DATA SET CATALOG # 113

OGO-5 Fluxgate Magnetometer

6 tapes

68-014A-14B

68-014A-14E

68-014A-14F

60 second Avg.

Table of Contents

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1. INTRODUCTION:

The documentation for this data set was originally on paper, kept in NSSDC's Data Set Catalogs (DSCs). The paper documentation in the Data Set Catalogs have been made into digital images, and then collected into a single PDF file for each Data Set Catalog. The inventory information in these DSCs is current as of July 1, 2004. This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system. The information existing in the DSCs is now not needed for locating the data files, but we did not remove that inventory information.

The offline tape datasets have now been migrated from the original magnetic tape to Archival Information Packages (AIP’s).

A prior restoration may have been done on data sets, if a requestor of this data set has questions; they should send an inquiry to the request office to see if additional information exists.

2. ERRATA/CHANGE LOG:

NOTE: Changes are made in a text box, and will show up that way when displayed on screen with a PDF reader.

When printing, special settings may be required to make the text box appear on the printed output.

Version	Date	Person	Page	Description of Change
01				
02				

3 LINKS TO RELEVANT INFORMATION IN THE ONLINE NSSDC INFORMATION SYSTEM:

http://nssdc.gsfc.nasa.gov/nmc/

[NOTE: This link will take you to the main page of the NSSDC Master Catalog. There you will be able to perform searches to find additional information]

4. CATALOG MATERIALS:

a. Associated Documents — To find associated documents you will need to know the document ID number and then click here.
http://nssdcftp.gsfc.nasa.gov/miscellaneous/documents/

b. Core Catalog Materials

OGO 5

FLUXGATE MAGNETOMETER

68-014A-14B

THIS DATA SET HAS BEEN RESTORED. THERE WERE ORIGINALLY 14 7-TRACK, 800 BPI TAPES, WRITTEN IN BINARY WITH STANDARD LABELS. THERE IS ONE RESTORED TAPE, THE RESTORED TAPE IS UNLABELED. THE DR TAPE IS A 3480 CARTRIDGE AND THE DS TAPE IS A 9-TRACK, 6250 BPI. THE TAPES WERE CREATED ON AN IBM 360 COMPUTER. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND TIME SPANS ARE AS FOLLOWS:

DR#	DS#	DD#	FILES	TIME SPAN
DR02621	DS02621	D06008	1-5	03/05/68 - 03/17/68
		D06009	6-10	03/17/68 - 03/30/68
		D06165	11-15	03/30/68 - 04/12/68
		D06166	16-20	04/12/68 - 04/25/68
		D06373	21-25	05/13/68 - 05/26/68
		D06860	26-30	05/21/68 - 06/03/68
		D06372	31-35	05/26/68 - 06/12/68
		D06859	36-40	06/03/68 - 06/16/68
		D08047	41-45	06/17/68 - 06/30/68
		D08048	46-50	06/30/68 - 07/13/68
		D08045	51-55	07/13/68 - 07/26/68
		D08046	56-60	07/26/68 - 08/08/68
		D08829	61-65	08/06/68 - 08/17/68
		D08830	66-70	08/19/68 - 09/01/68

OGO 5

4.608 SECOND AVERAGE B FIELD

68-014A-14C

THIS DATA SET HAS BEEN RESTORED. ORIGINALLY THERE WERE FIVE 9-TRACK, 1600 BPI TAPES WRITTEN IN BINARY. THERE ARE TWO RESTORED TAPES. THE DR TAPES ARE 3480 CARTRIDGES AND THE DS TAPES ARE 9-TRACK, 6250 BPI. THE ORIGINAL TAPES WERE CREATED ON AN IBM 360 COMPUTER AND WERE RESTORED ON AN IBM 9021 COMPUTER. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND TIME SPANS ARE AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR002632	DS002632	D029194	1-25	03/05/68 - 05/08/68
		D029195	26-50	05/08/68 - 07/12/68
DR002631	DS002631	D029196	1-25	07/12/68 - 09/14/68
		D029248	26-50	09/14/68 - 11/18/68
		D029249	51-70	11/18/68 - 01/10/69

OGO 5

FLUXGATE MAGNETOMETER

68-014A-14E

THIS DATA SET HAS BEEN RESTORED. THERE WERE ORIGINALLY 14 7-TRACK, 800 BPI TAPES, WRITTEN IN BINARY WITH STANDARD LABELS. THERE ARE 3 RESTORED TAPES. THE RESTORED TAPES ARE UN-LABELED. THE DR TAPES ARE 3480 CARTRIDGES AND THE DS TAPES ARE 9-TRACK, 6250 BPI. THE ORIGINAL TAPES WERE CREATED ON AN IBM 360 COMPUTER. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND TIME SPANS ARE AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR002636	DS002636	D005575	1-5	03/05/68 - 03/17/68
		D004813	6-10	03/17/68 - 03/30/68
		D006163	11-15	03/30/68 - 04/12/68
		D006164	16-20	04/12/68 - 04/25/68
		D006371	21-25	05/13/68 - 05/26/68
DR002637	DS002637	D006861	1-5	05/21/68 - 06/03/68
		D006370	6-10	05/26/68 - 06/12/68
		D006862	11-15	06/03/68 - 06/16/68
		D008052	16-20	06/17/68 - 06/30/68
		D008051	21-25	06/30/68 - 07/13/68
DR002638	DS002638	D008049	1-5	07/13/68 - 07/26/68
		D008050	6-10	07/26/68 - 08/08/68
		D008833	11-15	08/06/68 - 08/19/68
		D008834	16-20	08/19/68 - 09/01/68

OGO 5

1-MIN. AVG. B-FIELD, GSM COORD.

68-014A-14F

This data set has been restored. There were originally 15 7-track, 800 BPI tapes, written in Binary with standard labels. There is one restored tape. The restored tape is unlabeled. The DR tape is a 3480 cartridge and the DS tape is 9-track, 6250 BPI. The tapes were created on an IBM 360 computer and were restored on an IBM 3081 computer. The DR and DS number along with the corresponding D numbers and time spans are as follows:

DR#	DS#	D#	FILES	TIME SPAN
DR002775	DS002775	D004814	1-5	03/05/68 - 03/17/68
		D006007	6-10	03/17/68 - 03/30/68
		D006161	11-15	03/30/68 - 04/12/68
		D006162	16-20	04/12/68 - 04/25/68
		D006369	21-25	05/13/68 - 05/26/68
		D006863	26-30	05/21/68 - 06/03/68
		D006368	31-35	05/26/68 - 06/09/68
		D006864	36-40	06/03/68 - 06/16/68
		D008055	41-45	06/17/68 - 06/30/68
		D008056	46-50	06/30/68 - 07/13/68
		D008053	51-55	07/13/68 - 07/26/68
		D008054	56-60	07/26/68 - 08/08/68
		D008835	61-65	08/06/68 - 08/19/68
		D008836	66-70	08/19/68 - 09/01/68
		D029053	71	03/05/68 - 05/05/70

68-014A-14B

OGO-5

FLUXGATE MAGNETOMETER

60 SECOND AVERAGES

This data set consists of 6, 800 BPI, Binary tapes produced on the IBM/360, where the 'D' tapes are 9 track and the 'C' tapes are 7 track.

These six tapes are known as the Spacecraft Coordinate tapes. They are blocked 128 logical records per physical record.

Each tape has 15 files on it, 5 main files and a header and trailer file for each main file.

D#	C#	START	STOP
D-06008	C-04928	3/05/68	3/17/68
D-06009	C-04929	3/17/68	3/30/68
D-06165	C-05114	3/30/68	4/12/68
D-06166	C-05115	4/12/68	4/25/68
D-06372	C-05198	5/8/68 5/26/68	5/21/68 6/12/68
D-06373	C-05199	5/13/68 4/25/68	5/26/68 5/8/68

ATTACHED LETTER SENT TO:

Mr. Bruno Aparicio	Dr. Bruce Boller
Mr. Michel Aubry	Dr. Keith Ogilvie
Mr. J. N. Barfield	Dr. Vithalbai L. Patel
Dr. J. R. Burrows	Dr. Willard P. Olson
Dr. Jih-Kwin Chao	Dr. Lothar Rossberg
Dr. V. P. Golovkov	Dr. Ferdinand F. Cap
Mr. Paul Lane	Mrs. Marcia M. Neugebauer
Dr. J. Munch	Dr. Harry I. West, Jr.
Mr. Alfredo Navato	Dr. A. Nishida
Dr. Chris T. Russell	Dr. James L. Burch
Dr. V. A. Troitskaya	Dr. Raymond G. D'Arcy, Jr.
Dr. Johannes Wilhjelm	Dr. Frederick L. Scarf

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

NATIONAL SPACE SCIENCE DATA CENTER
CODE 601

TELEPHONE
301-982-6695

March 28, 1973

Dear Colleague:

The National Space Science Data Center (NSSDC) has just received the attached letter from the Coleman group at UCLA informing us of a possible offset problem in some of the early OGO 5 magnetometer data. We are forwarding it to you in this manner so that you may be informed of possible problems relating to certain potential uses of the data.

NSSDC will transmit further information regarding these data as soon as it becomes available. We suggest that, at this stage of our understanding of the potential problem, if you plan to use the early OGO 5 data, you contact me at (301-982-5783) or Dr. Christopher T. Russell at UCLA (213-825-3188).

Sincerely,

Donald J. Hei, Jr.
Acquisition and Analysis Branch

DH:fh

Attachment:
UCLA Letter

Memo

To: Users of UCLA OGO-5 fluxgate magnetometer data

From: C.T. Russell

Subject: Absolute accuracy of data on NSSDC tapes

Date: March 21, 1973

The purpose of this memo is to interject a note of caution in the use of the UCLA OGO-5 fluxgate magnetometer data as an absolute instrument in very low fields. The fluxgate magnetometer flown by the UCLA group has a dynamic range of ±64,000γ and a precision of ±1/16γ. This precision should not be confused with accuracy. The OGO-5 spacecraft has a set of magnetometers provided by GSFC which are designed for high accuracy. This set includes a rubidium vapor magnetometer with biasing coils and a fluxgate magnetometer with limited dynamic range. It was decided prelaunch to devote the major effort with magnetic cleanliness procedures on this set of magnetometers and intercalibrate the OGO-5 and GSFC data inflight. For this purpose, we were supplied with short stretches of GSFC data (5 minutes) once per orbit for orbits 1-52 and orbit 138 and above.

The initial data were consistent with an offset which changed moderately rapidly just after turn on but which asymptotically settled down by about orbit 25. The data above orbit 138 showed a rather constant offset but these offsets exhibited some temperature dependence. This temperature dependence was then used to determine offsets for orbits 53-138. Then one offset was chosen to represent the offset during the entire orbit and offsets were assumed to change at perigee when the instrument was exposed to a large field and thus exercised its various ladder-adder circuits. The instrument temperatures were not available until after the data were processed and assumptions were frequently made on the expected temperatures from data obtained on nearby orbits and from data obtained one year earlier or one year later.

In March 1971 when we wrote our data processing memo "Production Processing of the Data Obtained by the UCLA OGO-5 Fluxgate Magnetometer", we stated we expected an accuracy of from 1 to 2 gammas per component. All indications were from our experience to that date that such was the case. As processing continued into the second and third year of OGO-5, however, temperatures began to drop and during April-May and October-November 1969 and 1970 we would expect that the offset variations within a particular orbit might exceed 2γ per component. Furthermore, during spin up periods the temperatures dropped markedly causing offset problems.

Last but not least, Marcia Neugebauer and Don Hei have found stretches of OGO-5 data during March and April 1968 which they suspect have offsets exceeding the guidel.nes. This could be caused by several factors: first, clerical error (at least one case of this has been found); two, temperature variations larger than suspected; three, changes in the long term drift of the offset during the orbit and not just at perigee. Thus, at the present time I urge caution in the use of the OGO-5 UCLA fluxgate magnetometer data for absolute measurements in low fields. Until we can do further tests, I suggest that if accurate field values in low fields are essential to a particular study the GSFC magnetometer be used or that the accuracy of the OGO-5 data be verified by comparison with other spacecraft, or by one or another of the several techniques available for measuring spacecraft offsets from in-flight data, (Belcher, 1973; Hedgecock, 1973).

We are very interested in checking the offsets using these techniques ourselves, and plan to do this in the near future. As is true for all experimental groups these days, our budget for such studies is limited. Thus, we do not forsee a study of the OGO-5 offsets for the full three year period. However, we plan to attempt to determine enough offsets that an accurate data base is available for magnetospheric studies and that the degree of variability of the offsets is precisely determined. When this study is complete we will write another memo.

References

Belcher, J.W., A variation of the Davis-Smith method for inflight determination of spacecraft magnetic fields, submitted to J. Geophys. Res., 1973.

Hedgecock, P.C., An alternative mathematical technique for the determination of spacecraft magnetometer zero levels, submitted to Journal of Scientific Instruments, 1973.

CTR:pr

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Dr. James L. Burch
Dr. Raymond G. D'Arcy, Jr.
Dr. Frederick L. Scarf

4. The Roadmaps. (One Minute Averages)

a) Data Processing

In generating the Roadmap plots all data is processed and averaged, both real time and playback. This data is then stored on a disk pack by orbit in two data sets one for real time data and one for playback data. Then these two data sets are scanned taking data in time sequence from the real time set until a gap is found in the data. Then playback data is searched to try to fill this gap. When this gap is filled or if it cannot be filled the real time data is again read until the next gap and then the process repeats. The end result is a tape with an orbit's data in time sequence containing averages formed from the highest possible telemetry rate. The data from this tape is then printed and microfilm plotted. There are no missing times on these tapes. When data is not available for a particular time it is flagged with a value of 100000.

At the same time, as the Roadmap tape is being created which contains one minute averages, the 4.608 second averages are created. Thus the 4.608 second averages are also in time sequence for one orbit with priority given to the highest telemetry rate data. These tapes are not printed or plotted at UCLA but are sent to H. West at the Lawrence Radiation Laboratory, Livermore, California where they are microfilm plotted. These magnetic tapes are also continuous in time with missing data flagged with values of 100000.

The one minute averages are centered on each minute. The points in this interval are scanned for obvious bad points, the bad points are rejected and the good points are summed and then the total is divided by the number of good points. The number of good points is also saved. We note that this process is performed for each of the three vector components and the total field. The total field calculated is the average of the instantaneous field magnitudes.

In order to retain information on the high frequency end of the spectrum, rms deviations are also calculated for each of the vector components and the total field. We note that the rms deviation of the total field depends somewhat on the accuracy of the offsets used. Thus reliance on the accuracy of the calculation of the rms deviation of the total field should be avoided in low fields. The deviations of the vector components, however, is independent of offset errors.

The rms deviations are not strictly rms deviations in the usual definition of the term, but are actually the rms amplitude of waves in a band of frequencies from 0.07 Hz (15 second period) to the Nyquist frequency which is a function of the telemetry rate. To calculate this amplitude, the input data stream, across averaging intervals, was filtered with a two stage high pass recursive filter. The amplitude response of this filter is shown in figure 11. The output of this filter was squared and summed over each minute and divided by the number of points and then its square root was taken.

