[redacted]

#470

PIONEER 10

TRAJECTORY DATA

72-012A-00E

[redacted]

PIONEER 10

TRAJECTORY DATA TAPES

72-012A-00E

THIS DATA SET HAS BEEN RESTORED. ORIGINALLY THERE WERE 20 9-TRACK, 800 BPI TAPES WRITTEN IN EBCDIC. THERE ARE 5 RESTORED TAPES. THE DR TAPES ARE 3480 CARTRIDGES AND THE DS TAPES ARE 9-TRACK, 6250 BPI. THE TAPES WERE CREATED ON A UNIVAC 1108 COMPUTER. THE DR AND DS NUMBERS ALONG WITH THE CORRESPONDING D NUMBERS AND THE TIME SPANS ARE AS FOLLOWS:

DR#	DS#	D#	FILES	TIME SPAN
DR03531	DS03531	D59319	1-3	03/03/72 - 03/08/72
		D59321	4-6	03/09/72 - 03/30/72
		D59320	7-9	03/12/72 - 03/14/72
		D59322	10-12	03/24/72 - 10/26/73
DR03532	DS03532	D59324	1-3	10/20/72 - 12/04/73
		D59325	4-6	04/25/73 - 12/04/73
		D59323	7-9	10/14/73 - 12/14/73
		D59326	10-12	12/01/73 - 12/06/73
DR03533	DS03533	D59327	1-3	12/04/73 - 01/08/75
		D59329	4-6	12/04/73 - 01/08/75
		D59328	7-9	12/24/73 - 01/01/76
		D59330	10-12	01/01/76 - 01/01/78
DR03534	DS03534	D59331	1-3	01/01/78 - 12/29/79
		D59332	4-6	12/02/79 - 01/01/82
		D59333	7-9	12/01/80 - 06/01/81
		D59334	10-12	03/03/81 - 06/01/81
DR03535	DS03535	D59335	1-3	06/01/81 - 02/01/82
		D59336	4-6	01/01/82 - 01/10/84
		D59337	7-9	02/01/82 - 02/02/83
		D59338	10-12	01/01/83 - 05/01/84

REQ. AGENT	RAND #	ACQ. AGENT
DAD	V0204	WSC

PIONEER 10

TRAJECTORY DATA

72-012A-00E

THIS DATA SET CONSISTS OF 20 TAPES. THESE TAPES ARE 9-TRACK, 800 BPI, WRITTEN IN EBCDIC, AND WERE CREATED ON A UNIVAC 1108 COMPUTER IN 360 FORMAT. ALL OF THE TAPES CONTAIN 3 FILES.

D#	C#	TIME SPAN
D-59319	C-23335	03/03/72 - 03/08/72
D-59320	C-23336	03/03/72 - 03/14/72
D-59321	C-23337	03/09/72 - 03/30/72
D-59322	C-23338	03/24/72 - 10/26/73
D-59324	C-23340	10/20/72 - 12/04/73
D-59325	C-23341	04/25/73 - 12/04/73
D-59323	C-23339	10/14/73 - 12/14/73
D-59326	C-23342	12/01/73 - 12/06/73
D-59327	C-23343	12/04/73 - 01/08/75
D-59329	C-23345	12/04/73 - 01/08/75
D-59328	C-23344	12/24/73 - 01/01/76
D-59330	C-23346	01/01/76 - 01/01/78
D-59331	C-23347	01/01/78 - 12/29/79
D-59332	C-23348	12/01/79 - 01/01/82
D-59333	C-23349	12/01/80 - 06/01/81
D-59334	C-23350	03/03/81 - 06/01/81
D-59335	C-23351	06/01/81 - 02/01/82
D-59336	C-23352	01/01/82 - 01/10/84
D-59337	C-23353	02/01/82 - 02/02/83
D-59338	C-23354	01/01/83 - 05/01/84

Leave these 2 pages in DSC per HKH 2/97

SECTION V

INPUT AND OUTPUT

A. INPUT

The save tape (DPTRAJ) will be written on a 7-track tape at 800 bpi and in the binary mode by the UNIVAC 1108 computer at JPL. The format and word* assignment are given in Figure 5-1.

At the beginning of the tape, there are two physical records containing BCD information. The trajectory data follows these two records. Each logical save record consists of four physical records. Appropriate flags are provided to signal the beginning and the end of the trajectory data. The format of each physical record has the following characteristics:

1. Record #1

   This record consists of 252 words and contains the six-letter BCD mnemonics of all trajectory variables available.

2. Record #2

   This is a dummy record consisting of 140 words.

3. Record #3

   Physical records #3 through #6 are grouped together as one logical save record. These four records are repeated for each time point requested by the user in his input. There are 28 words in Record #3. The initial logical save record is signaled by the presence of the number 377777777777_8 in Word 3. Thereafter, for each logical save record following the initial one, Word 3 of physical Record #3 will contain zeros. Following the last logical save record, physical Record #3 is repeated several times with the end of data signaled by the presence again of 377777777777_8 in Word 3 of one of them. The end of data is not terminated by an end-of-file.

4. Record #4

   This record consists of 252 words. It contains the actual values of the trajectory variables. With the exception of Words 7 and 8, all variables are double precision quantities represented by two consecutive words comprising the UNIVAC 1108 double precision representation.

---

* Word refers to the UNIVAC 1108 36-bit computer word (six BCD characters).

PAR: ignore

Example: Words 23 and 24 both contain the number 12.

This designates the location of the first half and the second half of the double precision value for Variable #13, inertial azimuth angle (INAZIM).

Words 7 and 8 are two integers containing the value of Variable #3, the Gregorian calendar date. The format is an octal representation of the decimal values described below:

(Word 7) 00YYYYMMDDDD

(Word 8) 00HHNNSSPPPP

where: YYYY - Year

MM - Month

DDDD - Day

HH - Hour

NN - Minute

SS - Second

PPPP - Parts of a second

Example: March 3, 1972, at 02 hours 03 minutes and 59.9999 seconds:

(Word 7) $016542545063_8 = 001972030003_{10}$

(Word 8) $001410530177_8 = 000203599999_{10}$

5. Record #5 and Record #6

These records consist of 252 words each. Record #5 contains an additional set of parameters that are referred to as "programmable variables" and represents an option capability in the DPTRAJ Program. Record #6 is a dummy record and contains 252 words.

Two important facts should be realized:

(a) BCD conversion codes for the UNIVAC 1108 are different from the BCD codes of the IBM machine.

(b) Double precision numbers in FORTRAN V are represented to the base 2000_8.

PAR: Ignore

B. OUTPUT

The generalized form of the trajectory save tape is shown in Figure 5-2. The tape will be made up of the following three files of information:

(1) Header File - The Header File contains logistics type information and serves to identify the trajectory save tape as to content, date of generation, etc. Figure 5-3 references the specific requirements of each experimenter.

(2) Compendium File - This file contains a listing of all of the requested parameters on the trajectory save tape. It contains the acronym for the parameter and the calling sequence order. Figure 5-3 references the specific requirements of each experimenter.

(3) Trajectory Data File - This file contains the specific value of each parameter that each user has selected for use with his EDR data. Figure 5-3 references the specific requirements of each experimenter.

C. USER INPUT/OUTPUT

1. TRJP1 Start Up Card Format

The TRJP1 Start Up Card will have the format shown in Figure 5-8.

2. Teletype-Line Printer Messages

The Teletype-line printer messages are shown in Figures 5-9 through 5-28.

PHYSICAL RECORD DESCRIPTION

RECORD #1 (252 WORDS)

WORD							
1	NOT USED	NOT USED	ETSP50	JULDAT	VIGDAT	TFLANC	TFINJE
8	LTMUTC	NOT USED	RANGRP	MAGVEL	INPATH	INAZIM	REARPR
15	DECPRO	RTASCP	REARSU	DECSUN	RTASCS	REARMO	DECMOO
22	RTASCM	HRANGP	HMAGVP	HINPTH	CELLTP	CELLNP	CELLTE
29	CELLNE	XSCSEL	YSCSEL	ZSCSEL	SPSEXY	LNPSEL	NOT USED
36	NOT USED	XPGSFF	YPGSFF	ZPGSFF	DXPGSF	DYPGSF	DZPGSF
43	XPHSFF	YPHSFF	ZPHSFF	DXPHSF	DYPHSF	DZPHSF	XP1SFF
50	YP1SFF	ZP1SFF	DXP1SF	DYP1SF	DZP1SF	XP2SFF	YP2SFF
57	ZP2SFF	DXP2SF	DYP2SF	DZP2SF	B1MAGR	B1MAGV	B2MAGR
64	B2MAGV	EALATP	EALONP	EAVELP	EAPTHP	EAAZIP	B1LATP
71	B1LONP	B1VELP	B1PTHP	B1AZIP	B2LATP	B2LONP	B2VELP
78	B2PTHP	B2AZIP	EPB1AN	EPB2AN	EPSUAN	EPMOAN	CPEANG
85	CPSANG	MOPSAN	B1PB2A	MOEPAN	SEPANG	ESPANG	SPB1AN
92	SPB2AN	B1EPAN	B2EPAN	CONECE	CLCKCE	CONEC1	CLCKC1
99	CONEC2	CLCKC2	CONEE1	CLCKE1	CONEE2	CLCKE2	CONEEC
106	CLCKEC	CONE1E	CLCK1E	CONE12	CLCK12	CONE1C	CLCK1C
113	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
120	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
127	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
134	NOT USED	NOT USED	NOT USED	NOT USED	XP1	YP1	ZP1
141	DXP1	DYP1	DZP1	XE1	YE1	ZE1	DXE1
148	DYE1	DZE1	RE1	DECE1	RAE1	VIE1	LONE1
155	XM1	YM1	ZM1	XS1	YS1	ZS1	NOT USED
162	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	RS1
169	XE1	YE1	ZE1	XM1	YM1	ZM1	XS1
176	YS1	ZS1	DECS1	RAS1	VIS1	LONS1	ES5
183	SE5	S5E	MSP	SMP	EMP	A5SP	S5P
190	E5P	ESM	EMS	MES	EASD	SASD	MASD
197	A5ASD	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
204	-- WORDS 204 THROUGH 252 ARE NOT USED --						

RECORD #2 (140 WORDS)

WORD	
1	-- WORDS 1 THROUGH 140 ARE NOT USED --

Figure 5-1. Trajectory Physical Record Description
(Sheet 1 of 3)

RECORD #3 (28 WORDS)

WORD							
1	NOT USED	NOT USED	377777777777_8	NOT USED	NOT USED	NOT USED	NOT USED
8	-- WORDS 8 THROUGH 23 NOT USED --						

RECORD #4 (252 WORDS)

WORD							
1	NOT USED	NOT USED	1	1	2	2	3
8	3	4	4	5	5	6	6
15	NOT USED	NOT USED	13	13	10	10	11
22	11	12	12	7	7	8	8
29	9	9	14	14	15	15	16
36	16	17	17	18	18	19	19
43	20	20	23	23	24	24	21
50	21	22	22	25	25	26	26
57	27	27	28	28	29	29	30
64	30	31	31	NOT USED	NOT USED	NOT USED	NOT USED
71	32	32	33	33	34	34	35
78	35	36	36	37	37	38	38
85	39	39	40	40	41	41	42
92	42	43	43	44	44	45	45
99	46	46	47	47	48	48	49
106	49	50	50	51	51	52	52
113	53	53	54	54	55	55	56
120	56	57	57	58	58	59	59
127	60	60	61	61	62	62	63
134	63	64	64	65	65	66	66
141	67	67	68	68	69	69	70
148	70	71	71	72	72	73	73
155	74	74	75	75	76	76	77
162	77	78	78	79	79	80	80
169	81	81	82	82	83	83	84
176	84	85	85	86	86	87	87
183	88	88	89	89	90	90	91
190	91	92	92	93	93	94	94
197	95	95	96	96	97	97	98
204	98	99	99	100	100	101	101
211	102	102	103	103	104	104	105
218	105	106	106	107	107	NOT USED	NOT USED
225	-- WORDS 225 THROUGH 252 ARE NOT USED --						

Figure 5-1. Trajectory Physical Record Description
(Sheet 2 of 3)

