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LANDSAT-D

DATA FORMAT CONTROL BOOK

VOLUME VI APPENDIX A

PARTIALLY PROCESSED THEMATIC MAPPER

HIGH DENSITY TAPE (HDT-AT)

PREPARED FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

UNDER

CONTRACT NO. NAS5-25300

PREPARED BY

GENERAL ELECTRIC COMPANY

SPACE SYSTEMS DIVISION

LANHAM, MARYLAND

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LANDSAT-D

DATA FORMAT CONTROL BOOK

VOLUME VI APPENDIX A

PARTIALLY PROCESSED THEMATIC MAPPER

HIGH DENSITY TAPE (HDT-AT)

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REVISION LOG

This log identifies those portions of this document which have been revised since original issue. Revised portions of each page, for the current revision only, are identified by marginal striping.

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"	3-9	Figure 3.2-2	"
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"	3-20, 3-21	Figure 3.4-5, Figure 3.4-6	"
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"	3-40	Table 3.5-2	"
"	3-64,3-65, 3-66, 3-67, 3-68, 3-69,3-70, 3-71 thru 3-79	Table 3.5-6	"
"	3-87, 3-88	Table 3.5-9	"
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TBD/TBR/TBS LOG

PARAGRAPH NUMBER	PARAGRAPH NAME	TYPE	RESOLUTION EXPECTED
Table 3.5-5	Condition Code per Detector	TBD	5/82

SECTION 1

SCOPE

1.1 INTRODUCTION

The NASA GSFC Landsat-D Project is developing a Data Management System (DMS) to provide a variety of standard image products from the thematic mapper (TM) and multispectral scanner (MSS) instruments. The major digital image processing functions to be performed by the DMS include: screening imagery for quality, determining cloud cover, applying radiometric and geometric corrections (including resampling the data using either cubic convolution or nearest neighbor techniques and presenting the data in either a space oblique mercator, universal transverse mercator, or polar stereographic projection). One of the outputs from the DMS is partially processed TM data (radiometric corrections applied and geometric correction matrices for two projections appended) which is recorded on HDT-AT high density tapes. An HDT-AT is a 28-track high density tape.

This specification establishes the requirements for the format of the Landsat-D HDT-AT product. These requirements represent both derived and allocated requirements from the GSFC Specification for the Landsat-D System, GSFC-430-D-100.

This document is part of the Landsat-D Data Format Control Book. It is one of several appendices to Volume VI, which describe the format of Landsat-D and Landsat-D Prime products.

1.2 PURPOSE

The purpose of this document is to define the format of the HDTs which contain partially processed Landsats-D and D Prime TM image data.

This document and those cited in Section 2 provide complete specification of the HDT-AT data format and should be followed in utilizing and interpreting the format of these tapes.

1.3 APPLICABILITY

This document applies to all Landsat-D and D Prime partially processed TM data tapes recorded by the DMS as an output of initial image processing and to all copies of all or parts of these tapes. The formats for the HDTs which contain fully processed Landsat-D Prime TM data are defined in other Data Format Control Book Appendices.

SECTION 2

APPLICABLE DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

a. GSFC-430-D-100

GSFC Specification for the Landsat-D System

2.2 GENERAL ELECTRIC COMPANY DOCUMENTS

a. SVS 10127

Data Format Control Book, Volume VI - Products

2.3 OTHER DOCUMENTS

None

SECTION 3

PRODUCT DESCRIPTION

3.1 RECORDED-DATA FORMATS

Partially processed TM data and IRIG-A time code data will be recorded on HDT-AT by the Martin-Honeywell high density digital tape recorder (HDDR), Model No. 2879-L. The HDDR formatting functions: demultiplexing, track assignments, packing density, recorder framing, randomizing, byte parity, error correction coding, digital coding and time coding are defined in Data Format Control Book, Volume VI: Products (reference paragraph 2.2.a).

3.2 TAPE FORMAT

3.2.1 TIME CODE

The HDT-AT contains a longitudinal time track (with time monotonically increasing) on auxiliary track number 1 that provides an index to the location of image data on the HDT. The time is recorded in the IRIG-A format (reference paragraph 2.2.a) and has a time resolution to one tenth of a second. The ten-character time code provides: day of the year in hundreds, tens, and units; hours in tens and units; minutes in tens and units; and seconds in tens, units, and tenths. The time code gives the universal time at which the data was recorded on the original HDT-AT and is used to correlate image data to sequential position on the HDT. The time code may be discontinuous during data gaps. All other regions of the tape, including preamble/filler, will have time code recorded.

3.2.2 MAJOR FRAMES

All data on the tape is organized into major frames of 6400 eight-bit bytes in length. Each major frame is divided into eight minor frames of equal size. The length is constant for all HDT-AT. Figure 3.2-1 illustrates the general major frame format. Illustrations of major frames of specific data types are found in a later section.

3.2.2.1 Major Frame Sequence Number

For all types of major frames except preamble/filler and image data a four-byte (32 bits) long parameter called the major frame sequence number is incorporated.

The major frame sequence number is placed in each major frame following the minor frame type code. Since it is always present in non-image major frames, the major frame sequence number is not included in the data tables following. The major frame sequence number also distinguishes between the replicated major frames in a series of major frames of the same type.

The first three bytes depict octal representation of the major frame sequence and the last byte in this field ranges from 0, 1 to 2 in octal to give the replication number.

Each byte of the MFSN is encoded with each octal digit represented by two identical three-bit binary words, W1 and W3, which are preceded by two identical parity bits P1 and P2, as follows:

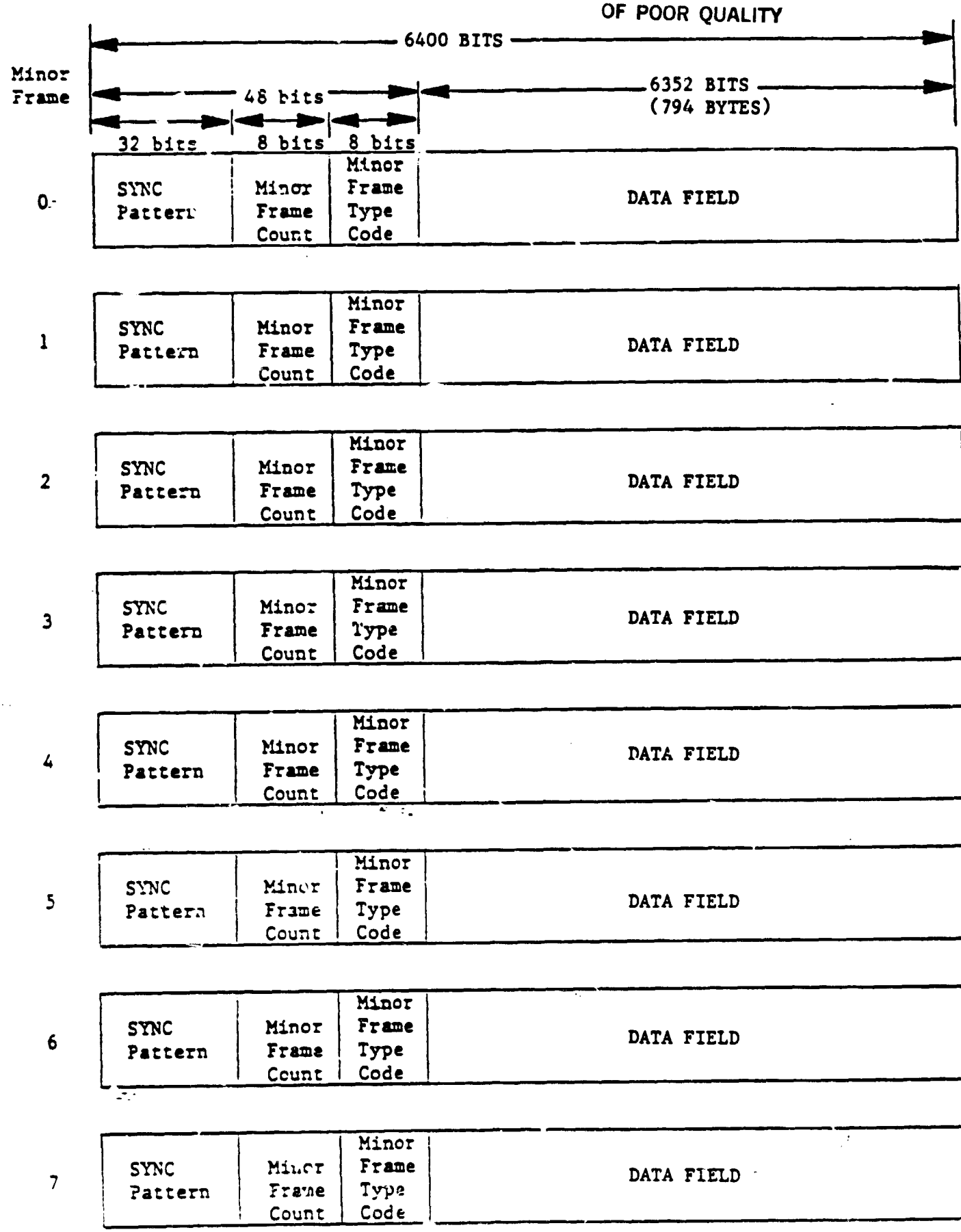


Figure 3.2-1. General Major Frame Format

OCTAL DIGIT	HEXADECIMAL	OCTAL	REPRESENTATION BINARY		
0	CO	300	11	000	000
1	09	011	00	001	001
2	12	022	00	010	010
3	DB	333	11	011	011
4	24	044	00	100	100
5	ED	355	11	101	101
6	F6	366	11	110	110
7	3F	077	00	111	111
			P1 P2	W1	W2

where:

W1 = Three-bit octal word number 1
W2 = Three-bit octal word number 2
P1 = Parity bit number 1 for W1
P2 = Parity bit number 2 for W2
P1 = P2
W1 = W2

For the fourth byte:

0_8: original
1_8: first replication
2_8: second replication

3.2.2.2 CHECKSUM

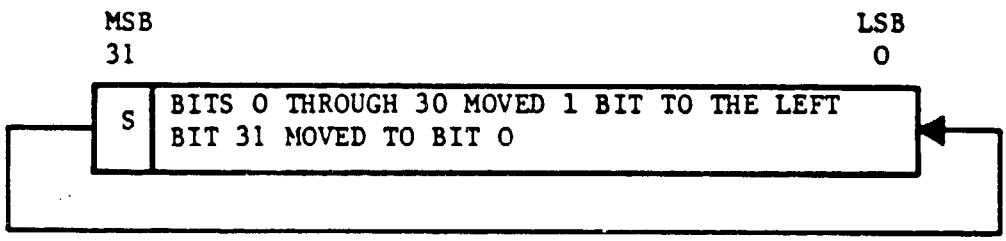
For all types of major frames except preamble/filler and image data a parameter called the CHECKSUM is computed. The four-byte (32-bit) CHECKSUM is computed on 32-bit segments of data commencing at the boundary between the major frame sequence number and the alphanumeric data and ending at the last 32-bit segment containing valid contiguous data, as defined in the format tables in paragraph 3.5; that is, the ten bytes (80 bits) of standard identification information at the beginning of each minor frame are not included in the computation of the CHECKSUM. The CHECKSUM is placed in the major frame following the data fields, the specific location is indicated in the description of each major frame type. The CHECKSUM computation is performed only on the data which precedes it in the

major frame (i.e., trailing zero fill is not included) except where minor frames are repeated.

The CHECKSUM, for a series of data bytes, is computed by performing successive EXCLUSIVE ORs (XOR) between the four bytes of CHECKSUM and a four-byte data block, followed by a CHECKSUM bit rotation. The computation is equivalent to the following set of procedural steps:

```
CHECKSUM = 0
DO FOR I = 1 to N  (where 4N is the number of bytes to be checked)
     CHECKSUM = CHECKSUM XOR DATA(I)
     CHECKSUM = ROTATE (CHECKSUM, 1 BIT LEFT)
ENDDO
```

where ROTATE means



3.2.3 MINOR FRAMES

Every minor frame is 800 bytes in length for all HDT-AT. The 794 byte data field is preceded by six bytes of standard information: four bytes of frame synchronization, one byte of minor frame count, and one byte of minor frame type code. The data field in image type minor frames is preceded by six bytes of scan line identification (SLID) in addition to the standard information.

3.2.3.1 Frame Synchronization

Frame synchronization is provided by a 32-bit pattern (11 111 010 111 100 110 011 010 000 000 000 binary; FAF3 3400 hexadecimal) at the beginning of every minor frame. The most significant bit occurs first and is the left-most bit of the pattern. In figures illustrating major frames this pattern is referred to as the SYNC pattern.

3.2.3.2 Minor Frame Count

The binary minor frame count within a major frame starts at zero and continues in sequence until its value equals seven. Under no circumstances will the minor frame count be reset to zero or any other number until the end of the major frame.

3.2.3.3 Minor Frame Type Code (MFTC)

The minor frame type code is a binary sequence that defines the type of data within a minor frame. Each minor frame contains one of eight types of information. Note that all minor frames in a major frame shall be the same type. The MFTC consists of two identical three-bit data words ($W_1 = W_2$) and two identical parity words ($P_1 = P_2$) which provide single bit-error-correcting capabilities. The codes used are:

DATA TYPE	HEXADECIMAL VALUE	OCTAL VALUE	BINARY REPRESENTATION
Preamble/Filler	C0	300	11 000 000
Tape Directory	09	011	00 001 001
Scene Header	12	022	00 010 010
Annotation	DB	333	11 011 011
Ancillary	24	044	00 100 100
Image	ED	355	11 101 101
Interval Trailer	F6	366	11 110 110
Interval Header	3F	077	00 111 111
			P_1P_2 W_1 W_2

Where:

W_1 = Three-bit MFTC word number 1
W_2 = Three-bit MFTC word number 2
P_1 = Parity Bit number 1 for W_1
P_2 = Parity Bit number 2 for W_2

3.2.4 TAPE DATA LAYOUT

The data on the tape is organized as shown in Figure 3.2-2.

Each HDT-AT shall have approximately 300 feet of unused tape header and trailer to facilitate manual tape handling.

The 300 foot tape header is followed by approximately 6000 major frames of preamble/filler. The tape directory is recorded next, followed by the archival data.

The archival data is divided into tape segments, corresponding to the amount of data processed from one process request. Each tape segment will consist of the data from at least one image data interval, organized as shown in Figure 3.2-2. Each tape segment will start with a repetition of the tape directory. The tape segment data is arranged such that the header, ancillary and annotation data for

all segment intervals are recorded first, followed by the image data in a band-interleaved-by-line (BIL) format, for those intervals. Each image interval is followed by an interval trailer. All non-image major frames (excluding preamble/filler) are replicated twice as shown in Figure 3.2-2, with 5-10 major frames of preamble/filler inserted after each major frame.

The tape segments are separated from one another, as are the image intervals, by either a data gap or preamble/filler.

The data gaps, if present, shall be 8-12 feet in length. They shall be preceded by 120-500 major frames of preamble/filler, and followed by 200-5000 major frames of preamble/filler. If no data gap exists, then there will be 420-5000 major frames of preamble/filler instead.

3.2.5 DATA REPRESENTATION

The alphanumeric data specified in this document shall be represented in one of the following formats:

a. ASCII (8 bits)

b. Single precision integer (16 bits, 2' sc)

c. Double precision integer (32 bits, 2' sc)

d. Single precision floating (32 bits)

e. Double precision floating (64 bits)

f. Zero fill.

The data formats are compatible with DEC VAX 11/780 data representation. Data is recorded such that the least significant byte of a 16-bit entity is recorded first, followed by the most significant byte.

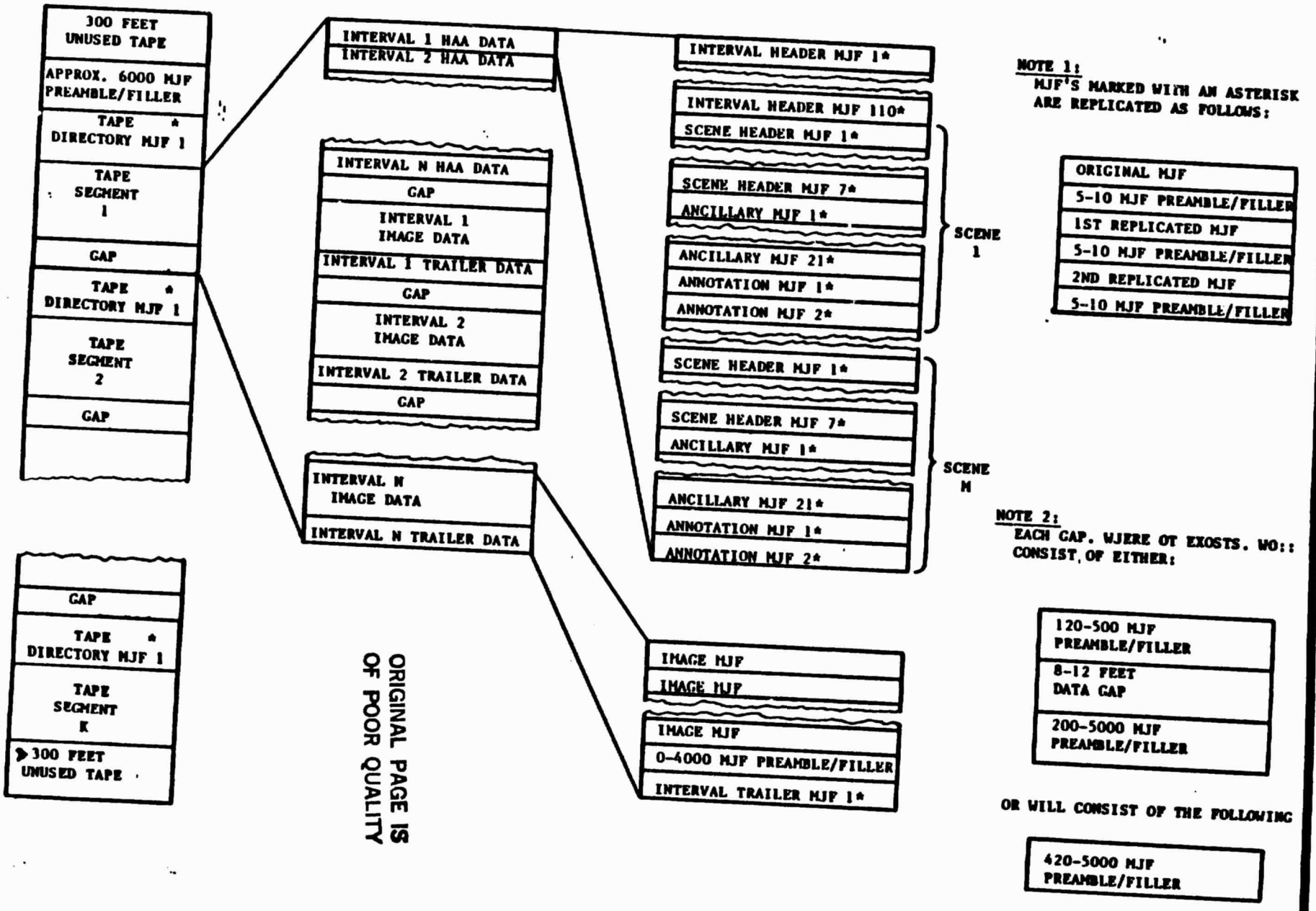


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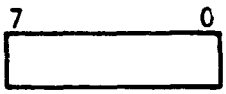
Figure 3.2-2. HDT-AT Data Layout

The detailed formats are specified in the following paragraphs.

3.2.5.1 ASCII

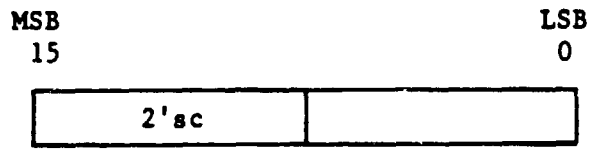
8 bit:



One seven-bit ASCII character per byte (eight bits). The ASCII character occupies the low order seven bits (bits 0-6), with bit 7 equal to zero.

3.2.5.2 Single Precision Integer (Integer *2)

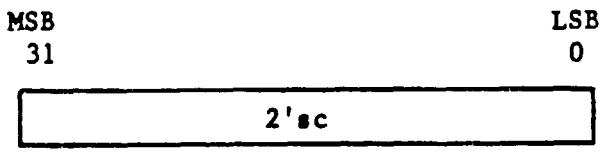
16 bits:



The integers are in two's complement form with bits increasing in significance from 0 through 14 and with bit 15 designating the sign (0 (+), 1 (-)). The value of the integer is in the range of -32,768 through 32,767.

3.2.5.3 Double Precision Integer (Integer *4)

32 bits:



The integers are in two's complement form with the bits increasing in significance from 0 through 30 and with bit 31 designating the sign. The value of the integer is in the range of -2147483648 to +2147483647.

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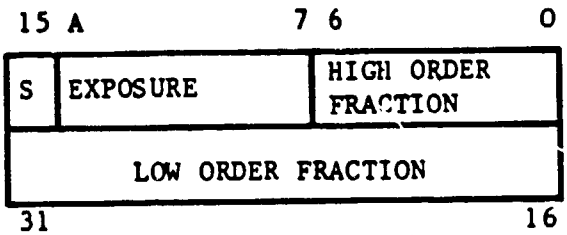
3.2.5.4 Single Precision Floating (Real *4)



S = SIGN BIT OF THE FRACTION

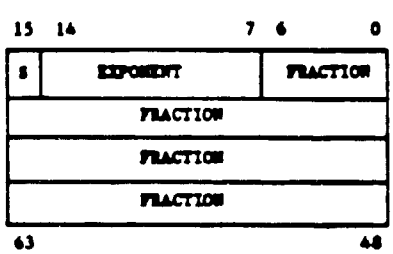
0 = + ; 1 = -

The floating point number consists of a sign, an exponent of a power of two, and a fraction between .5 (inclusive) and 1.0 (exclusive). The value of a floating point number is the sign applied to the fraction part, multiplied by two raised to the power specified by the exponent part.

A single precision number is stored in four contiguous bytes. The form of such a number is sign magnitude with bit 15 the sign bit. Bits 14:7 are an excess 128 binary exponent encoding values 0 through 255. An exponent value of 0 together with the sign bit of 0 indicates that the value of the floating point number is 0. Exponent values of 1 through 255 indicate true binary exponents -127 to +127. Bits 6:0 and 31:16 represent a normalized 25-bit fraction with the redundant most significant fraction bit (which is always 1 for a normalized number) not represented.

The magnitude of a floating point number is in the approximate range of 29×10^{-38} through 17×10^{34}. The precision is approximately seven decimal digits.

