# RSC-11-6
# DSN INTERFACES RADIO SCIENCE MEDIUM BAND COMPUTER COMPATIBLE IDR

(Insert this modular document in 820-13; Rev. A)

EFFECTIVE DATE: 1 July 1981
Initial Release Date: 1 September 1980
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A. PURPOSE.

This document defines and controls the format for the Radio Science System Medium Bandwidth Computer compatible Intermediate Data Record (IDR)*.

B. REVISION AND CONTROL.

Revisions or changes to the information herein may be initiated according to the procedure in Section I of this document.

C. GENERAL INFORMATION.

Radio Science Medium Band Computer compatible IDRs may be produced by the Network Radio Science Subsystem (WRS) or by the DSS Radio Science Subsystem (DRS) from Digital Recording Assembly (DRA) Original Data Recordings (ODRs) recorded by the DRS. These IDRs are digital tapes. Each tape will contain data for one spacecraft for one DSS for one pass.

*Radio Science IDRs should not be confused with the IDRs which are generated at the GCF and may contain Radio Science data (See 820-13; Rev. A; RSC-11-4).

D. MEDIUM BANDWIDTH RADIO SCIENCE IDR TAPE FORMAT.

The Medium Bandwidth Radio Science IDR tape format is shown in Figure RSC-11-6-1. This format conforms to the American National Standards Institute (ANSI) Standards for Phase Encoded (PE) tape, using wire tracks with a density of 1600 b/in.

The data portion of the tape format is as described below and shown in Figure RSC-11-6-2.

WORD 1

BIT

Time-Tag Validity Indicator*

1 Indicates that time-tag data in Words 6 through 9 are valid for this record

0 = Invalid

1 = Valid

Record Continuity Indicator

2 Indicates that this record is the first record of a playback run

0 = Continuation

1 = First Record

Copy Source Error Indicator

3 Applies to IDR tape copies only; indicates that this record was copied from an original record containing a parity error

0 = No Source Error

1 = Source Error

*If time tag is invalid, the remaining header information may be erroneous. Valid header information (Words 1 through 27) occur on integer seconds, as indicated by Time-Tag Validity.