We note that this rms deviation is very insensitive to field gradients whereas the usual rms deviation responds readily to field gradients. However, as all deviations it is very sensitive to bad data and sharp spikes in the rms deviations are probably due to telemetry errors.

b) Microfilm Plots in Spacecraft Coordinates

Each microfilm frame contains five hours of data, so that 13 pages are required to plot an orbit. However, we have plotted two frames for each five hour interval: one containing the vector field data and one containing the rms deviation data. Thus there are 26 frames for every orbit. These are numbered in the lower right-hand corner of every plot. (There are two pages 1, two pages 2, etc.). The data corresponding to the first time on the page and the orbit number are plotted in the upper right-hand corner of each page. Also, each page of data in spacecraft coordinates has the heading "Body Coordinates".

The format of the plot of the rms deviations remains fixed throughout the orbit. Figure 2 shows a typical frame of the rms deviation page. The top axis labelled "KBS" indicates the telemetry bit rate. However, since this is derived by counting the number of points in a one minute average it provides more information than just this. If data quality is poor and points have to be discarded, then this quantity will deviate from a straight line. Furthermore, data missing between files on the original data tapes for intervals less than one minute will show up as a downwards spike on this plot. We note that this quantity is plotted on a log scale.

The next four quantities from top to bottom are the rms deviations B_X, B_Y, B_Z and in the total field. The scale is one gamma per division and is linear. The plots saturate at five gammas. The deviations are usually quite accurate but errors may occur. These usually take the form of isolated spikes. On occasion isolated spikes every 40 minutes can occur. These are caused by incompletely correcting for the calibrate signal or missing it completely. Another possible error is an increase in general noise level due to poor quality data. This can be recognized by the deviation of the bit rate word from a straight line. Although most bad points are rejected from the averages and the rms deviations a few always get through and this raises the power in the fluctuations. Spikes occurring on only one axis or on both the X and Y axes and not the Z axis are especially suspicious, such as the ones at 2000 UT and 2105 UT on figure 2.

Figure 3 shows an rms deviation frame through perigee (Perigee is at 1641 UT). We see that data near perigee can be very noisy. This is not real. From 1500 to 1600 and from 1700 to 1800 we see a general rise and then fall of the noise level. This is due to boom vibrations. The sharp increase (and decreases) near 1600 and the sharp decrease in the deviations near 1700 are caused by the switching on and off of the routine for correcting for instrument transients. This is done because we cannot accurately correct for transients when the instrument steps too rapidly. The point where we stop correcting depends both on the telemetry rate and the field strength.

Figure 4 shows the plot of the three components of the field and the magnitude of the field corresponding to the deviations in figure 2. Horizontal lines give the zeroes for each component. These can move about to maximize the amount of data on a page. The zero for the total field is the bottom of the plot. The scale is linear and is 10 gammas per division.

Figure 5 shows the field through perigee for the same interval shown in figure 3. The vertical scale is logarithmic with positive values plotted in the upper half of the plot and negative values in the lower half. This is the only logarithmic plot per orbit.

c) Microfilm Plots in Geocentric Solar Ecliptic (GSE) Coordinates

The microfilm plots in GSE coordinates contain only the field data because the rms deviations cannot be rotated. To transform the data to GSE the orbit tape supplied by GSFC has been used. The data on this tape is every minute. Errors in the positional and orientation data as well as in the magnetic field data can affect the data in the GSE plot.

Figures 6 and 7 show the data in figures 5 and 4 rotated into GSE. The format is identical with the exception that the hourly GSE coordinates of the satellite have been printed at the top of each page. The distances are in earth radii. There are 13 frames per orbit.

d) Microfilm Plots in Geocentric Solar Magnetospheric (GSM) Coordinates

These plots are identical to the GSE plots except that the field and the position are given in the GSM system.

e) Magnetic Tapes in Spacecraft Coordinates

These tapes are 9 track, 800 BPI standard labelled binary tapes. They have 5 files per tape, each file corresponding to one orbit. These files usually overlap in time just before perigee. The JCL used to create the tape is

```
//GO.FT10F001 DD DISP=(NEW,KEEP),DSN=BDY001,
// UNIT=2400,LABEL=(1,SL,,OUT),VOL=SER=IG0005,
// DCB=(RECFM=V,LRECL=5128,BLKSIZE=5132)
```

The binary records are written by the Fortran statement:

```
WRITE(10) NREC, (IBT(I), BX(I), BY(I), BZ(I),
BT(I), BXRMS(I), BYRMS(I), BZRMS(I), BTRMS(I),
IQUAL(I), I=1, 128)
```

where

NREC=128

IBT=Bishop time (defined in Appendix)

BX= X component of the field in gammas

BY= Y component of the field in gammas

BZ= Z component of the field in gammas

BT= total field in gammas (obtained by averaging instantaneous values)

BXRMS= X rms deviation in gammas

BYRMS= Y rms deviation in gammas

BZRMS= Z rms deviation in gammas

BTRMS= Total field rms deviation in gammas

IQUAL= Quality indicator

The quality indicator IQUAL is the sum of two numbers, 1000 times NUMPTS + ICHL. NUMPTS is the number of data points used in the average and ICHL is a flag indicating the status of heater, calibrate signal and ladder step corrections during the averaging interval.

ICHL may be thought of as a binary number with seven bits: X_o, X_1, X_2, X_3....X_6.

If X_o equals 1, then sometime during the averaging interval a heater correction was required but the exact interval for applying this correction could not be found.

If X_2 equals 1, then sometime during the averaging interval a heater correction was applied.

If X_3 equals 1, then a calibration signal correction was made.

If X_4 equals 1, then at least one correction for a medium ladder step on the Z axis was made.

If X_5 equals 1, then at least one correction for a medium ladder step on the Y axis was made.

If X_6 equals 1, then at least one correction for a medium ladder step on the X axis was made.

We note that X_2 is not used, and that this seven bit binary number actually appears in IQUAL as a three digit decimal number.

f) Magnetic Tapes in GSE Coordinates

These tapes are 9 track, 800 BPI, standard labelled binary tapes. They have 5 files per tape, each file corresponding to one orbit. These files usually overlap in time just before perigee. The JCL used to create the tape is:

```
//GO.FT10F001 DD DISP=(NEW,KEEP),DSN=GSE001,
// UNIT=2400,LABEL=(1,SL,,OUT),VOL=SER=IG0006,
// DCB=(RECFM=V,LRECL=1228,BLKSIZE=1232)
```

The binary records are written by the Fortran statement:

```
WRITE(10)IORBIT,IBTST,XGSE,YGSE,ZGSE,RE,
BXE,BYE,BZE,BTE,IQUAL
```

where: BXE,BYE,BZE,BTE and IQUAL are arrays of 60 elements each and

IORBIT = Orbit number

IBTST = Bishop time of first point in record (Bishop time is defined in appendix)

XGSE = XGSE coordinate of satellite at start of record in Re

YGSE = YGSE coordinate of satellite at start of record in Re

ZGSE = ZGSE coordinate of satellite at start of record in Re

RE = Radial distance of satellite from the center of the earth in earth radii

BXE = X GSE component of the field in gammas

BYE = Y GSE component of the field in gammas

BZE = Z GSE component of the field in gammas

BTE = Total field magnitude (obtained by averaging instantaneous values)

IQUAL = Quality indicator as explained in previous section.

g) Magnetic Tapes in GSM Coordinates

Format identical to GSE tapes except that field and positional data are in GSM coordinates.

REQ. AGENT	RAND NO.	ACQ. AGENT
CAW	RC7558	DJH

OGO-5

4.608 SECOND AVERAGED B FIELD
68-014A-14C

This data set consists of merged OGO-5 tapes (each having 15 files and being standard label previously before the merging onto new tape) each containing 25 files of non-standard label data. The tapes are 9 track, 1600, binary, with odd parity.

D#	C#	FILES	TIME SPAN
D-29194	C-18795	25	03/05/68 - 05/08/68
D-29195	C-18796	25	05/21/68 - 07/12/68
D-29196	C-18797	25	07/12/68 - 09/15/68
D-29248	C-18940	25	09/15/68 - 11/19/68
D-29249	C-18941	20	11/19/68 - 01/10/69

*NOTE: The last tape processed may not have 25 files on it due to lack of more data.

OGO 5

FLUXGATE MAGNETOMETER

68-014A-14E

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DR#	DS#	D#	FILES	TIME SPAN
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		D004813	6-10	03/17/68 - 03/30/68
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		D006371	21-25	05/13/68 - 05/26/68
DR002637	DS002637	D006861	1-5	05/21/68 - 06/03/68
		D006370	6-10	05/26/68 - 06/12/68
		D006862	11-15	06/03/68 - 06/16/68
		D008052	16-20	06/17/68 - 06/30/68
		D008051	21-25	06/30/68 - 07/13/68
DR002638	DS002638	D008049	1-5	07/13/68 - 07/26/68
		D008050	6-10	07/26/68 - 08/08/68
		D008833	11-15	08/06/68 - 08/19/68
		D008834	16-20	08/19/68 - 09/01/68

OGO 5

1-MIN. AVG. B-FIELD, GSM COORD.

68-014A-14F

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		D006007	6-10	03/17/68 - 03/30/68
		D006161	11-15	03/30/68 - 04/12/68
		D006162	16-20	04/12/68 - 04/25/68
		D006369	21-25	05/13/68 - 05/26/68
		D006863	26-30	05/21/68 - 06/03/68
		D006368	31-35	05/26/68 - 06/09/68
		D006864	36-40	06/03/68 - 06/16/68
		D008055	41-45	06/17/68 - 06/30/68
		D008056	46-50	06/30/68 - 07/13/68
		D008053	51-55	07/13/68 - 07/26/68
		D008054	56-60	07/26/68 - 08/08/68
		D008835	61-65	08/06/68 - 08/19/68
		D008836	66-70	08/19/68 - 09/01/68
		D029053	71	03/05/68 - 05/05/70

OGO-5

1 MIN. AVG. B FIELD ON TAPE

68-014A-14F

This tape is an addition to the data set. The format of the tape is 9 track, 1600 BPI, unlabelled, binary and was created on an IBM/360. The tape contains 1 file, with the file containing orbits 1 thru 305 (Date 3/05/68 - 5/05/70).

D#	C#	DATE
D-29053	C-18728	3/5/68 - 5/5/70

SSC184

OGO-5

SSC184 is a 9 track, ~~1600~~ 6250 BPI, unlabelled, IBM 360/computer binary tape. The tape contains one file having orbits 1 - 305. The DCB parameters are: RECFM=VBS, LRECL=1228, BLKSIZE=6144, DEN=3.

Tape parameters:

IORBIT = Orbit number (Integer)

IBTST = Bishop time of first point in record (Integer) (see attached for definition)

XGSM = X GSM coordinate of satellite at start of record in Re (Real)

YGSM = Y GSM coordinate of satellite at start of record in Re (Real)

ZGSM = Z GSM coordinate of satellite at start of record in Re (Real)

RE = Radial distance of satellite from the center of the earth in earth radii (Real)

BXGSM = X GSM component of the field in gammas (Real)

BYGSM = Y GSM component of the field in gammas (Real)

BZGSM = Z GSM component of the field in gammas (Real)

BTGSM = Total field magnitude (obtained by averaging instantaneous values) (Real)

IQUAL = Quality indicator as explained in attachment (Integer)

NOTE: BXGSM, BYGSM, BZGSM,BTGSM and IQUAL are arrays of 60 elements each

BTRMS= Total field rms deviation in gammas

IQUAL= Quality indicator

The quality indicator IQUAL is the sum of two numbers, 1000 times NUMPTS + ICHL. NUMPTS is the number of data points used in the average and ICHL is a flag indicating the status of heater, calibrate signal and ladder step corrections during the averaging interval.

ICHL may be thought of as a binary number with seven bits: X_o, X_1, X_2, $X_3 \ldots X_6$.

If X_o equals 1, then sometime during the averaging interval a heater correction was required but the exact interval for applying this correction could not be found.

If X_2 equals 1, then sometime during the averaging interval a heater correction was applied.

If X_3 equals 1, then a calibration signal correction was made.

If X_4 equals 1, then at least one correction for a medium ladder step on the Z axis was made.

If X_5 equals 1, then at least one correction for a medium ladder step on the Y axis was made.

If X_6 equals 1, then at least one correction for a medium ladder step on the X axis was made.

We note that X_2 is not used, and that this seven bit binary number actually appears in IQUAL as a three digit decimal number.

```
      SUBROUTINE CONBT ( T, BT )
C ********************************************************************
C * 'BISHOP TIME' CONVERSION SUBROUTINE FOR OGO-5. BT IS DEFINED AS THE
C * NUMBER OF TENTHS OF A SECOND SINCE THE START OF YEAR 1966, THAT IS,
C * BT = 0 AT YR 66 DAY 1 HR 0 ETC., AND THE TIME UNIT IS 1/10 SEC.
C *     CALL CONBT( T, BT )  CONVERTS T ARRAY TO BT.
C *     CALL BTCON ( BT, T)  CONVERTS BT TO T ARRAY.
C * THE T ARRAY IS DEFINED AS FOLLOWS:
C *     T(1) = YEAR (66-71)                T(5) = HOUR (0-23)
C *     T(2) = DAY OF YEAR (1-366)         T(6) = MINUTE (0-59)
C *     T(3) = MONTH (1-12)                T(7) = SECOND (0-59)
C *     T(4) = DAY OF MONTH (1-31)         T(8) = MILLISECOND (0-999)
C * WHEN CONVERTING TO BT, T(3) AND T(4) ARE USED ONLY IF T(2) = 0.
C * OTHERWISE T(3) AND T(4) ARE IGNORED.  WHEN CONVERTING FROM BT, ALL
C * EIGHT ENTRIES OF THE T ARRAY ARE COMPUTED.
C * THE SUBROUTINE FAILS AFTER FEB. 28, 1972 AND BISHOP TIME
C * OVERFLOWS THE 360 WORD LATER THAT YEAR.
C *                                 PROGRAMMER - NEAL CLINE  JAN. 1968
C ********************************************************************
      INTEGER  T(8), BT,   M(13)
     * / 0, 31, 59, 90, 120, 151, 181, 212, 243, 273, 304, 334, 365 /
      N = ( T(1) - 66 ) * 365
      IF ( T(1) .GT. 68 )  N = N + 1
      IF ( T(2) .NE. 0 )  GO TO 10
          N = N + M(T(3)) + T(4) - 1
          IF ( T(3) .GT. 2 .AND. T(1) .EQ. 68 )  N = N + 1
          GO TO 20
   10 N = N + T(2) - 1
   20 BT = N*864000 + T(5)*36000 + T(6)*600 + T(7)*10 + T(8)/100
      RETURN
      ENTRY BTCON ( BT, T )
      N = BT / 864000
      IF ( N - 1095 ) 50, 30, 40
   30     T(1) = 68
          T(2) = 366
          GO TO 60
   40     N = N - 1
   50     T(1) = N/365 + 66
          T(2) = MOD( N, 365 ) + 1
   60 N = T(2)
      IF ( T(1) .NE. 68 )  GO TO 90
          IF ( N - 60 ) 90, 70, 80
   70         T(3) = 2
              T(4) = 29
              GO TO 120
   80         N = N - 1
   90 DO 100  K = 2, 13
          IF ( N .LE. M(K) )  GO TO 110
  100     CONTINUE
  110 T(3) = K - 1
      T(4) = N - M(K-1)
  120 T(5) = MOD( BT/36000, 24 )
      T(6) = MOD( BT/600, 60 )
      T(7) = MOD( BT/10, 60 )
      T(8) = MOD( BT, 10 ) * 100
      RETURN
      END
```

Appendix

Bishop time is the name of the unit of time used for the majority of the processing of the OGO-5 and ATS-1 fluxgate magnetometer data at UCLA. It is defined as the number of tenths of seconds since the start of the year 1966, that is, Bishop time equals zero, at 0000 U.T. on January 1, 1966. The advantage of using Bishop time is that one single 360 word can be used to cover a period of six years. Six years is longer than the life-expectancy of most satellites. The disadvantage is that this time word cannot be used to provide timing for the high telemetry rate data of OGO-5. This problem does not arise for the data discussed in this report because the highest sample rate given on these tapes is one point every 4.608 seconds.

