USER'S GUIDE
FOR THE
VAXMDR PROGRAM

PREPARED FOR

NASA AMES RESEARCH CENTER

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BY

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1.0 INTRODUCTION

The VAXMDR Program processes log tapes, IDR tapes, and LabVIEW files for Pioneer 10 and 11. It also produces a file of MDR records to be used as input for the VAXEDR program.

1.1 Capacities and Constraints

Under operator control, VAXMDR produces a file of MDR records and a MDR tape.

a. More than one log tape, IDR tape, or LabVIEW file may be used as input.

b. Duplicate HSDBs are deleted.

c. Filler and bad data blocks are deleted.

d. MDR records are time ordered.

e. An MDR can be written to tape, to a disk file, or both.

f. A file of messages is produced . Messages are written each time the station, lock status, time correction flag, Data Quality Indicator (DQI), format, bit rate, or mode change. Messages are also printed when there are deleted frames and when there is a time gap. All messages are tagged with the time the change occurred.

1.2 Hardware

VAXMDR runs under the VMS operating system on a MICRO VAX. The following list describes the current hardware configuration of the MICRO VAX.

a. Digital Equipment Corporation MICRO VAX 4000/300

b. 64 mbytes memory

c. Interface SCSI adapter

d. VT420 terminal or MAC using telnet

e. Systems Industries 9 track tri density tape drive and controller

f. 2.0 gigabyte SCSI hard disk drive

g. DEC C language translator

h. 2 optical disk drives

1.3 File Environment

MDR DISK FILE

This is a collection of MDR records. Each record is 168 bytes in length. For the layout of each MDR record, see Figure 1 and Table 1. The length of the file depends upon the amount of data collected. The procedures in Sections 2.4 and 2.5 can be used too copy this file to optical disk. The name of this file is in the form:

Figure 1. MDR Format (192 Bit Frame) (Sheet 1 of 2)

1	TIME TAG			
2	SC/ID	TIME COR FLAG	DAY OF YEAR	
3	UDT	DDT	SYNC COND CODE	DQI
4	# BIT ERRORS PN	YEAR DIGIT	SNR	
5	DSS	LOCK STATUS BITS	CONFIGURATION INDICATORS	
6	SPCL DATA TYPE	GDD	# OF DATA BITS IN RECORD	
7	#AGC SAMP AVER	HSD ERR CON BITS	RATE OF DATA TRANSMISSION	
8	AVERAGE AGC OVER DATA IN RECORD			
9	FORMAT	SPARE	NUMBER OF FRAMES	
10	ZEROS			
11 : 16	192 BIT FRAME ONE			
17 : 22	192 BIT FRAME TWO			
23 : 28	192 BIT FRAME THREE			
29 : 34	192 BIT FRAME FOUR			
35	MS CLOCK LSB'S (FRAME 2 OF 4)		MS CLOCK LSB'S (FRAME 3 OF 4)	
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37	COMPUTATIONS (1)	DDA STATUS (1)	SPARE	GROUND RECEIVER AGC
38	DDA I/P ERRORS (2)	DDA COMPUTATIONS (2)		DDA STATUS (2)
39	SPARE		DDA I/P ERRORS (3)	DDA
40	COMPUTATIONS (3)	DDA STATUS (3)	SPARE	
41	DDA I/P ERRORS (4)	DDA COMPUTATIONS (4)		DDA STATUS (4)
42	SCF 1	SCF 2	SCF 3	SCF 4

Figure 1. MDR Format (384 Bit Frame) (Sheet 2 of 2)

