

ESD TDR 64-371

ESTI FILE COPY

ESD-TDR-64-371

ESTI PROCESSED

ESD RECORD COPY

RETURN TO
SCIENTIFIC & TECHNICAL INFORMATION DIVISION
(ESTI), BUILDING 1211

COPY NR. _____ OF _____ COPIES

DDC TAB PROJ OFFICER

ACCESSION MASTER FILE

DATE _____

ESTI CONTROL NR. **AL 42185**

CY NR. _____ OF _____ CYS

Group Report

1964-45

Haystack Pointing System: Moon

H. E. Frachtman

10 September 1964

Prepared under Electronic Systems Division Contract AF 19(628)-500 by

Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts



ADO 606154

The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology, with the support of the U.S. Air Force under Contract AF 19(628)-500.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

HAYSTACK POINTING SYSTEM: MOON

H. E. FRACHTMAN

Group 62

GROUP REPORT 1964-45

10 SEPTEMBER 1964

LEXINGTON

MASSACHUSETTS

ABSTRACT

This report describes the procedure used by the Haystack pointing computer program for obtaining the celestial coordinates of the Moon at any time.

Accepted for the Air Force
Franklin C. Hudson, Deputy Chief
Air Force Lincoln Laboratory Office

I. INTRODUCTION

MOONTRACK is a program in the Haystack Univac 490 pointing system whose output is the celestial coordinates of the Moon at a given time. The program computes the coordinates by 4th difference interpolation in the tables of the apparent right ascension, declination, and radius vector of the Moon published in The American Ephemeris. The rates of change of the three quantities are computed by numerical differentiation.

II. INPUTS TO PROGRAM

A. Inputs Furnished by Core Memory

The program uses the registers listed in Table I for input information. The year and day are used to select the appropriate entries from the ephemeris. The coordinates of the Moon are interpolated for the time which is the sum of the times in CELTIME and DELTATEE.

B. Inputs Furnished by Magnetic Tape

The tape format of the Moon Ephemeris, which has been edited and recorded on tape by a 7094 program described in Reference (1), is shown in Fig. 1. Each block of 192 words covers a period of one day. The ephemeris for each day required 8 words for each of 24 hours. The program does not make use of the hour-year-month-day words in the block. The tape must be on Unit 1 (normally Servo B) of the Univac 490.

III. PROGRAM OUTPUTS

A. Outputs Left in Core Memory

The apparent celestial coordinates of the Moon, corresponding to the time in the register CELTIME, together with their numerical derivatives, are stored in the appropriate registers, as illustrated in Table II.

<u>Register</u>	<u>Contents and Scaling</u>
W(CELTIME)	Days B28
W(DELTATEE)	Days B28
U(YEARMONTH)	Year B15 (4 decimal digits)
L(YEARMONTH)	Month B0
L(DAY)	Day of Year B0
W(EQUATOR)	Equatorial radius of Earth B17

TABLE I
Core Memory Inputs to MOONTRACK Program

NOTE: Notation "B28" means that the binary point is to the right of bit 28.

I. D.		13 _d	14		0	Conventional Day Number	
All Zero		19	14	8	4	0	
		Hour	Year	Month	Day		
Right Ascension		B26		Radians			
First Difference	Right Ascension	B26		Radians			
Declination		B26		Radians			
First Difference	Declination	B26		Radians			
Radius Vector		B22		Earth Equatorial Radii			
First Difference	Radius Vector	B22		Earth Equatorial Radii			

Fig. 1. Magnetic Tape Format for Moon Ephemeris

<u>Register</u>	<u>Contents and Scaling</u>
W(RA)	Apparent Right Ascension B27 in revolutions
W(DEC)	Apparent Declination B27 in revolutions
W(RADIUS)	Distance from center of Earth to center of Moon, B22 Earth Equatorial radii
W(RADOT)	Numerical Derivative of Right Ascension B37 radians/sec
W(DEC DOT)	Numerical Derivative of Declination B37 radians/sec
W(RADIUS DOT)	Numerical Derivative of Radius Vector B24 nautical miles/sec

TABLE II
Core Memory Outputs of MOONTRACK Program

B. Typewriter Outputs

During initialization the MOONTRACK program will type, using the INTERCOM subroutine, certain information concerning the Moon. Items printed are:

1. Julian Day corresponding to values in YEARMONTH, DAY, and CELTIME (7 digits).
2. Apparent Right Ascension of the Moon (Hours, Minutes, Seconds to hundredths).
3. Apparent Declination of the Moon (Degrees, Minutes, Seconds to hundredths).
4. Day of Year corresponding to values in YEARMONTH and DAY (up to 3 digits).
5. Universal Time for which the coordinates are interpolated. It is the time in CELTIME at initialization (Hours, Minutes, Seconds to hundredths).
6. The distance between the centers of the Earth and the Moon (Earth's Equatorial radii to millionths).
7. The words "OBJECT MOON".

If, after a search through 12 files on Unit 1 (or the finding of an end of tape mark), the moon ephemerides are not found, the program will type "MOON EPHEMERIS FOR X/Y NOT AMONG FIRST 12 FILES" and will exit to the master control program error return. "X" and "Y" indicate the current month and year, respectively.

If there is a tape servo malfunction during search, the program will type "IIC STATUS S1 ZZ" and will exit to the master control program error return. The two digit octal number "ZZ" comes from the tape status word and indicates the error condition.

IV. ASTRONOMICAL SIGNIFICANCE

The apparent right ascension and declination of the Moon in the ephemerides are referred to the true equinox and equator of date and are corrected for planetary aberration. They are geocentric apparent quantities; the parallax correction is made by the coordinate conversion program (COCON) in the Haystack system. The values in the tables are computed for Ephemeris Time as argument. The equation

$$ET = UT + \Delta T$$

is used to convert from Universal Time to Ephemeris Time. The constant ΔT , represented by the number in the register DELTATEE is approximately 35 seconds.

The values for the radius vector and first difference of the radius vector which appear on the ephemeris tape (Figure 1) are computed from the Moon's horizontal parallax which occurs in the source data. The formula

$$D = \frac{1}{\sin h}$$

is used by the tape preparation program (Reference 1) to compute the distance D, in units of Earth's equatorial radii, from the geocentric equatorial horizontal parallax h. The register EQUATOR contains a number which represents the Earth's equatorial radius in nautical miles.

V. PROGRAM DETAILS

The MOONTRACK program is a subroutine of the Haystack Univac 490 pointing program. The initialization section begins at MOONINIT, the working section at MOONCONT. There are several closed subroutines within MOONTRACK. These are: DAYFIND, STATUSCK, INTERPOL, LEFRNDOFF, and MOONTIME. A listing of the program is given in Appendix I.

A. Initialization

The program, upon initialization, stores an RIL instruction in the tape channel internal interrupt register and an RJP STATUSCK instruction in the external interrupt register. The area in core into which the tape data will be read is cleared, together with some additional registers. This is done to make diagnosis easier in case of malfunction.

The daily Moon ephemeris entries are serially numbered by the program which generates the magnetic tape (Reference 1). These serial numbers are called "Conventional Day Numbers" (CDN). An arbitrary decision was made to produce and use tapes such that the CDN for 25 April 1963 is zero. The tape search process looks at the first word in each block, therefore, the MOONTRACK, program must compute the CDN of the block containing the entry for the required hour.

Using as inputs the year, day of year, and the effect of integral and half-integral values of CELTIME, the program computes the Julian Day number for the typewriter. The ephemerides start and run continuously from 25 April 1963, which has a Julian Day Number of 2438144.5; this number is subtracted from the computed Julian Day number and appears on tape as the Conventional Day Number. The first CDN in a block is stored in SAFE and TAPEBLOCK and the Moon identification number is added to generate a tape search comparison word.

Six blocks of Moon ephemerides are read to provide sufficient data for 4th difference Bessel interpolation for a four day period.

If the six block search and read operations are successful control is regained at NORMAL and the tape is rewound without interrupt or interlock.

The MOONTIME subroutine is entered to select and store the addresses of the ephemeris entries corresponding to the hour of the day and to compute the interpolation argument P. The register TIME2 contains a number representing the integral number of hours in the sum of CELTIME and DELTATEE.

Besselian interpolation of right ascension is done by the INTERPOL subroutine and the interpolated result is converted to hours, minutes, and seconds and stored for type out. Declination and distance are then interpolated and stored for type out. The other quantities which are to be typed out by INTERCOM are set up. Control is transferred to INTERCOM 7 times for the seven line type out, which completes operation of the initialization section of MOONTRACK.

B. Working Section

The MOONTRACK working section begins at MOONCONT. Control is transferred to the subroutine MOONTIME which selects the ephemeris entry corresponding to the current hour, stores the addresses of the table entries, and computes the interpolation argument P from the given value of CELTIME. The INTERPOL subroutine is then entered three times for the interpolation of right ascension, declination, radius and their time rates. All values are converted, scaled and stored properly in core memory and control is transferred to the master control program.

C. Subroutines

The initialization section of the MOONTRACK program makes use of the INTERPOL, DAYFIND, STATUSCK, LEFRNDOFF, and MOONTIME subroutines. The working section uses all except STATUSCK.

1. INTERPOL

The MOONTRACK interpolation subroutine uses Bessel's interpolation formula for (Reference 3) 4th difference interpolation of the Moon's ephemeris. The formula is

$$f_p = f_o + P\delta f_{1/2} + \frac{P(P-1)}{4} [\delta^2 f_o + \delta^2 f_1] \\ + \frac{P(P-1)(P-1/2)}{6} \delta^3 f_{1/2} + \frac{(P+1)P(P-1)(P-2)}{48} (\delta^4 f_o + \delta^4 f_1)$$

The quantities in the formula are associated with computer registers as follows:

- a. The address of f_0 is in index register 4.
- b. The interpolation argument P is in register P .
- c. $\delta f_{1/2}$ is in register GAMMA.
- d. $P(P-1)$ is in register PSQMP.
- e. $\delta^2 f_0 + \delta^2 f_1$ is in register DMINB.
- f. $\frac{P(P-1)}{6}$ is in register PSQMP6.
- g. $\delta^3 f_{1/2}$ is in register DMIN2CPLB.
- h. $(\delta^4 f_0 + \delta^4 f_1)$ is in register EP2BM2DMA.
- i. f_p is in the A register at the finish.

The subroutine also performs numerical differentiation using the following formula (Reference 3):

$$hf'_p = \delta f_{1/2} + \frac{2P-1}{4} [\delta^2 f_0 + \delta^2 f_1] \\ + \frac{3P^2 - 3P + 1/2}{6} \delta^3 f_{1/2}$$

At the completion of the subroutine, hf'_p is stored in the register NUMDERIV.

When the subroutine is entered, Index Register 4 contains the address of f_0 and the register SETINTAD contains the address of $\delta f_{1/2}$ of the quantity to be interpolated. Index register 3 is used to acquire the other two first difference registers.

