THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
8621 GEORGIA AVENUE
SILVER SPRING, MARYLAND 20910

TELEPHONE
953-7100
589-7700
AREA CODE 301

Please refer to:
TSSD-2499

Director
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. B. H. Ferer, Code 724

Subject: IMP-H CPME Experimenter's Tape

Enclosure: (1) APL Memo S1P-757-71, Required Items for the IMP-H CPME Experimenter's Tape

Dear Sir:

The enclosure specifies the items that are required on the IMP-H CPME experimenter's tape. A detailed description of the tape format will be submitted after the enclosed list of items is approved.

If further information is required, please contact R. L. McCutcheon at telephone number 953-7100, extension 2441.

Very truly yours,

R. B. Kershner
Space Development
Department Head

RBK:RLM:cy
Distribution
MDavis/GSFC/Code 724
WPBarnes/GSFC/Code 563
JHSchmidt/GSFC/Code 565
CDWende/GSFC/Code 601.1
TPArmstrong/Univ. of Kansas

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
SILVER SPRING, MARYLAND

SIP-757-71
June 16, 1971

TO: Distribution

FROM: R. L. McCutcheon

SUBJECT: Required Items for the IMP-H CPME Experimenter's Tape

The IMP-H CPME experimenter's tape should contain only one end of file for the entire tape, with an ID record preceding each "file" of data rather than an end of file mark following it. Here, a "file" is equated to the contents of an analog tape. Each ID record should contain the following information:

1. orbit number
2. recording station number
3. analog tape number
4. analog to digital converter ID
5. start time for this station
6. stop time for this station
7. quick look flag
8. experimenter ID
9. satellite ID
10. edit tape number
11. edit reel number
12. date of generation of experimenter tape

A data record should consist of two albums of telemetry data, starting with an even album and should also contain orbit and attitude data as listed below. In the event that only a part of a logical record is available, fill characters should be generated and the corresponding quality flags set accordingly.

1. U. T. (year, day, milliseconds)
2. album number (spacecraft clock with least significant bit incrementing at album rate)
3. quality flags for U. T. and spacecraft clock

4. orbital data
   a. geocentric latitude, longitude (degrees), and radial distance (kilometers) of the spacecraft
   b. solar ecliptic X_{SE}, Y_{SE}, Z_{SE} coordinates of the spacecraft in earth radii
   c. solar magnetospheric X, Y, Z coordinates of the spacecraft in earth radii
   d. sun-earth-spacecraft angle in degrees
   e. spacecraft velocity in geocentric solar ecliptic coordinates $\dot{X}_{SE}$, $\dot{Y}_{SE}$, $\dot{Z}_{SE}$, in earth radii/hour
   f. right ascension and declination of spacecraft in celestial coordinates
   g. orbit, no orbit data flag
5. attitude data
   a. spin period in milliseconds
   b. U. T. of last spin period determination
   c. spin axis Θ_{SE} (solar ecliptic) in degrees
   d. spin axis ϕ_{SE} (solar ecliptic) in degrees
   e. spin axis right ascension in degrees
   f. spin axis declination in degrees
   g. U. T. of last spin axis determination
   h. optical aspect flag (1 - normal, 0 - failed)
   i. optical aspect eclipse flag (1 - eclipse, 0 - no eclipse)
   j. sun time in milliseconds from beginning of snapshot to centered sun pulse
   k. attitude, no attitude data flag
6. APL-CPME Data: Table I gives a list of the CPME data outputs. All CPME data is to appear in "expanded" form on the experiment tape. Column 3 specifies the readout positions of the various items in the telemetry in terms of Snapshot, Sequence, Frame, Channel (with fractional channels denoted as: e.g., 4B/6 and 7 = last 4 bits of

channel 6 and all 8 bits of channel 7, or 6B/12 and 4B/13 = last 6 bits of channel 12 and first four bits of channel 13. The number of times each of the various outputs appear in a logical record is:

APL-R1 through R-7	32
APL-R8 through R-25	16
APL-Sel through Se-4	32
APL-DP	16
APL-AP	8
TOTAL	104

7. Data Quality Flags: One flag, to be defined by GSFC, indicating the probable reliability of the data should be included for each output of APL data each time it appears.

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SILVER SPRING, MARYLAND

TABLE 1

DATA LABELS AND POSITIONS

APL-Name	S/C Accum #	Position in TM Readout SS	SEQ	FR	CHANNEL	Descriptive Name
APL-R1	LR12 a_2 - 6	All	1	2	4B/6 & 7	M
APL-R2	LR12 a_2 - 10	All	1	10	4B/6 & 7	S
APL-R3	LR12 a_2 - 14	All	2	2	4B/6 & 7	P9
APL-R4	LR12 a_2 - 18	All	2	10	4B/6 & 7	P7
APL-R5	LR12 a_2 - 20	All	2	10	4B/9 & 10	Z1
APL-R6	LR12 a_2 - 22	All	3	2	4B/6 & 7	~~A7~~ A6
APL-R7	LR12 a_2 - 26	All	3	10	4B/6 & 7	~~A6~~ A5
APL-R8	LR12 a_3 - 6	Even	1	4	4B/6 & 7	~~A5~~ Z3
APL-R9	LR12 a_3 - 10	Odd	0	8	4B/6 & 7	A4
APL-R10	LR12 a_3 - 14	Even	0	8	4B/6 & 7	A3
APL-R11	LR12 a_3 - 18	Odd	1	4	4B/6 & 7	A2
APL-R12	LR10 a_3 - 1	Even	0	4	11 & 2 B/12	P11
APL-R13	LR10 a_3 - 2	Even	0	4	6B/12 & 4B/13	P10
APL-R14	LR10 a_3 - 5	Even	1	4	11 & 2B/12	E4
APL-R15	LR10 a_3 - 6	Even	1	4	6B/12 & 4B/13	E5
APL-R16	LR10 a_3 - 9	Odd	0	8	11 & 2B/12	E6
APL-R17	LR10 a_3 - 10	Odd	0	8	6B/12 & 4B/13	E2B
APL-R18	LR10 a_3 - 13	Even	0	8	11 & 2B/12	E2C
APL-R19	LR10 a_3 - 14	Even	0	8	6B/12 & 4B/13	P2
APL-R20	LR10 a_3 - 17	Odd	1	4	11 & 2B/12	P3
APL-R21	LR10 a_3 - 18	Odd	1	4	6B/12 & 4B/13	P4
APL-R22	LR10 a_3 - 21	Even	0	12	11 & 2B/12	P5
APL-R23	LR10 a_3 - 22	Even	0	12	6B/12 & 4B/13	P6
APL-R24	LR10 a_3 - 25	Odd	0	12	11 & 2B/12	P8
APL-R25	LR10 a_3 - 26	Odd	0	12	6B/12 & 4B/13	Z2