RECORD #5 (252 WORDS)

WORD							
1	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
8	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
15	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
22	NOT USED	NOT USED	108	108	109	109	110
29	110	111	111	112	112	113	113
36	114	114	115	115	116	116	117
43	117	118	118	119	119	120	120
50	121	121	122	122	123	123	124
57	124	125	125	126	126	127	127
64	128	128	129	129	130	130	NOT USED
71	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
78	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	131
85	131	132	132	133	133	134	134
92	135	135	136	136	137	137	138
99	138	139	139	140	140	141	141
106	142	142	143	143	144	144	145
113	145	146	146	147	147	148	148
120	149	149	150	150	151	151	152
127	152	153	153	154	154	155	155
134	156	156	157	157	158	158	159
141	159	160	160	NOT USED	NOT USED	NOT USED	NOT USED
148	-- WORDS 148 THROUGH 252 ARE NOT USED --						

RECORD #6 (252 WORDS)

WORD	
1	-- WORDS 1 THROUGH 252 ARE NOT USED --

Figure 5-1. Trajectory Physical Record Description
(Sheet 3 of 3)

Trajectory Tape Organization

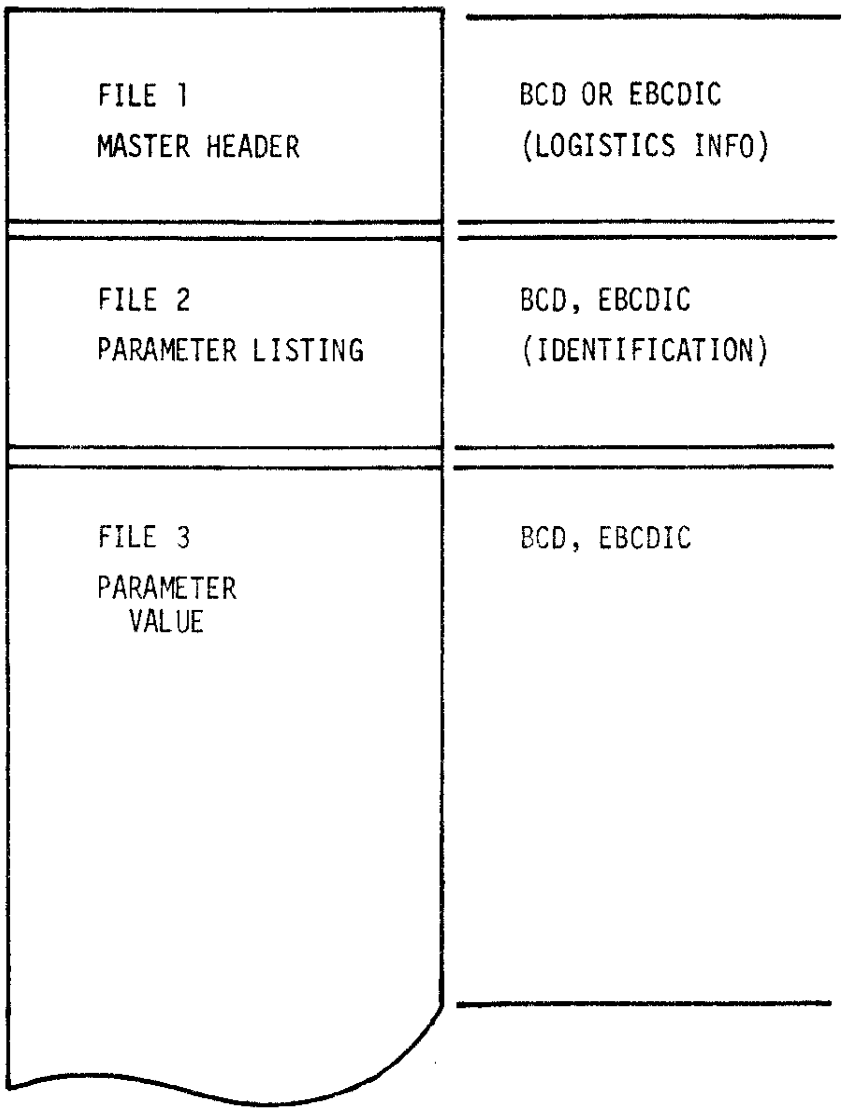


Figure 5-2. Trajectory Save Tape General Organization (DPTRAJ Output)

USER	JPL/HVM	ARC/PA	UC/CPI	UI/GTT	GSFC/CRT	UCSD/TPS	USC/HV	UA/IPP	MIT/IR	GE/AMD	LaRC/MD	OSU/IPP
Computer	UNIVAC 1108	IBM 360/67	XDS 930	UNIV 418	IBM 360/75	BURROUGHS 6500	IBM 370/155	CDC 6400	IBM 370/155	GE 635	CDC 6600	UNIVAC 1108
Word Size	36-bit	32-bit	24-bit	18-bit	32-bit	48-bit	32-bit	36-bit	32-bit	36-bit	36-bit	36-bit
Operating System	Exec-8	OS;TSS	OSMVT; PL-1	R/T Exec	OS	BUR TSS	OS	OS	OS	GECOS III	SCOPE 3.1	EXEC 8
Density (bpi)	800	800	556	556	800	556	800	556	800	556	556	556
Tracks	7	9	7	7	9	7	9	7	9	7	7	7
Tape Type	BCD	EBCDIC	BCD	Copy	EBCDIC	BCD	EBCDIC	BCD	EBCDIC	BCD	BCD	Copy
Specification Reference	PC-262.01 Section 3.1.3.1.6 PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.01 Section 3.1.3.1.6 PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.04 Section 3.1	PC-262.01 Section 3.1.3.1.6 PC-262.04 Section 3.1
Format Description	Figure 5-6	Figure 5-5	Figure 5-4	Figure 5-1	Figure 5-5	Figure 5-7	Figure 5-5	Figure 5-6	Figure 5-5	Figure 5-6	Figure 5-6	Figure 5-1

Figure 5-3. Summary of Experimenter DPTRAJ Requirements

NOTE FOR ALL FIGURES RELATING TO THE 32-BIT MACHINE.

File 3 contains one entry for each of the one hundred fifty seven (157) parameters. Each entry consists of twenty-four (24) EBCDIC characters with the decimal point inserted in the appropriate place.

The mnemonics in File 2 order and identify the parameters in File 3.

The relationship of the mnemonics to the parameters is as follows:

mnemonic 1 ... Entry 1
mnemonic 2 ... Entry 2
mnemonic 3 ... Entry 3 and Entry 4
mnemonic 4 ... Entry 5
.
.
.
mnemonic 156 ... Entry 157

Figure 5-5. Format Description for 32-Bit Machines - Notes (Sheet 1 of 20)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	P								I								O								N							
2	E								E								R															
3	F																T								R							
4	A								J								E								C							
5	T								O								R								Y							
6									D								A								T							
7	A																O								P							
8	E								R								A								T							
9	I								O								N								A							
10	L																T								A							
11	P								E																N							
12	O																								n							
13	n								n																N							
14	A								M								E								/							
15	E								X								P															
16	J								P								L															
17	G								E								N								E							
18	R								A								T								E							
19	D																M								M							
20	/								D								D								/							
21	Y								Y																A							
22	R								C																G							
23	E								N								E								R							
24	A								T								E								D							
25									M								M								/							
26	D								D								/								Y							
27	Y																															
28																																
29																																
30																																
31	S								T								A								R							

BLANK

TYPE-EBCDIC
LOGICAL RECORD LENGTH - 120 CHARACTERS
PHYSICAL RECORD LENGTH - 240 CHARACTERS
FILE SIZE - 1 PHYSICAL RECORD

Figure 5-5. Format Description for 32-Bit Machines - File 1 (Sheet 2 of 20)

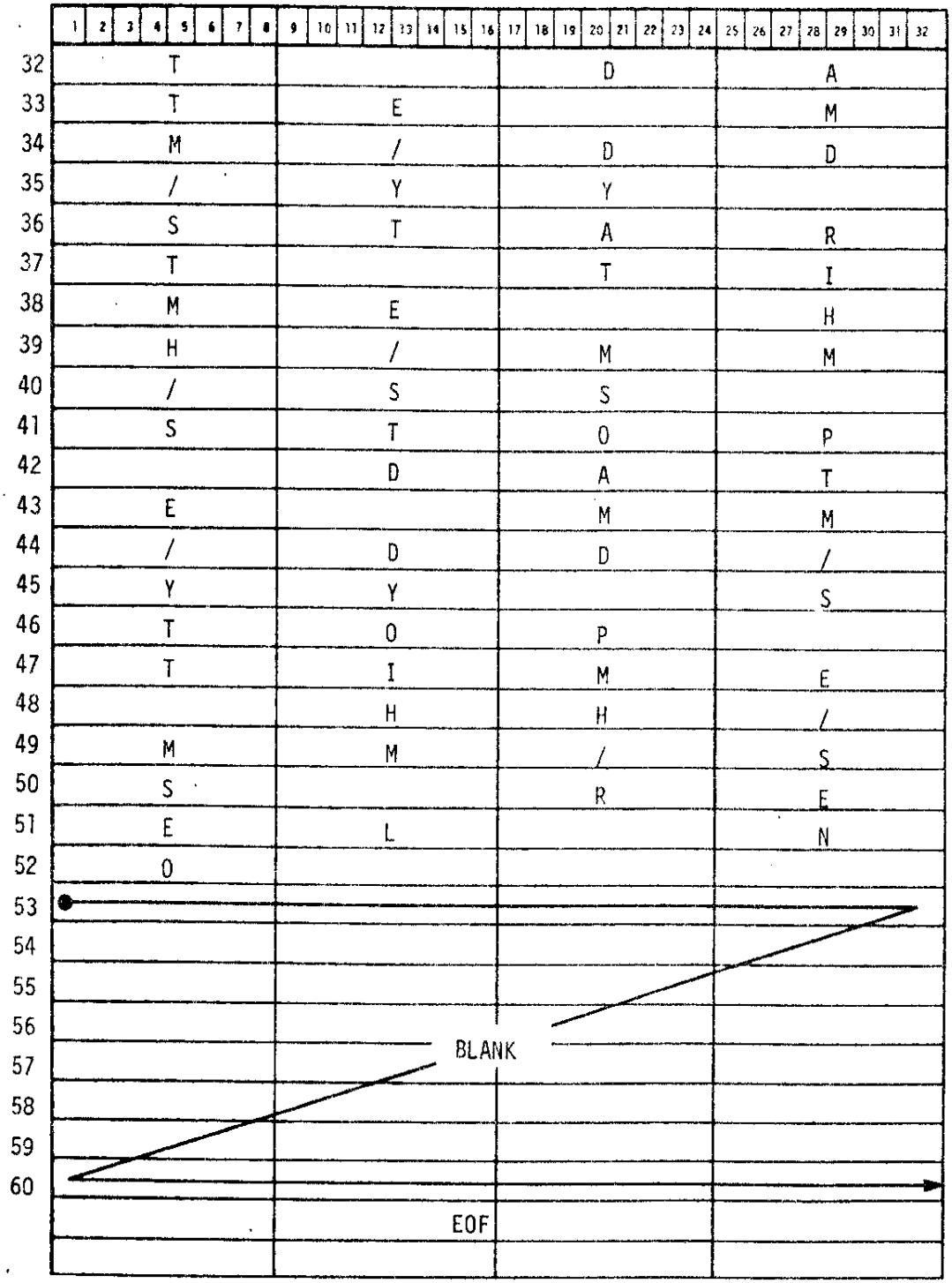


Figure 5-5. Format Description for 32-Bit Machines - File 1 (Sheet 3 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
E	T	S	P
5	O		
J	U	L	D
A	T		
V	I	G	D
A	T		
T	F	L	A
N	C		
T	F	I	N
J	E		
E	T	M	U
T	C		
R	A	N	G
R	P		
M	A	G	V
E	L		
I	N	P	A
T	H		
I	N	A	Z
I	M		
R	E	A	R
P	R		
D	E	C	P
R	O		
R	T	A	S
C	P		
R	E	A	R
S	U		
D	E	C	S
U	N		
R	T	A	S

