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PROJECT SKYLAB

TASK JSC/TRW AA-53

LUNAR OBSERVATIONS VERIFIER EDITOR PROGRAMMER'S MANUAL

REVISION 1

19 APRIL 1974

Prepared by
ANALYSIS AND EXPERIMENT SUPPORT SECTION
SOFTWARE TECHNOLOGY APPLICATIONS DEPARTMENT
TRW SYSTEMS GROUP

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Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
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ABSTRACT

The Lunar Observations Verifier Editor (LOVE) Programmer's Manual was submitted to the NASA Manned Spacecraft Center by TRW Systems Group as partial fulfillment of MSC/TRW Task A-196.1, Contract NAS 9-8166 (TRW Note No. 69-FMT-796). Revision 1 is submitted to the NASA Johnson Space Center by TRW Systems Group as partial fulfillment of JSC/TRW Task AA-53, Contract NAS 9-13834.

The prime purpose of the programmer's manual is to aid the programmer in understanding the programming aspects of the program. A description of the input, the printout, the deck setup, and tape configuration may be obtained from the LOVE User's Guide (change 4), TRW Note No. 71-FMT-720J.

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7. TAPE AND OBSERVATION FORMATS

7.1 SORT TAPE

The data record for the FORTRAN Sort Data Tape shall be composed of 14 observation frames of 20 words each. Each frame will be described by:

Word	Bits	Content
1-2	0-71	Time (double precision minutes)
3	0-35	Observation ID (alphanumeric/receiver/transmitter ID for LOVE pseudo)
4	0-7	Receiver ID (binary)
	8-15	Doppler resolver count
	16-35	Not used
5	0-17	Not used
	18-35	Object (vehicle) ID (alphanumeric)
6	0-5	Angle ID (binary)
	6-11	Range ID (binary)
	12-17	Range rate/doppler ID (binary)
	18-23	Not used
	24-29	Instruments
	30-35	Onboard type (see Section 7.7 for type descriptions)
7	0-34	Flags (see Section 7.7 for radar type codes)
	35	Format of words 8-10, 14-17 0 = integer 1 = LOVE pseudo
8	0-35	Angle 1
9	0-35	Angle 2
10	0-35	Range
11	0-35	Doppler Count (always integer)
12-13	0-71	Tau interval (DP minutes)
14	0-35	Range rate for integer format. Doppler shift if LOVE pseudo format
15	0-35	Gimbal 1
16	0-35	Gimbal 2

17	0-35	Gimbal 3
18	0-8	Characteristic of word 8 (LOVE pseudo only)
	9-17	Characteristic of word 9 (LOVE pseudo only)
	18-26	Characteristic of word 10 (LOVE pseudo only)
	27-35	Not used
19	0-8	Characteristic of word 14 (LOVE pseudo only)
	9-17	Characteristic of word 15 (LOVE pseudo only)
	18-26	Characteristic of word 16 (LOVE pseudo only)
	27-35	Characteristic of word 17 (LOVE pseudo only)
20		Not used

7.2 PROCESSOR DATA TAPES

7.2.1 SIC Tapes

7.2.1.1 Apollo SIC Tape

The Apollo SIC tape is a non-FORTRAN, odd parity, variable length record tape containing low and high speed observation frames. Each variable length record contains the number of bytes (one byte equals eight bits) in the record, and a variable number of observation frames. The number of bytes in each record is contained in the first 32 bits (1-32) of each record.

Each observation frame consists of a variable number of bits. The number of bits comprising an observation frame is dependent upon the content of the frame. The format of each frame is as follows:

Starting Bit	Ending Bit	Description
LCS_m	LCS_m+47	Number of bytes (NB) in logical observation frame
LCS_m+48	LCS_m+223	Remainder of header
LCS_m+224	LCS_m+247	Com-processor message label
LCS_m+248	LCS_m+259	Number of characters (NC) in message
LCS_m+260	LCS_m+295	Com-processor time word
LCS_m+296	$LCS_m+296+N$	Observation
$LCS_m+297+N$	LCS_m+LC_m-1	Filler bits

where

LC_m = number of bits (8*NB) of logical observation frame. It is the sum of the header (224 bits), com-processor message label (36 bits), com-processor time word (36 bits), observation count (varies per radar format), and a factor to round up to a multiple of 32.