2. DAYFIND

The DAYFIND subroutine computes the Julian Day number and CDN corresponding to the current day.

3. STATUSCK

The STATUSCK subroutine is entered from the external interrupt register associated with the tape channel when the interrupt occurs. Examination of the status code generates four possible outcomes:

- a. If the code indicates a normal completion, control is returned to the program at the interrupted point.
- b. If the code indicates that an end of tape mark was sensed, the tape is rewound and a message indicating failure to find the ephemeris is printed by the typewriter. The message is described in Section III B. Control is passed to the error return of the master control program.
- c. If the code indicates that an end of file mark was sensed, the register IMPERIAL is indexed and tested for the value 12. When less than 12 an end of tape condition is assumed and the action is as described in (b) above.

d. If the code indicates anything but end of file, end of tape, or normal completion, a tape error has occurred. The message described in Section III B, indicating the type of error, is printed by the typewriter and control is passed to the error return of the master control program.

4. LEFRNDOFF

The LEFRNDOFF subroutine left shifts the AQ register the number of places indicated by the contents of index register 5 and rounds the A register.

5. MOONTIME

The MOONTIME subroutine computes the integral value of the current ephemeris hour and stores the addresses of the quantities to be interpolated. It computes the value of the interpolation argument P.

VI. PROGRAM LISTING

The next 23 pages show a APURT output of the MOONTRACK program in 3 parts:

- Pp. 10-26: Printout of MOONTRACK program.
- Pp. 27-29: Alphabetic list of program symbols.
- Pp. 30-32: Numerical list of program symbols.

..... SPURT OUTPUT NO. 21C

MOONTRACK FRACHTMAN*7/14/64

NO. OF INSTRUCTIONS 03617
00000 THRU 01412
03611 THRU 03616

FRACHTMAN*7/14/64

CARDS	LI	IO LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
	0000	MUONTRACK	PROGRAM FRACHTMAN*7/14/64					
	0001	LUNAR	EQUALS 100	0000	C0232	C0002		
	0002	MUNITAPE	EQUALS 55	0000	22242	42325		
	0003	TAPEINPUT	EQUALS 35	0000	61000	C0000		
	0004	EPHEM	MEANS C.15*	0000	11030	00763		
	0005	HENRY	U-TAG MOUNCONT*MOUNINIT	0000	15030	C0055		
	0006	MOUNINIT	FO 1*MOUNP	0000	11030	00764		
	0007		ENTRY	0000	15030	C0035		
	0008		ENT A*(IGNORE)	0000	12400	G2215		
	0009		STR A*(MONITAPE)	0000	11000	C0000		
	0010		ENT A*(INTERUP)	0001	15034	C1374		
	0011		STR A*(TAPEINPUT)	0001	72400	CC011		1ST TEMP STORAGE
	0012		ENT 84*11650	0001	10030	63323		817
	0013		CL A*	0001	22030	C1000		
	0014	ERASE	STR A*(YRREMA(N+R4))	0001	C7200	CC001		
	0015		BJP 84*ERASE	0001	20000	CC001		
	0016		ENT Q*(EQUATOR)	0001	15030	00777		828
	0017		MUL W(RHRSEC)	0002	11020	63147		
	0018		LSH AQ*1*QPUS	0002	21000	03651		
	0019		ADD A*1	0002	15030	00743		
	0020		STR A*(ERMSEC)	0002	C3000	C0036		
	0021		ENT A*(YEARMONTH)	0002	23000	CC004		
	0022		SUB A*19610	0002	15030	C1374		(0.1,2,3)
	0023		STR A*(MONTHPRINT)	0002	22000	C2665		DAYS IN 4 YRS
	0024		RSH AQ*300	0002	14030	C1375		
	0025		DIV 4	0003	10030	01374		
	0026		STR A*(YRREMAIN)	0003	22000	C0555		
	0027		MUL 14610	0003	34030	C1375		
	0028		STR Q*(WHOLEYEAR)	0003	65000	C0323		
	0029		ENT Q*(YRREMAIN)	0003	11030	C1411		
	0030		MUL 3650	0003	15030	C1400		
	0031		RPL Y+Q*(WHOLEYEAR)	0003	73670	C0532		
	0032		RJP DAYFIND	0003	20030	03613		
	0033		ENT A*(SAFE)	0004	13670	CC762		
	0034	TRYAGAIN	STR A*(TAPEBLOCK)	0004	15030	C1401		
	0035		IN EPHEM*(EPHEMA)	0004	13670	C1401		
	0036		ADD A*147775	0004	61000	CC043		
	0037		EX-FCT EPHEM*(SRHIBIN)	0004	73670	C0533		
	0038		STR A*(TAPESEARCH)	0004	36030	C1401		
	0039		EX-FCT EPHEM*(TAPESEARCH)	0004	13670	CC762		
	0040		JP \$	0004	13670	C1401		
	0041		IN EPHEM*(EPHEM)	0004	12000	CCG00		
	0042		RPL Y+1*(TAPESEARCH)	0005	13670	C1401		
	0043		EX-FCT EPHEM*(SRHIBIN)	0005	61000	CC051		
	0044		NU-UP	0005	73670	CC534		
	0045		EX-FCT EPHEM*(TAPESEARCH)	0005	36030	C1401		
	0046		JP \$	0005	13670	CC762		
	0047		IN EPHEM*(EPHEM)	0005	12000	CCG00		
	0048		RPL Y+1*(TAPESEARCH)	0005	61000	CC051		
	0049		EX-FCT EPHEM*(TAPESEARCH)	0005	73670	CC534		
	0050		JP \$	0005	36030	C1401		
	0051		IN EPHEM*(EPHEM)	0005	13670	CC762		
	0052		RPL Y+1*(TAPESEARCH)	0005	12000	CCG00		
	0053		EX-FCT EPHEM*(SRHIBIN)	0005	61000	CC051		
	0054		NU-UP	0005	73670	CC534		
	0055		EX-FCT EPHEM*(TAPESEARCH)	0005	36030	C1401		
	0056		JP \$	0005	13670	CC762		
	0057		IN EPHEM*(EPHEM)	0005	12000	CCG00		
	0058		RPL Y+1*(TAPESEARCH)	0005	61000	CC051		
	0059		EX-FCT EPHEM*(TAPESEARCH)	0005	73670	CC534		
	0060		JP \$	0005	36030	C1401		
	0061		IN EPHEM*(EPHEM)	0005	13670	CC762		

CARDS	LI (D LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
.	OC062	NO-OP	00055	12000	CC0CC		
.	UC063	EX-FCT EPHEM*W(TAPESEARCH)	00056	13670	C1401		
.	OC064	JP \$	00057	61000	CC057		
.	OC065	IN EPHEM*W(EPHEMO)	0006C	73670	C0535		
.	OC066	RPL Y+1*W(TAPESEARCH)	00061	36030	C1401		
.	OC067	EX-FCT EPHEM*W(SRHIBIN)	00062	13670	C0762		
.	OC070	NO-OP	00063	12000	CC0CC		
.	UC071	EX-FCT EPHEM*W(TAPESEARCH)	00064	13670	C1401		
.	OC072	JP \$	00065	61000	CC065		
.	OC073	IN EPHEM*W(EPHEME)	00066	73670	C0536		
.	OC074	RPL Y+1*W(TAPESEARCH)	00067	36030	C1401		
.	OC075	EX-FCT EPHEM*W(SRH(BIN)	0007C	13670	C0762		
.	OC076	NO-OP	00071	12000	CC0CC		
.	OC077	EX-FCT EPHEM*W(TAPESEARCH)	00072	13670	C1401		
.	OC100	JP \$	00073	61000	CC073		
.	OC101	IN EPHEM*W(EPHEMF)	00074	73670	C0537		
.	OC102	RPL Y+1*W(TAPESEARCH)	00075	36030	C1401		
.	OC103	EX-FCT EPHEM*W(SRHIB(N)	00076	13670	C0762		
.	OC104	NO-OP	00077	12000	CC0CC		
.	OC105	EX-FCT EPHEM*W(TAPESEARCH)	00100	13670	C1401		
.	OC106	JP \$	00101	61000	CC073		
.	OC107	EX-FCT EPHEM*W(REWINONG)	00102	13670	C0765		
.	OC110	RJP MOUNTING	00103	65000	C0352		
.	OC111	ENT B4*(RAAO)	00104	12410	C1402		
.	OC112	ENT A*(RAOIFAD)	00105	11010	C1405		
.	OC113	STR A*(SETINTAO)	00106	15010	C1047		
.	OC114	RJP INTERPOL	00107	65000	C105C		
.	OC115	ENT Q*O*ANEG	00110	10700	CC0CC		
.	OC116	SUB A*(TWOPIE)*APOS	00111	21630	C1001		
.	OC117	ADD A*(TWOPIE)	00112	20C30	C10C1		
.	OC120	RSH AQ*270	00113	C3000	CC033		
.	OC121	OIV W(HRAO)	00114	23030	C077C		
.	OC122	STR Q*W(RA2)	00115	14C30	CC621		
.	OC123	CL Q*	00116	10C00	CC0CC		
.	OC124	RSH AQ*23D	00117	C3000	CC027		
.	OC125	OIV W(NSRAO)	0012C	23C30	CC771		
.	OC126	STR Q*W(RA4)	00121	14C30	CC624		
.	OC127	RSH AQ*300	00122	C3000	CC036		
.	OC130	MUL W(SRAO)	00123	22C30	C0767		
.	OC131	LSH AQ*2*QPOS	00124	C7200	CC002		
.	OC132	ADD A*1	00125	20000	CC001		
.	OC133	STR A*(RA6)	00126	15C30	CC627		
.	OC134	ENT B4*(DECAO)	00127	12410	C1403		
.	OC135	ENT A*(DECOIFAO)	0013C	11010	C1406		
.	OC136	STR A*(SETINTAO)	00131	15010	C1047		
.	OC137	RJP INTERPOL	00132	65000	C105C		
.	OC140	STR A*(GMT2)	00133	15C30	CC7C7		
.	OC141	ENT Q*O*APOS	00134	10600	CC0CC		
.	OC142	CP A*	00135	15C40	CC0CC		
.	OC143	RSH AQ*220	00136	C3C00	CC026		