3.2.5.5 Double Precision Floating (Real *8)



S = Sign bit 0(+), 1(-)

A double precision real number is stored in eight contiguous bytes. The form of a double precision real number is sign magnitude, with bit 15 the sign bit, bits 14:7 an excess 128 binary exponent, and bits 6:0 and 63:16 a normalized 56-bit fraction with the redundant most significant fraction bit not represented. The magnitude of a number lies in the range of .29*(10**-38) through 1.7 *(10**38). The precision is typically 16 decimal digits.

3.2.5.6 Zero Fill

Unless specified otherwise, any references to zero fill will refer to binary zero fill.

3.3 MAJOR FRAME TYPES

3.3.1 PREAMBLE/FILLER

Each minor frame of preamble/filler begins with the six bytes of standard identification data (sync pattern, minor frame count, and minor frame type code). The data field within a preamble/filler minor frame consists of alternating 1's and 0's (101010101010...). The major frame format is discussed in paragraph 3.4.1.

3.3.2 TAPE DIRECTORY

The tape directory appears once at the beginning of the tape and at the start of each subsequent tape segment and identifies the tape. It consists of one major frame containing an alphanumeric description of the tape. The tape directory

major frame is replicated twice. The description contains information such as the HDT reel identification (also written on the tape label), date of generation, etc. The major frame format is discussed in paragraph 3.4.2, and the data content is discussed in paragraph 3.5.1.

3.3.3 INTERVAL HEADER

The interval header appears once at the beginning of an interval and identifies the interval. It consists of 110 major frames of data. Each interval header major frame is replicated twice. The description contains information such as the interval sequence number, the number of scenes in the interval, etc. The major frame format is discussed in paragraph 3.4.3, and the data content is discussed in paragr. ›h 3.5.2.

3.3.4 SCENE HEADER

The header data appears once for each scene within an interval. It consists of seven major frames containing information associated with a particular scene of image data. This information describes the conditions under which the scene was recorded and the formats used. Each scene header major frame is replicated twice. The major frame format is discussed in paragraph 3.4.4, and the data content is discussed in paragraph 3.5.3.

3.3.5 ANCILLARY

Ancillary data appears once for each scene within an interval. Ancillary data consists of 21 major frames containing data required to geodetically correct the image. Each ancillary major frame is replicated twice. .ie major frame format

is discussed in paragraph 3.4.5, and the data content is discussed in paragraph 3.5.4.

3.3.6 ANNOTATION

The annotation data appears once for each scene within an interval. It consists of two major frames. The first major frame contains data for the SOM map projection. The second major frame contains data for the UTM or PS projection. Each annotation major frame is replicated twice. The major frame format is discussed in paragraph 3.4.6 and the data content is discussed in paragraph 3.5.5.

3.3.7 IMAGE

The image data appears once within an interval. It consists of one major frame per scan line containing radiometrically corrected image data. Image major frames also contain scan line identification and support data.

The nominal number of image major frames in an interval shall be

[374 + 335 X (N-1)]scans/interval X 16 lines/band X 7 bands

where N = number of scenes in the interval.

An interval of image data major frames may be interspersed with 1-3% (of the number of image major frames) preamble/filler major frames. The preamble/filler major frames will only be inserted between scans of image data. Each scan of image data consists of 112 scan lines (16 lines per band X 7 bands) or 112 major frames. The image major frame format is discussed in paragraph 3.4.7 and the data content is discussed in paragraph 3.5.6.

3.3.8 INTERVAL TRAILER

The interval trailer appears once at the end of an interval. It consists of one major frame containing quality data for the interval. Each interval trailer major frame is replicated twice.

The trailer major frame format is discussed in paragraph 3.4.8 and the data content is discussed in paragraph 3.5.7.

3.4 MAJOR FRAME FORMATS

3.4.1 PREAMBLE/FILLER

The preamble/filler major frame format is shown in Figure 3.4-1.

3.4.2 TAPE DIRECTORY

The tape directory major frame format is shown in Figure 3.4-2.

3.4.3 INTERVAL HEADER

The interval header major frame format is shown in Figure 3.4-3.

3.4.4 SCENE HEADER

The scene header major frame format is shown in Figure 3.4-4.

3.4.5 ANCILLARY

The ancillary major frame format is shown in Figure 3.4-5.

3.4.6 ANNOTATION

The annotation major frame format is shown in Figure 3.4-6.

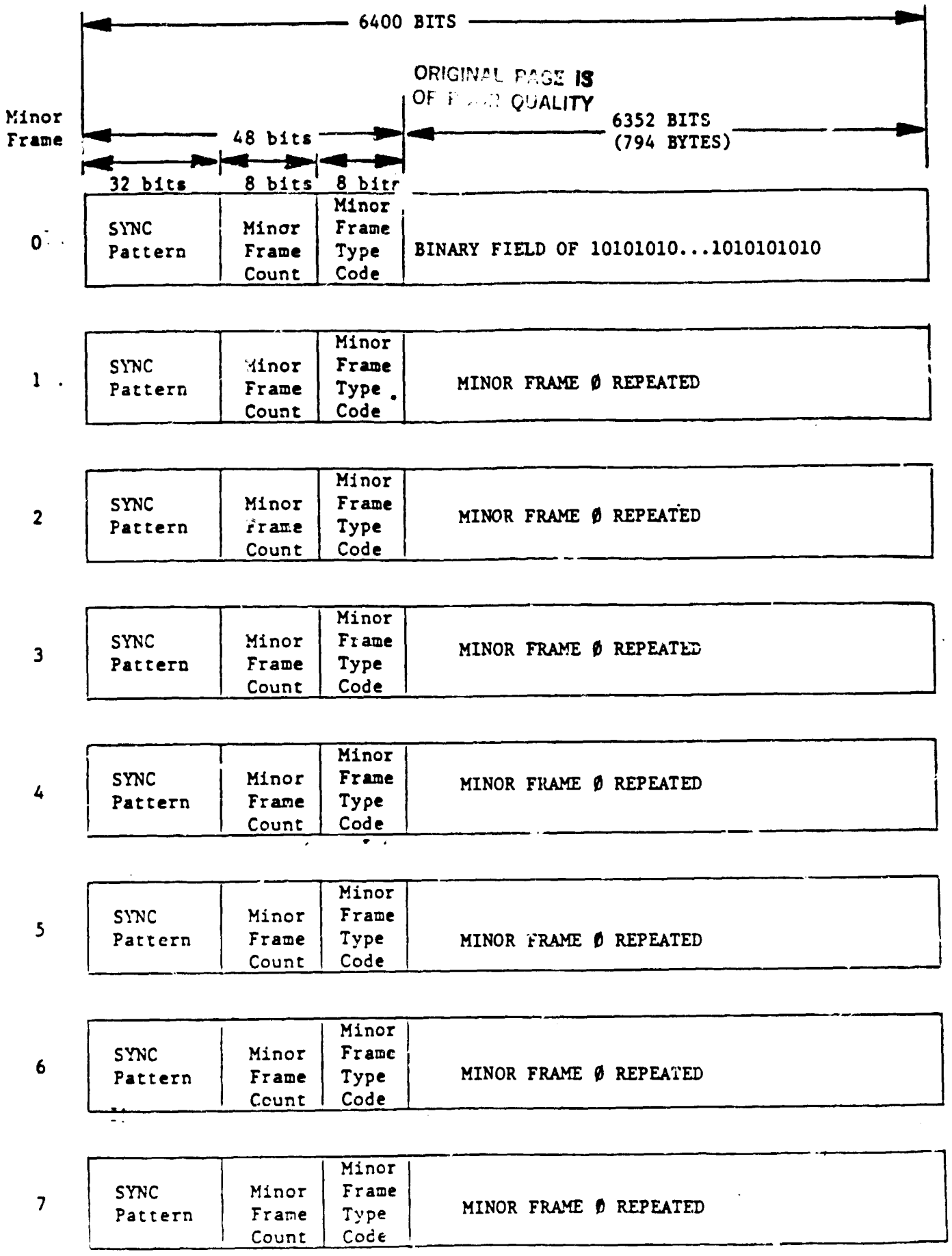


Figure 3.4-1. One Major Frame of Preamble/Filler

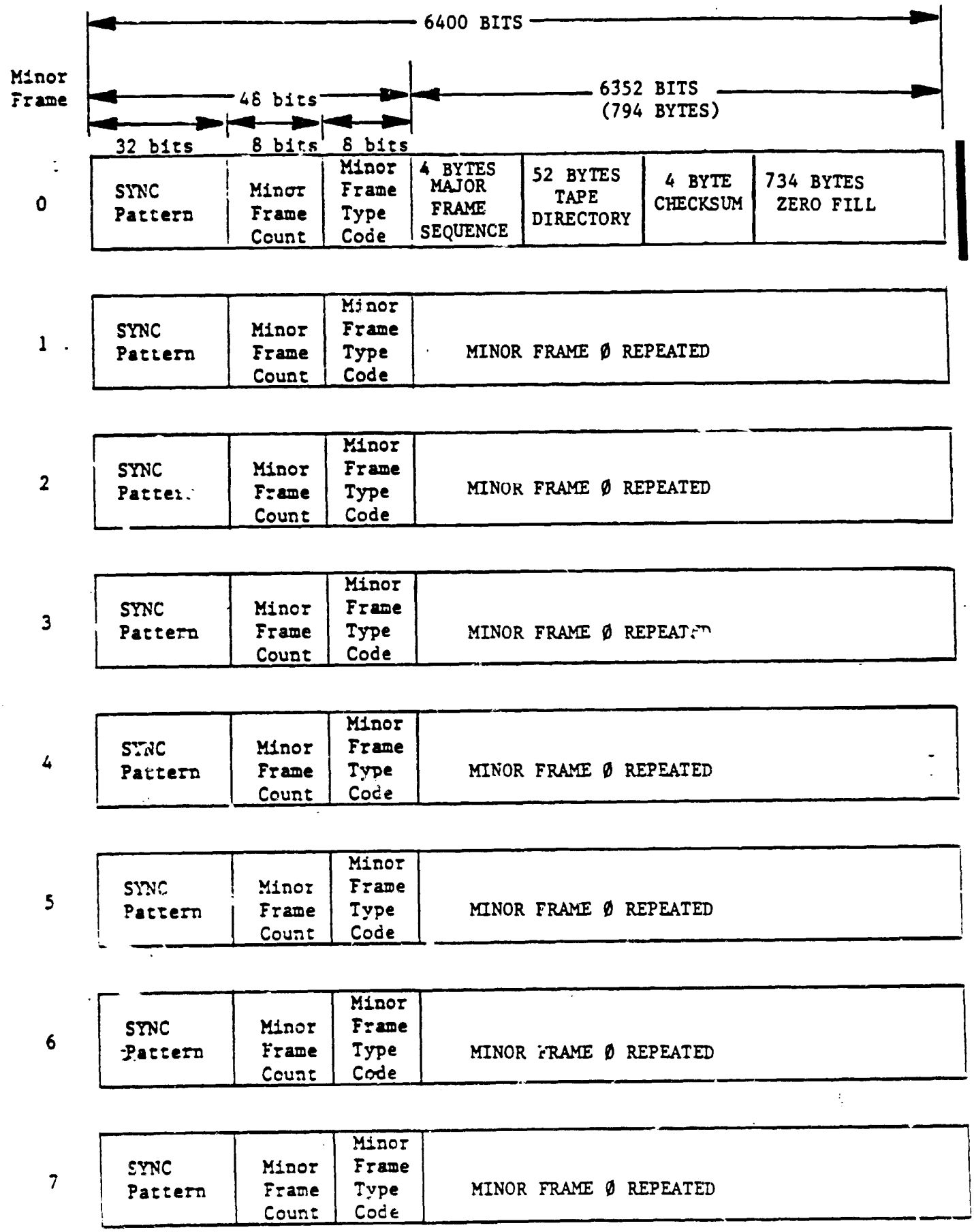


Figure 3.4-2. One Major Frame of Tape Directory

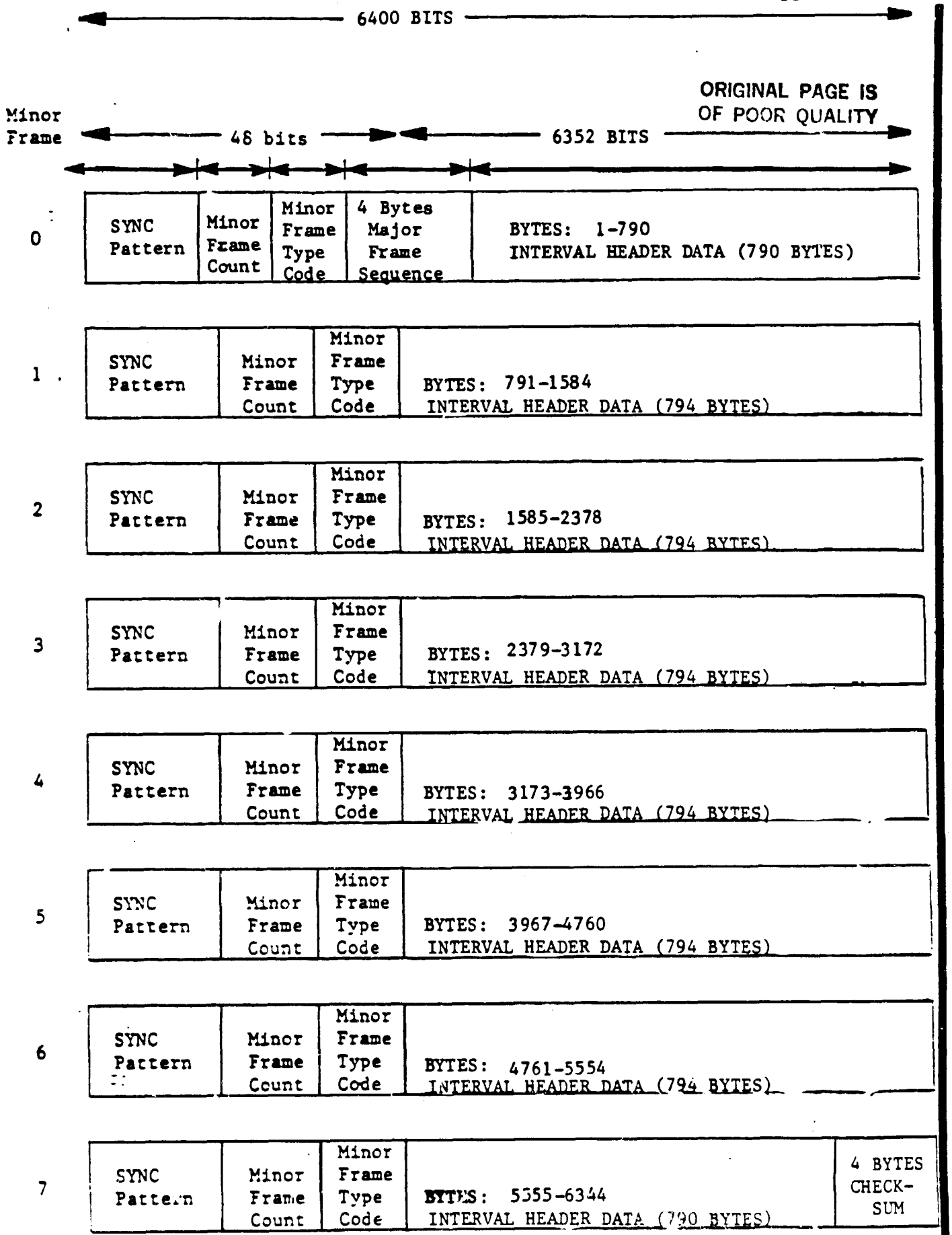
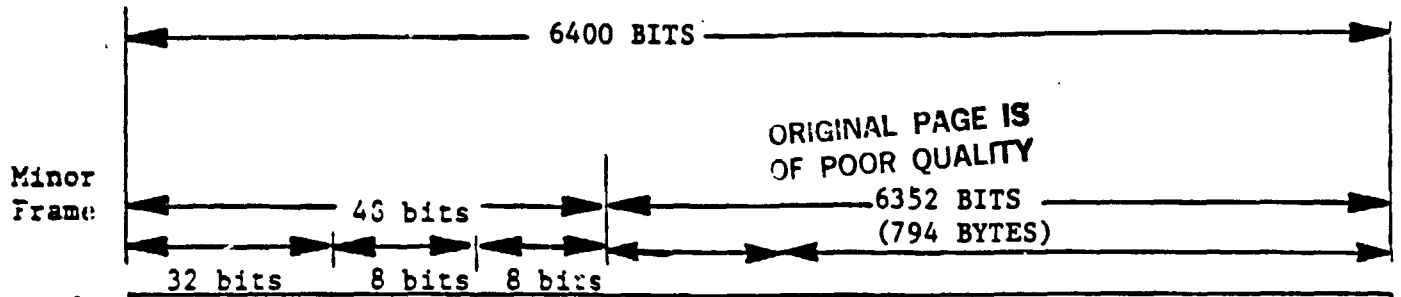


Figure 3.4-3. One Major Frame of Interval Header



0	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	4 BYTES MAJOR FRAME SEQUENCE	BYTES: 1-790 SCENE HEADER DATA (790 BYTES)
1	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 791-1584 SCENE HEADER DATA (794 BYTES)	
2	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 1585-2378 SCENE HEADER DATA (794 BYTES)	
3	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 2379-3172 SCENE HEADER DATA (794 BYTES)	
4	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 3173-3966 SCENE HEADER DATA (794 BYTES)	
5	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 3967-4760 SCENE HEADER DATA (794 BYTES)	
6	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 4761-5554 SCENE HEADER DATA (790 BYTES)	
7	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	BYTES: 5555-6344 SCENE HEADER DATA (790 BYTES)	4 BYTES CHECKSUM

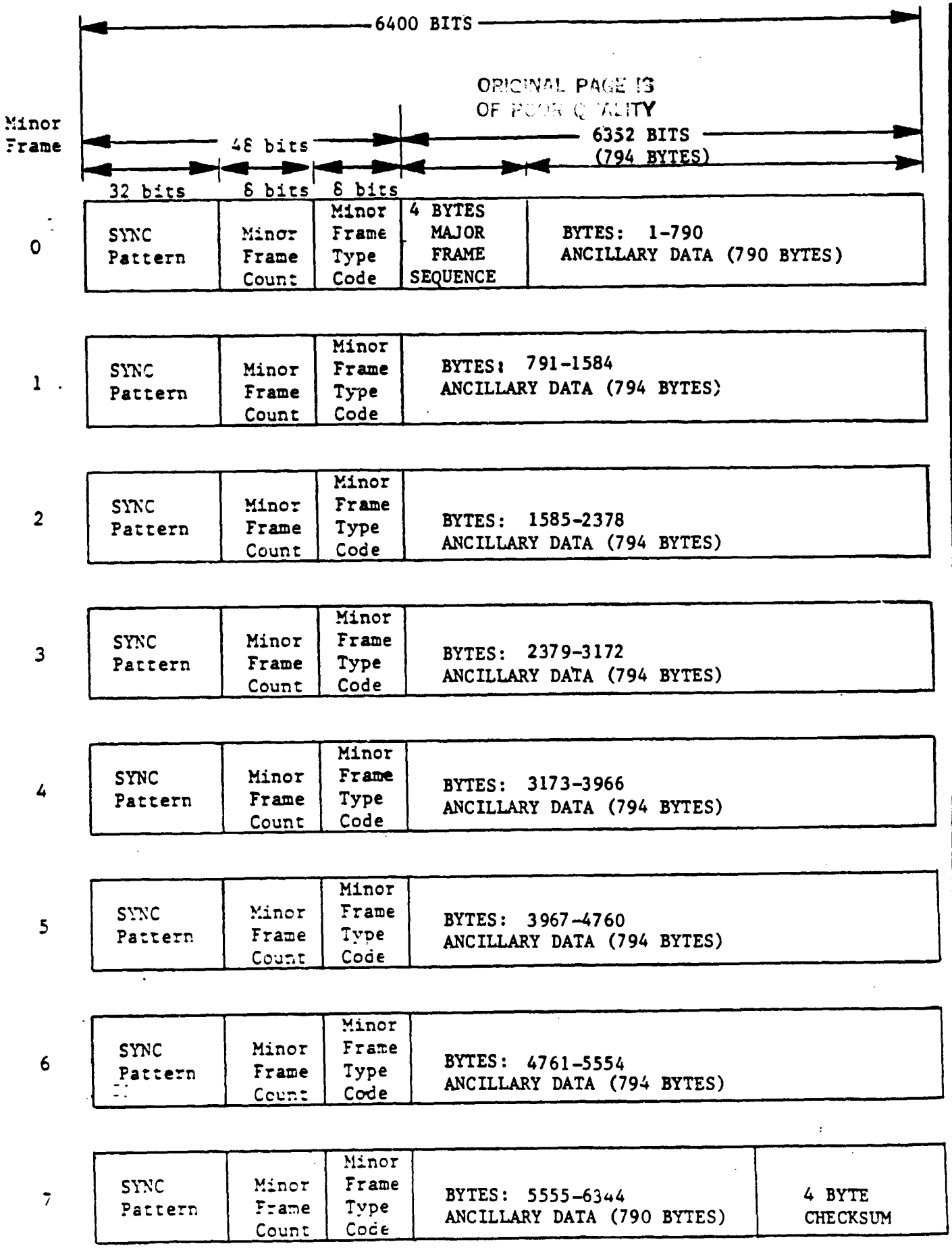


Figure 3.4-5. One Major Frame of Ancillary

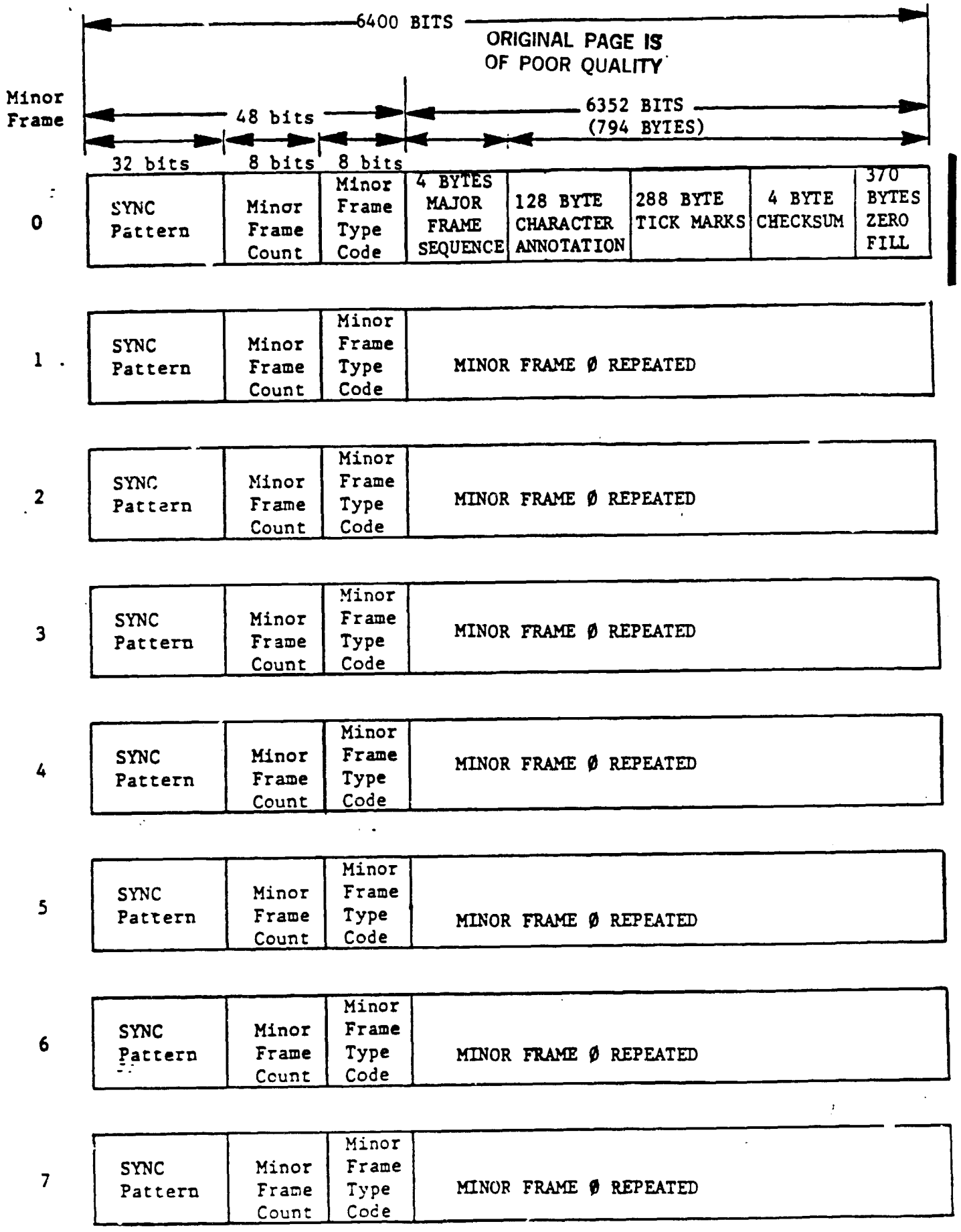


Figure 3.4-6. One Major Frame of Annotation

3.4.7 IMAGE DATA

The image data major frame format is shown in Figure 3.4-7.