N = number of bits (6*NC-72) in observation

LCS_1 = 33 for the first observation frame in the record

$$LCS_m = 33 + \sum_{j=1}^{m-1} LC_j \text{ for observation frame } m(m \geq 2)$$

Where LC_j is the length of observation frame j in bits.

The data on the SIC tape is terminated by an end of file. The possible formats of the observation are described in the Apollo Tracking Data Format Control Book.

7.2.1.2 Skylab SIC Tape

The Skylab SIC tape is a non-FORTRAN, odd parity, variable record length tape containing low and high speed observation frames. Each variable length record contains the number of bytes (one byte equals eight bits) in the record, and a variable number of observation frames. The number of bytes in each record is contained in the first 32 bits (1-32) of each record.

Each observation frame consists of a variable number of bits. The number of bits comprising an observation frame is dependent upon the content of the frame. The format of each frame is as follows:

Starting Bit	Ending Bit	Description
LCS_m	LCS_m+47	Number of bytes (NB) in logical observation frame
LCS_m+48	LCS_m+223	Remainder of header
LCS_m+224	LCS_m+250	Com-processor message label
LCS_m+251	LCS_m+259	Number of characters (NC) in C-band message or number of bytes (NC) in USB message

LCS_m+260	LCS_m+295	Com-processor time word
LCM_m+296	$LCS_m+296+N$	Observation
$LCS_m+297+N$	LCS_m+LC_m-1	Filler bits

where

LC_m = number of bits (8*NB) of logical observation frame. It is the sum of the header (224 bits), com-processor message label (36 bits), com-processor time word (36 bits), observation count (varies per radar format), and a factor to round up to a multiple of 32.

N = number of bits (6*NC-72) in C-band observation or number of bits (8*NC-72) in USB observation

LCS_1 = 33 for the first observation frame in the record

$$LCS_m = 33 + \sum_{j=1}^{m-1} LC_j \text{ for observation frame } m(m \geq 2)$$

Where LC_j is the length of observation frame j in bits.

The data on the Skylab SIC tape is terminated by an end of file. The possible formats of the observation are described in the Skylab Tracking Data Format Control Book, Revision 1.

7.2.2 FIELDA Tape

The FIELDA raw data tape is an odd parity non-FORTRAN, 556 or 800 bpi density tape containing the FIELDATA image of low speed observation frames. Each record, 84 characters (14 words) in length, will contain one teletype (low speed) observation frame whose characters have been converted to Fieldata code. The first character of the magnetic tape record contains the first converted character from the paper tape followed by succeeding characters from the paper tape. Line feed, figure shift, carriage return and alphabetic characters are not included in the magnetic tape record. Each file of observation frames is terminated by an end-of-file mark.

The format of each observation frame may be any one of those described in Section 2.3 of Apollo Tracking Data Format Control Book.

7.2.3 140WD Tape

The 140WD tape is an odd parity non-FORTRAN, 800 bpi density tape containing data only. These odd parity binary tapes have 140 word records with 20 observation frames per record. Each observation frame consists of 7 words, with the first 240 bits of each frame significant and the remainder of the 7-word frame filled with zeros.

The format of each observation frame may be any of the USB reporting formats described in Section 2.2 of Apollo Tracking Data Format Control Book.

7.2.4 BAD Tape

The BAD tape is a FORTRAN binary tape containing low and high speed observation frames: one observation frame consists of twenty (20) words, and there are ten (10) frames per record. The possible formats of the observation frames are described in the Apollo Tracking Data Format Control Book.

This tape can be generated by the PROCESSOR segment. All observation frames that were rejected are contained on this tape.

