction, 7 - suspect time or corrected time) Halfword 2 – DSS identification

Word	Contents
6	Halfword 1 – RAT flag (Roll attitude timer) Halfword 2 – ASPNPDC flag (Spin period) where: 0 – good value 1 – old value 2 – missing value 3 – corrected value
7	Halfword 1 – SPF flag (Spin period flag) Halfword 2 – HRIPPHEC flag (Roll pulse/Roll-index pulse phase error) (same description as Word 6)
8	Roll attitude timer (RAT)
9	Spin period (ASPNPDC)
10	Roll pulse/Roll - index pulse phase error (ARIPPHEC)
11	Halfword 1 – Spin period flag (SPF) in low order three bits. where: low order bit = 0 - Spin period sector generator (SPSG) roll reference = 0^{o} = 1 - SPSG roll reference = 180^{o} bits 2 and 3 = 00 - Non-spin averaging mode = 01 - ACS mode = 10 - Spin averaging mode Halfword 2 – Extended frame counter (ESC Subcom ID)
12	Roll attitude time (MS of RAT)
13	DC Bus Voltage
14	DC Bus Current
15	Spacecraft Platform Temperature
16	Signal to noise ratio (SNR)
17	Spare

Word	Contents

18 → N1 One or more sets of Subcom data. Each set appears in four consecutive words as follows:

	0(MSB)		31(LSB)
(1)	E-1,24		E-1,25
(2)	E-1,26		E-1,27
(3)	E-1,28		E-1,29
(4)	UUU		SSS

where:

E1-24 - Bilevel

E1-25 - Elect. Temp.

E1-26 - Housekeeping

E1-27 - Calibration Voltage

E1-28 - Detector Temperature

E1-29 - Ses. Voltage

UUU - Unsectored rate sequence I. D.

SSS - Sectored rate sequence I. D.

Padded data is indicated by a negative one (-1) for a particular S/C word.

N1 = 17 + (4* NSF)*NPR

where:

NSF = Number of sets of Subcom data per page based on Format (1-Format A, 2-Format B)

NPR = Number of pages contained in record (see Word 3, Halfword 1).

Word	Contents
N1+1 → N2	One or more sets of RATES data. Each set appears in seven consecutive words as follows:

(1) HET Rate $(A_2 K_1 + A_1 CI)$ B $\overline{CIII}$

(1) HET Rate $(A_2 K_1 + A_1 CI)$ B $\overline{CIII}$

(2) HET Rate $A_1 \overline{A}_2$ B CIII

(3) HET Rate A_2 B CIII

(4) HET Rate A_1 BK_2 $\overline{CIII}$

(5) LET Rate DI DII $\overline{F}$

(6) LET Rate DI DII $\leq$ $\overline{DF}$

Padded data is indicated with a negative one (-1).

N2 = N1 + 7* NPR

where:

NPR = Number of pages contained in record

(see Word 3, Halfword 1)

N2+1 → N3 All the PHA data associated with each page (1/4 experiment cycle) contained in record. Each PHA entry, comprised of a HET and LET event, has a unique time associated with it and appears in three consecutive words as follows:

	0 (MSB)	31 (LSB)
(1)	HET - 1	HET - 2
(2)	HET - 3	LET - 1
(3)	LET - 2	LET - 3

Padded data is indicated by a negative first halfword for an HET or LET event.

N3 = NZ + (3*NEF)* NPR

where:

NEF = Number of PHA entries, comprised of an HET and LET events, per page based on Format (16 - Format A, 8 - Format B)

NPR = Number of pages contained in record (see Word 3, Halfword 1)

5.1.2 PHA Summary Tapes

5.1.2.1 Description

The PHA Summary tapes will be multiple file, 9-track tapes written at a density of 1600 B.P.I. Each tape will contain summaries in time order according to the start time of the summarized data. Each file will contain one summary of data and will consist of a header record followed by one or more data records. Each file of data will be followed by a file mark and the last file on a tape will be followed by an additional file mark (i.e., 2 file marks). All records will have a fixed length of 7280 bytes.

The first record (header record) of each file will contain the start and stop times, spacecraft state parameters, summarized Rates data and other general information pertaining to the time interval associated with the data being summarized in the file.

The data records will follow the header record and will contain 520 entries. Each entry will be 7 halfwords in length (14 bytes). The first three halfwords will contain a PHA event with unique fields M through Q, (refer to section 5.1.1). The last four halfwords will contain the number of PHA events (with the above unique fields) that were recorded within the time interval specified in the header record. All entries within a summary will be sorted in descending numerical order according to the fields in the first 3 halfwords.

5.1.2.2 Header Record Format

Word	Content	
1	Milliseconds of day	)
2	Halfword 1 - Day (RMJD)	)Start time of first page of summary interval
	Halfword 2 - Day (RMJD)	)
3	Milliseconds of day	)End time of last page of summary interval
4	Number of records in file (including header record)	
5-10	The total time (in milliseconds) that the Rates data was accumulated as a function of the event type. The totals will be stored in the following order:	

$A_1 BK_2 \overline{CIII}$

$(A_2 K_1 + A_1 CI)\ B\ \overline{CIII}$

$A_2 B C III$

$A_1 \overline{A}_2 BCIII$

DIDII $\leq$D $\overline{F}$

DI DII $\overline{F}$

Word	Content
11-16	The total of the Rates data (i.e., the number of events that occurred) as a function of the event type. The totals will be stored in the same order as in words 5-10.
17	The total time (in milliseconds) that PHA events (includes both null and non-null events) were accumulated.
18-21	The total number of null events as a function of the priority mode. The totals will be stored in descending order according to their priority (i.e., the total for priority 4 will be stored in word 18, for priority 3 in word 19, etc.).
22-45	The total number of PHA events (non-null events) as a function of the event type and the priority mode. The totals will be stored first according to the event type (in the same order as in words 5-10) and then in descending order according to the priority. For example words 22-27 will contain totals for priority 4 for each of the event types and in the order shown, and words 28-33 will contain totals for priority 3 for each of the event types as shown, etc.
46	Halfword 1 – Roll attitude time (RAT) flag Halfword 2 – Spin period (ASPNPDC) flag where: 0 - good value 1 - old value 2 - missing value 3 - corrected value

Word		Content
47	X	Halfword 1 - Spin period flag (SPF) flag
	X	Halfword 2 - Roll pulse/Roll - index pulse

where:

0 - good value

1 - old value

2 - missing value

3 - corrected value

48	X	Roll attitude timer (RAT)
49	X	Spin period (ASPNPDC)
50	X	Roll pulse/roll-index pulse error (ARIPPHEC)
51	X	Spin period flag (SPF) in low order three bits

where:

low order bit = 0 – Spin period sector generator (SPSG) roll reference = 0°

= 1 – DPSG roll reference = 180°

bits 2 and 3 = 00 – Non-spin averaging mode

= 01 – ACS mode

= 10 – Spin averaging mode.

52	Roll attitude time (in milliseconds) of the RAT
53-1820	Spares

5.1.2.3 Data Record Format

Each data record will consist of 520 entries with 7 halfwords per entry. Below is the format of the 7 halfwords.

Halfwords	Content
	0 (MSB) 15 (LSB)
1	METTAAAAAAAAAAAA

where: M = 0 Good data

= 1 Missing/padded data

E = 0 LET event

= 1 HET event

TT = 00 $A_1 \bar{A}_2$ B CIII (HET)/DI DII $\bar{F}$ (LET)

= 01 A_2 B CIII (HET)/DI DII $\bar{D}F$ (LET)

= 10 $(A_2 K_1 + A_1 CI)$ B $\overline{CIII}$ (HET)

= 11 $A_1 BK_2$ $\overline{CIII}$ (HET)

A = Amplitude from detector A

	0 (MSB) 15 (LSB)
2	BBBBBBBBBBBBCCCC

where: B = Amplitude from detector B

C = Four most significant bits of the amplitude from detector C

	0 (MSB) 15 (LSB)
3	CCCCCCCCRSSSQ000

where: C = Eight least significant bits of the amplitude from detector C.

R = 0 CII threshold not exceeded)
)HET only
= 1 CII threshold is exceeded)

SSS = 0-7 Sectors 1-8 respectively

Halfword	Content
4	Frequency during priority mode 4
5	Frequency during priority mode 3
6	Frequency during priority mode 2
7	Frequency during priority mode 1

5.2 Disk Data Sets

5.2.1 DRS Tape Catalog Pointer

5.2.1.1 Description

The DRS Tape Catalog Pointer will be a permanent disk data set (1 track on a 2314 DASD) which contains the character (1, 2, 3, or 4) as the first byte of an 80 byte record. This data set will indicate which of the four DRS Tape Catalogs is the latest version (see section 5.2.2) and will be updated each time a new version of the DRS Tape Catalog is created.

5.2.2 DRS Tape Catalog

5.2.2.1 Description

The DRS Tape Catalog is a permanent disk data set (1 track on a 2314 DASD) which provides pertinent information about the PHA, Rates and CATALOG tapes previously created and the blank tapes currently available to the PIODRS. This provides the system with the capability to locate data previously processed and dynamically assign all new PHA and Rates tapes. The four latest versions of the DRS Tape Catalog are maintained on the disk to facilitate the continual updating of the

Catalog and to provide a rerun/recover capability. The latest version of the DRS Tape Catalog will be indicated by the DRS Tape Catalog Pointer.

The DRS Tape Catalog will contain the following information:

Displacement	Variable	Type	Description
0	IDSAT	I*4	Pioneer identification (F/G)
4	HPHATP	I*2	Total number of PHA tapes
6	HRATTP	I*2	Total number of Rates tapes
8	DPHATP(100)	R*8	PHA tape labels
808	MSPHAS(100)	I*4	PHA tape start time (MS)
1208	MSPHAE(100)	I*4	PHA tape end time (MS)
1608	HDPHAS(100)	I*2	PHA tape start date (RMJD)
1808	HDPHAE(100)	I*2	PHA tape end date (RMJD)
2008	HPHAFT(100)	I*2	Amount of space (feet)used on PHA tape
2208	DRATTP(100)	R*8	Rates tape labels
3008	MSRATS(100)	I*4	Rates tape start time (MS)
3408	MSRATE(100)	I*4	Rates tape end time (MS)
3808	HDRATS(100)	I*2	Rates tape start data (RMJD)
4008	HDRATE(100)	I*2	Rates tape end data (RMJD)
4208	HRATFT(100)	I*2	Amount of space (feet) used on Rates tape
4408	DBLNKP (50)	R*P	Labels of blank tapes for use as PHA tapes
4808	DBLNKR (50)	R*8	Labels of blank tapes for use as Rates tapes
5208	DCATLG (2, 2)	R*8	CATALOG tape labels DCATLG (I, J): I = 1 - Logistics/Attitude catalog tape label

I = 2 - Command catalog tape label

J = 1 - Primary tape

J = 2 - Backup tape

5240	HPHABK	I*2	Number of blank PHA tapes
5242	HRATBK	I*2	Number of blank Rates tapes
5244	LSTAFN	I*4	Last Absolute File Number assigned to data
5248	LSTLOG	I*4	Last track number used for Logistics /attitude catalog

5.2.3 PHA Summary Catalog Pointer

5.2.3.1 Description

The PHA Summary Catalog will be a permanent disk data set (1 track on a 2314 DASD) which will contain the character (1, 2, 3, or 4) as the first byte of an 80 byte record. This data set will indicate which of the four PHA Summary Catalogs is the latest version (see section 5.2.4) and is updated each time a new version of the PHA Summary Catalog is created.

5.2.4. PHA Summary Catalog

5.2.4.1 Description

The PHA Summary Catalog will be a permanent data set (1 track on a 2314 DASD) which will provide the system with pertinent information about the PHA Summary tapes created and the unused tapes available to the system. The Catalog facility will provide the system with the capability to locate data previously processed and dynamically assign all

new PHA Summary tapes. The four latest versions of the PHA Summary Catalog will be maintained on the disk to facilitate the continual updating of the Catalog and to provide a rerun/recover capability. The latest version of the Catalog will be indicated by the PHA Summary Catalog Pointer (see section 5.23)

The Catalog will consist of a tape array, a file array and some Catalog descriptors. The tape array will contain 160 entries; each entry will be 6 bytes in length. An entry in the tape array (i.e., a tape entry) will contain the label of a tape (in a packed format) and the number of records written onto each tape. The first halfword of the packed label will contain the first two alphabetic characters of the tape label and the second halfword will contain the last four numerical characters in binary format.

Is the last(sign) byte left off in the "packed" format. It is not necessary.

The tape array will consist of two section; the PHA Summary tape section and the unused tape section. The PHA Summary tape section will contain an entry for each PHA Summary tape produced and the entries will be ordered from the top of the tape array to the bottom according to the time of creation. When a PHA Summary tape is copied, the corresponding entry in the tape array will be deleted and all subsequent entries (within the PHA Summary tape section) will be moved up in the tape array.

The unused tape section of the tape array will contain an entry for all unused tapes available to the system. These entries will always be added to or deleted from the top of the unused tape section of the tape array.

The file array will consist of 700 entries; each entry will be 9 bytes in length. An entry will contain the begin and end times (in RMJDF) of each summary produced and a pointer to an entry in the tape array. This pointer will identify the tape to which the file belongs.

The file array will consist of three sections; the standard section, the special section, and the merge section. Entries within each section will be ordered according to the begin time of the summary.

