# NOTES ON THE
# ISEE-3
# DATA POOL TAPE

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## I. Introduction

The International Sun-Earth Explorer Mission is a joint NASA/ESA project intended to study the earth's magnetosphere and its response to disturbances in the solar wind. The ISEE-3 spacecraft is positioned ~240 earth radii upstream of the earth's bow-shock and observes the solar wind flowing towards the earth while the ISEE-1 and 2 spacecraft make observations in or near the magnetosphere. This project has been described in detail by Ogilvie, et al. (1977).* The primary purpose of the ISEE-3 data pool tape is to make basic quantities measured at ISEE-3 readily available beyond the individual experiment groups making the measurements. This is particularly desirable since the emphasis of this mission is on utilizing simultaneous data from all three spacecraft. The data pool tape does have some limitations, however. For example, the time resolution and selection of data is limited. Also, the algorithms for transforming measured quantities into physical units are generally not as complex as those that experimenters may eventually use in reducing their data. On the other hand, many users will profit more by quick access to somewhat imperfect data than by eventual access to more refined data. For instance, an experimenter can use the data pool tape to identify interesting time periods and hence greatly reduce the volume of refined data which he may request from another experimenter.

The data pool tape is produced at Goddard Space Flight Center by the Information Processing Division (IPD) using algorithms provided by each experimenter. IPD does its best to process the data accordingly, but it is staffed by programmers and not scientists and hence cannot be held responsible for identifying, for example, subtle changes in instrument performance, limitations of experiment response, or interference to an experiment.

In order, then, for a user to make sensible use of the data pool tape he requires a good description of each experiment, a description of the tape format and a description of the algorithms used. The first of these has been provided in the IEEE transactions on Geoscience Electronics, July 1978, Volume GE-16. It is intended that the remaining items be supplied in part by the present document. Following this introduction, we have provided notes on the ISEE-3 data pool tape together with the tape format. This precedes sections which have short write-ups from each experimenter regarding the method by which their data is reduced to yield the quantities on the tape and appropriate caveats. Finally there is a list of Principal Investigators with addresses and telephone numbers.

* Ogilvie, K. W., von Rosenvinge, T. T. and Durney, A. C., Science, 198, #131, 1977.

# NOTES ON THE ISEE-3 DATA POOL TAPE

## GENERAL DESCRIPTION AND USAGE

### 1. Structure of the Data Pool Tape

#### (A) Tapes

Each data pool user receives one reel of tape per week. This tape may be 7-track 556 cpi, 9-track 1600 cpi, or 9-track 800 cpi, depending upon the user's preference. All tapes are odd parity. Inter-record gaps are .65 inch for 9-track tapes and .75 inch for 7-track tapes.

#### (B) Files

Data pool information for a 7-day period is presented as a single tape file, beginning with a label record and ending with a standard tape mark (EOF mark). All records, including the label, are of the same length. The data pool file contains approximately 160 data records spanning 7 days of telemetry data. Redundant telemetry data (due to overlap in ground station coverage) has been removed. The data pool file coincides in time with a "shipping group" of the usual telemetry data (decom tapes) which is sent to each experimenter.

The data pool file appears 3 times on the tape for redundancy backup. See Figure 1.

#### (C) Data Words

##### (1) Word Size

Each data pool tape is written in computer words of a length compatible with the intended user's computer. Tapes thus constructed can be read directly into the user's computer with no reformatting. This holds true for both 7-track and 9-track tapes. For example, records intended for use with a CDC 6000 series computer would appear as packed strings of 60-bit fields. On a 9-track tape, each such 60-bit field occupies 7-1/2 tape characters. But the total number of words per record is an even number, so that the 60-bit fields can all be written in pairs, 15 tape characters per pair, and thus can be read normally by the CDC. (Other combinations of word size and tape type work out in a similar fashion).