TABLE 1 (Cont'd)

APL-Name	S/C Accum #	Position in TM Readout SS	SEQ	FR	CHANNEL	Descriptive Name SS0	SS1	SS2	SS3
APL-Se1	APL Se-1 $(1)_8$ - $(8)_8$	All	2	2	0 - 4 & 11 - 15	E1	E1	E1	E1
APL-Se2	APL Se-2 $(1)_8$ - $(8)_8$	All	2	10	0 - 4 & 11 - 15	E3*	E2A	E3*	E2A
APL-Se3	APL Se-3 $(1)_8$ - $(8)_8$	All	3	2	0 - 4 & 11 - 15	P1	E4	P1	E4
APL-Se4	APL Se-4 $(1)_8$ - $(8)_8$	All	3	10	0 - 4 & 11 - 15	A1	P11	P10	A6
APL-DP	APL DP 3 - 21	Even	0	12	1st Bit of Ch4				
APL-AP	AP #1	SS0	1	0	4	** APP	X	X	X

*E3 is divided into 32 subsectors and repeats with a 2 page period.

**APP has 8 subcommutated signals: Starting from PG 0 of even albums they are CD, PM, GA, HV, TP, D1, D2, D3.

R L McCutcheon

R. L. McCutcheon

RLM:cy
Distribution
AKossiakoff (2)
RWLarson
COBostrom
SMKrimigis
JWKohl
RLMcCutcheon (2)
SDO Central File
Archives (2)
File

UNITED STATES GOVERNMENT

Memorandum

GF —
WL —
MD —

TO : Mr. P. Butler
IMP Project Manager, Explorer Office, SA&TD, 701.1

DATE: August 9, 1971

FROM : Mr. J. H. Schmidt
Project Computation Section Telemetry Computation Branch, IPD, M&DO, 565.2

SUBJECT: IPD Milestone Schedule and Experimenter Tape Ground Rules for IMP-H

In my telephone correspondence with Mr. Martin Davis, code 701.1, I mentioned that I intended to provide you with a milestone schedule for the part of IPD Processing of IMP-H data for which I am responsible. The attached milestone schedule in attachment #1 and the set of ground rules in attachment #2 have been reviewed and approved by IPD for implementation. These two attachments really comprise a set because without acceptance of the ground rules in attachment #2 it would be totally impossible for us to meet the schedule shown in attachment #1.

I expect that since the IMP-H experimenters are supported by competent computer programmers, no difficulties should arise out of our imposing these ground rules.

It would be in order for me to explain that the source of these ground rules is the input and output format requirements of a standardized decom program which has been used in IPD for 160 numbered experiment formats to date. These include satellites from the OGO series, the OSO series, and the ATS series of satellites. Some of the IMP-H experimenters have in fact been either principle investigators or co-investigators on one or more of these previous satellites and will be already acquainted with tapes in the type of formats we will be using for IMP-H.

Our confidence in this decom system, gained by years of experience, allows us to show for instance a time lag of only about 10 days (see attachment #1) between the date of format agreements and delivery of tapes conforming to those formats to all experimenters using simulated input telemetry data. When I personally prepared the format coding for all of the experimenters on three satellites, the time required per experimenter never exceeded one-half day including checkout.

John H. Schmidt

John H. Schmidt
IMP-H Assistant DPE

Attachment 2

cc: Mr. T. Moore, M&DOD Manager, 513.2
Dr. Ness, Project Manager, 690.0
Mr. M. Davis, Experiment Manager, 701.1
Mr. Wm. Barnes, IMP-DPE, 564.3
Mr. F. A. Keipert, Chief, Information Processing Division, 560.0

565:2591:JHS:md

ATTACHMENT 1

This attachment contains suggested experimenter tape formats which conform to the IPD ground rules as found in Attachment 2.

The decom matrix used is one page of telemetry data. This matrix is scanned once for each line in your format.

