DOCUMENTATION OF THE DATA ANALYSIS SYSTEM
FOR THE GAMMA RAY MONITOR ABOARD OSO-H

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DECEMBER 1973

FINAL PROJECT REPORT FOR NAS 5-11054
DOCUMENTING DATA ANALYSIS SYSTEM

PREPARED FOR

NATIONAL SPACE SCIENCE DATA CENTER
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771
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Preface

This report contains a description of the programming system developed to prepare the data from the UNH (University of New Hampshire) gamma ray monitor on OSO-7 for scientific analysis. In order to help understand the reasons for our particular type of program development, this short preface will describe, from a scientific point of view, the detector, the data, and the objectives of the scientific analysis.

The gamma ray monitor consisted of a 7.6 cm x 7.6 cm NaI scintillator-photomultiplier central detector. This detector was covered on all sides, except for a forward aperture, by a 5 cm thick CsI scintillator shield. This shield acted as a collimator for gamma rays and also rejected direct charged-particle counts. The instrument was on the wheel section of OSO, which was spinning in a plane that always included the sun with a 2-second period. Data was taken during two 0.5-second intervals when the detector was "looking" at the sun and directly away from the sun. These two intervals were called the "solar" and "background" quadrants.

A small X-ray detector was also included in the instrument and data was taken from this in the same two quadrants.

The most important information from the monitor consisted of the two 370-channel pulse height spectra. Data in these spectra was accumulated over a 180-second time interval when the detector was pointing in the solar and background quadrant. Analysis of this data required that the channel numbers in the pulse height spectra be calibrated with an incident gamma ray of known energy. This calibration was accomplished twice per orbit when a radioactive source (RS cal) was gated into the detector instead of the normal spectrum. Therefore, the sets of pulse height spectra, the RS calibration spectra, counting rates from the various shield elements and the X-ray detector, and housekeeping measurements constitute the data that must be analyzed.
Data from the experiment was received in two ways: "quick look" data and experimenter tapes. "Quick look" data consisted of raw data received from a few selected orbits each day and was promptly sent to UNH via a telephone line. The experimenter tapes consisted of semiprocessed and cleaned-up data containing all of the information received from the experiment. The experimenter tapes were the prime data source for all scientific analysis.

Two pieces of hardware were used to process this data: a Varian 620/i mini-computer and the University's IBM-360-H50 computer. The Varian 620/i was used to process the quick look data for operational and engineering uses. As we will see below, it is used in the ongoing analysis of the fully processed prime data from the experimenter tapes. The IBM-360-H50 was used to process the experimenter tapes and to prepare new tapes containing data which could be more closely analyzed on the Varian. This report contains a description of the final procedure and programs used to reduce the original experimenter data.

The experimenter tapes were processed in several passes. These include:

Pass-I - strips off the X-ray and raw main frame (MF or central detector) data for use on the Varian 620. It also removes the calibration (RS) spectrum and provides various engineering and operational outputs.

Cal 1 - processes the RS calibration spectra for visual inspection and for use in Cal 2.

Cal 2 - provides a continuous gain calibration function versus time from Cal 1 and a manual input. This output allows us to calibrate all the central detector spectra that were taken between the RS calibrations.

Pass-III - provides standardized and gain-corrected spectra for use on the Varian 620. Numerous geophysical and S/C parameters are also added to the data in this pass.

Subprogram Feeder was used to read the experimenter tapes in Passes I and III.
The magnetic tape output of Pass-III constitutes the prime data bank that will be used in most of the scientific analysis efforts with the data from the gamma ray monitor. This scientific analysis, in brief, consists of selectively summing together numerous spectra in a search for gamma ray sources and events. The selection process consists of using only data in the proper time interval and with the proper geophysical and S/C parameters. The objective of the selection process is to maximize the gamma ray signal while minimizing the gamma ray background. As mentioned before, the selection process is carried out on the Varian 620/i computer.

The programs described in this report are the result of several false starts and many modifications. These final programs, however, have accomplished their aim very well indeed as the current analysis efforts using the final outputs continue to show.

David J. Forrest
Principal Scientist
Section 1

Subprogram FEEDER

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Subprogram FEEDER

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I. Introduction

A. Assumptions that influenced the organization of this report

It is assumed this report will primarily be used as a reference by individuals concerned with developing programs to analyze data from the UNH gamma ray monitor on the OSO-H spacecraft. Such individuals are assumed to be familiar with the Fortran programming language, and thus will recognize the meaning of the Fortran expressions used in this report to define the output of subprogram FEEDER. Also assumed is cognizance of the types of data produced by the UNH gamma ray monitor, of the manner these data are read onto the spacecraft's tape recorders, and of the types of auxiliary information merged by GSFC processing of OSO-H data.

This report is presented in order of increasing detail. The balance of this introduction reviews the objectives of subprogram FEEDER. Section II summarizes the categories of FEEDER's output as well as the types of commands a calling program must issue to obtain this output. The same information is provided in more detailed form in Sections IV and V.

B. Motivation for creating subprogram FEEDER

Experimenter Decomm tapes provided by GSFC are not conveniently organized for output to Fortran programs executed by an IBM-360 computer. About 15 percent of the words on the Decomm tapes are subdivided into bit-length fields. To separate these fields, the O/S Assembler language is easier to code and develops a more efficient program. But perhaps the major inconvenience stems from the conflict between the octal organization of data on the Decomm tapes and the hexadecimal organization of IBM-360 computers. Floating point words on the Decomm tapes have the 36-bit IBM-7094 format. Short integer words on the tapes have only 12 bits, as opposed to 16 bits for an IBM-360. When a Decomm tape is read by an IBM-360, the choice is between the evils of word misalignment and of word fragmentation. These inconveniences are compounded by the word fragmentation built into the readout mechanism of the UNH gamma ray experiment package.
Subprogram FEEDER is designed to cope with many of the difficulties that result from the inconvenient format of Decomm tapes. Bit-length fields are separated. Floating point words are converted to one of the IBM-360 formats. Experiment word fragments are spliced together and realigned to meet IBM-360 requirements.

C. Guidelines used in developing subprogram FEEDER

A major consideration in designing subprogram FEEDER was maximizing the ease of changing programmed strategies to identify, to interpret, to accept for analysis or to edit data from the Decomm tapes. All of these judgment-making activities are necessarily performed to some degree by any program analyzing Decomm data. To obtain data from the tapes, these analysis programs will presumably utilize subprogram FEEDER, a moderately lengthy set of routines written in Assembler language. To facilitate changing tactics, FEEDER simply stays out of the judgment-making process to the extent possible. FEEDER deletes nothing from the UNH data or from any identifiers, flags, or associated parameters that pertain to UNH data words. (Sail subcom data and non-UNH data from the digital and wheel analog subcoms are the only information always deleted by FEEDER.) Although this design feature places the burden of judgment-making solely on programs calling FEEDER, these programs will presumably be written in Fortran and thus be easier to modify.

Minimizing CPU time was another consideration in designing subprogram FEEDER. The use of Assembler language in itself allows a major reduction of CPU time. In addition FEEDER has built-in options that allow it to run at reduced work loads by ignoring types of data not needed by a calling program.

FEEDER performs a variety of services intended to help designers of calling programs. Data observation times are presented as a continuous parameter (seconds of century) to remove the necessity of constantly checking for end-of-day condition or for end-of-year condition. FEEDER constantly checks the data stream for discontinuities and indicates their presence or absence to calling programs. Other interruptive conditions are monitored and their existence reported to calling programs. Although FEEDER avoids determining whether and how to edit the data, it is designed to cooperate in certain editing activities. In addition, FEEDER performs a major re-shuffling of data from Decomm tapes in an effort to more
closely simulate the manner information is read out onto the spacecraft's tape recorders. Information from file label blocks and from orbit data blocks are shunted into storage areas while the Decomm data blocks are divided into "half-blocks" representing major frames. Consequently, the data stream appears to calling programs to be a sequence of major frames, with pertinent file label information and pertinent orbit data available on request.
II. An Introductory View of Subprogram FEEDER

A. Summary of Decomm tape organization

Each recording (via telemetry) of data stored on one of the spacecraft's tape recorders will normally produce one file of data on an experimenter's Decomm tapes. The quantity of data in any one Decomm file is thus restricted to the capacity (about 108 minutes) of the spacecraft's tape recorders. Decomm tapes sent to experimenters will typically contain several files of data. Presumably these files will be in chronological order.

Fig. II.A.1
Organization of a Decomm Tape Volume

Fig. II.A.2
Arrangement of Data Blocks Within a File of a Decomm Tape

Figures II.A.1 and II.A.2 (above) show the data stream encountered by reading forward on a Decomm tape. Subprogram FEEDER rearranges the data stream to appear as a series of half-blocks. The first half-block from a file is indicated by a flag and the first half-block from a tape is indicated by an additional flag. Upon request FEEDER can supply information from either of the last two file label blocks it has read. FEEDER can also retrieve orbit data values upon request.
B. Summary of data subprogram FEEDER supplies to a calling program

Subprogram FEEDER supplies information to a calling program through 5 named COMMON blocks referred to in this report as "windows".

1. The HEADER window

COMMON/HEADER/list

When requested, FEEDER will supply information about a particular file in the common block denoted by the symbol HEADER. Information can be supplied for either the file currently being read by FEEDER or the immediately preceding file, depending upon which is requested. The information supplied for a particular file includes

a. All information contained in the label record.

b. A list of sun-entrance and sun-exit times taken from orbit data items supplied for these events.

c. Identifiers, such as tape volume name, file count.

d. Time conversion constants, which can assist a calling program in computing the time of day for a particular data entry. These are also the constants used by FEEDER to compute data times.

e. Calendar form of the begin time of file and the end time of file. These could be useful identifiers for a calling program's printout.

f. Time(s) of ascending node crossing(s) obtained by scanning orbit data records.

2. The ORBIT window

COMMON/ORBIT/list

When requested, FEEDER will supply, for a given time \( t \), orbit parameter values for times \( t_1, t_2, t_3, \) and \( t_4 \) such that \( t_1 < t_2 < t < t_3 < t_4 \). A vector of 4 values is returned for each of the orbit parameters. Ordinarily the times \( t_1, t_2, t_3, \) and \( t_4 \) will be one minute
apart. It is possible, of course, for the calling program to request orbit data for a time \( t \) that is either near an extreme limit of available data or outside the range of available data. In the former case, FEEDER will post a flag indicating the times of the data returned are "off center" (\( t < t_2 \) or \( t > t_3 \)). In the latter case, an "out-of-range" flag is posted and the contents of the ORBIT window are left unmodified.

As FEEDER encounters the start of a new file of data, it updates the contents of the orbit data storage area it manages. However, under normal conditions, enough orbit data from the previous file is retained to accommodate any requests the calling program is likely to make.

3. The DECISION window

COMMON/DECIDE/list

Most of the varieties of data from Decomm data blocks are supplied to the calling program via the DECISION window. Main frame data (other than the 1st, 2nd, and 60th of the 64 experiment words) are the only type of data not included in the DECISION window.

The DECISION window contains 30 "panes". Unless modified by the calling program, each pane contains information from one half-block on the Decomm tape. Consecutive half-blocks, including all fill data half-blocks, are represented by consecutive panes of the DECISION window. The DECISION window is slightly longer than the minimum 24 panes required to allow correlation of data accumulated during corresponding time intervals. For example, if \( T_1 \) and \( T_2 \) are the begin time and end time for accumulating a full scan, then panes \( N - (N+11) \) might contain subcom data and attitude data read out between \( T_1 \) and \( T_2 \), while panes \( (N+12) - (N+23) \) should correspond to half-blocks containing the main frame data accumulated between \( T_1 \) and \( T_2 \).

Panes 15-30 correspond to half-blocks for which FEEDER can supply main frame data on request. FEEDER does not keep main frame data corresponding to panes 1-14 of the DECISION window.
Types of data in each pane of the window include:

a. Pane identifiers

(1) Starting time (seconds of century) of the major frame, if any, represented by the pane.

(2) Pointers to the Decomm tape block from which the pane originated.

(3) A set of flags pertaining to the pane which are generated by FEEDER.

b. Attitude data for the half-block, but only if the attitude processing option has been specified by the calling program.

c. Digital subcom data, in two forms, and flags pertaining to each word. In one form, the x-ray counts are the source values given on the Decomm tape. In the other form, x-ray counts are corrected for scaling. Digital subcom data is supplied only if the digital subcom processing option has been specified by the calling program.

d. Analog subcom data words and flags for each word. The two words containing command status and housekeeping information are always given. The remaining 8 words are supplied only if the analog subcom processing option has been specified by the calling program.

e. A useful form of the contents of the 1st, 2nd, and 60th of the 64 main frame experiment word fields in the half-block.

f. Counts of data words flagged. The only words counted are those processed by the options in effect.

g. Day-night status as indicated by the main frame flag fields on the Decomm data blocks.

4. The SCAN window

COMMON/SCANS/list

This window is used by FEEDER, when requested, to supply a calling program with main frame data vectors along with corresponding flag vectors. If the calling program had specified complete main frame data during the
initial call to FEEDER, FEEDER assumes the SCAN window to consist of 16 128-byte data vectors followed by 16 128-byte flag vectors. However, if partial main frame data had been specified in the initial call, FEEDER assumes the SCAN window to consist of 16 8-byte data vectors, 16 8-byte flag vectors, and a 3840-byte unused area.

Additional details are given in Section IV.D of this report.

5. The INTERRUPTION Vector

COMMON/INTRUP/list

This window contains a collection of flags and other information which indicate certain anomalies in the data stream have been detected by FEEDER.

C. Summary of commands that a calling program can issue to subprogram FEEDER

1. The initial command. As the name implies, this must be the first command issued and it must be issued once only. The calling program must pass information to be read during the current job step and the options FEEDER is to employ in processing the data.

When FEEDER returns control, it will have read enough of the first file of the first tape to place decision data from the first 16 half-blocks of the file in DECISION window panes 15-30.

2. The "advance-DECISION-window-N-panes" command

Normally information for the N oldest half-blocks is lost and the window is filled from the next 32 half-blocks. In other words, if half-blocks M-(M+29) were in the window before the advance, half-blocks (M+N)-(M+N+29) will be in the window after a normal advance. The main frame data that FEEDER can supply (in response to a subsequent request for main frame data) is also normally advanced by N half-blocks. Irregular advances are discussed in Section V.B of this report.

It is important to remember that the information in the DECISION window is a copy of corresponding information stored in FEEDER. Thus the calling program could, prior to commanding an advance of the window,
make alterations in the (N+1)th pane. The original contents of this pane would appear in the first pane after FEEDER has executed the advance.

3. The "fetch-ORBIT-data-for-time-T" command

If available, the desired information is moved to the ORBIT window. The success or failure of FEEDER'S response is posted in the INTERRUPTION vector.

4. The "fetch-file-information" commands

There are 2 commands which may be used, one for the most recently started Decomm file and one for the preceding Decomm file. Information for the appropriate file is moved to the HEADER window.

5. The "update-DECISION-window" command

This command allows a calling program to transfer edited DECISION window panes to FEEDER's copy of the DECISION window. FEEDER will then review its revised DECISION window and appropriately reset flags. The edited panes will be shifted by subsequent commands to advance the DECISION window.

6. The "update-main-frame-data" command

This command allows a calling program to transfer edited main frame data to FEEDER's copy of this data. The flagged words in the edited version are counted and the count is placed in the corresponding DECISION window pane for the main frame.

7. The "delete-half-blocks" command

This command orders FEEDER to "cut and splice" the data stream appearing in the DECISION window. Panes to the left of the specified panes are held in place, the specified panes are lost, panes to the right of those specified are shifted to about those held in place, and new half-blocks are read to complete the DECISION window.

8. The "skip-N-file" command

For this activity, the Decomm tape file from which the 30th pane of the DECISION window originated is counted as File 0. The Decomm tape is advanced until the first half-block from file N is in pane 15 of the DECISION window. The last 14 half-blocks of the preceding file will be in panes 1-14 of the DECISION window.
This command can also be used to go directly to the first file of the next tape. In this case no data from the last file of the current tape will be available in panes 1-14.

9. The "fetch-main-frame-data" command

Main frame data corresponding to $N$ consecutive panes of the DECISION window are moved to $N$ consecutive data vectors in the SCAN window, when $1 < N < 16$. For each main frame data word so moved, its flag field is moved into the corresponding element of the corresponding flag vector. The correspondence of DECISION pane numbers to SCAN window vectors is left solely to the discretion of the calling program.
III. Suggested Variable Names for Parameters Supplied by Subprogram FEEDER

The variable names listed below were invented primarily to facilitate the writing of this report by providing labels for the parameters whose definitions are given in Section IV. The parameters supplied by FEEDER are defined in the next section, one window at a time. For each window, the parameters are presented in alphabetical order of suggested variable names. To locate a definition, the list on the preceding page shows each of the suggested variable names in alphabetical order and associates each name to the common block in which the variable appears.
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<td>INTRUP</td>
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<td>HEADER</td>
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<td>INTRUP</td>
<td>F</td>
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<td>INTRUP</td>
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<td>B</td>
<td>QOFILS</td>
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<td>QOTGAP</td>
<td>ORBIT</td>
<td>ZKMP</td>
<td>ORBIT</td>
</tr>
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</table>

'F' DENOTES FILLER VARIABLE. 'B' DENOTES BACKGROUND VARIABLE.
IV. A. Description of the HEADER window

1. Format

The organization of information supplied via the HEADER window is shown in each of Figures IV.A.1, IV.A.2, and IV.A.3. Figure IV.A.1 is a chart of the window and gives a brief description of each parameter. Figure IV.A.2 lists suggested variable names on a similar chart of the window. Figure IV.A.3 shows the Fortran statement to define the suggested variable names.

For all 5 windows, the HEADER window contains the only double word parameters which do not contain a floating point number. The parameters are identified by the variable names UHSCID and UHTVOL.

2. Parameter definitions for the HEADER window (in alphabetical order of suggested variable names)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHDAfB</td>
<td>The day count of month in which the file timespan begins, based on information in the Decomm file label block.</td>
</tr>
<tr>
<td>HHDAfE</td>
<td>The day count of month in which the file timespan ends, based on information in the Decomm file label block. The value of HHDAfE will differ from that of HHDAfB if and only if the label block contains an end time of file that is less than the begin time of file.</td>
</tr>
<tr>
<td>HHFILN</td>
<td>The sequence count (starting at 1) of the Decomm file within the Decomm tape.</td>
</tr>
<tr>
<td>HHHRB</td>
<td>The hours of the begin day that elapse before the begin time of file, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHHRE</td>
<td>The hours of the end day that elapse before the end time of file, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHMINB</td>
<td>Minutes of the begin hour that elapse before the begin time of file, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHMINE</td>
<td>Minutes of the end hour that elapse before the end time of file, based on Decomm file label block information.</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>HHMONEB</td>
<td>Month count of year (1 implies January) in which the file timespan begins, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHMONE</td>
<td>Month count of year in which the file timespan ends, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHSECB</td>
<td>Seconds after the begin minute that the file timespan begins, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHSECE</td>
<td>Seconds after the end minute that the file timespan ends, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHTAPN</td>
<td>The count of the Decomm tape within the sequence of tapes read during the current job step.</td>
</tr>
<tr>
<td>HHYRB</td>
<td>The year (4 digits) the file timespan begins, based on Decomm file label block information.</td>
</tr>
<tr>
<td>HHYRE</td>
<td>The year (4 digits) the file timespan ends, based on Decomm file label block information.</td>
</tr>
<tr>
<td>IHAFN</td>
<td>The analog file number given in the file label block.</td>
</tr>
<tr>
<td>IHANCl</td>
<td>If meaningful, this parameter contains the ascending node count from the first orbit data item supplied for the Decomm file. IHANCl is meaningful only if IHORBC ≥ 0.</td>
</tr>
<tr>
<td>IHANC2</td>
<td>If meaningful, this parameter contains the ascending node count from the second &quot;ascending-node-crossing-data-item&quot; in the orbit data supplied for the Decomm file. This parameter is meaningful only if IHORBC ≥ 1.</td>
</tr>
<tr>
<td>IHANC3</td>
<td>If meaningful, this parameter contains the ascending node count from the second &quot;ascending-node-crossing-data-item&quot; in the orbit data supplied for the Decomm file. This parameter is meaningful only if IHORBC = 2.</td>
</tr>
<tr>
<td>IHATTC</td>
<td>The type of attitude computations given in the file label block. (See Attachment I for details.)</td>
</tr>
<tr>
<td>IHBEGT</td>
<td>The begin time of file (seconds of day) given in the file label block.</td>
</tr>
<tr>
<td>IHBFN</td>
<td>The buffer file number given in the file label block.</td>
</tr>
<tr>
<td>IHDECN</td>
<td>Decomm number given in the file label block.</td>
</tr>
<tr>
<td>IHDOY</td>
<td>Day count of year from the file label block.</td>
</tr>
<tr>
<td>IHENDT</td>
<td>End time of file (seconds of day) given in the file label block.</td>
</tr>
</tbody>
</table>
IHENTN  Number of sunlight-entrance times stored in the UNDAWN array.
IHEXPN  Experimenter number given in the file label block.
IHEXTN  Number of sunlight exit times stored in the UHDUSK array.
IHMTF   Master tape file number given in the file label block.
IHMTN   Master tape number given in the file label block.
IHORBC  IHORBC = -1 implies no ascending node count information is available for the current file. Otherwise IHORBC contains the number of changes in the ascending node count that appear in the orbit data items. (0, 1, or 2 are the only possibilities FEEDER will process.)
IHRN    Reel number given in the file label block.
IHSN    Station number given in the file label block.
IHSTN   Station tape number given in the file label block.
IHYEAR  Year (2 digits) given in the file label block.
QHENT(4) QHENT(N) = .TRUE. if and only if UHDAWN(N) was taken from an orbit data block on which a permanent I/O error occurred.
QHEXIT(4) QHEXIT(N) = .TRUE. if and only if UHDUSK(N) was taken from an orbit data block on which a permanent I/O error occurred.
QHIOE   QHIOE = .TRUE. if and only if I/O error occurred on the file label block.
QHMSGS  QHMSGS = .TRUE. if and only if FEEDER detected 1 or more of the following conditions in the array of information displayed in the HEADER window.

1. Contents of UHSCID did not match the value expected by FEEDER.

2. Year in label block was not in the 1970's.

3. Experimenter number was not 3.

4. Duration of file was greater than the maximum expected by FEEDER.
**QHVAC**

QHVAC = .TRUE. if and only if the contents of the HEADER window contain no meaningful information.

**UHDAY1**

Time (seconds of century) at 0000 hours of the day the file timespan begins, based on Decomm file label block information. This time is used in computing all other times supplied by FEEDER for data in the file. This time could be helpful to a calling program in converting times given in seconds of century to seconds of day.

**UHDAY2**

Time (seconds of century) at 2400 hours of the day the file timespan begins, based on Decomm file label block information.

**UHDUSK(4)**

Array of sunlight-exit times (seconds of century) taken from the orbit data records. The number of exit times stored in the array is given by IHEXTN and is not expected to exceed 1.

**UHLRFP(30)**

Array of floating point values given in the file label block. UHLRFP(N) contains the value given in characters (55+6N) through (60+6N) of the label block.

**UHSCID**

Spacecraft identification from the file label block. This parameter contains character information which can be printed using an A5 Fortran format code. (The 3 low-order bytes of this word contain blanks.)

**UHTANC**

If meaningful, this parameter contains the time (seconds of century) of the first "ascending-node-crossing-data-item" supplied for the Decomm file. This parameter is meaningful only if IHORBC = 1.

**UHTAN2**

If meaningful, this parameter contains the time (seconds of century) of the second "ascending-node-crossing-data-item" supplied for the Decomm file. This parameter is meaningful only if IHROBC = 2.

**UHTVOL**

Decomm tape volume name taken from the DD statement. This parameter contains character information which can be printed using an A6 Fortran format code. (The 2 low-order bytes contain blanks.)
### Figure IV A.1 Parameters Contained in the Header Window

<table>
<thead>
<tr>
<th>BYTES</th>
<th>DESCRIPTION</th>
<th>DATA TYPE</th>
<th>VALUES</th>
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<td>SATellite Number</td>
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<tr>
<td>9-16</td>
<td>STATION NUMBER</td>
<td>STATION NUMBER</td>
<td>FROM BCD</td>
</tr>
<tr>
<td>17-24</td>
<td>ANALOG FILE NUMBER</td>
<td>ANALOG FILE NUMBER</td>
<td>PORTION OF LABEL RECORD</td>
</tr>
<tr>
<td>25-32</td>
<td>DAY COUNT OF YEAR</td>
<td>DAY COUNT OF YEAR</td>
<td>VALUES</td>
</tr>
<tr>
<td>33-40</td>
<td>END TIME OF DAY (SECONDS)</td>
<td>END TIME OF DAY (SECONDS)</td>
<td>VALUES</td>
</tr>
<tr>
<td>41-48</td>
<td>DECOIM NUMBER</td>
<td>DECOIM NUMBER</td>
<td>FROM BCD</td>
</tr>
<tr>
<td>49-55</td>
<td>MASTER TAPE NUMBER</td>
<td>MASTER TAPE NUMBER</td>
<td>PORTION OF LABEL RECORD</td>
</tr>
<tr>
<td>56-64</td>
<td>TYPE OF ATTITUDE COMPUTATION</td>
<td>TYPE OF ATTITUDE COMPUTATION</td>
<td>VALUES</td>
</tr>
<tr>
<td>65-72</td>
<td>NUMBER OF SUNLIGHT ENTRANCE TIMES</td>
<td>NUMBER OF SUNLIGHT ENTRANCE TIMES</td>
<td>FROM BCD</td>
</tr>
<tr>
<td>73-80</td>
<td>I/O ERROR ON FIRST SUN ENTR.</td>
<td>I/O ERROR ON FIRST SUN ENTR.</td>
<td>ERROR ON FILE LABEL RECORD</td>
</tr>
<tr>
<td>81-88</td>
<td>I/O ERROR ON SECOND SUN ENTR.</td>
<td>I/O ERROR ON SECOND SUN ENTR.</td>
<td>ERROR ON FILE LABEL RECORD</td>
</tr>
<tr>
<td>89-96</td>
<td>I/O ERROR ON THIRD SUN ENTR.</td>
<td>I/O ERROR ON THIRD SUN ENTR.</td>
<td>ERROR ON FILE LABEL RECORD</td>
</tr>
<tr>
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<td>I/O ERROR ON FOURTH SUN ENTR.</td>
<td>ERROR ON FILE LABEL RECORD</td>
</tr>
<tr>
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<td>NUMBER OF SUNLIGHT EXIT TIMES</td>
<td>FROM BCD</td>
</tr>
<tr>
<td>113-120</td>
<td>I/O ERROR ON FIRST SUN EXIT</td>
<td>I/O ERROR ON FIRST SUN EXIT</td>
<td>ERROR ON FILE LABEL RECORD</td>
</tr>
<tr>
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<td>I/O ERROR ON SECOND SUN EXIT</td>
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<td>TIME AT 0000 HOURS OF DAY</td>
<td>TIME</td>
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<tr>
<td>153-159</td>
<td>TIME AT 2400 HOURS OF DAY</td>
<td>TIME AT 2400 HOURS OF DAY</td>
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<tr>
<td>160-168</td>
<td>FIRST FLOATING POINT WORD FROM FILE LABEL RECORD</td>
<td>FIRST FLOATING POINT WORD FROM FILE LABEL RECORD</td>
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<td>LAST (30TH) FLOATING POINT WORD FROM FILE LABEL RECORD</td>
<td>LAST (30TH) FLOATING POINT WORD FROM FILE LABEL RECORD</td>
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<td>DECOMM TAPE NAME (FROM DD STATEMENT)</td>
<td>DECOMM TAPE NAME (FROM DD STATEMENT)</td>
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<td>YEAR (4-DIGITS) AT START OF FILE</td>
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<td>425-432</td>
<td>COMPLETE MINUTES OF HOUR BEFORE START OF FILE</td>
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<td>ASC. MODE DATA INDICATOR</td>
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<td>ASC. MODE COUNT AT FIRST CROSSING</td>
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<tr>
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<td>ASC. MODE COUNT</td>
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<td>TIME (SECONDS OF CENTURY)</td>
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<td>Suggested Variable Names For The Header Window</td>
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**FORTRAN Coding Form**

**PROGRAM**

**PROGRAMMER**

**DATE**

**PUNCHING INSTRUCTIONS**

**GRAPHIC**

**PUNCH**

<table>
<thead>
<tr>
<th>FORTN STATEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implicit INTEGER<em>2(H), LOGICAL</em>1(Q), REAL*8(U)</td>
</tr>
<tr>
<td>COMMON /HEADER/VHSCID, ITHYEAR, IHSN, IHSN, ITHAFN, ITHAFN, IHDAY,</td>
</tr>
<tr>
<td>ITHMYT, ITHDAYT, ITHEXPN, ITHDECN, ITHAR, ITHMT, ITHMT, ITHMT,</td>
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<tr>
<td>ITHNTN, QHENT(4), UHDOWN(4), IHEXNT, QHEXIT(4), UHDUSK(4),</td>
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<tr>
<td>UHDAY1, UHDAY2, UHLRF(30)</td>
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<td>UHHTVOL, UHTAPN, UHFEILN, UHVAC, UHMSGS, UHIDE, UHXXX,</td>
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<td>UHYYB, UHMONE, UHDAY8, UHHRQ, UHMINE, UHSEC8,</td>
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<td>UHYYE, UHMONE, UHDAYE, UHARE, UHMINE, UHSEC8,</td>
</tr>
<tr>
<td>UHORC, IHTANC, IHTANC, IHTANC, UHTANC, UHTANC, UNUSED</td>
</tr>
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</table>

**Figure IV.A.3. Definition of the Header Window.**
B. Description of the ORBIT window

1. Format

The organization of the ORBIT window is shown in Figure IV.B.1 and is briefly described here. Before requesting orbit data, a calling program must enter a request time in the first word (suggested parameter name = UREQT) of the window. FEEDER responds, where possible, by completing the contents of the window. The sequence of parameters in the window is as follows:

a. Request time (seconds of century).

b. A vector of 4 data item times (seconds of century) from 4 consecutive data items. Where possible, FEEDER will select data item times so that the request time falls between the second and third of the 4 times.

c. Seventeen 4-element vectors containing single-precision floating point values. Each vector contains values corresponding to the 4 data-time times for one of the orbit parameters. The vectors are in the same order as listed in Attachment V, with the first vector containing the x-component of the satellite position and the last vector containing the ascending-node-crossing number.

d. A 4-element full word integer vector containing the type of data item indicators for the 4 data items.

e. Three 4-element single-byte logical vectors generated by FEEDER. These vectors contain flags pertaining to the data items returned in the window. A summary of these flag settings is posted in the INTERRUPTION vector whenever a calling program requests orbit data.

2. Definitions of ORBIT window parameters, by alphabetical order of suggested variable names

ALTKM(4)  ALTKM(N) is the height (km) of the satellite above the spheroid at time = UTIME(N).

ANXING(4)  ANXING(N) is the ascending-node-crossing number at time = UTIME(N).

BGAUSS(4)  BGAUSS(N) is the magnetic field strength (gauss) at time = UTIME(N).
DECMAG(4) DECMAG(N) is the declination (deg) of the magnetic field vector at time = UTIME(N).

ERMCIL(4) ERMCIL(N) is the McIlwain L parameter (earth radii) at time = UTIME(N).

GEOLAT(4) GEOLAT(N) is the geodetic latitude (deg) at time = UTIME(N).

GEOLON(4) GEOLON(N) is the geodetic longitude (deg) at time = UTIME(N).

ITEMID(4) ITEMID(N) is the type of data item code for time = UTIME(N).

1 implies regular item.
2 implies ascending node crossing.
3 implies north point item.
4 implies descending node crossing.
5 implies south point item.
6 implies sunlight-entrance item.
7 implies sunlight-exit item.

QOFILS(4) QOFILS(N) = .TRUE. if and only if the data item for time = UTIME(N) is the first data item (accepted by FEEDER) for a Decommm file.

QOIOE(4) QOIOE(N) = .TRUE. if and only if a permanent I/O error occurred on the orbit data block containing the data item for time = UTIME(N).

QOTGAP(4) QOTGAP(N) = .TRUE. if and only if the value of UTIME(N) exceeds the value of UTIME(N-1) by more than 60.001 seconds.

RAMAG(4) RAMAG(N) is the right ascension (deg) of the magnetic field vector at time = UTIME(N).

SUNXAU(4) SUNXAU(N) is the x-component (AU) of the solar vector at time = UTIME(N).

SUNYAU(4) SUNYAU(N) is the y-component (AU) of the solar vector at time = UTIME(N).

SUNZAU(4) SUNZAU(N) is the z-component (AU) of the solar vector at time = UTIME(N).

XKM(4) XKM(N) is the x-component (km) of the satellite position vector at time = UTIME(N).

XKMP5(4) XKMP5(N) is the x-component (km/sec) of the satellite velocity vector at time = UTIME(N).
$f_{KM}(4)$  $f_{KM}(N)$ is the y-component (km) of the satellite position vector at time $= UTIME(N)$.

$yKMP\dot{S}(4)$  $yKMP\dot{S}(N)$ is the y-component (km/sec) of the satellite velocity vector at time $= UTIME(N)$.

$Z_{KM}(4)$  $Z_{KM}(N)$ is the z-component (km) of the satellite position vector at time $= UTIME(N)$.

$ZKMP\dot{S}(4)$  $ZKMP\dot{S}(N)$ is the z-component (km/sec) of the satellite velocity vector at time $= UTIME(N)$.

$UREQT$  Time (seconds of century) for which the calling program requested orbit data.

$UTIME(4)$  Vector of times (seconds of century) for which FEEDER has supplied data items. For $N = 1, 2, 3$, $UTIME(N+1)$ is always greater than $UTIME(N)$. 
IMPLICIT INTEGER*2(H), LOGICAL*1(S), REAL*8(U)

COMMON /ORBIT, UREAT, UTME(4)
   XKM(4) YKM(4) ZKM(4) XKMP5(4) YKMPS(4) ZKMP5(4)
   GEOLON(4) GEOLAT(4) ALTKM(4) SUNXAU(4) SUNYAU(4) SUNZAU(4)
   LERMCIL(4) BGAUSS(4) RAMAC(4) DECMAG(4) ANXING(4)
   ITEMID(4) QC1OE(4) QOFILS(4) QOTGAP(4)

FIGURE IV.B.1. ORBIT WINDOW ORGANIZATION.
C. Description of the DECISION window

1. Format

The organization of the DECISION window is given in Figure IV.C.3. Figures IV.C.1 and IV.C.2 describe the organization of one pane of the window. Figure IV.C.1 is a chart of a window pane which briefly describes the information contained in each parameter. Figure IV.C.2 is also a chart of a window pane but which shows the assignment of suggested variable names to the parameters. The variable names suggested for DECISION window parameters were invented merely to aid in defining the organization of the window. Designers of calling programs will likely wish to rename these parameters since the double subscripting of the suggested variables will slow down program execution.

2. Definitions of parameters supplied by FEEDER in the DECISION window

These definitions are given in alphabetical order by the suggested variable names. Throughout these definitions, the subscript "N" will indicate pane N of the window.

ATTDAT

**ATTDAT(K,N)** contains the single-precision form of the K'th attitude word for the half-block. (For further details, see Figures IV.C.1, IV.C.2 and Data Format for OSO-H Experimenter Tape.) If the default option to omit processing attitude data is taken, FEEDER will initialize this array to zero and will not modify the contents of the array during program execution.

HPAFN

The number of analog subcom words for which some flag is set. In other words, HPAFN(1,N) contains a count of the number of nonzero entries in HPASF(K,N) for K = 1,10.

(Programming note: if HPAFN(1,N) = 0, any examination of analog subcom flag settings can be omitted.

HPASF

**HPASF(K,N)** is a collection of flags that pertain to the analog subcom word in HPASSV(K,N). If the bits of the half-word HPASF(K,M) are designated by "0000000ghfedcba", where 0's represent unused bits (set to zero) and "a" is the least significant bit, then:

bit i = 1 if and only if the sync status of the preceding half-block is uncertain because the wheel sync word was either missing or contained fill data.
bit h = 1 if and only if a slip in the wheel subcom data is indicated for the half-block.
bit g = 1 if and only if a slip in the wheel subcom data is indicated for the preceding half-block.
bit f = 1 if and only if the slip status in the wheel subcom is not clearly indicated for the preceding half-block.
bit e = 1 if and only if one or more sync errors occurred for the main frame containing the subcom word.
bit d = 1 if and only if one or more sync errors occurred for the main frame preceding the main frame containing the subcom word.
bit c = 1 if and only if the sync status of the preceding main frame is uncertain.
bit b = 1 if and only if the main frame containing the subcom word is a fill frame.
bit a = 1 if and only if fill data is supplied on the Decomm tape for the subcom word.

HPASSV  HPASSV(K,N) contains the value of the K'th analog subcom word for the half-block. By coincidence, HPASSV(K,N) is read out in main frame K and is identified as ASSC word K in the report OSO-H Experiment, Description and Operation, UNH Gamma Monitor, June 2, 1970. The report mentioned above and Figures IV.C.1 and IV.C.2 should adequately define the meaning of each of the 10 subcom words.

HPBLKN  HPBLKN(1,N) is the count of the block within the Decomm file from which the half-block originated.

HPDFN  The number of digital subcom words in the half-block for which some flag is set. In other words, HPDFN(1,N) is the count of nonzero entries in HPDSF(K,N), for K = 1,7.

(Programming note: if HPDFN(1,N) = 0, any examination of digital subcom flags can be omitted.)

HPDSF  HPDSF(K,N) is a collection of flags that pertain to the digital subcom word in both HPDSSV(K,N) and in HPDSIV(K,N). If the half-word HPDSF(K,N) is represented by "0000000ihgfedcba" where 0's represent unused bits (set to zero) and "a" is the least significant bit, then:

bit i = 1 if and only if the digital subcom status for the preceding half-block is uncertain because of either fill data or missing data for the digital subcom sync word.

bit h = 1 if and only if a slip in the digital subcom data is indicated for the half-block.
bit g = 1 if and only if a slip in the digital subcom data is indicated for the preceding half-block.

bit f = 1 if and only if the slip status for the preceding half-block is uncertain.

bit e = 1 if and only if one or more sync errors occurred for the main frame containing the subcom word.

bit d = 1 if and only if one or more sync errors occurred for the preceding main frame.

bit c = 1 if and only if the sync error status for the preceding main frame is uncertain.

bit b = 1 if and only if the main frame containing the subcom word is a fill frame.

bit a = 1 if and only if fill data is supplied on the Decomm tape for the subcom word.

HPDSIV (K,N) is the "interpreted" value of the K'th digital subcom word read out in the major frame represented by the half-block. Only the x-ray counts are interpreted by FEEDER; the time words and the energy ID word are left unchanged. If x is an x-ray count given by the Decomm tape, the interpreted values given in HPKSIV(K,N) for K = 1, 4, 6, or 7 are defined by f(x), where

\[
f(i) = \begin{cases} 
4(i-96) + 98, & \text{if } 0 \leq i < 95 \\
16(i-128)+232, & \text{if } 96 \leq i < 128 \\
64(i-160)+768, & \text{if } 128 \leq i < 160 \\
256(i-192)+2912, & \text{if } 160 \leq i < 192 
\end{cases}
\]

HPDSIV (1,N) is the functional interpretation of the digital subcom word value read out in main frame 9. Both the energy identification and the quadrant time for this word, if available, are in the preceding major frame.

HPDSIV (2,N) is the value of the digital subcom word read out in main frame 19. If meaningful, this word contains the energy identification for HPDSIV(K,N), where K = 3, 4, 5, 6, or 7 and for HPDSIV(1, N+1), assuming continuous data.

HPDSIV (3,N) is the value of the digital subcom word read out in main frame 22.

HPDSIV (4,N) is the functional interpretation of the digital subcom word value read out in main frame 23.

HPDSIV (5,N) is the value of the digital subcom word read out in main frame 24.
HPDSIV(6,N) is the functional interpretation of the
digital subcom word value read out in main frame 29.

HPDSIV(7,N) is the functional interpretation of the
digital subcom word value read out in main frame 47.

The meaning of unflagged entries in this array are
indicated in Figures IV.C.1 and IV.C.2 and are more
completely described in OSO-H Experiment, Description

HPDSSV

HPDSSV(K,N) is the source value of the K'th digital
subcom word read out in the major frame represented
by the half-block.

HPDSSV(K,N) = HPDSIV(K,N) for K = 2, 3 or 5.
f(HPDSSV(K,N)) = HPDSIV(K,N) for K = 1, 4, 6 or 7, where
f is the function described above for variable HPDSIV.

HPDTHF

HPDTHF(1,N) is a collection of flags pertaining to the
60th of the 64 main frame experiment words in the half-
block and applies to the contents of HPDTHW(1,N). The
pattern of flags contained in HPDTHF(1,N) is the same
as for all experiment words. If the bits of HPDTHF(1,N)
are represented by "0000000000edcba", where the 0's are
unused bits (set to zero) and "a" is the least significant
bit, then:

bit e = 1 if and only if one or more sync errors
occurred on at least one of the main frames
containing a portion of the experiment word.

bit d = 1 if and only if one or more sync errors
occurred on the main frame that preceded the
main frame containing the first portion of
the experiment word.

bit c = 1 if and only if uncertainty exists about
the status of the sync errors on the main
frame preceding the main frame containing the
first portion of the experiment word.

bit b = 1 if and only if any main frame containing a
portion of the experiment word was a fill frame.

bit a = 1 if and only if fill data was supplied for
either of the two main frame words containing
a portion of the experiment word.
HPDTHW
HPDTHW(1,N) contains 4 times the value supplied in the 60th of the 64 experiment words in this half-block. If pane(N-5) is the start of a readout for a quadrant of a full scan, then the sum of HPDTHW(1,N) and HPDTHW(1,N-5), if both parameters are meaningful and data are continuous, is the quadrant dead time as read out from the experiment's memory. The flags for HPDTHW(1,N) are given in HPDTHF(1,N). If a quadrant scan does not end on pane N, the contents of HPDTHW(1,N) are meaningless.

HPDTLW
HPDTLW(1,N) contains the intended value of the two lowest order bits of the second of the 64 experiment words in this half-block. If this pane is the start of a readout for a quadrant of a full scan, then the sum of HPDTLW(1,N) and HPDTHW(1,N+5), if both parameters are meaningful and data are continuous, is the quadrant dead time as read out from the experiment's memory. The flags for HPDTLW(1,N) are given in HPIDF(1,N). If a quadrant scan does not begin in pane N, the value in HPDTLW(1,N) is meaningless.

HPFILN
HPFILN(1,N) contains the sequence count of the file, within the Decommm tape, from which this half-block was read.

HPIDF
HPIDF(1,N) contains the collection of flags that pertain to the second of the 64 experiment words in this half-block. The meaning of the individual bits of HPIDF(1,N) is the same as described above for HPDTHF(1,N).

HPMFN
HPMFN(1,N) is a count of main frame experiment words that were processed from the half-block and which had one or more flags assigned. This count applied only to the main frame data which FEEDER can, under the options in effect, supply to the SCAN window. This count specifically excludes HPDTHW(1,N), HPDTLW(1,N), and HPSYNW(1,N).

(Programming note: If HPMFN(1,N) = 0, examination of flags for main frame data can be omitted for the major frame.)

If FEEDER is commanded to replace a half-block of main frame data corresponding to pane N by an edited version prepared by the calling program, then FEEDER counts the flags of the edited array and inserts the count in HPMFN(1,N). HPMFN(1,N) will remain unchanged if FEEDER is commanded to replace a half-block of decision data by an edited version prepared by a calling program.
HPSCTS  For the half-block in pane N, HPSCTS(1,N) is the count of nonfill minor frames for which 1 or more sync errors were reported in the flag field.

HPSSUM  HPSSUM(1,N) is the count of sync bits which were in error in all nonfill minor frames for the half-block in pane N.

HPSYNF  HPSYNF(1,N) is a collection of flags for the first of the 64 main frame experiment words in the half-block and whose value is given in HPSYNW(1,N). The meaning of the individual bits of HPSYNF(1,N) is the same as described above for HPDTHF(1,N).

HPSYNW  HPSYNW(1,N) contains the value of the first of the 64 main frame experiment words in the half-block. If this pane is the start of a quadrant scan, then HPSYNW(1,N), is meaningful, is the sync word for the scan and should contain 4095. If pane N is not the start of a quadrant scan, then the contents of HPSYNW(1,N) are not helpful.

HPTAPN  HPTAPN(1,N) is the sequence count of Decomm tapes (within the job step) from which the half-block was read.

HPTWIL  HPTWIL(1,N) is the number (from 1 to 48) of the main frame at which a change in the setting of the day-night indicator in the main frame flag field is detected. The main frame number is also taken from the flag field. HPTWIL(1,N) will either contain one of the numbers from 1 to 48 or HPTWIL(1,N)= 0 according as QPTWIL(1,N) = .TRUE. or QPTWIL(1,N) = .FALSE.

QPANY  QPANY(1,N) = QPVAC(1,N).OR.QPIOE(1,N).OR.QPFILS(1,N)
        .OR.QPTAPS(1,N).OR.QPTIMG(1,N).OR.QPFILL(1,N)

(Programming note: if QPANY(1,N) = .FALSE., no examination of the other parameters is necessary.)

QPATTF  Attitude flag field bits are represented, in left-to-right order, by QPATTF(K,N) with QPATTF(14,K) corresponding to the least significant bit of the attitude flag field. For further details see Figures IV.C.1 and IV.C.2 along with Attachment IV.

If the default option is taken to nonprocess attitude data, FEEDER will initialize this parameter's location to zero and will not further modify the area.

QPFILL  QPFILL(1,N) = .TRUE. if and only if the half-block contains only fill data.

QPFILS  QPFILS(1,N) = .TRUE. if and only if the half-block is the first half-block from a Decomm file.
QPJOE

QPJOE(1,N) = .TRUE. if and only if a permanent I/O error occurred on the data block from which the half-block in this pane was taken.

QPnite

QPnite(1,N) = .TRUE. if and only if the night indicator is set for the first nonfill main frame of the half-block. If QPFILL(1,N) = .TRUE., then QPnite(1,N) = .FALSE., but not conversely.

QPstat

QPstat(K,N) = .TRUE. if and only if a corresponding bit of the second of the 64 main frame experiment words is set to 1. QPstat(1,N) corresponds to the highest order bit while QPstat(10,N) corresponds to the second from the lowest order bit. Values from QPstat(K,N) are set regardless of main frame options in effect.

If pane N is the start of a quadrant scan and the second of the 64 main frame experiment words is meaningful, QPstat(K,N) will contain true-false interpretation of the main frame status bits. When QPstat(K,N) = .TRUE., its meaning is briefly indicated in Figures IV.C.1 and IV.C.2 and is more completely described in the report OSO-H Experiment, Description and Operation, UNH Gamma Ray Monitor, June 2, 1971.

If pane N is not the start of a quadrant scan, QPstat(K,N) contains useless information.

QPtaps

QPtaps(1,N) = .TRUE. if and only if the half-block is the first half-block of a Decomma tape.

QPtim

QPtim(1,N) = .TRUE. if and only if the difference

\[ \text{Uptime}(1,N) - \text{Uptime}(1,N-1) \]

varies from 15.36 seconds by more than 1 second. QPtim(1,1) is always set to .FALSE.

FEEDER's copy of QPtim(1,N) cannot be reset by a calling program except by revising the time words.

QPtwil

QPtwil(1,N) = .TRUE. if, for 2 different nonfill main frames, the day-night indicator for the main frame flag fields has different settings. [See QPnite(1,N) and HPTwil(1,N).]

QPvac

QPvac(1,N) = .TRUE. if and only if the current pane N of the window is not in use and does not reflect the contents of any half-block. This condition may be expected at the start of the first Decomma tape and at the end of the last Decomma tape.
UPTIME

UPTIME(1,N) contains the time (seconds of century) at the start of the major frame represented by the half-block.

The computation by FEEDER of values supplied in UPTIME(1,N) is described here to indicate possibilities for miscalculation. For each data block, the value of the milliseconds-of-day field is converted to seconds of day regardless of other anomalies, such as I/O errors, detected in the data block. If the result exceeds 5 seconds before the start time of day (which could be misinterpreted), the value in UHDAY1 (which could be wrong) is added to give the time for the first half-block. Otherwise, the value in UHDAY2 is added to compute the time of the first half-block. The time for the second half-block is computed by adding 15.36 to the time for first half-block.
Figure IV C.1 Parameters in each Pane of Decision Window

<table>
<thead>
<tr>
<th>Pane Flags</th>
<th>I/O Error for This Pane</th>
<th>First Pane in DECOMM File</th>
<th>First Pane in DECOMM Tape</th>
<th>Time Gap</th>
<th>Complete PAGE</th>
<th>This Page is 100% Fill Data</th>
<th>Tape Volume Count</th>
<th>Tape File Count</th>
<th>Block Count in File</th>
<th>Pane Flags</th>
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Table explaining parameters or values in each pane.
Figure IV.C.2. Suggested Variable Names for the Parameters in the N'th Pane of the Decision Window

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**FORTRAN Coding Form**

### PROGRAM

**DECISION WINDOW ORGANIZATION**

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<td>COMMON /DECIDE/ UDECIS(30,30)</td>
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<td>DIMENSION HDECIS(120,30), QDECIS(240,30)</td>
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<td>EQUIVALENCE (UDECIS(1,1), HDECIS(1,1), QDECIS(1,1))</td>
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<td>DIMENSION QA(NY(240,29), QPVAC(240,29), QTIME(240,29))</td>
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<td>QPFILE(240,29), QPTAPS(240,29), OPTIME(240,29), QPFILE(240,29),</td>
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*Standard card size. 130' fields are used. This form is continuous; feed this form.
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D. The SCAN data window

1. Organization

When requested to supply main frame experiment words to the SCAN data window, FEEDER assumes the window to begin with 16 data vectors followed by 16 flag vectors. (During initialization FEEDER zeros the entire 4096 bytes of the window.) All vectors are assumed by FEEDER to be either 8 bytes in length or 128 bytes in length, depending upon whether partial or complete main frame options, respectively, had been specified during the initial call to FEEDER.

