

JPL PUBLICATION 85-50

Planetary Image Conversion Task

Final Report

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September 15, 1985



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APPENDIX A

ARCHIVE TAPE (VSFEDR) FORMAT DESCRIPTION

1. ARCHIVE TAPE FORMAT

The converted images are stored in a "uniform" output format, called VICAR standard format experiment data record (VSFEDR). The VICAR (Video Image Communication and Retrieval) format was developed within JPL's Image Processing Laboratory and has been used for almost two decades to allow simplified access to and processing of digital images. It also provides the capability to store supplementary information (image identification, location, and characteristics) as well as processing information (audit trail) in conjunction with the digital image itself.

The basic archive tape (VSFEDR) format is as follows:

- (1) VICAR standard header label.
- (2) Mission-dependent VICAR labels.
- (3) Digital image lines.
- (4) Engineering data appended to each line.
- (5) Mission-dependent EDR header record (Viking and Voyager only).

The efficient utilization of magnetic tape for data storage requires "blocking" of logical records into physical records to reduce the overhead required for interrecord gaps. In producing the archive tapes a blocksize approaching 32K bytes was used, which corresponds to the largest generally used I/O buffer area on modern computer systems. Because of the variable format of Viking Lander images, records were not blocked. Reference Table A-1 for VSFEDR tape physical characteristics by mission. Figures A-1 through A-5 illustrate the archive tape format for each mission.

Table A-1. Archive Image (VSFEDR) Formats

Mission	Logical Record Length	Physical Record Length	Physical Records in File	Lines per Image	Pixels per Line	Engineering Bytes
Voyager	1,280	32,000	33	800	800	480
Viking Orbiter	1,600	32,000	53	1056	1204	396
Viking Lander	9,000*	9,000*	*	512	*	n/a
Mariner 10	968	31,944	22	700	832	136
Mariner 9	968	31,944	22	700	832	136

* Variable, minimum record length = 360, maximum = 9000.