The Catalog will contain the following descriptors:

a) The Pioneer identification (F/G)

b) The number of PHA Summary tape entries

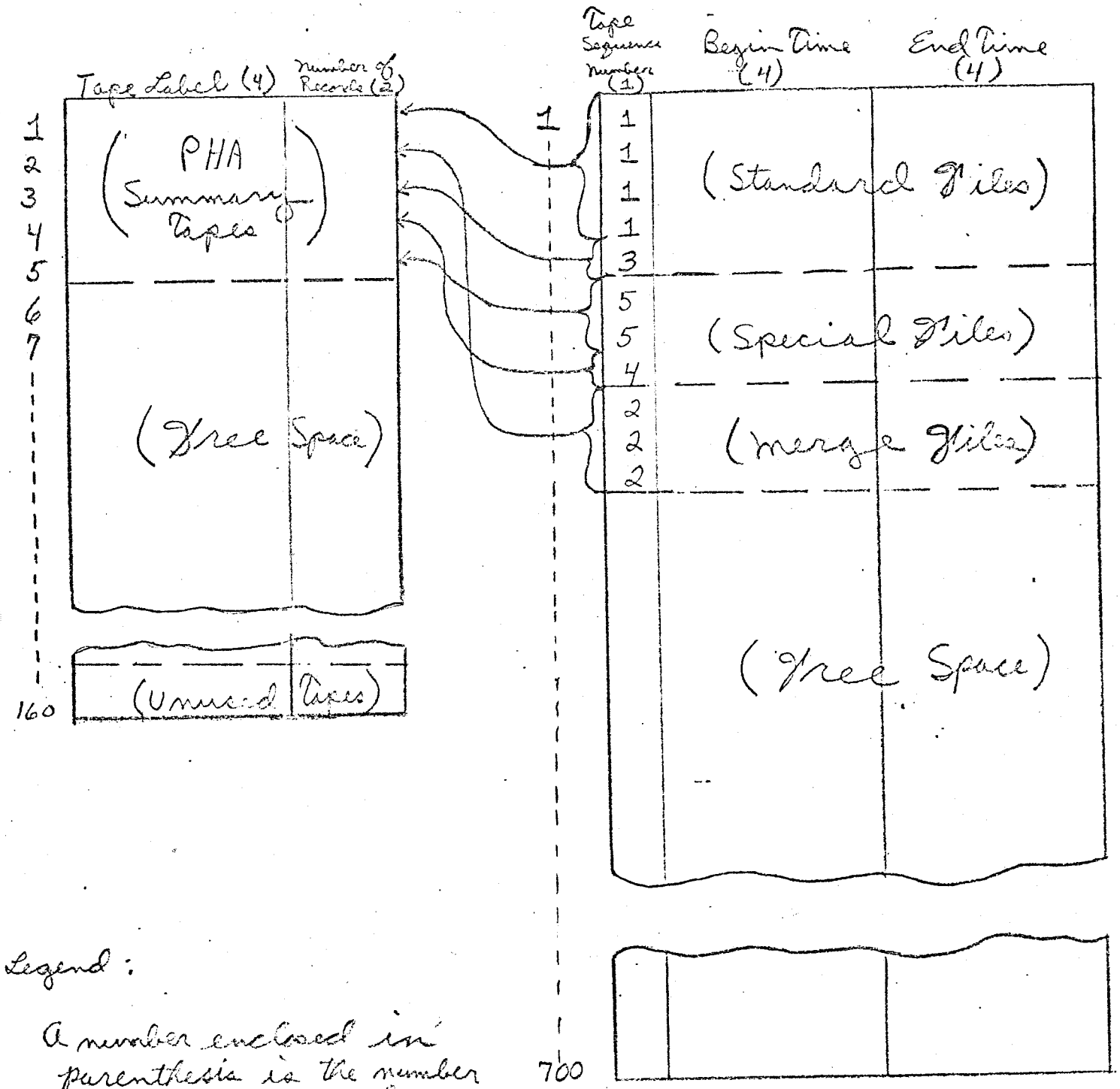
c) The number of unused (blank) tape entries

d) The number of standard file entries

e) The number of special file entries

f) The number of merge file entries

Figure 2. below contains diagrams of the tape and file array.



Legend:

A number enclosed in parenthesis is the number of bytes for the field

Figure 2. Diagram of the PHA Summary Catalog

5.2.4.2 Catalog Format

Displacement--	Variable	Type	Description
0	TLABEL(160)	R*4	PHA Summary tape label (packed format)
640	HNOREC(160)	I*2	Number of records on the PHA Summary tape.
960	QTSEQN(700)	L*1	Sequence number of the tape entry to which the file belongs
1660	BRMJDF(700)	R*4	Begin time of the summary (RMJDF).
4460	ERMJDF(700)	R*4	End time of the summary (RMJDF).
7260	HIDSAT	I*2	Pioneer identification character (F/G)
7262	HNSUMT	I*2	Number of PHA Summary tape entries
7264	HNBLKT	I*2	Number of unused tape entries
7266	HNSTDT	I*2	Number of standard tape entries
7268	HNSPCT	I*2	Number of special tape entries
7270	HNMRG	I*2	Number of merge tape entries

5.2.5 Temporary Data Sets

5.2.5.1 Description

Two temporary data sets will be utilized by PMERG and PMERG2 routines during the merging procedure. These data sets will reside on 20 cylinders of a 2314 direct access storage device and will be in the same format as the data records on the PHA Summary tape. Each track of the disk data set will contain one data record. (see section 5.1.2.3).

5.3 Cards

5.3.1 Parameter Cards

Parameter Cards will be used to specify processing options and the time interval(s) of the data to be processed. Consequently, there will be two types of parameter cards. The first type will be an option card and will allow the user to specify:

(a) whether special processing is to be used for this protection run.

(b) the labels of the PHA tapes to be processed (in which case the DRS Tape Catalog will not be searched.)

(c) which PHA Summary Catalog is to be used for dynamically allocating and recording the PHA Summary tapes.

(d) whether the current PHA Summary Catalog is to be printed in its entirety.

The default for these options will be to:

(a) use standard processing,

(b) search the DRS Tape Catalog for the PHA tapes containing the data for the summary interval(s) requested,

(c) use the current PHA Summary Catalog, pointed to by the PHA Summary Catalog Pointer, to dynamically allocate and record the PHA Summary tapes produced, and

(d) print only the updated section of the PHA Summary Catalog.

The second type will be a summary card and will allow the user to specify the time interval(s) during which the PHA and corresponding Rates data are to be summarized. On each summary card the user will be able to specify:

(a) the begin and end time of the desired summary interval, or

(b) the begin time of the first summary interval, the amount of time for each summary interval, and the number of contiguous summary intervals desired.

The times used to describe the summary interval(s) will be in terms of year, day, hour and minutes.

For each production run, the user will be required to provide one option card, followed by one or more summary cards. The parameter cards will be read using the NAMELIST convention of FORTRAN IV.

5.4 Printouts and Reports

PPHASP will produce three types of reports; a Message Report, a PHA Summary Report, and a Current Status Report. Each page of a report will contain the following standard header information:

(a) Name of the spacecraft and experiment – PIONEER F GSFC/CRT

(b) Name of program producing the report – PPHASP

(c) Type of report – PROCESSING MESSAGES, PHA SUMMARY or CURRENT STATUS

(d) Date of run – mmddyy

(e) Page number - nnn

5.4.1 Processing Messages Report

The Processing Messages Report will provide a history of all PHA tapes and records processed and the errors (abnormal conditions) encountered during processing. Each message produced will be in a

standard format (reading left to right) as follows:

(a) Time the message was generated – hhmmss

(b) Label of the PHA tape being processed – llllll

(c) Sequence number of the record being processed on the PHA tape – rrrrr

(d) Sequence number of the summary interval being processed – sss

(e) Message content

The Processing Messages will provide at least the following information. Those underlined will cause termination of the production run.

(a) Indication of errors detected on parameter cards (e.g., when a summary interval is requested having a begin time that is prior to or overlaps with a summary interval that was processed earlier in the production run.

(b) Indication of time backups on a PHA tape.

(c) Indication of overlap of summaries during standard production.

(d) Indication of I/O errors during processing. Records in error will be skipped.

(e) Indication of interval program errors (abnormal condition).

(f) The begin and end time of each requested summary interval.

(g) Indication when a production run is completed successfully.

5.4.2 PHA Summary Report

The PHA Summary Report will consist of a group of statistics for each summary interval processed. Each group will be separated from the other groups and will provide at least the following information about the summary interval.

(a) The actual begin and end time of the summary interval.

(b) The number of Rates readouts as a function of the event type.

(c) The number of events that occurred per second as a function of the event type.

(d) The possible error in events/second described in (c) above. This will be printed as a function of the event type where:

$$\text{error} = \pm \frac{\text{events/second}}{\sqrt{\text{number of events}}}$$

(e) The number of Pages processed.

(f) The number of Summary records written

(g) The percentage of time that the PHA events were accumulated (both good and null events).

(h) The percentage of time that the PHA events resulted in null events.

5.4.3 Current Status Report

A Current Status Report will be printed at the end of each production run to provide the current status of all tapes maintained in the PHA Summary Catalog. This report will provide the following information:

(a) The Satellite identification (PIONEER F)

(b) The number of PHA Summary tapes.

(c) The number of unused (blank) tapes available to the system.

(d) The number of standard summaries.

(e) The number of special summaries

(f) The number of merge summaries

(g) A list of all the unused tapes

(h) A list of all the PHA Summary tapes copied and created during the current run.

(i) A list of all entries in the PHA Summary Catalog or of only the updated section (standard/special). Refer to section 5.2.4)

(j) The current value of the Catalog Pointer indicating which PHA Summary Catalog is the most recent.

Notes on Pioneer edr formats
+ telemetry Keep

3. GSFC/CRT Tape Format

a. File 1 (See Figure 5-9.) - File 1 contains the logistics information. It consists of one physical record of 480 EBCDIC characters blocked into four logical records of 120 characters. The format is as follows:

Characters	Content
1 - 14	PIONEER F EDR
15 - 16	Number of acquisitions
17 - 30	ACQUISITIONS
31 - 39	GSFC/CRT
40 - 46	S/C ID
47 - 48	Spacecraft number
49 - 59	GENERATED
60 - 67	mm/dd/yy
68 - 80	REGENERATED
81 - 88	mm/dd/yy if blank not regenerated
89 - 96	ddd/yy day of data year of data ?
97 - 105	DSIF NO.
106 - 120	List of DSS that tracked during the EDR time period. The list will be the BCD conversions of the station codes shown in Figure 5-50. The entries will consist of two characters and will be separated by commas. 5 stations ?
121 - 134	TLM BIT RATES
135 - 240	List of all the bit rates encountered on this EDR tape. The entries consist of four characters and will be separated by commas.
241 - 252	TLM FORMATS

Characters	Content
253 - 360	List of all formats contained on this EDR tape. The entries consist of five alpha characters and will be separated by commas.
361 - 366	MODES
367 - 380	List of the modes encountered on this EDR tape. The entries consist of three alpha characters and will be separated by commas.
381 - 391	START TIME
392 - 396	hh/mm
397 - 407	STOP TIME
408 - 412	hh/mm
413 - 431	TAPE SEQUENCE NO.
432 - 433	Tape sequence number
434 - 480	Blanks

b. File 2 (See Figure 5-10) - File 2 is the command file. Each physical record consists of ten logical records. A logical record has the following format. The first eight characters of logical record one will indicate the total number of commands in File 2. The first eight characters of the remaining logical records will contain blanks. Characters 9-30 make up the first command, characters 31-52 make up the second command, characters 53-74 make up the third command, characters 75-96 make up the fourth command, characters 97-118 make up the fifth command, and characters 119-120 are blank. Thus, each logical record contains 120 characters and each physical record will contain 1200 characters (ten logical records). The format of each command is as follows:

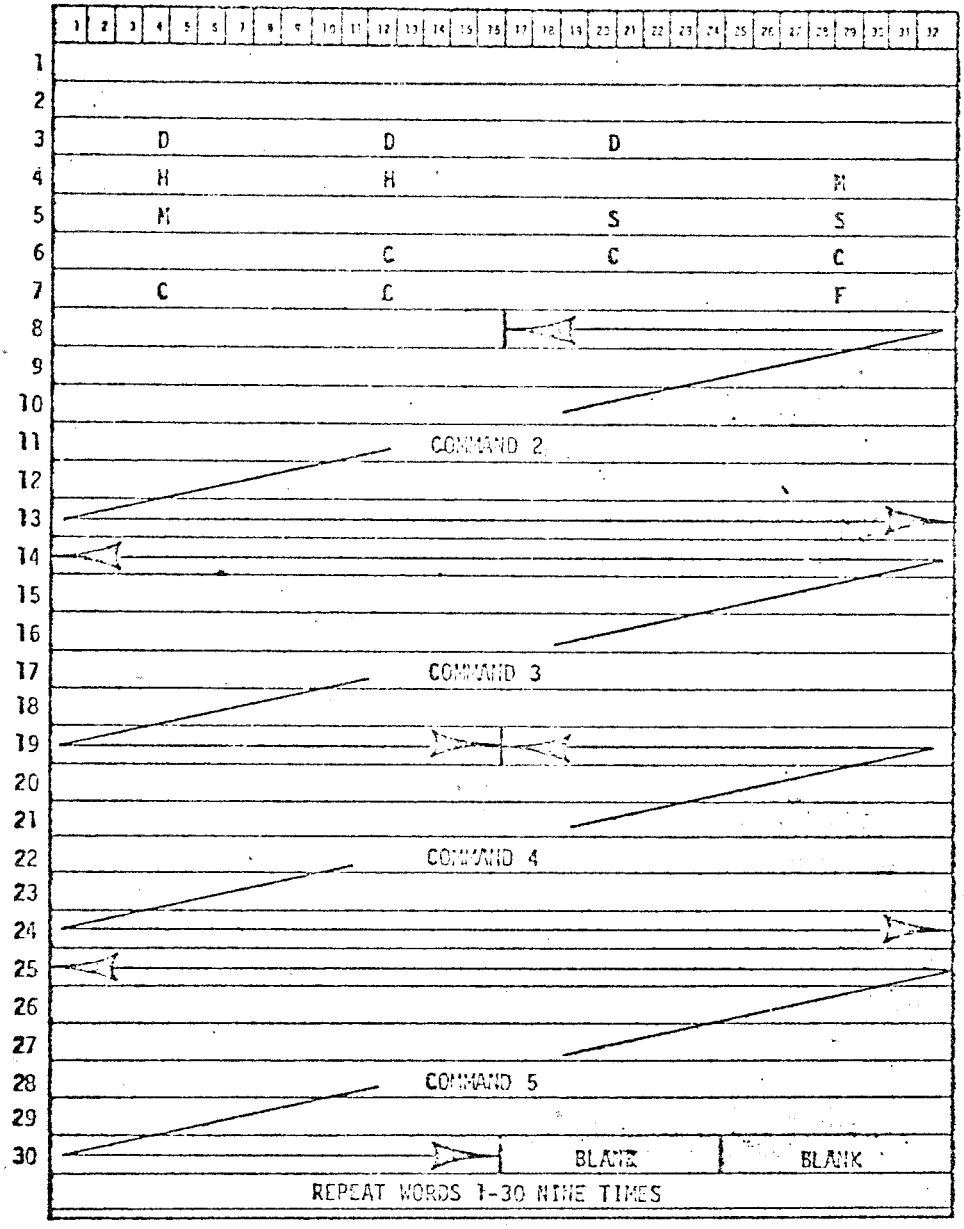
Character

```
1   5  8  11 14    20 22
↓   ↓  ↓  ↓  ↓     ↓  ↓
DDD HH MM SS CCCCC F
```

T.B.S.