The correspondence of DECISION window pane sequence numbers to vector sequence numbers is controlled in the calling program by parameters passed to FEEDER when a request is made for main frame data to be moved to the window. However, if FEEDER moves data into data vector N, the flag fields for the data are always moved into flag vector N.

2. Parameter definitions

HSCAN
The purpose of this parameter is to define the length of the window and to serve as a background parameter. However, when the complete main frame data option is in effect, HSCAN(K,N,1) contains the data value for the K'th experiment word in the N'th data vector while HSCAN(K,N,2) contains the corresponding flag field. The meanings of the bits of HSCAN(K,N,2) are the same as described for HPDTHF in the DECISION window.

HSDATL
HSDATL(K,N) contains the data value for the K'th experiment word stored in the N'th full length data vector. This parameter is to be used only when the complete main frame data option has been specified at initialization.

HSDATS
HSDATS(K,N) contains the value for the (K+60)th experiment word for the half-block whose data values are stored in the N'th short length (8 bytes) data vector. This parameter is to be used only when the partial main frame data option has been specified.

HSFLGL
HSFLGL(K,N) contains the flags pertaining to the data value contained in HSDATL(K,N). The bit meanings of HSFLGL(K,N) are the same as described for HPDTHF in the DECISION window. Like HSDATL, HSFLGL should be used only when the complete main frame data option has been specified.
HSFLGS(K,N) contains the flags pertaining to the data value contained in HSDATS(K,N). Like HSDATS, HSFLGS should be used only when the partial main frame data option has been specified. The bit meanings of HSFLGS are the same as described for HPDTHF in the DECISION window (see Section IV.C.2).
```
C  IMPLICIT INTEGER*2(I), LOGICAL*1(Q), REAL*8(U)
C
COMMON /SCANS/HSCAN(64,16,2)
DIMENSION HSDATL(64,16), HSDATS(4,16), HSFLGL(64,16),
HSFLGS(4,16)
EQUIVALENCE (HSCAN(1,1,1), HSDATL(1,1), HSDATS(1,1)),
(HSCAN(1,2,1), HSFLGS(1,1), HSFLG((1,1)))
C  FIGURE IV. D.2. SCAN DATA WINDOW ORGANIZATION.
```
E. Description of the INTERRUPTION vector window

1. Format

The organization of information supplied to a calling program via the INTERRUPTION vector is shown in each of Figures IV.E.1, IV.E.2, and IV.E.3. Figure IV.E.1 is a chart of the vector which hints at the meanings of the various parameters. Figure IV.E.2 is a similar chart which shows the assignment of suggested variable names to the parameters. Figure IV.E.3 is the Fortran statement necessary to define the suggested variables.

FEEDER employs different guidelines for resetting different portions of the INTERRUPTION vector. One section is always reset; other sections are completely reset, but for certain activities only; still other sections are treated as scratch areas to be used as needed.

a. Bytes 1-8 are always reset. A calling program must save any desired information from this portion before issuing another call to FEEDER.

b. Bytes 9-24 are completely reset whenever a calling program requests orbit data. These bytes are not modified by other commands.

c. The parameters in bytes 25-49, 55-56, 65-66 are a function of the current status of the DECISION window and are reset by FEEDER whenever a command affects the contents of the window.

(1) "Initial" command.
(2) "Advance-DECISION-window-N-panes" command.
(3) "Update-DECISION-window" command.
(4) "Delete-half-blocks" command.
(5) "Skip-N-files" command.

d. The remaining parameters of the DECISION window are used only as needed. The meaningfulness of such parameters is always indicated elsewhere.
2. Definitions of parameters in the INTERRUPTION vector, by alphabetical order of suggested variable names.

**HIDIOE(8,6)** Array of identifiers of Decomm tape blocks which caused permanent I/O errors. (This array is updated only when the occurrence of I/O errors is indicated both by HIOECT ≠ 0 and by QFIOEF = .TRUE.) Let N be the lesser of 6 and HIOECT. Then, for J = 1,N,

- **HIDIOE(1,J)** is the Decomm tape count within the current run for which, during last tape reading by FEEDER, the Jth I/O error occurred.
- **HIDIOE(2,J)** is the file count within the tape for the Jth I/O error.
- **HIDIOE(3,J)** is the block count within the file for the Jth I/O error.
- **HIDIOE(4,J)**, **HIDIOE(5,J)**, and **HIDIOE(6,J)** exist merely as a convenience to FEEDER and contain no helpful information.
- **HIDIOE(7,J)** contains the sense information provided in the 3rd and 4th bytes of the IOB (input-output block for the data set) after the I/O error was detected.
- **HIDIOE(8,J)** contains the status information from the channel status word after the I/O error was detected. FEEDER obtains this information from the 13th and 14th bytes of the IOB.

**HIOECT** The count of permanent I/O errors that occurred during the last call to FEEDER. (This parameter is reset with every call to FEEDER.)

**HNIOE** The count of panes in the DECISION window which result from Decomm tape blocks causing permanent I/O errors. (This parameter is updated each time the DECISION window is modified.)

**HNTIMG** The count of panes in the DECISION window for which the time disagrees with the time of the preceding pane. (This parameter is updated every time the DECISION window is modified.)

**HXFS1** The number of the first pane, if any, of the DECISION window which results from the first half-block of a Decomm tape file. (This parameter is updated only if QWFILS = .TRUE.)
The number of the second pane, if any, in the DECISION window which results from the first half-block of a Decomn tape file. (This parameter is updated only if QXSFIL = .TRUE.) All higher-numbered panes must be individually examined for this condition.

Vector of pane numbers which resulted from data blocks for which permanent I/O errors occurred. The contents of this vector are meaningless unless QWIOE = .TRUE. If meaningful, let N be the lesser of 4 and HNIOE. Then for J = 1,N, HXIOE(J) is the number of the Jth pane which is flagged as resulting from an I/O error.

If the value of HXIOE should exceed 4, the calling program will have to fish through the remainder of the DECISION window to locate those panes, after the 4th, which are flagged as resulting from an I/O error.

Vector of pane numbers which are flagged for time disagreement with preceding panes. (See QPTIMG definition in Section IV.C.2 of this report.) The contents of this vector are meaningful only if a time disagreement exists and is indicated both by QWTIMG = .TRUE. and by HNTIMG ≠ 0. If meaningful, let N be the lesser of the 19 and HNTIMG. Then, for J = 1,N, HXTIMG(J) is the number of the Jth pane to be flagged for time disagreement.

It seems preposterous to consider the possibility of overflowing this array. However, should HNTIMG exceed 19, and the calling program be too stubborn to lose interest, then the remainder of the DECISION window will have to be searched for other time gaps.

"Any-flag" indicator for the first 14 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

"Any-fill-half-block" indicator for the first 14 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

"Any-first-in-file-half-block" indicator for the first 14 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)
QDIOE  "Any-I/O-error" indicator for the first 14 panes of
the DECISION window. (This variable is updated whenever
the DECISION window is modified.)
QDIOE=QPIOE(1,1).OR.QPIOE(1,2).OR. ... .OR.QPIOE(1,14)

QDTAPS  "Any-first-in-tape-half-block" indicator for the first
14 panes of the DECISION window. (This variable is
updated whenever the DECISION window is modified.)
QDTAPS=QPTAPS(1,1).OR.QPTAPS(1,2).OR. ... .OR.QPTAPS(1,14)

QDTIMG  "Any-time-gap" indicator for the first 14 panes of
the DECISION window. (This variable is updated whenever
the DECISION window is modified.)
QDTIMG=QPTIMG(1,1).OR.QPTIMG(1,2).OR. ... .OR.QPTIMG(1,14)

QDVAC  "Any-vacancy" indicator for the first 14 panes of the
DECISION window. (This variable is updated whenever
the DECISION window is modified.)
QDVAC=QPVAC(1,1).OR.QPVAC(1,2).OR. ... .OR.QPVAC(1,14)

QFIOEF  =.TRUE. if and only if a permanent I/O error occurred
during the last call to FEEDER. (This variable is reset with every call to FEEDER.)

QHDERR  =.TRUE. if and only if the last call to FEEDER caused
the processing of a file label record containing un-
acceptable conditions. QHDERR=.TRUE. always causes
QUIT to be set to .TRUE., but not conversely. This
variable is updated with every call to FEEDER.

QOANY  "Any-flag" indicator for response to request of orbit
data. (This variable is updated with every request
for orbit data.)

QOCENT  "Off-center" indicator for orbit data. QOCENT=.TRUE.
implies the request time does not fall between the
second and third times of the orbit data items returned.
It also implies the request time is near an extreme
limit of currently stored orbit data. (This variable
is updated with every request for orbit data.)

QOCHNG  "ORBIT-count-change" indicator. QOCHNG=.TRUE. implies
the 4 data items returned do not all have the same
ascending node count. (This variable is updated with
every request for orbit data.)

QOEOF  "Any-EOF" indicator for orbit data. QOEOF=.TRUE.
implies the orbit data items returned do not all come
from the same file of the Decomm tape. (This variable
is updated with every request for orbit data.)
QOIOEF "Any-I/O-error" indicator for orbit data. QOIOEF=.TRUE. implies at least one of the orbit data items returned was taken from a block for which a permanent I/O error occurred. (This variable is updated with every request for orbit data.)

QOMISS "Unable-to-supply" indicator for orbit data. QOMISS=.TRUE. implies no data was available for the requested time. (This variable is updated with every request for orbit data.)

QONONE "No-orbit-data available" indicator. QONONE=.TRUE. implies FEEDER has no orbit data items stored. Likely causes of this condition are failure to specify orbit data processing option or lack of orbit data on quick-look tapes. (This variable is updated with every request for orbit data.)

QOTIMG "Time-gap" indicator for orbit data. QOTIMG = .TRUE. implies that, for a consecutive pair of the 4 data items returned, the difference between the data item times exceeded 60.001 seconds. (This variable is updated with every request for orbit data.)

QSANY "Any-flag" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

QSANY=QPANY(1,15).OR.QPANY(1,16).OR. ... .OR.QPANY(1,30)

QSFILL "Any-fill-half-block" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

QSFILL=QPFILL(1,15).OR.QPFILL(1,16).OR. ... .OR.QPFILL(1,30)

QSFILS "Any-first-in-file-half-block" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

QSFILS=QPFI LS(1,5).OR..OR. ... .OR.QPFILS(1,30)

QSIOE "Any-I/O-error" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

QSIOE=QPIOE(1,15).OR.QPIOE(1,16).OR. ... .OR.QPIOE(1,30)

QSTAPS "Any-first-in-tape-half-block" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)

QSTAPS=QPTAPS(1,15).OR.QPTAPS(1,16).OR. ... .OR.QPTAPS(1,30)
QSTIMG "Any-time-gap" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)
QSTIMG=QPTIMG(1,15).OR.QPTIMG(1,16).OR. ... .OR.QPTIMG(1,30)

QSVAC "Any-vacancy" indicator for the last 16 panes of the DECISION window. (This variable is updated whenever the DECISION window is modified.)
QSVAC=QPVAC(1,15).OR.QPVAC(1,16).OR. ... .OR.QPVAC(1,30)

QTAPEN =.TRUE. if and only if FEEDER has encountered the end of the last tape volume to be processed. This variable is updated with every call to FEEDER.

QUIT =.TRUE. only if further processing is either impossible or counter-productive. (This variable is updated with every call to FEEDER.)

QWANY "Any-flag" indicator for the entire DECISION window.
QWANY = QDANY.OR.QSANY

QWFILL "Any-fill-half-block" indicator for the DECISION window.
QWFILL = QDFILL.OR.QSFILL

QWFILS "Any-first-in-file-half-block" indicator for the DECISION window.
QWFILS = QDFILS.OR.QSFILS

QWIOE "Any-I/O-error" indicator for the DECISION window.
QWIOE = QDIOE.OR.QSIOE

QWTAPS "Any-first-in-tape-half-block" indicator for the DECISION window.
QWTAPS = QDTAPS.OR.QSTAPS

QWTIMG "Any-time-gap" indicator for the DECISION window.
QWTIMG = QDTIMG.OR.QSTIMG

QWVAC "Any-vacancy" indicator for the DECISION window.
QWVAC = QDVAC.OR.QSVAC

QXSFIL "Excess-file" indicator for the DECISION window.
QXSFIL=.TRUE. implies more than one half-block is flagged for being the first half-block from a Decommm tape file. (This variable is updated whenever the DECISION window is modified.)
### Figure IV E.1. Interruption Vector Parameters

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<thead>
<tr>
<th>Bytes</th>
<th>Description</th>
<th>Values</th>
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<td>1-8</td>
<td>CROSS ANOMALY</td>
<td>I/O ERROR JUST OCCURRED, NUMBER OF I/O ERRORS THAT JUST OCCURRED</td>
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<td>9-16</td>
<td>ANY OF NEXT 7 OR QUIT ORBIT DATA OFF CENTER</td>
<td>EOF EMBEDDED IN DATA ITEMS, NO ORBIT ITEMS RETURNED, TIME GAP IN ORBIT ITEMS</td>
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<td>17-24</td>
<td>ANY PANE FLAG</td>
<td>ANY EMPTY PANES, ANY PANES WITH I/O ERRORS, ANY NEW FILES</td>
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<td>25-32</td>
<td>2 OR MORE NEW FILES</td>
<td>NUMBER OF FIRST PANES FROM FIRST NEW FILE</td>
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<td>33-40</td>
<td>NUMBER OF FIRST PANES WITH I/O ERROR</td>
<td>NUMBER OF SECOND PANES WITH I/O ERROR</td>
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<td>41-48</td>
<td>NUMBER OF SECOND PANES WITH I/O ERROR</td>
<td>NUMBER OF THIRD PANES WITH I/O ERROR</td>
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<td>NUMBER OF THIRD PANES WITH I/O ERROR</td>
<td>NUMBER OF FOURTH PANES WITH I/O ERROR</td>
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<td>57-64</td>
<td>COUNT OF TIME GAPS BETWEEN PANES</td>
<td>NUMBER OF FIRST PANES PRECEDED BY TIME GAP</td>
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<td>NUMBER OF SECOND PANES PRECEDED BY TIME GAP</td>
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<td>2 OR MORE PANES</td>
<td>NUMBER OF FIRST PANE WITH 100% FILL</td>
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<td>NUMBER OF FIRST PANE WITH 100% FILL</td>
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<td>NUMBER OF THIRD PANE WITH 100% FILL</td>
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<td>13TH, 14TH BYTES OF I/O AFTER FIRST I/O ERROR</td>
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<td>121-128</td>
<td>2ND I/O ERROR</td>
<td>IDENTIFIERS, SENSE BYTES, FROM FEEDER'S</td>
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<td>4TH IDENTIFIERS, SENSE BYTES, FROM FEEDER'S</td>
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## Figure IV. E. 2  
**Suggested Variable Names For Interruption Vector.**

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<td>HIDIOE(1,7)</td>
<td>HIDIOE(2,7)</td>
<td>HIDIOE(3,7)</td>
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<td>HIDIOE(1,8)</td>
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</tbody>
</table>
```
* Figure IV.E.3. Suggested variables for interruption vector.

IMPLICIT INTEGER*(I), LOGICAL*(J), REAL*(K)

COMMON /INTRUP/QUIT,QFIOEF,HIXDEF,HIXDERR,QTAPEN,HIXXXX1,
        QVARY,QQXENT,QQCEOQ,EXCSS,QBITING,QDIOEF,QXCONQ,SRNONE,SRXXXX1,
        QQVARY,QQVAC,QQCEOQ,QQFILQ,QTAPR,QBITING,QQWILLQH@qqXX1,
        QQVARY,QQVAC,QQCEOQ,QQFILQ,QTAPR,QBITING,QQFILL,QQIXXX2,
        QQVARY,QQVAC,QQCEOQ,QQFILQ,QTAPR,QBITING,QQFILL,QQIXXX3,
        QQVARY,QQVAC,QQCEOQ,QQFILQ,QTAPR,QBITING,QQFILL,QQIXXX4,
        HXFX1,HXFX2,HXFX3,HXFX4,HXFX5,HXFX6,HXFX7,HXFX8,HXFX9,
        HXFX1,HXFX2,HXFX3,HXFX4,HXFX5,HXFX6,HXFX7,HXFX8,HXFX9
```
V. Detailed Description of the Commands to which FEEDER Responds

A sample CALL statement is provided for each command to provide a vehicle for defining the arguments passed. The first argument of every CALL statement identifies the command FEEDER is to execute.

Since the commands are presented in no particular sequence, the following index may be helpful.

<table>
<thead>
<tr>
<th>Section</th>
<th>Command Purpose</th>
</tr>
</thead>
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</tr>
<tr>
<td>V.B</td>
<td>Advancing the Decomm tape.</td>
</tr>
<tr>
<td>V.C</td>
<td>Retrieval of orbit data.</td>
</tr>
<tr>
<td>V.D</td>
<td>Retrieval of file label information.</td>
</tr>
<tr>
<td>V.E</td>
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<td>V.F</td>
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<td>V.G</td>
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<td>V.H</td>
<td>File skipping and tape skipping.</td>
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<tr>
<td>V.I</td>
<td>Displaying main frame data.</td>
</tr>
</tbody>
</table>

A. The "initial" command

CALL FEEDER (1,NTAPES,MFDOP,IATTOP,IDSOP,IASOP,IORBOP)

NTAPES The exact number of Decomm tapes to be processed during the job step.

MFDOP Option code to control the processing of main frame data to be supplied to the SCAN window.

MFDOP = 0 implies main frame data is not to be processed. (The 1st, 2nd, and 60th experiment words are processed for the DECISION window regardless of the option code passed via MFDOP.)

MFDOP = 1 implies all main frame data is to be processed. When subsequently requested to supply main frame data, FEEDER assumes the SCAN window to consist of 16 128-byte data vectors followed by 16 128-byte flag vectors.

MFDOP = 2 implies PHA channel counts are to be ignored. FEEDER will respond by processing the 61st through 64th experiment words for each half-block. (Of course, if the half-block does not end a quadrant scan, the 61st-64th experiment words will again be unwanted channel counts.) Only these 4
experiment words will be tested to establish the flag count contained in the HPMFN(1,N) variable in the DECISION window. When subsequently requested to supply main frame data, FEEDER will assume the SCAN data window to consist of 16 8-byte data vectors followed by 16 8-byte flag vectors.

If the value of MFDOP is not 0, 1, or 2, FEEDER will set QUIT = .TRUE. and assume a value of 0.

**IATTOP**
Option code to control the processing of attitude data words.

IATTOP = 0 implies omission of attitude data from the DECISION window for the current job step. The ATTDAT and QPATTF variable locations (see Figure IV.C.2) will be initially zeroed and subsequently ignored by FEEDER.

IATTOP ≠ 0 implies attitude data values are to be processed and to be placed in the DECISION window.

**IDSOP**
Option code to control the processing of digital subcom data.

IDSOP = 0 implies omission of digital subcom data from the DECISION window during the current job step. The HPDSSV, HPDSIV, HPDSF variable locations (see Figure IV.C.2) will be initially zeroed and subsequently ignored by FEEDER.

IDSOP ≠ 0 implies digital subcom data are to be processed and to be placed in the DECISION window.

**IASOP**
Option code to control the processing of analog subcom data words.

IASOP = 0 implies omission of processing wheel analog subcom words 3-10. Words 1 and 2 are processed regardless of the option specified by IASOP. The locations reserved in the DECISION window for words 3-10, and for their associated flags, are initialized to zero and are subsequently ignored by FEEDER. (See variables HPASSV and HPASF in Figure IV.C.2) Only words 1 and 2 will be examined to determine the count of flagged words for the variable HPAFN (1,N) in the DECISION window panes.

IASOP ≠ 0 implies all 10 wheel analog subcom words are to be processed and to be placed in the DECISION window.
IORBOP Option code to control the processing of orbit data.

IORBOP = 0 implies no orbit data needed during the current job step. If a subsequent request for orbit data is made, FEEDER will assume the calling program is insane and will set QUIT = .TRUE.

IORBOP = 1 implies only regular orbit data items are desired. FEEDER will store the first data item for each file, regardless of data item type. Subsequent special data items will be discarded and only regular data items stored to supply requests for orbit data.

IORBOP = 2 implies all orbit data items required.

If the value of IORBOP is not 0, 1, or 2, FEEDER will assume a value of 0 and will set QUIT = .TRUE.

Orbit data blocks are scanned for sun-entrance times, for sun-exit times and for ascending node crossings, regardless of the option specified by IORBOP.

B. The "advance-DECISION-window-N-panes" command

CALL FEEDER (2,N)

Where the value of N is the number of panes the DECISION window and associated main frame data are to be advanced. The response made by FEEDER varies with the value of N.

N < 0. FEEDER sets QUIT = .TRUE. and takes no further action.

N = 0. The display FEEDER most recently made in the DECISION window is reproduced. No other action takes place.

1 ≤ N ≤ 16. The contents of the first N panes are lost. The contents of the remaining (30-N) panes are shifted to the first (30-N) panes so that what was formerly in the (N+1)st pane is now in the 1st pane; what was formerly in the (N+2)nd pane is now in the 2nd pane, etc. Then N half-blocks are read from the Decomm tape to complete the new DECISION window display. The set of main frame data stored by FEEDER is updated to correspond to the new contents of panes 15-30 of the DECISION window, provided a main frame processing option has been elected. Appropriate settings are made for the QPANY(1,N) and the QPTIMG(1,N) flags. Finally, flag summaries and associated pointers are determined and placed in the INTERRUPTION vector.
N > 17. FEEDER recognizes this as a plunge forward into the unknown and will limit the advance, if necessary, to guarantee the contents of pane 14 after the advance will have originated from the same file as did pane 30 before the advance. Otherwise, FEEDER's response is the same as for $1 \leq N \leq 16$.

C. The "fetch-ORBIT-data-for-time-T" command

CALL FEEDER (3)

The ORBIT window variable UREQT is assumed by FEEDER to contain the request time T.

If the option had been specified to omit orbit data processing, FEEDER will set QUIT = .TRUE., appropriately set response flags in bytes 9-16 of the INTERRUPTION vector, but take no other action. In particular, the ORBIT window is unmodified by the command.

If time T falls within the range of available data, FEEDER will complete the ORBIT window. Let $t_1, t_2, \ldots t_n$ denote the times for which FEEDER has stored orbit data items. FEEDER will complete the ORBIT window if $t_1 \leq T < t_n + 60.000$, where all times are in seconds. If $T$ falls near enough to the lower (or upper) limit so that $T < t_2$ (or $T > t_{n-1}$), then FEEDER will enter the first 4 (or last 4) data items in the ORBIT window and will set QOCENT = .TRUE. Ordinarily FEEDER will select 4 consecutive data items for times $t_i, t_{i+1}, t_{i+2},$ and $t_{i+3}$ so that $t_{i+1} < T < t_{i+2}$.

If time T falls outside the range of available data ($T < t$, or $T > t_n + 60.000$ or no data available), FEEDER appropriately sets the response flags in bytes 9-16 of the INTERRUPTION vector, but takes no other action. In particular, the ORBIT window remains unchanged by the command.

D. The "fetch-file-information" commands

Two commands are available, one to obtain the information for the newer file currently being read by FEEDER and (older) file. For either command, the retrieved information is placed in the HEADER window.
1. Retrieving information from the older file

CALL FEEDER (4)

There is no information for an older file at the start of the first tape. Under certain circumstances there may be no information for an older file at the start of subsequent tapes. Consequently, it would be prudent to follow the command by examining the QHVAC parameters in the HEADER window.

2. Retrieving information from the newer file

CALL FEEDER (5)

E. The "update-DECISION-window" command

This command allows a calling program to edit one or more panes of the DECISION window. Displays made in the DECISION window are copies of a storage area containing what FEEDER considers to be the true status of the window. This command orders FEEDER to alter the contents of that storage area.

CALL FEEDER (6,NPANES,NFROM,NTO)

NPANES The number of consecutive panes to be revised.

NFROM The number of the DECISION window pane containing the revised information for the first pane to be edited. If NPANES > 1, the remaining revised information is taken from consecutively higher numbered panes.

NTO The number of the DECISION window pane (in storage) in which FEEDER is to place the revised information. In other words, the value of NTO is the number of the first pane to be edited. If NPANES > 1, the remaining revised information is placed in consecutively higher numbered panes.

FEEDER executes this command by performing the following sequence of tasks:

1. Bytes 1-8 of the INTERRUPTION vector are zeroed.

2. NPANES, NFROM, and NTO are inspected for reasonable values. If impossible values exist, FEEDER sets QUIT = .TRUE. and takes no further action.
3. New values for all parameters except HPMFN(1,N) are moved to each of the panes being edited. The exception of the HPMFN(1,N) parameter allows updating of corresponding main frame data to be performed either before or after the updating of DECISION data.

4. The QPANY(1,N) and QPTIMG(1,N) flags are reset appropriately for every pane in the DECISION window.

5. Flag summaries and pointers in the INTERRUPTION vector are reset to reflect the contents of the revised DECISION window.

6. The DECISION window is displayed in its edited form.

(Programming note: Any pane of the DECISION window may be used by a calling program to build an edited version of a pane. The proper contents of the building area will be displayed after FEEDER has completed the update. But be sure to first save any useful values that will be wiped out.)

F. The "update-main-frame-data" command

This command allows a calling program to edit main frame data corresponding to one or more panes of the DECISION window. Main frame data, which is supplied only by request, is kept by FEEDER in its own storage area. This command orders FEEDER to alter the contents of that area.

CALL FEEDER (7,NVECTS,NVECT1,NPANE1)

NVECTS The number of consecutive data vectors (and corresponding flag vectors) which contain the edited version of the main frame data.

NVECT1 The number of the first data vector (as well as of the first flag vector) which contains the edited main frame data. If NVECTS > 1, the remaining edited data is taken by FEEDER from consecutively higher numbered vectors.

NPANE1 The number of the first DECISION window pane for which corresponding main frame data is to be modified. If NVECTS > 1, the remaining edited data replaces main frame data corresponding to consecutively higher numbered DECISION window panes.
FEEDER responds by performing the following sequence of tasks:

1. Bytes 1-8 of the INTERRUPTION vector are zeroed.

2. NVECTS, NVECT1, and NPANEL are examined for reasonable values. If impossible values are detected or if the option to omit main frame data processing had been specified, FEEDER sets QUIT = .TRUE. and takes no further action.

3. The edited main frame data is moved as specified.

4. For each pane whose corresponding main frame data has been revised, the revised main frame flags are counted and the count is placed in the HPMFN(1,N) parameter.

G. The "delete-half-block" command

This command allows a calling program to shorten a section of the DECISION window so that the number of panes agrees with the number of major frames represented. Squeezing out a half-block containing only fill data is expected to be one of the applications for this command.

CALL FEEDER (8,NPANES,NPANEL)

NPANES The number of consecutive panes which are to be deleted from the DECISION window. NPANES is also the number of DECISION window panes for which corresponding main frame data will be deleted.

NPANEL The number of the first DECISION window pane to be deleted.

The DECISION window displayed by FEEDER after executing this command will show:

1. The first (NPANEL-1) panes are unchanged.

2. The data formerly in pane (NPANEL + NPANES) will be in pane NPANEL, the data formerly in pane 30 will be in pane (30-NPANES), and intermediate data will also be shifted by NPANES panes.

3. NPANES new half-blocks, Decomm tapes permitting, will be at the upper end of the DECISION window.
Main frame data that FEEDER can supply will also be updated to correspond to the half-blocks in DECISION window panes 15-30.

If the values of NPANES and NPANEL make the command impossible, FEEDER will set QUIT = .TRUE. and take no other action.

H. The "skip-N-files" command

This command allows a calling program to bypass substantial data on a Decomm tape without causing FEEDER the labor of processing the unwanted intervening information. The command can be modified to skip the remainder of a Decomm tape, if desired.

CALL FEEDER (9,N)

Where the value of N indicates the number of files to be skipped. The response made by FEEDER varies with the value of N:

N < 0. The current tape is dismounted and reading begins on the next tape. When control is returned, FEEDER has read enough of the next tape so that the first 16 half-blocks are in panes 15-30 of the DECISION window while the first 14 panes will be empty. No file information will be available for the HEADER window prior to the first file of the next tape, and neither will any orbit data be saved from previous files.

N ≥ 1. Decomm files are counted starting with file 0 being the file from which DECISION window pane 30 was taken prior to the file-skip command. If file N lies beyond the first file of the next tape, then FEEDER limits its response to be equivalent to a tape skip described above for N = 0. Otherwise, FEEDER proceeds as follows:

1. Files are skipped as necessary until file (N-1) is reached.

2. File information is taken (for the HEADER window) and orbit data is saved from file (N-1).

3. FEEDER proceeds more cautiously to retain the last 14 half-blocks of file (N-1) for the DECISION window. When control is returned, the first half-block from file N will be in pane 15 of the DECISION window. If options require it, orbit data will be available for file N, as well as some orbit data for the last part of file (N-1). File information from either file (N-1) or file N can be placed in the HEADER window.
I. The "fetch-N-vectors-of-main-frame-data" command

CALL FEEDER (10,N,NPANEL,NVECT1)

N
The number of consecutive DECISION window panes for which the corresponding main frame data is to be placed in the SCAN data window.

NPANEL
The number of the first DECISION window pane for which corresponding data is to be moved to the SCAN data window. If \( N > 1 \), remaining data is taken corresponding to the next (N-1) higher numbered panes.

NVECT1
The number of the data vector and of the corresponding flag vector to which values for pane NPANEL are moved. If \( N > 1 \), the remaining data and flags are moved to the next (N-1) higher numbered vectors.

If the values of \( N, \) NPANEL, NVECT1, make the command impossible, FEEDER will set QUIT = .TRUE. and take no further action.
Subroutine ADRESS

<table>
<thead>
<tr>
<th>Program Language</th>
<th>IBM-360 0/S Assembler Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>June 29, 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>A. Buck</td>
</tr>
<tr>
<td>Installation</td>
<td>University of New Hampshire</td>
</tr>
<tr>
<td></td>
<td>Space Science Center</td>
</tr>
<tr>
<td>Computer</td>
<td>IBM-360-H50</td>
</tr>
<tr>
<td>Subprograms Called</td>
<td>None</td>
</tr>
<tr>
<td>Description</td>
<td>Subroutine ADRESS initializes storage areas supplied by subroutine GETCOR. Storage areas are partitioned appropriately and addresses of the various partitions are stored as required by subroutine FEEDER and its subservient routines. Partition-in-use flags, where present, are set to indicate the partition is not currently in use.</td>
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</table>
Subroutine DECISION

<table>
<thead>
<tr>
<th>Program Language</th>
<th>IBM-360 O/S Assembler Language</th>
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</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>September 3, 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>A. Buck</td>
</tr>
<tr>
<td>Installation</td>
<td>University of New Hampshire</td>
</tr>
<tr>
<td></td>
<td>Space Science Center</td>
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<td>IBM-360-H50</td>
</tr>
<tr>
<td>Subprograms Called</td>
<td>None</td>
</tr>
</tbody>
</table>
| Description              | This subroutine performs all processing of main frame data, subcom data, and flag fields contained in one data block of a Decommm tape. For each of the two major frames, subroutine DECISION:

   A. Completes main frame storage partitions in accordance with the main frame data processing option in effect. In the event the short partition option is selected, the four experiment words are placed at the beginning of the allotted storage area.

   B. Nearly completes the DECISION window pane. The only DECISION pane parameters not developed by the subroutine are:

   QPANY Which depends on QPFILS and QPTAPS.

   QPFILS Which only FEEDER can set properly.

   QPTAPS Which only FEEDER can set properly.

   UPTIME Which FEEDER must develop to determine the proper settings for preceding sync flags.
Subroutine GETCOR

Program Language : Fortran IV, G-Level
Date Written : June 29, 1971
Programmer : A. Buck
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50
Dummy Arguments : None
Description : Subroutine GETCOR contains storage areas to be used by subprogram FEEDER and its subservient routines. GETCOR is called during initialization and in turn calls subroutine ADDRESS to relay area addresses to FEEDER.
Subroutine HEADEREC

Program Language : IBM-360 O/S Assembler Language
Date Written : June 4, 1971
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50
Subprogram Called : None
Description : Subroutine HEADEREC is designed to assist subprogram FEEDER by reformatting information in the file header record and storing the reformatted information to replace the older information in the two HEADER windows. (The term HEADER window here means an area of core storage containing information about a Decomm file in a form that is usable by a Fortran program. Most of the information is taken from the file header record.) In addition, subroutine HEADEREC computes time constants useful to other routines in analyzing orbit data records and experiment data to follow within the file.
Subroutine ORBSTOR

Program Language : IBM-360 O/S Assembler Language
Date Written : June 23, 1971
Programmer : A. Buck
Installation : University of New Hampshire
               Space Secience Center
Computer : IBM-360-H50
Subprograms Called : TAPREAD
Description : Subroutine ORBSTOR assists subprogram
               FEEDER by processing orbit data records
               in accordance with user options. ORBSTOR
               is to be called after the header record
               has been processed but before further
               requests to TAPREAD are made. ORBSTOR
               calls TAPREAD to supply all orbit data
               records and processes these records.
               ORBSTOR returns control to FEEDER as soon
               as a record is read normally but which
               does not identify as an orbit data record.
               Then, when control is returned to FEEDER,
               the first data record in the file is
               presumably available is the buffer whose
               address is stored at 'ABUFFNEW' (see
               DSECT defined by the symbol 'CONTORG').

A. All orbit data items are scanned
   for sunlight-entrance times and for
   sunlight-exit times. These times
   are stored in the newer of the two
   HEADER windows.

B. If the user has elected the orbit
   data option, orbit data is stored as
   described in subroutine ORBWNDW.

C. If the user has elected the all
   item option as well as the orbit data
   option, all data items are stored if
   possible. If the user refuses the all
   item option, only the earliest data
   item and subsequent regular data
   items are stored.
Subroutine ORBWNDW

Program Language : IBM-360 O/S Assembler Language

Date Written : May 3, 1971

Programmer : A. Buck

Installation : University of New Hampshire
               Space Science Center

Computer : IBM-360-H50

Subprograms Called : None

Description : This subroutine assists subroutine
               FEEDER by handling all requests for
               OSO-H orbit data (Ephemeris) values.
               Subroutine ORBWNDW locates, where
               possible, and returns a set of 4 values
               for each of 22 orbit data parameters.
               These 4 values correspond to a set of
               times which are centered as nearly as
               practical about a requested time. (All
               times are seconds of 20th century in
               double precision, floating point format.)

               Data is returned by ORBWNDW in a contiguous
               storage area called the 'ORBIT data win-
               dow'. The window area is 340 bytes in
               length and must originate in a double
               word boundary.

               OSO-H orbit data (i.e., Ephemeris data)
               applying to a particular experimenter
               tape file is located on tape records at
               the beginning of the file and preceding
               records containing experiment data.
               When the orbit data records are read,
               the FEEDER subprogram converts the in-
               formation to IBM-360 format and stores
               it for subsequent recall. (If the user
               fails to specify the orbit data options,
               the FEEDER subprogram will merely scan
               the orbit data for sunlight-entrance and
               exit times. No storage occurs and no
               recall is possible.) Since much of the
               OSO-H 3 data is read out at a time after
it was recorded, the FEEDER subprogram must retain some orbit data from the previous file to ensure providing orbit data corresponding to the time data was recorded.

Orbit data is recalled by specifying a time T near which values for orbit parameters are requested. Let \([T(1), T(2),... T(N)]\) be the times for which orbit data is stored. Subprogram FEEDER will, if possible, return 4 orbit data values for all orbit data values for all parameters for the set of times \([T(I), T(I+1), T(I+2), T(I+3)]\) which most nearly brackets time T. In particular:

A. If the user has failed to specify the orbit data processing option, FEEDER will:
   1. Print a message indicating the conflict.
   2. Set a flag indicating no orbit data returned.
   3. Set a flag indicating program should be aborted.

B. If T is less than T(1), or if T is greater than T(N) + 59999 msec., FEEDER will set a flag indicating no data returned.

C. If T is less than T(2) but not less than T(1) FEEDER will:
   1. Return values corresponding to T(1), T(2), T(3), T(4).
   2. Set a flag indicating times are not centered.

D. If T is greater than T(N-1) but less than \([T(N) + 60000 \text{ msec}]\), FEEDER will:
   1. Return values corresponding to T(N-3), T(N-2), T(N-1), T(N).
   2. Set a flag indicating times are not centered.
E. If $T$ is not less than $T(2)$ and not greater than $T(N-1)$, FEEDER will return sets of values corresponding to

Set of times $(T(I), T(I+1), T(I+2), T(I+3))$ where $T$ exceeds $T(I+1)$ but does not exceed $T(I+2)$.

In all, 22 orbit data parameters are managed by subprogram FEEDER.
Subroutine TAPREAD

Program Language : IBM-360 O/S Assembler Language
Date Written : August 17, 1971
Programmer : A. Buck
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Subprograms Called : None
Description : This subroutine assists subprogram
               FEEDER by reading and positioning OSO-H
               Experimenter Decomm tapes. The 7-track
               Decomm tapes are to be read using the
               data converter feature.

               End-of-file conditions are indicated
               to subprogram FEEDER by means of a return
               code in general register 15. Return codes
               of 0, 4, and 8 indicate no tape marks
               encountered during activity, record re-
               turned is first record after last tape
               mark detected during activity, and end
               of volume (2 consecutive tape marks)
               detected with no record returned.

               TAPREAD performs any of 4 tasks depending
               on the command code passed via general
               register 1.

               REGl=0  The next block is read from the
                        Decomm tape. If the first read
                        encounters a tape mark, the file
                        count is incremented, block count
                        reset to zero, and a second read
                        issued and checked.

               REGl=4  Any Decomm tape currently open is
                        closed and dismounted. The DDNAME
                        parameter for the next tape is
                        placed in the DCB and the next
                        tape opened. The first block is
                        read and returned.
REGl=8 The full word defined by the symbol FILESKIP (in FEEDER's control area) contains the number of files TAPREAD is to skip, beginning with the current file. The specified number of files are skipped and the first block is read from the following file and returned. If EOV limits the file skipping, the full word denoted by the symbol FILESKIP contains the number of files not skipped.

REGl=12 If possible, the 7th from the last block of the current file is read and returned.
FEEDER Messages

Subprogram FEEDER communicates to the user through a series of messages indicating

A. The condition of the input tapes and the data files on those tapes.

B. Requests made by the user that cannot be met.

C. Input/output errors.

D. Difficulties during program execution due to anomalies in the data. (Flags are usually set and printed to help determine the problem area.)

The following is a list of the message numbers and corresponding messages printed out by FEEDER subroutines. Each message is followed by a brief explanation.
M010. HEADER RECORD FAULTY. SATELLITE ID = ____________,
YEARS = ____________, EXPERIMENT NO. = ____________, BEGIN
TIME = ____________, END TIME = ____________

Explanation: Either the satellite identifier, the range of
years, the experiment number, the interval between time and
end time are inconsistent with the UNH-OSO experiment. These
are considered intolerable conditions. A quit-requested flag
is posted in the interruption vector.

M020. REQUEST FOR ORBIT DATA CONFLICTS WITH ORBIT OPTION.

Explanation: The user failed to elect the orbit data proces-
sing option and then later asked for orbit data. This message
is printed at most once per file.

M030. REQUEST FOR ORBIT DATA WHEN NONE IN STORAGE.

Self-explanatory. This could occur if quick-look tapes were
being used as input while the option to process orbit data
was in effect. This message is printed once per file at most.

M040. REQUESTED ORBIT DATA NOT IN STORAGE.

Self-explanatory. The request time of data did not fall with-
in the range of orbit data times of the orbit data currently
in storage. This message is never printed more than once per
file.

M050. END-OF-FILE DETECTED BY ORBIT DATA STORAGE ROUTINE.

Explanation: The organization of the experimenter tape is
incorrect.

M060. I/O ERROR AND ORBIT-DATA-ID ERROR CAUSED REFUSAL OF
EXPECTED ORBIT RECORD.

Explanation: The record was bypassed because of the existence
of both of the named conditions.

M070. ORBIT DATA IMPROPERLY TERMINATED ON TAPE.

Self-explanatory. The orbit data may or may not have been
properly filed.
M080. NO ORBIT DATA RECORDS IN FILE.
Self-explanatory.

M090. UNEXPECTED ORBIT DATA RECORD.
Explanation: The record identifier indicates the record contains orbit data. This contradicts the prediction based on the preceding record. Both records are accepted.

M100. INVALID DAY-OF-YEAR CAUSED ORBIT DATA RECORD REFUSAL.
Explanation: Day-of-year count of first data item disagrees with both possible day of year counts computed from the header record. The orbit data record is bypassed.

M110. INVALID DAY-OF-YEAR CAUSED DATA-ITEM REFUSAL. ITEM WAS SUNLIGHT ENTRANCE OR EXIT ITEM.
Explanation: An orbit data item was bypassed for the reason given. However, other orbit data items from the same record may have been successfully processed.

M120. OVERFLOW ON SUNLIGHT TIME ARRAY.
Explanation: The list of day-night exceeds planned storage. Only first four items are saved.

M130. TAPEMARK AT START OF TAPE NO.__________, SER = ____.
Explanation: Tapemark encountered at start of tape.

M150. I/O ERROR OCCURRED ON BLOCK _______ OF FILE _______ OF TAPE _______ (SER = _______) ON UNIT _______. SENSE = ________, STATUS = ________.
Explanation: Input/output error has occurred; usually a result of either bad tape or problem tape drive.

M160. NON-STANDARD BLOCK LENGTH = _______ COLORS ON BLOCK _______ OF FILE _______ OF TAPE _______ (SER = _______) ON UNIT _______.
Self-explanatory. Block of data of incorrect block size has been read.
M170. UNEXPECTED FRAME COUNTS AT BLOCK _____________.  
Self-explanatory.

M180. TIME FIELD DAY COUNT = _____ INSTEAD OF ____ OR ________.  
Explanation: Day of year count disagrees with both possible day-of-year counts computed from the header record.

M190. COMMAND CODE OUT OF ALLOWABLE RANGE.  
Self-explanatory: Command code is greater than 10.

M200. COMMAND PRECEDED INITIALIZATION COMMAND.  
Self-explanatory: Initialization command must be issued before other commands to FEEDER can be executed.

M210. INITIALIZATION COMMAND ISSUED MORE THAN ONCE.  
SUBSEQUENT COMMAND REFUSED.  
Self-explanatory.

M220. FEEDER TO PROCESS # _____ TAPES, (accept or reject) WASC WDS 3-10, accept or reject ATT DATA, (accept or reject) ORBIT ITEMS.  
Explanation: Message is printed after initialization command has been issued to indicate options selected by user.

M230. INVALID DECOMM TAPE COUNT.* 1 SUBSTITUTED.  
Explanation: Tape count may not exceed 12.

M240. INVALID MF DATA PROCESSING OPTION CODE. 0 SUBSTITUTED.  
Explanation: Code must be 0, 1, or 2.

M250. INVALID ORBIT OPTION CODE. 0 SUBSTITUTED.  
Explanation: Code must be 0, 1, or 2.
M260. INVALID PARAMETERS TO UPDATE DECISION WINDOW.
Explanation: Call arguments invalid.

M270. INVALID PARAMETERS TO UPDATE MAIN FRAME DATA.
Explanation: Call arguments invalid.

M280. INVALID PARAMETERS TO DELETE HALFBLOCKS.
Explanation: Call arguments invalid.

M290. FILESKIP TERMINATED BY EOV AT END OF FILE
Self-explanatory.

M300. INVALID PARAMETERS TO FETCH MAIN FRAME DATA.
Explanation: Call arguments invalid.

M310. ALL PANES ARE VACANT. END-OF-DATA FLAG IS
Explanation: Indicates no data in decision window.
FEEDER TO PROCESS 1 TAPES, ACCEPT ALL 4F DATA, ACCEPT 35Y 4DS, ACCEPT W 4C 4DS 3-10, ACCEPT ATT DATA, ACCEPT REG ORBIT ITEMS.

M140. BLOCK 1 READ FROM FILE 1 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 2 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 3 OF TAPE 1 (SER=EADZ24).

M140. BLOCK 1 READ FROM FILE 4 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 5 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 6 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 7 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 8 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 9 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 10 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 11 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 12 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 13 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 14 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 15 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 16 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 17 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 18 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 19 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 20 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 21 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 22 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 23 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 24 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 25 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 26 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 27 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 28 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 29 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 30 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 31 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 32 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 33 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 34 OF TAPE 1 (SER=EADZ24).

M170. UNEXPECTED FRAME COUNTS AT BLOCK 140.

M140. BLOCK 1 READ FROM FILE 1 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 2 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 3 OF TAPE 1 (SER=EADZ24).

M110. INVALID DAY-OF-YEAR CAUSES ORBIT DATA RECORD REFUSAL.

M140. BLOCK 1 READ FROM FILE 1 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 2 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 3 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 4 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 5 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 6 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 7 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 8 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 9 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 10 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 11 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 12 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 13 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 14 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 15 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 16 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 17 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 18 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 19 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 20 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 21 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 22 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 23 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 24 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 25 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 26 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 27 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 28 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 29 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 30 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 31 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 32 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 33 OF TAPE 1 (SER=EADZ24).
M140. BLOCK 1 READ FROM FILE 34 OF TAPE 1 (SER=EADZ24).
M220. FEEDER TO PROCESS 8 TAPES, ACCEPT ALL MF DATA. ACCEPT DSM 053, ACCEPT WASC WOS 3-10, ACCEPT ATT DATA, ACCEPT REG ORBIT ITEMS.

M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 1 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 2 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 3 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 4 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 5 OF TAPE 1 (SER=EXD314).
M170. UNEXPECTED FRAME COUNTS AT BLOCK 20.
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 6 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 7 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 8 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 9 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 10 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 11 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 12 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 13 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 14 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 15 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 16 OF TAPE 1 (SER=EXD314).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 1 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 2 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 3 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 4 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 5 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 6 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 7 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 8 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 9 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 10 OF TAPE 2 (SER=EXD315).
M040. REQUESTED ORBIT DATA NOT IN STORAGE.
        **** M140. BLOCK 1 READ FROM FILE 11 OF TAPE 2 (SER=EXD315).
Section 2

PASS-I

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XVIII. Subroutine SUMCAL (KFSUMY,KTSUMY)

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XX. Subroutine ENPLTA

XXI. Subroutine FGET (IDSN,IRSLT,IOVEC)

XXII. Subroutine INITPL

XXIII. Subroutine OUTLINE

XXIV. Description of INPUT

XXV. Description of OUTPUT

XXVI. Sample OUTPUT
I. Introduction

There are six possible options to this PASS. The options can be executed in any combination depending on the parameters specified on the control card. The options are as follows:

A. Engineering plot.

B. Line summary.

C. Calibration cards.

D. X-ray tape.

E. Good time cards.

F. Main frame data tape.

The engineering plots are constructed for the various log rate meters which monitor the counting rates of the scintillators comprising the instrument. Temperature, voltages, and status are also monitored. The output of the program is stored on a Memorex-3660 disk and then 7-track plot tapes are created in a second job step. The plots contain status information and housekeeping information rates for the central detector, cup, and slab.

Each line in the one-line summary represents information for three minutes of satellite data. This corresponds to the accumulation of a complete gamma ray spectrum. Time, rates, status, sync errors, and warnings are printed.

The calibration data consists of the central channels of the three gamma peaks in the calibration spectrum interpolated from a quadratic least squares fit to each peak. The total counts in each peak and the midpoint of the time interval during which the calibration was accumulated are also included.

The X-ray data is obtained from the Experiment tapes with detailed spin and timing information to allow exact time correlations of the X-ray data with solar activity indices from other experiments. This data is stored on a 9-track tape which is Fortran compatible and may be used on the IBM-360-H50. A 7-track reformatted version is also generated for use on a Varian-620/i minicomputer.
The good time cards consist of begin and end midpoint of the accumulation times for good continuous data. Only data collected when the central detector was on and with no time gaps is considered "good". These cards are later used as input into Pass-III.