- ONE TAPE PER 7-DAY DATA GROUP.
- ONE FILE PER DATA GROUP, REPEATED 3 TIMES FOR BACKUP.
- DATA POOL QUANTITIES ARE IN USER COMPATIBLE FLOATING POINT AND USER WORD LENGTH.
- DATA RECORDS ARE APPROXIMATELY 1 HOUR.

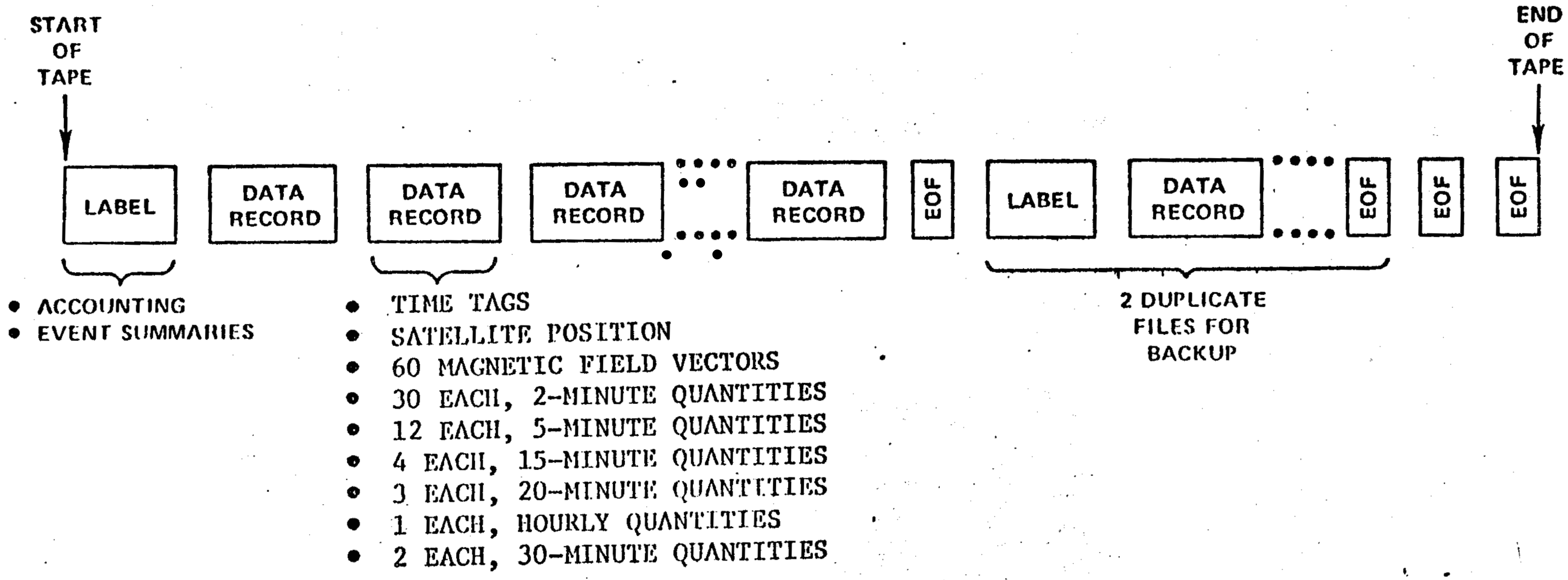



Figure 1. Data Pool Tape

## II. Contents of the Data Pool Tape

### (A) Time

The time values given on the data pool tape are UTC (Universal Time Code) at the time the data was transmitted from the spacecraft (i.e. transmission lag time has been removed). Times have been smoothed to remove random errors and then verified by intercomparison among all the ground stations. Time is given as Julian day (1-366) and seconds-of-day.

### (B) Clock

The clock used on the data pool tape is a minor frame counter. It is constructed by combining the 24-bit raw spacecraft clock with part of the frame counter. (This is the same clock as used on the telemetry data tapes).