On the next page is the listing of a subroutine to convert from Bishop time to ordinary Universal time and vice versa. The entry point BTCON converts from Bishop time while the entry point CONBT converts to Bishop time.

```
      C PROGRAM READS TAPE SSC184 AND PRINTS OUT FIRST 50 RECORDS       BKF00160
      C                                                                 BKF00180
            INTEGER NORB,NBT,T(8)/8*0/,IQL(60)                          BKF00200
            REAL C(4),B(60,4)                                           BKF00220
            DO 10 NREC=1,50                                             BKF00240
            READ(1) NORB,NBT,C,B,IQL                                    BKF00260
            CALL BTCON(NBT,T)                                           BKF00280
            WRITE(6,2000) T,NORB,C,B(1,1),B(1,2),B(1,3),B(1,4),IQL(1)   BKF00300
       2000 FORMAT(1X,8I4,1X,I4,1X,8F10.3,1X,I8)                        BKF00320
            DO 20 I=1,8                                                 BKF00340
         20 T(I)=0                                                      BKF00360
         10 CONTINUE                                                    BKF00380
            STOP                                                        BKF00400
            END                                                         BKF00420
```

D12080-0DOA
DLO=T
HCK=P

S00015-000

68-014A-14A
68-014A-14B
68-014A-14C
68-014A-14D
68-014A-14E
68-014A-14F
68-014A-14

PRODUCTION PROCESSING OF THE DATA OBTAINED BY THE UCLA OGO-5 FLUXGATE MAGNETOMETER

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Publication No. 905

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Bishop Time

UT IBT BX BY BZ BT IQUAL
1X, I14, 2X, I10, 5X, 4(F15.5, 5X), I15)

YYDDDHHMM SSMSS

Introduction

In designing the production processing plan for the UCLA OGO-5 fluxgate magnetometer data, it was decided to process the entire input data stream to provide a complete data base from which to undertake further studies. It was hoped that this data base could provide the criteria for data selection not only for the OGO-5 magnetometer experimenters but for other experimenters as well. With this in mind a series of plots were designed to describe the character of the data: to allow one to recognize different regions and to distinguish different regimes within these regions; to locate the boundaries of these regions; and to determine which time intervals were candidates for further analysis. At the same time it was recognized that such summary data could also be used as an analytical tool itself, so therefore these data were also stored on magnetic tape as well as plotted on microfilm plots. A useful summary plot, of course, maintains a constant time scale, and contains all the data in time sequence. So too, the summary data tapes become convenient because they have a fixed data rate and are time ordered, a feature not present in the original OGO-5 data. Needless to say, the summary tapes contain average data only and studies requiring high resolution data require recourse to the original data tapes.

Often times, the orbital position of the satellite rather than some character of the data dictates selecting a region for study. In order to be able to use orbital criteria, a series of orbit plots were also produced in several coordinate systems.

To obtain the most general overview of the data it was decided to make one minute averages of the data. These were plotted five hours to a page or microfilm frame. These plots, however, do not give the precise timing that is necessary for selecting intervals to study for certain phenomena such as the bow shock and magnetopause and thus another plot was made of the data using 4.608 second averages. This interval was dictated in part by the sample rate of the spacecraft. It represents 4, 32, or 256 individual vector measurements depending on telemetry bit rate. The 4.6 second averages were plotted with 20 minutes per page.

Both the one minute averages and the 4.6 second averages were plotted in the spacecraft coordinate system which is a quasi-inertial system but which is a function of orbit position and time of year. In this way the processing of the data would be independent of the receipt of orbit data and any instrument anomalies would maintain their character, e.g., relative size in the various vector components. However, since certain phenomena are more easily recognized in one coordinate system than another, the one minute averages were also converted to both geocentric solar magnetosphere (GSM) and geocentric solar ecliptic (GSE) coordinates and plotted. Thus there are three plots of the one minute averages: in spacecraft coordinates, in GSM coordinates and in GSE coordinates.

The OGO-5 spacecraft can transmit data at any one of three telemetry rates: 1, 8 or 64 kilobits per second. At the same time it can store data at 1 kilobit/sec for later transmission. Thus there can be two original data tapes for any one time interval at two different sample rates. In performing the data reduction, the highest data rate data has always been used in preference to the lowest data rate.

Needless to say processing all the data is relatively expensive, although highly valuable, and thus the amount of magnetic field data processed is a function of funding. The orbital data is much less expensive because there are much fewer data points per unit time. Thus orbital data processing is usually far ahead of the magnetic field data processing.

Printouts of all one minute average data and of many of the orbital parameters from the orbit tapes have been produced. It is not intended to send these to the National Space Science Data Center (NSSDC) since these printouts can be duplicated from the tapes.

Finally some remarks about data presentation. All data, on plots and on tapes are presented as vector components and total field. Such data can be more easily transformed and manipulated than data presented as magnitudes and angles and in general is as easy to interpret. Data presented as angles can be confusing if the angle is near one of its limits (say 90^o or -90^o) when it flips back and forth in response to small fluctuations.

In the sections to follow, we shall briefly describe the instrument, discuss the data processing procedure, and then describe the formats of the resulting plots and tapes. The description of the production of orbital plots has been given elsewhere[1], and will not be repeated in this report.

[1]Russell, C.T., OGO-5 orbital plots generated by the UCLA Fluxgate Magnetometer Group, Publication No. 792, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, 1969.

2. The Instrument

The UCLA fluxgate magnetometer was designed to provide an accurate triaxial vector measurement of the magnetic field from perigee at low altitudes to apogee in the interplanetary medium. Each of the three orthogonal sensors has a dynamic range of ±64,000 gammas and in low fields can resolve field changes of 1/8th of a gamma. This was accomplished with a basic magnetometer that measures ±16 gammas and a set of coils that provide fields to null out the field at the basic magnetometer to within ±16γ. The currents for these coils are provided in 64 steps of 16γ and 128 steps of 1024γ.. This is accomplished as follows: If a field of greater than +16γ or less than -16γ reaches the basic magnetometer, this field is reduced in steps of 16γ until the field at the basic magnetometer is within its operating range. When all available 16γ steps have been applied (64 possible) a field of 1024γ is applied and 63 of the 16γ steps are removed. This stepping procedure has a cycle rate of 500 hz which is far above the magnetometer sampling rates.

The measured field consists then of three quantities: the number of 1024γ nulling fields applied, the number of 16γ nulling fields and the output of the basic magnetometer from +16 to -16γ digitized in 256 parts, each 1/8γ. The sum of these three quantities for each independent axis gives the measured vector field.

The basic magnetometer is operated as a closed loop magnetometer with a frequency response that is flat to 150 hz and then rolls off at 20 db per decade above 150 hz. The three possible OGO-5 telemetry rates, 1, 8 and 64 kilobits per second, correspond to Nyquist frequencies of .43, 3.5 and 27.8 hz for the instrument. Since meaningful wave studies can be performed only if no signals above the Nyquist frequency reach the telemetry system, the output of the basic magnetometer enters a bit rate dependent filter before being digitally sampled. This critically damped fourth order filter has 8 db attenuation at half the Nyquist frequency, 20 db attenuation at the Nyquist frequency and 40 db attenuation at twice the Nyquist frequency.

The satellite can simultaneously transmit data to earth (real time data) and store data on the spacecraft on magnetic tape for later transmission (playback data). These data can be sampled at different rates: playback data is always sampled at 1 kilobit per second whereas the real time data has three possible rates. Thus, the instrument has actually two outputs, each with its independent filter depending on the sampling rate of the digitization unit to which the signal is routed.

The absolute accuracy of the measured field depends on many factors: the sensitivity of the magnetometer, the size of spacecraft fields and the possibility of drifts in the zero levels of the magnetometer. This magnetometer is the most sensitive fluxgate magnetometer ever flown on a spacecraft and is separated from the main body of the spacecraft by a twenty foot boom. However, there are other nearby experiments and this was a newly designed magnetometer. Comparing with the Goddard magnetometers on board which are on a similar boom restricted only to magnetometers, it was found that there was a slow drift from orbit to orbit of the apparent zero levels of the UCLA magnetometer. The Goddard magnetometers consist of a Rb vapor magnetometer and a fluxgate magnetometer both of which have been flown before on OGO-1 and OGO-3 and which provide consistent fields when compared. Data from these magnetometers, graciously supplied by the experimenters have been used to determine the zero level for each OGO-5 orbit. However, in view of the slow drift of the zero levels the absolute value of any one component may be in error from one to two gammas. On the other hand the rate of drift is exceedingly slow compared to the time scales of physical processes such as waves, discontinuities, etc. Thus changes in the field components can be accurately measured to the digitization window of the experiment, 1/8 gamma.

In order to check the calibration of the instrument, a calibration signal is applied to each sensor approximately every 40 minutes (actually every 39 minutes 19.296 seconds). The calibrate signal is 64 data points long, where the number of points is counted at the real time data rate if the satellite is transmitting real time data and at the data storage rate if it isn't. Four bias fields of 8, 32, -8 and -32 gammas are applied to each sensor and each is applied for 16 consecutive data points. The effect of these bias signals is removed in all data processing.

The unit housing the sensors has a heater which has a magnetic field when it is turned on. This heater bias field is approximately 8 gammas on the X and Y axes and 0.5 gammas on the Z-axis. This bias is also removed from all processed data.

3. General Remarks on Data Reduction

In processing a section of data the first step is to determine the sensor offsets. This is done by comparing with simultaneous measurements of the GSFC fluxgate magnetometer. (The GSFC data is corrected for its offsets with values determined from the Rubidium magnetometer data by the GSFC magnetometer group.) This is usually done once per orbit.

When the data enters the computer program, besides converting from voltages to gammas, the program corrects for three effects. The first effect is due to the heater bias. The program finds the heater signature by checking a heater on/off word which is sampled at 1/128th of the data rate and then looks for the expected heater on or off signature in the interval of 128 points bracketed by the change in the heater on/off word. This can fail if the data were very active, if there are data gaps or if the heater came on or went off at or near the end of a file of data (a file of data is defined by a continuous sequence of data on the original data tapes).

The second effect is that of the calibrate signal. The calibrate signal is much easier to identify than the heater signature. However, the occurrence of a calibration signal is not flagged by the instrument. Therefore, it is continuously searched for. It can be missed for the same reasons as the heater signature.

The third effect is the occurrence of transients whenever the medium ladder steps. Since the instrument obeys the Nyquist sampling criterion by having filters to remove signals above half the Nyquist frequency any step change in the data decays with a time constant which for this instrument equals six data points. The filters are applied only to the fine output of the magnetometer. Thus when an additional nulling field is applied to the sensor by the medium ladder (the medium ladder is the array of sixty-four 16 gamma steps that can be applied to each sensor) there is a transient 6 data points in duration. Various schemes have been applied to remove this transient depending in part on the nature of the data.

After these corrections the data is plotted, printed or averaged as required.

4. The Roadmaps. (One Minute Averages)

a) Data Processing

In generating the Roadmap plots all data is processed and averaged, both real time and playback. This data is then stored on a disk pack by orbit in two data sets one for real time data and one for playback data. Then these two data sets are scanned taking data in time sequence from the real time set until a gap is found in the data. Then playback data is searched to try to fill this gap. When this gap is filled or if it cannot be filled the real time data is again read until the next gap and then the process repeats. The end result is a tape with an orbit's data in time sequence containing averages formed from the highest possible telemetry rate. The data from this tape is then printed and microfilm plotted. There are no missing times on these tapes. When data is not available for a particular time it is flagged with a value of 100000.

At the same time, as the Roadmap tape is being created which contains one minute averages, the 4.608 second averages are created. Thus the 4.608 second averages are also in time sequence for one orbit with priority given to the highest telemetry rate data. These tapes are not printed or plotted at UCLA but are sent to H. West at the Lawrence Radiation Laboratory, Livermore, California where they are microfilm plotted. These magnetic tapes are also continuous in time with missing data flagged with values of 100000.

The one minute averages are centered on each minute. The points in this interval are scanned for obvious bad points, the bad points are rejected and the good points are summed and then the total is divided by the number of good points. The number of good points is also saved. We note that this process is performed for each of the three vector components and the total field. The total field calculated is the average of the instantaneous field magnitudes.

In order to retain information on the high frequency end of the spectrum, rms deviations are also calculated for each of the vector components and the total field. We note that the rms deviation of the total field depends somewhat on the accuracy of the offsets used. Thus reliance on the accuracy of the calculation of the rms deviation of the total field should be avoided in low fields. The deviations of the vector components, however, is independent of offset errors.

The rms deviations are not strictly rms deviations in the usual definition of the term, but are actually the rms amplitude of waves in a band of frequencies from 0.07 Hz (15 second period) to the Nyquist frequency which is a function of the telemetry rate. To calculate this amplitude, the input data stream, across averaging intervals, was filtered with a two stage high pass recursive filter. The amplitude response of this filter is shown in figure 1. The output of this filter was squared and summed over each minute and divided by the number of points and then its square root was taken.

R.M.S. Dev.