3.4.8 INTERVAL TRAILER

The trailer major frame format is shown in Figure 3.4-8.

3.5 MAJOR FRAME FIELD DEFINITION

This section specifies the content of all data fields within each major frame. The frame sync, minor frame count and type code, and the checksum have already been discussed in paragraph 3.2.1.

3.5.1 TAPE DIRECTORY

Tape directory contains tape reel ID, source of tape generation, software version and tape recorder ID.

None of this information is changed when copies of the tape are made.

The content and format are shown in Table 3.5-1.

3.5.2 INTERVAL HEADER

The interval header contains the following information:

a. Major Frame 1

   1. Image interval definition
   2. PCD telemetry interval definition
   3. Telemetry summary data
      - o TM housekeeping
      - o Ephemeris
      - o Attitude

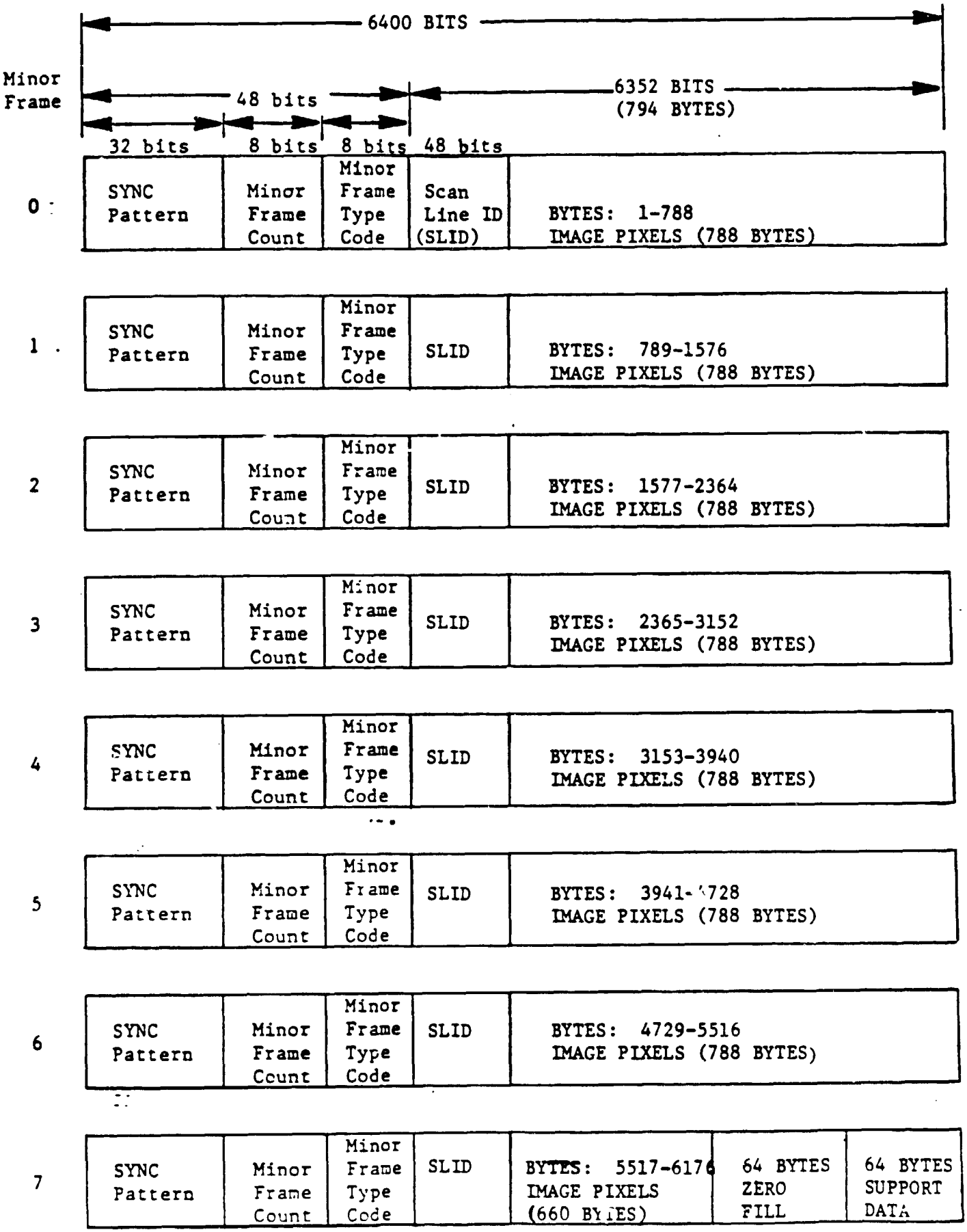


Figure 3.4-7. One Major Frame of Image

Minor Frame	32 bits	8 bits	8 bits	48 bits	6352 BITS (794 BYTES)
	6400 BITS				
0	SYNC Pattern	Minor Frame Count	Minor Frame Type Code	4 BYTES MAJOR FRAME SEQUENCE	BYTES: 1-790 TRAILER DATA (790 BYTES)
1	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 791-1584 TRAILER DATA (794 BYTES)
2	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 1585-2378 TRAILER DATA (794 BYTES)
3	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 2379-3172 TRAILER DATA (794 BYTES)
4	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 3173-3966 TRAILER DATA (794 BYTES)
5	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 3967-4760 TRAILER DATA (794 BYTES)
6	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 4761-5554 TRAILER DATA (794 BYTES)
7	SYNC Pattern	Minor Frame Count	Minor Frame Type Code		BYTES: 5555-6344 TRAILER DATA (790 BYTES) / 4 BYTE CHECKSUM

Figure 3.4-8. One Major Frame of Interval Trailer

Table 3.5-1. Tape Directory Data Elements

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1-12	12	Tape reel ID	ASCII	MNSTTYYDDDXX
13-20	8	Source of HDT-AT production 'TIPS#1ßß' 'ADDSßßßß' 'TIPS#2ßß' 'LASßßßßß'	ASCII	CHAR*8
21-24	4	HDDR Identification XX = 01-99	ASCII	'ßH' XX
25-40	16	Software Version Number (Free Format)	ASCII	CHAR*16
41-46	6	Date of HDT-AT Generation	ASCII	YYDDDß
		TAPE DATA CHARACTERISTICS		
47-48	2	Number of Bits Per Minor Frame (always 6400)		INTEGER*2
49-50	2	Number of Minor Frames Per Major Frame (Always 8)		INTERGER*2
51-52	2	Number of Replications For Non-Image Data (Always 2)		INTEGER*2

4. TM detector information

5. Radiometric correction data

6. MSCD from PCS.

b. Major Frames 2 and 3

1. TM housekeeping data records. Space is reserved for 56 records (56 X 16.384 seconds/record = 917.5 seconds) of data.

c. Major Frames 4, 5 and 6

1. Processed ephemeris data records. Space is reserved for 56 records (56 X 16.384 seconds/record = 917.5 seconds) of data.

d. Major Frames 7 through 110

1. Space is reserved for radiometric correction segment related data for 104 segments in the interval.

The contents and format are shown in Table 3.5-2 through Table 3.5-5.

3.5.3 SCENE HEADER DATA

The scene header contains the following information:

a. Major Frame 1

1. Image identification

2. Scene data characteristics

3. Control point historical information

4. Current control point information

5. Geometric correction quality data

6. Processed GCD quality data

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		IMAGE INTERVAL DEFINITION		
1-2	2	Mission Number N = '4': Landsat-D = '5': Landsat-D Prime	ASCII	'L'N
3-4	2	Interval Sequence Number (01-26)		INTEGER*2
5-6	2	Number of Scenes in the Interval (01-26)		INTEGER*2
7-22	16	Imaging Interval Start Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
23-38	16	Imaging Interval Stop Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
39-40	2	Data Source X = 'W': TDRSS/White Sands 'T': TGS	ASCII	XB
		PCD TELEMETRY INTERVAL DEFINITION		
41-56	16	PCD Telemetry Interval Start Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
57-72	16	PCD Telemetry Interval Stop Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
73-76	4	Orbit Number Spacecraft Orbit at the Start of Telemetry Acquisition		INTEGER*4
77-78	2	Orbital Direction M = 'A': Ascending Node 'D': Descending Node	ASCII	MB

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		TM HOUSEKEEPING SUMMARY DATA		
79-82	4	Number of TM Housekeeping Records. One record every PCD telemetry major frame (16,384 seconds)		INTEGER*4
83-98	16	Zero Fill		
99-100	2	Ephemeris Source E = 'G': GPS 'U': Uplinked	ASCII	EB
101-104	4	Number of Raw Ephemeris Points		INTEGER*4
105-108	4	Number of Rejected Raw Ephemeris Points		
		Accuracy of Ephemris Fit. RMS difference between the fit and the data points (earth centered inertial coordinates)		
109-112	4	Radial Position	Meters	REAL*4
113-116	4	Along-Track Position	Meters	REAL*4
117-120	4	Cross-Track Position	Meters	REAL*4
121-124	4	Number of Processed Ephemeris Data Records - one record every 16.384 seconds		INTEGER*4
125-140	16	Zero Fill		
		TM ATTITUDE SUMMARY DATA (DRIRU)		
141-144	4	Number of Low Frequency Attitude (DRIRU) Data Points		INTEGER*4
145-148	4	Number of Rejected (and Substituted) DRIRU Data Points		INTEGER*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
149-152	4	Number of Missing DRIRU Data Points		INTEGER*4
153-156	4	Number of DRIRU Data Point Discontinuities		INTEGER*4
		Mean of Angular Increments Between Successive DRIRU Data Points		
157-160	4	Roll Axis	Radians	REAL*4
161-164	4	Pitch Axis	Radians	REAL*4
165-168	4	Yaw Axis	Radians	REAL*4
		Variance of DRIRU Data Increments		
169-172	4	Roll Axis	RAD^2	REAL*4
173-176	4	Pitch Axis	RAD^2	REAL*4
177-180	4	Yaw Axis	RAD^2	REAL*4
		Maximum DRIRU Data Increment		
181-184	4	Roll Axis	Radians	REAL*4
185-188	4	Pitch Axis	Radians	REAL*4
189-192	4	Yaw Axis	Radians	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Mimimum DRIRU Data Increment		
193-196	4	Roll Axis	Radians	REAL*4
197-200	4	Pitch Axis	Radians	REAL*4
201-204	4	Yaw Axis	Radians	REAL*4
		Total Range of DRIRU Data		
205-208	4	Roll Axis	Radians	REAL*4
209-212	4	Pitch Axis	Radians	REAL*4
213-216	4	Yaw Axis	Radians	REAL*4
		TM ATTITUDE SUMMARY DATA (ADS)		
217-220	4	Number of High Frequency Attitude (ADS) Data Points		INTEGER*4
221-224	4	Number of Rejected (and Substituted) ADS Data Points		INTEGER*4
225-228	4	Number of Missing ADS Data Points		INTEGER*4
229-232	4	Number of ADS Data Point Discontinuities		INTEGER*4
		Mean of Angular Increments Between Successive Data Points		
233-236	4	Roll Axis	Radians	REAL*4
237-240	4	Pitch Axis	Radians	REAL*4
241-244	4	Yaw Axis	Radians	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Variance of ADS Data Increments		
245-248	4	Roll Axis	RAD^2	REAL*4
249-252	4	Pitch Axis	RAD^2	REAL*4
253-256	4	Yaw Axis	RAD^2	REAL*4
		Maximum ADS Data Increment		
257-260	4	Roll Axis	Radians	REAL*4
261-264	4	Pitch Axis	Radians	REAL*4
265-268	4	Yaw Axis	Radians	REAL*4
		Minimum ADS Data Increment		
269-272	4	Roll Axis	Radians	REAL*4
273-276	4	Pitch Axis	Radians	REAL*4
277-280	4	Yaw Axis	Radians	REAL*4
		Total Range of ADS Data		
281-284	4	Roll Axis	Radians	REAL*4
285-288	4	Pitch Axis	Radians	REAL*4
289-292	4	Yaw Axis	Radians	REAL*4
		TM ATTITUDE SUMMARY DATA (PROCESSED)		
		Mean of Angular Increments Between Successive Data Points After Rate Compensation		
293-296	4	Roll Axis	Radians	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
297-300	4	Pitch Axis	Radians	REAL*4
301-304	4	Yaw Axis	Radians	REAL*4
		Variance of Processed Data Increments		
305-308	4	Roll Axis	RAD^2	REAL*4
309-312	4	Pitch Axis	RAD^2	REAL*4
313-316	4	Yaw Axis	RAD^2	REAL*4
		Maximum Processed Data Increment		
317-320	4	Roll Axis	Radians	REAL*4
321-324	4	Pitch Axis	Radians	REAL*4
325-328	4	Yaw Axis	Radians	REAL*4
		Minimum Processed Data Increment		
329-332	4	Roll Axis	Radians	REAL*4
333-336	4	Pitch Axis	Radians	REAL*4
337-340	4	Yaw Axis	Radians	REAL*4
		Total Range of Processed Data		
341-344	4	Roll Axis	Radians	REAL*4
345-348	4	Pitch Axis	Radians	REAL*4
349-352	4	Yaw Axis	Radians	REAL*4
353-368	16	Zero Fill		

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		TM DETECTOR INFORMATION		
369-468	100	Active Detector Status Indicates Active/Inactive Status of All 100 TM Detectors D1...D100 in the order: B1D1...B1D16 B2D1...B2D16 B3D1...B3D16 B4D1...B4D16 B5D1...B5D16 B6D1,B6D2,B6D3,B6D4 B7D1...B7D16 X = '0': Inactive '1': Active	ASCII	X
469-470	2	Active Detector Count The number of active detectors based on the active detector status		INTEGER*2
		Substituted Detector Status		
471-670	200	A 100-element corresponding to all 100 TM detectors in the order D1...D100. Each position contains the detector number which was actually put on the tape.		INTEGER*2
671-686	16	Zero Fill		
		RADIOMETRIC CORRECTION		
687-692	6	RC Processing Start SLID		IIMMLB
693-696	4	Number of RC Segments in Interval		INTEGER*4
697-700	4	Number of Scans per RC Segment		INTEGER*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
701-704	4	Number of Subsegments per RC Segment		
		Calibration Processing Mode X = '0': No corrections applied '1': A priori (pre-flight) calibration '2': A priori gains with calculated biases '3': Calculated gains and biases '4': Non-standard corrections		
705	1	Band 1	ASCII	X
706	1	Band 2	ASCII	X
707	1	Band 3	ASCII	X
708	1	Band 4	ASCII	X
709	1	Band 5	ASCII	X
710	1	Band 6	ASCII	X
711	1	Band 7	ASCII	X
712	1	Blank Fill	ASCII	'B'
		Histogram Processing Selection Parameter X = '0': No '1': Yes		
713	1	Band 1	ASCII	X
714	1	Band 2	ASCII	X

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
715	1	Band 3	ASCII	X
716	1	Band 4	ASCII	X
717	1	Band 5	ASCII	X
718	1	Band 6	ASCII	X
719	1	Band 7	ASCII	X
720	1	Blank Fill	ASCII	b
		Number of Histogram Interations Allowed Per Band		
721-722	2	Band 1		INTEGER*2
723-724	2	Band 2		INTEGER*2
725-726	2	Band 3		INTEGER*2
727-728	2	Band 4		INTEGER*2
729-730	2	Band 5		INTEGER*2
731-732	2	Band 6		INTEGER*2
733-734	2	Band 7		INTEGER*2
		RMIN (Radiance Value to Which 0 is Set)		
735-738	4	Band 1	$MW/CM^2/SR$	REAL*4
739-742	4	Band 2	MW/CM^2SR	REAL*4
743-746	4	Band 3	$MW/CM^2/SR$	REAL*4
747-750	4	Band 4	$MW/CM^2/SR$	REAL*4
751-754	4	Band 5	$MW/CM^2/SR$	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
755-758	4	Band 6	$MW/CM^2/SR$	REAL*4
759-762	4	Band 7	$MW/CM^2/SR$	REAL*4
		RMAX (Radiance Value to Which 255 is Set)		
763-766	4	Band 1	$MW/CM^2/SR$	REAL*4
767-770	4	Band 2	$MW/CM^2/SR$	REAL*4
771-774	4	Band 3	$MW/CM^2/SR$	REAL*4
775-778	4	Band 4	$MW/CM^2/SR$	REAL*4
779-782	4	Band 5	$MW/CM^2/SR$	REAL*4
783-786	4	Band 6	$MW/CM^2/SR$	REAL*4
787-790	4	Band 7	$MW/CM^2/SR$	REAL*4
791	1	Internal Calibration Lamp Mode X = 'S': Sequencer Mode 'P': Primary Mode - Constant Level 'B': Backup Mode - Constant Level	ASCII	X
		Internal Calibration Lamps used for constant level lamp modes only Blank fill for sequencer mode X = '0': Lamp not used '1': Lamp is used	ASCII	
792	1	Cal Lamp 1	ASCII	X

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
793	1	Cal Lamp 2	ASCII	X
794	1	Cal Lamp 3	ASCII	X
795-810	16	Zero Fill		
		MIRROR SCAN CORRECTION DATA FROM PCS		
		Nominal Line Length		
811-814	4	Forward Scans	MSEC	REAL*4
815-818	4	Reverse Scans	MSEC	REAL*4
		Maximum Observed Line Length Error		
819-822	4	Forward Scans	MSEC	REAL*4
823-826	4	Reverse Scans	MSEC	REAL*4
		Minimum Observed Line Length Error		
827-830	4	Forward Scans	MSEC	REAL*4
831-834	4	Reverse Scans	MSEC	REAL*4
		Mean Observed Line Length Error		
835-838	4	Forward Scans	MSEC	REAL*4
839-842	4	Reverse Scans	MSEC	REAL*4
		Sigma Observed Line Length Error		
843-846	4	Forward Scans	MSEC	REAL*4
847-850	4	Reverse Scans	MSEC	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Nominal First Half Scan Time		
851-854	4	Forward Scans	MSEC	REAL*4
855-858	4	Reverse Scans	MSEC	REAL*4
		Maximum Observed First Half Scan Error		
859-862	4	Forward Scans	MSEC	REAL*4
863-866	4	Reverse Scans	MSEC	REAL*4
		Minimum Observed First Half Scan Error		
867-870	4	Forward Scans	MSEC	REAL*4
871-874	4	Reverse Scans	MSEC	REAL*4
		Mean Observed First Half Scan Error		
875-878	4	Forward Scans	MSEC	REAL*4
879-882	4	Reverse Scans	MSEC	REAL*4
		Sigma Observed First Half Scan Error		
883-886	4	Forward Scans	MSEC	REAL*4
887-890	4	Reverse Scans	MSEC	REAL*4
		Nominal Second Half Scan Time		
891-894	4	Forward Scans	MSEC	REAL*4
895-898	4	Reverse Scans	MSEC	REAL*4
		Maximum Observed Second Half Scan Error		
899-902	4	Forward Scans	MSEC	REAL*4
903-906	4	Reverse Scans	MSEC	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Minimum Observed Second Half Scan Error		
907-910	4	Forward Scans	MSEC	REAL*4
911-914	4	Reverse Scans	MSEC	REAL*4
		Mean Observed Second Half Scan Error		
915-918	4	Forward Scans	MSEC	REAL*4
919-922	4	Reverse Scans	MSEC	REAL*4
		Sigma Observed Second Half Scan Error		
923-926	4	Forward Scans	MSEC	REAL*4
927-930	4	Reverse Scans	MSEC	REAL*4
		Maximum Nonlinearity at Mid-Scan		
931-934	4	Forward Scans	MICRORAD	REAL*4
935-938	4	Reverse Scans	MICRORAD	REAL*4
		Minimum Nonlinearity at Mid-Scan		
939-942	4	Forward Scans	MICRORAD	REAL*4
943-946	4	Reverse Scans	MICRORAD	REAL*4
		Mean Nonlinearity at Mid-Scan		
947-950	4	Forward Scans	MICRORAD	REAL*4
951-954	4	Reverse Scans	MICRORAD	REAL*4
		Sigma Nonlinearity at Mid-Scan		
955-958	4	Forward Scans	MICRORAD	REAL*4

