NASA CR-
144552

COMPUTER PROGRAM DESIGN SPECIFICATIONS FOR THE BALLOON-BORNE ULTRAVIOLET STELLAR SPECTROMETER (BUSS) SCIENCE DATA DECOMMUTATION PROGRAM (BAPS48)

Program Q938

Job Order 83-157

Prepared By

Lockheed Electronics Company, Inc
Aerospace Systems Division
Houston, Texas

Contract NAS 9-12200
For
INSTITUTIONAL DATA SYSTEMS DIVISION

National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas
October 1975

LEC-6888

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TECHNICAL REPORT INDEX/ABSTRACT
(See instructions on reverse side.)

1. TITLE AND SUBTITLE OF DOCUMENT

COMPUTER PROGRAM DESIGN SPECIFICATIONS FOR THE BALLOON-BORNE ULTRAVIOLET STELLAR SPECTROMETER (BUSS) SCIENCE DATA DECOMMUTATION PROGRAM (BAPS48)

2. JSC NO.

JSC-09941

3. ORIGINATOR/ORGANIZATION NAME

Lockheed Electronics Company, Inc.

4. CONTRACT OR GRANT NO.

NAS 9-12200

5. ORIGINATOR/ORIGINATOR DOCUMENT NO.

LEC-6888

6. PUBLICATION DATE (THIS ISSUE)

October 1975

7. SECURITY CLASSIFICATION

Unclassified

8. JSC OFFICE OF PRIMARY RESPONSIBILITY

H. Stephenson/FD5

9. LIMITATIONS

GOVERNMENT HAS UNLIMITED RIGHTS [X] YES [ ] NO

10. AUTHOR(S)

R M. Rodriguez

10a. STATE LIMITATIONS AND AUTHORITY

11. DOCUMENT CONTRACT REFERENCES

MSFC REGULATION STRUCTURE NO.

Not applicable

CONTRACT EXHIBIT NO.

Not applicable

CHL NO. AND REVISION

Not applicable

CHL LIST ITEM NO.

Not applicable

12. HARDWARE CONFIGURATION

S/C

Not applicable

S/C ITEM

Not applicable

MAJOR EQUIPMENT GROUP

Not applicable

13. ABSTRACT

The Balloon-Borne Ultraviolet Stellar Spectrometer (BUSS) Science Data Decommutation Program (BAPS48) is a pulse code modulation (PCM) decommutation program that will format the BUSS science data contained on a one-inch PCM tracking tape into a seven-track serial bit stream formatted digital tape.

14. SUBJECT TERMS:

Decommutation	BUSS	
Serial	Serial bit stream	

JSC Form 833 (Rev Sep 74) NASA-JSC

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FIGURES

ABBREVIATIONS AND ACRONYMS

BAPS48	BUSS Science Data Decommutation Program
BCD	Binary-coded decimal
BPI	Bits per inch
BUSS	Balloon-Borne Ultraviolet Stellar Spectrometer
GENDES	Data Distribution Generation Program
LSB	Least significant bit
MSB	Most significnat bit
PCM	Pulse code modulation
PDC	Programmed data channel
SBS	Serial bit stream

1. PROGRAM PURPOSE

The Balloon-Borne Ultraviolet Stellar Spectrometer (BUSS) Science Data Decommutation Program (BAPS48) will be a pulse code modulation (PCM) decommutation program. The program will decommutate the BUSS science data contained on 1-inch analog tapes and output on seven-track serial bit stream (SBS) formatted digital tapes.

2. PROGRAM IDENTIFICATION

Title:	Balloon-Borne Ultraviolet Stellar Spectrometer (BUSS) Science Data Decommutation Program
Acronym:	BAPS48
Program number:	Q938
Author:	Rodolfo M. Rodriguez
Installation:	JSC, Houston, Texas
Program type:	Main
Authorization:	Contract number NAS 9-12200
Source language:	COMPASS32
Computer:	CDC 3200/CDC programmed data channel (PDC)
Operating system:	CDC 3200 Real-Time Scope

3. ANALYSIS

BAPS48 will input 48 kilobit science data from the PCM subsystem, utilizing the CDC 3200 programmed data channel (PDC) and time code information from the timing subsystem. Time and data will be output in SBS format. BAPS48 will optionally interrogate the line counter and status word and accept data scans when one of the following conditions is present.