3 CYCLES X 5 CYCLES

FREQUENCY RESPONSE OF TWO STAGE HIGH PASS FILTER USED IN RMS DEVIATIONS IN ROAD MAPS

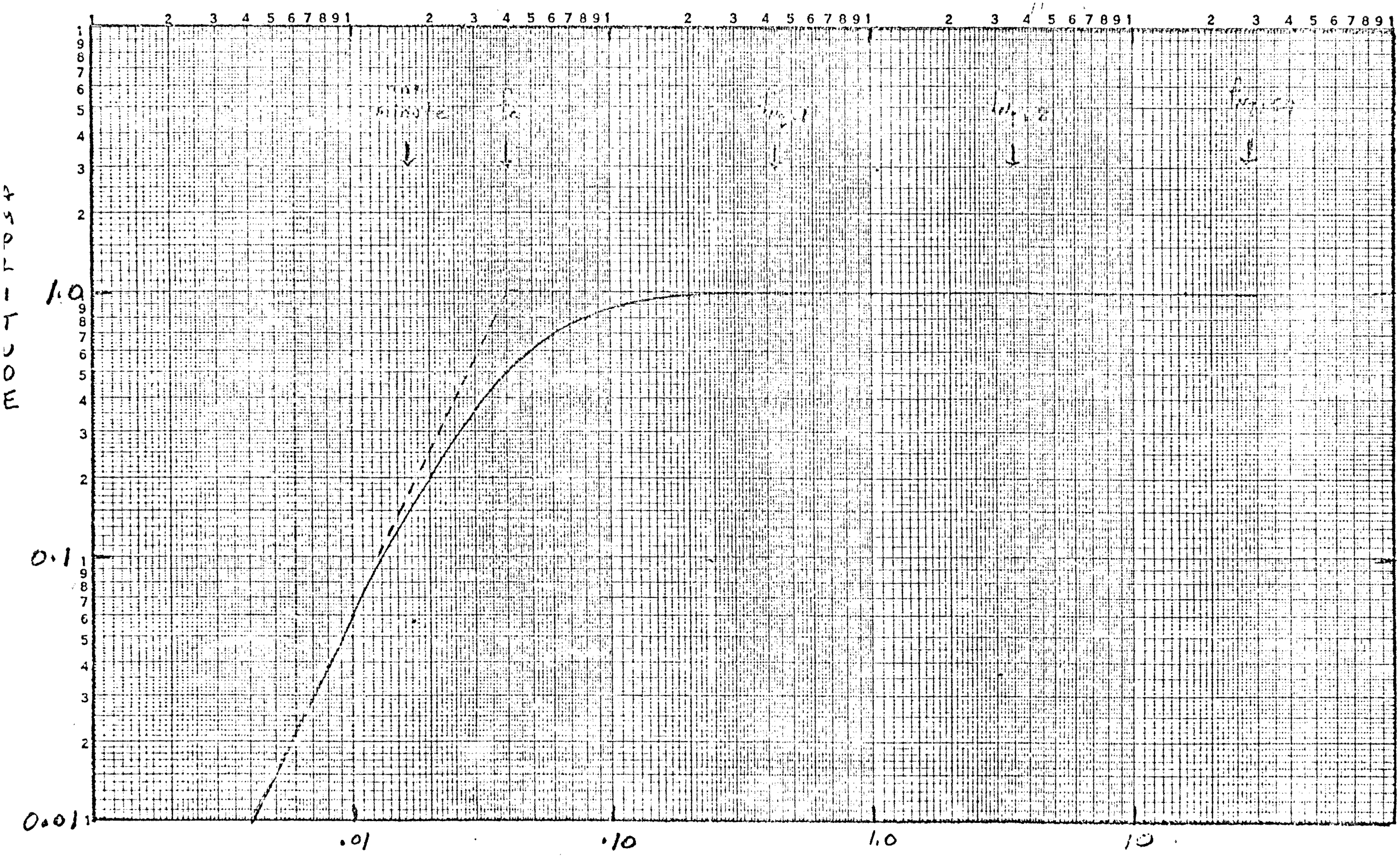


Figure 1

We note that this rms deviation is very insensitive to field gradients whereas the usual rms deviation responds readily to field gradients. However, as all deviations it is very sensitive to bad data and sharp spikes in the rms deviations are probably due to telemetry errors.

b) Microfilm Plots in Spacecraft Coordinates

Each microfilm frame contains five hours of data, so that 13 pages are required to plot an orbit. However, we have plotted two frames for each five hour interval: one containing the vector field data and one containing the rms deviation data. Thus there are 26 frames for every orbit. These are numbered in the lower right-hand corner of every plot. (There are two pages 1, two pages 2, etc.). The data corresponding to the first time on the page and the orbit number are plotted in the upper right-hand corner of each page. Also, each page of data in spacecraft coordinates has the heading "Body Coordinates".

The format of the plot of the rms deviations remains fixed throughout the orbit. Figure 2 shows a typical frame of the rms deviation page. The top axis labelled "KBS" indicates the telemetry bit rate. However, since this is derived by counting the number of points in a one minute average it provides more information than just this. If data quality is poor and points have to be discarded, then this quantity will deviate from a straight line. Furthermore, data missing between files on the original data tapes for intervals less than one minute will show

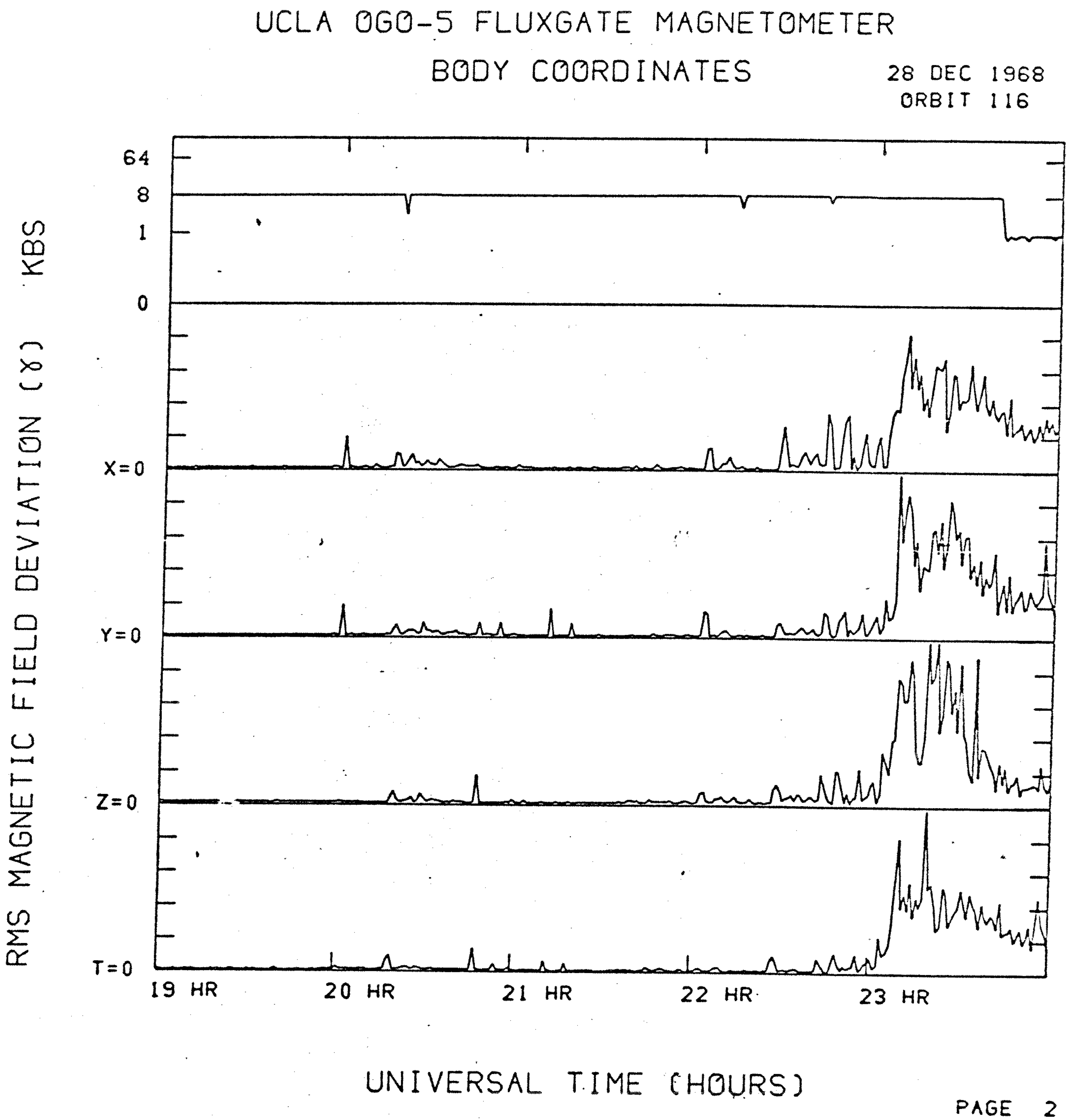

UCLA OGO-5 FLUXGATE MAGNETOMETER
BODY COORDINATES
28 DEC 1968
ORBIT 116
64
8
1
0
KBS
RMS MAGNETIC FIELD DEVIATION (γ)
X=0
Y=0
Z=0
T=0
19 HR
20 HR
21 HR
22 HR
23 HR
UNIVERSAL TIME (HOURS)
PAGE 2

Fig. 2

Data quality indicators

up as a downwards spike on this plot. We note that this quantity is plotted on a log scale.

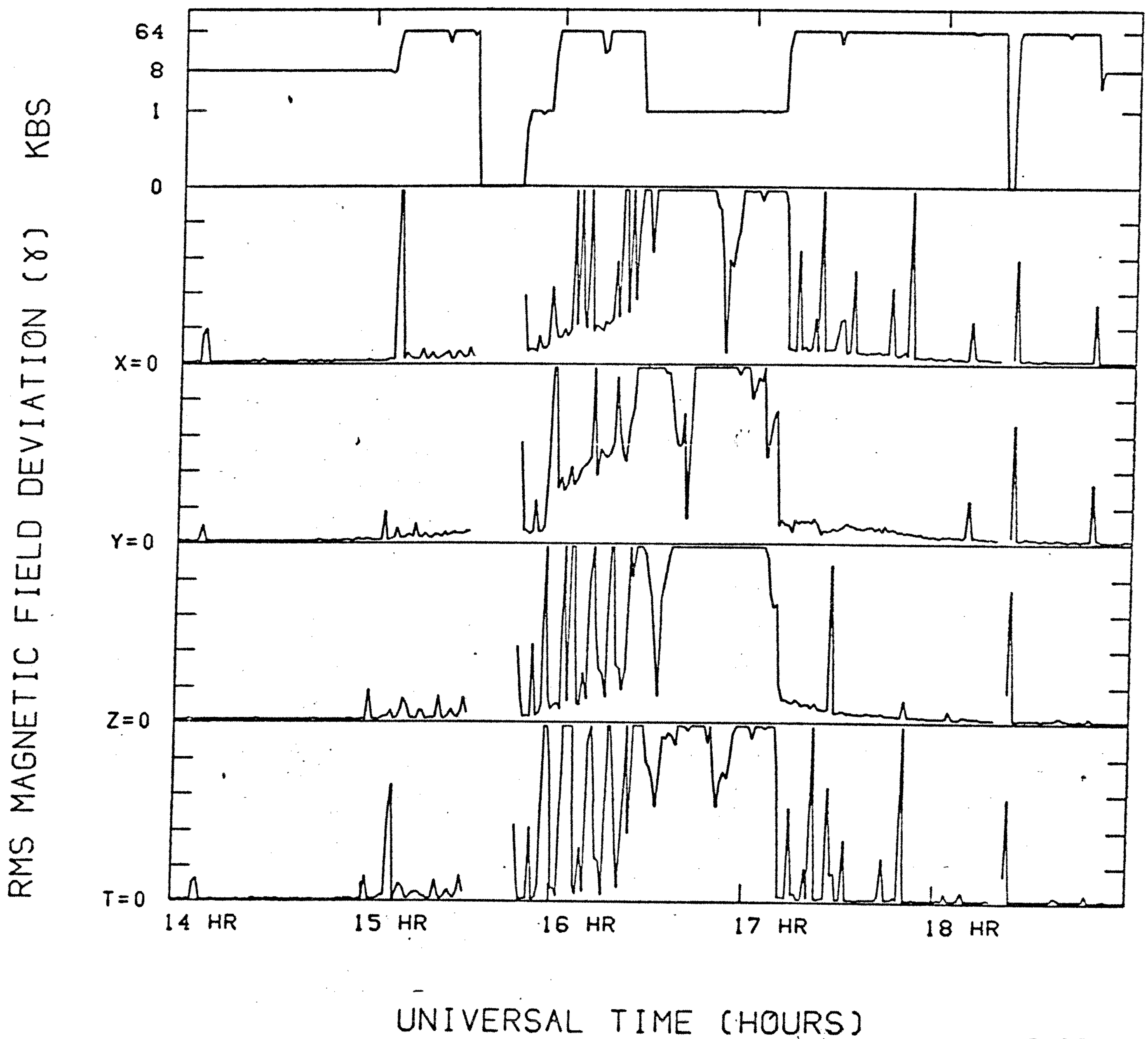
The next four quantities from top to bottom are the rms deviations B_X, B_Y, B_Z and in the total field. The scale is one gamma per division and is linear. The plots saturate at five gammas. The deviations are usually quite accurate but errors may occur. These usually take the form of isolated spikes. On occasion isolated spikes every 40 minutes can occur. These are caused by incompletely correcting for the calibrate signal or missing it completely. Another possible error is an increase in general noise level due to poor quality data. This can be recognized by the deviation of the bit rate word from a straight line. Although most bad points are rejected from the averages and the rms deviations a few always get through and this raises the power in the fluctuations. Spikes occurring on only one axis or on both the X and Y axes and not the Z axis are especially suspicious, such as the ones at 2000 UT and 2105 UT on figure 2.

Figure 3 shows an rms deviation frame through perigee (Perigee is at 1641 UT). We see that data near perigee can be very noisy. This is not real. From 1500 to 1600 and from 1700 to 1800 we see a general rise and then fall of the noise level. This is due to boom vibrations. The sharp increase (and decreases) near 1600 and the sharp decrease in the deviations near 1700 are caused by the switching on and off of the routine for correcting for instrument transients. This is done because we cannot accurately correct for transients when the instrument

UCLA OGO-5 FLUXGATE MAGNETOMETER

BODY COORDINATES

28 DEC 1968
ORBIT 116



steps too rapidly. The point where we stop correcting depends both on the telemetry rate and the field strength.