FRACHTMAN*7/14/64

CARDS	LI	ID	LABEL	TA	STATEMENT	LOC	F	JKB	Y	NCIES
.	UC226		AIRPORT	U-TAG	INITIALDAT*0	00221	C0566		CC00C	
.	UC227			RJP	U(INTERCOM)	00222	65020	63426		
.	UC230			U-TAG	GMT*0	00223	C0665		CC00C	
.	UC231			RJP	U(INTERCOM)	00224	65020	63426		
.	UC232			U-TAG	INITIALDIS*0	00225	C0720		CC00C	
.	UC233			RJP	U(INTERCOM)	00226	65020	63426		
.	UC234			U-TAG	INITIAL800*0	00227	C0731		CC00C	
.	UC235			RPL	Y+1*(MOONINIT)	00230	36010		CC00C	
.	UC236			JP	A	00231	61070		CC00C	
.	UC237			ENTRY		00232	61000		CC00C	
.	UC240			RPL	Y+1*(MOONCONT)	00233	36010		CC00C	
.	UC241			RJP	MOONTIME	00234	65000		00352	
.	UC242		HARVARD	ENT	R4*(RAAD)	00235	12410		01402	
.	UC243			ENT	A*(RADIFAD)	00236	11010		01405	
.	UC244			STR	A*(SETINTAD)	00237	15010		01047	
.	UC245			RJP	INTERPOL	00240	65000		0105C	
.	UC246			RSH	AQ*300	00241	C3000		00036	
.	UC247			MUL	W(REVSRADIAN)	00242	22030		C0761	
.	UC250			JP	MOOSE*QPOS	00243	60200		00245	
.	UC251			ADD	A*1	00244	20000		00001	
.	UC252		MOOSE	STR	A*(RA)	00245	15030		63002	
.	UC253			ENT	Q*(NUMDERIV)	00246	10030		01041	B 40
.	UC254			MUL	W(RHRSEC)	00247	22030		0100C	
.	UC255			ENT	B5*1	00250	12500		00001	
.	UC256			RJP	LEFRNDOFF	00251	65000		01364	
.	UC257			STR	A*(RADOT)	00252	15030		63007	B 37
.	UC260			ENT	R4*(OECAD)	00253	12410		01403	
.	UC261			ENT	A*(OECDFAD)	00254	11010		01406	
.	UC262			STR	A*(SETINTAD)	00255	15010		01047	
.	UC263			RJP	INTERPOL	00256	65000		0105C	
.	UC264			RSH	AQ*300	00257	C3000		00036	
.	UC265			MUL	W(REVSRADIAN)	00260	22030		C0761	
.	UC266			JP	NEGDEC*ANEG	00261	60700		C0527	
.	UC267			JP	BEAVER*QPOS	00262	60200		00264	
.	UC270			ADD	A*1	00263	20000		00001	
.	UC271		BEAVER	STR	A*(DEC)	00264	15030		63003	
.	UC272			ENT	Q*(NUMDERIV)	00265	10030		01041	
.	UC273			MUL	W(RHRSEC)	00266	22030		0100C	
.	UC274			ENT	B5*1	00267	12500		00001	
.	UC275			RJP	LEFRNDOFF	00270	65000		01364	B 37
.	UC276			STR	A*(OECOOT)	00271	15030		6301C	
.	UC277			ENT	R4*(OISTAD)	00272	12410		01404	
.	UC300			ENT	A*(DISTDIFAD)	00273	11010		01407	
.	UC301			STR	A*(SETINTAD)	00274	15010		01047	
.	UC302			RJP	INTERPOL	00275	65000		0105C	
.	UC303			STR	A*(RADIUS)	00276	15030		63006	B 22
.	UC304			ENT	Q*(NUMDERIV)	00277	10030		01041	
.	UC305			MUL	W(ERNMSEC)	00300	22030		C0777	
.	UC306			ENT	B5*4	00301	12500		00004	
.	UC307			RJP	LEFRNDOFF	00302	65000		01364	

FRACHTMAN*7/14/64

MOONTRACK

NOTES

CAROS

LI IO LABEL

TA STATEMENT

LOC

F JKB Y

B24

LI	IO	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
0C310			STR A*(RAIUSOOT)	00303	15030	63C11		
0C311		SEAPORT	EXIT	00304	61010	C0232		
0C312		FLATNEG	CP A*	00305	15040	0000C		
0C313			SUB A*(HALFOAY)*APOS	00306	21630	0076C		
0C314			JP LESSONE	00307	61000	C0321		
0C315			RSH AQ*300	0031C	C3000	CC036		
0C316			DIV W(HALFOAY)	00311	23030	0076C		
0C317			LSH AQ*300	00312	C7000	CC036		
0C320			SUB A*1	00313	21000	CC001		
0C321			JP TWOLESS*AZERO	00314	60400	C0317		
0C322			JP TWOLESS*ANEG	00315	60700	C0317		
0C323			ENT A*-3*SKIP	00316	11140	77774		
0C324		TWOLESS	ENT A*-2	00317	11040	77775		
0C325			JP STORE	00320	61000	C034C		
0C326		LESSONE	ENT A*-1	00321	11040	77776		
0C327			JP STORE	00322	61000	C034C		
0C330		DAYFIND	ENTRY	00323	61000	CC0CC		
0C331			ENT A*(CELTIME)*APOS	00324	11630	63133		
0C332			JP FLATNEG	00325	61000	03035		
0C333			SUB A*(HALFOAY)*APOS	00326	21630	0076C		
0C334			JP LESSONE	00327	61000	C0321		
0C335			RSH AQ*300	00330	C3000	CC036		
0C336			DIV W(HALFOAY)	00331	23030	0076C		
0C337			LSH AQ*300	00332	C7000	CC036		
0C340			SUB A*1	00333	21000	CC001		
0C341			JP CERO*AZERO	00334	60400	00337		
0C342			JP CERO*ANEG	00335	60700	00337		
0C343			ENT A*1*SKIP	00336	11100	CC001		
0C344		CERO	ENT A*0	00337	11000	CC0CC		
0C345		STORE	STR A*(DAYINCRMNT)	00340	15C30	CC351		
0C346			ADD A*(WHOLEYEAR)	00341	20030	C1375		
0C347			ADD A*24373000	00342	20030	03614		
0C350			ADD A*(DAY)	00343	20010	6315C		
0C351			STR A*(JULIANOAY)	00344	15030	C1376		
0C352			SUB A*24381450	00345	21030	03615		
0C353			SUB A*(DAYINCRMNT)	00346	21030	00351		
0C354			STR A*(SAFE)	00347	15030	C1411		
0C355			EXIT	00350	61C10	C0323		
0C356		DAYINCRMNT	0	00351	C0000	CC00C		
0C357		MUONTIME	ENTRY	00352	61000	CC00C		
0C360			ENT A*(CELTIME)	00353	11C30	63133		
0C361			ADD A*(OELTATEE)*APOS	00354	20630	63316		
0C362			JP NEGTIME	00355	61C00	CC0406		
0C363			ENT 84*5760	00356	12400	C11CC		
0C364		WURLODFAIR	RSH AQ*300	00357	C3C00	CC036		
0C365			DIV W(HOOR)	00360	23C30	C0766		
0C366			STR Q*(TIME2)	00361	14C30	0141C		
0C367			CL Q*	00362	10000	CC0CC		
0C370			DIV W(HOOR)	00363	23030	CC766		
0C371			LSH AQ*290	00364	C7C00	CC035		

JO DEC 31 196C GNWCH NOON

JO APR 25 1963 GNWCH NOON

FRACHTMAN*7/14/64

CARDS	LI	IO LABEL	TA STATEMENT	MOONTRACK	LOC	F	JKR	Y	NOTES
.	0C372		SEL	CL*W(KEY)	00365	52030	C1013		
.	0C373		STR	A*W(P)	00366	15030	C1022		
.	0C374		ENT	A*W(TIME2)	00367	11030	C141C		
.	0C375		LSH	A*3	00370	C6000	C0003		
.	0C376		ADD	A*AEPEM+2+B4	00371	20004	C1414		
.	0C377		STR	A*L(RAAO)	00372	15010	C1402		
.	UC4G0		ADD	A*1	00373	20000	C0001		
.	UC401		STR	A*L(RAOIFAO)	00374	15C10	C1405		
.	UC4C2		ADD	A*1	00375	20000	C0001		
.	UC4L3		STR	A*L(OECAO)	00376	15C10	C1403		
.	UC4G4		ADD	A*1	00377	20000	C0001		
.	UC4C5		STR	A*L(OECOIFAO)	00400	15010	C1406		
.	UC4G6		ADD	A*1	00401	20000	C0001		
.	UC4L7		STR	A*L(OISTAO)	00402	15C10	C1404		
.	UC410		ADD	A*1	00403	20000	C0001		
.	UC411		STR	A*L(OISTOIFAO)	00404	15010	C1407		
.	UC412		EXIT		00405	61010	C0352		
.	UC413	NEGTIME	CL	B4*	00406	12400	C000C		
.	UC414		SUR	A*W(KEY)	00407	21030	C1013		
.	UC415		JP	WORLDSFAIR	00410	61000	C0357		
.	UC416	STATUSCK	ENTRY		00411	61000	C000C		
.	UC417		STR	EPHEM*W(TAPSTAT)	00412	17670	C0524		
.	UC420		ENT	A*U(TAPSTAT)	00413	11020	C0524		
.	UC421		RSH	A*110	00414	C2000	C0013		
.	UC422		STR	A*W(TAPSTAT+1)	00415	15030	C0525		
.	UC423		RPL	Y+1*L(STATUSCK)	00416	36010	C0411		
.	UC424		ENT	B3*L(TAPSTAT+1)	00417	12310	C0525		
.	UC425		RIL		00420	60000	C000C		
.	UC426		JP	STATACT+R3	00421	61003	C0422		
.	UC427	STATACT	JP	BUST	00422	61000	C0476		
.	UC430		JP	BUST	00423	61000	C0476		
.	UC431		JP	BUST	00424	61000	C0476		
.	UC432		JP	BUST	00425	61000	C0476		
.	UC433		JP	BUST	00426	61000	C0476		
.	UC434		JP	BUST	00427	61000	C0476		
.	UC435		JP	BUST	00430	61000	C0476		
.	UC436		JP	BUST	00431	61000	C0476		
.	UC437		EXIT		00432	61010	C0411		
.	UC440		JP	BUST	00433	61000	C0476		
.	UC441		JP	BUST	00434	61000	C0476		
.	UC442		JP	ENDFILE	00435	61000	C0472		
.	UC443		JP	CANTFNO	00436	61000	C0442		
.	UC444		JP	RUST	00437	61000	C0476		
.	UC445		JP	BUST	00440	61000	C0476		
.	UC446		JP	BUST	00441	61000	C0476		
.	UC447	CANTFNO	EX-FCT	EPHEM*W(REWINONO)	00442	13670	C0765		
.	UC450		ENT	B4*L(MUNTHPRINT)	00443	12410	C0743		
.	UC451		ENT	A*W(YEARPRINT+B4)	00444	11034	C1002		
.	UC452		STR	A*W(NOOATA2)	00445	15030	C0546		
.	UC453		ENT	B4*L(YEARMONTH)	00446	12410	63147		

4 SEC ERR SYNC 20
 5 REMINDING 24
 6 CHAR COUNT 30
 7 ILLEGAL 34
 10 40 NORMAL
 11 REPEAT 44
 12 SEC ERR CCNT 50
 13 ECF 54
 14 EOT 60
 15 NLNSLCH
 16 ABN F C 70
 17 INTERLOCK 74