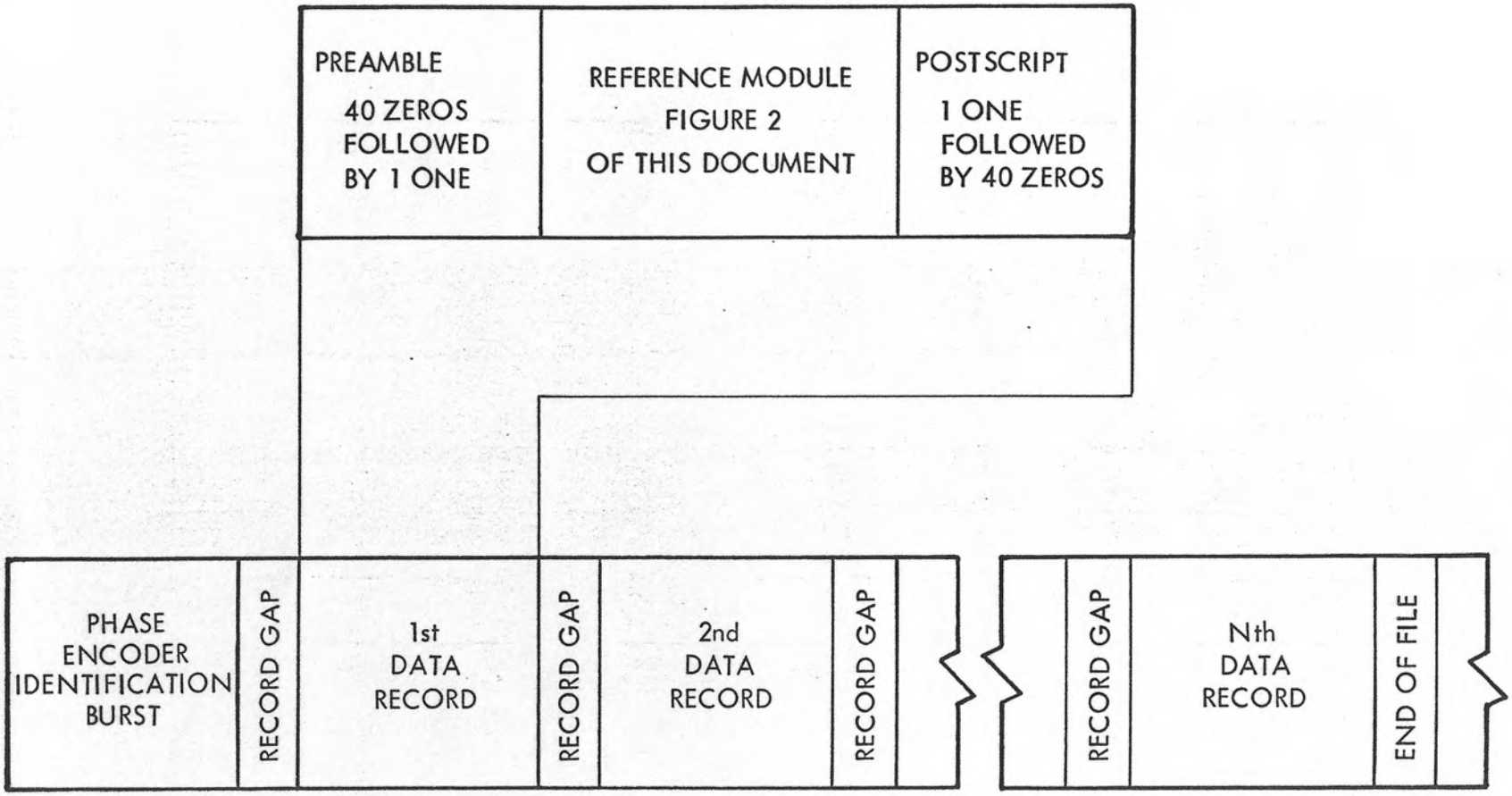



Figure RSC-11-6-1. Medium Bandwidth Radio Science Computer Compatible Tape Format Conforming to ANSI Standards