Reference Text

FIGURE 5-9 GSFC/CRT FILE 1



GSFC/CRT FILE 2 COMMAND
TYPE - EBCDIC
LOGICAL RECORD LENGTH - 120 CHARACTERS
PHYSICAL RECORD LENGTH - 1200 CHARACTERS
FILE LENGTH - VARIABLE

Figure 5-10. GSFC/CRT File 2

where: DDD - Day of year of command verification.

HH MM SS - EVT*

CCCCC - Command mnemonic

F - V = Command verified
N = Command not verified
C = Command unverifiable

* NOTE: Time is the actual or expected verification time calculated as follows:

EVT (Multiple Commands) - Time of transmission of the 22nd bit of execute command + RTLT + Delay Time.

EVT (Single Commands) - Time of transmission of the 22nd bit of execute command + RTLT.

EVT (Verified Command) - Actual verification time.

It should be noted that ACS and CDU commands cause multiple entries to be created. The ACS commands consist of four entries. The time and flag (F) of all but the first command entry will contain blanks. The CDU commands consist of three entries. The time will contain blanks for all but the first entry and the flag for the third entry will be blank.

c. File 3 (See Figure 5-11.) - File 3 is in binary and contains S/C Attitude Data from the past 31 days. There is a six-word entry from each day. The last entry is the most current Attitude Data. Missing entries will be filled with zeros.

(1) Word 1 (Day - GMT) - Elapsed days since start of year.

(2) Word 2 (Hr-Min-Sec - GMT) - Elapsed milliseconds since start of day for time of first data word in record.

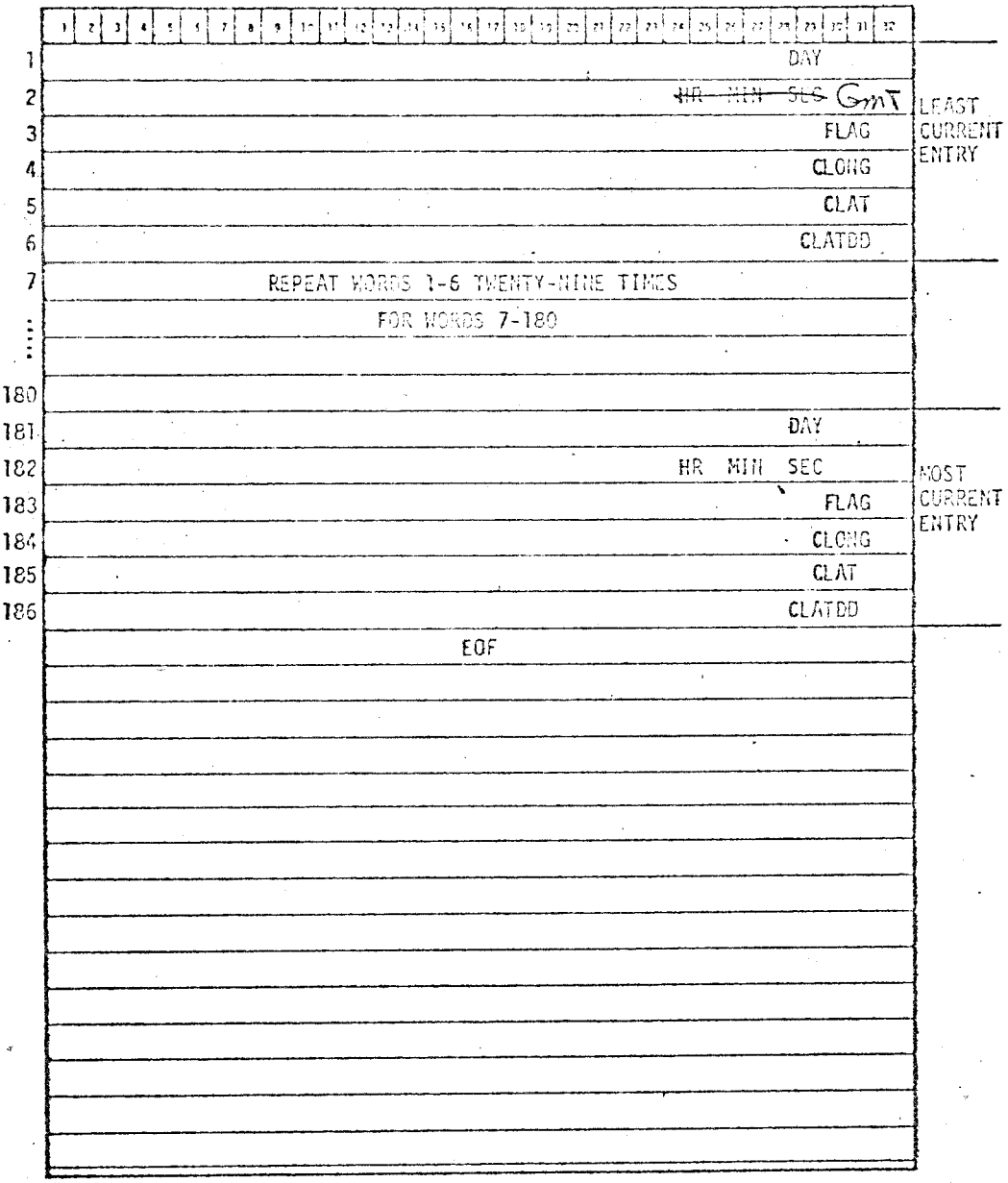
(3) Word 3 (Flag) - The flag interpretation is as follows:

00 = Special Refinement (±0.1 degree accuracy)

01 = High-Gain Antenna (±0.3 degree accuracy)

10 = Medium-Gain Antenna (±1.3 degree accuracy)

11 = Dynamic Position for Delta V Maneuver (±3.0 degree accuracy)



GSFC/CRT FILE 3 ATTITUDE DATA
TYPE - BINARY
LOGICAL RECORD LENGTH - 6 WORDS
PHYSICAL RECORD LENGTH - 186 WORDS
FILE SIZE - 1 PHYSICAL RECORD

Figure 5-11. GSFC/CRT File 3

(4) Word 4 (CLONG - Celestial Longitude) - Floating point form as used on customer's computer.

(5) Word 5 (CLAT - Celestial Latitude) - Floating point form as used on customer's computer.

(6) Word 6 (CLATBD - Celestial Latitude Drift/Day) - Floating point form as used on customer's computer.

d. File 4 (See Figure 5-12.) - All words are right justified and binary unless otherwise stated.

(1) Word 1 (GMT) - Time in elapsed milliseconds from start of day for time of the first data word in the record.

(2) Word 2 (Day of Year) - Self explanatory.

(3) Word 3 (TCF) - Time correction flag. The following codes are in binary: 0 = no correction, 111 = suspect time or corrected time.

(4) Word 4 - Spare.

(5) Word 5 (SNR) - (Signal + Noise)/Noise in floating point form as used on customer's computer.

(6) Word 6 (DSS) - Deep space station which was tracking. See Figure 5-50.

(7) Word 7 (Bit Rate) - Bit rate at which data record was taken. See Figure 5-51.

(8) Word 8 (MOD-FMT) - Mode and Format are two data values, three bits and five bits respectively, packed to form, eight bits right justified of Word 8.

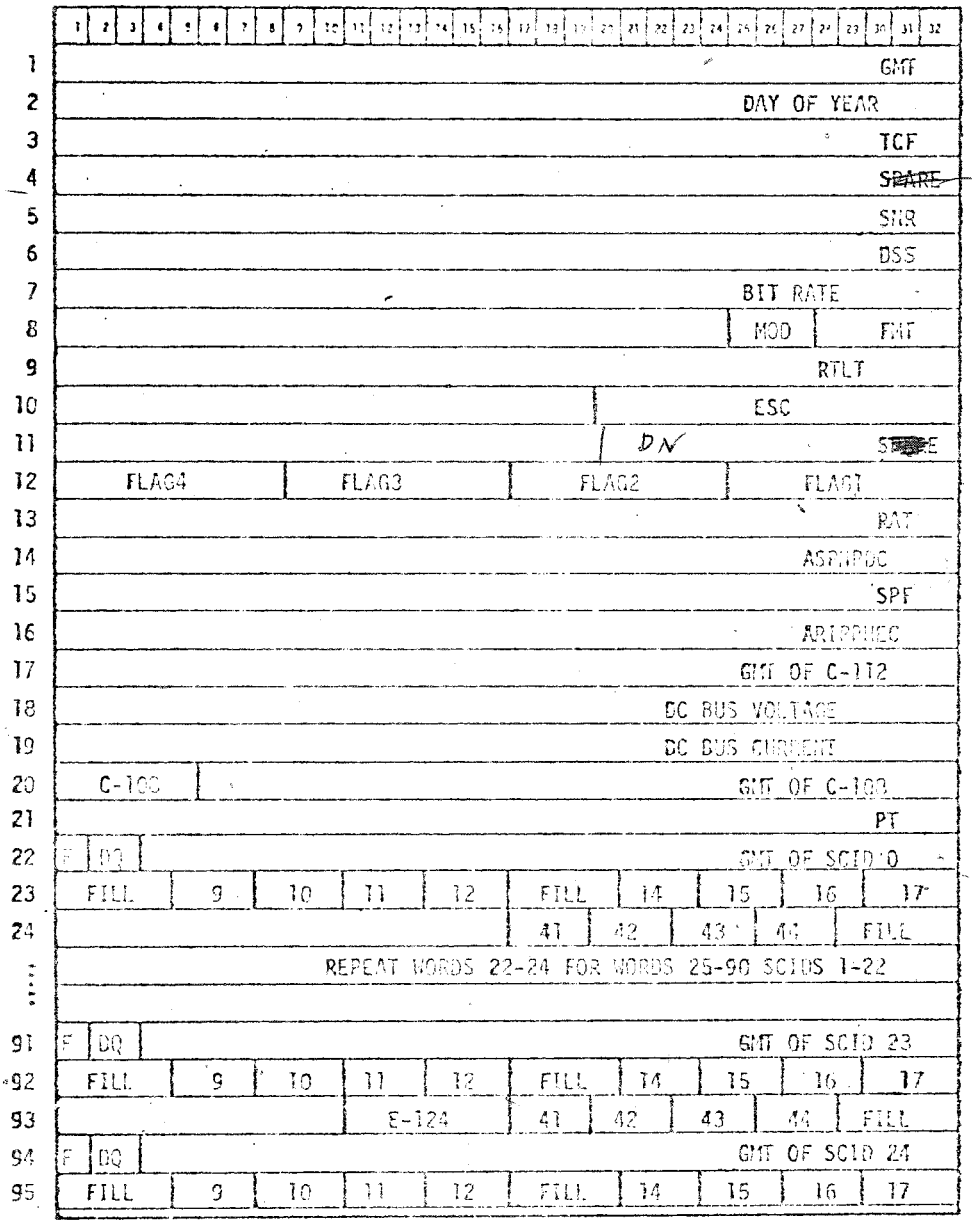
Mode: The following codes are in binary: 000 or 001 = real time; 100 or 101 = telemetry store; 010 or 011 = memory readout.

Format: See Figure 5-52.

(9) Word 9 (RTLT) - The Round Trip Light Time will be given in total milliseconds.

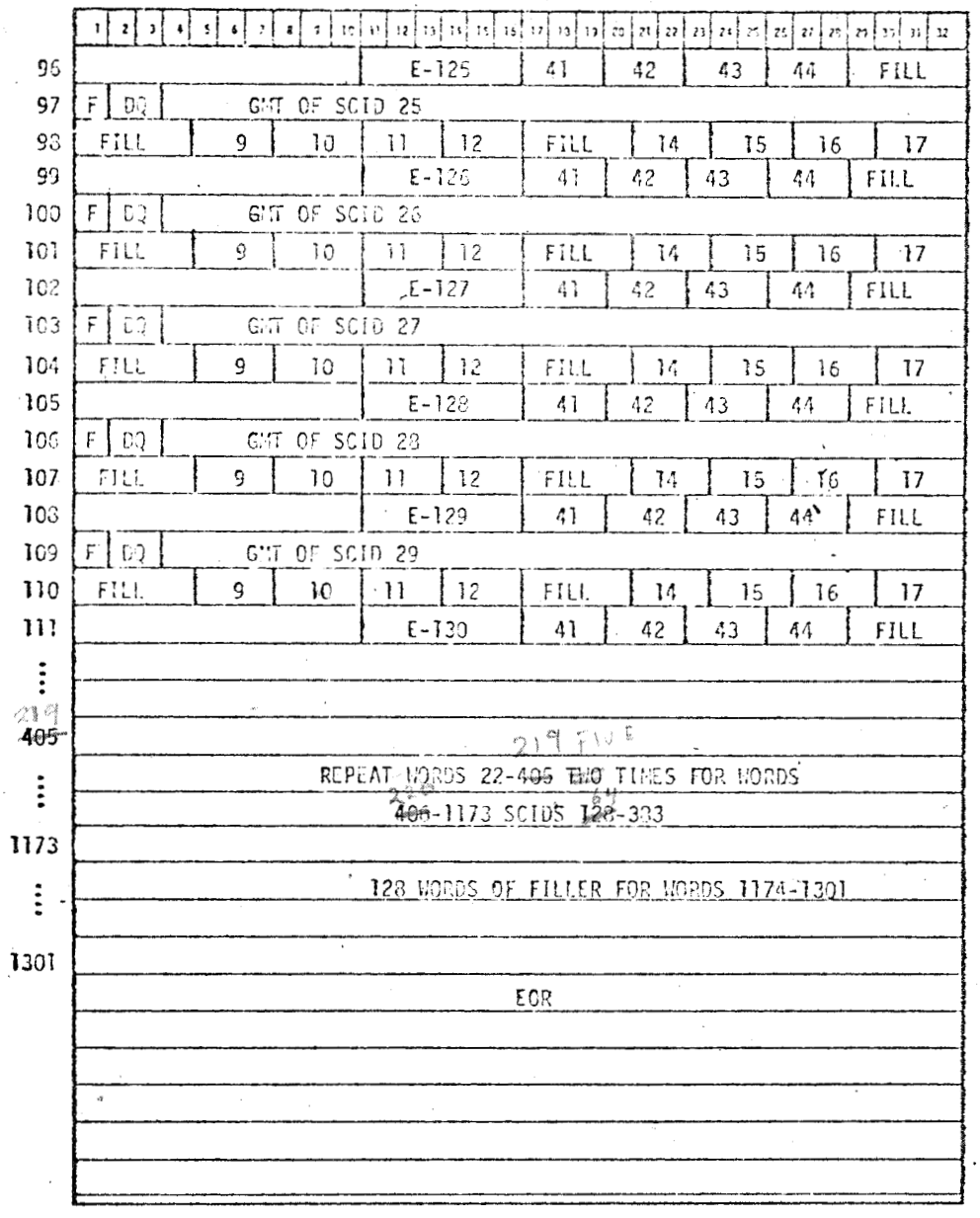
(10) Word 10 (ESC Subcom ID) - The Extended Frame Counter will be a combined word from the S/C telemetry of both the sub-commutator identification word and the extended frame counter word. Together they comprise a counter from 0 to 8191.