Main frame data for each quadrant scan collected when power was on is written onto a 9-track tape along with analog data and read-out time. The tape is then converted to 7-track for use on the Varian-620/i minicomputer with Tektronix-4010 display unit interface.
II. Macro Systems Flowchart (PASS-I)

EXP DATA TAPES

CONTROL CARD

STEP 1
PASS-I
MAIN PRGM
OSOP103C

DISK STORAGE
LINE SUMMARY
Error List
FILE SUMMARY
TAPE SUMMARY
RUN SUMMARY

CALIBRATION
CARDS

X-RAY
TAPE
9 TRK

GOOD TIME
CARDS

X-RAY
CONVERSION
PROGRAM

7 TRK
X-RAY TAPE
VARIAN

MAIN FRAME
DATA TAPE
9 TRK

UTILITY
IEBGENER

7 TRK
MF TAPE
VARIAN

STEP 2
PASS-I
PLOT
DRIVER

7 TRK
PLOT
TAPES
III. Job Stream Schematic (PASS-I)
IV. JOB CONTROL LANGUAGE - PASS-I

// T548, 20, 60), 'CROTEAU, PASS-I', CLASS=E, TIME=10, REGION=240K,
// MSGLEVEL=(1,1)
//STEP1 EXEC PGM=OSOP103G, TIME=10
//STEP18 DD DSN=USER,T548,SUBLIB,DISP=SHR
//DECOM1 DD UNIT=TAPE7,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD224
//DECOM2 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD307
//DECOM3 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD308
//DECOM4 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD346
//DECOM5 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD347
//DECOM6 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD329
//DECOM7 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD330
//DECOM8 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD317
//DECOM9 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD318
//DECOM10 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD319
//DECOM11 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD029
//DECOM12 DD UNIT=AFF=DECOM1,DISP=OLD, LABEL=(1,NL,,IN),
 // DCB=(BLKSIZE=1000, DEN=1, TRTCH=C),
 // VOLUME=SER=EXD030
//FPUTO1 DD UNIT=2400,DISP=(NEW, KEEP), LABEL=(1,SL),
 // DSNAME=XRAY, DCB=(RECFM=FB, LRECL=76, BLKSIZE=1520),
 // VOLUME=SER=CC0920
//FPUTO2 DD UNIT=2400,DISP=(NEW, KEEP), LABEL=(1,SL),
 // DSNAME=MFDATA, DCB=(RECFM=FB, LRECL=908, BLKSIZE=908),
 // VOLUME=SER=MFD020
//FTWT01 DD UNIT=SYSDA,DSN=&&PLOTCOM,DISP=(NEW, PASS),
 // DCB=(BLKSIZE=6500), SPACE=(TRK,(200,1000),RLSE)
//FT19F001 DD UNIT=SYSDA,DISP=(NEW, PASS),DSN=&&NPLOT,
 // DCB=(RECFM=FB, LRECL=24, BLKSIZE=24), SPACE=(TRK,1)
//MSGDD DD SYSDOUT=A
//SYSDUMP DD SYSDOUT=A
//FT06F001 DD SYSDOUT=A, DCB=(RECFM=UA, BLKSIZE=133)
//FT07F001 DD SYSDOUT=B, DCB=(RECFM=F, BLKSIZE=80)
//FT15F001 DD SYSDOUT=A, DCB=(RECFM=UA, BLKSIZE=133)
//FT16F001 DD SYSOUT=A,DCB=(RECFM=UA,BLKSIZE=133)
//FT17F001 DD SYSOUT=A,DCB=(RECFM=UA,BLKSIZE=133)
//FT18F001 DD SYSOUT=A,DCB=(RECFM=UA,BLKSIZE=133)
//FT20F001 DD SYSOUT=A,DCB=(RECFM=UA,BLKSIZE=133)
//FT05F001 DD *

1 1 1 1 1 1 0 0 1 1 1 1 0 199
/*
//STEP2 EXEC PLOTGLG,REGION=126K,TIME.GO=10
//LKED.SYSLIB DD DSN=USER.T317.SUBLIB,DISP=SHR
// DD DSN=USER.T548.SUBLIB,DISP=SHR
// DD DSN=SYS1.FORTLIB,DISP=SHR
// DD DSN=USER.PLOTLIB,DISP=SHR
// DD DSN=USER.SSPLIB,DISP=SHR
//LKED.SYSLMOD DD DSN=&GOSET(SUE2)
//LKED.SYSIN DD *

*** OSOP104A OBJECT DECK ***
/*
//GO.FT32F001 DD UNIT=(TAPE7,,DEFER),DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO1
//GO.FT32F002 DD UNIT=AFF=FT32F001,DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO2
//GO.FT32F003 DD UNIT=AFF=FT32F001,DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO3
//GO.FT32F004 DD UNIT=AFF=FT32F001,DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO4
//GO.FT32F005 DD UNIT=AFF=FT32F001,DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO5
//GO.FT32F006 DD UNIT=AFF=FT32F001,DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO6
//GO.FT32F007 DD UNIT=AFF=FT32F001,DSN=PLOTTER,DISP=(NEW,KEEP),
// LABEL=(1,BLP),
// DCB=(DEN=1,TRCH=ET,BUFNO=1,RECFM=U,BLKSIZE=1024),
// VOL=SER=PLOTO7
//GO.FT19F001 DD DSNAME=&&PLOT,DISP=(OLD,DELETE),DCB=(RECFM=F,
// LRECL=24,BLKSIZE=24)
//GO.FGET01 DD DSN=&PLOTCOM,DISP=(OLD,DELETE),DCB=(RECFM=F,
// LRECL=6500,BLKSIZE=6500)
//GO.SYSUDUMP DD SYSOUT=A
//GO.SYSIN DD *
/*
//
V. Data Processing Program (OSOP103C)

Program Language : Fortran IV, H-Level
Date Written : January 1972
Programmer : A. Buck
Installation : University of New Hampshire
               Space Science Center
Computer : IBM-360-H50
Subprograms Called : FORTIM, FEEDER, MOVER, PLOUT, SUMARY,
                     SUMCAL, FTWRIT, FPUT, CALNDR, QUASH,
                     PUZZLE, OUTPUT

The purpose of this program is to control the flow of data, to select and edit valid sections of data, and to output these selected sections according to desired options.

The basic functions performed by the program are as follows:

A. The initialization (and reinitialization) of variables referenced by OUTPUT.

B. The input of experiment data using FEEDER.

C. The rejection of data due to I/O errors, illogical data, indeterminate data, and high voltage off.

D. The assignment of time sequence identifiers to each major frame. Locating and identifying the start of the background scan and start of solar scan.

E. The selection of sets of consecutive input major frames for processing (optimally, 12 major frames comprising 1 full scan are selected)

1. Same file
2. Same scan mode
3. Same calibration status
4. Not over three minutes of data.
5. Followed by start of background scan.

F. The production of data anomaly messages.

G. The production of summaries for each file, for each tape, and for the entire run.

H. The output of:
   1. Data anomaly messages.
   2. File summary.
   3. Plot frame count.
   4. Return code.
   5. Engineering data tables to be plotted.

I. The call to OUTPUT.

The inputs to this program are:

A. The experimenter data tape.

B. The option specification card (otherwise known as the control card).

The outputs of this program are:

A. For each run
   1. FEEDER messages - printer.
   2. Data condition messages - printer.
   3. File summaries - printer.
   5. Return code.
B. Optional Outputs

1. Engineering plot tables - disk.

2. Line summaries - printer.

3. Calibration cards - card punch.

4. X-ray data - tape.

5. Good time cards - card punch.

6. Main frame data - tape.

Subprogram FEEDER uses common storage to provide this program with the input data. This program, in turn, provides subservient routines with the information they need to examine the selected data through common storage. In the following pages, the variables in common storage are described to help the reader follow program logic.

A. Labelled common areas

1. COMMON/HEADER/ : description of variables can be found in Section 1 of this report.

2. COMMON/DECIDE/ : description of variables can be found in Section 1 of this report.

3. COMMON/INTRUP/ : description of variables can be found in Section 1 of this report.

4. Extension to COMMON/INTRUP/ : the following is a list and description of the variables that form the extension to the interruption vector.

   a. X-ray tape parameters

   (Note: all variables beginning with an H are integer half words; variables beginning with a U are double precision floating point words; variables beginning with a Q are logical bytes (8 bits); all other variables follow the explicit Fortran conventions.)

   HYRR1 : year of 1st major frame.

   HYRR2 : year of 2nd major frame.

   HDAY1 : day of 1st major frame.

   HDAY2 : day of 2nd major frame.

   HHR1 : hour of 1st major frame.
HHR2 : hour of 2nd major frame.
HMIN1 : minutes of 1st major frame.
HMIN2 : minutes of 2nd major frame.
SEC1 : seconds of 1st major frame.
SEC2 : seconds of 2nd major frame.
HSTAT1 : status of 1st major frame.
HLSOL : solar 7.5 - 15 keV (interpreted counts).
HM1SOL : solar 15 - 30 keV (interpreted counts).
HM2SOL : solar 30 - 60 keV (interpreted counts).
HHSOL : solar 60 - 120 keV (interpreted counts).
HLBKD : background 7.5 - 15 keV (interpreted counts).
HM1MKD : background 15 - 30 keV (interpreted counts).
HM2BKD : background 30 - 60 keV (interpreted counts).
HHBKD : background 60 - 120 keV (interpreted counts).
HSQT1 : solar quadrant time of 1st major frame.
HSQT2 : solar quadrant time of 2nd major frame.
HBQT1 : background quadrant time of 1st major frame.
HBQT2 : background quadrant time of 2nd major frame.
HSTAT2 : status word of 2nd major frame.
ASPIN1 : spin rate of 1st major frame.
ASPIN2 : spin rate of 2nd major frame.
AZZ1 : azimuth encoder time of 1st major frame.
AZZ2 : azimuth encoder time of 2nd major frame.
HELCAL : electronic calibration: 1 = on 2 = off.
HRAD : radiation calibration: 1 = on 2 = off.
HDANT : day - night indicator: 1 = day 2 = night.
HFIL : extra half-word.
b. Main frame data tape parameters:

HYR : year of read-out.
HMO : month of read-out.
HDA : day of read-out.
HJUL : Julian day of read-out.
HHR : hour of read-out.
HMN : minutes of read-out.
HSE : seconds of read-out.
HAN(60) : analog subcom words (10 words per major frame).
HMFDAT(384) : main frame data (raw counts).
HTGAP : time gap indicator: '1' = time gap '0' = no time gap.
HFRCNT : # major frames processed in section.
HEXTRA : extra word.

c. Other arrays and variables provided in COMMON/INTRUP/

ASWSOD IMAGGY JXPANE(15) LPFPX QSOL1
BG(4) IMFD KACDSN LSDOY QSOL2
FRCTN IMG1 KADDSN LSTPLT QSSCHG
HLCAL(16) IMINH KAMDSN LXPAPI(16) QSWSCON
HLMODE(16) IOPT KAUSEX LXPANE SWSOD
HLSOLR(16) IPLICIT KFWHSC LXPLT(16) TTHSOD
HLSTAT(16) IQD1 KGAPSC MAXEND TPSOD
Hprev IRCNT KJCDSN MPU2SC UBGDCT
HTFN(6) IRUNDA KJDDSN MSEVER UEGDT
IBKSL1 IRUNT KJMDSN MSGID(2) UHFSOC
IBKSL2 ISCN1 KLOSSC MSGINC UPLTGO
ICALIB ISCSTR KLSDNS MSGSET ULSTAT
ICNTRO ISHD1 KNCDSN NAFPANE
ICNTRO1 ISHLDO KNDDSN NAQUAD
ICOFF ISTDLD KNMDSN NABOS
IDAH ISTDHD KONDAND(7) NBOS
IDAYHD ISTPNN LABOS NOSEQD
IDNITE ISTPL1 LADOY NOWHV
IDN1 IXPANE LAMODE(16) NFIL
IERROR IXRAY LASHV ODSCHG(15)
IFILST IXSEQD(3,7) LBOS OGAP
IGDT IZERO(133) LHDECN QGIVUP
IGNH IZ(16) LHFBLK QSET
IGNL JPXMTH(47) LHFDAY QSHVON
IHRH JPXMOD(47) LHFPX QSHVON
ILIST JXBGN1(47) LISEND QSLVOF
ILSUMY JXDIEF LPFDAY QSLVON
ASWSOD : time (seconds of day) of sync word values saved.

BG(4) : array of 4 half-words containing the alphamerie characters SO, BO, BK, BO.

FRCTN : contains the quotient of 1/390.625. This value is used in the calculation of clock time.

HLCAL(16) : calibration status code. HDCAL(1) = HLCAL(2):
0 → no calibration.
1 → radiation calibration in progress.
2 → electronic calibration in progress.
4 → no calibration in progress but immediately follows a calibration.

(Note: code 4 appears once only for the half-scan following a calibration.)

HLMODE(16) : scan mode indicator. HDMODE(1) = HLMODE(2):
6 → full scan.
2 → intermediate scan.
1 → short scan.
0 → do not know.

HDMODE(J) = half-scan length (major frames) of mode indicated by J'th beginning of scan in panes 15 - 29.

HLMODE(1) is used to save most recent value of HDMODE from previously processed major frames.

HLSOLR(16) : solar - background indicator HDSOLR(1) = HLSOLR(2).

HDSOLR(J) = 0 or 1 according as solar or background was indicated in J'th beginning of scan in panes 15 - 29.

HLSOLR(1) is used to save the most recent value of HDSOLR from the previously processed major frames.

HLSTAT(16) : Status bits other than solar - background. HDSTAT(1) = HLSTAT(2):

HDSTAT(J) = status bits for J'th beginning of scan in panes 15 - 29.
HLSTAT(1) = used to save the most recent value of HDSTAT from previously processed major frames.

HLSTAT(1) = -1 implies that there are meaningless values is HLSOLR(1), HLMODE(1), LXPLT(1), HLCAL(1), ULSTAT, LSDOY, LSSOD.

HPREV : -1 indicates there is no previous status.

HTFN(6) : array containing file and tape delimiters.

IBKSL1 : refers to the scan mode of the beginning good time being saved in the good time card section of OUTPUT: = 1 for SO (solar) = 4 for BO (both).

IBKSL2 : refers to the scan mode of the ending good time being saved in the good time card section of OUTPUT: = 3 for BK (background) = 4 for BO (both).

ICALIB : = 1 indicates that calibration cards are desired.

ICNTRLO : status line hold area for central - detector on - off indication: 1 = on 2 = off.

ICNTRL : alphameric representation of the central - detector on - off indication for status line. ON or OFF.

ICOFF : hold area for central detector on - off indication in the plot section of OUTPUT.

IDAYH : saved day of last printed status line.

IDAYHD : day - night hold area in x-ray section of OUTPUT.

IDNITE : hold area for the numeric representation of day - night condition for status line: 1 = day 2 = nite.

IDN1 : alphameric representation of day - night indication for status line: DAY or NITE.

IERROR : = 1 if a problem occurred in OUTPUT that requires run termination by the main program. (e.g. I/O error occurred in tape write).

IFILG : filler.

IFILR : filler.

IFILST : = 1 to indicate a file start which signifies that a status line should be printed,
IGDT : = 1 to indicate that good time cards are desired.
IGNHL : hold area for gain indication in line summary section of OUTPUT: 1 = hi 2 = lo.
IGN1 : alphanumerical representation for the gain indication to be printed in the status line: HI or LO.
IHRH : saved hours of day printed in the last status line.
ILIST : = 1 to indicate line summary is desired.
ILSUMY : = 1 to force program to save day, hour, minutes and seconds of the status line.
IMAGGY : hold area for magnetometer-gyro reference to be printed in status line: 1 = magnetometer 2 = gyro.
IMFD : = 1 to indicate that a main frame data tape is desired.
IMGL : alphanumerical representation of the magnetometer-gyro reference to be printed in status line. MAG or GYRO.
IMINH : saved minutes of status line.
IOPT : 0 = combination of options desired.
          1 = engineering plot only.
          2 = line summary only.
          3 = calibration cards only.
          4 = x-ray tape only.
          5 = good time cards only.
          6 = main frame data tape only.
IOPT is read in from the control card.
IPLSOT : = 1 to indicate the engineering plot is desired.
IQDL : alphanumerical representation of the normal-alternate quadrant to be printed in status line: NORM or ALT.
IRCNT : the number of main frame data tape records written.
IRUNDA : run date (argument used in call to FORTIM).
IRUNT : run time (argument used in call to FORTIM).

ISCN1 : alphameric representation of the scan mode to print in the status line. F, I, or S.

ISCSTR : hold area for the scan mode to be printed in status line: 1 = FULL 2 = INTER 3 = SHORT.

ISHDI : alphameric representation of the shield on - off indication to be printed in the status line: ON or OFF.

ISHLDO : numeric representation of the shield on - off indication to be saved with the printing of the status line: 1 = ON 2 = OFF.

ISTHLD : status hold area in x-ray tape section of OUTPUT.

ISTPHD : step number hold area in plot section of OUTPUT.

ISTPNH : step number hold area in line summary section of OUTPUT.

ISTP1 : step number print area for status line.

IXPANE : index of first pane of current section.

IXRAY : = 1 to indicate that the x-ray tape option is desired.

IXSEQD(3,7) : for J = 1, NOSEQD
IXSEQD(I,J) = index of I'th pane, J'th digital sequence. (An index of 0 implies fill is to be used.)

IZERO(133) : an array equivalent to various other arrays for initialization purposes.

IZZ(16) : array equivalent to IXAPLT(15).

JPXMOD(47) : array used to express scan mode identification code as a function of monitor array index:

0 + not determined.
1 + full.
2 + intermediate.
3 + short.
4 + cannot tell.
JPXMTH(47) : array used to express method of assigning scan
mode identification as a function of monitor
array index.

A method code of:

0 implies sheer guessing due to complete lack
of scan mode clues.

1 implies mode determined from the first of
two continuous status words.

2 implies mode determined throughout a complete
scan from valid status word within the scan.

3 implies mode determined filling an identifi-
cation gap by using the HGAPOS and HIDFIL
arrays.

4 implies mode determined from analog data.

5 implies mode determined by free wheeling.

JXBGND(47) : array used to express start of complete scan
as a function of monitor array index:

\[ JXBGND(J) = 1 \text{ if a complete scan starts in major } \]
\[ \text{frame corresponding to monitor index } = J, \]
\[ = 0 \text{ otherwise} \]

JXDIFF : index conversion factor = (JPXID(N)-N).

JXPANE(15) : pane indices of frames containing status words.

KACDSN : first calibration print data set (not used after
program maintenance).

KADDSN : first dump data set.

KAMDSN : first message print data set.

KAUSEX : dump necessity indicator:

0 → do not dump.

1,3 → status word loss.

2,3 → analog sync loss.

KFWHSC : message severity code of '1'.

KGAPSC : message severity code of '2'.
KJCDSN : increment for calibration print data set.
KJDDSN : increment for dump data set.
KJMDSN : increment for message print data set.
KLOSSC : message severity code '2'.
KLSDSN : line summary data set (logical unit 6).
KNCDSN : last calibration print data set.
KNDDSN : last dump data set.
KNMDSN : last message print data set.
KOMAND(7) : area that contains the data requirements desired by the user and requested by FEEDER.
LABOS : count of analog sync words recognized in section.
LADOY : time (day of year) of sync word values saved.
LAMODE(16) : scan mode indicator: JAMODE(1) = LAMODE(2)
JAMODE(J) contains the mode (1=full, 2=intermediate, 3=short, 4=not available) indicated in ASSC 1-2 following the analog sync word whose plot index is given in JXAPLT(J).
LAMODE(1) is used to save the mode corresponding to LXAPLT(1).
Frame containing scan mode must immediately (in time) follow sync word frame.
LASHV : high voltage indicator for previous section (0 = off, 1 = on).
LBOS : count of status words in current section.
LHDECN : Decomm run number * 100 + file count.
LHFBLK : block number of last major frame handled (whether or not included in line summaries).
LHFDOY : time (day of year) of last frame handled (whether or not included in line summaries).
LHFPIX : plot index of last major frame handled (whether or not included in line summaries).
LISEND : maximum plot index for which entries allowed.
LPFD0Y : time (day of year) of the last major frame processed (included in line summaries).

LPFPX : plot index of last major frame processed (included in line summaries).

LSDOY : time (day of year) of saved status parameter values.

LSTPLT : plot index of the last pane to have been processed.

LXAPLT(16) : plot indices: JXAPLT(1) = LXAPLT(2).

\[ LXAPLT(1) = -10,000 \] no plot index saved from previous data.

LXPANE : index of last pane of current section.

LXPLT(16) : plot index of frame containing status word: JXPLT(1) = LXPLT(2).

\[ JXPLT(J) = \text{plot index for } J\text{'th beginning of scan in panes 15 - 29.} \]

LXPLT(1) is used to save most recent value of JXPLT from previously processed major frames.

MAXEND : GLB of pane indices after current section due to status word synchronization.

MPUZSC : message severity code of '0'.

MSEVER : message severity codes.

MSGID(2) : alphameric message set fields.

MSGINC : message set count increment.

MSGSET : message set counter.

MXPANE : number of last pane for current section due to status word sync requirements.

NAQUAD : hold area for normal - alternate quadrant to be printed in status line: 1 = normal  2 = alternate

NABOS : count of analog sync words recognized or count of sync words for analog word 1 in panes 15 - 29.

NBOS : count of status words recognized in window or count of beginning of scans in panes 15 - 29.

NOSEQD : count of sequences selected for x-ray processing or number of digital sequences identifiable in current section.
NOWHV : high voltage indicator for current section
(0 = on  1 = off).

NPFIL : number of entries in IHORB.

QDSCHG(15) : QDSCHG(J) = .TRUE. implies the status indicated
for the J'th beginning of scan in panes 15 - 29
represents a change from the status in the pre-
vious beginning of scan. [The solar-background
bit and the low-order dead time bits are ignored
in the setting of QDSCHG(J).]

QGAP : .TRUE. indicates time gap is present.

QGIVUP : program perplexity indicator.

  .TRUE. → dump, do not process.

QSET : = .TRUE. indicates good time card information to
be punched.

QSHVOF : shield or central detector OFF condition observed
(in DECISION window).

QSHVON : shield or central detector ON condition observed
(in DECISION window).

QSLVOF : low voltage OFF condition observed (in DECISION
window).

QSLVON : low voltage ON condition observed (in DECISION
window).

QSOL1 : = .TRUE. if normal background quadrant has been
processed for main frame data section of OUTPUT
and solar quadrant is now to be processed.

QSOL2 : = .TRUE. if abnormal (time gap) background
quadrant has been processed and solar quadrant
is now to be processed. (Main frame data sec-
tion of OUTPUT.)

QSSCHG : any-status-change-in-section indicator.

QSWCON : status word continuity indicator.

SWSOD : time (seconds of day) of saved status parameter
values.

THFSOD : time (seconds of day) of last major frame handled
(whether or not included in line summaries).
TPFSOD : time (seconds of day) of last major frame processed (included in line summaries).
UBGDT : beginning good time in seconds of century.
UEGDT : ending good time in seconds of century.
UHFSOC : time (seconds of century) of last major frame handled (whether or not included in line summaries).
UPLTGO : time (seconds of century) of first plot element.
ULSTAT : time (seconds of century) of saved status parameter values.

B. Unlabelled common area:

HHOUR(1300) : hour of each major frame: -2 = no value.
HDAY(1300) : day-night status: 0 = no value 1 = day 2 = night.
HNALT(1300) : normal-alternate quadrant: 0 = no value 1 = normal 2 = alternate.
HMAG(1300) : magnetometer-gyro reference: 0 = no value 1 = magnetometer 2 = gyro.
HCOFF(1300) : central detector: 0 = no value 1 = on 2 = off.
HSOFF(1300) : shield: 0 = no value 1 = on 2 = off.
HTEL(1300) : electronic temperature: -2 = no value.
HDET(1300) : detector temperature: -2 = no value.
HCNTR(1300) : central detector voltage: -2 = no value.
HSPRT(1300) : shield counts: -2 = no value.
HLOW(1300) : low voltage: -2 = no value.
HSGAL(1300) : solar gamma counts .3 - 9 MeV: -2 = no value.
HBGAL(1300) : background gamma counts .3 - 9 MeV: -2 = no value.
HSGAH(1300) : solar gamma counts > 9 MeV: -2 = no value.
HBGAH(1300) : background gamma counts > 9 MeV: -2 = no value.
HCUPS(1300) : solar cup charged particle count: -2 = no value.
HCUPB(1300) : background cup charged particle counts: -2 = no value.
HSLSB(1300) : solar slab charged particle counts: -2 = no value.
HSLBB(1300) : background slab charged particle counts: -2 = no value.
HGAIN(1300) : gain: 0 = no value 1 = high 2 = low.
HSTEP(1300) : step number: 0 = no value -2 = zero counts
HSCN(1300) : scan mode: 1 = full 2 = intermediate 3 = short 0 = no value.
IHORB(10) : array of orbit numbers.
IXHORB(10) : plot indices for the orbit numbers.
IDAY : day of year at start of plot frame.
LENPLT : value equals last valid plot index for plot frame.

C. Variables and arrays of interest either not in common storage or equivalenced to arrays in common.

HAMASK(47) : analog status masks (elements 1 - 32 unused).
HASBIT(47) : analog status indication bit value (elements 1 - 32 unused).
HASTEP(47) : analog value step = \( \frac{\text{analog readout} + 65}{45} \) (elements 1 - 32 unused).
HMFBIT(47) : main frame status bits (status bits propagated for half-scans in which the status word is found) (elements 1 - 27 unused).
IDTAPF : tape and file identifier for current file.
IXAPLT(30) : IXAPLT(I) = \( \frac{(\text{UPTIME}(1,I) - \text{UPLTGO})}{15.36} \) = index of plot array for pane I.
IXASEQ(47) : analog subcom sequence identifiers (1 + sync word) (elements 1 - 27 unused).
IXBEGS : plot index for scheduled start of scan.
IXNEXS : plot index for scheduled start of scan following section.
IXP15 : plot index for frame in pane 15. IXP15 = IXAPLT(15).
JDSID(47) : digital subcom energy ID indicators (elements 1 - 32 unused).
JPXID(47) : plot indices in time sequence reconstruction (elements 1 - 32 unused).

JPXPAN(47) : pane indices in time sequence reconstruction 0 + missing frame.

JXAPLT(15) : JXAPLT(1) ≠ LXAPLT(2).

JXAPLT(J) = plot index for major frames containing the analog sync word in panes 15 - 29.

LXAPLT(1) is used to store the plot index for the most recent identifiable analog sync word from previously processed major frames.

KADDEN(30) : section addend parameters for statistics.

1. count incrementer for sections processed.
2. count incrementer for sections bypassed.
3. count incrementer for complete sections processed.
4. count incrementer for complete sections processed with no analog flags.
5. count incrementer for complete sections processed with no MF flags.
6. number of scheduled status words missing or not recognized (processed sections).
7. number of time gaps (imbedded within a Decomm file) - total.
8. number of time gaps (imbedded within a Decomm file) - total "short".
9. major frames lost due to time gaps.
10. major frames bypassed.
11. total major frames processed.
12. major frames processed with no flagged analog.
13. major frames processed with no flagged DSF.
14. major frames processed with no flagged MF.
15. total x-ray sequences selected for processing.
16. total x-ray sequences selected with no flags for digital subcom source data.
17. sync error instances count for frames processed.
18. sync error bit count for frames processed.
19. contradiction count (one message each).
20. day-night change count (of sections).
21. radioactive calibration count (of sections starting with radiation calibration in progress).
22. electronic calibration count (of sections starting with electronic calibration in progress).
23. total sections (processed or bypassed).
24 - 30. spares.

KFSUMY(40) : file summary information. KFSUMY(1) ≡ HFSUMY(1):

<table>
<thead>
<tr>
<th>Section Addends</th>
<th>HFSUMY</th>
<th>KFSUMY</th>
</tr>
</thead>
<tbody>
<tr>
<td>accumulators</td>
<td>1-30</td>
<td></td>
</tr>
<tr>
<td>I/O errors</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>begin time</td>
<td>63-67</td>
<td></td>
</tr>
<tr>
<td>end time</td>
<td>68-72</td>
<td></td>
</tr>
<tr>
<td>tape sequence</td>
<td>73</td>
<td>37</td>
</tr>
<tr>
<td>file sequence</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>spares</td>
<td></td>
<td>38-40</td>
</tr>
</tbody>
</table>

KRSUMY : run summary information. KRSUMY(1) ≡ HRSUMY(1):

<table>
<thead>
<tr>
<th>Section Addends</th>
<th>HRSUMY</th>
<th>KRSUMY</th>
</tr>
</thead>
<tbody>
<tr>
<td>accumulators</td>
<td>1-30</td>
<td></td>
</tr>
<tr>
<td>I/O errors</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>earliest begin</td>
<td>63-67</td>
<td></td>
</tr>
<tr>
<td>latest end</td>
<td>68-72</td>
<td></td>
</tr>
<tr>
<td>final tape</td>
<td>73</td>
<td>38</td>
</tr>
<tr>
<td>total files</td>
<td>74</td>
<td>39-40</td>
</tr>
<tr>
<td>spares</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

KTSUMY : tape summary information. KTSUMY(1) ≡ HTSUMY(1):

<table>
<thead>
<tr>
<th>Section Addends</th>
<th>HTSUMY</th>
<th>KTSUMY</th>
</tr>
</thead>
<tbody>
<tr>
<td>accumulators</td>
<td>1-30</td>
<td></td>
</tr>
<tr>
<td>I/O errors</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>earliest begin</td>
<td>63-67</td>
<td></td>
</tr>
<tr>
<td>latest end</td>
<td>68-72</td>
<td></td>
</tr>
<tr>
<td>tape sequence</td>
<td>73</td>
<td>38</td>
</tr>
<tr>
<td>final file</td>
<td>74</td>
<td>39-40</td>
</tr>
<tr>
<td>spares</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KIOERR(2,3) : I/O error accumulators.

KIOERR(1,J) = tape and file ID for J'th accumulator.
KIOERR(2,J) = count of I/O errors.

LENHAF(4) : conversion table to get half-scan length from
scan mode code.

LISPLT : number of elements in arrays used to store values
to be plotted.

LXEND : GLB of pane indices after current section.

LXSYND : plot index for pane containing most recent "clear"
low energy ID for digital subcom data.

LXSYNW : plot index for pane containing most recent "clear"
 sync word for wheel subcom data.

MAXGAP : maximum number of missing panes allowed without
forcing plot output.

NPANES : count of panes in current section.

QNOPLT : .TRUE. if plots not wanted.

QSSCHG : .TRUE. implies a change in status exists at
some major frame in the current section.

ULSYND : time (seconds of century) of major frame con-
taining most recent "clear" sync word for energy
ID for digital subcom data.

ULSYNW : time (seconds of century) of major frame con-
taining most recent "clear" sync word for wheel
subcom data.

VI. Subroutine CALIB (X, NSUM)

Program Language : Fortran IV, G-Level
Date Written : August 1972
Programmer : S. Croteau
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) X: an output array of three floating point elements containing the three peak channels for the spectrum.

2) NSUM: an output array of three full word integer elements containing the sum of counts surrounding each peak.

Subprograms Called : None

Description : This subroutine locates the two highest peaks and ascertains that they are valid peaks as opposed to bit errors. The program then calculates an approximate guess channel for the third peak. It then searches for the third peak within a range of the guess channel, -5 to the guess channel, +5. The center of peak is then calculated for the three peaks (results are stored in X) and the counts are summed for each of the three peaks (results are stored in NSUM).

Program logic is as follows:

\[ E_1 = C_1 (n_1 + n_0)^2 \]

1. Find \( n_1 \) (highest counts/channel)
2. Find \( n_2 \) (second highest counts/channel)

Check if:

3. \( \Delta E = 1.33 - 1.17 = \text{Constant} \)
   \( |n_2 - n_1| \leq 15 \)
4. \( n_1 < n_2 \)
5. Define: \( n_3' = \sqrt{\frac{2.525}{1.17/(n_1+n_0)^2}} - 80.2 \)

6. Find \( n_3 \) (highest counts/channel) between \( n_3' - 5 \leq n_3 < n_3' + 5 \)

7. Define \( X(n_j) \)

\[
\bar{n}_j = \sum_{i=-2}^{+2} \frac{N_{j+i} n_{j+i}}{N_j + i \sum N_{j+i}} \quad j = 1, 2, 3
\]

8. Define NSUM(\( N_j \))

\[
N_j = \sum_{i=-2}^{+2} N_{j+i} \quad i = 1, 2, 3
\]
VII. Subroutine CALNDR (USOC,IYR,IMO,IDA,IHR,IMN,SEC)

Program Language : Fortran IV, G-Level

Date Written : February 1972

Programmer : S. Croteau

Installation : University of New Hampshire
              Space Science Center

Computer : IBM-360-H50

Dummy Arguments : 1) USOC: double precision input floating-point variable containing seconds of century.

2) IYR: output integer full word containing year.

3) IMO: output integer full word containing month.

4) IDA: output integer full word containing day.

5) IHR: output integer full word containing hour.

6) IMN: output integer full word containing minutes.

7) SEC: output floating point full word containing seconds.

Subprograms Called : None

Description : This subroutine accepts seconds of century as input via the argument list and converts this time to calendar time -- year, month, day, hours, minutes, and seconds. The input value in seconds of century is a 64-bit floating point word. The output variables are 32-bit integers except for the seconds which are stored in a 32-bit floating point word.
VIII: Subprogram FEEDER

Refer to Section 1 of this report for a description of this program.
IX. Subroutine FORTIM (IRUNDA, IRUNT)

Program Language : IBM O/S 360 Assembler Language

Date Written : July, 1969

Programmer : A. Buck

Installation : University of New Hampshire
Space Science Center

Computer : IBM-360-H50

Dummy Arguments : 1) IRUNDA: output integer full word
containing the date.

2) IRUNT: output integer full word
containing the time of day in hundredths
of a second.

Subprograms Called : None

Description : Subroutine FORTIM uses the time macro
to fetch the date and the time from
the computer clock. The date and the
time are only as accurate as the cor-
responding information entered by the
operator.

Example : FORTIM is called at 2.37 seconds after
3 minutes after 1 o'clock. A.M. on
February 10, 1970. When control is
returned from subroutine FORTIM, IRUNDA
contains 70041 in binary form and IRUNT
contains 3780237 in binary form.
X. Subroutine FPUT (IDSN, ICMD, IRSLT, IOVEC)

Program Language : IBM O/S 360 Assembler Language
Date Written : February 4, 1971
Programmer : A. Buck
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50

Dummy Arguments : 1) IDSN: a full word integer input parameter specifying the data set to which activity is directed. The integer stored at IDSN must be greater than zero but less than 21.

2) ICMD: a full word input integer variable containing a request type code which specifies the activity to be performed.
   a) ICMD = 1 implies that a logical record is to be written.
   b) ICMD = 2 implies the data set is to be ended. Once ended, the data set is unavailable to the calling program through the same data set number.

3) IRSLT: a full word output integer variable in which subroutine FPUT can place a return code as follows:
   a) IRSLT = -1 implies request was illegal for one of the reasons below:
      i. IDSN contained a value less than 1 or greater than 20.
      ii. ICMD contained a value less than 1 or greater than 2.
      iii. A write request was made to a data set that had been ended.
iv. An endfile request was made to a data set either before the first write request or after the data set had been ended.

b) IRSLT = 0 implies request was executed normally.

c) IRSLT = 1 implies an I/O error occurred while writing a block. The data set was ended.

4) IOVEC: an input vector whose high order byte is the first byte to be written (when ICMD = 1) in a logical record.

The number of bytes written is specified by the LRECL subparameter on the DD statement describing the data set.

Subprograms Called : None

Description : Subroutine FPUT is a QSAM output subroutine to write logical records from an area defined by the calling program. This routine is specifically designed to allow a Fortran program to create without format control an extensive data set to which the DCB subparameter 'RECFM = FB' applies. For data sets to which 'RECFM = F' or 'RECFM = U' applies, subroutine FTWRT may be more easily used.

Subroutine FPUT can manage as many as 20 data sets in the same job step. As many as desired may be active simultaneously. Once the endfile command has been issued to a data set, subroutine FPUT will refuse to perform any further activity for that particular data set. The large number of data sets allows writing as many as 20 files to the same magnetic tape volume as a possible application.

DD Statements required...

If subroutine FPUT is called with IDSN=1 (or 2,..., or 20) the user must supply a DD Statement having the DD name FPUT01 (or FPUT02,..., or FPUT20). The DD Statement must include the DCB subparameters 'RECFM', 'LRECL', and 'BLKSIZE' but must omit 'DSORG' and 'MACRF'. 
XI. Subroutine FTWRIT (IDSN,ICMD,IEXT,IRSLT,OUTBLK)

Program Language : IBM O/S 360 Assembler Language
Date Written : December 31, 1970
Programmer : A. Buck
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) IDSN: a full word input integer variable specifying the number (1, 2, or 3) of the data set to which the command is directed.

2) ICMD: a full word input integer variable containing a command code specifying the action to be taken by the subroutine as follows...

   a) ICMD = 1 : write a block to the data set.

   b) ICMD = 2 : write a tape mark and position the tape past the tape mark.

   c) ICMD = 3 : close the data set. (endfile).

3) IEXT: a full word input integer variable containing the number of bytes to be written when ICMD = 1. (If the value of ICMD is not 1, the value of IEXT is ignored.)

4) IRSLT: a full word output integer variable into which subroutine FTWRIT can place a response code. When control is returned to the calling program the meaning of the contents of IRSLT is as follows...
a) IRSLT = -1 : Command was invalid. One of the following occurred:
   i. IDSN was not 1, 2, or 3.
   ii. ICMD was not 1, 2, or 3.
   iii. A request to process the data set was made after the data set had been closed.

b) IRSLT = 0 : Command executed successfully.

c) IRSLT = 1 : An uncorrectable I/O error occurred while writing the block. The data set was closed.

5) OUTBLK: any variable or array element (integer, real, logical or complex) whose high order byte will be the first byte written to the block when ICMD = 1.

Subprograms Called : None

Description : This subroutine is a BSAM output routine to write data sets to which the DCB sub-parameter 'RECFM = U' applies. As many as 3 such data sets may be open at one time. The subroutine...

1) Writes blocks stored in the calling program.

2) On command, will write a tape mark and position the tape beyond the tape mark. This enables the calling program to write more than one file on an unlabelled tape without additional DD Statements.

3) On command, will close the data set. Once closed, the subroutine will consider invalid all subsequent requests to process the data set.

4) Returns a response code to the calling program to indicate the success or failure of the subroutine to execute the command.
DD Statements required...

A DD Statement having the name FTWT01 (or FTWT02 or FTWT03) must be supplied if subroutine FTWRIT is called with IDS\(N = 1\) (or 2 or 3). The only DCB subparameters needed on the DD Statement are 'BLKSIZE' and, where appropriate, 'DEN' and 'TRTCH'. The label subparameter 'LABEL = (,,OUT)' must not be used for any data set to which the write-tape-mark command (ICMD = 2) is directed.
XII. Subroutine MOVER (AREA1,IDISP1,AREA2,IDISP2,LEN)

Program Language : IBM O/S 360 Assembler Language
Date Written : March 23, 1971
Programmer : A. Buck
Installation : University of New Hampshire
                Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) AREAl: any variable or array element
                  (integer, real, logical, or complex)
                  whose highest order byte is used as
                  the 'output vector reference byte'.

                  2) IDISP1: a full word input integer
                  whose value is the number of bytes to
                  be skipped, starting with the 'output
                  vector reference byte' to locate the
                  highest order byte of the first (output)
                  area.

                  3) AREA2: any variable or array element
                  (integer, real, logical, or complex)
                  whose highest order byte is used as
                  the 'input vector reference byte'.

                  4) IDISP2: a full word input integer
                  whose value is the number of bytes
                  to be skipped, starting with the 'input
                  vector reference byte' to locate the
                  highest order of the second (source)
                  area.

                  5) LEN: a full word input integer whose
                  value is the number of bytes to be moved.

Subprograms Called : None
Description : Subroutine MOVER causes the contents of
               a first area of core storage to be re-
               placed by the contents of a second area
               of same length as the first. Replace-
               ment occurs on one byte at a time starting
               at the highest order bytes of the two
               areas and proceeding through progressively
               lower order bytes. Any number of bytes
               may be moved by one call to subroutine
               MOVER.
Programming notes...

The two areas may overlap in any way. Suppose the Fortran calling program has dimensioned a vector by the statement

```
Dimension A (1000)
```

Examples are shown below in the use of subroutine MOVER to 'Propagate' or to 'Downshift' values in the vector.

Propagation...

The two statements

```
A(1) = 0.0
CALL MOVER (A,4,A,0,3996)
```

Could be used in place of the loop

```
Do 1 I = 1,1000
1 A(I) = 0.0
```

Downshifting...

The statement

```
CALL MOVER (A,0,A,8,3992)
```

Could be used in place of the loop

```
Do 2 I = 1,998
2 A(I) = A(I+2)
```
XIII. Subroutine OUTPUT (version C)

Program Language : Fortran IV, H-Level
Date Written : January 1972
Programmer : S. Croteau
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : FEEDER, MOVER, CALIB, CALNDR, FPUT

The purpose of this program is to output the experiment data in any of six different forms. The options desired are specified by a control card read by the main program. The options are:

A. Engineering plot
B. Line summary
C. Calibration cards
D. X-ray tape
E. Good time cards
F. Main frame data tape

Any combination of options may be selected for one production run.

Subroutine OUTPUT receives the input data from the main data processing program and from FEEDER through common storage. When called by the main program, OUTPUT expects a section of coherent data to be stored in panes 15 - 26 of the DECISION
window. If possible, this should cover three minutes of accumulated data and begin with a background scan. Each pane of the decision window contains one major frame of data.

There is a program section in OUTPUT for each different option. It is, in fact, six programs in one. The following is a description of each of these program sections:

A. Engineering plot section:

The plotting section of OUTPUT creates tables that are 1300 half-words long corresponding to the 1300 elements in each engineering plot frame. OUTPUT processes up to 12 major frames per call. This means that up to 12 elements of each table are filled with one call to OUTPUT. The main data processing program sets up plot indices to be used by OUTPUT. After the tables have been filled, they are stored on disk by the main program and the plot index is reset to start a new plot frame. The tables for each engineering plot frame are stored on disk until the end of the run. In the second job step, the disk is read by the plot production program and the plotter tapes are generated.

B. Line summary section:

The line summary section prints out two types of lines; the status line and the summary line. The status line is an alphanumeric representation of status, shield and central detector on-off, and the step number. This line is printed whenever one of these values changes. An asterisk precedes the changing value. This line is also printed at the start of each new file and after a long time gap. The summary line is a summary of analog and status information for three minutes of data or one full scan, three intermediate scans, or six short scans. The time printed is the beginning of accumulation time. The status word printed with the line is the status that was read out with the data and is not the status at accumulation. The message number printed with a summary line associates that line with an error message in the error listing.

C. Calibration card section:

This section interrogates HDCAL(1) to see if the main frame data was accumulated in the calibrate mode. If so, FEEDER is called to provide the main frame data in partitions 1 - 12 of the SCAN window. Subroutine CALIB is then called
to identify the three peaks, calculate the integrated peak channels, and sum the counts surrounding each peak. The peak channels and counts are returned and punched out along with the time at midpoint of accumulation.

D. X-ray section:

The x-ray data is provided to this program through the DECISION window (i.e. DECIDE common area) in two forms; source values as they are on the Decomm tape or x-ray counts corrected for scaling. The values that are used to create the x-ray tape in this program are the corrected or interpreted values. The digital subcom data for one cycle is contained in three major frames. The third major frame for one cycle is the first major frame for the next cycle.

Major frame #1 contains:

<table>
<thead>
<tr>
<th>DSM WORD #</th>
<th>9</th>
<th>60 - 120 keV Data - Background (for previous cycle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td></td>
<td>Energy ID (Low) all zeros</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Quadrant time - Solar</td>
</tr>
<tr>
<td>23</td>
<td>7.5 - 15 keV Data - Solar</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>Quadrant time - Background</td>
</tr>
<tr>
<td>29</td>
<td>7.5 - 15 keV Data - Background</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>15 - 30 keV Data - Solar</td>
<td></td>
</tr>
</tbody>
</table>

Major frame #2 contains:

<table>
<thead>
<tr>
<th>DSM WORD #</th>
<th>9</th>
<th>15 - 30 keV Data - Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td></td>
<td>Energy ID (High) all ones</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Quadrant time - Solar</td>
</tr>
<tr>
<td>23</td>
<td>30 - 60 keV Data - Solar</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>Quadrant time - Background</td>
</tr>
<tr>
<td>29</td>
<td>30 - 60 keV Data - Background</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>60 - 120 keV Data - Solar</td>
<td></td>
</tr>
</tbody>
</table>

Major frame #3 contains:

<table>
<thead>
<tr>
<th>DSM WORD #</th>
<th>9</th>
<th>60 - 120 keV Data - Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td></td>
<td>Energy ID (Low) all zeros</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Quadrant time - Solar</td>
</tr>
<tr>
<td>23</td>
<td>7.5 - 15 keV Data - Solar</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>Quadrant time - Background</td>
</tr>
<tr>
<td>29</td>
<td>7.5 - 15 keV Data - Background</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>15 - 30 keV Data - Solar</td>
<td></td>
</tr>
</tbody>
</table>
This program section creates one x-ray tape record for each x-ray cycle. A fill of -l's is used to represent missing frames.

E. Good time card section:

The good time card section is responsible for making the decision as to whether the data in a spectrum is to be considered good or whether it is to be bypassed. The criteria used for determining data to be bypassed are as follows:

1. Central detector off
2. Time gap (interfile.gap).
3. Any information missing - sync word loss, major frame loss.

The program checks LASHV (last high voltage) and NOWHV (now high voltage) to decide whether or not the spectrum meets the requirement of central detector on.

If the last high voltage and the present high voltage are on, the spectrum is accepted. If neither is on, the spectrum is rejected. If the last high voltage is on and the present high voltage is off, the spectrum is accepted because it was accumulated when high voltage was on. If the last high voltage is off and the present high voltage is on, the spectrum is rejected because it was accumulated during high voltage off.

This program section saves the begin time and the end time (midpoint of accumulation times) in seconds of century in a double precision (64-bit) floating point word. It also saves whether the begin time starts at a solar quadrant or includes both quadrants and whether the end time ends at a background quadrant or includes both quadrants. When a rejection requirement is fulfilled, a good time card is punched and new begin and end times are saved.

F. Main frame data tape section:

This program section begins by determining whether the data section provided by the data processing program is complete, that is, whether all major frames are present for each quadrant. If so, FEEDER is called to fetch the main frame data for twelve major frames. If not, the program initializes the scan window to -l's and calls FEEDER to fetch the main frame data for each major frame present in the three minute span, placing the main frame data in the appropriate partition allowing for major
frame loss. This means that 12 partitions of the scan window are filled, either with main frame data or -l's to represent data loss.

The same logic is followed to fill in the analog word array for each quadrant. A fill of -l's is used to represent missing information. A flag is set to indicate the presence of a time gap and a count of major frames present in the quadrant is given. The real time is converted from seconds of century to calendar time and introduces the record on tape.

OUTPUT employs the same labelled common areas as described in Part V of this section. In addition, there is a labelled common area called /SMOLST/ used to transfer information to subroutine CALIB and containing the following arrays:

SKAN(377,2) : this array is included because subroutine CALIB was written for use by another program and the labelled common area requires this array.

SSCAN(377,2) : this array is also included to make this program compatible with the storage requirements of CALIB.

HARRAY(768) : the second half of this array contains the main frame data for the solar quadrant of the calibration.

Here is an alphabetic list of variables and arrays of interest not in common followed by the description for each term mentioned:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASOD</td>
<td></td>
</tr>
<tr>
<td>AL(3)</td>
<td></td>
</tr>
<tr>
<td>BCUP</td>
<td></td>
</tr>
<tr>
<td>BGLOG</td>
<td></td>
</tr>
<tr>
<td>BGSUM</td>
<td></td>
</tr>
<tr>
<td>BSLAB</td>
<td></td>
</tr>
<tr>
<td>CKTMB</td>
<td></td>
</tr>
<tr>
<td>CKTMS</td>
<td></td>
</tr>
<tr>
<td>CLOCK</td>
<td></td>
</tr>
<tr>
<td>COUNT</td>
<td></td>
</tr>
<tr>
<td>DDTMB</td>
<td></td>
</tr>
<tr>
<td>DDTMS</td>
<td></td>
</tr>
<tr>
<td>DIVB</td>
<td></td>
</tr>
<tr>
<td>DIVS</td>
<td></td>
</tr>
<tr>
<td>DTEMP</td>
<td></td>
</tr>
<tr>
<td>DTMB</td>
<td></td>
</tr>
<tr>
<td>DTMS</td>
<td></td>
</tr>
<tr>
<td>ETEMP</td>
<td></td>
</tr>
<tr>
<td>HCLOCK(64)</td>
<td></td>
</tr>
<tr>
<td>HFULL(768)</td>
<td></td>
</tr>
<tr>
<td>HHOLD</td>
<td></td>
</tr>
<tr>
<td>HSTPNO</td>
<td></td>
</tr>
<tr>
<td>ASOD</td>
<td></td>
</tr>
<tr>
<td>IANLG</td>
<td></td>
</tr>
<tr>
<td>IPRST</td>
<td></td>
</tr>
<tr>
<td>IVD</td>
<td></td>
</tr>
<tr>
<td>UHOUR(24)</td>
<td></td>
</tr>
<tr>
<td>IANLT</td>
<td></td>
</tr>
<tr>
<td>IQUAD(2)</td>
<td></td>
</tr>
<tr>
<td>IXPLT</td>
<td></td>
</tr>
<tr>
<td>UPT</td>
<td></td>
</tr>
<tr>
<td>IASTER(2)</td>
<td></td>
</tr>
<tr>
<td>IREC</td>
<td></td>
</tr>
<tr>
<td>IXPLT1</td>
<td></td>
</tr>
<tr>
<td>USCAN</td>
<td></td>
</tr>
<tr>
<td>ICHGPN(12)</td>
<td></td>
</tr>
<tr>
<td>IRSLT</td>
<td></td>
</tr>
<tr>
<td>JPART</td>
<td></td>
</tr>
<tr>
<td>USODAY</td>
<td></td>
</tr>
<tr>
<td>ICHIV</td>
<td></td>
</tr>
<tr>
<td>ISCAN(4)</td>
<td></td>
</tr>
<tr>
<td>LMONTH(12)</td>
<td></td>
</tr>
<tr>
<td>UTME</td>
<td></td>
</tr>
<tr>
<td>ICPHV</td>
<td></td>
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<tr>
<td>ISHHV</td>
<td></td>
</tr>
<tr>
<td>NSS (3)</td>
<td></td>
</tr>
<tr>
<td>ISKN</td>
<td></td>
</tr>
<tr>
<td>PANE</td>
<td></td>
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<td>ICPVD</td>
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<td>ISKLN</td>
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<tr>
<td>HSTPNO</td>
<td></td>
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<tr>
<td>IDANI(2)</td>
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</tr>
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<td>ISODAY</td>
<td></td>
</tr>
<tr>
<td>QCAL</td>
<td></td>
</tr>
<tr>
<td>IDETT</td>
<td></td>
</tr>
<tr>
<td>ISOFF</td>
<td></td>
</tr>
<tr>
<td>SCAN</td>
<td></td>
</tr>
<tr>
<td>ISTAT1</td>
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</tr>
<tr>
<td>IDLTD</td>
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</tr>
<tr>
<td>ISTAT2</td>
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</tr>
<tr>
<td>SCUP</td>
<td></td>
</tr>
<tr>
<td>IEFPD</td>
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<tr>
<td>ISTAT3</td>
<td></td>
</tr>
<tr>
<td>SCUPB1</td>
<td></td>
</tr>
<tr>
<td>IGHLH</td>
<td></td>
</tr>
<tr>
<td>ISTAT4</td>
<td></td>
</tr>
<tr>
<td>SCUPSL</td>
<td></td>
</tr>
<tr>
<td>IHILO(2)</td>
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<tr>
<td>ISTAT5</td>
<td></td>
</tr>
<tr>
<td>SGAMB</td>
<td></td>
</tr>
<tr>
<td>ILETT(13)</td>
<td></td>
</tr>
<tr>
<td>ISTAT6</td>
<td></td>
</tr>
<tr>
<td>SGAMS</td>
<td></td>
</tr>
<tr>
<td>ILVD</td>
<td></td>
</tr>
<tr>
<td>ISTAT7</td>
<td></td>
</tr>
<tr>
<td>SGLOG</td>
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<tr>
<td>ILVPS</td>
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</tr>
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<td>ISTPHD</td>
<td></td>
</tr>
<tr>
<td>SGSUM</td>
<td></td>
</tr>
<tr>
<td>IMAG</td>
<td></td>
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<tr>
<td>ISYNER</td>
<td></td>
</tr>
<tr>
<td>SSLAB</td>
<td></td>
</tr>
<tr>
<td>IMGY(2)</td>
<td></td>
</tr>
<tr>
<td>ISYN1</td>
<td></td>
</tr>
<tr>
<td>SSLABB</td>
<td></td>
</tr>
<tr>
<td>IONOF(3)</td>
<td></td>
</tr>
<tr>
<td>ISYN2</td>
<td></td>
</tr>
<tr>
<td>SSLABS</td>
<td></td>
</tr>
<tr>
<td>IPRINT</td>
<td></td>
</tr>
<tr>
<td>ITD</td>
<td></td>
</tr>
<tr>
<td>STPNO</td>
<td></td>
</tr>
</tbody>
</table>
ASOD : floating point full word variable containing the seconds of day for the major frame being processed (engineering plot).