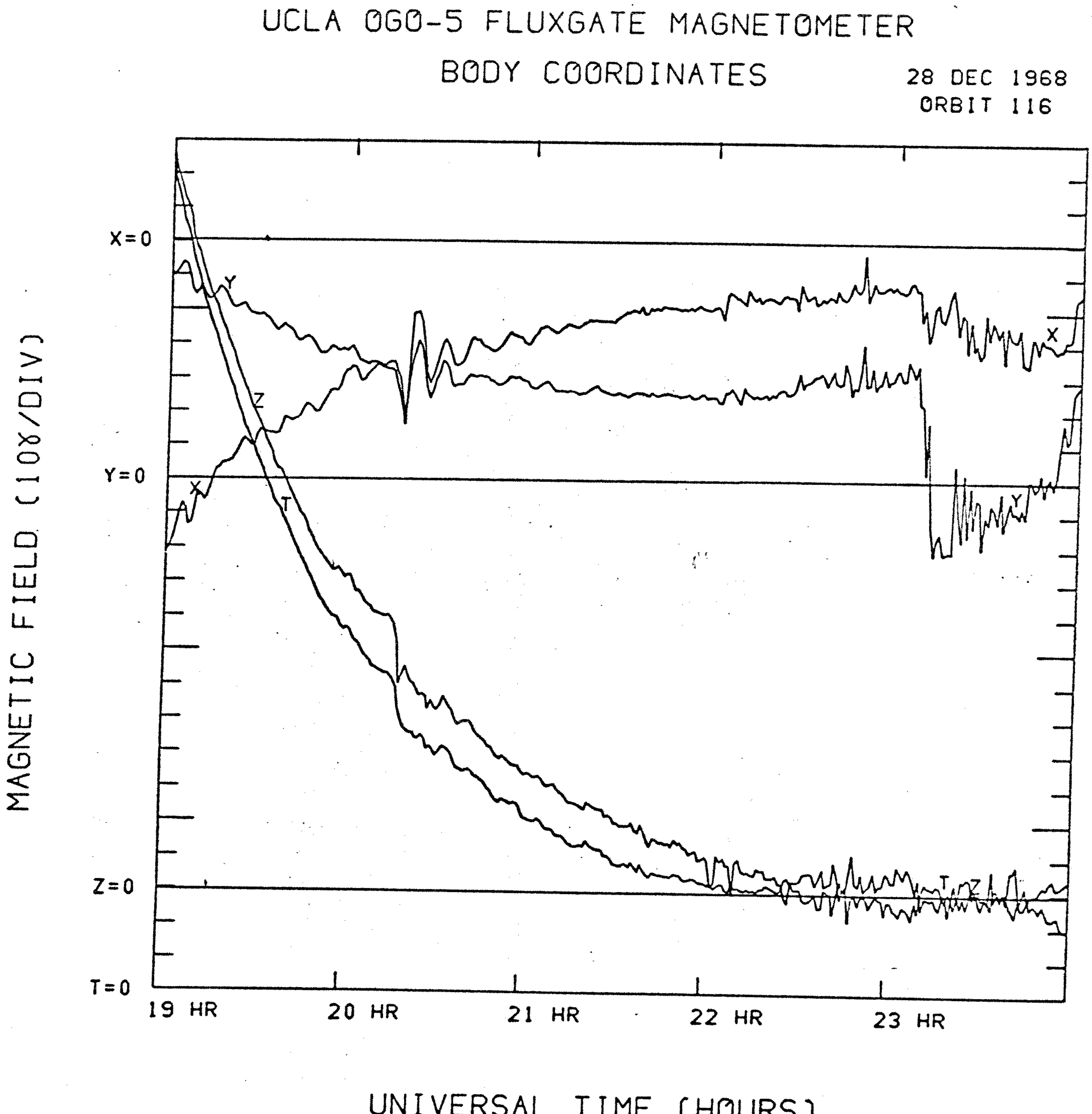
Figure 4 shows the plot of the three components of the field and the magnitude of the field corresponding to the deviations in figure 2. Horizontal lines give the zeroes for each component. These can move about to maximize the amount of data on a page. The zero for the total field is the bottom of the plot. The scale is linear and is 10 gammas per division.

Figure 5 shows the field through perigee for the same interval shown in figure 3. The vertical scale is logarithmic with positive values plotted in the upper half of the plot and negative values in the lower half. This is the only logarithmic plot per orbit.

c) Microfilm Plots in Geocentric Solar Ecliptic (GSE) Coordinates

The microfilm plots in GSE coordinates contain only the field data because the rms deviations cannot be rotated. To transform the data to GSE the orbit tape supplied by GSFC has been used. The data on this tape is every minute. Errors in the positional and orientation data as well as in the magnetic field data can affect the data in the GSE plot.

Figures 6 and 7 show the data in figures 5 and 4 rotated into GSE. The format is identical with the exception that the hourly GSE coordinates of the satellite have been printed at the top of each page. The distances are in earth radii. There are 13 frames per orbit.



UCLA OGO-5 FLUXGATE MAGNETOMETER
BODY COORDINATES
28 DEC 1968
ORBIT 116
MAGNETIC FIELD (10γ/DIV)
X=0
Y=0
Z=0
T=0
X
Y
Z
T
19 HR
20 HR
21 HR
22 HR
23 HR
UNIVERSAL TIME (HOURS)

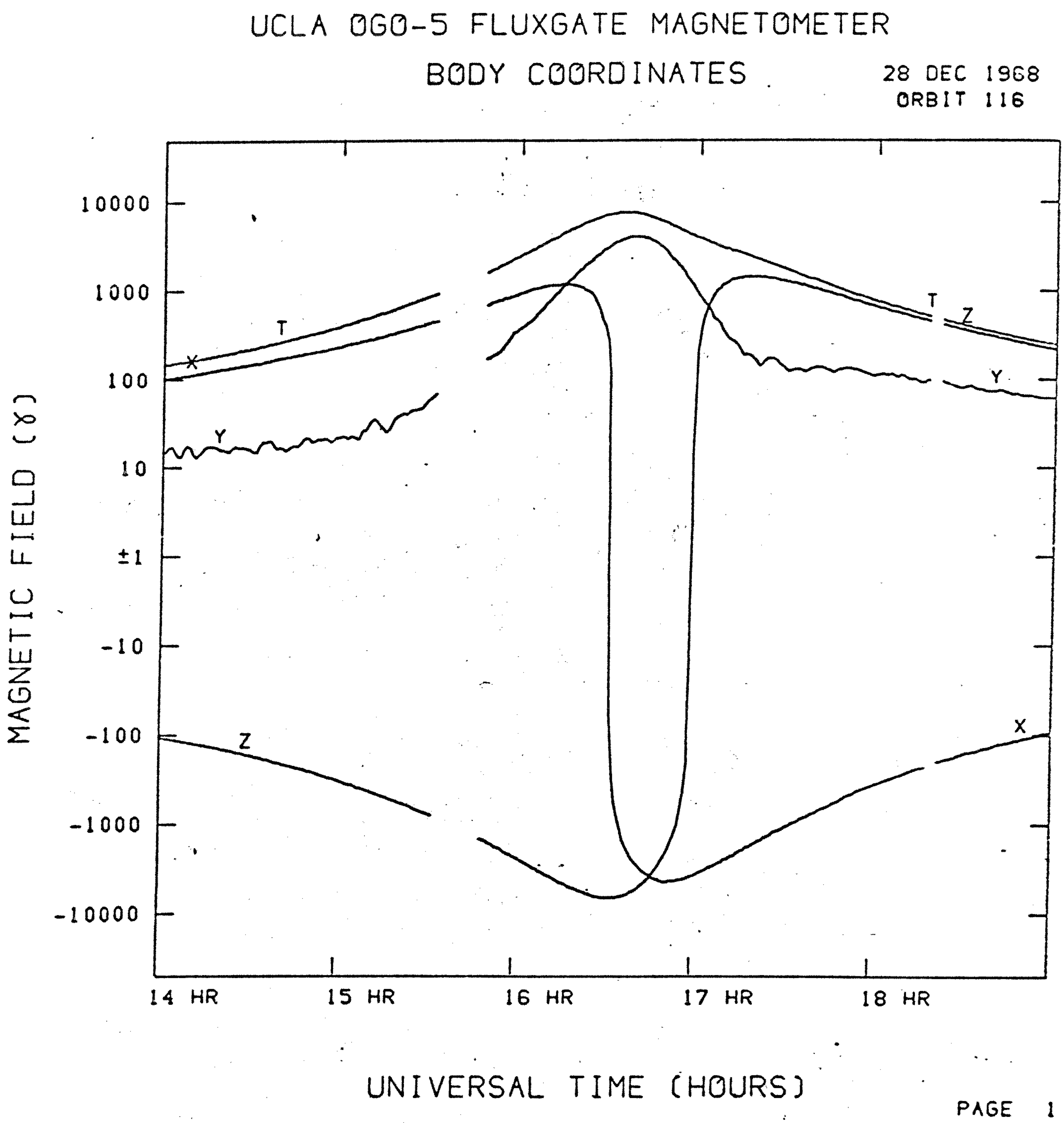

UCLA OGO-5 FLUXGATE MAGNETOMETER
BODY COORDINATES
28 DEC 1968
ORBIT 116
MAGNETIC FIELD (γ)
10000
1000
100
10
±1
-10
-100
-1000
-10000
T
X
Y
Z
14 HR
15 HR
16 HR
17 HR
18 HR
UNIVERSAL TIME (HOURS)
PAGE 1

Fig. 5

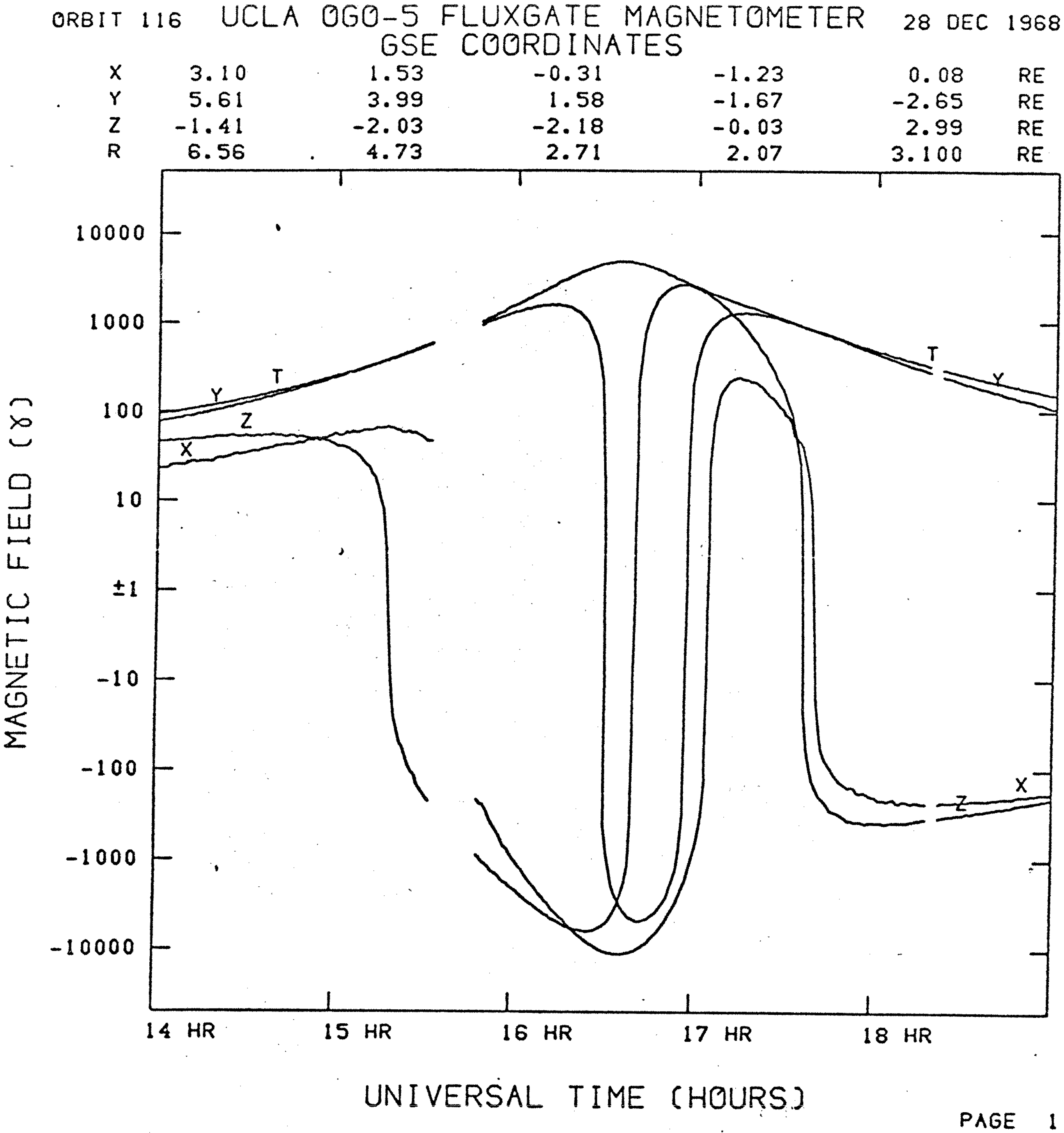
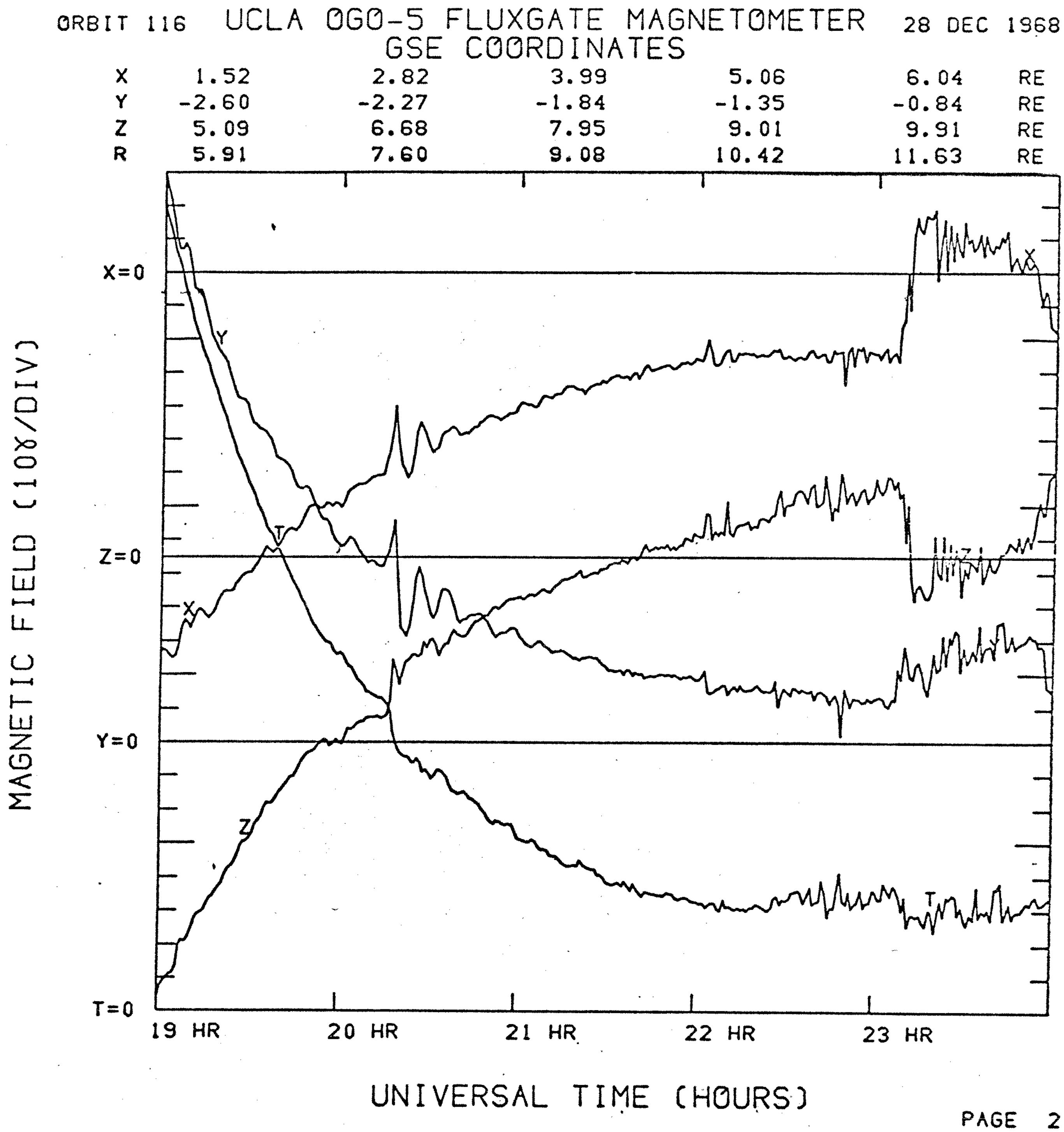