FRACHTMAN*7/14/64

MOONTRACK

CARDS	LI ID LABEL	TA STATEMENT	LOC	F JK8 Y	NOTES
.	UC454	ENT A*W(MONTHPR(NT+84)	00447	11034	00743
.	UC455	RPL A*Y*W(NODATA2)	00450	24030	00546
.	UC456	CL A*	00451	11000	00000
.	UC457	ENT Q*L(BARKIER)	00452	10010	00473
.	UC460	DIV I2	00453	23000	00012
.	UC461	ADD A*60	00454	20000	00060
.	UC462	STR A*U(IMPERIAL)	00455	15020	01377
.	UC463	CL A*	00456	11000	00000
.	UC464	DIV I2	00457	23000	00012
.	UC465	JP ALBERT*AZERU	00460	60400	00462
.	UC466	ADD A*60	00461	20000	00060
.	UC467	LSH A*6	00462	06000	00006
.	UC470	ADD A*U(IMPERIAL)	00463	20020	01377
.	UC471	LSH A*6	00464	06000	00006
.	UC472	ADD A*3105000005	00465	20030	03616
.	UC473	STR A*W(NODATA3)	00466	15030	00552
.	UC474	RJP U(INTERCOM)	00467	65020	63426
.	UC475	U-TAG NODATA*0	00470	00540	00000
.	UC476	JP L(MOONINIT)	00471	61010	00002
.	UC477	RPL Y*1*L(IMPERIAL)	00472	36010	01377
.	UC500	SUB A*120	00473	21000	00014
.	UC501	JP CANTFIND*AZERO	00474	60400	00442
.	UC502	JP TRYAGA(N	00475	61000	00034
.	UC503	EX-FACT EPHEM*W(REWINDNC)	00476	13670	00765
.	UC504	ENT A*L(TAPSTAT+1)	00477	11010	00525
.	UC505	RSH A*1	00500	02000	00001
.	UC506	ADD A*60	00501	20000	00060
.	UC507	LSH A*6	00502	06000	00006
.	UC510	STR A*L(TAPSTAT+2)	00503	15010	00526
.	UC511	ENT A*L(TAPSTAT+1)	00504	11010	00525
.	UC512	SEL CL*X77776	00505	52040	77776
.	UC513	LSH A*2	00506	06000	00002
.	UC514	ADD A*60	00507	20000	00060
.	UC515	ADD A*L(TAPSTAT+2)	00510	20010	00526
.	UC516	STR A*L(TAPEBUST1+3)	00511	15010	00522
.	UC517	RJP U(INTERCOM)	00512	65020	63426
.	UC520	U-TAG TAPEBUST*0	00513	00515	00000
.	UC521	JP L(MOON(NIT)	00514	61010	00002
.	UC522	FD O*A	00515	06050	50505
.	UC523	-0 TAPEBUST1	00516	77777	00517
.	UC524	FD O*II(C	00517	16161	61005
.	UC525	FD O*STATU	00520	30310	63132
.	UC526	FD 2*S S1	00521	30050	53061
.	UC527	-0	00522	05050	50505
.	UC530	+0	00523	77777	77777
.	UC531	+0	00524	00000	00000
.	UC532	+0	00525	00000	00000
.	UC533	JP BEAVER*QNEG	00526	00000	00000
.	UC534	SUB A*1	00527	60300	00264
.			00530	21000	00001

MUONTRACK FRACHTMAN*7/14/64

CARDS	LI	IO LABEL	TA	STATEMENT	LOC	F	JKB	Y	NOTES
.	UC535			JP BEAVER	00531	61C00		CC264	
.	UC536	EPHEMA	U-TAG	AEPHEM+1910*AEPHEM	00532	C1711		01412	
.	UC537	EPHMB	U-TAG	ACPHM+3830*AEPHEM+1920	00533	C2211		01712	
.	UC540	EPHEMC	U-TAG	AEPHEM+5750*AEPHEM+3840	00534	C2511		02212	
.	UC541	EPHEMD	U-TAG	AEPHEM+7670*AEPHEM+5760	00535	C3011		02512	
.	UC542	EPHEME	U-TAG	AEPHEM+9590*AEPHEM+7680	00536	C3311		03012	
.	UC543	EPHEMF	U-TAG	AEPHEM+11510*AEPHEM+9600	00537	C3611		03312	
.	UC544	NUOATA	FD	O*A	0054C	C6050		50505	
.	UC545		-O	NOOATA1	00541	77777		C0542	
.	UC546	NUOATA1	FD	O*MOON	00542	22242		42305	
.	UC547		FD	O*EPHEM	00543	12251		51222	
.	UC550		FD	O*ERIS	00544	12271		63005	
.	UC551		FD	O*FOR	00545	13242		70505	
.	UC552	NUOATA2	FD	O*63/63	00546	66637		46663	
.	UC553		FD	O* NOT	00547	C5232		431C5	
.	UC554		FD	O*AMONG	00550	C6222		42314	
.	UC555		FD	O* FIRS	00551	C5131		6273C	
.	UC556	NUOATA3	FD	O* T	00552	31050		505C5	
.	UC557		FD	O*FILES	00553	13162		1123C	
.	UC560		-O		00554	77777		77777	
.	UC561	INITIALJD	FD	O*A	00555	C6050		50505	
.	UC562		U-TAG	INITIAL2*INITIAL1	00556	C0563		C0557	
.	UC563	INITIAL1	FD	O*JULIA	00557	17322		11606	
.	UC564		FD	2*N OAY	0056C	23051		10636	
.	UC565		-O		00561	C5050		505C5	
.	UC566	INITIAL2	FD	O*O	00562	77777		77777	
.	UC567		-O	INITIAL3	00563	11050		50505	
.	UC570	INITIAL3	O		00564	77777		C0565	
.	UC571	INITIALDAT	FD	O*A	00565	C0000		C0C0C	
.	UC572	INITIAL10	U-TAG	INITIAL11*INITIAL10	00566	C6050		50505	
.	UC573		FD	3*OAY OF YEAR	00567	C0574		0057C	
.	UC574		-O		0057C	11063		60524	
.	UC575	INITIAL11	FD	O*O	00571	13053		61206	
.	UC576		-O	INITIAL12	00572	27C50		5C5C5	
.	UC577	INITIAL12	O		00573	77777		77777	
.	UC6C0	RIGHTASC	FD	O*A	00574	11C50		505C5	
.	UC601		O	RA1	00575	77777		0C576	
.	UC602		FD	O*O	00576	C0000		0C0CC	
.	UC603		O	RA2	00577	C6050		5C5C5	
.	UC604		FD	O*A	0060C	C0C00		C0615	
.	UC605		O	RA3	00601	11050		50505	
.	UC606		FD	O*O	00602	C0C00		CC621	
.	UC607		O	RA4	00603	C6050		50505	
.	UC610		FD	O*A	00604	C0C00		CC622	
.	UC611		O	RA5	00605	11050		505C5	
.	UC612		FD	O*X2B23	00606	C0C00		CC624	
.	UC613		O	KA6	00607	C6050		5C5C5	
.			FD	O*X2B23	0C61C	C0C00		CC625	
.			FD	0	00611	35620		76263	
.			O		0C612	C0C00		CC627	

FRACHTMAN*7/14/64

MOONTRACK

CARDS	LI	IO LABEL	TA STATEMENT	LOC	F	JKB	Y	NC	TES
.	0C614		FO 0*A	00613	C6050	50505			
.	UC615		-0 RA7	00614	77777	0C63C			
.	UC616	RA1	FD 3*RIGHT ASC	00615	27161	41531			
.				00616	C5063	C1005			
.	0C617		-0	00617	C5050	50505			
.	UC620	RA2	0	00620	77777	77777			
.	UC621	RA3	1505	00621	C0C00	0C0CC			
.	0C622		-0	00622	C0C00	C15C5			
.	UC623	RA4	U	00623	77777	77777			
.	UC624	RA5	2205	00624	C0C00	0C0CC			
.	UC625		-0	00625	C0C00	02205			
.	UC626	RA6	0	00626	77777	77777			
.	UC627	RA7	30	00627	C0000	0C0CC			
.	UC630		-0	00630	C0000	0C03C			
.	UC631	DLN	FD 0*A	00631	77777	77777			
.	UC632		U 0LN1	00632	C6050	50505			
.	0C633		FC 0*0	00633	C0000	0650C			
.	0C634		0 0LN2	00634	11050	50505			
.	0C635		FO 0*A	00635	C0C00	0654			
.	UC636		0 0LN3	00636	C6050	50505			
.	0C637		FO 0*0	00637	C0000	0655			
.	0C640		0 0LN4	00640	11050	50505			
.	0C641		FO 0*A	00641	C0000	0657			
.	0C642		U 0LN5	00642	C6C50	50505			
.	UC643		FD 0*X2823	00643	C0000	066C			
.	UC644		0 0LN6	00644	35620	76263			
.	0C645		FO 0*A	00645	C0C00	0662			
.	0C646		-0 0LN7	00646	C6050	50505			
.	UC647	DLN1	FO 3*DECLINATION	00647	77777	0663			
.				00650	11121	02116			
.				00651	23063	11624			
.				00652	23C50	50505			
.	0C650		-0	00653	77777	77777			
.	UC651	DLN2	U	00654	C0000	0C0CC			
.	0C652	DLN3	1105	00655	C0000	01105			
.	UC653		-0	00656	77777	77777			
.	UC654	DLN4	0	00657	C0000	0C0CC			
.	UC655	DLN5	7205	00660	C0000	07205			
.	UC656		-U	00661	77777	77777			
.	0C657	DLN6	0	00662	C0000	0C0CC			
.	UC660	DLN7	52	00663	C0000	00052			
.	0C661		-U	00664	77777	77777			
.	UC662	GMT	FO 0*A	00665	C6050	50505			
.	UC663		0 GMT1	00666	C0C00	CC7C3			
.	0C664		FO 0*0	00667	11050	50505			
.	UC665		0 GMT2	0067C	C0C00	CC7C7			
.	0C666		FO 0*A	00671	C6C50	50505			
.	UC667		U GMT3	00672	C0000	0C71C			
.	0C670		FO 0*0	00673	11050	50505			
.	UC671		U GMT4	00674	C0C00	CC712			