Table 3.5-2. Interval Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
959-962	4	Reverse Scans	MICRORAD	REAL*4
963-6344	5382	Zero Fill		

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		TM HOUSEKEEPING DATA RECORDS		
		Space is reserved for up to 56 records (56 x 16.384 = 917.5 seconds) of TM housekeeping data		
		Major Frame 2 contains records 1-28 Major Frame 3 contains records 29-56		
		If less than 56 records are present, the remainder of the records will be zero filled (binary zero)		
		RECORD #1 FORMAT		
1-4	4	Record number (1-56)		INTEGER*4
5-18	14	Observation Time (GMT)	ASCII	YYDDDHHMMSSTT
		Processed TM Housekeeping Data		
19-22	4	Blackbody Temp (IS-59)	^{o}C	REAL*4
23-26	4	Silicon FPA Temp (IS-60)	^{o}C	REAL*4
27-30	4	Calibration Shutter Flag Temp (IS-61)	^{o}C	REAL*4
31-34	4	Backup Shutter Temp (IS-62)	^{o}C	REAL*4
35-38	4	Baffle Temp (IS-69)	^{o}C	REAL*4
39-42	4	Cold Stage FPA Monitor Temp (IS-70)	^{o}K	REAL*4

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
43-46	4	Cold Stage FPA Control Temp (IS-67)	^{o}K	REAL*4
47-50	4	Cal Lamps Filter Temp (IS-95)	^{o}C	REAL*4
51-54	4	SLC Temp (IS-94)	^{o}C	REAL*4
55-58	4	Cal Shutter Hub Temp (IS-86)	^{o}C	REAL*4
59-62	4	Even Ambient Preamp Temp (IS-83)	^{o}C	REAL*4
63-66	4	Band 6 Post Amp Temp (IS-75)	^{o}C	REAL*4
67-70	4	Relay Optics Temp (IS-73)	^{o}C	REAL*4
71-74	4	Cold Preamp Temp (IS-72)	^{o}C	REAL*4
75-78	4	Odd Ambient Preamp Temp (IS-71)	^{o}C	REAL*4
		TM Housekeeping Data Serial Words		
		Each bit of every serial word is represented by one ASCII character (0 or 1) in the order Bit 0...Bit 7		
		Serial Word A		
79	1	Spare	ASCII	X
80	1	Thermal Shutdown Enabled/ Disabled	ASCII	X

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
81	1	SMA +Z Heater Controller On/Off	ASCII	X
82	1	SMA -Z Heater Controller On/Off	ASCII	X
83	1	Serial Command Receiver 1 On/Off	ASCII	X
84	1	Shutter Fusible Link Switch A Closed/Open	ASCII	X
85	1	Shutter Fusible Link Switch B Closed/Open	ASCII	X
86	1	Shutter Fusible Link Switch C Closed/Open	ASCII	X
		Serial Word B		
87	1	Band 1 On/Off	ASCII	X
88	1	Band 2 On/Off	ASCII	X
89	1	Band 3 On/Off	ASCII	X
90	1	Band 4 On/Off	ASCII	X
91	1	Band 5 On/Off	ASCII	X
92	1	Band 6 On/Off	ASCII	X
93	1	Band 7 On/Off	ASCII	X
94	1	Cold Stage Telemetry On/Off	ASCII	X
		Serial Word C		
95	1	Cooler Door Closed/Open	ASCII	X

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
96	1	Cooler Door Position Outgas/Not Outgas	ASCII	X
97	1	Cooler Door Full Open/ Not Full Open	ASCII	X
98	1	Cooler Door Magnet On/Off	ASCII	X
99	1	Cooler Door Motor On/Off	ASCII	X
100	1	Cooler Door Fuse Link Switch A Closed/Open	ASCII	X
101	1	Cooler Door Fuse Link Switch B Closed/Open	ASCII	X
102	1	Cooler Door Fuse Link Switch C Closed/Open	ASCII	X
		Serial Word D		
103	1	Cal Lamp 1 On/Off	ASCII	X
104	1	Cal Lamp 2 On/Off	ASCII	X
105	1	Cal Lamp 3 On/Off	ASCII	X
106	1	Cal Lamp 1 Override On/Off	ASCII	X
107	1	Cal Lamp 2 Override On/Off	ASCII	X
108	1	Cal Lamp 3 Override On/Off	ASCII	X
109	1	Cal Sequencer On/Off	ASCII	X
110	1	Multiplexer Backup On/Off	ASCII	X

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Serial Word E		
111	1	Inchworm Power On/Off	ASCII	X
112	1	LVDT On/Off	ASCII	X
113	1	Blackbody On/Off	ASCII	X
114	1	Blackbody T2 On/Off	ASCII	X
115	1	Blackbody T3 On/Off	ASCII	X
116	1	Blackbody Backup On/Off	ASCII	X
117	1	SME 1 On/Off	ASCII	X
118	1	SME 2 On/Off	ASCII	X
		Serial Word F		
119	1	Baffle Heater Controller On/Off	ASCII	X
120	1	Baffle Heater Backup On/Off	ASCII	X
121	1	Macrodiscrete Generator A Primary On/Off	ASCII	X
122	1	Macrodiscrete Generator A Redundant On/Off	ASCII	X
123	1	Macrodiscrete Generator B Primary On/Off	ASCII	X
124	1	Macrodiscrete Generator B Redundant On/Off	ASCII	X

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
125	1	Multiplexer On/Off	ASCII	X
126	1	Midscan Pulse On/Off	ASCII	X
		Serial Word G		
127	1	Scan Line Corrector 1 On/Off	ASCII	X
128	1	Scan Line Corrector 2 On/Off	ASCII	X
129	1	Cal Shutter On/Off	ASCII	X
130	1	Cal Shutter Phase Error Yes/No	ASCII	X
131	1	Cal Shutter Amplitude Errors Yes/No	ASCII	X
132	1	Backup Shutter On/Off	ASCII	X
133	1	Backup Shutter Phase Error Yes/No	ASCII	X
134	1	Backup Shutter Amplitude Error Yes/No	ASCII	X
		Serial Word H		
135	1	Cold Stage Heater Controller On/Off	ASCII	X
136	1	Cold Stage Outgas Heater Enabled/Disabled	ASCII	X
137	1	Intermediate Stage Heater Controller On/Off	ASCII	X

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
138	1	Intermediate Stage Heater Enabled/Disabled	ASCII	X
139	1	Cold FPA Heater Controller On/Off	ASCII	X
140	1	Cold FPA T2 On/Off	ASCII	X
141	1	Cold FPA T3 On/Off	ASCII	X
142	1	Cold FPA Telemetry On/Off	ASCII	X
		Serial Word L		
143	1	DC Restore Normal/Not Normal	ASCII	X
144	1	Frame DC Restore Selected Yes/No	ASCII	X
145	1	Telemetry Scaling On/Off	ASCII	X
146	1	SMA +Z Heater Enabled/Disabled	ASCII	X
147	1	SMA -Z Heater Enabled/Disabled	ASCII	X
148	1	Midscan Pulse Backup On/Off	ASCII	X
49	1	SME 1 Select SAM	ASCII	X
150	1	Spare	ASCII	X
151-154	4	Primary Mirror Temp (IS-79)	^{o}C	REAL*4

Table 3.5-3. Interval Header Major Frames 2-3
TM Housekeeping Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
155-158	4	Primary Mirror Mask Temp (IS-80)	^{o}C	REAL*4
159-162	4	Secondary Mirror Temp (IS-82)	^{o}C	REAL*4
163-166	4	Secondary Mirror Mask Temp (IS-82)	^{o}C	REAL*4
167-170	4	Telescope Housing Temp (IS-84)	^{o}C	REAL*4
171-174	4	Telescope Baseplate Temp (IS-85)	^{o}C	REAL*4
175-182	8	Spare	ASCII	CHAR*8
183-190	8	Spare	ASCII	CHAR*8
191-222	32	Processed TM Housekeeping Data Quality Indicators Space reserved for 32 One-byte quality indicators: 22 for instrument temperatures 10 for serial words Order is same as given above X = '0': GOOD '1': BAD	ASCII	X
223-226	4	Zero Fill		

Table 3.5-4. Interval Header Major Frames 4-6
Ephemeris Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Processed Ephemeris Data Records		
		Space is reserved for up to 56 records (56 x 16.384 = 917.5 seconds) of ephemeris data		
		Major Frame 4: Records 1-2 Major Frame 5: Records 23-44 Major Frame 6: Records 45-56 Records 45-56 If less than 56 records are present, the remainder of the major frames will be zero filled.		
		Each record is formatted as follows:		
1-2	2	Record Sequence Number (1-56) (Telemetry Major Frame Sequence Number)		INTEGER*2
		Observation Times Relative to PCD Telemetry Interval Spacecraft Start Time		
3-10	8	Observation Time 1	SECONDS	REAL*8
11-18	8	Observation Time 2	SECONDS	REAL*8
19-26	8	Observation Time 3	SECONDS	REAL*8
27-34	8	Observation Time 4	SECONDS	REAL*8
35-42	8	Observation Time 5	SECONDS	REAL*8
43-50	8	Observation Time 6	SECONDS	REAL*8

Table 3.5-4. Interval Header Major Frames 4-6
Ephemeris Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
51-58	8	Observation Time 7	SECONDS	REAL*8
59-66	8	Observation Time 8	SECONDS	REAL*8
		Processed Ephemeris (ECITOD Reference)		
67-78	12	Position: X1,Y1,Z1	KM	REAL*4
79-90	12	Velocity: X1,Y1,Z1	KM/SEC	REAL*4
91-102	12	Position: X2,Y2,Z2	KM	REAL*4
103-114	12	Velocity: X2,Y2,Z2	KM/SEC	REAL*4
115-126	12	Position: X3,Y3,Z3	KM	REAL*4
127-138	12	Velocity: X3,Y3,Z3	KM/SEC	REAL*4
139-150	12	Position: X4,Y4,Z4	KM	REAL*4
151-162	12	Velocity: X4,Y4,Z4	KM/SEC	REAL*4
163-174	12	Position: X5,Y5,Z5	KM	REAL*4
175-186	12	Velocity: X5,Y5,Z5	KM/SEC	REAL*4
187-198	12	Position: X6,Y6,Z6	KM	REAL*4
199-210	12	Velocity: X6,Y6,Z6	KM/SEC	REAL*4
211-222	12	Position: X7,Y7,Z7	KM	REAL*4
223-234	12	Velocity: X7,Y7,Z7	KM/SEC	REAL*4
235-246	12	Position: X8,Y8,Z8	KM	REAL*4
247-258	12	Velocity: X8,Y8,Z8	KM/SEC	REAL*4

Table 3.5-4. Interval Header Major Frames 4-6
Ephemeris Data Records

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
259-274	16	Zero Fill		

Table 3.5-5. Interval Header Major Frames 7-110
Radiometric Correction Segment Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		One Major Frame Per RC Segment		
1-4	4	RC Segment ID		INTEGER*4
5-404	400	Condition Code Per Detector One value per detector, in the order D1...D100 Condition code definition is TBD		INTEGER*4
405-3604	3200	Number of cal values usable per detector per state, in the order State 1: D1...D100 State 2: D1...D100 . . . State 8: D1...D100		INTEGER*4
3605-4004	400	Number of shutter valves usable per detector. One value per detector, in the order D1...D100		INTEGER*4
4005-4404	400	Linear fit sigma per detector, one value per detector, in the order D1...D100	COUNTS	INTEGER*4
4405-4804	400	RMS noise per detector. One value per detector, in the order D1...D100	COUNTS	REAL*4
4805-5204	400	Histogram multiplicative gain modification size per detector. One value per detector, in the order D1...D100	COUNTS-CM^2 -SR/MW	REAL*4

Table 3.5-5. Interval Header Major Frames 7-110
Radiometric Correction Segment Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
5205-5604	400	Histogram additive bias modification size per detector. One value per detector, in the order D1...D100	COUNTS	REAL*4

b. Major Frame 2

1. Unprocessed SCD

c. Major Frames 3-7

1. Scene control point chips and related data organized as follows:

- o Major Frame 3: CPs 1-5
- o Major Frame 4: CPs 6-10
- o Major Frame 5: CPs 11-15
- o Major Frame 6: CPs 16-20
- o Major Frame 7: CPs 21-25

(Unused major frames are zero filled).

The data content and format are shown in Tables 3.5-6 through 3.5-9.

3.5.4 ANCILLARY DATA

The ancillary data provides geometric correction information which enables partially processed imagery to be fully processed at a later date, i.e., to go from a geometrically uncorrected array of pixels to a geometrically corrected array of pixels. A total of 21 major frames of ancillary data constitute the ancillary data section. The ancillary major frames contain information in the following order:

Major Frame 1

Geometric modeling data

Major Frame 2 - 21

GCD: High frequency matrices

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1-10	10	NASA Scene ID	ASCII	MDDDDHHMMS
11-18	8	WRS Designator M = '4': Landsat-D '5': Landsat-D Prime	ASCII	ßMPPPRRR
19-22	4	Orbit Number Scene Boundaries - defines what data will be processed to one fully processed scene		INTEGER*4
23-28	6	Scene Start SLID		IIMMLB
29-34	6	Scene Stop SLID		IIMMLB
35-40	6	WRS Scene Center SLID		IIMMLB
41-44	4	WRS Scene Center Pixel Number		INTEGER*4
45-60	16	Scene Start Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
61-76	16	Scene Stop Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
77-92	16	Zero Fill		
		SCENE DATA CHARACTERISTICS		
93-96	4	Number of Major Frames of Scene Header (Always 7)		INTEGER*4
97-100	4	Number of Major Frames of Ancillary Data (Always 2)		INTEGER*4
101-104	4	Number of Major Frames of Annotation Data (Always 2)		INTEGER*4

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
105-108	4	Number of Major Frames of Image Data		INTEGER*4
109-110	2	Number of Bits per Pixel (Always 8)		INTEGER*2
111-112	2	Radiometric Corrections Applied X = '0': NO '1': YES	ASCII	XØ
113-128	16	Zero Fill		
129-130		Map Projection Selected (Corresponds to second map projection in ancillary and annotation sections; first map projection is always SOM) X = 'U': Universal Transverse Mercator 'P': Polar Stereographic	ASCII	XØ
131-138	8	Band Indicator N = Number of bands per scene A digit is filled in if that band is present; blank filled if data for that band is invalid Overall Band Quality Code The code is defined in Table 3.5-7	ASCII	N1234567
139	1	Band 1	ASCII	X
140	1	Band 2	ASCII	X

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
141	1	Band 3	ASCII	X
142	1	Band 4	ASCII	X
143	1	Band 5	ASCII	X
144	1	BAnd 6	ASCII	X
145	1	Band 7	ASCII	X
146	1	Blank Fill	ASCII	'B'
147-150	4	WRS Horizontal Offset From Fully Processed Image Center	PIXELS	REAL*4
151-154	4	Nominal Overlap Mark Pixel Offset	PIXELS	INTEGER*2
155-170	16	Zero Fill		
		CONTROL POINT HISTORICAL INFORMATION		
		Overall Band Qualities of Reference Scene (Code Defined in Table 3.5-7)		
171-172	2	Band 1	ASCII	X'B'
173-174	2	Band 2	ASCII	X'B'
175-176	2	Band 3	ASCII	X'B'
177-178	2	Band 4	ASCII	X'B'
179-180	2	Band 5	ASCII	X'B'
181-182	2	Band 6	ASCII	X'B'

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
183-184	2	Band 7	ASCII	X'B'
185-188	4	Number of Scenes in Control Point (CP) Extraction Interval		INTEGER*4
189-192	4	Sequence Number in CP Extraction Interval		INTEGER*
193-196	4	Number of Geodetic Points Used in CP Generation Process, for the Interval		INTEGER*4
197-200	4	Number of Geodetic Points which were in the Reference Scene		INTEGER*4
201-204	4	Average* Initial Auto-correlation Peak Value For CPs from the Reference Scene		REAL*4
205-208	4	Average Initial Peak Curvature - for CPs from the Reference Scene		REAL*4
209-220	12	Reference Scene ID	ASCII	MSPPPRRRDDD
		Ninety Percent Error Ellipse		
221-224	4	Along-Track, for the Interval	METERS	REAL*4
225-228	4	Across-Track, for the Interval	METERS	REAL*4

* Average of CPs used in caluculations for present scene.

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
229-232	4	Along-Track, for the Reference Scene	METERS	REAL*4
233-236	4	Across-Track, for the Reference Scene	METERS	REAL*4
237-240	4	Average* Previous Registration Success - Percent Successful Registrations of Control Points		REAL*4
		CURRENT CONTROL POINT INFORMATION		
241-244	4	Number of Scenes in Interval		INTEGER*4
245-248	4	Sequence Number of this Scene in the Interval		INTEGER*4
249-252	4	Total Number of CPs Used in Performing Geometric Correction, for the Interval		INTEGER*4
253-256	4	Number of CPs which were from this Scene		INTEGER*4
257-260	4	Number of CPs which were From Scenes Prior to this in the Interval		INTEGER*4
261-264	4	Number of Geodetic CPs Used in Geometric Corrections, for the Interval		INTEGER*4
265-268	4	Total Number of CP Correlations Attempted for the Interval		

* Average of CPs used in calculations for present scene.

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
269-272	4	Number of CPs Rejected During Correlation Process		INTEGER*4
273-276	4	Number of Correlated CPs in the Interval Rejected During Pre-Filtering Process		INTEGER*4
277-280	4	Number of Correlated CPs in the Interval Rejected During the Filtering Process		INTEGER*4
281-284	4	Total Number of CP Correlations Attempted for This Scene		INTEGER*4
285-288	4	Total Number of CPs in This Scene Rejected During Correlation Process		INTEGER*4
289-292	4	Number of Correlated CPs in This Scene Rejected During Pre-Filtering Process		INTEGER*4
293-296	4	Number of Correlated CPs in This Scene Rejected During Filtering Process		INTEGER*4
297-298	2	Interval Correction Type XX = 'NC': No Correction 'MX': Mixed Correction 'MS': Mean Shifts	ASCII	XX
299-300	2	Scene Correction Type XX = 'NC': No Correction 'MS': Mean Shifts	ASCII	XX

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		'FD': Fixed Deltas 'SV': State Vector		
301-302	2	CP Band Mode X = '0': All CPs from the Reference Band '1': Mixed Bands	ASCII	XЬ
303-304	2	CP Interval Mode X = '0': All CPs from one CPLB interval '1': Mixed CPLB Intervals	ASCII	XЬ
305-904	600	Control Point Identication For each used CP in this scene, the following data will be given (24 bytes for each CP, up to 25 CPs)		
		Control Point Chip ID (15 Bytes)	ASCII	MSPPPRRRBTXXYYY
		Zero Fill (1 Byte)		
		Control Point Location: Line Number in Fully Processed Scene		REAL*4
		Pixel Number in Fully Processed Scene		REAL*4
905-908	4	Average* CP Correlation Peak Value for this Scene		REAL*4
909-912	4	Average* CP Correlation Peak Curvature for This Scene		REAL*4

* Average of CPs used in calculations for present scene.

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
913-928	16	Zero Fill		
		GEOMETRIC CORRECTION		
929	1	Overall Geometric Quality Code An assessment of the overall quality of the geometric modeling process based upon the GED filter RMS residuals for the scene (E_x and E_y) if $E = \sqrt{E_x^2 + E_y^2}$ (units in meters) XX = 'E' if $0 \leq E < 3$ 'G' if $3 \leq E < 4.25$ 'A' if $4.25 \leq E$	ASCII	X
930-932	3	Blank Fill	ASCII	'ßßß'
933-936	4	Value for E from above		
		RMS Geometric Modeling Errors		
		How well the geometric model matched the CP data		
937-940	4	Along-Track, for the Interval	METERS	REAL*4
941-944	4	Across-Track, for the Interval	METERS	REAL*4
945-948	4	Along-Track, for the Scene	METERS	REAL*4
949-952	4	Across-Track, for the Scene	METERS	REAL*4

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		State Vector at Scene Center		
953-956	4	Position (Radial)	METERS	REAL*4
957-960	4	Position (Along-Track)	METERS	REAL*4
961-964	4	Position (Cross-Track)	METERS	REAL*4
965-968	4	Position Rate (Radial)	METERS/SEC	REAL*4
969-972	4	Position Rate (Along-Track)	METERS/SEC	REAL*4
973-976	4	Position Rate (Cross-Track)	METERS/SEC	REAL*4
977-980	4	Angle (Roll)	RADIANS	REAL*4
981-984	4	Angle (Pitch)	RADIANS	REAL*4
985-988	4	Angle (Yaw)	RADIANS	REAL*4
989-992	4	Angular Rate (Roll)	RAD/SEC	REAL*4
993-996	4	Angular Rate (Pitch)	RAD/SEC	REAL*4
997-1000	4	Angular Rate (Yaw)	RAD/SEC	REAL*4
1001-1024	24	Reserved		
1025-1600	576	State Error Covariance Matrix at Scene Center A 12 x 12 Square Matrix Consistent with the State Vector, in the Order: P1,1 P1,2...P1,12 . . . P12,1 P12,2...P12,12		REAL*4