ORBIT 116 UCLA OGO-5 FLUXGATE MAGNETOMETER 28 DEC 1968
GSE COORDINATES
X 3.10 1.53 -0.31 -1.23 0.08 RE
Y 5.61 3.99 1.58 -1.67 -2.65 RE
Z -1.41 -2.03 -2.18 -0.03 2.99 RE
R 6.56 4.73 2.71 2.07 3.100 RE
10000
1000
100
10
±1
-10
-100
-1000
-10000
T
Y
Z
X
14 HR
15 HR
16 HR
17 HR
18 HR
MAGNETIC FIELD (γ)
UNIVERSAL TIME (HOURS)
PAGE 1

Fig. 6



ORBIT 116 UCLA OGO-5 FLUXGATE MAGNETOMETER 28 DEC 1968
GSE COORDINATES
X 1.52 2.82 3.99 5.06 6.04 RE
Y -2.60 -2.27 -1.84 -1.35 -0.84 RE
Z 5.09 6.68 7.95 9.01 9.91 RE
R 5.91 7.60 9.08 10.42 11.63 RE
X=0
Z=0
Y=0
T=0
X
Y
Z
T
MAGNETIC FIELD (10γ/DIV)
19 HR
20 HR
21 HR
22 HR
23 HR
UNIVERSAL TIME (HOURS)
PAGE 2

Fig. 7

d) Microfilm Plots in Geocentric Solar Magnetospheric (GSM) Coordinates

These plots are identical to the GSE plots except that the field and the position are given in the GSM system.

e) Magnetic Tapes in Spacecraft Coordinates

These tapes are 9 track, 800 BPI standard labelled binary tapes. They have 5 files per tape, each file corresponding to one orbit. These files usually overlap in time just before perigee. The JCL used to create the tape is

```
//GO.FT10F001 DD DISP=(NEW,KEEP),DSN=BDY001,
// UNIT=2400,LABEL=(1,SL,,OUT),VOL=SER=IG0005,
// DCB=(RECFM=V,LRECL=5128,BLKSIZE=5132)
```

The binary records are written by the Fortran statement:

```
WRITE(10) NREC, (IBT(I), BX(I), BY(I), BZ(I),
BT(I), BXRMS(I), BYRMS(I), BZRMS(I), BTRMS(I),
IQUAL(I), I=1, 128)
```

where

NREC=128

IBT=Bishop time (defined in Appendix)

BX= X component of the field in gammas

BY= Y component of the field in gammas

BZ= Z component of the field in gammas

BT= total field in gammas (obtained by averaging instantaneous values)

BXRMS= X rms deviation in gammas

BYRMS= Y rms deviation in gammas

BZRMS= Z rms deviation in gammas

BTRMS= Total field rms deviation in gammas

IQUAL= Quality indicator

The quality indicator IQUAL is the sum of two numbers, 1000 times NUMPTS + ICHL. NUMPTS is the number of data points used in the average and ICHL is a flag indicating the status of heater, calibrate signal and ladder step corrections during the averaging interval.

ICHL may be thought of as a binary number with seven bits: X_o, X_1, X_2, X_3....X_6.

If X_o equals 1, then sometime during the averaging interval a heater correction was required but the exact interval for applying this correction could not be found.

If X_2 equals 1, then sometime during the averaging interval a heater correction was applied.

If X_3 equals 1, then a calibration signal correction was made.

If X_4 equals 1, then at least one correction for a medium ladder step on the Z axis was made.

If X_5 equals 1, then at least one correction for a medium ladder step on the Y axis was made.

If X_6 equals 1, then at least one correction for a medium ladder step on the X axis was made.

We note that X_2 is not used, and that this seven bit binary number actually appears in IQUAL as a three digit decimal number.

f) Magnetic Tapes in GSE Coordinates

These tapes are 9 track, 800 BPI, standard labelled binary tapes. They have 5 files per tape, each file corresponding to one orbit. These files usually overlap in time just before perigee. The JCL used to create the tape is:

```
//GO.FT10F001 DD DISP=(NEW,KEEP),DSN=GSE001,
// UNIT=2400,LABEL=(1,SL,,OUT),VOL=SER=IG0006,
// DCB=(RECFM=V,LRECL=1228,BLKSIZE=1232)
```

The binary records are written by the Fortran statement:

```
WRITE(10)IORBIT,IBTST,XGSE,YGSE,ZGSE,RE,
BXE,BYE,BZE,BTE,IQUAL
```

where: BXE,BYE,BZE,BTE and IQUAL are arrays of 60 elements each and

IORBIT = Orbit number

IBTST = Bishop time of first point in record (Bishop time is defined in appendix)

XGSE = XGSE coordinate of satellite at start of record in Re

YGSE = YGSE coordinate of satellite at start of record in Re

ZGSE = ZGSE coordinate of satellite at start of record in Re

RE = Radial distance of satellite from the center of the earth in earth radii

BXE = X GSE component of the field in gammas

BYE = Y GSE component of the field in gammas

BZE = Z GSE component of the field in gammas

BTE = Total field magnitude (obtained by averaging instantaneous values)

IQUAL = Quality indicator as explained in previous section.

g) Magnetic Tapes in GSM Coordinates

Format identical to GSE tapes except that field and positional data are in GSM coordinates.

4.608 Second Averages

a) Data Processing

The data processing for the 4.608 second averages is performed at the same time as the one minute averages and is completely analogous to the one minute average processing except that no rms deviations are produced.

b) Microfilm Plots in Spacecraft Coordinates

The microfilm plots of the 4.608 averages are produced at the Lawrance Radiation Laboratory, Livermore under the supervision of H.I. West, Jr. The plots are in spacecraft coordinates only and cover 20 minutes of data per frame. Thus there are approximately 180 frames per orbit. The scale on the plots is linear. The usual scale for the plots is 10 gammas per division but near perigee this scale is increased to 100 or 1000 gammas per division as necessary to keep the data on scale.

Figure 8 shows a sample of these plots, for the period of the magnetopause crossing shown in the previous figures (2, 4 and 6). The header at the top of each page indentifies the time interval. The orbit number, year, month, day of month, day of year, day from launch and the times of the first and last plotted points on the page are given here. At the bottom of the page is information obtained from the orbit tape. The field given, here, in spacecraft coordinates is that predicted by the reference field only. Also given are the predicted L value, and magnetic latitude, the radial distance to the

OGO V	ORBIT	YEAR	MONTH	DATE	Y DAY	L DAY	HOUR	MINUTES	SECONDS	RECORD	PAGE
INIT.	116	68	DEC	28	363	299	22	50	48.192	55	[illegible]
FINAL							23	10	23.232	56	

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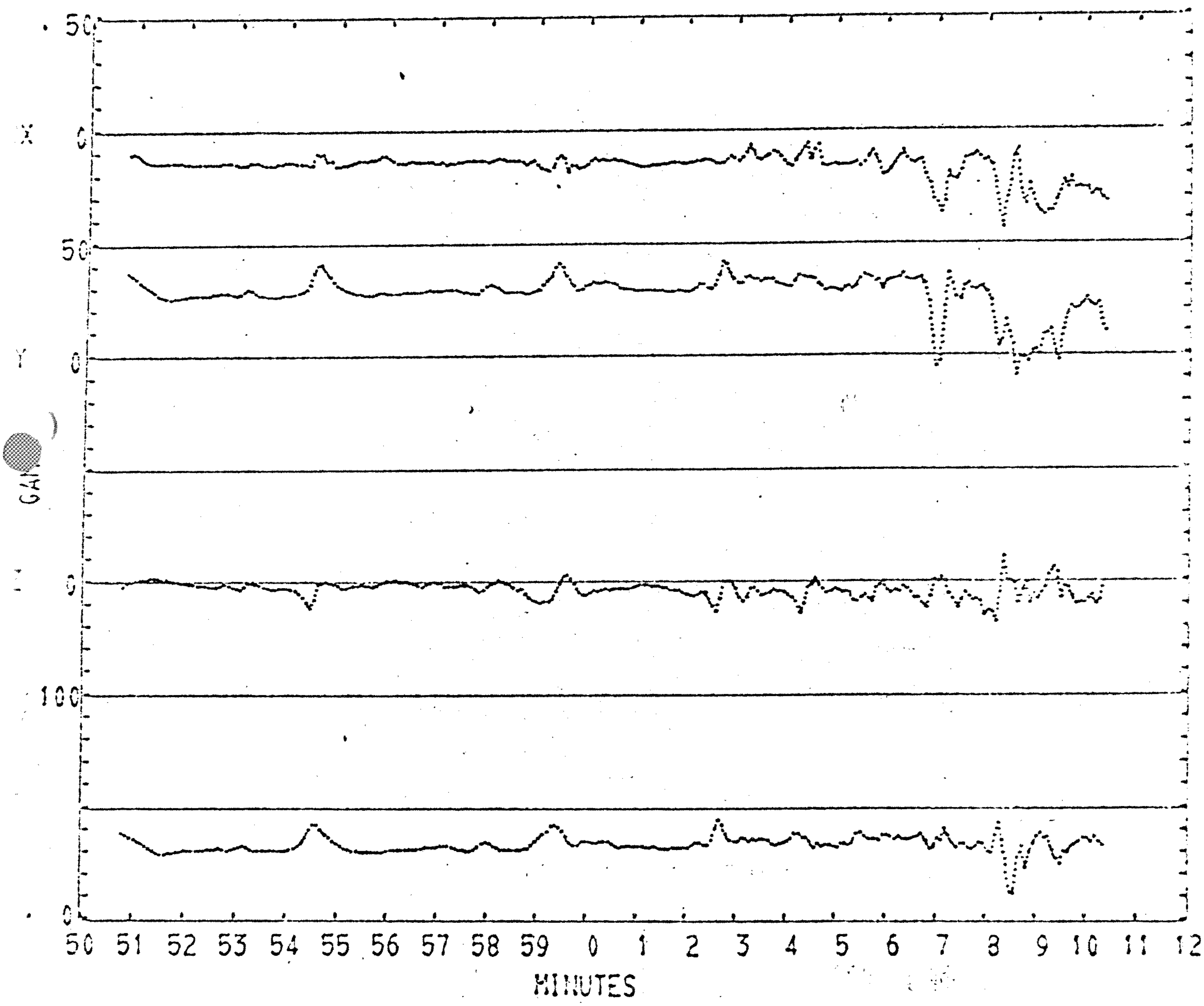

T-ORB	BX	BY	BZ	B	L	MAG LAT	R	PHI	THETA
INIT.	-6.4	16.3	22.3	28.3	15.90	32.17	11.45	351.1	58.6
FINAL	-5.7	15.1	19.6	25.3	16.03	31.03	11.83	353.1	58.2

Fig. 8

satellite and the solar ecliptic longitude and latitude of the satellite.

Occasional errors do appear on these plots and we have not redone these plots to correct them. Some of these errors have been mentioned before: bad telemetry, missed heater corrections and missed calibrate signals, (or incorrectly compensated calibrate signals). Bad telemetry usually shows up as isolated spikes. Missed heater corrections appear as a short duration increase or decrease of 8 gammas on both X and Y axes and no discernible change in Z. Missed calibration signals appear on all three axes. Incorrectly compensated calibrations may only appear on one axis but its 4 steps are usually recognizable. Plotting errors can also occur on these plots. These usually result in missing data, or incomplete plots. Also the zero levels on the plots and tapes for orbits 1-37 may be slightly different due to reprocessing of the tape when better offsets were determined. When differences are noted, the tape contains the correct values.

d) Magnetic Tapes

These tapes are 9 track standard labelled binary tapes. They have 5 files per tape, each file corresponding to one orbit. These files usually overlap in time just before perigee. The JCL used to create the tape is:

```
//GO.FTIOF001 DD DISP=(NEW,KEEP),DSN=PNTOOI,UNIT=2400,
// LABEL=(1,SL,,OUT),VOL=SER=IG0012,
// DCB=(RECFM=V,LRECL=3080,BLKSIZE=3084)
```

The binary records are written by the Fortran statement.

```
WRITE(10)NREC,(IBT(I),BX(I),BY(I),BZ(I),BT(I),IQUAL(I),
I=1,128)
```

where NREC = 128

IBT = Bishop time of data (see appendix)

BX = X spacecraft component of the field in gammas

BY = Y spacecraft component of the field in gammas

BZ = Z spacecraft component of the field in gammas

BT = total field in gammas

IQUAL = Quality indicator as explained in a previous section

Appendix

Bishop time is the name of the unit of time used for the majority of the processing of the OGO-5 and ATS-1 fluxgate magnetometer data at UCLA. It is defined as the number of tenths of seconds since the start of the year 1966, that is, Bishop time equals zero, at 0000 U.T. on January 1, 1966. The advantage of using Bishop time is that one single 360 word can be used to cover a period of six years. Six years is longer than the life-expectancy of most satellites. The disadvantage is that this time word cannot be used to provide timing for the high telemetry rate data of OGO-5. This problem does not arise for the data discussed in this report because the highest sample rate given on these tapes is one point every 4.608 seconds.

On the next page is the listing of a subroutine to convert from Bishop time to ordinary Universal time and vice versa. The entry point BTCON converts from Bishop time while the entry point CONBT converts to Bishop time.

```
      SUBROUTINE CONBT ( T, BT )
C ***********************************************************************
C *   'BISHOP TIME' CONVERSION SUBROUTINE FOR OGO-5. BT IS DEFINED AS THE  *
C *   NUMBER OF TENTHS OF A SECOND SINCE THE START OF YEAR 1966, THAT IS,  *
C *   BT = 0 AT YR 66 DAY 1 HR 0 ETC., AND THE TIME UNIT IS 1/10 SEC.      *
C *       CALL CONBT( T, BT )  CONVERTS T ARRAY TO BT.                     *
C *       CALL BTCON ( BT, T)  CONVERTS BT TO T ARRAY.                     *
C *   THE T ARRAY IS DEFINED AS FOLLOWS:                                   *
C *       T(1) = YEAR (66-71)                  T(5) = HOUR (0-23)          *
C *       T(2) = DAY OF YEAR (1-366)           T(6) = MINUTE (0-59)        *
C *       T(3) = MONTH (1-12)                  T(7) = SECOND (0-59)        *
C *       T(4) = DAY OF MONTH (1-31)           T(8) = MILLISECOND (0-999)  *
C *   WHEN CONVERTING TO BT, T(3) AND T(4) ARE USED ONLY IF T(2) = 0.      *
C *   OTHERWISE T(3) AND T(4) ARE IGNORED.  WHEN CONVERTING FROM BT, ALL   *
C *   EIGHT ENTRIES OF THE T ARRAY ARE COMPUTED.                           *
C *   THE SUBROUTINE FAILS AFTER FEB. 28, 1972 AND BISHOP TIME             *
C *   OVERFLOWS THE 360 WORD LATER THAT YEAR.                              *
C *                                     PROGRAMMER - NEAL CLINE  JAN. 1968 *
C ***********************************************************************
      INTEGER  T(8), BT,   M(13)
     *  / 0, 31, 59, 90, 120, 151, 181, 212, 243, 273, 304, 334, 365 /
      N = ( T(1) - 66 ) * 365
      IF ( T(1) .GT. 68 )  N = N + 1
      IF ( T(2) .NE. 0 )  GO TO 10
          N = N + M(T(3)) + T(4) - 1
          IF ( T(3) .GT. 2 .AND. T(1) .EQ. 68 )  N = N + 1
          GO TO 20
   10 N = N + T(2) - 1
   20 BT = N*864000 + T(5)*36000 + T(6)*600 + T(7)*10 + T(8)/100
      RETURN
      ENTRY BTCON ( BT, T )
      N = BT / 864000
      IF ( N - 1095 ) 50, 30, 40
   30     T(1) = 68
          T(2) = 366
          GO TO 60
   40     N = N - 1
   50     T(1) = N/365 + 66
          T(2) = MOD( N, 365 ) + 1
   60 N = T(2)
      IF ( T(1) .NE. 68 )  GO TO 90
          IF ( N - 60 ) 90, 70, 80
   70         T(3) = 2
              T(4) = 29
              GO TO 120
   80         N = N - 1
   90 DO 100  K = 2, 13
          IF ( N .LE. M(K) )  GO TO 110
  100     CONTINUE
  110 T(3) = K - 1
      T(4) = N - M(K-1)
  120 T(5) = MOD( BT/36000, 24 )
      T(6) = MOD( BT/600, 60 )
      T(7) = MOD( BT/10, 60 )
      T(8) = MOD( BT, 10 ) * 100
      RETURN
      END
```

