DATA SET CATALOG #185

Mariner IV

Magnetometer Data Package

67-060A-05A	1 tape
67-060A-05B	1 tape

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 This inventory information is now no longer maintained in the DSCs, but is now managed in the inventory part of the NSSDC information system.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

MARINER 5

TRIAX. MAGNETIC FIELD ON TAPE

67-060A-05A PSFP 00087

THIS DATA SET HAS BEEN RESTORED. THERE WAS ORIGINALLY ONE 7-TRACK, 556 BPI TAPE WRITTEN IN BINARY. THERE IS ONE RESTORED TAPE. THE DR TAPE IS A 3480 CARTRIDGE AND THE DS TAPE IS 9-TRACK, 6250 BPI. THE ORIGINAL TAPE WAS CREATED ON AN IBM 7094 COMPUTER AND WAS RESTORED ON THE MRS SYSTEM. THE DR AND DS NUMBER ALONG WITH THE CORRESPONDING D NUMBER AND TIME SPAN IS AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR005508	DS005508	D008689	1	06/14/67 - 11/21/67

MARINER 5

TRIAX HR. AVG MAGNETIC FLD TAPE

67-060A-05B PSFP-00121

THIS DATA SET HAS BEEN RESTORED. THE ORIGINAL TAPE WAS 9-TRACK, 800 BPI WITH ONE FILE OF DATA. THE TAPE WAS CREATED ON AN IBM 360 COMPUTER. THERE IS ONE RESTORED TAPE WITH ONE FILE OF DATA, THE DR TAPE IS A 3480 CARTRIDGE AND THE DS TAPE IS 9-TRACK, 6250 BPI. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND THE TIME SPAN IS AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR02874	DS02874	D08688	1	06/14/67 - 11/21/67

67-060A-05A

67-060A-05B

MARINER V MAGNETOMETER DATA PACKAGE

This data set consists of 2 Mariner 5 Magnetic Field and Hourly Averages Magnetic Field data tapes.

67-060A-05A Basic Magnetic Field Analysis tape (BAMFAT) 556 BPI, 7 track, Binary.

D#	C#	FILES	START	STOP
D-08689	C-07719	1	06/14/67	11/21/67

67-060A-05B Magnetic Field Average tape 800 BPI, 9 track, Binary. Dupe is 7 track

D#	C#	FILES	START	STOP
D-08688	C-07720	1	06/14/67	11/21/67

MARINER V MAGNETOMETER DATA PACKAGE

as submitted to the

NATIONAL SPACE SCIENCE DATA CENTER

January 1972

Principal Investigator:	E. J. Smith
Co-Investigators:	P. J. Coleman, Jr.
	L. Davis, Jr.
	D. E. Jones
Associate:	J. W. Belcher

PREFACE

The Mariner V Magnetometer Experiment yielded of the order of 300,000 good quality measurements of the magnetic field in interplanetary space from the orbit of the Earth to just inside the orbit of Venus during the period from June 14 to November 22, 1967.

This experiment was proposed to NASA, prepared for flight, and the results analyzed by the following team: Principal Investigator: Dr. Edward J. Smith, Jet Propulsion Laboratory, Pasadena, California; Co-Investigators: Dr. Paul J. Coleman,Jr., University of California at Los Angeles, Dr. Leverett Davis, Jr., California Institute of Technology, Pasadena, and Dr. Douglas E. Jones, Brigham Young University, Provo, Utah.

Although all members of the team participated in and were generally responsible for all of its activities, there was a division of detailed responsibilities. Dr. Smith was mainly responsible for the design, construction, testing, integration with the spacecraft, and calibration of the magnetometer at the Jet Propulsion Laboratory, with substantial support at certain periods from Dr. Jones. The raw digital data supplied on magnetic tapes by the Mariner Project at JPL to the experimenters were reduced and transformed as described in Section I to give the components of the vector magnetic field in a specified inertial coordinate system. This was done primarily by John W. Belcher working under the direction of Dr. Davis at the California Institute of Technology. Ronald Rosenberg, working under the direction of Dr. Coleman at UCLA, supported some phases of the work where programs developed for the Mariner IV data reduction could be adapted to the Mariner V data. The actual production of the tapes and the plots of this data package and their description in the main body of this report are the work of Dr. Belcher with some collaboration by the experimenters.

The data contained in this Data Package have been used as the basis for a number of scientific papers by the experimenters and their associates and by other scientists with whom the data have been shared. Any users of this Data Package who have difficulty in using it, or who need further information on the experimental procedures used, or who wish to learn how their proposed use of the data is related to other investigations already in progress are invited to communicate with the undersigned.

E. J. Smith.

E. J. Smith
Jet Propulsion Laboratory

INTRODUCTION

In this report, we describe the basic tapes, programs, and plots used to study and analyze magnetic field data from the Mariner V (Venus 1967) flight. A brief summary of the overall data reduction procedure is given, and the form and content of the two resulting data tapes are described in detail (including unpacking routines). We also describe the data plots, which are available in microfilm form.

The Data Package consists of:

(1) Two magnetic tapes: the BAMFAT Tape (Basic Magnetic Field Analysis Tape) that gives every recovered field measurement in packed form, and the AVERAGE Tape that gives averages and variances of the basic data.

(2) Programs for reading and unpacking the BAMFAT tape.

(3) Complete plots of the basic data and 168.75 second averages thereof, in microfilm form.

I. SUMMARY OF DATA REDUCTION PROCEDURE

A. Master Data Library Tapes

Mariner V (Venus 1967) was in operation from June 14, 1967 to November 22, 1967. Magnetic field measurements were made by a low-field, vector, helium magnetometer [Connor, 1968]. Three triaxial field samples were obtained every 12.6 seconds at the high data rate, and every 50.4 seconds at the low data rate. The high data rate period extended from the beginning of the mission until July 24, 1967 (day 205), after which time data were taken at the low rate except for four hours of high rate data on day 298; there are approximately 40 days of high rate data and 120 days of low rate data.

The first step in the analysis of the Mariner V data was the reduction of the raw magnetometer data to a form which could be used conveniently. The basic source of data for the Mariner V experiment is the Master Data Library (MDL) tapes. These tapes are provided by the Jet Propulsion Laboratory and contain the entire telemetry stream from the spacecraft. The basic data sampling sequence is called a frame and consists of a number of individual measurements for each experiment on board. The real time sampling length of the frame is 12.6 (50.4) seconds at the high (low) rate, and each frame has one time associated with it. Three vector readings of the magnetic field are returned per frame; they are spaced 1/7, 2/7, and 4/7 of the frame length after the beginning of the frame. The three components of the field are measured in a right-handed XYZ cartesian coordinate system fixed in the spacecraft. The attitude control jets in conjunction with sun and Canopus sensors keep the Z axis oriented along a radial line from the spacecraft to the sun, and keep the plane containing the Z-axis and the vector ℓ_X-ℓ_Y so oriented that it passes through Canopus.