- The six most significant bits (MSB) of the line counter (10 through 15) are all zeros.

- Bit 6 (deflection on) of the status word is on.
- Bit 7 (deflection normal) of the status word is on.

One scan per record will be output. Information variables, such as number of frames processed, sync status, time status, etc., will be written on the typewriter. Jump switch 5 will be used to inhibit the connection of the PDC and PCM system. Jump switch 2 will be used to inhibit the writing of data to the SBS output tape.

4. INPUT DESCRIPTION

The input data will consist of a PCM test tape, simulated data for preliminary evaluation of the program, and data descriptor cards used by the Data Descriptor Generation Program (GENDES) to create a data descriptor.

4.1 PCM TEST TAPE

The BUSS PCM data tape will be a Delayed Modulation-Mark (Miller) encoded 14-track PCM tape, 1 inch wide, and recorded at 30 inches per second in the direct mode to yield a 48-kilobit rate. IRIG B timing and a 50-kilohertz reference will also be directly recorded on separate tracks. Data will be recorded in eight-bit bytes with the least significant bit (LSB) first.

The PCM format will consist of the following words, in chronological order:

- 32-bit synchronization word
- 16-bit line counter word
- 16-bit status word
- 1,016 eight-bit words scientific data (one raster)
- 32-bit check word
- 16-bit line counter word
- 16-bit status word

The last three items will be repeated 16 times to form a total frame length of 1,152 eight-bit words.

The synchronization word will be:

MSB LSB
11111010111100110011010000000000

and will be transmitted LSB first, eight bits at a time, starting at the least significant eight-bit byte.

The check word will be:

MSB LSB
00000101000011001100101100000000

and will be transmitted in the same manner as the sync word.

The 10 least significant bits will indicate the status of the line counter.

The status word bits will have the following meanings:

bit 15 (MSB) – spare (logic 0)
bit 14 – spare
bit 13 – spare
bit 12 – spare
bit 11 – spare
bit 10 – erase lamp on
bit 9 – target voltage erase
bit 8 – target voltage readout
bit 7 – deflection normal
bit 6 – deflection on
bit 5 – focus current on
bit 4 – photocathode voltage on
bit 3 – readout high voltages on
bit 2 – heater and alignment on
bit 1 – stepping motor
bit 0 (LSB) – shutter open

4.2 SIMULATED DATA

The stored program simulator will be used to generate simulated test data to evaluate the preliminary performance of the program. The format of the simulated data that will be used is illustrated in figure 1.

4.3 DATA DESCRIPTOR CARDS

Input cards will describe each measurement for GENDES, which will write the descriptor file on the first tape at the beginning of each decommutation job. Figure 2 shows a listing of the data descriptor cards.

5. OUTPUT DESCRIPTION

The output will consist of a SBS formatted digital tape and the typewriter log.

5.1 OUTPUT DIGITAL TAPE

The output tape will be a standard SBS format consisting of time and data scans. It will contain a data descriptor in file 1 generated by GENDES. File 2 will contain the science data and will be recorded at one scan of data per record. Each record will contain 522 24-bit words per record, which is equivalent to 348 36-bit words per record or 261 48-bit words per record. A description of the science data record format is found in figure 3.

The tape will have the following characteristics:

- Seven-track magnetic digital tape
- 800 bits per inch (BPI) odd parity
- One scan per record
- 522 24-bits words/record

SIMULATED DATA

Pin	Eight-bit octal simulator output value	Eight-bit octal converted value		Comments
0	000	000		
1	054	064	Sync	
2	317	363		
3	137	372		
4	000	000	LCOUNT	Simulated value varies 0-1023
5	000	000		
6	237	371	Status	
7	257	365		
8	200	001	DATA1	
9	100	002	DATA2	
10	003	300	DATA3	
•	•	•	•	Simulated value repeated and incremented by 1, 111 times.
•	•	•	•	
•	•	•	•	
121	162	116	DATA114	
122	316	163	DATA115	
•	•	•	•	
•	•	•	•	Repeated 903 times
•	•	•	•	
1022	316	163	DATA1015	
1023	056	164	DATA1016	
1024	000	000		
1025	323	313	CKWORD	
1026	060	014		
1027	240	005		
1028	000	000	LCOUNT2	
1029	000	000		
1030	237	371	STATUS2	
1031	257	365		
•	•	•		
•	•	•	Fill-repeated 119 times	
•	•	•		
1150	257	165		
1151	236	171	LAST varies 121 to 139*	