Al(3) : floating point full word array containing the integrated peak channels for a radiation calibration after a call to CALIB (calibration card).

BCUP : floating point full word containing the average background cup for the data section being processed (line summary).

BGLOG : floating point full word containing the average background gamma x .1 (line summary).

BGSUM : floating point full word containing the quotient of the background gamma sum divided by background live time (line summary).

BSLAB : floating point full word containing the average background slab for the data section being processed (line summary).

CKTMB : double word variable containing the background clock time (= PHA clock time x 8 x 1/390.625) (line summary).

CKTMS : double word variable containing the solar clock time (= PHA clock time x 8 x 1/390.625) (line summary).

CLOCK : floating point full word containing the PHA clock time (line summary).

COUNT : floating point full word variable containing the step number in raw form (engineering plot and line summary).

DDTMB : double word variable containing the background dead time (= DTMB x .001515) (line summary).

DDTMS : double word variable containing the solar dead time (= DTMS x .001515) (line summary).

DIVB : floating point full word containing the background live time (line summary).

DIVS : floating point full word containing the solar live time (line summary).

DTEMP : floating point full word containing the average detector temperature divided by 10 (line summary).
**DTMB**: double word variable containing the sum of the value of the 2 lowest order bits of the status word for a background quadrant and $4 \times$ the value of the 60th main frame experiment word in the last major frame of that quadrant (line summary).

**DTMS**: double word variable containing the sum of the value of the 2 lowest order bits of the status word for a solar quadrant and $4 \times$ the value of the 60th main frame experiment word in the last major frame of that quadrant (line summary).

**ETEMP**: floating point full word containing the average electronic temperature divided by 10 (line summary).

**HCLOCK(64)**: integer half-word array equivalenced to partition 1 of the scan window into which the main frame data of the last major frame of each quadrant is placed to obtain the PHA clock time in HCLOCK(64) (line summary).

**HFULL(768)**: integer half-word array equivalenced to the first twelve partitions of the scan window - may contain all the main frame data for one full scan (main frame data tape).

**HHOLD**: integer half-word set to -1 to determine whether the background quadrant is missing or whether a time gap exists in the quadrant (main frame data tape).

**HSTPNO**: half-word integer variable containing the fixed point value for the step number (line summary).

**IANLG**: integer full word variable used as an index for analog sub-subcomended words ASC 1:1-6, ASC 2:1-6 (engineering plot and line summary).

**IANLT**: integer full word variable used to save the normal - alternate quadrant status (engineering plot).

**IASTER(2)**: full word array containing the following alphanumeric information: blank and *.

**ICHGPN(12)**: full word integer array containing the pane numbers of sync major frames where status change occurs (not including background - solar change).

**ICHIV**: integer full word variable containing the average central detector HVPS analog (line summary).

**ICHV**: integer full word variable containing the sum of the central HVPS analog for the data section being processed (line summary).
ICPHV : integer full word variable containing the sum of the charged particle HVPS analogs for the data section being processed (line summary).

ICPVD : integer full word variable holding the number of major frames used in the charged-particle HVPS analog summation (line summary).

IDANI(2) : full word array containing alphameric DAY or NITE.

IDETT : integer full word variable containing the sum of the detector temperature for the data section being processed (line summary).

IDHLD : integer full word variable used to save the day-night status in the engineering plot section.

IELTP : integer full word variable containing the sum of electronic temperature for the data section being processed (line summary).

IEPD : integer full word variable holding the number of major frames used in the electronic temperature summation (line summary).

IGHLD : integer full word variable used to save the gain status in the engineering plot section.

IHIL0(2) : full word array containing alphameric HI and LO.

ILETT(13) : full word array containing alphameric F,I,S,A,N,E,blank,R,D,M,G,P,C.

ILVD : integer full word variable holding the number of entries in the low HVPS analog summation.

ILVPS : integer full word variable containing the average of the LVPS analogs for the data section being processed (line summary).

IMAG : integer full word variable used to save the magnetometer - gyro reference in the engineering plot section.

IMGY(2) : full word array containing alphameric MAG and GYRO.

IONOF(3) : full word array containing the following alphameric information: ON, OFF, and blank.

IPRINT : integer full word variable set to 1 to indicate that a status line must be printed due to a parameter change (line summary).
IPRST : integer full word variable used as a print-status-line indicator (line summary).

IQUAD(2) : full word array containing alphameric N and A.

IREC : integer full word variable used as a record counter for x-ray records written (x-ray tape section).

IRSLT : integer full word variable containing the return code as a result of a call to FPUT (x-ray tape and main frame data tape sections).

ISCAN(4) : double word array containing the following alphabetic information: FULL, INTER, SHORT, INVLD.

ISCNH : integer full word variable used to save the scan mode in the engineering plot section.

ISHHV : integer full word variable containing the average shield HVPS analog for the data section being processed (line summary).

ISKN : full word variable containing the alphabetic representation of the scan mode (F = full, I = intermediate, S = short).

ISODAY : integer full word variable containing seconds of day for the major frame being processed (line summary).

ISOFF : integer full word variable used to save shield on - off (engineering plot).

ISTAT1 : full word variable containing the alphabetic representation for normal - alternate quadrant (N = normal, A = alternate) (line summary).

ISTAT2 : full word variable containing the alphabetic representation for electronic calibration on - off (E = on, blank = off) (line summary).

ISTAT3 : full word variable containing the alphabetic representation for radiation calibration on - off (R = on, blank = off) (line summary).

ISTAT4 : full word variable containing the alphabetic representation for day - night indicator (D = day, N = night) (line summary).

ISTAT5 : full word variable containing the alphabetic representation for magnetometer - gyro reference (M = magnetometer, G = gyro) (line summary).
ISTAT6 : full word variable containing the alphameric representation for charged particle on - off (P = on, blank = off) (line summary).

ISTAT7 : full word variable containing the alphameric representation for central detector on - off (C = on, blank = off) (line summary).

ISTPHD : integer full word variable used to save the step number in the engineering plot section.

ISYNER : integer full word variable equal to ISYN2 (line summary).

ISYN1 : integer full word variable containing the count of non-fill minor frames with sync errors in the data section being processed (line summary).

ISYN2 : integer full word variable containing the total sum of bits in error in non-fill minor frame sync for the data section being processed (line summary).

ITD : integer full word variable holding the number of major frames used in the detector temperature summation (line summary).

IVD : integer full word variable holding the number of major frames used in the central HVPS analog summation (line summary).

IXPLT : integer full word variable containing the plot index of the major frame being processed (engineering plot).

IXPLT1 : integer full word variable used as plot index through a time gap (engineering plot).

JPART : integer full word variable containing the number of the first partition where main frame data is to be placed in the call to FEEDER (main frame data section).

LMONTH(12) : integer full word array containing the day of year of the end of each month of a leap year.

MONTH(12) : integer full word array containing the day of year at the end of each month of an ordinary year.

NSS(3) : integer full word array containing the sum of counts surrounding the three calibration peaks after a call to CALIB.
**Pane**

*integer full word variable containing the pane number of the major frame being processed (from IXPANE to LXPANE)*.

**Qcal**

* = .TRUE. if a call to CALIB must be made and a calibration card punched (calibration card section).*

**Scan**

* floating point variable containing the number of seconds to subtract from the background read-out time in order to obtain the time at beginning of data accumulation. (184.32 for full scan, 61.44 for intermediate scan, 30.72 for short scan).*

**Scantm(3)**

* floating point array containing the number of seconds to subtract from background read-out time to obtain the time at midpoint of data accumulation (92.16 for full scan, 30.72 for intermediate scan, 15.36 for short scan).*

**Scup**

* floating point full word variable containing the average solar cup for the data section being processed (line summary).*

**Scupbl**

* floating point full word variable containing the sum of the sixth ASC word from each major frame of the data section being processed (charged particle cup, background) (line summary).*

**Scups1**

* floating point full word variable containing the sum of the tenth ASC word from each major frame of the data section being processed (charged particle cup, solar) (line summary).*

**Sgamb**

* floating point full word variable used to contain the sum of the third ASC word from each major frame in the data section being processed (gamma .3 - 9.1 MeV, background) (line summary).*

**Sgams**

* floating point full word variable used to contain the sum of the seventh ASC word from each major frame in the data section being processed (gamma .3 - 9.1 MeV, solar) (line summary).*

**Sglog**

* floating point full word variable containing the average solar gamma x .1 (line summary).*

**Sgsun**

* floating point full word variable containing the quotient of the solar gamma sum divided by the solar live time (line summary).*

**Sslab**

* floating point full word variable containing the average solar slab for the data section being processed (line summary).*
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSLABB</td>
<td>Floating point full word variable containing the sum of the fifth ASC word from each major frame of the data section being processed (charged particle slab, background) (line summary).</td>
</tr>
<tr>
<td>SSLABS</td>
<td>Floating point full word variable containing the sum of the ninth ASC word from each major frame of the data section being processed (charged-particle slab, solar) (line summary).</td>
</tr>
<tr>
<td>STPNO</td>
<td>Floating point full word variable used to calculate the step number (engineering plot and line summary).</td>
</tr>
<tr>
<td>UHOUR (24)</td>
<td>Double word array containing seconds of hour for hours 1 to 24.</td>
</tr>
<tr>
<td>UPT</td>
<td>Double word variable used to hold time in seconds of century.</td>
</tr>
<tr>
<td>USCAN</td>
<td>Double word variable containing the number of seconds to subtract from read-out time to obtain midpoint of accumulation time.</td>
</tr>
<tr>
<td>USODAY</td>
<td>Double word variable used to contain the seconds of day for the major frame being processed.</td>
</tr>
<tr>
<td>UTME</td>
<td>Double word variable containing the time at midpoint of accumulation in seconds of century for a calibration (calibration card section).</td>
</tr>
</tbody>
</table>
XIV. Subroutine PLOUT

Program Language      :  Fortran IV, G-Level
Date Written          :  January 1972
Programmer            :  A. Buck
Installation          :  University of New Hampshire
                        Space Science Center
Computer              :  IBM-360-H50
Dummy Arguments       :  None
Subprograms Called    :  FTWRT,MOVER
Description           :  Subroutine PLOUT writes the tables
                        created by the plot section of subroutine
                        OUTPUT onto disk. The tables contain
                        the information necessary for one
                        plot frame. The main program of Pass-I
                        initializes these tables.
XV. Subroutine PUZZLE (version C)

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : A. Buck
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : MOVER
Description : This program tries to solve 'puzzling' situations by realigning major frames
              surrounding sync word loss or time gap occurrence. Certain messages are printed
              out depending on the problem-solving method used.
XVI. Function QUASH (HAR,HMASK,LEN)

Program Language : IBM O/S 360 Assembler Language
Date Written : January 1972
Programmer : A. Buck
Installation : University of New Hampshire
Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) HAR: flag word
                   2) HMASK: mask
                   3) LEN: integer full word specifying
                      the length in bytes of the flag word
                      and the mask.
Subprograms Called : None
Description : QUASH turns off the flag bits you are
              willing to ignore and then gives a true-
              false reading.
XVII. Subroutine SUMARY (KFSUMY, HFSUMY, KNFDSN, KAFDSN, KJFDSN, I)

Program Language: Fortran IV, G-Level

Date Written: January 1972, Revised March 14, 1972

Programmer: A. Buck

Installation: University of New Hampshire
Space Science Center

Computer: IBM-360-H50

Dummy Arguments:
1) KFSUMY: an input vector containing the accumulated statistics (full word integers) (see file summary description in Part V of this section).

2) HFSUMY: the same input vector. (half-word integers)

3) KNFDSN: an input integer variable defining the first data set number on which the display is to be written.

4) KAFDSN: an input integer variable defining the last data set number on which the display is to be written.

5) KSFDSN: an input integer variable containing the greater of [1, (KAFDSN - KNFDSN)].

6) I: an input integer variable defining the type of statistical display required.

Subprograms Called: None

Description: This program assists the main program by creating and printing a display of statistics accumulated in an array passed by the main program. Subroutine SUMARY is responsible for accumulating time intervals spanned by individual tapes (when I = 2) for use in the final run summary report (I = 3).
XVIII. Subroutine SUMCAL (KFSUMY,KTSUMY)

Program Language : IBM O/S 360 Assembler Language
Date Written : January 1972
Programmer : A. Buck
Installation : University of New Hampshire
               Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) KFSUMY: an input vector containing
                   the accumulated statistics for a file.
                   2) KTSUMY: an output vector containing
                   the accumulated statistics for the tape.
                   (see summary descriptions in Part V of
                   this section).
Subprograms Called : None
Description : This program compares the begin time
              of the file with the begin time in the
              tape accumulator. If the file time is
              earlier, the earlier time is moved to
              the tape summary begin time. The end
              times are also compared and the later
              time is moved to the tape summary
              end time.
XIX. Plot Production Program (OSOP104A)

Program Language : Fortran IV, G-Level
Date Written : February 1972
Programmer : A. Buck
Installation : University of New Hampshire
Space Science Center
Computer : IBM-360-H50
Subprograms Called : FGET, INITPL, OUTLINE, ENPLTA, PLOT (see Section 7)

The purpose of this program is the distribution of plots on the plotter tapes and plot construction. The program reads the disk file containing the plot frame count. From this count, it computes the number of tapes that will be required to plot a maximum of three plot frames per tape. A maximum of three plot frames per tape was selected because of the poor condition of the Calcomp plot hardware at the University of New Hampshire Computation Center. After two hours of plotting, the hardware has a tendency to malfunction. It usually takes about two hours to plot three frames. There is no restart option to begin plotting again at the frame in which the malfunction occurred.

The plot production program reads the engineering plot tables stored on disk and calls INITPL, OUTLINE, and ENPLTA for actual plot construction. For one week of data, seven plotter tapes are generated containing three plot frames per tape.
XX. Subroutine ENPLTA

<table>
<thead>
<tr>
<th>Program Language</th>
<th>Fortran IV, G-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>October 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>S. Croteau</td>
</tr>
<tr>
<td>Installation</td>
<td>University of New Hampshire Space Science Center</td>
</tr>
<tr>
<td>Computer</td>
<td>IBM-360-H50</td>
</tr>
<tr>
<td>Dummy Arguments</td>
<td>None</td>
</tr>
<tr>
<td>Subprograms Called</td>
<td>PLOT (see Section 7), CHAR (see Section 7), OUTLINE</td>
</tr>
<tr>
<td>Description</td>
<td>This program plots one plot frame consisting of 23 arrays dimensioned at 1300 half words each. Each half word represents one major frame of data and is represented by one hundredth of an inch on the &quot;X&quot; axis. Each array represents an individual plot within the total engineering plot frame. ENPLTA reads and plots each table one at a time. The ORBIT number printed is the ascending-node-crossing number. The day of year for each frame is also written on the disk record.</td>
</tr>
</tbody>
</table>
XXI. Subroutine FGET (IDSN,IRSLT,IOVEC)

Program Language : IBM O/S 360 Assembler Language
Date Written : February 4, 1971
Programmer : A. Buck
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50

Dummy Arguments : 1) IDSN: a full word input integer containing the data set number to which the call is directed. (IDSN must be 1, 2, or 3).

2) IRSLT: a full word output integer in which subroutine FGET may place an activity-result code as follows...

a) IRSLT = -1 if the requested activity was invalid. This code is returned if either of the following occur:
   i. IDSN contains a number less than 1 or greater than 3.
   ii. Data set has been previously closed.

b) IRSLT = 0 if data is read and no I/O error is detected.

c) IRSLT = 1 if an I/O error occurred on the block containing the data placed in IOVEC. The calling program has the responsibility for accepting or rejecting the data. In addition, the calling program is responsible for proper reaction to the remaining records in the block for which IRSLT will be 0.
d) IRLT = 2 if end-of-file was detected. The contents of IOVEC are not changed. The data set is closed and cannot be used again by subroutine FGET with the same value of IDS.

3) IOVEC: an output vector in which FGET can place the record. The actual variable used for IOVEC may be integer, real, logical, or complex. The first leftmost byte of the data record is placed in the high-order byte of IOVEC when reading occurs. The number of bytes placed in IOVEC is specified by the LRECL subparameter of the DD Statement.

Subprograms Called: None

Description: This subroutine is a QSAM input subroutine to read logical records into an area defined by the calling program. This routine is specifically designed to supply a Fortran calling program with logical records from a data set to which the DCB subparameter 'RECFM = FB' applies. For data sets to which 'RECFM = F' or 'RECFM = U' applies, subroutine FTREAD may be more easily used. "RECFM = V" is specifically prohibited.

Subroutine FGET can manage as many as 3 data sets during the same job step. The data sets may be open (active) simultaneously provided no two data sets are on the same magnetic tape.

DD Statements required...

If FGET is to be called with IDS = 1 (or 2 or 3), then the user must describe the data set by a DD Statement having the DD name FGET01 (or FGET02 or FGET03). The DD Statement must include the DCB subparameters 'RECFM', 'LRECL', and 'BLKSIZE' but must omit 'DSORG' or'M4ACRF'.
XXII. Subroutine INITPL

Program Language : Fortran IV, G-Level
Date Written : September 1971
Programmer : S. Croteau
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : PLOT
Description : This subroutine makes the initial call to PLOT (see Section 7) in preparation for the engineering plot. The call to this subroutine is made by the main program in the second step of PASS-I. The subroutine requests that PLOT calculate the scale constants but neither a plotting area outline nor grid is drawn. The physical size of the engineering plot is 13.0 inches in the "X" direction and 10.0 inches in the "Y" direction.
XXIII. Subroutine OUTLINE

Program Language : Fortran IV, G-Level
Date Written : September 1971
Programmer : S. Croteau
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : PLOT, CHAR
Description : This program plots the frame and labeling information for the engineering plot using the PLOT and CHAR software provided by the Computation Center (see Section 7). The call to this subroutine is made by the main program in the second step of PASS-I each time a new frame is desired.
XXIV. Description of input

A. Control Card Format

<table>
<thead>
<tr>
<th>Card</th>
<th>Description</th>
<th>Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTAPES</td>
<td>Number of tapes to be processed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MFDOP</td>
<td>Main frame data not processed.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All main frame data processed.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PHA channel counts ignored.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>IATTO</td>
<td>Omission of attitude data.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Attitude data values processed.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>IDSOP</td>
<td>Omission of digital subcom data.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digital subcom data processed.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>IASOP</td>
<td>Omission of wheel analog subcom words 3-10.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All 10 wheel analog words to be processed.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>IORBOP</td>
<td>No orbit data needed.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regular orbit data items are desired.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All ORBIT data items required.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>IOPT</td>
<td>Combination.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plot only.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Line summary only.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calibration cards only.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X-ray tape only.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good time cards only.</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Main frame data tape only.</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
IPILOT  1 = Plot.
        0 = No plot.

ILIST  1 = Line summary.
        0 = No line summary.

ICALIB 1 = Main frame display of calibration.
         0 = No display.

IXRAY  1 = Create X-ray tape.
         0 = No tape.

IGDT   1 = Punch good time cards.
         0 = No good time cards.

IMFD   1 = Create MF data tape.
         0 = No MF data tape.

HMAXTA Maximum number of tapes to be processed.

HMAXFI Maximum number of files to be processed.
B. Experimenter Data Tape

This tape format was sent to EXP3 by Mr. Henry Linder, GSFC.

1. Data Format for OSO-H Experimenter Tape

University of New Hampshire Experimenter Number 3

<table>
<thead>
<tr>
<th>Characters</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 12</td>
<td>Time field.</td>
</tr>
<tr>
<td>13 - 18</td>
<td>Spin rate (rad/sec).</td>
</tr>
<tr>
<td>19 - 24</td>
<td>Pitch angle (rad).</td>
</tr>
<tr>
<td>25 - 30</td>
<td>Roll angle (rad).</td>
</tr>
<tr>
<td>31 - 36</td>
<td>Aspect angle (rad).</td>
</tr>
<tr>
<td>37 - 42</td>
<td>Right ascension of spin axis (rad).</td>
</tr>
<tr>
<td>43 - 48</td>
<td>Declination of spin axis (rad).</td>
</tr>
<tr>
<td>49 - 54</td>
<td>Right ascension of roll axis (rad).</td>
</tr>
<tr>
<td>55 - 60</td>
<td>Declination of roll axis (rad).</td>
</tr>
<tr>
<td>61 - 66</td>
<td>Right ascension of aspect axis (rad).</td>
</tr>
<tr>
<td>67 - 72</td>
<td>Declination of aspect axis (rad).</td>
</tr>
<tr>
<td>73 - 78</td>
<td>Azimuth time of encoder pulse with respect to beginning of minor frame 1.</td>
</tr>
<tr>
<td>79 - 84</td>
<td>Attitude flag field. See Attachment IV.</td>
</tr>
<tr>
<td>85 - 90</td>
<td>Spare.</td>
</tr>
<tr>
<td>91 - 168</td>
<td>Same type of data as in characters 13 - 90 but for time $T_2 = T_1 + 15.36$ sec (i.e., for the second major frame) one major frame contains 48 minor frames.</td>
</tr>
</tbody>
</table>

169-170+12N Minor frame word 11.
171-172+12N Minor frame word 12.
173-174+12N Wheel subcommutator.
175-176+12N Sail subcommutator.
177-178+12N Digital subcommutator.
170-180+12N Flag field for each minor frame.

2. Explanations about the Format

Where $0 < N < 95$ corresponds to main frames 1 - 48 containing a complete subcom cycle followed by main frames 1 - 48 containing the next complete subcom cycle; thus every record length is 1320 6-bit characters or 220 36-bit computer words.

The tapes will be written with odd parity and a density of 556 BPI. Each file will be started with a label record, as described in Attachment I, followed by records filled with ORBIT information as described
in Attachment V, and then will be followed by the PCM data records. An end-of-file (EOF) mark closes the file. Several files are written on the same tape until two EOF marks indicate the end of data on the tape.

The time field contains subcom slip flag, day count of year, and milliseconds of day. The time field is described in Attachment II.

The attitude data is referenced to the time $T_1$ given in the time field except for the second set of attitude data which is referenced to time $T_2 = T_1 + 15.36$ sec. The attitude flag field is described in Attachment IV. All attitude words are written in IBM-7094 floating point format.

The flag field contains the frame number (1-48) in the subcom cycle, number of bit errors in the main frame sync word, fill data flag, and day/night indicator. The flag field is described in Attachment III.

Any changes to the above-described data tape format should be directed to Henry G. Linder, GSFC, Code 565, Greenbelt, Maryland, 20771.
## ATTACHMENT I

### Label Record Description

<table>
<thead>
<tr>
<th>Characters</th>
<th>Form</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5</td>
<td>BCD</td>
<td>Satellite identification number.</td>
</tr>
<tr>
<td>6 - 7</td>
<td>BCD</td>
<td>Year.</td>
</tr>
<tr>
<td>8 - 10</td>
<td>BCD</td>
<td>Station number.</td>
</tr>
<tr>
<td>11 - 14</td>
<td>BCD</td>
<td>Station tape number.</td>
</tr>
<tr>
<td>15 - 16</td>
<td>BCD</td>
<td>Analog file number.</td>
</tr>
<tr>
<td>17 - 18</td>
<td>BCD</td>
<td>Buffer file number.</td>
</tr>
<tr>
<td>19 - 21</td>
<td>BCD</td>
<td>Day count of year.</td>
</tr>
<tr>
<td>26 - 30</td>
<td>BCD</td>
<td>Start time (sec).</td>
</tr>
<tr>
<td>32 - 36</td>
<td>BCD</td>
<td>End time (sec).</td>
</tr>
<tr>
<td>37 - 38</td>
<td>BCD</td>
<td>Experimenter number.</td>
</tr>
<tr>
<td>39 - 40</td>
<td>BCD</td>
<td>Decomm number.</td>
</tr>
<tr>
<td>41 - 42</td>
<td>BCD</td>
<td>Reel number.</td>
</tr>
<tr>
<td>43 - 44</td>
<td>BCD</td>
<td>Master tape file.</td>
</tr>
<tr>
<td>45 - 48</td>
<td>BCD</td>
<td>Master tape number.</td>
</tr>
<tr>
<td>49</td>
<td>BCD</td>
<td>Type of attitude computation: (0 = \text{based on star sensor in-})&lt;br&gt;(\text{puts at night and SORE in-})&lt;br&gt;(\text{puts in day time, }1 = \text{based on magnetic field measure-})&lt;br&gt;(\text{ment inputs and SORE inputs in day time (accuracy 2-3).})</td>
</tr>
<tr>
<td>50 - 60</td>
<td>BCD</td>
<td>Fill data (blank).</td>
</tr>
<tr>
<td>67 - 72</td>
<td>Floating Pt.</td>
<td>Seconds of day.</td>
</tr>
<tr>
<td>73 - 78</td>
<td>Floating Pt.</td>
<td>Semi-Major axis, a (km).</td>
</tr>
<tr>
<td>91 - 96</td>
<td>Floating Pt.</td>
<td>Right ascension of ascending node, (\Omega) (deg).</td>
</tr>
<tr>
<td>97 - 102</td>
<td>Floating Pt.</td>
<td>Rate of change of R.A. of ascending node (deg/day).</td>
</tr>
<tr>
<td>103 - 108</td>
<td>Floating Pt.</td>
<td>Argument of perigee, (\dot{\omega}) (deg).</td>
</tr>
<tr>
<td>109 - 114</td>
<td>Floating Pt.</td>
<td>Rate of change of argument of perigee (deg/day).</td>
</tr>
<tr>
<td>121 - 126</td>
<td>Floating Pt.</td>
<td>Rate of change of period, P (deg/day).</td>
</tr>
<tr>
<td>127 - 132</td>
<td>Floating Pt.</td>
<td>Date.</td>
</tr>
<tr>
<td>133 - 138</td>
<td>Floating Pt.</td>
<td>Day count of year coordinate system.</td>
</tr>
</tbody>
</table>
### ATTACHMENT I

<table>
<thead>
<tr>
<th>Characters</th>
<th>Form</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>139 - 144</td>
<td>Floating Pt.</td>
<td>Apparent sidereal time in radians.</td>
</tr>
<tr>
<td>145 - 150</td>
<td>Floating Pt.</td>
<td>No. of frames expected.</td>
</tr>
<tr>
<td>151 - 156</td>
<td>Floating Pt.</td>
<td>No. of frames recovered.</td>
</tr>
<tr>
<td>157 - 162</td>
<td>Floating Pt.</td>
<td>No. of frames recovered.</td>
</tr>
<tr>
<td>163 - 168</td>
<td>Floating Pt.</td>
<td>No. of frames with 0 bit errors.</td>
</tr>
<tr>
<td>169 - 174</td>
<td>Floating Pt.</td>
<td>No. of frames with 1 bit errors.</td>
</tr>
<tr>
<td>175 - 180</td>
<td>Floating Pt.</td>
<td>No. of frames with 2 bit errors.</td>
</tr>
<tr>
<td>181 - 186</td>
<td>Floating Pt.</td>
<td>No. of frames with 3+ bit errors.</td>
</tr>
<tr>
<td>187 - 192</td>
<td>Floating Pt.</td>
<td>No. of frames with 0 bit errors.</td>
</tr>
<tr>
<td>193 - 198</td>
<td>Floating Pt.</td>
<td>No. of frames with 1 bit errors.</td>
</tr>
<tr>
<td>199 - 204</td>
<td>Floating Pt.</td>
<td>No. of frames with 2 bit errors.</td>
</tr>
<tr>
<td>205 - 210</td>
<td>Floating Pt.</td>
<td>No. of frames with 3+ bit errors.</td>
</tr>
<tr>
<td>211 - 216</td>
<td>Floating Pt.</td>
<td>No. of subcom slips in sail.</td>
</tr>
<tr>
<td>217 - 222</td>
<td>Floating Pt.</td>
<td>No. of subcom slips in wheel.</td>
</tr>
<tr>
<td>223 - 228</td>
<td>Floating Pt.</td>
<td>No. of subcom slips in digital.</td>
</tr>
<tr>
<td>229 - 234</td>
<td>Floating Pt.</td>
<td>No. of losses of frame sync.</td>
</tr>
<tr>
<td>235 - 240</td>
<td>Floating Pt.</td>
<td>No. of frames with fill.</td>
</tr>
<tr>
<td>241</td>
<td></td>
<td>Remainder of record blank.</td>
</tr>
</tbody>
</table>
**ATTACHMENT II**

**Description of Time Field**

<table>
<thead>
<tr>
<th>Character</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Subcom Slip Flag*</td>
</tr>
<tr>
<td>2 - 4</td>
<td>Not Used.</td>
</tr>
<tr>
<td>5 - 6</td>
<td>Day Count of Year (1 - 366).</td>
</tr>
<tr>
<td>7</td>
<td>Not Used.</td>
</tr>
<tr>
<td>8 - 12</td>
<td>Milliseconds of Day. (Time at word 1 of frame 1 of first subcom cycle in record).</td>
</tr>
</tbody>
</table>

* The configuration of the subcom slip flag is as follows (bit 1 is least significant bit in character): 1 = slip occurred, 0 = no slip.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Slip of sail subcom in subcom cycle 1.</td>
</tr>
<tr>
<td>2</td>
<td>Slip of wheel subcom in subcom cycle 1.</td>
</tr>
<tr>
<td>3</td>
<td>Slip of digital subcom in subcom cycle 1.</td>
</tr>
<tr>
<td>4</td>
<td>Slip of sail subcom in subcom cycle 2.</td>
</tr>
<tr>
<td>5</td>
<td>Slip of wheel subcom in subcom cycle 2.</td>
</tr>
<tr>
<td>6</td>
<td>Slip of digital subcom in subcom cycle 2.</td>
</tr>
</tbody>
</table>
Description of Flag Field

(Bit 1 is least significant bit in character)

Flag Field Character 1 (i.e. left-most character of field) contains:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 4</td>
<td>No. of bit errors in main sync word.</td>
</tr>
<tr>
<td>5</td>
<td>1 = fill data in this frame, 0 = none.</td>
</tr>
<tr>
<td>6</td>
<td>1 = night, 0 = day.</td>
</tr>
</tbody>
</table>

Flag Field Character 2 (i.e., right-most character of field) contains:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 6</td>
<td>No. of frame in subcom cycle (1 - 48).</td>
</tr>
</tbody>
</table>
**ATTACHMENT IV**

Description of Attitude Flag Field (Field is in 7094 format where bit 1 is LSB)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No $\phi$, $\eta$, $\beta$s data; data point was interpolated.</td>
</tr>
<tr>
<td>2</td>
<td>No $\omega$ data; data point was interpolated.</td>
</tr>
<tr>
<td>3</td>
<td>$\phi$ data out of bounds; data point was interpolated.</td>
</tr>
<tr>
<td>4</td>
<td>$\eta$ data out of bounds; data point was interpolated.</td>
</tr>
<tr>
<td>5</td>
<td>$\omega$ data out of bounds; data point was interpolated; $\beta$s is also interpolated by gyro pulse.</td>
</tr>
<tr>
<td>6</td>
<td>Pitch gas was activated.</td>
</tr>
<tr>
<td>7</td>
<td>No encoder pulse detected.</td>
</tr>
<tr>
<td>8</td>
<td>More than one encoder pulse detected.</td>
</tr>
<tr>
<td>9</td>
<td>Not used.</td>
</tr>
<tr>
<td>10</td>
<td>Not used.</td>
</tr>
<tr>
<td>11</td>
<td>Not used.</td>
</tr>
<tr>
<td>12</td>
<td>No pitch angle available.</td>
</tr>
<tr>
<td>13</td>
<td>No spin calculation possible.</td>
</tr>
<tr>
<td>14</td>
<td>No aspect calculation possible.</td>
</tr>
</tbody>
</table>
ATTACHMENT V

Description of Records With ORBIT Information

The first records in each file after the label record will contain the ORBIT information for the time interval covered by the data file. The first word in each record will contain all 1's (binary) indicating that ORBIT information will follow. The record will then be filled with 20-word data blocks containing the following information:

<table>
<thead>
<tr>
<th>Word No.</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type of data item indicator:</td>
</tr>
<tr>
<td></td>
<td>= 1 regular satellite data item.</td>
</tr>
<tr>
<td></td>
<td>= 2 regular satellite data item.</td>
</tr>
<tr>
<td></td>
<td>= 3 north point data item.</td>
</tr>
<tr>
<td></td>
<td>= 4 descending node crossing.</td>
</tr>
<tr>
<td></td>
<td>= 5 south point data item.</td>
</tr>
<tr>
<td></td>
<td>= 6 sunlight entrance.</td>
</tr>
<tr>
<td></td>
<td>= 7 sunlight exit.</td>
</tr>
<tr>
<td>2</td>
<td>Day count of year, time of data.</td>
</tr>
<tr>
<td>3</td>
<td>Seconds of day, time of data.</td>
</tr>
<tr>
<td>4</td>
<td>Satellite position vector $x$ (km).</td>
</tr>
<tr>
<td>5</td>
<td>Satellite position vector $y$ (km).</td>
</tr>
<tr>
<td>6</td>
<td>Satellite position vector $z$ (km).</td>
</tr>
<tr>
<td>7</td>
<td>Satellite velocity vector $x$ (km/sec).</td>
</tr>
<tr>
<td>8</td>
<td>Satellite velocity vector $y$ (km/sec).</td>
</tr>
<tr>
<td>9</td>
<td>Satellite velocity vector $z$ (km/sec).</td>
</tr>
<tr>
<td>10</td>
<td>Geodetic longitude (deg).</td>
</tr>
<tr>
<td>11</td>
<td>Geodetic latitude (deg).</td>
</tr>
<tr>
<td>12</td>
<td>Height above spheroid (km).</td>
</tr>
<tr>
<td>13</td>
<td>Solar vector $S_x$ (AU).</td>
</tr>
<tr>
<td>14</td>
<td>Solar vector $S_y$ (AU).</td>
</tr>
<tr>
<td>15</td>
<td>Solar vector $S_z$ (AU).</td>
</tr>
<tr>
<td>16</td>
<td>McIlwain L. Parameter L (earth radii).</td>
</tr>
<tr>
<td>17</td>
<td>Magnetic field strength B (gauss).</td>
</tr>
<tr>
<td>18</td>
<td>Right ascension of magnetic field vector (deg).</td>
</tr>
<tr>
<td>19</td>
<td>Declination of magnetic field vector (deg).</td>
</tr>
<tr>
<td>20</td>
<td>Ascending-node-crossing number.</td>
</tr>
</tbody>
</table>

All data with the exception of the geodetic information is given in Geocentric Equatorial Inertial (GEI) coordinates. Geodetic longitude is positive east of Greenwich, negative west of Greenwich. Geodetic northern latitudes are positive, and southern latitudes are negative. The geodetic information is based on the use of Fisher's Ellipsoid with an equatorial radius of 6378.166 km and a flattening of $f = 1/298.25$. 
ATTACHMENT V

The 20-word data blocks will fill the first and succeeding records until the given ORBIT information covers the entire time interval of the data file. The 20-word data block will never be divided into parts to fit into the end of one data record and the beginning of another. The ending of ORBIT data is noted by filling the remainder of the data record with 88888888. (Floating point.) All ORBIT information is written in IBM-7094 floating point format.
XXV. Description of Output

A. Engineering Plot (Optional Output)

One hundredth of an inch represents 15.36 seconds or one major frame of data.

1. DAY-NIGHT : '-'=day ' '=night
2. ALTERNATE-NORMAL quadrant : '-'=alternate ' '=normal
3. MAGNETOMETER-GYRO reference : '-'=magnetometer ' '=gyro
4. CENTRAL DETECTOR ON-OFF : '-'=OFF ' '=ON
5. SHIELD ON-OFF : '-'=OFF ' '=ON
6. SCAN MODE : 'F'=full 'I'=intermediate 'S'=short

(The scan mode is printed at the start of each file and also after a change in scan mode.)

7. GAIN HIGH-LOW : 'H'=high 'L'=low

(Gain is printed at the start of each file and when gain changes.)

8. STEP NUMBER : The step number is calculated using the following constants and equations:

For gain = 1
\[ aV + b = \text{step} \]
\[ a \left( \frac{\text{cnts}}{51} \right) + b = \text{step} \]
\[ 1.5011 \ a + b = 0 \]
\[ 3.565 \ a + b = 63 \]
\[ 2.064 \ a = 63 \]
\[ a = 30.52 + .5 \text{ and} \]
\[ b = -45.81 \text{ truncate} \]
For gain = 1/3
\[ aV + b = \text{step} \]
\[ a\left(\frac{\text{cnts}}{51}\right) + b = \text{step} \]
\[ 0.011 \ a + b = 0 \]
\[ 2.074 \ a + b = 63 \]
\[ a = 30.53 \quad + .5 \quad \text{and} \]
\[ b = -.336 \quad \text{truncate} \]

9. ELECTRONIC TEMPERATURE: Point should occur every 6 major frames.
\[ \text{POINT} = \frac{\text{counts}}{255} \ast .25 \text{ in.} \]

10. DETECTOR TEMPERATURE: Same as No. 9.

11. CENTRAL DETECTOR: Same as No. 9.

12. SHIELD: Same as No. 9.

13. LOW VOLTAGE: Same as No. 9.

14. GAMMA COUNTS .3 to 9 MeV SOLAR: Point should occur every major frame.
\[ \text{POINT} = \frac{\text{counts} \ 0-120}{120} \ast 1.0 \text{ in.} \]

15. GAMMA COUNTS .3 to 9 MeV BACKGROUND: Same as No. 14.

16. GAMMA COUNTS > 9 MeV SOLAR: Point should occur every major frame.
\[ \text{POINT} = \frac{\text{counts} \ 0-60}{60} \ast 1.0 \text{ in.} \]

17. GAMMA COUNTS > 9 MeV BACKGROUND: Same as No. 16.

18. CUP SOLAR: Point should occur every major frame.
\[ \text{POINT} = \frac{\text{counts} \ 60-160}{100} \ast 1.0 \text{ in.} \]

19. CUP BACKGROUND: Same as No. 18.
20. SLAB SOLAR: Point should occur every major frame.  
\[ \text{POINT} = \frac{\text{counts 60-160}}{100} * 1.0 \text{ in.} \]

21. SLAB BACKGROUND: Same as No. 20.

22. DAY OF YEAR: Printed at start of each frame and whenever day changes.  
Time on the engineering plots is real time.

23. HOURS OF DAY: Hours 0-23 are printed -- day count changes at 0.

24. ORBIT NUMBER: This is the ascending node crossing number.
B. Printed Output

1. Line Summary (Optional Output)

Status Line

The status line is printed at the start of each file, after a long time gap, and whenever status, central detector on-off, or step number change. An asterisk is printed to the left of the field in which a change has occurred.

The status line consists of:

a. DAY -------

b. HOUR

This is the time of the major frame in which change occurs--the time is the accumulation time.

c. MINUTES

d. SECONDS---

e. SCAN MODE: 'FULL', 'INTER', 'SHORT', or 'INVLD' (invalid).

f. QUADRANT: 'A' - alternate 'N' - normal.

g. DAY or NITE: Determined from status word.

h. MAG or GYRO: Magnetometer or gyro reference (status word).

i. SHLD/on-off: Determined from status word--charged particle.

j. CNTR/on-off: central detector -- determined from analog word (ASC 1-5).

k. GAIN/hi-lo: Gain high or low -- determined from status word.

l. STEP NUMBER: Analog word ASC 1-6.

The step number is calculated using same formulae and constants as in the plot section.

Summary Line

One summary line is printed for 3 minutes of data; one full scan, 3 intermediate scans, or 6 short scans are represented by one line.
a. DAY ------
b. HOUR 
   This is the first major frame in the section processed; it is the accumulation time.
c. MINUTES 
d. SECONDS--
e. SOLAR

DEAD TIME (seconds) = DEAD TIME * .001515

CLOCK TIME (seconds) = PHA CLOCK TIME * 1/390.625 * 2 INTER 1 SHORT

GAMMA SUM = ΣSOLAR GAMMA .3 to 9 MeV / (SOLAR CLOCK TIME - DEAD TIME)

Following a radiation calibration:

GAMMA SUM = ΣSOLAR GAMMA .3 to 9 MeV / 100.0

GAMMA LOG = ΣSOLAR GAMMA .3 to 9 MeV / No. major frames) * .1

CUP RATE = Average solar cup rate = ΣSOLAR CUP / No. major frames

SLAB RATE = Average solar slab rate = ΣSOLAR SLAB / No. major frames

f. BACKGROUND

DEAD TIME (seconds) = DEAD TIME * .001515

CLOCK TIME (seconds) = PHA CLOCK TIME * 1/390.625 * 2 INTER 1 SHORT

GAMMA SUM = ΣBACKGROUND GAMMA .3 to 9 MeV / (CLOCK TIME DEAD TIME)

Following a radiation calibration:

GAMMA SUM = 0.0

GAMMA LOG = (ΣBACKGROUND GAMMA .3 to 9 MeV / No. major frames) * .1

CUP RATE = Average background cup rate = ΣBACKGROUND CUP / No. major frames

SLAB RATE = Average background slab rate = ΣBACKGROUND SLAB / No. major frames
g. AVERAGE DETECTOR TEMPERATURE

h. AVERAGE ELECTRONIC TEMPERATURE

i. AVERAGE CENTRAL HIGH VOLTAGE

j. AVERAGE SHIELD HIGH VOLTAGE

k. STATUS BITS:
   SCAN MODE : 'F'=Full, 'I'=Intermediate, 'S'=Short
   QUADRANT : 'A'=Alternate, 'N'=Normal
   ELECTRONIC CALIBRATION : 'E'=ON 'I'=OFF
   RADIATION CALIBRATION : 'R'=ON 'I'=OFF
   DAY-NIGHT indicator : 'D'=day 'N'=night
   MAG-GYRO reference : 'M'=mag 'G'=gyro
   CHARGED PARTICLE : 'P'=ON 'I'=OFF
   CENTRAL DETECTOR : 'C'=ON 'I'=OFF

l. AVERAGE LOW VOLTAGE

m. NUMBER SYNC ERRORS IN SECTION PROCESSED

n. ERROR MESSAGE NUMBER--if any
   Cross-reference with error listing at end of line summary.
It is possible to have error messages interspersed with summary lines as well as having them printed in an error listing at the end of the run.

This would simply involve recompiling the main program with changes in the data statements containing the logical unit numbers for the different print sets used.

2. File, Tape, and Run Summaries (Output Each Run)

These summaries are an accumulation of statistics concerning the quantity and quality of the data for either a file, a tape, or a whole run.

Here is a list of the parameter accumulators that produce the necessary statistics:

- Count incrementer for sections processed.
- Count incrementer for sections bypassed.
- Count incrementer for complete (=12 major frames) sections processed.
- Count incrementer for complete sections processed with no analog flags.
- Count incrementer for complete sections processed with no MF flags.
- Number of scheduled status words missing or not recognized (processed sections).
- Number of time gaps (imbedded within a Decomm file) - total.
- Number of time gaps (imbedded within a Decomm file) - total "short".
- Major frames lost due to time gaps.
- Major frames bypassed.

For major frames processed:

- Total.
- No flagged analog.
- No flagged DSF (digital subcom).
- No flagged MF (main frame).
For X ray sequences selected for processing:
o. Total selected.
p. Total selected with no flags for digital subcom.
q. Sync error instance count for frames processed.
r. Sync error bit count for frames processed.
s. Contradiction count.
t. Day-night change count (of sections).
u. Radioactive calibration count (of sections starting with R-Cal in progress).
v. Electronic calibration count (of sections starting with E-Cal in progress).
w. Total sections (processed or bypassed).

For file summary:
x. I/O errors detected.
y. Begin time parameters (yr, day of yr, hr, min, sec).
z. End time parameters (yr, day of yr, hr, min, sec).

aa. Tape sequence count.
bb. File sequence count.

For tape summary:
cc. I/O errors detected.
dd. Earliest begin time parameters.
ee. Latest end time parameters.
ff. Tape sequence count.
gg. Final file count.

For run summary:
hh. I/O errors detected.
ii. Earliest begin time parameters.
jj. Latest end time parameters.
kk. Final tape sequence count.
ll. Total files summarized.

mm. Files summarized but completely bypassed.

3. Data Anomaly Messages (Output Each Run)

Error messages are numbered so as to correspond to a summary line of the line summary. The number "nnnn" below represents this sequence count. It appears at the end of a summary line and at the beginning of the corresponding error message. There is also a severity code accompanying each message. This code '-s' simply tells the user the seriousness of the problem encountered. A severity code of 0 or 1 is quite common and reflects no serious problem. A severity code of 2 reflects greater problems such as time backslippage or I/O errors.

It is good to note that even if the line summary is not requested by the user, error messages and file, tape, and run summaries are provided by the program.

The messages that make up the error message listing are as follows:

nnnn = SEQUENCE COUNT (FOR PASS-I RUN MADE AT nnnmm HOURS OF yydd) OF FOLLOWING MESSAGE SERIES.

-s I/O ERRORS OCCURRED ON n BLOCKS. IDENTIFIERS (TAPE, FILE, BLOCK, SENSE 1, SENSE 2) ARE SHOWN BELOW. 
t, f, b, x, z, --t_n f_n b_n x_n z_n

-s PROGRAM TERMINATION REQUESTED BY FEEDER. CALL ARGUMENTS = (aa, bb, cc, dd, ee, ff, gg), IHEXPN = hh, QHDERR = p, QHTAPN = q.

-s TIME GAP (EXCEEDING nnn MAJOR FRAMES) HAS OCCURRED IN DATA ACCEPTED BY PASS-I PROGRAM.

-s TIME BACKSLIPPAGE IN TAPE INPUT DATA. PREVIOUS IDENTIFIERS = (DAY = ddd, SECONDS = sssssss, TIME = tt, FILE = ff, BLOCK = bbb). CURRENT IDENTIFIERS = (DAY = ddd, SECONDS = sssssssss, TAPE = tt, FILE = ff, BLOCK = bbb).

-s PROGRAM TERMINATED BY EXCESS FILES. Pane 15 IDENTIFIERS = (TAPE = tt, FILE = ff, BLOCK = bbb).
DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS = (IB = bb, IA = aa, TAPE = tt, FILE = ff, BLK = bbb, DAY = ddd, SECONDS = ssssss.ss).

SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

COMPLETE BREAKDOWN IN SCAN MODE ID. IDENTIFIERS = (TAPE = tt, FILE = ff, BLK = bb, DAY = ddd, SECONDS = sssss.ss).
C. Calibration Cards (Optional Output)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MINUTES</th>
<th>SECONDS</th>
<th>CHANNEL (1)</th>
<th>CHANNEL (2)</th>
<th>CHANNEL (3)</th>
<th>COUNTS (1)</th>
<th>COUNTS (2)</th>
<th>COUNTS (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>999999999999</td>
<td>999999999999</td>
</tr>
</tbody>
</table>

**YEAR**

**MONTH**

**DAY**

**HOUR**

**MINUTES**

**SECONDS**

**CHANNEL (1)**

**CHANNEL (2)**

**CHANNEL (3)**

**COUNTS (1)**

**COUNTS (2)**

**COUNTS (3)**

**ID**

Channel number of 1st peak channel.

Channel number of 2nd peak channel.

Channel number of 3rd peak channel.

Sum of counts around 1st peak channel.

Sum of counts around 2nd peak channel.

Sum of counts around 3rd peak channel.

'200' for calibration cards.
D. X-Ray Data Tape (Optional Output)

This is a 9-track tape containing interpreted x-ray values. For missing major frames, a filler of -1's is used. The time parameter reflects real time.

The logical record length is 76 characters and the block size is 1520 characters.