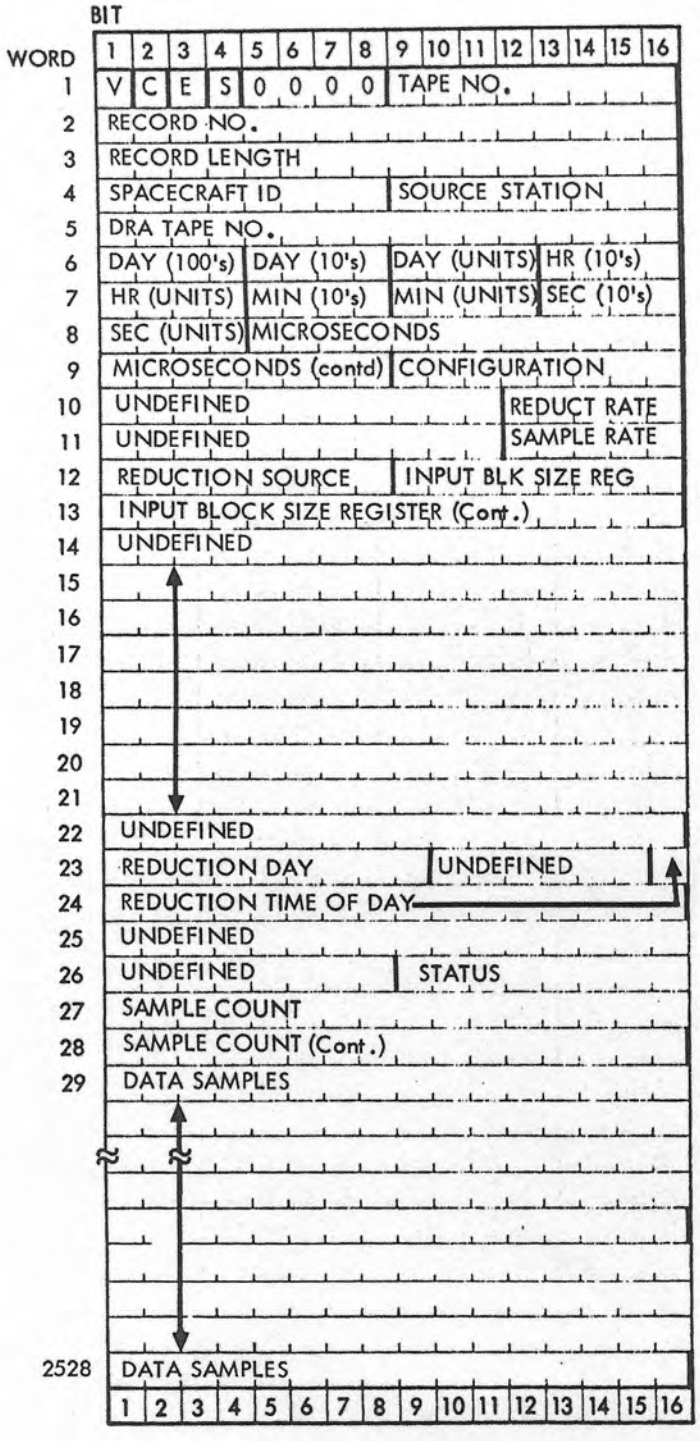



Figure RSC-11-6-2. Medium (Bandwidth) Record Format

Sample Count Validity Indicator

4 Indicates that the sample count in Words 27 and 28 is valid for this record

0 = Invalid

1 = Valid

ODA Tape Type Indicator

5 thru 8 Always set to 0000 to indicate medium band reduction tape.

Tape Number

9 thru 16 Binary integer number; increments each time a tape is completed for a given playback run

WORD 2

BIT

Record Number

1 thru 16 16-bit binary integer

WORD 3

BIT

Record Length

1 thru 16 16-bit binary integer; indicates number of words in this record; set to $2528_{10}$

WORD 4

BIT

Spacecraft Number

1 thru 8 Binary representation of spacecraft number (Refer to module OPS-6-6, Tables OPS-6-6-9 and -10 of this document)

Source Station

9 thru 16 Binary representation of DSS station number

WORD 5

BIT

DRA Tape Number

1 thru 16 — 16-bit binary number; tape number of DRA tape which is the source for this reduction record

WORD 6

BIT

Data Time Tag

1 thru 4 — Hundreds of Days; the data time tag is valid only when Word 1, bit 1 is set to 1; the time tag in general will not correspond to an exact integral second, but the first data sample in the record will correspond to the exact integral second which is closest to the time tag

Data Time Tag (Continued)

5 thru 8 — Tens of Days

Data Time Tag (Continued)

9 thru 12 — Units of Days

Data Time Tag (Continued)

13 thru 16 — Tens of Hours

WORD 7

BIT

Data Time Tag (Continued)

1 thru 4 — Units of Hours

Data Time Tag (Continued)

5 thru 8 — Tens of Minutes

Data Time Tag (Continued)

9 thru 12 — Units of Minutes

Data Time Tag (Continued)

13 thru 16 Tens of Seconds

WORD 8

BIT

Data Time Tag (Continued)

1 thru 4 Units of Seconds

Data Time Tag (Continued)

5 thru 16 First 12 bits of 20-bit binary number indicating number of microseconds since start of second (MSB is bit 5)

WORD 9

BIT

Data Time Tag (Continued)

1 thru 8 Last 8 bits of 20-bit binary number indicating number of microseconds since start of second (LSB is bit 8)

DRA Configuration/Status (DRA Input Selection)

9 thru 11 Should always be set to 001 for medium-band data

000 = Input #1
001 = Input #2
010 = Input #3
011 = Input #4
100 = Test Input

12 DRA Configuration/Status (DRA 1-PPS Status)

0 = Present
1 = Absent

13 DRA Configuration/Status (DRA Clock Sync Status)

0 = In-Sync (Normal)
1 = Out-of-Sync

14 DRA Configuration/Status (Real-Time Recording Monitor Source)

0 = Recorder A

1 = Recorder B

15 DRA Configuration/Status (DRA Microsecond Time Status)

0 = Normal

1 = Abnormal

16 DRA Configuration/Status (DRA Time-Track Sync)

0 = Out-of-Sync

1 = In-Sync (Normal)

WORD 10

BIT

Unused (Reserved) Bits

1 thru 11 Undefined

Reduction Rate

12 thru 16 Rate at which data samples are transferred from DRA tape to computer-compatible tape; the following are the only codes valid for playback operations:

| | Playback Rate (samples/sec) | DRA Tape Speed (ips) |
|---|---|---|
| 10000 | 50K | 7.5 |
| 01000 | 62.5K | 7.5 |
| 00000 | 75K | 7.5 |