Since the full clock will not fit in all types of floating point works without truncation, it is broken into 2 pieces, the low order 21 bits in one word, the remaining high order portion in another. The full clock can be reconstructed by converting both clock pieces to integer, then adding them together.

It should be noted that time, rather than clock, is the primary reference for data pool items. Clock is subject to rollover within the data pool file, as well as to unpredicted jumps forward or backward.

### (C) Timelines

The time versus clock relationship, may not be linear throughout the entire data pool file. Breaks occur if the bit rate changes, at end-of-year, and if the clock jumps or rolls over. A segment of data in which time versus clock is linear is defined as a time/clock baseline or "timeline."

Data accumulation intervals for experiment algorithms do not continue across timelines; that is, each data pool quantity is computed using data which begins and ends in the same timeline. See Figure 2.

### (D) Data Records

Data records are fixed length, 810 words long. A full record holds 64 minutes of information.

Within a timeline, each data record represent
tition in time. Data items are positioned within the records by time, relative to the start of the record (see "Time Tagging," below). Fill code is substituted where data is unavailable. If a gap in data coverage greater than 64 minutes occurs, it is possible that an entire record will be fill code. In this case the dummy record indicator is turned on.

(2) Floating Point Format

The entire data pool tape, the file label record and all data records, are in floating point format. (This provides a uniform, standard appearance of all information, facilitates conversion to the various computer word sizes, and simplifies tape printing and verification). The floating point representation used on each tape is specified by the user, and, like the word size, is compatible with the computer which will process the tape.

Most data pool tape quantities are originally computed in floating point and should be interpreted as such. Certain items, however, are obvious as integer values converted to floating point representation (day-of-year, seconds-of-day, clock, various indicator flags, etc.). The user may interpret such items either as floating point (in which case appropriate precautions should be taken to prevent possible truncation during conversion to integer).