*Every 20 cycles the following conditions occur:

LAST = 145 Normal
146 Normal
147 Out-of-sync
148 Normal
—— Out-of-sync
149 Normal
150 Status bit 9 off for previous 20 cycles
151 Normal

NOTE: The RAPS48 data will be received LSB first in eight-bit words. The simulated program has been designed to reflect this characteristic. The simulated value seen by the PCM will be LSB first. The RAPS48 program will invert these and output the converted value.

Figure 1. – Format of the simulated data.

```
        010321032  17  8  5208   48000          6            122075
DAYS       24  0 0 1   1 1   2   2
YEAR1      24  0 0 1   1 1   2   2
TIME1      48  0 1 3   1 1   4   4
SYNC1       3 45 1 3   1 1   0   4
SYNC5       3 42 5 3   1 1   0   4
SYNC9       3 39 5 3   1 1   0   4
INDEX       9 33 5 3   1 1   0   4
SYNCWORD 32    0 5 3   1 1   4   4
ENDHEADER
LCOUNT1     8  4 5 0   1 1   1   4
LCOUNT2     8  4 5 0   1 1   1   5
STATUS1     8  4 5 0   1 1   1   6
STATUS2     8  4 5 0   1 1   1   7
DATA1       8  4 5 0   1 1   1   8
DATA2       8  4 5 0   1 1   1   9
DATA3       8  4 5 0   1 1   1  10
DATA4       8  4 5 0   1 1   1  11
DATA5       8  4 5 0   1 1   1  12
DATA6       8  4 5 0   1 1   1  13
DATA7       8  4 5 0   1 1   1  14
DATA8       8  4 5 0   1 1   1  15
DATA9       8  4 5 0   1 1   1  16
DATA10      8  4 5 0   1 1   1  17
DATA11      8  4 5 0   1 1   1  18
DATA12      8  4 5 0   1 1   1  19
DATA13      8  4 5 0   1 1   1  20
DATA15      8  4 5 0   1 1   1  21
DATA15      8  4 5 0   1 1   1  22
DATA16      8  4 5 0   1 1   1  23
```


Figure 2. – Listing of the data descriptor cards.

SCIENCE DATA OUTPUT RECORD

WORD	47			23			0
1	DAYS (BCD)					YEAR (BCD)	
2	DATAQUAL						
3	TIME1						
4	47 SYNC1	44 SYNC5	41		31	SYNCWORD	
5	LCOUNT1			LCOUNT2		STATUS1	STATUS2
6	DATA1			DATA2		DATA3	DATA4
. . .	. . .			. . .		. . .	. . .
259	DATA1013			DATA1014		DATA1015	DATA1016
260	CKWORD1			CKWORD2		CKWORD3	CKWORD4
261	LCOUNT11			LCOUNT22		STATUS11	STATUS22

*Data words 4 through 261 will be stored eight bits left-justified in a 12-bit field.

The terms in the record are defined as follows:

- DATAQUAL = -0
- TIME1 = Binary milliseconds, 36 bits right-justified in 48 bits
- SYNC1 = Timing status indicator
- SYNC5 = Main frame sync indicator
- SYNCWORD = 32-bit synchronization word
- LCOUNT = 16-bit line counter word
- STATUS = 16-bit status word
- DATA = 1016 eight-bit scientific data word
- CKWORD = 32-bit check word

The record has the following characteristics:

- 1 Scan/record
- 261 48-bit words/record
  (348 36-bit words/record)
  (522 24-bit words/record)

Figure 3. – Science Data Output Record of the SBS tape.

- Nonlabeled
- Non-FORTRAN-compatible, buffered output

The data file will be contained on continuation reels, if needed, until the standard two end-of-file markers signal the end of data.

5.2 TYPEWRITER LOG

The typewriter log will be the standard information message produced by decommutation programs. The parameters that the information message will display are shown in figure 4.

6. RESTRICTIONS

This program is designed to run on a CDC 3200 equipped with a program data channel and telemetry equipment.