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1601-2320	720	Reserved		
		Measurement Error Matrix (R-Matrix)		
2321-2324	4	Along-Track Sigma	METERS	REAL*4
2325-2328	4	Cross-Track Sigma	METERS	REAL*4
2329-2344	16	Zero Fill		
		PROCESSED GCD STATISTICS		
		for the benchmark and high frequency matrices, 2 sets of values are given, one for forward scans and one for reverse scans. The values given are: a. Mean and variance of the difference between successive points in the matrix, both along the x-coordinate index (i), and along the sweep index (j) b. Maximum and minimum difference between successive points in the matrix, both along the x-coordinate system (i) and along the sweep index (j) The order of these values is as follows:		
		For Benchmark Matrix 1 (SOM)		
		Forward Scans, Matrix P_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2345-2348	4	Mean (i)		REAL*4
2349-2352	4	Mean (j)		REAL*4
2353-2356	4	Variance (i)		REAL*4
2357-2360	4	Variance (j)		REAL*4
2361-2364	4	Max Difference (i)		REAL*4
2365-2368	4	Max Difference (j)		REAL*4
2369-2372	4	Min Difference (i)		REAL*4
2373-2376	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Forward Scan, Matrix P_1		
2377-2380	4	Mean (i)		REAL*4
2381-2384	4	Mean (j)		REAL*4
2385-2388	4	Variance (i)		REAL*4
2389-2392	4	Variance (j)		REAL*4
2393-2396	4	Max Difference (i)		REAL*4
2397-2400	4	Max Difference (j)		REAL*4
2401-2404	4	Min Difference (i)		REAL*4
2405-2408	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Forward Scan, Matrix Y_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2409-2412	4	Mean (i)		REAL*4
2413-2416	4	Mean (j)		REAL*4
2417-2420	4	Variance (i)		REAL*4
2421-2424	4	Variance (j)		REAL*4
2425-2428	4	Max Difference (i)		REAL*4
2429-2432	4	Max Difference (j)		REAL*4
2433-2436	4	Min Difference (i)		REAL*4
2437-2440	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Forward Scan, Matrix Y_1		
2441-2444	4	Mean (i)		REAL*4
2445-2448	4	Mean (j)		REAL*4
2449-2452	4	Variance (i)		REAL*4
2453-2456	4	Variance (j)		REAL*4
2457-2460	4	Max Difference (i)		REAL*4
2461-2464	4	Max Difference (j)		REAL*4
2465-2468	4	Min Difference (i)		REAL*4
2469-2472	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Reverse Scan, Matrix P_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2473-2476	4	Mean (i)		REAL*4
2477-2480	4	Mean (j)		REAL*4
2481-2484	4	Variance (i)		REAL*4
2485-2488	4	Variance (j)		REAL*4
2489-2492	4	Max Difference (i)		REAL*4
2493-2496	4	Max Difference (j)		REAL*4
2497-2500	4	Min Difference (i)		REAL*4
2501-2504	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Reverse Scan, Matrix P_1		
2505-2508	4	Mean (i)		REAL*4
2509-2512	4	Mean (j)		REAL*4
2513-2516	4	Variance (i)		REAL*4
2517-2520	4	Variance (j)		REAL*4
2521-2524	4	Max Difference (i)		REAL*4
2525-2528	4	Max Difference (j)		REAL*4
2529-2532	4	Min Difference (i)		REAL*4
2533-2536	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Reverse Scan, Matrix Y_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2537-2540	4	Mean (i)		REAL*4
2541-2544	4	Mean (j)		REAL*4
2545-2548	4	Variance (i)		REAL*4
2549-2552	4	Variance (j)		REAL*4
2553-2556	4	Max Difference (i)		REAL*4
2557-2560	4	Max Difference (j)		REAL*4
2561-2564	4	Min Difference (i)		REAL*4
2565-2568	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (SOM)		
		Reverse Scan, Matrix Y_1		
2569-2572	4	Mean (i)		REAL*4
2573-2576	4	Mean (j)		REAL*4
2577-2580	4	Variance (i)		REAL*4
2581-2584	4	Variance (j)		REAL*4
2585-2588	4	Max Difference (i)		REAL*4
2589-2592	4	Max Difference (j)		REAL*4
2593-2596	4	Min Difference (i)		REAL*4
2597-2600	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Forward Scan, Matrix P_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2601-2604	4	Mean (i)		REAL*4
2605-2608	4	Mean (j)		REAL*4
2609-2612	4	Variance (i)		REAL*4
2613-2616	4	Variance (j)		REAL*4
2617-2620	4	Max Difference (i)		REAL*4
2621-2624	4	Max Difference (j)		REAL*4
2625-2628	4	Min Difference (i)		REAL*4
2629-2632	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Forward Scan, Matrix P_1		
2633-2636	4	Mean (i)		REAL*4
2637-2640	4	Mean (j)		REAL*4
2641-2644	4	Variance (i)		REAL*4
2645-2648	4	Variance (j)		REAL*4
2649-2652	4	Max Difference (i)		REAL*4
2653-2656	4	Max Difference (j)		REAL*4
2657-2660	4	Min Difference (i)		REAL*4
2661-2664	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Forward Scan, Matrix Y_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2665-2668	4	Mean (i)		REAL*4
2669-2672	4	Mean (j)		REAL*4
2673-2676	4	Variance (i)		REAL*4
2677-2680	4	Variance (j)		REAL*4
2681-2684	4	Max Difference (i)		REAL*4
2685-2688	4	Max Difference (j)		REAL*4
2689-2692	4	Min Difference (i)		REAL*4
2693-2696	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Forward Scan, Matrix Y_1		
2697-2700	4	Mean (i)		REAL*4
2701-2704	4	Mean (j)		REAL*4
2705-2708	4	Variance (i)		REAL*4
2709-2712	4	Variance (j)		REAL*4
2713-2716	4	Max Difference (i)		REAL*4
2717-2720	4	Max Difference (j)		REAL*4
2721-2724	4	Min Difference (i)		REAL*4
2725-2728	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Reverse Scan, Matrix P_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2729-2732	4	Mean (i)		REAL*4
2733-2736	4	Mean (j)		REAL*4
2737-2740	4	Variance (i)		REAL*4
2741-2744	4	Variance (j)		REAL*4
2745-2748	4	Max Difference (i)		REAL*4
2749-2752	4	Max Difference (j)		REAL*4
2753-2756	4	Min Difference (i)		REAL*4
2757-2760	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Reverse Scan, Matrix P_1		
2761-2764	4	Mean (i)		REAL*4
2765-2768	4	Mean (j)		REAL*4
2769-2772	4	Variance (i)		REAL*4
2773-2776	4	Variance (j)		REAL*4
2777-2780	4	Max Difference (i)		REAL*4
2781-2784	4	Max Difference (j)		REAL*4
2785-2788	4	Min Difference (i)		REAL*4
2789-2792	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 1 (UTM or PS)		
		Reverse Scan, Matrix Y_0		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2793-2796	4	Mean (i)		REAL*4
2797-2800	4	Mean (j)		REAL*4
2801-2804	4	Variance (i)		REAL*4
2805-2808	4	Variance (j)		REAL*4
2809-2812	4	Max Difference (i)		REAL*4
2813-2816	4	Max Difference (j)		REAL*4
2817-2820	4	Min Difference (i)		REAL*4
2821-2824	4	Min Difference (j)		REAL*4
		For Benchmark Matrix 2 (UTM or PS)		
		Reverse Scan, Matrix Y_1		
2825-2828	4	Mean (i)		REAL*4
2829-2832	4	Mean (j)		REAL*4
2833-2836	4	Variance (i)		REAL*4
2837-2840	4	Variance (j)		REAL*4
2841-2844	4	Max Difference (i)		REAL*4
2845-2848	4	Max Difference (j)		REAL*4
2849-2852	4	Min Difference (i)		REAL*4
2853-2856	4	Min Difference (j)		REAL*4
		For High Frequency Along Scan Matrix (Θ HF)		
		Forward Scans		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2857-2860	4	Mean (i)		REAL*4
2861-2864	4	Mean (j)		REAL*4
2865-2868	4	Variance (i)		REAL*4
2869-2872	4	Variance (j)		REAL*4
2873-2876	4	Max Difference (i)		REAL*4
2877-2880	4	Max Difference (j)		REAL*4
2881-2884	4	Min Difference (i)		REAL*4
2885-2888	4	Min Difference (j)		REAL*4
		For High Frequency Along Scan Matrix (Θ HF)		
		Reverse Scans		
2889-2892	4	Mean (i)		REAL*4
2893-2896	4	Mean (j)		REAL*4
2897-2900	4	Variance (i)		REAL*4
2901-2904	4	Variance (j)		REAL*4
2905-2908	4	Max Difference (i)		REAL*4
2909-2912	4	Max Difference (j)		REAL*4
2913-2916	4	Min Difference (i)		REAL*4
2917-2920	4	Min Difference (j)		REAL*4
		High Frequency Cross Scan Matrix (σ HF)		
		Forward Scans		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2921-2924	4	Mean (i)		REAL*4
2925-2928	4	Mean (j)		REAL*4
2929-2932	4	Variance (i)		REAL*4
2933-2936	4	Variance (j)		REAL*4
2937-2940	4	Max Difference (i)		REAL*4
2941-2944	4	Max Difference (j)		REAL*4
2945-2948	4	Min Difference (i)		REAL*4
2949-2952	4	Min Difference (j)		REAL*4
		High Frequency Cross Scan Matrix (σ HF)		
		Reverse Scans		
2953-2956	4	Mean (i)		REAL*4
2957-2960	4	Mean (j)		REAL*4
2961-2964	4	Variance (i)		REAL*4
2965-2968	4	Variance (j)		REAL*4
2969-2972	4	Max Difference (i)		REAL*4
2973-2976	4	Max Difference (j)		REAL*4
2977-2980	4	Min Difference (i)		REAL*4
2981-2984	4	Min Difference (j)		REAL*4
		High Frequency Along Scan Matrix (θ HF)		
2985-2988		Fwd Scan Max Value		REAL*4

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2989-2992	4	Fwd Scan Min Value		REAL*4
2993-2996	4	Rev Scan Max Value		REAL*4
2997-3000	4	Rev Scan Max Value		REAL*4
		High Frequency Cross Scan Matrix (σ HF)		
3001-3004	4	Fwd Scan Max Value		REAL*4
3005-3008	4	Fwd Scan Min Value		REAL*4
3009-3012	4	Rev Scan Max Value		REAL*4
3013-3016	4	Rev Scan Min Value		REAL*4
		Scan Gap Size		
3017-3020	4	Max Value	PIXELS	REAL*4
3021-3024		Min Value	PIXELS	REAL*4
3025-3028	4	Mean Value	PIXELS	REAL*4
3029-3032	4	Number Exceeding Max Threshold		INTEGER*4
3033-3036	4	Number Exceeding Min Threshold		INTEGER*4
		Scan Gap Skew		
3037-3040	4	Max Value	PIXELS	REAL*4
3041-3044	4	Min Value	Pixels	REAL*4
3045-3048	4	Mean Value	PIXELS	REAL*4

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
3049-3052	4	Number Exceeding Max Threshold		INTEGER*4
3053-3056	4	Number Exceeding Min Threshold		INTEGER*4
		Horizontal Strip (Segment) Input		
		Pixel Distance		
3057-3060	4	Max Value	PIXELS	REAL*4
3061-3064	4	Min Value	PIXELS	REAL*4
3065-3068	4	Mean Value	PIXELS	REAL*4
3069-3072	4	Number Exceeding Max Threshold		INTEGER*4
3073-3076	4	Number Exceeding Min Threshold		INTEGER*4
3077-3080	4	Max Rotation Angle	RADIANS	REAL*4
3081-3096	16	Zero Fill		
		HARDWARE QUALITY DATA (THIS SCENE)		
3097-3144	48	R-Tape Read Errors (Pass 1) Counts of corrected and uncorrected bit errors for the scene on a 5-second basis (last 5 seconds ignored).		INTEGER*2
	..	Space reserved for 60 seconds of data (12 samples) Order: $N_1(1)$, $N_2(1)$... $N_1(12)$ $N_2(12)$		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		where: N_1 = Uncorrected error count N_2 = Corrected error count		
3145-3148	4	Number of Major Frame Sync Losses (Pass 1)		INTEGER*4
3149-3152	4	Number of Minor Frame Sync Losses (Pass 1)		INTEGER*4
3153-3156	4	Number of Minor Frame Sync Errors (Pass 1)		INTEGER*4
3157-3160	4	Number of Bit Slips (Pass 1)		INTEGER*4
3161-3164	4	Number of Time Code Substitutions (Pass 1)		INTEGER*4
3165-3180	16	Zero Fill		
		IMAGE OVERLAP MARK DATA (MAP PROJECTION #1)		
		Location data is given for the corners of the image overlap marks for use in the fully processed output image.		
		Location data is given in the form of a scan line number (relative to scene start) and a pixel number (both in the fully processed output image) for the four overlap marks.		

Table 3.5-6. Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Upper Left Overlap Mark		
3181-3184	4	Fully Processed Scan Line		INTEGER*4
3185-3188	4	Pixel Number		INTEGER*4
		Upper Right Overlap Mark		
3189-3192	4	Fully Processed Scan Line		INTEGER*4
3193-3196	4	Pixel Number		INTEGER*4
		Lower Left Overlap Mark		
3197-3200	4	Fully Processed Scan Line		INTEGER*4
3201-3204	4	Pixel Number		INTEGER*4
		Lower Right Overlap Mark		
3205-3208	4	Fully Processed Scan Line		INTEGER*4
3209-3212	4	Pixel Number		INTEGER*4
		IMAGE OVERLAP MAKR DATA (MAP PROJECTION #2)		
		Location data is given for the corners of the image overlap marks for use in the fully processed output image.		
		Location data is given in the form of a scan line number (relative to scene start) and a pixel number (both in the fully processed output image) for the four overlap marks.		

Table 3.5-6 Scene Header Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Upper Left Overlap Mark		
3213-3216	4	Fully Processed Scan Line		INTEGER*4
3217-3220	4	Pixel Number		INTEGER*4
		Upper Right Overlap Mark		
3221-3224	4	Fully Processed Scan Line		INTEGER*4
3225-3228	4	Pixel Number		INTEGER*4
		Lower Left Overlap Mark		
3229-3232	4	Fully Processed Scan Line		INTEGER*4
3233-3236	4	Pixel Number		INTEGER*4
		Lower Right Overlap Mark		
3237-3240	4	Scan line		INTEGER*4
3241-3244	4	Pixel Number		INTEGER*4
3245-6344	3100	Zero Fill		

Table 3.5-7. Overall Band Quality Code

The assessment of the overall quality of a band of imagery is based on the combined geometric, radiometric, and image data quality. The codes are defined as follows:

OVERALL BAND QUALITY CODE	RELATIVE QUALITY	GEOMETRIC QUALITY CODE	RADIOMETRIC QUALITY CODE	IMAGE QUALITY CODE
D	BEST	E	E	E
C		E	E	G
B		E	G	E
A		G	E	E
9		E	G	G
8		G	E	G
7		G	G	E
6		G	G	G
5		A	E	E
4		A	E	G
3		A	G	E
2		A	G	G
1		A	E, G, OR A	A
0	ACCEPTABLE	A	A	E, G, OR A

The Geometric Quality Code is defined in Table 3.5-6.

The Radiometric Quality Code is defined as follows:

$0 \leq RCA < 1.0 \rightarrow CODE = E$
$1.0 \leq RCA < 2.0 \rightarrow CODE = G$
$2.0 \leq RCA \rightarrow CODE = A$

where RCA (Radiometric Calibration Accuracy) is the maximum difference between detector means for the band.

The Image Quality Code is defined as follows:

$0 \leq DQI < 1.5 \rightarrow CODE = E$
$1.5 \leq DQI < 4.5 \rightarrow CODE = G$
$4.5 \leq DQI \rightarrow CODE = A$

where DQI = major frame sync losses + minor frame sync losses/20 + irrecoverable ECC count error/20 (all on a scene basis during Pass 1).

Table 3.5-8. Scene Header Major Frame 2
Unprocessed SCD Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		MAP PROJECTION DEPENDENT DATA (SOM)		
1-4	4	Map Projection #1 Identification		'SOMØ'
5-8	4	SOM Row Switch		INTEGER*4
9-16	8	WRS Scene Center - X	KILOMETERS	REAL*8
17-24	8	WRS Scene Center - Y	KILOMETERS	REAL*8
25-28	4	Display Rotation Angle	RADIANS	REAL*4
29-32	4	Horizontal Display Shift	KILOMETERS	REAL*4
		Benchmark Matrix for Map Projection #1		
33-288	256	PØ (i,j,k) i = 1...8 x-coordinate index j = 1,2,3,4 sweep index k = 1,2 scan direction (1=FWD, 2=REV) (Data stored such that the leftmost subscripts vary most rapidly)	PIXELS	REAL*4
289-544	256	YØ (i,j,k) (Same as PØ)	KILOMETERS	REAL*4
545-800	256	P1 (i j,k) (Same as PØ)	PIXELS	REAL*4
801-1056	256	Y1 (i,j,k) (Same as PØ)	KILOMETERS	REAL*4

Table 3.5-8. Scene Header Major Frame 2
Unprocessed SCD Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		MAP PROJECTION DEPENDENT DATA (UTM OR PS)		
1057-1060	4	Map Projection #2 Identification XXX = 'UTM' or 'PSb'		XXXb
1061-1064	4	UTM Central Meridian		INTEGER*4
1065-1072	8	WRS Scene Center - X	KILOMETERS	REAL*8
1073-1080	8	WRS Scene Center - Y	KILOMETERS	REAL*8
1080-1084	4	Display Rotation Angle	RADIANS	REAL*4
1085-1088	4	Horizontal Display Shift	KILOMETERS	REAL*4
		Benchmark Matrix for Map Projection #2		
1089-1344	256	PØ (i,j,k) i = 1...8 x-coordinate index j = 1,2,3,4 sweep index k = 1,2 scan direction (1=FWD, 2=REV) (Data stored such that the leftmost subscripts vary most rapidly)	PIXELS	REAL*4
1345-1600	256	YØ (i,j,k) (Same as PØ)	KILOMETERS	REAL*4
1601-1856	256	P1 (i,j,k) (Same as P1)	PIXELS	REAL*4
1857-2112	256	Y1 (i,j,k) (Same as PØ)	KILOMETERS	

Table 3.5-8. Scene Header Major Frame 2
Unprocessed SCD Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2113-6348	4236	Zero Fill		

Table 3.5-9. Scene Header Major Frame 3-7
Control Point Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Space is reserved for 25 control points per scene, distributed as follows: Major Frame 3: Control Points 1-5 Major Frame 4: Control Points 6-10 Major Frame 5: Control Points 11-15 Major Frame 6: Control Points 16-20 Major Frame 7: Control Points 21-25 Each record (1 control point) is formatted as follows:		
1-15	15	Control Point Chip Identification	ASCII	MSPPPRRRBTXXYYY
16	1	Control Point Use in This Scene X = '0': Not needed in this scene '1': Failed contract check, correlation not attempted '2': Correlation attempted, but failed '3': Correlation successful, failed GED pre-filter '4': Correlation successful, failed GED processing '5': Contributed successfully to GED	ASCII	X
17-26	10	Reference Image NASA Scene ID	ASCII	MDDDDHHMMS

Table 3.5-9. Scene Header Major Frame 3-7
Control Point Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		M = Mission Number (see above) DDDD = Days Since Launch HH = Hours MM = Minutes T = Tens of Seconds		
27-34	8	Control Point Latitude (Center of Chip) N = 'N': North 'S': South DD = Degrees (00-90) MM = Minutes (00-59) SS = Seconds (00-59) T = Tenths of a Second (0-9)	ASCII	NDDMMSST
35-43	9	Control Point Longitude (Center of Chip) N = 'E': East 'W': West DDD = Degrees (000-359) MM = Minutes (00-59) SS = Seconds (00-59) T = Tenths of a Second (0-9)	ASCII	NDDDMMSST
44-47	4	Control Point Elevation Relative to Sea Level	METERS	INTEGER*4
		Control Point Chip Dimensions		
48-49	2	Number of Lines (Always 32)		INTEGER*2
50-51	2	Number of Pixels/Line (Always 32)		INTEGER*2
52-55	4	Control Point Chip Center Line Number		REAL*4

Table 3.5-9. Scene Header Major Frame 3-7
Control Point Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
56-59	4	Control Point Chip Center Pixel Number		REAL*4
60	1	Digitized Map Projection X = 'S': SOM 'U': UTM 'P': P/S	ASCII	X
61	1	Map Scale Code	ASCII	X
		Correlation Record		
62-63	2	Number of Attempts		INTEGER*2
64-65	2	Number of Successes		INTEGER*2
		Overall Band Qualities of Reference Image (Reference Table 3.5-7)		
66	1	Band 1	ASCII	X
67	1	Band 2	ASCII	X
68	1	Band 3	ASCII	X
69	1	Band 4	ASCII	X
70	1	Band 5	ASCII	X
71	1	Band 6	ASCII	X
72	1	Band 7	ASCII	X
73-74	2	Number of Geodetic Control Points Used in Reference Image		INTEGER*2
75-76	2	Control Point Season (Month of Year 1-12)		INTEGER*2

Table 3.5-9. Scene Header Major Frame 3-7
Control Point Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
77-79	3	Control Point Feature Type Code	ASCII	XX
80-83	4	Control Point Initial Auto Correlation Peak Value		REAL*4
84-87	4	Control Point Initial Auto Correlation Peak Curvature		REAL*4
		Ninety Percent Error Ellipse		
88-91	4	Along-Track Error	METERS	REAL*4
92-95	4	Across-Track Error	METERS	REAL*4
96-99	4	Mean Radiance of Chip		REAL*4
		CP Chip Pixel Intensity Values		
100-1123	1024	A 32 x 32 matrix listed by (row, column), i.e., $P_{1,1}\ P_{1,2}\cdots P_{1,32}$ $P_{2,1}, P_{2,2}\cdots P_{2,32}$ . . . $P_{32,1}, P_{32,2}\cdots P_{32,32}$		BYTE
1124-2246	1123	Control Point 2 description is in the same format as for control point 1.		
2247-3369	1123	Control Point 3 description is in the same format as for control point 1.		

Table 3.5-9. Scene Header Major Frame 3-7
Control Point Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
3370-4492	1123	Control Point 4 description is in the same format as for control point 1.		
4493-5615	1123	Control Point 5 description is in the same format as for control point 1.		
5616-6344	729	Zero fill		

The ancillary data field content and format are shown in Table 3.5-10 and Table 3.5-11.

3.5.5 ANNOTATION

Annotation data consists of alphanumeric information printed at the bottom of a film product and the tick mark information that surrounds the fully processed framed image for a specific map projection. Figure 3.5-1 illustrates the relationship of both the annotation and the tick mark information relative to the fully processed image writing area independent of map projection.