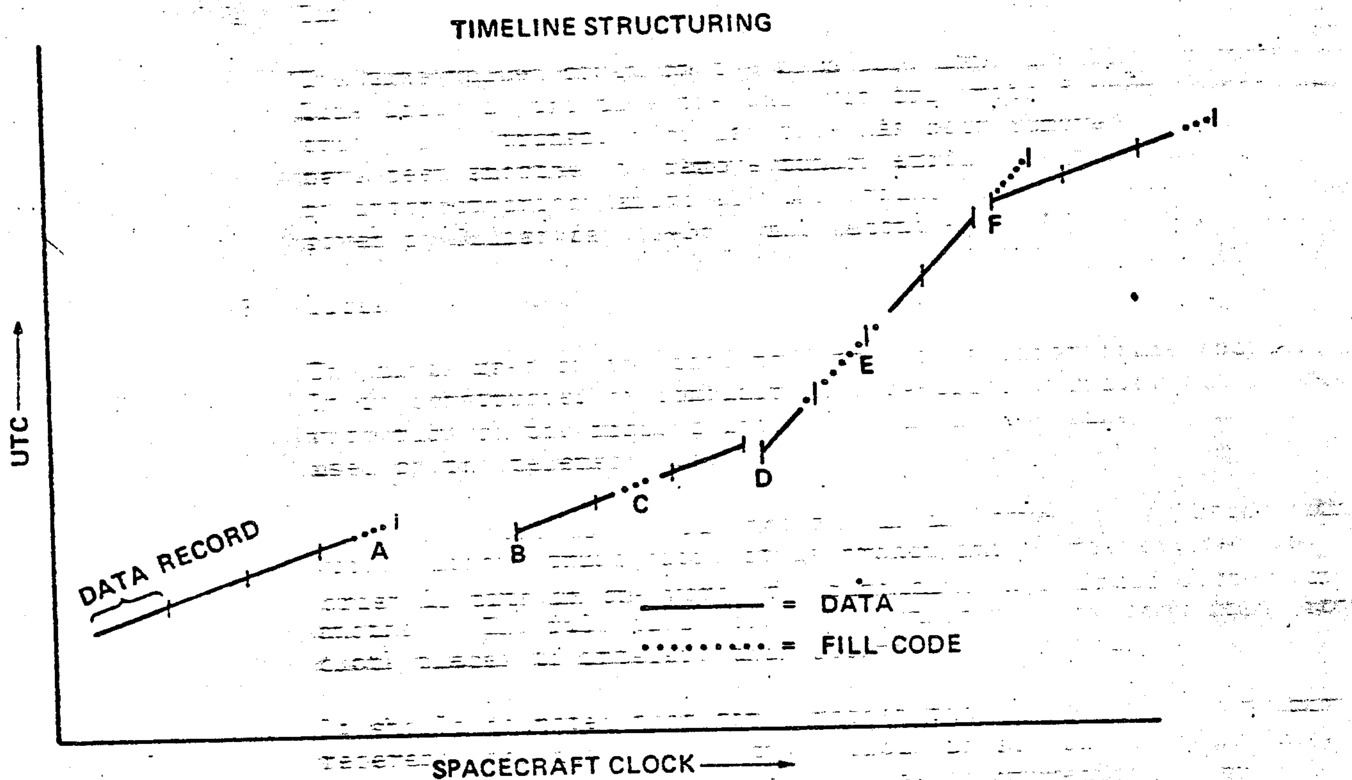
(3) Missing Data

Missing data items are indicated by a negative value fill code in place of the missing item. The exact value of the fill code is dependent on the type of floating point used, but will in all cases be outside the legitimate range of any data item.

Missing data pool items may be the result of gaps in data recovery at the ground station, or the result of data being rejected by one of the experiment processing algorithms.

It is possible that uncertain conditions may lead to a data pool result of questionable validity. Rather than be rejected, such results may, in certain cases, be presented as the negative of the actual result. Thus, a negative number other than the fill code, if in a field which should normally be positive, represents a doubtful result and may be used, but with caution. (Note that this does not apply to those values which may normally be negative, such as magnetic field components).

Data taken when the spacecraft is in engineering format is rejected by the data pool program.



Spacecraft Clock

A. Last record of timeline contains fill beyond the end of the timeline.

B. A new timeline begins due to a clock reset. No gap in data coverage.

C. Data gap within a record results in fill code.

D. New timeline begins due to a bit rate change.

E. Large data gap results in an entire record of fill code. Note that the record following the all-fill record begins with fill, but has a start time assigned as if data were present.

F. New timeline begins due to a bit rate change.

Figure 2. Timeline Structuring

The format of the data record is given in Table 2.

(E) Time Tagging

There are seven types of data pool information, according to frequency of readout: (1) 60 per record, 1-minute intervals, (2) 30 per record, 2-minute intervals; (3) 12 per record, 5-minute interval; (4) 4 per record, 15-minute intervals; (5) 3 per record, 20-minute intervals; (6) 2 per record, 30-minute intervals; (7) once per record. ("Minute," as used here, means an ISEE minute," or 64-seconds independent of bit-rate.

The start time of the data record (words 1 and 2) is the start time of sampling interval number at all seven frequencies of readout. The start times of subsequent intervals are computed relative to interval number 1.

Examples (Refer to Table 3):

Example 1 -- The magnetic field vector {Bz(1), Bx(1), By(1)}, in words 201-203 was computed for the 64-second interval beginning at the record start time.

The vector {Bz(60), Bx(60), By(60)} , in words 555-557, was computed over the 64-second interval beginning at t=(record start time) + (59 x 64 seconds). Similarly, vector {Bz(3), Bx(3), By(3)} , words 213-215, was computed over the 64-second interval beginning at t=(record start time) + (128 seconds).

Example 2 -- Find the energetic particles flux, energy >15 MeV, at a point in time 20 minutes from the start of the record.