Attachment 1

CENTER

RESPONSIBILITY:
APPROVAL

ACCOMPLISHMENT

MILESTONE SCHEDULE

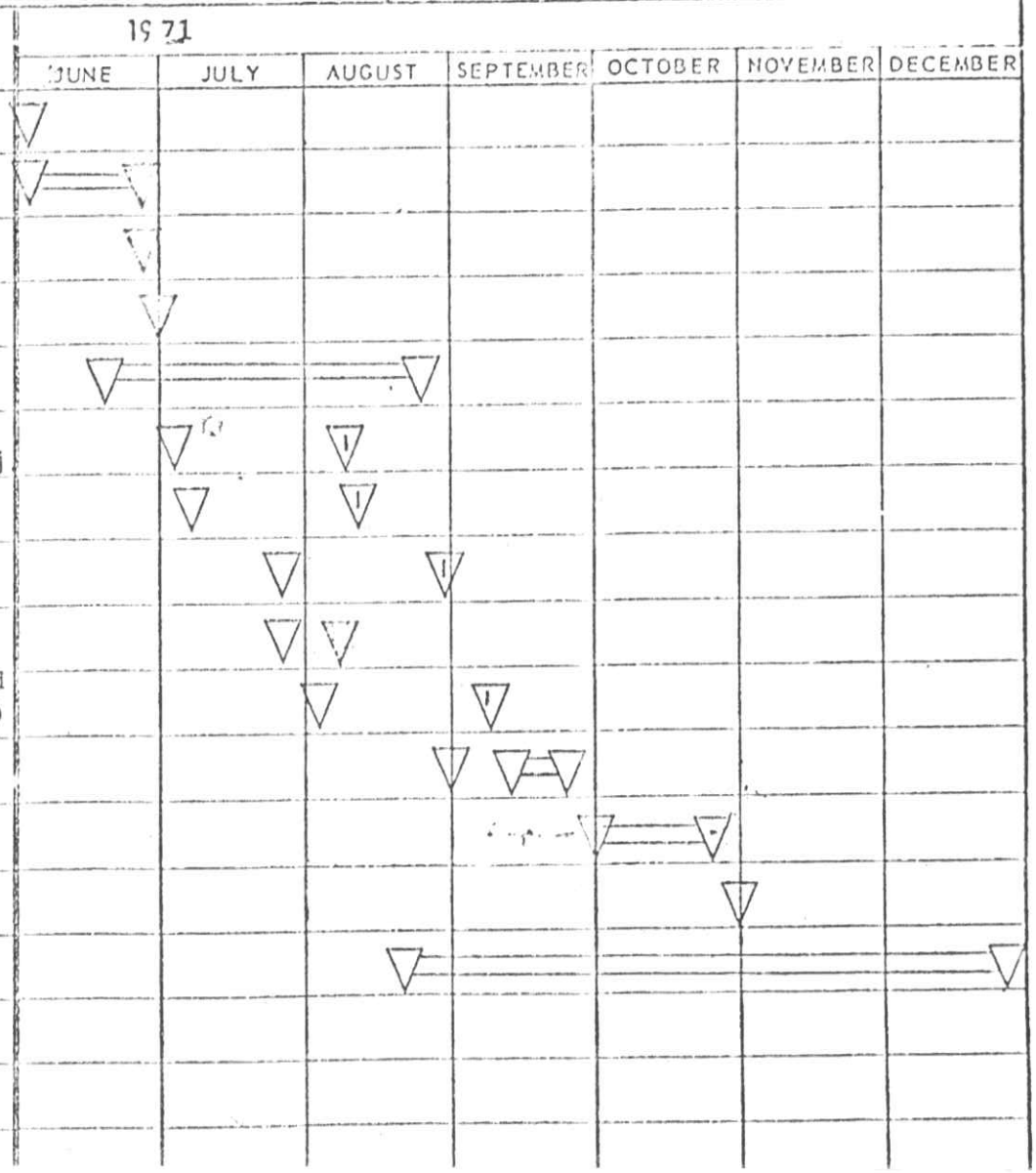
PROJECT IMP-H DECOM PROCESSING

ORIG. SCHED. APPR. JUNE 1, 1971 (DATE)

LAST SCHED. CHG. 1 AUGUST 4, 1971 (DATE) (NO.) (INITIALS)

STATUS AS OF AUGUST 4, 1971 (DATE) (INITIALS)

	MILESTONES
1	Assistant DDE assigned with instructions to redesign the IMP Decom System for IMP-H.
2	IMP-H Decom System Design.
3	Present proposed System to IPD for approva.
4	IMP-H Decom Processing System Design approved.
5	Implement approved system.
6	Send Milestone Chart & IPD Ground Rules to Proj
7	Announce meeting with local experimenters.
8	Give presentation to local experimenters. Plan data tape formats after presentation.
9	Begin contacting non-GSFC experimenters.
10	Deliver decom tapes to experimenters (simulated data)
11	Thermo-Vac tests and decom formats frozen.
12	Process Thermo-Vac test data
13	Ship Thermo-Vac test data to experimenters.
14	Update IMP-I to IMP-H Attitude Determination.
15	
16	



GROUND RULES CONCERNING IMP-H EXPERIMENTER TAPE

The IMP-H experimenter tape decom system was built around the following ground-rules:

1. The tapes will not contain a tape header record.

2. Each file shall contain all of the processable data from one analog tape recorded at a ground station.

3. Each file shall consist of (1) a file label, (2) an undetermined number of data records, and (3) an end-of-file mark. I know that a few IBM 360 users prefer that no EOF marks appear on their tapes except at the end. The GSFC IBM 360 users have access to the FT10 routine which enables them to read multi-file tapes, but since some non-GSFC don't have this routine and may not have availed themselves of one of the many other such routines floating around, I will provide a sentinel record instead of EOF marks at the end of each file. Any experimenter who received more than one output tape per run will, however, find EOF marks ending all of the tapes in the run. My checkout of any formats not including the normal file termination mark will be seriously hampered since all of my utility programs operate on a file by file basis.

4. The file label will be identical in content to the Housekeeping tape file labels described in the IMP-I Data Processing Plan (X563-70-337) on page 9-19. The label record length will be equal to the data records which follow.

5. The 8-bit telemetry channels will be presented to experimenters in 12-bit fields. This will be 2 tape characters on the 7-track decom tapes with the four highorder bits equal to zero. Each 36-bit field on tape will contain three 8-bit data channels.

6. The raw telemetry channels will be given to the experimenters on the basis of requested channels.

7. The decom matrix from which the program will decom the experimenters' data will be equal to one page. The experimenters' formats will be based upon one page where the smallest record they may receive is their information from one page with the ground time given once per page. The most they could receive would be limited by the maximum record size they prefer to read-in by their computer.

8. The page from which our program will decom the data shall begin with ground time and data from sequence 0, or if sequence 0 is not available, then time and fill data in its place, and so on .... This assumes that the ground time which refers to channel 0 of frame 0 of a page can be used to compute the relative time anywhere within the page. Those who choose more than one page per output record should treat each page as a unit because we will not decom any complete pages of fill data. This means there can be time discontinuity between pages but not within pages.

9. Our program does not recognize page numbers. If the experimenters want to process their data from odd pages differently than from even pages, it is incumbent upon them to make the determination.

10. All housekeeping channels will be provided to all experimenters.

11. The data records will contain ground time once per page and the telemetered data from that page. No other forms of data will be merged in.

12. A second type of tape will be sent to each experimenter in addition to the PCM data tape. These tapes will have identical formats but will have record lengths compatible with the users computer. They will contain all of the coordinate transformation being computed for IMP-I plus attitude and orbital position data. The data item interval shall be once per minute on the minute unless this is found to be a higher frequency than required.

Westinghouse Electric Corporation

Defense and Space Center

Mail Stop 825
Friendship International Airport
Box 1897, Baltimore, Md. 21203

October 20, 1971

Dr. S. M. Krimigis
Johns Hopkins University
Applied Physics Laboratory
8621 Georgia Avenue
Silver Spring, Md. 20910

Dear Dr. Krimigis,

Westinghouse is responsible for Control Center software development for IMP-H at the Multi-Satellite Operations Control Center. We need information about your requirements for real-time software support.

Please answer the enclosed questions and send the information to me as soon as possible. If there is any question, I can be reached at Goddard at X. 6446 or at Westinghouse at (301) 765-2240.