1	TIME TAG			
2	SC/ID	TIME COR FLAG	DAY OF YEAR	
3	UDT	DDT	SYNC COND CODE	DQI
4	# BIT ERRORS PN	YEAR DIGIT	SNR	
5	DSS	LOCK STATUS BITS	CONFIGURATION INDICATORS	
6	SPCL DATA TYPE	GDD	# OF DATA BITS IN RECORD	
7	#AGC SAMP AVER	HSD ERR CON BITS	RATE OF DATA TRANSMISSION	
8	AVERAGE AGC OVER DATA IN RECORD			
9	FORMAT	SPARE	NUMBER OF FRAMES	
10	ZEROS			
11				
⋮	384 BIT FRAME ONE			
22				
23				
⋮	384 BIT FRAME TWO			
34				
35	MS CLOCK LSB'S (FRAME 2 OF 2)		SPARE	
36	SPARE		DDA I/P ERRORS (1)	DDA
37	COMPUTATIONS (1)	DDA STATUS	SPARE	GROUND RECEIVER AGC
38	DDA I/P ERRORS (2)	DDA COMPUTATIONS (2)		DDA STATUS (2)
39	SPARE		FILLER	
40	FILLER			
41	FILLER			
42	SCF 1	SCF 2		

Table 1. MDR Format Description (Sheet 1 of 5)

ITEM	LENGTH & ORIENTATION	DESCRIPTION
TIME TAG	1 fullword (32 bits)	Binary time in elapsed milliseconds from start of day (GMT) of ground receipt at specified Deep Space Station (DSS) of first bit of data in record.
SPC	1 byte	Spacecraft number assigned spacecraft number in binary. OCTAL 23 Pioneer 10 24 Pioneer Saturn 33 Pioneer 10 Simulation 34 Pioneer Saturn Simulation
TCF	1 byte	Time correction flag (0 = no correction; FF_{16} = suspect or corrected).
DOY	1 halfword	Day of year associated with item 1 in 4-bit packed BCD.
UDT	1 byte	User data type code (see Module OPS-6-2A in 820-13)
DDT	1 byte	Data dependent type code (see Module OPS-6-2A in 820-13). OPS-6-2A
SCC	1 byte	Sync condition code VALUE (BINARY) — MEANING 11 Full sync, leading and trailing PN code found 111 Full sync, leading PN only was requested and found 10 Leading PN code only 1 Trailing PN code only 0 No sync - no PN codes found

Table 1. MDR Format Description (Sheet 2 of 5)

ITEM	LENGTH & ORIENTATION	DESCRIPTION
DQI	1 byte	Data Quality Indicator VALUE (BINARY) — MEANING 11 — All indicators are good, data is good 10 — At least one indicator is bad, data is suspect 01 — At least two indicators are bad, data is suspect 0 — Data is bad - no sync This value is computed by the following logic: DQI = FS (1÷S÷H) where: FS = 1 if data stream is in sync 0 if data stream is not in sync S = 1 if average SNR over frame is ≥ a specified minimum 0 if average SNR over frame is < a specified minimum H = 1 if HSD block was received with no error indicators 0 if any bit errors were detected in HSD block
PN ERRORS	1 byte	Number of bit errors detected in leading PN in binary.
YR DIGIT	1 byte	Last 2 digits of year in 4-bit packed BCD if available; otherwise 0.
SNR	1 halfword	SNR (signal-to-noise ratio extracted from HSD (block). This is a 12-bit fixed binary quantity with the binary point just to the right of the 2^5 bit (±xxxxxx.xxxxxx as binary positions).
DSS	1 byte	DSS of data receipt (Station No. in binary.) (See Module OPS-6-2 in 820-13.) OPS-6-21A

Table 1. MDR Format Description (Sheet 3 of 5)