The required information set is from the Anderson algorithm, words 681-682, labeled EFLUX (1) - EFLUX (12). This data is given at intervals of 5 ISEE-minutes or every 320 seconds. Let RST equal the record start time. Then,

RST + 20 min = RST + 1200 sec = RST + 3.75 intervals

The desired value would thus be best approximated by interval No. 4, word 684.

(F) File Label

The file label record, Table 1, contains identification and accounting information for the data pool file. It also contains the minimum and maximum spin periods encountered over the 7-day file period, an index to all timelines in the file, and magnetometer parameters. The record is padded to the length of the data records.

As indicated in Table 1, the first 1440 bits should be ignored by the user. These bits are used for internal accounting purposes by Goddard Space Flight Center.

## Table 1: DATA POOL FILE LABEL

| WORD NUMBER* | DESCRIPTION (ALL VALUES ARE FLOATING POINT) |
|---|---|
| 1 | |
| | 1440 BITS FOR GSFC INTERNAL USE. |
| N | |
| N+1 | SATELLITE ID NUMBER |
| N+2 | INTENDED RECIPIENT OF THIS TAPE. (SEE TABLE 2) |
| N+3 | YY,START OF FILE, 2 DIGITS OF YEAR. |
| N+4 | DDD,START OF FILE,DAY OF YEAR. |
| N+5 | SSSSS,START OF FILE,SECONDS OF DAY. |
| N+6 | YY,END OF FILE,2 DIGITS OF YEAR. |
| N+7 | DDD.END OF FILE,DAY OF YEAR. |
| N+8 | SSSSS,END OF FILE,SECONDS OF DAY. |
| N+9 | HIGH ORDER BITS. CLOCK AT START OF THE DATA POOL FILE. |
| N+10 | LOW ORDER 21 BITS. CLOCK AT START OF THE DATA POOL FILE. |
| N+11 | GROUP NUMBER (CORRESPONDING TO THE TELEMETRY DATA TAPE GROUP NUMBER |
| N+12 | MINIMUM VALUE OF SPIN PERIOD FOUND WITHIN THIS FILE IN SECONDS. |
| N+13 | MAXIMUM VALUE OF SPIN PERIOD FOUND WITHIN THIS FILE IN SECONDS. |
| N+14 | SMH1 Z-OFFSET USED FOR THIS RUN. |
| N+15 | SMH2 NUMBER OF ESTIMATES MADE FOR Z-OFFSET ABOVE. |
| N+16 | SMH3 ALPHA USED FOR Z-OFFSET ABOVE. |
| N+17 | SMH4 GROUP NUMBER OF THE DATA GROUP USED TO DETERMINE Z-OFFSET. |
| N+18 . . . N+80 | SPARES. |
| N+81 | NUMBER OF TIME LINES (MAXIMUM OF 80) |
| N+82 | START DAY OF YEAR (1). |
| N+83 | START SECONDS OF DAY (1). |
| N+84 | HIGH ORDER BITS OF THE SPACECRAFT CLOCK (1). |
| N+85 | LOW ORDER 21 BITS OF START SPACECRAFT CLOCK (1). |
| N+86 | BIT RATE (1.0 FOR 512 BPS, 2.0 FOR 1024 BPS AND, 4.0 FOR 2048 BPS) |
| N+87 | START RECORD NUMBER. |
| . . . | |
| N+656 | START DAY OF YEAR (80). |
| N+657 | START SECONDS OF DAY (80). |
| N+658 | HIGH ORDER BITS OF START SPACECRAFT CLOCK (80). |
| N+659 | LOW ORDER 21 BITS OF START SPACECRAFT CLOCK (80). |
| N+660 | BIT RATE (1.0 FOR 512 BPS, 2.0 FOR 1024 BPS AND, 4.0 FOR 2048 BPS) |
| N+661 | START RECORD NUMBER (80). |
| N+662 . 810 | FILL TO EQUAL DATA RECORD LENGTH. |