$JOB 13:03:25
$NOP DUMP OF X-379
$ASS IN MS4
$EXEC DPHEX BS
INPUT TAPE ON MS4
DATA INPUT 1 1 1

25 FILES

TIME : BISHOP TIME

OGO - 5

03/05/68 – 05/08/68 D-29194

HFI

FILE 1 RECORD 1 LENGTH 3784 BYTES

(0)	0C0C0050	0C080000	0000008C	28E82B00	45186A00	45186A00	45186A00	45186A00	00000000	28E82B2E
(40)	45186A00	45186A00	45186A00	45186A00	00000000	28E82B5C	45186A00	45186A00	45186A00	45186A00
(80)	00000000	28E82B8A	45186A00	45186A00	45186A00	45186A00	00000000	28E82BB8	45186A00	45186A00
(120)	45186A00	45186A00	00000000	28E82BE6	45186A00	45186A00	45186A00	45186A00	00000000	28E82C14
(160)	45186A00	45186A00	45186A00	45186A00	00000000	28E82C42	45186A00	45186A00	45186A00	45186A00
(200)	00000000	28E82C70	45186A00	45186A00	45186A00	45186A00	00000000	28E82C9E	45186A00	45186A00
(240)	45186A00	45186A00	00000000	28E82CCC	45186A00	45186A00	45186A00	45186A00	00000000	28E82CFA
(280)	45186A00	45186A00	45186A00	45186A00	00000000	28E82D28	45186A00	45186A00	45186A00	45186A00
(320)	00000000	28E82D57	45186A00	45186A00	45186A00	45186A00	00000000	28E82D85	45186A00	45186A00
(360)	45186A00	45186A00	00000000	28E82DB3	45186A00	45186A00	45186A00	45186A00	00000000	28E82DE1
(400)	45186A00	45186A00	45186A00	45186A00	00000000	28E82E0F	45186A00	45186A00	45186A00	45186A00
(440)	00000000	28E82E3D	45186A00	45186A00	45186A00	45186A00	00000000	28E82E6B	45186A00	45186A00
(480)	45186A00	45186A00	00000000	28E82E99	45186A00	45186A00	45186A00	45186A00	00000000	28E82EC7
(520)	45186A00	45186A00	45186A00	45186A00	00000000	28E82EF5	45186A00	45186A00	45186A00	45186A00
(560)	00000000	28E82F23	45186A00	45186A00	45186A00	45186A00	00000000	28E82F51	45186A00	45186A00
(600)	45186A00	45186A00	00000000	28E82F80	45186A00	45186A00	45186A00	45186A00	00000000	28E82FAE
(640)	45186A00	45186A00	45186A00	45186A00	00000000	28E82FDC	45186A00	45186A00	45186A00	45186A00
(680)	00000000	28E8300A	45186A00	45186A00	45186A00	45186A00	00000000	28E83038	45186A00	45186A00
(720)	45186A00	45186A00	00000000	28E83066	45186A00	45186A00	45186A00	45186A00	00000000	28E83094
(760)	45186A00	45186A00	45186A00	45186A00	00000000	28E830C2	45186A00	45186A00	45186A00	45186A00
(800)	00000000	28E830F0	45186A00	45186A00	45186A00	45186A00	00000000	28E8311E	45186A00	45186A00
(840)	45186A00	45186A00	00000000	28E8314C	45186A00	45186A00	45186A00	45186A00	00000000	28E8317A
(880)	45186A00	45186A00	45186A00	45186A00	00000000	28E831A8	45186A00	45186A00	45186A00	45186A00
(920)	00000000	28E831D7	45186A00	45186A00	45186A00	45186A00	00000000	28E83205	45186A00	45186A00
(960)	45186A00	45186A00	00000000	28E83233	45186A00	45186A00	45186A00	45186A00	00000000	28E83261
(1000)	45186A00	45186A00	45186A00	45186A00	00000000	28E8328F	45186A00	45186A00	45186A00	45186A00
(1040)	00000000	28E832BD	45186A00	45186A00	45186A00	45186A00	00000000	28E832EB	45186A00	45186A00
(1080)	45186A00	45186A00	00000000	28E83319	45186A00	45186A00	45186A00	45186A00	00000000	28E83347
(1120)	45186A00	45186A00	45186A00	45186A00	00000000	28E83375	45186A00	45186A00	45186A00	45186A00
(1160)	00000000	28E833A3	45186A00	45186A00	45186A00	45186A00	00000000	28E833D1	45186A00	45186A00
(1200)	45186A00	45186A00	00000000	28E83400	45186A00	45186A00	45186A00	45186A00	00000000	28E8342E
(1240)	45186A00	45186A00	45186A00	45186A00	00000000	28E8345C	45186A00	45186A00	45186A00	45186A00
(1280)	00000000	28E8348A	45186A00	45186A00	45186A00	45186A00	00000000	28E834B8	45186A00	45186A00
(1320)	45186A00	45186A00	00000000	28E834E6	45186A00	45186A00	45186A00	45186A00	00000000	28E83514
(1360)	45186A00	45186A00	45186A00	45186A00	00000000	28E83542	45186A00	45186A00	45186A00	45186A00
(1400)	00000000	28E83570	45186A00	45186A00	45186A00	45186A00	00000000	28E8359E	45186A00	45186A00
(1440)	45186A00	45186A00	00000000	28E835CC	45186A00	45186A00	45186A00	45186A00	00000000	28E835FA
(1480)	45186A00	45186A00	45186A00	45186A00	00000000	28E83628	45186A00	45186A00	45186A00	45186A00
(1520)	00000000	28E83657	45186A00	45186A00	45186A00	45186A00	00000000	28E83685	45186A00	45186A00
(1560)	45186A00	45186A00	00000000	28E836B3	45186A00	45186A00	45186A00	45186A00	00000000	28E836E1
(1600)	45186A00	45186A00	45186A00	45186A00	00000000	28E8370F	45186A00	45186A00	45186A00	45186A00
(1640)	00000000	28E8373D	45186A00	45186A00	45186A00	45186A00	00000000	28E8376B	45186A00	45186A00
(1680)	45186A00	45186A00	00000000	28E83799	45186A00	45186A00	45186A00	45186A00	00000000	28E837C7
(1720)	45186A00	45186A00	45186A00	45186A00	00000000	28E837F5	45186A00	45186A00	45186A00	45186A00
(1760)	00000000	28E83823	45186A00	45186A00	45186A00	45186A00	00000000	28E83851	45186A00	45186A00
(1800)	45186A00	45186A00	00000000	28E83880	45186A00	45186A00	45186A00	45186A00	00000000	28E838AE
(1840)	45186A00	45186A00	45186A00	45186A00	00000000	28E838DC	45186A00	45186A00	45186A00	45186A00
(1880)	00000000	28E8390A	45186A00	45186A00	45186A00	45186A00	00000000	28E83938	45186A00	45186A00
(1920)	45186A00	45186A00	00000000	28E83966	45186A00	45186A00	45186A00	45186A00	00000000	28E83994
(1960)	45186A00	45186A00	45186A00	45186A00	00000000	28E839C2	45186A00	45186A00	45186A00	45186A00
(2000)	00000000	28E839F0	45186A00	45186A00	45186A00	45186A00	00000000	28E83A1E	45186A00	45186A00
(2040)	45186A00	45186A00	00000000	28E83A4C	45186A00	45186A00	45186A00	45186A00	00000000	28E83A7A
(2080)	45186A00	45186A00	45186A00	45186A00	00000000	28E83AA8	45186A00	45186A00	45186A00	45186A00
(2120)	00000000	28E83AD7	45186A00	45186A00	45186A00	45186A00	00000000	28E83B05	45186A00	45186A00
(2160)	45186A00	45186A00	00000000	28E83B33	45186A00	45186A00	45186A00	45186A00	00000000	28E83B61
(2200)	45186A00	45186A00	45186A00	45186A00	00000000	28E83B8F	45186A00	45186A00	45186A00	45186A00

[28E82B00]
CONVERT TO DECIMAL AND THAT = 1/10 OF A SEC.
DIVIDE DECIMAL # BY 864,000 AND GIVES YOU # OF DAYS.
START FROM YR 66 AT DAY 1.
EXAMPLE: (535 DAYS WOULD BE
535
-365
170 DAY 170
WHICH IS 06/20/67

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28FFCCCC	427B51C8	43121BF4
(1800)	C2AA400F	43165EE9	0003E801	28FFCCFA	427D2A0D	43121A85	C2AA8BFE	43166AEE	0003E800	28FFCD28
(1840)	427F2887	431218A4	C2AAF32A	431677B0	0003E800	28FFCD57	428112F5	43121635	C2AB6AC1	43168433
(1880)	0003E800	28FFCD85	428318E1	43121500	C2ABC237	43169182	0003E800	28FFCDB3	42851026	4312143A
(1920)	C2AC2A25	43169F78	0003E800	28FFCDE1	42871D79	431212D7	C2AC9460	4316ADAB	0003E800	28FFCE0F
(1960)	42891BE9	43120FE3	C2AD05DF	4316BAA6	0003E800	28FFCE3D	428B3760	43120CB0	C2AD7546	4316C837
(2000)	0003E801	28FFCE6B	428D49FC	43120789	C2ADF5CA	4316D486	0003E800	28FFCE99	428F4AEF	4312059D
(2040)	C2AE65EE	4316E301	0003E800	28FFCEC7	42915734	43120300	C2AEE869	4316F16C	0003E800	28FFCEF5
(2080)	429376DB	4311FDE3	C2AF7C8A	4316FFAD	0003E800	28FFCF23	42957DD5	4311F9C6	C2B01312	43170E05
(2120)	0003E800	28FFCF51	429783FC	4311F430	C2B0723E	431719B6	0003E800	28FFCF80	42998972	4311EDDB
(2160)	C2B10749	43172695	0003E800	28FFCFAE	429B8576	4311E952	C2B1662E	43173324	0003E801	28FFCFDC
(2200)	429D6F07	4311E40B	C2B1DB01	43173F73	0003E800	28FFD00A	429F692A	4311E10C	C2B24415	43174DBE
(2240)	0003E800	28FFD038	42A166EE	4311DCE3	C2B2B47A	4317589B	0003E800	28FFD066	42A34EA8	4311D855
(2280)	C2B32816	431768D0	0003E800	28FFD094	42A54485	4311D27C	C2B3A3E0	431775D0	0003E800	28FFD0C2
(2320)	42A73CCA	4311CBE2	C2B42687	431782A8	0003E800	28FFD0F0	42A93FD7	4311C596	C2B4C06E	431790E3
(2360)	0003E800	28FFD11E	42AB61DD	4311BFE0	C2B55C88	4317ACAB	0003E801	28FFD14C	42AD58C4	4311B8B0
(2400)	C2B5FAA6	4317AE55	0003E800	28FFD17A	42AF6D4B	4311B2FD	C2B6710B	4317BCED	0003E800	28FFD1A8
(2440)	42B1397C	4311AE2F	C2B70956	4317CB43	0003E804	28FFD1D7	42B324CB	4311A720	C2B77D06	4317D7DC
(2480)	0003E800	28FFD205	42B4FA1E	4311A262	C2B7FEF9	4317E618	0003E800	28FFD233	42B6DA89	43119E19
(2520)	C2B88974	4317F55F	0003E800	28FFD261	42B8C8C4	431198E8	C2B8ECC0	43180357	0003E800	28FFD28F
(2560)	42BAE113	431192B8	C2B9346D	4318112A	0003E801	28FFD2BD	42BCCD8B	43118C4D	C2B99357	43181E56
(2600)	0003E800	28FFD2EB	42BEAE11	4311855F	C2BA1621	43182BFD	0003E800	28FFD319	42C09073	43117DC0
(2640)	C2BA95C6	4318393C	0003E800	28FFD347	42C289A7	431174B5	C2BB2A90	431846F3	0003E800	28FFD375
(2680)	42C480EE	43116CE8	C2BBD0B2	4318562B	0003E800	28FFD3A3	42C66E9A	43116423	C2BC7858	43186497
(2720)	0003E800	28FFD3D1	42C858BA	43115CBF	C2BD158C	431873B6	0003E800	28FFD400	42CA45F4	431154F4
(2760)	C2BDC74B	43188367	0003E800	28FFD42E	42CC5E92	43114BB6	C2BEEF74	43189737	0003E801	28FFD45C
(2800)	42CE5652	43114253	C2BF6B6B	4318A4CD	0003E800	28FFD48A	42D02B69	43113A20	C2BFE998	4318B24B
(2840)	0003E800	28FFD4B8	42D1FADD	4311326C	C2C04E81	4318BF4E	0003E800	28FFD4E6	42D3DCDB	431129DF
(2880)	C2C0DD98	4318CDBF	0003E800	28FFD514	42D5CC28	431121F5	C2C188B2	4318DE10	0003E800	28FFD542
(2920)	42D7C182	43111B3B	C2C227E0	4318EF2B	0003E800	28FFD570	42D9BB54	43111407	C2C2A96D	4318FF55
(2960)	0003E800	28FFD59E	42DBBFD8	43110B80	C2C30FDE	43190E45	0003E801	28FFD5CC	42DD7B78	43110142
(3000)	C2C36C24	4319195E	0003E800	28FFD5FA	42DF5611	4310F877	C2C3D0DC	431926E5	0003E800	28FFD628
(3040)	42E1571D	4310EE6B	C2C459A4	43193626	0003E800	28FFD657	42E33AEE	4310E555	C2C4EFCE	4319458D
(3080)	0003E800									

FILE 1 # OF DATA RECORDS 263 # SUCCESSFUL READS 263
PERMANENT READ ERRORS 0 # ZERO BYTE ERRORS 1 # SHORT RECORDS 0 # UNDEFINED ERRORS 0
OF RECORDS RETRIED 1 TOTAL # OF RETRIES 1