Sincerely,

Mary Ann Long

Mary Ann Long
Engineer

IMP-H Real Time Experiment Processing

We need to know whether or not you want the real-time quick-look printout for your experiment to be the same as your integration printout. If you want a different format, send us the specifications.

Under the real-time operating system no provisions can be made for operator selected experiment options. Options depending on your data, the bit rate, or other telemetered items are permitted. If your integration program has options typed in, we need to know which option you want.

It is important to remember that in real-time operation there will usually be some loss of synch and that any scheme which assumes good, continuous data will cause trouble.

Information about your experiment data, modes of operation, subcommutators, command verification, etc. is needed. It is necessary that the S/C controller be able to verify your commands with a CRT display or special "control panel" printout without having to run your quick-look program at the time. Therefore, it is necessary to have this information spelled out even if we are going to convert your integration program for real-time use.

A standard header will be used which provides:

Bit rate
Station name
Orbit number
Date
Clock source (GMT, DTS1, DTS2, or DTS3)
Time
Data quality
Monitor PCM unit number
Computer system number
S/C clock (octal)
S/C clock (hours/min/sec)
Telemetry page number
On or off line processing
Experiment title

1. Do you want to use your integration printout? If not, what form do you want?

2. If you are using your integration printout, does it have any operator specified options? If so, which option do you want?

3. How can we tell if your experiment is on or off?

4. a. Where is your data in the telemetry format? Specify page, snapshot, sequence, frame, channel, starting bit, and length (in bits).

   b. Should the data be complemented?

   c. Should the bit order be reversed? If so, how many bits at a time?

   d. Is the data item a 10 or 12 bit accumulator?

5. How can we determine the mode your experiment is in, any warning indications, or other performance parameters which the S/C controller will need to know?

CODE 560

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Mr. Paul Butler
Explorer Projects Office, SA&TD, 701

DATE: November 16, 1971

FROM : Mr. John H. Schmidt
Telemetry Computation Branch, IPD, M&DOD, 565.2

SUBJECT: IMP-H Data Tape Format Letter.

Please find attached the IMP-H data tape formats for your distribution.

John H. Schmidt

John H. Schmidt
Project Computation Section

565:2740M:JHS:rb

Attachment

5010-106

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : DISTRIBUTION **DATE:** November 11, 1971

FROM : Mr. John H. Schmidt
Telemetry Computation Branch, 565.2

SUBJECT: IMP-H Experimenter Tape Formats

Since this is my first communication with most of you, I should introduce myself and let you know how I fit into the GSFC Team. In early June 1971 I was assigned to work with the IMP-H Data Processing Engineer, Mr. William Barnes. My duties involve helping you arrange a digital tape format for the IMP-H data which contains all of your PCM Data in records which are compatible in a record length to your computer and also compatible with the GSFC processing system. My duties not only involve this liaison but it is also my job to acquire the computer programs here at GSFC which will govern the writing of your data tapes.

Attachment 1 contains a suggested data tape format for each experimenter. I believe you will find that the one with your name on it has all of your PCM data included; however, if you see that I overlooked something, please let me know. These format descriptions and the tapes which have already been generated and verified as corresponding to the format descriptions are the natural outcome of the way I prepare for format discussions with experimenters before a satellite launch. I have studied the data channels assigned to each of you and have prepared a format which places your data in convenient arrays when read by your computer programs.

Some of you may find the suggested format to your liking and you may indicate your approval by letter to me with copies to the IMP-H Project Office. Some may approve of the basic data arrangement as read from each page but may prefer some other multiple of pages per record than the suggested six. I would expect that this would be changed by most everyone.

In the past, when I have prepared suggested data tape formats for experimenters there have been a few who felt at first that the basic scheme was unacceptable. If any IMP-H experimenter should feel this way then please contact me. We then can make arrangements for me to communicate with your computer programmers and we can negotiate a format that will both be convenient for you to read and still conform to the GSFC-IPD ground rules as shown in attachment 2.

5010-104

Subject: IMP-H Experimenter Tape Formats

In order that you may more easily follow the format descriptions in attachment 1, I will give a description of the file label records and also the time and flag fields in the data records.

The file label record will be the same length as your data records thus all records on the data tape will be equal.

CHARACTERS	DESCRIPTION
1-5	Satellite ID NUMBER (assigned at launch)
6	Blank
7-10	Station ID
11-12	Blank
13-16	Analog Tape Numbers
17-18	Blank
19-20	Analog file #
21-24	Blank
25-29	Record Date (YMMDD)
30-36	Blank
37-40	Analog Start time (HHMM)*
41-48	Blank
49-52	Analog start time (HHMM)*
53-60	Blank
61-64	Data type 0000 = Normal 0001 = Encoder bypass 0002 = Encoder failure 0003 = Uncoded
65-66	Blank
67	Data rate 0 = Low bit rate
68-78	Blank 1 = High bit rate
79-82	Master Edit Tape Number
83-84	Master Edit File Number
85-N	Fill data out to N Characters. N = your data record length.

*Actual start and end times will vary as much as a minute.

Each data record and in fact each page of data will begin with time, flags and performance parameters according to the following format.

CHARACTERS	DESCRIPTION	
1-2	Continuity flags by value = 0 or 1 2° = 0 no fill data in page 2 = 0 no time discontinuity following	
3-4	Zeros	
5-6	Day count of year January 1 = 1	
7-12	Milliseconds of day of first bit of page	
13-14		(Sequence 0, 1, 2, 3)
15-16	Time quality flags	(Sequence 4, 5, 6, 7)
17-18		(Sequence 8, 9, 10, 11)
19-20		(Sequence 12, 13, 14, 15)
21-22		(Sequence 0, 1, 2, 3)
23-24	Data quality flags	(Sequence 4, 5, 6, 7)
25-26		(Sequence 8, 9, 10, 11)
27-28		(Sequence 12, 13, 14, 15)
29-30	Zeros	
31-36	Pseudo Sequence Counter	(Sequence 0)
37-42	" " "	(Sequence 1)
43-48	" " "	(Sequence 2)
.	. . .	.
.	. . .	.
.	. . .	.
121-126	" " "	(Sequence 15)
127-158	ADP (16, 1-15)	
159-190	(ADP 32, 17-31) or (48, 33-47)	
191-254	DPP A2, 5-36	
255-278	A3, 1-24	
279-310	EDP 1-4	
311-358	OA (Chan 4-15 S.S.1, S.S.3)	
359-N	Experimenters data.	