## Table 2: DATA POOL - [illegible] RECORD

| WORD NUMBER | DESCRIPTION (ALL VALUES ARE FLOATING POINT) | | |
|---|---|---|---|
| 1 | DAY OF YEAR,RECORD START | | |
| 2 | SECONDS OF DAY,RECORD START | | |
| 3 | CLOCK,RECORD START. HIGH ORDER PORTION | | |
| 4 | CLOCK,RECORD START. LOW ORDER 21 BITS | | |
| 5 | RECOVERY FACTOR:<br>(MINOR FRAMES PROCESSED)/(7.5 X 256.).FOR 512 BPS<br>(MINOR FRAMES PROCESSED)/(15 X 256.).FOR 1024 BPS<br>(MINOR FRAMES PROCESSED)/(30 X 256.).FOR 2048 BPS | | |
| 6 | BIT RATE:<br>1.0 = 512 BPS (BACKUP)<br>2.0 = 1024 BPS (LOW)<br>4.0 = 2048 BPS (HIGH) | | |
| 7 | DUMMY RECORD INDICATOR:<br>0.0 = AT LEAST ONE MINOR FRAME OF DATA WITHIN THIS RECORD'S S<br>7.0 = NO DATA WITHIN THE SPAN OF THIS RECORD. A DUMMY RECORD | | |
| 8 | TIMELINE INDICATOR:<br>0.0 = THIS RECORD LIES ON AN EXISTING TIMELINE<br>7.0 = THIS RECORD BEGINS A NEW TIMELINE | | |
| 9 | DATA RECORD NUMBER | | |
| 10 - 12 | SPARES | | |
| 13 | BO-X | OFFSET USED FOR SMH BX | |
| 14 | BO-Y | OFFSET USED FOR SMH BY | |
| 15 | | | |
| 16 | WORDS 15 TO 19 FOR SMH USE ONLY | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | SPIN PERIOD AVERAGE,PREVIOUS HOUR. | | |
| 21 | GSE-X | | |
| 22 | GSE-Y SATELLITE POSITION VECTOR IN GSE COORDINATES | | |
| 23 | GSE-Z (AT TIME OF FIRST POINT IN THIS RECORD) | | |
| 24-168 | SPARES | | |
| | * * * * * * * * * HOVESTADT ALGORITHM * * * * * * * * * * | | |
| 169 | PROLP(1) | 0.17-0.4MEV PROTONS | 1ST OF 4 |
| . | | | |
| . | | | |
| 172 | PROLP(4) | 0.17-0.4MEV PROTONS | 4TH OF 4 |
| 173 | ALFLA(1) | 0.12-0.25MEV ALPHAS | 1ST OF 4 |
| . | | | |
| . | | | |
| 176 | ALFLA(4) | 0.12-0.25MEV ALPHAS | 4TH OF 4 |
| 177 | HEAVYS(1) | HEAVIES (Z>2) GT 0.1MEV | 1ST OF 4 |
| . | | | |
| . | | | |
| 180 | HEAVYS(4) | HEAVIES (Z>2) GT 0.1MEV | 4TH OF 4 |
| 181 | PROHP1(1) | 5-10MEV PROTONS | 1ST OF 4 |
| . | | | |
| . | | | |
| 184 | PROHP1(4) | 5-10MEV PROTONS | 4TH OF 4 |