ITEM	LENGTH & ORIENTATION	DESCRIPTION
LOCK STATUS	1 byte	Lock status bits extracted from HSD block (byte configuration) for Pioneer 10/Saturn: 0 1 2 3 4 5 6 7 0 0 XXXXXX Bits 0-1 = 0 Bit 2 = 0, Receiver in Lock (V) 1, Out of Lock Bit 3 = 0, Demodulator in Lock (M) 1, Out of Lock Bit 4 = 0, Bit Sync in Lock, or not in use (I) 1, Out of Lock Bit 5 = 0, Symbol Sync in Lock, or not in use (S) 1, Out of Lock Bit 6 = 0, Data Decoder Assembly in Lock, or not in use (D) 1, Out of Lock Bit 7 = 0, Block Decoder in Lock (B) 1, Out of Lock
CONFIG INDICATOR	1 halfword WORD 9 = 1 and 2 Ø 3 thru 5 REC 6 Thru 8 DEMOD 9 thru 10 TCP 11 Int Bit Loop 12 SSA-1 13 SSA-2 14 Block Dec 15-16 DEC CONFIG	DSS configuration bits extracted from HSD blocks (see Table TLM-3-2-5). TLM-3-3A WORD 9 DSS Configuration: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0 0 0 0 0 RCVR DEMOD TCP BLC SSC BDC CDC Bits 5-6 = Receiver (RCVR): 01 =1; 10 = 2; 11 = 3; 00 = 4 Bits 7-9 = Demodulator (DEMOD): 001 = 1; 010 = 2; 011 = 3; 100 = 4; 101 = 5; 110 = 6 Bits 10-11 = Computer (TCP): 00 = Alpha; 01 = Data; 10 = Gamma Bit 12 = Internal Bit Loop Configuration (BLC): 0 = ON; 1 = OFF

Table 1. MDR Format Description (Sheet 4 of 5)

ITEM	LENGTH & ORIENTATION	DESCRIPTION
CONFIG INDICATOR (Contd)		Bit 13 = External Symbol Sync Configuration (SSC): 0 = ON; 1 = OFF Bit 14 = Block Decoder Configuration (BDC): 0 = ON; 1 = OFF Bit 15 = Convolutional Decoder Configuration (CDC): 0 = ON; 1 = OFF (not used, set to 1)
SDT	1 byte	Special data type code. The high order bit of this byte (leftmost bit) will be set to 1 for a Pioneer DSU readout. The second, third, and fourth bit of this byte will be set to 1's for Pioneer decoded data and 0's for Pioneer uncoded (non-encoded) data.
GDD	1 byte	Gross data descriptor 0 = Real time transmission all systems 1 = Non-telemetry data replay by DSS 2 = All system data replay by GCF 4 = Telemetry data (digital) replay by DSS 5 = Telemetry data (analog) replay by DSS
NO. OF DATA BITS	1 halfword	Total number of data bits in the record in binary. For Pioneer 10/Saturn, synced data is equal to 192 or 384; and for non-synced data, it is the number of data bits in the last subformat containing data and is always less than or equal to 192.
NO. AGC SAMPLES	1 byte	Number of AGC samples included in average AGC (Item No. 27)
HSD ERR CONDITION	1 byte	Error condition bits from HSD block (bits reflect condition of receipt of block: 0 = bad; 1 = good)

Table 1. MDR Format Description (Sheet 5 of 5)

ITEM	LENGTH & ORIENTATION	DESCRIPTION
RATE OF DATA TRANS	1 halfword	Rate of transmission of data from spacecraft (binary): Value in Binary (Last Byte of Word 6) / Pioneer 10/Saturn Rate in Bits per Second Bit 1234 5678 1000 — 16 1001 — 32 1010 — 64 1011 — 128 1100 — 256 1101 — 512 1110 — 1024 1111 — 2048
AVG AGC	1 fullword	Average AGC over the data record. This is a fixed point integer, binary quantity averaged over the entire data in the record. This binary value has a binary point between Bits 28 and 29.
NO. OF FRAMES	1 halfword	Number of Pioneer frames: 0 = One 192-bit frame 4 = Two 192-bit frames or one 384-bit frame 8 = Three 192-bit frames C = Four 192-bit frames or two 384-bit frames
MIL CLOCK LSB 2, 3, 4	1 halfword	Least significant 16 bits of time for frames 2, 3 and 4
DDA INFO	1 word	Bits 1-9 = DDA input errors Bits 10-24 = DDA Computations Bits 25-32 = DDA Status
SCF NO. 1	1 byte	SCID correction flag for frames 1, 2, 3, 4 0 = No correction 1 = Corrected

Mxxyyzzz.MDR

where: xx = Spacecraft number
yy = Last 2 digits of year
zzz = Day of year

MDR TAPE

This tape contains the same data as the MDR disk file. A tape record contains 42 MDR records. The tape header is 80 bytes in length. For the layout of the tape header, see Figure 2.