Measurements of the field components are returned in digital units (DN) in the range from +511 to -511. The conversion function from DN to gamma is very nearly linear with approximately .4γ per DN. Once every 2048 frames there is a 24 frame calibration sequence during which known fields of approximately ±40γ and ±80γ are produced at the position of the magnetometer; this calibration insures the reliability of the DN to gamma conversion. Using a Fortran program XRPM provided by JPL, the magnetometer digital readings in each frame, along the with frame time and various quality control words, were read from the eleven MDL tapes comprising the Mariner V mission and written on two intermediate tapes called MARDI tapes. The MARDI tapes were then processed through various phases which successively: (1) converted DN measurements to gamma; (2) removed the calibration offsets; (3) provided quality tags for each individual vector reading based on the number of bit errors in the telemetry stream for the frame and the consistency of that reading (within broad ranges) as compared to adjacent measurements.

B. Spacecraft Field Corrections

An extensive analysis of good quality data on the MARDI tapes was carried out to determine the spacecraft magnetic field [Davis and Smith, 1968]. Magnetometer readings $\underset{\sim}{M}$ are the sum of two vectors

$$\underset{\sim}{M} = \underset{\sim}{B} + \underset{\sim}{S}$$

where $\underset{\sim}{B}$ is the true interplanetary magnetic field (often rapidly varying) and $\underset{\sim}{S}$ is the (unknown) spacecraft field (usually constant or only slowly varying). Mathematically, $\underset{\sim}{S}$ is so chosen as to minimize the high frequency variance in $|\underset{\sim}{B}| = |\underset{\sim}{M} - \underset{\sim}{S}|$ during selected intervals. The method is based on the fact that previous experiments have shown the fine scale fluctuations in the interplanetary field to be primarily changes in direction, with

relatively small changes in field strength. An appreciable error in the spacecraft field estimate for a given component will cause purely directional fluctuations to produce apparent field strength fluctuations. This fact, coupled with the above comment as to the nature of the variations, enables an inflight determination of the spacecraft field to be made. It has subsequently been shown that this method is quite reasonable in view of the physical nature (Alfvénic) of the predominant fine scale field fluctuations. The spacecraft field correction used for Mariner V is on the order of 10γ in magnitude and is considered reliable within at least .25γ on each component. The spacecraft field estimate was never changed more than once per day, and, with the exception or five isolated points, was changed at most .1γ per axis from one day to the next. In most of these five exceptional cases, there was a significant change in the mode of operation of the spacecraft that could have caused the change in zero offset. Subtraction of the spacecraft field from the XYZ magnetometer measurements gives the true interplanetary magnetic field $\underset{\sim}{B}$.

C. RTN Coordinates and the BAMFAT Tape

Using trajectory and spacecraft orientation information provided by JPL, the field vectors $\underset{\sim}{B}$ were rotated from the XYZ system to orthogonal RTN solar equatorial coordinates, defined as follows: the positive R direction is radially outward from the sun; the T direction is parallel to the solar equatorial plane and positive in the direction of planetary motion; and the N direction is northward along $\underset{\sim}{R} \times \underset{\sim}{T}$ so that RTN is right-handed. The RTN field components of the vectors, with times and quality tags, were then written on the Basic Magnetic Field Analysis Tape (BAMFAT). One tape contains the entire mission, both high and low data rate. The basic unit is still one

data frame packed into five 36 bit words, with 128 frames per BAMFAT record; spacecraft trajectory information is written once per record. The BAMFAT tape contains on the order of 300,000 good quality measurements of the interplanetary magnetic field.

As a check on this entire data reduction procedure, a program was written that reads the BAMFAT tape, rotates each vector reading back to the spacecraft coordinates (XYZ), removes the corrections for spacecraft field and calibration offsets, and reverses the conversion from DN to gammas. This program was run and the output listed for enough segments of the BAMFAT tape to convince us by comparison of the results with the listings of the original MDL tapes that the data reduction procedure had no programming or logical errors. If there is ever any reason to recover the magnetometer data in its original DN form as recorded on the MDL tapes, it is probably easier to use the BAMFAT tape with this program than to work with the original MDL tapes. During the "grey-out" period ($266^d3^h37^m47.8^s$ to $274^d2^h30^m58.8^s$), when data quality was very poor, this procedure leaves the value shown by the MDL tape uncertain by an integral multiple of 128.

D. Magnetic Field Averages

Using only good quality data from the BAMFAT tape, we have computed averages and variances of the field data over intervals of 168.75 sec (2^{-9} day), 22.5 min (2^{-6} day), 3 hr (2^{-3} day), and one day. For each interval we compute $\langle \underset{\sim}{B} \rangle$, $\langle |\underset{\sim}{B}| \rangle$, and the matrix $\underset{\sim}{S}$ defined by

$$S_{ij} = \langle B_i B_j \rangle - \langle B_i \rangle \langle B_j \rangle$$

where $\langle\ \rangle$ denotes averaging over the specified time interval. This information is stored on magnetic tape (cf. II.B. below).

IV. DATA TAPES

A. BAMFAT Tape

1. Tape Description

The BAMFAT tape is a binary, Fortran compatible tape produced on an IBM 7094 (density = 556 bpi, physical record size = 330 words). It contains Mariner V magnetometer data in packed form. The format used will now be described.

The basic unit of data on the tape is a frame; each frame contains one time and three vector readings of the magnetic field. A frame of information is packed into five 7094 words, as in Figure 1. The significance of the quantities shown are:

NT(1): day from beginning of year (binary coding, Jan.1 is Day 1)