Table 2 (Continued)

| | | | |
|---|---|---|---|
| 185 | PROHP2(1) | 10-20MEV PROTONS | 1ST OF 4 |
| • | | | |
| • | | | |
| 188 | PROHP2(4) | 10-20MEV PROTONS | 4TH OF 4 |
| * * * * * * * * * MANEUVER INFORMATION * * * * * * * * * * | | | |
| 189 | MANUVR(1) | MANEUVER INDICATORS FOR EACH OF THE TWELVE | |
| 190 | MANUVR(2) | 5 MINUTE(APPROX) INTERVALS OF THIS RECORD: | |
| 191 | MANUVR(3) | 0.0 = NO MANEUVER IN THIS INTERVAL | |
| 192 | MANUVR(4) | 7.0 = MANEUVER INDICATED DURING THIS INTERVAL | |
| 193 | MANUVR(5) | | |
| 194 | MANUVR(6) | | |
| 195 | MANUVR(7) | | |
| 196 | MANUVR(8) | | |
| 197 | MANUVR(9) | | |
| 198 | MANUVR(10) | | |
| 199 | MANUVR(11) | | |
| 200 | MANUVR(12) | | |
| * * * * * * * * * SMITH ALGORITHM (MAGNETOMETER) * * * * * * * * * * | | | |
| 201 | BZ(1) | SPIN AXIS COMPONENT | |
| 202 | BX(1) | SATELLITE-SUN LINE COMPONENT | MAG FIELD VECTOR |
| 203 | BY(1) | 3RD COMPONENT OF TRIAD | 1ST OF 60 VECTO |
| 204 | BMAG(1) | MAGNITUDE | |
| 205 | BDELTA(1) | LATITUDE | MAGNETIC FIELD VECTOR |
| 206 | BPHI(1) | LONGITUDE | 1ST OF 60 VECTORS |
| 207-554 | 2ND THROUGH 59TH MAGNETIC FIELD VECTORS. | | |
| 555 | BZ(60) | SPIN AXIS COMPONENT | |
| 556 | BX(60) | SATELLITE-SUN LINE COMPONENT | MAG FIELD VECTOR |
| 557 | BY(60) | 3RD COMPONENT OF TRIAD | 60TH OF 60 VEC |
| 558 | BMAG(60) | MAGNITUDE | |
| 559 | BDELTA(60) | LATITUDE | MAGNETIC FIELD VECTOR |
| 560 | BPHI(60) | LONGITUDE | 60TH OF 60 VECTORS |
| * * * * * * * * * STEINBERG ALGORITHM * * * * * * * * * * | | | |
| 561 | RAMAP1(1) | AVERAGE VOLTAGE AND RMS (1000KHZ.) | |
| 562 | RARMS1(1) | 1ST OF 30 SETS | |
| • | | | |
| • | | | |
| 619 | RAMAP1(30) | AVERAGE VOLTAGE AND RMS (1000KHZ.) | |
| 620 | RARMS1(30) | 30TH OF 30 SETS | |
| 621 | RAMAP2(1) | AVERAGE VOLTAGE AND RMS (200KHZ.) | |
| 622 | RARMS2(1) | 1ST OF 30 SETS | |
| • | | | |
| • | | | |
| 679 | RAMAP2(30) | AVERAGE VOLTAGE AND RMS (200KHZ.) | |
| 680 | RARMS2(30) | 30TH OF 30 SETS | |