HSDBFILE

Temporary file which contains HSDBs. This file is usually deleted by VAXMDR when it is no longer needed. For the layout of each HSDB record see Figure 3. The name of this file is in the form:

Lxxyyzzz.MDR

where: xx = Spacecraft number
yy = Last 2 digits of year
zzz = Day of year

MESSAGE FILE

File of messages produced during processing. The name of this file is POC.

1.4 Software Overview

How VAXMDR interacts with the outside world is shown in Figure 4.

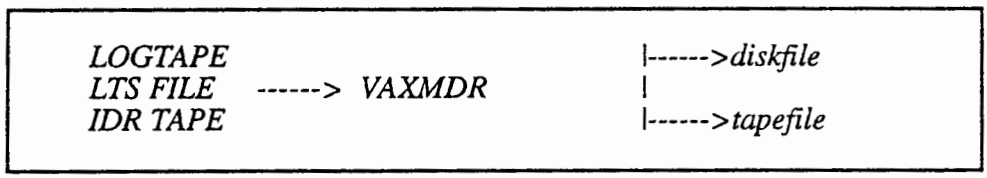


Figure 4. VAXMDR Interface

Figure 2. Telemetry Master Data Record Tape Header

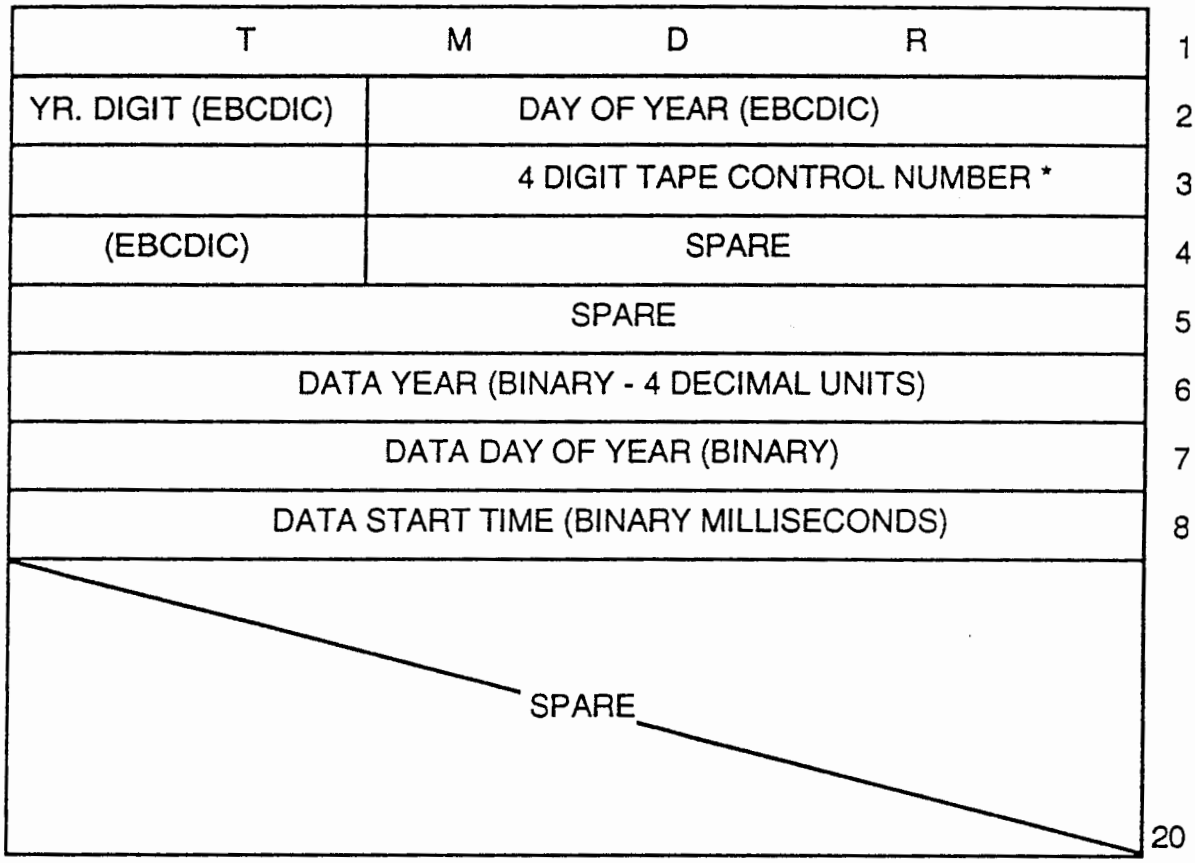


Figure 3. Pioneer High-Rate Format for 192 Bit Frame Coded Data (Sheet 1 of 2)

