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A GENERAL COMPUTER DATA PROCESSING SYSTEM: DOCUMENTATION OF THE ATS-5 GROUND STATION MAGNETOMETER PROGRAM

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GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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CONTENTS

CONTENTS (Continued)

APPENDICES

A GENERAL COMPUTER DATA PROCESSING SYSTEM: DOCUMENTATION OF THE ATS-5 GROUND STATION MAGNETOMETER PROGRAM

INTRODUCTION

A computer program capable of transforming and displaying specific time-dependent data recorded on an indefinitely large number of tape reels is a common need within scientific activities. The ATS-5 Ground Station Magnetometer Data Processing Program described in this documentation is of this type. It is suggested that the data operations accomplished by this processing system are of sufficiently general application that the system could be used to process other types of data with little modification. To enable a determination of the applicability of this system for a particular data processing use, a list of these data operations is presented below. Also, a concept-level "plain language" flow chart for their implementation is presented in Appendix A, and a commented listing of the production program is presented in Appendix C. The program logic is summarized under "Main Program" on page 15, and in the flow chart in Appendix A. This documentation uses an original instructional device involving numbered comments to aid the reader to understand the program. This is explained more fully on pages 4 and 14.

The effectiveness with which the program has processed the ATS-5 data suggests that it successfully avoids the weak points of too much or too little sophistication which has troubled other data processing programs observed by the author. Data systems written by the author using the techniques described in this publication have kept the number of unprocessed ATS-5 flight and ground data tapes on hand to zero and are concise enough to be completed in four months by one experienced person. The production program card deck will be supplied upon request.

1. General Data Operations in this Program

A. Expression of data time in terms of a single physical unit (milliseconds) for computational convenience for data extending over minutes, hours, days, or years (see explanation under "Data Time Value Assignment" on page 11).

B. Selection of time intervals of data to be processed by designation of their beginning times (TI) and end times (TF) on program input cards in chronological order.

C. Search through the tape to data with times within the time interval currently selected for processing.

D. Confirmation that the tape used in the computer run is the one in the data tape library bearing the data time intervals selected for processing by the TI, TF program input cards. This is done by print-out of the beginning and end time of the data tape mounted on the tape drive which shows if this tape contained the data time interval currently selected for processing as indicated by print-out of its TI and TF. This program proceeds to the next TI, TF selector card if the mounted data tape post-dates the first TI, TF selector card. It terminates the computer run if the end of the data tape is encountered while searching for or processing data in the currently selected time interval.

NOTE: In other programs using this general data processing scheme such as those for ATS-5 and OGO-6 satellite flight data which, contrary to this program, are intended to process many data tapes in a single computer run differing action is taken when the mounted tape does not contain data in the currently selected time interval. Instead, the computer operator is provided with on-line printer messages showing the begin and end time of each tape he mounts enabling him to ultimately mount the tape containing data in the currently selected time interval (also printed on-line) if this tape has been made available to him, and through some oversight he at first mounts some other tape. These programs permit the operator to proceed to the next TI, TF selector card if the proper tape is not available. Also, programs using this general data processing scheme avoid the considerable programming complication of a "data time span versus relevant data tape identification number" directory logic module for automatic on-line printer tape mounting requests. In these programs this directory function is achieved by designation of the data tape identification numbers in the sequence in which they are to be used in the run by the person submitting the program. This person refers to the data tape shipping slips for tape begin and end time information to do this. This scheme has been found practicable even when as many as 12 or more ATS-5 satellite PB data tapes have been submitted in a computer run directly producing output data displays. The sheet of on-line printer messages showing begin and end times of the time intervals selected for processing, the begin and end times of the data tapes actually mounted, and printed indications of the computer operator's response to the respective tape mount requests constitutes a report that would show any deviations from the data tape utilization instructions submitted with the job. The only prerequisite on the data organization on a tape for this general data processing scheme to process all data on it is that the data within any given file be in chronological order — the various files of the tape do not have to be. Also, it is permissible for data missing from a tape to appear on another tape.

E. Ignore any data on the tape with time which is out of chronological order.

F. Do processing unaffected by any missing data, i.e. irregular jumps in data times.

G. Unpack the data values from their fields of various bit lengths in each logical record (a grouping of bits on tape comprising the data in a definite format which by repetition forms the data tape) into fortran variables for processing in the main program.

H. Mathematical conversion of the data into appropriate physical units.

I. Isolation of collections of data (referred to as Plot B arrays) of specific time intervals relative to the beginning of the day of data to do statistics on and/or to graphically display on microfilm as a function of time (termed the Plot B display).

J. Obtain collections of time-averaged data points (referred to as Plot C arrays) to produce "quick-look" summarizing graphical microfilm plots of events over specific time intervals relative to the beginning of the day of data (termed the Plot C display). These "summary" microfilm frames appear right after the end of the microfilm frames which they summarize. The time interval over which an average is computed is a variable of the program presently set at 30 seconds.

K. In graphical microfilm display, choice of ordinate and abscissa scale (independently) to display data plotted in any given frame with the best resolution. The choice of scale is based on the prevailing data sampling time interval for the abscissa scale, and the range in data values plotted in the microfilm frame for the ordinate scale.

L. Display numerical values of processed data as a function of time on paper print-out.

2. Functions of this Documentation

A. Define the type of data processing accomplished by this program pointing out the methods used, and their usefulness for writing programs to do similar processing on data of other types (see Appendix A for flow chart illustrating how various general data operations are done in this program.)

B. Describe the data, source of data, and data tape format specifically processed by this program (see Appendix B for the data tape and logical record format).

C. Itemize all subroutines and their functions.

D. Explain in detail the program logic using numerous plain language comments prefacing the program statements to which they apply (see program listings in Appendix C and detailed "Autoflow" flow chart in Appendix D). These comments are numbered to identify corresponding specific program statements in the program listing by comment number reference in explanations of program logic in the written documentation and in the flow charts in Appendices A and D.

E. Describe the various display outputs of the program and show samples of them (see Appendices E, F, and G).

COMPUTER INFORMATION

The program is written for the IBM/360, Operating System release number 16 or higher with the new SCORS Stromberg Carlson 4020 plotter subroutine package. However, the main program can be used without change for any plotter since all plotting logic is "modular", i.e., done by subroutines called by the main program. To use the program to drive a plotter other than the SC4020, it is necessary only to replace the SC4020 subroutine calls by calls to the subroutine package of the replacing plotter.

The main program and all but one of the subroutines are in Fortran IV. A small subroutine named PICK used for unpacking the data values from the bit sequences in the logical records on the data tape is in IBM/360 Assembly Language. Subroutine PICK is sufficiently general to be used for data "unpacking" in a logical record of any format.

All program input and output operations are done by Fortran IV in the main program since IBM/360 Fortran has sufficiently versatile capabilities to read data tapes of arbitrary format without the need for the less simple I/O instructions of the assembly language.

The amount of IBM/360 core required by the program is 200,000 bytes. The IBM/360 computer time required on the Model 75 is about 20 minutes for each day of data. On the IBM/360 Model 91 the program runs twice as fast.

DATA DESCRIPTION AND SOURCE

The data read from a tape and processed by this program is raw magnetometer readings of the components of the geomagnetic field in the H, D, Z coordinate system (see Appendix H for definition) and readings from an additional experiment channel (called R readings) at a specific location on the earth's surface as a function of time. This location is at a Canadian geophysical ground station situated near the foot of the geomagnetic line of force passing through the ATS-5 satellite. Two such stations are operating: LYNN LAKE and THOMPSON in Manitoba, Canada. All of the data on a given tape will be from one of these stations. The output displays of the program are identified by labelling showing the name of the station to which they apply.

At both stations, data is written on the tapes by inexpensive tape decks fed by the magnetometer. The tape decks are specially designed to directly write the data on tape in physical records (a division of data bits on tape containing special non-data control and check bits and bounded on both sides by "inter-record gap" tape marks) in accordance with IBM/360 tape physical record specifications. This enables reading of the data tapes by the IBM/360 without intermediate tape format conversion procedures. Approximately 30 days of data is written on a tape, the tape deck-magnetometer digital data recording unit being unattended for this length of time.

The phrase "set of H, D, Z, R data" used throughout this documentation signifies the values of the H, D, Z, and R data readings sampled at the same instant of time and recorded on tape in the normal course of operation of the ground station digital magnetic data recording unit.

PROGRAM PURPOSE AND OUTPUTS

The purpose of the program is to convert the raw H, D, Z coordinate system geomagnetic field component data count readings and auxiliary experiment channel R readings (if channel R is being used for magnetic data) on tapes from ATS-5 ground stations into gamma (equal to 10^{-5} gauss) units for a selected time interval of interest, and to display the results.

The display output of the program is as follows:

1. time-ordered numerical print-out of H, D, Z (in gamma units), and the name of the experiment on the R channel and the R data values (see sample in Appendix E).

2. graphical plot of the instantaneous H, D, and Z values plotted individually as a function of time on Stromberg Carlson 4020 plotter microfilm (called Plot B, see sample in Appendix F).

3. graphical plot of 30-second average H, D, and Z values (in gammas) plotted individually as a function of time on SC 4020 plotter microfilm (called Plot C, see sample in Appendix G).

NOTE: The time assigned to each averaged H, D, or Z value is the mid-time of the 30-second time interval containing the data used for calculating the respective average.

GROUND STATION DATA TAPE FORMAT

The designed tape format is as follows (see Appendix B for detailed schematic diagram of the tape format):

1. Physical record (alternatively called "block") control bits and inter-record gap length — within IBM specifications.

2. Physical record length — 7200 IBM/360 bytes.

3. Logical record characteristics (see Appendix B for detailed description of a logical record).

   A. Length — 72 IBM/360 bytes

   B. Logical records per block — 100

   C. Data contents of a logical record (in order of occurrence on tape)

      1) time (day of year, hour, minute, second) of first of the ten sets of H, D, Z, R data counts in the logical record

      2) station ID code

      3) R experiment channel code

      4) data year code

      5) first of the ten sets of H, D, Z, R data counts in the logical record

6) 48 dummy bits not presently used

7) the nine remaining sets of H, D, Z, R data counts of the logical record

D. Time span covered by logical record — depends on the time interval between sampling of each set of H, D, Z, R data. This time interval is set manually by a control on the Magnetometer Field Monitor (see "Design Sample Time Intervals" below). The data sample time interval is usually one second.

E. Data files per tape — 1

SPECIAL SITUATIONS ON DATA TAPE

The actual tapes differed from the original design specifications in some blocks as follows:

1. block length less than 7200 bytes (some as short as one byte)

2. control bits not within IBM specifications

3. data sampling time interval different from design value

4. year code (see "ID Codes" below) for 1969 wrong (for entirety of tape)

5. day of year of a logical record occasionally wrong

6. occasional blocks with incorrect format in that the block does not begin with the beginning of a logical record (the data time field) causing all following logical records of the block to also be off-format

7. spurious extra ends of file on data tape

The IBM/360 reacts to short blocks (less than 18 bytes) and/or incorrect control bits as though an I/O error for the block involved occurs. This causes multiple re-reads of the block by the IBM/360 rapidly wearing through the data tape.

STEPS TAKEN TO ACCOMMODATE SPECIAL SITUATIONS
ON GROUND STATION DATA TAPES

1. A computer that re-reads blocks with faulty control bits and/or length less than 18 bytes zero times was found. A program for it, shown in Appendix I, was written to copy blocks of the original tape padded out to 7200 bytes by hex 9's if short and with a hex 1 inserted in the last hex digit of the dummy bit field of the first logical record as an indicator if read with I/O error. All data of a block with such an indicator is flagged with an "F" in the microfilm display and numerical print-out since data read with an I/O error may be unreliable. The copied data tape has no faulty control bit or short block problem when run on the IBM/360. This computer used for copying is the IBM/1800 located in Goddard Space Flight Center, Building 2 ground floor. It can be operated by the programmer himself.

2. The program calculates the data sampling time interval for the data of a logical record (with valid time information) by dividing by 10 the difference between the first data sample time (the first 9 hex digits of the logical record) and that of the next consecutive logical record if it has valid time information. This handles any operationally imposed data sampling time interval changes within the block. Tests determining what constitutes valid times are described in (3.) following. The 10 sets of H, D, Z, R data of any logical record having a data sampling time interval differing from design specifications are processed as usual, but are flagged with a "T" in the microfilm display and the numerical print-out.

3. A logical record which has an invalid time field (first 9 hex digits) or which is followed by a logical record having an invalid time field (making determination of data sampling time interval impossible) is not processed. Following are conditions defining an invalid time field of a logical record:

   A. day of year, hour, minute, or second having an impossible value, e.g., day of year greater than 366 or less than 1 (if this occurs the time field of the logical record is set to zero as an indicator instead of the equivalent number of milliseconds since the "ZERO YEAR" time origin as described below).

   B. time of the logical record greater than time of following logical record (chronological order test).

C. time difference between logical record and the following one greater than maximum value (10 seconds) prescribed by design specifications (guards against the use of an incorrect data sampling time interval in assigning a time to each of the 10 sets of H, D, Z, R data in the logical record).

4. To enable processing of the data in the occasional short blocks (less than 7200 bytes) on the original tape the program puts hex 9's in that part of the fortran array (IDAT) receiving the data block which is not filled by the block due to its shortness. In this way data from a previous block will not remain at the end of the array to be incorrectly interpreted as data of a new block. Thus, the program will ignore any blocks having hex 9's in the time field of the 2nd logical record or before. Also, any logical records having hex 9's in it or in the time field of the following logical record is recognized as the last logical record of a short data block and is not processed.

5. In the absence of the correct year code field in all logical records of data tapes of year 1969, (year code for '69 as well as '70 was zero), the change of day of year to a value less than 365 was used to indicate beginning of 1970 data. Due to the unreliability of the year code field in the data tapes, the correct year at the beginning of the tape being processed is supplied by means of a fortran statement placed in the main program.

6. Data tapes with spurious ends-of-file are processed by means of a specially modified program deck which considers the tape as one having multiple IBM/360 data sets and uses the required special IBM 360 job control cards. The actual number of files on the tape must be entered into this special program which is not shown in this publication. A copy of this program can be obtained from the author.

7. Avoidance of data loss in tape blocks with format errors was accomplished by use of special program logic. This logic searches for the first occurrence in the tape block of a distinctive bit configuration (the dummy bit field of the logical record as shown in Appendix B). Since this relatively easy to locate bit configuration occurs at a fixed position within a logical record, the hexadecimal digit beginning the first logical record in the tape block is also determined once the first dummy bit configuration is found. If the hexadecimal digit beginning the first logical record is not the first hexadecimal digit in the tape block, the fortran array containing the data of the tape block is shifted so that it is before processing continues. This format error corrector fails if

the logical record length is not constant as occasionally happens. The program utilizing this corrector logic is not shown in this publication. Copies of this program can be supplied however.

STATION, ADDITIONAL EXPERIMENT CHANNEL (R), AND DATA YEAR ID CODES

See Appendix B for where these codes appear in each logical record of the data tape. The field length for each code is 4 bits, i.e., one hexadecimal digit. The codes, in hexadecimal, follow:

1. Station Codes
   - A. 1 = LYNN LAKE
   - B. 2 = THOMPSON
   - C. 3 = WINNIPEG
   - D. 4 = THE PAS
2. Additional Experiment Channel (R) Codes
   - A. 0 = not used
   - B. 1 = H magnetic field component
   - C. 2 = D magnetic field component
   - D. 3 = Z magnetic field component
   - E. 4 = proton experiment (total magnetic field)
   - F. 5 = other experiment (photometer, etc.)
3. Year Codes
   - A. 9 = 1969
   - B. 0 = 1970
   - C. 1 = 1971

D. 2 = 1972

E. 3 = 1973

etc.

DATA TIME VALUE ASSIGNMENT

Each logical record has 10 sets of H, D, Z, R data each set corresponding to an instant of time. Only the time (in day of year, hour, minute, second) of the first set of H, D, Z, R data is given in the logical record. The time for each of the 9 remaining sets of H, D, Z, R data is obtained by adding to the time of the first H, D, Z, R set the data sampling time interval (between each H, D, Z, R set of data) the number of times appropriate for the particular set of H, D, Z, R to which a time value is being assigned. For example, to get the time of the third H, D, Z, R set the data sampling time interval is added to the time of the first H, D, Z, R set twice. As mentioned above, the data sampling time interval for the logical record is the difference between the time of its first set of H, D, Z, R data and the time of the first H, D, Z, R set in the next consecutive logical record divided by 10. If either of these two times do not pass the time validity tests described above, no data sampling time interval is calculable and the data of the logical record is ignored. This method enables automatic handling of change of the operating sampling time interval wherever it occurs on the data tape.

To do computations with time, such as time addition to get data point times, or taking time difference between begin time of a microfilm frame and the data point time being plotted (to get its abscissa in one system of units as required by plot subroutines), etc., any time value used in the program is converted from calendar units (year, day of year, hour, minute, second) to the equivalent number of milliseconds the time value is from an arbitrary time origin. This time origin (called ZERO YEAR) is prior to the earliest time value in the data tapes so that the "number of milliseconds since ZERO YEAR" equivalent of a data point time will never be negative. The arbitrary point in time taken as ZERO YEAR is zero hour, minute and second of the first day of any year if this time precedes the earliest data to be processed. However, ZERO YEAR must not pre-date the data so much that the "number of milliseconds since ZERO YEAR" expressing the latest time used in the program is so large as to exceed the computer storage allotted to it. In this program, times (in "milliseconds since zero year") are in fortran double precision which allows (for the IBM/360) processing of times near enough to ZERO YEAR so that their equivalent in "milliseconds since ZERO YEAR" is 17 significant digits or less. Thus many years of data

can be processed without change of the ZERO YEAR (set by a fortran arithmetic statement to 1969 at beginning of main program).

The program uses two auxiliary subroutines for operations on time. These are subroutine MSZRDP to go from time in calendar units (year, day, hour, minute, second) to the equivalent in milliseconds since ZERO YEAR, and subroutine MSCLDP to go from "milliseconds since ZERO YEAR" to the more convenient equivalent in calendar units (year, day of year, hour, minute, second).

MAGNETIC FIELD MONITOR DESIGN DATA SAMPLE TIME INTERVALS

The operating data sample time interval is set by a control switch on the Magnetic Field Monitor and is seldom changed. The usual data sample time interval is one second, i.e., the time interval between times of consecutive sets of H, D, Z, R data is usually one second. The possible data sample time intervals by original monitor design are .1 sec, 1 sec, 2 sec, 5 sec, or 10 sec.

PLOT B (NON-AVERAGED DATA DISPLAY) FORMAT

Each microfilm frame consists of a graph of the H component (in gammas) as a function of time, a similar D component graph, and a similar Z component graph of the same frame. See Appendix F for a sample plot B.

The time scale for the H, D, and Z component plots on the frame is the same and depends on the data sampling time interval for the first set of H, D, Z data of the microfilm frame so that the time scale optimum for the prevailing sampling time interval at the start of the plots is used. The time scale (the data time length covered in the microfilm frame) that we considered optimum as a function of data sampling time interval is as follows:

DATA SAMPLING TIME INTERVAL	DATA TIME LENGTH COVERED IN FRAME
.1 second	1 minute
1 second	6 minute
2 second	12 minute
5 second	1 hour
10 second	1 hour

The program causes the begin time and end time of any plot B to delimit an integral multiple of the chosen data time length from time zero of the day of data, and to include at least one data point positioned properly on the time scale even though data gaps may exist. This facilitates data comparisons for different days. A vertical line appears on the microfilm frame every sixth of the selected data time length covered by the frame. The time intervals between these vertical lines are further sub-divided by 10 short vertical "tic" marks.

The vertical scale for the H (in gamma units) plot of the frame depends on the maximum and minimum values of the H component values being displayed in the plot. Similarly for the vertical scale of the D plot, also the vertical scale of the Z plot. Only six vertical scales, i.e., low and high limit of vertical scale for a given component are possible. The specific vertical scale chosen for the component plot on the particular microfilm frame is the first of the following six scales which includes both the maximum and the minimum of the component values displayed in the plot.

VERTICAL PLOT SCALES

(the one displaying the component with the best resolution is chosen for the microfilm frame)

-60. to +60.
-150. to +150.
-300. to +300.
-600. to +600.
-1200. to +1200.
-2400. to +2400.

A horizontal line appears on the respective component plot on the microfilm frame every sixth of the data range (in gamma units) covered by the selected vertical scale. The scale between these horizontal lines is further sub-divided by 10 short horizontal "tic" marks.

PLOT C (AVERAGED DATA DISPLAY) FORMAT

A Plot C appears every time data spanning an hour of time has been displayed by plot B's. Its purpose is to summarize (as 30-second time interval averages) for each individual component the instantaneous data displayed in the intervening (an "hour's worth") plot B's. This provides a "quick-look" capability to the

scientist using the microfilm. For example, a plot C summarizes and appears after every ten plot B's when the plot B data time length is six minutes (which is the norm).

The scheme for the vertical and horizontal scales for plot C are the same as those for plot B described above except the horizontal scale (the time scale) is non-variable and always covers one hour of data. See Appendix G for a sample of plot C.

EQUATIONS USED IN PROGRAM

1. To obtain the H, D, or Z field components values from magnetometer "counts" for the individual component as recorded on the data tape.

FIELD COMPONENT (in gammas) = COUNTS FOR COMPONENT × .976408 - 2000.

2. To provide reliability that a 30-second average component value does approximate the true field component value at the time assigned it, no average component value is established for the 30-second interval unless at least 1/3 of the maximum number (30 seconds divided by the data sampling time interval) is available in the 30-second interval for computing its average. Thus, the minimum number of component values required (CPCTMN) for getting a 30-second average component value is given by

$$\text{CPCTMN} = \frac{1}{3} \cdot \frac{30000.}{\text{TSPLST}} = \frac{10000.}{\text{TSPLST}}$$

where TSPLST is the data sampling time interval at end of the 30-second interval. TSPLST rarely changes.

SPECIFICS OF PROGRAM LOGIC

Only the general features of the program are discussed here since in-depth details intended to expedite the programmer's learning task appear as numbered comments in the main program listing in Appendix C. Numbering of the comments makes it possible to locate the specific group of Fortran statements being explained in the text below which cites comment numbers, or being represented by flow chart blocks (Appendix A has general flow chart, Appendix D has detailed "Autoflow" flow chart) adjacent to which the corresponding listing comment statement numbers appear.

1. Main Program

The scheme of data processing used in the main program resulted from attempting to attain a specific goal: to write the most brief, straightforward, efficient program for processing the given data. The ability to process only selected time intervals (by designating their begin and end times, i.e., TI, TF's on data cards read by the program) or the entire data tape was also included in the program. The general data processing scheme used here for ATS-5 ground station data has also been used quite successfully with large volumes of data from other sources (ATS-5 PCM and PFM flight data, and also OGO-6 flight data).

The data processing steps done by the main program are:

A. read next TI, TF or end-of-computer run indicator (XX) on data card (comment 2); the XX card is always last data card.

B. read next block on data tape until last time of block is greater or equal to TI (comments 2 to 10); terminate run if end-of-tape encountered in this "search mode".

C. get begin time of block accessed by previous step; back to step "A" if this begin time is greater than TF, i.e., beyond present TI, TF (comment 10).

D. process the logical records of the block that are within the present TI, TF by storing the time and the H, D, Z (in gammas) and R of each of the 10 sets of H, D, Z, R counts of each logical record in the arrays ("B arrays") containing the data to be displayed by a plot B (comments 11 to 34).

NOTE: The extra step of storing data in an array instead of plotting it directly is necessary in order to pre-determine the best vertical scale for the H, D, and Z plots individually before doing the plot B or the plot C.

During this processing, 3 situations may occur:

1) data time larger than TF encountered — in this event go to step "A" (comment 16).

2) end of block on data tape reached in processing — in this event to to step "B" (comment 15).

3) data time larger than end time of present plot B encountered — in this event go to step "E", etc., below (comment 22).

E. get 30 second average data points for plot C from the B array before it is filled by data for the next plot B; store these averaged data points in an array termed the "C array" (comments 22 to 31).

F. if, in step "E", a 30 second average data point with time greater than end time of present plot C is encountered, use the data in present C array to do a plot C. After this plot C is done, the C array is again available for storing more 30 second averaged data for the next plot C starting with its first location (comments 26 to 28).

G. now that the data in the B array has been utilized (for averaging), use this data to do the plot B whose end time was just exceeded; after this, the B array is again available. Continue storing the data from the logical records into the B array starting with their first location (comments 31 to 34).

H. computer run ends by reading the last TI, TF data card which is always the symbol XX indicating the computer run is to be terminated (see step "A"), or by encountering end-of-tape (comments 2 and 7).

2. Subroutine MSZRDP (IYR, IDY, IHR, MN, ISEC, TM)

A. Purpose — to get "millisecond since ZERO YEAR" equivalent in double precision of a time known in calendar units, i.e., year, day of year, hour, minute, and second.

B. Calling Sequence —

1) IYR = last 2 digits of year (fortran integer)

2) IDY = day of year, i.e., Julian day (fortran integer)

3) IHR = hour of day (0 to 24, fortran integer)

4) MN = minute (fortran integer)

5) ISEC = second (fortran integer)

6) TM = the equivalent in "milliseconds since ZERO YEAR" (fortran double precision variable) of the time specified by the 5 preceding calling sequence elements.

C. Common Section — one only, named ZROYR, to communicate value of ZERO YEAR, in common with main program in which value is set (for explanation of the term ZERO YEAR see the section above entitled "Data Time Value Assignment").

3. Subroutine MSCLDP (TM, IYR, IDY, IHR, MN, SEC)

A. Purpose — to get the calendar units equivalent, i.e., year, day of year, hour, minute, second of a time known in "milliseconds since ZERO YEAR". Also returns month and day of month (see "common sections" below).

B. Calling Sequence —

1) TM = the equivalent in "milliseconds since ZERO YEAR" (fortran double precision variable) of time specified by the 5 following calling sequence elements outputted by this subroutine.

2) IYR = last 2 digits of year (fortran integer).

3) IDY = day of year, i.e., Julian day (fortran integer).

4) IHR = hour of day (0 to 24, fortran integer).

5) MN = minute (fortran integer).

6) SEC = second (fortran single precision floating point variable).

C. Common Sections —

1) name is ZROYR, used to communicate value of ZERO YEAR to this subroutine, in common with main program in which value is set.

2) name is DATE, used to return month (MNTH, typed as fortran integer but contains BCD alphabetic information) and day of month (IDYMTH, fortran integer) to calling program.

4. Subroutine ATSGRT (IWD1, IWD2, IYR, TM)

A. Purpose — to get the data time presented in the logical record in "milliseconds since ZERO YEAR".

B. Calling Sequence —

1) IWD1 = a fortran integer word consisting of the first 4 bytes of the logical record, i.e., day, hour, minute and 10's digit of second (see format of the logical record in Appendix B).

2) IWD2 = a fortran integer word consisting of the second 4 bytes of the logical record needed only to get 1's digit of seconds.

3) IYR = last 2 digits of year of data, set by arithmetic statement at beginning of the calling program (the main program) instead of picked-up from data tape since the data year code for year 1969 is incorrect on the tapes.

4) TM = the equivalent in "milliseconds since ZERO YEAR" (fortran double precision variable) of the data time presented in the logical record.