MAGDPT

| | | | |
|---|---|---|---|
| | * * * * * * * * * ANDERSON ALGORITHM * * * * * * * * * * | | |
| 681 | EFLUX(1) | PARTICLE FLUX, ENERGY > 15KEV | 1ST OF 12 |
| • | | | |
| • | | | |
| • | | | |
| 692 | EFLUX(12) | PARTICLE FLUX, ENERGY > 15KEV | 12TH OF 12 |
| 693 | XRAY(1) | COUNTS PER SECOND,20-37 KEV | 1ST OF 12 |
| • | | | |
| • | | | |
| • | | | |
| 704 | XRAY(12) | COUNTS PER SECOND,20-37 KEV | 12TH OF 12 |
| | * * * * * * * * * BAME ALGORITHM * * * * * * * * * * | | |
| 705 | IONPD(1) | ION PSEUDO-DENSITY (PARTICLES/CC) | 1ST OF 1 |
| • | | | |
| • | | | |
| • | | | |
| 716 | IONPD(12) | ION PSEUDO-DENSITY (PARTICLES/CC) | 12TH OF 1 |
| 717 | WINDPS(1) | SOLAR WIND PSEUDO-SPEED (KM/SEC) | 1ST OF 1 |
| • | | | |
| • | | | |
| • | | | |
| 728 | WINDPS(12) | SOLAR WIND PSEUDO-SPEED (KM/SEC) | 12TH OF 1 |
| 729 | WINDPA(1) | SOLAR WIND PSEUDO FLOW ANGLE (DEG) | 1ST OF 1 |
| • | | | |
| • | | | |
| • | | | |
| 740 | WINDPA(12) | SOLAR WIND PSEUDO FLOW ANGLE (DEG) | 12TH OF 1 |
| | * * * * * * * * * SCARF ALGORITHM * * * * * * * * * * | | |
| 741 | PLA31(1) | PLASMA WAVE 31HZ MAX. VOLTAGE | 1ST OF 12 |
| 742 | PLA1K(1) | PLASMA WAVE 1KHZ MAX VOLTAGE | 1ST OF 12 |
| 743 | PLA31K(1) | PLASMA WAVE 31KHZ MAX VOLTAGE | 1ST OF 12 |
| 744 | PLANT(1) | PLASMA WAVE ANTENNA STATUS | 1ST OF 12 |
| • | | | |
| • | | | |
| • | | | |
| 785 | PLA31(12) | PLASMA WAVE 31HZ MAX. VOLTAGE | 12TH OF 1 |
| 786 | PLA1K(12) | PLASMA WAVE 1KHZ MAX VOLTAGE | 12TH OF 1 |
| 787 | PLA31K(12) | PLASMA WAVE 31KHZ MAX VOLTAGE | 12TH OF 1 |
| 788 | PLANT(12) | PLASMA WAVE ANTENNA STATUS | 12TH OF 1 |
| | * * * * * * * * * VON ROSENVINGE ALGORITHM * * * * * * * * * * | | |
| 789 | PARTLO(1) | PARTICLES, LOW RANGE 4-57MEV/NUCLEON | 1ST OF |
| • | | | |
| • | | | |
| 792 | PARTLO(4) | PARTICLES, LOW RANGE 4-57MEV/NUCLEON | 4TH OF |
| 793 | PARTHI(1) | PARTICLES, HIGH RANGE 18-70MEV/NUCLEON | 1ST OF |
| • | | | |
| • | | | |
| 796 | PARTHI(4) | PARTICLES, HIGH RANGE 18-70MEV/NUCLEON | 4TH OF |

Table 2 (Continued)

| | | | |
|---|---|---|---|
| | | * * * * * * * * * DE FEITER ALGORITHM * * * * * * * * * * | |
| 797 | PROLO1(1) | PROTONS 78-205 KEV | 1ST OF 3 |
| 798 | PROLO2(1) | PROTONS 536-1400KEV | 1ST OF 3 |
| 799 | ISOTRO(1) | ISOTROPY INDEX | 1ST OF 3 |
| 800 | QUAD(1) | QUADRANT | 1ST OF 3 |
| • | | | |
| • | | | |
| • | | | |
| 805 | PROLO1(3) | PROTONS 78-205 KEV | 3RD OF 3 |
| 806 | PROLO2(3) | PROTONS 536-1400KEV | 3RD OF 3 |
| 807 | ISOTRO(3) | ISOTROPY INDEX | 3RD OF 3 |
| 808 | QUAD(3) | QUADRANT | 3RD OF 3 |
| | | * * * * * * * * * MEYER ALGORITHM * * * * * * * * * * | |
| 809 | LOWEE(1) | LOW ENERGY 5-150MEV ELECTRONS RATE | 1 OF 2 |
| 810 | LOWEE(2) | LOW ENERGY 5-150MEV ELECTRONS RATE | 2 OF 2 |