(11) Word 11 - Spare.



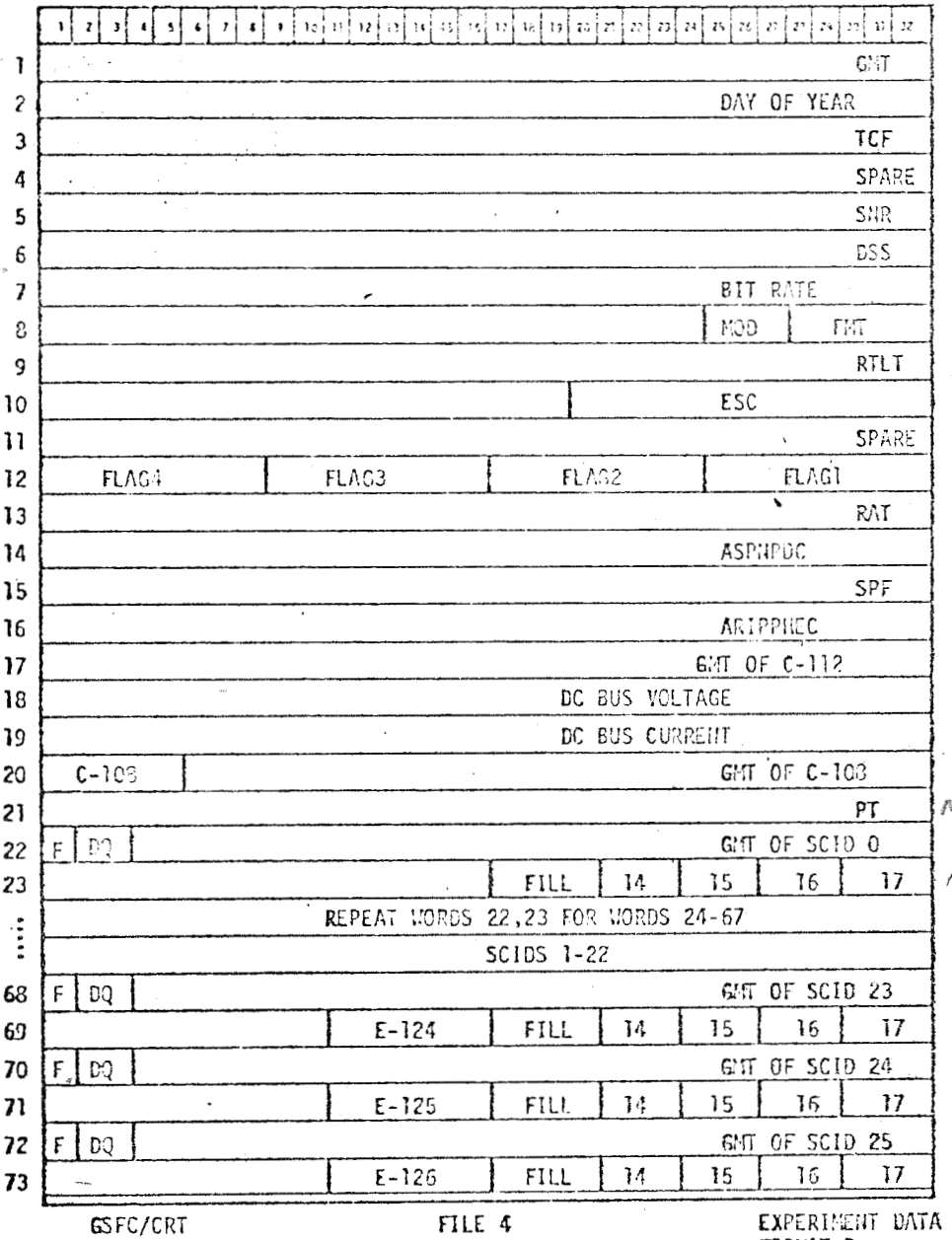
GSFC/CRT FILE 4 EXPERIMENT DATA
TYPE - BINARY FORMAT A
LOGICAL RECORD LENGTH - 384 WORDS
PHYSICAL RECORD LENGTH - 1301 WORDS
FILE SIZE - VARIABLE

Figure 5-12. GSFC/CRT File 4 (Sheet 1 of 4)



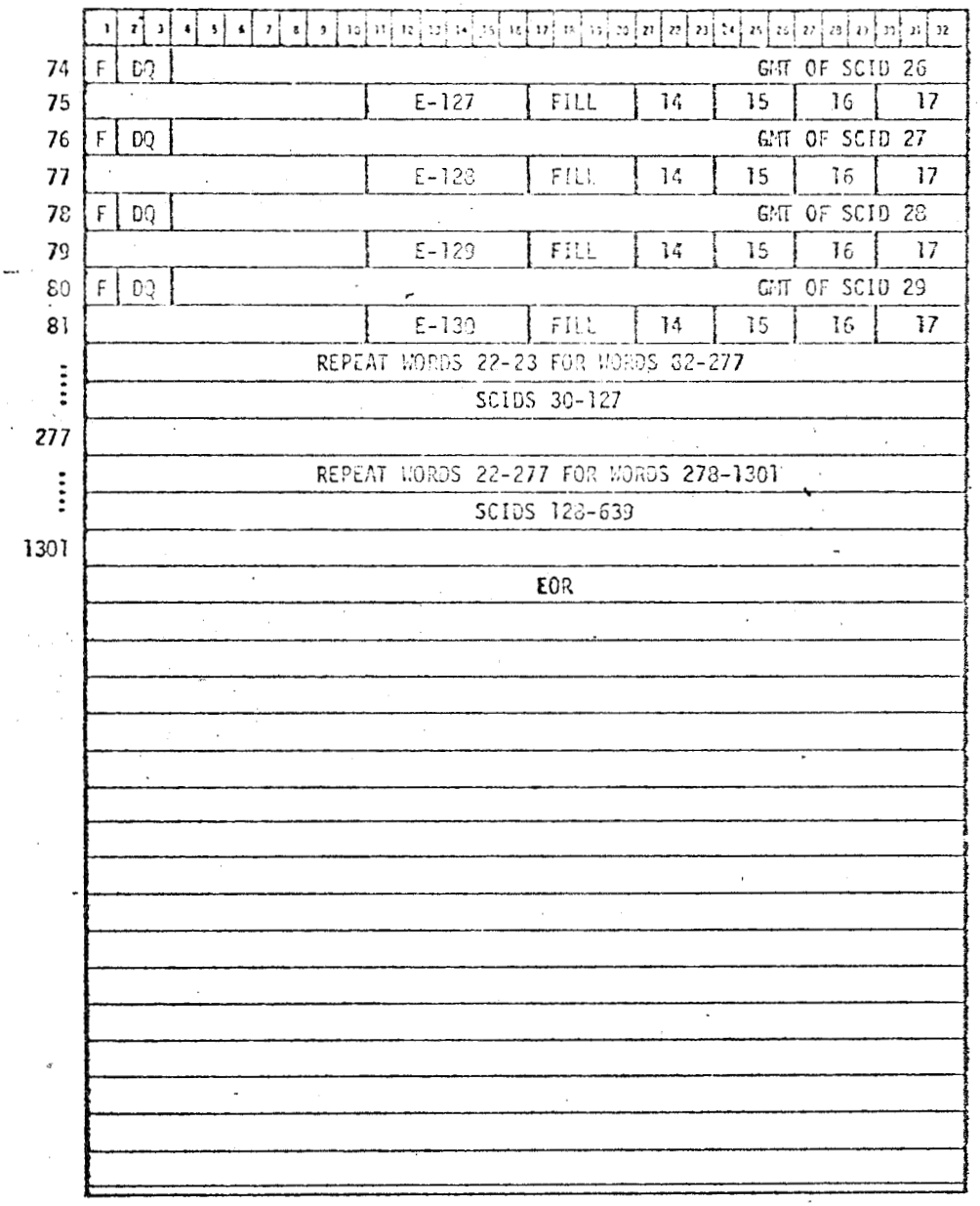
GSFC/CRT FILE 4 EXPERIMENT DATA FORMAT A (CONTD)

Figure 5-12. GSFC/CRT File 4 (Sheet 2 of 4)



GSFC/CRT FILE 4 EXPERIMENT DATA
TYPE - BINARY FORMAT B
LOGICAL RECORD LENGTH - 256 WORDS
PHYSICAL RECORD LENGTH - 1301 WORDS
FILE SIZE - VARIABLE

Figure 5-12. GSFC/CRT File 4 (Sheet 3 of 4)



GSFC/CRT FILE 4 EXPERIMENT DATA FORMAT B (CONTD)

Figure 5-12. GSFC/CRT File 4 (Sheet 4 of 4)

(12) Word 12 (Flag 1, Flag 2, Flag 3, Flag 4) - These are flags for RAT, ASPNPDC, SPF, ARIPPHEC, respectively. Each flag is eight bits. Flag values are: 0 = OK, 1 = old value, 10 = missing value, and 11 = corrected value.

(13) Word 13 (RAT - Roll Attitude Timer) - Engineering Subcom Words C-112 and C-116. This time permits correlation of the attitude of the roll index reference line with given telemetered science and engineering data. (Floating point form as used on customer's computer.)

(14) Word (ASPNPDC - Spin Period) - The time between two successive roll pulses of the spacecraft. (Engineering Words C-405, C-406, C-407.) Floating point form as used on customer's computer.

(15) Word 15 (SPF) - Engineering Word C-417 is the flag for spin period (three bits). If low order is 0, then SPSG (Spin Period Sector Generator) roll reference = 0°, if set to 1 = 180°.

Bits 2 and 3	SPSG Modes
00	Non-Spin Averaging
01	ACS
10	Spin Averaging

(16) Word 16 (ARIPPHEC - Roll Pulse/Roll-Index Pulse Phase Error) - The phase error measurement between the Roll Pulse and Roll-Index Pulse with up to a maximum of 60 msec of phase error, generated by the Spin Period Sector Generator (SPSG). Floating point form as used on customer's computer.

(17) Word 17 (Time of C-112) - GMT time that C--12 was received. All "ones" indicate time was missing.

(18) Word 18 (DC Bus Voltage - C-107) - Range 26-30 VDC. Floating point form as used on customer's computer. All "ones" indicate value was missing.

(19) Word 19 DC Bus Current - C-129) - Range 0-6A. Floating point form as used on customer's computer. All "ones" indicate value was missing.

(20) Word 20 (C-108/GMT of C-108) - Located in Bit 5 of Word 20. It indicates the power status of the GSFC/CRT instrument: 1 = on, 0 = off. GMT of C-108 is located in Bits 6-32 of Word 20. It is the time that C-108 was received. If Word 20 is all "ones", C-108 was missing for this subcom cycle.

(21) Word 21 (PT - S/C Platform Temperature #6) - -20°F to 110°F. Floating point form as used on customer's computer. All "ones" indicate PT was missing for this subcom cycle.

(22) Word 22 (F, DQ) - Bit 1 of Word 22 is the fill indicator: 0 equals data, 1 equals fill. Bits 2 and 3 of Word 22 are dependent on Bit 1 of Word 22. If Bit 1 equals 0, then Bits 2 and 3 (DQ) are the Data Quality Indicator. The following codes in binary: 11 equals all indicators are good, data is good; 10 equals at least one indicator is bad, data is suspect; 01 equals at least two indicators are bad, data is suspect; 00 equals data is bad. See Figure 5-49. If Bit 1 equals 1, then Bit 2 will indicate extent of filler: 0 equals at least this frame of data is filled with "ones" and data resumes in this physical record; 1 equals the rest of this physical record is filled with "ones".