5. Subroutine PICK (ITO, IFROM, ISW, IOFST, NRBTS)

A. Language — IBM 360 assembly language.

B. Purpose — to unpack a bit string of the logical record constituting one of its data fields and move it to a fortran integer word in the calling program which then uses it.

C. Calling Sequence (all elements are integers) —

1) ITO = address of fortran word where bits are to be moved and right-adjusted in this word.

2) IFROM = address of fortran word containing the bit string comprising the data field wanted.

3) ISW = word combination switch, when non-zero allows more than one fortran word to be used in building the bit string being returned as a data field to the calling program in the fortran word specified by ITO above.

4) IOFST = number of bits that contents of word specified by IFROM above must be shifted left in order to left-adjust the bit string to be moved to the calling program.

5) NRBTS = number of bits comprising bit string, i.e., data field wanted.

6. Subroutine ATSGPB (TMBARY, BT, IDBAR, ICT, IVSC, SCLM1, SCLM2, TIPB, TFRLTH (IHSC), IFLG, ITFLG)

A. Purpose — contains all logic of program for doing the plot B for the Stromberg Carlson 4020 microfilm plotter; plots all data presently contained in the B arrays which are communicated to it; the data in the B arrays is within the specific begin and end time chosen by the main program and suitable to the present data sampling time interval (see section entitled "Plot B Format" above).

B. Calling Sequence (all input quantities to subroutine) —

1) TMBARY = array containing time in double precision "milliseconds since ZERO YEAR" of each set of H, D, Z components plotted; dimensioned large enough (to 730) for the case in which the B array contains the greatest number of points to be plotted, i.e., when the data sampling time interval is 5 seconds with a 1 hour time length displayed on plot B.

2) BT = two-dimensional array containing the individual H, D, Z component values to be plotted; first subscript selects component to plot (1 for H, 2 for D, 3 for Z); second subscript selects the H, D, Z set being plotted (data sampled at the same instant of time comprise a set). Each H, D, and Z value is in gamma units and fortran single precision.

3) IDBAR = two dimensional fortran integer array containing the individual identification codes used primarily in SUBROUTINE ATSGPR; its first element is used in this subroutine to identify for labelling purposes the ground station whose data is being plotted; the first subscript selects which code (1 for station, 2 for identification of extra experimental channel R, 3 for indication of year of data); second subscript selects the H, D, Z set to which the codes apply.

4) ICT = actual number of H, D, Z sets ("data points") in array BT (see above) to plot.

5) IVSC = array containing as one of its 3 elements the subscript of the vertical scale (see below) that displays the H component with best resolution on this plot B; similarly for D and Z.

6) SCLM1 = array containing the plot B lower limit for each of the six possible vertical scales for the individual H, D, or Z component; the specific lower limit for the individual H, D, or Z plot on this plot B is selected by the SCLM1 array subscript value stored in the IVSC array element corresponding to the component (H, D, or Z). For example, the lower limit of the H plot vertical scale is the SCLM1 array element with subscript equal to IVSC(1). Similarly for D and Z.

7) SCLM2 = array defined similarly to array SCLM1 except SCLM2 contains the plot B upper limits for each of the six possible vertical scales.

8) TIPB = begin time in fortran double precision "milliseconds since ZERO YEAR" of this plot B; not necessarily a data time but it is the begin time of the closest integral multiple from zero instant of the data day of the time length selected for (see section entitled "Plot B Format") and displayed in this plot B that contains the first data time on the plot B.

9) TFRLTH(IHSC) = the element of array TFRLTH selected by the value of subscript IHSC; array TFRLTH contains the millisecond equivalent of the various data time lengths that plot B displays as selected by the prevailing (at beginning of data in the corresponding B array) data sampling time interval.

10) IFLG = array containing symbol for each set of H, D, Z values ("data point") indicating if the data tape block it is in was read by the IBM/1800 copy program and/or the actual data processing IBM/360 program with an I/O error. The symbol "F" is used to signify I/O error. Caution in interpreting such data should be used by the scientist. The blank symbol is used to indicate data read without an I/O error.

11) ITFLG = array containing symbol for each set of H, D, Z values ("data point") indicating if the data sampling time interval value for the set is equal to one of the design values (stored in array TINT). The symbol "T" is used to mark a data point at which the data sampling time interval is unexpected. Data marked by a "T" is not necessarily wrong. The blank symbol is used to indicate data at which the data sampling time interval is equal to a design value.

C. Common Section — name is DATE, used to return month (MNTH, typed as fortran integer, but contains BCD alphabetic information) and day of month (IDYMTH, fortran integer) to calling program.

7. Subroutine ATSGPR (TMBARY, BT, R, IDBAR, IFLG, ITFLG, ICT)

A. Purpose — this subroutine is called only if the symbol "PRT" appears on the TI, TF data card (see below); contains all logic of the program to do numerical print-out of the H, D, Z magnetic field component values in gamma units in chronological order for data within the currently selected TI, TF. Included in this print-out is the data of the additional experimental data channel (R) and the name of the experiment on channel R. If the R data is either the H, D, or Z component it is in gamma units, otherwise the R data is printed out exactly as found on the data tape, i.e., in counts. The data printed out by a call to this subroutine is the contents of the present plot B array at time of the call.

B. Calling Sequence —

1) R = array containing all R channel data values for data times in present plot B array; in gamma units if R channel has magnetic data, otherwise in counts; in either case, fortran single precision.

2) for explanation of other elements of calling sequence see explanations given for them under SUBROUTINE ATSGPB.

C. Common Section —

1) name is DATE; communicates month (integer-type fortran variable MNTH containing 3-character alphabetic name of month), and day of month (fortran integer IDYMTH) communicated from SUBROUTINE MSCLDP (see above) to this subroutine for printing out time information.

8. Subroutine ATSGPC (TMAV, BTAV, ISBSTA, ICTC, IVSC, SCLM1, SCLM2, TIPC)

A. Purpose — contains all logic for doing an SC 4020 microfilm frame (a plot C) displaying the 30 second averaged H, D, and Z magnetic field component values in individual plots on the frame from data in the C arrays each time called.

B. Calling Sequence —

1) TMAV = array containing times in fortran double precision "milliseconds since ZERO YEAR" of the H, D, Z 30 second average component values displayed in this plot C; dimensioned large enough (to 130) to hold maximum number of data times (at 30 second spacing) contained within the fixed data time length displayed by a plot C (1 hour).

2) BTAV = two-dimensional array containing the H, D, and Z 30 second average component values to be individually displayed on plot C; first subscript selects component (1 for H, 2 for D, 3 for Z); second subscript selects the set of average H, D, Z values being individually plotted where "set" in this usage signifies an average H, D, and Z value all applying to the same assigned data time (stored in array TMAV above).

3) ISBSTA = ground station identifier code used to choose ground station name with which to label this plot C; the code used comes from the logical record that contains the first set of instantaneous H, D, Z component data values included in the B array last used for averaging and filling of the C arrays.

4) ICTC = actual number of 30 second average H, D, Z component value "sets" in C array to be displayed on this plot C.

5) IVSC, SCLM1, SCLM2 = see explanations for these arrays given under calling sequence for SUBROUTINE ATSGPB.

6) TIPC = begin time in fortran double precision "milliseconds since ZERO YEAR" of this plot C; not necessarily a data time but it is the begin time of the closest integral multiple from zero instant of the data day of the fixed plot C time length (1 hour) which contains the time of the first 30 second average H, D, Z component values on the plot C.

C. Common Section —

1) name is DATE; explanation similar to that for common section DATE in subroutine ATSGPB above.

9. Subroutine ERRSET (IERNO, INOAL, INOMES, ITRACE, ADDUSE, IRANGE)

A. Purpose — this is an IBM/360 Fortran Programming System subroutine. It prevents the operating system from terminating the computer run if multiple short blocks, i.e., of length (in bytes) less than that specified by the Job Control Language (see Appendix J) for the data set, are encountered on the ground station data tape. This "short block" situation does sometimes occur due to tape deck operation deviation from design.

B. Calling Sequence —

1) see explanation of this subroutine in IBM/360 System Reference Manual "Fortran IV (G and H) Programmer's Guide" (form number C28-6817-0) in Chapter entitled "Extended Error Message Facility".

10. Subroutine PLTND

A. Purpose — this is one of the subroutines of the programs used in generating the SC4020 plotter tape for microfilm production. It must be the last SC4020 subroutine call in the program in order to force emptying of any residual contents in the SC4020 output tape buffers at the end of the computer run. It is part of the SCORS subroutine package for the SC4020 plotter described in the publication "SC4020 Microfilm Recorder User's Manual" by Computer Sciences Corp.

11. Subroutine EXIT

A. Purpose — this is an IBM/360 Fortran Programming System subroutine. It is used to terminate program execution by returning control to the IBM/360 Operating System. See IBM/360 System Reference Manual "Fortran IV Language" (form number C28-6515-7) in Appendix C: Fortran-Supplied Subprograms.

NOTE: All subroutines of the program which are not described above are used in generating the SC4020 plotter tape for microfilm production. They are part of the SCORS subroutine package for the SC4020 plotter described in the publication "SC 4020 Microfilm Recorder User's Manual" by Computer Sciences Corp.

12. Program Input/Output Details

For a more in-depth explanation of input/output details than that following see Appendix J which contains a listing of the actual IBM/360 Job Control Language

used in the program. It also shows where the TI, TF selector cards go in the deck and their format.

A. Inputs

1) the data tape from the ATS-5 ground station

a) read by fortran in the main program on unit 11

b) tracks — 9

c) mode — binary (as usual for 9 track tapes)

d) density — 800 BPI (as usual for 9 track tapes)

e) format — see Appendix B and section entitled "Ground Station Data Tape Format" above.

NOTE: The RECFM (physical record format) parameter on the DD card for the input data tape was set to U (meaning undefined) because the original data tapes may have occasional short length physical records.

2) the TI, TF selector program input cards

a) read by fortran in the main program on unit 5

b) position in deck — immediately after the GO.DATA5 DD * JCL card of the program deck in chronological order (see Appendix J)

c) format — data fields other than "PRTSEL" are read by the I fortran field specification and must therefore be right-adjusted in the card columns assigned to the data field.

data field main program fortran variable and description	card columns assigned to the data field on the input card
SYM, causes termination of computer run if the characters XX are punched in the card columns assigned to it	2, 3
IYRI, last 2 digits of the year of the begin	

time (TI) of the data interval selected for processing by this input card, for example if the year is 1970, the characters 70 are punched	7, 8
IDYI, the day of year of the begin time (TI) of the selected data interval	10, 11, 12
IHRI, the hour of the begin time (TI) of the selected data interval	14, 15
MNI, the minute of the begin time (TI) of the selected data interval	17, 18
ISECI, the second of the begin time (TI) of the selected data interval	20, 21
IYRF, the year of the end time (TF) of the selected data interval	34, 35
IDYF, the day of year of the end time (TF) of the selected data interval	37, 38, 39
IHRF, the hour of the end time (TF) of the selected data interval	41, 42
MNF, the minute of the end time (TF) of the selected data interval	44, 45
ISECF, the second of the end time (TF) of the selected data interval	47, 48
PRTSEL, the variable on the input card used to select the time-ordered numerical data value paper print-out display (see Appendix E for sample) of the data in the time interval selected by this TI, TF card. This display is outputted only if the characters PRT are punched in the columns assigned. If the assigned columns are left blank this display is not outputted. Variable PRTSEL is typed integer and read in by means of fortran field specification A.	50, 51, 52

NOTE: As stated above, when more than one TI, TF input card is used they should be put in chronological order as indicated in Appendix J. If they are not, the data selected by the TI, TF cards which are out of chronological order with respect to the first TI, TF input card will not processed. However, the data selected by the first TI, TF card will be processed in any case if it is contained on the data tape mounted.

NOTE: As explained in the section above entitled "Data Time Value Assignment" the TI, TF input cards must only specify data time intervals later in time than the ZERO YEAR value set in the program.

NOTE: As mentioned above, to terminate the computer run properly, a card with the characters XX punched in columns 2 and 3 must follow the last TI, TF card.

B. Outputs

1) the tape which the Stromberg Carlson Plotter uses as its input to produce the microfilm consisting of the plot B display (see Appendix F for sample) with the plot C display (see Appendix G for sample).

   a) written by fortran in one or more of the subroutines of the new SCORS Stromberg Carlson 4020 plotter package on unit 10.

   b) tracks — 7

   c) mode — binary

   d) density — 556 BPI

NOTE: In general several SC4020 plotter tape reels are outputted in a computer run since so many microfilm frames are necessary to display the data on a full ATS-5 ground station data tape. For such a full tape, i.e., one containing 30 days of data, approximately 7400 microfilm frames are produced from ten full SC4020 plotter tape reels outputted by the computer run. The new SCORS SC4020 plotter subroutine package and the IBM/360 Job Control Language DD card for fortran unit 10 shown in Appendix J in conjunction have all necessary logic for the program to request a blank tape to continue outputting SC4020 microfilm plotter tapes when a previous tape is filled up.

2) the optionally selected (see discussion of selector variable PRTSEL in the explanation of the TI, TF input card above in this section) time-ordered numerical data value paper printout display.

   a) written by fortran in subroutine ATSGPR on unit 6

   b) see sample of this display in Appendix E

3) printed messages giving the beginning and end time (TI, TF) of each data time interval appearing on an input card read by the program; the beginning and end time of the mounted ATS-5 ground station data tape (the end time is printed only if the end-of-tape is encountered during processing of the data); the number of SC4020 plotter microfilm frames residing on the plotter input tapes produced by the computer run.

   a) written by fortran in the main program on unit 6.

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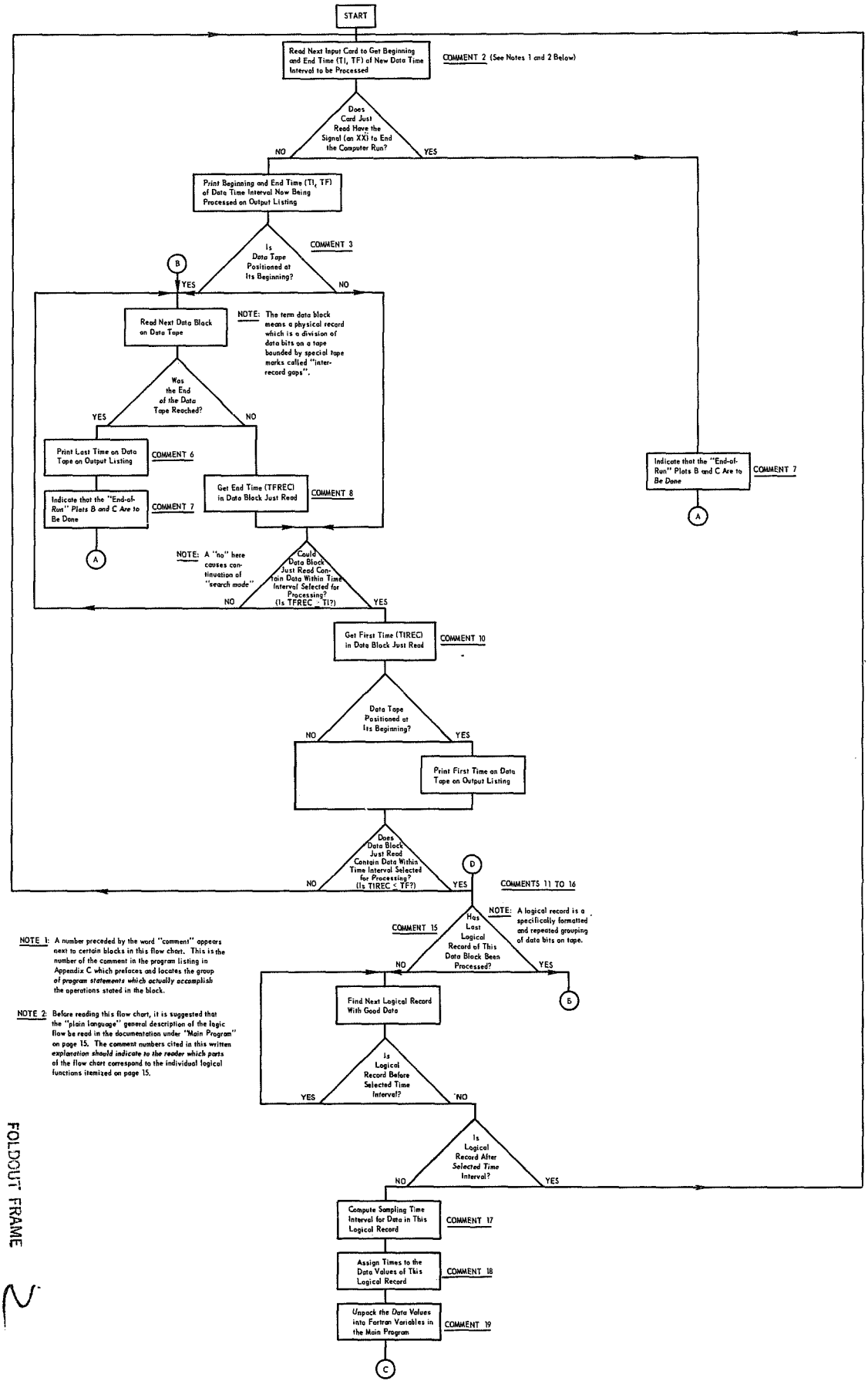
APPENDIX A

CONCEPT-LEVEL FLOW CHART

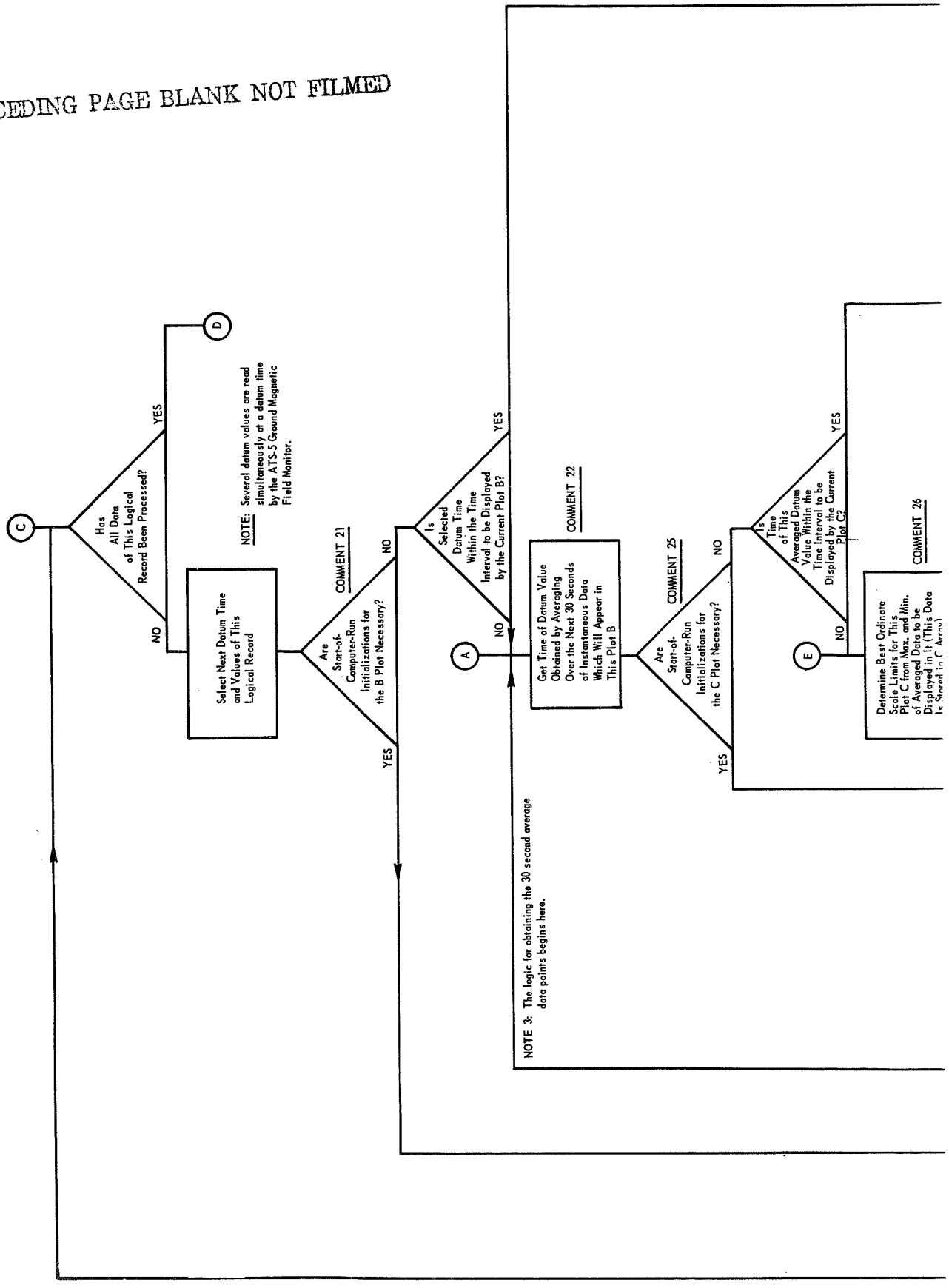
FOLDOUT FRAME 1

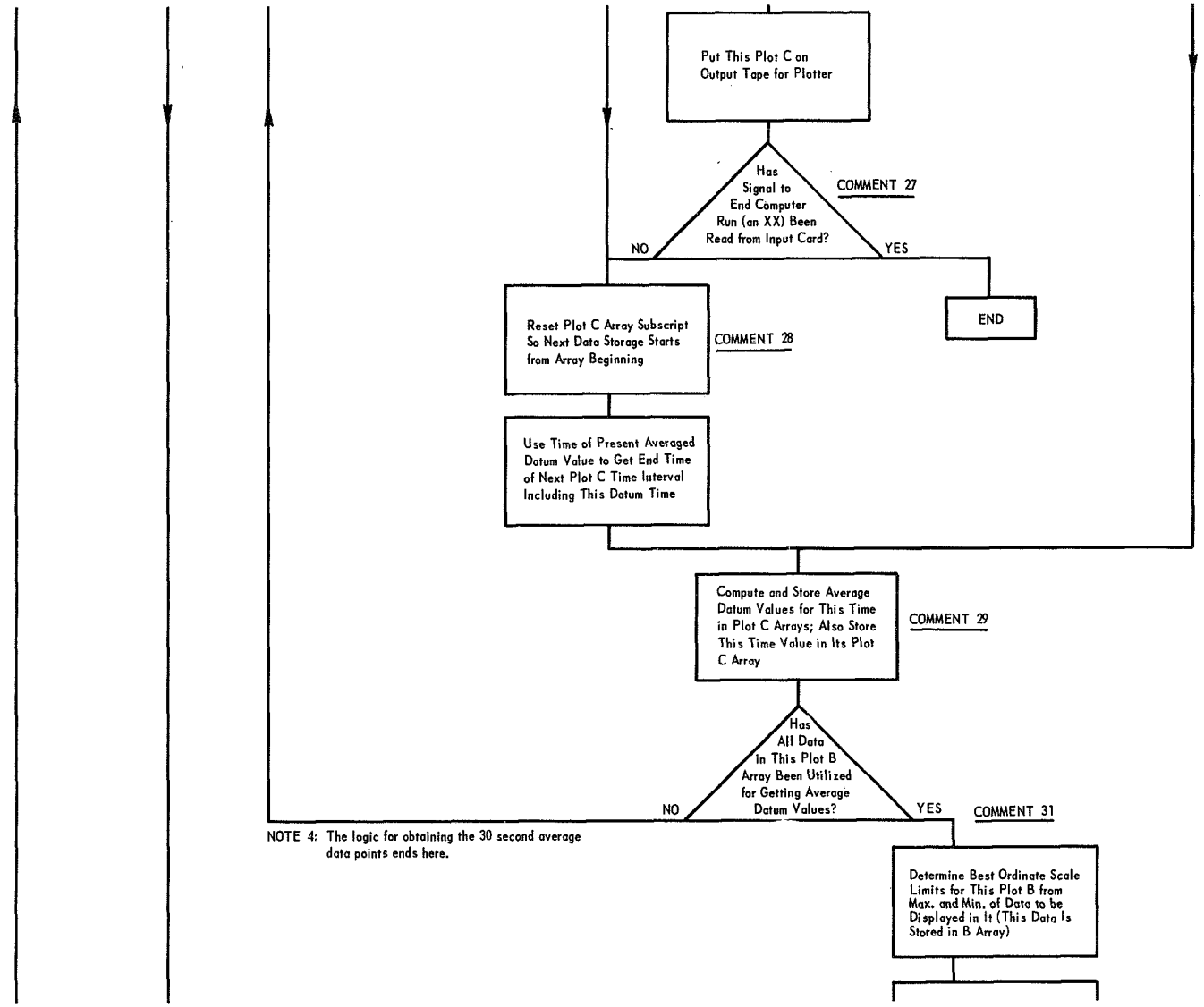


NOTE 1: A number preceded by the word "comment" appears next to certain blocks in this flow chart. This is the number of the comment in the program listing in Appendix C which prefaces and locates the group of program statements which actually accomplish the operations stated in the block.

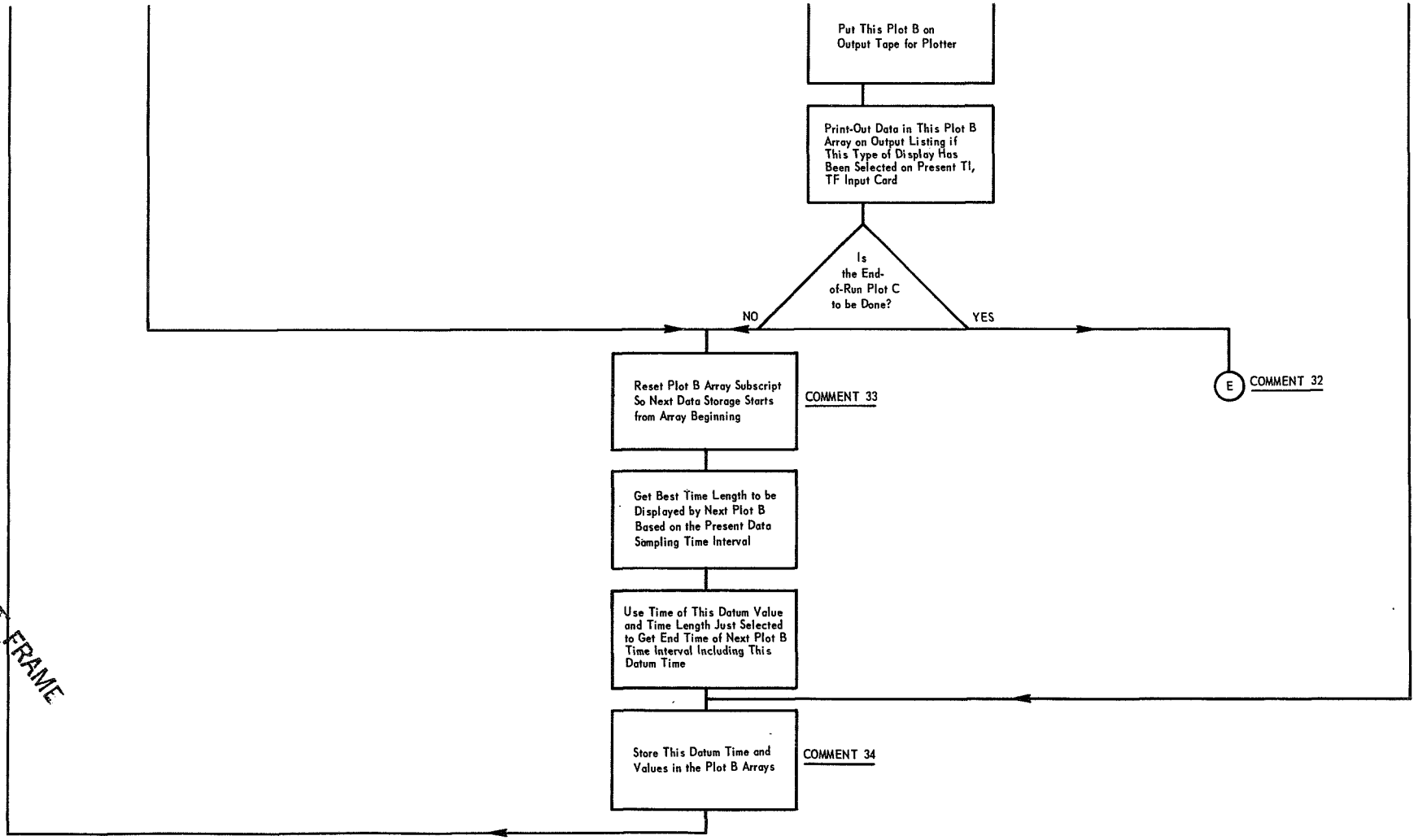
NOTE 2: Before reading this flow chart, it is suggested that the "plain language" general description of the logic flow be read in the documentation under "Main Program" on page 15. The comment numbers cited in this written explanation should indicate to the reader which parts of the flow chart correspond to the individual logical functions itemized on page 15.