Please note that this format is blocked for a 36-bit computer word which will be standard for 32 or 36-bit computer word equipment. Those of you who have 48 or 60-bit machines will find the above data format written in the word length of your computer words. You will see this in attachment 1.

The time and data Quality flags from the page are grouped four sequences to each 12 bit digital field as follows:

2 - 2 = quality flag from sequence 0
2 - 2 = " " " " 1
2 - 2 = " " " " 2
2 - 2 = " " " " 3
2 - 2 = Zeros. (same as high order bits accompanying data channels (8 bits).

The meaning of the flags is shown in table form:

Value	Time Quality	Data Quality
0	Analog time unverified	Excellent ($PE \leq 10^{-6}$)
1	Analog time verified by S/C clock	Good ($PE < 10^{-4}$)
2	Analog time in error-S/C clock used	Fill
3	Time put with fill data-computed	Undetermined

Those who choose to use the generalized telemetry data tape format will receive also a tape containing the satellite position and attitude along with the positions of sun and moon, etc. See attachment #3 for the list. This tape shall have one set of data points given each 10 minutes. All experimenters who accept formats according to ground rules in attachment 2 would receive the same tape.

Because some IMP-H experimenters had experiments on IMP-I and were expecting nearly the same type of tapes on IMP-H we have relaxed a few of the ground rules shown in attachment 2. According to the relaxed ground rules we will do some limited pre-analysis data manipulation. An additional processing step will have to be added to our data processing system which will accept as input the tapes described in attachment 1 to perform this pre-analysis data manipulation. Our procedure will be to produce the tapes described in attachment 1 for each experiment. This attachment 1 formatted tape will be shipped to you one month after each thermovacuum test. The Information Processing Division (IPD) will completely verify that the output tapes conform to the formats described in attachment 1 or the finally negotiated formats prepared under the relaxed ground rules. Any experimenter who might desire to change his format from that shown in attachment 1 within the IPD ground rules may do so at any time prior to launch. This may be a telephone call if desired and the only approval required is that of the undersigned. This is one of the purposes of using this system which within the ground rules is easily modified and re-verified. No changes will be allowed after launch, however, without approval of the IMP project.

These IMP-H experimenters may negotiate with IPD for a format within the relaxed ground rules found below. Those of you who negotiate a format under the relaxed ground rules will not receive the output from any of the thermovacuum tests until about May or June 1972. The relaxed IPD ground rules which were established by a joint agreement between IPD, IMP-H Project Scientist and, the IMP Project Manager are as follows:

1. The performance parameters and OA data will be converted to engineering units and written in floating point binary on your point unless otherwise specified. Should you specify some other form then you must send a concise description sufficient for me to write a mock string of bits from our 36-bit word machine such that it satisfies you when you read the tape. This conversion will of * course result in increased record length since the information(contaubed ub twi 6-bit characters) on the tape described in attachment 1 now will be written into a whole world in your machine.

2. Raw (uncalibrated, rectified (flipped, etc.), packed telemetry data will be provided on an album basis or larger. This can be done by packing time and data per page into albums or giving time once per album with data from the album. As an example, suppose you have outputs from two counters A and B which each read out twice per page. You could receive $Time_1$ AABB $Time_2$ AABB $Time_3$ AABB $Time_4$ AABB or Time AA_1 AA_2 AA_3 AA_4 BB_1 BB_2 BB_3 BB_4. In the second format you would receive time only once per album. I have excluded from the example the ADP and DPP and attitude/orbit items which would appear (blocked) in between the time and sensor data.

3. Orbit/attitude data will be merged with telemetry data. There are 77 items of information (see attachment 3) all or none of which will be provided to the experimenters. The time of these orbit/attitude data items will be on the minute. The interval betwen data item will be a matter of experimenter's choice, and will be merged either within data records or written in records between data records. The main argument for relaxing the ground rules was the requirement for merging telemetry data with attitude/orbit/ephemeris data for the experimenters. Those experimenters choosing their tapes written under the relaxed ground rules will not receive a copy of the tape listed in attachment 3 which is prepared to accompany attachment 1 type formats.

* (contained in two 6 bit characters)

4. After formats have been agreed upon no changes will be accepted by IPD unless approved by both the IMP Project Manager, the IMP Project Scientist and the undersigned who must all agree the changes lie within either the original ground rules or the relaxed ground rules as interpreted by each. It would be impossible at this time to say if such approved changes would alter your delivery schedule. It should be noticed that each experimenter's delivery schedule is independent in our new IMP processing system. Should one experimenter have justifiable need for a massive change in his format the remainder of the experimenters delivery schedules will not be affected.

5. The experimenter requesting output tapes under the relaxed ground rules must prepare detailed written specifications to IPD to serve as a basis for our working together to provide you with an output tape. Any changes to the original specification must also be requested in writing.

John H. Schmidt

John H Schmidt
Project Computation Section

IMP-H TELEMETRY DATA TAPE FORMAT DESCRIPTION

EXPERIMENT NUMBER: X25

EXPERIMENTER: Dr. Krimigis

TAPE DENSITY 800 BPI (6) PAGES PER RECORD ch. to 8

7-TRACK DIGITAL TAPES 36 BIT WORD FORMAT

TAPE CHARACTERS		DATA LINE DESCRIPTION	CHANNELS	FRAMES	SEQUENCES
RECORD TOTAL	THIS LINE		(0-15)	(0-15)	(0-15)
2	2	Continuity flags			
4	2	Day of Year January 1 = 1			
12	6	Milliseconds of Day			
28	16	Time and Data Quality Flags			
30	2	Zeros			
36	6	Pseudo Sequence Counter (Sequence 0)			
42	6	" " " (" 1)			
48	6	" " " (" 2)			
.	.	. . . . .			
.	.	. . . . .			
.	.	. . . . .			
126	6	" " " (" 15)			
158	32	APP (16, 1-15)			
190	32	APP (32, 17-31) or(48, 33-47)			
254	64	DPP A2 (5-36)			
278	24	A3 (1-24)			
310	32	EDP			
358	48	OA (Channels 4-15 S.S.1,S.S.3)			
438	80	Se-1	0-4, 11-15	2	2,6,10,14
518	80	Se-2	0-4, 11-15	10	2,6,10,14
598	80	Se-3	0-4, 11-15	2	3,7,11,15
678	80	Se-4	0-4, 11-15	10	3,7,11,15
694	16	R1	6,7	2	1,5,9,13
710	16	R2	6,7	10	1,5,9,13
726	16	R3	6,7	2	2,6,10,14
742	16	R4	6,7	10	2,6,10,14
758	16	R5	9,10	10	2,6,10,14
774	16	R6	6,7	2	3,7,11,15