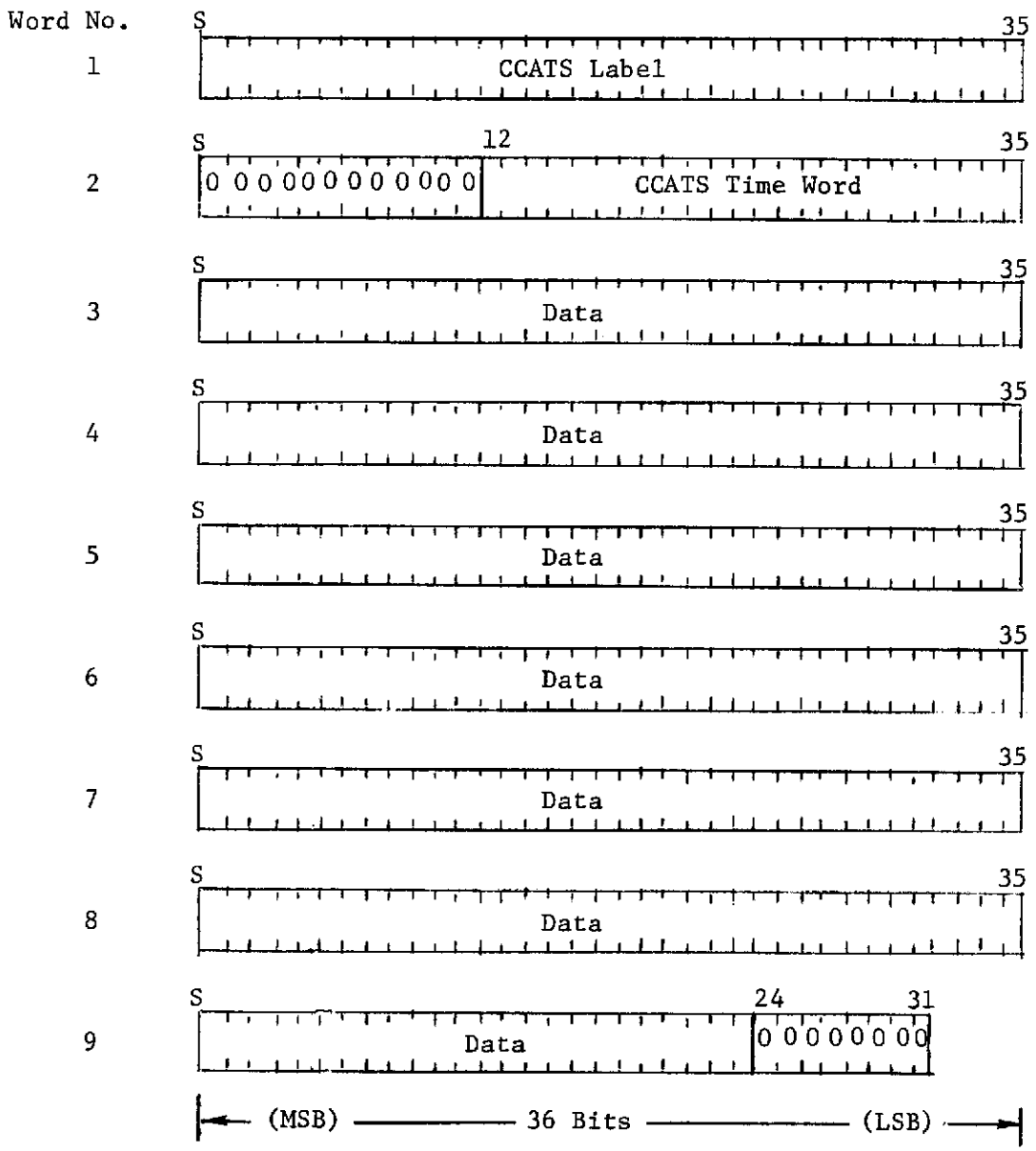
7.2.5 PFS Tape

The PFS tape is an odd parity non-FORTRAN, 800 bpi density tape containing high speed data only. These odd parity binary tapes have 89 word records with 10 observation frames* per record. Each frame consists of 320 bits with each successive frame starting with the 321 bit from the previous one.