The tick mark data region has space reserved for eight tick marks on each side of the image. The order of tick mark data (both in appearance in the respective minor frame and on the image product) is summarized below:

TICK MARK ZONE	ORDER OF APPEARANCE
Top	Left to right
Left	Top to bottom
Right	Top to bottom
Bottom	Left to right

Figure 3.5-2 illustrates tick mark features and their proper utilization in a fully processed (i.e., geometrically corrected) image. Pixel 1, scan line 1 in the fully processed image is the reference point from which all tick mark information is provided. Each tick mark is located approximately 1000 meters from the fully processed image area. As shown at the bottom of Figure 3.5-2, the

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		A. SCENE INDEPENDENT DATA		
1-4	4	Scale of Fully Processed Output Inter-Pixel Distance	METERS/ PIXEL	REAL*4
5-8	4	Scale of Fully Process Output Inter-Line Distance	METERS/ PIXEL	REAL*4
		TM Mirror Model Coefficients		
		Forward Scan		
9-12	4	C_{0F}		REAL*4
13-16	4	C_{1F}		REAL*4
17-20	4	C_{2F}		REAL*4
21-24	4	C_{3F}		REAL*4
25-28	4	C_{4F}		REAL*4
29-32	4	C_{5F}		REAL*4
		Reverse Scan		
33-36	4	C_{0R}		REAL*4
37-40	4	C_{1R}		REAL*4
41-44	4	C_{2R}		REAL*4
45-48	4	C_{3R}		REAL*4
49-52	4	C_{4R}		REAL*4

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
53-56	4	C_{5R}		REAL*4
57-60	4	First Half Scan Mirror Angle	RADIANS	REAL*4
61-64	4	Second Half Scan Mirror Angle	RADIANS	REAL*4
65-68	4	Semi-Major Axis of Earth Ellipsoid (International Spheroid)	METERS	REAL*4
69-72	4	Semi-Minor Axis of Earth Ellipsoid (International Spheroid)	METERS	REAL*4
73-104	32	Zero Fill		
		B. SCENE DEPENDENT DATA		
105-106	2	Scene Sequence Number		INTEGER*2
107-108	2	WRS Path Number		INTEGER*2
109-110	2	WRS Row Number		INTEGER*2
111-112	2	Mission Number X = '4': Landsat-D '5': Landsat-D Prime	ASCII	XØ
113-128	16	First Scan Start Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
129-144	16	Last Scan Start Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
145-152	8	Scene Center Spacecraft Time Relative to PCD Telemetry Start	SECONDS	REAL*8

Table 3.5-10. Ancillary Major Frame 1 Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		(accurate to 0.13 milliseconds)		
153-154	2	Sweep Number (Relative to the Sweep #1 of the imaging interval) for the Sweep Containing the WRS Scene Center		INTEGER*2
155-156	2	Number of Scans in the Scene (Always 374)		INTEGER*2
157-160	4	Earth Radius at Scene Center	KILOMETERS	REAL*4
161-164	4	Spacecraft Orbit Radius at Scene Center	KILOMETERS	REAL*4
165-168	4	Earth Rotation Parameter (Image Skew)	RADIANS	REAL*4
169-172	4	Spacecraft Heading Angle at Scene Center	RADIANS	REAL*4
173-176	4	Cross-Scan Benchmark Matrix Offset	RADIANS	REAL*4
177-192	16	PCD Telemetry Start Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
193-208	16	PCD Telemetry Stop Spacecraft Time	ASCII	YYDDDHHMMSSTTTFF
209-212	4	WRS scene latitude (unrounded)	RADIANS	REAL*4
213-216	4	WRS scene longitude (unrounded)	RADIANS	REAL*4

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
217-240	24	Zero fill		
		C.1 MAP PROJECTION DEPENDENT DATA (SOM)		
241-244	4	Map Projection #1 Identification		'SOMb'
245-248	4	SOM Row Switch		INTEGER*4
249-256	8	WRS Scene Center - X	KILOMETERS	REAL*8
257-264	8	WRS Scene Center - Y	KILOMETERS	REAL*8
265-268	4	Display Rotation Angle	RADIANS	REAL*4
269-272	4	Horizontal Display Shift	KILOMETERS	REAL*4
		Benchmark Matrix For Map Projection #1		
273-528	256	PØ (i,j,k) i = 1...8 x-coordinate index j = 1,2,3,4 sweep index k = 1,2 scan direction (Data stored such that the leftmost subscripts vary most rapidly)	PIXELS	REAL*4
529-784	256	YØ (i,j,k) (Same as PØ)	KILOMETERS	REAL*4
785-1040	256	P1 (i,j,k) (Same as PØ)	PIXELS	REAL*4
1041-1296	256	Y1 (i,j,k) (Same as PØ)	KILOMETERS	REAL*4

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1297-1424	128	Zero Fill		
		C.2 MAP PROJECTION DEPENDENT DATA (UTM or PS)		
1425-1428	4	Map Projection #2 Identification XXX = 'UTM' or 'PSØ'		XXXØ
1429-1432	4	UTM Central Meridian		INTEGER*4
1433-1440	8	WRS Scene Center - X	KILOMETERS	REAL*8
1441-1448	8	WRS Scene Center - Y	KILOMETERS	REAL*8
1449-1452	4	Display Rotation Angle	RADIANS	REAL*4
1453-1456	4	Horizontal Display Shift	KILOMETERS	REAL*4
		Benchmark Matrix for Map Projection #2		
1457-1712	256	PØ (i,j,k) i = 1...8 x-coordinate index j = 1,2,3,4 sweep index k = 1,2 scan direction (Data stored such that the leftmost subscripts vary most rapidly)	PIXELS	REAL*4
1713-1968	256	YØ (i,j,k) (Same as PØ)	KILOMETERS	REAL*4
1969-2224	256	P1 (i,j,k) (Same as P)	PIXELS	REAL*4

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2225-2480	256	Y1 (i,j,k) (Same as P1)	KILOMETERS	
2481-2608	128	Zero Fill		
		D. GCD SPARSE MATRICES		
2609-2610	2	Scene Sequence Number		INTEGER*2
2611-2614	4	Position Vector Scan Rate - Forward	KM/SEC	REAL*4
2615-2618	4	Position Vector Scan Rate - Reverse	KM/SEC	REAL*4
		Nominal Along-Scan Focal Plane Band Locations (Refer to Optical Axis)		
2619-2622	4	Band 1	RADIANS	REAL*4
2623-2626	4	Band 2	RADIANS	REAL*4
2627-2630	4	Band 3	RADIANS	REAL*4
2631-2634	4	Band 4	RADIANS	REAL*4
2635-2638	4	Band 5	RADIANS	REAL*4
2639-2642	4	Band 6	RADIANS	REAL*4
2643-2646	4	Band 7	RADIANS	REAL*4
		Along Scan Focal Plane Detector Locations Data (Refer to Band Center)		
2647-3542	896	(m,n,k) m = 1,...7 Band number	RADIANS	REAL*4

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		n = 1,...16 Detector number k = 1,2 Scan direction (1=FWD, 2=REV) (Data stored such that the leftmost subscripts vary most rapidly)		
		Cross Scan Detector Array Center Locations (Refer to Optical Axis)		
3543-3546	4	Band 1	RADIANS	REAL*4
3547-3550	4	Band 2	RADIANS	REAL*4
3551-3554	4	Band 3	RADIANS	REAL*4
3555-3558	4	Band 4	RADIANS	REAL*4
3559-3562	4	Band 5	RADIANS	REAL*4
3563-3566	4	Band 6	RADIANS	REAL*4
3567-3570	4	Band 7	RADIANS	REAL*4
		Cross Scan Focal Plane Detector Spacing		
3571-3574	4	Band 1	RADIANS	REAL*4
3575-3578	4	Band 2	RADIANS	REAL*4
3579-3582	4	Band 3	RADIANS	REAL*4
3583-3586	4	Band 4	RADIANS	REAL*4
3587-3590	4	Band 5	RADIANS	REAL*4

Table 3.5-10. Ancillary Major Frame 1
Geometric Modeling Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
3591-3594	4	Band 6	RADIANS	REAL*4
3595-3598	4	Band 7	RADIANS	REAL*4
		DFP Odd Detector Sample Shift Data		
3599-3654	56	Nd (m,k) m = 1...7 Band number k = 1,2 Scan direction (1=FW, 2=REV) (Data stored such that The leftmost subscript varies most rapidly)	PIXELS	INTEGER*4
3655-6344	2690	Zero Fill		

Table 3.5-11. Ancillary Major Frames 2-21
High Frequency Matrices

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1-2	2			
3-4	2	Record Sequence Number (01-374)		INTEGER*2
		<u>High Frequency Along-Scan Matrix</u>		
5-144	140	Theta (i,n) i = 1,...35 Sample number n = Scan number (Record seq number) Order: Theta (1,n)... Theta (35,n)	RADIANS	REAL*4
		<u>High Frequency Cross-Scan Matrix</u>		
145-284	140	Sigma (i,n) i = 1,...35 Sample number n = Scan number (Record seq number) Order: Sigma (1,n)... Sigma (35,n)	RADIANS	REAL*4
285-288	4	Fully Processed Scan Line Length	PIXELS	INTEGER*4
289-296	8	Mirror Scan Start Time Relative to PCD Telemetry Start Time	SECONDS	REAL*8
		NOTE: The data is distributed in major frames 2-21 as follows: Major Frames 2-20: Scans 1-361 (19 scan lines each) Major Frame 21: Scans 362-374 (13 scan lines)		

Table 3.5-11 Ancillary Major Frames 2-21
High Frequency Matrices

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		The unused data bytes in each major frame are zero filled.		

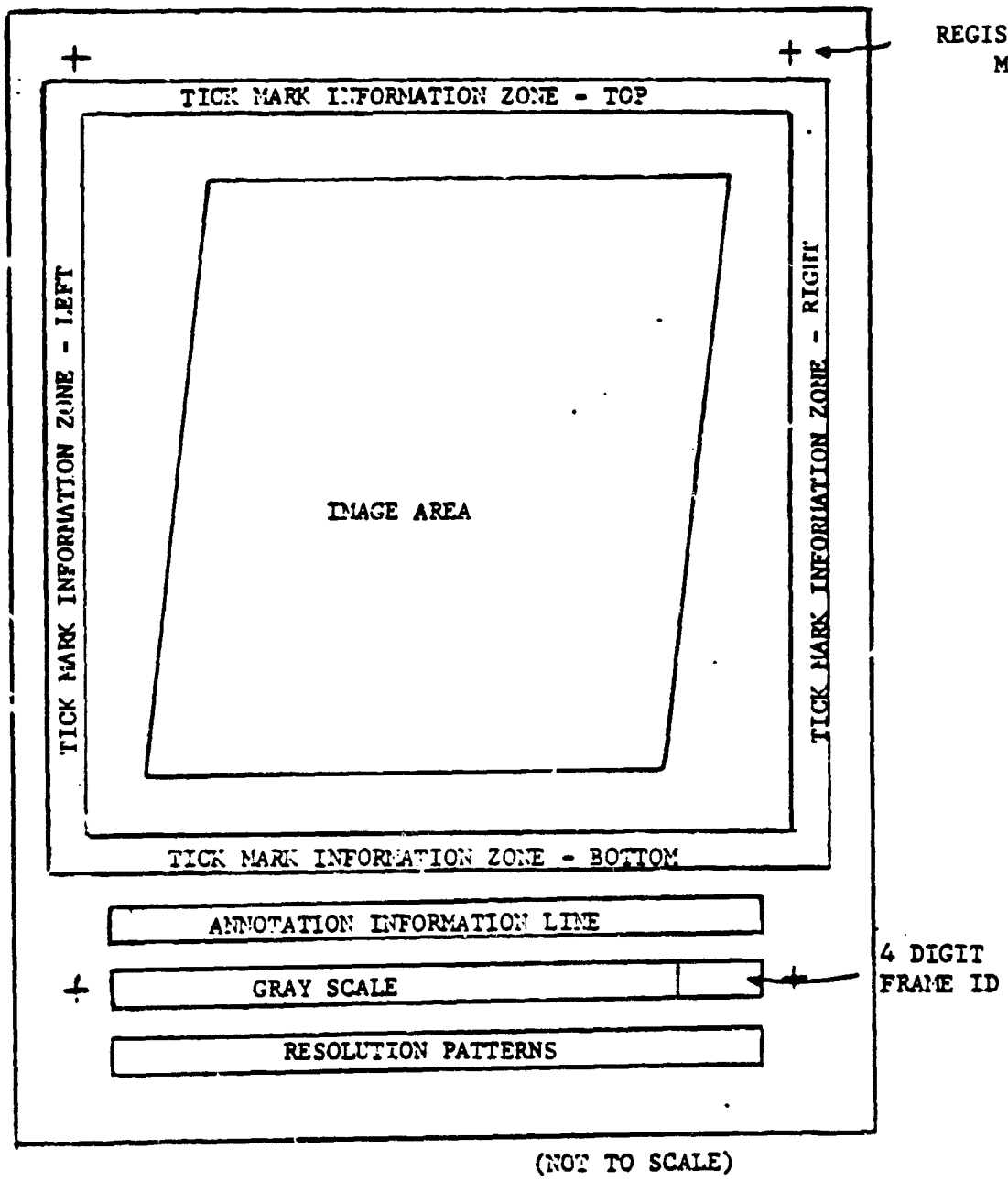
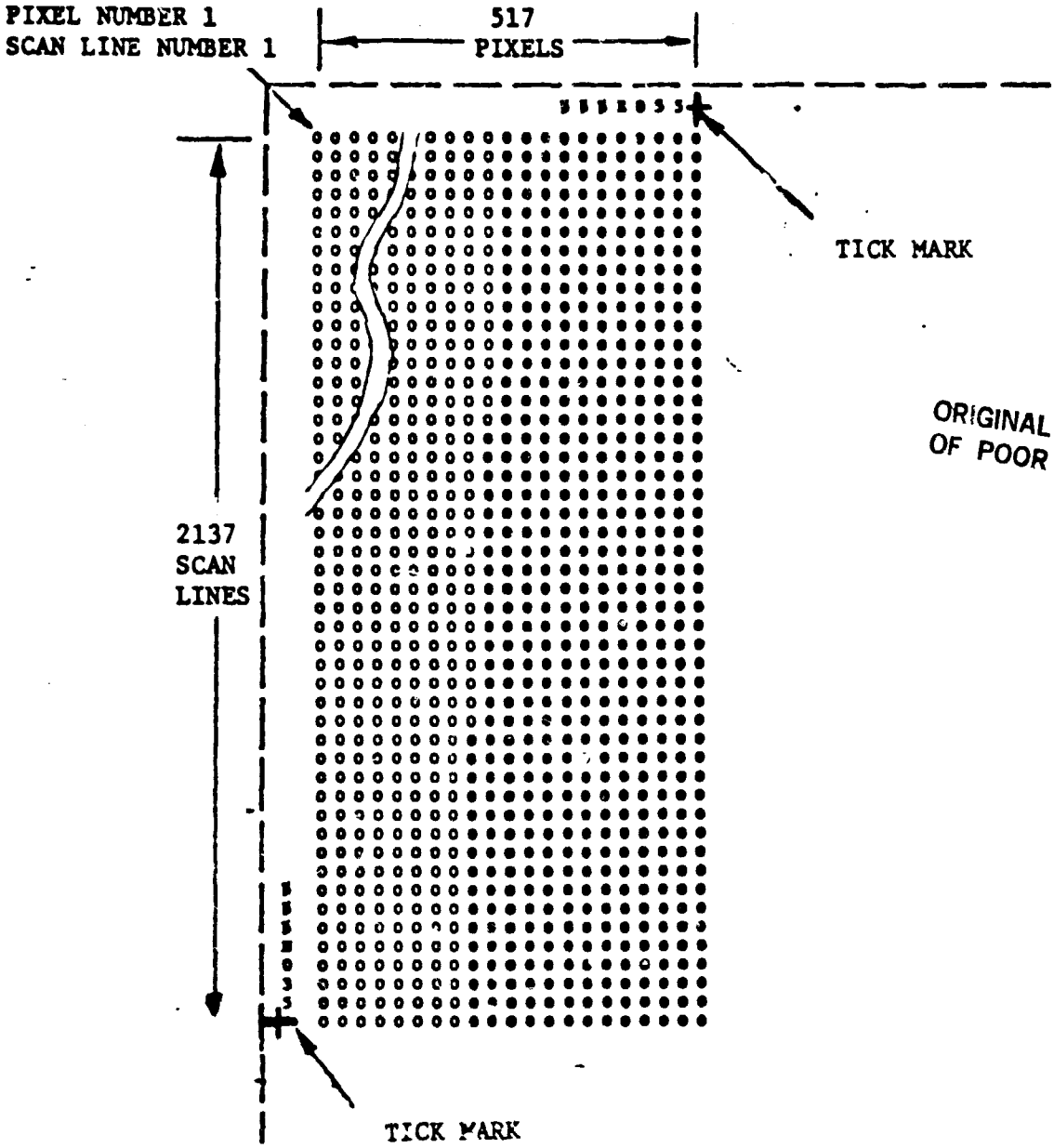


Figure 3.5-1. Relationship between Annotation Information and Image Writing Area



Annotation Format and Location with respect to Tick Mark*

	Binary Location of Tick Mark		Coordinate Data (Leading blanks format shown)						
Top	10000010	00000101	⊻	⊻	⊻	E	0	5	5
Side	10001000	01011001	⊻	⊻	⊻	N	0	3	5

*When MSB = 1, annotation is above or to left of tick mark
When MSB = 0, annotation is below or to right of tick mark

Figure 3.5-2. An Example of the Placement of Two Tick Mark Coordinates and Their Corresponding Annotation with Respect to Fully Processed Image Data

most significant bit in the binary tick mark location bytes specifies the placement and format of the coordinate data. Specifically a "0" signifies tick mark annotation placement is either below or to the right of the tick mark, with trailer blanks, and a "1" signifies tick mark annotation placement is either above or to the left of the tick mark, with leading blanks. Tick mark annotation examples for various map projections are provided in Figure 3.5-3.

Tick marks are provided for the following map projections

a. UTM or PS

b. Either UTM or PS.

Tick marks for the SOM projection are always provided. Tick marks for the UTM map projection are provided when the framed image data covers sites from the equator up to 65°N latitude or 65°S latitude. For areas north of 65°N latitude or south of 65° latitude tick marks for the PS map projection are provided.

For all map projections, one tick mark with latitude/longitude coordinates will be inserted in each of the four tick mark borders. They will consist of one pair of latitude and one pair of longitude tick marks giving the latitude and longitude of the scene reference point. The scene reference point is defined as the point with the latitude and longitude of the WRS scene center after each has been rounded to the nearest 0.25°. In the event of conflict between the physical location of a latitude/longitude tick mark and any other tick mark, the latitude/longitude tick mark will take precedence.

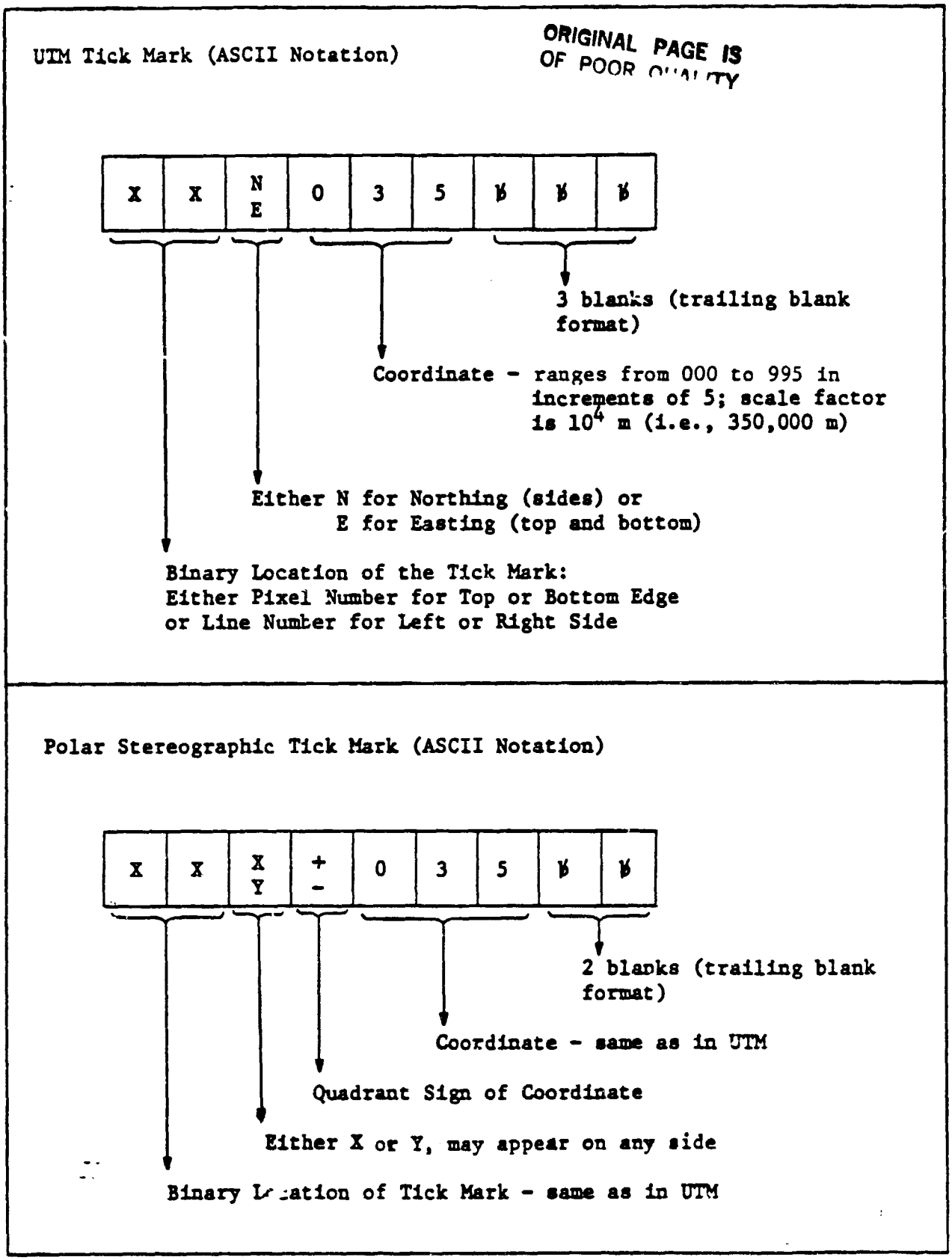


Figure 3.5-3. Tick Mark Annotation

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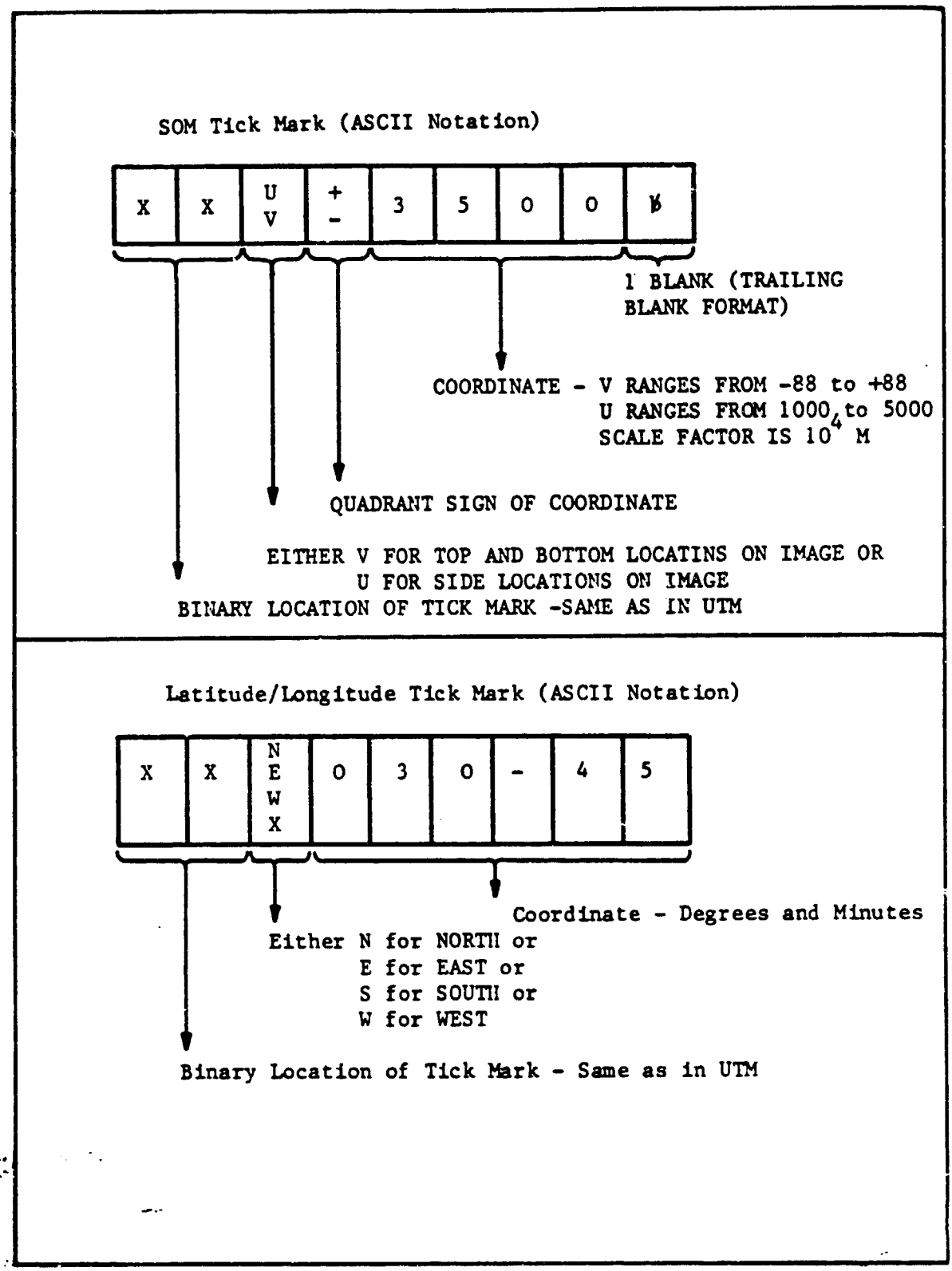


Figure 3.5-3. Tick Mark Annotation (Cont'd.)