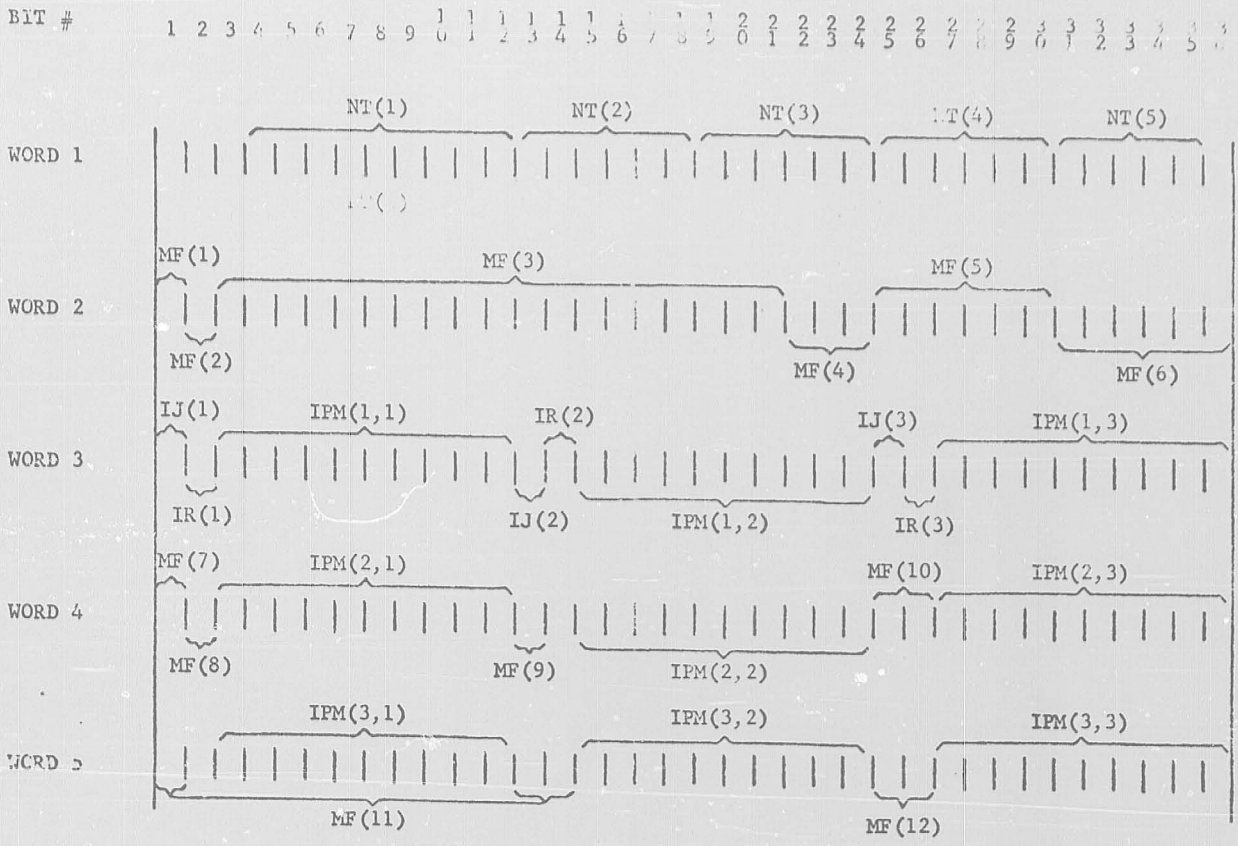
NT(2): hour

NT(3): minute

NT(4): integral part of second

NT(5): fractions of second, in 32nd of a second

IPM: IPM(1,J) is the R component of the J^{th} vector reading in frame (J = 1,2,3), IPM(2,J) the T component, and IPM(3,J) the N component of the J^{th} vector reading. IPM(I,J) is stored in nine bits, with the first bit a sign bit (0 for +, 1 for -) and the remaining eight to be read as a binary number. IPM(I,J) is thus an integer from +511 to -511 and gives magnetic field components in units of tenths of a gamma. IPM(I,J) must be divided by 10 to obtain units of gamma. These magnetic field readings are corrected both for the spacecraft field and the calibration sequence. The time associated with the frame is that of the PN sequence; the readings are delayed beyond this time by 1/7 of the frame interval for IPM(I,1), by 2/7 for IPM(I,2), and by 4/7 for IPM(I,3). The frame interval is 12.6 seconds at the high data rate and 50.4 seconds at the low rate.



7094 WORD HAS 36 BITS/BIT 1 IS THE SIGN BIT.

FIGURE I

IR(J): This is a range tag for the J^{th} vector reading of the frame; if any component of this vector is greater than BMAX in absolute value, IR(J) = 1. IR(J) = 0 otherwise. BMAX is 20γ for the high rate data and 30γ for the low rate data.

IJ(J): This is a spike tag for the J^{th} vector reading of the frame. If the following holds for <u>any</u> component of the vector, $|B^i_J - B^i_{J-1}| \geq$ 4 gamma and $|B^i_{J+1} - B^i_{J-1}| \leq 2$ gamma, then IJ(J) = 1. If J-1 = 0 or J+1 = 4, then we refer to the nearest vector in the preceding or following frame. IJ(J) = 0 otherwise.

MF(1): DAS bit number 25 (JPL1). This should have been 1 or 0, changing every 128 frames, but it is zero throughout the entire mission.

MF(2): DAS bit 211. This bit is 0 or 1, changing every frame.

MF(3): Frame count. An integer assigned to each frame by the spacecraft clock. Gaps in the frame count sequence imply gaps in the data usually because of gaps in the transmission. Numbers out of sequence on the original MDL tapes usually imply bits incorrectly read in transmission.

MF(4): Quality control prefix from the quality word for this frame (JPL2).

MF(5): This word, taken from the original MDL tape, is used to locate the magnetometer calibration sequence; MF(5) = frame count (modulo 2048) for 32 frames from the beginning of the sequence, and increases by 1 every 64 frames after that until the next sequence.

MF(6): NDCI from the quality word. This is the number of telemetry words in the frame that had error flags attached.

MF(7), MF(8), MF(9): These tags were used to locate time jumps and frame count anomalies on the MDL tapes, and have no significance on BAMFAT tapes.

MF(10): This is 1 if dummy data has been inserted (see below), 2 if frame count has been corrected, 3 during roll periods, and 0 otherwise.

MF(11): During the magnetometer calibration sequences, this is

1 for frames 1-4 of the sequence

2 for frames 5-8

6 for frame 9

3 for frames 17-20

4 for frames 21-24

5 for frame 25

0 otherwise

MF(12): 2 for frames 1-4 of the sequence

1 for frames 17-20

For general use, much of the information in the frame is superfluous. For example, MF(1), MF(5), MF(11), and MF(12) are all used to locate various parts of the calibration sequence, which has been corrected for on this tape. For most purposes, the important quantities are the time, frame count, field values, and the IR and IJ matrices. If IR is non-zero, the reading should never be used; if IJ is non-zero, the reading may or may not be used, depending on the inclination of the user. When the telemetry stream is bad, it is usually very bad (that is, giving very large field values), and these times will be tagged by the IR. Occasionally, however, there are bad data which are not out of range, but which produce spikes in the field values; these events are tagged by the IJ, and are not necessarily bad, but probably are. They are almost certainly bad if MF(6) (number of telemetry words in error) is non-zero, or if MF(10) = 2 (indicating that the frame count for that frame had to be corrected, which usually means that other things are also suspect).

The five words per frame are stored on the BAMFAT tape in groups of up to 128 frames at a time (i.e., up to 128 frames per data record). The basic WRITE statement which produced a logical record on the 7094 was as follows:

```
WRITE(8) NTYPE, NREC, MM, NN,
((NOUT(M,N),M = 1,MM), N = 1, NN),
(CR(K), K = 1,6), CPHI, SPHI
DIMENSION NOUT(5,128), CR(6)
```

NTYPE is the type of record and NREC is the record number. There are four types of records.