Here is a list of the parameters on the x-ray tape. (All parameters are 16-bit integers except for numbers 7,8,25, 26,27, and 28 which are 32-bit floating point words):

1. YEAR of 1st major frame.
2. YEAR of 2nd major frame.
3. DAY OF YEAR of 1st major frame.
4. DAY OF YEAR of 2nd major frame.
5. HOUR OF DATA of 1st major frame.
6. HOUR OF DATA of 2nd major frame.
7. MINUTES OF DATA of 1st major frame.
8. MINUTES OF DATA of 2nd major frame.
9. SECONDS OF DATA of 1st major frame.
10. SECONDS OF DATA of 2nd major frame.
11. STATUS WORD of 12 bits in half-word of 1st major frame.
12. SOLAR 7.5 - 15 keV
13. SOLAR 15 - 30 keV
14. SOLAR 30 - 60 keV
15. SOLAR 60 - 120 keV
16. BACKGROUND 7.5 - 15 keV
17. BACKGROUND 15 - 30 keV
18. BACKGROUND 30 - 60 keV
19. BACKGROUND 60 - 120 keV
20. SOLAR QUADRANT TIME of 1st major frame.
21. SOLAR QUADRANT TIME of 2nd major frame.
22. BACKGROUND QUADRANT TIME of 1st major frame.
23. BACKGROUND QUADRANT TIME of 2nd major frame.
24. STATUS WORD of 12 bits in half word of 2nd major frame.
25. SPIN RATE of 1st major frame.
26. SPIN RATE of 2nd major frame.
27. AZIMUTH ENCODER TIME of 1st major frame.
28. AZIMUTH ENCODER TIME of 2nd major frame.
29. ELECTRONIC CALIBRATION 1 - on, 2 - off, 0 - no major frame.
30. RADIATION CALIBRATION 1 - on, 2 - off, 0 - no major frame.
31. DAY - NIGHT INDICATOR 1 - day, 2 - night, 0 - no status.
32. EXTRA WORD.
E. Good Time Cards (Optional Output)

These cards indicate the begin time and end time of good Experimenter data scans.

The format is as follows:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MINUTES</th>
<th>SECONDS</th>
<th>Bo/So</th>
</tr>
</thead>
</table>

- **YEAR**
- **MONTH**
- **DAY**
- **HOUR**
- **MINUTES**
- **SECONDS**
- **Bo/So**

**This is the midpoint of accumulation of the first scan to be processed.**

**This field indicates whether to begin processing both background and solar or solar only.**
This is the accumulation time of the last scan to be processed.

This field indicates whether to stop processing at the background scan or after processing both background and solar.

= '100' for good time cards.
F. Main Frame Data Tape (Optional Output)

All parameters on this tape are 16-bit integers. The logical word length is 908 characters with a block size of 908 characters.

- **HYR**: Year
- **HMO**: Month
- **HDA**: Day
- **HJUL**: Julian Date
- **HHR**: Hour
- **HMN**: Minutes
- **HSE**: Seconds

: This time is the read-out time of the first major frame processed in this section. The time is the read-out time of the main frame data and the real time of analog words and main frame status. When the first major frame is missing, the read-out time for the quadrant scan is calculated if possible.

- **HAN(60)**: Analog words

: Optimally, there are 6 major frames processed per quadrant scan and this field contains the 60 analog words for the scan, 10 words from each major frame processed. When there are major frames missing, -1's are substituted in the area where the gap occurred, if possible. (This is not usually possible at the beginning of a file.)

- **HMFDAT(384)**: Main Frame Date

: This file contains the main frame data corresponding to a quadrant scan of 6 major frames. If there is a time gap, -1's fill the area where the gap occurred if this is possible. The main frame data was accumulated 184.32 seconds earlier than the above given read-out time for a background quadrant and 276.48 seconds earlier for a solar quadrant.

- **HTGAP**: Time gap indicator

: This is an indicator that is set to '0' when 6 major frames are being processed and set to '1' when there is data missing in the section.
HFRCNT : Frame counter

This is the major frame counter. It indicates how many major frames are being processed in the section.

HEXTRA : Extra field

This indicator is set to zero and is an extra field added to the tape for possible future use.
## Line Summary

<table>
<thead>
<tr>
<th>RJN DATE</th>
<th>YR/DAY OF YR</th>
<th>HRS/MIN</th>
<th>CVR/</th>
<th>GAIN/MI</th>
<th>STEP/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>216 21 33 34.8</td>
<td>2340</td>
<td>FULL</td>
<td>M4AQD</td>
<td>NITE</td>
<td>GYFO</td>
</tr>
<tr>
<td>216 21 33 34.8</td>
<td>2340</td>
<td>FULL</td>
<td>M4AQD</td>
<td>NITE</td>
<td>GYFO</td>
</tr>
</tbody>
</table>

| TIME | TD | TC | SOLAR | SUM | LOG | CUP | SLAB | TO | TC | GAMMA | BACKGROUND | SUM | LOG | CUP | SLAB | DET | FL | HI | V | HI | V | BITS | MESSA$E | ERRS |
|------|---|---|-------|-----|-----|-----|------|----|---|-------|------------|-----|-----|-----|------|----|----|----|----|----|----|-------|-----|
| 216 21 33 4.1 | FULL | M4AQD | NITE | GYFO | SLD/ON | CR/ON | GAIN/MI | STEP/0 |
| 216 21 33 19.4 | FULL | M4AQD | NITE | GYFO | SLD/ON | CR/ON | GAIN/MI | STEP/0 |

### Notes
- The table contains data for various parameters related to SOLAR and GAMMA measurements, including TD, TC, SOLAR, SUM, LOG, CUP, SLAB, TO, TC, GAMMA, BACKGROUND, SUM, LOG, CUP, SLAB, DET, FL, HI, V, HI, V, BITS, MESSA$E, and ERRS.
- The data spans a range of values for each parameter, indicating variations over time.
- The presence of specific terms such as FULL, M4AQD, NITE, GYFO, SLD/ON, CR/ON, and GAIN/MI suggest a detailed analysis or monitoring system for these metrics.
SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.

1 = SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.
   -0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.
   -1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

2 = SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.
   -0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.
   -1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

3 = SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.
   -0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.
   -1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

4 = SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.
   -0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.
   -1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

5 = SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.
   -0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.
   -1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

6 = SEQUENCE COUNT (FOR PASS-1 RUN MADE AT 922 HOURS OF 72119) OF FOLLOWING MESSAGE SERIES.
   -0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.
   -1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-0 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT Scan MODE IDENTIFICATION.

-1 SUBROUTINE PUZZLE RESORTING TO FREE-WHEELING FOR FINAL SCAN MODE ID ATTEMPT.

ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=11, IA=36, TAPE=1, FILE=6, BLK=15, DAY=290, SECONDS=24473.65

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=14, IA=37, TAPE=1, FILE=7, BLK=15, DAY=290, SECONDS=25065.82

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=13, IA=36, TAPE=1, FILE=6, BLK=15, DAY=290, SECONDS=24473.65

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=14, IA=37, TAPE=1, FILE=7, BLK=15, DAY=290, SECONDS=25065.82

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

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-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=13, IA=36, TAPE=1, FILE=6, BLK=15, DAY=290, SECONDS=24473.65

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=14, IA=37, TAPE=1, FILE=7, BLK=15, DAY=290, SECONDS=25065.82

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

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-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=13, IA=36, TAPE=1, FILE=6, BLK=15, DAY=290, SECONDS=24473.65

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=14, IA=37, TAPE=1, FILE=7, BLK=15, DAY=290, SECONDS=25065.82

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=13, IA=36, TAPE=1, FILE=6, BLK=15, DAY=290, SECONDS=24473.65

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.

-1 STATUS WORD DISCONTINUITY. SUBROUTINE PUZZLE CALLED TO ATTEMPT SCAN MODE IDENTIFICATION.

-2 ILLEGAL GAP IN STATUS WORDS. IDENTIFIERS=ID=14, IA=37, TAPE=1, FILE=7, BLK=15, DAY=290, SECONDS=25065.82

-0 DATA ACCEPTANCE SUSPENDED DUE TO HIGH VOLTAGE BEING OFF.
### File, Tape, and Run Summary

**FILE SUMMARY FOR 1ST FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**FILE SUMMARY FOR 2ND FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**FILE SUMMARY FOR 3RD FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**FILE SUMMARY FOR 4TH FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**FILE SUMMARY FOR 5TH FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**FILE SUMMARY FOR 6TH FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**FILE SUMMARY FOR 7TH FILE READ FROM TAPE=(COUNT=1, VOLSER=EXD224) DURING PASS-1 RUN STARTED AT 23:40 HOURS OF 73355.**

**DATA TIMES FROM 1972Y 2160 24M 35H 47M 35M 29 0.0 0 0 0 0 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.**

<table>
<thead>
<tr>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNT</td>
<td>30 30 0</td>
<td>358 358 358</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.63</td>
<td>1.63</td>
<td>93.3 93.3 93.3</td>
<td>0 0 0</td>
</tr>
<tr>
<td>CT</td>
<td>93.4</td>
<td>93.4</td>
<td>93.4 93.4 93.4</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>
File, Tape, and Run Summary

DATA TIMES FROM 1972Y 14D 2H 44' 265 TO 1972Y 2190 3H 36' 45S. 0 I/O ERRORS. 0 SC SYNC BITS IN ERROR IN 0 MINOR FRAMES.

<table>
<thead>
<tr>
<th>SECTION QUANTITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL CESS PASS</td>
<td>TOTAL CESS PASS LOSS</td>
<td>CESS PLETE MF</td>
<td>CESS WHEEL DSF MF</td>
<td>LECT CLEAN</td>
</tr>
<tr>
<td>CNT</td>
<td>30</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HRS</td>
<td>1.52</td>
<td>1.52</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>PCT</td>
<td>93.3</td>
<td>93.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

TAPE SUMMARY FOR 34 FILES READ FROM TAPE # COUNT= 1, VOLSE=EX0224J DURING PASS-1 RUN STARTED AT 1700 HOURS OF 74014.

DATA TIMES FROM 1972Y 2100 2H 354' 37s TO 1972Y 2190 3H 36' 45S. 0 I/O ERRORS. 5117 SC SYNC BITS IN ERROR IN 716 MINOR FRAMES.

<table>
<thead>
<tr>
<th>SECTION QUANTITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL CESS PASS</td>
<td>TOTAL CESS PASS LOSS</td>
<td>CESS PLETE MF</td>
<td>CESS WHEEL DSF MF</td>
<td>LECT CLEAN</td>
</tr>
<tr>
<td>CNT</td>
<td>988</td>
<td>988</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>HRS</td>
<td>48.90</td>
<td>48.90</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>PCT</td>
<td>90.4</td>
<td>90.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

RUN SUMMARY FOR 34 FILES READ FROM 1 TAPE DURING PASS-1 RUN STARTED AT 1700 HOURS OF 74014.

DATA TIMES FROM 1972Y 2100 2H 354' 37s TO 1972Y 2190 3H 36' 45S. 0 I/O ERRORS. 5117 SC SYNC BITS IN ERROR IN 716 MINOR FRAMES.

<table>
<thead>
<tr>
<th>SECTION QUANTITY</th>
<th>MAJOR-FRAME QUANTITY</th>
<th>SECTION QUALITY</th>
<th>MAJOR-FRAME QUALITY</th>
<th>XRAY DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL CESS PASS</td>
<td>TOTAL CESS PASS LOSS</td>
<td>CESS PLETE MF</td>
<td>CESS WHEEL DSF MF</td>
<td>LECT CLEAN</td>
</tr>
<tr>
<td>CNT</td>
<td>988</td>
<td>988</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>HRS</td>
<td>48.90</td>
<td>48.90</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>PCT</td>
<td>90.4</td>
<td>90.4</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
## PASS-1 GOOD TIME CARDS

| 72 | 8 3 21 | 36:39.1 | 80 | 72 | 8 3 23 | 11:52.2 | 80 |
| 72 | 8 3 23 | 11:56.9 | 80 | 72 | 8 3 23 | 11:52.2 | 80 |
| 72 | 8 4 0  | 50:10.4 | 80 | 72 | 8 4 1  | 54:41.2 | 80 |
| 72 | 8 4 2  | 6:58.0  | 80 | 72 | 8 4 3  | 32:15.7 | 80 |
| 72 | 8 4 3  | 45:15.7 | 80 | 72 | 8 4 3  | 45:15.7 | 80 |
| 72 | 8 4 5  | 20:50.5 | 80 | 72 | 8 4 6  | 27:52.2 | 80 |
| 72 | 8 4 6  | 37:47.0 | 80 | 72 | 8 4 6  | 37:47.0 | 80 |
| 72 | 8 4 8  | 18:26.8 | 80 | 72 | 8 4 10 | 47:32.1 | 80 |
| 72 | 8 4 10 | 56:144.6 | 80 | 72 | 8 4 13 | 27:54.2 | 80 |
| 72 | 8 4 13 | 38:6.7  | 80 | 72 | 8 4 15 | 7:12.0  | 80 |
| 72 | 8 4 15 | 16:24.5 | 80 | 72 | 8 4 16 | 45:29.7 | 80 |
| 72 | 8 4 16 | 54:42.2 | 80 | 72 | 8 4 18 | 23:47.5 | 80 |
| 72 | 8 4 18 | 33:0.3  | 80 | 72 | 8 4 20 | 32:48.3 | 80 |
| 72 | 8 4 20 | 6:47.4  | 80 | 72 | 8 4 22 | 11:6.1  | 80 |
| 72 | 8 4 22 | 23:22.9 | 80 | 72 | 8 4 23 | 49:23.9 | 80 |
| 72 | 8 5 0  | 1:40.7  | 80 | 72 | 8 5 1  | 27:41.6 | 80 |
| 72 | 8 5 1  | 36:54.2 | 80 | 72 | 8 5 2  | 15:50.4 | 80 |
| 72 | 8 5 2  | 22:59.0 | 80 | 72 | 8 5 2  | 44:29.3 | 80 |
| 72 | 8 5 2  | 53:14.8 | 80 | 72 | 8 5 4  | 22:47.1 | 80 |
| 72 | 8 5 4  | 31:59.6 | 80 | 72 | 8 5 6  | 4:4.8   | 80 |
| 72 | 8 5 6  | 10:17.3 | 80 | 72 | 8 5 7  | 36:18.3 | 80 |
| 72 | 8 5 7  | 14:35.6 | 80 | 72 | 8 5 9  | 59:2.5  | 80 |
| 72 | 8 5 9  | 8:15.1  | 80 | 72 | 8 5 12 | 28:2.8  | 80 |
| 72 | 8 5 12 | 9:41.1  | 80 | 72 | 8 5 13 | 30:46.3 | 80 |
| 72 | 8 5 13 | 47:58.8 | 80 | 72 | 8 5 15 | 17:4.1  | 80 |
| 72 | 8 5 15 | 26:16.7 | 80 | 72 | 8 5 16 | 37:47.5 | 80 |
| 72 | 8 5 16 | 39:60.0 | 80 | 72 | 8 5 18 | 6:0.9   | 80 |
| 72 | 8 5 18 | 15:13.4 | 80 | 72 | 8 5 19 | 41:14.4 | 80 |
| 72 | 8 5 19 | 50:26.9 | 80 | 72 | 8 5 21 | 22:36.5 | 80 |
| 72 | 8 5 21 | 31:49.0 | 80 | 72 | 8 5 22 | 57:49.9 | 80 |
| 72 | 8 5 22 | 10:6.7  | 80 | 72 | 8 6 0  | 36:7.7  | 80 |
| 72 | 8 6 0  | 45:20.3 | 80 | 72 | 8 6 1  | 52:55.3 | 80 |
| 72 | 8 6 1  | 2:7.8   | 80 | 72 | 8 6 3  | 31:13.1 | 80 |
Section 3

CALL

I. Introduction 3-1
II. Macro Systems Flowchart 3-2
III. Job Stream Schematic 3-3
IV. Job Control Language 3-4
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X. Sample Output Listing
I. Introduction

This program reads a series of input cards, the first of which contains the \( n_0 \) to be used in the calculation of the gain constant (for our purposes, a constant \( n_0 \) of 80.2 was used). The other input cards are calibration cards generated by Pass-I. Each card contains midpoint of accumulation time, three peak channels, and three peak counts. From this information CALL calculates an \( n_0 \) for each input card from the relation:

\[
\frac{n_0}{n_{i_1} + n_{i_2} + n_{i_3}} = \frac{E_i}{E_1} \frac{n_{i_2} - n_{i_1}}{n_{i_2} - n_{i_1}}
\]

An average \( n_0 \) is found for all the cards read.

The program then calculates a gain constant for each card using weighted average:

\[
c = \gamma \left( \frac{E_i}{n_{i_1}} \right)^2
\]

where:

\[
E_1 = 1.17323 \text{ MeV}
\]

\[
E_2 = 1.33248 \text{ MeV}
\]

\[
E_3 = 2.525 \text{ MeV}
\]

\[
w_i = \frac{N_i}{N_1 + N_2 + N_3}
\]

\( N_i \) = number of counts under the peak at energy \( E_i \)

\( n_i \) = the channel that corresponds to the energy \( E_i \).

An error statistic is calculated for each calibration in the following way:

For \( i = 1,3 \)

\[
ER_i = \frac{(E_i - C(n_{i_1} + n_{i_0}))^2}{E_i}
\]

\[
ERROR = \sqrt{\frac{1}{3} \left( \frac{ER_i}{E_i} \right)^2}
\]

A magnetic tape record is generated for each calibration card and contains time at midpoint of accumulation, \( C \), and \( n_0 \). The program then prints a listing of all the cards read - time, \( C \), average \( n_0 \), \( I \), \( N_0 \), channels, counts, and the error indicator.

This listing is reviewed by our project engineer and epoch times are derived from this source in conjunction with the output from the Van Allen Predict program (see Section 6).
II. Macro Systems Flowchart (CAL1)

PASS-I

CALIBRATION CARDS

$\text{CAL1}$

$n_0 = 80.2$

$t_1, N_1, n_1, C_1$

$n_0, \bar{n}_0, \delta E_1$

Visual Obsrv Selection of Epoch Times

Epoch time cards

$t_1, C_1, \bar{n}_0$
III. Job Stream Schematic (CAL1)

DATA
//GO.SYSIN DD*
JCL
/*/ 
CAL1 OBJ. DECK
//LKED. SYSIN DD*
//LKED.SYSLIB DD
//STEP1 EXEC FORTGLG
JOB CARD
V. JOB CONTROL LANGUAGE - CAL1

/* LINECNT 62
//STEP1 EXEC FORTGLG
//LKED.SYSLIB DD DSN=USER.T317.SUBLIB,DISP=SHR
// DD DSN=USER.T548.SUBLIB,DISP=SHR
// DD DSN=SYS1.FORTLIB,DISP=SHR
// DD DSN=USER.SSPLIB,DISP=SHR
//LKED.SYSIN DD *

*** CAL1 OBJECT DECK ***

/*
//GO.FPUTOL DD UNIT=2400,DISP=(NEW,KEEP),LABEL=(1,SL),
// DSN=CAL1,DCB=(RECFM=FB,LRECL=36,BLKSIZE=1800),
// VOLUME=SER=CC0922
//GO.SYSUDUMP DD SYSOUT=A
//GO.SYSIN DD *
80.2
/*
//
V. CALL (Main Program)

Program Language : Fortran IV, G-Level
Date Written : May 1972
Programmer : S. Croteau
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : FPUT, FORTIM

The purpose of this program is to calculate c for each calibration using a constant $n_o$ of 80.2. An error statistic is also found which is the error in the least squares fit to the three energy points as a function of channel number. The reasons for calculating this error statistic are:

1. To make sure the computer hasn't picked up a spurious peak (e.g. bit error).
2. To ascertain that the instrument has remained linear.

The program first reads in the calibration cards generated by PASS-I. It then calculates:

1. An $n_o$ for each card.
2. An average $n_o$ for all the cards.
3. C using an $n_o$ of 80.2.
4. The error statistic.

The results of these calculations are stored in tables. A tape record is then written for each calibration and a report is printed of all input and calculated output values.
A. Unlabelled Common

JYR : Integer full word variable containing the year at midpoint of accumulation.

JMO : Integer full word variable containing the month at midpoint of accumulation.

JDA : Integer full word variable containing the day at midpoint of accumulation.

JHR : Integer full word variable containing the hour at midpoint of accumulation.

JMIN : Integer full word variable containing the minutes at midpoint of accumulation.

ISEC : Integer full word variable containing the seconds at midpoint of accumulation.

CONST : Floating point full word variable containing C.

ZNZ : Floating point full word variable containing \( n_0 \).

ERROR : Floating point full word variable containing the calculated error statistic.

B. Variables and Arrays of Interest

IYR (1000) : Integer full word array containing the year at midpoint of accumulation read from the calibration cards.

IMO (1000) : Integer full word array containing the month at midpoint of accumulation read from the calibration cards.

IDA (1000) : Integer full word array containing the day at midpoint of accumulation read from the calibration cards.

IHR (1000) : Integer full word array containing the hour at midpoint of accumulation read from the calibration cards.

IMN (1000) : Integer full word array containing the minutes at midpoint of accumulation read from the calibration cards.
SEC (1000) : Floating point full word array containing the seconds at midpoint of accumulation read from the calibration cards.

SN1 (1000) : Floating point full word array containing the integrated channel number of the first peak in the calibration spectrum.

SN2 (1000) : Floating point full word array containing the integrated channel number of the second peak in the calibration spectrum.

SN3 (1000) : Floating point full word array containing the integrated channel number of the third peak in the calibration spectrum.

ICTS1 (1000) : Integer full word array containing the total counts surrounding the first peak.

ICTS2 (1000) : Integer full word array containing the total counts surrounding the second peak.

ICTS3 (1000) : Integer full word array containing the total counts surrounding the third peak.

C (1000) : Floating point full word array containing the calculated C for each calibration card read.

Z (1000) : Floating point full word array containing the calculated \(n_0\) for each calibration card read.

ERR (1000) : Floating point full word array containing the error statistic for each calibration card read.

MONTH (12) : Integer full word array containing the Julian day for the last day of each month of a normal year.

LMONTH (12) : Integer full word array containing the Julian day for the last day of each month of a leap year.

E1 : Floating point full word constant containing the energy associated with the first peak.

E2 : Floating point full word constant containing the energy associated with the second peak.

E3 : Floating point full word constant containing the energy associated with the third or sum peak.

SUM : Floating point full word variable containing the total \(n_0\) for all calibrations.

IHOLD : Integer full word variable containing the total number of calibration cards read.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Integer full word variable containing the calibration card code (=200).</td>
</tr>
<tr>
<td>AVEZNZ</td>
<td>Floating point full word variable containing the average $n_0$ for all cards read.</td>
</tr>
<tr>
<td>JUL</td>
<td>Integer full word variable containing the calculated Julian day.</td>
</tr>
<tr>
<td>IHRMN</td>
<td>Integer full word variable containing combined hours and minutes of day ($= \text{HRS} \times 100 + \text{minutes}$).</td>
</tr>
<tr>
<td>IRSLT</td>
<td>Integer full word variable containing the return code from a call to FPUT.</td>
</tr>
<tr>
<td>IRUNDA</td>
<td>Integer full word variable containing the run day after a call to FORTIM.</td>
</tr>
<tr>
<td>IRUNT</td>
<td>Integer full word variable containing the run time after a call to FORTIM.</td>
</tr>
<tr>
<td>LNECNT</td>
<td>Integer full word variable used as a line counter.</td>
</tr>
<tr>
<td>$n_0$</td>
<td>Floating point full word containing the $n_0$ to be used in the calculation of $C(80.2)$.</td>
</tr>
</tbody>
</table>
VI. Subroutine FORTIM (IRUNDA, IRUNT)

Program Language : IBM O/S 360 Assembler Language
Date Written : July 1969
Programmer : A. Buck
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) IRUNDA: output integer full word containing the date.
                  2) IRUNT: output integer full word containing the time of day in hundredths of a second.
Subprograms Called : None
Description : Subroutine FORTIM uses the time macro to fetch the date and the time from the computer clock. The date and the time are only as accurate as the corresponding information entered by the operator.
Example : FORTIM is called at 2.37 seconds after 3 minutes after 1 o'clock, A.M. on February 10, 1970. When control is returned from subroutine FORTIM, IRUNDA contains 70041 in binary form and IRUNT contains 3780237 in binary form.
VII. Subroutine FPUT (IDSN,ICMD,IRSLT,IOVEC)

<table>
<thead>
<tr>
<th>Program Language</th>
<th>IBM O/S 360 Assembler Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>February 4, 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>A. Buck</td>
</tr>
<tr>
<td>Installation</td>
<td>University of New Hampshire</td>
</tr>
<tr>
<td></td>
<td>Space Science Center</td>
</tr>
<tr>
<td>Computer</td>
<td>IBM-360-H50</td>
</tr>
<tr>
<td>Dummy Arguments</td>
<td></td>
</tr>
<tr>
<td>1) IDSN: a full word integer</td>
<td>parameter specifying the data set to which activity is directed. The integer stored at IDSN must be greater than zero but less than 21.</td>
</tr>
<tr>
<td>2) ICMD: a full word input</td>
<td>integer containing a request type code which specifies the activity to be performed.</td>
</tr>
<tr>
<td></td>
<td>a) ICMD = 1 implies that a logical record is to be written.</td>
</tr>
<tr>
<td></td>
<td>b) ICMD = 2 implies the data set is to be ended. Once ended, the data set is unavailable to the calling program through the same data set number.</td>
</tr>
<tr>
<td>3) IRSLT: a full word output</td>
<td>integer which subroutine FPUT can place a return code as follows</td>
</tr>
<tr>
<td></td>
<td>a) IRSLT = -1 implies request was illegal for one of the reasons below:</td>
</tr>
<tr>
<td></td>
<td>i. IDSN contained a value less than 1 or greater than 20.</td>
</tr>
<tr>
<td></td>
<td>ii. ICMD contained a value less than 1 or greater than 2.</td>
</tr>
<tr>
<td></td>
<td>iii. A write request was made to a data set that had been ended.</td>
</tr>
</tbody>
</table>
iv. An endfile request was made to a data set either before the first write request or after the data set had been ended.

b) $\text{IRSLT} = 0$ implies request was executed normally.

c) $\text{IRSLT} = 1$ implies an I/O error occurred while writing a block. The data set was ended.

4) $\text{IOVEC}$: an input vector whose high order byte is the first byte to be written (when $\text{ICMD} = 1$) in a logical record.

The number of bytes written is specified by the $\text{LRECL}$ subparameter on the DD statement describing the data set.

Subprograms Called: None

Description: Subroutine FPUT is a QSAM output subroutine to write logical records from an area defined by the calling program. This routine is specifically designed to allow a Fortran program to create without format control an extensive data set to which the DCB subparameter '$\text{RECFM} = \text{FB}$' applies. For data sets to which '$\text{RECFM} = \text{F}$' or '$\text{RECFM} = \text{U}$' applies, subroutine FTWRIT may be more easily used.

Subroutine FPUT can manage as many as 20 data sets in the same job step. As many as desired may be active simultaneously. Once the endfile command has been issued to a data set, subroutine FPUT will refuse to perform any further activity for that particular data set. The large number of data sets allows writing as many as 20 files to the same magnetic tape volume as a possible application.

DD Statements required...

If subroutine FPUT is called with $\text{IDSN}=1$ (or 2, ..., or 20) the user must supply a DD Statement having the DD name FPUT01 (or FPUT02, ..., or FPUT20). The DD Statement must include the DCB subparameters '$\text{RECFM}$', '$\text{LRECL}$', and '$\text{BLKSIZE}$' but must omit '$\text{DSORG}$' and '$\text{MACRF}$'.
VIII. Description of Input (CALL)

The Pass-I calibration cards have the following format:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MINUTES</th>
<th>SECONDS</th>
<th>CHANNEL (1)</th>
<th>CHANNEL (2)</th>
<th>CHANNEL (3)</th>
<th>COUNTS (1)</th>
<th>COUNTS (2)</th>
<th>COUNTS (3)</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- YEAR
- MONTH
- DAY
- HOUR
- MINUTES
- SECONDS

Midpoint scantime.

- CHANNEL (1): Channel number of 1st peak channel
- CHANNEL (2): Channel number of 2nd peak channel
- CHANNEL (3): Channel number of 3rd peak channel
- COUNTS (1): Sum of counts around 1st peak channel
- COUNTS (2): Sum of counts around 2nd peak channel
- COUNTS (3): Sum of counts around 3rd peak channel

ID = '200' for calibration cards
IX. Description of Output (CALL)

CALL output tape format is as follows:

\[(LRECL = 36, BLKSIZE = 1800)\]

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>Midpoint time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOUR</td>
<td>MINUTES</td>
<td>SECONDS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculated for each input card in the following manner:

\[
w_i = \frac{N_i}{N_1 + N_2 + N_3}
\]

\[
C = \frac{\sum w_i E_i}{\sum w_i (n_i - n_0)^2}
\]

- \(E_1 = 1.7323\)
- \(E_2 = 1.33248\)
- \(E_3 = 2.525\)

The \(n_0\) that is read in the first input card - for our applications 80.2 is used.
<table>
<thead>
<tr>
<th>SCAM TIME</th>
<th>YEAR / DAY OF YEAR</th>
<th>HRS / MIN</th>
<th>PEAK CHANNELS AND COUNTS</th>
<th>CTS1</th>
<th>CTS2</th>
<th>CTS3</th>
<th>ERROR</th>
</tr>
</thead>
<tbody>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04:57:00</td>
<td>00:00:00</td>
<td>00:00:00</td>
<td>78.3 80.4 77.3 87.9 150.9 1143 997 100</td>
<td>0.0023</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 4

CAL2

<table>
<thead>
<tr>
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</tr>
</thead>
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<td>4-4</td>
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<td>4-5</td>
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<td>4-6</td>
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<td>4-11</td>
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<td>4-15</td>
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<td>4-17</td>
</tr>
<tr>
<td>XI. Description of Input</td>
<td>4-18</td>
</tr>
<tr>
<td>XII. Description of Output</td>
<td>4-20</td>
</tr>
<tr>
<td>XIII. Sample Output Listing</td>
<td></td>
</tr>
</tbody>
</table>
I. Introduction

The objective of CAL2 is to provide the information that will allow us to gain correct as much of the gain variable real pulse height spectra as possible into the gain corrected, known and nonvariable pulse height spectra output from PASS-III. These gain-corrected spectra can then be directly compared over any time period in a search for gamma ray sources.

To accomplish this, several bits of information are used. These are:

A. Output of CAL1 - this provides known detector gain points at specific lines twice per orbit.

B. Output of the VA Predict program - this provides the times and intensities of particular VA belt passages.

C. Our acquired knowledge of typical detector operation during and after first turn on and specific intensity VA belt passage.

A typical day's operation might be as follows; after an eight hour turn off during the most intense VA belt passages, the instrument's HV are turned on. The central detector's gain drifts downward for several hours after this while coming to equilibrium. Sometimes during these first few hours there are several relatively minor step gain changes caused by slight "clipping" of the VA belt edges. After several hours the gain becomes constant in time and usually remains so for a period of 8 to 12 hours. At this time, the gain becomes affected as the spacecraft begins to "clip" the VA belts again. This effect increases until the VA belt intensity becomes great enough to require the turning off of the central detector's HV.

To handle these varying gain conditions, three quality indicators were developed.

Quality 1 - best data, peak position of each successive RS calibration should differ by one channel or less, no VA belt contamination.

Quality 2 - intermediate quality data, peak position from each successive RS calibration can differ by up to 3 - 4 channels but must do so smoothly in time, only very minor VA belt contamination allowed.

Quality 3 - all the rest of the data.
Hence we have high confidence that Quality 1 data has been gain corrected accurately, moderate confidence in Q2, and no confidence in Q3.

The boundary times of turn on and turn off, telemetry interruption, and quality changes are input values punched on epoch time cards.

All of this information combined with the RS CAL data from CAL1 forms the input to the computer operation portion of CAL2. The output of this is an analytical function giving the gain of the central detector as a function of time. This in turn forms one of the inputs of PASS-III so that all of the pulse height spectra can be gain corrected within the confidence levels specified by the quality indicator.
II. Macro Systems Flowchart (CAL2)
III. Job Stream Schematic (CAL2)
IV. JOB CONTROL LANGUAGE - CAL2

// T548-12,....,55), 'S.CROTEAU,CAL2',CLASS=F,TIME=05,REGION=120K
/*LINESCT 62
//STEP1 EXEC FORTGLG
//LKED.SYSLIB DD DSN=USER.T317.SUBLIB,DISP=SHR
// DD DSN=USER.T548.SUBLIB,DISP=SHR
// DD DSN=SYS1.FORTLIB,DISP=SHR
// DD DSN=USER.SSPLIB,DISP=SHR
//LKED.SYRuN DD *

*** CAL2 OBJECT DECK ***

/*
//GO.FGETO1 DD UNIT=2400,DISP=(OLD,KEEP),LABEL=(1,SL),
// DSNAME=CAL1,DCB=(RECFM=FB,LRECL=36,BLKSIZF=1800),
// VOLUME=SER=CC0922
//GO.SYSUDUMP DD SYSOUT=A
//GO.SYSIN DD *

*** DELETIONS AND EPOCH TIME CARDS ***

/*
//
V. CAL2 (Main Program)

Program Language: Fortran IV, G-Level
Date Written: June 1972
Programmer: S. Croteau
Installation: University of New Hampshire
Computer: IBM-360-H50
Subprograms Called: FORTIM, SOCENT, CALNDR, SIM2, FGET

This program reads in deletion cards, epoch time cards, and the output tape from CAL1. The deletion cards contain the times of tape records to be ignored and a '1' in column 80. The epoch time cards contain the epoch times, the quality indicator, and a '2' in column 80. The quality indicator is a number from 1 to 3, 1 being good quality and 3 being poor quality. This indicator is carried over on the Pass-III tape to all spectra falling within the range of this epoch. The calibration input tape records generated by CAL1 contain midpoint of accumulation time, C, and n, (80.2). The deletions must always precede the epoch cards, both being in chronological order. The epoch time cards and the tape records merge so that a certain number of calibrations correspond to each epoch time.

CAL2 fits a gain function to data of a given epoch, T, in the form:

\[ C(t) = q + r(t-T) + s(t-T)^2 \]

Let N be the number of calibrations for one epoch.

For \( N = 1 \)
\[ r = s = 0 \]
\[ q = c_1 \]

For \( N = 2 \)
\[ s = 0 \]
\[ c_1 = q + r(t_1-T) \]
\[ c_2 = q + r(t_2-T) \]
\[ r = \frac{c_2-c_1}{t_2-t_1} \]
\[ q = c_1 - (c_2 - c_1) \left( \frac{t_1-T}{t_2-t_1} \right) \]
For $N = 3$ using linear least squares fit:

$$
\Delta = \sum_i (C - C_i)^2 \text{ with } s = 0
$$

$$
\frac{\partial \Delta}{\partial q} = \frac{\partial \Delta}{\partial r} = 0
$$

$$
\Delta = \sum_i (q + r\Delta t_i - C_i)^2 \text{ where } \Delta t_i = t_i - T
$$

$$
\frac{\partial \Delta}{\partial q} = \sum_i (q + r\Delta t_i - C_i) = 0
$$

$$
\frac{\partial \Delta}{\partial r} = \sum_i (q\Delta t_i + r(\Delta t_i)^2 - C_i\Delta t_i) = 0
$$

$$
3q + rE\Delta t_i = E C_i
$$

$$
qE\Delta t_i + rE(\Delta t_i)^2 = E C_i\Delta t_i
$$

For $N > 4$ using quadratic least squares:

$$
\frac{\partial \Delta}{\partial q} = \frac{\partial \Delta}{\partial r} = \frac{\partial \Delta}{\partial s} = 0
$$

$$
Nq + rE\Delta t_i + sE(\Delta t_i)^2 = EC_i
$$

$$
qE\Delta t_i + rE(\Delta t_i)^2 + sE(\Delta t_i)^3 = EC_i\Delta t_i
$$

$$
qE(\Delta t_i)^2 + rE(\Delta t_i)^3 + sE(\Delta t_i)^4 = EC_i(\Delta t_i)^2
$$

Subroutine SIMQ is used to solve for $q$, $r$, and $s$.

Calibration cards are punched containing the epoch time, $q$, $r$, $s$, $n$, the quality indicator, and an ID (300 or 301). A listing of the inputs and outputs is provided by the program.

The following is a description of some parameters used in the program:

**A. Unlabelled Common**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JYR</td>
<td>integer full word variable containing year at midpoint of accumulation read from input tape.</td>
</tr>
<tr>
<td>JMO</td>
<td>integer full word variable containing month at midpoint of accumulation read from input tape.</td>
</tr>
<tr>
<td>JDA</td>
<td>integer full word variable containing day at midpoint of accumulation read from input tape.</td>
</tr>
</tbody>
</table>
JHR : integer full word variable containing hour at midpoint of accumulation read from input tape.

JMN : integer full word variable containing minutes at midpoint of accumulation read from input tape.

ISEC : integer full word variable containing seconds at midpoint of accumulation read from input tape.

C : floating point full word variable containing the value of C for this calibration.

AVENO : floating point full word variable containing the average $n_0$ for this calibration (80.2).

ERR : floating point full word variable containing the error statistic calculated in CALL for this calibration.

B. Variables and Arrays of Interest

A(9) : floating point full word array containing the coefficients stored column wise used as an argument to SIMQ.

B(3) : floating point full word array containing the original constants used in the call to SIMQ. These are replaced by final solution values.

CONST(1000) : floating point full word array containing the C value of the calibrations to be processed for an epoch time.

CTI : floating point full word variable containing the solution to the equation

$$CTI = \frac{(C - (q + r(t_1 - T) + s(t_1 - T)^2))/C}{T}$$

ERROR(1000) : floating point full word array containing the error statistic for the calibration records to be processed for a certain epoch.

FRACTN : floating point full word variable containing the solution to

$$\frac{t_1 - T}{t_2 - t_1}$$

ID1 : integer full word variable containing card code '300'.
ID2 : integer full word variable containing card code '301'.

IDELT : integer full word variable used as a subscript in the processing of deletions.

IEND : integer full word variable set to 1 to indicate the last epoch time card has been read.

IERERROR : integer full word variable set to 1 to indicate that a calibration has been read which has no corresponding epoch time card.

IQLTY(2) : integer full word array containing the quality indicator for the two epoch times being compared with the calibration times on the input tape.

IQUAL(500) : integer full word array containing the quality indicator to be punched in the calibration cards.

IRSLT : integer full word variable containing the return code from the call to FGET.

IRUNDA : integer full word variable used as an argument in the call to FORTIM; contains the run day.

IRUNT : integer full word variable used as an argument in the FORTIM; contains the run time.

JEND : integer full word variable set to 1 to indicate the last tape record has been read.

KS : integer full word variable used as an output argument of SIMQ. 0 = normal operation 1 = singular set of equations.

KTIME : integer full word variable containing hours * 100 + minutes.

NEQU : integer full word variable used to contain the number of equations to be solved by SIMQ (input argument).

QDEL : logical 8-bit indicator set to .TRUE. when a tape record is to be ignored.

Q(500) : floating point full word array containing the values of q to be punched.

R(500) : floating point full word array containing the values of r to be punched.

S(500) : floating point full word array containing the values of s to be punched.
T1 : floating point full word variable containing the solution to $t_1 - T$.

T2 : floating point full word variable containing the solution to $t_2 - T$.

T3 : floating point full word variable containing the solution to $t_3 - T$.

UDEL(500) : double word floating point array containing the deletion times in seconds of century.

UEPOCH(2) : double word floating point array containing the two epoch times (in seconds of century) that are being compared with the calibration tape.

UMID(1000) : double word floating point array containing the time in seconds of century of calibration records processed for an epoch.

UTIME : double word floating point variable containing the time in seconds of century of the tape record currently being processed.

UT(500) : double word floating point array containing the epoch times in seconds of century of the calibration cards to be punched.

ZNZ(1000) : floating point full word array containing the $n_o$ read from the calibration records to be processed for a certain epoch time.

ZNZERO(500) : floating point full word array containing the average $n_o$ to be punched.
VI. Subroutine CALNDR (USOC, IYR, IMO, IDA, IHR, IMN, SEC)

Program Language : Fortran IV, G-Level
Date Written : February 1972
Programmer : S. Croțeau
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) USOC: double precision input floating point variable containing seconds of century.
                 2) IYR: output integer full word containing year.
                 3) IMO: output integer full word containing month.
                 4) IDA: output integer full word containing day.
                 5) IHR: output integer full word containing hour.
                 6) IMN: output integer full word containing minutes.
                 7) SEC: output floating point full word containing seconds.

Subprograms Called : None
Description : This subroutine accepts seconds of century as input via the argument list and converts this time to calendar time -- year, month, day, hours, minutes, and seconds. The input value in seconds of century is a 64-bit floating point word. The output variables are 32-bit integers except for the seconds which are stored in a 32-bit floating point word.
VII. Subroutine FGET (IDSN,IRSLT,IOVEC)

Program Language : IBM O/S 360 Assembler Language
Date Written : February 4, 1971
Programmer : A. Buck
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) IDSN: a full word input integer containing
                  the data set number to which
                  the call is directed. (IDSN must be
                  1, 2, or 3).
                  2) IRSLT: a full word output integer
                  in which subroutine FGET may place an
                  activity-result code as follows...

                  a) IRSLT = -1 if the requested
                     activity was invalid. This code
                     is returned if either of the fol-
                     lowing occur:

                     i. IDSN contains a number
                        less than 1 or greater than
                        3.

                     ii. Data set has been pre-
                         viously closed.

                  b) IRSLT = 0 if data is read and
                     no I/O error is detected.

                  c) IRSLT = 1 if an I/O error occurred
                     on the block containing the data
                     placed in IOVEC. The calling pro-
                     gram has the responsibility for
                     accepting or rejecting the data.
                     In addition, the calling program
                     is responsible for proper reaction
                     to the remaining records in the
                     block for which IRSLT will be 0.
d) IRSLT = 2 if end-of-file was detected. The contents of IOVEC are not changed. The data set is closed and can not be used again by subroutine FGET with the same value of IDSN.

3) IOVEC: an output vector in which FGET can place the record. The actual variable used for IOVEC may be integer, real, logical, or complex. The first leftmost byte of the data record is placed in the high-order byte of IOVEC when reading occurs. The number of bytes placed in IOVEC is specified by the LRECL subparameter of the DD Statement.

Subprograms Called : None

Description : This subroutine is a QSAM input subroutine to read logical records into an area defined by the calling program. This routine is specifically designed to supply a Fortran calling program with logical records from a data set to which the DCB subparameter 'RECFM = FB' applies. For data sets to which 'RECFM = F' or 'RECFM = U' applies, subroutine FTREAD may be more easily used. 'RECFM = V' is specifically prohibited.

Subroutine FGET can manage as many as 3 data sets during the same job step. The data sets may be open (active) simultaneously provided no two data sets are on the same magnetic tape.

DD Statements required...

If FGET is to be called with IDSN = 1 (or 2 or 3), then the user must describe the data set by a DD Statement having the DD name FGET01 (or FGET02 or FGET03). The DD Statement must include the DCB subparameters 'RECFM', 'LRECL', and 'BLKSIZE' but must omit 'DSORG' or 'MACRF'.
VIII. Subroutine FORTIM (IRUNDA, IRUNT)

Program Language : IBM O/S 360 Assembler Language
Date Written : July, 1969
Programmer : A. Buck
Installation : University of New Hampshire
              Space Science Center
Computer : IBM-360-H50
Dummy Arguments : 1) IRUNDA: output integer full word
                  containing the date.
                  2) IRUNT: output integer full word
                  containing the time of day in hundredths
                  of a second.
Subprograms Called : None
Description : Subroutine FORTIM uses the time macro
to fetch the date and the time from
the computer clock. The date and the
time are only as accurate as the cor-
responding information entered by the
operator.
Example : FORTIM is called at 2.37 seconds after
3 minutes after 1 o'clock A.M. on
February 10, 1970. When control is
returned from subroutine FORTIM, IRUNDA
contains 70041 in binary form and IRUNT
contains 3780237 in binary form.
IX. Subroutine SIMQ (A,B,N,KS)

Program Language : Fortran IV, G-Level

Date Written :

Programmer :

Installation : University of New Hampshire Space Science Center

Computer : IBM-360-H50

Dummy Arguments : (A,B,N,KS)

A  Matrix of coefficients stored columnwise. These are destroyed in the computation. The size of matrix A is N by N.

B  Vector of original constants (length N). These are replaced by final solution values, vector X.

N  Number of equations and variables. N must be .GT. 1.

KS  Output digit
   0 for a normal solution
   1 for a singular set of equations

Purpose : Obtain solution of a set of simultaneous linear equations, AX = B.

Subprograms Called : None

Description : This subroutine is found on page 178 of System/360 Scientific Subroutine Package published by IBM. The following is the description of the program found on that page.

Matrix A must be general.

If matrix is singular, solution values all meaningless. An alternative solution may be obtained by using matrix inversion (MINV) and matrix product (GMPRD).
Method of solution is by elimination using largest pivotal divisor. Each stage of elimination consists of interchanging rows when necessary to avoid division by zero or small elements.

The forward solution to obtain variable N is done in N stages. The back solution for the other variable is calculated by successive substitutions. Final solution values are developed in vector B, with variable 1 in B(1), variable 2 in B(2), ..., variable N in B(N). If no pivot can be found exceeding a tolerance of 0.0, the matrix is considered singular and KS is set to 1. This tolerance can be modified by replacing the first statement.
X. Subroutine SOCENT (IYR,IMO,IDA,IHR,IMN,SEC,USOC)

Program Language : Fortran IV, G-Level
Date Written : February, 1972.
Programmer : S. Croteau
Installation : University of New Hampshire
Computer : IBM-360-H50

Dummy Arguments :
1) IYR: input integer fullword containing year (2 digits).
2) IMO: input integer fullword containing month.
3) IDA: input integer fullword containing day.
4) IHR: input integer fullword containing hour.
5) IMN: input integer fullword containing minutes.
6) SEC: input floating point variable containing seconds.
7) USOC: doubleword floating point output variable containing seconds of century.

Subprograms Called : None

Description : This subroutine converts calendar time to seconds of century.
XI. Description of Input (CAL2)

A. Deletion

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MON</th>
<th>DA</th>
<th>HR</th>
<th>MIN</th>
<th>SEC</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Year of deletion  
Month of deletion  
Day of deletion  
Hour of deletion  
Minute of deletion  
Second of deletion  
'1' for deletion
B. EPOCH time card

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MON</th>
<th>DA</th>
<th>HR</th>
<th>MIN</th>
<th>SEC</th>
<th>QUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

UNIVERSITY OF NEW HAMPSHIRE

COMPUTATION CENTER

YEAR
Month of epoch time
MON
Day of epoch time
DA
HR
MIN
SEC
QUAL
Quality indicator

'1' = Good
'2' = Fair
'3' = Poor

ID
= '2' for epoch time card
YR  
Year of epoch time

MO  
Month of epoch time

DA  
Day of epoch time

HR  
Hour of epoch time

MIN  
Minute of epoch time

SEC  
Second of epoch time

QUAL  
Quality indicator

'1' = Good
'2' = Fair
'3' = Poor

q  
This is the value of $C_0$

r  
This is the value of $\frac{dC}{dT}$

$\bar{n}_0$  
Average $n_0$ (80.2)

s  
This is a second derivative.
It is not equal to zero only if there are more than three calibrations for the same epoch time; it is calculated using three equations.

ID  
= '300' for calibration card type 1
= '301' for calibration card type 2
<table>
<thead>
<tr>
<th>RUN DATE</th>
<th>YEAR / DAY OF YEAR</th>
<th>HRS / MIN</th>
<th>SCAN TIME</th>
<th>MID-POINT OF ACCUM.</th>
<th>C</th>
<th>(C-CITI)/C</th>
<th>ERROR</th>
<th>Q</th>
<th>R</th>
<th>S</th>
<th>AVE NO</th>
<th>EPOCH TIME</th>
<th>QLTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>71 12</td>
<td>8 11 53 37.0</td>
<td>0.4447E-04</td>
<td>-0.401E-02</td>
<td>0.9017E-02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71 12</td>
<td>8 12 24 20.0</td>
<td>0.654E-04</td>
<td>0.2795E-02</td>
<td>0.113E-01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71 12</td>
<td>8 13 25 46.0</td>
<td>0.457E-04</td>
<td>0.1507E-02</td>
<td>0.470E-02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>71 12</td>
<td>8 13 56 30.0</td>
<td>0.458E-04</td>
<td>0.1521E-02</td>
<td>0.970E-02</td>
<td></td>
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# Section 5

## Pass-III

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Pass-III

I. Introduction

Pass-III reads in as input a control card, Van Allen cards, good time cards, calibration cards, and the Experimenter data tape.

The control card contains the parameters needed for the initial call to FEEDER.

The Van Allen cards contain the Van Allen data accumulated in the previous Pass-III production run in the form of calendar time, peak flux, and integrated flux. Each time a new file of data is read, the Van Allen data values are calculated from the orbit data records found at the beginning of the file. If no Van Allen cards are entered, the program initializes the Van Allen data array to zeroes and begins accumulating VA data from the first file read on tape 1 of the current run.

The good time cards (generated by Pass-I) contain the beginning and end times of good complete scans of data (solar or background or both). This is data in which the sync word was present, in which there was no missing data (no time gaps), and which was accumulated when the central detector was on.

The calibration cards (generated by CAL2) contain the epoch time, data quality indicator, and $q, r, s, n_o$ used to gain correct the spectra.

Pass-III stores the values from each of these cards in arrays. The calendar times are converted to seconds of century. The first good time is then read and the Experimenter tape is searched until the corresponding time to the nearest second is found. Processing begins at background or solar quadrant depending on what is specified in the good time card (BO or SO). Pass-III processes six major frames at a time (equivalent to one solar quadrant or one background quadrant) until the first end time is reached. Processing stops at background or solar depending on what is requested in the good time card (BK or BO). Pass-III then reads the next begin time and continues processing in the same manner as just described until the last end time is reached.