7. DIAGNOSTICS

All information about program condition will be presented by the information message. No special diagnostic messages will be printed.

SYNC	OFF	0	3	48820	173	48652	0	1083	0
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)

NOTES:

(a) Main frame synchronization status: SRCH – search mode
VERF – verification mode
SYNC – synchronization mode

(b) Present position of sense switch 2

(c) Number of times that synchronization has been lost and a return to search mode has been made

(d) Total number of frames deleted as a result of status word check

(e) Total number of frames processed

(f) Total number of frames with bad or questionable time status

(g) Total number of frames with good time status

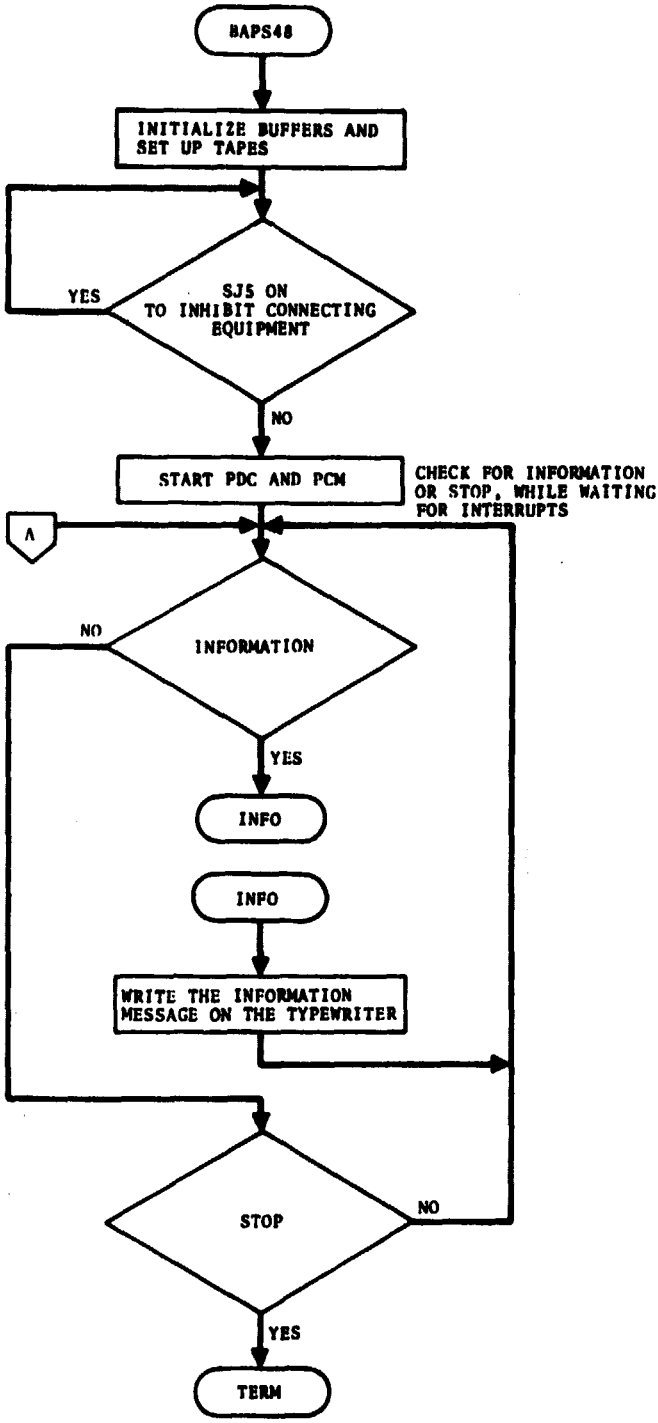
(h) Total number of actual time jumps according to status lines

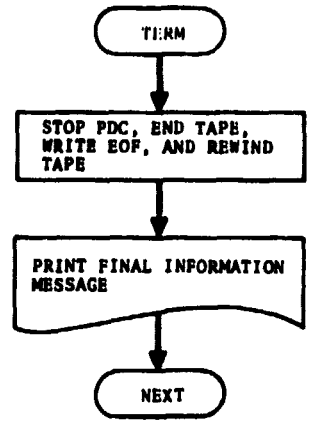
(i) Current number of records written on tape