FOLDOUT FRAME 2





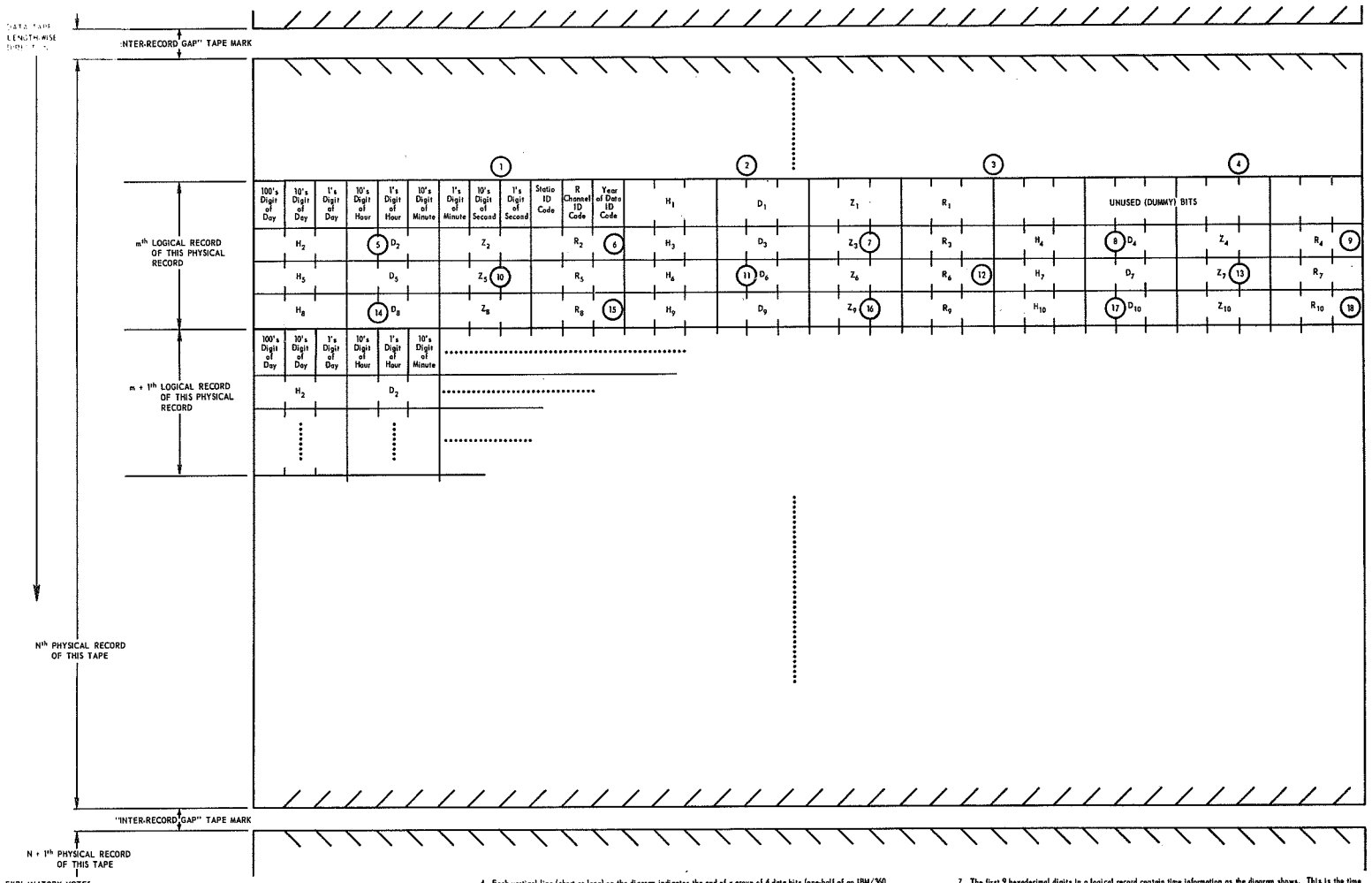
NOTE 4: The logic for obtaining the 30 second average data points ends here.



FOLDOUT FRAME 2

APPENDIX B

FORMAT OF THE ATS-5 GROUND STATION MAGNETOMETER DATA TAPE



EXPLANATORY NOTES

1. A physical record is a division of data bits on tape containing special non-data control and check bits bounded on both sides by "inter-record gap" tape marks.
2. A logical record is a grouping of the data bits on tape in a definite data field format which by repetition forms a data tape. The diagram above shows the data field format of the logical records as defined for this particular tape.
3. The actual number of bits recorded across this tape is 9 bits (8 data bits and 1 odd parity bit) comprising an IBM/360 standard "byte". The diagram above is not in "1 to 1 scale" to the actual bit lay-out on a data tape. The tape density is 800 bytes/inch.
4. Each vertical line (short or long) on the diagram indicates the end of a group of 4 data bits (one-half of an IBM/360 byte, generally called a hexadecimal digit).
5. The number of logical records arbitrarily selected to be contained in a physical record of this tape is 100. Since, as the diagram shows, each logical record is 72 bytes long, each physical record is 7200 bytes long.
6. A symbol such as H_x, for example, enclosed by extended vertical lines in the diagram means that the value of the 4th reading of the H component (in units of data counts) of the geomagnetic field in the logical record is given in the binary number system by the 12 bits included by these extended vertical lines (data field delimiters). Similarly, for the other symbols such as D, Z, or R. Readings of H, D, Z, or R datum values having the same subscript (a "set") in the diagram have been taken at the same time. The method of obtaining the time to which a set of H, D, Z, R readings apply is described below (the R reading might not be a geomagnetic component reading, see text).
7. The first 9 hexadecimal digits in a logical record contain time information as the diagram shows. This is the time of the reading of the first set of H, D, Z, and R data values, i.e. the time of reading of H_1, D_1, Z_1, and R_1 of the diagram. The times of the other H, D, Z, R sets of data are obtained by means of a proportioning principle using the time difference between the time given by the first 9 hexadecimal digits of this logical record and that given by the first 9 hexadecimal digits of the next logical records (with suitable time validity tests as described in the text), and the fact that each logical record contains 10 H, D, Z, R sets of data.
8. A circled number such as (12), for example, indicates what data fields the 12th IBM/360 Fortran "word" of the logical record would contain for data "unpacking" purposes through calls to subroutines by a fortran main program.
9. The end of the data tape is indicated by an IBM/360 end of file mark.

FOLDOUT FRAME 1

FOLDOUT FRAME 2

APPENDIX C

PROGRAM LISTINGS

```
      CCOM1  ***** MAIN PROGRAM OF THE ATS-5 GROUND STATION DATA PROCESSING   00000008
      C       *       SYSTEM - THE NAME OF THIS PROGRAM IS ATSGRD             00000009
      C                                                                       00000010
0001        DIMENSION BT(3,730),BTAV(3,130),IDAT(18,101),R(730),IDBAR(3,730), 00000011
           1ID(3),IDCT(4,10),TFRLTH(5),TINT(5),CPSUM(3),CPCT(3),IVSC(3),      00000012
           2SCLM1(6),SCLM2(6),IFLG(730),ITFLG(730)                            00000013
0002        INTEGER SYM,XXBCD,PRTBCD,PRTSEL,PRTSV                             00000014
0003        DOUBLE PRECISION TI,TF,TIREC,TFREC,TM1,TM2,TIPB,TFPB,TIPC,TFPC,   00000015
           1TAVL,TSPL(10),TMBARY(730),TMAV(130)                               00000016
0004        DATA IBGTP/0/,ISTRTB/0/,ISTRTC/0/,I9S/Z99999999/,IFRCT/0/,        00000017
           1                          TFRLTH/60000.,360000.,720000.,3600000., 00000018
           23600000./,SCLM1/-60.,-150.,-300.,-600.,-1200.,-2400./,            00000019
           3SCLM2/60.,150.,300.,600.,1200.,2400./,XXBCD/2HXX/,IASTRK/IHF/,    00000020
           4IBLNK/1H /,TINT/100.,1000.,2000.,5000.,10000./,NSWXX/0/,ILTRT/1HT/00000021
           5,PRTBCD/3HPRT/                                                    00000022
0005        COMMON/ZROYR/IZYR                                                 00000023
0006        WRITE(6,1301)                                                     00000024
0007     1301 FORMAT(1H1///1X,'ATS-5 GROUND STATION DATA TAPE PROCESSING')    00000025
0008        CALL ERRSET(212,300,0,0,0,0)                                      00000026
0009        IZYR= 69                                                          00000027
0010        IYR=70                                                            00000028
      C                                                                       00000029
      CCOM2  *****  READ NEXT TI,TF OR XX IF NO MORE                         00000030
      C                                                                       00000031
0011      900 PRTSV=PRTSEL                                                  00000032
0012          READ(5,7071) SYM,IYRI,IDYI,IHRI,MNI,ISECI,IYRF,IDYF,IHRF,MNF,ISECF00000033
           1,PRTSEL                                                           00000034
0013     7071 FORMAT(1X,A2,3X,I2,1X,I3,1X,I2,1X,I2,1X,I2,12X,I2,1X,I3,1X,I2,1X, 00000035
           1I2,1X,I2,1X,A3)                                                   00000036
0014        IF(SYM.NE.XXBCD) GO TO 2000                                       00000037
0015        PRTSEL=PRTSV                                                      00000038
0016        GO TO 45                                                          00000039
0017     2000 CALL MSZRDP(IYRI,IDYI,IHRI,MNI,ISECI,TI)                        00000040
0018        CALL MSZRDP(IYRF,IDYF,IHRF,MNF,ISECF,TF)                          00000041
0019        CALL MSCLDP(TI,IYRI,IDYI,IHRI,MNI,SECI)                           00000042
0020        CALL MSCLDP(TF,IYRF,IDYF,IHRF,MNF,SECF)                           00000043
0021        WRITE(6,401)IYRI,IDYI,IHRI,MNI,SECI,IYRF,IDYF,IHRF,MNF,SECF      00000044
0022      401 FORMAT(///1X, 27HREAD NEW TI,TF TIME REQUEST      ,5X, 6HTI IS ,I2,00000045
           1IH/,I3,1H/,I2,1H/,I2,1H/,F6.3,10X, 6HTF IS ,I2,1H/,I3,1H/,I2,1H/,I00000046
           22,1H/,F6.3)                                                       00000047
      C                                                                       00000048
      CCOM3  *****  DETERMINE IF PRESENT BLOCK IS IN NEW TI,TF               00000049
      C       *       OR READ BLOCK IF AT TAPE BEGIN POINT (ENTER SEARCH MODE) 00000050
      C                                                                       00000051
0023        IF(IBGTP.EQ.1) GO TO 800                                          00000052
      C                                                                       00000053
      CCOM4  *****  BEFORE READING NEXT BLOCK INTO DATA ARRAY IDAT           00000054
      C       *       PRESET IT TO ALL 9'S (THIS CAUSES 9'S TO BE AT          00000055
      C       *       END OF IDAT APRAY IF BLOCK IS SHORT TO SHOW END OF GOOD  00000056
      C       *       DATA)                                                   00000057
      C                                                                       00000058
0024      903 DO 1 I=2,101                                                    00000059
0025          DO 1 J=1,18                                                     00000060
0026        1 IDAT(J,I)=I9S                                                   00000061
0027          READ(11,2,ERR=3,END=4) ((IDAT(J,I),J=1,18),I=2,101)            00000062
0028        2 FORMAT(200A4,200A4,200A4,200A4,200A4,200A4,200A4,200A4,200A4)   00000063
0029          IF(IDAT(1,3).EQ.I9S.OR.IDAT(2,3).EQ.I9S) GO TO 903              00000064
0030          IRCIND=IBLNK                                                    00000065
0031          GO TO 704                                                       00000066
      C                                                                       00000067
      CCOM5  *****  ERR PROCESSING (USE IDAT IF 2 OR MORE TIME FIELDS WERE READ 00068
      C       *       IF NOT CONTINUE READING UNTIL TRUE EVEN IF ERR FLAG ON - 00000069
      C       *       ASSIGN A FLAG OF F TO ALL DATA FROM BLOCK)               00000070
      C                                                                       00000071
0032        3 IRCIND=IASTRK                                                   00000072
0033       41 IF(IDAT(1,3).NE.I9S.AND.IDAT(2,3).NE.I9S) GO TO 704           00000073
0034          READ(11,2,ERR=41,END=4) ((IDAT(J,I),J=1,18),I=2,101)           00000074
0035          GO TO 41                                                        00000075
      C                                                                       00000076
      CCOM6  *****  END OF TAPE PROCESSING (1 FILE PER TAPE)                 00000077
      C                                                                       00000078
0036        4 CALL MSCLDP(TFREC,IYR2,IDY,IHR,MN,SEC)                          00000079
0037          WRITE(6,706)IYR2,IDY,IHR,MN,SEC                                 00000080
0038      706 FORMAT(///1X, 66HENCOUNTERED END OF THIS PB TAPE - LAST FIELD DATA00000081
           1'TIME ON TAPE IS I2,1H/,I3,1H/,I2,1H/,I2,1H/,F6.3)                00000082
0039       45 IF(ISTRTB.EQ.0) GO TO 1252                                      00000083
      C                                                                       00000084
      CCOM7  *****  COMPUTER RUN DONE - JUMP TO PROCESSING OF DATA           00000085
      C       *       REMAINING IN PLOT B AND C ARRAY, THEN TERMINATE         00000086
      C                                                                       00000087
```

```
0040            SYM=XXBCD                                                       00000088
0041            GO TO 803                                                       00000089
0042         1252 WRITE(6,1253)IFRCT                                            00000090
0043         1253 FORMAT(///1X,'NUMBER OF 4020 PLOT FRAMES DONE=',I10)          00000091
0044            CALL PLTND                                                      00000092
0045            CALL EXIT                                                       00000093
               C                                                               00000094
               CCOM8  *****  FIND END TIME OF BLOCK (TFREC) IGNORING ANY 9'S IN 00000095
               C      *      DATA ARRAY (IDAT) - LSTLR IS SUBSCRIPT OF LAST GOOD 00000096
               C      *      LOGICAL RECORD OF BLOCK - SUBR ATSGRT RETURNS A ZERO 00000097
               C      *      IF TIME DATA IS BAD                              00000098
               C                                                               00000099
0046          704 I=101                                                        00000100
0047          904 IF(IDAT(1,I).NE.I9S.AND.IDAT(2,I).NE.I9S)GO TO 902           00000101
0048            5 IF(I.EQ.2) GO TO 903                                         00000102
0049              I=I-1                                                        00000103
0050              GO TO 904                                                    00000104
0051          902 CALL ATSGRT(IDAT(1,I),IDAT(2,I),IYR,TFREC)                   00000105
0052              IF(TFREC.EQ.0.D0) GO TO 5                                    00000106
0053              LSTLR=I                                                      00000107
0054              IF(IBGTP.EQ.0) GO TO 1254                                    00000108
0055          800 IF(TFREC.GE.TI) GO TO 1254                                   00000109
               C                                                               00000110
               CCOM9  *****  BLOCK PRE-DATES TI,TF - ENTER OR CONTINUE SEARCH MODE - 00000111
               C      *      LAST LOGICAL RECORD OF LAST BLOCK PROCESSED MUST BE 00000112
               C      *      DISCARDED DUE TO BREAK IN TIME CONTINUITY (IPRELR SWITCH 00000113
               C      *      SET TO ZERO)                                     00000114
               C                                                               00000115
0056            IPRELR=0                                                        00000116
0057            GO TO 903                                                       00000117
               C                                                               00000118
               CCOM10 *****  BLOCK ENDS AFTER TI OR TAPE IS AT BEGIN POINT - COMPUTE 00000119
               C      *      DATA BLOCK BEGIN TIME (TIREC) - IF TIREC LESS THAN TF 00000120
               C      *      SEARCH MODE IS COMPLETED - IFSTLR IS SUBSCRIPT OF 1ST GOOD00000121
               C      *      LOGICAL RECORD OF BLOCK                          00000122
               C                                                               00000123
0058         1254 I=1                                                         00000124
0059            8 I=I+1                                                       00000125
0060              CALL ATSGRT(IDAT(1,I),IDAT(2,I),IYR,TIFEC)                   00000126
0061              IF(TIREC.EQ.0.D0) GO TO 8                                    00000127
0062              IF(TFREC.LT.TIREC)GO TO 903                                  00000128
0063              IFSTLR=I                                                     00000129
0064              IF(IBGTP.EQ.1) GO TO 9                                       00000130
0065              CALL MSCLDP(TIREC,IYR2,IDY,IHR,MN,SEC)                       00000131
0066              IPRELR=0                                                     00000132
0067              IBGTP=1                                                      00000133
0068              WRITE(6,711) IYR2,IDY,IHR,MN,SEC                             00000134
0069          711 FORMAT(///1X, 41HFIRST FIELD DATA TIME ON THIS PB TAPE IS I2,1H/,I00000135
                 13,1H/,I2,1H/,I2,1H/,F6.3)                                    00000136
0070              GO TO 800                                                    00000137
0071            9 IF(TIREC.GT.TF) GO TO 900                                    00000138
               C                                                               00000139
               CCOM11 *****  ANOTHER BLOCK IN THIS TI,TF IS FOUND - PROCESS IT 00000140
               C                                                               00000141
0072              IF(IRCIND.EQ.IASTRK) GO TO 40                                00000142
               C                                                               00000143
               CCOM12 *****  BLOCKS ON ORIGINAL TAPE READ BY COPY PROGRAM WITH AN 00000144
               C      *      I/O ERROR HAVE NON-ZERO HEX CHARACTER (1) INSERTED IN 00000145
               C      *      36TH HEX DIGIT OF COPIED BLOCK - ASSIGN F FLAG TO DATA 00000146
               C      *      IN SUCH BLOCKS                                   00000147
               C                                                               00000148
0073              IRTST=0                                                      00000149
0074              CALL PICK(IRTST,IDAT(5,2),0,15,1)                            00000150
0075              IF(IRTST.NE.0) IRCIND=IASTRK                                 00000151
               C                                                               00000152
               CCOM13 *****  LAST LOGICAL RECORD OF LAST BLOCK PROCESSED IS IN 1ST 00000153
               C      *      18 WORDS OF IDAT ARRAY - PROCESS IT ONLY IF THERE IS NO 00000154
               C      *      BREAK IN TIME CONTINUITY TO NEXT DATA BLOCK      00000155
               C                                                               00000156
0076           40 IF(IPRELR.EQ.0.OR.IFSTLR.NE.2) GO TO 43                      00000157
0077              ISB=1                                                        00000158
0078              GO TO 600                                                    00000159
0079           43 ISB=IFSTLR                                                   00000160
0080              TM2 = TIREC                                                  00000161
               C                                                               00000162
               CCOM14 *****  SEARCH THROUGH LOGICAL RECORDS OF BLOCK UNTIL NEXT 00000163
               C      *      ONE BOUNDED BY VALID,CHRONOLOGICALLY ORDERED TAPE 00000164
               C      *      TIMES (TM1,TM2) DIFFERING BY 10 SECONDS OR LESS  00000165
               C      *      AND WITHIN TI,TF IS FOUND                        00000166
               C                                                               00000167
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0081          600 TM1=TM2                                                    00000168
0082           10 IF(ISB.LT.LSTLR) GO TO 42                                  00000169
               C                                                             00000170
              CCOM15 *****  GO ON TO NEXT BLOCK IN TI,TF IF ALL LOGICAL RECORDS OF  00000171
               C       *      THIS BLOCK EXCEPT LAST ONE ARE PROCESSED - SAVE THE  00000172
               C       *      LAST LOGICAL RECORD (AT BEGINNING OF IDAT ARRAY) FOR 00000173
               C       *      PROCESSING WHEN NEXT BLOCK IS ACCESSED IF THERE IS NO 00000174
               C       *      TIME GAP BETWEEN BLOCKS (IPRELR SET TO 1)            00000175
               C                                                             00000176
0083                  IPRELR=0                                               00000177
0084                  IF(LSTLR.NE.101) GO TO 903                             00000178
0085                  IPRELR=1                                               00000179
0086                  TM2=TFREC                                              00000180
0087                  DO 49 I=1,18                                           00000181
0088           49     IDAT(I,1)=IDAT(I,101)                                  00000182
0089                  GO TO 903                                              00000183
               C                                                             00000184
              CCOM16 *****  FIND NEXT GOOD LOGICAL RECORD (SEE COMMENT 14 FOR  00000185
               C       *  DEFINITION OF ''GOOD'')                           00000186
               C                                                             00000187
0090           42     ISB=ISB+1                                              00000188
0091                  CALL ATSGRT(IDAT(1,ISB),IDAT(2,ISB),IYR,TM2)           00000189
0092                  IF(TM2.NE.0.D0.AND.TM2.GE.TM1) GO TO 113               00000190
0093           11     IF(ISB.EQ.LSTLR) GO TO 903                             00000191
0094                  ISB=ISB+1                                              00000192
0095                  CALL ATSGRT(IDAT(1,ISB),IDAT(2,ISB),IYR,TM1)           00000193
0096                  IF(TM1.EQ.0.D0) GO TO 11                               00000194
0097                  GO TO 10                                               00000195
0098          113     IF(TM2.LT.TI)GO TO 600                                 00000196
0099                  IF(TM1.GT.TF)GO TO 900                                 00000197
               C                                                             00000198
              CCOM17 *****  A GOOD TM1,TM2 PAIR HAS BEEN FOUND - PROCESS THE 10  00000199
               C       *      H,D,Z,R SETS OF DATA (LOGICAL RECORD) BOUNDED BY THIS 00000200
               C       *      TM1,TM2 - FIND DATA SAMPLE TIME INTERVAL (TSPLST)  00000201
               C       *      - ASSIGN A FLAG OF 1 TO ALL 10 H,D,Z,R SETS IF TSPLST 00000202
               C       *      DIFFERS FROM ENGINEERING SPEC VALUES               00000203
               C                                                             00000204
0100                  TSPLST=(TM2-TM1)/10.D0                                 00000205
0101                  IF(TSPLST.GT.1C000.) GO TO 11                          00000206
0102                  DO 9995 I=1,5                                          00000207
0103                  IF(TSPLST.EQ.TINT(I)) GO TO 9996                       00000208
0104           9995   CONTINUE                                               00000209
0105                  ITMIND=ILTRT                                           00000210
0106                  GO TO 9997                                             00000211
0107           9996   ITMIND=IBLNK                                           00000212
               C                                                             00000213
              CCOM18 *****  ASSIGN TIME (ARRAY TSPL) TO EACH OF THE 10 H,D,Z,R  00000214
               C       *      SETS OF DATA  (TIMES DIVIDE TIME INTERVAL BETWEEN  00000215
               C       *      TM1 AND TM2 INTO 10 EQUAL STEPS) - PUT ID INFO FOR 00000216
               C       *      LOGICAL RECORD (STATION CODE, R CHANNEL USE CODE, YEAR 00000217
               C       *      CODE) IN ARRAY ID                                  00000218
               C                                                             00000219
0108           9997   TSPL(1)=TM1                                            00000220
0109                  DO 16 I= 2,10                                          00000221
0110           16     TSPL(I)= TSPL(I-1) + TSPLST                            00000222
0111                  IOFFST=4                                               00000223
0112                  DO 25 I=1,3                                            00000224
0113                  CALL PICK(ID(I),IDAT(2,ISB-1),0,IOFFST,4)              00000225
0114           25     IOFFST=IOFFST+4                                        00000226
               C                                                             00000227
              CCOM19 *****  PUT THE 10 SETS OF H,D,Z,R DATA COUNTS OF THIS LOGICAL  00000228
               C       *      RECORD IN ARRAY IDCT - SKIP THE 48 DUMMY BITS AFTER 1ST 00000229
               C       *      H,D,Z,R SET                                        00000230
               C                                                             00000231
0115                  CALL PICK(IDCT(1,1),IDAT(2,ISB-1),0,16,12)             00000232
0116                  CALL PICK(IDCT(2,1),IDAT(2,ISB-1),0,28,4)              00000233
0117                  CALL PICK(IDCT(2,1),IDAT(3,ISB-1),1,0,8)               00000234
0118                  CALL PICK(IDCT(3,1),IDAT(3,ISB-1),0,8,12)              00000235
0119                  CALL PICK(IDCT(4,1),IDAT(3,ISB-1),0,20,12)             00000236
0120                  IWD=5                                                  00000237
0121                  NOBTS=12                                               00000238
0122                  NBTUSD=16                                              00000239
0123                  DO 12 I= 2,10                                          00000240
0124                  DO 12 J= 1,4                                           00000241
0125                  IWC = 0                                                00000242
0126                  NBTSOB=0                                               00000243
0127           14     CALL PICK(IDCT(J,I),IDAT(IWD,ISB-1),IWC,NBTUSD,NOBTS)  00000244
0128                  NBTSOB= NBTSOB+NOBTS                                   00000245
0129                  NBTUSD=NBTUSD+NOBTS                                    00000246
0130                  IF(NBTSOB.EQ.12) GO TO 13                              00000247
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0131                NOBTS= 12 - NBTSOB                                          00000248
0132                IWD=IWD+1                                                   00000249
0133                NBTUSD=0                                                    00000250
0134                IWC=1                                                       00000251
0135                GO TO 14                                                    00000252
0136             13 IF(NBTUSD.EQ.32) GO TO 15                                   00000253
0137                NOBTS = 32-NBTUSD                                           00000254
0138                IF(NOBTS.GT.12) NOBTS=12                                    00000255
0139                GO TO 12                                                    00000256
0140             15 NOBTS = 12                                                  00000257
0141                IWD= IWD+ 1                                                 00000258
0142                NBTUSD= 0                                                   00000259
0143             12 CONTINUE                                                    00000260
                 C                                                           00000261
                 CCOM20 *****  STORE THE 10 H,D,Z,R SETS AND THEIR TIMES AND ID INFO  00000262
                 C       *     IN THE PLOT B ARRAYS- IF AN H,D,Z,R SET DATA TIME    00000263
                 C       *     EXCEEDS PRESENT PLOT B END TIME, PROCESS THE B ARRAY 00000264
                 C       *     DATA (AVERAGING FOR PLOT C), DO PLOT B,THEN GET END TIME 00000265
                 C       *     OF NEXT B ARRAY (TFPB) AND REUSE B ARRAY STORAGE FOR NEXT 00000266
                 C       *     PLOT B                                               00000267
                 C                                                           00000268
0144                I= 0                                                        00000269
0145             24 IF(I.EQ.10) GO TO  600                                      00000270
0146                I=I+1                                                       00000271
                 C                                                           00000272
                 CCOM21 *****  AFTER SELECTING 1ST OF THE H,D,Z,R SETS FOR STORAGE IN  00000273
                 C       *     B ARRAY (I=1) JUMP TO B ARRAY END TIME COMPUTATION ,ETC. 00000274
                 C       *     IF THE STARTING-OUT SWITCH IS ON (ISTRTB=0)          00000275
                 C                                                           00000276
0147                IF(ISTRTB.NE.0)GO TO 17                                     00000277
0148                TFPB= 0.D0                                                  00000278
0149                ISTRTB=1                                                    00000279
0150                GO TO 804                                                   00000280
0151             17 IF(TSPL(I).LE.TFPB)GO TO 601                                00000281
                 C                                                           00000282
                 CCOM22 *****  PLOT B ARRAY END TIME EXCEEDED - COMPUTE 30 SEC        00000283
                 C       *     AVERAGE DATA POINTS FROM DATA IN B ARRAY AND STORE    00000284
                 C       *     THEM IN C ARRAY - GET END TIME (TAVL) OF 1ST 30 SEC  00000285
                 C       *     INTERVAL FROM B ARRAY BEGIN TIME AND ZERO 30 SEC     00000286
                 C       *     COMPONENT SUMMATIONS AND COUNTS TO START (ICT IS     00000287
                 C       *     COUNT OF DATA POINTS IN B ARRAY TO BE PROCESSED)     00000288
                 C                                                           00000289
0152             803 J=0                                                        00000290
0153                TAVL=TIPB+30000.                                            00000291
0154             7029 DO 7005 K= 1,3                                            00000292
0155                CPSUM(K)= 0.                                                00000293
0156             7005 CPCT(K)=0.                                                00000294
0157             7019 IF(J.EQ.ICT) GO TO 7017                                   00000295
0158                J=J+1                                                       00000296
0159                IF(TMBARY(J).GT.TAVL) GO TO 7017                            00000297
                 C                                                           00000298
                 CCOM23 *****  STILL WITHIN THIS 30 SEC TIME INTERVAL - ADD THIS B     00000299
                 C       *     ARRAY DATA (SELECTED BY SUBSCRIPT J) TO 30 SEC SUMS  00000300
                 C       *     (DATA GREATER THAN 1950 IN MAGNITUDE IS ERRONEOUS AND 00000301
                 C       *     IGNORED)                                             00000302
                 C                                                           00000303
0160                DO 7018 K=1,3                                               00000304
0161                IF(ABS(BT(K,J)).GT.1950.) GO TO 7018                        00000305
0162                CPSUM(K)=CPSUM(K)+BT(K,J)                                   00000306
0163                CPCT(K)=CPCT(K)+1.                                          00000307
0164             7018 CONTINUE                                                  00000308
0165                GO TO 7019                                                  00000309
                 C                                                           00000310
                 CCOM24 *****  END TIME FOR THIS 30 SEC INTERVAL EXCEEDED - SUMS FOR   00000311
                 C       *     THIS AVERAGE POINT ARE COMPLETE - USE TO OBTAIN H,D,Z 00000312
                 C       *     COMPONENT AVERAGES -FIRST SEE IF ENOUGH (CPCTMN) POINTS 00000313
                 C       *     HAVE BEEN USED FOR RELIABILITY OF AVERAGE POINT      00000314
                 C                                                           00000315
0166             7017 JSB=J-1                                                   00000316
0167                IF(JSB.EQ.0)JSB=2                                           00000317
0168                TDF=DABS(TMBARY(J)-TMBARY(JSB))                             00000318
0169                CPCTMN=10000./TDF                                           00000319
0170                IF(CPCT(1).LT.CPCTMN.AND.CPCT(2).LT.CPCTMN.AND.CPCT(3).LT.CPCTMN) 00000320
                   1GO TO 7008                                                  00000321
                 C                                                           00000322
                 CCOM25 *****  AFTER OBTAINING A 30 SECOND AVERAGE DATA POINT JUMP TO  00000323
                 C       *     C ARRAY END TIME (TFPC) COMPUTATION,ETC. IF THE      00000324
                 C       *     STARTING-OUT SWITCH IS ON (ISTRTC=0)                 00000325
                 C                                                           00000326
0171                IF(ISTRTC.NE.0)GO TO 18                                     00000327
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0172                TFPC=0.D0                                                   00000328
0173                ISTRTC=1                                                    00000329
0174                GO TO 7024                                                  00000330
0175             18 IF((TAVL - 15000.).LE.TFPC)GO TO 7025                       00000331
                 C                                                              00000332
                 CCOM26 *****  PLOT C ARRAY END TIME EXCEEDED - GET PLOT C VERTICAL  00000333
                 C       *     SCALE LIMITS FOR H,D,Z RESPECTIVELY (ICTC IS COUNT OF  00000334
                 C       *     30 SEC AVERAGE DATA POINTS IN C ARRAY TO BE PROCESSED)  00000335
                 C       *     -DO PLOT C                                       00000336
                 C                                                              00000337
0176          9994 DO 7012 K=1,3                                                00000338
0177                XMIN= 1.E6                                                  00000339
0178                XMAX= 0.                                                    00000340
0179                DO 7066 L=1,ICTC                                            00000341
0180                IF(BTAV(K,L).EQ.9999.) GO TO 7066                           00000342
0181                IF(BTAV(K,L).GT.XMAX)XMAX=BTAV(K,L)                         00000343
0182                IF(BTAV(K,L).LT.XMIN)XMIN=BTAV(K,L)                         00000344
0183          7066 CONTINUE                                                     00000345
0184                DO 7013 L=1,6                                               00000346
0185                IF(XMIN.GE.SCLM1(L).AND.XMAX.LE.SCLM2(L)) GO TO 7012        00000347
0186          7013 CONTINUE                                                     00000348
0187          7012 IVSC(K)=L                                                    00000349
0188                CALL ATSGPC(TMAV,BTAV,ISBSTA,ICTC,IVSC,SCLM1,SCLM2,TIPC)    00000350
0189                IFRCT=IFRCT+1                                               00000351
                 C                                                              00000352
                 CCOM27 *****  SWITCH NSWXX = 1 IF REMAINDER OF DATA IN C ARRAY AT  00000353
                 C       *     END OF COMPUTER RUN HAS BEEN PLOTTED - SWITCH NSW130=1  00000354
                 C       *     IF PLOT C DONE BECAUSE C ARRAY FILLED-UP (POSSIBLE ONLY  00000355
                 C       *     IF DATA SAMPLE TIME INTERVAL CHANGES - TFPC SET TO ZERO  00000356
                 C       *     TO RESET COMPUTATION FOR NEXT TFPC IN THIS CASE)  00000357
                 C                                                              00000358
0190                IF(NSWXX.EQ.1) GO TO 1252                                   00000359
0191                IF(NSW130.EQ.1) TFPC=0.D0                                   00000360
                 C                                                              00000361
                 CCOM28 *****  INITIALIZE FOR NEXT PLOT C ARRAY - GET ITS END TIME(TFPC)  00000362
                 C       *     USING TIME OF 1ST AVERAGE POINT TO BE STORED IN IT  00000363
                 C       *     -ISBSTA IS STATION CODE SUBSCRIPT FOR PLOT C LABELLING  00000364
                 C                                                              00000365
0192          7024 ICTC=0                                                       00000366
0193          7011 TIPC=TFPC                                                    00000367
0194                TFPC=TFPC+ 3600000.                                         00000368
0195                IF((TAVL-15000.).GE.TFPC) GO TO 7011                        00000369
0196                NSW130=0                                                    00000370
0197                ISBSTA=IDBAR(1,J)                                           00000371
0198          7025 IF(ICTC.LT.130) GO TO 9998                                   00000372
0199                NSW130=1                                                    00000373
0200                GO TO 9994                                                  00000374
                 C                                                              00000375
                 CCOM29 *****  COMPUTE RESPECTIVE H,D,Z AVERAGE VALUES FROM 30 SEC  00000376
                 C       *     SUMS AND COUNTS AND STORE IN PLOT C IF IT IS NOT FULL  00000377
                 C       *     -IF AVERAGE UNRELIABLE SET IT TO 9999.           00000378
                 C                                                              00000379
0201          9998 ICTC=ICTC+1                                                  00000380
0202                DO 7026 K=1,3                                               00000381
0203                BTAV(K,ICTC)=9999.                                          00000382
0204                IF(CPCT(K).LT.CPCTMN) GO TO 7026                            00000383
0205                BTAV(K,ICTC)= CPSUM(K)/CPCT(K)                              00000384
0206          7026 CONTINUE                                                     00000385
0207                TMAV(ICTC)= TAVL-15000.                                     00000386
0208          7008 IF(J.EQ.ICT) GO TO 7030                                      00000387
                 C                                                              00000388
                 CCOM30 *****  GET END TIME (TAVL) OF NEXT 30 SEC AVERAGING INTERVAL  00000389
                 C       *     FROM TIME OF 1ST B ARRAY POINT TO BE INCLUDED IN AVERAGE  00000390
                 C       *     GET NEXT AVERAGE POINT,ETC.                      00000391
                 C                                                              00000392
0209             19 TAVL=TAVL+30000.                                            00000393
0210                IF(TMBARY(J).GE.TAVL) GO TO 19                              00000394
0211                J=J-1                                                       00000395
0212                GO TO 7029                                                  00000396
                 C                                                              00000397
                 CCOM31 *****  DATA OF THIS B ARRAY AVERAGED - PLOT C WAS DONE IF  00000398
                 C       *     APPROPRIATE - NOW DO PLOT B - GET PLOT B VERTICAL  00000399
                 C       *     SCALE LIMITS FOR H,D,Z RESPECTIVELY FIRST - CALL ATSGPR  00000400
                 C       *     IF SELECTED TO PRINT-OUT DATA IN THIS B ARRAY  00000401
                 C                                                              00000402
0213          7030 DO 30 J=1,3                                                  00000403
0214                XMIN=1.E6                                                   00000404
0215                XMAX=0.                                                     00000405
0216                DO 31 K=1,ICT                                               00000406
0217                IF(ABS(BT(J,K)).GE.1950.) GO TO 31                          00000407
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0218                IF(BT(J,K).GT.XMAX)XMAX =BT(J,K)                          00000408
0219                IF(BT(J,K).LT.XMIN)XMIN =BT(J,K)                          00000409
0220             31 CONTINUE                                                  00000410
0221                DO 32 K=1,6                                               00000411
0222                IF(XMIN.GE.SCLM1(K).AND.XMAX.LE.SCLM2(K)) GO TO 30        00000412
0223             32 CONTINUE                                                  00000413
0224             30 IVSC(J)= K                                                00000414
0225                CALL ATSGPB(TMBARY,BT,IDBAR,ICT,IVSC,SCLM1,SCLM2,TIPB,    00000415
                   1TFRLTH(IHSC),IFLG,ITFLG)                                 00000416
0226                IFRCT= IFRCT+1                                            00000417
0227                IF(PRTSEL.NE.PRTBCD) GO TO 2001                           00000418
0228                CALL ATSGPR(TMBARY,BT,R,IDBAR,IFLG,ITFLG,ICT)             00000419
0229          2001  IF(SYM.NE.XXBCD) GO TO 804                               00000420
                C                                                           00000421
                CCOM32 *****  IF PROCESSING DATA REMAINING IN B AND C ARRAYS AT END  00000422
                C       *     OF COMPUTER RUN FORCE LAST PLOT C AND TERMINATE AFTER  00000423
                C       *     IT IS DONE INSTEAD OF INITIALIZING FOR NEXT PLOT B     00000424
                C                                                           00000425
0230                NSWXX=1                                                 00000426
0231                GO TO 9994                                              00000427
                C                                                           00000428
                CCOM33 *****  INITIALIZE FOR NEXT USE OF B ARRAY - USE DATA  00000429
                C       *     SAMPLE TIME INTERVAL EXISTING FOR LAST DATA POINT PUT  00000430
                C       *     IN PREVIOUS B ARRAY TO SELECT TIME SCALE (SELECTED BY  00000431
                C       *     SUBSCRIPT IHSC) FOR NEXT PLOT B - GET ITS END TIME (TFPB) 00000432
                C       *     USING TIME OF 1ST DATA POINT TO BE STORED IN IT - RESET THIS  0433
                C       *     COMPUTATION (TFPB TO ZERO) IF PLOT B TIME LENGTH HAS   00000434
                C       *     CHANGED OR LAST PLOT B WAS DONE DUE TO FILLED B ARRAY,I.E.00000435
                C       *     SWITCH NSW730 SET TO 1 (POSSIBLE ONLY IF DATA SAMPLE   00000436
                C       *     TIME INTERVAL CHANGES WITHIN DATA IN LAST B ARRAY)      00000437
                C                                                           00000438
0232             804  ICT=0                                                 00000439
0233                IHSCSV=IHSC                                             00000440
0234                DO 20 J= 1,5                                            00000441
0235                IF(TSPLST.LT.TINT(J)) GO TO 21                          00000442
0236             20 CONTINUE                                                00000443
0237                IHSC = 5                                                00000444
0238                GO TO 1255                                              00000445
0239             21 IHSC = J-1                                              00000446
0240                IF(IHSC.EQ.0)IHSC=1                                     00000447
0241          1255  IF(IHSCSV.NE.IHSC.OR.NSW730.EQ.1) TFPB=0.D0             00000448
0242           602  TIPB= TFPB                                              00000449
0243                TFPB = TFPB+ TFRLTH(IHSC)                               00000450
0244                IF(TSPL(I).GE.TFPB) GO TO 602                           00000451
0245                NSW730=0                                                00000452
                C                                                           00000453
                CCOM34 *****  STORE TIME,H,D,Z,R,STATION CODE,R CODE,DATA YEAR CODE,  00000454
                C       *     ERR FLAG,AND TIMING FLAG IN APPROPRIATE B ARRAY- H,D,Z  00000455
                C       *     CONVERTED FROM COUNTS TO GAMMAS - R CONVERTED TO GAMMAS 00000456
                C       *     ONLY IF A FIELD READING - GO BACK TO GET NEXT OF THE   00000457
                C       *     10 H,D,Z,R SAMPLES OF THIS LOGICAL RECORD TO PROCESS   00000458
                C                                                           00000459
0246           601  IF(ICT.LT.730) GO TO 9970                              00000460
0247                NSW730=1                                                00000461
0248                GO TO 803                                               00000462
0249          9970  ICT=ICT+1                                               00000463
0250                TMBARY(ICT)= TSPL(I)                                    00000464
0251                DO 23 J=1,3                                             00000465
0252             23 BT(J,ICT)= FLOAT(IDCT(J,I))*.976408 - 2000.             00000466
0253                R(ICT) = IDCT(4,I)                                      00000467
0254                IF(ID(2).EQ.1.OR.ID(2).EQ.2.OR.ID(2).EQ.3)R(ICT)=R(ICT)*.976408  00000468
                   1-2000.                                                  00000469
0255                IDBAR(1,ICT)=ID(1)                                      00000470
0256                IDBAR(2,ICT)=ID(2)                                      00000471
0257                IDBAR(3,ICT)=ID(3)                                      00000472
0258                IFLG(ICT)=IRCIND                                        00000473
0259                ITFLG(ICT)=ITMIND                                       00000474
0260                GO TO 24                                                00000475
0261                END                                                     00000476
```