TYPE-EBCDIC
LOGICAL RECORD LENGTH - 120 CHARACTERS
PHYSICAL RECORD LENGTH - 1560 CHARACTERS
FILE SIZE - 1 PHYSICAL RECORD

Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 4 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
C	S		
R	E	A	R
M	O		
D	E	C	M
O	O		
R	T	A	S
C	M		
H	R	A	N
G	P		
H	M	A	G
V	P		
H	I	N	P
T	H		
C	E	L	L
T	P		
C	E	L	L
N	P		
C	E	L	L
T	E		
C	E	L	L
N	E		
X	S	C	S
E	L		
Y	S	C	S
E	L		
Z	S	C	S
E	L		
S	P	S	E
X	Y		
L	N	P	S
E	L		

Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 5 of 20)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
X								P								G								S							
F								F																							
Y								P								G								S							
F								F																							
Z								P								G								S							
F								F																							
D								X								P								G							
S								F																							
D								Y								P								G							
S								F																							
D								Z								P								G							
S								F																							
X								P								H								S							
F								F																							
Y								P								H								S							
F								F																							
Z								P								H								S							
F								F																							
D								X								P								H							
S								F																							
D								Y								P								H							
S								F																							
D								Z								P								H							
S								F																							
X								P								1								S							
F								F																							
Y								P								1								S							
F								F																							
Z								P								1								S							
F								F																							
D								X								P								1							

Figure 5-5. Format Description for 32-Bit Machines - File 2
(Sheet 6 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
S	F		
D	Y	P	1
S	F		
D	Z	P	1
S	F		
X	P	2	S
F	F		
Y	P	2	S
F	F		
Z	P	2	S
F	F		
D	X	P	2
S	F		
D	Y	P	2
S	F		
D	Z	P	2
S	F		
B	1	M	A
G	R		
B	1	M	A
G	V		
B	2	M	A
G	R		
B	2	M	A
G	V		
E	A	L	A
T	P		
E	A	L	O
N	P		
E	A	V	E
L	P		

Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 7 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
E	A	P	T
H	P		
E	A	A	Z
I	P		
B	1	L	A
T	P		
B	1	L	0
N	P		
B	1	V	E
L	P		
B	1	P	T
H	P		
B	1	A	Z
I	P		
B	2	L	A
T	P		
B	2	L	0
N	P		
B	2	V	E
L	P		
B	2	P	T
H	P		
B	2	A	Z
I	P		
E	P	B	1
A	N		
E	P	B	2
A	N		
E	P	S	U
A	N		
E	P	M	0

Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 8 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
A	N		
C	P	E	A
N	G		
C	P	S	A
N	G		
M	O	P	S
A	N		
B	1	P	B
2	A		
M	O	E	P
A	N		
S	E	P	A
N	G		
E	S	P	A
N	G		
S	P	B	1
A	N		
S	P	B	2
A	N		
B	1	E	P
A	N		
B	2	E	P
A	N		
C	O	N	E
C	E		
C	L	C	K
C	E		
C	O	N	E
C	1		
C	L	C	C
C	1		

Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 9 of 20)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
C								0								N								E							
C								2																							
C								L								C								K							
C								2																							
C								0								N								E							
E								1																							
C								L								C								K							
E								1																							
C								0								N								E							
E								2																							
C								L								C								K							
E								2																							
C								0								N								E							
E								C																							
C								L								C								K							
E								C																							
C								0								N								E							
1								E																							
C								L								C								K							
1								E																							
C								0								N								E							
1								2																							
C								L								C								K							
1								2																							
C								0								N								E							
1								C																							
C								L								C								K							
1								C																							
H								0								U								R							
A								N																							

Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 10 of 20)

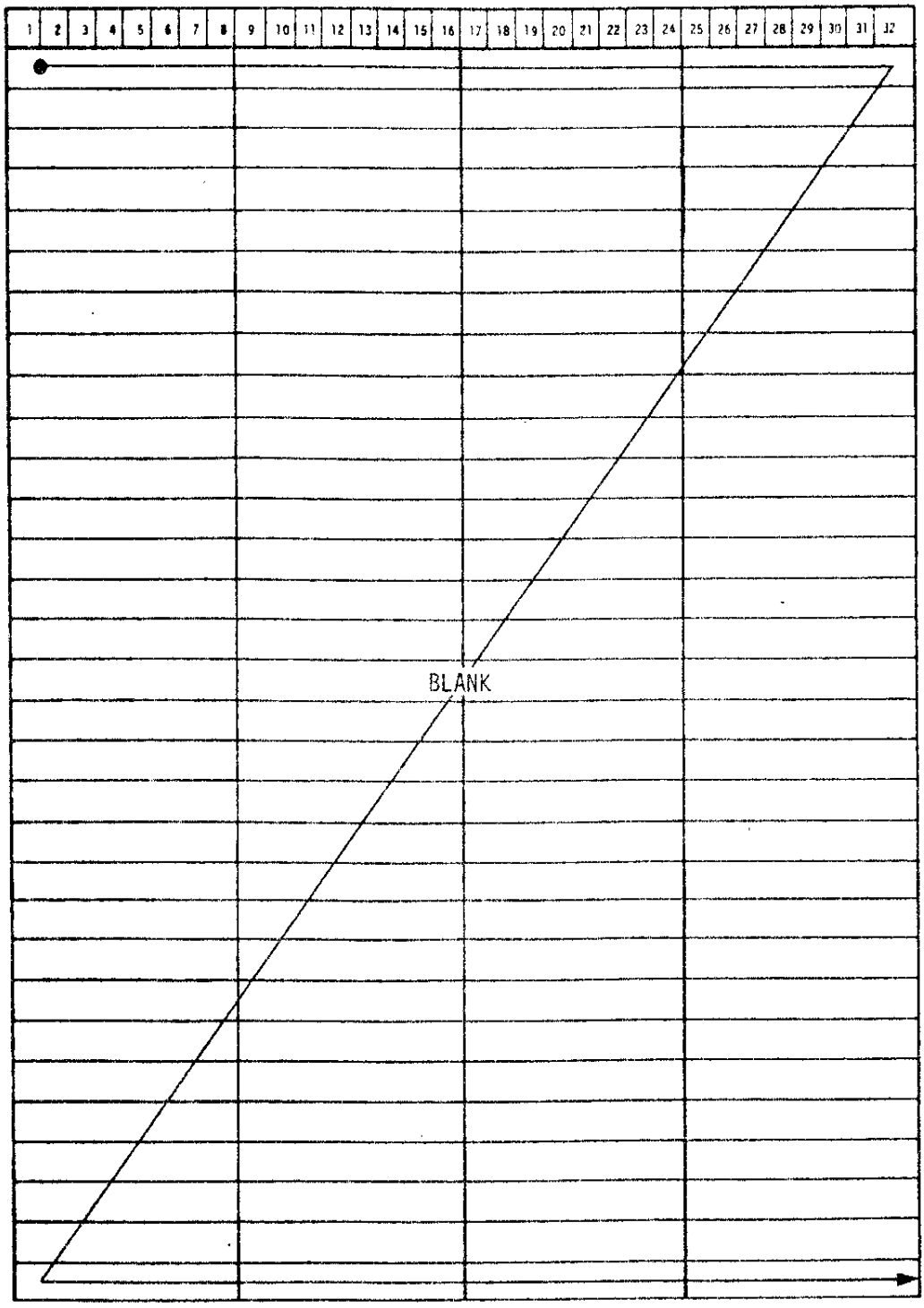


Figure 5-5. Format Description for 32-Bit Machines - File 2
(Sheet 11 of 20)

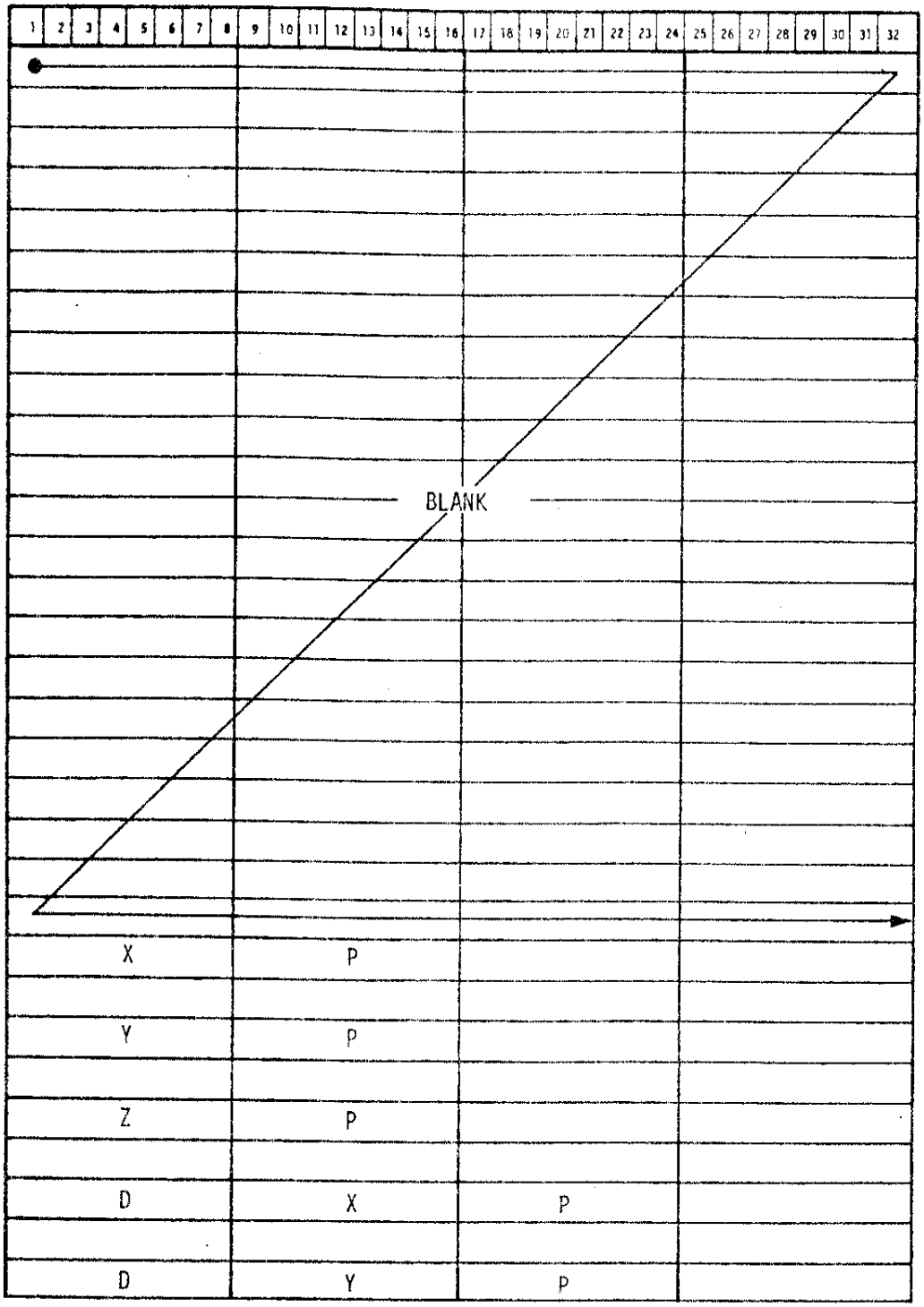


Figure 5-5. Format Description for 32-Bit Machines - File 2 (Sheet 12 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
D	Z	P	
X	M		
Y	M		
Z	M		
X	S		
Y	S		
Z	S		
X	5		
Y	5		
Z	5		
R	A	5	
D	E	C	5
R	5		
V	I	5	
X	E		

Figure 5-5. Format Description for 32-Bit Machines - File 2 TRJP1 only (Sheet 13 of 20)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
				D							Z								P											
				X							M																				
				Y							M																				
				Z							M																				
				X							S																				
				Y							S																				
				Z							S																				
				X							6																				
				Y							6																				
				Z							6																				
				R							A								6											
				D							E								C					6						
				R							6																				
				V							I								6											
				X							E																				