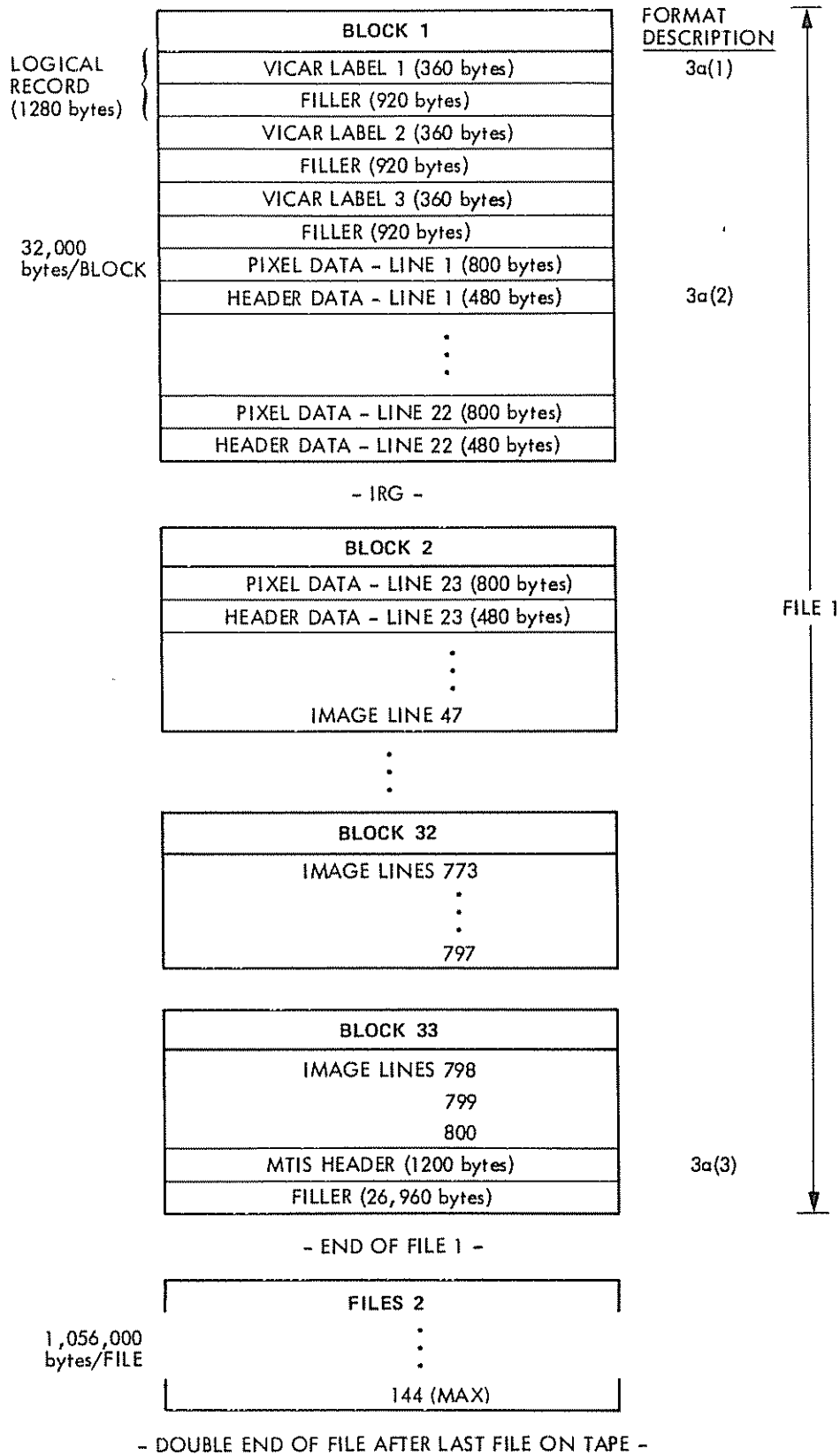


Figure A-1. Voyager Image File Format

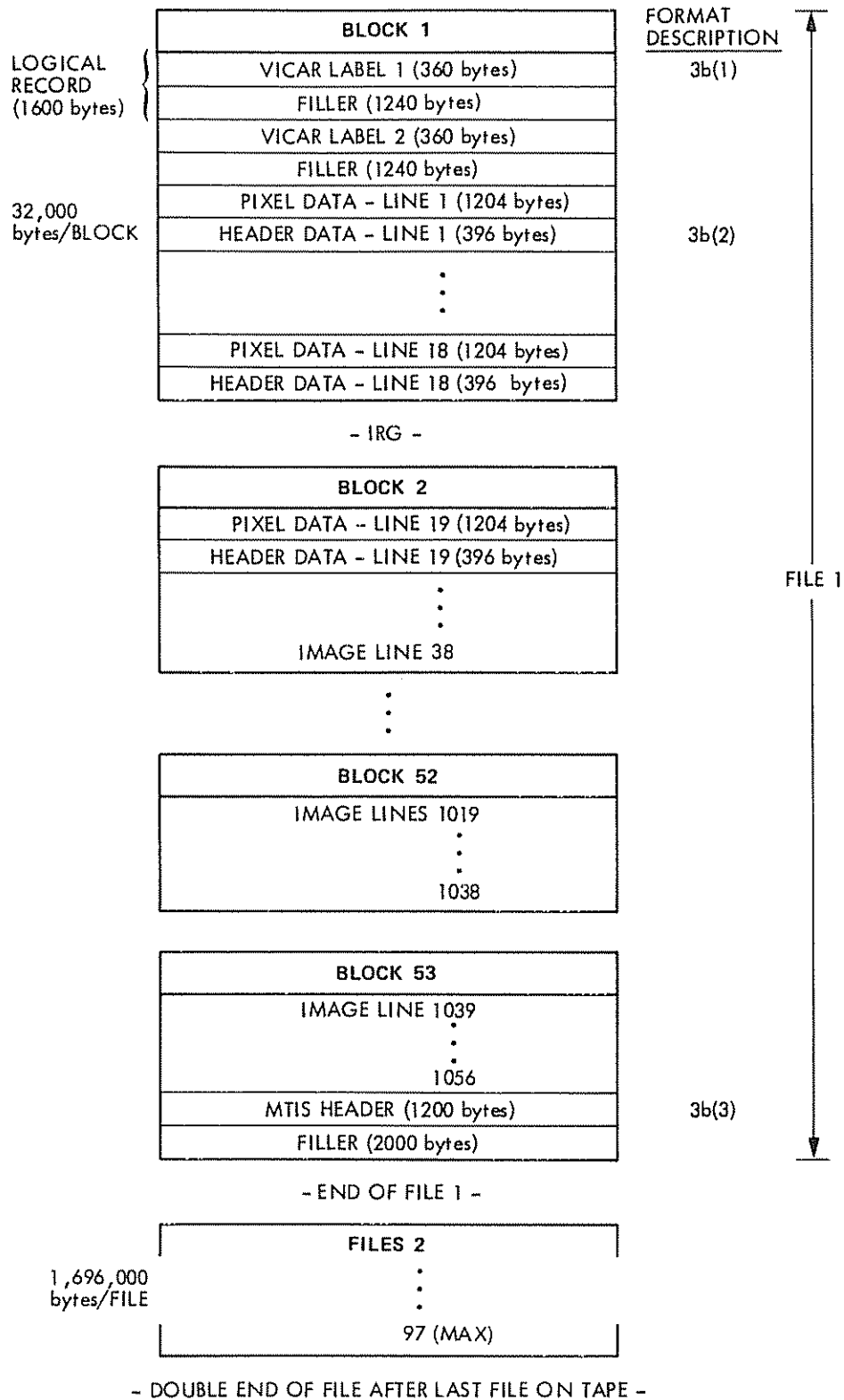


Figure A-2. Viking Orbiter Image File Format

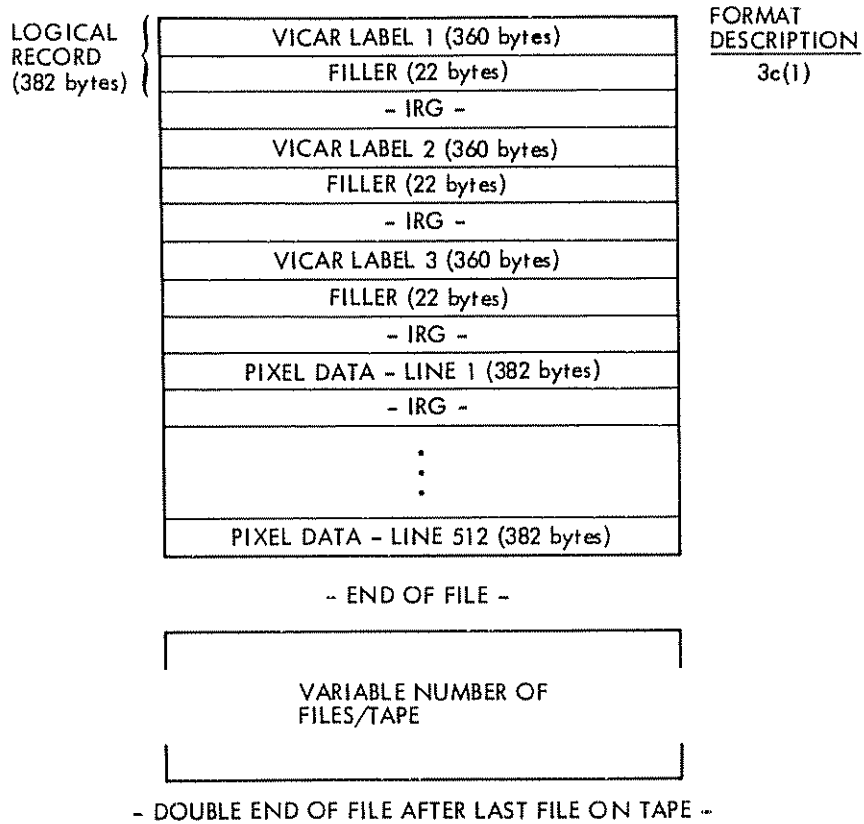


Figure A-3. Viking Lander Image File Format

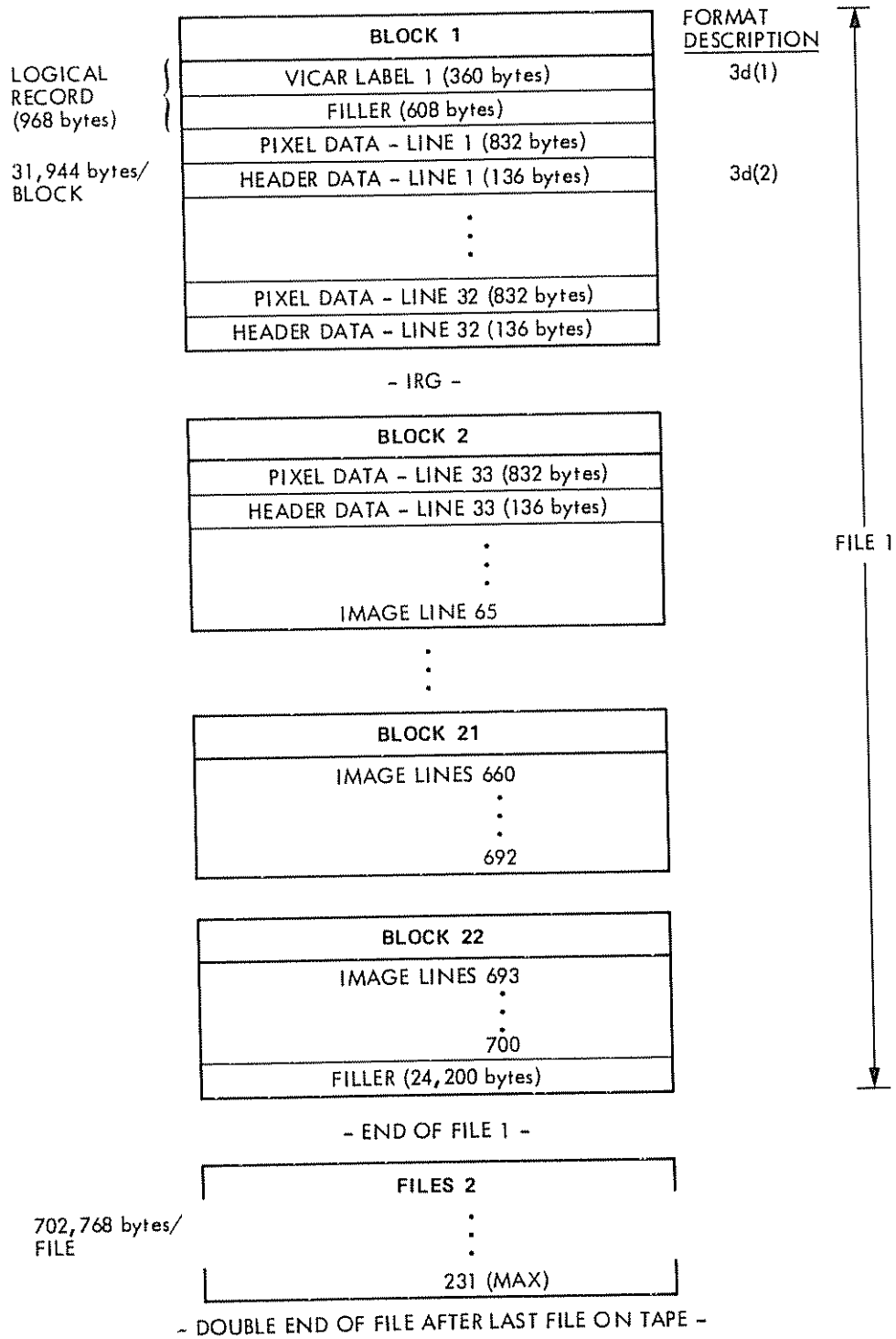


Figure A-4. Mariner 10 Image File Format

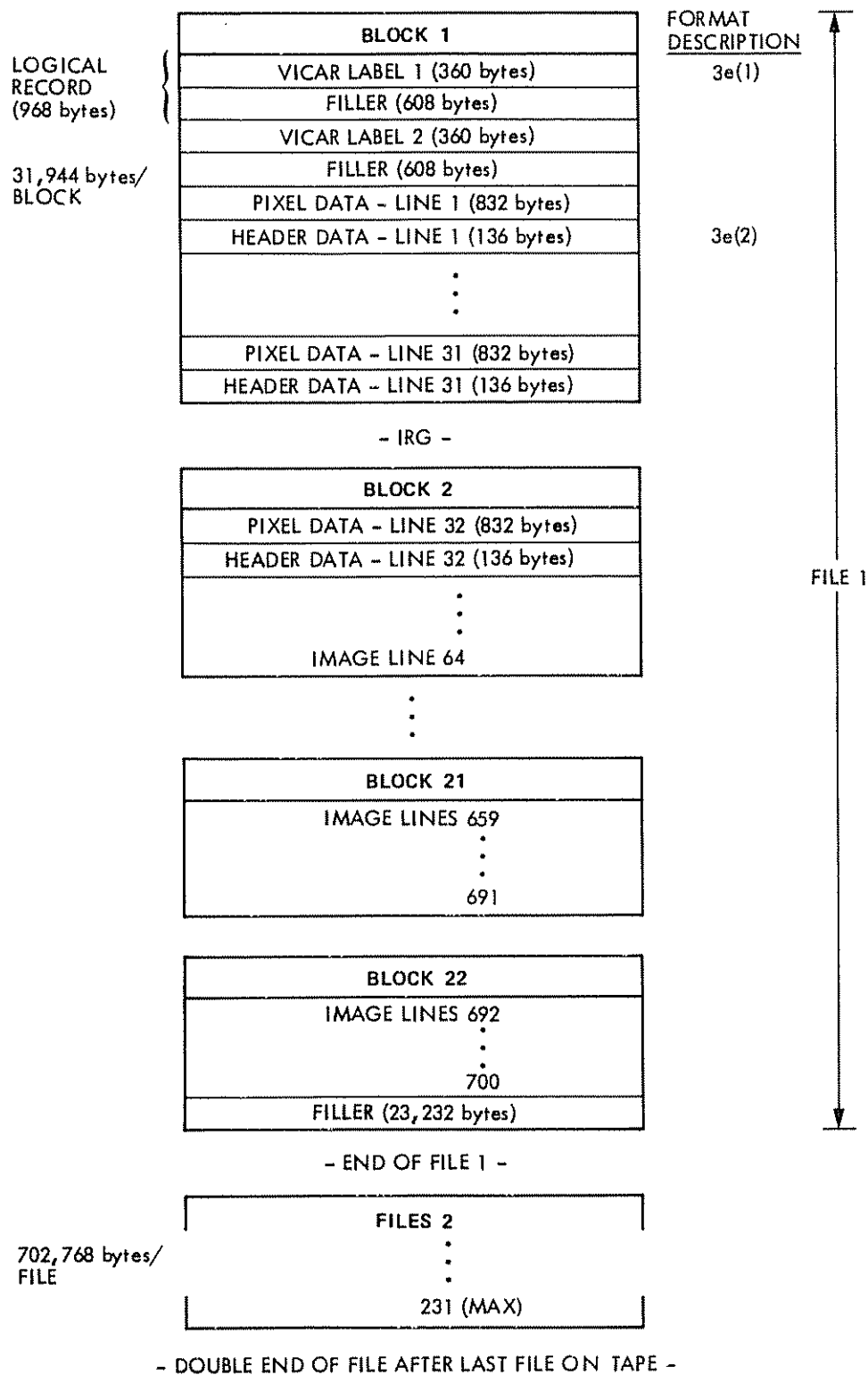


Figure A-5. Mariner 9 Image File Format

The VICAR format image is produced from a project EDR or MDR by executing a "logging" program. The logging programs were developed separately for each mission to handle the particular idiosyncrasies of project data record formats. Basic logging program functions are to construct a VICAR label set for the output file, read the project EDR and strip out just the image pixel data, write out the VICAR image file, and report on the success of these activities to the user. In producing the VICAR format image certain header data and engineering telemetry parameters carried by the EDR are eliminated. This was not considered acceptable for the development of the VSFEDR archive so the logging programs had to be modified to retain all EDR data. This was done by moving all engineering header data associated with an image line to the tail of the image data within a single logical line record. Project header records were stored in a buffer and inserted in the VSF output file after the last line record. Thus, all engineering parameters are retained, but may be conveniently ignored by the user when the image file is read.