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      C                                                                      00000477
      C                                                                      00000478
      C                                                                      00000479
      C                                                                      00000480
      C      ***** SUBROUTINE ATSGRT-CONVERTS TIME DATA IN THE LOGICAL RECORD 00000481
      C      *       BEING PROCESSED INTO THE EQUIVALENT IN MILLISECONDS-SINCE-00000482
      C      *       ZERO-YEAR UNITS - ARRAY ITMEL HOLDS THE 9 HEX DIGITS OF  00000483
      C      *       THE TIME DATA - SEE APPENDIX B FOR DATA TAPE FORMAT      00000484
      C                                                                      00000485
0001          SUBROUTINE ATSGRT(IWD1,IWD2,IYR,TM)                            00000486
0002          DOUBLE PRECISION TM                                            00000487
0003          DIMENSION ITMEL(9)                                             00000488
0004          IOFFST=0                                                       00000489
0005          DO 1 I=1,8                                                     00000490
0006          CALL PICK(ITMEL(I),IWD1,0,IOFFST,4)                            00000491
0007        1 IOFFST=IOFFST + 4                                              00000492
0008          CALL PICK(ITMEL(9),IWD2,0,0,4)                                 00000493
0009          IDY= ITMEL(1)*100 + ITMEL(2)*10 +ITMEL(3)                      00000494
0010          IHR= ITMEL(4)*10  + ITMEL(5)                                   00000495
0011          MN = ITMEL(6)*10 + ITMEL(7)                                    00000496
0012          ISEC= ITMEL(8)*10 + ITMEL(9)                                   00000497
      C                                                                      00000498
      C       *****  RETURN A RESULT OF ZERO IF TIME DATA IS INVALID         00000499
      C                                                                      00000500
0013          TM=0.D0                                                        00000501
0014          IF(IDY.LT.1.OR.IDY.GT.366.OR.IHR.GT.24.OR.MN.GT.60.OR.ISEC.GT.60) 00000502
             1GO TO 2                                                        00000503
0015          CALL MSZRDP(IYR,IDY,IHR,MN,ISEC,TM)                            00000504
0016        2 RETURN                                                         00000505
0017          END                                                            00000506
```

```
      C      ***** SUBROUTINE ATSGPR-GENERATES PRINT-OUT ON THE SYSTEM OUTPUT 00000511
      C      *       UNIT OF THE DATA PRESENTLY STORED IN THE B ARRAY AS A    00000512
      C      *       FUNCTION OF TIME - SEE APPENDIX E FOR A SAMPLE OF THIS   00000513
      C      *       PRINT-OUT                                                00000514
      C                                                                       00000515
0001          SUBROUTINE ATSGPR(TMBARY,BT,R,IDBAR,IFLG,ITFLG,ICT)             00000516
0002          DIMENSION BT(3,730),R(730),IDBAR(3,730),IFLG(730),ISTLBL(2,4),  00000517
             1IRLBL(3,6),ITFLG(730)                                           00000518
0003          DOUBLE PRECISION TMBARY(730)                                     00000519
0004          DATA ISTLBL/4HLYNN,4HLAKE,4HTHOM,4HPSUN,4HWINN,4HIPEG,4HTHE ,    00000520
             14HPAS /,IRLBL/4HNOT ,4HUSED,4H    ,4HH AX,4HIS  ,4H    ,4HD AX,  00000521
             24HIS  ,4H    ,4HZ AX,4HIS  ,4H    ,4HPROT,4HON E,4HXP  ,4HOTHE,  00000522
             34HR EX,4HP   /                                                   00000523
0005          DATA LNCTR/0/                                                    00000524
0006          COMMON/DATE/MNTH,IDYMTH                                          00000525
0007          DO 1 I= 1,ICT                                                    00000526
0008          IF(LNCTR.NE.0) GO TO 2                                           00000527
0009          ISBSTA=IDBAR(1,I)                                                00000528
0010          ISBR= IDBAR(2,I)+1                                               00000529
0011          WRITE(6,3) ISTLBL(1,ISBSTA),ISTLBL(2,ISBSTA),IRLBL(1,ISBR),      00000530
             1IRLBL(2,ISBR),IRLBL(3,ISBR),IRLBL(1,ISBR),IRLBL(2,ISBR),        00000531
             2IRLBL(3,ISBR)                                                   00000532
0012         3 FORMAT(1H1/// 9X, 54HATS-E MFM          CANADIAN DOMINION OBSERV00000533
             1ATORY AT ,2A4,1X, 48HMANITOBA        MAGNETIC FIELD MEASUREMENTS 00000534
             2 R=,3A4//10X, 95HDATE     DAY OF     TIME          H AXIS    D AXIS 00000535
             3   Z AXIS    TOTAL FIELD    FG MINUS          R/8X, 93HYR MON DAY  00000536
             4YEAR   HR  MN  SEC    (GAMMAS)  (GAMMAS)  (GAMMAS)    (GAMMAS)   00000537
             5  PROTON        ,3A4//)                                          00000538
0013          LNCTR= LNCTR +8                                                  00000539
      C                                                                       00000540
      C      *****  SET FIELD MAGNITUDE TO 9999. IF ANY OF THE 3 COMPONENTS   00000541
      C      *       ARE INCORRECT,I.E. GREATER THAN 1950. GAMMAS             00000542
      C                                                                       00000543
0014         2 B=9999.                                                        00000544
0015          IF(BT(1,I).LT.1950..AND.BT(2,I).LT.1950..AND.BT(3,I).LT.1950.)B= 00000545
             1SQRT(BT(1,I)**2 + BT(2,I)**2 + BT(3,I)**2)                      00000546
0016          CALL MSCLDP(TMBARY(I),IYR,IDY,IHR,MN,SEC)                        00000547
0017          WRITE(6,4) IYR,MNTH,IDYMTH,IDY,IHR,MN,SEC,BT(1,I),BT(2,I),BT(3,I),00000548
             1B,R(I),IFLG(I),ITFLG(I)                                         00000549
0018         4 FORMAT(8X,I2,1X,A3,1X,I2,3X,I3,4X,I2,2X,I2,2X,F4.1,3X,F7.1,3X,F7.100000550
             1,3X,F7.1,4X,F6.1,22X,F7.1,1X,A1,1X,A1)                          00000551
0019          LNCTR= LNCTR+1                                                   00000552
0020         1 IF(LNCTR.GE.60)LNCTR=0                                         00000553
0021          RETURN                                                           00000554
0022          END                                                              00000555
```

```
      C      ***** SUBROUTINE ATSGPB-GENERATES PLOT OF H,D,Z COMPONENT VALUES 00000560
      C      *       (INDIVIDUALLY) OVER THE CHRONOLOGICALLY NEXT DATA TIME   00000561
      C      *       SPAN,I.E. CONTENTS OF PRESENT B ARRAY - THE VERTICAL SCALE00000562
      C      *       OF THE PLOT FOR A COMPONENT IS SELECTED FROM SEVERAL      00000563
      C      *       POSSIBLE SCALES FOR THE BEST DATA DISPLAY RESOLUTION IN   00000564
      C      *       ACCORDANCE WITH THE RANGE OF DATA DISPLAYED IN THE PLOT - 00000565
      C      *       THE HORIZONTAL (TIME) SCALE IS CHOSEN FROM SEVERAL        00000566
      C      *       POSSIBLE SCALES FOR THE BEST DATA DISPLAY RESOLUTION IN   00000567
      C      *       ACCORDANCE WITH THE DATA SAMPLING TIME INTERVAL FOR THE   00000568
      C      *       FIRST DATA VALUE STORED IN THE PRESENT B ARRAY - THE      00000569
      C      *       CHOICE OF THE VERTICAL SCALE FOR EACH COMPONENT AND THE   00000570
      C      *       HORIZONTAL (TIME) SCALE IS DONE IN THE MAIN PROGRAM - SEE 00000571
      C      *       APPENDIX F FOR A SAMPLE PLOT B                            00000572
      C                                                                        00000573
0001          SUBROUTINE ATSGPB(TMBARY,BT,IDBAR,ICT,IVSC,SCLM1,SCLM2,TIPB,    00000574
     1TFRLTH,IFLG,ITFLG)                                                       00000575
0002          DIMENSION BT(3,730),IDBAR(3,730),IFLG(730),IVSC(3),SCLM1(6),    00000576
     1SCLM2(6),ISTLBL(2,4),MB(3),MT(3),ITFLG(730)                              00000577
0003          DOUBLE PRECISION TMBARY(730),TIPB,TSCL                           00000578
0004          DATA ISTLBL/4HLYNN,4HLAKE,4HTHOM,4HPSON,4HWINN,4HIPEG,4HTHE ,    00000579
     14HPAS /                                                                  00000580
0005          DATA NSTART/0/,MB/672,355,38/,MT/38,355,672/,IBLNK/1H /          00000581
0006          COMMON/DATE/MNTH,IDYMTH                                          00000582
0007          IF(NSTART.EQ.1) GO TO 100                                        00000583
0008          CALL IDFRMV('H.J.GILLIS','645','21','2279')                      00000584
0009          CALL CAMRAV(35)                                                  00000585
0010          NSTART=1                                                         00000586
0011      100 CALL FRAMEV                                                      00000587
      C                                                                        00000588
      C      ***** CHECK FOR ILLEGAL STATION CODE BEFORE PRINTING STATION     00000589
      C      *       LABEL ON THIS FRAME                                      00000590
      C                                                                        00000591
0012          IF(IDBAR(1,1).GT.4) GO TO 105                                    00000592
0013          ISBSTA = IDBAR(1,1)                                              00000593
0014          CALL PRINTV(8,ISTLBL(1,ISBSTA),200,1010)                         00000594
      C                                                                        00000595
      C      ***** PRINT ALL LABELLING FOR THIS PLOT B                        00000596
      C                                                                        00000597
0015      105 CALL PRINTV(8,8HMANITOBA,470,1010)                               00000598
0016          CALL PRINTV(6,6HPLOT B,830,1010)                                 00000599
0017          CALL MSCLDP(TIPB,IYR,IDY,IHR,MN,SEC)                             00000600
0018          CALL PRINTV( 6,6HDAY = ,792,993)                                 00000601
0019          CALL LABLV(FLOAT(IDY),840,993,3,1,3)                             00000602
0020          CALL PRINTV( 10,10H   DATE = ,864,993)                           00000603
0021          CALL LABLV(FLOAT(IDYMTH),944,993,2,1,2)                          00000604
0022          CALL PRINTV(3,MNTH,960,993)                                      00000605
0023          CALL LABLV(FLOAT(IYR),1050,993,2,1,2)                            00000606
0024          CALL PRINTV(2,2HUT,450,13)                                       00000607
0025          CALL PRINTV( 5,5HATS-E,300,13)                                   00000608
0026          CALL PRINTV( 13,13HDOMINION OBSY,850,13)                         00000609
0027          CALL PRINTV(1,1HH,27,788)                                        00000610
0028          CALL PRINTV(1,1HD,27,472)                                        00000611
0029          CALL PRINTV(1,1HZ,27,156)                                        00000612
0030          CALL APRNTV(C,-12,6,6HGAMMAS,12,442)                             00000613
      C                                                                        00000614
      C      *****  GENERATE GRID AND PLOT FOR THE H DATA,THEN DO THE SAME FOR00000615
      C      *       THE D AND Z COMPONENT ON THE SAME MICROFILM FRAME - THE   00000616
      C      *       COMPONENT PLOTTED IS SELECTED BY DO INDEX J               00000617
      C                                                                        00000618
0031          DO 5 J = 1,3                                                     00000619
0032          ISUB=IVSC(J)                                                     00000620
0033          CALL SETMIV(42,8,MB(J),MT(J))                                    00000621
0034          CALL GRIDIV(2,0.,TFRLTH,SCLM1(ISUB),SCLM2(ISUB),TFRLTH/6.,       00000622
     1(SCLM2(ISUB)-SCLM1(ISUB))/6.,0,0,0,1,0,4)                                00000623
      C                                                                        00000624
      C      *****  DRAW TIC MARKS FOR HORIZONTAL (TIME) AXIS FOR THIS GRID   00000625
      C                                                                        00000626
0035          DO 1 I= 1,59                                                     00000627
0036          IF(MOD(I,10).EQ.0) GO TO 1                                       00000628
0037          XI= FLOAT(I)*TFRLTH/60.                                          00000629
0038          IF(MOD(I,5).EQ.0) GO TO 2                                        00000630
0039          CALL LINEV( NXV(XI),NYV(SCLM1(ISUB)),NXV(XI),NYV(SCLM1(ISUB))+8) 00000631
0040          GO TO 1                                                          00000632
0041        2 CALL LINEV(NXV(XI),NYV(SCLM1(ISUB)),NXV(XI),NYV(SCLM1(ISUB))+16) 00000633
0042        1 CONTINUE                                                         00000634
      C                                                                        00000635
```