NTYPE = 1: These are data records. MM = 5; NN is the number of frames in the data record; NN will be 128 unless the data record precedes a skip record (explained below). NOUT(M,N),M = 1,5, fixed N, are the five packed words of the Nth frame of this record. The CR matrix contains coordinate information, in unpacked 7094 floating point. The basic coordinates used are radius, latitude, and longitude in a spherical polar coordinate system (solar equatorial coordinates) based on the sun's axis of rotation. Longitude is measured from the ascending node of the intersection of the sun's equatorial plane with the ecliptic and is, for an object in the ecliptic plane, equal to the ecliptic longitude plus $75^{\circ}.30 \pm 0^{\circ}.23$; where the exact value in the range $\pm 0^{\circ}.23$ depends on longitude and is due to the angle between the equatorial planes in the two systems.

CR(1) = distance of Mariner from sun (KM)

CR(2) = latitude of Mariner in solar equatorial coordinates (degrees)

CR(3) = longitude of Mariner in solar equatorial coordinates (degrees)

CR(4) = distance of Earth from sun (KM)

CR(5) = latitude of Earth in solar equatorial coordinates (degrees)

CR(6) = longitude of Earth in solar equatorial coordinates (degrees)

CPHI and SPHI are cos and sin of the angle used to rotate from the XYZ spacecraft system to solar equatorial coordinates

$$B_R = -B_Z$$

$$B_T = B_X*CPHI - B_Y*SPHI$$

$$B_N = -B_X*SPHI - B_Y*CPHI$$

NTYPE = 2: These are skip records. There are frequent gaps in the data; when the gap is less than 128 frames, dummy frames with proper time and frame count, and IPM(I,J) = -500, are made to fill in the gap. If there are more than 128 frames, the data record is terminated at NN ≤ 128, NTYPE is set to 2, and a skip record is written as follows:

NOUT(1,N) = NT(N), N = 1,5
NOUT(2,N) = NT1(N), N = 1,5
NOUT(3,1) = FC
NOUT(4,1) = FC1
NT(1) = day, NT(2) = hour, etc.

where NT and FC are the time and frame count of the last frame before the gap, and NT1 and FC1 are the time and frame count of the first frame after the gap, all in the 5 word time format of p. 6.

NTYPE = 3: This is an end record. There are only two on the tape. One is written between the high and low rate data (the separation occurs at $205^d\ 19^h\ 19^m\ 12.5^s$), and one is written at the end of the low rate data, just before the EOF. There is only one EOF on the BAMFAT tape, and this occurs after the low rate data. There is a brief stretch of high rate data during the low data rate period, from $298^d\ 16^h\ 40^m\ 56.3^s$ to $298^d\ 20^h\ 45^m\ 10.9^s$.

NTYPE = 4: These are partially reduced data records for the "grey-out" period ($266^d\ 3^h\ 37^m\ 47.8^s$ to $274^d\ 2^h\ 30^m\ 58.8^s$), when data quality was very poor (high number of bit errors). A relatively complicated scheme

is used to write these records, and the reader should skip this section unless he specifically wants to use grey-out data.

The format of the NTYPE = 4 data records is exactly the same as for the NTYPE = 1 data records. All information in a frame is the same as described above, except for the IPM, IJ, and IR matrices (see Figure 1). Let MDN(I,J) be I^{th} component of the J^{th} vector reading of the frame, in digital units (+511 to -511) exactly as read from the MDL tapes. I = 1,2,3 refer to the XYZ components of the spacecraft frame. We define the quantities

MDN1(I,J) = MDN(I,J) with 256 bit set to 0

MDN2(I,J) = MDN1(I,J) with 128 and 256 bits set to 0

since we now know that this will always be the case for good data. Let CON(MDN) be a function subroutine which converts digital units to gamma. If the frame is not part of a calibration sequence, we set

B(I,J) = CON(MDN2(I,J))-BSCF(I)

where BSCF is the spacecraft field estimate. B and BSCF are in gamma. If the frame is part of a calibration sequence, we set

B(I,J) = CON(MDN(I,J))-BCAL(I) - BSCF(I)

where BCAL is the appropriate calibration offset.

For each 22.5 minute interval of the grey-out period, an average value of the field BAVE(I) and an allowed range BRAN(I) for each of the XYZ axes was specified (by visual examination of the data plots of all data). The quality word Q for each component was determined by the criteria

if $|B(I,J)-BAVE(I)| \leq BRAN(I)$, Q(I,J) = good

if $|B(I,J) - BAVE(I)| > BRAN(I)$, Q(I,J) = bad

As before, J is the J^{th} vector reading, I = 1,2,3 refers to XYZ axes.

We are now in a position to define the IPM, IR, and IJ matrices as used in the NTYPE = 4 data records. If IR(J) = 0, then Q(3,J) was good,

and IPM(1,J) = -B(3,J)*10., to nearest integer (units of tenths of gamma). If IR(J) = 1, then Q(3,J) was bad, and IPM(1,J) = MDN(3,J) (digital units). If IJ(J) = 0, then both Q(1,J) and Q(2,J) were good, and IPM(2,J) = 10.*[B(1,J)*CPHI-B(2,J)*SPHI]. IPM(3,J) = 10.*[B(1,J)*SPHI-B(2,J)*CPHI] to nearest integer (units of tenths of gamma). If IJ(J) = 1 then either Q(1,J) or Q(2,J) were bad, or both. If $|IPM(2,J)| \geq 256$, then Q(1,J) was bad, and IPM(2,J) = MDN1(1,J) with 256 bit set to 1 (digital units). If $|IPM(2,J)| < 256$, then Q(1,J) was good, and IPM(2,J) = 10.*B(1,J) (units of tenths of gamma). If $|IPM(3,J)| \geq 256$, then Q(2,J) was bad, and IPM(3,J) = MDN1(2,J) with 256 bit set to 1 (digital units). If $|IPM(3,J)| < 256$, then Q(2,J) was good, and IPM(3,J) = 10.*B(2,J) (units of tenths of gamma).

Note that if both IR(J) and IJ(J) are zero, then the J^{th} vector reading is supposedly of good quality, has been rotated into RTN units, and the IPM matrix is to be interpreted exactly as in NTYPE = 1 data records. If either IR(J) or IJ(J) is non-zero, then some error was adjudged to be present in one or more components of the J^{th} reading.

2. BAMFAT RECORD LOG

If extensive use is to be made of the BAMFAT tape, it will be convenient to make a BAMFAT RECORD LOG by listing NTYPE, NREC for each data record on the BAMFAT tape. The LOG should also include the time and frame count of the first frame for each record with NTYPE = 1 or 4 and may, if desired, contain the times for NTYPE = 2 and the coordinate data from NTYPE = 1 or 4. Such a listing of the coordinate data may be very useful in any analysis of the data.