For each quadrant accepted as good data, orbit and attitudinal parameters are calculated and the gamma spectrum is gain shifted. The status word is realigned with the data spectrum and interpreted. Various flags are set to indicate the condition of the data processed, e.g. the presence of bit errors, dead time fold over, I/O errors, etc.
The output of Pass-III is a tape containing the parameters, calculated angles, gain-shifted spectrum, interpreted status, and flags for each half-scan or six major frames processed. This tape has a record length and block size of 3540 bytes.

A short listing is produced by Pass-III consisting of the first good time and last end time, tape volume serial numbers of tapes read, Decomm run numbers for each tape, the run date, and various warnings when unusual problems occur.
III. JOB STREAM SCHEMATIC

PASS-III

//
/*
Van Allen Cards
Calibration Cards
Good Time Cards
Control Cards
//GO.SYSIN DD *
Tape JCL
//STEPLIB
//EXEC PGM=030P301A
Job Card
IV. JOB CONTROL LANGUAGE - PASS-III

// T548-13,10),'S.CROTEAU,PASS-III',CLASS=F,TIME=15,REGION=160K
//STEP1 EXEC PGM=OSDP301A,TIME=15
//STEPLIB DD DSN=USER.T548.SUBLIB,DISP=SHR
//DECOM1 DD UNIT=TAPE7,DISP=OLD,LABEL=(11,NL,,IN),
//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD329
//DECOM2 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD307
//DECOM3 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD308
//DECOM4 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD346
//DECOM5 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD347
//DECOM6 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
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//      VOLUME=SER=EXD329
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//      VOLUME=SER=EXD295
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//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD306
//DECOM9 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//      DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//      VOLUME=SER=EXD283
//DECOM10 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//       DCB=(BLKSIZE=1000,DEN=1,TRTCH=C),
//       VOLUME=SER=EXD295
//DECOM11 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//       DCB=(BLKSIZE=1000,TRTCH=C),
//       VOLUME=SER=EXD296
//DECOM12 DD UNIT=AFF=DECOM1,DISP=OLD,LABEL=(11,NL,,IN),
//       DCB=(BLKSIZE=1000,TRTCH=C),
//       VOLUME=SER=EXD297
//FPUT01 DD UNIT=2400,DISP=(NEW,KEEP),LABEL=(1,SL),
//       DSNAME=PASSIII,DCB=(RECFM=F,LRECL=3540,BLKSIZE=3540),
//       VOLUME=SER=PRM057
//FT06F001 DD SYSOUT=A,DCB=(RECFM=FU,BLKSIZE=133)
//MSGDD DD SYSOUT=A
//SYSUDUMP DD SYSOUT=A
//FT07F001 DD SYSOUT=B,DCB=(RECFM=F,BLKSIZE=80)
//FT05F001 DD *
11111111 11015

*** GOOD TIME CARDS, CALIBRATION CARDS, VAN ALLEN CARDS ***
V. Pass-III Main Program (OSOP301A)

Program Language : Fortran IV, G-Level
Date Written : April 1972
Programmer : S. Croteau
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : INTPRM, SOCENT, HPARM, FEEDER, CALNDR, PARM, FORTIM, GAINB, FPUT

This program prepares an area in common storage containing all the necessary parameters for one tape record. The following operations are performed by the program in the preparation of the parameter tape record:

A. Reads in the data cards (good time cards, calibration cards, Van Allen cards) and stores the data values in arrays.

B. Reads in the Experimenter data tape using subprogram FEEDER.

C. Converts the data times from read-out time to accumulation time in seconds of century.

D. Matches good times with data and begins processing at proper scan (background or solar).

E. Call HPARM at the start of each file read to fetch Van Allen parameters (time, peak flux, and integrated flux). The program stores these values in arrays. The first 14 values should always have times less than the data time being processed. The fifteenth should always be later.

F. Realigns the status so that it corresponds to the main frame data. In order to do this the program saves the status and the interpreted status bits from FEEDER and uses them with the main frame data read out three minutes later.

G. Calls PARM for each three-minute scan to calculate orbit and attitudinal parameters.

H. Calculates the Julian date.
I. Calculates the satellite-earth-sun angle and the horizon angle in the following way:

Satellite-earth-sun angle = (Satellite RA) - (Sun RA)

(where RA right ascension)

Horizon angle = \(\tan^{-1}\left(\frac{\text{radius earth}}{\text{radius earth} + \text{alt}} \right) \cdot \frac{180}{\pi}\)

J. Calculates the total x-ray counts in channel 1 from the interpreted digital subcom source values.

K. Calls FORTIM to fetch run date.

L. Checks the major frames for I/O errors and sets a flag.

M. Calls GAINB to gain correct the spectrum.

N. Counts the number of flagged MF data words in a spectrum and stores the value.

O. Checks the spectrum for bit errors and sets a flag.

P. Calculates the live time and dead time.

Q. Determines the existence of dead time fold over, adjusts the dead time if fold over exists, and sets a flag.

R. Computes rates surrounding Co\(^{60}\) leakage peaks for each spectrum

\[
\text{Ch. 151-155 + Ch. 161-165} \\
\text{Ch. 144-148 + Ch. 168-172}
\]

S. Calculates the average rate (Co\(^{60}\)) which should be an average of all continuous spectra, background or solar, between calibrations.

T. Calls FPUT to write a record.

U. Reads the next good time card.

V. Compares the data time to the next calibration time. If the data time is greater, the program uses this calibration to make the gain correction.

W. At end of job, the program punches the first 14 positions of the Van Allen data tables. These will be used as input into the next Pass-III run.
The following is a description of common storage and of the variables and arrays that are of major interest within the program. All variable names beginning with a U are double precision, those beginning with an H are integer half-words, and those beginning with a Q are logical bytes (8 bits).

A. COMMON/HEADER/
   COMMON/ORBIT/
   COMMON/DECIDE/ These areas are described in Section 1 of this report.
   COMMON/SCANS/
   COMMON/INTRUP/

B. COMMON/PARMLS/ This area is filled by each call to PARM.

UVATIM(4) : double precision floating point array containing the times of peak flux encountered.
PC : floating point full word variable containing rigidity.
GLON : floating point full word variable containing longitude.
GLAT : floating point full word variable containing latitude.
ALT : floating point full word variable containing altitude.
SQRA : floating point full word variable containing sun quadrant right ascension.
SQDEC : floating point full word variable containing sun quadrant declination.
BQRA : floating point full word variable containing background quadrant right ascension.
BQDEC : floating point full word variable containing background quadrant declination.
SPNRA : floating point full word variable containing spin right ascension.
SPNDEC : floating point full word variable containing spin declination.
SQTHE : floating point full word variable containing theta sun quadrant.
SQPHI : floating point full word variable containing phi sun quadrant.
BQTHE : floating point full word variable containing theta background quadrant.
BQPHI : floating point full word variable containing phi background quadrant.
SPNTHE : floating point full word variable containing theta spin axis.
SPNPHI : floating point full word variable containing phi spin axis.
SATRA : floating point full word variable containing satellite right ascension.
SATDEC : floating point full word variable containing satellite declination.
ALAT : floating point full word variable used by another program calling PARM.
VAPEAK(4) : floating point full word array containing the peak flux.
VAFLUX(4) : floating point full word array containing the integrated flux.
IDTAPE : integer full word variable set aside to contain tape identification.
IDFILE : integer full word variable set aside to contain file identification.
NORB : integer full word variable used by another program calling PARM.
NVAPAS : integer full word variable containing the number of peak fluxes encountered.
NVAPRN : integer full word variable used by another program calling PARM.
BGAU : floating point full word variable containing the magnetic field strength B (Gauss).
ERMCL : floating point full word variable containing the McIlwain L parameter.
SUNRA : floating point full word variable containing the sun right ascension.
SUNDEC : floating point full word variable containing the sun declination.

QVUPDT : logical 8-bit flag which remained unused.

QVSTRT : logical 8-bit flag which remained unused.

QATT : logical 8-bit indicator set to .TRUE. if no attitude data available.

QORB : logical 8-bit flag set to .TRUE. to indicate no orbit data available.

QPM : logical 8-bit flag set to .TRUE. if it was not possible to calculate sun RA or sun DEC.

QXTRA(3) : logical 8-bit flags used as filler.

C. COMMON/RECORD/ See Part XXIII of this "Description of Output."

D. COMMON/GAINLS/ The parameters in this storage area are input values into subroutine GAINB.

CVAL : floating point full word variable containing the value of \( q + r (t-T) + s (t-T)^2 \).

SK : floating point full word variable containing the standard C of \( 0.00005 \) (or \( 5 \times 10^{-4} \)).

NNAUGT : floating point full word variable containing \( n_0 \).

CHCTS(377) : floating point full word array containing the raw data spectrum prior to gain correction.

E. Variables and Arrays of Interest (not in common).

AMXFLX(30) : floating point full word array containing the most recent entries of Van Allen peak flux.

BKLR : floating point full word variable containing the sum of the lower range background X-ray interpreted values.

BKQDT : floating point full word variable containing the sum of background quadrant time.

BRATES(5) : floating point full word array of background Co\(^{60}\) rates to be summed.
BRATE1 : floating point full word variable used as a hold area for background X-ray rate (background quadrant).

BRATE2 : floating point full word variable used as a hold area for solar X-ray rate (background quadrant).

CNSTNT : floating point full word variable into which q or peak flux are read from the input cards.

CONST(200) : floating point full word array into which are stored all values of q from the calibration cards.

DERIV1(200) : floating point full word array into which are stored all values of r from the calibration cards.

DERIV2(200) : floating point full word array into which are stored all values of s from the calibration cards.

DERVT : floating point full word variable into which r or s or the integrated flux are read from input cards.

HBNUM : half-word integer variable containing the number of background entries in BRATES.

HB1 : half-word integer variable used for storing a background status word.

HDAYHD : half-word integer variable holding day-night status:
\[1 \rightarrow \text{day} \]
\[2 \rightarrow \text{night} \]

HFILE : half-word integer variable containing the file count of the current file.

HQUAL(200) : half-word integer array into which are stored all quality indicators from the calibration cards.

HSNUM : half-word integer variable containing the number of solar entries in SRATES.

HS1 : half-word integer variable used to store a solar status word.

IASOP : integer full word variable specifying the analog subcom data option desired:
\[0 \rightarrow \text{omission of analog subcom data} \]
\[1 \rightarrow \text{analog subcom data to be processed} \]

IATTOP : integer full word variable specifying the attitude data option desired:
\[0 \rightarrow \text{omission of attitude data} \]
\[1 \rightarrow \text{attitude data to be processed} \]
IBEG : double word floating point variable containing the begin time (in seconds of century) being dealt with.

ICAL : integer full word variable containing the total number of calibration entries.

ICHG : integer full word variable used in the determination of the presence or absence of a bit error in the spectrum.

IDSOP : integer full word variable specifying the digital subcom data option desired:
- 0 → omission of digital subcom data
- 1 → digital subcom data to be processed

ID1 : integer full word variable into which the card code is read.

IEND : double word floating point variable containing the end time (in seconds of century) being dealt with.

IF1 : integer full word variables used in the determination of the presence or absence of bit errors in the gamma spectrum:
- IF1 = 1
- IF2 = 10
- IF3 = 15

IGOOD : integer full word variable containing the total number of good time cards read.

IORBOP : integer full word variable specifying the orbit data option desired:
- 0 → no orbit data
- 1 → regular orbit data items desired
- 2 → all orbit data items desired

IREC : integer full word variable containing the number of output records written.

IRSLT : see Part XI of this section.

IRUNDA : see Part X of this section.

IRUNT : see Part X of this section.

ISBCAL : integer full word variable used as an index to calibration arrays.

ISBGDT : integer full word variable used as an index to the good time card arrays.

ISCANT : double word floating point variable containing the time of the current scan in seconds of century.
ISOBK(3) : integer full word array containing alphameric representations of background (BK), solar (SO), and both (BO).

ITYPE1(200) : integer full word array containing the scan type corresponding to begin time.

ITYPE2(200) : integer full word array containing the scan type corresponding to the end time.

ITYP1 : integer full word variable containing BO or SO to indicate whether the begin time starts with both quadrants or solar only.

ITYP2 : integer full word variable containing BK or BO to indicate whether the end time ends with both scans or background only.

LMONTH(12) : integer full word array containing the Julian day of the last day of each month of a leap-year.

MFDOP : integer full word variable specifying the main frame data option desired:
0 = no main frame data to be processed
1 = all main frame data to be processed
2 = PHA channel counts to be ignored

MONTH(12) : integer full word array containing the Julian day of the last day of each month of a regular year.

NTAPES : integer full word variable containing the number of tapes to be read.

QB(10) : logical array holding the interpreted status bits for a background spectrum.

QMESS : logical 8-bit flag controlling a message printed at abnormal run termination by the program.

QS(10) : logical array holding the interpreted status bits for a solar spectrum.

QSEEK : logical 8-bit flag set to .TRUE. if no status word has been saved.

QSOLAR : logical 8-bit flag set to .TRUE. when PARM has to be called while processing a solar scan (usually PARM is called only when processing a background scan).

QX(10) : logical array used as an intermediate area in the transfer of data from QS or QB to QPSTAT or vice versa.
RATE(2) : floating point full word array containing the background and solar X-ray rates for channel 1.

SAVED1 : double word floating point variable containing the sum of channels 151-155 and 161-165.

SAVED2 : double word floating point variable containing the sum of channels 144-148 and 168-172.

SOLLR : floating point full word variable containing the sum of the lower range solar interpreted values.

SOLQDT : floating point full word variable containing the sum for solar quadrant time.

SRATES(50) : floating point full word array of solar Co$^{60}$ rates to be summed.

SRATE1 : floating point full word variable used as a hold area for background X-ray rate (solar quadrant).

SRATE2 : floating point full word variable used as a hold area for solar X-ray rate (solar quadrant).

TCLOCK : floating point full word variable containing the clock time.

TEG(30) : floating point full word array containing the most recent entries of integrated flux.

UEPOCH(200) : double word floating point array into which are stored the epoch times (in seconds of century) from the calibration cards.

UGTBEG(200) : double word floating point array into which are stored all begin times in seconds of century from the good time cards.

UGTEND(200) : double word floating point array into which are stored all end times in seconds of century from the good time cards.

UPRINT : double word floating point variable containing the accumulation time of the first scan to be processed in this run.

UPRT : double word floating point variable containing the accumulation time of the last scan to be processed in this run.

UTMID : double word floating point variable containing the midpoint of accumulation time for a spectrum.
UT1 : double word floating point variable containing the accumulation time of a scan in seconds of century.

UT2 : double word floating point variable containing the accumulation time of the following scan in seconds of century.

UVASOC(30) : double word floating point array containing the most current entries of the time of peak flux (seconds of century).

ZNZ : floating point full word variable into which $n_o$ is read from the calibration card.

ZNZERO(200) : floating point full word array into which are stored all values of $n_o$ from the calibration cards.
VI. Subroutine CALNDR (USOC,IYR,IMO,IDA,IHR,IMN,SEC)

Program Language : Fortran IV, G-Level
Date Written : February 1972
Programmer : S. Croteau
Installation : University of New Hampshire
Computer : IBM-360-H50

Dummy Arguments :
1) USOC: double precision input floating point variable containing seconds of century.
2) IYR: output integer full word containing year.
3) IMO: output integer full word containing month.
4) IDA: output integer full word containing day.
5) IHR: output integer full word containing hour.
6) IMN: output integer full word containing minutes.
7) SEC: output floating point full word containing seconds.

Subprograms Called : None

Description : This subroutine accepts seconds of century as input via the argument list and converts this time to calendar time -- year, month, day, hours, minutes, and seconds. The input value in seconds of century is a 64-bit floating point word. The output variables are 32-bit integers except for the seconds which are stored in a 32-bit floating point word.
VII. Subroutine CELEAR (RA, DEC, SATRA, SATDEC, THETA, PHI)

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : Dr. P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50

Dummy Arguments : 1) RA: input floating point full word variable containing right ascension.

2) DEC: input floating point full word variable containing declination.

3) SATRA: input floating point full word variable containing satellite right ascension.

4) SATDEC: input floating point full word variable containing satellite declination.

5) THETA: output floating point full word variable containing theta.

6) PHI: output floating point full word variable containing phi.

Subprograms Called : SPHREC, ROTATE, RECSPH

Description : This subroutine transforms a vector specified in celestial coordinates into a vector in earth-centered coordinates.
### VIII. Subroutine CROSS (A,B,AXBN)

<table>
<thead>
<tr>
<th>Program Language</th>
<th>: Fortran IV, G-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>: January, 1972</td>
</tr>
<tr>
<td>Programmer</td>
<td>: P. Higbie</td>
</tr>
<tr>
<td>Installation</td>
<td>: University of New Hampshire</td>
</tr>
<tr>
<td>Computer</td>
<td>: IBM-360-H50</td>
</tr>
<tr>
<td>Dummy Arguments</td>
<td>: 1) A: input floating point array of three values.</td>
</tr>
<tr>
<td></td>
<td>2) B: input floating point array of three values.</td>
</tr>
<tr>
<td></td>
<td>3) AXBN: output floating point array of three values.</td>
</tr>
<tr>
<td>Subprograms Called</td>
<td>: None</td>
</tr>
<tr>
<td>Description</td>
<td>: This subroutine is a vector routine called by subroutine PARM in the calculation of the scan quadrant declination. It does what its name implies.</td>
</tr>
</tbody>
</table>
IX. Subprogram FEEDER

Program Language : IBM O/S Assembler Language

See Section 1 of this report.
X. Subroutine FORTIM (IRUNDA, IRUNT)

Program Language: IBM O/S 360 Assembler Language

Date Written: July 1969

Programmer: A. Buck

Installation: University of New Hampshire Space Science Center

Computer: IBM-360-H50

Dummy Arguments:
1) IRUNDA: output integer full word containing the date.
2) IRUNT: output integer full word containing the time of day in hundredths of a second.

Subprograms Called: None.

Description: Subroutine FORTIM uses the time macro to fetch the date and the time from the computer clock. The date and the time are only as accurate as the corresponding information entered by the operator.

Example: FORTIM is called at 2.37 seconds after 3 minutes after 1 o'clock, A.M. on February 10, 1970. When control is returned from subroutine FORTIM, IRUNDA contains 70041 in binary form and IRUNT contains 3780237 in binary form.
# XI\ Subroutine FPUT (IDSN,ICMD,IRSLT,IOVEC)

<table>
<thead>
<tr>
<th>Program Language</th>
<th>IBM O/S 360 Assembler Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>February 4, 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>A. Buck</td>
</tr>
<tr>
<td>Installation</td>
<td>University of New Hampshire</td>
</tr>
<tr>
<td></td>
<td>Space Science Center</td>
</tr>
<tr>
<td>Computer</td>
<td>IBM-360-H50</td>
</tr>
<tr>
<td>Dummy Arguments</td>
<td>1) IDSN: a full word integer input parameter specifying the data set to which activity is directed. The integer stored at IDSN must be greater than zero but less than 21.</td>
</tr>
<tr>
<td></td>
<td>2) ICMD: a full word input integer variable containing a request type code which specifies the activity to be performed.</td>
</tr>
<tr>
<td></td>
<td>a) ICMD = 1 implies that a logical record is to be written.</td>
</tr>
<tr>
<td></td>
<td>b) ICMD = 2 implies the data set is to be ended. Once ended, the data set is unavailable to the calling program through the same data set number.</td>
</tr>
<tr>
<td></td>
<td>3) IRS LT: a full word output integer variable in which subroutine FPUT can place a return code as follows</td>
</tr>
<tr>
<td></td>
<td>a) IRS LT = -1 implies request was illegal for one of the reasons below:</td>
</tr>
<tr>
<td></td>
<td>i. IDSN contained a value less than 1 or greater than 20.</td>
</tr>
<tr>
<td></td>
<td>ii. ICMD contained a value less than 1 or greater than 2.</td>
</tr>
<tr>
<td></td>
<td>iii. A write request was made to a data set that had been ended.</td>
</tr>
</tbody>
</table>
iv. An endfile request was made to a data set either before the first write request or after the data set had been ended.

b) $\text{IRSLT} = 0$ implies request was executed normally.

c) $\text{IRSLT} = 1$ implies an I/O error occurred while writing a block. The data set was ended.

4) $\text{IOVEC}$: an input vector whose high order byte is the first byte to be written (when $\text{ICMD} = 1$) in a logical record.

The number of bytes written is specified by the LRECL subparameter on the DD statement describing the data set.

Subprograms Called : None

Description : Subroutine FPUT is a QSAM output subroutine to write logical records from an area defined by the calling program. This routine is specifically designed to allow a Fortran program to create without format control an extensive data set to which the DCB subparameter 'RECFM = FB' applies. For data sets to which 'RECFM = F' or 'RECFM = U' applies, subroutine FTWRIT may be more easily used.

Subroutine FPUT can manage as many as 20 data sets in the same job step. As many as desired may be active simultaneously. Once the endfile command has been issued to a data set, subroutine FPUT will refuse to perform any further activity for that particular data set. The large number of data sets allows writing as many as 20 files to the same magnetic tape volume as a possible application.

DD Statements required...

If subroutine FPUT is called with $\text{IDSN}=1$ (or 2,..., or 20) the user must supply a DD Statement having the DD name FPUT01 (or FPUT02,..., or FPUT20). The DD statement must include the DCB subparameters 'RECFM', 'LRECL', and 'BLKSIZE' but must omit 'DSORG' and 'MACRF'.

XII. Subroutine GAINB (CHAN,MONE1,MTWO2)

Program Language : Fortran IV, G-Level
Date Written : November 1972
Programmer : S. Croteau
Installation : University of New Hampshire
Computer : IBM-360-H50

Dummy Arguments : 1) CHAN: output floating point full word array containing the gain-corrected spectrum.
2) MONE1: output integer full word variable containing the channel number of the first element of CHAN.
3) MTWO2: output integer full word variable containing the channel number of the last element of the gain-corrected spectrum in CHAN.

Subprograms Called : None

Description : This subroutine does a gain change normalization in the following manner:

A. Experimenter tape

where

\( n = \text{channel number} \)

\( N_n = \text{counts in channel } n \)

\( E_n = C(n + n_0)^2 = \text{energy of left channel edge} \)

\( \Delta E_n = E_{n+1} - E_n = 2C (n + n_0 + \frac{1}{2}) = \text{width of energy window for channel } n \)

\( C, n_0 = \text{determined gain and offset parameters} \)

\( n_n = \frac{N_n}{\Delta E_n} = \text{counts per MeV in channel } n. \)

B. Pass-III normalized tape
\[ n = > n \]
\[ N_n = > N_n \]
\[ E_m = K_m^2 \]
\[ K = \text{fixed gain} = 0.5 \times 10^{-4} \]

let
\[ m_1 = \text{first integer } \sqrt[2]{E_K} (15 + n_o) \]
\[ m_2 = \text{last integer } \sqrt[2]{E_K} (377 + n_o) \]

C. Gain Changing

The number of counts in the experimenter tapes is
\[ n_E = \sum_{15}^{16} n_{E15} + \sum_{16}^{17} n_{E16} + \sum_{17}^{18} n_{E17} + \ldots + \sum_{376}^{377} n_{E376} \]

The number of counts per channel in the Pass-III tape is:
\[ M_m = \int_{E_m}^{E_{m+1}} n_E \, dE \]

The inputs to this program are the C value, the standard C(0.00005), NZERO(80.2), and the main frame data for either a background or a solar quadrant. The energy is computed for channels 1 to 377 and then the counts/MeV are calculated by dividing the number of counts in a certain channel by the difference in MeV between that channel and the following channel. Then the energy is computed for channels MONE1 to MTWO2. The energies of the two spectra are compared and the program computes channel counts for the new spectrum by multiplying the difference of energies in MeV by counts/MeV. An array of 4 values is used to store all the counts for one particular channel and is summed to give the total counts for that channel. This procedure is followed for all the channels through MTWO2. The new gain-corrected spectrum is then passed to the calling program through CHAN.
XIII. ENTRY HPARM

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : FEEDER, VABELT
Description : ENTRY HPARM is an entry of subroutine PARM. HPARM is used to calculate Van Allen Belt parameters as well as the sun right ascension and declination. The technique is the same as that used in the stand-alone operations Van Allen Predict Program (see Section 6). Both programs used the subroutine VABELT involving data interpolated from World Maps of Flux Contours (NASA SP-3054).

The orbital data used by HPARM is supplied by subprogram FEEDER from the experimenter data tapes. HPARM is called at the beginning of each new file and returns the peak flux, the time and the integrated dose of any Van Allen Belt encounter.
XIV. ENTRY INTPRM

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : None
Description : ENTRY INTPRM is an entry of subroutine PARM. It is called once during program execution prior to any call to PARM or HPARM. It simply serves the purpose of initializing variables and constants to be used in subsequent calls to the other two routines.
XV. Subroutine PARM

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Dummy Arguments : None
Subprograms Called : SPHREC, CROSS, RECSPH, REEDER, CELEAR, VCR

Description : Subroutine PARM calculates the right ascension and the declination for the satellite. The spin and reference direction data is acquired from the header information supplied with each major frame of data. Magnetic coordinate information and the position of the satellite at the time of spectra accumulation is taken from the orbit data supplied by FEEDER from the experimenter data tapes. This information is then used to calculate the reference directions in an earth-centered coordinate system. The subroutine VCR is called to calculate the vertical cutoff rigidity.
XVI. Subroutine RECSFH (THETA, PHI, V)

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Dummy Arguments : 1) THETA: output floating point full word variable containing theta.
2) PHI: output floating point full word variable containing phi.
3) V: input floating point array of three elements used to calculate theta and phi.
Subprograms Called : None
Description : This subroutine is called by PARM to calculate THETA and PHI from the 3-element array V.
XVII. Subroutine ROTATE (N,AA,V,VP)

Program Language : Fortran IV, G-Level
Date Written : January 1972
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50

Dummy Arguments : 1) N: input integer full word variable set to 1, 2, or 3 to indicate how the axes are to be rotated.

2) AA: input floating point full word variable containing the right ascension.

3) V: input floating point full word vector of three elements to be rotated.

4) VP: output floating point full word vector of three elements.

Subprograms Called : None

Description : This program is called by CELEAR in the transformation from celestial coordinates to earth-centered coordinates. ROTATE is called to establish the new coordinate system by rotating the axis.
XVIII. Subroutine SOCENT (IRY,IMO,IDA,IHR,IMN,SEC,USOC)

Program Language : Fortran IV, G-Level

Date Written : February 1972

Programmer : S. Croteau

Installation : University of New Hampshire

Computer : IBM-360-H50

Dummy Arguments : 1) IYR: input integer full word variable containing year.

2) IMO: input integer full word variable containing month.

3) IDA: input integer full word variable containing day.

4) IHR: input integer full word variable containing hour.

5) IMIN: input integer full word variable containing minutes.

6) SEC: input floating point full word variable containing seconds.

7) USOC: output double word floating point variable containing seconds of century.

Subprograms Called : None

Description : This subroutine converts calendar time to seconds of century.
XIX. Subroutine SPHREC (THETA, PHI, V)

Program Language : Fortran IV, G-Level

Date Written : January 1972

Programmer : P. Higbie

Installation : University of New Hampshire

Computer : IBM-360-H50

Dummy Arguments : 1) THETA: input floating point full word variable containing theta.

2) PHI: input floating point full word variable containing phi.

3) V: output floating point full word array of 3 elements.

Subprograms Called : None

Description : This subroutine is called by CELEAR and by PARM. It accepts as input THETA and PHI and returns the 3-element array V for values of theta from -10.0 to 10.0.
XX. Subroutine VABELT (GLON,GLAT,ALT,FLUX)

<table>
<thead>
<tr>
<th>Program Language</th>
<th>Fortran IV, G-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>December 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>P. Higbie</td>
</tr>
<tr>
<td>Installation</td>
<td>University of New Hampshire</td>
</tr>
<tr>
<td>Computer</td>
<td>IBM-360-H50</td>
</tr>
<tr>
<td>Dummy Arguments</td>
<td>1) GLON: input floating point full word variable containing the longitude.</td>
</tr>
<tr>
<td></td>
<td>2) GLAT: input floating point full word variable containing the latitude.</td>
</tr>
<tr>
<td></td>
<td>3) ALT: input floating point full word variable containing the altitude.</td>
</tr>
<tr>
<td></td>
<td>4) FLUX: output floating point full word variable containing the flux.</td>
</tr>
<tr>
<td>Subprograms Called</td>
<td>None</td>
</tr>
<tr>
<td>Description</td>
<td>Data for the VABELT program was taken by interpolating at 15° intervals the data shown in the document, &quot;World Maps of Constant B, L, and Flux Contours,&quot; (NASA SP-3054). The data is for integral proton fluxes for E&gt;5 MeV. Linear interpolation on the grid defined by the array FLXGRD is performed according to techniques given in McCormick and Salvadori, Numerical Methods in Fortran, page 118. The argument list consists of the longitude of the satellite in degrees, the latitude of the satellite in degrees, and the altitude of the satellite in kilometers. The program returns the proton flux at the given coordinates (counts/cm²·sec).</td>
</tr>
</tbody>
</table>
XXI. Subroutine VCR (GLON, GLAT, PC)

Program Language : Fortran IV, G-Level
Date Written : December 1971
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Dummy Arguments :
1) GLON: input floating point full word variable containing the longitude.
2) GLAT: input floating point full word variable containing the latitude.
3) PC: output floating point full word variable containing the rigidity.
Subprograms Called : None
Description : Subroutine VCR performs an interpolation on the map of cutoff rigidities given by Shea et al. The latitude and longitude must be supplied as input parameters; the vertical cutoff rigidity (PC) is returned.
XXII. Description of Input

A. Control card format

This card must be the first card read. The format is as follows

<table>
<thead>
<tr>
<th>NTAPES</th>
<th>MFDOP</th>
<th>IATTOP</th>
<th>IDSOP</th>
<th>IASOP</th>
<th>IORBOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

- **NTAPES**
  - Number of tapes to be processed
  - 0 = Main frame data not processed
  - 1 = All main frame data processed
  - 2 = PHA channel counts ignored

- **MFDOP**
  - 0 = Omission of attitude data
  - 1 = Attitude data values processed

- **IATTOP**
  - 0 = Omission of digital subcom data
  - 1 = Digital subcom data processed

- **IDSOP**
  - 0 = Omission of wheel analog subcom words 3 - 10
  - 1 = All 10 wheel analog words to be processed

- **IASOP**
  - 0 = No orbit data needed
  - 1 = Regular orbit data items are desired
  - 2 = All orbit data items required
IF1 = 1  IF2 = 10  IF3 = 15

These input values are used in the determination of the presence or absence of bit errors in the gamma spectrum. They were included in the control card so as to simplify a re-definition of the requirements as to what constitutes a bit error. As it turned out, the original definition and requirements proved to be quite adequate.
B. Van Allen cards

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MIN</th>
<th>SEC</th>
<th>MAX FLUX</th>
<th>INTEGRATED FLUX</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>222</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22222222</td>
<td>2222222222</td>
<td>'400'</td>
</tr>
<tr>
<td>333</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33333333</td>
<td>3333333333</td>
<td>'400'</td>
</tr>
<tr>
<td>444</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44444444</td>
<td>4444444444</td>
<td>'400'</td>
</tr>
<tr>
<td>555</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>55555555</td>
<td>5555555555</td>
<td>'400'</td>
</tr>
<tr>
<td>666</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66</td>
<td>66666666</td>
<td>6666666666</td>
<td>'400'</td>
</tr>
<tr>
<td>777</td>
<td>77</td>
<td>77</td>
<td>77</td>
<td>77</td>
<td>77</td>
<td>77777777</td>
<td>7777777777</td>
<td>'400'</td>
</tr>
<tr>
<td>888</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>88888888</td>
<td>8888888888</td>
<td>'400'</td>
</tr>
</tbody>
</table>

YEAR -------------------------

MONTH

DAY

HOUR

MIN

SEC -------------------------

MAX FLUX

The value corresponding to the maximum flux for a given orbit.

INTEGRATED FLUX

The integrated flux for a given orbit.

ID

= '400' for Van Allen cards

The calendar time representing the accumulation time of the maximum flux.
C. Good Time cards

These cards are output by Pass-I. The format is as follows:

```
<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MINUTES</th>
<th>SECONDS</th>
</tr>
</thead>
</table>
```

The midpoint of accumulation of the first scan to be processed.

<table>
<thead>
<tr>
<th>BO/SO</th>
</tr>
</thead>
</table>

Indicates whether to begin processing both background and solar or solar only.

```
<table>
<thead>
<tr>
<th>YR</th>
<th>MO</th>
<th>DA</th>
<th>HR</th>
<th>MN</th>
<th>SC</th>
</tr>
</thead>
</table>
```

The midpoint of accumulation of the last scan to be processed.
BO/BK Indicates whether to stop processing at the background scan or after processing both background and solar.

ID = '100' for good times cards.
D. Calibration cards

These are the output cards from CAL2. There are two cards punched for each epoch time. The formats are as follows

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MIN</th>
<th>SEC</th>
<th>q</th>
<th>r</th>
<th>N_o</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
</tr>
<tr>
<td>001</td>
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<td>001</td>
<td>001</td>
<td>001</td>
</tr>
<tr>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>DAY</th>
<th>HOUR</th>
<th>MIN</th>
<th>SEC</th>
<th>QUAL</th>
<th>S</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
</tr>
<tr>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
</tr>
<tr>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
</tr>
<tr>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
<td>001</td>
</tr>
</tbody>
</table>
YEAR
MONTH
DAY
HOURS
MINUTES
SECONDS

The epoch time

q
r
\( \overline{n}_o \)
QUAL

The value of \( C_o \)
The value of \( \frac{dC}{dt} \)
The average \( n_o \) (80.2)
The quality indicator

'1' = good quality
'2' = questionable quality
'3' = poor quality

s

The second derivative. Not equal to zero only if there were more than three calibration runs for the same epoch time - it is calculated using three equations.

ID

= '300' for calibration card type 1.
= '301' for calibration card type 2.
E. Experimenter Data Tape

Pass-III reads the experimenter tapes using Subprogram FEEDER. For a description of the tape format, see Section 2 XXIII B of this report.
XXIII. Description of Output

The output of this program is a 9-track parameter tape with a logical record length of 3540 and a block size of 3540 8-bit bytes.

The first letter of each variable described below indicates its type as follows:

- A-G: 32-bit floating point word.
- H: 16-bit integer.
- O-T: 32-bit floating point word.
- U: 64-bit character.
- V-Z: 32-bit floating point word.

The type format is as follows:

- **TIME**
  - IYRB
  - IMOB
  - IDAB
  - JULB
  - IHRB
  - IMINB
  - SECB

  Begin time is the accumulation time of the spectrum.

- **TIME**
  - IYRE
  - IMOE
  - IDAE
  - JULE
  - IHRE
  - IMINE
  - SECE

  End time is the accumulation time for the next scan - should by 184.32 seconds greater than begin time.

- **STATUS**
  - HSOBK
  - HDANT
  - HNMALT
  - HSCN
  - HLCAL
  - HRCAL
  - HMGYRO
  - HSTAT

  '1' = SOLAR  '2' = BACKGROUND
  '1' = DAY    '2' = NIGHT
  '1' = NORMAL '2' = ALTERNATE
  '1' = FULL  '2' = INTERMEDIATE '3' = SHORT
  ELECTRONIC CALIBRATION '1' = ON  '2' = OFF
  RADIATION CALIBRATION '1' = ON  '2' = OFF
  '1' = MAGNETOMETER '2' = GYRO

12-bit status word. This is status at accumulation and corresponds to main frame data.
RIGID

Vertical cutoff rigidity at time of midpoint.

POSITION INFORMATION

BGAUS
ERMSIL

B and L magnetic coordinates.

XLAT
XLONG
XALT

Latitude
Longitude
Altitude

VARIABLE OBJECTS

RASAT
DECSAT
RASUN
DECSUN

Satellite right ascension
Satellite declination
Sun right ascension
Sun declination

CELESTIAL COORDINATES

RASQD
DECSQD

If solar: Right ascension sun quadrant
If background: Right ascension background quadrant

If solar: Declination sun quadrant
If background: Declination background quadrant

RASPIN
DECSPN

Right ascension spin axis
Declination spin axis

THEESUN

If solar: Theta sun quadrant
If background: Theta background quadrant

PHISUN

If solar: Phi sun quadrant
If background: Phi background quadrant

THETAS
PHIS
SESANG

Theta spin axis
Phi spin axis
Satellite-earth-sun angle

THETAS = \frac{R \theta + \text{Alt}}{180^{\circ}}

AHORIZ

Horizon angle

RXRA(1)

BACKGROUND = Total X-ray counts in channel 1

= \frac{\Xi I 29}{\Xi I I - 24}

RXRA(2)

SOLAR = Total X-ray counts in channel 1

= \frac{\Xi I 23}{\Xi I I - 22}
VAN ALLEN PARAMETERS

- IYRVPK(14)
- IMOVPK(14)
- IDAVPK(14)
- JULVPK(14)
- IHRVPK(14)
- IMNVPK(14)
- SECVPK(14)
- FLUX(14)
- FLXINT(14)

Time of Van Allen peaks.

- Flux
- Integrated flux

UTAPE
Tape volume serial number

IFILE
Decomm run number

ICYRDA
Run date: year and day of year

ICRHRM
Run date: hours and minutes

MONE1
Output from gain shift - 1st channel

MTWO2
Output from gain shift - last channel

TLIVE
\[ TLIVE = TCLOCK - TDEAD \]

\[ TCLOCK = \text{Clock time} \times \frac{1}{390.625} \times 8 \]

TDEAD
Deadtime = DEADTIME \times 0.001515
(+ 24.90 if fold over present)

CHAN(700)
Gain-shifted spectrum

HBITER
Bit error indicator
= '0' if no bit errors present
= '1' if at least 1 bit error found

HFOLD
Indicates dead time fold over
= '0' if no fold over present
= '1' if rigidity < 60 and dead time < 10.0. When HFOLD = 1, the dead time has been adjusted by addition of 24.90 to the original value.
HRATE  =  \frac{A + B}{D + E} \quad \text{where}

A = \text{ch. 151 to 155}
B = \text{ch. 161 to 165}
D = \text{ch. 144 to 148}
E = \text{ch. 168 to 172}

HAVRTE  =  \frac{\text{HRATE}}{\text{HDIV}} \quad \text{(No. of entries)}

There is one average for solar quadrants and one average for background quadrants.

HDIV

The number of scans for which rates are included to calculate HAVRTE. Starts over after every time gap and after every calibration.

HFLGS

Number of flagged main frame data words.

HQUAL

Quality indicator - indicates quality of gain shift.

HATT

= '0' if attitude data was available
= '1' if no attitude data was available

HORB

= '0' if orbit data was available
= '1' if no orbit data was available

HPRM

= '0' if SUNRA and SUNDEC are valid
= '1' if SUNRA and SUNDEC are not valid

HIO

= Number of I/O error major frames in section

HEXTA(9)

Extra words to be used at a later date.
Sample Output
PASS-III

NUMBER OF CARDS WITH INVALID ID = 0
TAPE IDENTIFICATION DECOMM RUN NUMBER = 158 VOLUME=SER=EXD314
FIRST GOOD TIME YEAR=72 MONTH=12 DAY=6 HOUR=1 MINUTES=10 SECONDS=46.8
RUN DATE YR / DAY OF YR 73249 HRS / MIN 2008
TAPE IDENTIFICATION RUN NUMBER = 158 VOLUME=SER=EXD315
TAPE IDENTIFICATION RUN NUMBER = 159 VOLUME=SER=EXD292
TAPE IDENTIFICATION RUN NUMBER = 159 VOLUME=SER=EXD293
TAPE IDENTIFICATION RUN NUMBER = 160 VOLUME=SER=EXD316
TAPE IDENTIFICATION RUN NUMBER = 161 VOLUME=SER=EXD294
TAPE IDENTIFICATION RUN NUMBER = 161 VOLUME=SER=EXD295
TAPE IDENTIFICATION RUN NUMBER = 162 VOLUME=SER=EXD306
LAST GOOD TIME YEAR=72 MONTH=12 DAY=17 HOUR=0 MINUTES=58 SECONDS=22.8
NUMBER RECORDS WRITTEN = 5370
## Section 6

Van Allen Belt Predict Program

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
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<td>6-1</td>
</tr>
<tr>
<td>II.</td>
<td>Macro Systems Flowchart</td>
<td>6-2</td>
</tr>
<tr>
<td>III.</td>
<td>Job Stream Schematic</td>
<td>6-3</td>
</tr>
<tr>
<td>IV.</td>
<td>Job Control Language</td>
<td>6-4</td>
</tr>
<tr>
<td>V.</td>
<td>Disk Preparation Program</td>
<td>6-5</td>
</tr>
<tr>
<td>VI.</td>
<td>VAPREDICT Main Program</td>
<td>6-7</td>
</tr>
<tr>
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<td>6-8</td>
</tr>
<tr>
<td>VIII.</td>
<td>Subroutine VABELT (GLON,GLAT,ALT,FLUX)</td>
<td>6-9</td>
</tr>
<tr>
<td>IX.</td>
<td>Description of Input</td>
<td>6-10</td>
</tr>
<tr>
<td>X.</td>
<td>Description of Output</td>
<td>6-19</td>
</tr>
<tr>
<td>XI.</td>
<td>Sample Output Listing</td>
<td>6-20</td>
</tr>
</tbody>
</table>
I. Introduction

This program is a stand-alone program which computes certain parameters for the satellite's passage through the Van Allen Belt. The basic subroutines called are HEIGHT and VABELT which are also used in the primary data analysis.

A data set is prepared from data supplied by NASA (E.G. Stassinopolous) in a preparatory step and stored on disk. Normal operational use requires an Ephemeris data tape supplied by NASA (J.B. Joyce) and the data set stored on disk.

The predict program computes for a given period of time the peak flux encountered, the time of the peak flux, the integral flux during the orbit, the times where the satellite encountered and then left regions with fluxes $>10^3$ photons/cm$^2$-sec with the corresponding positional information.

Estimated uncertainties are less than one minute for the orbital elements, three weeks from epoch. At the three-sigma confidence level the VA data is off by a factor of 2 at worst.
II. Macro System Flowchart (Van Allen Predict)

- **VA DATA**
- **MAIN (ENERGY SELECT)**
- **USER T548 VA DATA**
- **DISK PREPARATION**
- **OPERATIONAL USE**
- **EPHEMERIS TAPE**
- **PREDICT PROGRAM**
- **PEAK TIME PEAK FLUX INTEGRATED FLUX**
III. Job Stream Schematic (Van Allen Predict)
IV. JOB CONTROL LANGUAGE - VAPREDICT

// T548), 'VAPREDICT,INKIE G.', CLASS=F, TIME=10, REGION=140K
// STEP1 EXEC FORTGLG
// LKED.SYSLIB DD DSN=USER.T548.SUBLIB, DISP=SHR
// DD DSN=USER.T317.SUBLIB, DISP=SHR
// DD DSN=SYS1.FORTLIB, DISP=SHR
// DD DSN=USER.SSPLIB, DISP=SHR
// LKED.SYSIN DD *

*** VAPREDICT AND VABELT OBJECT DECKS ***

/*/ 
//GO.FT10F001 DD DISP=OLD, DSN=USER.T548.VADATA
//GO.FT09F001 DD UNIT=2400, DCB=(RECFM=VS, BLKSIZE=2808), LABEL=(1, BLP), 
// VOLUME=SER=EFMOOA
//GO.SYSUDUMP DD SYSOUT=A
//GO.FT08F001 DD *
3. 2. 50.
270. 51. 300.
60. 270. 9.
*/ 
//GO.SYSIN DD *
72 
*/ 
//
V. Disk Preparation Program

<table>
<thead>
<tr>
<th>Program Language</th>
<th>: Fortran IV, G-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Written</td>
<td>: September 1971</td>
</tr>
<tr>
<td>Programmer</td>
<td>: P. Higbie</td>
</tr>
<tr>
<td>Installation</td>
<td>: University of New Hampshire</td>
</tr>
<tr>
<td>Computer</td>
<td>: IBM-360-H50</td>
</tr>
<tr>
<td>Subprograms Called</td>
<td>: None</td>
</tr>
<tr>
<td>Description</td>
<td>: This program is used to generate the array FLXGRD (flux grid) and to put it out on disk on the data set named USER.T548. VADATA. This grid remains on disk throughout the use of the Van Allen Predict program. The data set is prepared from data supplied by NASA (E. G. Stassinopolous). Energy selection may be accompanied by changing the variable equated to FLXGRD. The listing has F15 for this variable which corresponds to a flux map of protons greater than 15 MeV in energy. Corresponding to the various FN's are the energies N=3,5,15,30,50,100 MeV. A listing of the program is given for reference (Figure V.1).</td>
</tr>
</tbody>
</table>
DIMENSION ALT (7), FLXGRD(51,49,7)
DO 10 IALT=1,7
READ(9,300) ALT(IALT)
300 FORMAT(2F6.1,F8.5,F6.2,6E12.4)
DO 10 ILAT=1,49
DO 10 ILON=1,51
JLAT=50-ILAT
READ(9,300) GLAT, GLON, B, XL, F3, F5, FL5, F30, F50, F100
10 FLXGRD(ILON, JLAT, IALT)=FL5
WRITE(10) FLXGRD
END FILE 10
END

//GO.FT10F001 DD UNIT=SYSDA, DISP=(NEW,CATLG),
DSN=USER, TS48, VADATA, VOL=SER=USER01

Figure V.1. Disk Preparation Program
VI. VAPREDICT Main Program

Program Language : Fortran IV, G-Level
Date Written : September 1971
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : HEIGHT, VABELT
Description : This program reads the ephemeris data tape, calculates the longitude and the latitude, calls HEIGHT to calculate the altitude, and calls VABELT to calculate the flux. The program computes for a given period of time the peak flux encountered, the time of the peak flux, the integral flux during the orbit, the times when the satellite encountered and the left regions with fluxes >10^3 photons/cm^2 sec with the corresponding positional information. A listing is then generated containing all of the information mentioned above.
VII. Subroutine HEIGHT (GLAT, R, ALT)

| Program Language          | : Fortran IV, G-Level          |
| Date Written              | : September 1971               |
| Programmer                | : P. Higbie                   |
| Installation              | : University of New Hampshire |
| Computer                  | : IBM-360-H50                 |
| Dummy Arguments           | : 1) GLAT: input floating point full word variable containing latitude. |
|                           | 2) R: input floating point full word variable related to time. |
|                           | 3) ALT: output floating point full word variable containing altitude. |
| Subprograms Called        | : None                        |
| Description               | : This subroutine is responsible for the calculation of the altitude of the satellite at a certain latitude. |
VIII. Subroutine VABELT (GLON, GLAT, ALT, FLUX)

Program Language : Fortran IV, G-Level
Date Written : December 1971
Programmer : P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Dummy Arguments : 1) GLON: input floating point full word variable containing the longitude.

2) GLAT: input floating point full word variable containing the latitude.

3) ALT: input floating point full word variable containing the altitude.

4) FLUX: output floating point full word variable containing the flux.

Subprograms Called : None
Description : Data for the VABELT program was taken by interpolating at 15° intervals the data shown in the document, "World Maps of Constant B, L, and Flux Contours," (NASA SP-3054). The data is for integral proton fluxes for E>5 MeV.