The format of each observation frame may be any of the high speed reporting formats described in Section 2.2 of the Apollo Tracking Data Format Control book.

The layout of each frame is as follows:

*The routine which retrieves each frame allows a multiple number of frames per record.



Notes:

1. Words No. 1 and 2 are the CCATS Label and Time Word, respectively, which are inserted by ALCS by the receiving station (ALCS).

2. Words No. 3-9 contain the 240 bits of high speed tracking data from remote sites. Bits 24-31 of Word No. 9 are filler zeros added by ALCS.

3. The next observation begins immediately after bit 31 of word 9.

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7.3 MASTER TAPES

7.3.1 JPLB1 Master Tape

The JPLB1 master tape is an odd parity, 800 bpi density, non-FORTRAN tape containing observation data from the Deep Space Network stations. This tape is produced by the Jet Propulsion Laboratory's Tracking Data Processor Program (TDP).

The first record is a 139-word TDP Master File summary record consisting of a 3-word master file label, a 12-word summary of the master file, fifteen (15) 8-word station summaries, one unused word, a word containing the number of replaced time points in the file, a word containing the total number of time points in the file, and a check sum word. The detail format description of the master file summary record is found in Table 1 of the Formats of Edited DSN Tracking Data document.

Following the summary record are a series of data records. The data record consists of a 3-word label, a word containing the disk address of the record, 200 words of observation data, 25 unused words, and a check sum word (a total of 230 words). Each observation data frame consists of 13 words, so 15 5/13 frames are stored in one record. The first eight words of the second data record would be the continuation of the last frame of the first record. The detailed format description of each frame is found in Table 2 of the Formats of Edited DSN Tracking Data document. Two equations are necessary to convert from range units (seconds) to range. These may be found in Section 5.3.

Each file of observation frames is terminated by an end-of-file mark.

7.3.2 1108 Master Tapes

The 1108 master tapes are created by this program. They are odd parity, 800 bpi density tapes containing observation data in chronological order. There are two tape formats. The MASTER tape, created by the PROCESSOR segment of the program, contains non-FORTRAN physical records. The EDITED MASTER tape, created by the EDITOR segment of the program, contains FORTRAN logical records. Although the actual record length of the MASTER and EDITED MASTER tapes differ, the contents of the physical record of the MASTER tape and the logical record of the EDITED MASTER tape are the same. Therefore, the following description applies to both tapes.

The first record is a 50-word header block containing the double precision base day, a 2-word run identifier, a 2-word tape identifier, and 44 words reserved for comments.

This is followed by observation data frame records. Each record shall normally be composed of 20 observation frames of 32 words each. The format of each data frame is described below. Each tape is terminated by an end-of-tape frame. This 32 word frame consists of 30 alphanumeric words of THE END in words 1-6 and 9-32, and one double precision word (7-8) of 1.0 D30. This end-of-tape frame is placed in the remaining frames of an incomplete data record. An end-of-file mark follows the record containing the end-of-tape frame.

The data record for the Master Data Tape shall be composed of 20 observation frames of 32 words each. Each frame will be described by:

Word	Bits	Content
1	0-7	Receiver ID (binary)
	8-15	Doppler resolver count (binary)
	16-35	Sequence number (binary)
2	0-17	Receiver ID (alphanumeric)
	18-35	Transmitter ID (alphanumeric)
3	0-5	Angle ID (binary)
	6-11	Range ID (binary)
	12-17	Range rate/doppler ID (binary)
	18	1 if V_x present; otherwise 0
	19	1 if V_y present; otherwise 0
	20	1 if V_z present; otherwise 0
	21-23	Not used
	24-29	Instruments
	30-35	Onboard type (see Section 7.7 for type descriptions)
4	0-17	Same as 0-17 of word 3 (used as cross-reference)
	18-35	Object (vehicle) ID (alphanumeric)
5		Flags (0/1):
	0	Real/test
	1	Low/high
	2	C-band/USB radar
	3	Fixed/mobile
	4	Range/VCO frequency
	5	Good/bad range