VALUE (BINARY)	BCD	MEANING
11	3	ALL INDICATORS ARE GOOD, DATA IS GOOD
10	2	AT LEAST ONE INDICATOR IS BAD, DATA IS SUSPECT
01	1	AT LEAST TWO INDICATORS ARE BAD, DATA IS SUSPECT
0	0	DATA IS BAD - NO SYNC

THIS VALUE IS COMPUTED BY THE FOLLOWING LOGIC:

QI = FS (1+S+H), where:

FS = 1 IF DATA STREAM IS IN SYNC IN 360
0 IF DATA STREAM NOT IN SYNC

S = 1 IF AVERAGE SNR OVER FRAME IS $\geq$ A SPECIFIED MINIMUM
0 IF AVERAGE SNR OVER FRAME IS $<$ A SPECIFIED MINIMUM

H = 1 IF HSD BLOCK WAS RECEIVED WITH NO ERROR INDICATORS
0 IF ANY BIT ERRORS WERE DETECTED IN HSD BLOCK

Figure 5-49. Quality Indicator (Binary)

	VALUE (BINARY)
DSS 11	00001011
DSS 12	00001100
DSS 14	00001110
DSS 21	00010101
DSN SIMULATION CENTER (SIMCEN) DSS 27	00011011
DSS 41	00101001
DSS 42	00101010
DSS 51	00110011
DSS 61	00111101
DSS 62	00111110
DSS 71	01000111
CAPE BUILDING AO (DSS 70)	01000110
SFOF (DSS 00)	00000000
MERRITT ISLAND MSFN (MIL) (DSS 90)	01011010
USNS VANGUARD MSFN (VAN) (DSS 91)	01011011
BERMUDA MSFN (BDA) (DSS 92)	01011100
ASCENSION MSFN (ACN) (DSS 93)	01011101
CANARY ISLAND MSFN (CYI) (DSS 94)	01011110
BOULDER, COLORADO (DSS 99)	01100011

Figure 5-50. DSS Codes (Source Codes)

VALUE (BINARY)	BCD	RATE IN BITS PER SECOND
0000	0	16
0001	1	32
0010	2	64
0011	3	128
0100	4	256
0101	5	512
0110	6	1024
0111	7	2048

Figure 5-51. Rate of Data Transmission From Spacecraft (Binary)

FORMAT ID	BCD	FORMAT
0100Ø	8 OR 9	A
0000Ø	0 OR 1	B
0X100	4 OR 12	C 1
0X101	5 OR 13	C 2
0X110	6 OR 14	C 3
0X111	7 OR 15	C 4
11000	24	D1 WITH A
10000	16	D1 WITH B
11001	25	D2 WITH A
10001	17	D2 WITH B
11010	26	D3 WITH A
10010	18	D3 WITH B

Ø = DON'T CARE STATE (MAY BE A ONE OR A ZERO)
X = 1 WHEN IN ROTARY C (OPERATIONALLY FORCED)

Figure 5-52. Format ID Assignments

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA 94035

REPLY TO ATTN OF: PAF-2-37(244-8)

August 2, 1972

Mr. Bonnard Teegarden
Code 61 Building 2 Room 23
Goddard Space Flight Center
Greenbelt, Maryland 20771

Subject: Redefinition of EDR Formats for File 3 and 4

Recently it has come to our attention that the spacecraft attitude and pointing data supplied in File 3 of your Experiment Data Record (EDR) is not sufficient to resolve the reference-axis phase error for computing your instrument sectoring. A detailed analysis performed on the spacecraft data from launch to the first of June has revealed that this problem is quite complex. The analysis has revealed that a number of other parameters and status bits must be checked in order to determine the type and extent of correction that must be made. We recognize that each investigator has different requirements for the accuracy required in the solution of this problem. We, therefore, have attempted to carry the solution, for at least those cases we have identified, down to the finest detail. From this, it is your prerogative to select the depth of detail you desire for the accuracy you require. The net effect of this whole problem is that we have been forced to modify, to a small extent, the format and content of the data in your EDR's for File 3, which contains the spacecraft attitude data, and File 4, which contains the science data from your instrument. The enclosed package, therefore, is essentially broken down into two parts. They are:

1. The new File 3 format contains the spacecraft attitude data along with an explanation of the parameters contained therein. The essential difference between this format and the previous one is that we have deleted the Celestial Latitude Drift of the spin axis and added the clock angle of the sun (CKAH) and the clock angle of the star, Canopus (CKAS).

2. The new File 4 format contains a minor change wherein we have inserted additional information into a spare word in the fixed words of the data record. These two pieces of information are:

a. Bits 5 and 6 of engineering word C-431. These two bits indicate whether the spacecraft is operating from the star sensor, sun sensor A, or sun sensor B. The configuration of bits are interpreted as:

00 - Error

01 - Star

10 - Sun B

11 - Sun A

b. Engineering words C-419 and C-420. These two words together contain a 2^{12} counter indicating the star delay. The conversion of this counter to an angular off-set is:

$$\text{Star Delay (degrees)} = \frac{(\text{Contents of C-419 \& C-420})\ 360^\circ}{256 \quad (\text{spin period})}$$

At the present time a review of the results of the detailed analysis, which includes working equations for the solution of the reference-axis phase error for computing your instrument look angles, is being conducted. This information will be sent to you upon completion of this review.

You will note that the items discussed above are marked as "draft". We are sending this rough form to you in the interest of saving some time; however, all of this information will eventually be published in the appropriate sections of document PC-262, Pioneer F/G: Off-Line Data Processing System.

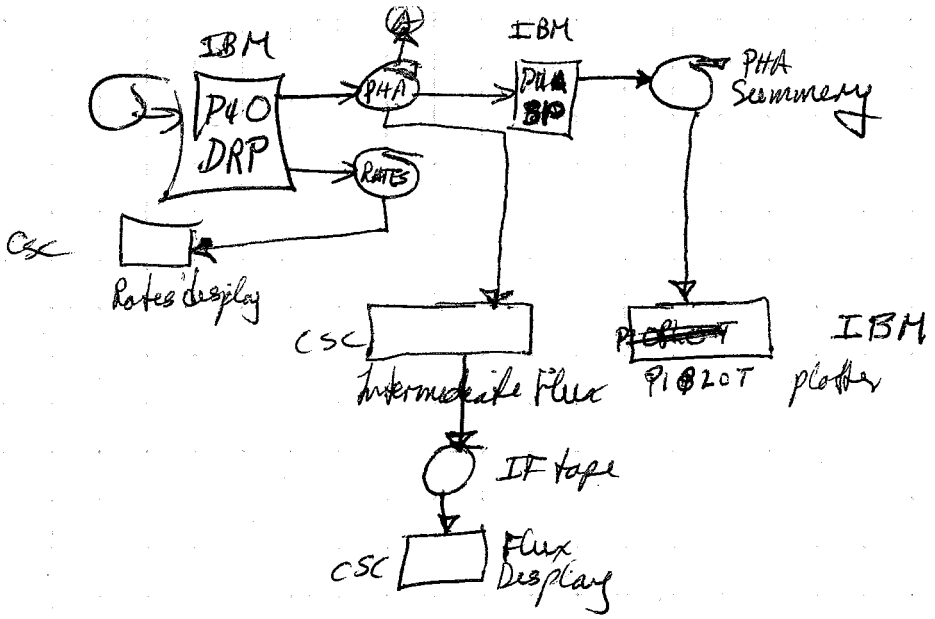
I would like to point out that on June 22, we ran the Acceptance Test on a JPL produced Master Data Record (MDR) tape. This, of course, is a superior and more complete data source than the System Data Record (SDR) tape which we were forced to use in generating the first 30 EDR's that we sent to you. It is our intention to regenerate all EDR's that we have sent to you using these new source tapes. We will follow the philosophy for generating EDR's that was outlined at the Quarterly Review on April 24. That is, we will send you EDR's on the most current data we have; and this will probably begin with Day 176 (June 24). We will maintain the current flow of data and then, in parallel, we will regenerate all the past data starting at launch. The production flow of the new data will commence during the first

week of July. It necessarily follows, of course, that all of these new data tapes will be in the form and format given in the enclosures discussed earlier. We request that you return the earlier EDR's that we sent you when you receive the regenerated data. This will eliminate future confusion because of the difference in the data formats.

Charles F Hall

Charles F. Hall
Manager, Pioneer Project

Enclosures:
1. EDR File 3 Data Format
2. EDR File 4 Data Format



Analcer Analysis routine

Frame — 64 words (36 bits each)

format A — 3 words of exp data / frame

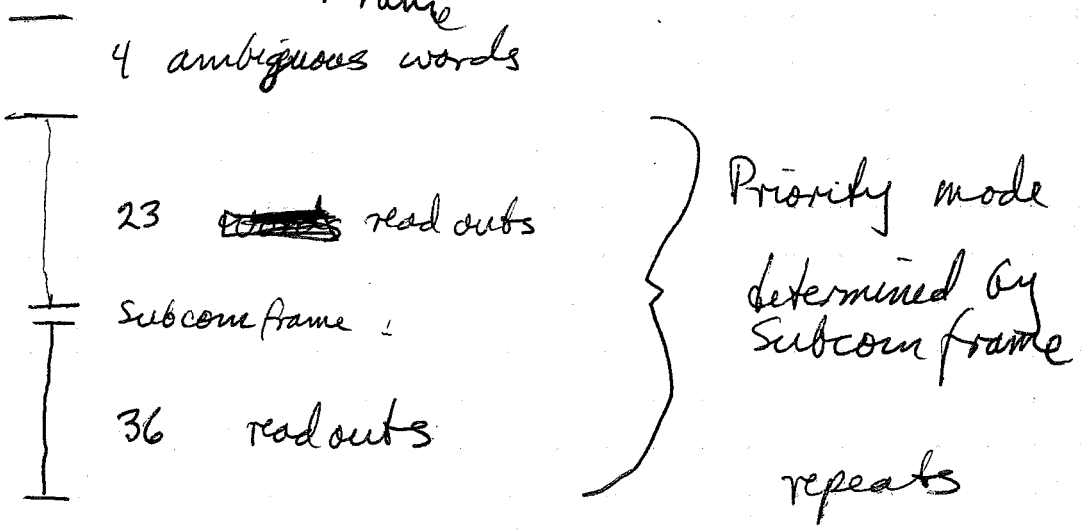
B — 1 word of exp data / frame

Album — one complete exp cycle

format A — 256 frames

B — 512 frames

128 frames for one PHA cycle


Frame
4 ambiguous words
23 readouts
Subcom frame 1
36 readouts
Priority mode
determined by
Subcom frame
repeats

Common Descriptions

The common block /DRSTAP/ is the tape catalog. it is described on page 38 of the Pulse Height Analysis Summarized System Documentation (Feb 1972).

The common block /DATREC/ is the description of the EDR file 4 data record. The following is from BFEC/ARC-027 page 5-37 together with a source listing of the common area dated 11:08:45.22, 5-17-72.

	Source Name	Type	Definition
1	MSDATA	I4	Time, in millisecs, from the start of the day to the time of the first data word in the record.
2	MDAYYR	I4	Day of the year
3	MTMFLG	I4	Time correction flag (TCF) 0 = no correction 7 = corrected or suspect time
4	MDSPRL	I4	Spare word.
5	SNR	R4	Signal to noise ratio (S+N)/N
6	MDSS	I4	Deep Space Station tracking the PIONEER. The correlation codes are given in BFEC/ARC-027 page 5-153 Figure 5-50
7	MBITRT	I4	Bit rate at which the data was taken. 0 = 16 bps 1 = 32 2 = 64 3 = 128 4 = 256 5 = 512 6 = 1024 7 = 2048 Bit rate = $2^{MBITRT+4}$
8	MFORMT	I4	Mode and Format. Eight bits are used mmmfffff See BFEC/ARC-027 page 5-155 Figure 5-52 for Format ID assignments. mmm = 000 or 001 realtime = 101 or 100 telemetry = 010 or 011 memory read out

Common Descriptions

Continuation of the description of /DATREC/

	Source Name	Type	Definition
9	HSRTLT	I4	Round trip light time in millisecs.
10	HEXSKD	I4	Extended frame counter. This is a combination of the subcommutator ID word and the frame counter word. This has a range of ∅ to 8191
11	HDSPR2	I4	Spare word
12	HFLAGS	I4	Four one byte flags for the Roll Attitude Timer, the Spin Period, the Spin Period Flag, and the Roll Pulse/Roll-Index Pulse Phase error. For each flag ∅ = OK 1 = old value 1∅ = missing value 11 = corrected value
13	RATTIM	R4	Roll Attitude Timer. This time permits correlation of the attitude of the attitude of the roll index reference line with given telemetered data
14	SPNPER	R4	Spin Period. The time between two successive ~~pulses~~ roll pulses of the spacecraft.
15	HSPF	I4	Spin Period Flag. See BFEC/ARC-∅27 page 5-42 for description. ~~This gives~~
16	ROLPUL	R4	Roll Pulse/Roll-Index Pulse Phase Error. The phase error between the Roll Pulse and the Roll-Index Pulse. The maximum is 60 millisecs of error.
17	HTH112	I4	The GMT time that C-112 was recieved. All ones (=-1) indicate time is missing.
18	BUSVLT	R4	D.C. Bus Voltage (C-107) 26-30 VDC. All ones indicate value is missing.
19	BUSCUR	R4	D.C. Bus Current (C-129) 0-6 A. All ones indicate value is missing.

Common Description

Continuation of the description of /DATREC/

	Source Name	Type	Description
20	MTH108	I4	C-108 and GMT of C-108. Bit 5 is the power status of the GSFC/CRT instrument 1= on, 0= off. Bits 6 through 32 are the GMT that C-108 was recieved. All ones (-1) indicate C-108 is missing.
21	PLTTEM	R4	S/C Platform Temperature -20°F to 110°F All ones indicate value is missing
22	IDATA(1280)	I4	Experiment data. The descriptions of the various formats and EQUIVALENT arrays follows

The following descriptions of the data formats give only the contents of the data words and not the bit positions of the data within the words. For a detailed description see "Specifications for Pioneer GSFC/CRT Data Reduction System" Dec 71 page 5-4 and 5-5, and BFEC/ARC-027 Figure 5-12 pages 5-38 to 41.

Format A structure

range	word	Contents
n=0,22	22 + n	GMT time of frame n
	23 + n	S/C words 9,10,11,12,14,15,16,17
	24 + n	S/C words 41,42,43,44
repeat for n: 64,127 — Repeat for 2 more Subcom Sequences		
n=23,29	22 + n	GMT time of frame n
	23 + n	S/C words 9,10,11,12,14,15,16,17
	24 + n	S/C words [E-1, [illegible]], 41,42,43,44 [E-1, n+1]
n=30,63	22 + n	GMT time of frame n
	23 + n	S/C words 9,10,11,12,14,15,16,17
	24 + n	S/C words 41,42,43,44

$n-2)+1 = 29$
$n = 27$

Common Description

Continuation of the description of /DATREC/

Format B structure

Repeat for 4 more subcom sequences

Repeat for n = 64 and 127

range	word	Contents
n = 0, 22	22 + n	GMT time of frame n
	23 + n	S/C words 14, 15, 16, 17
n = 23, 29	22 + n	GMT time of frame n
	23 + n	S/C words LE-1, n+1], 14, 15, 16, 17
n = 30, 63	22 + n	GMT time of frame n
	23 + n	S/C words 14, 15, 16, 17

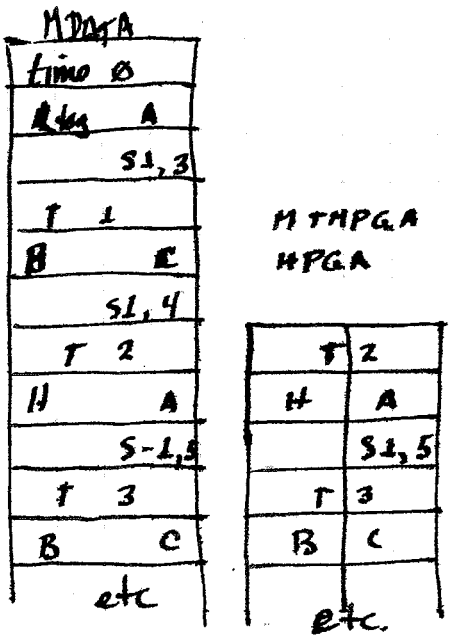
In order to describe the EQUIVALENCES it is necessary to first describe the telemetry format in considerable detail. The following pages are notes done by Joe Novitsky and my own pictures of the telemetry format and the data fit into the telemetry frames.