WORD 11

BIT

Unused (Reserved) Bits

1 thru 11 Undefined

Channel Sampling Rate

12 thru 16 Sampling rate at which data were originally recorded on the DRA tape; rate is the same for all four data channels

| | Sampling Rate (samples/sec) | DRA Tape Speed (ips) |
|---|---|---|
| 10000 | 50K | 7.5 |
| 01000 | 62.5K | 7.5 |
| 00000 | 75K | 7.5 |
| 10001 | 100K | 15 |
| 01001 | 125K | 15 |
| 00001 | 150K | 15 |
| 10010 | 200K | 30 |
| 01010 | 250K | 30 |
| 00010 | 300K | 30 |
| 10011 | 400K | 60 |
| 01011 | 500K | 60 |
| 00011 | 600K | 60 |
| 10100 | 800K | 120 |
| 01100 | 1.0M | 120 |
| 00100 | 1.2M | 120 |

WORD 12

BIT

Reduction Data Source

1 Indicates data flow path for reduction data

0 = DRA Tape (Normal)

1 = DRA Bypass (Short-loop test only)

Reduction Decimation Ratio

2 thru 4 Factor by which data samples on the DRA tape are decimated during playback/transfer to this tape record

111 = 1 (no decimation)
110 = 2
101 = 3
100 = 4
011 = 5
010 = 6
001 = 7
000 = 8

1 PPS Track Selection

5 Indicates which track on the DRA tape is used for the start-of-second reference

0 = Track 16
1 = Track 21

Time Track Selection

6 Indicates which track on DRA tape is used for time-of-day reference

0 = Track 22
1 = Track 23

Reduction Channel Selection

7 and 8 Indicates which originally recorded medium-bandwidth input channel is selected for playback

00 = Channel 1
01 = Channel 2
10 = Channel 3
11 = Channel 4

Input Block Size Register

9 thru 16 Number of samples in 1 second or reduced data expressed as a negative two's complement binary number.

WORD 13

| BIT | |
|---|---|
| | Input Block Size Register (Cont.) |
| 1 thru 16 | |

WORDS 14 THRU 22

| BIT | |
|---|---|
| | Unused (Reserved) Bits |
| 1 thru 16 | Undefined |

WORD 23

| BIT | |
|---|---|
| | Reduction Day or Year |
| 1 thru 9 | Contains binary value of reduction day (GMT) |
| | Unused (Reserved) Bits |
| 10 thru 15 | Undefined |
| | Reduction Time of Day |
| 16 | First bit (MSB) of 17-bit number representing number of seconds since beginning of day |

WORD 24

| BIT | |
|---|---|
| | Reduction Time of Day (Cont.) |
| 1 thru 16 | Last 16 bits of 17-bit number representing number of seconds since beginning of day |

WORD 25

| BIT | |
|---|---|
| | Unused (Reserved) Bits |
| 1 thru 16 | Undefined |

WORD 26

BIT

Unused (Reserved) Bits

1 thru 8 Undefined

9 Status

1 = Input buffer overflow

0 = No overflow

10 Status (Cont.)

1 = 1 pps Out-of-Sync

0 = Not Out-of-Sync

11 Status (Cont.)

1 = Bit Slip

0 = No Out-of-Sync

12-13 Status (Cont.)

Spares

14 thru 16 Decimation Counter Value

111 = 1 (No decimation)

110 = 2

101 = 3

100 = 4

011 = 5

010 = 6

001 = 7

000 = 8

WORDS 27 and 28

BIT

Sample Count

1 thru 16 A 32-bit binary number which relates the first data sample in this block to an integral second; valid only when Word 1, bit 4 is set to 1; a number "n" stored in

this field indicates that the first sample in this block was the nth sample after the start of the second (at a decimation ratio of one -- see Word 12, bits 2 through 4); MSB is Word 27, bit 1 and LSB is Word 28, bit 16.

NOTE

Refer to appendix for cases involving other decimation ratios.