	6	Range acquired/not acquired
	7	Locked/free running VCO
	8-11	Doppler rate
	12-15	Doppler type
	16	Nondestruct/destruct doppler
	17	Rubidium/crystal frequency
	18	N1/N2 mode (destruct doppler)
	19	Good/bad doppler or range rate
	20	Auto/nonauto tracking
	21	Good/bad angle
	22	No error/error reported
	23	MSFN/DSN
	24	Skin/beacon track
	25-29	Radar type (see Section 7.7 for radar type codes)
	30	Dual mode station
	31	Equivalent azimuth/elevation flag
	32	Onboard flag
	33-34	Not used
	35	Internal switch
6	0-35	Doppler count (binary)
7-8	0-71	Time (minutes) since base day
9-10	0-71	Tau interval (minutes)
11-12	0-71	Angle 1 (radians) or V_x (er/min)
13-14	0-71	Angle 2 (radians) or V_y (er/min)
15-16	0-71	Range (earth radii) or V_z (er/min)
17-18	0-71	Range rate/doppler shift/range (er/min) (cycles/min) (er)
19-20	0-71	Gimbal angle 1 (radians)
21-22	0-71	Gimbal angle 2 (radians)
23-24	0-71	Gimbal angle 3 (radians)
25-26	0-71	Receiver frequency (cycles/min)
27-28	0-71	Transmitter frequency (cycles/min)
29	0-35	Angle 1 sigma (radians)
30	0-35	Angle 2 sigma (radians)
31	0-35	Range sigma (er)
32	0-35	Range rate/doppler sigma (er/min)

7.4 RESIDUAL TAPE

The residual tape (observed minus computer observation) generated by HOPE consists of an identification record followed by the corresponding data records. The data record for the HOPE Residual Tape is composed of 16 observation frames of 40 words each. Each frame is described by:

Identification Record

Word	ID	Type	Description
1-2	COBSTM	DP	Observation base time
3-12	ITITLE	I	Internal titles stored in HOPE
13-15	TITLE	I	Input run title
26-52	ITITL1	I	Additional identification information includes date and time

Data Records

Word	ID	Type	Description
1	ID(1)	I	See word 1, 1108 Master tape
2	ID(2)	I	See word 2, 1108 Master tape
3	ID(3)	I	See word 3, 1108 Master tape
4	ID(4)	I	See word 4, 1108 Master tape
5	ID(5)	I	See word 5, 1108 Master tape
6	ID(6)	I	Delete flag*

*Delete flag word:

Bits	Description
0-2	Angle 1
3-5	Angle 2
6-8	Range
9-11	Range rate

Values of the delete flag:

0	Not deleted
1	Deleted by weight
2	Deleted by number
3	Deleted as a gross outlier

Data Records (continued)

Word	ID	Type	Description
7-8	D(1)	DP	Time
9-10	D(2)	DP	Tau interval
11-12	D(3)	DP	Angle 1
13-14	D(4)	DP	Angle 2
15-16	D(5)	DP	Range
17-18	D(6)	DP	Range rate or doppler
19-20	D(7)	DP	Gimbal 1
21-22	D(8)	DP	Gimbal 2
23-24	D(9)	DP	Gimbal 3
25-26	D(10)	DP	Receiver frequency
27-28	D(11)	DP	Transmitter frequency
29	D(12)	R	Angle 1 sigma
30	D(13)	R	Angle 2 sigma
31	D(14)	R	Range sigma
32	D(15)	R	Range rate or doppler sigma
33-34	RESID(1)	DP	Angle 1 residual
35-36	RESID(2)	DP	Angle 2 residual
37-38	RESID(3)	DP	Range residual
39-40	RESID(4)	DP	Range rate or doppler residual