Common Descriptions

Continuation of the description of /DATREC/.

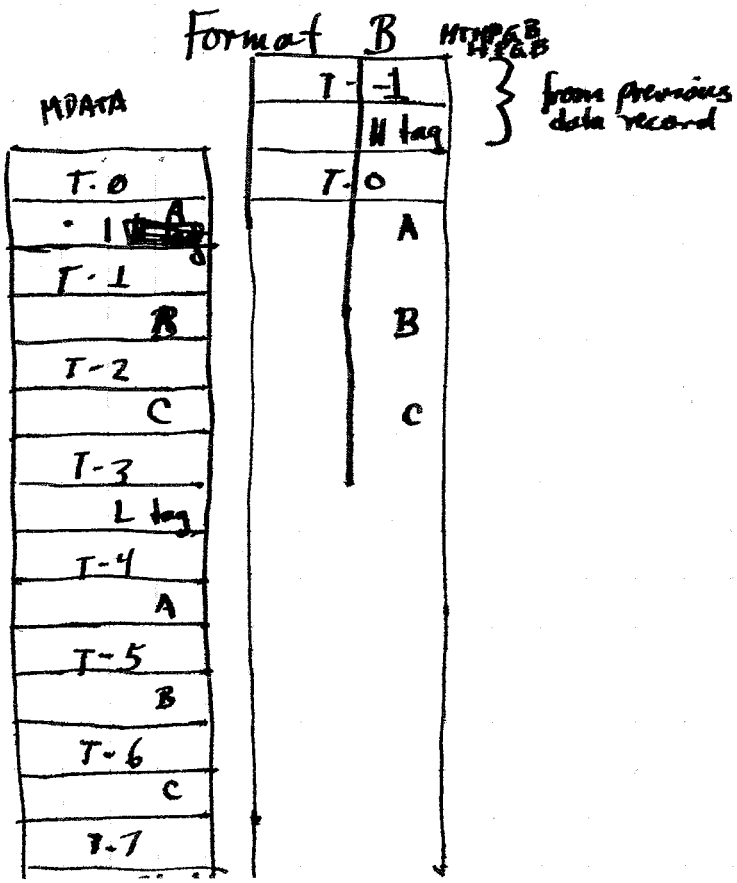
Equivalences of the data portion of DATREC. This is the array MDATA.

Format A

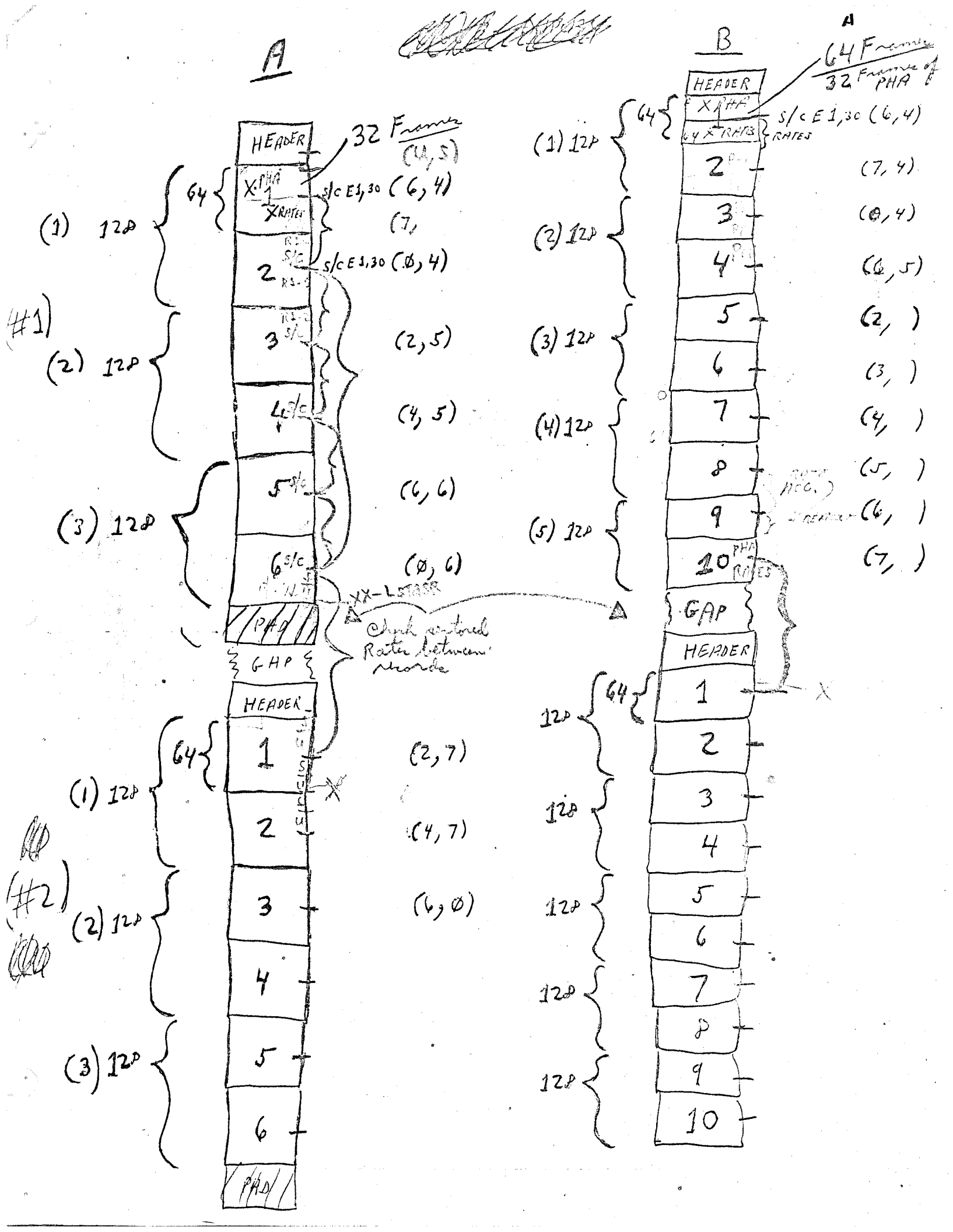


In Format A the arrays MTHPGA(192,6) and HPGA(384,6) are displaced so that the first frame in the MTHPGA and HPGA equivalent arrays is the first frame of the MDATA array associated with the first priority sequence. The items earlier in the MDATA array are associated with a previous priority sequence. The first index counts 1/3 frames the second pages. There are 3 words per frame (6 halfwords) and 64 frames per page.