2. VICAR LABEL FORMAT

VICAR labels are stored in character string format, appearing as 72 byte records, normally grouped into 360 character blocks, each containing 5 or less label records. The first record, a VICAR header record, defines the image data format and size. A variable number of application dependent label records follow, terminated by a label record containing a character "L" in byte 72. Like the imaging EDR formats, the VICAR label records used by IPL vary from mission to mission. In general the image id comes first, followed by engineering parameters defining the camera state and a subset of SEDR parameters including the image footprint latitude and longitudes, and other useful interpretive parameters (picture size, range to target, lighting and viewing conditions).

The VICAR standard system label precedes each set of mission specific labels. The format adopted in 1977 is as follows:

(all characters represented in EBCDIC format)

Byte 1 to 2	- Characters "77" or blank
Byte 17 to 24	- Number of lines in image or blank.
Byte 25 to 32	- Number of samples in image or blank.
Byte 33 to 36	- Number of lines in image.
Byte 37 to 40	- Number of samples per line.
Byte 41 to 42	- Pixel code - "L" or "I" for binary integer.
Byte 43 to 44	- Bytes per sample (1).
Byte 71	- Label identification (not always present).
Byte 72	- Character "C" indicating more labels follow, or "L" to indicate the last label.

Formats for additional VICAR labels are shown below. Note that the number of lines for Viking Orbiter and Voyager images includes an extra line which is actually the MTIS EDR header label, appended after the last actual image line in a file. The number of samples includes any engineering telemetry bytes appended at the end of the actual pixel values for the line. Most users can ignore these extra lines and samples in processing archive image files.

Viking Orbiter, Mariner 10, and Mariner 9 labels are always identical. Viking Lander labels may vary due to the list of missing lines at the end of the label set. A great number of images do not have SEDR values in the positions allocated for them in the VICAR label format. Even when values appear, they can not be guaranteed to contain valid data values. For accurate SEDR data the mission specific SEDR or picture catalog should be used.

3. ARCHIVE FILE CONTENTS BY MISSION

This section describes the labels and engineering parameters included in the archive tape format for each mission data set. The VICAR header labels for each mission are presented first, followed by a description of the engineering parameters contained in EDR image file header records, and those associated with each image line.

a. Voyager File Format

Each Voyager image file consists of 33 blocks containing 32,000 bytes per block. Each block is composed of 25 logical records of 1280 bytes each. The first three logical records of the first block contain 3 sets of VICAR label information. The labels are followed by 800 logical records (one per image line) containing pixel data and engineering data. A 1280-byte MTIS EDR header record follows the last line record of the image. The data contents of the labels, engineering data, and header record are provided below. Definitions for the parameters in the header records were taken from JPL document 618-792 (Ref. A-1).

1) Voyager VICAR Labels

```

77          0801    1280 8011280 L 1          SC
VGR-1  FDS 15187.04  PICNO 1659J1-041  SCET 79.024 10:12:35  C
NA CAMERA EXP 00240.0 MSEC FILT 2( BLUE ) LO GAIN SCAN RATE 1:1  C
ERT 79.024 22:04:05  1/ 1 FULL RES VIDICON TEMP -81.00 DEG C  C
IN/100520/21 OUT/*****/**          DSS #** BIT SNR 9.617  C

OFFE5 A/45000BD7 B/6101 C/397F D/007F0000 ETLM/001800CB00GA00A50012Q  C
NA OPCAL 00(*****.* MSEC) PIXAVG 248/1 OPERATIONAL MODE 2(NAONLY)  C
CAM ECAL CYCLE BEAM RESET OPEN CLOSE FLOOD AEXPM FIL G1 SHUT MODE  C
NA NO READ YES NO NO NO NO NO 2 P * NORMAL  C
WA NO PREP NO YES NO NO NO NO 2 P 7 NORMAL  C

INCIDENCE ANGLE 97.6 EMISSION ANGLE 90.2 PHASE ANGLE 104.2  C
NORTH AZIMUTH ANGLE 45.1 KM/LINE 2.06 KM/SAMP 2.06  C
ALT 220406 KM SL.RANGE 0 KM VFOV 1594 KM HFOV 1396 KM  C
LAT 11(UL) 27(UR) 33(LL) 52(LR) 30(C) 14(SUB S/C) 0(SUBSOL)  C
LONG 202(UL) 247(UR) 195(LL) 186(LR) 196(C) 294(SUB S/C) 189(SUBSOL)  L

```

2) Voyager Line Header Data

The Voyager MTIS EDR line header contains 220 bytes of data. It consists of a 116-byte MTIS header block, 76-byte source data summary, and 28-byte status/engineering block. Byte locations are given relative to the start of the header block, which would actually be byte 801 of the VSFEDR line record.

Byte	Contents
------	----------

MTIS Header Block:

1 -	2	Record id (8 bits), unused (8 bits).
3 -	4	Physical sequence number on tape.
5 -	6	Logical sequence number on tape.
7 -	8	ERT year of century (7 bits), day of year (9 bits).
9 -	10	ERT minute of day (11 bits).
11 -	12	ERT milliseconds of minute.
13 -	18	Unused.
19 -	20	FDS mod 16 count.
21 -	22	FDS mod 60 count.
23 -	24	FDS line count.
25 -	36	Unused.
37 -	68	MTIS physical recording words 1 to 16 (16 bits each).
69 -	70	GCF sync code (MSB).
71		GCF sync code (LSB).
72		Source code.
73		Destination code.
74		Block format code.
75 -	76	GDD (3 bits), UDT code (7 bits), DDT code (6 bits).
77 -	78	"O", Spacecraft number (7 bits), time (MSB).
79 -	80	Time (LSB).
81 -	82	Unused (2 bits), day of year (12 bits), block serial number MSB (2 bits).
83		LSB of block serial number.
84		Millisecond clock.
85		Serial number.
86		GCF configuration status.
87 -	88	Unused (13 bits), esc (2 bits), unused (1 bit).
89 -	116	Unused.