Figure 5-5. Format Description for 32-Bit Machines — File 2 TRJP2 only (Sheet 14 of 20)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Y								E																							
Z								E																							
H								X										M												
H								Y										M												
H								Z										M												
H								X										5												
H								Y										5												
H								Z										5												
H								R										A												5
H								D										E												C
5																															
H								R										5												
H								V										I												5
E								S										5												
S								E										5												
S								5										E												
M								S										P												

Figure 5-5. Format Description for 32-Bit Machines - File 2 TRJP1 only (Sheet 15 of 20)

1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
Y	E		
Z	E		
H	X	M	
H	Y	M	
H	Z	M	
H	X	6	
H	Y	6	
H	Z	6	
H	R	A	6
H	D	E	C
6			
H	R	6	
H	V	I	6
E	S	6	
S	E	6	
S	6	E	
M	S	P	

Figure 5-5. Format Description for 32-Bit Machines — File 2 TRJP2 only (Sheet 16 of 20)

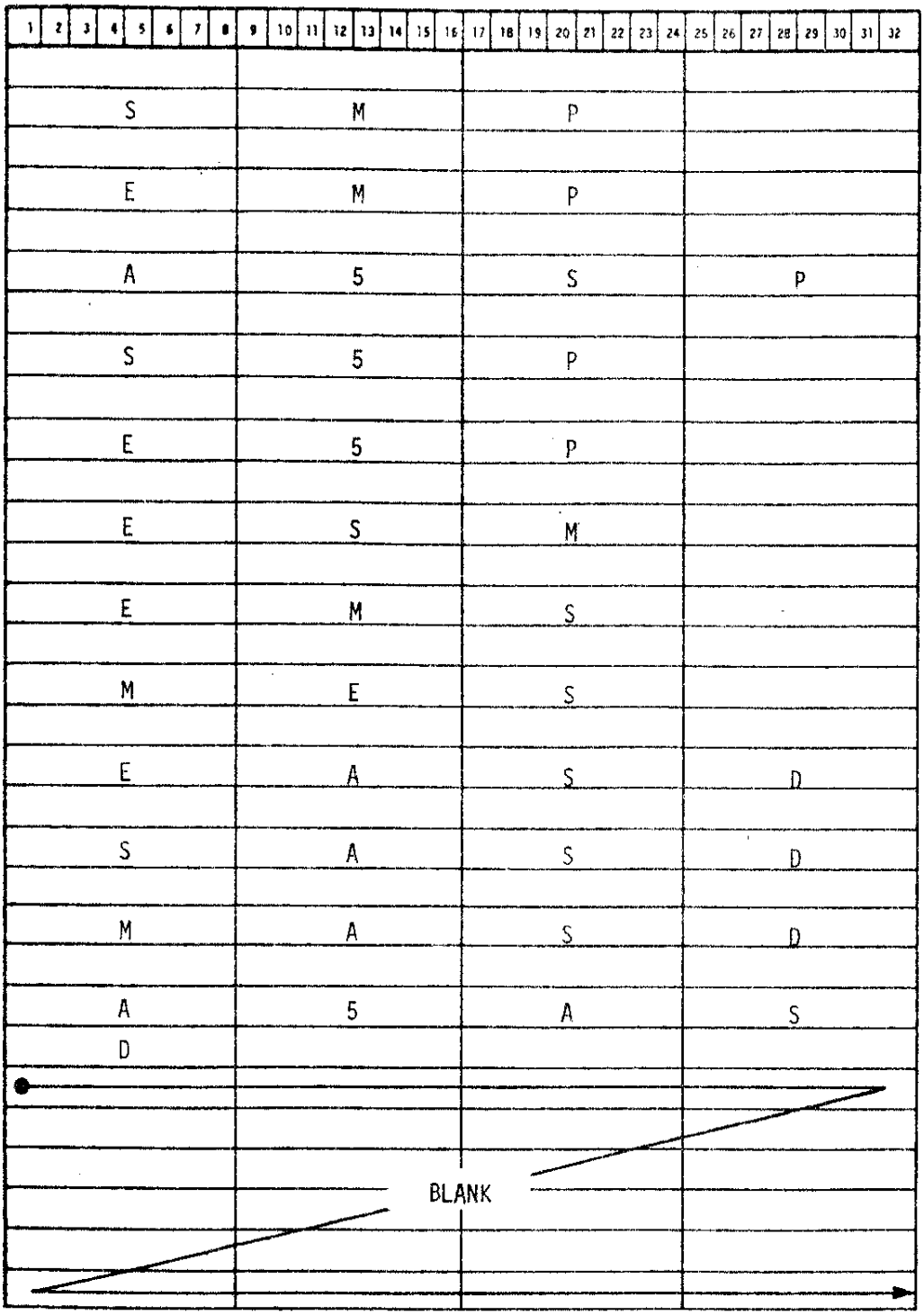


Figure 5-5. Format Description for 32-Bit Machines - File 2 TRJP1 only (Sheet 17 of 20)

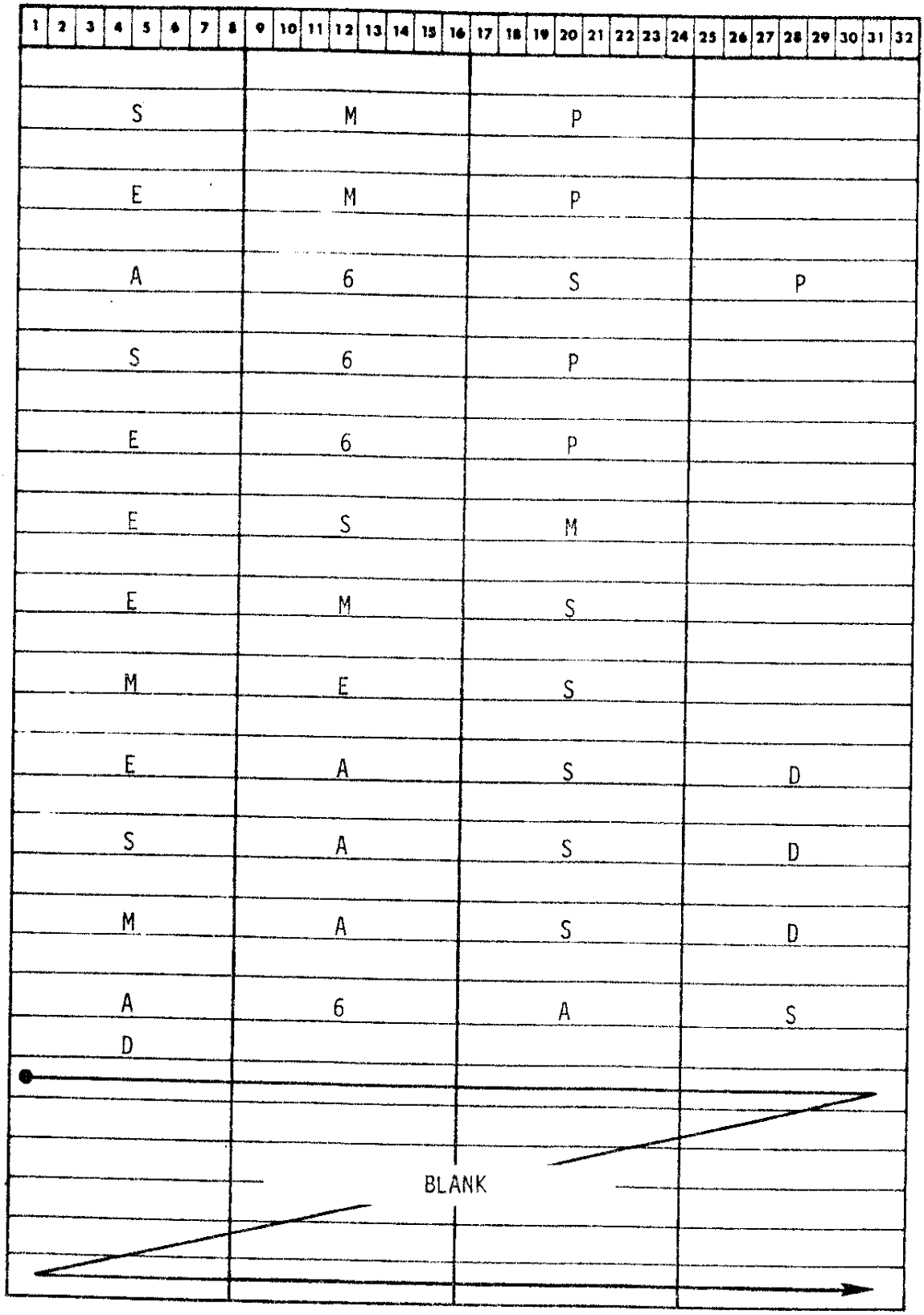


Figure 5-5. Format Description for 32-Bit Machines — File 2 TRJP2 only (Sheet 18 of 20)

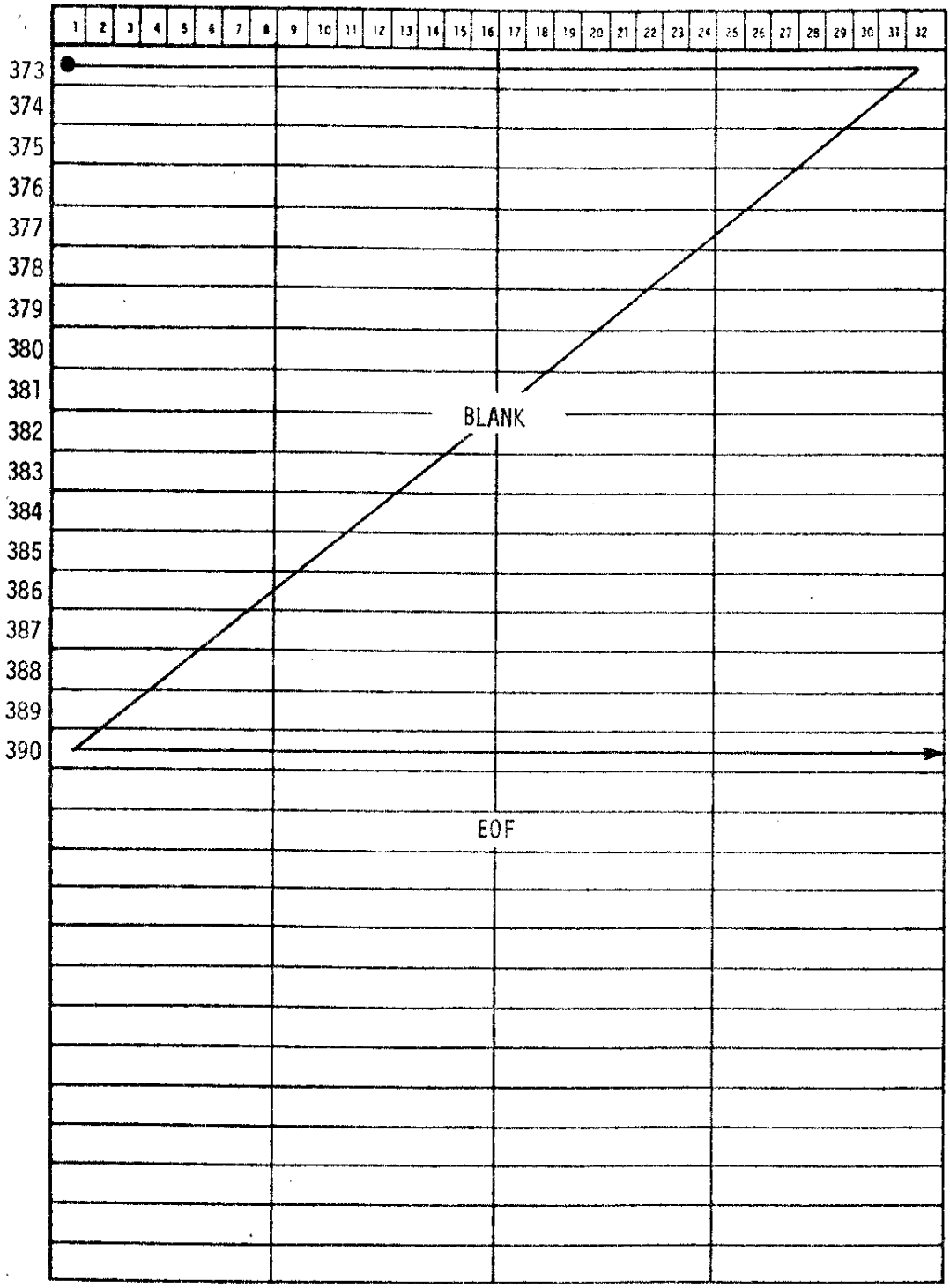


Figure 5-5. Format Description for 32-Bit Machines - File 2
(Sheet 19 of 20)

	1 2 3 4 5 6 7 8	9 10 11 12 13 14 15 16	17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 32
1	(SIGN) ±			
2				
3		ENTRY	1	
4				
5				
6		BLANK	BLANK	BLANK
.				
.				
.				
937	(SIGN) ±			
938				
939		ENTRY	157	
940				
941				
942		BLANK	BLANK	BLANK
		EOR		

TYPE-EBCDIC
LOGICAL RECORD LENGTH - 24 CHARACTERS
PHYSICAL RECORD LENGTH - 3768 CHARACTERS
FILE SIZE

Figure 5-5. Format Description for 32-Bit Machines - File 3 (Sheet 20 of 20)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Ames Research Center
Moffett Field, California 94035

PIONEER PROGRAM

SPECIFICATION PC-262.04

Pioneer F/G Trajectory Data User Requirements

December 20, 1971

1. SCOPE

Specification PC-262.04 describes the detailed requirements for processing the Navigation Team-prepared Trajectory Data "Save" Tape at Ames Research Center on the XDS Sigma 5 computer.