WORDS 29 THRU 2528

BIT

1 thru 16 Data Samples

Each word contains two 8-bit data samples. MSBs of samples are in bit 1 and bit 9; the "earlier" sample is in bits 1 through 8

# APPENDIX A

## MEDIUM BAND IDR RECORDS

The medium band converter hardware inputs data to the computer through two channels, a control/monitor channel, and a data channel. The control/monitor channel input contains time of day and status. It appears in the record in Words 6 through 13. The data channel input contains A/D converter values and a header. It appears in the record in Words 25 through 28. The header on the data channel contains 8 bytes of auxiliary information that are inserted into the data stream when the number of data samples indicated by the block size register has been input to the computer. The ODA software sets the block size register to equal the sample rate of the recorder at playback speed. If the record sample rate was 300K samples/second, the playback rate is 75K samples/second. Validity flags are set when an input occurs on either the control/monitor channel or the data channel. The data header validity flag is set when an input occurs on the data channel (every 75K samples of input data) and the time validity flag is set every 300K samples of input data. A control/monitor channel input sets bit 1 of Word 1 of the medium bandwidth record. The data channel header input sets bit 4 or Word 1.

The decimation ratio is the factor by which the data samples on the DRA tape are decimated during IDR production. A decimation ratio of one indicates that every recorded sample is input to the computer. A decimation ratio of 3 indicates that every third sample is input to the computer.

The sample count in the ODA medium band IDR is the count of the number of data samples (on the DRA tape) that have occured since the last tape 1 pps. It indicates the data sample that is to be associated with the time of the record.

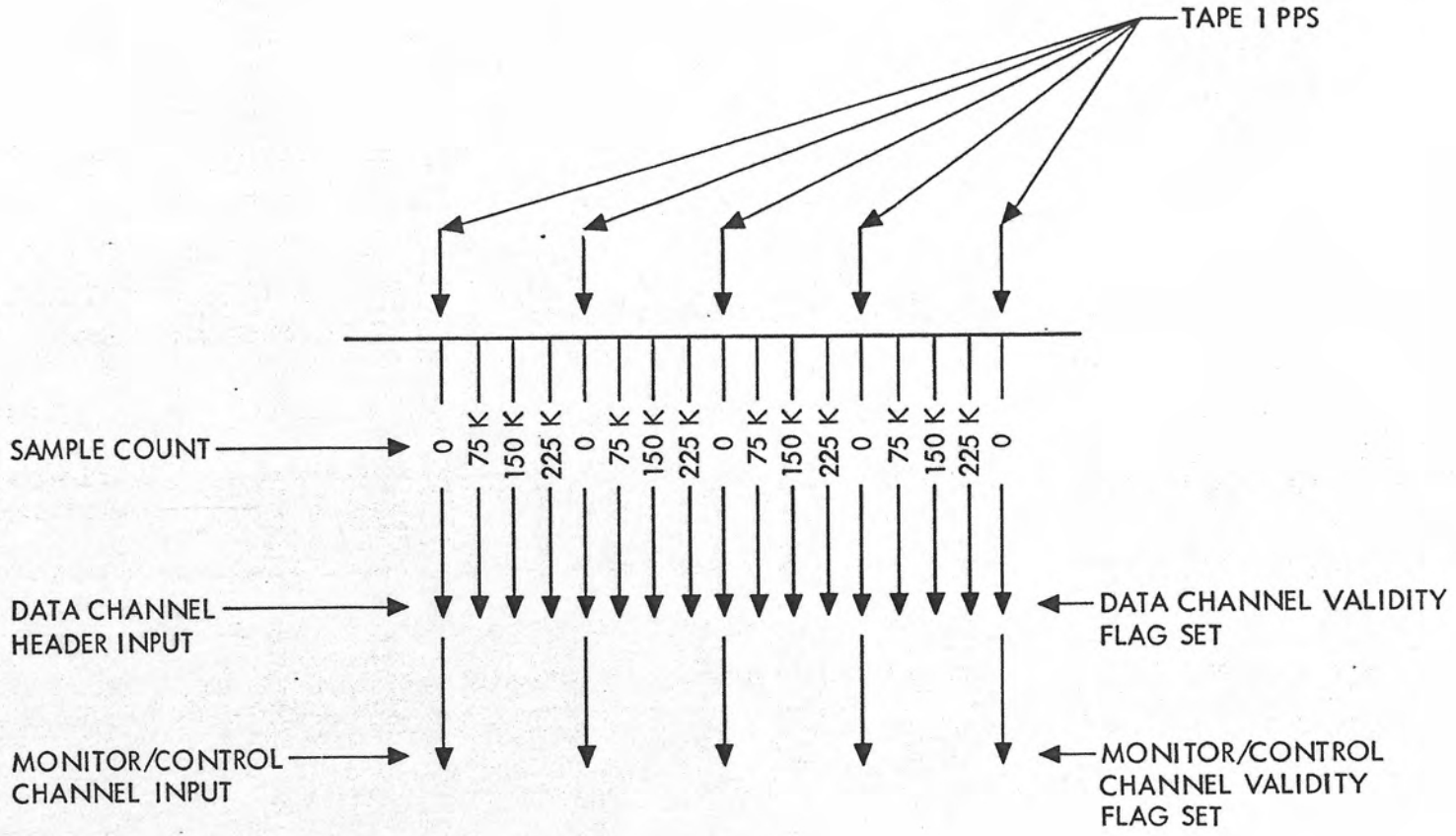
Figure 1 shows the monitor/control and data channel inputs for a decimation ratio 1. The DRS recorder is operated at 1/4 the rate at which the data were recorded. The block size register is set to 75,000. This causes a data