EXPERIMENT NUMBER: X25 (Continued)
EXPERIMENTER: Dr. Krimigis

TAPE CHARACTERS		DATA LINE DESCRIPTION	CHANNELS	FRAMES	SEQUENCES
790	16	R7	6,7	10	3,7,11,15
798	8	R8	6,7	4	1,9
806	8	R9	6,7	8	4,12
814	8	R10	6,7	8	0,8
822	8	R11	6,7	4	5,13
830	8	R12	11,12	4	0,8
838	8	R13	12,13	4	0,8
846	8	R14	11,12	4	1,9
854	8	R15	12,13	4	1,9
862	8	R16	11,12	8	4,12
870	8	R17	12,13	8	4,12
878	8	R18	11,12	8	0,8
886	8	R19	12,13	8	0,8
894	8	R20	11,12	4	5,13
910	8	R22	11,12	12	0,8
918	8	R23	12,13	12	0,8
926	8	R24	11,12	12	4,12
934	8	R25	12,13	12	4,12
936	2	Fill at End of Each Page			

936 Characters/Page
5616 Characters/Record
40 Files Maximum/Tape

ATTACHMENT #2

GROUND RULES CONSERNING IMP-H EXPERIMENTER TAPES

The IMP-H experimenter tape decom system was built around the following ground-rules:

1. The tapes will not contain a tape header record.

2. Each file shall contain all of the processible data from one analog tape recorded at a ground station.

3. Each file shall consist of (1) a file label, (2) an undetermined number of data records, and (3) an end-of-file mark. I know that a few IBM 360 users prefer that no EOF marks appear on their tapes except at the end. The GSFC IBM 360 users have access to the FTIO routine which enables them to read multi-file tapes, but since some non-GSFC users don't have this routine and may not have availed themselves of one of the many other such routines floating around I will provide a sentinel record instead of EOF marks at the end of each file. Any experimenter who received more than one output tape per run will however find EOF marks ending all of the tapes in the run. My checkout of any formats not including the normal file termination mark will be seriously hampered since all of my utility programs operate on a file by file basis.

4. The file label will be indentical in content to the Housekeeping tape file labels described in the IMP-I Data Processing Plan (X563-70-337) on page 9-19. The label record length will be equal to the data records which follow.

5. The 8-bit telemetry channels will be presented to experimenters in 12-bit fields. This will be 2 tape characters on the 7-track decom tapes with the four highorder bits equal to zero. Each 36-bit field on tape will contain three 8-bit data channels.

6. The raw telemetry channels will be given to the experimenters on the basis of requested channels.

7. The decom matrix from which the program will decom the experimenter's data will be equal to one page. The experimenter's formats will be based upon one page where the smallest record they may receive is their information from one page with the ground time given once per page. The most they could receive would be limited by the maximum record size they prefer to read-in by their computer.

8. The page from which our program will decom the data shall begin with ground time and data from sequence 0, or if sequence 0 is not available then time and fill data in its place, and so on.... This assures that the ground time which refers to channel 0 of frame 0 of a page can be used to compute the relative time anywhere within the page. Those who choose more than one page per output record should treat each page as a unit because we will not decom any complete pages of fill data. This means there can be time discontinuity between pages but not within pages.

9. Our program does not recognize page numbers. If the experimenters want to process their data from odd pages differently than from even pages, it is incumbent upon them to make the determination.

10. All housekeeping channels will be provided to all experimenters.

11. The data records will contain ground time once per page and the telemetered data from that page. No other forms of data will be merged in.

12. A second type of tape will be sent to each experimenter in addition to the PCM data tape. These tapes will have identical formats but will have record lengths compatible with the users computer. They will contain all of the coordinate transformation being computed for IMP-I plus attitude and orbital position data. The data item interval shall be once per minute on the minute unless this is found to be a higher frequency than required.

ATTACHMENT 3

ATTITUDE/ORBIT/EPHEMERIS TAPE FORMAT

All words are 36 bits long, IBM 7094 format.

The time interval between records shall be 10 minutes.

WORD NO.	FORM	IDENTIFICATION
0	Fixed Pt.	Fortran record size indicator (=000117010001) This indicates a total data word count of 75 .
1	Floating Pt.	Day of year } time of orbit data
2	" "	Milliseconds of day } in this record
3	" "	Longitude (deg.) } satellite position in
4	" "	Latitude (deg.) } geocentric coordinates
5	" "	Longitude (deg.) } satellite position in
6	" "	Latitude (deg.) } geomagnetic coordinates
7	" "	R (earth radii) a geomagnetic coordinate of the satellite position, C.U.L.
8	" "	r, radial distance of the satellite from the center of the earth (km.)
9	" "	GSE X } Satellite position in Geocentric Solar
10	" "	GSE Y } Ecliptic Coordinates (km.)
11	" "	GSE Z }
12	" "	GSM X } Satellite position in Geocentric Solar
13	" "	GSM Y } Magnetospheric Coordinates (km.)
14	" "	GSM Z }
15	" "	GSE X } Moon position in Geocentric Solar
16	" "	GSE Y } Ecliptic Coordinates (km.)
17	" "	GSE Z }
18	" "	GSM X } Moon position in Geocentric Solar
19	" "	GSM Y } Magnetospheric Coordinates (km.)
20	" "	GSM Z }

WORD NO.	FORM	IDENTIFICATION
21	Floating Pt.	GEI X — Satellite position in Geocentric Equatorial Inertial (km.)
22	" "	GEI Y — Satellite position in Geocentric Equatorial Inertial (km.)
23	" "	GEI Z — Satellite position in Geocentric Equatorial Inertial (km.)
24	" "	GEI X — Sun position in Geocentric Equatorial Inertial (A.U.)
25	" "	GEI Y — Sun position in Geocentric Equatorial Inertial (A.U.)
26	" "	GEI Z — Sun position in Geocentric Equatorial Inertial (A.U.)
27	" "	Longitude — Sub-solar point in geomagnetic coordinates (deg.)
28	" "	Latitude — Sub-solar point in geomagnetic coordinates (deg.)
29	" "	Distance from the satellite to the Moon (km.)
30	" "	Distance parallel to the x-axis from the satellite to the moon (km.)
31	" "	1st row, 1st column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
32	" "	1st row, 2nd column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
33	" "	1st row, 3rd column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
34	" "	2nd row, 1st column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
35	" "	2nd row, 3rd column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
36	" "	2nd row, 3rd column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
37	" "	3rd row, 1st column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
38	" "	3rd row, 2nd column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
39	" "	3rd row, 3rd column — Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
40	" "	1st row, 1st column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
41	" "	1st row, 2nd column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
42	" "	1st row, 3rd column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
43	" "	2nd row, 1st column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
44	" "	2nd row, 2nd column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
45	" "	2nd row, 3rd column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
46	" "	3rd row, 1st column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
47	" "	3rd row, 2nd column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
48	" "	3rd row, 3rd column — Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.