7.5 JPL S-BAND MODIFIED FORMAT 6 TAPE

The 'TDF' (Tracking Data Format) option of the PROCESSOR PUNCH statement produces a non-FORTRAN, even parity, BCD image, magnetic tape containing card image observation frames. Each record contains one observation frame of 72 characters (12 words) per record. The format of each frame is the Jet Propulsion Laboratory (JPL) S-band modified format 6. This format is as follows:

Character Number	Description
1-2	Numeric receiver identification
3	Blank
4-5	Format identification

6	Blank = 06		
7-8	Object identification		
9	Blank		
	Value	Data Condition Code	
10	8	Nondestruct doppler	
11	0	Good doppler data	
	2	Bad doppler data, automatically recorded	
	4	Bad doppler manual switch	
	7	Bad doppler, range, manual switch	
12	0	Two-way coherent doppler	
	2	Three-way noncoherent doppler	
	6	Three-way coherent doppler	
13	0	Rubidium standard and synthesis VCO loop in lock	
	1	One of above out of lock	
14	Blank		
15-16	Hours		
17-18	Minutes		
19-21	Tenths of seconds		
22	Blank		
23-25	Day of year		
26	Blank		
27-36	Contents of the doppler counter in hertz at the time of sampling		
37	Blank		
38-40	Doppler resolver - a measure of the fraction of a cycle of doppler at the instant of counter sample (tenths of nanoseconds)		
41	Blank		
42-51	Range (decimal range units)		

52	Range data condition code	
	Value	Condition
	0	Good range in acquisition mode
	1	Bad range or not in acquisition mode
53-72	Blank	

7.6 ODF TAPE

Tapes in the OD format are created by the LOVE program and are formed by restructuring HOPE format tapes into tapes that may be input to the JPL orbit determination program. The OD format tapes contain FORTRAN logical records and are odd parity, 800 bits-per-inch density, seven-track tapes. Only observations from the stations listed in the following table will be included on these tapes. The station codes replace the abbreviations on the HOPE format tape.

ODFORMAT Station Code - Abbreviations

Code	Abbreviation	Station Name
1	BDA	Bermuda
2	CYI	Canary Islands
3	ACN	Ascension
4	RID	Madrid Wing
5	MAD	Madrid
6	CRO	Carnarvon
7	GWM	Guam
8	HSK	Honeysuckle Creek
9	NBE	Canberra Wing
10	HAW	Hawaii
11	GDS	Goldstone
12	PIR	Goldstone Wing
13	TEX	Texas
14	MIL	Merritt Island
15	ANG	Antigua

The OD format tape is composed of several record groups. A description of the contents and format of each group follows:

A. FILE IDENTIFICATION GROUP

1. Header Record

Word	Type	Value	Contents
1	I	11	Size (in SP words) of each logical record in A.2.0
2	I	4	Identifies content of A.2.0 records as HOL
3	I	1	Indicates group does not end with a trailer record
4	I	101	File identification group indicator
5	I	0	Not used

2. One Record which Identifies the File

Word	Type	Value	Contents
1	I	10	The number of integral words in the record
2-4	HOL	SPACECRAFT ID = xx	The xx is the spacecraft number
5-9	HOL	Y, M, D, H, M = xx, xx, xx, xx 1108	The x's represent the time the file was written
10-11	HOL	ODE = LOVE	The LOVE is the version of ODE that created the file

B. USER LABEL GROUP

1. Header Record

Word	Type	Value	Contents
1	I	15	Size (in SP words) of each logical record in B.2.0
2	I	4	Identifies content of B.2.0 record as HOL
3	I	0	Indicates group ends with a trailer
4	I	103	Label group indicator
5	I	0	Not used

2. Three Records of Hollerith Descriptive Text - The records contain comments under which the file was created.

a. Record 1

Word	Type	Value	Contents
1	I	14	The number of integral words in the record
2-3	HOL	"yymmddhhmmss"	Date and time run was made
4-5	HOL	1108 MASTER	
6-15	HOL		60 Hollerith characters (comments)

b. Records 2 and 3

Word	Type	Value	Contents
1	I	14	The number of integral words in the record
2-15	HOL		84 Hollerith characters (continued comments)