Linear interpolation on the grid defined by the array FLXGRD is performed according to techniques given in McCormick and Salvadori, Numerical Methods in Fortran, page 118. The argument list consists of the longitude of the satellite in degrees, the latitude of the satellite in degrees, and the altitude of the satellite in kilometers. The program returns the proton flux at the given coordinates (counts/cm²/sec).
IX. Description of Input Ephemeris Data Tape

This input tape is a 9-track tape (RECFM = VS, BLKSIZE = 2808)

<table>
<thead>
<tr>
<th>ENTRY DESCRIPTION</th>
<th>RECORD 1</th>
<th>INTERNAL</th>
<th>EPHEM OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Type of tape ID (The word &quot;EPHEM&quot; in EBCDIC)</td>
<td>8</td>
<td>LF</td>
<td>-</td>
</tr>
<tr>
<td>(2) Satellite number (7 digits)</td>
<td>4</td>
<td>LI</td>
<td>-</td>
</tr>
<tr>
<td>(3) UTC, A.1 indicator; = 1, A.1</td>
<td>4</td>
<td>LI</td>
<td>-</td>
</tr>
<tr>
<td>= 2, UTC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Items 4, 5, and 6 given Start time of the Ephemeris)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Date</td>
<td></td>
<td></td>
<td>Year, Month, Day</td>
</tr>
<tr>
<td>(5) Day count of year</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(6) Seconds of day</td>
<td></td>
<td>LF</td>
<td>Days from Jan. 0</td>
</tr>
<tr>
<td>(Items 7, 8, and 9 give End time of the Ephemeris)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) Date</td>
<td></td>
<td>LF</td>
<td>Year, Month, Day</td>
</tr>
<tr>
<td>(8) Day count of year</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(9) Seconds of day</td>
<td></td>
<td>LF</td>
<td>Days from Jan. 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LF</td>
<td>Seconds</td>
</tr>
<tr>
<td>ENTRY DESCRIPTION</td>
<td>RECORD 1</td>
<td>INTERNAL</td>
<td>EPHEM OUTPUT</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>(10) At, interval between ephemeris points</td>
<td>8  LF  DUT</td>
<td>LF  Seconds</td>
<td></td>
</tr>
<tr>
<td>(11) -(26) Run ID taken from MIR comment cards</td>
<td>8  LF  -</td>
<td>EBCDIC (Up to 128 characters)</td>
<td></td>
</tr>
<tr>
<td>(27) Reference day for DODS (September 15, 1957)</td>
<td>8  LF  Calendar</td>
<td>LF  Year, Month, Day</td>
<td></td>
</tr>
<tr>
<td>(28) Type of Coordinate System Used for Output</td>
<td>4  LI  -</td>
<td>EBCDIC (1st 4 Bytes EBCDIC, and 2nd 4 Bytes LI Indicator value): &quot;True&quot; 1 &quot;Mean&quot; 2 &quot;Inter&quot; 3</td>
<td></td>
</tr>
<tr>
<td>= 1, True Equator and Equinox plus Equation of Equinoxes, = 2, Mean Equator and Mean Equinox = 3, True Equator and True Equinox</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(29) Orbit Theory Used:</td>
<td>4  LI  -</td>
<td>EBCDIC (8 Bytes Saying &quot;Cowell&quot; or &quot;Brouwer&quot;)</td>
<td></td>
</tr>
<tr>
<td>= 1, Cowell = 2, Brouwer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(30) Solar Radiation Constant</td>
<td>4  SF  \frac{gm}{DUL DUTZ}</td>
<td>LF  \frac{gm}{cm sec^2}</td>
<td></td>
</tr>
<tr>
<td>(31) Solar Flux Number</td>
<td>4  SF  -</td>
<td>LF  -</td>
<td></td>
</tr>
<tr>
<td>(32) C_D, Coefficient of Drag</td>
<td>4  SF  -</td>
<td>LF  -</td>
<td></td>
</tr>
<tr>
<td>Entry Description</td>
<td>Record 1</td>
<td>INTERNAL</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Bytes</td>
<td>Format</td>
<td>Units</td>
<td>Format</td>
</tr>
<tr>
<td>(33) $C_R$, Shape</td>
<td>8</td>
<td>LF</td>
<td>-</td>
</tr>
<tr>
<td>(34) Atmosphere Model ID</td>
<td>8</td>
<td>LF</td>
<td>-</td>
</tr>
<tr>
<td>(35) Cross sectional area of satellite</td>
<td>8</td>
<td>LF</td>
<td>DUL$^2$</td>
</tr>
<tr>
<td>(36) Mass of satellite</td>
<td>8</td>
<td>LF</td>
<td>gm</td>
</tr>
<tr>
<td>(37) Zonal and tessera harmonics indicate</td>
<td>4</td>
<td>LI</td>
<td>-</td>
</tr>
<tr>
<td>(Use same</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(38) Brouwer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(39) Lunar gravitation perturbation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(40) Solar radiation perturbation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(41) Solar gravitation perturbation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENTRY DESCRIPTION</td>
<td>RECOR D 1</td>
<td>INTERNAL</td>
<td>EPH EM OUTPUT</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>----------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>Bytes</td>
<td>Format</td>
<td>Units</td>
</tr>
<tr>
<td>(42) Drag perturbation indicator</td>
<td>4</td>
<td>LI</td>
<td>-</td>
</tr>
<tr>
<td>(43) Elements epoch, t₀</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(44) Year</td>
<td>8</td>
<td>LF</td>
<td>Year</td>
</tr>
<tr>
<td>(45) Month</td>
<td>8</td>
<td>LF</td>
<td>Month</td>
</tr>
<tr>
<td>(46) Day</td>
<td>8</td>
<td>LF</td>
<td>Day</td>
</tr>
<tr>
<td>(47) Hour</td>
<td>8</td>
<td>LF</td>
<td>Hour</td>
</tr>
<tr>
<td>(48) Minute</td>
<td>8</td>
<td>LF</td>
<td>Minute</td>
</tr>
<tr>
<td>(49) Seconds X 1000</td>
<td>8</td>
<td>LF</td>
<td>Seconds</td>
</tr>
<tr>
<td>(50) Semi-major axis at t₀</td>
<td>8</td>
<td>LF</td>
<td>DUL</td>
</tr>
<tr>
<td>(51) Eccentricity at t₀</td>
<td>8</td>
<td>LF</td>
<td>-</td>
</tr>
<tr>
<td>(52) Inclination at t₀</td>
<td>8</td>
<td>LF</td>
<td>rad</td>
</tr>
<tr>
<td>ENTRY DESCRIPTION</td>
<td>RECORD 1</td>
<td>INTERNAL</td>
<td>EPHEM OUTPUT</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------</td>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td>Bytes</td>
<td>Format</td>
<td>Units</td>
</tr>
<tr>
<td>(53) Argument of perigee</td>
<td>8</td>
<td>LF</td>
<td>rad</td>
</tr>
<tr>
<td>at $t_0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(54) Node at $t_0$</td>
<td>8</td>
<td>LF</td>
<td>rad</td>
</tr>
<tr>
<td>(55) Mean anomaly at $t_0$</td>
<td>8</td>
<td>LF</td>
<td>rad</td>
</tr>
</tbody>
</table>

(Items 56 through 71 are osculating values evaluated at $t_0$)

<p>| (56) True Anomaly       | 8        | LF     | rad   | LF     | rad   |
| (57) Arg. of lat. - (53) + (56) | 8 | LF     | rad   | LF     | rad   |
| (58) Flight path angle  | 8        | LF     | rad   | LF     | rad   |
| (59) Eccentric Anomaly  | 8        | LF     | rad   | LF     | rad   |
| (60) Period             | 8        | LF     | DUT   | LF     | DUT   |
| (61) Perigee height     | 8        | LF     | DUL   | LF     | km    |
| (62) Apogee height      | 8        | LF     | DUL   | LF     | km    |
| (63) Mean motion        | 8        | LF     | rad/DUT | LF   | rad/DUT |</p>
<table>
<thead>
<tr>
<th>ENTRY DESCRIPTION</th>
<th>RECORD 1</th>
<th>INTERNAL</th>
<th>EPHEM OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bytes</td>
<td>Format</td>
<td>Units</td>
</tr>
<tr>
<td>(64) Argument of perigee secular rate of change</td>
<td>8</td>
<td>LF</td>
<td>rad/DUT</td>
</tr>
<tr>
<td>(65) Node secular rate of change</td>
<td>8</td>
<td>LF</td>
<td>rad/DUT</td>
</tr>
<tr>
<td>(66) X Epoch</td>
<td>8</td>
<td>LF</td>
<td>DUL</td>
</tr>
<tr>
<td>(67) Y Position</td>
<td>8</td>
<td>LF</td>
<td>DUL/DUT</td>
</tr>
<tr>
<td>(68) Z Vector</td>
<td>8</td>
<td>LF</td>
<td>DUL/DUT</td>
</tr>
<tr>
<td>(69) X Epoch</td>
<td>8</td>
<td>LF</td>
<td>DUL/DUT</td>
</tr>
<tr>
<td>(70) Y Velocity</td>
<td>8</td>
<td>LF</td>
<td>DUL/DUT</td>
</tr>
<tr>
<td>(71) Z Vector</td>
<td>8</td>
<td>LF</td>
<td>DUL/DUT</td>
</tr>
<tr>
<td>(72) -(91) Times of Brouwer drag coefficients; $t_{p,0}, t_{p,1}, \ldots t_{p,19}$</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(92) -(111) Brouwer first order drag coefficients; $N_{2,0}, \ldots$</td>
<td>8</td>
<td>LF</td>
<td>rad</td>
</tr>
<tr>
<td>or Cowell drag coefficients</td>
<td>or internal</td>
<td>or internal</td>
<td>units of</td>
</tr>
<tr>
<td>ENTRY DESCRIPTION</td>
<td>RECORD 1</td>
<td>INTERNAL</td>
<td>EPHEM OUTPUT</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------</td>
<td>----------</td>
<td>--------------</td>
</tr>
<tr>
<td>Bytes</td>
<td>Format</td>
<td>Units</td>
<td>Format</td>
</tr>
<tr>
<td>(112)-(131) Brouwer second order drag coefficients; $N_{3,0}, N_{3,1}, \ldots, N_{3,19}$</td>
<td>8</td>
<td>LF</td>
<td>rad</td>
</tr>
<tr>
<td>(132) Number of non-zero times in items (72)-(91)</td>
<td>4</td>
<td>LI</td>
<td>-</td>
</tr>
<tr>
<td>(133)-(192) Unknowns associated with epoch elements if their origin was previous DC or PCE</td>
<td>8</td>
<td>LF</td>
<td>-</td>
</tr>
<tr>
<td>(193) Start time of ephemeris</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(194) End time of ephemeris</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(195) $\Delta t$, interval between ephermeris points</td>
<td>8</td>
<td>LF</td>
<td>DUT</td>
</tr>
<tr>
<td>(196) LPN indicator</td>
<td>4</td>
<td>LI</td>
<td>-</td>
</tr>
<tr>
<td>= 1, include precession and nutation</td>
<td>2, include precession only</td>
<td>3, neglect precession and nutation</td>
<td></td>
</tr>
<tr>
<td>(197) Greenwich hour angle at epoch</td>
<td>8</td>
<td>LF</td>
<td>Rad</td>
</tr>
<tr>
<td>(198)-(293) - not used (zeros)</td>
<td>8</td>
<td>LF</td>
<td>-</td>
</tr>
<tr>
<td>ENTRY DESCRIPTION</td>
<td>RECORD 1</td>
<td></td>
<td>EPHEM OUTPUT</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>Bytes</td>
<td>Internal</td>
<td>Ephem Output</td>
</tr>
<tr>
<td></td>
<td>Format</td>
<td>Units</td>
<td>Format</td>
</tr>
<tr>
<td>(1) Date of 1st ephem. point</td>
<td>8</td>
<td>LF DUT</td>
<td>LF Year, Mo. time, t, of Day</td>
</tr>
<tr>
<td>(2) Day count of year</td>
<td></td>
<td></td>
<td>LF Days from Jan. 0</td>
</tr>
<tr>
<td>(3) Seconds of day</td>
<td></td>
<td></td>
<td>LF Seconds</td>
</tr>
<tr>
<td>(4) Interval between data items, Δt</td>
<td>8</td>
<td>LF DUT</td>
<td>LF Seconds</td>
</tr>
<tr>
<td>(5) X position</td>
<td>8</td>
<td>LF DUL</td>
<td>LF DUL</td>
</tr>
<tr>
<td>(6) Y vector</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) Z</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8) X velocity</td>
<td>8</td>
<td>LF DUL</td>
<td>LF DUL</td>
</tr>
<tr>
<td>(9) Y vector</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10) Z</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| (11)-(304) KK-1 other ephemeris position and velocity vector sets and end-of-data indicators if KK<50.
<table>
<thead>
<tr>
<th>ENTRY DESCRIPTION</th>
<th>RECORD 1</th>
<th>INTERNAL</th>
<th>EPHEM OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(305) t</td>
<td></td>
<td>8</td>
<td>LF DUT</td>
</tr>
<tr>
<td>(306)</td>
<td>Δt</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>(307)-(350) not used (zeros)</td>
<td>8 each</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)-(10) SENTINEL = +.9999999999999999+16</td>
<td></td>
<td>8</td>
<td>LF -</td>
</tr>
<tr>
<td>(11)-(350) not used</td>
<td></td>
<td>8 each</td>
<td>-</td>
</tr>
</tbody>
</table>

Bytes Format Units | Format Units
X. Description of Output

The output of the Van Allen Predict program is a listing consisting of the following fields:

A. Year
B. Julian Day
C. Month
D. Day of month
E. Hour/minutes
F. Peak flux in cm$^{-2}$sec$^{-1}$
G. Integral flux (dose) in cm$^{-2}$
H. Time and position in which the flux becomes $> 10^3$ cm$^{-2}$sec$^{-1}$. This includes the start time in day of year, hour/minutes, the longitude, latitude, and altitude.
I. Time and position in which the flux fell back below $10^3$ cm$^{-2}$sec$^{-1}$. This includes end time in day of year, hour/minutes, the longitude, latitude, and altitude.

Please note that the output identifies times where the satellite encountered flux $> 10^3$ cm$^{-2}$sec$^{-1}$ as well as times where VA passage occurred but with flux $< 10^3$ cm$^{-2}$sec$^{-1}$. Time gaps may be observed where there were no VA encounters.
XI. Sample Output

| PLANET | TIME | PASS | PEAK FLUX | INTEGRAL | START | LON | LAT | ALT | END | LON | LAT | ALT |
|--------|------|------|-----------|----------|-------|-----|-----|-----|-----|-----|-----|-----|-----|
| 72 1A | 05:59:40 | 20  | 0.5327E+02 | 0.6601E+05 | 346 | 450 | 318.0 | -17.7 | 907.8 | 346 | 504 | 347.2 | -29.6 | 456.5 |
| 72 1A | 05:59:40 | 21  | 0.5250E+02 | 0.7102E+06 | 346 | 633 | 311.0 | -25.5 | 435.8 | 366 | 682 | 347.5 | -33.0 | 477.1 |
| 72 1A | 05:59:40 | 22  | 0.5216E+02 | 0.7111E+07 | 340 | 810 | 305.9 | -30.9 | 459.4 | 366 | 820 | 348.2 | -31.2 | 487.5 |
| 72 1A | 05:59:40 | 23  | 0.5168E+02 | 0.7206E+08 | 366 | 948 | 305.6 | -31.1 | 480.2 | 366 | 959 | 350.2 | -23.2 | 482.7 |
| 72 1A | 05:59:40 | 24  | 0.5092E+02 | 0.7425E+09 | 366 | 1125 | 302.8 | -30.9 | 476.5 | 366 | 1137 | 355.5 | -13.0 | 465.4 |
| 72 1A | 05:59:40 | 25  | 0.5034E+02 | 0.7413E+10 | 366 | 1304 | 304.6 | -22.5 | 482.3 | 366 | 1313 | 333.2 | -5.9 | 449.8 |
| 72 1A | 05:59:40 | 26  | 0.4962E+02 | 0.7304E+11 | 366 | 1485 | 306.4 | -22.3 | 488.6 | 366 | 1494 | 336.3 | -5.9 | 449.8 |
| 72 1A | 05:59:40 | 27  | 0.4843E+02 | 0.7235E+12 | 366 | 1663 | 306.3 | -22.3 | 494.9 | 366 | 1673 | 339.0 | -6.0 | 441.3 |

Reproducibility of the original page is poor.

6-20
Section 7

University of New Hampshire
Computation Center
PLOT Routine

I. Introduction 7-1
II. PLOT Program Descriptions 7-2
III. PLOT Programming Procedure 7-7
IV. Annotation (CHAR) Subroutine 7-8
V. CHAR Programming Procedures 7-9
VI. The Care and Feeding of the Plotter Programs 7-10
I. Introduction

The IBM-360 PLOT and CHAR routines enable the programmer who uses graphic output to take advantage of the speed and facilities of the 360 for calculations and use the IBM-1620/1627 for plotting only. PLOT and CHAR on the IBM-360 produces the plotter commands (i.e., number strings) and puts them into a 7-track tape which can later be read and plotted by the IBM-1620/1627.

An * appears in the right-hand margin of this paper by those sections and remarks which are unique to the 360 PLOT and CHAR routines. The programmer who is already familiar with the 1620 PLOT and CHAR routines need only read those sections.
II. PLOT Program Descriptions

The following definitions apply to the parameters used in a call to PLOT. All X and Y values are to be expressed in inches. The subroutine processes floating point values in the short format.

A. IC = control integer which must have one of the following values: 1, 101, 201, 0, 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, 90, 99, 7, 100. See "Use of Control Integer" under the specific programming procedure in question.

B. XMIN equal to or less than minimum X value to be plotted.

C. XMAX equal to or greater than maximum X value to be plotted.

D. XL = the required physical length of the plot in the X direction.

E. XD = X increment to be indicated on plot outline = \((XMAX - XMIN)/INC\), where INC equals the line of increments desired.

F. YMIN equal to or less than minimum Y value to be plotted.

G. YMAX equal to or greater than maximum Y value to be plotted.

H. YL = the required physical length of the plot in Y direction.

I. YD = Y increment to be indicated on plot outline = \((YMAX - YMIN)/INC\), where INC equals the number of increments desired.
Choice of variable names for the above information is left to the discretion of the programmer, except for the restrictions that the control integer must be a fixed point variable or constant and the rest be floating point variables (with or without subscripts), constants, or expressions. Array names must not be used.
In brief, PLOT has three sections:

1. Framing and scaling
2. Point-to-point plotting
3. Reinitialization
   a. Framing and Scaling Section

In this section, scaling constants are calculated and a plot outline or grid is drawn governed by the control integer IC. These scaling constants are then used to scale all X and Y values in the point-to-point plot section. Therefore, it is imperative that a call to PLOT with IC = 1, 101, 201 be made before any actual plotting is done.

After the frame is drawn the pen is placed in the up status.

Use of the Control Integer (IC)

One of the following three control integers must be used in this section:

- IC = 1
- IC = 101
- IC = 201

When IC = 1 is used, scale constants are calculated and a plotting area outline is drawn. When IC = 101 is used, scale constants are calculated and a grid over the plotting area is drawn. When IC = 201 is used, scale constants are calculated, but neither a plotting area outline nor grid is drawn. (For efficient programming, set XD equal to XMAX - XMIN, and YD equal to YMAX - YMIN, when IC = 201 is used.) The latter control integer is used when a reference frame is already available or when one is not required.

b. Point-to-Point Section

This section of PLOT scales a given point (X,Y) to correspond to the frame established.

Use of Control Integer (IC)

One of the following fourteen control integers must be used in this section:
NOTE: The pen always moves to the point to be plotted in the status in which it was left (up or down) from the previous call.

<table>
<thead>
<tr>
<th>IC</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>When IC = 0 is used, the point (X,Y) is scaled, the pen moves to the resultant coordinate (X plot, Y plot), and a plus sign (+) is drawn through the point. The pen remains down after the plus sign is drawn</td>
</tr>
<tr>
<td>9</td>
<td>When IC = 9 is used, the point (X,Y) is scaled, the pen moves to the resultant coordinate (X plot, Y plot), and a plus sign (+) is drawn through the point.</td>
</tr>
<tr>
<td>90</td>
<td>When IC = 90 is used, the point (X,Y) is scaled, and the pen moves to the resultant coordinate (X plot, Y plot). Then pen is commanded down when the point to be plotted is reached.</td>
</tr>
<tr>
<td>99</td>
<td>When IC = 99 is used, the pen is commanded up. No other action takes place.</td>
</tr>
<tr>
<td>10</td>
<td>The same as IC = 0 except that a square (▪) is drawn through the point.</td>
</tr>
<tr>
<td>19</td>
<td>The same as IC = 9 except that a square (▪) is drawn through the point.</td>
</tr>
<tr>
<td>20</td>
<td>The same as IC = 0 except that an octagon (◊) is drawn through the point.</td>
</tr>
<tr>
<td>29</td>
<td>The same as IC = 9 except that an octagon (◊) is drawn through the point.</td>
</tr>
<tr>
<td>30</td>
<td>The same as IC = 0 except that a diamond (◇) is drawn through the point.</td>
</tr>
<tr>
<td>39</td>
<td>The same as IC = 9 except that a diamond (◇) is drawn through the point.</td>
</tr>
<tr>
<td>40</td>
<td>The same as IC = 0 except that a triangle (▲) is drawn through the point.</td>
</tr>
<tr>
<td>49</td>
<td>The same as IC = 9 except that a triangle (▲) is drawn through the point.</td>
</tr>
</tbody>
</table>
IC = 50. The same as IC = 0 except that a flag (¶) is drawn through the point.

IC = 59. The same as IC = 9 except that a flag (¶) is drawn through the point.

NOTE: If the pen up or down status is altered manually or by some routine other than PLOT (for example, the CHAR routine) IC = 99 should be executed prior to the resumption of point-to-point plotting. The reason for this lies in the fact that PLOT is designed to keep track of the pen up or down status so that the pen does not have to be commanded to assume its present status. (One hundred ms are required for each pen up or down command.) By executing an IC = 99 call, as just described, pen up status is established physically and within the program.

c. Reinitialization Section

IC = 7
IC = 100

After all points have been plotted within a frame, IC = 7 may be called if a new frame is to be drawn. Calling IC = 7 causes the pen to move in the up status to a point 2.5 inches beyond the frame.

After all plotting is complete for the entire program, IC = 100 should be called so that the PLOT program can put the final record onto tape. If IC = 100 is not called, the last part of the plot will be lost.
III. PLOT Programming Procedure

Prior to calling PLOT, the programmer must determine and place in storage the XMIN, XMAX, XL, SD, YMIN, YMAX, YL, YD, and IC information as previously defined.

The actual names of the variables are unimportant as long as IC is a fixed-point variable or constant, and the rest of the variables are floating-point variables, constants, or expression (except that array names must not be used).

Because of the make-up of the plot routine, the first time it is entered the following statement must be used:

```
CALL PLOT (IC,XMIN,XMAX,XL,XD,YMIN,YMAX,YL,YD)
```

where IC must equal 1, 101, or 201.

After the initial statement has been executed, the subroutine can be entered at any time by one of the following two statements:

```
CALL PLOT (IC,X,Y)
```

```
CALL PLOT (IC)
```

where IC in the first statement must be 0, 9, 10, 19, 20, 29, 30, 39, 40, 49, 50, 59, or 90 and X,Y are the coordinates of the point to be plotted. IC in the second statement must be 7, 99, or 100.
IV. Annotation (CHAR) Subroutine

CHAR allows a FORTRAN program to plot letters, numbers, and all FORTRAN special characters from information supplied by FORMAT statements.

a. Program Description

The position of the pen, at the time CHAR is called, is at the lower left-hand corner of the character to be drawn. Because the information to be plotted is obtained from FORMAT statements furnished by the programmer, actual variable values can be plotted at object time.

Each character that is plotted is represented in the subroutine by a string of digits. These digits, when transmitted to the plotter, cause the proper pen and paper motion required to draw the desired character. When all of the specified characters are drawn, the pen is returned to the starting position with the pen in the up status.

A maximum of 100 characters (including blanks) can be drawn on any one call to CHAR.
V. **CHAR Programming Procedures**

The CHAR subroutine is accessed by the following three statements:

```
n FORMAT (S_1,S_3,S_3,...S_N,100X)
    WRITE (4,n) VAR_1,VAR_2,VAR_3,...VAR_N
    CALL CHAR (SZE,lHV)
```

The arguments in the call statement are defined as follows:

- **SZE** = a floating point variable or constant equal in value to the desired size of the characters to be plotted, expressed in tenths of inches.
- **lHV** = an integer variable or constant. If lHV = 0, characters are drawn parallel to the X-axis. Otherwise, characters are drawn parallel to Y-axis.

The FORMAT statement supplies the information as to what is to be drawn, and under what FORMAT specifications. The items in the FORMAT statement are defined as follows:

- **S** = a FORMAT specification. FORMAT specifications may not be separated by a slash (/).
- **n** = a statement number, corresponding to n in the WRITE statement.

The 100X is necessary for regulating record length on disk.

The WRITE statement places the characters which are to be plotted onto disk so that CHAR can reference them in order to translate the characters into plotter commands.

For information on how to use the Greek alphabet and other special characters, see appendix B.
VI. The Care and Feeding of the Plotter Programs

A. Operating Instructions

The plotter routines are part of the system library, and the job control statements that are needed in order to use PLOT or CHAR are a cataloged procedure. This procedure is specified on the EXEC card in the following manner:

//STEP1 EXEC PLOTECLG -- To compile and execute a FORTRAN program which uses PLOT and/or CHAR.

//STEP1 EXEC PLOTELG -- To execute a previously compiled FORTRAN program which uses the PLOT and/or CHAR routine.

NOTE: PLOTECLG has the same functions as FORTECLG; and PLOTELG has the same function as FORTELG. There is no equivalent to FORTECDK or FORTEC. To compile a program using PLOT and CHAR, FORTEC can be used.

B. Output to the Plotter Tape

When the program begins outputting onto the plotter tape, the message "PLOTTING BEGUN" is written on the printer. When plotting is completed (i.e., after a call to PLOT (100) the message "PLOTTING COMPLETED" is printed.

The programmer may find, when looking over his printed output, that he does not want his results plotted out on the 1627 (for example, if he realizes that his plotting would be incorrect). In this case, ask the operator in the IBM 360 room for a CANCEL PLOT slip which is filled out and returned to him. Note that if PLOTTING BEGUN has not been printed then there is no plotter output and nothing could be canceled. However, if PLOTTING BEGUN has been printed, there will be plotter output even if PLOTTING COMPLETED has not been printed.

C. Tape Procedures

The plotting output is put onto a 7-track tape which is later plotted out on the IBM 1627 using the IBM 1620. The Computation Center has a limited number of 7-track tapes which can be borrowed for this purpose (see Howard Stiles, Room M123). On the 360 Run Request Form check Plotter Tape under output and put the number of your 7-track tape in the Tapes Required section.
It is suggested that those, other than students, who use these routines frequently buy their own 7-track tape. Also, they should sign up for their own 1620 time to plot the tape. A copy of the 1620 program for writing this tape onto the plotter will be left in the right-most hopper on top of the 1622 card reader punch. Operating instructions for this program are under TAPE-TO- PLOTTER in the 1620 Systems Operating Instructions.
APPENDIX A

CONCENTRIC CIRCLE ROUTINE

DIMENSION ARRAY(II)
DO 109 N=I,II
READ(I,105) ARRAY(N)
105 FORMAT(12)
109 CONTINUE
THETA=0.0
IC=1
ICC=90
ICCC=7
T=61.
XX=-5.5
S=30.
R=5.0
M=T
LL=I
2 CALL PLOT(IC,-5.0,5.0,5.0,1.0,-5.0,5.0,5.0,1.0)
DO 106 N=I,II
CALL PLOT(ICC,XX-5.4)
WRITE(4,100)ARRAY(N)
CALL CHAR(0.1,0)
100 FORMAT(12,100X)
CALL PLOT(99)
106 XX=XX+1.
CALL PLOT(ICC,5.2,-5.0)
WRITE(4,101)
CALL CHAR(0.1,0)
101 FORMAT(6HX-AXIS,100X)
YY=5.0
3 CALL PLOT(ICC,-5.7,YY)
YY=YY
WRITE(4,103)YY
CALL CHAR(0.1,0)
103 FORMAT(13,100X)
YY=YY+1.0
IF(YY-6.0)3,4,4
4 CALL PLOT(ICC,-7.2,0.0)
WRITE(4,104)
CALL CHAR(0.1,0)
104 FORMAT(6HY-AXIS,100X)
11 ICC = 10
GO TO 24
12 ICC = 19
GO TO 24
13 ICC = 20
GO TO 24
14 ICC = 29
GO TO 24
15 ICC = 30
GO TO 24
16   ICC = 39
    GO TO 24
17   ICC = 40
    GO TO 24
18   ICC = 49
    GO TO 24
19   ICC = 50
    GO TO 24
20   ICC = 59
    GO TO 24
21   ICC = 0
    GO TO 24
22   ICC = 9
    GO TO 24
23   ICC = 90
2400 25  K=1,M
   X=5.0
   X=R*COS(THETA)
   Y=R*SIN(THETA)
   THETA=THETA+3.14159265/S
   CALL PLOT(ICC,X,Y)
25 CONTINUE
   CALL PLOT(99)
   M=T
   S=S=2.
   T=2.*S+1.
   R=R-.38
   LL=LL+L
   GO TO (11,12,13,14,15,16,17,18,19,20,21,22,23,99),LL
99   CALL PLOT(99)
   CALL PLOT(ICC,-10.,8.4)
   WRITE(4,200)
   CALL CHAR(0.4,0)
200 FORMAT(24H/STUVWXYZJKLI NOPQRSTUVWXYZ,100X)
   CALL PLOT(99)
   CALL PLOT(ICC,-10.,7.2)
   WRITE(4,201)
   CALL CHAR(0.4,0)
201 FORMAT(27HABCD EFGHIJKLMNOPQRSTUVWXYZ,100X)
   CALL PLOT(99)
   CALL PLOT(ICC,-10.,6.0)
   WRITE(4,202)
   CALL CHAR(0.4,0)
202 FORMAT(27H0123456789,R(,,/.)*Z.$*,100X)
   CALL PLOT(100)
   CALL EXIT
END
APPENDIX B

Plotting Special Characters

It is possible in CHAR to use the Greek Alphabet and the special symbols: <, >, ≠, %, ¤, [ , ], , °. This is accomplished by multipunching the FORMAT statement characters in accordance with the following symbol table. Some confusion may arise when the programmer looks at how this FORMAT statement is compiled as these special multipunched characters may cause totally unrelated characters to print out during compilation.

Example 1: If one wishes to plot $\alpha = \beta + \gamma$
the FORMAT statement would be punched

```
12 12 12
FORMAT(5H 0 = 0 + 0) or
1 2 3
```

```
12 12 12
FORMAT ( 0 = 0 + 0)
1 2 3
```

NOTE: The ' mark in the second example is a 5/8 punch

Example 2: Plot $\delta = 50^\circ$, $A < B$, $\phi = [(RADIUS)\times\pi]$

```
5 12 11 12 11 11 12 11 5
FORMAT (8 0 = 50 0, A 8, B 0 = 0 (RADIUS)\times 11 0 8)
4 9 4 4 8 7 9
8 2
```

In the following table a / next to a character indicates that this is the standard keypunch code for the 026 keypunches so that these characters need not be multipunched. In the case where there is more than one multipunch defined for a character, either multipunch can be used.
# APPENDIX B-2

<table>
<thead>
<tr>
<th>CHARACTER</th>
<th>IBM 0-0 2 2 6 9 PUNCH</th>
<th>CHARACTER</th>
<th>IBM 0-0 2 2 6 9 PUNCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>12-0-1</td>
<td>A</td>
<td>12-1</td>
</tr>
<tr>
<td>b</td>
<td>12-0-2</td>
<td>B</td>
<td>12-2</td>
</tr>
<tr>
<td>γ</td>
<td>12-0-3</td>
<td>C</td>
<td>12-3</td>
</tr>
<tr>
<td>δ</td>
<td>12-0-4</td>
<td>D</td>
<td>12-4</td>
</tr>
<tr>
<td>ε</td>
<td>12-0-5</td>
<td>E</td>
<td>12-5</td>
</tr>
<tr>
<td>ζ</td>
<td>12-0-6</td>
<td>F</td>
<td>12-6</td>
</tr>
<tr>
<td>η</td>
<td>12-0-7</td>
<td>G</td>
<td>12-7</td>
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<td>θ</td>
<td>12-0-8</td>
<td>H</td>
<td>12-8</td>
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<td>ι</td>
<td>12-0-9</td>
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<td>12-9</td>
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<td>12-1-1</td>
<td>J</td>
<td>11-1</td>
</tr>
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<td>λ</td>
<td>12-1-2</td>
<td>K</td>
<td>11-2</td>
</tr>
<tr>
<td>μ</td>
<td>12-1-3</td>
<td>L</td>
<td>11-3</td>
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<td>ν</td>
<td>12-1-4</td>
<td>Μ</td>
<td>11-4</td>
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<td>12-1-6</td>
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<td>11-6</td>
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<td>11-7</td>
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<td>12-1-8</td>
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<td>12-1-9</td>
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<td>0-2</td>
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<tr>
<td>υ</td>
<td>11-0-3</td>
<td>T</td>
<td>0-3</td>
</tr>
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<td>θ</td>
<td>11-0-4</td>
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<td>11-0-5</td>
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<tr>
<td>ω</td>
<td>0-8-6</td>
<td></td>
<td>0-9</td>
</tr>
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<td>&gt;</td>
<td>11-8-2</td>
<td></td>
<td></td>
</tr>
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<td>1</td>
</tr>
<tr>
<td>/</td>
<td>12-11-0-9-8-5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
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<td>3</td>
</tr>
<tr>
<td>/</td>
<td>12-11-0-9-8-6</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>/</td>
<td>8-7</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>/</td>
<td>0-1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>/</td>
<td>12</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>/</td>
<td>12-8-6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>/</td>
<td>0-6-4</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>/</td>
<td>12-8-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/</td>
<td>8-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/</td>
<td>8-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/</td>
<td>12-8-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/</td>
<td>11-8-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/</td>
<td>(Degree)</td>
<td></td>
<td>12-14-0-9-8-2</td>
</tr>
<tr>
<td>/</td>
<td>!</td>
<td></td>
<td>12-8-3</td>
</tr>
<tr>
<td>/</td>
<td>$</td>
<td></td>
<td>11-8-3</td>
</tr>
<tr>
<td>/</td>
<td>*</td>
<td></td>
<td>11-8-4</td>
</tr>
<tr>
<td>/</td>
<td>-</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>/</td>
<td>,</td>
<td></td>
<td>8-3-0</td>
</tr>
</tbody>
</table>
# APPENDIX C

Common Error Messages

<table>
<thead>
<tr>
<th>Messages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1HC2121</td>
<td>Check that the FORMAT statements for CHAR have 100X in them.</td>
</tr>
<tr>
<td>INVALID IC</td>
<td>In the call to PLOT, IC was set equal to an invalid code (see pages 2-3) or was not a fixed-point number.</td>
</tr>
<tr>
<td>Blank plotted on output where character was expected.</td>
<td>The programmer attempted to plot (using CHAR) an illegal character. See Appendix B.</td>
</tr>
<tr>
<td>1HC2101</td>
<td>Illegal arguments passed in PLOT or CHAR. (For example, if X or Y had been fixed point variables.)</td>
</tr>
</tbody>
</table>
ADDITIONAL IC-CODES (91 and 88) FOR THE PLOT SUBROUTINE

1. An IC-code of 91 is practically identical to IC = 90, except that with a 91 code, the pen remains in the 'UP' position.

2. A size parameter specification has been added to the PLOT subroutine. To make use of this option, the programmer must employ the following call statement:

   CALL PLOT (88,X,Y,M,N)

This option should not be used for the following codes:

   100, 99, 91, 90, 7, 1, 101, and 201

The above numbers should be used as first parameters in CALL PLOT.

An IC-code of 88 enables the programmer to state the size of the symbols to be drawn. X and Y are floating point variables for the coordinates X and Y; M indicates the symbol code as shown in the old PLOT instructions (see blue stencil) e.g., -- 29 for the octagon, leaving the pen up after the symbol is drawn on the plotter, -- 40 for a triangle leaving the pen down, etc.

N may be any whole number ranging from 1 through 79 to give the sizes of the desired symbol. The maximum size will be little over 1 1/2 inches (79 x .02). For instance, the statement CALL PLOT (88,X,Y,19,50) will cause a square of 1 inch high to be drawn in XY. XY is in the center of every symbol except for the octagon, in which case XY is off center:

A value greater than 79 for N will give an error message.

Below is a list of variables for the corresponding sizes (given at intervals of 5).
<table>
<thead>
<tr>
<th>N</th>
<th>SIZE (of symbol in inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>.0</td>
</tr>
<tr>
<td>5</td>
<td>.1</td>
</tr>
<tr>
<td>10</td>
<td>.2</td>
</tr>
<tr>
<td>15</td>
<td>.3</td>
</tr>
<tr>
<td>20</td>
<td>.4</td>
</tr>
<tr>
<td>25</td>
<td>.5 (1/2 in.)</td>
</tr>
<tr>
<td>30</td>
<td>.6</td>
</tr>
<tr>
<td>35</td>
<td>.7</td>
</tr>
<tr>
<td>50</td>
<td>1.0 (1 in.)</td>
</tr>
<tr>
<td>55</td>
<td>1.1</td>
</tr>
<tr>
<td>60</td>
<td>1.2</td>
</tr>
<tr>
<td>65</td>
<td>1.3</td>
</tr>
<tr>
<td>70</td>
<td>1.4</td>
</tr>
<tr>
<td>75</td>
<td>1.5 (1 1/2 in.)</td>
</tr>
</tbody>
</table>

min. 1 .02
max. 79 1.38
APPENDIX D

Storage Requirements

The PLOT and CHAR subroutine package is composed of the following routines:

<table>
<thead>
<tr>
<th>Name</th>
<th>Length</th>
<th>Use In</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLOT</td>
<td>ABO</td>
<td>PLOT</td>
</tr>
<tr>
<td>CHAR</td>
<td>2C8</td>
<td>CHAR</td>
</tr>
<tr>
<td>CHAR</td>
<td>884</td>
<td>CHAR</td>
</tr>
<tr>
<td>øPT</td>
<td>614</td>
<td>PLOT and CHAR</td>
</tr>
<tr>
<td>BAD</td>
<td>1DO</td>
<td>PLOT</td>
</tr>
<tr>
<td>LAST</td>
<td>218</td>
<td>PLOT</td>
</tr>
<tr>
<td>CTø</td>
<td>32</td>
<td>PLOT and CHAR</td>
</tr>
</tbody>
</table>

Total Length = $205_{16} = 828_{10}$

Minor changes may be added to these programs, thus altering their length slightly.
I. Introduction

Five 7-track magnetic tapes generated at BBRC and containing the calibration data were merged and converted into a 9-track 360-compatible tape. The data set on this tape was compared with the log book records and the erroneous records were corrected.

Since the gain of the system changed by about 7% during the calibration period, gamma ray lines 1.460 MeV ($K^{40}$) and 2.615 MeV ($Th^{228}$) observed in the background spectra were used to determine gain as a function of time over the 5-day period. Background data averaged over ten-minute intervals distributed throughout the calibration period was used to determine $n_0$ and $C$. The value for $n_0$, averaged over the entire calibration period, was then used to determine $C$ for individual graphs; linear interpolation was used to find $C$ for intermediate times.

After determining $C$ for each data set, the spectra were then smoothed and the gain corrected to a standard $C$ ($= 0.444 \times 10^{-4}$) in the manner described by P. Higbie, D. Forrest, I. Gleske, E. Chupp, Experimental Gamma Ray Response Function for the OSO-7 Spacecraft, Nucl. Instr. Meth. 108 (1973), 167-176.

Data sets with the same elevation ($\theta$) and azimuth ($\phi$) angles were added together and average spectra for each set of $\theta$ and $\phi$ determined; Na$^{24}$ spectra were treated differently from the other three sources. In the case of Na$^{24}$ spectra, room background was first subtracted from the source spectra. This was done to remove background contribution due to natural radioactivity (mainly $K^{40}$ and $Th^{228}$).

The room background-corrected spectra were then corrected for the activity difference between the two Na$^{24}$ sources and decay in the counting rate due to short half-life (15 hours) of the Na$^{23}$ source. [Two series of runs were made separately with the two sources listed in Higbie et al. (1973).]

The runs with the shadow cone 'in' were then subtracted from the corresponding spectra with the shadow cone 'out'. This provided a rough correction for the effect of scattering and room background correction for Sn$^{113}$, Cs$^{137}$, and Zn$^{65}$ sources.

Final spectra for the different values of $\theta$ and $\phi$ are on tape CALTP.
III. OSOH100

Program Language : Fortran IV G-Level
Programmer : S. Croteau
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : FGET, SHIFT, FPUT

This program reads the calibration data tapes generated at BBRC using FGET with data converter off, calls SHIFT to reorganize the data bits so that two bytes of data are derived from every three bytes read, and writes the new records onto a 9-track tape using FPUT.
IV. OSOH101

Program Language : Fortran IV G-Level
Programmer : J. Kantauskis
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : FGET

This program reads the 9-track 360-compatible calibration tape called RSDATA. From each tape record a background card and a solar card is punched. OSOH101 right justifies THETA and PHI and converts THETA, PHI, and TIME from the Varian Data 620/i internal octal code to character code. OSOH101 also converts the source field to a number code. This is done by checking column 21 of the tape record for an S(Sn¹³³), C(Cs¹³⁷), Z(Zn⁶⁵), N(Na³⁴), B (background in Varian octal code) and converting it to a 1, 2, 3, 4, or 5, respectively. The program also searches the cone field of the tape and converts the C (cone) or N (no cone) from octal format to character format.
V. OSOH102

Program Language : Fortran IV, G-Level
Programmer : J. Kantauskis
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : FGET, FPUT

OSOH102 reads the 9-track 360-compatible calibration data tape (RSDATA) and the corrected header cards from OSOH101. For each tape record read two header cards (background and solar) are read. Each header card is tested for a C in the cone field. If there is a C in the cone field, a new cone field is given a value of '1' otherwise the new cone field is given a value of '2'. Characters 42 and 426 of the tape are the status fields. These two fields are converted from octal to binary. The background header (the first of the two headers read) and the 11th and 12th binary positions of the status plus characters 41-424 of RSDATA are used to create a background record on the new tape. The same is done to create each solar record except the solar header and characters 425-808 of RSDATA are used.
VI. OSOH103

Program Language : Fortran IV, G-Level
Programmer : J. Kantauskis
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : MATCH1, MATCH2

Before OSOH103 is executed, control cards are inserted manually into the header deck (from OSOH101) at the desired locations. The three control cards and their meanings are:

1) '7' in column 1 : Called ACODE in program. ACODE means add the corresponding data fields of the tape which match the following headers, separating background records from solar records.

2) '8' in column 1 : Called SCODE in program. SCODE means add the corresponding data fields of the tape records which match the following headers accumulating background and solar data separately.

3) '9' in column 1 : Called ECODE in program. When ECODE is read, it means execute. There are two cases:

   a) ECODE follows directly behind the ACODE group of headers. Here ECODE means to graph the sum of the solar and sum of the background records which were accumulated beforehand.
b) ECODE follows directly behind the SCODE group of headers. Here ECODE means to graph the sum of the background and solar records which were accumulated after SCODE. Then to subtract the sum of the background and solar sums taken after SCODE. Then to graph this difference.

The header cards are read and matched with the records on the tape generated by OSOH102.
VII. OSOH105

Program Language : Fortran IV, G-Level
Programmer : J. Kantauskis
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

This program reads the tape generated by OSOH103 and calculates \( n_0 \) and \( C \). The program then punches the 122 values of \( C \) along with the card number.
VIII. OSOH105A

Program Language : Fortran IV, G-Level
Programmer : J. Kantauskis
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

This program combines two decks of cards to form one deck. It reads one deck containing card number, hours, minutes, and day, and another deck containing card number and c (output of OSOH105). It then punches cards containing card number, c, hours, minutes, and day.
IX. OSOH106

Program Language : Fortran IV, G-Level
Programmer : J. Kantauskis
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

This program reads the 122-card table created by OSOH105A. Once the table has been read in, header cards, which fall within the time range of the table, are read. For each header card the appropriate tabular entries are determined based on 'day' and 'time'. Then 'c' is determined for the header card by interpolating between 'c' and 'time' of the table and 'time' of the header card.

\[ C = C_1 + \frac{T-T_1}{T_2-T_1} (C_2-C_1) \]

Finally the new header cards are punched which will now contain the new values of 'c'.

The program OSOH106A is a version of OSOH106 with a change in the format statement of the input card and output card as shown in the comment cards in program OSOH106.
X. OSOH108

Program Language : Fortran IV, G-Level
Programmer     : J. Kantauskis
Installation   : University of New Hampshire
Computer       : IBM-360-H50
Subprograms Called : FGET, SMOTHE, GAIN, FPUT

This program reads the header cards finds the matching records on tape (output of OSOH102), smooths the spectra, then gain shifts the smoothed spectra and writes the smoothed shifted spectra on another tape. The program also keeps a total of the counts in the smoothed shifted spectra.

Smoothing Subroutine:

The function used to smooth the spectra is the following:

\[ Y_i = \frac{(-3Y_{i-2} + 12Y_{i-1} + 17Y_i + 12Y_{i+1} - 3Y_{i+2})}{35} \]

The proof and explanation of this can be found in Volume 36 Number 8 of the July 1964 issue of Analytical Chemistry, "Smoothing and Differentiation of Data by Simplified Least Squares Procedures", by Savitsky and Galay.

Gain Shifting Subroutine:

\[ Y_1 = \sqrt{C(N_1 + N_0)}^2/C_s - M_0 \]
\[ Y_2 = \sqrt{C(N_2 + N_0)}^2/C_s - M_0 \]

Where C is read from the header cards, the rest is given in the program.
\( M_1 \) is the next integer higher than \( Y_1 \),
\( M_2 \) is the next integer lower than \( Y_2 \).

Now the shifted channels \( X_i \) are found as follows:

\[
X_i = \sqrt{C_s (i + M_0)^2/C - N_0} \quad \text{where } i \text{ is the loop from } M_1 \text{ to } M_2.
\]

The \( Y_i \) values corresponding to the \( X_i \) values are found through interpolation. The three interpolation methods are used, Newton's Forward, Newton's Backward, and Stirlings Central Difference. Once the values of \( Y_i \) have been found, the shifted spectrum \( M(i) \) is calculated from \( i \) to \( M_2 - M_1 + 1 \)

\[
M_i = \frac{C_s}{C} \times \frac{(M + M_0)}{(X_i + N_0)} \times Y(X_i)
\]

where \( M \) goes from \( M_1 \) to \( M_2 \).
XI. OSOH109

Program Language : Fortran IV, G-Level
Programmers : J. Kantauskis, P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

The tape that was generated by OSOH108 is read onto disk and remains on disk until the conclusion of this series of production runs. The major function of OSOH109 is to subtract the background spectrum (cone in) from the source spectrum for sources Sn, Zn, and Cs. The new records are written onto a new disk file.
XII. OSOH110

Program Language : Fortran IV, G-Level
Programmers : J. Kantauskis, P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

This program reads both data sets on disk and continues the work of OSOH109 by writing more records on the new data set. Its major function is to subtract room background from the source spectrum for Na$^{24}$. 
XIII. OSOH118

Program Language : Fortran IV, G-Level
Programmers : J. Kantauskis, P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

This program reads the new data set on disk, subtracts the 'cone in' spectrum from the source spectrum for Na$^{24}$, corrects for decay, and then writes the new record onto the same data set on disk.
XIV. OSOH120

Program Language : Fortran IV, G-Level
Progammers : J. Kantauskis, P. Higbie
Installation : University of New Hampshire
Computer : IBM-360-H50
Subprograms Called : None

This program reads the file on disk and prints out the desired spectra.
XV. Subroutine FGET (IDSN,IRSLT,IOVEC)

Program Language : IBM O/S 360 Assembler Language
Date Written : February 4, 1971
Programmer : A. Buck
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50

Dummy Arguments : 1) IDSN: a full word input integer containing the data set number to which the call is directed. (IDSN must be 1, 2, or 3).

2) IRSLT: a full word output integer in which subroutine FGET may place an activity-result code as follows...

   a) IRSLT = -1 if the requested activity was invalid. This code is returned if either of the following occur:

      i. IDSN contains a number less than 1 or greater than 3.

      ii. Data set has been previously closed.

   b) IRSLT = 0 if data is read and no I/O error is detected.

   c) IRSLT = 1 if an I/O error occurred on the block containing the data placed in IOVEC. The calling program has the responsibility for accepting or rejecting the data. In addition, the calling program is responsible for proper reaction to the remaining records in the block for which IRSLT will be 0.
d) $\text{IRSLT} = 2$ if end-of-file was
detected. The contents of $\text{IOVEC}$
are not changed. The data set
is closed and can not be used again
by subroutine $\text{FGET}$ with the same
value of $\text{IDSN}$.

3) $\text{IOVEC}$: an output vector in which
$\text{FGET}$ can place the record. The actual
variable used for $\text{IOVEC}$ may be integer,
real, logical, or complex. The first
leftmost byte of the data record is
placed in the high-order byte of $\text{IOVEC}$
when reading occurs. The number of
bytes placed in $\text{IOVEC}$ is specified by
the $\text{LRECL}$ subparameter of the DD State-
ment.

Subprograms Called : None

Description : This subroutine is a QSAM input subroutine
to read logical records into an area de-
ined by the calling program. This
routine is specifically designed to
supply a Fortran calling program with
logical records from a data set to which
the DCB subparameter 'RECFM = FB' applies.
For data sets to which 'RECFM = F' or
'RECFM = U' applies, subroutine $\text{FTREAD}$
may be more easily used. "RECFM = V" is
specifically prohibited.

Subroutine $\text{FGET}$ can manage as many as
3 data sets during the same job step.
The data sets may be open (active)
simultaneously provided no two data sets
are on the same magnetic tape.

DD Statements required...

If $\text{FGET}$ is to be called with $\text{IDSN} = 1$
(or 2 or 3), then the user must describe
the data set by a DD Statement having the
DD name $\text{FGET01}$ (or $\text{FGET02}$ or $\text{FGET03}$).
The DD Statement must include the DCB
subparameters 'RECFM', 'LRECL', and
'BLKSIZE' but must omit 'DSORG' or 'MACRF'.
Subroutine FPUT (IDSN, ICMD, IRSLT, IOVEC)

Program Language : IBM O/S 360 Assembler Language
Date Written : February 4, 1971
Programmer : A. Buck
Installation : University of New Hampshire Space Science Center
Computer : IBM-360-H50

Dummy Arguments : 1) IDSN: a full word integer input parameter specifying the data set to which activity is directed. The integer stored at IDSN must be greater than zero but less than 21.

2) ICMD: a full word input integer variable containing a request type code which specifies the activity to be performed.
   a) ICMD = 1 implies that a logical record is to be written.
   b) ICMD = 2 implies the data set is to be ended. Once ended, the data set is unavailable to the calling program through the same data set number.

3) IRSLT: a full word output integer variable in which subroutine FPUT can place a return code as follows
   a) IRSLT = -1 implies request was illegal for one of the reasons below:
      i. IDSN contained a value less than 1 or greater than 20.
      ii. ICMD contained a value less than 1 or greater than 2.
      iii. A write request was made to a data set that had been ended.
iv. An endfile request was made to a data set either before the first write request or after the data set had been ended.

b) IRSLT = 0 implies request was executed normally.

c) IRSLT = 1 implies an I/O error occurred while writing a block. The data set was ended.

4) IOVEC: an input vector whose high order byte is the first byte to be written (when ICMD = 1) in a logical record.

   The number of bytes written is specified by the LRECL subparameter on the DD statement describing the data set.

Subprograms Called : None

Description : Subroutine FPUT is a QSAM output subroutine to write logical records from an area defined by the calling program. This routine is specifically designed to allow a Fortran program to create without format control an extensive data set to which the DCB subparameter 'RECFM = FB' applies. For data sets to which 'RECFM = F' or RECFM = U' applies, subroutine FWRITE may be more easily used.