```
                C       *****  DRAW TIC MARKS FOR VERTICAL (GAMMA UNIT) AXIS FOR THIS    00000636
                C       *      GRID                                                      00000637
                C                                                                        00000638
0043                    DO 3 I=1,59                                                      00000639
0044                    IF(MOD(I,10).EQ.0) GO TO 3                                       00000640
0045                    XI = FLOAT(I)*(SCLM2(ISUB)- SCLM1(ISUB))/60. + SCLM1(ISUB)       00000641
0046                    IF(MOD(I,5).EQ.0) GO TO 4                                        00000642
0047                    CALL LINEV(NXV(0.),NYV(XI),NXV(0.)+8,NYV(XI))                    00000643
0048                    GO TO 3                                                          00000644
0049                  4 CALL LINEV(NXV(0.),NYV(XI),NXV(0.)+16,NYV(XI))                   00000645
0050                  3 CONTINUE                                                         00000646
0051                    DO 5 I= 1,ICT                                                    00000647
                C                                                                        00000648
                C       *****  COMPUTE HORIZONTAL COORDINATE OF THIS DATA POINT           00000649
                C       *      (SELECTED BY DO INDEX I) - PLOT T AND/OR F FLAG IF        00000650
                C       *      APPROPRIATE FOR THIS DATA POINT                           00000651
                C                                                                        00000652
0052                    T= TMBARY(I)- TIPB                                               00000653
0053                    IF(J.NE.3.OR.IFLG(I).EQ.IBLNK) GO TO 40                          00000654
0054                    CALL PRINTV(1,IFLG(I),NXV(T),NYV(SCLM1(ISUB))-20)                00000655
0055                 40 IF(J.NE.3.OR.ITFLG(I).EQ.IBLNK) GO TO 401                        00000656
0056                    CALL PRINTV(1,ITFLG(I),NXV(T),NYV(SCLM1(ISUB))-29)               00000657
0057                401 IX=NXV(T)                                                        00000658
0058                    ARG2=BT(J,I)                                                     00000659
0059                    IY=NYV(ARG2)                                                     00000660
                C                                                                        00000661
                C       *****  PLOT VALUE OF SELECTED FIELD COMPONENT ON ITS GRID         00000662
                C                                                                        00000663
0060                  5 CALL PLOTV(IX,IY,42)                                             00000664
                C                                                                        00000665
                C       *****  PRINT THE TIME (HOUR,MINUTE,OR SECOND) REPRESENTED BY EACH00000666
                C       *      VERTICAL GRID LINE ON THE PLOT AT BOTTOM OF PLOT BENEATH   00000667
                C       *      THE LINE                                                  00000668
                C                                                                        00000669
0061                    ARG=SCLM1(ISUB)                                                  00000670
0062                    IYB=NYV(ARG)                                                     00000671
0063                    TSCL= TIPB                                                       00000672
0064                    DO 6 I= 1,7                                                      00000673
0065                    CALL MSCLDP(TSCL,IYR,IDY,IHR,MN,SEC)                             00000674
0066                    T= TSCL - TIPB                                                   00000675
0067                    IX=NXV(T)                                                        00000676
0068                    IF(I.EQ.1.OR.I.EQ.7.OR.TFRLTH.NE.60000.) GO TO 7                 00000677
0069                    ISEC= SEC                                                        00000678
0070                    CALL LABLV(FLOAT(ISEC),IX-8,IYB-12,2,1,2)                        00000679
0071                    GO TO 6                                                          00000680
0072                  7 CALL LABLV(FLOAT(IHR),IX-16,IYB-4,2,1,2)                         00000681
0073                    CALL LABLV(FLOAT(MN),IX,IYB-4,2,1,2)                             00000682
0074                  6 TSCL = TSCL + TFRLTH/6.                                          00000683
0075                    RETURN                                                           00000684
0076                    END                                                              00000685
```

```
      C     ***** SUBROUTINE ATSGPC------GENERATES A PLOT OF THIRTY          00000690
      C     *       SECOND AVERAGE H, D, Z, COMPONENT VALUES                 00000691
      C     *       (INDIVIDUALLY) OVER THE CHRONOLOGICALLY NEXT DATA TIME   00000692
      C     *       SPAN,I.E. CONTENTS OF PRESENT C ARRAY - THE VERTICAL SCALE00000693
      C     *       OF THE PLOT FOR A COMPONENT IS SELECTED FROM SEVERAL     00000694
      C     *       POSSIBLE SCALES FOR THE BEST DATA DISPLAY RESOLUTION IN  00000695
      C     *       ACCORDANCE WITH THE RANGE OF DATA DISPLAYED IN THE PLOT - 00000696
      C     *       THE HORIZONTAL (TIME) SCALE IS SET AT 1 HOUR IN LENGTH   00000697
      C     *       AND BEGINS AT THE EXACT HOUR IMMEDIATELY PRECEDING THE   00000698
      C     *       TIME OF THE 1ST DATA VALUE STORED IN THE PRESENT C ARRAY -00000699
      C     *       CHOICE OF THE VERTICAL SCALE FOR EACH COMPONENT AND THE  00000700
      C     *       HORIZONTAL (TIME) SCALE IS DONE IN THE MAIN PROGRAM - SEE 00000701
      C     *       APPENDIX G FOR A SAMPLE PLOT C                           00000702
      C                                                                      00000703
0001        SUBROUTINE ATSGPC(TMCARY,BT,ISBSTA,ICTC,IVSC,SCLM1,SCLM2,TIPC)  00000704
0002        DIMENSION BT(3,130),                    IVSC(3),SCLM1(6),      00000705
           1SCLM2(6),ISTLBL(2,4),MB(3),MT(3)                                 00000706
0003        DOUBLE PRECISION TMCARY(130),TIPC,TSCL                           00000707
0004        DATA ISTLBL/4HLYNN,4HLAKE,4HTHOM,4HPSON,4HWINN,4HIPEG,4HTHE ,    00000708
           14HPAS /                                                          00000709
0005        DATA          MB/672,355,387/,MT/38,355,672/, TFRLTH/3600000./   00000710
0006        COMMON/DATE/MNTH,IDYMTH                                          00000711
0007        CALL FRAMEV                                                      00000712
      C                                                                      00000713
      C     ***** CHECK FOR ILLEGAL STATION CODE BEFORE PRINTING STATION     00000714
      C     *       LABEL ON THIS FRAME                                      00000715
      C                                                                      00000716
0008        IF(ISBSTA.GT.4) GO TO 105                                        00000717
0009        CALL PRINTV(8,ISTLBL(1,ISBSTA),200,1010)                         00000718
      C                                                                      00000719
      C     *****  PRINT ALL LABELLING FOR THIS PLOT B                       00000720
      C                                                                      00000721
0010      105 CALL PRINTV(8,8HMANITOBA,470,1010)                           00000722
0011        CALL PRINTV(6,6HPLOT C,830,1010)                                 00000723
0012        CALL PRINTV(20,20H(30 SECOND AVERAGES),270,993)                  00000724
0013        CALL MSCLDP(TIPC,IYR,IDY,IHR,MN,SEC)                             00000725
0014        CALL PRINTV( 6,6HDAY = ,792,993)                                 00000726
0015        CALL LABLV(FLOAT(IDY),840,993,3,1,3)                             00000727
0016        CALL PRINTV( 10,10H   DATE = ,864,993)                           00000728
0017        CALL LABLV(FLOAT(IDYMTH),944,993,2,1,2)                          00000729
0018        CALL PRINTV(3,MNTH,960,993)                                      00000730
0019        CALL LABLV(FLOAT(IYR),1000,993,2,1,2)                            00000731
0020        CALL PRINTV(2,2HUT,450,13)                                       00000732
0021        CALL PRINTV( 5,5HATS-E,300,13)                                   00000733
0022        CALL PRINTV( 13,13HDOMINION OBSY,850,13)                         00000734
0023        CALL PRINTV(1,1HH,27,788)                                        00000735
0024        CALL PRINTV(1,1HD,27,472)                                        00000736
0025        CALL PRINTV(1,1HZ,27,156)                                        00000737
0026        CALL APRNTV(0,-12,6,6HGAMMAS,12,442)                             00000738
      C                                                                      00000739
      C     *****  GENERATE GRID AND PLOT FOR THE H DATA,THEN DO THE SAME FOR00000740
      C     *       THE D AND Z COMPONENT ON THE SAME MICROFILM FRAME - THE   00000741
      C     *       COMPONENT PLOTTED IS SELECTED BY DO INDEX J              00000742
      C                                                                      00000743
0027        DO 5 J = 1,3                                                     00000744
0028        ISUB=IVSC(J)                                                     00000745
0029        CALL SETMIV(42,8,MB(J),MT(J))                                    00000746
0030        CALL GRID1V(2.0.,TFRLTH,SCLM1(ISUB),SCLM2(ISUB),TFRLTH/6.,       00000747
           1(SCLM2(ISUB)-SCLM1(ISUB))/6.,0,0,0,1,0,4)                        00000748
      C                                                                      00000749
      C     *****  DRAW TIC MARKS FOR HORIZONTAL (TIME) AXIS FOR THIS GRID   00000750
      C                                                                      00000751
0031        DO 1 I= 1,59                                                     00000752
0032        IF(MOD(I,10).EQ.0) GO TO 1                                       00000753
0033        XI= FLOAT(I)*TFRLTH/60.                                          00000754
0034        IF(MOD(I,5).EQ.0) GO TO 2                                        00000755
0035        CALL LINEV( NXV(XI),NYV(SCLM1(ISUB)),NXV(XI),NYV(SCLM1(ISUB))+8) 00000756
0036        GO TO 1                                                          00000757
0037      2 CALL LINEV(NXV(XI),NYV(SCLM1(ISUB)),NXV(XI),NYV(SCLM1(ISUB))+16) 00000758
0038      1 CONTINUE                                                         00000759
      C                                                                      00000760
      C     *****  DRAW TIC MARKS FOR VERTICAL (GAMMA UNIT) AXIS FOR THIS    00000761
      C     *       GRID                                                     00000762
      C                                                                      00000763
0039        DO 3 I=1,59                                                      00000764
0040        IF(MOD(I,10).EQ.0) GO TO 3                                       00000765
```

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0041                XI = FLOAT(I)*(SCLM2(ISUB)- SCLM1(ISUB))/60. + SCLM1(ISUB)      00000766
0042                IF(MOD(I,5).EQ.0) GO TO 4                                       00000767
0043                CALL LINEV(NXV(0.),NYV(XI),NXV(0.)+8,NYV(XI))                   00000768
0044                GO TO 3                                                         00000769
0045              4 CALL LINEV(NXV(0.),NYV(XI),NXV(0.)+16,NYV(XI))                  00000770
0046              3 CONTINUE                                                        00000771
0047                DO 5 I= 1,ICTC                                                  00000772
                  C                                                               00000773
                  C      *****  COMPUTE HORIZONTAL COORDINATE OF THIS DATA POINT   00000774
                  C      *       (SELECTED BY DO INDEX I)                         00000775
                  C                                                               00000776
0048                T=TMCARY(I)-TIPC                                              00000777
0049                IX=NXV(I)                                                     00000778
0050                ARG2=BT(J,I)                                                  00000779
0051                IY=NYV(ARG2)                                                  00000780
                  C                                                               00000781
                  C      *****  PLOT VALUE OF SELECTED FIELD COMPONENT ON ITS GRID 00000782
                  C                                                               00000783
0052              5 CALL PLOTV(IX,IY,42)                                          00000784
                  C                                                               00000785
                  C      *****  PRINT THE TIME    (HOUR AND MINUTE)    REPRESENTED BY EACH00000786
                  C      *       VERTICAL GRID LINE ON THE PLOT AT BOTTOM OF PLOT BENEATH 00000787
                  C      *       THE LINE                                         00000788
                  C                                                               00000789
0053                ARG=SCLM1(ISUB)                                               00000790
0054                IYB=NYV(ARG)                                                  00000791
0055                TSCL= TIPC                                                    00000792
0056                DO 6 I= 1,7                                                   00000793
0057                CALL MSCLDP(TSCL,IYR,IDY,IHR,MN,SEC)                          00000794
0058                T= TSCL - TIPC                                                00000795
0059                IX=NXV(T)                                                     00000796
0060                CALL LABLV(FLOAT(IHR),IX-16,IYB-4,2,1,2)                      00000797
```

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FORTRAN IV G LEVEL  18                  ATSGPC          DATE = 70273        19/20/19

0061                CALL LABLV(FLOAT(MN),IX,IYB-4,2,1,2)                          00000798
0062              6 TSCL = TSCL + TFRLTH/6.                                       00000799
0063                RETURN                                                        00000800
0064                END                                                           00000801
```

```
      C      ***** SUBROUTINE MSZRDP-CONVERTS A DATA TIME GIVEN BY YEAR,DAY   00000806
      C      *       HOUR,MINUTE,AND SECOND TO ITS EQUIVALENT IN A SINGLE TIME 00000807
      C      *       UNIT,I.E. MILLISECONDS SINCE ZERO YEAR (SEE EXPLANATION   00000808
      C      *       IN DOCUMENTATION TEXT)                                    00000809
      C                                                                        00000810
0001          SUBROUTINE MSZRDP(YR,DAY,IHR,MN,ISEC,TMSZYR)                   00000811
0002          DOUBLE PRECISION TMSZYR,YMS,YINC,DAYMS,MSDY                    00000812
0003          INTEGER YR,DAY,      YRSV                                      00000813
0004          COMMON/ZROYR/IZYR                                              00000814
0005          DATA YRSV/0/                                                   00000815
      C                                                                        00000816
      C      *****  BY-PASS CALCULATION OF MILLISECONDS FROM ZERO YEAR TO YEAR00000817
      C      *       OF THIS DATA TIME IF IT IS SAME AS YEAR OF THE DATA TIME  00000818
      C      *       IN THE LAST CALL TO THIS SUBROUTINE TO AVOID UNNECESSARY  00000819
      C      *       COMPUTATION                                              00000820
      C                                                                        00000821
0006          IF(YR.EQ.YRSV)GO TO 2                                          00000822
0007          YRSV=YR                                                        00000823
0008          YMS=0.D0                                                       00000824
0009          IF(YR.EQ.IZYR)GO TO 2                                          00000825
0010          IUL = YR-1                                                     00000826
      C                                                                        00000827
      C      *****  ADD THE MILLISECOND EQUIVALENT OF A YEAR FOR EACH YEAR    00000828
      C      *       THIS DATA TIME EXCEEDS THE ZERO YEAR AS PART OF THE      00000829
      C      *       COMPUTATION OF THE FINAL RESULT (TMSZYR) RETURNED BY THIS 00000830
      C      *       SUBROUTINE - MAKE APPROPRIATE ADJUSTMENT FOR ANY LEAP YEAR00000831
      C      *       ENCOUNTERED IN THIS COMPUTATION                           00000832
      C                                                                        00000833
0011          DO 1 I=IZYR,IUL                                                00000834
0012          YINC=31536000000.D0                                            00000835
0013          IF(MOD(I,4).EQ.0)YINC=31622400000.D0                           00000836
0014        1 YMS=YMS+YINC                                                   00000837
0015        2 DAYMS=(DFLOAT(DAY)-1.D0)*86400000.D0                           00000838
0016          MSDY=IHR*3600000+MN*60000+ISEC*1000                            00000839
0017          TMSZYR=YMS+DAYMS+MSDY                                          00000840
0018          RETURN                                                         00000841
0019          END                                                            00000842
```

```
      C     ***** SUBROUTINE MSCLDP-CONVERTS A DATA TIME IN MS SINCE ZERO    00000847
      C     *       YEAR (SEE EXPLANATION IN DOCUMENTATION TEXT) TO ITS      00000848
      C     *       EQUIVALENT IN YEAR,DAY OF YEAR,HOUR,MINUTE,SECOND,       00000849
      C     *       MONTH, AND DAY OF MONTH(THE LATTER TWO OUTPUTS ARE IN THE 00000850
      C     *       COMMON SECTION NAMED DATE)                               00000851
      C                                                                      00000852
0001        SUBROUTINE MSCLDP(TM,YR,DAY,HR,MIN,SEC)                        00000853
0002        DIMENSION MNTHLM(12),MTHBCD(12)                                00000854
0003        DATA MNTHLM/31,59,90,120,151,181,212,243,273,304,334,365/      00000855
0004        DATA MTHBCD/3HJAN,3HFEB,3HMAR  ,3HAPR  ,3HMAY,3HJUN ,3HJUL ,3HAUG,00000856
           13HSEP ,3HOCT,3HNOV,3HDEC/,MTHERR/4HERRM/                       00000857
0005        INTEGER          YR,YRORG,     DAY,DYRM,HR,HRM                 00000858
0006        DOUBLE PRECISION TM,TMWRK,YRMS                                 00000859
0007        COMMON/ZROYR/YRORG                                             00000860
0008        COMMON/DATE/MNTH,IDYMTH                                        00000861
0009        TMWRK=TM                                                       00000862
0010        YR=YRORG                                                       00000863
      C                                                                    00000864
      C     *****  FIND YEAR OF DATA BY ADDING 1 TO ZERO YEAR FOR EVERY     00000865
      C     *       MILLISECOND EQUIVALENT OF A YEAR CONTAINED IN THE INPUT 00000866
      C     *       DATA TIME(IN MS SINCE ZERO YEAR) - MAKE PROPER ADJUSTMENT00000867
      C     *       FOR LEAP YEAR                                           00000868
      C                                                                    00000869
0011        DO 1 I=1,5                                                     00000870
0012        YRMS= 31536000000.D0                                           00000871
0013        IF(MOD(YR,4).EQ.0) YRMS = 31622400000.D0                       00000872
0014        IF(TMWRK.LT.YRMS)GO TO 2                                       00000873
0015        TMWRK=TMWRK - YRMS                                             00000874
0016      1 YR=YR+1                                                        00000875
      C                                                                    00000876
      C     *****  COMPUTE DAY OF YEAR FROM NUMBER OF MS REMAINING IN INPUT 00000877
      C     *       TIME WHEN ALL EXACT YEAR EQUIVALENTS IN MS HAVE BEEN    00000878
      C     *       REMOVED                                                 00000879
      C                                                                    00000880
0017      2 DAY = TMWRK/86400000.D0+1.                                     00000881
0018        DYRM=DMOD(TMWRK,86400000.D0)                                   00000882
      C                                                                    00000883
      C     *****  COMPUTE HOUR OF DAY FROM NUMBER OF MS REMAINING IN INPUT 00000884
      C     *       TIME WHEN ALL EXACT DAY EQUIVALENTS IN MS HAVE BEEN     00000885
      C     *       REMOVED - SIMILARLY GET MINUTE AND SECOND               00000886
      C                                                                    00000887
0019        HR = DYRM/3600000                                              00000888
0020        HRM= MOD(DYRM,3600000)                                         00000889
0021        MIN=  HRM/60000                                                00000890
0022        MINRM= MOD(HRM,60000)                                          00000891
0023        SEC= FLOAT(MINRM)/1000.                                        00000892
      C                                                                    00000893
      C     *****  FIND MONTH OF INPUT DATA TIME - TO DO THIS FIND THE MONTH 00000894
      C     *       HAVING A BEGIN AND END DAY OF THE YEAR WHICH BRACKET THE 00000895
      C     *       DAY OF THE YEAR OF THE INPUT TIME AS FOUND ABOVE         00000896
      C                                                                    00000897
0024        IF(DAY.GT.MNTHLM(1)) GO TO 3                                   00000898
0025        IDYMTH=DAY                                                     00000899
0026        MNTH=MTHBCD(1)                                                 00000900
0027        RETURN                                                         00000901
      C                                                                    00000902
      C     *****  ADD 1 TO END DAY OF YEAR OF ALL MONTHS OF THE YEAR AFTER 00000903
      C     *       JANUARY IF THE YEAR OF THE INPUT DATA TIME IS A LEAP YEAR00000904
      C                                                                    00000905
0028      3 INC=0                                                          00000906
0029        IF(YRMS.EQ.31622400000.D0)INC=1                                00000907
0030        DO 4 I=2,12                                                    00000908
0031        IF(DAY.LE.(MNTHLM(I)+INC)) GO TO 5                             00000909
0032      4 CONTINUE                                                       00000910
      C                                                                    00000911
      C     *****  ERROR RETURN                                            00000912
      C                                                                    00000913
0033        IDYMTH=50                                                      00000914
0034        MNTH=MTHERR                                                    00000915
0035        RETURN                                                         00000916
      C                                                                    00000917
      C     *****  CALCULATE DAY OF MONTH BY SUBTRACTING THE BEGIN DAY OF THE00000918
      C     *       YEAR OF THE MONTH CONTAINING THE INPUT DATA TIME FROM THE00000919
      C     *       DAY OF THE YEAR OF THE INPUT DATA TIME - IF THE MONTH OF 00000920
      C     *       THE DATA TIME IS FEBRUARY ITS BEGIN DAY OF THE YEAR IS   00000921
      C     *       THE SAME WHETHER THE YEAR OF THE INPUT DATA TIME IS A    00000922
      C     *       LEAP YEAR OR NOT                                         00000923
      C                                                                    00000924
0036      5 IF(I.EQ.2)INC=0                                                00000925
0037        IDYMTH=DAY-MNTHLM(I-1)-INC                                     00000926
0038        MNTH=MTHBCD(I)                                                 00000927
0039        RETURN                                                         00000928
0040        END                                                            00000929
```