3. Group Trailer

Word	Type	Value	Contents
1	I	1	
2	HOL	000000	Six Hollerith zeros

C. ORBIT DATA SUMMARY GROUP

1. Header Record

Word	Type	Value	Contents
1	I	9	Size (in SP words) of each logical record in C.2.
2	I	2	Identifies content of C.2 records as double precision (DP)
3	I	0	Indicates group ends with a trailer
4	I	105	Orbit data summary group indicator
5	I	0	Not used

2. A Record for Each Data Type that Exists for Each Station

Word	Type	Value	Contents
1	I	4	Number of double precision words in the record
2	DP	1.00000000600eeffD+16	where c = tracking network indicator ee = receiving station number ff = data-type indicator
3	DP	Number of points	
4	DP	Time of earliest point	Seconds after January 1, 1950, 0:0:0.0
5	DP	Time of latest point	

3. Group Trailer

Word	Type	Value	Contents
1	I	1	
2,3	I	0.000	

D. ORBIT DATA IDENTIFIER GROUP

1. Header Record

Word	Type	Value	Contents
1	I	6	Size (in SP words) of each logical record in D.2.
2	I	4	Identifies content of D.2. records as HOL
3	I	1	Indicates group does not end with a trailer record
4	I	107	Orbit data identifier group indicator
5	I	0	Not used

2. One Record which Identifies the Various Fields and the Positions Within the Orbit Data Record

Word	Type	Value	Contents
1	I	5	Number of integral words in the record
2	HOL	TIMTAG	
3	HOL	IDWORD	
4	HOL	OBSVBL	
5	HOL	FREQCY	
6	HOL	PASSID	

E. ORBIT DATA GROUP

1. Header Record

Word	Type	Value	Contents
1	I	241	Size (in SP words) of largest logical record in E.2.
2	I	2	Identifies content of E.2. records as DP
3	I	0	Indicates group ends with a trailer
4	I	109	Orbit data group indicator
5	I	0	Not used

2. A Series of Records (possibly void)

Word	Type	Value	Contents
1	I	M	The number of double precision words of data in the record. M=120 except possibly for the last record in which M=R*5 where R is the number of logical data records containing one observation each

Words 2 to 2M+1 contain R logical data records. Each logical data record consists of five double precision words containing one Doppler observation. The data records are ordered in increasing order of time/net/station/data type. One logical data record is described as follows:

Word	Type	Value	Contents
1,2	DP		Time of observation; seconds after January 1, 1950, 0:0:0.0
3,4	DP		1.aaaaaaabcddeeffD+16 where aaaaaaa = Doppler compression time in hundredths of seconds for Doppler data b = radio band indicator 1 = S, 2 = X, 3 = L c = tracking network indicator 1 = DSN, 2 = STDN, 3 = ETR dd = transmitting station number ee = receiving station number ff = data-type indicator 11 = one-way Doppler 12 = two-way Doppler 13 = three-way Doppler 14 = three-way coherent Doppler 31 = ETR range 32 = MARK 1 range 33 = MARK 1A range 34 = Tau range 35 = Mu range 51 = azimuth 52 = elevation 53 = hour angle 54 = declination 55 = X30 56 = Y30 57 = X85 58 = Y85
5,6	DP		Doppler observable
7,8	DP		Reference frequency for Doppler, where reference frequency is defined as the frequency of the (i) transponder if Doppler ground mode is one-way (ii) transmitter if Doppler ground mode is two-way. Reference frequency is taken at light corrected time of data point
9,10	DP		1.aaaabD+16 where aaaa = pass identification b = split pass identification