Source Data Summary Block:

117 -	118	Line number.
119 -	120	Format id.
121 -	122	Bit signal-to-noise ratio.
123 -	124	Unused.
125 -	126	Symbol synchronizer signal-to-noise ratio.
127 -	128	Unused.
129 -	130	AGC.
131 -	132	Unused.

- 133 - 134 Number of sync code errors.
- 135 - 136 Number of FDS count errors.
- 137 - 138 Unused.
- 139 - 140 Allowed number of sync code errors.
- 141 - 142 Allowed number of FDS count errors.
- 143 - 144 Number of minor frames.
- 145 - 146 Number of full minor frames.
- 147 - 148 Number of partial minor frames.
- 149 - 150 Number of mission minor frames.

The following ten 16-bit words contain the sync status in bits 1 and 2:

- 151 - 170 Number of frame id errors MF #1 through MF #10.
- 171 - 190 Number of bits retained MF #1 through MF #10.
- 191 Input source.
- 192 Input type.

Status/Engineering Block:

- 193 - 212 Imaging science subsystem status/engineering word MF #1 through MF #10.
- 213 - 216 Unused.
- 217 - 218 First valid pixel id.
- 219 - 220 Last valid pixel id.

3) Voyager MTIS EDR Header Block

This block occurs after the last VSFEDR line record in each image file. It is composed of a 116-byte MTIS header block, 76-byte source data summary, 56-byte status/engineering summary, and 1024-byte source data histogram.

Byte	Contents
------	----------

MTIS Header Block:

- | | |
|---------|---|
| 1 | Record id. |
| 2 | File number. |
| 3 - 4 | Physical sequence number on tape. |
| 5 - 6 | Logical sequence number on tape. |
| 7 - 8 | ERT year of century (7 bits), day of year (9 bits). |
| 9 - 10 | ERT minute of day (11 bits). |
| 11 - 12 | ERT milliseconds of minute. |
| 13 - 14 | ERT year of century (7 bits), day of year (9 bits). |
| 15 - 16 | ERT minute of day (11 bits). |
| 17 - 18 | ERT milliseconds of minute. |
| 19 - 20 | FDS mod 16 count. |
| 21 - 22 | FDS mod 60 count. |
| 23 - 24 | FDS line count. |
| 25 - 26 | FDS mod 16 count. |

27 - 28 FDS mod 60 count.
29 - 30 FDS line count.
31 - 32 SCET year of century (7 bits), day of year (9 bits).
33 - 34 SCET minutes of day.
35 - 36 SCET milliseconds of minute.
37 - 68 MTIS physical recording words 1 to 16 (16 bits each).

GCF Parameters for First Line Record:

69 - 70 GCF sync code (MSB).
71 GCF sync code (LSB).
72 Source code.
73 Destination code.
74 Block format code.
75 - 76 GDD (3 bits), UDT code (7 bits), DDT code (6 bits).
77 - 78 "0", Spacecraft number (7 bits), time (MSB).
79 - 80 Time (LSB).
81 - 82 Unused (2 bits), day of year (12 bits), block serial number
MSB (2 bits).
83 LSB of block serial number.
84 Millisecond clock.
85 Serial number.
86 GCF configuration status.
87 - 88 Unused (13 bits), esc (2 bits), unused (1 bit).

GCF Parameters for Last Line Record:

89 - 90 GCF sync code (MSB).
91 GCF sync code (LSB).
92 Source code.
93 Destination code.
94 Block format code.
95 - 96 GDD (3 bits), UDT code (7 bits), DDT code (6 bits).
97 - 98 "0", Spacecraft number (7 bits), time (MSB).
99 - 100 Time (LSB).
101 - 102 Unused (2 bits), day of year (12 bits), block serial number
MSB (2 bits).
103 LSB of block serial number.
104 Millisecond clock.
105 Serial number.
106 GCF configuration status.
107 - 108 Unused (13 bits), esc (2 bits), unused (1 bit).
109 - 116 Unused.

Source Data Summary Block:

117 - 118 Unused.
119 - 120 Format id.
121 - 122 Bit signal-to-noise ratio minimum.
123 - 124 Bit signal-to-noise ratio maximum.
125 - 126 Symbol synchronizer signal-to-noise ratio minimum.
127 - 128 Symbol synchronizer signal-to-noise ratio maximum.
129 - 130 AGC minimum.

131	-	132	AGC maximum.
133	-	134	Number of sync code errors.
135	-	136	Number of FDS count errors.
137	-	138	Sync parameters.
139	-	140	Allowed number of sync code errors.
141	-	142	Allowed number of FDS count errors.
143	-	144	Number of lines.
145	-	146	Number of full lines.
147	-	148	Number of partial lines.
149	-	150	Number of unreadable records.
151	-	152	Number of logical sequence breaks.
153	-	160	Sort parameter 1 thru 4 (16 bits each).
161	-	162	Number of minor frames from IDR.
163	-	164	Number of minor frames from WBDL.
165	-	166	Number of minor frames from SDR.
167	-	168	Number of missing minor frames.
169	-	170	Unused.
171	-	180	Picno (picture count, target, spacecraft, day).
181	-	190	Unused.
191			Input source.
192			Input type.

Status/Engineering Data:

193	-	194	Shuttered picture indicator.
195	-	196	Slow scan status.
197	-	198	Exposure time, filter, elec cal.
199	-	200	Picture count.
201	-	220	Parameter A through D values, 3 16-bit values each, representing a present value, word indicator and word pointer.
221	-	230	Ten 8-bit analog samples with the 8 MSB of each word representing the narrow-angle camera sample and the 8 LSB representing the wide-angle camera.
231	-	232	Pixel average, command status.
233	-	242	ISS engineering measurements.
243	-	248	Unused.

Source Data Histogram:

249	-	252	Number of pixels with value 0 (32 bits).
253			Number of pixels with value 1 ... 254.
1269	-	1272	Number of pixels with value 255 (32 bits).
1273	-	1274	Unused.
1275	-	1276	FDS mod 16 count.
1277	-	1278	FDS mod 64 count.

b. Viking Orbiter File Format

Each Viking Orbiter image file consists of 53 blocks containing 32,000 bytes per block. Each block is composed of 20 logical records of 1600 bytes each. The first two logical records of the first block contain 2 sets of VICAR label information. The labels are followed by 1056 logical records

(one per image line) containing pixel data and engineering data. A 1200-byte MTIS EDR header record follows the last line record of the image. The data contents of the labels, engineering data, and header record are provided below. Definitions for the engineering parameters in the header records are taken from JPL document 620-319 (Ref. A-2).