MOONTRACK FRACHTMAN*7/14/64

CAROS	LI	ID LABEL	TA STATEMENT	LOC	F	JKB	Y	NCTES
	0C672		FO O*A	00675	00675	00675	00675	
	0C673		0 GMT5	00676	00676	00676	00676	
	0C674		FO O*X2823	00677	00677	00677	00677	
	0C675		0 GMT6	00700	00700	00700	00700	
	0C676		FO O*A	00701	00701	00701	00701	
	0C677		-0 GMT7	00702	00702	00702	00702	
	0C700	GMT1	FO 3*UNIVERSAL TIME	00703	00703	00703	00703	
				00704	00704	00704	00704	
				00705	00705	00705	00705	
				00706	00706	00706	00706	
	0C701		-0	00707	00707	00707	00707	
	0C702	GMT2	0	00707	00707	00707	00707	
	0C703	GMT3	1505	0071C	0071C	0071C	0071C	
	0C704		-0	00711	00711	00711	00711	
	0C705	GMT4	0	00712	00712	00712	00712	
	0G706	GMT5	2205	00713	00713	00713	00713	
	0C707		-0	00714	00714	00714	00714	
	0C710	GMT6	0	00715	00715	00715	00715	
	0C711	GMT7	30	00716	00716	00716	00716	
	0C712		-0	00717	00717	00717	00717	
	0C713	INITIAL01S	FO U*A	0072C	0072C	0072C	0072C	
	0C714		U-TAG INITIAL17*INITIAL16	00721	00721	00721	00721	
	0C715	INITIAL16	FO O*OISTA	00722	00722	00722	00722	
	0C716		FO O*NCE	00723	00723	00723	00723	
	0C717		FO O*E R	00724	00724	00724	00724	
	0C720		-0	00725	00725	00725	00725	
	0C721	INITIAL17	FO O*X6822	00726	00726	00726	00726	
	0C722		-0 INITIAL18	00727	00727	00727	00727	
	0C723	INITIAL18	0	0073C	0073C	0073C	0073C	
	0C724	INITIALR00	FO O*A	00731	00731	00731	00731	
	0C725		U-TAG INITIAL20*INITIAL19	00732	00732	00732	00732	
	0C726	INITIAL19	FO 3*OBJECT	00733	00733	00733	00733	
				00734	00734	00734	00734	
				00735	00735	00735	00735	
				00736	00736	00736	00736	
	0C727		-0	00736	00736	00736	00736	
	0C730	INITIAL20	FC O*A	00737	00737	00737	00737	
	0C731		-0 INITIAL21	0074C	0074C	0074C	0074C	
	0C732	INITIAL21	2224242300	00741	00741	00741	00741	
	0C733		-0	00742	00742	00742	00742	FC 0 MOCN
	0C734	MONTHPRINT	0	00742	00742	00742	00742	
	0C735		0061000000	00743	00743	00743	00743	
	0C736		0062000000	00744	00744	00744	00744	
	0C737		0063000000	00745	00745	00745	00745	
	0C740		0064000000	00746	00746	00746	00746	
	0C741		0065000000	0C747	00747	00747	00747	
	0C742		0066000000	0075C	0075C	0075C	0075C	
	0C743		0067000000	00751	00751	00751	00751	
	0C744		0070000000	00752	00752	00752	00752	
	0C745		0071000000	00753	00753	00753	00753	
	0C746		6160000000	00754	00754	00754	00754	
	0C747		6161000000	00755	00755	00755	00755	
				00756	00756	00756	00756	

FRACHTMAN*7/14/64

MOONTRACK

CARDS	LI ID LABEL	TA STATEMENT	LUC	F	JKB	Y	NOTES
.	OC750	6162000000	00757	61620	CC00C		
.	OC751 HALFOAY	1000000000	00760	10000	CC00C		
.	OC752 REVSRADIAM	2427630154	00761	24276	30154		DEC C.636661977B29
.	OC753 SHIBIN	5600000002	00762	56000	CC002		
.	OC754 IGNORE	6000000000	00763	60000	CC00C		
.	OC755 INTERRUPT	RJP STATUSCK	00764	65000	00411		NO INT
.	OC756 REWINO	2010000002	00765	20100	CC002		DEC 1118481180
.	OC757 HOUR	0052525253	00766	C0525	25253		DEC 13750.987B15
.	OC760 SRAD	3266677126	00767	32666	77126		DEC 20C/PI
.	OC761 HRAD	1030124435	00770	10301	24435		DEC .26179939829
.	OC762 MINSRAD	2167643241	00771	21676	43241		DEC .55850536829
.	OC763 HDAY	1252525250	00772	12525	25250		DEC 8PI/720
.	OC764 MDAY	2660266026	00773	26602	66026		DEC 24.832
.	OC765 SDAY	2506000000	00774	25060	CC00C		DEC 1C/1440
.	OC766 SECSRAD	2304045527	00775	23040	45527		DEC 86400.000812
.	OC767 SARAD	3113343172	00776	31133	43172		DEC .59573905829
.	OC770 ERNSEC	0	00777	C0000	CC00C		DEC 13PI/43200
.	OC771 RHRSEC	2215053171	01000	22150	53171		DEC 206264.81811
.	OC772 TWOPIE	3110375523	01001	31103	75523		DEC .56888889829
.	OC773 YEARPRINT	0000746661	01002	C0007	46661		DEC 11/3600
.	OC774	0000746662	01003	C0007	46662		DEC 6.2831853826
.	OC775	0000746663	01004	C0007	46663		
.	OC776	0000746664	01005	C0007	46664		
.	OC777	0000746665	01006	C0007	46665		
.	O1000	0000746666	01007	C0007	46666		
.	O1001	0000746667	01010	C0007	46667		
.	O1002	0000746670	01011	C0007	46670		
.	O1003	0000746671	01012	C0007	46671		
.	O1004 KEY	4000000000	01013	40000	CC00C		
.	O1005 FIRSTOIFF	0	01014	C0000	CC00C		
.	O1006 BETA	0	01015	C0000	CC00C		
.	O1007 GAMMA	0	01016	C0000	CC00C		
.	O1010 DELTA	0	01017	C0000	CC00C		
.	O1011 EPSILON	0	01020	C0000	CC00C		
.	O1012 FUNCTION	0	01021	C0000	CC00C		
.	O1013 P	0	01022	C0000	CC00C		
.	O1014 HALF	2000000000	01023	20000	CC00C		
.	O1015 DMINB	0	01024	C0000	CC00C		
.	O1016 DMIN2CPLB	0	01025	C0000	CC00C		
.	O1017 EP2RM2DMA	0	01026	C0000	CC00C		
.	O1020 BESSCL	0	01027	C0000	CC00C		
.	O1021	0	01030	C0000	CC00C		

MOONTRACK FRACHTMAN*7/14/64

CARDS	LL	ID	L	REL	TA	STATEMENT	LCC	F	JKB	Y	NOTES
.	01022				U		01031	C000			CCCC
.	01023				0		01032	C000			CCCC
.	01024				U		01033	C000			CCCC
.	01025	PSQMP			0		01034	C000			CCCC
.	01026	PSQMP6			U		01035	C000			CCCC
.	01027	THIRO				1252525252	01036	12525			25252
.	01030	SIXTH				0525252525	01037	C5252			52525
.	01031	KENNEDY			0		01040	C000			CCCC
.	01032	NOMDERIV			0		01041	C000			CCCC
.	01033	F3ESSEL			0		01042	C000			CCCC
.	01034				0		01043	C000			CCCC
.	01035				0		01044	C000			CCCC
.	01036				0		01045	C000			CCCC
.	01037				0		01046	C000			CCCC
.	01040	SCINTAO			0		01047	C000			CCCC
.	01041	INTERPOL			0		01050	61000			00000
.	01042				ENTRY	Q*-20	01051	10C40			77757
.	01043				ENT	Y+Q*L(SETINTAO)	01052	34010			C1047
.	01044				RPL	B3*L(SETINTAD)	01053	12310			C1C47
.	01045				ENT	A*(O+B3)	01054	11033			00000
.	01046				STR	A*(FIRSTOIFF)	01055	15030			C1014
.	01047				ENT	B3*10+R3	01056	12303			C001C
.	01050				ENT	A*(O+R3)	01057	11033			CCCCC
.	01051				STR	A*(BETA)	01060	15030			C1015
.	01052				ENT	B3*10+R3	01061	12303			C001C
.	01053				ENT	A*(O+R3)	01062	11033			CCCCC
.	01054				STR	A*(GAMMA)	01063	15030			C1016
.	01055				ENT	B3*10+R3	01064	12303			C001C
.	01056				ENT	A*(O+B3)	01065	11033			CCCCC
.	01057				STR	A*(DELTA)	01066	15030			C1C17
.	01060				ENT	B3*10+R3	01067	12303			CCCCC
.	01061				ENT	A*(O+R3)	01070	11033			CCCCC
.	01062				STR	A*(EPSILON)	01071	15030			C102C
.	01063				ENT	A*(DELTA)	01072	11030			C1C17
.	01064				SUB	A*(BETA)	01073	21C30			C1015
.	01065				STR	A*(OMINR)	01074	15030			C1C24
.	01066				ACC	A*(DMINB)	01075	20030			C1024
.	01067				STR	A*(BESSEL)	01076	15030			C1C27
.	01070				ENT	A*(DELTA)	01077	11C30			C1C17
.	01071				ADD	A*(BETA)	01100	20030			C1C15
.	01072				SUB	A*(GAMMA)	01101	21C30			C1016
.	01073				SUB	A*(GAMMA)	01102	21C30			C1016
.	01074				STR	A*(OMINZCPLR)	01103	15C30			C1C25
.	01075				ENT	A*(EPSILON)	01104	11030			C1C2C
.	01076				SOR	A*(FIRSTOIFF)	01105	21C30			C1014
.	01077				SUB	A*(BESSEL)	01106	21C30			C1C27
.	01100				STR	A*(EP2BM2DMA)	01107	15C30			C1026
.	01101				ENT	Q*(P)	01110	10C30			C1022
.	01102				MUL	W(GAMMA)	01111	22C30			C1016
.	01103				LSH	A0*1	01112	C7000			CCCCC