3. Group Trailer

Word	Type	Value	Contents
1	I	1	
2	DP	0.0D0	

F. CONTROL STATEMENT GROUP

1. Header Record

Word	Type	Value	Contents
1	I	15	Size (in SP words) of each logical record in F.2.
2	I	4	Identifies content of F.2. records as HOL
3	I	0	Indicates group ends with a trailer
4	I	111	ODE control statement group indicator
5	I	0	Not used

2. Group Trailer

Word	Type	Value	Contents
1	I	1	
2	HOL	Six HOL zeros	

G. FILE CLOSE GROUP

1. Header Record

Word	Type	Value	Contents
1	I	1	
2	I	5	
3	I	0	
4	I	0	
5	I	0	

2. End of File Mark

7.7 TYPE DESCRIPTIONS

The following type identification codes are found in both the SORT tape format and the 1108 MASTER tape format:

1. ANGLE IDENTIFICATIONS - observable type word, bits 0-5 (word 6 of SORT, word 3 of MASTER)

Value	Description
0	No angles
1	AZ/EL
2	X-Y30
3	X-Y85
4	HA/DEC
5	Shaft/trunnion (scope)
6	Shaft/trunnion (sextant)
7	Sextant (trunnion only)
8	Shaft/trunnion (radar)

2. RANGE IDENTIFICATIONS - observable type word, bits 6-11 (word 6 of SORT, word 3 of MASTER)

Value	Description
0	No range
1	Range

3. DOPPLER IDENTIFICATIONS - observable type word, bits 12-17 (word 6 of SORT, word 3 of MASTER)

Value	Description
0	No range rate or doppler
1	Range rate
2	Two-way doppler
3	Three-way doppler
4	Three-way coherent doppler

4. ONBOARD INSTRUMENTS - observable type word, bits 24-29 (word 6 of SORT, word 3 of MASTER)

Value	Description
0	Not onboard
1	Rendezvous radar
2	Sextant
3	Telescope
4	VHF ranging radar
5	Landing radar

5. ONBOARD OBSERVATION TYPE - observable type word, bits 30-35 (word 6 of SORT, word 3 of MASTER)

Value	Description
0	Not onboard
1	Rendezvous radar (CSM)
2	Sextant (star/earth landmark)
3	Sextant (star/lunar landmark)
4	Sextant (star/earth horizon)
5	Sextant (star/lunar horizon)
6	Sextant or scope (LM)
7	Sextant or scope (STAR)
8	Sextant or scope (earth landmark)
9	Sextant or scope (lunar landmark)
10	LM on moon (CSM)
11	VHF ranging
12	Landing radar

6. RADAR TYPE - flag word, bits 25-29 (word 7 of SORT, word 5 of MASTER)

Value	Description
1	High speed USB
2	High speed FPS-16 (C-band)
3	High speed FPQ-6 (C-band)
4	High speed TPQ-18 (C-band)
5	High speed FPS-16M (C-band)
6	High speed ship
7	Low speed USB

8. LIMITATIONS

Each processing segment (PROCESSOR and EDITOR) of the LOVE program will process 19,000 observation frames in 15 minutes. The limitation of the number of observation data frames that can be processed is dependent upon the number of observation frames that can be placed on one output reel of magnetic tape. This limitation for the PROCESSOR is 100,000 frames and for the EDITOR is 60,000 frames.

The EDITOR common storage array IC is limited to 17,000 locations. All blocks created by the EDITOR segment are placed in this array as well as the input buffers for the input master tapes and the input buffers for the input statements. Although the common storage buffer is large, it will overflow if too many continuation cards are used (> 20).

Because of the limitation of the number of observations to be placed on a Master tape, SIC tape processing in the PROCESSOR should be limited to less than 2000 records in one case. Multiple cases in a single execution can be run to bypass this limitation.

Finally, it is not possible to process both Apollo SIC tapes and Skylab SIC tapes without the use of a special two-file, relocatable program tape. To use this version, the deck setup is prefaced with a selection program which allows either Skylab or Apollo data to be processed. The proper selection is obtained by inserting a data card with the name APOLLO or SKYLAB, beginning in column one.