1) Viking Orbiter VICAR Labels

```

77                               10571600 L 1           C
VO75 1A PICNO= 209A11                               C
                               FILTER 4 (CLEAR) EXP   13 MSEC FGD 111   C
FSC 29993423          OET-GMT 77 018 05 13 37        TPER +00 28 39   C
RNG= 6491 KM HFOV=   94 KM VFOV=   89 KM          SCL=   79 M/PXL       C

SMEAR= 0.4 PXLs          SMRDIR= 128 DEG FROM UP      HRA 234 DG       C
NOR AZ 196 DG SUN AZ   87 DG S/C AZ 286 DG  INA 58 DG  EMA 18 DG       C
PHA 75 DG SUNS LS= 188.0 DG  EDR=           /02 MAX-D=           C
LAT  C= +21.40  UL= +22.36  UR= +20.84  LL= +21.96  LR= +20.42       C
LONG C= 5.73   UL= 5.22    UR= 4.70   LL= 6.79   LR= 6.25           L

```

2) Viking Orbiter Line Header Parameters

The Viking Orbiter EDR line record header contains 396 bytes of data. It is composed of a 32-byte MTIS header, 56-byte source data summary, seven 32-byte SDR header records (one per track), and seven 12-byte V1280 flyback blocks. Locations are given relative to the start of the header block which is actually at byte 1205 of the line record.

Byte	Contents
------	----------

MTIS Header Block:

1 -	1	Record id.
2		Unused
3 -	4	Recording sequence number on EDR tape.
5 -	6	Logical sequence number on EDR file.
7		Year of century of start of data.
8		Day of year of start of data.
9 -	10	Minutes of day of start of data (10 bits).
11 -	12	Milliseconds of minute of start of data.
13		Year of century of end of data.
14		Day of year of end of data.
15 -	16	Minutes of day of end of data (10 bits).
17 -	18	Milliseconds of minute of start of data.
19 -	22	FDS time of start of data.
23 -	26	FDS time of end of data.
27 -	32	EDR tape id (ASCII).

Source Data Summary Block:

33		Unused.
34		File number on EDR tape.
35		Fill in type.
36		Track presence mask.
37	-	38 Average pixel value.
39	-	40 Unused.
41	-	42 Data Receipt Site Mask.
43	-	44 Minimum signal-to-noise ratio (SNR).
45	-	46 Maximum signal-to-noise ratio (SNR).
47	-	48 Unused.
49	-	50 Minimum average gain control (AGC).
51	-	52 Maximum average gain control (AGC).
53	-	54 Unused.
55	-	56 Total number of segments.
57	-	58 Number of fully synched segments.
59	-	60 Number of partially synched segments.
61	-	62 Number of segments with data quality ind = 0.
63	-	64 Number of segments with data quality ind = 1.
65	-	66 Number of segments with data quality ind = 2.
67	-	68 Number of segments with data quality ind = 3.
69	-	70 Number of segments with data quality ind = 4.
71	-	72 Number of corrected FDS counts.
73	-	74 Number of pseudonoise code (pn) errors.
75	-	88 Unused.

SDR Data Blocks. The following data block repeats for each of the seven sets of line segments used to generate the image. Data locations are shown for the first segment. Locations for succeeding segments are at loc + ((segment-1) * 32).

89	-	90	Data quality indicator (3 bits), rate code (3 bits), revision number (10 bits).
91	-	92	MSB of average gain control (? bits), bit sync flag (1 bit), be (1 bit), unused (? bits).
93	-	94	LSB of average gain control (4 bits), signal-to-noise ratio (12 bits).
95	-	96	Lock count (number of continuously locked telem frames).
97	-	98	MSB of FDS count (? bits).
99	-	100	LSB of FDS count (? bits).
101	-	102	TD PF (? bits), track number (? bits), line number (? bits).
103	-	104	DSS station id (8 bits), milliseconds of minute (8 bits).
105	-	106	GCF UTD (? bits), day of year (? bits).
107	-	108	SC(1) (1 bit), DSIF lock status (? bits), MSB of seconds of minute (? bits).
109	-	110	GCF DDT (8 bits), LSB of seconds of minute (? bits).
111	-	112	SC(2) (? bits), DSIF configuration code (? bits).
113	-	114	Sync error (? bits), data bit count (? bits).
115	-	116	DP (1 bit), unused (1 bit), HEW index (? bits), housekeeping engineering word (? bits).

117 - 118 DP (1 bit), unused (1 bit), SEW index (? bits), science engineering word (? bits).
 119 - 120 Unused.

V1280 Flyback Block. This block repeats 7 times, one for each set of line segments used to construct the line. The location of data values in segments 2 - 7 is $loc + ((track - 1) * 12)$.

313 - 314 Unused (2 bits), MSB of sync word (14 bits).
 315 - 316 LSB of sync word (14 bits), MSB of track id (1 bit).
 317 - 318 LSB of track id (2 bits), engineering data (5 bits), MSB of picture id (9 bits).
 319 - 320 LSB of picture id (10 bits), MSB of line id (6 bits).
 321 - 322 LSB of line id (5 bits), FDS flag (1 bit), HRD (1 bit), embedded science data (5 bits), unused (4 bits).
 323 - 324 Unused.

3) Viking Orbiter EDR Header Record Format

This block occurs after the last VSFEDR line record in each image file. It is composed of a 32-byte MTIS header block, 80-byte source data summary, 48-byte status/engineering summary, and 1024-byte source data histogram.

Byte	Contents
------	----------

MTIS Header Block:

1	-	1	Record id.
2			Unused.
3	-	4	Recording sequence number on EDR tape.
5	-	6	Logical sequence number on EDR file.
7			Year of century of start of data.
8			Day of year of start of data.
9	-	10	Minutes of day of start of data (10 bits).
11	-	12	Milliseconds of minute of start of data.
13			Year of century of end of data.
14			Day of year of end of data.
15	-	16	Minutes of day of end of data (10 bits).
17	-	18	Milliseconds of minute of start of data.
19	-	22	FDS time of start of data.
23	-	26	FDS time of end of data.
27	-	32	EDR tape id (ASCII).