2. APPLICABLE DOCUMENTS

2.1 NASA/ARC SPECIFICATIONS

PC-262.00, Pioneer F/G: Off-Line Data Processing System at ARC

PC-262.01, Pioneer F/G: Off-Line Data Processing System Detailed Processing Requirements.

PC-262.02, Pioneer F/G: Input and Output Tape Requirements

PC-262.03, Pioneer F/G: Data User Requirements

PC-261.00, Pioneer F/G: On-Line Ground Data System Software Specification - General

3. GENERAL PROCESSING REQUIREMENTS

One of the sources of the users trajectory data will be the output of the JPL DPTRAJ "save" tape as defined in PC-262.01, Pioneer F/G: Input and Output Tape Requirements. This tape in addition to being the source for each user's trajectory requirements, shall also provide a capability to calculate the "round-trip-light-time" (RTLT) required in each user's EDR. A description of the parameters is given in section 3.1 of this specification.

A second source of trajectory information for each user is the output of the JPL Planetary Orbital Geometry and Science Instruments Scan Program (POGASIS). The input tape description is given in PC-262.02, Pioneer F/G: Input and Output Tape Requirements. The output format and parameter description will be supplied at at a later date.

3.1 DPTRAJ TRAJECTORY SAVE TAPE VARIABLES

Each regular record of the DPTRAJ save tape contains time annotated trajectory parameters. The following list describes and defines the available parameters.

BCD NAME	TIME GROUP
ETSP50	(1) Time past 0^h JANUARY 1, 1950 (sec)*
JULDAT	(2) Julian Date (days)
VIGDAT	(3) Gregorian calendar date (yr, mo, day, hr, min, sec)
TFLANC	(4) Time from launch (sec)
TFINJE	(5) Time from initial epoch of trajectory (sec)
ETMUTC	(6) ET-UTC (sec)**

*The time reference is ET (ephemeris time).

**ET and UTC (Universal Time Coordinated).

3.1.1 Geocentric. The following parameters are defined in the inertial spherical coordinate system described on Figure 3.1.1. For this group the reference body is the Earth and the plane of reference is the Earth's true equator of date.

REARPR	(7)	Radius to the spacecraft (km)
DECPRO	(8)	Declination of the spacecraft (deg)
RTASCP	(9)	Right ascension of the spacecraft (deg)
MAGVEL	(10)	Speed of the spacecraft (km/sec)
INPATH	(11)	Inertial flight path angle (deg)
INAZIM	(12)	Inertial azimuth angle (deg)
RANGRP	(13)	Range rate (km/sec); the time rate of change of the magnitude of the radius vector
REARSU	(14)	Earth-Sun distance (km)
DECSUN	(15)	Declination of the Sun (deg)
RTASCS	(16)	Right ascension of the Sun (deg)
REARMO	(17)	Earth-Moon distance (km)
DECMOO	(18)	Declination of the moon (deg)
RTASCM	(19)	Right ascension of the moon (deg)

3.1.2 Heliocentric. For this group of parameters there are two coordinate systems centered at the Sun.

The following parameters are defined in the inertial spherical coordinate system described on Figure 3.1.1. For this group the reference body is the Sun and the plane of reference is the true ecliptic of date.

HRANGP	(20)	Radius to the S/C (km)
CELLTP	(21)	Celestial latitude of the S/C (deg)
CELLNP	(22)	Celestial longitude of the S/C (deg)
HMAGVP	(23)	Speed of the S/C (km/sec)
HINPTH	(24)	Inertial flight path angle (deg)

CELLTE (25) Celestial latitude of the Earth (deg)

CELLNE (26) Celestial longitude of the Earth (deg)

The following parameters are defined in the Sun-Earth cartesian coordinate system described on Figure 3.1.2.

XSCSEL (27) X-component of the S/C in the Sun-Earth system (km)

YXCSEL (28) Y-component of the S/C in the Sun-Earth system (km)

ZSCSEL (29) Z-component of the S/C in the Sun-Earth system (km)

SPSEXY (30) Sun-S/C distance in the X-Y plane of the Sun-Earth system (km); the projection of the Sun-S/C vector onto the X-Y plane

LNPSEL (31) Longitude of the S/C in the Sun-Earth system (deg)

3.1.3 Inertial Cartesian. The following parameters represent cartesian position and velocity vectors of the S/C from the Earth, Sun, Jupiter and Mars. Figure 3.1.3 describes the inertial cartesian coordinate system. The plane of reference for these parameters is the true ecliptic of date.

XPGSFF (32) X-component of the S/C (Earth centered) (km)

YPGSFF (33) Y-component of the S/C (Earth centered) (km)

ZPGSFF (34) Z-component of the S/C (Earth centered) (km)

DXPGSF (35) $\dot{X}$-time rate of change in the X-component (km/sec)

DYPGSF (36) $\dot{Y}$-time rate of change in the Y-component (km/sec)

DZPGSF (37) $\dot{Z}$-time rate of change in the Z-component (km/sec)

XPHSFF (38) X-component of the S/C (Sun centered) (km)

YPHSFF (39) Y-component of the S/C (Sun centered) (km)

ZPHSFF	(40)	Z-component of the S/C (Sun centered) (km)
DXPHSF	(41)	$\dot{X}$-time rate of change in the X-component (km/sec)
DYPHSF	(42)	$\dot{Y}$-time rate of change in the Y-component (km/sec)
DZPHSF	(43)	$\dot{Z}$-time rate of change in the Z-component (km/sec)
XP1SFF	(44)	X-component of the S/C (Jupiter centered) (km)
YP1SFF	(45)	Y-component of the S/C (Jupiter centered) (km)
ZP1SFF	(46)	Z-component of the S/C (Jupiter centered) (km)
DXP1SF	(47)	$\dot{X}$-time rate of change in the X-component (km/sec)
DYP1SF	(48)	$\dot{Y}$-time rate of change in the Y component (km/sec)
DZP1SF	(49)	$\dot{Z}$-time rate of change in the Z component (km/sec)
XP2SFF	(50)	X-component of the S/C (Mars centered) (km)
YP2SFF	(51)	Y-component of the S/C (Mars Centered) (km)
ZP2SFF	(52)	Z-component of the S/C (Mars Centered) (km)
DXP2SF	(53)	$\dot{X}$-time rate of change in the X-component (km/sec)
DYP2SF	(54)	$\dot{Y}$-time rate of change in the Y-component (km/sec)
DZP2SF	(55)	$\dot{Z}$-time rate of change in the Z-component (km/sec)

Additionally:

B1MAGR	(56)	Jupiter-S/C distance (km)
B1MAGV	(57)	Velocity of the S/C with respect to Jupiter (km/sec)
B2MAGR	(58)	Mars-S/C distance (km)
B2MAGR	(59)	Velocity of the S/C with respect to Mars (km/sec)

3.1.4 Body-Fixed. The following parameters are referenced to a rotating coordinate system fixed to either the Earth, Jupiter, or Mars. The mathematical models of the body-fixed system (equator, prime meridian, rotational dynamics) are defined in reference 1. The body-fixed coordinate system is shown on Figure 3.1.4.

- EARTH -

EALATP	(60)	Latitude of the S/C (deg)
EALONP	(61)	Longitude of the S/C (deg)
EAVELP	(62)	Velocity of the S/C (km/sec)
EAPTHP	(63)	Body-fixed path angle (deg)
EAAZIP	(64)	Body-fixed azimuth angle (deg)

- JUPITER -

B1LATP	(65)	Latitude of the S/C (deg)
B1LONP	(66)	Longitude of the S/C (deg)
B1VELP	(67)	Velocity of the S/C (km/sec)
B1PTHP	(68)	Body-fixed path angle (deg)
B1AZIP	(69)	Body-fixed azimuth angle (deg)

- MARS -

B2LATP	(70)	Latitude of the S/C (deg)
B2LONP	(71)	Longitude of the S/C (deg)
B2VELP	(72)	Velocity of the S/C (km/sec)

B2PTHP (73) Body-fixed path angle (deg)

B2AZIP (74) Body-fixed azimuth angle (deg)

3.1.5 Angles (all the angles are in degrees). This group contains two types of angles.

(a) Three body angles
(b) Cone and Clock angles.

The following list of parameters represent the angles between two radius vectors from the same vertex. As an example the Earth-S/C-Jupiter angle is the minimum angle between the S/C-to-Earth vector and the S/C-to-Jupiter vector (see Figure 3.1.5 sheet 1).

EPB1AN (75) Earth-S/C-Jupiter

EPB2AN (76) Earth-S/C-Mars

EPSUAN (77) Earth-S/C-Sun

EPMOAN (78) Earth-S/C-Moon

CPEANG (79) Canopus-S/C-Earth

CPSANG (80) Canopus-S/C-Sun

MOPSAN (81) Moon-S/C-Sun

B1PB2A (82) Jupiter-S/C-Mars

MOEPAN (83) Moon-Earth-S/C

SEPANG (84) Sun-Earth-S/C

ESPANG (85) Earth-Sun-S/C

SPB1AN (86) Sun-S/C-Jupiter

SPB2AN (87) Sun-S/C-Mars

B1EPAN (88) Jupiter-Earth-S/C

B2EPAN (89) Mars-Earth-S/C

The following parameters represent the cone and clock angles for three different cone-clock systems. On Figure 3.1.5 sheet 2, the typical cone-clock coordinate system is defined.

- Sun-S/C-Canopus -

CONECE	(90)	Cone angle of the Earth
CLCKCE	(91)	Clock angle of the Earth
CONEC1	(92)	Cone angle of Jupiter
CLCKC1	(93)	Clock angle of Jupiter
CONEC2	(94)	Cone angle of Mars
CLCKC2	(95)	Clock angle of Mars

-Sun-S/C-Earth-

CONEE1	(96)	Cone angle of Jupiter
CLCKE1	(97)	Clock angle of Jupiter
CONEE2	(98)	Cone angle of Mars
CLCKE2	(99)	Clock angle of Mars
CONEEC	(100)	Cone angle of Canopus
CLCKEC	(101)	Clock angle of Canopus

- Sun-S/C-Jupiter -

CONE1E	(102)	Cone angle of the Earth
CLCK1E	(103)	Clock angle of the Earth
CONE12	(104)	Cone angle of Mars
CLCK12	(105)	Clock angle of Mars
CONE1C	(106)	Cone angle of Canopus
CLCK1C	(107)	Clock angle of Canopus

3.1.6 Programmable Variables. The following parameters were selected from the DPTRAJ output using the "programmable variable" option and are included on the save tape.