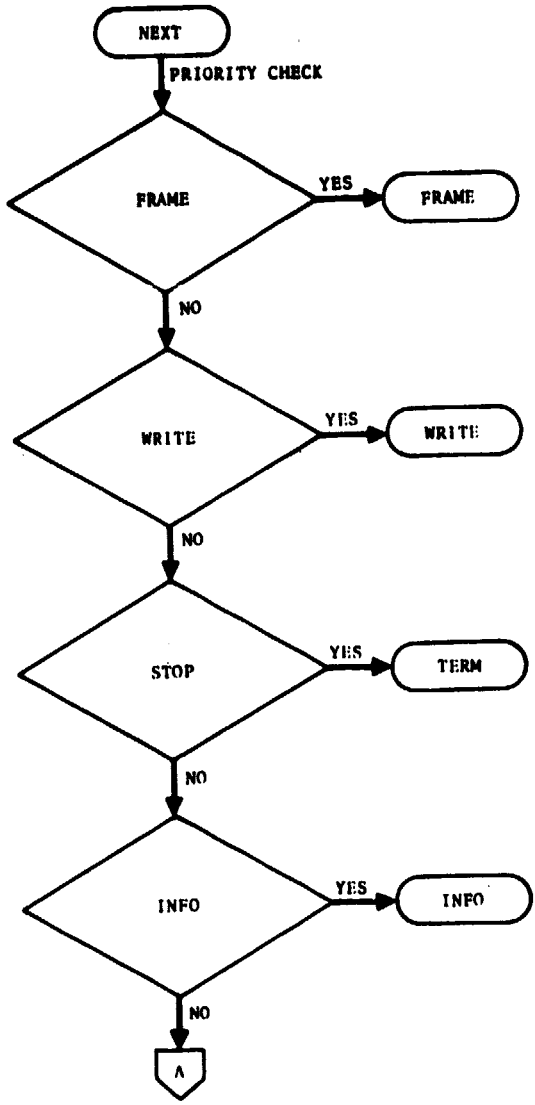
(j) Current number of records lost

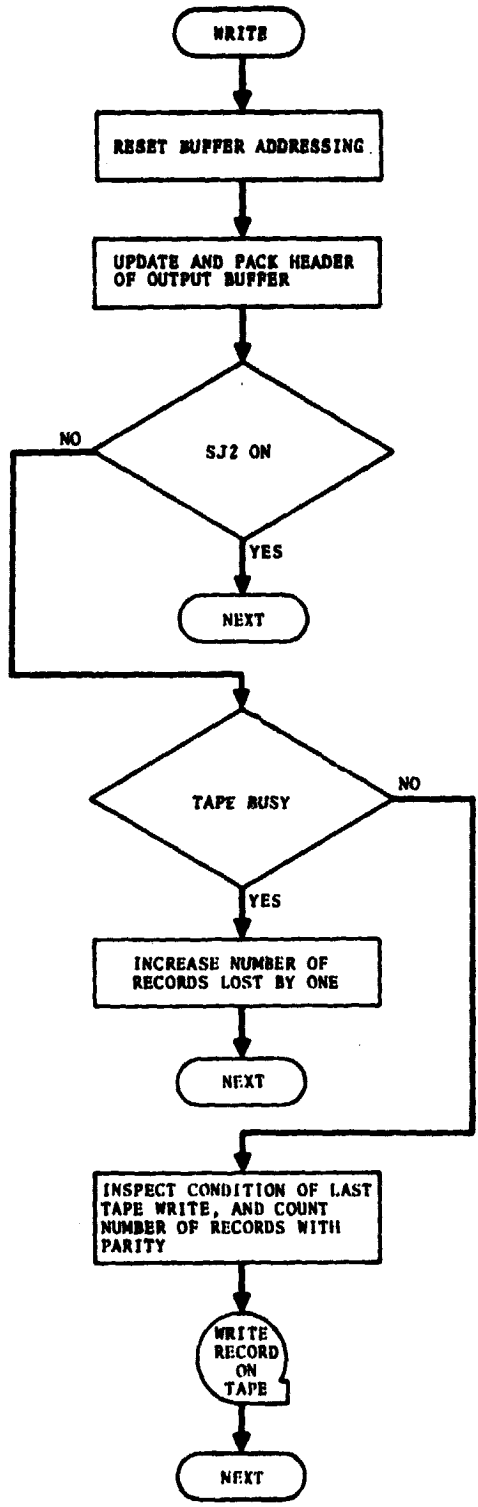
Figure 4. – Information message description of the typewriter log.