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$AVF IN 24

(2320)	45186A00	45186A00	45186A00	45186A00	00000000	28E83C75	45186A00	45186A00	45186A00	45186A00
(2360)	00000000	28E83CA3	45186A00	45186A00	45186A00	45186A00	00000000	28E83CD1	45186A00	45186A00
(2400)	45186A00	45186A00	00000000	28E83D00	45186A00	45186A00	45186A00	45186A00	00000000	28E83D2E
(2440)	45186A00	45186A00	45186A00	45186A00	00000000	28E83D5C	45186A00	45186A00	45186A00	45186A00
(2480)	00000000	28E83D8A	45186A00	45186A00	45186A00	45186A00	00000000	28E83DB8	45186A00	45186A00
(2520)	45186A00	45186A00	00000000	28E83DE6	45186A00	45186A00	45186A00	45186A00	00000000	28E83E14
(2560)	45186A00	45186A00	45186A00	45186A00	00000000	28E83E42	45186A00	45186A00	45186A00	45186A00
(2600)	00000000	28E83E70	45186A00	45186A00	45186A00	45186A00	00000000	28E83E9E	45186A00	45186A00
(2640)	45186A00	45186A00	00000000	28E83ECC	45186A00	45186A00	45186A00	45186A00	00000000	28E83EFA
(2680)	45186A00	45186A00	45186A00	45186A00	00000000	28E83F28	45186A00	45186A00	45186A00	45186A00
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(2800)	45186A00	45186A00	45186A00	45186A00	00000000	28E8400F	45186A00	45186A00	45186A00	45186A00
(2840)	00000000	28E8403D	45186A00	45186A00	45186A00	45186A00	00000000	28E8406B	45186A00	45186A00
(2880)	45186A00	45186A00	00000000	28E84099	45186A00	45186A00	45186A00	45186A00	00000000	28E840C7
(2920)	45186A00	45186A00	45186A00	45186A00	00000000	28E840F5	45186A00	45186A00	45186A00	45186A00
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(3000)	45186A00	45186A00	00000000	28E84180	45186A00	45186A00	45186A00	45186A00	00000000	28E841AE
(3040)	45186A00	45186A00	45186A00	45186A00	00000000	28E841DC	45186A00	45186A00	45186A00	45186A00
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FILE 1 RECORD 263 LENGTH 3084 BYTES

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(40)	C21C09DD	4310D1E4	C28CB089	43130F74	0003E811	28FFBFD7	C219DDFC	4310DE35	C28CDD04	4313188A
(80)	0003E810	28FFC005	C217C5E1	4310EB13	C28D584D	431324BF	0003E810	28FFC033	C215A60A	4310F65F
(120)	C28DADE4	43132E4F	0003E810	28FFC061	C2137AA7	4311027F	C28E03E3	43133991	0003E810	28FFC08F
(160)	C2114BD5	4311086D	C28E783D	43134016	0003E437	28FFC0BD	C1F39880	431118DC	C28E9E9B	43134DFF
(200)	0003E810	28FFC0EB	C1D1624C	43112490	C28FC29C	431359B2	0003E810	28FFC119	C1AEF8BC	43112EA3
(240)	C28F5FE5	431363F8	0003E811	28FFC147	C18B49C3	43113991	C28FBFF4	43136F4D	0003E810	28FFC175
(280)	C1688018	4311430B	C29039E8	43137A60	0003E42A	28FFC1A3	C1463D06	43114B7B	C2907BCD	43138329
(320)	0003E810	28FFC1D1	C1232580	431154A5	C291040B	43138EDB	0003E810	28FFC200	BF85DE00	431160DC
(360)	C291649A	43139C5B	0003E810	28FFC22E	4121CF4A	43116ABC	C291C186	4313A7E8	0003E810	28FFC25C
(400)	4143F567	431174CD	C2920C22	4313B355	0003E811	28FFC28A	41660000	43117E13	C29231EB	4313BD37
(440)	0003E810	28FFC2B8	41855DDF	431186E0	C29281E3	4313C80E	0003E810	28FFC2E6	41A6BDCC	431190FD
(480)	C292E04B	4313D4BC	0003E810	28FFC314	41C59BA2	43119C0F	C29311B2	4313E114	0003E810	28FFC342
(520)	41E4ACB9	4311A57A	C293468B	4313EC3F	0003E810	28FFC370	42104F32	4311AF50	C2938A75	4313F876
(560)	0003E810	28FFC39E	421256A0	4311B831	C293CC8E	431403FE	0003E810	28FFC3CC	42142AFB	4311BC2E
(600)	C293F4F4	43140A72	0003E813	28FFC3FA	421636A7	4311C246	C2946C92	43141573	0003E800	28FFC428
(640)	42185E9D	4311C93A	C294E788	431421A5	0003E800	28FFC457	421A7FB5	4311CF4E	C2956276	43142D40
(680)	0003E801	28FFC485	421CA385	4311D494	C295AE9D	43143707	0003E800	28FFC4B3	421EC7EF	4311D93D
(720)	C2962EE4	431441FE	0003E800	28FFC4E1	4220EC4C	4311DDDD	C296A958	43144CFB	0003E800	28FFC50F
(760)	4222EA0D	4311E34B	C29729D9	431458CE	0003E800	28FFC53D	4224D82C	4311E7DA	C297C7EC	431464CD
(800)	0003E800	28FFC56B	42270350	4311EB5F	C2984F82	43146FDD	0003E800	28FFC599	4229077A	4311EE15
(840)	C2988437	4314791E	0003E800	28FFC5C7	422AF913	4311F32A	C2990186	431483CD	0003E801	28FFC5F5
(880)	422D026A	4311F98D	C299502B	4314900A	0003E800	28FFC623	422F0EA5	4311FE9E	C299C70F	43149C82
(920)	0003E800	28FFC651	42311A7E	43120340	C29A369C	4314A892	0003E800	28FFC680	4233349A	4312085B
(960)	C29AB57E	4314B5D1	0003E800	28FFC6AE	42354B7F	43120C70	C29B198C	4314C18E	0003E800	28FFC6DC
(1000)	423773E8	43120EF2	C29B85CC	4314CC8A	0003E800	28FFC70A	42397BE7	43121198	C29BE4E0	4314D720
(1040)	0003E800	28FFC738	423B9166	43121487	C29C41FF	4314E23C	0003E801	28FFC766	423DB295	431216B6
(1080)	C29C9672	4314ECC5	0003E800	28FFC794	423FC62E	4312197D	C29D2340	4314F981	0003E800	28FFC7C2
(1120)	4241CAAE	43121BCC	C29DB727	4315060D	0003E800	28FFC7F0	4243BD3E	43121E5F	C29E3C18	43151257
(1160)	0003E800	28FFC81E	4245DF69	43122048	C29E9F95	43151DDC	0003E800	28FFC84C	4247DD09	43122180
(1200)	C29F08B1	431528AA	0003E800	28FFC87A	4249D142	4312238E	C29F64B3	431533D8	0003E800	28FFC8A8
(1240)	424BF692	43122471	C2A01FDA	431541AD	0003E801	28FFC8D7	424F2568	43122506	C2A0B964	43154E99
(1280)	0003E800	28FFC905	42504090	431226CC	C2A117D6	43155AB5	0003E800	28FFC933	42525AE8	431228F1
(1320)	C2A1939F	4315682C	0003E800	28FFC961	42546B46	431228BD	C2A1E82B	43157286	0003E800	28FFC98F
(1360)	42567C1B	4312284D	C2A24064	43157CFC	0003E800	28FFC9BD	42588502	431226FD	C2A2B9C7	431587BC
(1400)	0003E800	28FFC9EB	425AA20C	43122746	C2A32E98	43159434	0003E801	28FFCA19	425CB5BD	431227CC
(1440)	C2A37086	43159FBB	0003E800	28FFCA47	425EE800	43122839	C2A3F0CF	4315AC40	0003E800	28FFCA75
(1480)	4260B804	43122826	C2A45F07	4315B845	0003E800	28FFCAA3	4262A681	43122773	C2A4EDFB	4315C497
(1520)	0003E800	28FFCAD1	4264C083	431226D4	C2A55A20	4315D0E4	0003E800	28FFCB00	4266CE06	4312277E
(1560)	C2A5C895	4315DE48	0003E800	28FFCB2E	4268DD79	43122704	C2A62700	4315EA74	0003E800	28FFCB5C
(1600)	426AE5E4	431225E5	C2A69B93	4315F6C9	0003E801	28FFCB8A	426CDED5	43122420	C2A6F5E6	431601AF
(1640)	0003E804	28FFCBB8	426F0317	43122398	C2A768D3	43160F56	0003E800	28FFCBE6	42711858	43122427
(1680)	C2A7D0B3	43161D81	0003E800	28FFCC14	427321AA	431222D8	C2A83AB1	43162A02	0003E800	28FFCC42

4221A33B	42220256	4221DE63	4221BDEC	42217537	42210A06	4220D014	4220B492	4220CF5E	4220F3E2
4220C4A8	4220BEFE	4220939A	42207D26	4220D17B	4220F214	4220DA6F	42212217	422141B3	42218152
42221245	4222AC44	4222C756	4222EB04	422310D1	42234284	4223230E	4222FAAC	4223706F	4223C644
4223F06A	42243415	4224207F	4224965D	4224F3E6	422557EB	4225CE33	42267E46	42275AC3	422811D2
42284FEB	42286A32	422835DE	42284988	4228B667	42291D44	00065CE8	00065518	00065CF8	00065CF8
00065910	00064588	00065910	00065910	00065900	00C65900	00065518	0C065900	00065CE8	00065900
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00065528	00065CF8	00065910	00065528	00064D58	00065140	00C65518	00065CE8	00065518	00065CE8
00065CE8	00065900	00C6590F	00065CE8	00065130	00064960	00064960	00065900	00064960	00064D48
00064960	00065CE8	00065CF8	00065140	00065CE8	00065910	00065910	00063DB8	00064970	C0065130
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RECORD 3899 OF FILE 1
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4220B561	42213A78	4221E17B	42226C00	4222F163	42235ED0	42238EC1	4223C13A	4223D263	42246288
42251C61	4225BD01	42269ECC	42270D31	42277ACF	4228223F	4228ECE6	42295A63	4229BC7C	4229CE33
422A50AF	422ACBEF	422B719D	422B9FD3	422C2742	422D0799	422E4F0A	422F1FC0	422F7157	45186A00
423067F0	4230B341	4231B0B3	4232D4C3	4233C8AD	423468A2	423599D9	45186AC0	45186A00	45186A00
45186AC0	45186A00	45186A00	45186A00	45186A00	45186A00	45186A00	45186A00	45186A00	45186A00
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C2168DF2	C21650C2	C2161D80	C2160FDA	C2162191	C216A185	C217648E	C217E175	C21E84D0	C218F214
C21956CF	C219B407	C219E410	C219EC32	C21A18E8	C21A935F	C21AFB0D	C21B5AE7	C21C2DF3	C21CD400
C21D6D49	C21E3041	C21EA847	C21F2D49	C21FC846	C21FC958	C21FB4C4	C21F4EDB	C21FCEB4	45186A00
C220CF2A	C2215A2B	C2216741	C2210F32	C220E955	C2209E6D	C21EF856	45186A00	45186A00	45186A00
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41CBACF1	41C1988C	41B96678	41AC878F	4199F96E	418FCB9B	41870C6E	417E0231	4173366C	416F7D62
416C8662	41667954	415C7706	414A54A6	4145A246	4148B1FA	41494077	41406F33	412FAACD	41235FA9
41256CA6	411DF409	411033FA	40D561FE	40979305	402B8ABD	C06EFF5C	C11DA137	C12ABF3B	45186A00
C13A91F7	C144E12A	C159E7A4	C16BA984	C17A77F6	C181CBC9	C193E6CF	45186A00	45186A00	45186A00
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4229B8A9	4229D0D4	422A16AE	422A48D8	422A7846	422AF1A5	422E6488	422BB6A0	422C00C9	422CA98D
422D7269	422E1BB5	422EDAE1	422F1A95	422F86D0	42305987	423113A6	4231BF3B	42327326	4232D465
42339888	42346841	42352EC9	4235A0E0	42366826	42371EC4	42382095	42389BAB	42392E76	45186A00
423A97CE	423B2F32	423C239E	423D02B6	423DD56D	423E4C69	423E988C	45186AC0	45186A00	45186A00
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4264C1C6	426672AB	42678F87	426882AA	4269B0AA	426B2242	426CC6A0	426E61C3	426FE987	4270B1D8
4271DCB4	42736BCF	42752BF8	4276B2BF	42778A89	4278D276	427AF0A6	427CF5A9	427F71C9	428123E9
428295CF	4284301F	4285B1D4	42877E83	4289F372	428BAA5B	428D7C0F	428EDB77	4290A4C8	42922528
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C2277014	C226B2AC	C225BA64	C2239F17	C22135B1	C21FB28F	C21F91F8	C22168D0	C22313C4	C2236C49
C222DE6B	C223038C	C22106E5	C21ED53B	C21E2D68	C21D050C	C21D9714	C21E01CF	C21D9347	C21D4CEA
C21BFDD6	C21BDBD5	C21C230E	C21B2666	C21ACA27	C21B25B9	C218811D	C2167B61	C214C3FD	C21269C3
C2125693	C2137A3C	C211FD75	C2101422	C1FA510B	C1F22C3F	C1E2EB90	C1D74ABE	C1EE0777	C1A78FA5
C18F5975	C158EF30	C1332E7E	C114C081	411034C9	45186A00	45186A00	45186A00	45186A00	45186A00
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C22AFFE7	C22C4A81	C22DE2F9	C22FE890	C2328FC8	C234AA42	C236BEC7	C236727A	C236A059	C2374FFA
C2397F15	C23BA310	C23E8274	C240CC4F	C2426A0F	C244161C	C244CE7C	C2463314	C247A195	C24916A6
C24AD94B	C24C23FC	C24D75CF	C24F7781	C251DC36	C253CFB6	C25614A0	C25804D0	C2595A25	C25B4B47
C25C4154	C25E201D	C2606C44	C2625A13	C2634B74	C2655BE6	C26767E5	C2687977	C269C92C	C26BEE22
C26E2902	C26FDCF3	C2716B16	C2724A1D	C2741B4E	45186A00	45186A00	45186AC0	45186A00	45186A00
425B9066	425C7ADA	425D7588	425E995C	4260580B	426206A4	426395A9	42650114	4265BF93	426735AC
42684E78	42697E9C	426ADBC7	426C10B1	426D75E2	426E2DE0	426FB21C	42723362	42749E65	4276D44E
427922E9	42789B93	427D6521	427EC6C5	42806C20	428236F9	428411DC	42863671	42882023	42897AF3
428B1B4C	428D0D84	428F40B8	42916754	42935769	429587F7	429812E8	429A7E11	429D072F	429F387A
42A0EF58	42A37075	42A9D188	42A83231	42AAB013	42AD3AD1	42AFD062	42B17D32	42B3968F	42B5F9E2
42B83AF9	42BACB51	42BCFB44	42BFCA97	42C17F8A	00000000	00000000	000000C0	00000000	00000000
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5/05/70

3899 RECORDS IN FILE 1 OF TAPE

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IEF285I   VOL SER NOS= K3SCR3.
IEF285I   SYS77048.T090937.RV000.YZJRJTX4.S0000082        DELETED
IEF285I   VOL SER NOS= K3SCR3.
IEF285I   SYS77048.T090937.SV000.YZJRJTX4.R0000077        SYSOUT
IEF285I   VOL SER NOS= K3SCR4.
IEF285I   SYS77048.T090937.SV000.YZJRJTX4.R0000078        DELETED
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