```
PICK     ROUTINE TO PICK OUT CONTIGUOUS BITS -- D N C                                                    PAGE    1

   LOC  OBJECT CODE     ADDR1 ADDR2  STMT   SOURCE STATEMENT .                                F30SEP69  9/30/70

                                      2 **CALL PICK(TO,FRO,OTO,OFRO,NOBI) ********************************** 00000934
                                      3 *                                                                  * 00000935
                                      4 * TO = ADDRESS OF WORD WHERE BITS ARE TO BE MOVED (XR2)            * 00000936
                                      5 * FRO = ADDRESS OF WORD WHERE BITS ARE TO BE GOTTEN (XR3)          * 00000937
                                      6 * OTO = SWITCH THAT ALLOWS COMBINING W/C(TO) WHEN.NE.0,(XR4)       * 00000938
                                      7 * OFRO = OFFSET OF WORD WHERE BITS ARE LOCATED (XR5) ,IN BITS      * 00000939
                                      8 * NOBI = NUMBER OF BITS INVOLVED IN OPERATION (XR6),.LE.63         * 00000940
                                      9 *                                                                  * 00000941
                                     10 *   ALL PARAMETERS ARE INTEGERS                                   * 00000942
                                     11 *                                                                  * 00000943
                                     12 ********************************************************************** 00000944
                                     13 *                                                                  * 00000945
000000                               14 PICK     CSECT                                                      00000946
000000 90EC D00C          0000C      15          STM   14,12,12(13)                                         00000947
000004 05C0                          16          BALR  12,0                                                 00000948
000006                               17          USING *,12                                                 00000949
000006 9826 1030          00000      18          LM    2,6,0(1)        STORE ARG ADD'S                    00000950
00000A 5875 0030          00000      19          L     7,0(5)          OFFSET                             00000951
00000E 4270 C02D          00033      20          STC   7,SLSB+3        FIX SHIFT LEFT SINGLE INSTR.       00000952
000012 5876 0030          00000      21          L     7,0(6)          NOBI                               00000953
000016 4270 C031          00037      22          STC   7,SLDB+3        FIX SHIFT LEFT DOUBLE INSTR.       00000954
00001A 5882 0030          00000      23          L     8,0(2)                                             00000955
00001E 5893 0030          00000      24          L     9,0(3)          FRO                                00000956
000022 5874 0030          00000      25          L     7,0(4)          CHECK FOR DOUBLE WORD-COMBINING    00000957
000026 5970 C04A          00050      26          C     7,=F'0'                                            00000958
00002A 4770 C02A          00030      27          BNE   SLSB                                               00000959
00002E 1988                          28 NDBC     SR    8,8             NO DOUBLE WORD-COMBINING           00000960
000030 8990 0030          00000      29 SLSB     SLL   9,0(0)          SHIFT LEFT OFRO                    00000961
000034 8D80 0000          00000      30 SLDB     SLDL  8,0(0)          NOBI                               00000962
000038 5082 0030          00000      31 NEXT     ST    8,0(2)          STORE DATA AT TO                   00000963
00003C 982C D01C          001C      32          LM    2,12,28(13)     RESTORE XRS                        00000964
000040 58FD 000C          0000C      33          L     14,12(13)                                          00000965
000044 92FF D00C          0000C      34          MVI   12(13),X'FF'                                       00000966
000048 07FE                          35          BCR   15,14           EXIT                               00000967
000000                               36          END   PICK                                               00000968
000050 00000000                      37                =F'0'
```

APPENDIX D

"AUTO-FLOW" PROGRAM FLOW CHART

NOTE: THE AUTOFLOW INSTRUCTION BOOKLET OBTAINABLE FROM THE APPLIED DATA RESEARCH CORP. OFFICE AT GSFC CONTAINS AN EXPLANATION OF THE NUMBERS WRITTEN ADJACENT TO THE AUTOFLOW CHART BOXES. THESE NUMBERS ARE GENERALLY AUTOFLOW PAGE, BOX, OR FORTRAN STATEMENT NUMBERS.

CHART TITLE - MAIN PROGRAM

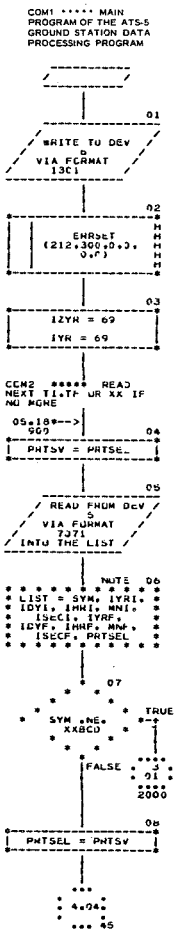


CHART TITLE - MAIN PROGRAM

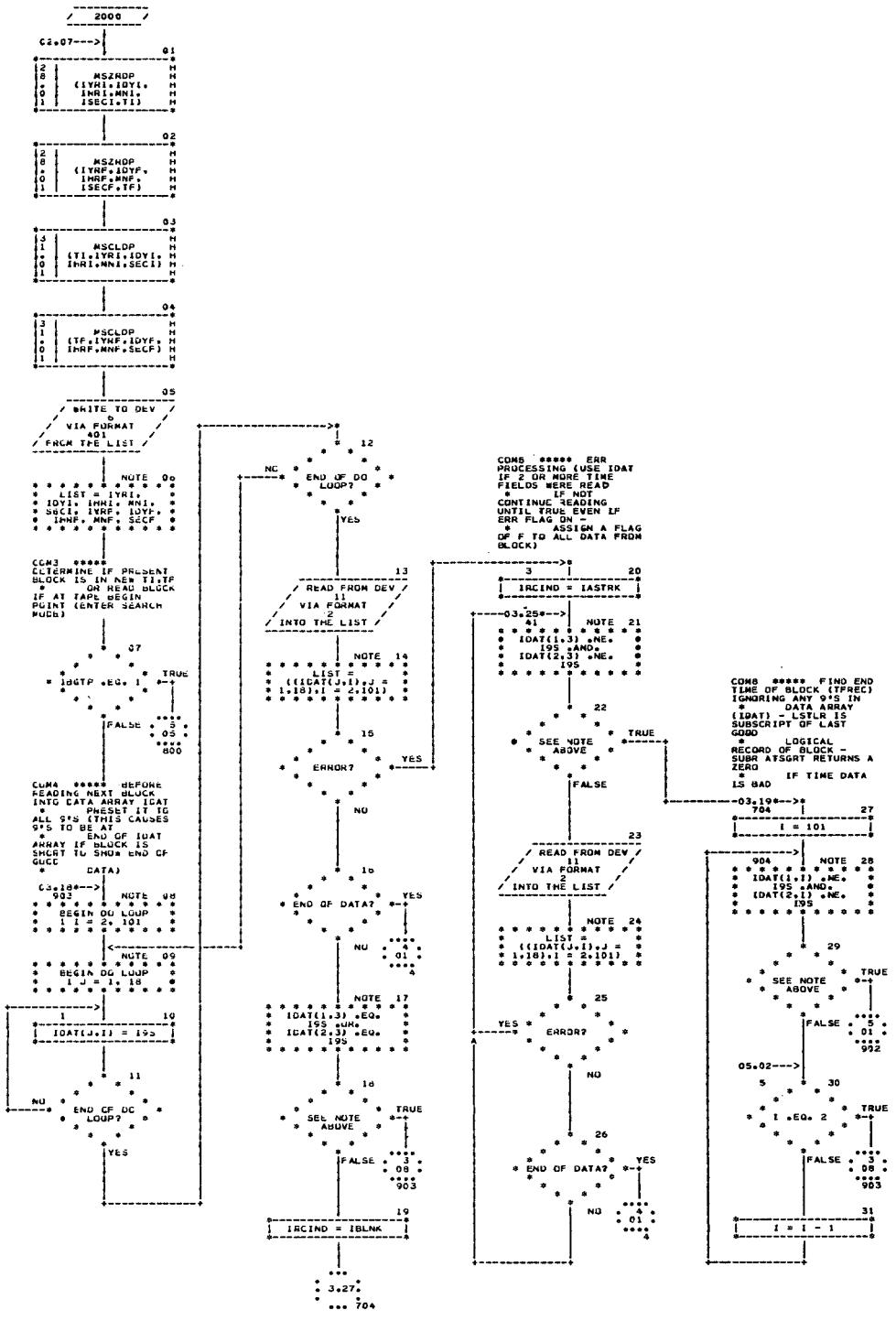


CHART TITLE - MAIN PROGRAM

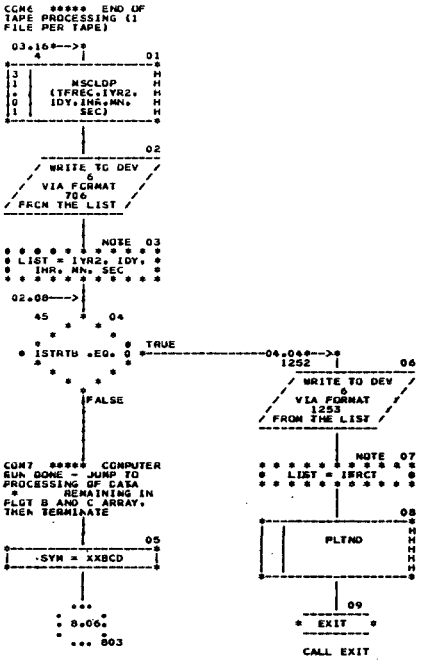


CHART TITLE - MAIN PROGRAM

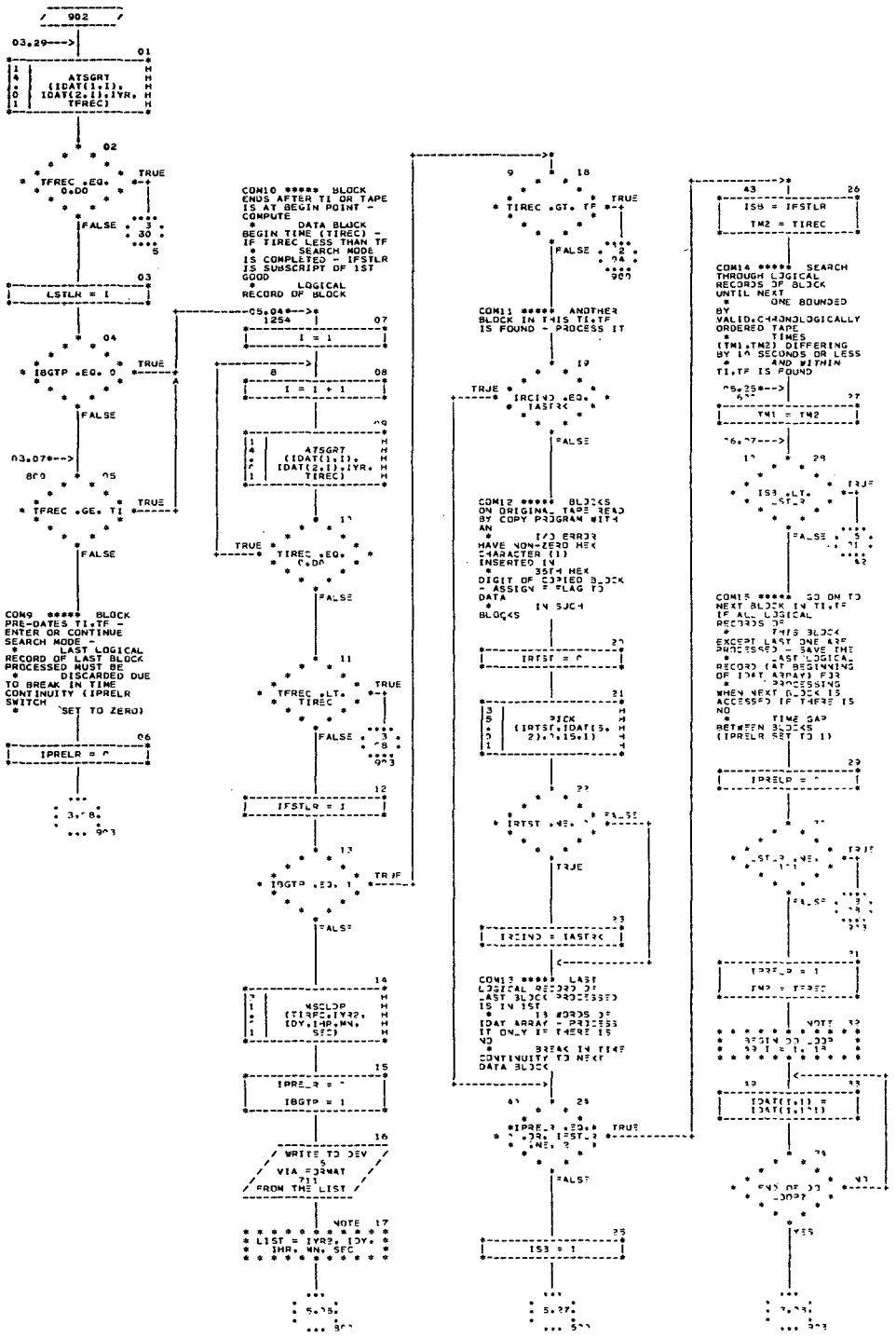


CHART TITLE - MAIN PROGRAM

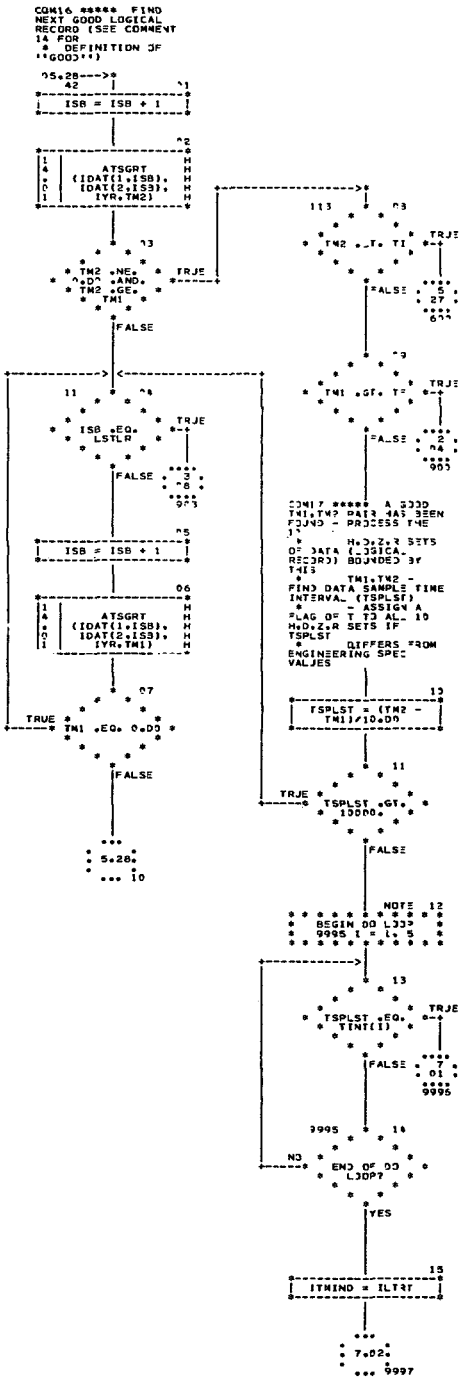


CHART TITLE - MAIN PROGRAM

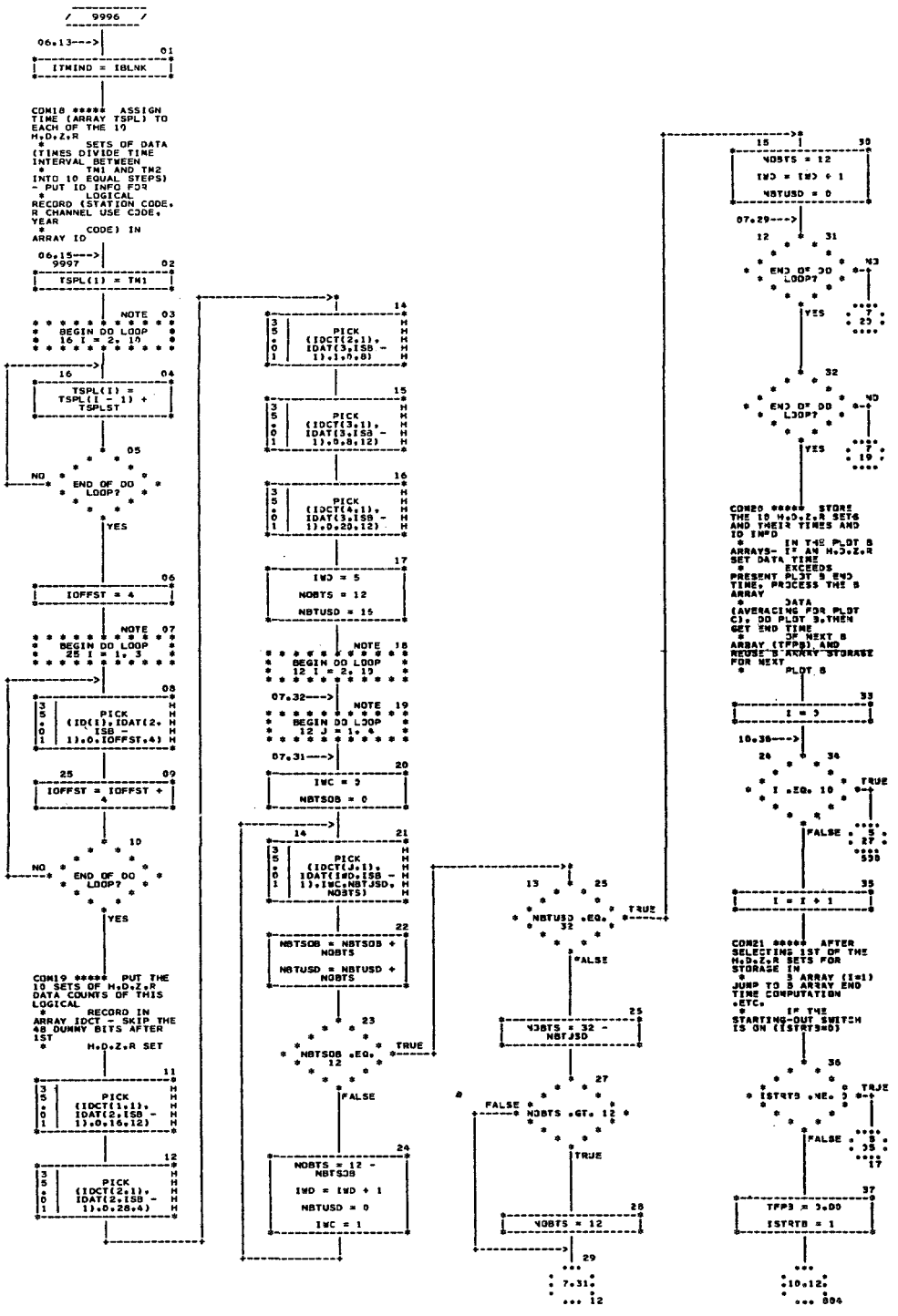


CHART TITLE - MAIN PROGRAM

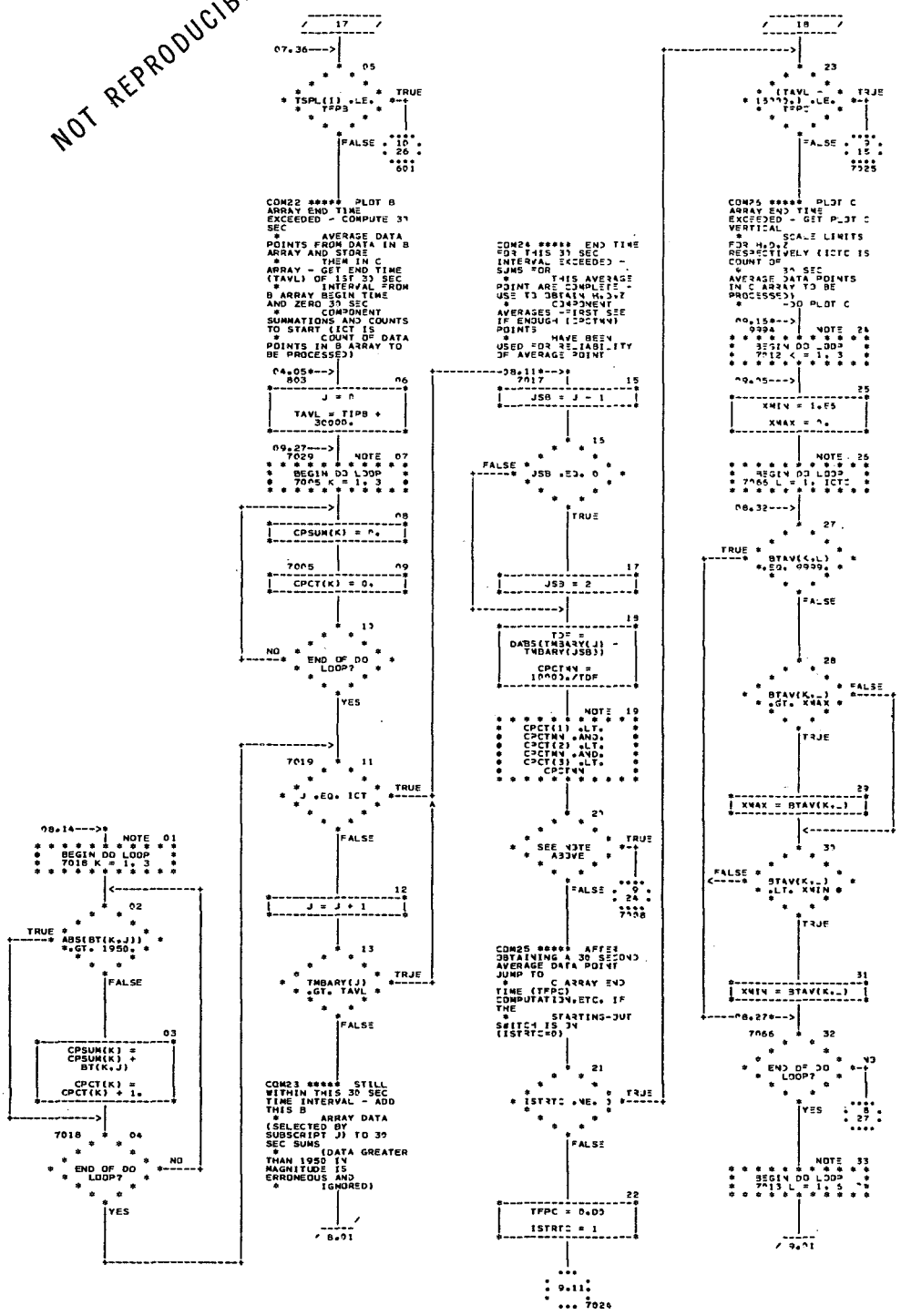


CHART TITLE - MAIN PROGRAM

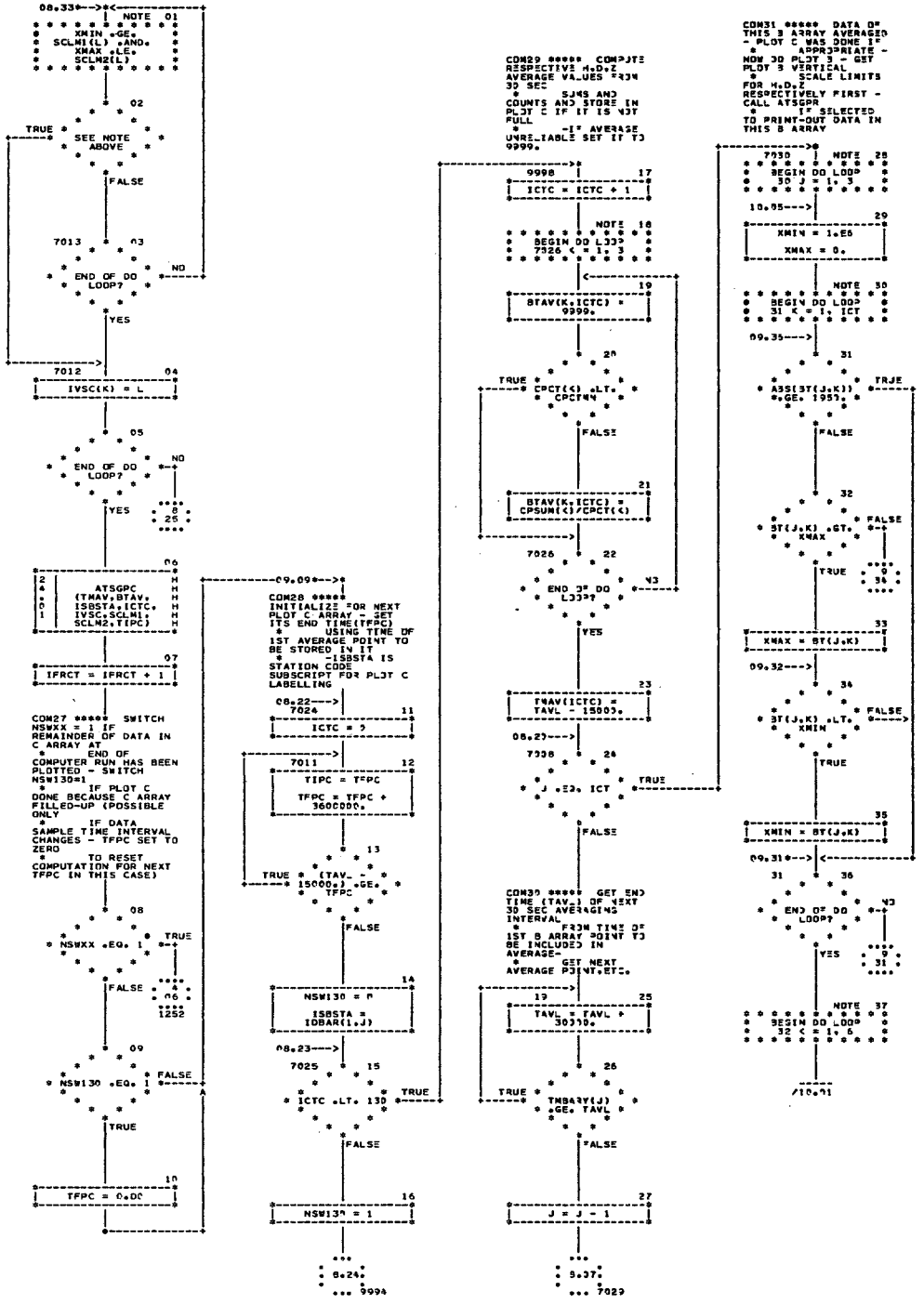


CHART TITLE - MAIN PROGRAM

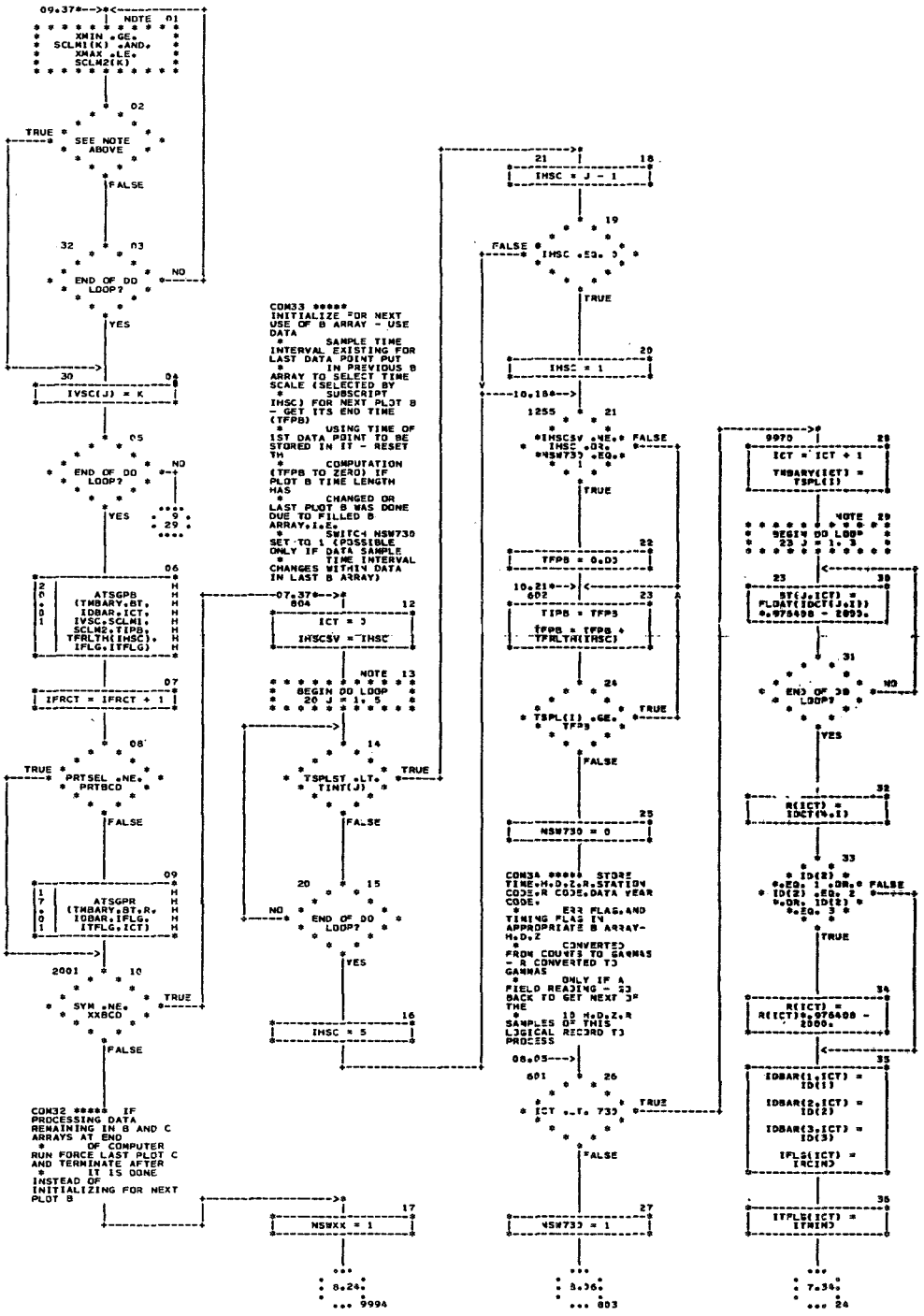


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DIMENSION BT(3,730),BTAV(3,130),IDAT(18,101),R(730),IDBAR(3,730),
      ID(3),IDCT(4,10),TFRLTH(5),TINT(5),CPSUM(3),CPCT(3),IVSC(3),
      SCLM1(6),SCLM2(6),IFLG(730),ITFLG(73))
      INTEGER SYM,XXBCD,PRTBCD,PRTSEL,PRTSV
      DOUBLE PRECISION TI,TF,TIREC,TFREC,TM1,TM2,TIP3,TFP3,TIPC,TFPC,
      TAVL,TSPL(10),TMBARY(730),TMAV(130)
      DATA IBGTP/0/,ISTRT3/0/,ISTRTC/0/,I99/Z99999999/,IFRCT/0/,
                              TFRLTH/6000.,360000.,720000.,3600000.,
      3600000./,SCLM1/-60.,-150.,-300.,-600.,-1200.,-2400./,
      SCLM2/60.,150.,300.,600.,1200.,2400./,XXBCD/2HXX/,IASTR/1HF/,
      IBLNK/1H /,TINT/100.,1000.,2000.,5000.,10000./,NS#XX/0/,I_TRT/1HT/
      ,PRTBCD/3HPRT/
      COMMON/ZROYR/IZYR
1391  FORMAT(1H1///1X,'ATS-5 GROUND STATION DATA TAPE PROCESSING')
7071  FORMAT(1X,A2,3X,I2,1X,I3,1X,I2,1X,I2,1X,I2,1X,I2,12X,I2,1X,I3,1X,I2,1X,
      I2,1X,I2,1X,A3)
401   FORMAT(///1X, 27HREAD NEW TI,TF TIME REQUEST     ,5X, 5HTI IS ,I2,
      1H/,I3,1H/,I2,1H/,I2,1H/,F6.3,10X, 5HTF IS ,I2,1H/,I3,1H/,I2,1H/,I
      2,1H/,F6.3)
2     FORMAT(20A4,20A4,20A4,20A4,20A4,20A4,20A4,20A4,20A4,20A4)
706   FORMAT(///1X, 66HENCOUNTERED END OF THIS P3 TAPE - LAST FIELD DATA
       TIME ON TAPE IS I2,1H/,I3,1H/,I2,1H/,I2,1H/,F6.3)
1253  FORMAT(///1X,'NUMBER OF 4020 PLOT FRAMES DONE=',I10)
711   FORMAT(///1X, 41HFIRST FIELD DATA TIME ON THIS P3 TAPE IS I2,1H/,I
      3,1H/,I2,1H/,I2,1H/,F6.3)
```