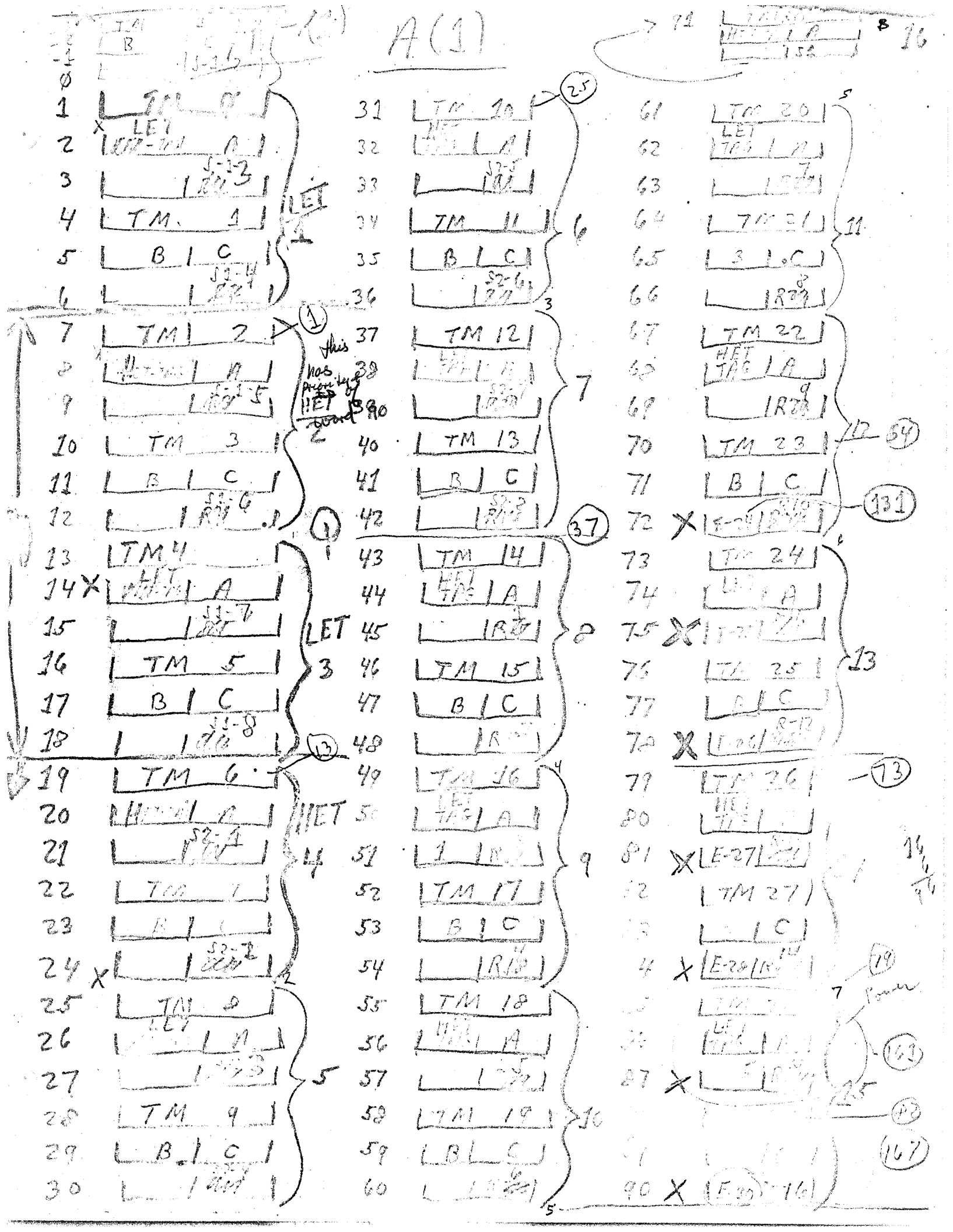
Format B

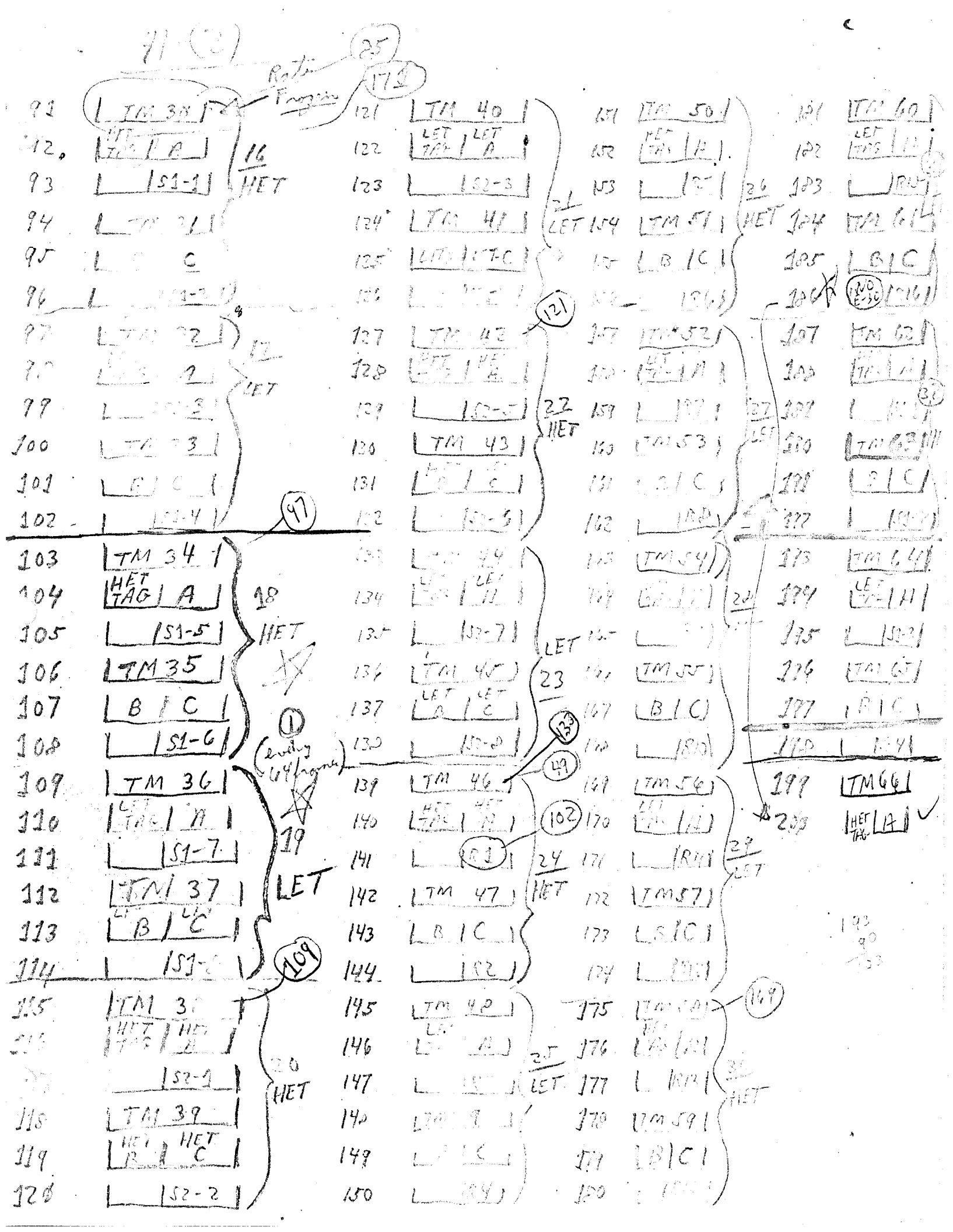


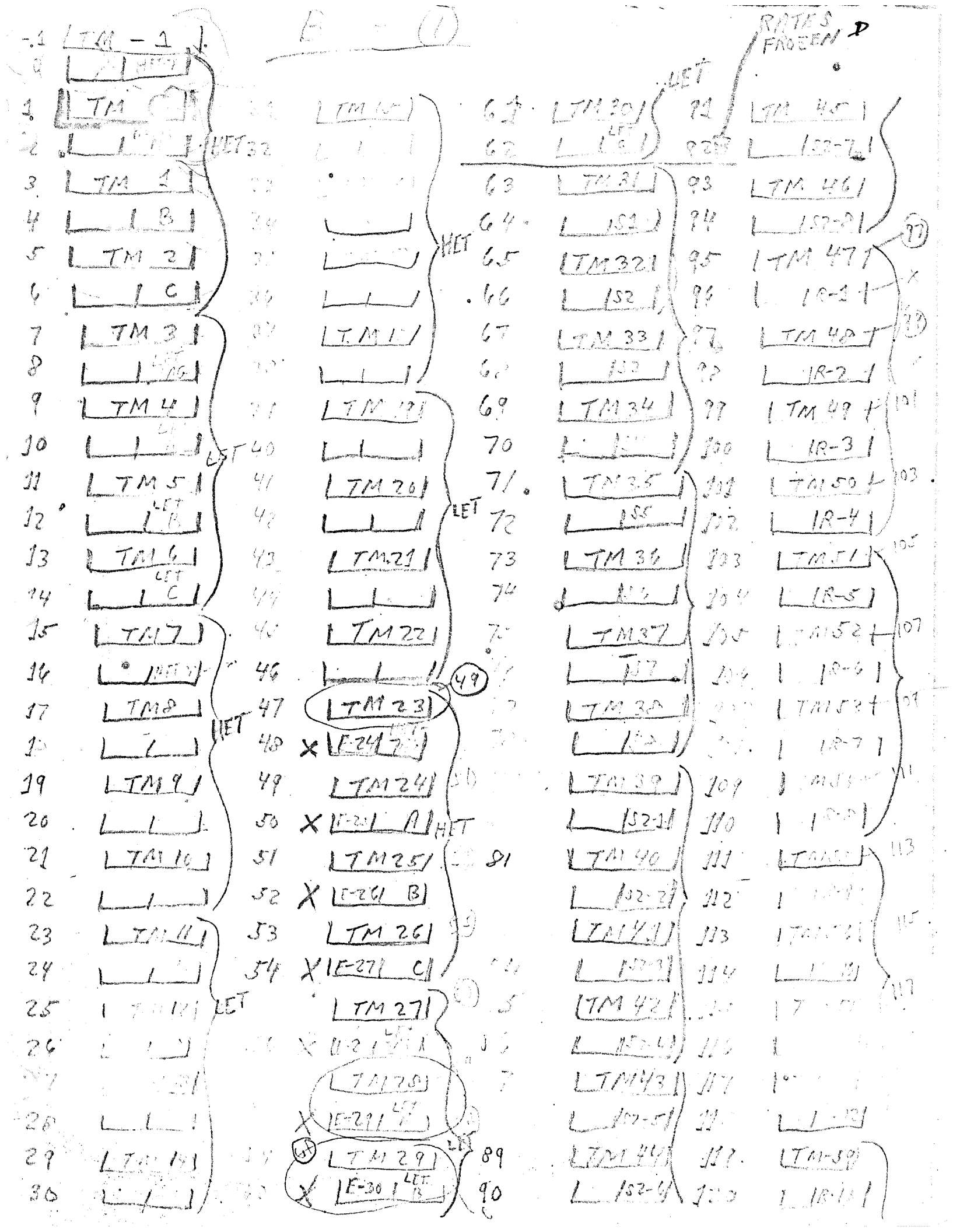
In the B format part of the first priority sequence is on the previous data record. These words are saved. In order to line up the MTHPGB and HPGB and MPGB arrays they are given 2 extra words space at the beginning and the MDATA array displaced two words from their beginning. The first index counts words (1/2 frames). The second (of three) counts pages (128 words/page). The second (of three) counts page halves and the third counts pages.


A
HEADER
32 Frames
(4, 5)
64
X PHA
X RATES
s/c E 1,30 (6, 4)
(7,
(1) 12Ø
2
s/c E 1,30 (Ø, 4)
(#1)
3
(2, 5)
(2) 12Ø
4 s/c
(4, 5)
5 s/c
(6, 6)
(3) 12Ø
6 s/c
(Ø, 6)
XX-LOCATOR
PAD
GAP
Link control Rates between Nodes
HEADER
64
1
(2, 7)
(1) 12Ø
2
(4, 7)
(#2)
3
(6, Ø)
(2) 12Ø
4
5
(3) 12Ø
6
PAD
B
64 Frames
32 Frames PHA
HEADER
X PHA
64 X RATES
S/C E 1,30 (6, 4)
RATES
(1) 12Ø
2
(7, 4)
3
(Ø, 4)
(2) 12Ø
4
(6, 5)
5
(2,)
(3) 12Ø
6
(3,)
7
(4,)
(4) 12Ø
8
(5,)
9
(6,)
(5) 12Ø
10 PHA RATES
(7,)
GAP
HEADER
64
1
12Ø
2
12Ø
3
4
12Ø
5
6
12Ø
7
8
12Ø
9
10

A(1)

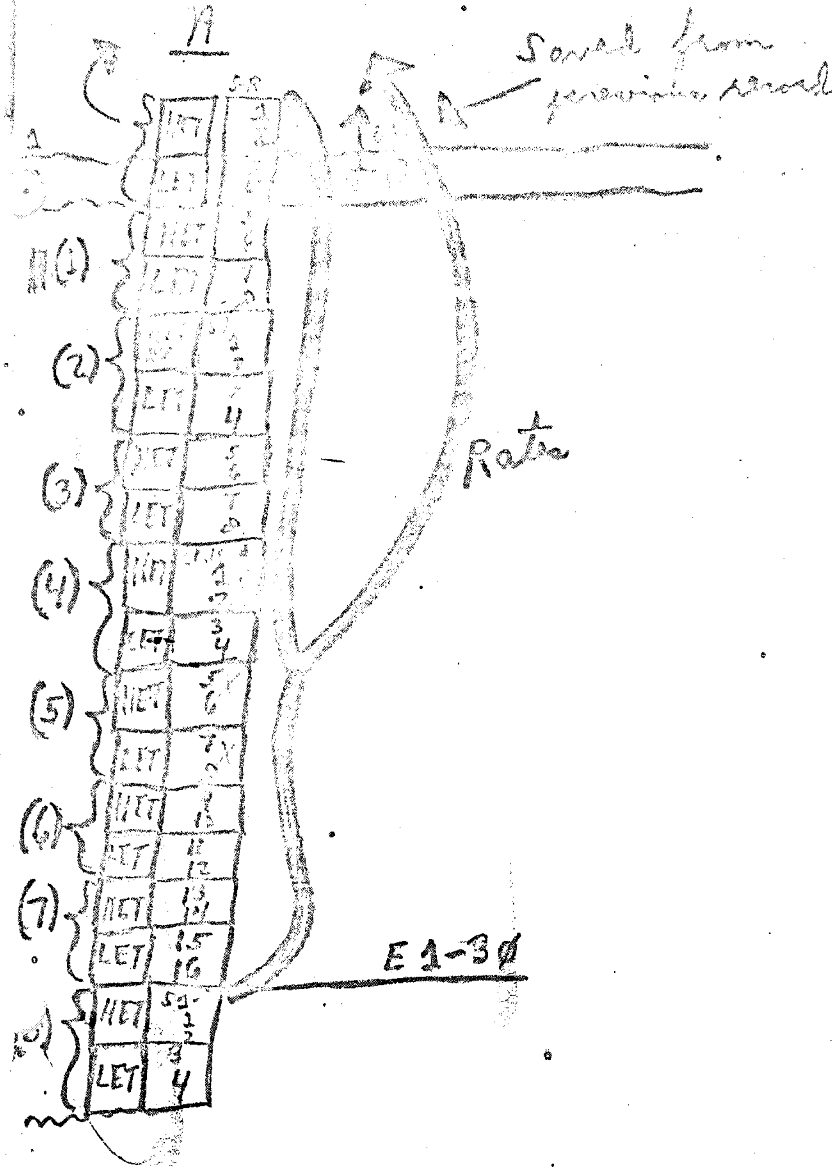

TM 0
LET
TM 1
B C
TM 2
This has priority by LET count
TM 3
B C
TM 4
LET
TM 5
B C
TM 6
LET
TM 7
B C
TM 8
LET
TM 9
B C
TM 10
LET
TM 11
B C
TM 12
LET
TM 13
B C
TM 14
LET
TM 15
B C
TM 16
LET
TM 17
B C
TM 18
LET
TM 19
B C
TM 20
LET
TM 21
B C
TM 22
LET
TM 23
B C
TM 24
LET
TM 25
B C
TM 26
LET
TM 27
B C

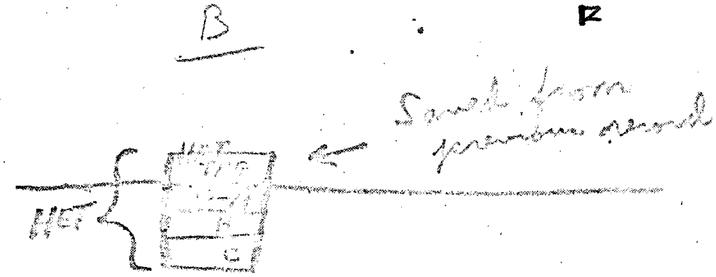

Ratio Fragment
16 HET
18 HET
19 LET
20 HET
21 LET
22 HET
23 LET
24 HET
25
26 HET
27 LET
28 LET
29 LET
30 HET
31 HET
(1) (end of 64 fragment)
(97)
(102)
(109)
(121)
(123)
(169)
(179)
(199)

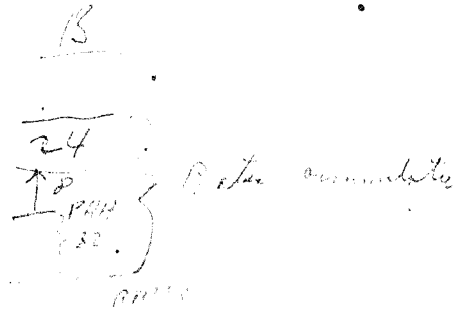


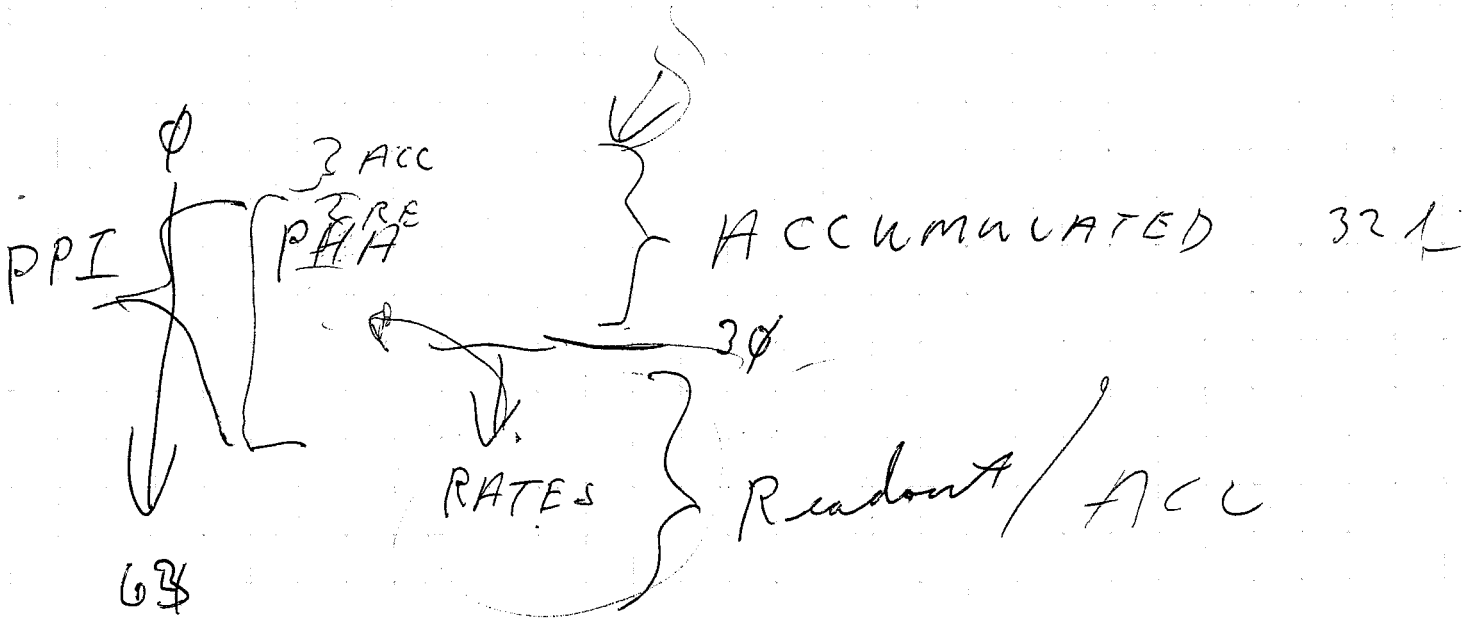
121	TM-60		151	TM-76		181	TM-90	26
122	R-14		152	LET-TM6		182	C	
123	TM-61		153	TM-76		183	TM-91	27
124	R-15		154	A		184	LET-TM6	
125	TM-62		155	TM-77	LET	185	TM-92	28
126	R-16		156	B		186	R-29	
127	TM-63		157	TM-78		187	TM-93	29
128	HET-TM6		158	C		188	B	
129	TM-64	HET	159	TM-79		189	TM-94	30
130	A		160	HET-TM6		190	C	
131	TM-65		161	TM-80	HET	191	TM-95	
132	B		162	A		192	S1	
133	TM-66		163	TM-81		193		
134	C		164	B		194		
135	TM-67		165	TM-82		195		
136	LET-TM6		166	C		196		
137	TM-68		167	TM-83				
138	H		168	LET-TM6				
139	TM-69		169	TM-84	LET			
140	B	LET	170	A				
141	TM-70		171	TM-85				
142	C		172	B				
143	TM-71		173	TM-86				
144	HET-TM6		174	C				
145	TM-72		175	TM-87				
146	A	HET	176	HET-TM6				
147	TM 73		177	TM-88				
148	B		178					
149	TM 74		179	TM-89				
150	C		180	B				