An example of character annotation field content and format are shown in Table 3.5-11. The tick mark field content and format are shown in Table 3.5-12 and Table 3.5-13.

3.5.6 IMAGE

The radiometrically corrected image data is recorded in band-interleaved-by-line (BIL) format. The BIL format is shown in Figure 3.5-4. The organization of the image data on the HDT-AT is illustrated in Figure 3.5-5.

The thermal band (band 6) data is replicated (16 times) such that it appears similar in format to the spectral band data. The thermal band replication is illustrated in Figure 3.5-6.

The image data for all bands within each scan are aligned by shifting a fixed integer number of pixels. The arrangement of pixels within the forward and reverse scans after alignment is shown in Figure 3.5-7 and Figure 3.5-8, respectively.

Each major frame of image data contains one band-line of image pixels (eight bits/pixel). In addition the image pixels are preceded by a scan line identification (SLID) and followed by a support data field. The support data contains quality and radiometric calibration information.

The SLID content and format are shown in Figure 3.5-9. The image pixels and support data content and format are shown in Table 3.5-15.

Table 3.5-12. Annotation Major Frames 1-2
Character Annotation Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		WRS Path and Row Identifier		
1	1	N = 'A': Ascending Node 'D': Descending Node		N
2-4	3	WRS Path Number (001-233)		PPP
5	1	Fixed		'-'
6-8	3	WRS Row Number (001-248)		RRR
9-12	4	Fixed		'ΒΒΒΒ'
		Date of Image Acquisition		
13-14	2	Day of Month (01-31)		DD
15-17	3	Month (Jan-Dec)		MMM
18-19	2	Year (81-99)		YY
20	1	Fixed		'Β'
		Image Center Latitude and Longitude of the Center of the TM Image		
21-22	2	Fixed		'CΒ'
23	1	L = 'N': North latitude 'S': South latitude		L
24-25	2	Degrees Latitude		DD
26	1	Fixed		'-'
27-28	2	Minutes Latitude		MM
29	1	Fixed		'/'

Table 3.5-12. Annotation Major Frames 1-2
Character Annotation Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
30	1	W = 'E': East longitude 'W': West longitude		W
31-33	3	Degrees Longitude		DDD
34	1	Fixed		'-'
35-36	2	Minutes Longitude		MM
37	1	Fixed		'b'
		WRS Scene Center Latitude and Longitude of the WRS Scene Center		
38-39	2	Fixed		'Nb'
40	1	L = 'N': North latitude 'S': South latitude		L
41-42	2	Degrees Latitude		DD
43	1	Fixed		'-'
44-45	2	Minutes Latitude		MM
46	1	Fixed		'/'
47	1	W = 'E': East longitude 'W': West longitude		W
48-50	3	Degrees Longitude		DDD
51	1	Fixed		'-'
52-53	2	Minutes Longitude		MM
54	1	Fixed		'b/'

Table 3.5-12. Annotation Major Frames 1-2
Character Annotation Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Sensor and Spectral Band Identification Code: Presence of that number indicates presence of that band; a blank char indicates absence of that band		
55-56	2	Fixed		'TB'
57	1	Band 1		1
58	1	Band 2		2
59	1	Band 3		3
60	1	Band 4		4
61	1	Band 5		5
62	1	Band 6		6
63	1	Band 7		7
64	1	Fixed		'B'
		Sun Angles The sun elevation and azimuth angles measured clockwise from true north at the midpoint of the TM frame, to the nearest degree		
65-70	6	Fixed		'SUNBEL'
71-72	2	Degrees Elevation (Blank for Ascending Node)		GG

Table 3.5-12. Annotation Major Frames 1-2
Character Annotation Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
73-74	2	Fixed		'BA'
75-77	3	Degrees Azimuth (Blank for Ascending Node)		HHH
78	1	Fixed		'B'
		Processing Codes These codes apply to the geometric correction matrix values and to the final geometrically corrected image data.		
		Type of Geometric Correction Applied to the Data		
79	1	G = 'U': Uncorrected 'S': System level corrected 'G: Geometrically corrected based on geodetic information (no temporal registration performed) 'T': Temporal registration using geodetic information from a single reference scene 'R': Temporal registration to a single reference scene (no geodetic information available)		G
80	1	Fixed		'B'

Table 3.5-12. Annotation Major Frames 1-2
Character Annotation Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
81	1	Type of Map Projection P = 'P': Polar stereographic 'S': Space Oblique Mercator 'U': Universal Transverse Mercator		P
82	1	Fixed		'-'
83	1	Resampling Algorithm R = 'C': Cubic convolution 'N': Nearest neighbor 'B': Geometrically 'B': Geometrically uncorrected		R
84	1	Type Ephemeris Used to Compute Image Center E = 'P': Predictive 'G': GPS 'D': Definitive		E
85	1	Processing Procedure N = 'N': Normal processing procedure 'A': Abnormal processing procedure (defined as any processing procedure other than the normal processing procedure)		N
86-90	5	Fixed		'BBBBB'
91-103	13	Agency and Project Identification		'NASABLANDSATB'
		<u>Scene Identification Number</u>		
104-105	2	Fixed		'E-'

Table 3.5-12. Annotation Major Frames 1-2
Character Annotation Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
106	1	N = '4': Landsat-D '5': Landsat-D Prime		N
107-110	4	Day Number, Relative to Launch, at Time of Observation		DDDD
111	1	Fixed		'-'
112-113	2	Hour at Time of Observation		HH
114-115	2	Minute at Time of Observation		MM
116	1	Tens of Seconds at Time of Observation		S
117	1	Fixed		'-'
118	1	Band Number (Blank for HDT-AT)		B
119-128	10	Fixed		'ßßßßßßßßßß'

Table 3.5-13. Annotation Major Frames 1-2
Tick Mark Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1-9	9	Top Edge Tick Mark #1*	ASCII	XXXXXXXXX
10-18	9	Top Edge Tick Mark #2	ASCII	XXXXXXXXX
19-27	9	Top Edge Tick Mark #3	ASCII	XXXXXXXXX
28-36	9	Top Edge Tick Mark #4	ASCII	XXXXXXXXX
37-45	9	Top Edge Tick Mark #5	ASCII	XXXXXXXXX
46-54	9	Top Edge Tick Mark #6	ASCII	XXXXXXXXX
55-63	9	Top Edge Tick Mark #7	ASCII	XXXXXXXXX
64-72	9	Top Edge Tick Mark #8	ASCII	XXXXXXXXX
73-81	9	Left Edge Tick Mark #1*	ASCII	XXXXXXXXX
82-90	9	Left Edge Tick Mark #2	ASCII	XXXXXXXXX
91-99	9	Left Edge Tick Mark #3	ASCII	XXXXXXXXX
100-108	9	Left Edge Tick Mark #4	ASCII	XXXXXXXXX
109-117	9	Left Edge Tick Mark #5	ASCII	XXXXXXXXX
118-126	9	Left Edge Tick Mark #6	ASCII	XXXXXXXXX
127-135	9	Left Edge Tick Mark #7	ASCII	XXXXXXXXX
136-144	9	Left Edge Tick Mark #8	ASCII	XXXXXXXXX
145-153	9	Right Edge Tick Mark #1*	ASCII	XXXXXXXXX
154-162	9	Right Edge Tick Mark #2	ASCII	XXXXXXXXX

* Note: Tick Mark Format is described in Table 3.5-14.

Table 3.5-13. Annotation Major Frames 1-2
Tick Mark Data

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
163-171	9	Right Edge Tick Mark #3	ASCII	XXXXXXXXX
172-180	9	Right Edge Tick Mark #4	ASCII	XXXXXXXXX
181-189	9	Right Edge Tick Mark #5	ASCII	XXXXXXXXX
190-198	9	Right Edge Tick Mark #6	ASCII	XXXXXXXXX
199-207	9	Right Edge Tick Mark #7	ASCII	XXXXXXXXX
208-216	9	Right Edge Tick Mark #8	ASCII	XXXXXXXXX
217-225	9	Bottom Edge Tick Mark #1*	ASCII	
226-234	9	Bottom Edge Tick Mark #2	ASCII	
235-243	9	Bottom Edge Tick Mark #3	ASCII	
244-252	9	Bottom Edge Tick Mark #4	ASCII	
253-261	9	Bottom Edge Tick Mark #5	ASCII	
262-270	9	Bottom Edge Tick Mark #6	ASCII	
271-279	9	Bottom Edge Tick Mark #7	ASCII	
280-288	9	Bottom Edge Tick Mark #8	ASCII	

* Note: Tick Mark Format is described in Table 3.5-14.

Table 3.5-14. Tick Mark Formats

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		All formats are nine bytes in length containing two common fields: a. A 2-byte location field defining the pixel number location for a top or bottom edge tick mark, or line number location for a left or right edge tick mark b. A 7-byte identification field which contains the characters used to identify the tick mark		
		UTM Coordinate Tick Mark		
		Trailing Blank Format		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3	1	Position: Northing - Sides 'N' Easting - Top or Bottom 'E'	ASCII	X
4-6	3	Coordinate	ASCII	XXX
7-9	3	Fixed	ASCII	'ßßß'
		UTM Coordinate Tick Mark		
		Leading Blank Format		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3-5	3	Fixed	ASCII	'ßßß'

Table 3.5-14. Tick Mark Formats

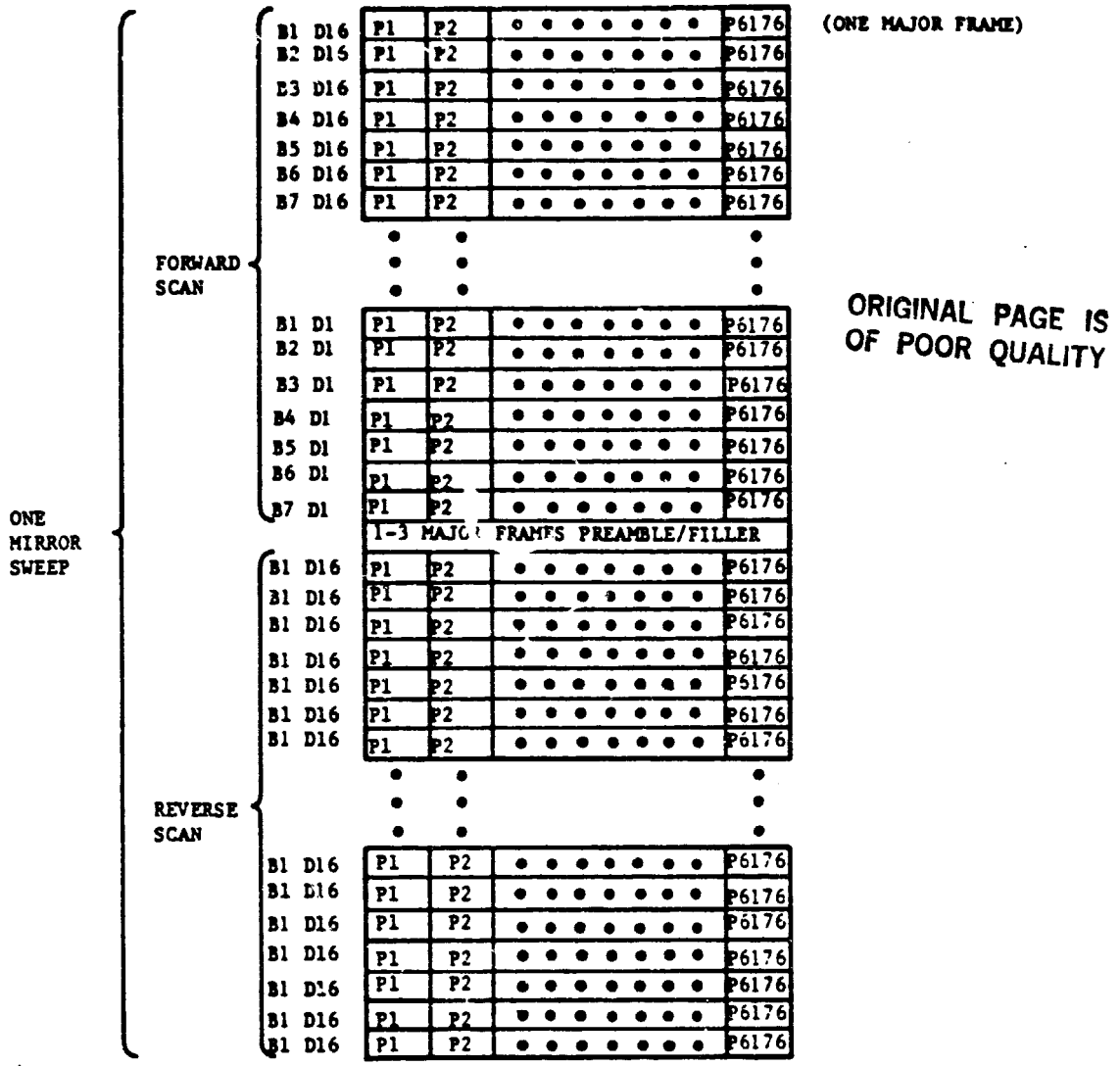
BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
6	1	Position: Northing - Sides 'N' Easting - Top or Bottom 'E'	ASCII	X
7-9	3	Coordinate	ASCII	XXX
		Polar Stereographic Tick Mark		
		Trailing Blank Format		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3	1	Position: 'X' or 'Y'	ASCII	X
4	1	Quadrant Sign of Coordinate '+' or '-'	ASCII	X
5-7	3	Coordinate	ASCII	XXX
8-9	2	Fixed	ASCII	'ЬЬ'
		Polar Stereographic Tick Mark		
		Leading Blank Format		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3-4	2	Fixed	ASCII	'ЬЬ'
5	1	Position: 'X' or 'Y'	ASCII	X
6	1	Quadrant Sign of Coordinate: '+' or '-'	ASCII	X
7-9	3	Coordinate	ASCII	XXX

Table 3.5-14. Tick Mark Formats

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		SOM Tick Mark		
		Trailing Blank Format		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3	1	Position: 'V': Top and Bottom 'U': Sides	ASCII	X
4	1	Quadrant sign of coordinate: '+' or '-'	ASCII	X
5-8	4	Coordinate	ASCII	XXXX
9	1	Fixed	ASCII	'B'
		SOM Tick Mark - Leading Blank Format		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3	1	Fixed	ASCII	'B'
4	1	Position: 'V': Top and Bottom 'U': Sides	ASCII	X
5	1	Quadrant sign of coordinate: '+' or '-'	ASCII	X
6-9	4	Coordinate	ASCII	XXXX

Table 3.5-14. Tick Mark Formats

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Latitude/Longitude Tick Mark		
1-2	2	Location of Tick Mark	LINE/ PIXEL	INTEGER*2
3	1	Position: 'N': North 'E': East 'S': South 'W': West	ASCII	X
4-6	3	Degrees	ASCII	XXX
7	1	Fixed	ASCII	'-'
8-9	2	Minutes	ASCII	XX



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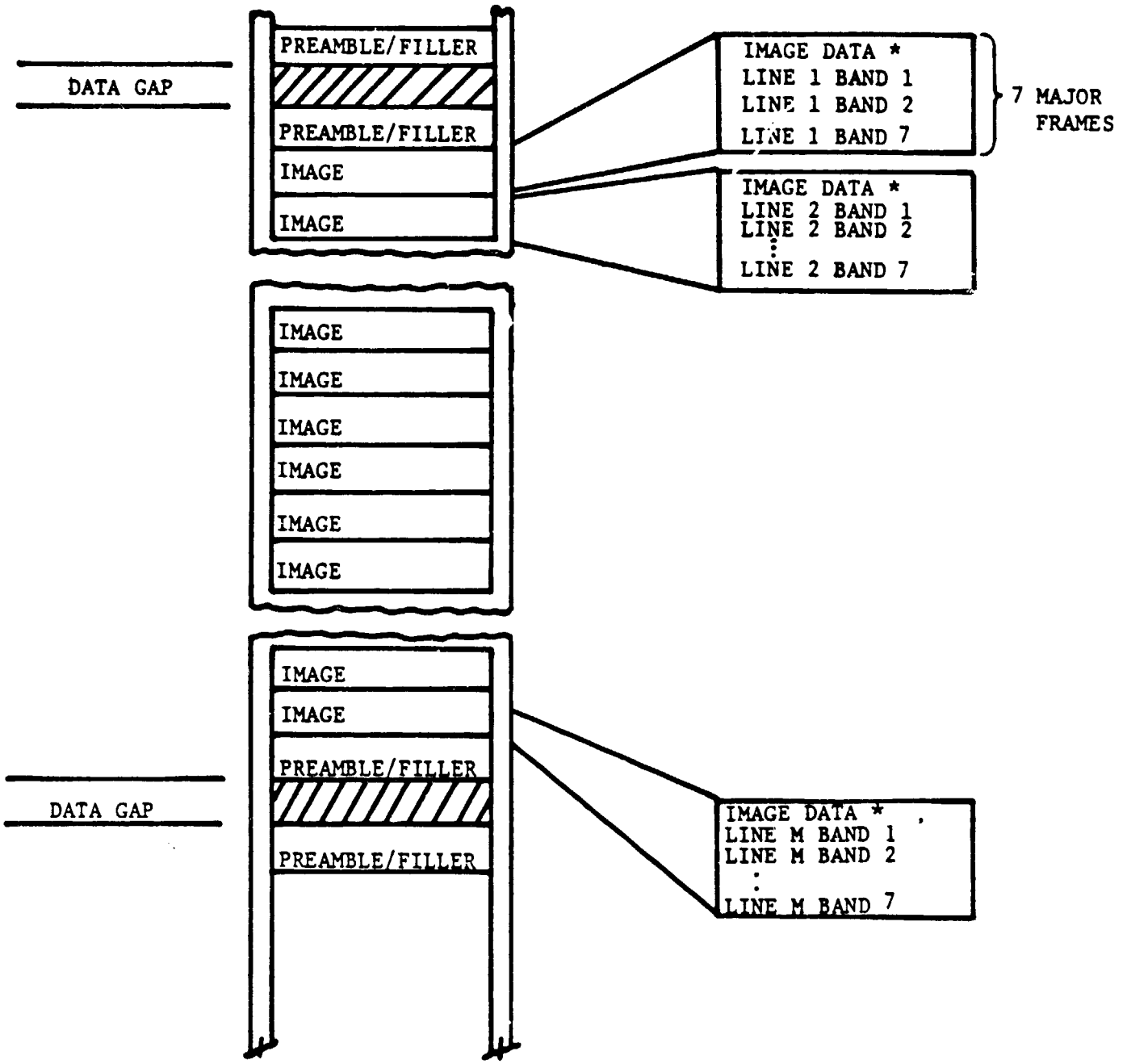
Notes: 1) Bands are in the order: B1, B2, B3, B4, B5, B6, B7

2) Detectors are in the order: 16,15,14, . . . , 2, 1
Detector 16 represents the top (North) of the image on the descending node

3) Forward scan for descending node (daylight) is west-to-east.
Reverse scan for descending node (daylight) is east-to-west.