Source Data Summary Block:

33			Unused.
34			File number on EDR tape.
35			Fill-in type.
36			Track presence mask.

37	-	38	Average pixel value.
38	-	40	Unused.
41	-	42	Data Receipt Site Mask.
43	-	44	Minimum signal-to-noise ratio (SNR).
45	-	46	Maximum signal-to-noise ratio (SNR).
47	-	48	Unused.
49	-	50	Minimum average gain control (AGC).
51	-	52	Maximum average gain control (AGC).
53	-	54	Unused.
55	-	56	Total number of segments.
57	-	58	Number of fully synched segments.
59	-	60	Number of partially synched segments.
61	-	62	Number of segments with data quality ind = 0.
63	-	64	Number of segments with data quality ind = 1.
65	-	66	Number of segments with data quality ind = 2.
67	-	68	Number of segments with data quality ind = 3.
69	-	70	Number of segments with data quality ind = 4.
71	-	72	Number of corrected FDS counts.
73	-	74	Number of pseudonoise code (pn) errors.
75	-	76	Number of adjusted pn errors.
77	-	78	Number of unreadable source data records.
79	-	80	Number of source data logical sequence breaks.
81	-	82	Number of source data breaks.
83	-	84	Unused.
85	-	86	Number of lines.
87	-	88	Number of full lines.
89	-	90	Number of partial lines.
91	-	92	First line number.
93	-	94	Last line number.
95	-	96	Unused.
97	-	102	Picno - orbit, spacecraft, sequence in orbit (ASCII).
103	-	104	Viking reconstruction processing run number.
105	-	110	EDF disk label.
111	-	112	Unused.

Telemetry Engineering Summary Block. Each value in this block consists of two bytes (16 bits). Bit one of each word represents a data presence flag (0 = absent, 1 = present). Bit 2 is unused. Bits 3, 4, and 5 contain the data quality indicator associated with the measurement (0 = bad, 4 = good). Bit 6 is unused. The value(s) represented by the remaining bits are described below.

113	-	114	Transmitted code word. C (1 bit), gain code (1 bit), light flood (1 bit), filter (2 bits), exposure (5 bits).
115	-	116	Binary '101' (3 bits), filter number (3 bits), camera serial number (4 bits).
117	-	118	Received code word. C (1 bit), gain code (1 bit), light flood (1 bit), filter (2 bits), exposure (5 bits).
119	-	120	Unused.
121	-	122	+50 volts dc.
123	-	124	+15 volts dc.
125	-	126	+12 volts dc.
127	-	128	+5 volts dc.
129	-	130	-15 volts dc.

131 - 132 -23 volts dc.
133 - 134 Average video.
135 - 136 Power converter input 1.
137 - 138 Cathode current 1.
139 - 140 Cathode current 2.
141 - 142 Filament 1.
143 - 144 Frame sweep 1.
145 - 146 Line sweep 1.
147 - 148 Grid 3 voltage.
149 - 150 Focus 1.
151 - 152 Digital ladder.
153 - 160 Unused.

Source Data Histogram. This source data histogram contains a series of 256, 4-byte (32-bit), values giving the count of occurrences of each pixel value within the image. The first entry represents the number of pixels with value 0, followed by the number of pixels with value 1, etc., up to 255.

161 - 164 Number of pixels with value 0.
165 - 168 Number of pixels with value 1.
169 - 1196 Values 2 through 254.
1197 - 1200 Number of pixels with value 255.

c. Viking Lander File Format

Each Viking Lander image file consists of 515 or more blocks (depending on the number of label records) containing a variable number of bytes per block. The number of bytes per block is equal to the number of scan lines taken by the camera or 360, whichever is larger. The data contents of the labels are shown below.

1) Viking Lander VICAR Labels

1	1	512	382	I	1		C
VIKING LANDER 1	CAMERA 2				CE LABEL 11J191/172		C
DIODE BB4	STEP SIZE 0.04				CHANNEL/MODE 5/2		C
AZIMUTH 20/215.0	ELEVATION -10(-20.22/			0.22)			C
OFFSET 1	GAIN 2	SCAN RATE 16K			DCS ACTIVE		C
DATA RATE 12324	PSA TEMP 12C(37)				DATA PATH REC/UH		AC
LINES TOTAL 382	RESCAN BEGIN 376				RESCAN TOTAL 7		C
SUN AZ/EL 140.1/68.3	ANTI-SOLAR AZ/EL 258/-65						C
LLD/T 172/17:24:39	DATA LINK RAWEDR				EVENT D/GMT 013/06.33.56		C
AVE DN VALUE 107.30	STAND DEV 29.06				RANGE 20 TO 240		AC
MISSING LINES 0	GAPS 0				PERCENT MISSING 0.00		AC
SOURCE TAPE/FILE DMI051/ 9					VICAR TAPE/FILE DN0098/13		C
SEGMENT AZ/EL/STEP SIZE 200.000/	0.220/0.04000000						C
STRETCH - TEXTAD - TEXTAD							HL

2) Viking Lander Missing Lines Labels

MISSING LINE GAPS (FIRST-LAST) 1438-1438 C

3) Viking Lander Calibration Labels

UNO7UNO7UNO7UNO7	IR1 IR1 IR1 IR1	RED RED RED RED	BB3 BB3 BB3 BB3	AC
BB4 BB4 BB4 BB4	IR3 IR3 IR3 IR3	BLU BLU BLU BLU	BLUSURVSURVSURVSURV	AC
UNO6UNO6UNO6UNO6	IR2 IR2 IR2 IR2	GRN GRN GRN GRN	UN12UN12UN12UN12	AC
SUN SUN SUN SUN	BB1 BB1 BB1 BB1	BB2 BB2 BB2 BB2		AL

d. Mariner 10 File Format

Each Mariner 10 image file consists of 22 blocks containing 31,944 bytes per block. Each block is composed of 33 logical records of 968 bytes each. The first logical record of the first block contains a single set of VICAR label information. The labels are followed by 700 logical records (one per image line) containing pixel data and engineering data. The data contents of the labels and engineering data are provided below.

1) Mariner 10 VICAR Labels

77			700 968 L 1	SC
MVM73	FDS=0057910	IM-1	ERT YR=74 DAY=036 GMT=18/21/02	C
CAMERA=B	FILTER=6(UV)		NOMINAL EXPOSURE= 45.7 MSEC	L

2) Mariner 10 Line Header Data

The Mariner 10 header block consists of a byte header block and a byte subheader block. Definitions for these engineering values are taken from JPL document 615-43 (Ref. A-3). Locations of parameters are given relative to the beginning of the header data, which is actually at byte 833 in the VSFEDR line record.