channel header input once per second. Note that the 1 pps that was recorded on the DRA tape when it was running at 300K samples, occurs every 4 seconds when the data is played back at 1/4 rate.

Figure 2 shows the two input channels when the decimation ratio is 3. The data channel header is still input every 75,000 samples, but since every third sample is being input, 225K recorded samples must pass before 75K are input to the computer. Data channel header inputs now occur every 3 seconds. The data channel validity flag is set every 3 seconds, which is 3/4 of a tape second. The control/monitor validity flag is set every 12 seconds, which is every 3 tape seconds.

Figure 3 shows the actual sample count for a decimation ratio of 3. Every third sample is input in the computer, and causes the block size counter increment. When the counter reaches 75,000, a data channel header is input. The raw sample counter value input at the start of a tape 1 pps period is 299997. Samples 299998 and 299999 were not yet counted when the header was input. The ODA software adjusts the sample count to compensate for the decimation ratio and to tag the first sample in the record as 1 rather than 0. It also subtracts the record sample rate from the compensated sample count when a control/monitor input occurs. The records with valid time in the header, therefore, have sample counts of 1, indicating that the first sample corresponds to the time in the record. An illustration of this appears below.

| DECIMATION RATIO = 1 | | DECIMATION RATIO = 3 | |
|---|---|---|---|
| Record No. | Sample Count | Record No. | Sample Count |
| 1 | 1 | 1 | 3 |
| 16 | 75001 | 16 | 225001 |
| 31 | 150001 | 31 | 150001 |
| 46 | 225001 | 46 | 75001 |
| 61 | 1 | 61 | 1 |
| 76 | 75001 | 76 | 225001 |
| 91 | 150001 | 91 | 150001 |
| 106 | 225001 | 106 | 75001 |
| 121 | 1 | 121 | 1 |




DECIMATION RATIO = 1
RECORD SAMPLE RATE = 300 K
PLAYBACK SAMPLE RATE = 75 K
DATA CHANNEL HEADER INPUT EACH 75 K RECORDED SAMPLES
SAMPLE COUNT RESET BY TAPE 1PPS