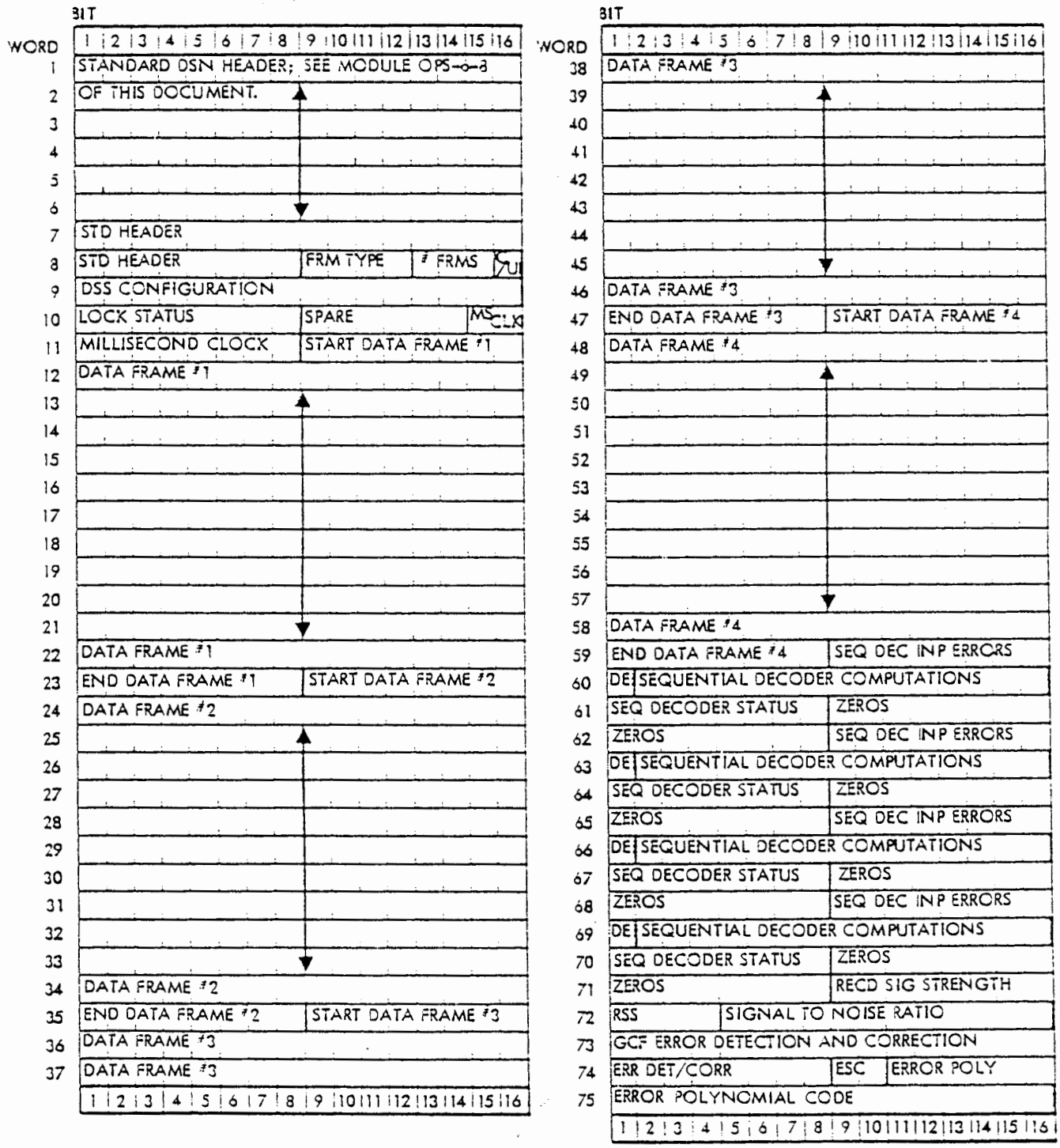