FRACHTMAN*7/14/64

MOONTRACK

NOTES

TA STATEMENT

LI ID LABEL

CARDS

F JKB Y

LOC

CARDS	LI ID LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
.	01104	STR A*(BESSEL+1)	01113	15030	C103C		
.	01105	STR A*(BESSEL)*APOS	01114	15630	C1027		
.	01106	JP NEGBESS1	01115	61000	C135C		
.	01107	LSH AQ*29D	01116	70000	00035		
.	01110	SEL CL*(KEY)	01117	52030	01013		
.	01111	STOR1 STR A*(FBESSEL)	01120	15030	C1042		
.	01112	STR A*(FBESSEL+1)	01121	15030	01043		
.	01113	ENT Q*(P)	01122	10030	C1022		
.	01114	MUL W(P)	01123	22030	01022		
.	01115	ENT B5*1	01124	12500	00001		
.	01116	RJP LEFRNDUFF	01125	65000	01364		
.	01117	SUB A*(P)	01126	21030	01022		
.	01120	STR A*(PSQMP)	01127	15030	01034		
.	01121	RSH AQ*30D	01130	30000	00036		
.	01122	MUL W(DMINB)	01131	22030	01024		
.	01123	RSH AQ*1	01132	30000	00001		
.	01124	STR A*(BESSEL+2)*APOS	01133	15630	01031		
.	01125	JP NEGBESS2	01134	61000	C1353		
.	01126	LSH AQ*29D	01135	70000	00035		
.	01127	SEL CL*(KEY)	01136	52030	C1013		
.	01130	STOR2 STR A*(FBESSEL+2)	01137	15030	C1044		
.	01131	ENT A*(PSQMP)	01140	11030	01034		
.	01132	RSH AQ*30D	01141	30000	00036		
.	01133	DIV 6*AZERO	01142	23400	00006		
.	01134	JP REMAINDER	01143	61000	C125C		
.	01135	L(NCOLN STR Q*(PSQMP6)	01144	14030	C1035		
.	01136	ENT Q*(P)	01145	10030	01022		
.	01137	SUB Q*(HALF)	01146	27030	C1023		
.	01140	MUL W(PSQMP6)	01147	22030	C1035		
.	01141	RJP LEFRNDUFF	01150	65000	01364		
.	01142	RSH AQ*30D	01151	30000	00036		
.	01143	MUL W(DMIN2CPLB)	01152	22030	C1025		
.	01144	LSH AQ*1	01153	30000	00001		
.	01145	STR A*(BESSEL+3)*APOS	01154	15630	01032		
.	01146	JP NEGBESS3	01155	61000	01356		
.	01147	LSH AQ*29D	01156	70000	00035		
.	01150	SEL CL*(KEY)	01157	52030	01013		
.	01151	STOR3 STR A*(FBESSEL+3)	01160	15030	C1045		
.	01152	ENT Q*(PSQMP6)	01161	10030	01035		
.	01153	SUB Q*(THIRD)	01162	27030	C1036		
.	01154	MUL W(PSQMP)	01163	22030	01034		
.	01155	RJP LEFRNDUFF	01164	65000	01364		
.	01156	RSH AQ*30D	01165	30000	00036		
.	01157	MUL W(EP28M2DMA)	01166	22030	C1026		
.	01160	RSH AQ*2	01167	30000	00002		
.	01161	STR A*(BESSEL+4)*APOS	01170	15630	C1033		
.	01162	JP NEGBESS4	01171	61000	01361		
.	01163	LSH AQ*29D	01172	70000	00035		
.	01164	SEL CL*(KEY)	01173	52030	C1013		
.	01165	STOR4 STR A*(FBESSEL+4)	01174	15030	C1046		

FRACHTMAN*7/14/64

MOONTRACK

CARDS	L1 ID	LAREL	TA STATEMENT	ENT	LUC	F	JKB	Y	NOTES
.	01166			ENT A*(W(FBESSEL)	01175	11C30	C1042		
.	01167			SEL CP*(W(FBESSEL+2)	01176	51C30	C1044		
.	01170			JP FLOTEST1*APOS	01177	60600	C1262		
.	01171	NUFLO1		ENT Q*(W(BESSEL+2)	01200	10030	C1031		
.	01172	F(X1)		RPL Y+Q*(W(BESSEL)	01201	34C30	C1027		
.	01173			ENT A*(W(FBESSEL+2)	01202	11030	C1044		
.	01174			RPL A+Y*(W(FBESSEL)	01203	24C30	C1042		
.	01175			SEL CP*(W(FBESSEL+3)	01204	51C30	C1045		
.	01176			JP FLOTEST2*APOS	01205	60600	C1304		
.	01177	NUFLO2		ENT Q*(W(BESSEL+3)	01206	10030	C1032		
.	01200	F(X2)		RPL Y+Q*(W(BESSEL)	01207	34C30	C1027		
.	01201			ENT A*(W(FBESSEL+3)	01210	11030	C1045		
.	01202			RPL A+Y*(W(FBESSEL)	01211	24C30	C1042		
.	01203			SEL CP*(W(FBESSEL+4)	01212	51030	C1046		
.	01204			JP FLOTEST3*APOS	01213	60600	C1326		
.	01205	NUFLO3		ENT Q*(W(BESSEL+4)	01214	10030	C1033		
.	01206	FIX3		RPL Y+Q*(W(BESSEL)	01215	34C30	C1027		
.	01207			ENT A*(W(FBESSEL+4)	01216	11030	C1046		
.	01210			RPL A+Y*(W(FBESSEL)	01217	24C30	C1042		
.	01211			ENT Q*(W(P)	01220	10030	C1022		
.	01212			SUB Q*(W(HALF)	01221	27030	C1023		
.	01213			MUL W(DMIND)	01222	22030	C1024		
.	01214			CL B5*	01223	12500	CC00C		
.	01215			RJP LEFRNOOFF	01224	65000	C1364		
.	01216			STR A*(W(KENNEEY)	01225	15030	C104C		
.	01217			ENT Q*(W(PSOMP)	01226	10030	C1034		
.	01220			ADD Q*(W(SIXTH)	01227	26030	C1037		
.	01221			MUL W(DMIN2CPLB)	01230	22C30	C1025		
.	01222			RJP LEFRNOOFF	01231	65000	C1364		
.	01223			ADD A*(W(KENNEEY)	01232	20030	C104C		
.	01224			ADD A*(W(GAMMA)	01233	20030	C1016		
.	01225			STR A*(W(NUMOERIV)	01234	15030	C1041		
.	01226			ENT A*(W(FBESSEL)*APOS	01235	11630	C1042		
.	01227			JP MINUS	01236	61000	C1244		
.	01230			LSH A*1*ANEG	01237	67000	CC001		
.	01231			ENT A*(W(BESSEL)*SKIP	01240	11130	C1027		
.	01232			RPL Y+1*(W(BESSEL)	01241	36030	C1027		
.	01233	SUM		ADD A*(W(O+84)	01242	20034	CC00C		
.	01234			EXIT	01243	61010	C105C		
.	01235	M(NUS		LSH A*1*APOS	01244	66600	CC001		
.	01236			ENT A*(W(BESSEL)*SKIP	01245	11130	C1027		
.	01237			RPL Y-1*(W(BESSEL)	01246	37030	C1027		
.	01240			JP SUM	01247	61000	C1242		
.	01241	REMAINDER		JP CIV(L*QPOS	01250	60200	C1256		
.	01242			STR A*A	01251	15040	CC00C		
.	01243			SUB A*3*APOS	01252	21600	CC003		
.	01244			JP LINCOLN	01253	61000	C1144		
.	01245			SUB Q*1	01254	27000	CC001		
.	01246			JP LINCOLN	01255	61000	C1144		
.	01247	CIVIL		SUB A*3*APOS	01256	21600	CC003		

FRACHTMAN*7/14/64

MOONTRACK

CARDS	LI	ID	LABEL	TA	STATEMENT	LOC	F	JK8	Y	NC	TES
.	01250			JP	LINCOLN	01257	61000	C1144			
.	01251			ADD	Q*1	01260	26000	CC001			
.	01252			JP	LINCOLN	01261	61000	C1144			
.	01253	FLOTEST1		ENT	A*(FBESSEL)*ANEG	01262	11730	C1042			
.	01254			ADD	A*(FBESSEL+2)*SKIP	01263	20130	C1044			
.	01255			JP	BOTHNEG1	01264	61000	C1274			
.	01256			JP	NDFLO1*APOS	01265	60600	C120C			
.	01257			SEL	CL*(KEY)	01266	52030	C1013			
.	01260			STR	A*(FBESSEL)	01267	15030	C1042			
.	01261			ENT	Q*(BESSEL+2)	0127C	10030	C1031			
.	01262			ADD	Q*1	01271	26000	CC001			
.	01263			RPL	Y+Q*(BESSEL)	01272	34030	C1027			
.	01264			JP	FIX1+3	01273	61000	C1204			
.	01265	BOTHNEG1		ADD	A*(FBESSEL+2)	01274	20030	C1044			
.	01266			JP	NDFLO1*ANEG	01275	60700	C120C			
.	01267			SEL	SET*(KEY)	01276	50030	C1013			
.	01270			STR	A*(FBESSEL)	01277	15030	C1042			
.	01271			ENT	Q*(BESSEL+2)	0130C	10030	C1031			
.	01272			SUB	Q*1	01301	27000	CC001			
.	01273			RPL	Y+Q*(BESSEL)	01302	34030	C1027			
.	01274			JP	FIX1+3	01303	61000	C1204			
.	01275	FLOTEST2		ENT	A*(FBESSEL)*ANEG	01304	11730	C1042			
.	01276			ADD	A*(FBESSEL+3)*SKIP	01305	20130	C1045			
.	01277			JP	BOTHNEG2	01306	61000	C1316			
.	01300			JP	NDFLO2*APOS	01307	60600	C1206			
.	01301			SEL	CL*(KEY)	0131C	52030	C1013			
.	01302			STR	A*(FBESSEL)	01311	15030	C1042			
.	01303			ENT	Q*(BESSEL+3)	01312	10030	C1032			
.	01304			ADD	Q*1	01313	26000	CC001			
.	01305			RPL	Y+Q*(BESSEL)	01314	34030	C1027			
.	01306			JP	FIX2+3	01315	61000	C1212			
.	01307	BOTHNEG2		ADD	A*(FBESSEL+3)	01316	20030	C1045			
.	01310			JP	NDFLO2*ANEG	01317	60700	C1206			
.	01311			SEL	SET*(KEY)	01320	50030	C1013			
.	01312			STR	A*(FBESSEL)	01321	15030	C1042			
.	01313			ENT	Q*(BESSEL+3)	01322	10030	C1032			
.	01314			SUB	Q*1	01323	27000	CC001			
.	01315			RPL	Y+Q*(BESSEL)	01324	34030	C1027			
.	01316			JP	FIX2+3	01325	61000	C1212			
.	01317	FLOTEST3		ENT	A*(FBESSEL)*ANEG	01326	11730	C1042			
.	01320			ADD	A*(FBESSEL+4)*SKIP	01327	20130	C1046			
.	01321			JP	BOTHNEG3	01330	61000	C134C			
.	01322			JP	NDFLO3*APOS	01331	60600	C1214			
.	01323			SEL	CL*(KEY)	01332	52030	C1013			
.	01324			STR	A*(FBESSEL)	01333	15030	C1042			
.	01325			ENT	Q*(BESSEL+4)	01334	10030	C1033			
.	01326			ADD	Q*1	01335	26000	CC001			
.	01327			RPL	Y+Q*(BESSEL)	01336	34030	C1027			
.	01330			JP	FIX3+3	01337	61000	C122C			
.	01331	BOTHNEG3		ADD	A*(FBESSEL+4)	01340	20030	C1046			