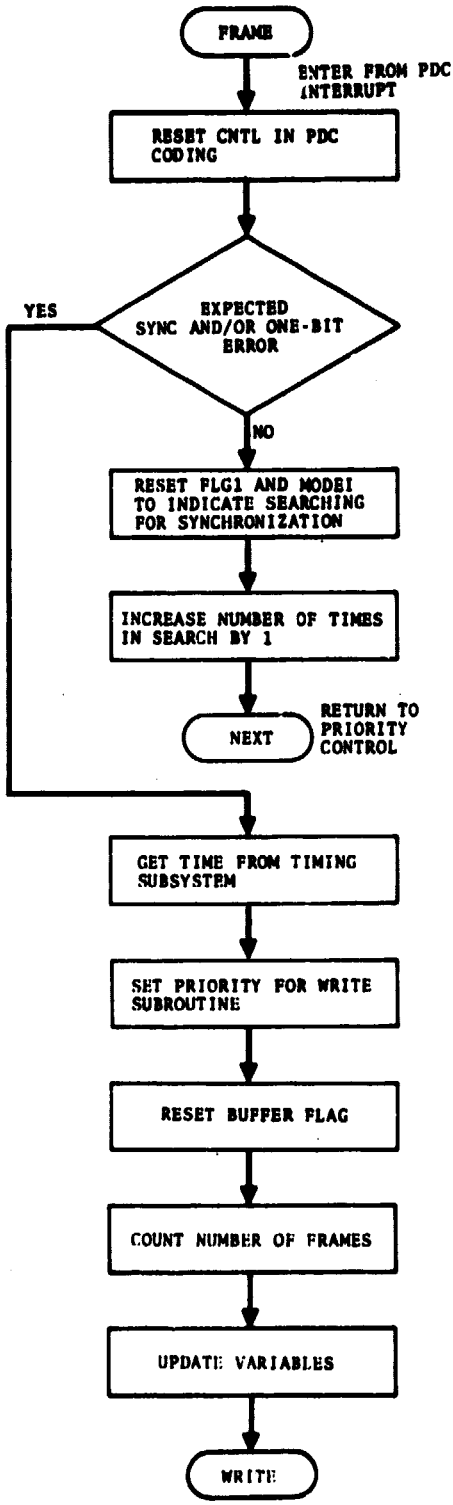
8. PROGRAM FLOW CHART






NEXT
PRIORITY CHECK
FRAME
YES
FRAME
NO
WRITE
YES
WRITE
NO
STOP
YES
TERM
NO
INFO
YES
INFO
NO
A


WRITE
RESET BUFFER ADDRESSING
UPDATE AND PACK HEADER OF OUTPUT BUFFER
SJ2 ON
NO
YES
NEXT
TAPE BUSY
NO
YES
INCREASE NUMBER OF RECORDS LOST BY ONE
NEXT
INSPECT CONDITION OF LAST TAPE WRITE, AND COUNT NUMBER OF RECORDS WITH PARITY
WRITE RECORD ON TAPE
NEXT


FRAME
ENTER FROM PDC INTERRUPT
RESET CNTL IN PDC CODING
EXPECTED SYNC AND/OR ONE-BIT ERROR
YES
NO
RESET FLG1 AND MODE1 TO INDICATE SEARCHING FOR SYNCHRONIZATION
INCREASE NUMBER OF TIMES IN SEARCH BY 1
NEXT
RETURN TO PRIORITY CONTROL
GET TIME FROM TIMING SUBSYSTEM
SET PRIORITY FOR WRITE SUBROUTINE
RESET BUFFER FLAG
COUNT NUMBER OF FRAMES
UPDATE VARIABLES
WRITE

9. EQUIPMENT REQUIREMENTS

The equipment requirements for this program will be as follows:

- CDC 3200 computer system with console typewriter
- CDC programmed data channel (PDC)
- Tape drives
- Card reader
- Line printer
- Timing subsystem
- PCM subsystem
- Analog tape transport (1 inch)
- Simulator system (needed for preliminary testing)