DATA SET NAME- FINE-TIME SCALE MAGNETOMETER DATA ON TAPE NSSDC ID 67-060A-05A DJH DCATCD 4 DBDCOD 2

AVAILABILITY OF DATA SET- DATA AT NSSDC BEING PROCESSED

TIME PERIOD COVERED- 061467 TO 112167 (AS VERIFIED BY NSSDC)

QUANTITY OF DATA IN THIS DATA SET- 1 REEL(S) OF MAGNETIC TAPE

DATA SET BRIEF DESCRIPTION

THIS EXPERIMENTER SUPPLIED DATA SET ON BINARY 556-BPI, 7-TRACK IBM 7094 MAGNETIC TAPE HAS A PHYSICAL RECORD SIZE OF 330 WORDS, AND A NOMINAL LOGICAL RECORD SIZE OF 652 WORDS. NOMINALLY THERE ARE 128 FRAMES OF DATA PER LOGICAL RECORD. EACH FRAME CONTAINS FIVE PACKED DATA WORDS, CORRESPONDING TO ONE TIME WORD AND CARTESIAN COMPONENTS OF THREE VECTOR READINGS OF THE MAGNETIC FIELD. THE TIME COVERED BY EACH FRAME IS 12.6 SEC FOR THE HIGH SATELLITE BIT RATE AND 50.4 SEC FOR THE LOW RATE. AT THE END OF EACH LOGICAL RECORD ARE CONTAINED EPHEMERIS INFORMATION AND DATA REQUIRED TO GENERATE THE ORIGINAL TELEMETERED DATA IN SPACECRAFT COORDINATES. THESE DATA ARE IN THE JPL VERSION OF SPACECRAFT-CENTERED SOLAR ECLIPTIC COORDINATES WITH THE X AXIS POINTING RADIALLY AWAY FROM THE SUN, THE Y AXIS POINTING IN THE DIRECTION OF PLANETARY MOTION, AND THE Z AXIS NORMAL TO THE ECLIPTIC (POSITIVE NORTH). ALL AVAILABLE GOOD QUALITY DATA POINTS ARE CONTAINED ON THIS TAPE -- ABOUT 300,000 VECTOR VALUES.

DATA SET NAME- ONE, THREE, AND 24 HOUR AVERAGES OF INTERPLANETARY MAGNETIC FIELD VECTORS NSSDC ID 67-060A-05B DJH DCATCD 4 DBDCOD 2

AVAILABILITY OF DATA SET- DATA AT NSSDC BEING PROCESSED

TIME PERIOD COVERED- 061467 TO 112167 (AS VERIFIED BY NSSDC)

QUANTITY OF DATA IN THIS DATA SET- 1 REEL(S) OF MAGNETIC TAPE

DATA SET BRIEF DESCRIPTION

THESE 9-TRACK, IBM 360, BINARY TAPES, SUPPLIED BY THE EXPERIMENTER, CONTAIN AVERAGED DATA FROM THE JPL HELIUM MAGNETOMETER EXPERIMENT ON MARINER 5. THEY ARE 800-BPI TAPES WITH TWO LOGICAL RECORDS PER 24 HR OF DATA. THE FIRST LOGICAL RECORD SPANS 20 PHYSICAL RECORDS OF 257 WORDS AND ONE PHYSICAL RECORD OF 173 WORDS. THIS RECORD CONTAINS TIME, EPHEMERIS, 168.75-SEC, 22.5-MIN, 3-HR, AND 1-DAY AVERAGES OF THE MAGNETIC FIELD VECTOR COMPONENTS IN GSE, AND THE FIELD MAGNITUDE, VARIANCE, AND NUMBER OF VECTOR READINGS IN EACH AVERAGE. THE SECOND LOGICAL RECORD SPANS SIX PHYSICAL RECORDS OF 255 WORDS AND ONE PHYSICAL RECORD OF 227 WORDS. IT CONTAINS THE CROSS VARIANCES FOR EACH OF THE ABOVE SETS OF AVERAGES.

3. Reading and Unpacking

Reading the BAMFAT tape on the IBM 7094 is simply a Fortran read, since the tape was generated on the 7094. A 7094 map subroutine has been written which unpacks the five words in Figure 1 and returns the various quantities (c.f. III.A.below).

Because the BAMFAT tape is a seven track 7094 binary tape (density = 556 bpi, physical record size = 330 words) reading it on the IBM 360/75 is more complicated. Assembly language programs have been developed for this purpose, and for unpacking the information in a frame once it is in the computer (c.f. III.B. below). The DP statement for reading the BAMFAT tape on the IBM 360 is

```
//TAPE7   DD    DISP=OLD,VOLUME=SER=BAMFAT,UNIT=TAPE7,
          LABEL=(1,BLP),DCB=(DEN=1,BLKSIZE=1980,RECFM=U)
```

B. AVERAGE Tape

The AVERAGE tape contains averages, variances, and cross variances of the field data over intervals of 1/512 of a day, 1/64 of a day, 1/8 of a day, and one day, for both high and low rate data from Mariner V. There is only one file on the IBM 360, 9-track binary tape. Each day's averages and variances are contained in two logical records, as follows

```
DIMENSION A1(4,512), V1(4,512), C1(512), A2(4,64), V2(4,64),C2(64),
    A3(4,8), V3(4,8), C3(8), A4(4), V4(4)

DIMENSION VC1(3,512), VC2(3,64), VC3(3,8), VC4(3)

READ (30) NDAY, RAD, RLAT, RLON, CPHI, SPHI, A1, V1, C1, A2,V2,C2,
    A3, V3, C3, A4, V4, C4

READ (30) VC1, VC2, VC3, VC4
```

NDAY is the day; RAD, RLAT, RLON are the solar equatorial coordinates of the Mariner at the time in the day of the last good data (for coordinates at more accurately known times, use the BAMFAT tape); CPHI and SPHI are the cos and

sin of the angle used to rotate from XYZ spacecraft coordinates to RTN coordinates. A1(I,J) is the average of B_I over the J^{th} 512^{th} of the day (I = 1, 2, 3, 4 refers to B_R, B_T, B_N and $|\vec{B}|$). V1(I,J) is the variance of B_I over the J^{th} 512^{th} of the day. C1(J) is the number of vector readings used in the averaging process over the J^{th} 512^{th} of a day. A2, V2, and C2 are the same type of arrays for 64^{ths} of the day, A3, V3, and C3 for eights of a day, and A4, V4 and C4 for the entire day.

The second logical record contains cross variances, as follows:

$$VC1(1,J) = \langle B_R B_T \rangle - \langle B_R \rangle \langle B_T \rangle$$

$$VC1(2,J) = \langle B_T B_N \rangle - \langle B_T \rangle \langle B_N \rangle$$

$$VC1(3,J) = \langle B_R B_N \rangle - \langle B_R \rangle \langle B_N \rangle$$

where the averages are over the J^{th} 512^{th} of the day. VC2, VC3, and VC4 are the same things for 64^{ths}, 8^{ths} and the whole day, respectively. Only vectors with the IR and IJ flags both zero were used in these averages.