FRACHTMAN*7/14/64

CARDS	LI	ID	LABEL	TA STATEMENT	MOONTRACK	LUC	F	JKB	Y	NOTES
.	01332			JP NOFLO3*ANEG		01341	60700	C1214		
.	01333			SEL SET*(KEY)		01342	50030	C1013		
.	01334			STR A*(FBESSEL)		01343	15030	C1042		
.	01335			ENT Q*(BESSEL+4)		01344	10030	C1033		
.	01336			SUB Q*1		01345	27000	CC001		
.	01337			RPL Y+Q*(RESSEL)		01346	34030	C1027		
.	01340			JP FIX3+3		01347	61000	O122C		
.	01341	NEGRESS1		LSH AQ*290		0135C	7000	CC035		
.	01342			SEL SET*(KEY)		01351	50030	C1013		
.	01343			JP STOR1		01352	61000	O112C		
.	01344	NEGRESS2		LSH AQ*290		01353	7000	CC035		
.	01345			SEL SET*(KEY)		01354	50030	C1013		
.	01346			JP STOR2		01355	61000	O1137		
.	01347	NEGRESS3		LSH AQ*290		01356	7000	CC035		
.	01350			SEL SET*(KEY)		01357	50030	C1013		
.	01351			JP STOR3		01360	61000	O116C		
.	01352	NEGRESS4		LSH AQ*290		01361	7000	CC035		
.	01353			SEL SET*(KEY)		01362	50030	O1013		
.	01354			JP STOR4		01363	61000	O1174		
.	01355	LEFRNDOFF		ENTRY		01364	61000	CC0CC		
.	01356			JP MIKE*ANEG		01365	60700	C1371		
.	01357			LSH AQ*B5*QPOS		01366	7205	CC00C		
.	01360			ADD A*1		01367	20000	CC001		
.	01361			EXIT		0137C	61010	O1364		
.	01362	MIKE		LSH AQ*B5*QNEG		01371	7305	CC0CC		
.	01363			SUB A*1		01372	21000	CC001		
.	01364			EXIT		01373	61010	O1364		
.	01365	YRREMAIN		0		01374	0000	CC0CC		
.	01366	WHOLEYEAR		0		01375	0000	CC0CC		
.	01367	JULIANDAY		0		01376	0000	CC0CC		
.	01370	IMPERIAL		0		01377	0000	CC0CC		
.	01371	TAPEBLOCK		0		0140C	0000	CC0CC		
.	01372	TAPESEARCH		0		01401	0000	CC0CC		
.	01373	KAAD		0		01402	0000	CC0CC		
.	01374	OECAD		0		01403	0000	CC0CC		
.	01375	OISTAD		0		01404	0000	CC0CC		
.	01376	RADIFAD		0		01405	0000	CC0CC		
.	01377	DECOIFAD		0		01406	0000	CC0CC		
.	01400	DISTOIFAD		0		01407	0000	CC0CC		
.	01401	TIME2		0		0141C	0000	CC0CC		
.	01402	SAFE		0		01411	0000	CC0CC		
.	01403	AEPHEM		RESERVE 1151D		01412	0000	CC0CC		
.	01404	LASTERPHEM		0		03611	0000	CC0CC		
.	01405			RESERVE 1		03612	0000	CC0CC		
.						03613	CC014	77775		
.						03614	CC012	30264		
.						03615	CC012	32001		
.						03616	31050	CC0C5		

ENTER WITH B5 SET TO SHIFTS

FRACHTMAN*7/14/64

MOONTRACK

LABEL	LOC	LABEL	LOC	LABEL	LOC	LABEL	LOC
IDZELCOR	63001	ID2ENTPNT	63411	ID2RACCOR	63051	ID2RACCOR	63051
IDZRADIO	63441	ID2RECRD	63211	ID2SYSENT	77577	ID2SYSENT	77577
ID2SYSNAM	77677	ID2SYSPAR	63311	ID2TIME	63131	ID2TIME	63131
ID3RADIO	63776	ID4RADIO	63777	ID5RADIO	64776	ID5RADIO	64776
ID6RADIO	64777	ID7RADIO	65777	ID8RADIO	65777	ID8RADIO	65777
ID9RADIO	66776	IGNDRE	00763	IMPERIAL	01377	IMPERIAL	01377
INAZIMAOO	63446	INELEVAO	63447	INITIAL1	00557	INITIAL1	00557
INITIAL10	00570	INITIAL11	00574	INITIAL12	00576	INITIAL12	00576
INITIAL16	00722	INITIAL17	00726	INITIAL18	00730	INITIAL18	00730
INITIAL19	00733	INITIAL2	00563	INITIAL2C	00737	INITIAL2C	00737
INITIAL21	00741	INITIAL3	00565	INITIALRUC	00731	INITIALRUC	00731
INITIALDAT	00566	INITIALDIS	00720	INITIALJC	00555	INITIALJC	00555
INTER	63413	INTERAZIM	7200C	INTERCOM	63426	INTERCOM	63426
INTERDPP	74000	INTERLEV	7300C	INTERPCL	01050	INTERPCL	01050
INTERRRANGE	76777	INTERUPT	00764	JULIANDAY	01376	JULIANDAY	01376
KENNEDY	01040	KEY	01013	LONGITUDE	63320	LONGITUDE	63320
LASTEPHEM	03611	LEFRNOFF	01364	LESSCNE	00321	LESSCNE	00321
LINGDLN	01144	LUNAR	00100	MODNCCNT	00232	MODNCCNT	00232
MOONINIT	00002	MONTHIME	00352	MOCSE	00245	MOCSE	00245
MONITAPE	00055	MONTHPRINT	00743	MAINSWITCH	63334	MAINSWITCH	63334
MCPFILLER	71000	MCPGM	63412	MDAY	00773	MDAY	00773
MIKE	01371	MINREG	63152	MINSRAC	00771	MINSRAC	00771
MINUS	01244	NODATA	00540	NCDATA1	00542	NCDATA1	00542
NODATA2	00546	NODATA3	00552	NCFLO1	01200	NCFLO1	01200
NOFLO2	01206	NOFLO3	01214	NORMAL	00102	NORMAL	00102
NEGRESS1	01350	NEGRESS2	01353	NEGRESS3	01356	NEGRESS3	01356
NEGRESS4	01361	NEGDEC	00527	NEGTIME	00406	NEGTIME	00406
NUMDERIV	01041	P	01022	POLE	63324	POLE	63324
PLANP	63434	PRINT	00212	PRLCG	63423	PRLCG	63423
PSQMP	01034	PSQMP6	01035	RA	63002	RA	63002
RA1	00615	RA2	00621	RA3	00622	RA3	00622
RA4	00624	RA5	00625	RA6	00627	RA6	00627
RA7	00630	RAAD	01402	RAADT	63007	RAADT	63007
RADARMOOE	63312	RADIOMETER	63102	RADIFAC	01405	RADIFAC	01405
RADIUS	63006	RADIUSOOT	63011	RANGE	63052	RANGE	63052
RANGEOUT	70777	RANGEADD	63445	RANGEDOT	63062	RANGEDOT	63062
RDMTR	63430	RDXXX	63433	RECAZIM	67000	RECAZIM	67000
RECELEV	70000	RECFILE	63212	RECR	63415	RECR	63415
REMAINDER	01250	REVSRAOIAN	00761	REWINDNO	00765	REWINDNO	00765
RHTASC	00577	RHRSEC	01000	SAFE	01411	SAFE	01411
SARAD	00776	SAZIM	63055	SELTIME	63134	SELTIME	63134
SDAY	00774	SDEC	63005	SEAPCRT	00304	SEAPCRT	00304
SECONDS	63140	SECSRAD	00775	SELEV	63056	SELEV	63056
SETINTAD	01047	SIDERTIME	63012	SINCRIENT	63064	SINCRIENT	63064
SINAZEL	63066	SIXTH	01037	SKIP	63331	SKIP	63331
SKA	63004	SRAD	00767	SRACTIME	63136	SRACTIME	63136
SRHIBIN	00762	STOR1	0112C	STCR2	01137	STCR2	01137
STOR3	01160	STOR4	01174	STCR	00340	STCR	00340
STATACT	00422	STATUSCK	00411	SUM	01242	SUM	01242
SYSTEMRIES	77600	SYSNAMCS	7770C	SYSTAT1	63313	SYSTAT1	63313
SYSTAT2	63314	SYSTATD	63315	TAPERBLOCK	01400	TAPERBLOCK	01400

MOONTRACK FRACHYMAN*7/14/64

LABEL	LOC	LABEL	LOC	LABEL	LOC
TAPEBUST	00515	TAPEBUST1	00517	TAPEINPUT	00035
TAPESEARCH	01401	TAPSTAT	00524	THIRD	01036
TIME2	01410	TIMEMODE	63103	TIMEP	63435
TRUERANGE	63063	TRUETIME	63132	TRYAGAIN	00034
TWOLESS	00317	TWOPIE	01001	VIZDECL	63014
VIZOEC2	63016	VIZRAL	63013	VIZRA2	63015
WORLOSFAIR	00357	WFORD	63432	WFACD	63450
WFFREQ	63333	WHOLEYEAR	01375	YEARMONTH	63147
YEARPRINT	01002	YRREMAIN	01374	YRTRAN	63327
ZRTRAN	63330				

FRACHTMAN*7/14/64

MOUNTRACK

LABEL	LOC	LABEL	LOC	LABEL	LOC
HENRY	00000	MODNINIT	00002	ERASE	00011
TRYAGAIN	00034	TAPEINPUT	00035	MONITAPE	00055
LUNAR	00100	NORMAL	00102	PRINT	00212
AIRPORT	00230	MOONCONT	00232	HARVARC	00235
MOOSE	00245	BEAVER	00264	SEAPCRT	00304
FLATNEG	00305	TWOLESS	00317	LESSCNE	00321
DAYFIND	00323	CERO	00337	STDR	00340
DAYINCRMNT	00351	MOONTIME	00352	WORLDSFAIR	00357
NEGTIME	00406	STATUSCK	00411	STATACT	00422
CANTFIND	00442	ALBERT	00462	ENDFILE	00472
BARRIER	00473	BUST	00476	TAPEBUST	00515
TAPEBUST1	00517	TAPSTAT	00524	NEGDEC	00527
EPHEMA	00532	EPHEMB	00533	EPHEMC	00534
EPHEM0	00535	EPHEME	00536	EPHEMF	00537
NODATA	00540	NODATA1	00542	NODATA2	00546
NODATA3	00552	INITIALJO	00555	INITIAL1	00557
INITIAL2	00563	INITIAL3	00565	INITIALDAT	00566
INITIAL10	00570	INITIAL11	00574	INITIAL12	00576
RGHTASC	00577	RA1	00615	RA2	00621
RA3	00622	RA4	00624	RA5	00625
RA6	00627	RA7	00630	DLN	00632
DLN1	00650	DLN2	00654	DLN3	00655
DLN4	00657	DLN5	00660	DLN6	00662
DLN7	00663	GMT	00665	GMT1	00703
GMT2	00707	GMT3	00710	GMT4	00712
GMT5	00713	GMT6	00715	GMT7	00716
INITIALDIS	00720	INITIAL16	00722	INITIAL17	00726
INITIAL18	00730	INITIAL800	00731	INITIAL19	00733
INITIAL20	00737	INITIAL21	00741	MCNTHPRINT	00743
HALFDAY	00760	REVSADIAN	00761	SRHIBIN	00762
IGNORE	00763	INTERUPT	00764	REWINDNO	00765
HOOR	00766	SRAD	00767	HRAC	00770
MINSRAD	00771	HOAY	00772	MDAY	00773
SDAY	00774	SECSRAD	00775	SARAD	00776
ERMSEC	00777	RHRSEC	01000	TWCPIE	01001
YEARPRINT	01002	KEY	01013	FIRSTDIFF	01014
BETA	01015	GAMMA	01016	DELTA	01017
EPSILON	01020	FUNCTION	01021	P	01022
HALF	01023	DMINB	01024	DMIN2CPLB	01025
EP28M2DMA	01026	BESSEL	01027	PSQMP	01034
PSQMP6	01035	THIRD	01036	SIXTH	01037
KENNEDY	01040	NUMBERIV	01041	FBESSEL	01042
SETINIAD	01047	INTERPOL	01050	STDR1	01120
STOR2	01137	LINCOLN	01144	STCR3	01160
STOR4	01174	NOFLO1	01200	FIX1	01201
NOFLO2	01206	FIX2	01207	NCFLC3	01214
FIX3	01215	SUM	01242	MINUS	01244
REMAINDR	01250	CIVIL	01256	FLOTTEST1	01262
BOTHNEG1	01274	FLOTTEST2	01304	BCTHNEG2	01316
FLOTTEST3	01326	BOTHNEG3	01340	NEGBESS1	01350
NEGBESS2	01353	NEGBESS3	01356	NEGBESS4	01361