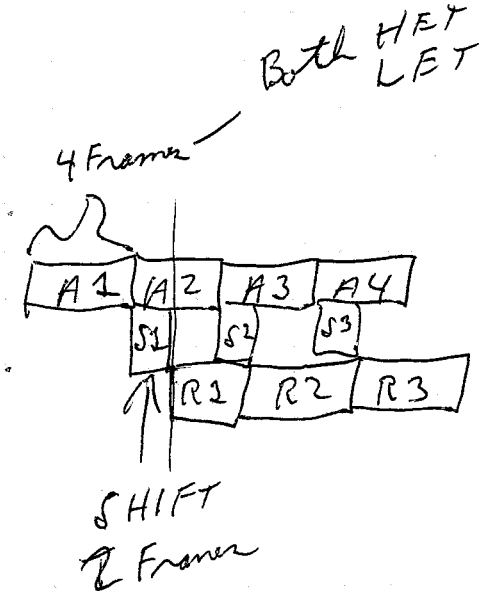
R


A
Saved from previous record
Rates
E 1-30
(1)
(2)
(3)
(4)
(5)
(6)
(7)
HET
LET


B
Saved from previous record
HET


B
24
Rates accumulator

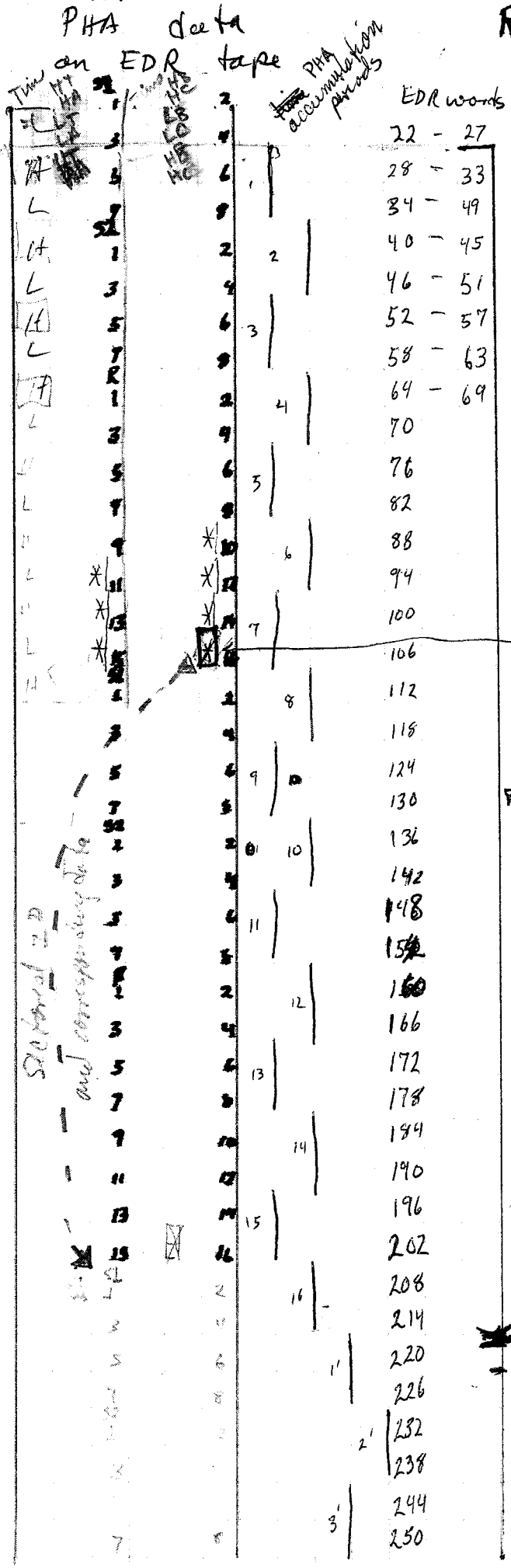

ϕ
3 ACC
ZERO
PPI
PHA
ACCUMULATED
32
3ϕ
RATES
Readout / ACC
6ϕ


Both HET
LET
4 Frames
A1
A2
A3
A4
S1
S2
S3
R1
R2
R3
SHIFT
2 Frames

Format A
PHA data on EDR tape

Rates data

Words of EDR Section		
1 - 6	-2	-1
7 - 12	0	1
13 - 18	2	
19 - 24	4	
25 - 30	6	
31 - 36	8	
37 - 42	10	
43 - 48	12	
49 - 54	14	
55 - 60	16	
61 - 66	18	
67 - 72	20	
73 - 78	22	
79 - 84	24	
85 - 90	26	
91 - 96	28	
97 - 102	30	
103 - 108	32	
109 - 114	34	
115 - 120	36	
121 - 126	38	
127 - 132	40	
133 - 138	42	
139 - 144	44	
145 - 150	46	
151 - 156	48	
157 - 162	50	
163 - 168	52	
169 - 174	54	
175 - 180	56	
181 - 186	58	
187 - 192	60	
193 - 198	62	
199 - 204	64	
205 - 210	66	
	68	
	70	
	72	
	74	



begin new sequence ID and priority.

* gives E-1,nn words

[X] is E-1,30 which establishes the priority mode for 1-16, 1'-16' (accumulation periods)

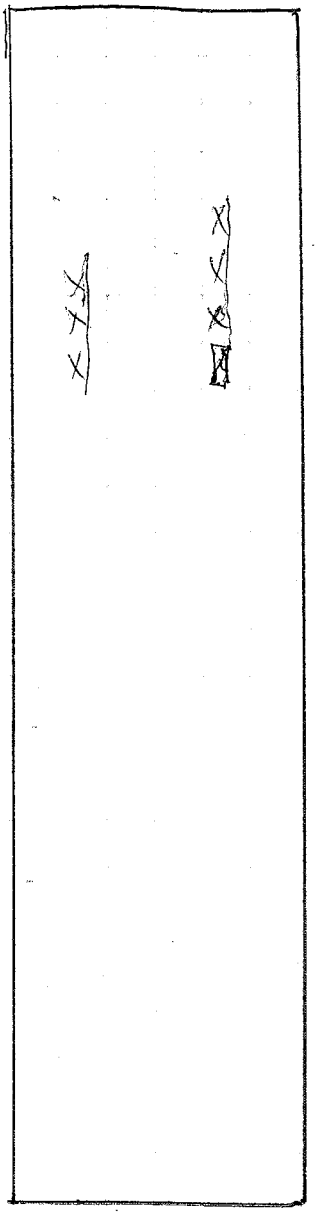
priority established here for all frames enclosed by rightmost bracket.

The time of a PHA HET or LET event is the time of the first frame of its accumulation period minus the time of six frames minus half of the round trip light time.

missing E1,30

begin new seq ID and priority

FORMAT A
PHA data
on the EDR tape



76		
78		
80		
82		
4		
6		
8		
90		
2		
4		
6		
8		
100		
2		
4		
6		
8		
110		
2		
4		
6		
8		
120		
2		
4		
	4'	256
		262
	5'	268
		274
	6'	280
		286
	7'	292
		298
	8'	304
		310
	9'	316
		322
	10'	328
		334
	11'	340
		346
	12'	352
		358
	13'	364
		370
	14'	376
		382
	15'	388
		394
	16'	400
		406

begin new sequence ID and priority

Values in sectored rate registers

	SS_3 SS_2 SS_1	
S1	* 0 0	$A, \bar{A}, B$ CI $\overline{CIII}$
	* 0 1	A_2 B K, $\overline{CIII}$
	* 1 0	DI DII $\overline{F}$
	* 1 1	DI DII E, $\overline{F}$
S2	0 0 0	SI_3 $\overline{SII}$ $\overline{SII_a}$ SIII
	0 0 1	SI_6 "
	0 1 0	SI_7 "
	0 1 1	SI_8 "
	1 0 0	$\overline{SI}$ SII_5 $\overline{SII_a}$ $\overline{SIII}$
	1 0 1	" SII_4 "
	1 1 0	" SII_7 "
	1 1 1	" SII_8 "

S1 and S2 are each a group of 8 rate registers. The rates are output in the telemetry frames in the following order.

1) S1 - 1 through 8
2) S2 - 1 through
17) R1, R2, ... R15, R16

the bits $S_2 S_1$ A/B, and $SS_3\ SS_2\ SS_1$ are in the word E-1, 30. The time associated with the word E-1, 30 is the cooling time of the rates which follow that word. The starting time is 32 frames before the E-1, 30 word (which should have another E-1, 30 but frequently doesn't at the time) is the starting time. The bits $SS_3\ SS_2\ SS_1$ give the ~~Sequence~~ sequence ID of the next sectored rates.

This set of sectored rates will come out only if the bit seven in the HET tag changes state after the E1,30 word. That is if $E_{1,30}$ shows a 6 on the sectored ID then the data following it is 5 until bit 7 of the HET tag changes. At that point the data is six and the Sig. ID is (which points to the next number) is seven.

Values in non sectored registers

	S2 S1 A/B	
R1	* * *	$(A_2K_1 + A_1\overline{CI})B\overline{CIII}$
R2	* * 0	$\overline{A}_2 A_1 B \overline{CIII}$
	* * 1	$A_1 B K_2 \overline{CIII}$
R3	* * 0	$A_1 B \overline{CIII}$
	* * 1	$A_2 B K_2 \overline{CI}$
R4	* * 0	$A_2 B K_2 CI \overline{CII}$
	* * 1	A_1
R5	* * 0	$A_2 B K_2 CI CII \overline{CIII}$
	* * 1	A_2
R6	* * 0	$A_1 \overline{A}_2 B \overline{CI}$
	* * 1	$A_1 \overline{A}_2 B CI \overline{CIII}$
R7	* * 0	$A_1 \overline{A}_2 B CI CII \overline{CIII}$
	* * 1	$A_2 B K_1 \overline{CI}$
R8	* * 0	$A_2 B K_1 CI \overline{CII}$
	* * 1	$A_2 B K_1 CI CII \overline{CIII}$
R9	* 0 0	B
	* 0 1	CI
	* 1 0	CII
	* 1 1	$CIII$
R10	0 0 0	DI_1
	0 0 1	DI_2
	0 1 0	DI_3
	0 1 1	DI_4
	1 0 0	DI_5
	1 0 1	DI_6
	1 1 0	DI_7
	1 1 1	DI_8

no commutation

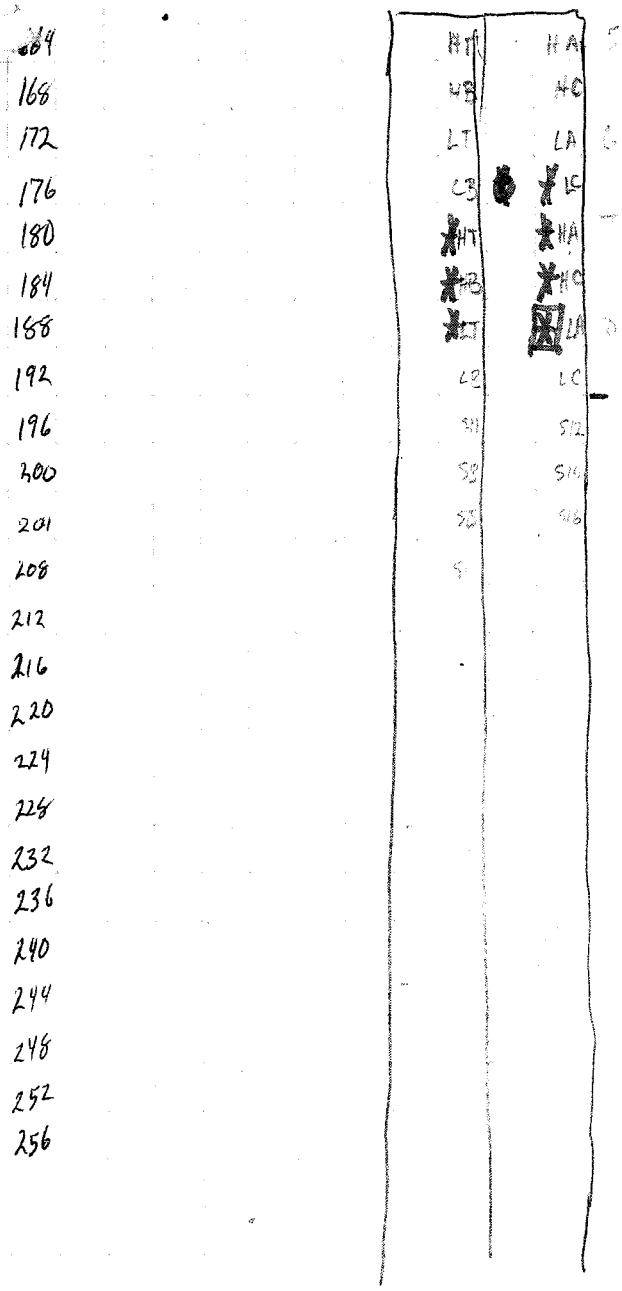
In format A bit A/B changes every 32 frames. In format B bit (and A/D) A/B changes every 64 frames. In format A/D it changes every 128 frames. Bits S1 and S2 form a binary counter with bit A/B as the low order bit.

Values in non sectored registers

	S2	S1	A/B	
R11	*	*	0	D_I D_{II} $\bar{F}$
	*	*	⊥	D_I D_{II} ΣD $\bar{F}$
R12	*	*	0	D_I D_{II} E_1 $\bar{F}$
	*	*	⊥	D_I D_{II} ΣD E_3 $\bar{F}$
R13	*	*	0	D_I D_{II} E_2 $\bar{F}$
	*	*	⊥	D_I D_{II} ΣD E_4 $\bar{F}$
R14	0	0	0	D_I
	0	0	⊥	D_{II}
	0	⊥	0	E_1
	0	⊥	⊥	F
	⊥	0	0	S_I
	⊥	0	⊥	S_{II}
	⊥	⊥	0	S_{III}
	⊥	⊥	⊥	S_{II_a}
R15	*	0	0	S_I $\overline{S_{II}}$ $\overline{S_{II_a}}$ $\overline{S_{III}}$
	*	0	⊥	S_{I_2} "
	*	⊥	0	S_{I_3} "
	*	⊥	⊥	S_{I_4} "
R16	*	0	0	S_I S_{II_1} $\overline{S_{II_a}}$ $\overline{S_{III}}$
	*	0	⊥	" S_{II_2} "
	*	⊥	0	" S_{II_3} "
	*	⊥	⊥	" S_{II_4} "

Format B

words of EDR data section



Format 13

Words of EDR data section