The following parameters (108 - 119) are cartesian position and velocity vectors of the spacecraft and the Earth with respect to an inertial coordinate system centered at Jupiter. Figure 3.1.3 describes the system. The plane of reference for these parameters is the Earth's true equator of date. Parameters 125 - 130 are also defined in this system.

XP1	(108)	X-component of the spacecraft (km)
YP1	(109)	Y-component of the spacecraft (km)
ZP1	(110)	Z-component of the spacecraft (km)
DXP1	(111)	$\dot{X}$-time rate of change in the X-component (km/sec)
DYP1	(112)	$\dot{Y}$-time rate of change in the Y-component (km/sec)
DZP1	(113)	$\dot{Z}$-time rate of change in the Z-component (km/sec)
XE1	(114)	X-component of the Earth (km)
YE1	(115)	Y-component of the Earth (km)
ZE1	(116)	Z-component of the Earth (km)
DXE1	(117)	$\dot{X}$-time rate of change in the X-component (km/sec)
DYE1	(118)	$\dot{Y}$-time rate of change in the Y-component (km/sec)
DZE1	(119)	$\dot{Z}$-time rate of change in the Z-component (km/sec)

The following parameters (120 - 123) are defined in the Jupiter-centered inertial spherical coordinate system with the Earth's true equator of date as the reference plane (see Figure 3.1.1).

RE1 (120) Distance from Jupiter to the Earth (km)

DECE1 (121) Declination of the Earth (deg)

RAE1 (122) Right ascension of the Earth (deg)

VIE1 (123) Speed of the Earth (km/sec)

The following parameter (124) is defined in the Jupiter-fixed coordinate system shown on Figure 3.1.4.

LONE1 (124) Longitude of the Earth (deg)

Parameters 125 through 130 are defined in the Jupiter-centered inertial cartesian coordinate system as previously noted above.

XM1 (125) X-component of the Moon (km)

YM1 (126) Y-component of the Moon (km)

ZM1 (127) Z-component of the Moon (km)

XS1 (128) X-component of the Sun (km)

YS1 (129) Y-component of the Sun (km)

ZS1 (130) Z-component of the Sun (km)

Parameter 131 is the magnitude of the cartesian position vector for the Sun.

RS1 (131) Distance to the Sun (km)

The following parameters (132 - 140) are cartesian position vectors for the Earth, Moon and Sun with respect to an inertial coordinate system centered at Jupiter. Figure 3.1.3 describes the system. The plane of reference for these parameters is the true ecliptic of date.

XE1 (132) X-component of the Earth (km)

YE1 (133) Y-component of the Earth (km)

ZE1 (134) Z-component of the Earth (km)

XM1 (135) X-component of the Moon (km)

YM1 (136) Y-component of the Moon (km)

ZM1 (137) Z-component of the Moon (km)

XS1 (138) X-component of the Sun (km)

YS1 (139) Y-component of the Sun (km)

ZS1 (140) Z-component of the Sun (km)

The following parameters (141 - 143) are defined in the Jupiter-centered inertial spherical coordinate system with the true ecliptic of date as the reference plane (see Figure 3.1.1).

DECS1 (141) Celestial latitude of the Sun (deg)

RAS1 (142) Celestial longitude of the Sun (deg)

VIS1 (143) Speed of the Sun (km/sec)

The following parameter (144) is defined in the Jupiter-fixed coordinate system shown on Figure 3.1.4.

LONS1 (144) Longitude of the Earth (deg)

The following parameters (145 - 156) represent additional three body angles (see Figure 3.1.5 and the earlier discussion of these angles).

ES5 (145) Earth-Sun-Jupiter (deg)

SE5 (146) Sun-Earth-Jupiter (deg)

S5E (147) Sun-Jupiter-Earth (deg)

MSP (148) Moon-Sun-spacecraft (deg)

SMP (149) Sun-Moon-spacecraft (deg)

EMP (150) Earth-Moon-spacecraft (deg)

A5SP (151) Jupiter-Sun-spacecraft (deg)

S5P (152) Sun-Jupiter-spacecraft (deg)

E5P (153) Earth-Jupiter-spacecraft (deg)

ESM (154) Earth-Sun-Moon (deg)

EMS (155) Earth-Moon-Sun (deg)

MES (156) Moon-Earth-Sun (deg)

The following four parameters (157 - 160) are angular distances subtended by the semi-diameters of the Earth, Sun, Moon and Jupiter as seen from the spacecraft (see Figure 3.1.6).

EASD (157) Angular semi-diameter of the Earth (deg)

SASD (158) Angular semi-diameter of the Sun (deg)

MASD (159) Angular semi-diameter of the Moon (deg)

A5ASD (160) Angular semi-diameter of Jupiter (deg)

3.1.6.1 Computed Values. The parameters outlined above in section 3.1.6 are an added feature to the trajectory tape, however, using some of these parameters in combination, it is possible to compute other parameters that are of more direct use to the experimenters. The parameters to be computed, their description, and the transformation required are given below.

(a) Earth-Centered Body Group (Earth's true equator of date)

	REQUESTED		TRANSFORMATION REQUIRED
1	XP	=	XP1 - XE1 or (108) - (114)
2	YP position of S/C	=	YP1 - YE1 or (109) - (115)
3	ZP	=	ZP1 - ZE1 or (110) - (116)
4	DXP1	=	DXP1 - DXE1 or (111) - (117)
5	DYP velocity of S/C	=	DYP1 - DYE1 or (112) - (118)
6	DZP	=	DZP1 - DZE1 or (113) - (119)
7	XM	=	XM1 - XE1 or (125) - (114)
8	YM position of moon	=	YM1 - YE1 or (126) - (115)
9	ZM	=	ZM1 - ZE1 or (127) - (116)
10	XS	=	XS1 - XE1 or (128) - (114)
11	YS position of sun	=	YS1 - YE1 or (129) - (115)
12	ZS	=	ZS1 - ZE1 or (130) - (116)
13	X5	=	-XE1 or -(114)
14	Y5 position of Jupiter	=	-YE1 or -(115)
15	Z5	=	-ZE1 or -(116)
16	RA5 R/A of Jupiter	=	RAE1 + 180° or (122) + 180°
17	DEC5 Dec. of Jupiter	=	-DECE1 or -(121)
18	R5 Radius to Jupiter	=	RE1 or (120)
19	VI5 Velocity of Jupiter	=	VIE1 or (123)
20	HOUR ANGLE HA of the Vernal Equinox	=	RTASCP -EALONP or (9)-(61)

(b) Sun-Centered Body Group (Earth's true orbit of date)

21	XE		=	XE1 - XS1 or (132) - (138)
22	YE	position of earth	=	YE1 - YS1 or (133) - (139)
23	ZE		=	ZE1 - ZS1 or (134) - (140)
24	XM		=	XM1 - XS1 or (135) - (138)
25	YM	position of moon	=	YM1 - YS1 or (136) - (139)
26	ZM		=	ZM1 - ZS1 or (137) - (140)
27	X5		=	-XS1 or -(138)
28	Y5	position of Jupiter	=	-YS1 or -(139)
29	Z5		=	-ZS1 or -(140)
30	RA5	Cel. Long.Jupiter	=	RAS1 = 180° or (142) + 180°
31	DEC5	Cel. Long.Jupiter	=	-DECS1 or -(141)
32	R5	Radius to Jupiter	=	RS1 or (131)
33	VI5	Velocity of Jupiter	=	VIS1 or (143)

3.2 OUTPUT TRAJECTORY DATA USER REQUIREMENTS

The generalized form of the trajectory "save" tape is shown in Figure 3.2. The tape shall be made up of three files of information as described below.

3.2.1 Header File. The Header File shall contain logistics type of information and shall serve to identify the trajectory "save" tape as to content, date of generation, etc. Figure 3.2, sheet 2 references the specific requirements of each experimenter.

3.2.2 Compendium File. This file shall contain a listing of all the requested parameters on the trajectory "save" tape. It shall contain the acronym for the parameter and the calling sequence order. Figure 3.2 sheet 2 references the specific requirements of each experimenter.

3.2.3 Trajectory Data File. This file shall contain the specific value of each parameter that each user has selected for use with his EDR data. Figure 3.2 sheet 2 references the specific requirements of each experimenter.

3.3 DOCUMENT CONTROL

This specification shall be subject to rigid document control by NASA/ARC. In the event changes are required to this specification, replacement, or additional pages will be furnished by NASA/ARC. Replacement or additional pages will be appropriately labeled to indicate change and dates of changes.

4. PRODUCT ASSURANCE PROVISIONS

Not applicable.

5. HANDLING, SHIPPING, AND STORAGE

Not applicable.

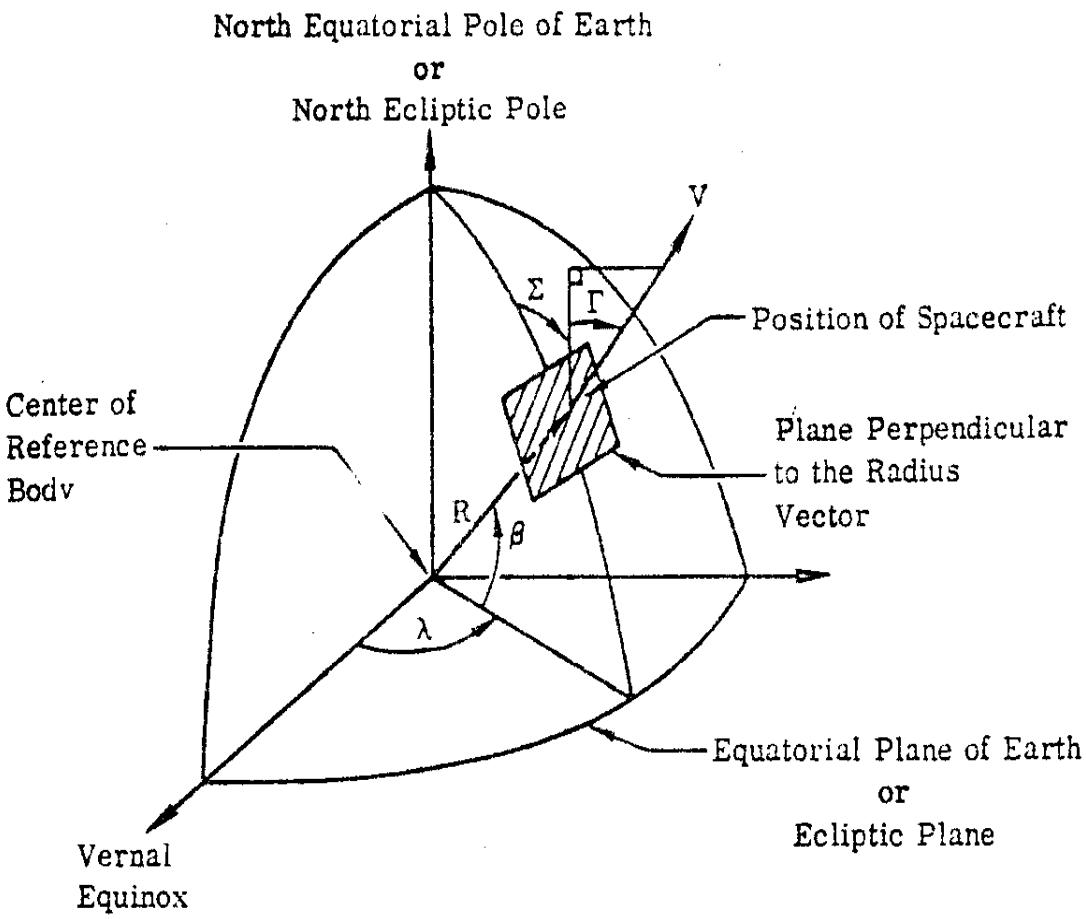
6. NOTES

6.1 ABBREVIATIONS

See Section 6.1 of specification PC-262.00.

6.2 GLOSSARY OF TERMS

See Section 6.2 of specification PC-262.00.



The plane of reference in the Inertial Spherical Coordinate System shall be either the ecliptic plane or the equatorial plane of Earth.