WORD NO.	FORM	IDENTIFICATION
49	Floating Pt.	Right Ascension } Satellite position in
50	" "	Declination } celestial inertial (deg.)
51	" "	Right Ascension } Velocity vector in
52	" "	Declination } celestial inertial (deg.)
53	" "	Magnitude of the velocity (km./sec.)
54	" "	L McIlwain parameter (earth radii)
55	" "	B Magnetic field strength (Gamma)
56	" "	B/B_o Ratio of the magnetic field strength at the satellite-to-the-field strength at the satellite
57	" "	Satellite-earth-sun- angle, Lsep (deg.)
58	" "	Satellite-earth-moon angle (deg.)
59	" "	Right ascension } Magnetic vector in
60	" "	Declination } celestial inertial (deg.)
61	" "	Longitude } Sub-solar point in (deg.)
62	" "	Latitude } Geocentric Equatorial Inertial
63	" "	GSE X } Theoretical geomagnetic field in
64	" "	GSE Y } Geocentric Solar Ecliptic coordinates
65	" "	GSE Z } (in gamma)
66	" "	Type of data item indicator: 1 = regular satellite data item 2 = ascending node crossing data item 3 = North point data item 4 = descending node data item 5 = south point data item 6 = sunlight entrance data item 7 = sunlight exit data item
67	" "	Date of data (YR MO DA)

WORD NO.	FORM	IDENTIFICATION
68	Floating Pt.	Longitude } Geodetic satellite position (deg.)
69	" "	Latitude }
70	" "	Height above spheroid (km.)
71	" "	Ascending node crossing number (pass number)
72	" "	Year of data (YR)
73-75	" "	Zero fill for spares
76	" "	Delta time between time of Ephemeris item and next previous sun pulse which stopped OA - ST Counter (Seconds).
77	" "	Spin period (Seconds)
78	" "	Right Ascension } Spin vector in celestial
79	" "	Declination } inertial (Deg.)
80	Fixed Point	Check sum of data words in words number 1 - 79
81	" "	FORTRAN record size indicator (= 000117010001_8) This indicates a total data word count of 75_{10} words.

Notes:

Longitude is positive east of Greenwich and negative west of Greenwich (-180° to + 180°)
North latitude is positive and south latitude is negative (-90° to +90°)
Date of data (word number 67) equals day + 100 (months + year (100)). Example: February 10, 1967 at 2 hours U.T. is recorded as 670210 in word 67, 41 in day count (word 1), 7200000 in milliseconds of day (word 2), and 67 in year of data (word 72).

ATTACHMENT 4

EXPERIMENTER TAPE FORMAT OUTLINE (Under Relaxed Ground Rules)

- Time once per page (or album)
- Time Quality, Data Quality flags and pseudo sequence counters
- All performance parameters (in floating point if requested)
- Uncalibrated telemetry data (flipped or expanded, etc.)
- Attitude/Orbit/Ephemeris information - either here or blocked in between data records.

Each file will still conform to the data recorded on one analog tape at the gound station and each file on the experimenter tape will consist of a file label, data records and an end-of-file mark. Two consecutive EOF marks will signal the end of a tape.

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
8621 GEORGIA AVENUE
SILVER SPRING, MARYLAND 20910

TELEPHONE
953-7100
589-7700
AREA CODE 301

DEC 10 1971

Please refer to:
TSSD-2815

Director
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. B. H. Ferer, Code 701.1

Subject: IMP-H CPME Experimenter's Tape

Reference: GSFC memo by J. H. Schmidt, "IMP-H Data Tape Format Letter", dated November 16, 1971.

Dear Sir:

Enclosed are the tape format specifications for the Charged Particles Measurement Experiment of IMP-H. All items listed should conform to the relaxed ground rules of the above reference.

If further information is required, please contact R. L. McCutcheon at telephone number 953-7100, extension 2441.

Very truly yours,

Original signed by
R. B. Kershner

R. B. Kershner
Space Development
Department Head

RLM
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THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
SILVER SPRING, MARYLAND

S1P-846-71
December 9, 1971

TO: Distribution

FROM: R. L. McCutcheon

SUBJECT: Final Tape Format for the IMP-H CPME Experimenter's Tape.

The tape format for ID records and data records are given below in tables I and II, respectively. Both types of records have the same length, with "fill" of zeros where it is requested.

Each experimenter tape should contain an end of file mark only at the end of the tape, to indicate just that. Hence, ID records and data records should be found continuously in the input stream, with the first word of the ID records used as an indicator.

Each logical record should be 4581 bytes (8 bits) long and they should be blocked 5 to 1 for a block size of 22,905 bytes. The last block on the tape can contain less than 5 logical records. Seven-track, 800 BPI tapes are requested.