The DD statement for this 9 track 360 tape is as follows:

```
//FT30F001  DD  UNIT = 2400,
LABEL = (1,BLP), DISP=(OLD,
KEEP), DCB=(RECFM=VS,
LRECL=1024, BLKSIZE=1028),
```

III. PROGRAMS

A. Unpacking BAMFAT on the IBM 7094

The UNPACK 7094 program is a 7094 map routine written to unpack a frame of information from the BAMFAT tape. If NOUT(5) are the five 7094 packed words containing one frame of Mariner V data, then they are unpacked by calling:

```
CALL UNPACK (NOUT, NT, MF, IJ, IR, PM)
DIMENSION NOUT(5), NT(5), MF(12), IJ(3), IR(3), PM(3,3)
```

For a description of the information returned, see the BAMFAT tape write-up in section II.A.

B. Reading and Unpacking BAMFAT on the 360/75

The set of cards entitled UNPACK 360 consists of the basic programs used to read BAMFAT tapes into the IBM 360/75; it is a combination of Fortran subroutines, unpacking routines, and 7-track tape reading routines. It was provided by Ron Rosenberg of UCLA, and questions concerning its detailed nature should be directed to R. Rosenberg, care of Professor P.J.Coleman, Institute of Geophysics, University of California, Los Angeles, California 90024. The routines included in this package are:

BAMBIT READ7	ASSEMBLER
BAM360 SKIP ERMSG7	FORTRAN

READ7 reads the 7-track tape, and BAMBIT unpacks a frame of information. To read in one logical record of the BAMFAT tape, one calls BAM360 as follows:

```
DIMENSION NNOUT(4,5)
INTEGER*2 NOUTH(3,5,128)
DOUBLE PRECISION CR(6), CPHI, SPHI
CALL BAM360(NTYPE, NREC, MM, NN,
NOUTH, NNOUT, CR, CPHI, SPHI)
```

The quantities NTYPE, NREC, MM, NN, CR, CPHI and SPHI are as described above in section II.A. (BAMFAT Tape Description). For NTYPE = 1 or 4 (data records), each of the five 7094 packed words for the N^{th} frame of the record has been stored in three half-integer 360/75 words, in the matrix NOUTH(3,5,N). To unpack this information for the N^{th} frame, BAMBIT is called:

```
DIMENSION NT(5), MF(12), IPM(3,3), IJ(3), IR(3)
CALL BAMBIT(NOUTH(1,1,N), NT, MF, IPM, IR, IJ)
```

The quantities returned are as shown in Figure 1 and described in section II.A. For NTYPE = 1 records, it must be remembered that IPM is in units of tenths of gamma.

For NTYPE = 2 (skip records), NNOUT(4,5) gives the beginning and end times of the data gap, as described in section II.A. End records are NTYPE = 3.

The Fortran routine SKIP can be used to skip up to a certain desired data record, as follows:

```
CALL SKIP (NREC,ILH)
```

This call will skip the BAMFAT tape up to just before data record NREC of the high (ILH=0) or low (ILH=1) rate data. For the most efficient use of this routine, a BAMFAT record log of the kind described in section II.A.2, will be needed.

IV. PLOTS

Complete plots of the data on the BAMFAT tape are available on the time scale of one hour per plot (high data rate) and three hours per plot (low data rate). The R, T, and N components of the field and the field magnitude are plotted. The zero levels of the components are indicated by heavier grid lines, with the zero of field strength at the bottom of the plot. Occasionally, the zero grid line may be shifted from its normal position, in which case ZERO SHIFT appears at the lower left of the plot.

In addition, the 168.75 sec averages of the R, T, and N components of the magnetic field, and the 168.75 sec averages of the field magnitude (not

the magnitude of the averaged components), are plotted on a scale of one day per plot. Occasionally, during periods of very high field, the vertical scale is compressed by a factor of two, in which case 1/2 SCALE appears at the lower left of the plot.

Dupe of 8689 START June 14 1967 6 hrs 29 min
STOP Nov 21 1967, 17 hrs 59 min

FILE 0001 REC 0001 CH 1980

0001	000511000000	000000000001	000000000001	000000000005	000000000200	024506352104	200001201200	613061306130
0049	604200426042	003400340034	024506353552	000001301300	410661304102	004200426042	003400340034	024506355220
0097	200001401400	613061306130	004200426042	003400340034	024506356666	000001501500	613061306130	004200426042
0145	003400340034	024506360734	200001601600	613061306130	004200426042	003400340034	024506362404	000001701700
0193	613061306130	004200426042	003400340034	024506364052	200002002000	613061306130	004200426042	003400340034
0241	024506365520	000002102100	613061306130	004200426042	003400340034	024506367166	200002202200	613061306130
0289	004200426042	003400340034	024506371234	000002302300	613061306130	004200426042	003400340034	024506372704
0337	200002402400	613061306130	004200426042	003400340034	024506374352	000002502500	613061306130	004200426042
0385	003400340034	024506376020	200002602600	613061306130	004200426042	003400340034	024506400066	000002702700
0433	613061306130	004200426042	003400340034	024506401534	200003003000	613061306130	004200426042	003400340034
0481	024506403204	000003103100	613061306130	004200426042	003400340034	024506404652	200003203200	613061306130
0529	004200426042	003400340034	024506406320	000003303300	613061306130	004200426042	003400340034	024506410366
0577	200003403400	613061306130	004200426042	003400340034	024506412034	000003503500	613061306130	004200426042
0625	003400340034	024506413504	200003603600	613061306130	004200426042	003400340034	024506415152	000003703700
0673	613061306130	004200426042	003400340034	024506416620	200004004000	613061306130	004200426042	003400340034
0721	024506420666	000004104000	613061306130	004200426042	003400340034	024506422336	200004204000	613061306130
0769	004200426042	003400340034	024506424004	000004304000	613061306130	004200426042	003400340034	024506425452
0817	200004404000	613061306130	004200426042	003400340034	024506427120	000004504000	613061306130	004200426042
0865	003400340034	024506431170	200004604000	613061306130	004200426042	003400340034	024506432636	000004704000
0913	613061306130	004200426042	003400340034	024506434304	200005004000	613061306130	004200426042	003400340034
0961	024506435752	000005104000	613061306130	004200426042	003400340034	024506440020	200005204000	613061306130
1009	004200426042	003400340034	024506441470	000005304000	613061306130	004200426042	003400340034	024506443136
1057	200005404000	613061306130	004200426042	003400340034	024506444604	000005504000	613061306130	004200426042
1105	003400340034	024506446252	200005604000	613061306130	004200426042	003400340034	024506450320	000005704000
1153	613061306130	004200426042	003400340034	024506451770	200006004000	613061306130	004200426042	003400340034
1201	024506453436	000006104000	613061306130	004200426042	003400340034	024506455104	200006204000	613061306130
1249	004200426042	003400340034	024506456552	000006304000	613061306130	004200426042	003400340034	024506460620
1297	200006404000	613061306130	004200426042	003400340034	024506462270	000006504000	613061306130	004200426042
1345	003400340034	024506463736	200006604000	613061306130	004200426042	003400340034	024506465404	000006704000
1393	613061306130	004200426042	003400340034	024506467052	200007004000	613061306130	004200426042	003400340034
1441	024506471122	000007104000	613061306130	004200426042	003400340034	024506472570	200007204000	613061306130
1489	004200426042	003400340034	024506474236	000007304000	613061306130	004200426042	003400340034	024506475704
1537	200007404000	613061306130	004200426042	003400340034	024506477352	000007504000	613061306130	004200426042
1585	003400340034	024506501422	200007604000	613061306130	004200426042	003400340034	024506503070	000007704000
1633	613061306130	004200426042	003400340034	024506504536	200010004100	613061306130	004200426042	003400340034
1681	024506506204	000010104100	613061306130	004200426042	003400340034	024506510252	200010204100	613061306130
1729	004200426042	003400340034	024506511722	000010304100	613061306130	004200426042	003400340034	024506513370
1777	200010404100	613061306130	004200426042	003400340034	024506515036	000010504100	613061306130	004200426042
1825	003400340034	024506516504	200010604100	613061306130	004200426042	003400340034	024506520552	000010704100
1873	613061306130	004200426042	003400340034	024506522222	200011004100	613061306130	004200426042	003400340034
1921	024506523670	000011104100	613061306130	004200426042	003400340034	024506525336	200011204100	613061306130
1969	004200426042	003400340034						