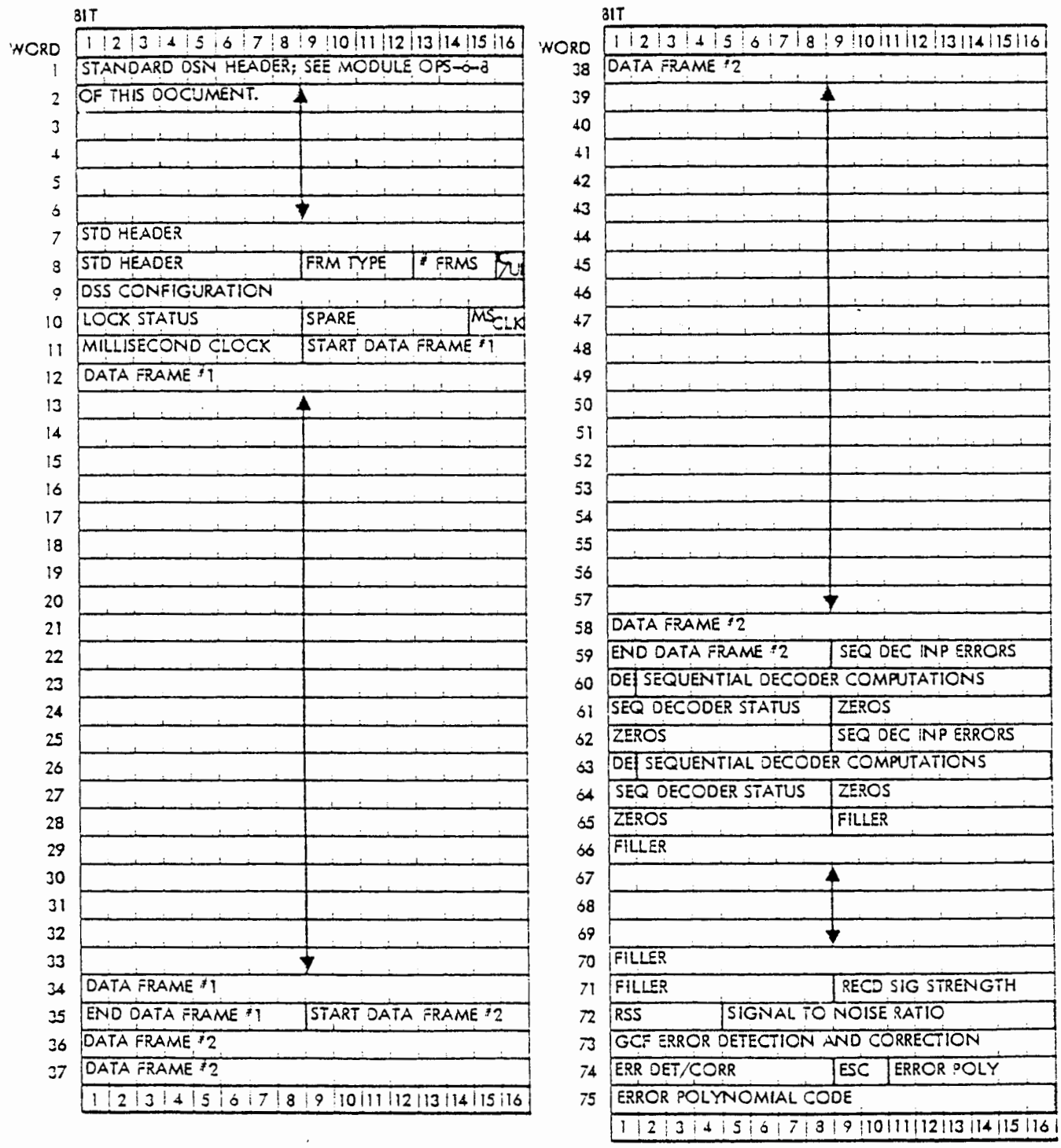