CHART TITLE - INTRODUCTORY COMMENTS


```
***** SUBROUTINE ATSGRT-CONVERTS TIME DATA IN THE LOGICAL RECORD
*       BEING PROCESSED INTO THE EQUIVALENT IN MILLISECONDS-SINCE-
*       ZERO-YEAR UNITS - ARRAY ITMEL HOLDS THE 9 HEX DIGITS OF
*       THE TIME DATA - SEE APPENDIX B FOR DATA TAPE FORMAT
```

CHART TITLE - SUBROUTINE ATSGRT(IWD1,IWD2,IYR,TM)

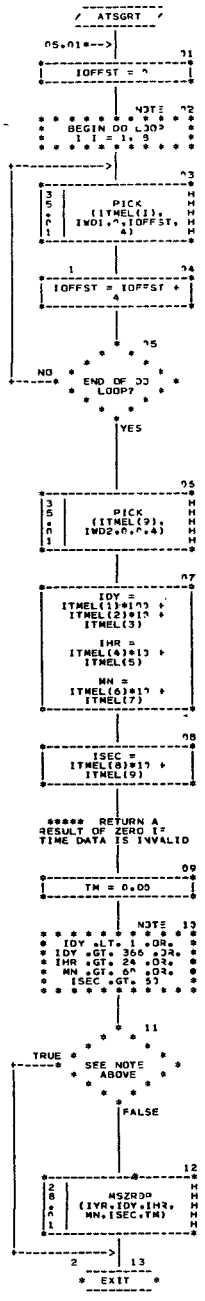


CHART TITLE - NON-PROCEDURAL STATEMENTS


```
      DOUBLE PRECISION TM
      DIMENSION ITMEL(9)
```

CHART TITLE - INTRODUCTORY COMMENTS


```
***** SUBROUTINE ATSGPR-GENERATES PRINT-OUT ON THE SYSTEM OUTPUT
*       UNIT OF THE DATA PRESENTLY STORED IN THE B ARRAY AS A
*       FUNCTION OF TIME - SEE APPENDIX E FOR A SAMPLE OF THIS
*       PRINT-OUT
```

CHART TITLE - SUBROUTINE ATSGPR(TMBARY,BT,R,IDBAR,IFLG,ITFLG,ICT)

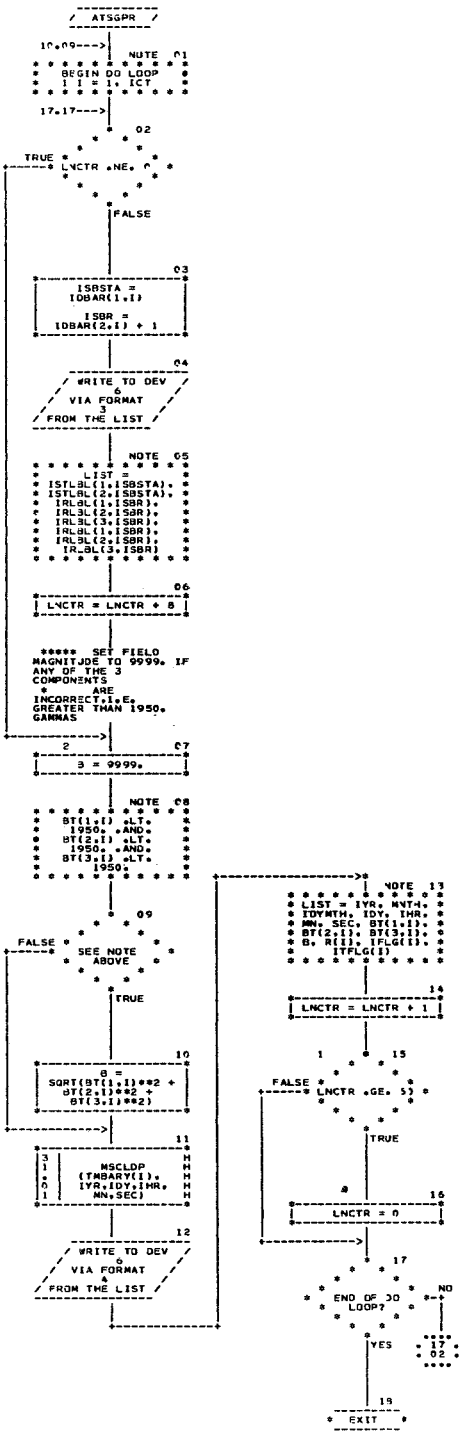


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DIMENSION BT(3,730),R(730),IDBAR(3,730),IF_G(730),IST_B_(2,4),
      IRLBL(3,6),ITFLG(730)
      DOUBLE PRECISION TMBARY(730)
      DATA ISTLBL/4HLYNN,4HLAKE,4HTHOM,4HPSON,4HWINN,4HIPEG,4HTHE ,
      4HPAS /,IRLBL/4HNOT ,4HUSED,4H    ,4HH AX,4HIS  ,4H    ,4HD AX,
      4HIS  ,4H    ,4HZ AX,4HIS  ,4H    ,4HPROT,4HON E,4HXP  ,4HDTHE,
      4HR EX,4HP   /
      DATA LNCTR/0/
      COMMON/DATE/MNTH,IDYMTH
    3 FORMAT(1H1/// 9X, 54HATS-E MFM            CANADIAN DOMINION OBSERV
      ATORY AT ,2A4,1X, 48HMANITOBA        MAGNETIC FIELD MEASUREMENTS
       R=,3A4//10X, 95HDATE      DAY OF      TIME         H AXIS     D AXIS
         Z AXIS     TOTAL FIELD     FG MINUS          R/8X, 93HYR MON DAY
      YEAR   HR  MN  SEC     (GAMMAS)  (GAMMAS)  (GAMMAS)     (GAMMAS)
        PROTON        ,3A4//)
    4 FORMAT(8X,I2,1X,A3,1X,I2,3X,I3,4X,I2,2X,I2,2X,F4.1,3X,F7.1,3X,F7.1
      ,3X,F7.1,4X,F6.1,22X,F7.1,1X,A1,1X,A1)
```

CHART TITLE - INTRODUCTORY COMMENTS


```
***** SUBROUTINE ATSGPB-GENERATES PLOT OF H,D,Z COMPONENT VALUES
*       (INDIVIDUALLY) OVER THE CHRONOLOGICALLY NEXT DATA TIME
*       SPAN,I.E. CONTENTS OF PRESENT B ARRAY - THE VERTICAL SCALE
*       OF THE PLOT FOR A COMPONENT IS SELECTED FROM SEVERAL
*       POSSIBLE SCALES FOR THE BEST DATA DISPLAY RESOLUTION IN
*       ACCORDANCE WITH THE RANGE OF DATA DISPLAYED IN THE PLOT -
*       THE HORIZONTAL (TIME) SCALE IS CHOSEN FROM SEVERAL
*       POSSIBLE SCALES FOR THE BEST DATA DISPLAY RESOLUTION IN
*       ACCORDANCE WITH THE DATA SAMPLING TIME INTERVAL FOR THE
*       FIRST DATA VALUE STORED IN THE PRESENT B ARRAY - THE
*       CHOICE OF THE VERTICAL SCALE FOR EACH COMPONENT AND THE
*       HORIZONTAL (TIME) SCALE IS DONE IN THE MAIN PROGRAM - SEE
*       APPENDIX F FOR A SAMPLE PLOT B
```

CHART TITLE - SUBROUTINE ATSGPB(TMBARY,BT,ID3AR,ICT,IVSC,SCLM1,SCLM2,TIPB,TER,T

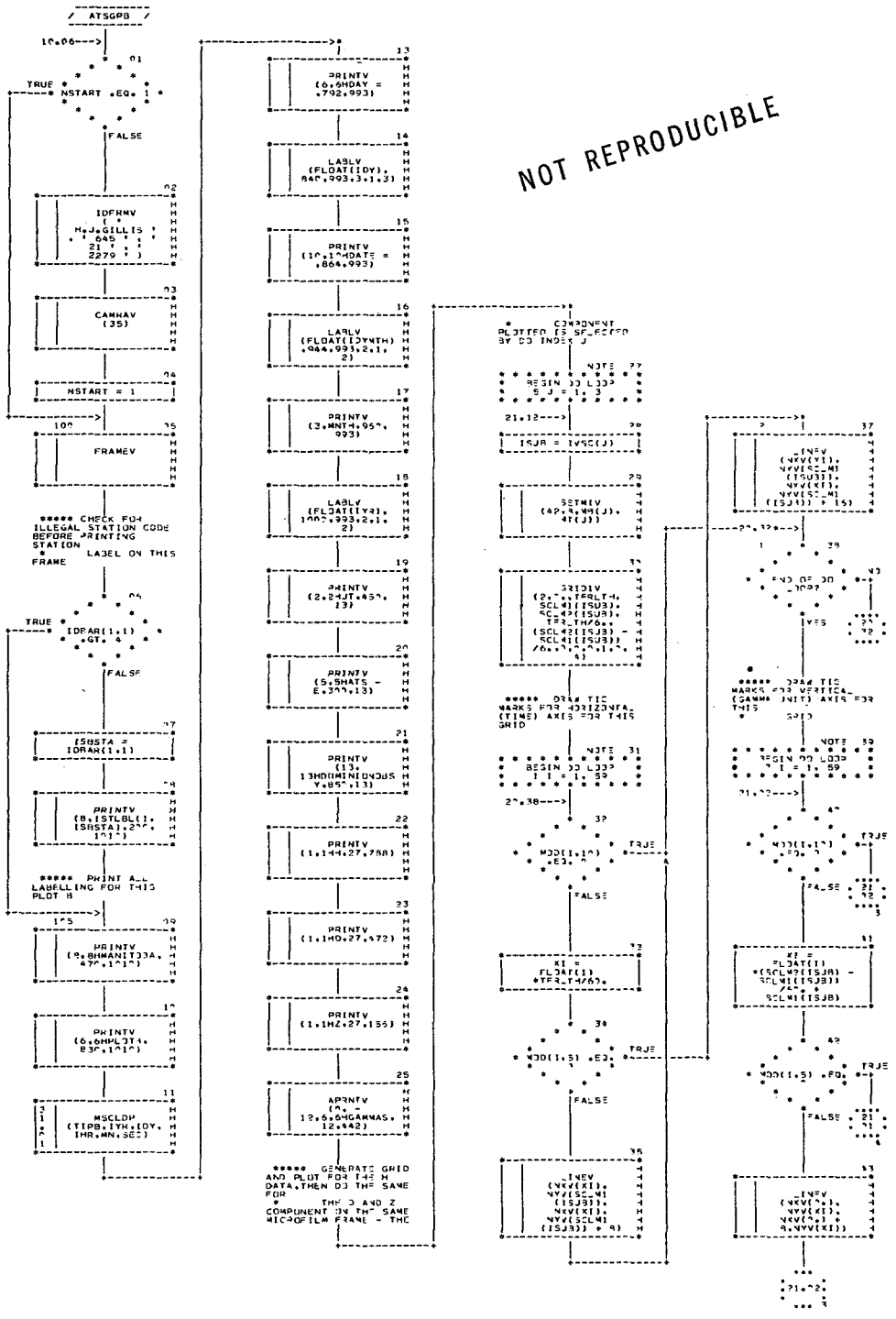


CHART TITLE - SUBROUTINE ATSGPB(TMBARY,BT,IDBAR,ICT,IVSC,SCLM1,SC_M2,TIP3,TFR_F

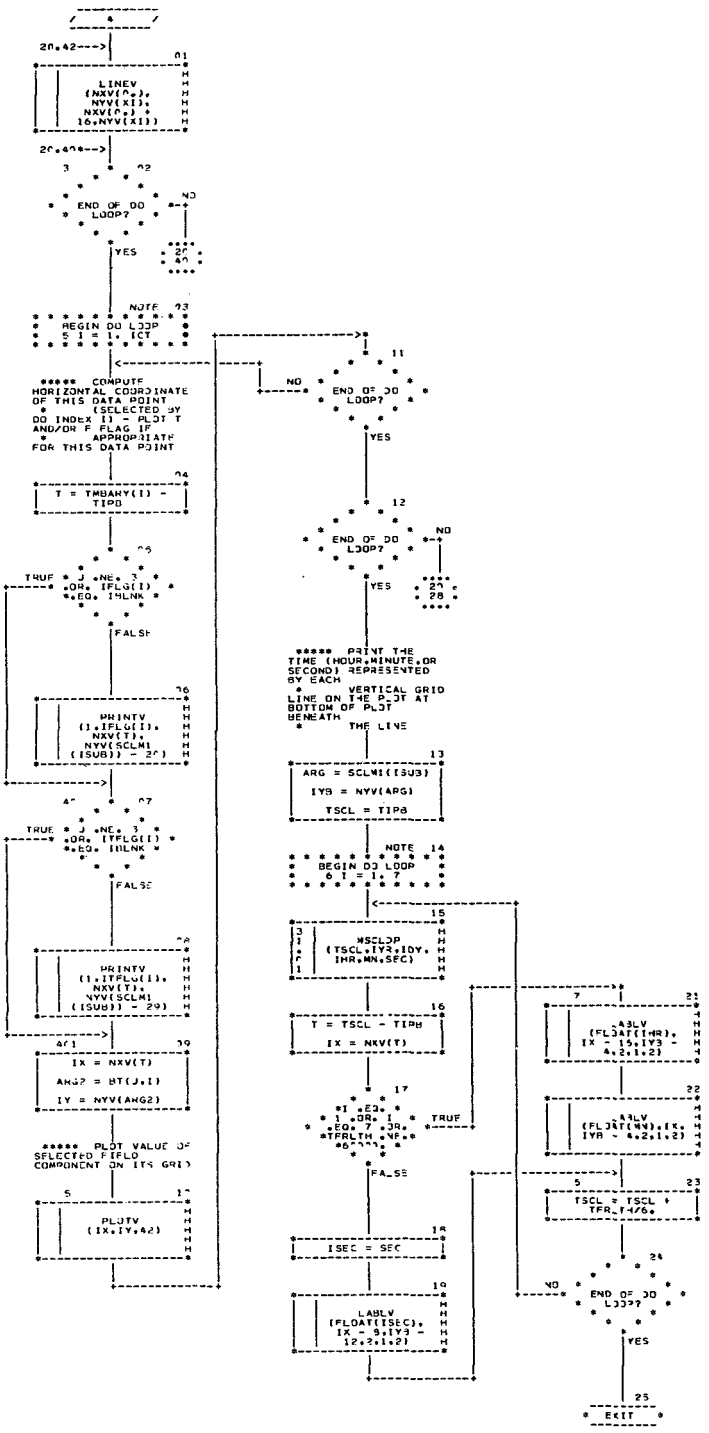


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DIMENSION BT(3,730),IDBAR(3,730),IF_G(730),IVSC(3),SC_M1(5),
     SCLM2(6),ISTLBL(2,4),MB(3),MT(3),ITFLG(730)
      DOUBLE PRECISION TMBARY(730),TIPB,TSC_
      DATA ISTLBL/4HLYNN,4HLAKE,4HTHOM,4HPSON,4HWINN,4HIPEG,4HTHE ,
     4HPAS /
      DATA NSTART/0/,MB/672,355,38/,MT/38,355,672/,IB_NK/1H /
      COMMON/DATE/MNTH,IDYMTH
```

CHART TITLE - INTRODUCTORY COMMENTS

```
***** SUBROUTINE ATSGPC------GENERATES A PLOT OF THIRTY
*       SECOND AVERAGE H, D, Z, COMPONENT VALUES
*       (INDIVIDUALLY) OVER THE CHRONOLOGICALLY NEXT DATA TIME
*       SPAN, I.E. CONTENTS OF PRESENT C ARRAY - THE VERTICAL SCALE
*       OF THE PLOT FOR A COMPONENT IS SELECTED FROM SEVERAL
*       POSSIBLE SCALES FOR THE BEST DATA DISPLAY RESOLUTION IN
*       ACCORDANCE WITH THE RANGE OF DATA DISPLAYED IN THE PLOT -
*       THE HORIZONTAL (TIME) SCALE IS SET AT 1 HOUR IN LENGTH
*       AND BEGINS AT THE EXACT HOUR IMMEDIATELY PRECEDING THE
*       TIME OF THE 1ST DATA VALUE STORED IN THE PRESENT C ARRAY -
*       CHOICE OF THE VERTICAL SCALE FOR EACH COMPONENT AND THE
*       HORIZONTAL (TIME) SCALE IS DONE IN THE MAIN PROGRAM - SEE
*       APPENDIX G FOR A SAMPLE PLOT C
```

CHART TITLE - SUBROUTINE ATSGPC(TMCANY,GT,ISBSTA,ICTC,IVSC,SCLM1,SCLM2,FIPC)

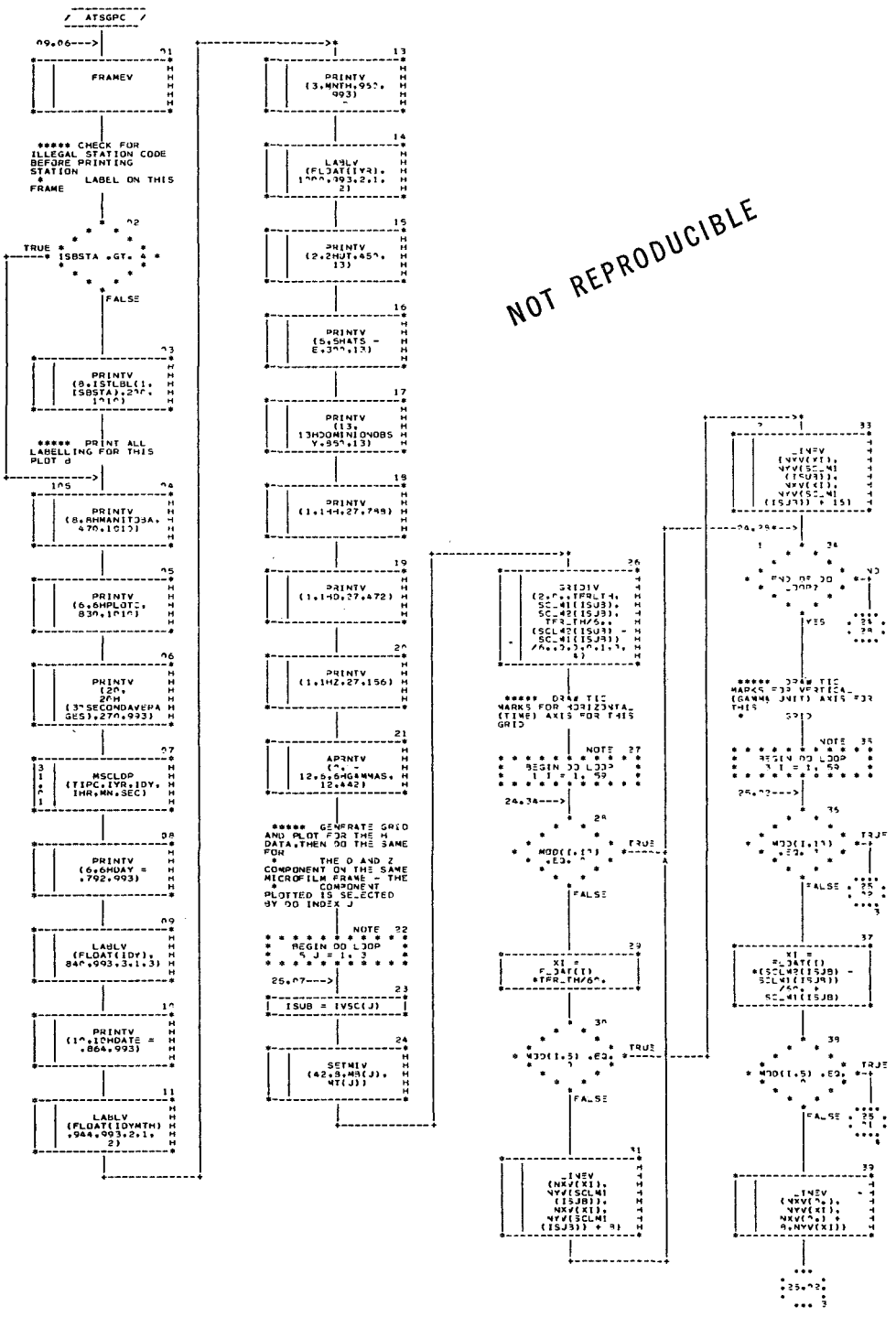


CHART TITLE - SUBROUTINE ATSGPC(TMCARY,BT,ISBSTA,ICTC,IVSC,SCLMI,SC_M2,TIPC)

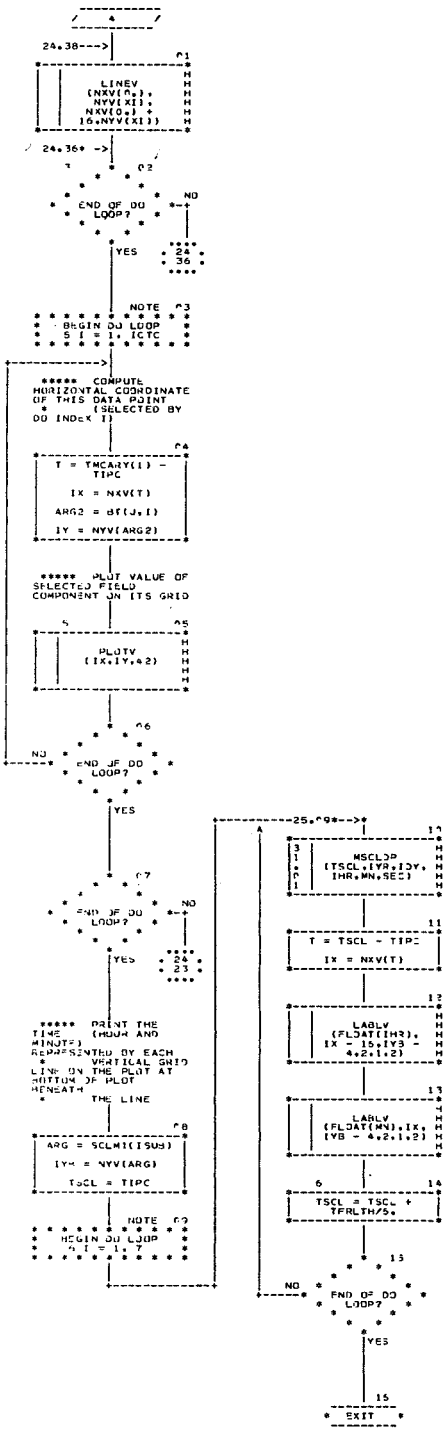


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DIMENSION BT(3,13^),                          IVSC(3),SC_M1(6),
     SCLM2(6),ISTL3L(2,4),MB(3),MT(3)
      DOUBLE PRECISION TMCARY(13^),TIPC,TSC_
      DATA ISTLBL/4HLYNN,4HLAKE,4HTHOM,4HPSON,4HWINN,4HIPEG,4HTHE ,
     4HPAS /
      DATA            MB/672,355,38/,MT/38,355,672/, TER_TH/35^^^^^^,/
      COMMON/DATE/MNTH,IDYMTH
```

CHART TITLE - INTRODUCTORY COMMENTS


```
***** SUBROUTINE MSZRDP-CONVERTS A DATA TIME GIVEN BY YEAR,DAY
*       HOUR,MINUTE,AND SECOND TO ITS EQUIVALENT IN A SINGLE TIME
*       UNIT,I.E. MILLISECONDS SINCE ZERO YEAR (SEE EXPLANATION
*       IN DOCUMENTATION TEXT)
```

CHART TITLE - SUBROUTINE MSZROP(YR,DAY,IHR,MN,ISEC,TMSZYR)

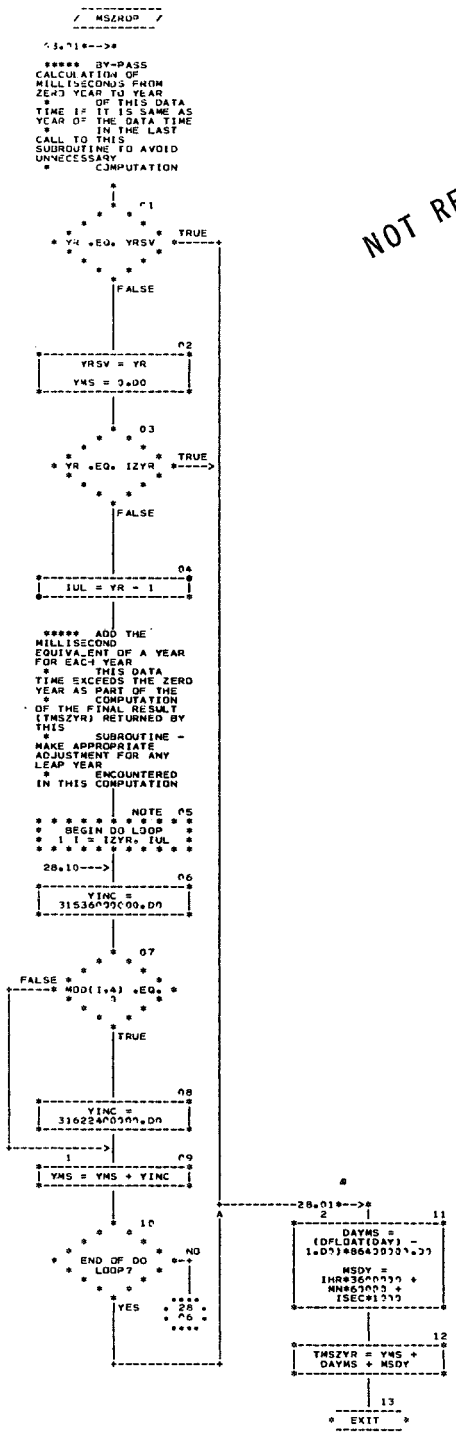


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DOUBLE PRECISION TMSZYR,YMS,YINC,DAYMS,MSDY
      INTEGER YR,DAY,     YRSV
      COMMON/ZROYR/IZYR
      DATA YRSV/0/
```