FILE 0001 REC 0002 CH 1944

0001	000503000002	024506527004	000011304100	613061306130	004200426042	003400340034	024506531052	200011404100
0049	613061306130	004200426042	003400340034	024506532522	000011504100	613061306130	004200426042	003400340034
0097	024506534170	200011604100	613061306130	004200426042	003400340034	024506535636	000011704100	613061306130
0145	004200426042	003400340034	024506537306	200012004100	613061306130	004200426042	003400340034	024506541354
0193	000012104100	613061306130	004200426042	003400340034	024506543022	200012204100	613061306130	004200426042
0241	003400340034	024506544470	000012304100	613061306130	004200426042	003400340034	024506546136	200012404100
0289	613061306130	004200426042	003400340034	024506550206	000012504100	613061306130	004200426042	003400340034
0337	024506551654	200012604100	613061306130	004200426042	003400340034	024506553322	000012704100	613061306130
0385	004200426042	003400340034	024506554770	200013004100	613061306130	004200426042	003400340034	024506556436
0433	000013104100	613061306130	177717777777	077707707777	024506560506	200013204100	613061304130	163514647124
0481	070005360213	024506562154	000013304100	613061306130	061707776777	147316451777	024506563622	200013404100
0529	613061306130	077700426042	177700340034	024506565270	000013504100	613061306130	004200426042	003400340034
0577	024506566736	200013604100	613061306130	004200426042	003400340034	024506571006	000013704100	613061306130
0625	004200426042	003400340034	024506572454	200014004100	613061306130	004200426042	003400340034	024506574122
0673	000014104100	613061306130	004200426042	003400340034	024506575570	200014204100	613061306130	004200426042
0721	003400340034	024506577236	000014304100	613061306130	004200426042	003400340034	024506601306	200014404100
0769	613061306130	004200426042	003400340034	024506602754	000014504100	613061306130	004200426042	003400340034
0817	024506604422	200014604100	613061306130	004200426042	003400340034	024506606072	000014704100	613061306130
0865	004200426042	003400340034	024506610140	200015004100	613061306130	004200426042	003400340034	024506611606

FILE 0001 REC 0005 CH 1944

0529	107710771077	015301500153	000200050002	050520417160	200313207100	107711031103	015501550153	100210020002
0577	050520426012	000313307100	110311071103	016001600154	000100011007	050520434644	200313407100	107711031103
0625	015301550160	000210021005	050520443474	000313507100	110311131107	015501530151	002200260012	050520452326
0673	200313607100	106710671067	014501450150	102210221025	050520461160	000313707100	106710671067	014501450145
0721	102210221022	050520470012	200314007100	107310731073	014301450151	101610220012	050520476244	000314107100
0769	106710671073	014601420143	101410241016	050520505076	200314207100	107310731077	015101450141	101210221032
0817	050520513730	000314307100	107310671073	014501450145	102210271027	050520522562	200314407100	107710731073
0865	015001450145	102510271027	050520531414	000314507100	107710771077	014501450145	102210221022	050520540246
0913	200314607100	106710771077	015001450145	101710221022	050520546476	000314707100	107310731077	014501450145
0961	102210221022	050520555332	200315007100	107310771067	013501460140	102310141021	050520564162	000315107100
1009	107310731067	014101370136	100610271034	050520573014	200315207100	106710631067	013701340135	102710311023
1057	050520601646	000315307100	107310671063	014101440134	103710351031	050520610500	200315407100	106710671067
1105	014101440143	103210351042	050520616732	000315507100	106310631063	014101470141	103210321037	050520625564
1153	200315607100	107310671067	015501570155	103310361033	050520634416	000315707100	106710671067	015501550160
1201	103310331031	050520643250	200316007100	107310671073	015501520155	102610301026	050520652102	000316107100
1249	107310731073	015201550155	103010261026	050520660732	200316207100	106710671067	016001550160	103110331031
1297	050520667164	000316307100	107310671073	015601550155	102010261026	050520676016	200316407100	107310671067
1345	015001520137	101710301027	050520704650	000316507100	105710571057	013401350135	103110231023	050520713502
1393	200316607100	105710571053	014701500152	100610011004	050520722334	000316707100	105310531047	014401440142
1441	101110030000	050520731166	200317007100	105710571057	014201410140	102410321021	050521000020	000317107100
1489	105310531057	013501350140	101610161013	050521006252	200317207100	105710571057	014001430140	102110161013
1537	050521015104	000317307100	105710571057	014001410145	101310061027	050521023734	200317407100	106310631063
1585	014501440141	102710351032	050521032570	000317507100	106310631057	014401410141	103510371037	050521041420
1633	200317607100	106310631063	014101440144	103210351035	050521050252	200317724100	374367777743	414311625643
1681	104211201435	050521055122	200320007200	106310631067	414501450145	104610461046	050521065340	000320107200
1729	106310631063	015101510154	104310431041	050521074170	200320207200	106310671067	015101510150	104310431051
1777	050521103022	000320307200	106710671067	014701510151	103210361036	050521111654	200320407200	106310631067
1825	015101540147	103610411032	050521120506	000320507200	106310631063	014301430142	101610161024	050521126740
1873	200320607200	105710571057	015301520151	102210301036	23356540376O	603427433467	206440756702	234431661240
1921	202411455664	605410612230	600626777250	200466506563				