R radius: The distance from the center of the reference body to the spacecraft

β declination (equatorial reference plane): The angle between the reference body-spacecraft radius vector and the reference body equatorial plane; measured positive north of the equatorial plane

β celestial latitude (ecliptic reference plane): The angle between the reference body-spacecraft radius vector and the reference body ecliptic plane; measured positive north of the ecliptic plane

λ right ascension (equatorial reference plane): The angle between the Vernal Equinox line and the projection of the reference body-spacecraft radius vector onto the Earth equatorial plane; measured eastward from the Vernal Equinox

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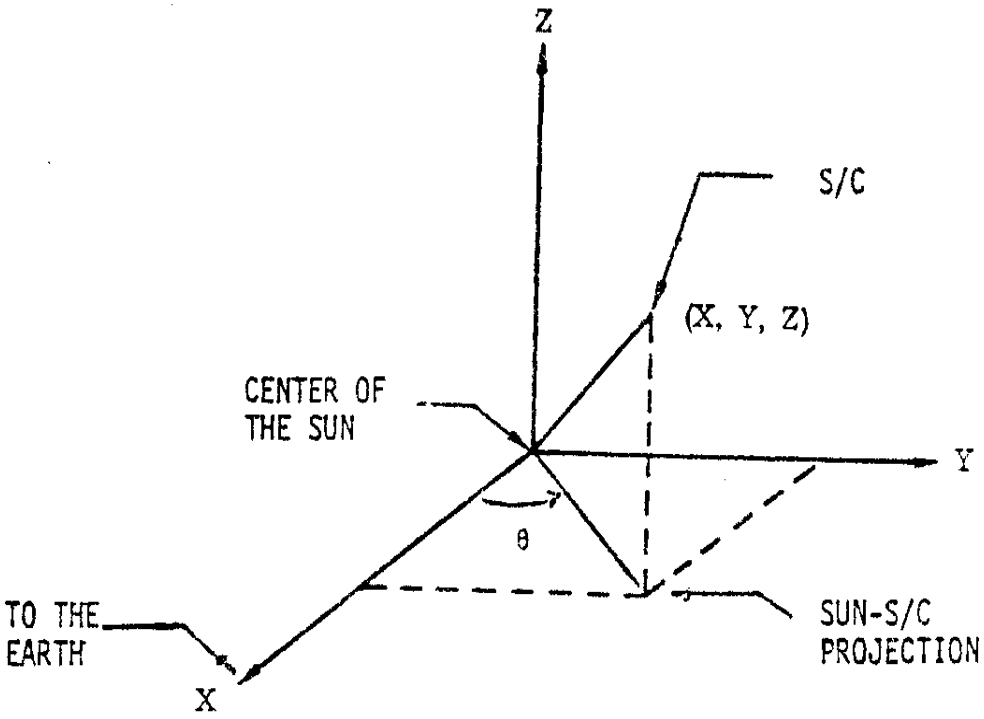
	INERTIAL SPHERICAL COORDINATE SYSTEM	DOC. NO PC-262.04
		FIG. 3.1.1
	REV NO. 1 / DATE 12/20/71	SHEET 1 OF 2

λ celestial longitude (ecliptic reference plane): the angle between the Vernal Equinox line and the projection of the reference body-spacecraft radius vector onto the ecliptic plane; measured eastward from the Vernal Equinox line

V speed: the magnitude of the spacecraft inertial velocity

Γ inertial flight path angle: the angle between the spacecraft inertial velocity vector and the plane normal to the reference body-spacecraft radius vector; positive away from the center of the body

Σ inertial azimuth angle: the angle between the local meridian and the projection of the inertial velocity vector onto the plane normal to the reference body-spacecraft radius vector; measured positive east of north



X Positive towards the Earth

Y Positive from the Sun and perpendicular to the X-axis and lying in the ecliptic plane of date

Z Positive from the Sun completing the right hand system

θ Longitude of S/C

NOTE: This system rotates with the Earth about the Sun

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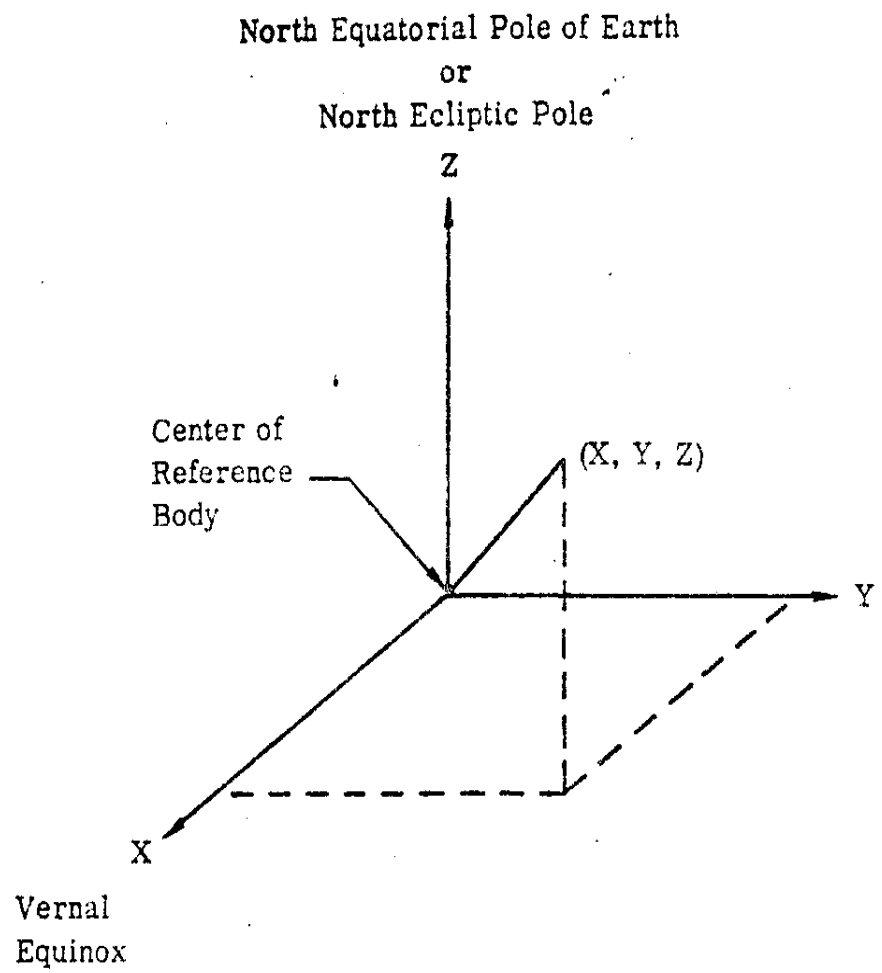
	SUN-EARTH-LINE CARTESIAN	DOC NO. PC-262.04
		FIG. 3.1.2
	REV. NO. 1 / DATE 12/20/71	SHEET 1 OF 1



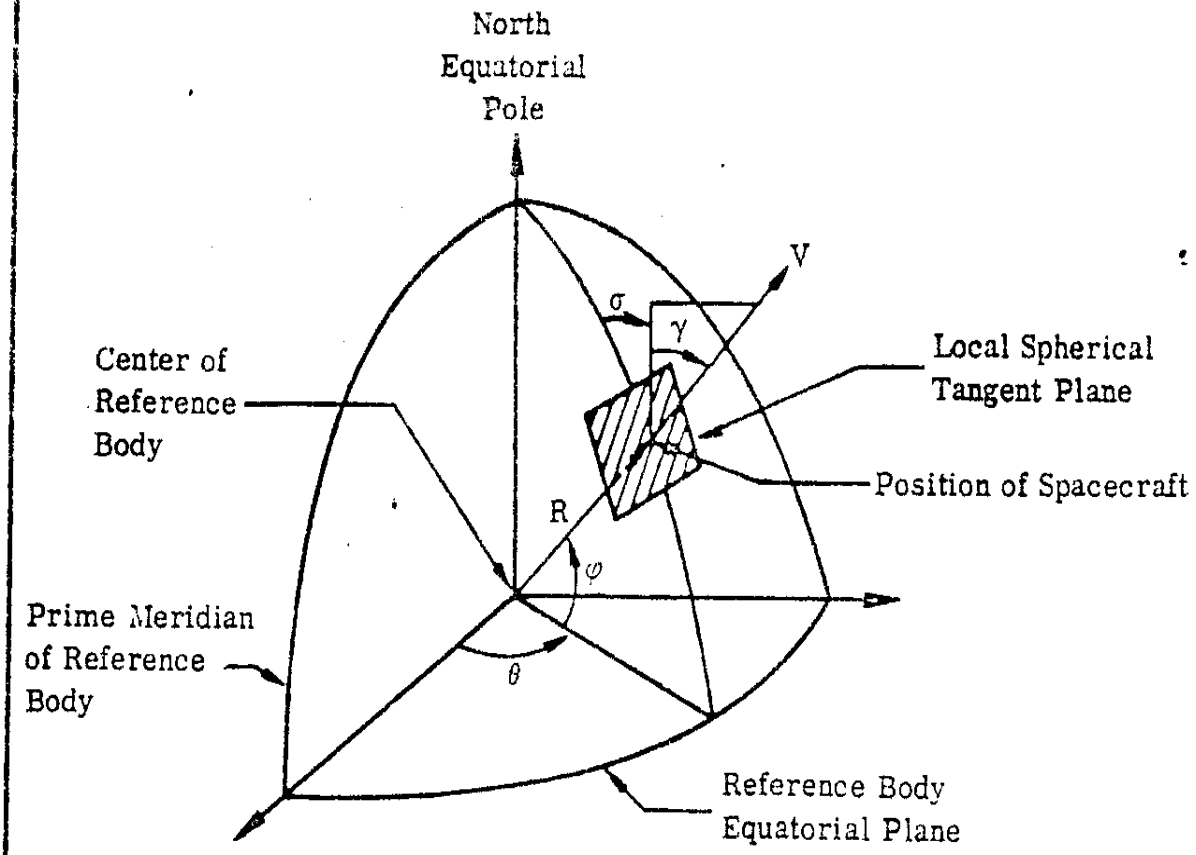
The plane of reference in the Inertial Cartesian System shall be either the ecliptic plane or equatorial plane of the Earth.

X positive toward the Vernal Equinox and determined by the intersection of the true Earth equator and ecliptic of date

Y positive outward from the center of the reference body, perpendicular to and east of the X-axis and lying in the ecliptic or equatorial plane

Z positive toward the north ecliptic or equatorial pole of Earth and completes the orthogonal system

REPRODUCED FROM	TITLE	PIONEER PROGRAM NASA AMES RESEARCH CENTER MOFFETT FIELD, CALIFORNIA
	INERTIAL CARTESIAN COORDINATE SYSTEM	DOC NO PC-262.04
		FIG. 3.1.3
	REV NO 1 / DATE 12/20/71	SHEET 1 OF 1



R radius: the distance from the center of the reference body to the spacecraft

φ latitude: the body-centered latitude of the spacecraft measured positive north of the reference body's equator

θ longitude: the longitude of the spacecraft measured eastward from the prime meridian of the reference body to the projection of the radius vector onto the equatorial plane

V speed: the magnitude of velocity of the spacecraft

γ flight path angle: the angle, measured positive away from the reference body between the relative velocity vector of the spacecraft and the local spherical tangent plane

σ azimuth angle: the angle, measured eastward in the local spherical tangent plane, from true north to the projection of the relative velocity vector of the spacecraft onto the local spherical tangent plane