R L McCutcheon

R. L. McCutcheon

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TABLE I - ID Record Format

Item Number	Item Description	Target Field Size (bits)	8-Bit Byte Offset
1	id record indicator: set to 32 ones	32	0
2	satellite ID number: eight EBCDIC characters	64	4
3	station id - binary integer	32	12
4	analog tape number 4 EBCDIC characters	32	16
5	analog file number 4 EBCDIC characters	32	20
6	record date (YMMDDbbb) 8 EBCDIC characters	64	24
7	analog start time (HHMM) 4 EBCDIC characters	32	32
8	analog stop time (HHMM) 4 EBCDIC characters	32	36
9	data type - binary integer 0 = normal 1 = encoder bypass 2 = encoder failure 3 = uncoded	32	40
10	experimenter ID 4 EBCDIC characters	32	44
11	data rate 0 = low bit rate 1 = high bit rate	32	48
12	master edit tape number 4 EBCDIC characters	32	52

TABLE I - Continued

Item Number	Item Description	Target Field Size (bits)	8-Bit Byte Offset
13	master edit file number 4 EBCDIC characters	32	56
14	fill to data record length	35880	60
			4545

TABLE II - Data Record Format

Item Number	Item Description	Telemetry Position Sequences	Frames	Channel	Target Field Size (bits)	8-Bit Byte Offset
1	year[1]	time of page 0, sequence 0,			16	0
2	day	frame 0, of an even[2]			16	2
3	milliseconds	album			32	4
4	spacecraft clock	same time as above			32	8
5	pseudo-sequence counter	same time as above			32	12
6	Se-1 ①	2	2	8B/0,2B/1	16	16[3]
	②	2	2	6B/1,4B/2	16	18
	③	2	2	4B/2,6B/3	16	20
	④	2	2	2B/3,8B/4	16	22
	⑤	2	2	8B/11,2B/12	16	24
	⑥	2	2	6B/12,4B/13	16	26
	⑦	2	2	4B/13,6B/14	16	28
	⑧	2	2	2B/14,8B/15	16	30
	Repeat of above for sequences 6, 10, 14					
7	Se-2 ①-⑧	2,6,10,14	10	same as item 6	16	80
8	Se-3 ①-⑧	3,7,11,15	2	same as item 6	16	144
9	Se-4 ①-⑧	3,7,11,15	10	same as item 6	16	208
10	R1	1,5,9,13	2	4B/6&7	16	272
11	R2	1,5,9,13	10	4B/6&7	16	280
12	R3	2,6,10,14	2	4B/6&7	16	288
13	R4	2,6,10,14	10	4B/6&7	16	296
14	R5	2,6,10,14	10	4B/9&10	16	304

TABLE II - Continued

Item Number	Item Description	Telemetry Position Sequences	Frame	Channel	Target Field Size (bits)	8-Bit Byte Offset
15	R6	3,7,11,15	2	4B/6&7	16	312
16	R7	3,7,11,15	10	4B/6&7	16	320
17	R8	1,9	4	4B/6&7	16	328
18	R9	4,12	8	4B/6&7	16	332
19	R10	0,8	8	4B/6&7	16	336
20	R11	5,13	4	4B/6&7	16	340
21	R12	0,8	4	11&2B/12	16	344
22	R13	0,8	4	6B/12&4B/13	16	348
23	R14	1,9	4	11&2B/12	16	352
24	R15	1,9	4	6B/12 &4B/13	16	356
25	R16	4,12	8	11&2B/12	16	360
26	R17	4,12	8	6B/12&4B/13	16	364
27	R18	0,8	8	11&2B/12	16	368
28	R19	0,8	8	6B/12&4B/13	16	372
29	R20	5,13	4	11&2B/12	16	376
30	R21	5,13	4	6B/12&4B/13	16	380
31	R22	0,8	12	11&2B/12	16	384
32	R23	0,8	12	6B/12&4B/13	16	388
33	R24	4,12	12	11&2B/12	16	392
34	R25	4,12	12	6B/12&4B/13	16	396
35	data quality flags - 16 sequences[4]				8	400
36	time quality flag - sequence 0				8	416

TABLE II - Continued

Item Number	Item Description	Telemetry Position Sequences	Frame	Channel	Target Field Size (Bits)	8-Bit Byte Offset
37	spacecraft clock quality flag - sequence 0				8	417
38	DPP-a3,1-4	0	4	4	8	418
39	DPP-a3,13-16	0	8	4	8	419
40	DPP-a3,21-24	0	12	4	8	420
41	DPP-a3,5-8	1	4	4	8	421
42	DPP-a2,5-8	1	8	4	8	422
43	DPP-a2,9-12	1	12	4	8	423
44	DPP-a2,13-16	2	4	4	8	424
45	DPP-a2,17-20	2	8	4	8	425
46	DPP-a2,21-24	2	12	4	8	426
47	DPP-a2,25-28	3	4	4	8	427
48	DPP-a2,29-32	3	8	4	8	428
49	DPP-a2,33-36	3	12	4	8	429
50	DPP-a3,9-12	4	8	4	8	430
51	DPP-a3,17-20	5	4	4	8	431
52	AP16,&1-15[5]	ALL	0	4	8	432
53	AP32,&17-31	ALL	0	5	8	448
or	AP48,&33-47	ALL	0	5	8	
54	OA data	4,12	4	4-15	8/chan	464
55	repeat of items 1 thru 54 for page 1 of an "even" album					488
56	repeat of items 1 thru 54 for page 2 of an "even" album					976
57	repeat of items 1 thru 54 for page 3 of an "even" album					1464

TABLE II - Continued

Item Number	Item Description	Telemetry Position Sequences	Frame	Channel	Target Field Size (bits)	8-Bit Byte Offset
58	items 1 thru 66 of attitude/orbit/ephemeris table-see attachment 1 of reference 1				32	1952
59	item 67 (see above) YRMODAbb (EBCDIC)				8/char	2216
60	items 68 thru 79 from above table				32	2224
61	repeat of items 1 thru 60 for the next album, an "odd" one					2272 2272 4544
62	one 8-bit byte to pad to a multiple of 36 bits					1 4545

*logical record size = 4545 bytes = 1010 36-bit words

Notes

1 All items are binary integers except for the attitude/orbit/ephemeris data, which is in IBM 360 floating point format.

2 An even album is one in which satellite clock lines $\bar{a}_5$, $\bar{a}_6$, and $\bar{a}_7$ are all ones. Note that $\bar{a}_7 = \bar{C}_{25}$ at 1600 BPS and $\bar{a}_7 = \bar{C}_{27}$ at 400 BPS.

3 Items 6 through 34 are telemetry data and should appear in the 16 bit target field as a 10 or 12 bit integer as they are specified. This should be the floating point compressed form as described in Appendix C, sheets 7-11 of the IMP H&J Encoder document.

4 Each quality flag should be a 2 bit integer right-justified in the 8 bit target field with the left-most 6 bits as zeros.

5 The DPP's should remain four to a channel as they appear in the telemetry read-out: $D_1D_2D_3D_4D_1D_2D_3D_4$; i.e., each one repeats.

6 The AP's should be placed in 8 bit fields so that the conversion to volts is as follows:

VOLTS = 5.75 - .025*(8 bit count);
i.e., 230 counts = 0. volts and
30 counts = 5. volts.