4) 6176 pixels/line is the nominal line length

Figure 3.5-4. BIL Format for Image Data



*FOR EACH BAND LINE, IMAGE DATA PIXELS OCCUR IN THE FOLLOWING ORDER:

PIXEL1, PIXEL 2, . . . , PIXEL 6176

Figure 3.5-5. BIL Image Data Organization on the HDT-AT

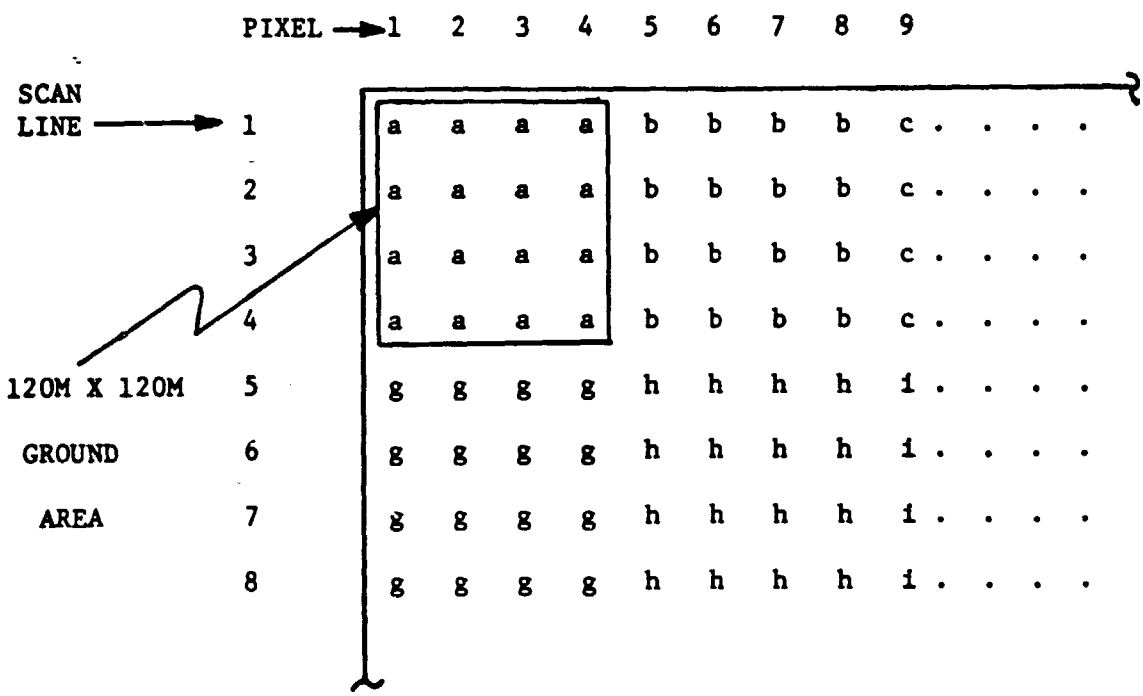
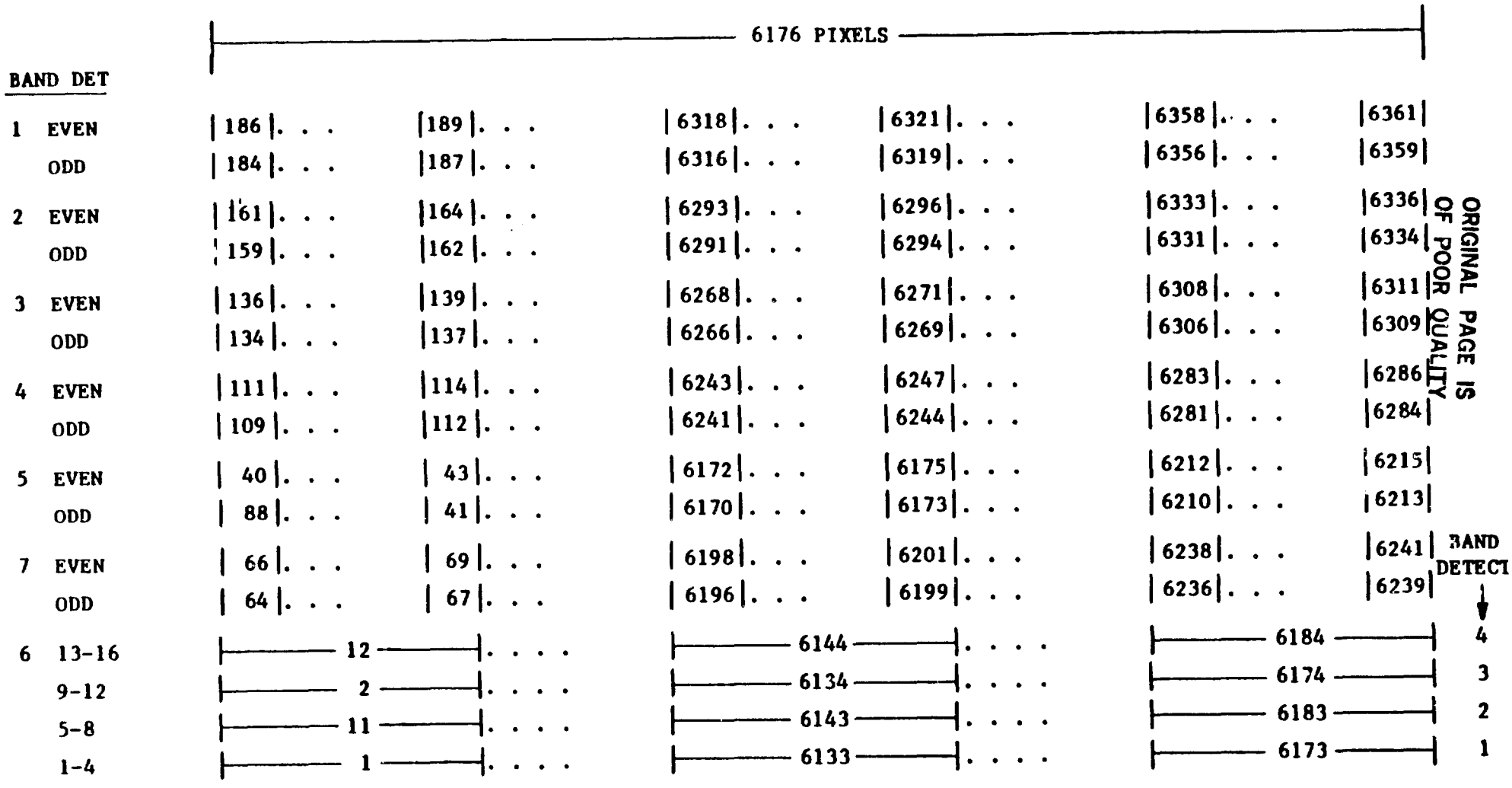


Figure 3.5-6. Image Data Pixel and Line Replication for the Thermal Band

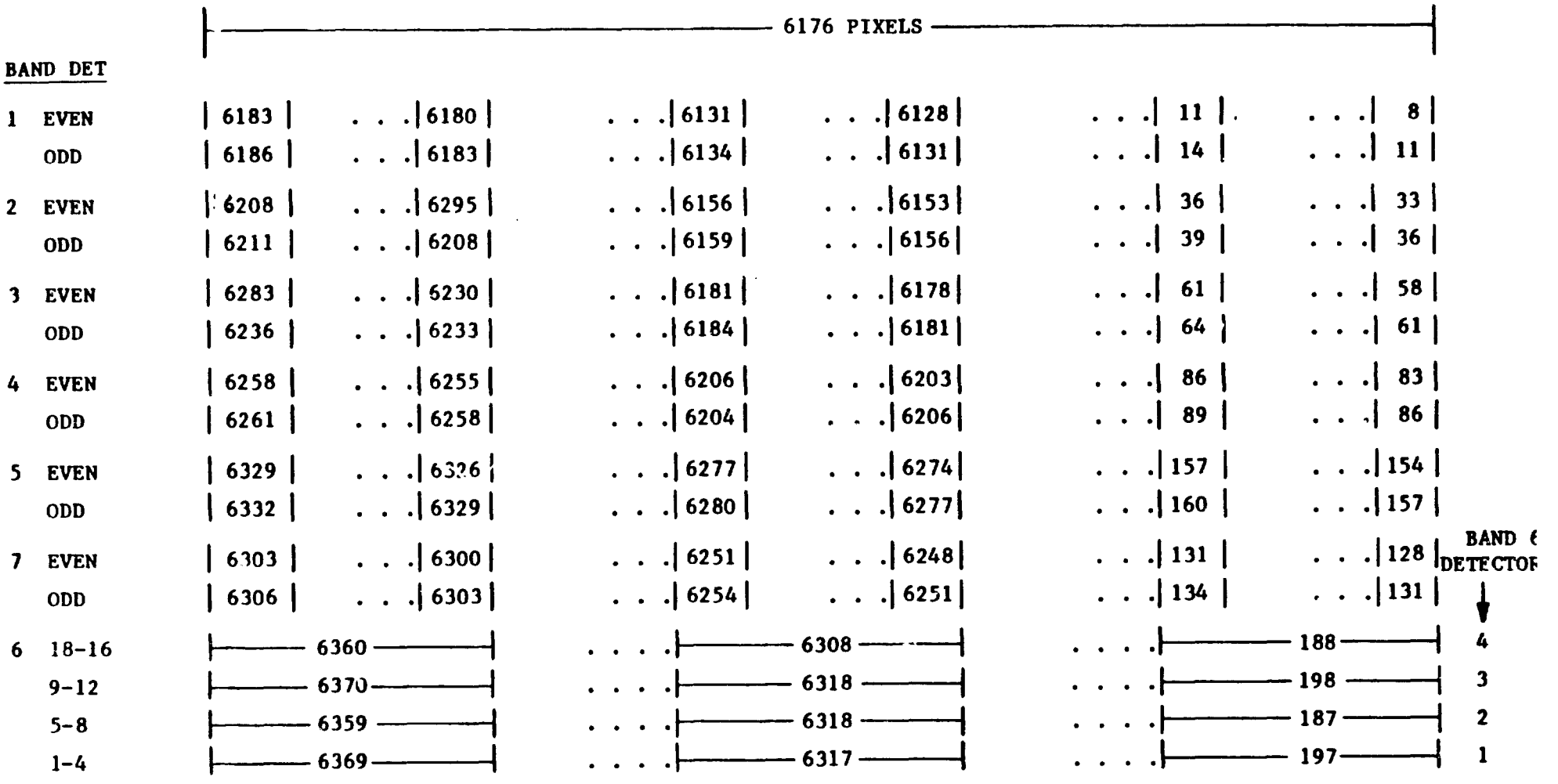


NOTE: (1) Numbers shown are sample (pixel) numbers in the input image data

(2) A nominal scan lasts 6320 samples. Pixels having numbers greater than the number of actual samples received have indeterminate values.

(3) Band 6 shown replicated.

Figure 3.5-7. Image Data Arrangment - Forward Scan Pixel Alignment

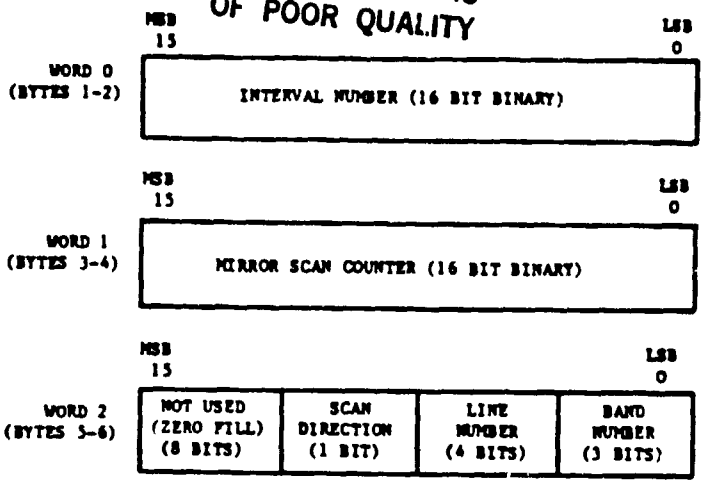


NOTE: (1) Numbers shown are sample (pixel) numbers in the input image data.

(2) A nominal scan lasts 6320 samples. Pixels having numbers greater than the number of actual samples received have indeterminate values.

(3) Band 6 shown replicated.

Figure 3.5-8. Image Data Arrangement - Reverse Scan Pixel Alignment



Interval Number
The sequential enumeration of each interval on tape (1-26)

Mirror Scan Counter
The sequential enumeration of each mirror scan within an interval (1-13000)

Scan Direction
Set to 0 fcr forward scans and 1 for reverse scans

Line Number
Defined as follows:

LINE NUMBER	B1-5,7 DETECTOR	B6 DETECTOR
0	16	4
1	15	4
2	14	4
3	13	4
4	12	3
5	11	3
6	10	3
7	9	3
8	8	2
9	7	2
10	6	2
11	5	2
12	4	1
13	3	1
14	2	1
15	1	1

Band Number
Indicates the spectral band of the scan line (1-7)

Figure 3.5-9. Image Data Elements Scan Line Identification (SLID)

Table 3.5-15. Image Major Frame Format

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1-6176	6176	Image Data Represents one band line of radiometrically corrected image (8 bits/pixel) providing approximately 185 km. of ground coverage	PIXELS	BINARY
6176-6240	64	Zero Fill		
		SUPPORT DATA		
6241-6244	4	Counted Active Line Length Number of pixels counted during the active scan time (from line start to end scan code) by the DSM (Pass 1)	PIXELS	INTEGER*4
6245-6248	4	Imbedded Line Length Number of pixels in the scan line (active scan time) determined from the line length information imbedded in the data stream by the spacecraft (Pass 1)	PIXELS	INTEGER*4
6249-6252	4	Current Line Length Number of active pixels in this line after pixel alignment	PIXELS	INTEGER*4
6253-6256	4	First Half Scan Error	MICRO-SECONDS	REAL*4
6257-6260	4	Second Half Scan Error	MICRO-SECONDS	REAL*4
6261-6276	16	Spacecraft Time Code	ASCII	YYDDDHHMMSSTTTFF

Table 3.5-15. Image Major Frame Format

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
6277	1	Spacecraft Time Code Quality X = '0': Good '1': Substituted/ Flywheeled	ASCII	X
6278	1	Scan Line Quality X = '0': Scan with good image data '1': Line substituted on input (Pass 1) '2': Line substituted on output (Pass 2) '3': Line substituted both on input and output '4': Line substituted due to bad detector	ASCII	X
6279	1	Cal Lamp Value Quality X = '0': Good '1': Not used '2': Not available	ASCII	X
6280	1	Computed Cal Lamp State Normally one of eight states (1-8) or undefined (9)	ASCII	X
6281-6284	4	Computed Cal Lamp Value		REAL*4
6285-6288	4	Computed Shutter Value		REAL*4
6289-6292	4	Cal Lamp Gain Value Gain value computed in the radiometric correction processing using cal lamp data only		REAL*4
6293-6296	4	Cal Lamp Bias Value bias value computed in the	KM/SEC	REAL*4

Table 3.5-15. Image Major Frame Format

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		radiometric correction process using cal lamp data only		
6297-6300	4	Applied Gain Value Final gain value used to compute the RLUTs, after scene content correction (if applied) and blending		REAL*4
6301-6304	4	Applied Bias Value Final bias value used to compute the RLUTs, after scene content correction (if applied) and blending		REAL*4

3.5.7 INTERVAL TRAILER

The interval trailer contains quality information on the image data for the entire interval. The quality information consists of:

a. Quality indicator summary counts

b. R-tape read errors for pass 1 and pass 2

c. A-tape write errors for pass 2.

d. Hardware quality data.

The content and format of the interval trailer are given in Table 3.5-16.

Table 3.5-16. Interval Trailer Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
1-4	4	Scan Count - Total number of scans in the interval		INTEGER*4
		Quality Indicator Summary Counts		
		The number of scans in the interval having the quality Q_i, where		
5-8	4	Q_1 = Scan lines with good image data		INTEGER*4
9-12	4	Q_2 = Scan lines with image data substituted on the input (Pass 1)		INTEGER*4
13-16	4	Q_3 = Scan lines with image data substituted both on input (Pass 2)		INTEGER*4
17-20	4	Q_4 = Scan lines with image data substitution both on input and output		INTEGER*4
21-24	4	Q_5 = Scan lines with substituted or flywheeled spacecraft time		INTEGER*4
25-824	800	R-Tape Read Errors (Pass 1)		INTEGER*2
		Counts of corrected and uncorrected bit errors for the interval on a 5-second basis (last 5 seconds ignored). Space reserved for 1000 seconds of data (200 samples)		

Table 3.5-16. Interval Trailer Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
		Order: $N_1(1)$, $N_2(2)$... $N_1(200)$, $N_2(200)$ where N_1 = Uncorrected error count N_2 = Corrected error count		
825-1624	800	R-Tape Read Errors (Pass 2) Format same as above		INTEGER*2
1625-2424	800	A-Tape Write Errors (Pass 2) Format same as above		INTEGER*2
		Number of Major Frame Sync Losses		
2425-2428	4	Pass 1		INTEGER*4
2429-2432	4	Pass 2		INTEGER*4
		Number of Minor Frame Sync Losses		
2433-2436	4	Pass 1		INTEGER*4
2437-2440	4	Pass 2		INTEGER*4
		Number of Minor Frame Sync Errors		
2441-2444	4	Pass 1		INTEGER*4
2445-2448	4	Pass 2		INTEGER*4
		Number of Bit Slips		
2449-2452	4	Pass 1		INTEGER*4

Table 3.5-16. Interval Trailer Major Frame 1

BYTE NUMBERS	FIELD WIDTH (BYTES)	DESCRIPTION	UNITS	STANDARD FORMAT
2453-2456	4	Pass 2		INTEGER*4
		Number of Time Code Substitutions in TIPS		
2457-2460	4	Pass 1		INTEGER*4
2461-2464	4	Number of PCS Time Code Substitutions		INTEGER*4
2465-2468	4	Reserved		
2469-6344	3876	Zero Fill		

SECTION 4

ACRONYMS, ABBREVIATIONS, SYMBOLS AND TERMS

Band	A collection of pixels representing a spectral portion of a scene
BIL	Band-Interleaved-by-Line
Bit	The smallest element of binary, computer-intelligible data
BSQ	Band sequential
Byte	A unit of data consisting of eight bits
CCT	Computer Compatible Tape
CP	Control point
Detector	A component of a sensor that is able to sense the energy level in a select spectral band
EDC	EROS Data Center
EDIPS	EDC Digital Image Processing System
EROS	Earth Resources Observation System
GSFC	Goddard Space Flight Center
HDT	High Density Digital Tape
Interval	Set of contiguous scan line imagery comprised of one or more scenes
IRIG-A	Inter-range Instrumentation Group standard time, format A
Landsat	Land Satellite (formerly ERTS)

Line	A cross track motion of an active detector (a full scene width)
LSB	Least Significant Bit
MFSN	Major Frame Sequence Number
MFTC	Minor Frame Type Code
MSB	Most Significant Bit
Pixel	One image detector sample
Process Request	One processing work unit within the TIPS
PS	Polar Stereographic
Right Justified	Technique of positioning data so that the least significant bit appears in the rightmost position
S/C	Spacecraft
Scan	A cross track motion of an active detector (a full scene width)
Scene	A segment of Landsat image data which corresponds to a 185 x 170 km area or the ground.
Sensor	An imaging instrument (a sensor may consist of one or more detectors)
SLID	Scan Line Identification
SOM	Space Oblique Mercator
Swath	The dimension of the ground seen as transverse to spacecraft velocity, within the sensor field of view
Sweep	Two cross-track motions of a sensor; equal to two scan lines

Tick Marks	Positional marks placed on imagery to enable a location grid coordinate system to be constructed
TIPS	TM Image Processing System
TM	Thematic Mapper
UTM	Universal Transverse Mercator
WRS	World Reference System

SECTION 5

STANDARD FORMATS

The following standard formats and definitions are used in this document.

	STANDARD FORMAT	DEFINITION
1.	X	Single-character alphanumeric
2.	X...X	Multi-character alphanumeric
3.	9	Single-digit numeric interger
4.	9...9	Multi-digit numeric integer
5.	'.'	Single-character literal
6.	'...'	Multi-character literal
7.	C*n	n-character field
8.	MNSTTYYDDDXX	Tape ID/Film Roll ID M = Mission 'L' = Landsat N = Mission Number '4' = Landsat-D '5' = Landsat-D' '0' = Mixed Landsat-D and D' S = Sensor Type 'T' = TM 'M' = MSS TT = Tape Type 'HR' = HDT-RT 'HA' = HDT-AT 'HP' = HDT-PT 'CA' = CCT-AT 'CP' = CCT-PT 'LA' = F241-AT 'LP' = F241-PT 'SC' = SCD tape YY (last 2 digits of year) = 01-99 DDD (day of year) = 001-366 XX (sequence number within day) = 01-99
9.	MSPPPRRRDDDD	Internal Scene ID M = Mission Number '4' = Landsat-D '5' = Landsat-D' S = Sensor Type 'T' = TM 'M' = MSS

	STANDARD FORMAT	DEFINITION
		PPP = WRS Path Number (001-233) RRR = WRS Row Number (001-248) DDDD = Days since launch of acquisition (0001-9999)
10.	MDDDDHHMMS	NASA Scene ID M = Mission Number '4' = Landsat-D '5' = Landsat-D' DDDD = Days since launch at time of observation (0001-9999) HH = GMT hour at time of observation (00-23) MM = GMT minute at time of observation (00-59) S = GMT tens of seconds at time of observation (0-5)
11.	SSSYYDDDXXXX	Process Request ID SSS = Subsystem name ('TIP') YY = Last 2 digits of year (01-99) DDD = Day of year (001-366) XXXX = Sequence number within day (0001-9999)
12.	YYDDDHHMMSS	Date/Time (GMT) YY = Last 2 digits of year (01-99) DDD = Day of year (001-366) HH = Hour (00-23) MM = Minute (00-59) SS = Second (00-59)
13.	YYDDDHHMMSSTTTFF	Spacecraft Time YY = Last 2 ditis of year (00-99) DDD = Day of year (001-366) HH = Hour (00-23) MM = Minute (00-59) SS = Second (00-59) TTT = Thousandths of a second (000-999) FF = 1/16 of a millisecond (00-15)
14.	MSPPPRRRBTXXYYY	Control Point ID M = Mission Number '4' = Landsat-D '5' = Landsat-D' S = Sensor Type 'T' = TM 'M' = MSS

	STANDARD FORMAT	DEFINITION
		PPP = WRS Path (001-233) RRR = WRS Row (001-248) B = Band number (1-7) T = CP Type 'G' = geodetic CP 'S' = supplementary CP 'R' = relative CP XX = Zone (01-25) YYY = Sequence number within scene (001-999)
15.	DDDHHMMSST	IRIG Time DDD = Day of year (001-366) HH = Hour (00-23) MM = Minute (00-59) SS = Second (00-59) T = Tenths of a second (0-9)
16.	INTEGER*4	4-byte integer format
17.	INTEGER*2	2-byte integer format
18.	REAL*4	4-byte floating point format
19.	REAL*8	8-byte floating point format
20.	IIMMLB	Scan Line ID (SLID) II = Interval Number (16-bit binary number) (01-26) MM = Mirror Scan Counter (16-bit binary number) (1-13000) LB = Scan direction (1-bit) Line number (4-bit) Band number (3-bit) (Refer to HDT-AT Format Spec - SLID definition)
21.	MPPPRRR	WRS Designator M = Mission Number '4' = Landsat-D '5' = Landsat-D' PPP = WRS Path (001-233) RRR = WRS Row (001-248)