Figure 3. Pioneer High-Rate Format for 384 Bit Frame Coded Data (Sheet 2 of 2)



2.0 MDR PROCEDURES

2.1 General Information

VAXMDR produces a Telemetry Master Data Record (TMDR) from TELSYS Log Tapes, Intermediate Data Records (IDRs), and LabVIEW disk files. The TMDR may be a disk file or a tape. The disk file may also be loaded on to an optical disk. Input messages from a computer operator or an indirect command file tell VAXMDR what data are to be processed, where to obtain the input data, and where to create the TMDR.

2.2 MDR Installation

The following steps show how to install VAXMDR:

(a) Log onto account POLDPS.

(b) Load the VAXMDR system tape onto the tape drive.

(c) Enter the command "BACKUP MUA0:POLDPS.BCK [*...] "

2.3 MDR Processing Procedure

A typical sequence of steps for creating a TMDR would be as follows:

(a) Log onto account POLDPS.

(b) Either enter the following commands by hand or create and run a command file:

By hand	Command File	Comments
RUN MDR	$RUN MDR	Start VAXMDR program.
DOY,94,017	DOY,94,017	Process 1994 data from day 017.
SC,24	SC,24	Process data from spacecraft 11.
FILE	FILE	One or more disk files will be read.
TAPE	TAPE	One or more tapes will be read.
MDRTAPE	MDRTAPE	An MDR tape will be created.
MDRFILE	MDRFILE	An MDR disk file will also be created.
CONTROL+Z	$EOD	End of file.
LOG1.DAT	LOG1.DAT	Name of input file 1.
LOG2.DAT	LOG2.DAT	Name of input file 2.
CONTROL+Z	$EOD	End of file.

(c) VAXMDR will ask:

"Tape Ready? [Y/N] "

Enter 'Y' when the tape is on line and at load point. Do not software mount the tape. The tape will be dismounted after it has been read. Enter Control Z to kill the program.

(d) VAXMDR will then ask:

"More Tape? [Y/N] "

Enter 'Y' if there is another log or IDR tape to read. Otherwise enter 'N'. Repeat steps c and d until all tapes have been entered.

(e) VAXMDR will then ask you to mount an output tape. See step c.

2.4 Initializing an Optical Disk

Enter the following VMS commands to initialize an optical disk:

```
INIT DKA0: MDRCHIVE/STRUCT=1
MOU DKA0: MDRCHIVE
CREATE DKA0:[POLDPS]/DIR
```

2.5 Copying Files to Optical Disk

The following steps show how to copy an MDR disk file to an optical disk:

(a) Insert the optical disk into one of the disk drives.

(b) Initialize the disk, if necessary.

(c) To mount the disk, enter the command "MOU DKA0: MDRCHIVE."

(d) Use the VMS COPY command to move the desired files from the internal disk to the optical disk.

3.0 INPUT MESSAGES

All operator input messages are described in this section.

3.1 Day Of Year Control (DOY)

3.1.1 Purpose

To specify the day of year (DOY) to be processed.