FILE 0001 REC 0006 CH 1980

0001	000511000000	000000000001	000000002410	000000000005	000000000200	050521135572	000320707200	105310571063
0049	014401510147	103510361032	050521144424	200321007200	106310631057	015401510146	104110431040	050521153256
0097	000321107200	105710631063	015301500153	104610511046	050521162110	200321207200	106310631057	015101500150
0145	104310511051	050521170742	000321307200	106310671053	015001500147	105110511056	050521177172	200321407200
0193	106310571063	014501410125	106010631101	050521206024	000321507200	106310571063	013301260126	107510741074
0241	050521214656	200321607200	106310631057	013101300126	107110771074	050521223510	000321707200	105710571063
0289	012501210122	110111111104	050521232342	200322007200	105710571063	012601250125	107411011101	050521241174
0337	000322107200	105710571057	013001240122	107711071104	050521250026	200322207200	105710571057	012501300125
0385	110111771101	050521256312	000322307200	106310571057	012201220122	110411041076	050521265112	200322407200
0433	106310571053	012201140122	107611031076	050521273744	000322507200	105310631057	013401270120	105010611073
0481	050521302576	200322607200	105710571063	010601060067	111011101116	050521311430	000322707200	105710671063
0529	011601010100	107011021107	050521320262	200323007200	105310571057	012701220122	104710601060	050521326514
0577	000323107200	105710631073	011201070076	107210751104	050521336346	200323207200	106310631063	011701200121
0625	110110731065	050521344200	000323307200	105710531063	011201150115	107210751075	050521353032	200323407200
0673	106310631057	011201060111	110011021106	050521361662	000323507200	105710531047	011401110104	110311061077
0721	050521370514	200323607200	105310531057	010100760112	110211041072	050521376746	000323707200	105710571047
0769	011001130040	106710651113	050521405600	200324007200	104310471057	004500510046	112211121114	050521414432
0817	000324107200	105310471053	004700510051	110711121112	050521423264	200324207200	104710471047	004700520047
0865	110711041107	050521432116	000324307200	104710531053	004100470044	110611071103	050521440750	200324407200
0913	104710471047	003300360036	110511031110	050521447202	000324507200	105310471047	003300300030	110511101110
0961	050521456032	200324607200	105710531053	003000300036	111011101103	050521464664	000324707200	106310531057
1009	005300610056	107110721074	050521473516	200325007200	105710631057	007500760076	106610601060	050521502350
1057	000325107200	105710571057	010001060106	106310561056	050521511202	200325207200	105710531063	010001000104
1105	106310631053	050521520034	000325307200	105710531047	004700550060	110111021077	050521526266	200325407200
1153	105310531057	007201000066	107010631072	050521535120	000325507200	105310531053	010301060111	106110641062
1201	050521543752	200325607200	105310531053	010601030103	105610611061	050521552604	000325707200	105310531057
1249	011101140106	106210571064	050521561434	200326007200	105310531063	007701000072	107110631070	050521570270
1297	000326107200	105710571053	011301270125	106510471043	050521576520	200326207200	104310431043	012701170114
1345	000100050003	050521605352	000326307200	104310431043	011401100113	000310051003	050521614204	200326407200
1393	103710431043	011001130110	100510031005	050521623036	000326507200	104310431043	011301100110	100310051012
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STOP Time
1000 2/1/1967
17 hr 59 min

Dupe of D-8688
START June 14, 1967
STOP Nov 21, 1967

REC 1, LENGTH 1028

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REC 2, LENGTH 1028

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REC 3, LENGTH 1028

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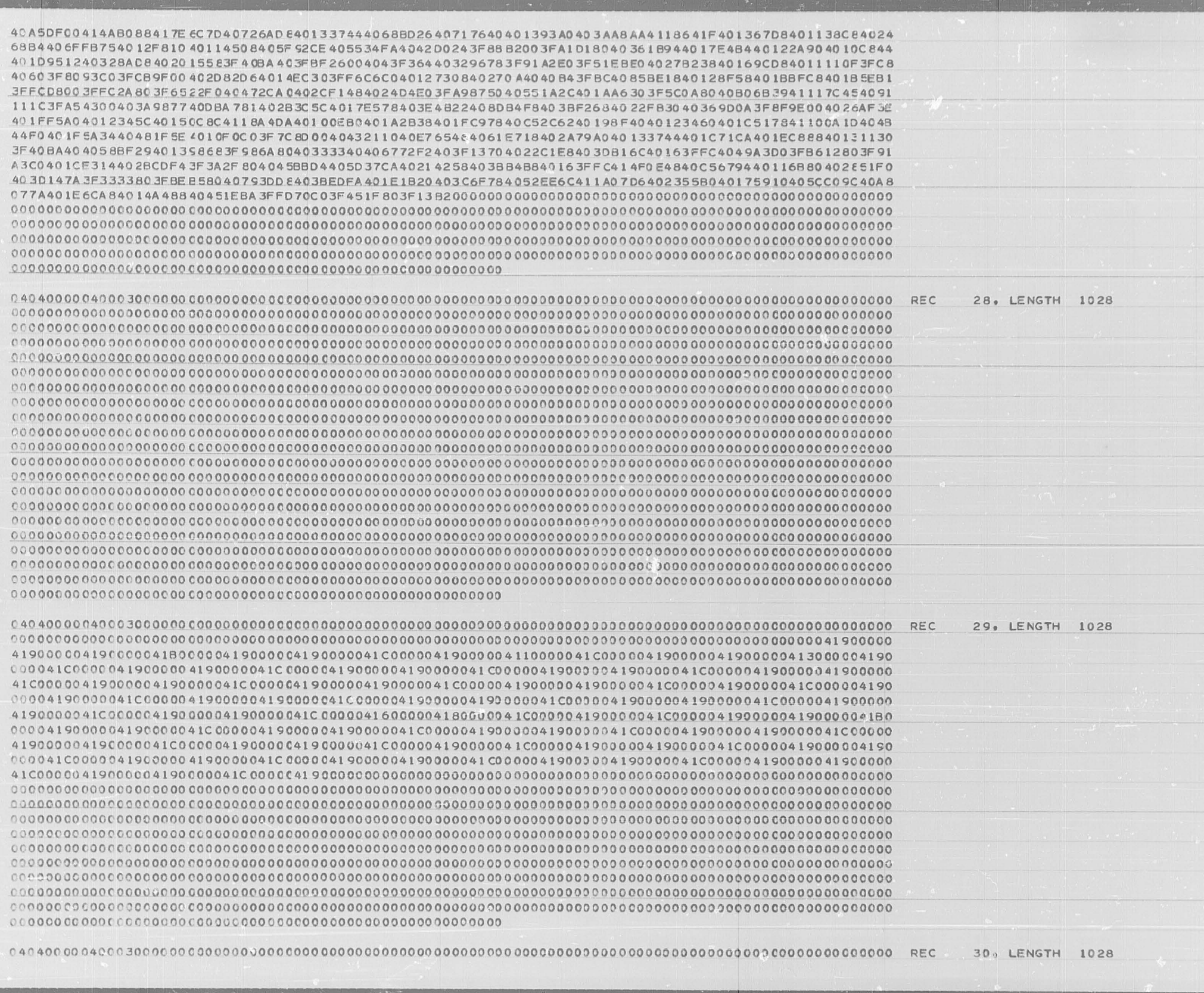

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