Bit	Contents
-----	----------

Header Block:

1	-	18	Record id.
19	-	36	Record sequence number on tape.
37	-	54	Record id sequence number.
55	-	64	GMT start time milliseconds.
65	-	73	GMT start time day.
74	-	90	GMT start time seconds.
91	-	100	GMT stop time milliseconds,
101	-	109	GMT stop time day.
110	-	126	GMT stop time seconds.
127	-	144	Unused.

145 - 160 Unused.
 161 - 180 FDS count (increments once per lines)
 176 - 180 Das subtime (line count between das time increments).
 181 - 188 Unused.
 189 - 198 FDS minor frame count (cycles 1 to 700 for every FDS count increment (image)).
 199 - 216 Unused.
 217 - 220 Rate code of transmitted data.
 221 - 234 Number of data bits in this record.
 235 - 252 Number of consecutive in-sync frames.
 253 - 360 Unused.

Subheader Block. The following subheader data are formatted in 18-bit words beginning with a data flag bit (0=available, 1=not available) followed by 17 bits representing the data item value right justified in the field.

361 - 576 Unused.
 577 - 594 IM-1 unused; IM-3 pixel edit option flag (1 bit).
 595 - 612 TV status data (16 bits).
 613 - 630 TV exposure data (14 bits).
 631 - 648 Filter position data (4 bits).
 649 - 666 CC-5-8 coded command (13 bits).
 667 - 684 CC-5-9 coded command (13 bits).
 685 - 702 CC-5-10 coded command (13 bits).
 703 - 720 CC-5-11 coded command (13 bits).
 721 - 738 TV housekeeping word 1 (10 bits).
 739 - 756 TV housekeeping word 2 (10 bits).
 757 - 774 TV housekeeping word 3 (10 bits).
 775 - 792 TV housekeeping word 4 (10 bits).
 793 - 810 TV housekeeping word 5 (10 bits).
 811 - 828 TV housekeeping word 6 (10 bits).
 829 - 846 TV housekeeping word 7 (10 bits).
 847 - 864 TV housekeeping word 8 (10 bits).
 865 - 882 TV housekeeping word 9 (10 bits).
 883 - 900 TV housekeeping word 10 (10 bits).
 901 - 1088 Fill.

e. Mariner 9 File Format

Each Mariner 9 image file consists of 22 blocks containing 31,944 bytes per block. Each block is composed of 33 logical records of 968 bytes each. The first logical record of the first block contains a single set of VICAR label information. The labels are followed by 700 logical records (one per image line) containing pixel data and engineering data. The data contents of the labels and engineering data are provided below.

1) Mariner 9 VICAR Labels

77		700 968 L 1		SC
MARINER 9	115A31/32	YR 72 DAY 10 GMT 225324	DAS TIME 05708398	C
PICTURE NUMBER	03495	EXP TIME 192 MSEC	FILTER POS 8	C
ALT 2200 KM		APPROX WIDTH 1418 KM	APPROX HT 766 KM	C
VIEW ZENITH ANGLE 59.0		SOLAR ZENITH ANGLE 77.3	PHASE ANGLE 78.0	C

LONGITUDE-CENTER 116.7 CORNERS ***** 107.2 126.2 110.0
 LATITUDE--CENTER 40.2 CORNERS ***** 43.8 37.5 31.1

C
L

2) Mariner 9 Line Header Data

The VSFEDR header data appended to each Mariner 9 imaging line is a copy of the R7938 telemetry header and subheader data for each line of pixel values. Values for these fields are taken from JPL document 610-124 (Ref. A-4). Bit locations are given relative to the start of the header which is actually at byte 833 or bit 6657. The header consists of 20 18-bit words and the subheader is 30 18-bit words (total 50 x 18 bits = 900 bits or 113 data bytes plus 23 fill bytes) as follows:

Bit	Contents
-----	----------

Header Block:

1	-	3	Spacecraft serial number.
4	-	6	Octal 3.
7	-	18	Data stream identifier.
19	-	36	Record sequence number.
37	-	54	Record id sequence number.
55	-	64	GMT start time milliseconds.
65	-	73	GMT start time day.
74	-	90	GMT start time seconds.
91	-	100	GMT stop time milliseconds.
101	-	109	GMT stop time day.
110	-	126	GMT stop time seconds.
127	-	144	Unused.
145	-	150	Unused.
151	-	175	Das time (increments once per 20 lines)
176	-	180	Das subtime (line count between das time increments).
181	-	270	Unused.
271	-	271	Decommutation mode (0=frame, 1=PN).
272	-	285	Unused.
286	-	288	PN errors allowed.
289	-	290	PN sequence status (1=no leading or trailing, 2=no leading, good trailing, 3=good leading no trailing, 4=good leading and good trailing).
291	-	303	Number of data bits in record.
304	-	306	Number of bit errors found in leading PN.
307	-	314	Half word in data block containing first element.
315	-	324	Current line count.
325	-	327	Unused.
328	-	332	Number of bits per pixel.
333	-	342	Number of pixels per line.
343	-	347	Unused.
348	-	350	Number of pixels per word.
351	-	360	Number of lines per picture.

Subheader Block. The following subheader data are formatted in 18-bit words beginning with a data flag bit (1=available, 0=not available), followed by 17 bits representing the data item value right justified in the field.

361	-	378	Picture count (6 bits).
379	-	396	Line count (10 bits).
397	-	414	Camera id (1 bit).
415	-	432	Exposure interval (4 bits).
433	-	450	Filter position (4 bits).
451	-	468	Z-008 TV beam current status (1 bit).
469	-	486	Z-015 TV calibrate status (1 bit).
487	-	504	Z-016 TV pixel average (4 bits).
505	-	522	Z-049 A shutter mode status (1 bit).
523	-	540	Z-050 filter mode status (1 bit).
541	-	558	Z-058 B shutter mode status (1 bit).
559	-	576	Z-068 shutter enable status (1 bit).
577	-	594	Z-514 DAS sequence (5 bits).
595	-	612	Z-515 A cathode current (10 bits).
613	-	630	Z-517 A grid 2 voltage (10 bits).
631	-	648	Z-517 event ladder (10 bits).
649	-	666	Z-518 A-B focus current (10 bits).
667	-	684	Z-519 plus 4 volts (10 bits).
685	-	702	Z-525 B cathode current (10 bits).
703	-	720	Z-526 B grid 2 voltage (10 bits).
721	-	738	Z-527 P/S input current (10 bits).
739	-	756	Z-528 B optics temperature (10 bits).
757	-	774	Z-529 average video (10 bits).
775	-	900	Unused.
901	-	1088	Fill.