Figure 1. Time and Data Channel Inputs Showing Sample Count

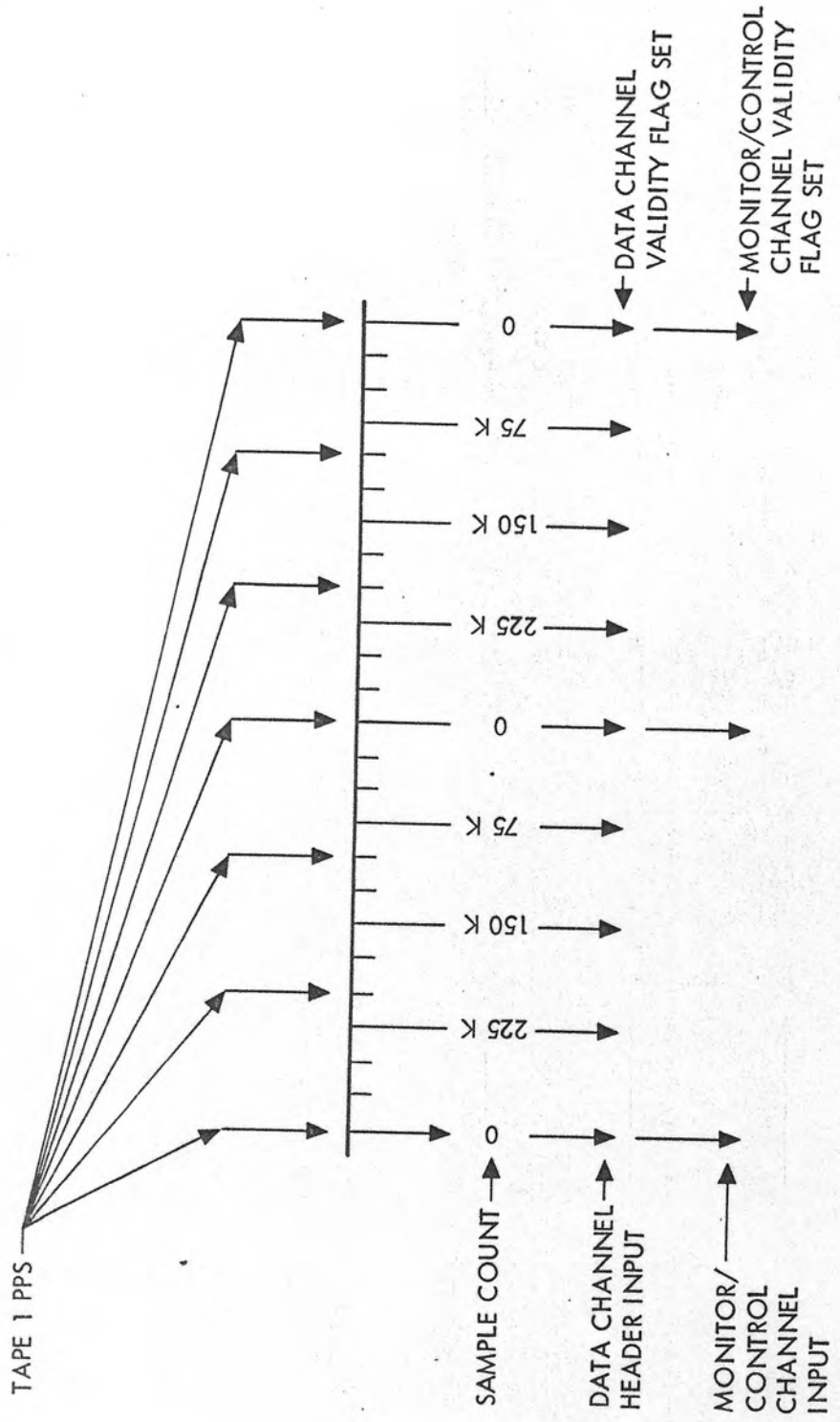
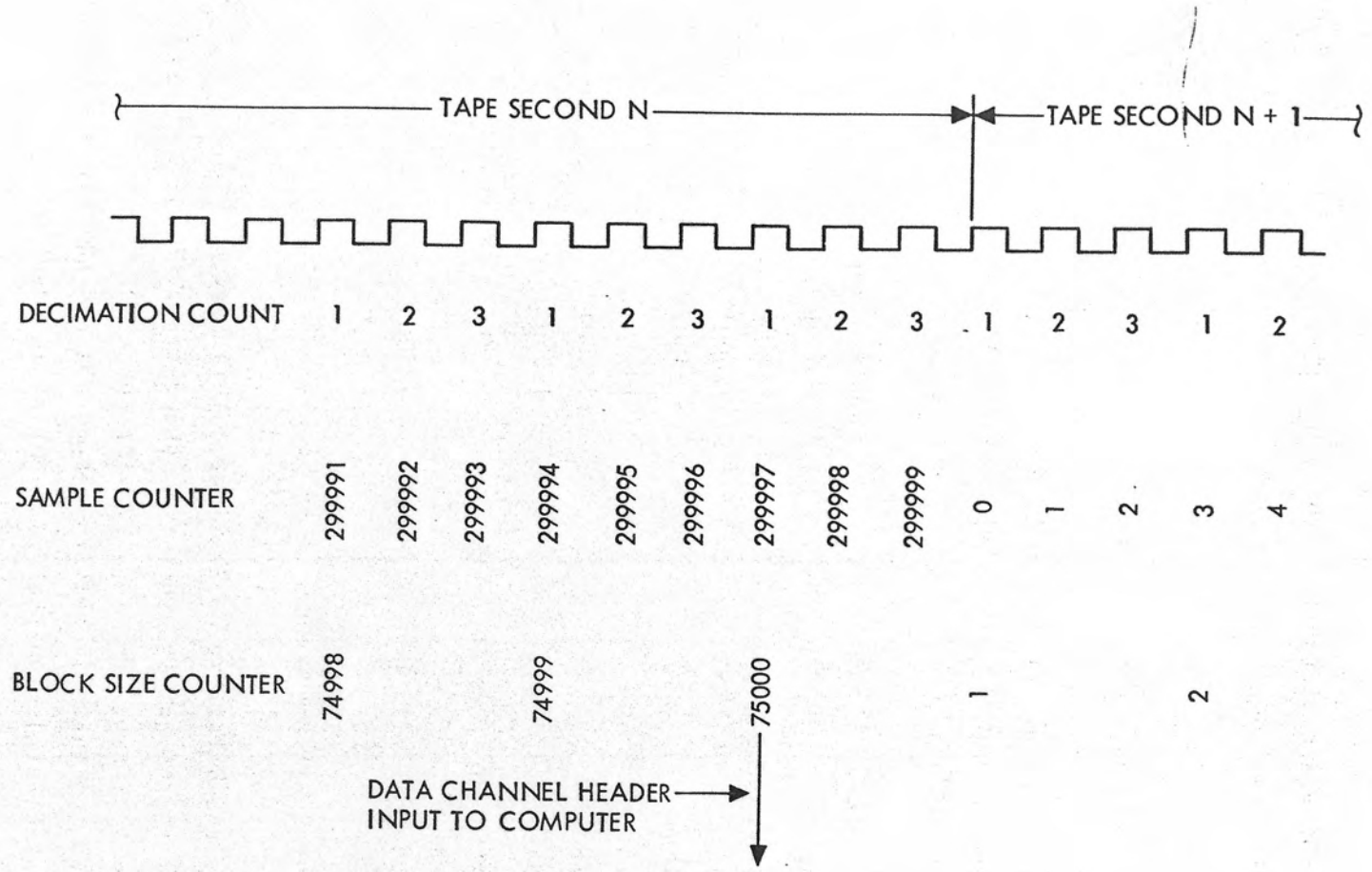