Subroutine FPUT can manage as many as 20 data sets in the same job step. As many as desired may be active simultaneously. Once the endfile command has been issued to a data set, subroutine FPUT will refuse to perform any further activity for that particular data set. The large number of data sets allows writing as many as 20 files to the same magnetic tape volume as a possible application.

DD Statements required...

If subroutine FPUT is called with IDSN=1 (or 2, ..., or 20) the user must supply a DD Statement having the DD name FPUT01 (or FPUT02, ..., or FPUT20). The DD statement must include the DCB subparameters 'RECFM', 'LRECL', and 'BLKSIZE' but must omit 'DSORG' and 'MACRF'. 
XVII. Description of Final Output Tape

The data control block for this tape is as follows:

\[ \text{DCB} = (\text{REC}FM = \text{FB}, \text{LRECL} = 1680, \text{BLKSIZE} = 1680) \]

The tape contains the final spectra for the different values of \( \theta \) and \( \phi \). All variables on this tape are 32-bit words. The format is as follows:

Word No. 
---
1 : Source number (integer) 
2 : Elevation angle (\( \theta \)) (integer) 
3 : Azimuth angle (\( \phi \)) (integer) 
4 : First channel (\( M_1 \)) (integer) 
5 : Last channel (\( M_2 \)) (integer) 
6 : Sum of counts in the original source spectrum (floating point) 
7 : Sum of counts in the original background spectrum (floating point) 
8 : Sum of counts in the smoothed gain-shifted source spectrum from \( M_1 \) to \( M_2 \) (floating point) 
9 : Sum of counts in the smoothed gain-shifted background spectrum from \( M_1 \) to \( M_2 \) (floating point) 
10 : Same as 8 but accumulated in a different step (floating point) 
11 : Same as 9 but accumulated in a different step (floating point) 
12-20 : Counters and extra words (floating point) 
21-420 : Spectrum (400 channels) (floating point) 

Note: In the Na\(^{2+} \) source, Nos. 6-11 appear in the following order: 6, 8, 10, 7, 9, 11.
OSO-H
EXPERIMENT, DESCRIPTION AND OPERATION
UNH GAMMA RAY MONITOR

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Co-Investigators:
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Durham, New Hampshire 03824

(Revision Date: June 2, 1970)

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I. EXPERIMENT DESCRIPTION

A. Objective:

The primary objective of the proposed experiment is to monitor the high energy photon spectrum (0.3 to 9.1 MeV) at the OSO altitude (approximately 575 km) and correlate the observations with the time when the detector is exposed to the sun and with other observations of solar activity. Our primary interest is to study the characteristics (intensity and time variation) of gamma rays emitted by the sun. If nuclear reactions occur in the solar atmosphere, either continuously or sporadically, then several nuclear gamma rays might be produced in sufficient quantity to be observable at the earth. An important feature of this gamma ray experiment is the measurement of gamma ray energies with the highest resolution possible with the basic detector and the spacecraft telemetry system in order to emphasize any line structure in the gamma ray flux. As an example, gamma rays at 0.51 MeV, 2.22 MeV, 4.43 MeV, and 6.15 MeV would indicate production of positrons, neutrons, and excited nuclei from various nuclear processes.

The experiment will also provide monitoring of the continuous spectrum of photons in the energy range from 0.3 to 9.1 MeV. Additional information from the experiment will provide knowledge of changes in background radiations. These are likely due to earth albedo gamma rays, electron bremsstrahlung, and neutron and charged particle interactions in the
detector and the spacecraft. This information is important for further understanding of solar-terrestrial relations since some gamma rays may be produced in the earth's atmosphere by other solar radiation. Also, such information is essential for determining the direction for detector development for solar and celestial gamma ray astronomy.

The main features of the experiment and detector may be summarized as follows:

(1) Monitor solar gamma ray flux from 0.3 to 9.1 MeV with a high resolution gamma ray spectrometer to search for nuclear gamma ray lines.

(2) Monitor the continuum solar gamma ray spectrum over the same energy range, and simultaneously monitor the 7.5 to 120 keV X-ray range.

(3) Provide for internal calibration of detector automatically or on external command.

(4) Data handling mode may be changed on command to emphasize high resolution or a broad spectral survey.

B. Instrument:

The gamma ray spectrum is measured by means of a high resolution NaI(Tl) gamma ray spectrometer surrounded with a CsI(Na) active collimator which also acts as a charged particle shield. The basic layout of the detector is shown in Figure 1. The central gamma ray spectrometer is viewed by a single ruggedized photomultiplier. The CsI(Na) shield, which consists of a large cup and a front slab, is viewed by five photomultipliers (RCA70132B-Hemispherical Photocathode), three
1/4" thick NaI(Tl) X-ray detector.

Calibration (Co$^{60}$ source at end of light pipe)

X-ray calibration (Am241 light pulser.)

CsI (Na) Front slab anticoincidence shield

CsI (Na) cup anticoincidence shield

(Three tubes at 120°)

3X3" NaI (Tl) integral line crystal and photo multiplier assembly.

Fig. 1 Detector Schematic
of which are arranged around the front end and one at the rear end of the cup, and the fifth views the front slab of the shield and an Am$^{241}$ calibration source. In addition, a single photomultiplier (RCA 4461) views a thin NaI(Tl) crystal (1/4"), which acts as a detector for low energy solar X-rays and low energy charged particles. The purpose of the detector is to provide data to be used for correlation purposes in the data analysis. Another PM tube (RCA70132B) views a calibration source Co$^{60}$ (see below).

The arrangement of the detector in the OSO wheel compartment (#9) is shown in Figure 2. Quadrants 1-4 give the various viewing aspects for the detector relative to the spacecraft sun line. These will be referred to again in the discussion of the experiment operation.

Figure 3 shows the system functional block diagram. Basic scientific data is represented by:

(1) the gamma ray spectrum from the central detector as measured by the 377 channel quadratic pulse height analyzer,
(2) the X-ray spectrum over the energy range 7.5-120 keV as measured by a four channel pulse height analyzer,
(3) high energy neutron events occurring in the central detector as measured by pulse shape discrimination circuitry.

Additional detector housekeeping data monitored is:

(1) CsI(Na) front slab counting rates
(2) CsI(Na) cup counting rates
(3) Central detector integral counting rates
Quad. 1
Reference direction
Sun,
Pseudo sun,
or
determined by
Magnetometer.

Quad. 2
(Alternate solar)

Quad. 3
(Background)

Quad. 4
(Alternate Background)

View from top at instant compartment C/L lies along sun line.

Fig. 2
Calibration of the spectrometer and X-ray detector is accomplished periodically by use of a Co\textsuperscript{60} source giving gamma lines at 1.17 and 1.33 MeV, and an Am\textsuperscript{241} source giving an X-ray line at 60 keV and iodine escape peak at 32 keV and possible Np\textsuperscript{237} X-rays. Each of these sources consists of a scintillating material viewed by one of the photomultipliers. Since the gamma rays or X-rays from the sources are coincident with the charged particles emitted by the sources, the calibration lines may be electronically rejected or selected. Electronic calibration signals are also provided. The calibration data appears on the normal data channels but is identified by an analog word ASSC 1-4 and bits 5 & 6 in the MF status word.

The assignment of scientific and housekeeping data is given in Section III and also Table I, Data Format. The assignment of commands is given in Table II. The command number assignment agrees with that given in the UNH interface pin list (Table 8-1, page 8-2 of the Preliminary Allocation and Performance Summary Data dated June 15, 1969).
### TABLE I (A)

**DATA ASSIGNMENT**

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<th>Time resolution</th>
<th>Energy and Item</th>
<th>Readout Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Detector</td>
<td>184 Sec.</td>
<td>377 ch, .3 to 9.1 MeV</td>
<td>2 MF word (11,12)</td>
</tr>
<tr>
<td></td>
<td>61 Sec.</td>
<td>solar-background</td>
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<tr>
<td></td>
<td>30 Sec.</td>
<td>121 ch, .3 to 9.1 MeV</td>
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<td></td>
<td></td>
<td>solar-background</td>
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<td></td>
<td></td>
<td>57 ch, .3 to 9.1 MeV</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>solar-background</td>
<td></td>
</tr>
<tr>
<td>X-Ray Detector</td>
<td>30 Sec.</td>
<td>7.5-15 keV solar</td>
<td>DSM 23 t&lt;sub&gt;n&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.5-15 keV background</td>
<td>DSM 29 t&lt;sub&gt;n&lt;/sub&gt;</td>
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<tr>
<td></td>
<td></td>
<td>15-30 keV solar</td>
<td>DSM 47 t&lt;sub&gt;n&lt;/sub&gt;</td>
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<tr>
<td></td>
<td></td>
<td>15-30 keV background</td>
<td>DSM 9 t&lt;sub&gt;n+1&lt;/sub&gt;</td>
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<tr>
<td></td>
<td></td>
<td>30-60 keV solar</td>
<td>DSM 23 t&lt;sub&gt;n+1&lt;/sub&gt;</td>
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<tr>
<td></td>
<td></td>
<td>30-60 keV background</td>
<td>DSM 29 t&lt;sub&gt;n+1&lt;/sub&gt;</td>
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<td>60-120 keV solar</td>
<td>DSM 47 t&lt;sub&gt;n+1&lt;/sub&gt;</td>
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<td>60-120 keV background</td>
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<td>Quadrant Time - solar</td>
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<td></td>
<td>Quadrant Time - background</td>
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<td></td>
<td>30 Sec.</td>
<td>Energy ID (Sync)-Low Band (7.5-15, 15-30 keV)</td>
<td>DSM 19 t&lt;sub&gt;n&lt;/sub&gt;</td>
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<td></td>
<td>High Band (30-60, 60-120 keV)</td>
<td>DSM 19 t&lt;sub&gt;n+1&lt;/sub&gt;</td>
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<tr>
<td>Central Detector</td>
<td>200 Sec.</td>
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<td>MeV - background</td>
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<td>Front Slab</td>
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<td></td>
<td></td>
<td>- Quadrant and gain mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Command status</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Inflight calibration on/off</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Command status</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- (2) HVPS on/off</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Command status</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- HV Programmer</td>
<td></td>
</tr>
</tbody>
</table>
TABLE II

<table>
<thead>
<tr>
<th>Command No.</th>
<th>BBRC Pin No.</th>
<th>When Affected</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Connector 09J02)</td>
<td></td>
<td>Mode when power is turned on is underlined.</td>
</tr>
<tr>
<td>1</td>
<td>U</td>
<td>EOS</td>
<td>Quadrant (Normal/Alternate)</td>
</tr>
<tr>
<td>2</td>
<td>V</td>
<td>EOS</td>
<td>Scan (Full, Intermediate, Short)</td>
</tr>
<tr>
<td>3</td>
<td>W</td>
<td>EOS</td>
<td>Calibrate (on or off)</td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td>EOS</td>
<td>Gain Change (X1 or X 1/3)</td>
</tr>
<tr>
<td>5</td>
<td>Y</td>
<td>EOS if issued once, n steps immediately for n+1 commands n steps if EOS interrupts command sequence</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Z</td>
<td>Immediate</td>
<td>Central HV (ON/OFF)</td>
</tr>
<tr>
<td>7</td>
<td>A</td>
<td>Immediate</td>
<td>Shield HV (ON/OFF)</td>
</tr>
<tr>
<td>8</td>
<td>B</td>
<td>Immediate</td>
<td>Auto Calibration (Inhibit/Active)</td>
</tr>
<tr>
<td>9</td>
<td>C</td>
<td>Immediate</td>
<td>Magnetometer Pulse (Enable/Disable)</td>
</tr>
</tbody>
</table>

EOS - End of scan: at completion of readout of both solar and quadrant for MF data.

All instrument circuitry predicated on single (non-redundant) pulses on command lines.
II. EXPERIMENT OPERATION

The central detector measures the energy spectra of gamma rays passing through, without interacting in, the thin front slab. The thicker cup absorbs a fraction of the gamma rays produced within the spacecraft and also rejects a fraction of those gammas which merely scatter in the central detector. Both shields also reject charged particles. Gammas are recorded while the sun is within 45° of the compartment center line and similarly in the opposite direction for background comparison. An opening angle can only be defined in terms of the relative absorption of gammas in the thin front slab and thicker cup. A nominal value of 45° can be used.

The magnetic core memory is divided into two parts, so that one half can continuously record gamma rays of all energies while the other is being read out. When a readout is completed the roles of the two halves are reversed.

The operation of the experiment in the various modes can now be described by references to Figures 1 and 3 and Tables 1 and II. The various operational modes are:

- Normal Operation
- Night Operation
- Change Time Resolution
- Change Gain
- Change H.V.
- Quadrant Change
- Calibration

Normal Operation:

In the normal mode of operation the data assigned to the main frame, DMF, DSP, and ASC words are previously stored in
solar and background buffers, logarithmic count meters, or adaptive accumulators (see Figure 3). Designation of an event in a given detector element for labeling as solar or background is determined first by the day azimuth aspect signal from the spacecraft. This signal is provided by the BBRC sun sensor as it sees the sun before the axis of our detector does (41.2°). This signal goes to a quadrant generator which generates a signal identifying the quadrant the detector lies in. If an event occurs in the allowed quadrant interval (1 or 3) it is appropriately recorded.

The various data is accumulated for a time interval dependent on the telemetry sampling rate, and this determines the time resolution listed in Tables I and III. For example, in the normal mode the central detector gamma ray spectrum is analyzed with a 377 channel quadratic analyzer, and the spectrum is accumulated over a real time of 184.32 sec (duty cycle 25% due to wheel spin; actual accumulation time is 46 sec. The quadrant time is monitored.)

In the normal mode of operation similar remarks apply to all other data listed in Table I.

Night Operation:

The experiment is intended to operate continuously through the night; however, the quadrant generator is now controlled by either the night azimuth signal (gyro) or the magnetic aspect (magnetometer) signal. In the former case, an apparent sun
pulse is generated so the two quadrants during which data is accumulated correspond to directions away from the sun (into the night sky) and toward the sun (thus intercepting the earth).

If, for some reason, it is desired to change from the normally chosen gyro-signal to the magnetometer signal for the night reference, a magnetic pulse enable command would be activated (see Table II). The detector viewing direction with respect to the earth sun line will, of course, be different than in the former case. The status of this command is monitored in the MF status word and ASSC 2-6. The day/night signal automatically causes the quadrant and generator to select the solar reference or night reference (which ever is enabled) signal.

**Change Time Resolution:**

The time resolution for obtaining the gamma ray spectrum may be reduced by using only a portion of PHA memory. Thus, by external command, time resolutions of 61.44 sec and 30.72 sec are available (normally 184 sec, see Table I and III). The available channels in this mode sample certain selected portions of the spectrum. The status of this command is monitored by analog word ASSC 1-2.

**Change Gain:**

The portion of the central detector spectrum analyzed may be selected by issuing a command which changes the gain of the central detector channel by 1/3. This is done by an appropriate change of the high voltage. The status of this command is monitored by analog word ASSC 1-3 and the DMF status word (bit 10).
TABLE III

DATA TIMING FORMAT

<table>
<thead>
<tr>
<th>TIME FRAME-SEC</th>
<th>MAIN FRAME</th>
<th>DSM</th>
<th>ASSC*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FULL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>15.36</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>30.72</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>46.08</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>61.44</td>
<td>(S+B)</td>
<td>1</td>
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<tr>
<td>5</td>
<td>76.80</td>
<td>(S+B)</td>
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<tr>
<td>6</td>
<td>92.16</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>107.52</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>122.88</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>137.24</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>153.60</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>168.96</td>
<td>(S+B)</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>184.32</td>
<td>(S+B)</td>
<td>1</td>
</tr>
</tbody>
</table>

NOTE: B = BACKGROUND (ANTI SOLAR DATA)
S = SOLAR

*ASSC WORDS 1 & 2 SUBCOMMITTED IN 6 FRAME CYCLES
NOT NECESSARILY SYNCHRONIZED WITH DIGITAL OUTPUTS
High Voltage Change:

The operating high voltage on the central detector photomultiplier may also be changed in increments by a step command. This voltage may be varied over approximately 200 volts in 64 steps. The step reference is reported by ASSC 1-6 and an analogue reading of the voltage is given by ASSC 2-3.

Quadrant Change:

The viewing quadrants for the detector are normally 1 and 3 (see Figure 2). A change to quadrants 2 and 4 may be made on command. The status of the command is monitored by analogue word ASSC 1-3 and the DMF status word (bit 2).

Calibration Mode:

Normally the instrument functions with the gamma ray and x-ray calibration lines electronically removed from the spectrum of the respective detectors. At the passage of the satellite from either night into day, or day into night, a radioactive source calibration is automatically initiated which lasts for three (3) minutes. Evidence for this operation is monitored on analogue word ASSC 1-4, and the DMF status word (bit 6). This automatic calibration sequence may be removed by activating the auto calibrate inhibit command.

A calibration sequence can also be initiated in real time by a calibrate on/off command to provide electronic and radioactive source calibration source data. Status of this command is monitored by analogue word ASSC 1-4, and the DMF status word (bits 5 and 6).
Emergency Operation:

In case of instrument or spacecraft difficulties, the following procedure should be followed:

1. If there is corona or arcing, or if the analog data on ASSC 2-3 or ASSC 2-4 show excessive high voltage or unusually low voltage, then the two high voltage off commands should be issued.

These alarm levels are:

Voltage ASSC 2-3

1500 < $E_o$ < 2200V for an EMR central detector
1500 < $E_o$ < 1900V for an RCA central detector

ASSC 2-4

1000 < $E_o$ < 1500V for C70132B

2. If the instrument is stuck in the auto calibrate mode, the Auto Calibrate Inhibit command should be issued. If the instrument is in normal command calibrate mode, issuing a second command returns it to normal operation.

3. Telemetry dropout: Turn off the high voltage automatically with the computer. If the high voltage is found not to be involved in such dropouts, this feature should be disabled.
III. DATA FORMAT

In reporting this data format we will make the following assumptions:

1. The primary use of this description will be during checkout at Ball Brothers.

2. Ball Brothers has a computer which can receive keyboard or sense switch commands, and display various segments of the data we wish displayed.

3. The data format should be that which makes the most sense to us as experimenters.

For our instrument, the DMF, DSF, and ASSC data are independent of each other, and so we will discuss them separately in the following.

A. Main Frame Data:

Our primary data, that is the data from our NaI(Tl) detector, comes out on main frame words 11 and 12. Data is taken in two quadrants, one centered on the solar direction and the other on the anti-solar direction. These are referred to as solar and background quadrants, respectively. There is a mode in which the two other quadrants are chosen instead of these. This is referred to as the alternate quadrant mode. The main portion of our data is essentially a readout of a pulse height analyzer. There are three time scales involved. There is the short scan in which the background and solar data is readout in approximately 31 seconds; the intermediate scan, taking 61 seconds; and the full scan, taking 184 seconds. The speed of the I/O devices available at Ball Brothers will determine to some degree how
our data is displayed. For example, if a printer is available that can print approximately four (4) lines per second, our best display would probably be a histogram type graph.

The formats for the full, intermediate, and short scans are shown in Figures 4, 5, and 6. The internal instrument word length is 12 bits. The main frame word length is 8 bits, the main frames 11 and 12 are linked together for a total of 16 bits. The consequence is that instrument words are chopped up between main frame words 11 and 12; however, four instrument words fit into six main frame words or into three main frame cycles. Each scan, whether from background or solar quadrant begins with a 12 bit flag of one's. This is followed by a status word shown in Table IV. Bits 3 and 4 of the status word indicate the scan mode of the next data block to be read out. The words following the status word give the number of counts in each subsequent channel of the pulse height analyzer. In the intermediate and short scan modes not every channel of the analyzer is covered, just certain selected channels (Table V). The last five instrument words in each quadrant readout give data on neutrons, dead time, and accumulation time for the pulse height analyzer. The two low order bits in the status word are the least significant bits for the dead time given in the fifth from the last word. For each quadrant readout, the status should be displayed in a mnemonic form, rather than just displaying bits. The number of counts in each channel should be displayed in decimal. If the printer is fast enough, a graphical display probably would be more easily interpreted. The number of counts in the three neutron
**MAIN FRAME FORMAT - FULL SCAN**

<table>
<thead>
<tr>
<th>Bits</th>
<th>1 . . 5 . . 9 . . 13 . . 16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MF 11</strong></td>
<td><strong>MF 12</strong></td>
</tr>
<tr>
<td><strong>Flag</strong></td>
<td><strong>Status</strong></td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td><em>Channel 1</em>*</td>
</tr>
<tr>
<td><strong>CH. 1</strong></td>
<td><strong>Channel 2</strong></td>
</tr>
<tr>
<td><strong>Channel 3</strong></td>
<td><strong>CH. 4</strong></td>
</tr>
<tr>
<td><strong>Channel 4</strong></td>
<td><strong>Channel 5</strong></td>
</tr>
<tr>
<td><strong>CH. 5</strong></td>
<td><strong>Channel 6</strong></td>
</tr>
</tbody>
</table>

---

**Background Data**

**Channel 375**

**Channel 376**

**Channel 377**

**CH. 377**

**Dead Time**

**Neutron 1**

**Neutron 2**

**Neutron 3**

**N. 3**

**PHA Clock Time**

---

**Solar Data**

**Channel 375**

**Channel 376**

**Channel 377**

**CH. 377**

**Dead Time**

**Neutron 1**

**Neutron 2**

**Neutron 3**

**N. 3**

**PHA Clock Time**

---

*For energy-channel assignments see Gamma Channel Table*

**Figure 4**
### Main Frame Format - Intermediate Scan

#### Bits

<table>
<thead>
<tr>
<th>Main Frame</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
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<tbody>
<tr>
<td>Flag</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Status *Channel 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Ch. 1</td>
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<td>Channel 2</td>
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<td></td>
</tr>
<tr>
<td>Channel 3</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ch. 4</td>
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<tr>
<td>Channel 5</td>
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<tr>
<td>Channel 6</td>
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<td></td>
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</table>

#### Background Data

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<th>Ch. 126</th>
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<tbody>
<tr>
<td>Channel 120</td>
<td>Channel 121</td>
</tr>
<tr>
<td>Ch. 121</td>
<td>Dead Time</td>
</tr>
<tr>
<td>Neutron 1</td>
<td>N. 2</td>
</tr>
<tr>
<td>Neutron 2</td>
<td>Neutron 3</td>
</tr>
<tr>
<td>N. 3</td>
<td>Pha Clock Time</td>
</tr>
<tr>
<td>Flag</td>
<td>Status</td>
</tr>
<tr>
<td>Status</td>
<td>Channel 1</td>
</tr>
<tr>
<td>Ch. 1</td>
<td>Channel 2</td>
</tr>
<tr>
<td>Channel 3</td>
<td>Ch. 4</td>
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<td>Channel 4</td>
<td>Channel 5</td>
</tr>
<tr>
<td>Ch. 5</td>
<td>Channel 6</td>
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</tbody>
</table>

#### Solar Data

<table>
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<tr>
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<th>Ch. 120</th>
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<tbody>
<tr>
<td>Channel 120</td>
<td>Channel 121</td>
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<tr>
<td>Ch. 121</td>
<td>Dead Time</td>
</tr>
<tr>
<td>Neutron 1</td>
<td>N. 2</td>
</tr>
<tr>
<td>Neutron 2</td>
<td>Neutron 3</td>
</tr>
<tr>
<td>N. 3</td>
<td>Pha Clock Time</td>
</tr>
</tbody>
</table>

---

*For energy-channel assignments see Table V*

**Figure 5**
MAIN FRAME FORMAT - SHORT SCAN*

<table>
<thead>
<tr>
<th>Main Frames</th>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>FLAG STATUS</td>
</tr>
<tr>
<td>2</td>
<td>STATUS *CHANNEL 1</td>
</tr>
<tr>
<td>3</td>
<td>CH. 1 CHANNEL 2</td>
</tr>
<tr>
<td>4</td>
<td>CHANNEL 3 CH. 4</td>
</tr>
<tr>
<td>5</td>
<td>CHANNEL 4 CHANNEL 5</td>
</tr>
<tr>
<td>6</td>
<td>CH. 5 CHANNEL 6</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8-41</td>
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<tr>
<td>42</td>
<td>CHANNEL 55 CH. 56</td>
</tr>
<tr>
<td>43</td>
<td>CHANNEL 56 CHANNEL 57</td>
</tr>
<tr>
<td>44</td>
<td>CH. 57 DEAD TIME</td>
</tr>
<tr>
<td>45</td>
<td>NEUTRON 1 N. 2</td>
</tr>
<tr>
<td>46</td>
<td>NEUTRON 2 NEUTRON 3</td>
</tr>
<tr>
<td>47</td>
<td>N. 3 PHA CLOCK TIME</td>
</tr>
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<td>48</td>
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</tr>
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<td>49</td>
<td>FLAG STATUS</td>
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<tr>
<td>50</td>
<td>STATUS CHANNEL 1</td>
</tr>
<tr>
<td>51</td>
<td>CH. 1 CHANNEL 2</td>
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<td>52</td>
<td>CHANNEL 3 CH. 4</td>
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<td>CHANNEL 4 CHANNEL 5</td>
</tr>
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<td>CH. 5 CHANNEL 6</td>
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<td>56-89</td>
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<tr>
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<td>CHANNEL 55 CH. 56</td>
</tr>
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<td>91</td>
<td>CHANNEL 56 CHANNEL 57</td>
</tr>
<tr>
<td>92</td>
<td>CH. 57 DEAD TIME</td>
</tr>
<tr>
<td>93</td>
<td>NEUTRON 1 N. 2</td>
</tr>
<tr>
<td>94</td>
<td>NEUTRON 2 NEUTRON 3</td>
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<td>95</td>
<td>N. 3 PHA CLOCK TIME</td>
</tr>
<tr>
<td>96</td>
<td></td>
</tr>
</tbody>
</table>

* FOR ENERGY-CHANNEL ASSIGNMENTS SEE TABLE V

FIGURE 6
TABLE IV.

Main Frame - Experiment Words: 12 Bits. Total Experiment Words Per Cycle: $2 \times 384 = 768$

MF Flag: 12 "1's"

<table>
<thead>
<tr>
<th>MF Status</th>
<th>S1</th>
<th>S2</th>
<th>S3 &amp; S4</th>
<th>S4</th>
<th>S3</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
<th>S8</th>
<th>S9</th>
<th>S10</th>
<th>S11</th>
<th>S12</th>
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<tbody>
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<td>0</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar Data</td>
<td></td>
<td></td>
<td>Background Data</td>
<td></td>
<td></td>
<td>Normal Quadrant Mode</td>
<td></td>
<td></td>
<td>Intermediate Scan Mode</td>
<td></td>
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<td>Full Scan Mode</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td>Backgound Data</td>
<td></td>
<td></td>
<td>Alternate Quadrant Mode</td>
<td></td>
<td></td>
<td>Short Scan Mode</td>
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<td>Electronic Calibration ON</td>
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<td></td>
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<td>Electronic Calibration OFF</td>
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<td>Radiation Source Calibration ON</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Radiation Source Calibration OFF</td>
<td></td>
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<td>Day</td>
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<td>Night</td>
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<td></td>
<td></td>
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<td>Magnetometer Reference</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Charge Particle HVPS ON</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Gain = Times one</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Gain = Times one third</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Least significant bit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Next least significant bit</td>
<td></td>
</tr>
</tbody>
</table>

Channel Data: Most significant bit FIRST
Least significant bit LAST
Channel 1 is lowest energy window
Channel 377 is highest energy window

PHA Live Time: $1 \text{ bit} = [1/390.625] \text{ seconds} \times 8 \text{ Full S.} \quad 2 \text{ Inter S.} \quad 1 \text{ Short S.}$

PHA Dead Time: $1 \text{ bit} = 1.495 \text{ msec.}$
TABLE V.
Gamma Channels (in time of full scan channel numbers)

<table>
<thead>
<tr>
<th>Full Scan word no.</th>
<th>Intermediate scan word no.</th>
<th>Short scan word no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>---</td>
</tr>
<tr>
<td>17-33</td>
<td>3-19</td>
<td>2-18</td>
</tr>
<tr>
<td>41</td>
<td>10</td>
<td>---</td>
</tr>
<tr>
<td>49</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>57</td>
<td>22</td>
<td>---</td>
</tr>
<tr>
<td>65</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>73</td>
<td>24</td>
<td>---</td>
</tr>
<tr>
<td>81-97</td>
<td>25-41</td>
<td>21-37</td>
</tr>
<tr>
<td>105</td>
<td>42</td>
<td>---</td>
</tr>
<tr>
<td>113</td>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>121</td>
<td>44</td>
<td>---</td>
</tr>
<tr>
<td>129</td>
<td>45</td>
<td>39</td>
</tr>
<tr>
<td>137-153</td>
<td>46-62</td>
<td>40-56</td>
</tr>
<tr>
<td>161</td>
<td>63</td>
<td>57</td>
</tr>
<tr>
<td>169</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>177</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>185</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>193</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>209</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>217</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>225</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>233-249</td>
<td>72-88</td>
<td></td>
</tr>
<tr>
<td>257</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>265</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>273</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>281</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>289-305</td>
<td>93-109</td>
<td></td>
</tr>
<tr>
<td>313</td>
<td>110</td>
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</tr>
<tr>
<td>321</td>
<td>111</td>
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<td>329</td>
<td>112</td>
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<tr>
<td>337</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>345</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>353</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>361</td>
<td>116</td>
<td></td>
</tr>
<tr>
<td>369-373</td>
<td>117-121</td>
<td></td>
</tr>
</tbody>
</table>
channels should be displayed separately, and the pulse height analyzer dead time and accumulation time should be scaled according to the appropriate factor, to be determined, and given in seconds. The University of New Hampshire has developed Fortran and IBM Assembler Language programs which may be of some value in reformatting this data.

B. DSF Data Format:

The basic format is shown Table VI. The DSF data is primarily concerned with the x-ray detector. The counts in each detection range, for example 7.5 to 15 keV background data, are not true counts, but counts compressed by an adaptive scaler. These counts may be decompressed according to the following function:

\[
C = \begin{cases} 
S & S < 95 \\
4(S-96) + 98 & 96 < S < 127 \\
16(S-128) + 232 & 128 < S < 159 \\
64(S-160) + 752 & 160 < S < 191 \\
256(S-192) + 2784 & 192 < S
\end{cases}
\]

Where \( C \) is the corrected count number and \( S \) is the value of the scaler.

The appropriate scale factor for the quadrant time (accumulation time for the x-ray scalers) will also be provided.

C. Analog Subcom Data Format:

The basic formats are shown in Tables VII, VIII, and IX. The University of New Hampshire is assigned analog subcom words 1-10. We have sub-subcomed analog words 1 and 2. Analog subcom
**TABLE VI**

**DSF DATA FORMAT**

<table>
<thead>
<tr>
<th>DSM WORD NO.</th>
<th>(MF 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>12</td>
<td>29</td>
</tr>
<tr>
<td>13</td>
<td>47</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
</tr>
</tbody>
</table>

Low Energy ID (7.5-30) All 0's

High Energy ID (30-60 keV) All 1's

Complete x-ray cycle takes two DSF cycles or 31.32 seconds.
### TABLE VII.

**ASSC DATA FORMAT**

<table>
<thead>
<tr>
<th>ASSC Word (MF 1)</th>
<th>BBRC Pin No. (connector $09J01)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 1</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>COMMAND STATUS</td>
</tr>
<tr>
<td>2</td>
<td>Sync</td>
</tr>
<tr>
<td>3</td>
<td>Scan Mode</td>
</tr>
<tr>
<td>4</td>
<td>Quadrant and Gain Mode</td>
</tr>
<tr>
<td>5</td>
<td>IFC ON/OFF</td>
</tr>
<tr>
<td>6</td>
<td>HVPS's ON/OFF</td>
</tr>
<tr>
<td></td>
<td>COMMAND STATUS</td>
</tr>
<tr>
<td></td>
<td>HVPS Programmer Step</td>
</tr>
<tr>
<td>2 - 1</td>
<td>Detector Temperature</td>
</tr>
<tr>
<td>2</td>
<td>Electronic Temperature</td>
</tr>
<tr>
<td>3</td>
<td>Central HVPS Analog</td>
</tr>
<tr>
<td>4</td>
<td>Charged Particle HVPS Analog</td>
</tr>
<tr>
<td>5</td>
<td>LVPS Analog</td>
</tr>
<tr>
<td>6</td>
<td>Mag Pulse Enable</td>
</tr>
<tr>
<td>3</td>
<td>$\gamma$ .3 to 9.1 MeV Background ........................................ Q</td>
</tr>
<tr>
<td>4</td>
<td>$\gamma &gt; 9.1$ MeV Background ................................................... R</td>
</tr>
<tr>
<td>5</td>
<td>CP Slab Background .................. S</td>
</tr>
<tr>
<td>6</td>
<td>CP Cup Background .................. T</td>
</tr>
<tr>
<td>7</td>
<td>$\gamma$.3 to 9.1 MeV Solar ............... U</td>
</tr>
<tr>
<td>8</td>
<td>$\gamma &gt; 9.1$ MeV Solar ............... V</td>
</tr>
<tr>
<td>9</td>
<td>CP Slab Solar ...................... W</td>
</tr>
<tr>
<td>10</td>
<td>CP Cup Solar ...................... X</td>
</tr>
</tbody>
</table>
TABLE VIII.
ASSC DATA SUMMARY - ASSC 1-n

COMMAND STATUS

1. FLAG (ID Sync) 5.0 volts

2. SCAN MODE
   (00) Full Scan = 0.05 volts
   (10) Intermediate Scan = 0.9 volts
   (01) Short Scan = 1.8 volts

3. QUADRANT AND GAIN MODE

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Gain</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0) Alternate</td>
<td>(0) Times 1/3</td>
<td>0.05 V</td>
</tr>
<tr>
<td>(1) Normal</td>
<td>(0) Times 1/3</td>
<td>0.9 V</td>
</tr>
<tr>
<td>(0) Alternate</td>
<td>(1) Times 1</td>
<td>1.8 V</td>
</tr>
<tr>
<td>(1) Normal</td>
<td>(1) Times 1</td>
<td>2.7 V</td>
</tr>
</tbody>
</table>

4. IFC MODE
   (00) IFC OFF = 0.05 Volts
   (10) Electronic Calib. = 0.9 Volts
   (01) Radiation Source Calib. = 1.8 Volts

5. HVPS MODE

<table>
<thead>
<tr>
<th>Central HVPS</th>
<th>Charge Part. HVPS</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 OFF</td>
<td>0 OFF</td>
<td>0.05</td>
</tr>
<tr>
<td>1 ON</td>
<td>0 OFF</td>
<td>0.9</td>
</tr>
<tr>
<td>0 OFF</td>
<td>1 ON</td>
<td>1.8</td>
</tr>
<tr>
<td>1 ON</td>
<td>1 ON</td>
<td>2.7</td>
</tr>
</tbody>
</table>

6. HVPS REFERENCE 64 steps
   
   Gain x 1/3 \[0.000 - 2.112\] \} 33 mv/step
   Gain x 1 \[1.500 - 3.162\] \}
### TABLE IX.

**ASSC DATA SUMMARY - ASSC 2-n

HOUSEKEEPING**

<table>
<thead>
<tr>
<th>n</th>
<th>Temperature - Detector</th>
<th>+50°C = 1.55 V (nominal)</th>
<th>0°C = 3.25 V (nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Temperature - Electronics</td>
<td>-30°C = 4.27 V (nominal)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Central HVPS Analog</td>
<td>≈ 4 V estimate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Charged Particle HVPS Analog</td>
<td>≈ 4 V estimate</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>LVPS Analog 1 - 20 V ÷ 5 = 4V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Magnetometer Aspect Pulse Enable and Auto Radioactive Source Calibration Inhibit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUTO RS CAL.</th>
<th>MAG. ASPECT</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>0.05V</td>
</tr>
<tr>
<td>ON</td>
<td>OFF</td>
<td>0.9</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>1.8</td>
</tr>
<tr>
<td>ON</td>
<td>ON</td>
<td>2.7</td>
</tr>
</tbody>
</table>
word 1 displays a flag word valid for both ASSC words 1 and 2, and various command status words. ASSC 1-2, 1-3, 1-4 contain redundant information also given in the MF status word. For analog subcom word 2, the first two sub-subcom words give temperature information, words 3 and 4 give analog information for the two high voltage power supplies, word 5 monitors the low voltage power supply, and word 6 indicates the command for auto RS calibration and magnetometer aspect pulse enable. Analog subcom words 3-10 monitor counting rates in various parts of the instrument. Calibration graphs will have to be provided for voltage versus counting rate for these various rates. This will be done experimentally during calibration of the instrument.

Calibration Formats:

For both the command calibration and automatic calibration operations the commands are held up until the completion of a readout. The calibration sequences were designed for the full scan mode and therefore should be normally initiated only in that mode.

The command calibration initiates an electronic calibration sequence, lasting 184 seconds, during which time discriminator thresholds are tested with pulses of various voltages. The number of pulses differs for each test voltage so they may be distinguished in the spectral readout. The input pulse rates and their relation to the discriminator settings are summarized in Table X.

Table XI illustrates the outcomes for testing the central detector electronics.
# TABLE X.

**ELECTRONIC IFC TIMING (FULL SCAN)**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tbody>
<tr>
<td>EOS</td>
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</tr>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td>L</td>
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<td></td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>9.1+MeV</td>
<td>0.3-MeV</td>
<td>0.3+MeV</td>
<td>1.0 MeV</td>
<td>9.1-MeV</td>
<td>9.1+MeV</td>
<td>0.3-MeV</td>
<td></td>
</tr>
<tr>
<td>781 cps</td>
<td>48 cps</td>
<td>6.25 kc</td>
<td>781 cps</td>
<td>48 cps</td>
<td>6.25 kc</td>
<td>781 cps</td>
<td></td>
</tr>
<tr>
<td>7.5-15</td>
<td>15-30</td>
<td>30-60</td>
<td>60-120</td>
<td>7.5-15</td>
<td>15-30</td>
<td>30-60</td>
<td>60-120</td>
</tr>
<tr>
<td>U+</td>
<td>L+</td>
<td>U-</td>
<td>L-</td>
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<td>U-</td>
<td>L-</td>
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<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

**Definitions:**

- **AG** = Energy Window
- **T** = Threshold of Cup or Slab
- ***=** System Data Acceptance
- **N** = System Data Not Accepted
- **+=** +10% (nom.)
- **-=** -10% (nom.)

- **V_T,O** = Test Voltage for Cup/Slab
- **U** = Upper Discriminator Threshold for X-ray Detector
- **L** = Lower Discriminator Threshold for X-ray Detector
- **attenuated** for given range
<table>
<thead>
<tr>
<th>CYCLE NUMBER</th>
<th>CYCLE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>9</td>
</tr>
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<td>N (coinc.</td>
<td>N (coinc.</td>
</tr>
<tr>
<td>reject)</td>
<td>reject)</td>
</tr>
<tr>
<td>0.3+MeV</td>
<td>1.0 MeV</td>
</tr>
<tr>
<td>48 cps</td>
<td>6.25 kc</td>
</tr>
<tr>
<td>T^+</td>
<td>T^+</td>
</tr>
<tr>
<td>781 cps</td>
<td>100 kc</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>30-60</td>
<td>60-120</td>
</tr>
<tr>
<td>U^-</td>
<td>L^-</td>
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<tr>
<td>N</td>
<td>N</td>
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</table>

<table>
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<tr>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>9.1-MeV</td>
<td>9.1+MeV</td>
</tr>
<tr>
<td>781 cps</td>
<td>48 cps</td>
</tr>
<tr>
<td>T^-</td>
<td>T^-</td>
</tr>
<tr>
<td>6.25 kc</td>
<td>100 kc</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>30-60</td>
<td>60-120</td>
</tr>
<tr>
<td>U^-</td>
<td>L^-</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CYCLE NUMBER</th>
<th>CYCLE NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
</tr>
<tr>
<td>0.3-MeV</td>
<td></td>
</tr>
<tr>
<td>48 cps</td>
<td></td>
</tr>
<tr>
<td>T^-</td>
<td></td>
</tr>
<tr>
<td>781 cps</td>
<td></td>
</tr>
<tr>
<td>*</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td></td>
</tr>
<tr>
<td>30-60</td>
<td>60-120</td>
</tr>
<tr>
<td>U^-</td>
<td>L^-</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

EOS = Leading Edge of DMF Word 32, following WASC Word 48 and Last DMF Words 11, 12 which output Solar Data

X-ray at 6.25 kc for all cases in relation to discriminator setting

neutron channel two (20 to 30 MeV Channel) 48 cps all cycles
### TABLE XI.

**MAIN FRAME ELECTRONIC CHECK**

<table>
<thead>
<tr>
<th>Nominal Channel</th>
<th>Nominal Energy</th>
<th>Approximate no. of pulses generated X-1/4</th>
<th>Exact Equation</th>
<th>Interpretation if observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>0.270 kev</td>
<td>$2577(0V6)$</td>
<td>$7079^{*}T$</td>
<td>Lower threshold set too low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\pm 3000$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.330 kev</td>
<td>$3520(0V5)$</td>
<td>$6250^{*}T$</td>
<td>Normal (lower threshold not too high)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\pm 3000$</td>
<td>$629 P_{4}T$</td>
<td>Coinc. reject may not be operating</td>
</tr>
<tr>
<td>70</td>
<td>1.0 MeV</td>
<td>$2999 \pm 360$</td>
<td>$781^{*}T$</td>
<td>Normal (1 MeV location)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$4119(0V5)$</td>
<td>$7031^{*}T$</td>
<td>Coincidence's reject not working</td>
</tr>
<tr>
<td>354</td>
<td>8.19 MeV</td>
<td>$3183 \pm 415$</td>
<td>$829^{*}T$</td>
<td>Normal (upper threshold not too low)</td>
</tr>
<tr>
<td>400</td>
<td>10.0 MeV</td>
<td>$2577(0V6)$</td>
<td>$7079^{*}T$</td>
<td>Upper threshold set too high</td>
</tr>
</tbody>
</table>

OVn - Counts have overflowed scaler n times.

$T = \frac{\text{clock time}}{4}$

$^{*}$ to be calculated modulo 4096

$T = 15.36$ for each cycle.
The cup and slab thresholds and log rate meters for cup, slab, and central detectors are tested in 15.36 second segments; that is, the test frequencies are changed after every 48 ASSC words. The expected rates are given in Table XII. "Cycle number" indicates which group of 48 ASSC words the expected rate is to be found in. Counts in ASSC 3-10 in any cycles other than indicated are anomalous and should be printed out for diagnosis.

The twelve cycle group will start immediately after a solar quadrant has been read out if a command has been issued. To be specific, the calibration command is executed at the trailing edge of the DMF sync (i.e. the end of DMF word32) following the readout of solar clock time. The twelve ensuing 15.36 second intervals constitute the cycle group referred to. This should allow the calibration sequence to be identified in real time. The sequence may always be identified retrospectively from the data.

The circuitry for the X-ray detector consists of an upper and lower discriminator preceded by a variable attenuator which is stepped to give various energy ranges. The disc thresholds are checked with pulses ± 10% above and below their nominal values. Table XIII shows the only places which should contain data.

The radioactive calibration format is handled as routine data.
### TABLE XII
COUNT RATE CHECK

<table>
<thead>
<tr>
<th>ASC #</th>
<th>FUNCTION TESTED</th>
<th>EXPECTED VOLTAGE RATE (48 Hz)</th>
<th>ASC CYCLE #</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>gamma rate (.3-9)B</td>
<td>5</td>
<td>4, 10</td>
</tr>
<tr>
<td>7</td>
<td>gamma rate (.3-9)S</td>
<td>5</td>
<td>4, 10</td>
</tr>
<tr>
<td>4</td>
<td>gamma rate (&gt;9)B</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>gamma rate (&gt;9)S</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>slab rate B</td>
<td>----</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>slab rate S</td>
<td>----</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>cup rate B</td>
<td>----</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>cup rate S</td>
<td>----</td>
<td>8</td>
</tr>
</tbody>
</table>

B - Background  
S - Solar  

cycle # explained in text
**TABLE XIII.**

**X-RAY CHANNELS WHICH SHOULD CONTAIN DATA**

<table>
<thead>
<tr>
<th>Cycle #</th>
<th>DSF #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>15-30 keV</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>15-30</td>
</tr>
<tr>
<td>3, 5, 11</td>
<td>23</td>
<td>7.5-15</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>7.5-15</td>
</tr>
</tbody>
</table>
IV. SPECIAL HANDLING REQUIREMENTS

The instrument will be packed in a special case for transport to BBRC and ETR. It should be handled as a delicate scientific instrument. During storage the case will be flushed and pressured slightly above ambient with dry nitrogen. The temperature and humidity restrictions are:

- < 40% relative humidity
- < 10°C per hour temperature rate of change

V. ENVIRONMENTAL REQUIREMENTS

Even though the instrument is sealed, it has not been designed for high humidity. The scintillation crystals are hygroscopic so it is desirable to limit high humidity and direct water exposure to the instrument.

The detector should be kept in an environment with relative humidity of less than 40% at all times.

The detector should not see a temperature change of more than 10°C/hour. Therefore, prudence should be used in tests at the magnetics building and the open solarium. This figure for the temperature changes is that recommended by Harshaw Chemical Company for the NaI(Tl) central detector. The thermal inertial of the complete assembled detector may modify this figure for the instrument as a whole. This can be determined during testing since the temperature of the central detector is monitored by ASSC 2-1.

At ETR the humidity in the compartment could be controlled by circulating dry N₂ around the instrument.
VI. SPECIAL TEST REQUIREMENTS

Gamma ray angular distribution measurements will be required when all experiments are in spacecraft. See also VII and VIII.

VII. ALIGNMENT REQUIREMENTS

Alignment of front slab cover to be perpendicular to compartment center line to 1/2° is adequate.

VIII. RADIOACTIVE SOURCE REQUIREMENTS

We need small (1 to 10 μc) sources to verify operation of our detector during tests. Also we would like to measure the spacecraft attenuation using a strong source and rotating the spacecraft in both pitch and azimuth. This should be done with a full complement of instruments.

A possible method of checking the quadrant generator is shown in Figure 7. A quadrant signal will also be available from the instrument. This will more probably be used.

In addition the instrument contains two permanently mounted sources, $\text{Am}^{241}$ and $\text{Co}^{60}$. The strength of each is approximately 0.02 μc.

A long run with the instrument supported externally, but located in the spacecraft compartment should be made. The spacecraft should be wheeled away and the background subtracted. This will give some information about the activity of the spacecraft itself.
IX. HIGH VOLTAGE OPERATION REQUIREMENTS

Instrument will operate at atmospheric pressure. In vacuum testing the high voltages should be turned off during pump down.

X. SQUIB REQUIREMENTS

None.
XI. TEST PROCEDURES AT BBRC

1. Exercise of Commands

Each command should be exercised singly. Combinations and permutations test the internal system logic and are not likely to cause problems in the s/c command transmission channels.

<table>
<thead>
<tr>
<th>Command</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant</td>
<td>Repositioning of source if s/c is spinning and print out of spectrum, or observing electronic quadrant signal from instrument.</td>
</tr>
<tr>
<td>Gain change</td>
<td>Printout of spectrum and status (ASSC 1-3)</td>
</tr>
<tr>
<td>Magnetometer pulse Enable</td>
<td>Repositioning of source and dummy magnetic pulses (e.g. 90° to gyro signal)</td>
</tr>
<tr>
<td>Mode Command</td>
<td>Printout of spectrum</td>
</tr>
<tr>
<td>Calibration on/off</td>
<td>Printout of spectrum, DSM, and ASC</td>
</tr>
<tr>
<td>- HVPS step command</td>
<td>Issue command n times. Print spectrum housekeeping before and after</td>
</tr>
<tr>
<td>- HVPS on/off command</td>
<td>Print spectrum and housekeeping</td>
</tr>
<tr>
<td>Shield HVPS on/off</td>
<td>Print spectrum and housekeeping before and after</td>
</tr>
<tr>
<td>Auto R.S. Calibration Inhibit</td>
<td>Print Spectrum</td>
</tr>
</tbody>
</table>

2. Some sort of source test; turn HVPS off and run for long time. (Other EE type tests?) Spin rate at minimum and maximum.
Radioactive Source * move until source appears to find edge

spin

\( 45^\circ \)

* artificial sun source

quadrant lines where data taking begins

FIGURE 7
quadrant generation check
### FIGURES

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<td>19</td>
</tr>
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<td>20</td>
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<td>21</td>
</tr>
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<td>39</td>
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</tbody>
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<th>Title</th>
<th>Page</th>
</tr>
</thead>
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<td></td>
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<td>8</td>
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<td>B. Housekeeping</td>
<td>9</td>
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<tr>
<td>II. Command Assignment</td>
<td>10</td>
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<td>III. Data Timing Format</td>
<td>14</td>
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<td>IV. MF Status Word</td>
<td>22</td>
</tr>
<tr>
<td>V. Gamma Channels for Short and Intermediate Scans</td>
<td>23</td>
</tr>
<tr>
<td>VI. DSF Data Format</td>
<td>25</td>
</tr>
<tr>
<td>VII. ASSC Data Format</td>
<td>26</td>
</tr>
<tr>
<td>VIII. ASSC 1 Sub-subcom Format</td>
<td>27</td>
</tr>
<tr>
<td>IX. ASSC 2 Sub-subcom Format</td>
<td>28</td>
</tr>
<tr>
<td>X. Summary of Electronic Test Pulses</td>
<td>30</td>
</tr>
<tr>
<td>XI. Main Frame Electronic Check</td>
<td>31</td>
</tr>
<tr>
<td>XII. Count Rate Check</td>
<td>33</td>
</tr>
<tr>
<td>XIII. X-Ray Threshold Check</td>
<td>34</td>
</tr>
</tbody>
</table>