CHART TITLE - INTRODUCTORY COMMENTS


```
***** SUBROUTINE MSCLDP-CONVERTS A DATA TIME IN MS SINCE ZERO
*       YEAR (SEE EXPLANATION IN DOCUMENTATION TEXT) TO ITS
*       EQUIVALENT IN YEAR,DAY OF YEAR,HOUR,MINUTE,SECOND,
*       MONTH,AND DAY OF MONTH(THE LATTER TWO OUTPUTS ARE IN THE
*       COMMON SECTION NAMED DATE)
```

CHART TITLE - SUBROUTINE MSCLDP(TM,YR,DAY,HR,MIN,SEC)

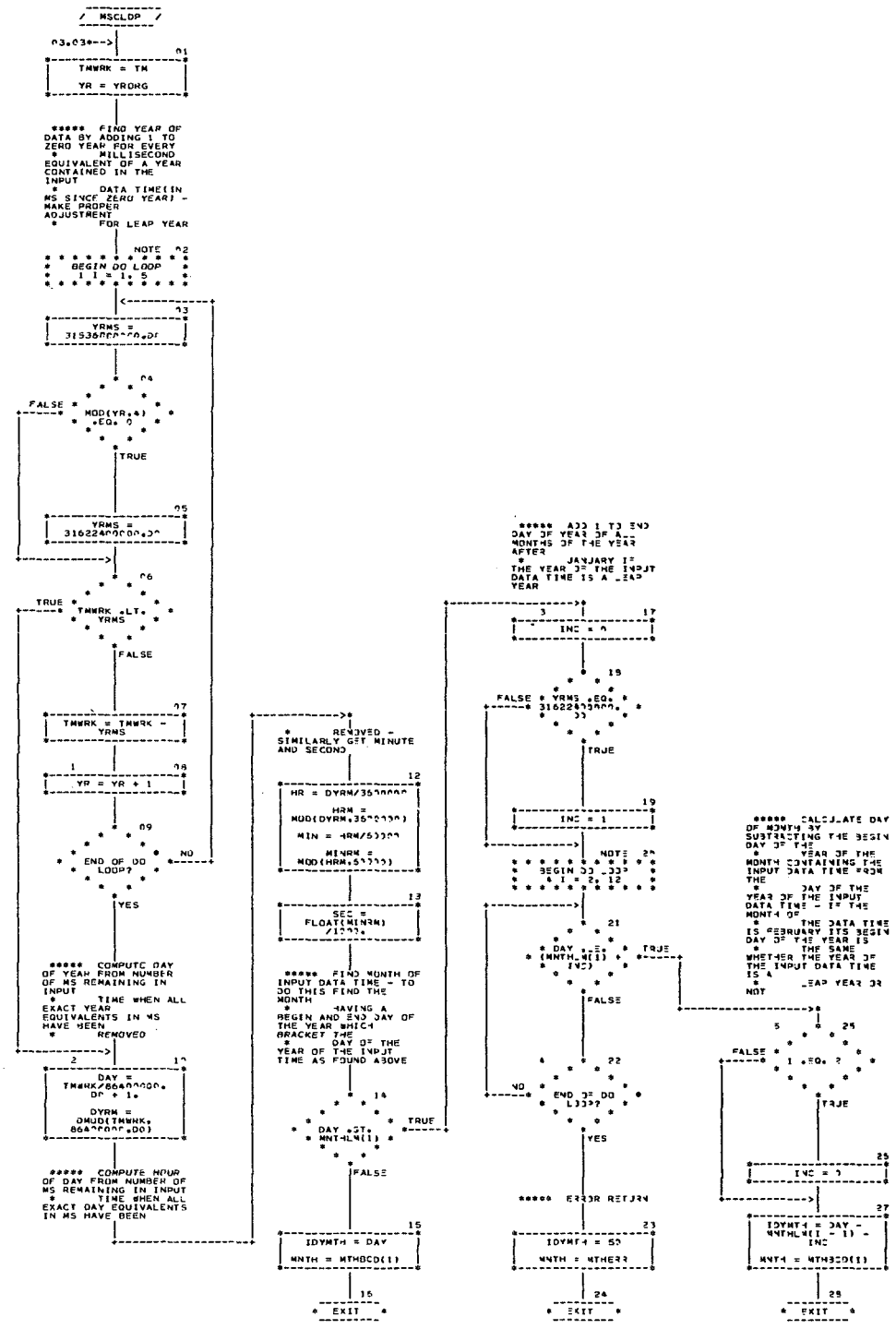


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DIMENSION MNTHLM(12),MTHBCD(12)
      DATA MNTHLM/31,59,90,120,151,181,212,243,273,304,334,355/
      DATA MTHBCD/3HJAN,3HFEB,3HMAR  ,3HAPR  ,3HMAY,3HJUN ,3HJUL  ,3HAUG,
     3HSEP ,3HOCT,3HNOV,3HDEC/,MTHERR/4HERRM/
      INTEGER          YR,YRORG,     DAY,DYRM,HR,HRM
      DOUBLE PRECISION TM,TMWRK,YRMS
      COMMON/ZROYR/YRORG
      COMMON/DATE/MNTH,IDYMTH
```

CHART TITLE - ' ROUTINE TO PICK OUT CONTIGUOUS BITS -- O N C '

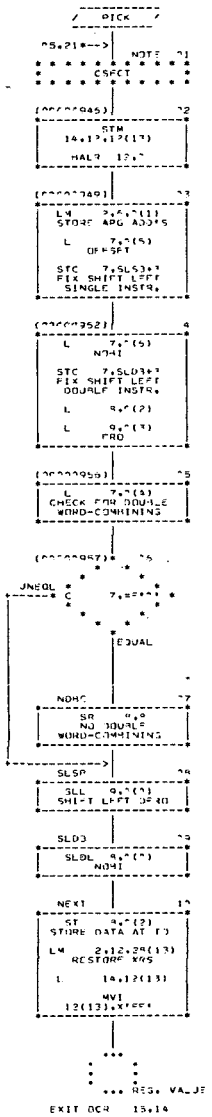
```
CALL
PICK(TO,FRO,OTO,OFRO,
NOBI)
 ********************
*****************

TO = ADDRESS OF WORD
WHERE BITS ARE TO BE
MOVED (XR2)
 *
FRO = ADDRESS OF WORD
WHERE BITS ARE TO BE
GOTTEN (XR3)
 *
OTO = SWITCH THAT
ALLOWS COMBINING
W/C(TO)
WHEN.NE.0,(XR4)
 *
OFRO = OFFSET OF WORD
WHERE BITS ARE
LOCATED (XR5) ,IN
BITS          *
NOBI = NUMBER OF BITS
INVOLVED IN OPERATION
(XR6),.LE.63
 *

ALL PARAMETERS ARE
INTEGERS
 *

**********************
**********************
**********************
******
```

CHART TITLE - * ROUTINE TO PICK OUT CONTIGUOUS BITS -- O N C *



END OF AUTOFLOW CHART SET 941 INPUT STATEMENTS PROCESSED EXECUTION TIME = 1 MIN 7 SEC

APPENDIX E

SAMPLE OF THE NUMERICAL DATA VALUE

PRINT-OUT DISPLAY OUTPUT

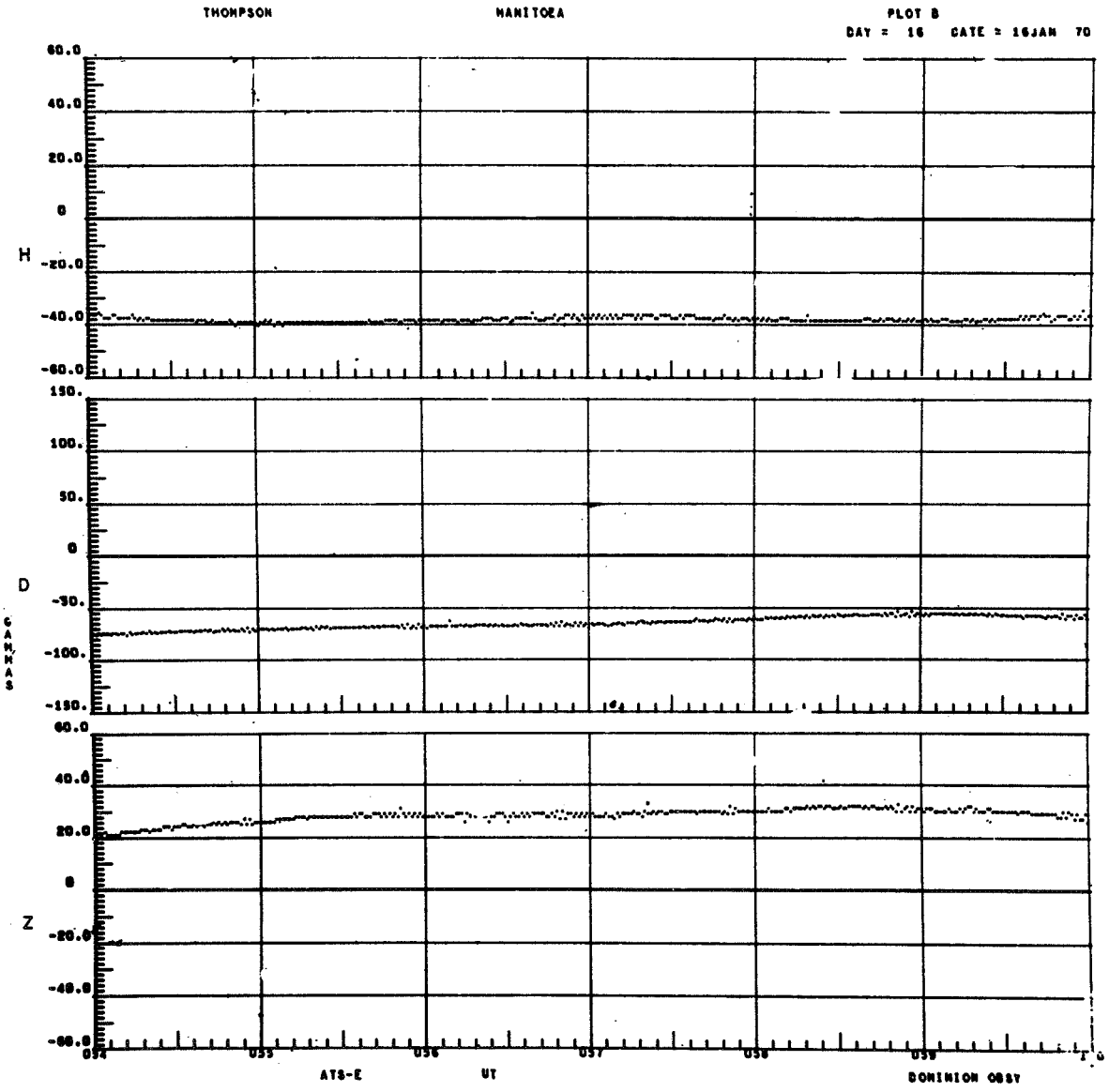
ATS-E MFM CANADIAN DOMINION OBSERVATORY AT THOMPSON MANITOBA MAGNETIC FIELD MEASUREMENTS R=NOT USED

DATE YR MON DAY	DAY OF YEAR	TIME HR MN SEC	H AXIS (GAMMAS)	D AXIS (GAMMAS)	Z AXIS (GAMMAS)	TOTAL FIELD (GAMMAS)	FG MINUS PROTON	R NOT USED
69 DEC 15	349	17 47 58.0	-19.8	-27.7	-17.9	38.5		1733.0
69 DEC 15	349	17 47 59.0	-18.9	-28.6	-17.9	38.7		1735.0
69 DEC 15	349	17 48 0.0	-17.9	-29.6	-17.9	38.9		1734.0
69 DEC 15	349	17 48 1.0	-19.8	-28.6	-17.9	39.2		1735.0
69 DEC 15	349	17 48 2.0	-18.9	-28.6	-18.9	39.1		1734.0
69 DEC 15	349	17 48 3.0	-17.9	-30.6	-16.9	39.3		1733.0
69 DEC 15	349	17 48 4.0	-19.8	-28.6	-18.9	39.6		1733.0
69 DEC 15	349	17 48 5.0	-18.9	-28.6	-18.9	39.1		1733.0
69 DEC 15	349	17 48 6.0	-17.9	-28.6	-16.9	37.8		1733.0
69 DEC 15	349	17 48 7.0	-18.9	-28.6	-17.9	38.7		1733.0
69 DEC 15	349	17 48 8.0	-19.8	-28.6	-17.9	39.2		1733.0
69 DEC 15	349	17 48 9.0	-17.9	-29.6	-16.9	38.5		1733.0
69 DEC 15	349	17 48 10.0	-18.9	-28.6	-17.9	38.7		1733.0
69 DEC 15	349	17 48 11.0	-19.8	-28.6	-17.9	39.2		1733.0
69 DEC 15	349	17 48 12.0	-17.9	-28.6	-15.9	37.3		1733.0
69 DEC 15	349	17 48 13.0	-19.8	-28.6	-16.9	38.7		1734.0
69 DEC 15	349	17 48 14.0	-19.8	-28.6	-17.9	39.2		1733.0
69 DEC 15	349	17 48 15.0	-17.9	-28.6	-15.9	37.3		1732.0
69 DEC 15	349	17 48 16.0	-20.8	-28.6	-16.9	39.2		1733.0
69 DEC 15	349	17 48 17.0	-18.9	-28.6	-16.9	38.2		1733.0
69 DEC 15	349	17 48 18.0	-17.9	-28.6	-15.9	37.3		1732.0
69 DEC 15	349	17 48 19.0	-20.8	-28.6	-16.9	39.2		1733.0
69 DEC 15	349	17 48 20.0	-18.9	-27.7	-15.9	37.1		1733.0
69 DEC 15	349	17 48 21.0	-19.8	-27.7	-15.0	37.2		1733.0
69 DEC 15	349	17 48 22.0	-19.8	-27.7	-15.9	37.6		1732.0
69 DEC 15	349	17 48 23.0	-19.8	-28.6	-15.9	38.3		1732.0
69 DEC 15	349	17 48 24.0	-18.9	-27.7	-15.9	37.1		1732.0
69 DEC 15	349	17 48 25.0	-19.8	-27.7	-15.9	37.6		1732.0
69 DEC 15	349	17 48 26.0	-19.8	-27.7	-15.9	37.6		1732.0
69 DEC 15	349	17 48 27.0	-18.9	-27.7	-15.0	36.7		1732.0
69 DEC 15	349	17 48 28.0	-15.9	-27.7	-15.9	35.7		1733.0
69 DEC 15	349	17 48 29.0	-19.8	-26.7	-15.0	36.5		1733.0
69 DEC 15	349	17 48 30.0	-19.8	-26.7	-15.0	36.5		1732.0
69 DEC 15	349	17 48 31.0	-20.8	-26.7	-16.9	37.8		1733.0
69 DEC 15	349	17 48 32.0	-19.8	-26.7	-15.0	36.5		1732.0
69 DEC 15	349	17 48 33.0	-19.8	-26.7	-15.0	36.5		1732.0
69 DEC 15	349	17 48 34.0	-20.8	-26.7	-14.0	36.6		1732.0
69 DEC 15	349	17 48 35.0	-19.8	-26.7	-14.0	36.1		1732.0
69 DEC 15	349	17 48 36.0	-20.8	-26.7	-15.0	37.0		1729.0
69 DEC 15	349	17 48 37.0	-20.8	-26.7	-15.0	37.0		1732.0
69 DEC 15	349	17 48 38.0	-20.8	-25.7	-14.0	35.9		1731.0
69 DEC 15	349	17 48 39.0	-20.8	-25.7	-14.0	35.9		1732.0
69 DEC 15	349	17 48 40.0	-20.8	-25.7	-14.0	35.9		1731.0
69 DEC 15	349	17 48 41.0	-20.8	-26.7	-14.0	36.6		1731.0
69 DEC 15	349	17 48 42.0	-20.8	-25.7	-14.0	35.9		1731.0
69 DEC 15	349	17 48 43.0	-21.8	-26.7	-14.0	37.2		1731.0
69 DEC 15	349	17 48 44.0	-20.8	-25.7	-13.0	35.5		1732.0
69 DEC 15	349	17 48 45.0	-20.8	-25.7	-15.0	36.3		1731.0
69 DEC 15	349	17 48 46.0	-19.8	-25.7	-14.0	35.4		1731.0
69 DEC 15	349	17 48 47.0	-20.8	-24.7	-14.0	35.2		1731.0
69 DEC 15	349	17 48 48.0	-20.8	-25.7	-14.0	35.9		1731.0
69 DEC 15	349	17 48 49.0	-20.8	-27.7	-14.0	37.3		1732.0

APPENDIX F

SAMPLE OF THE MICROFILM NON-AVERAGED

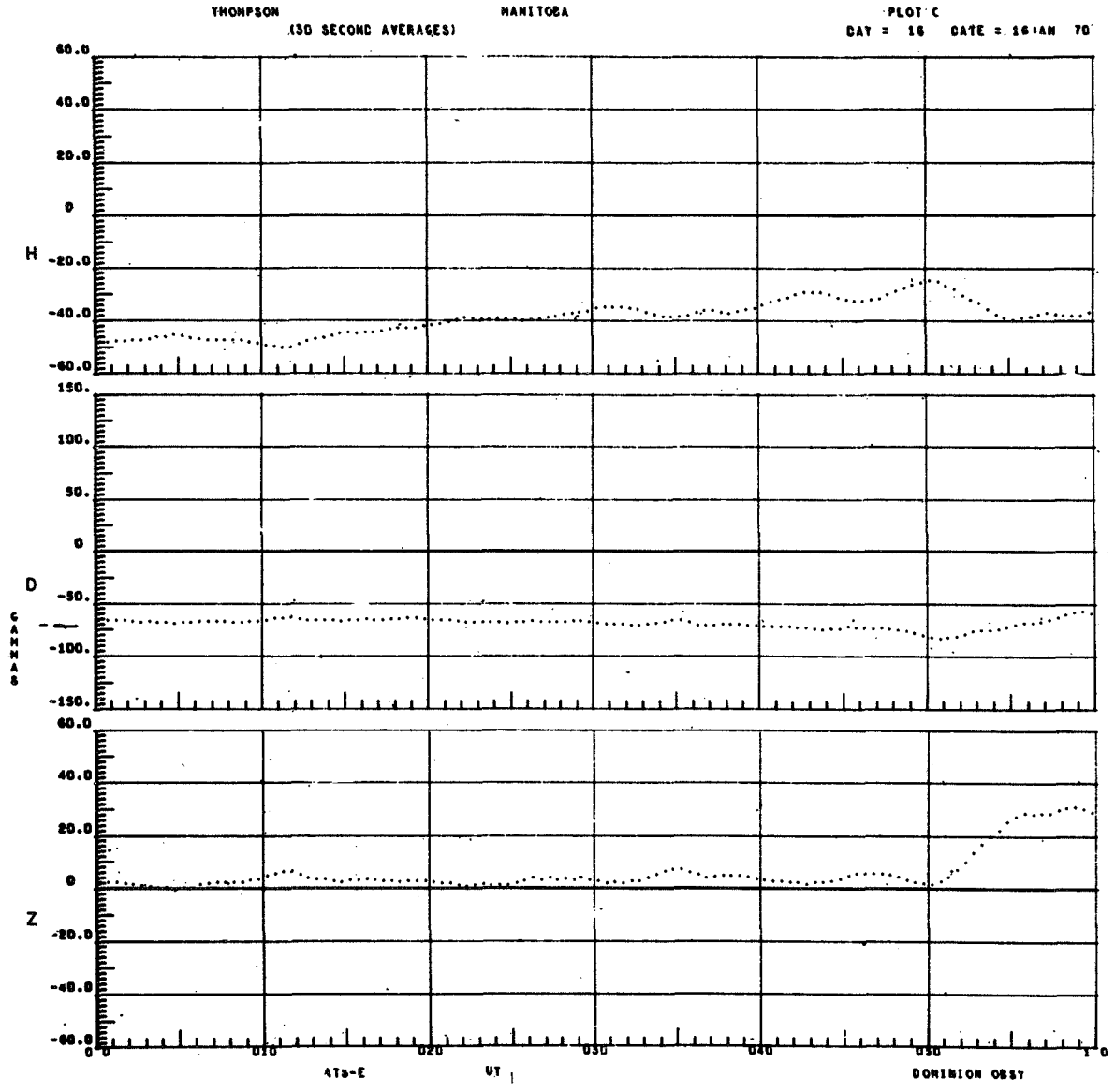
DATA DISPLAY OUTPUT (PLOT B)


THOMPSON
MANITOBA
PLOT B
DAY = 16 DATE = 16JAN 70
H
D
GAMMAS
Z
ATS-E
UT
DOMINION OBSY

APPENDIX G

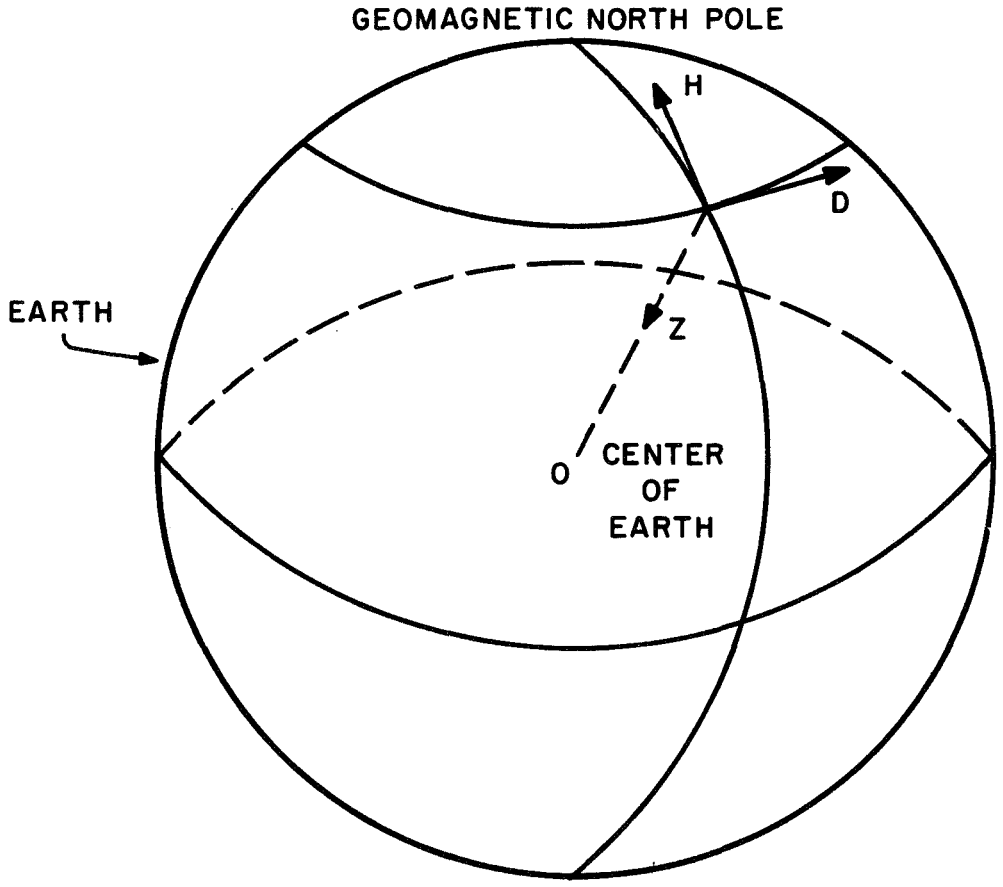
SAMPLE OF THE MICROFILM AVERAGED

DATA DISPLAY OUTPUT (PLOT C)


THOMPSON
MANITOBA
PLOT C
(30 SECOND AVERAGES)
DAY = 16 DATE = 16-JAN 70
H
D
Z
GAMMAS
60.0
40.0
20.0
0
-20.0
-40.0
-60.0
150.
100.
50.
0
-50.
-100.
-150.
010
020
030
040
050
ATS-E
UT
DOMINION OBSY

APPENDIX H

DEFINITION OF THE H, D, Z DATA COORDINATE SYSTEM



H,D,Z Coordinates. On any spherical surface concentric with the earth the H axis points to the geomagnetic north, the D axis to the geomagnetic east, and the Z axis to the center of the earth.

APPENDIX I

IBM 1800 PROGRAM FOR COPYING ATS-5 GROUND STATION TAPES

Written by Dave Fisher of IBM
at Goddard Space Flight Center

```
*APPENDIX I - IBM 1800 PROGRAM FOR COPYING
*ATS-5 GROUND STATION TAPES - WRITTEN BY
*DAVE FISHER OF IBM AT GODDARD SPACE FLIGHT CENTER
*
*
*
BEGIN LDX  L1 -3600      FILL BUFFER WITH HEX 9'S
      LD       HEX9
LOOP  STO  L1 AREA+3601
      MDX    1 1
      MDX      LOOP
      CALL     MAGT       READ TAPE RECORD
      DC       LIST
      LD       LIST       TEST BUSY
      BSC      Z
      MDX      *-3
      LD       LIST+6     CHECK FOR EOF
      CMP      FOUR
      MDX      WRITE
      MDX      WRITE
      CALL     MAGT       WRITE FILE MARK ON OUTPUT
*TAPE
      DC       LISTM
      LD       LISTM      TEST BUSY
      BSC      Z
      MDX      *-3
      CALL     TYPEN      TYPE ENDING MESSAGE
      DC       LSTYP
      CALL     EXIT
WRITE CMP      SIX        CHECK READ ERROR
      MDX      WRT
      MDX      WRT
      LD       ONE        YES-SET FLAG IN OUTPUT
*RECORD
      STO      AREA+9
WRT   CALL     MAGT       WRITE OUTPUT TAPE RECORD
      DC       WLIST
      LD       WLIST      TEST BUSY
      BSC      Z
      MDX      *-3
      MDX      BEGIN      GO TO PROCESS NEXT RECORD
LSTYP DC
      DC
      BSS      5
      DC       /2011
      DC       MES
SIX   DC       6
ONE   DC       1
HEX9  DC       /9999
```

```
MES     DC      MES2-MES1
MES1    DMES    'RATS-E COPY JOB COMPLETED'E
MES2    BES     0
LIST    DC
        DC
        BSS     4
        DC
        DC      /2000
        DC      AREA
LISTM   DC
        DC
        BSS     4
        DC
        DC      /8001
        DC
WLIST   DC
        DC
        BSS     4
        DC
        DC      /4001
        DC      AREA
FOUR    DC      4
AREA    DC      3600
        BSS     3600
        END     BEGIN
```

APPENDIX J

LISTING SHOWING THE IBM 360 JOB CONTROL CARDS AND THE TI, TF CARDS FOR RUNNING THE ATS-5 GROUND STATION MAGNETOMETER DATA PROCESSING PROGRAM