Figure 2. Time and Data Channel Inputs Showing Sample Count




| | | |
|---|---|---|
| RAW SAMPLE COUNT | = | 299997 |
| ODA S/W ADDS | | +4 |
| ODA S/W SUBTRACTS | | -300000 |
| IDR SAMPLE COUNT | = | 1 |

Figure 3. IDR Sample Count-Decimation Ratio = 3

The sequence repeats throughout the entire IDR tape for records that do not have missing or additional samples. Note that the first record on the decimated tape has a sample count of 3 rather than 1. This occurs because the first input occurs at the start of second rather than when the block size count is exhausted, causing the raw sample count to be input as 299999 rather than 299997.

A DRA tape can contain data errors. These errors usually occur as parity errors in the data samples. If an error occurs on the 1 pps track that causes a spurious tape 1 pps, the sample counter will not contain the correct count. The sample count returns to normal during the next second. This situation is illustrated below record 181.

| Record No. | Sample Count |
|---|---|
| 121 | 1 |
| 136 | 225001 |
| 151 | 150001 |
| 166 | 75001 |
| 181 | 164196 |
| 196 | 225001 |
| 211 | 150001 |
| 226 | 75001 |
| 241 | 1 |
| 256 | 225001 |

A DRA tape of poor quality may have "loss of sync" errors in addition to the sample count reset errors. The data clock and the data lose synchronization when this occurs, the data samples are lost. This type of error is indicated by an offset in the sample count. In the example below, records 451 through 481 illustrate this type of error. During the interval, the sample count changed from 1 to 4. The data between record 451 and 481 are not useable because the time tag associated with the data samples is unknown.

| Record No. | Sample Count | Record No. | Sample Count |
|---|---|---|---|
| 361 | 1 | 466 | 29791 |
| 376 | 225001 | 481 | 4 |
| 391 | 150001 | 496 | 225004 |
| 406 | 48288 | 511 | 150004 |
| 421 | 273288 | 526 | 75004 |
| 436 | 225001 | 541 | 4 |
| 451 | 150001 | | |

When the sample count shifted from 1 to 4, it indicated that the time tag of the first sample in the record shifted by 3 sample periods at the record ratio, and is now 3 sample periods later in time than before. Another way to consider it is that the first sample in the block would have been the fourth sample had the sync loss not occured.