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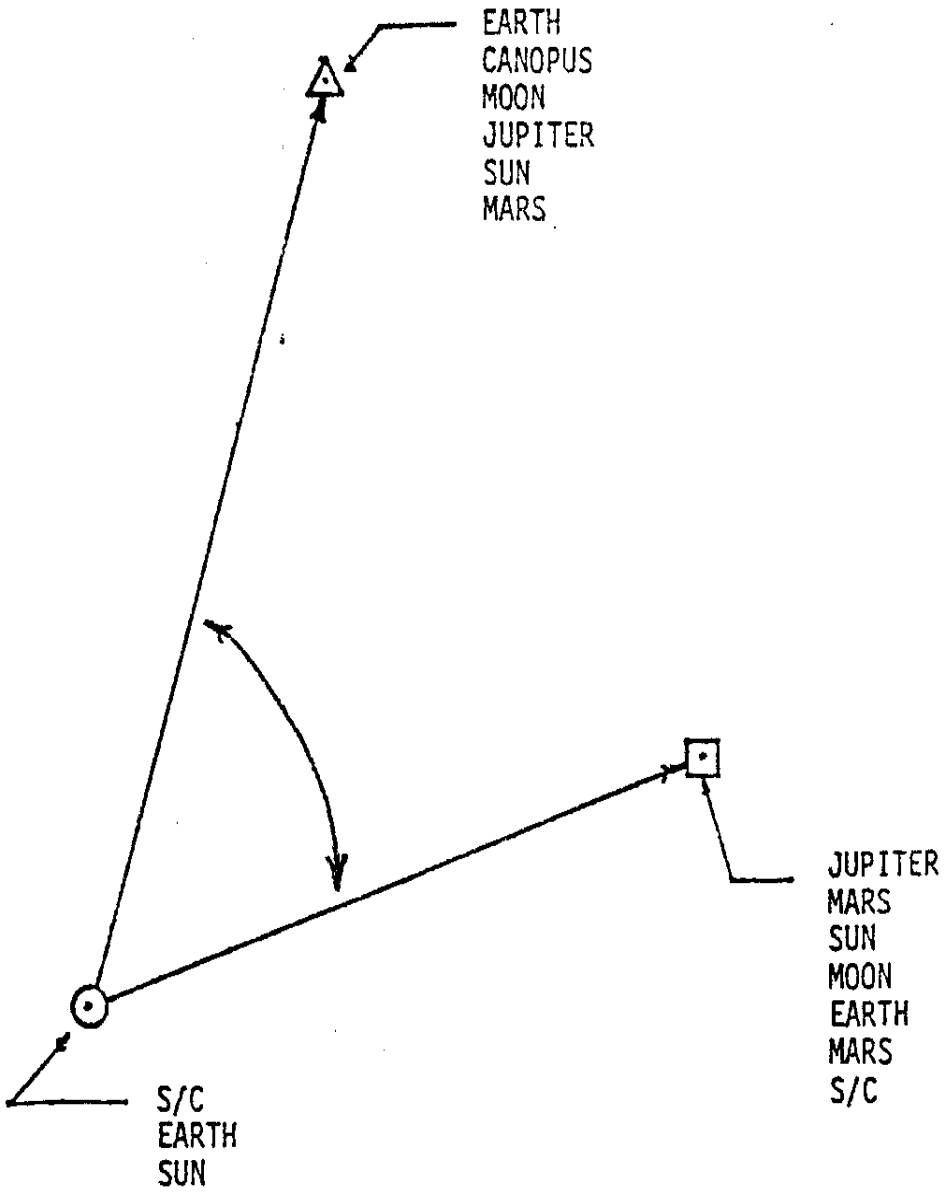
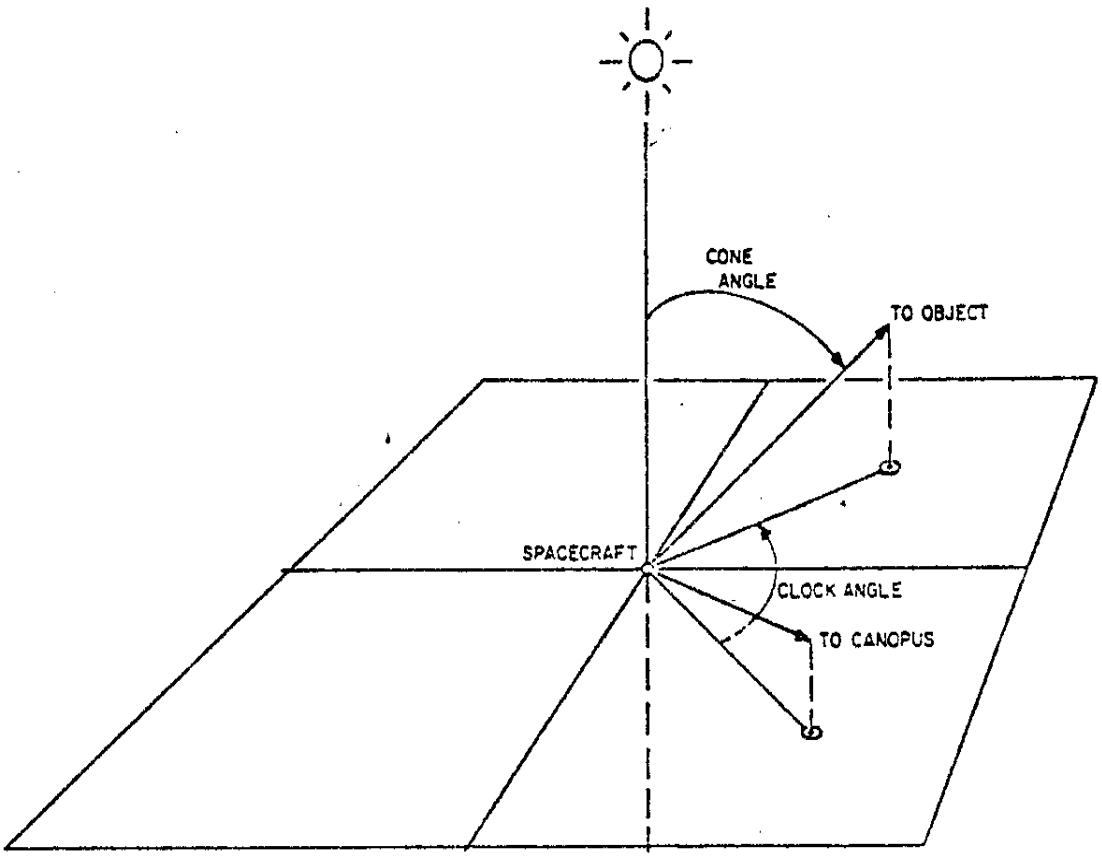
	BODY-FIXED SPHERICAL COORDINATE SYSTEM	DOC NO PC-262.04
		FIG 3.1.4
	REV NO 1 DATE 12/20/71	SHEET 1 OF 1



REPRODUCED FROM	TITLE: THREE BODY ANGLES	PIONEER PROGRAM NASA AMES RESEARCH CENTER MOFFETT FIELD, CALIFORNIA
		DOC. NO. PC-262.04
		FIG. 3.1.5
	REV NO 1 / DATE 12/20/71	SHEET 1 OF 2

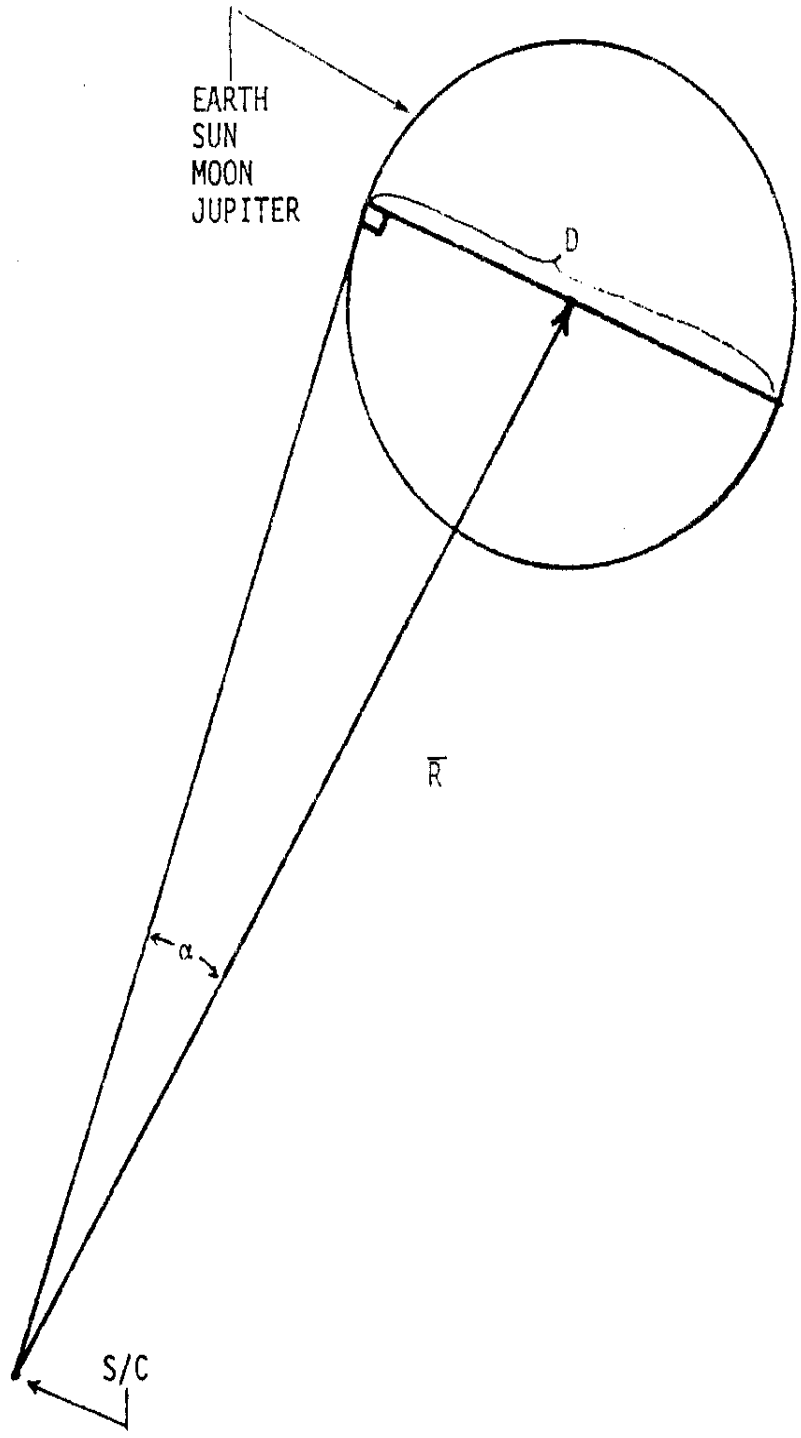


Cone Angle of Object: The angle from the spacecraft-Sun vector to the spacecraft-object-vector

Clock Angle of Object: The angle measured clockwise (when looking towards the Sun) from the Sun-spacecraft-Canopus plane to the Sun-spacecraft-object plane

NOTE: Canopus can be replaced by the Earth or Jupiter to form two additional systems.

REPRODUCED FROM	TITLE CONE, CLOCK ANGLES	PIONEER PROGRAM NASA AMES RESEARCH CENTER MOFFETT FIELD, CALIFORNIA
		DOC. NO. PC-262.04
		FIG. 3.1.5
	REV NO 1 / DATE 12/20/71	SHEET 2 OF 2



α Angular semi-diameter of the Earth, Sun, Moon and Jupiter:

$$\sin^{-1}\left(\frac{D/2}{\bar{R}}\right)$$

REPRODUCED FROM	TITLE ANGULAR SEMI-DIAMETER	PIONEER PROGRAM NASA AMES RESEARCH CENTER MOFFETT FIELD CALIFORNIA
		DOC NO PC-262.04
		FIG 3.1.6
	REV NO 1 DATE 12/20/71	SHEET 1 OF 1

D-59319

3/3/72 - 3/8/72

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N  B1EPAN  B2EPAN  CONECE  CLCKCE  CONEC1  CLCKC1  CONEC2  CLCKC2  CONEE1  CLCKE1  CONEE2  CLCKE2
CONEEC  CLCKEC  CONE1E  CLCK1E  CONE12  CLCK12  CONE1C  CLCK1C  HOURAN

                                                                                                XP       Y
P       ZP       DXP      DYP      DZP      XM       YM       ZM       XS       YS       ZS       X5       Y5
      Z5       RA5      DEC5     R5       VI5      XE       YE       ZE       HXM      HYM      HZM      HX5
 HY5      HZ5      HRA5     HDEC5    HR5      HVI5     ES5      SE5      S5E      MSP      SMP      EMP      A5
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3/5/72 - 3/14/72

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MOORE BUSINESS FORMS INC., FORM 1-13 PRINTED IN U.S.A.

D-59333
12/1/1980 - 6/1/1981

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