FRACHTMAN#7/14/64

MOUNTRACK		FRACHTMAN#7/14/64	
LABEL	LOC	LABEL	LOC
LEFRNDOFF	01364	MIKE	01371
WHOLEYEAR	01375	JULIANDAY	01376
TAPEBLUCK	01400	TAPESEARCH	01401
DECAD	01403	DISTAD	01404
DECOIFAD	01406	DISTDIFAD	01407
SAFE	01411	AEPHEM	01412
A\$\$\$\$1111	03613	A\$\$\$\$1112	03614
A\$\$\$\$1114	03616	ID1CELCOR	63000
RA	63002	DEC	63003
SDEC	63005	RADIUS	63006
DECOOT	63010	RADIUSOOT	63011
VIZRAI	63013	VIZDECI	63014
VIZDEC2	63016	ID1RADCOR	63050
RANGE	63052	AZIM	63053
SAZIM	63055	SELEV	63056
CAZIM	63060	CELEV	63061
TRUERANGE	63063	SINORIENT	63064
SINAZEL	63066	COSAZEL	63070
ACQELEV	63075	FRAMESIZE	63101
TIMEMODE	63103	FIRSTELEV	63104
ASTRODEC	63106	ID1TIME	63130
TRUETIME	63132	CELTIME	63133
CONVERTIME	63135	SRADTIME	63136
SECONDS	63140	DSECONDS	63141
ESTSHIFTED	63143	GMTSHIFTED	63144
BLASTOFF	63146	YEARMONTH	63147
HOURREG	63151	MINREG	63152
DUMSECTTG	63154	ID1RECRD	63210
RECFILE	63212	ID1SYSPAR	63310
RADARMODE	63312	SYSTAT1	63313
SYSTATD	63315	DELTATEE	63316
LONGITUDE	63320	GEODETLAT	63321
EQUATOR	63323	PDL	63324
HEIGHT	63326	YRTRAN	63327
SKIP	63331	AUCDNVER	63332
MAINSWITCH	63334	EXPNAME	63350
ID2ENTPNT	63411	MCPGM	63412
COCON	63414	RECKD	63415
AESCN	63417	CORCT	63420
CHCDR	63422	PRLOG	63423
DATANALYZE	63425	INTERCDM	63426
RDMPTR	63430	CHPAR	63431
RDXXX	63433	PLANP	63434
ID1RADIO	63440	ID2RADIO	63441
ELEVADD	63443	UOPPAD	63444
INAZIMADD	63446	INELEVADD	63447
ID3RADIO	63776	ID4RADIO	63777
ID5RADIO	64776	ID6RADIO	64777
ID7RADIO	65776	ID8RADIO	65777
ID9RADIO	66776	ID10RADIO	66777
ID11RADIO	67776	ID12RADIO	67777
YRREMAIN	01374	YRREMAIN	01374
IMPERIAL	01377	IMPERIAL	01377
RAAD	01402	RAAD	01402
RADIFAD	01405	RADIFAD	01405
TIME2	01410	TIME2	01410
LASTEPEHM	03611	LASTEPEHM	03611
A\$\$\$\$1113	03615	A\$\$\$\$1113	03615
ID2CELCOR	63001	ID2CELCOR	63001
SRA	63004	SRA	63004
RADOT	63007	RADOT	63007
SIDERTIME	63012	SIDERTIME	63012
VIZRA2	63015	VIZRA2	63015
ID2RADCOR	63051	ID2RADCOR	63051
ELEV	63054	ELEV	63054
GRANGE	63057	GRANGE	63057
RANGEDDT	63062	RANGEDDT	63062
COSGRIENT	63065	COSGRIENT	63065
ACQAZIM	63071	ACQAZIM	63071
RADIOMETER	63102	RADIOMETER	63102
ASTRCRA	63105	ASTRCRA	63105
ID2TIME	63131	ID2TIME	63131
CELTIME	63134	CELTIME	63134
HDURMINUTE	63137	HDURMINUTE	63137
ACTUALTIME	63142	ACTUALTIME	63142
GMTMCDU24	63145	GMTMCDU24	63145
DAY	63150	DAY	63150
FIRSTTHRU	63153	FIRSTTHRU	63153
ID2RECRD	63211	ID2RECRD	63211
ID2SYSPAR	63311	ID2SYSPAR	63311
SYSTAT2	63314	SYSTAT2	63314
FREQUENCY	63317	FREQUENCY	63317
GEDCENLAT	63322	GEDCENLAT	63322
AZIMOVER	63325	AZIMOVER	63325
ZRTRAN	63330	ZRTRAN	63330
WFFREC	63333	WFFREC	63333
ID1ENTPNT	63410	ID1ENTPNT	63410
INTER	63413	INTER	63413
ADSCN	63416	ADSCN	63416
DYDMP	63421	DYDMP	63421
CELCMPGM	63424	CELCMPGM	63424
ACQUI	63427	ACQUI	63427
WFDR	63432	WFDR	63432
TIMEP	63435	TIMEP	63435
AZIMADD	63442	AZIMADD	63442
RANGEADD	63445	RANGEADD	63445
WFACD	63450	WFACD	63450
AZIMCUT	64000	AZIMCUT	64000
ELEVOUT	65000	ELEVOUT	65000
DDPPDUT	66000	DDPPDUT	66000
RECAZIM	67000	RECAZIM	67000
RECELEV	70000	RECELEV	70000

FRACHTMAN*7/14/64

MOONTRACK		FRACHTMAN*7/14/64	
LABEL	LDC	LABEL	LDC
I013RADIO	70775	I014RADIO	70776
MCPFILLER	71000	I015RADIO	71776
INTERAZIM	72000	I017RADIO	72776
INTERELEV	73000	I019RADIO	73776
INTERUOPP	74000	I021RADIO	74776
AZIMIN	75000	I023RADIO	75776
ELEVIN	76000	I025RADIO	76775
INTERRANGE	76777	I01SYSENT	77576
SYSENTRIES	77600	I01SYSNAM	77676
SYSNAMES	77700	RANGECUT	70777
		I016RADIO	71777
		I018RADIO	72777
		I02CRADIO	73777
		I022RADIO	74777
		I024RADIO	75777
		I026RADIO	76776
		I02SYSENT	77577
		I02SYSNAM	77677

REFERENCES

1. "Haystack Pointing System Ephemeris Tape Program", M. I. T. Lincoln Laboratory, Publication 1964-41. (In preparation)
2. Explanatory Supplement to the Astronomical Ephemeris and the American Ephemeris and Nautical Almanac (Her Majesty's Stationery Office, London, 1961).
3. R. Butler and E. Kerr, An Introduction to Numerical Methods (Sir Isaac Pitman and Sons, Ltd. , London).

DISTRIBUTION LIST

W. B. Davenport
G. P. Dinneen
H. G. Weiss
J. W. Meyer

Group 31

J. S. Arthur
J. R. Burdette
C. A. Clark
C. T. Frerichs
R. F. Gagne
G. M. Hyde
R. P. Ingals
M. L. Meeks
J. E. Morriello
V. C. Pineo
W. Rutkowski
P. B. Sebring
M. L. Stone
S. Weinreb

Group 62

P. Rosen
F. E. Heart
W. R. Crowther
J. D. Drinan
H. E. Frachtman
D. M. Hafford
A. A. Mathiasen
F. Nagy
S. B. Russell
R. J. Saliga
P. D. Smith
P. Stylos
R. Teoste
S. J. White
Group 62 Office (5)

Group 76

A. O. Kuhnel

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)		2 a. REPORT SECURITY CLASSIFICATION	
Lincoln Labs., Lexington, Mass.		UNCLASSIFIED	
		2 b. GROUP	
		N/A	
3. REPORT TITLE			
Haystack Pointing System: Moon			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
Group Report			
5. AUTHOR(S) (Last name, first name, initial)			
Frachtman, H.E.			
6. REPORT DATE		7 a. TOTAL NO. OF PAGES	7 b. NO. OF REFS
Sep 64		36	3
8 a. CONTRACT OR GRANT NO.		9 a. ORIGINATOR'S REPORT NUMBER(S)	
AF19(628)500		GR-1964-45	
b. PROJECT NO.		9 b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
c.		ESD-TDR-64-371	
d.			
10. AVAILABILITY/LIMITATION NOTICES			
Qualified Requesters May Obtain Copies From DDC.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
		ESD, L.G. Hanscom Field, Bedford, Mass.	
13. ABSTRACT			
<p>This report describes the procedure used by the Haystack pointing computer program for obtaining the celestial coordinates of the Moon at any time.</p>			

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
<p>Haystack Moontrack Program Inputs Program Outputs Astronomical Significance</p>						

INSTRUCTIONS

1. **ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.
- 2a. **REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.
- 2b. **GROUP:** Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.
3. **REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.
4. **DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.
5. **AUTHOR(S):** Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.
6. **REPORT DATE:** Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.
- 7a. **TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.
- 7b. **NUMBER OF REFERENCES:** Enter the total number of references cited in the report.
- 8a. **CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.
- 8b, 8c, & 8d. **PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.
- 9a. **ORIGINATOR'S REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.
- 9b. **OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).
10. **AVAILABILITY/LIMITATION NOTICES:** Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign announcement and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."
- (5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. **SUPPLEMENTARY NOTES:** Use for additional explanatory notes.
12. **SPONSORING MILITARY ACTIVITY:** Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.
13. **ABSTRACT:** Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.
14. **KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.