3.1.2 Format

DOY,YEAR,DAY-OF-YEAR

DOY,nn,nnn

3.1.3 Explicit Arguments

YEAR

The last two digits of the year being processed.

DAY_OF_YEAR

The three digit day of year being processed.

3.1.4 Functional Description

This command specifies the day of year to be processed. VAXMDR will filter out all data which isn't for the specified DOY. This command is required. The year digits are for the MDR output tape only. VAXMDR assumes the input tapes are for the specified year.

3.2 Dump Control (DUMP)

3.2.1 Purpose

To create a hexadecimal dump of the High Speed Data Blocks (HSDBs) being processed.

3.2.2 Format

DUMP,BLOCKS,LOCATION

DUMP,nnnnnnnnn,n

3.2.3 Explicit Arguments

BLOCKS

The number of blocks to dump. This argument must be less than or equal to 100 million.

LOCATION

Which VAXMDR routine is to dump the data. See the following table.

LOCATION	DESCRIPTION
1	Unfiltered HSDBs .
2	After unwanted HSDBs have been filtered out.
3	After HSDBs have been sorted.
4	After HSDBs have been sorted and bit flipped.

3.2.4 Functional Description

The HSDBs are converted to ASCII and written to file 'DUMP.DAT'. Old versions of DUMP.DAT are deleted when the new version is created.

3.3 File Input Control (FILE)

3.3.1 Purpose

To read files created by LabVIEW or the NODELT command.

3.3.2 Format

FILE,FILENAME

FILE,aaaaaaaaa

3.3.3 Explicit Arguments

FILENAME

If there is only one file to read, it's name can be entered here. This field should be left blank if there is more than one file to read. The file names go after the $EOD or control+z as shown in section 2.3 of this document.

3.3.4 Functional Description

Each file is read and processed by VAXMDR.

3.4 Temporary File (NODELT)

3.4.1 Purpose

To prevent VAXMDR from deleting the HSDB file. This file contains the sorted and merged data from the input files and tapes.

3.4.2 Format

NODELT

3.4.3 Explicit Arguments

None.

3.4.4 Functional Description

The HSDB file contains the sorted and merged data from the input files and tapes. This file is usually deleted by VAXMDR. On subsequent runs, the FILE command may be used to read this data from a single disk file. This command is used during testing. The name of the file is 'Lxxyyzzz.LOG' where xx is the spacecraft number, yy is the last two digits of the year, and zzz is the 3 digit day of year.

3.5 File Output Control (MDRFILE)

3.5.1 Purpose

To create an MDR disk file.

3.5.2 Format

MDRFILE

3.5.3 Explicit Arguments

None

3.5.4 Functional Description

A disk file is created. The name of the file is 'Mxxyyzzz.MDR' where xx is the spacecraft number, yy is the last two digits of the year, and zzz is the 3 digit day of year. Any files with the same name are deleted.

3.6 Tape Output Control (MDRTAPE)

3.6.1 Purpose

To create an MDR tape.

3.6.2 Format

MDRTAPE

3.6.3 Explicit Arguments

None

3.6.4 Functional Description

An MDR tape is created.

3.7 Spacecraft Control (SC)

3.7.1 Purpose

To specify which spacecraft is being processed.

3.7.2 Format

SC,SPACECRAFT

SC,nn

3.7.3 Explicit Arguments

SPACECRAFT

This may be 23 or 24.

3.7.4 Functional Description

If this command is not entered, the spacecraft number defaults to 23.

3.8 Tape Input Control (TAPE)

3.8.1 Purpose

To read TELSYS log tapes or IDR tapes.

3.8.2 Format

TAPE

3.8.3 Explicit Arguments

None.

3.8.4 Functional Description

Each tape is read and processed by VAXMDR.

4.0 FUNCTION OUTPUT

4.1 Hexadecimal Dump of HSDBs

The output of the DUMP function is shown in Figure 5.

Figure 5. DUMP Output