ESD-13530

OPTICAL MASS MEMORY SYSTEM

(AMM-13)

CONTRACT NUMBER NAS8-33687

AMM-13 SYSTEM SEGMENT SPECIFICATION

Reissue 2

(CDRL 005)

PREPARED FOR

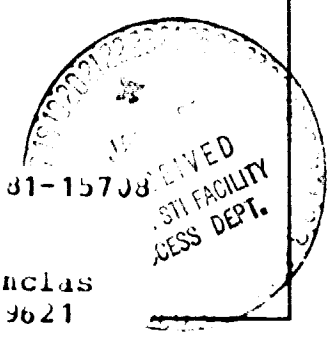
GEORGE C. MARSHALL SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MARSHALL SPACE FLIGHT CENTER (MSFC), ALABAMA 35812

NASA PROJECT ENGINEER: G. A. BAILEY

PHONE: (205) 453-1595



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29 OCTOBER 1980

REVISION RECORD

REVISION	DATE	DESCRIPTION	APPROVAL.
Reissue 1	10 June 1980	Editorial Changes - various	[signature] 6-10-80
Reissue 2	29 OCT 1980	System Reconfiguration — various	[signature] 10-28-80 RRD 10-28-80

AMM-13 SYSTEM SEGMENT SPECIFICATION

CDRL 005

REISSUE #2

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APPROVAL:

HARRIS CORPORATION:

APPROVAL:

MSFC:

TABLE OF CONTENTS

1.0 SCOPE

This specification establishes the performance, design, development, and test requirements for an Optical Mass Memory System prototype, hereinafter referred to as AMM-13. This system interfaces to other system segments of the NASA End-to-End Data System (NEEDS) via the Data Base Management System (DBMS) segment.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the documents referred herein and the contents of this specification, this specification shall govern.

2.1 Government Documents

Contract NAS8-33687 - Statement of Work

Low Cost Reader - Statement of Work(1)

2.2 MSFC/Harris Documents

AMM/DBMS Interface Control Document, Reissue 2 Dated 29 Oct. 1980

2.3 Harris Documents

AMM-13 Subsystem Specifications

2.4 Vendor Documents

(1) The Low Cost Reader is included in this Specification for completeness. It is not presently included in the contract scope.

2.4.1 Digital Equipment Corporation (DEC)

QE 001-GS VAX/VMS Operator and Software Documentation Kit

AA-D025A-TE Operators Guide

DEC Peripheral Manuals (As appropriate)

DEC Installation Guide

2.4.2 AMPEX Corporation

PTD Engineering Spec. Sheet

PTD Engineering Spec. 3308829-01

DCP Engineering Spec. 3309527-01

Disk Handler Spec. (TBD)

2.5 Standards

EIA RS232C Interface Between Data Terminal Equipment and Data communication Equipment employing serial Binary Data Interchange.

2.6 Other Reference Documents

DBMS Contract SOW, Date (TBD).

3.0 REQUIREMENTS

3.1 System Definition

The AMM-13 is a prototype Archival Mass Memory digital data storage and retrieval system. This system shall have a storage capacity of 10^{13} bits (10^{12} bits on line) and will be tested in an operational environment, as a peripheral device, with other system segments (DBMS and

CMS). The AMM-13 design and function will be compatible with the requirements of future similar systems with capacities of 10^{15} bits such that no technique or technology used shall preclude expandability to 10^{15} bits.

The AMM-13 shall provide the necessary computer, resident software, and electro-optical devices necessary to record, verify, and retrieve the optically stored digital data from an archival data base. The stored data will be transferred to another system segment (DBMS/CMS) for distribution to the ultimate user.

3.1.1 General Description

The AMM-13 prototype archival mass memory system shall consist of hardware and software to provide the following functions:

(a) Control - Commands and controls the AMM-13 resources to effect operation of the other functional processes.

(b) Input - The ingest of data from the DBMS or the Input Data Bus Port Adapter.

(c) Record - The recording of ingested digital data on photographic film using optical techniques.

(d) Fiche Processing/Replication - Developing and fixing the exposed photographic film and preparing duplicates of processed fiche.

(e) Storage and Retrieval - The storage of processed fiche for on-line and/or off-line retrieval and reading of stored data using optical techniques.

(f) Output - The conveyance by electrical digital data transfer of the retrieved data to the DBMS or the Output Data Bus Port Adapter.

(g) Verification - On-line validation of the accuracy of the recorded data.

3.1.2 Mission

The AMM-13 mission shall be to provide a prototype 10^{13} bit Archival Mass Memory for test and demonstration at NASA (MSFC) in an operational mode to verify design objectives and establish performance criteria as specified herein.

3.1.3 Major Subsystem Listing

The following major subsystems comprise the AMM-13:

(a) Computer Subsystem

(b) Software Subsystem

(c) Input Subsystem

(d) Recorder Subsystem

(e) Fiche Processor/Replicator Subsystem

(f) Verify Subsystem

(g) Storage and Retrieval Subsystem

(h) Output Subsystem

(i) Low Cost Reader Subsystem

3.1.4 System Diagrams

The overall system functional flow is depicted by Figure 3.1.4.1. This diagram indicates the basic relationships between the major system functions listed in Paragraph 3.1.1. The input and output process flows are shown in Figures 3.1.4.2 and 3.1.4.3 respectively. Nine major susbystems have been listed in Paragraph 3.1.3 to perform the seven system functions. These subsystems are depicted in the overall system block diagram shown in Figure 3.1.4.4. System level functions and subfunctions are allocated to each of the subsystems as shown in Figures 3.1.4.5 (a) through (i).

3.1.4.1 Function Flow Diagram

See Figure 3 1.4.1

3.1.4.2 Input Process Flow

See Figure 3.1.4.2 and 3.1.4.2 (a)

3.1.4.3 Output Process Flow

See Figure 3.1.4.3

3.1.4.4 System Block Diagram

See Figure 3.1.4.4

3.1.4.5 Subsystem Functional Allocation Charts

See Figures 3.1.4.5.1 through 3.1.4.5.9

3.1.4.6 Detailed System Block Diagrams

See Attachment A Figures 1 through 6.

AMM-13 FUNCTIONAL FLOW DIAGRAM

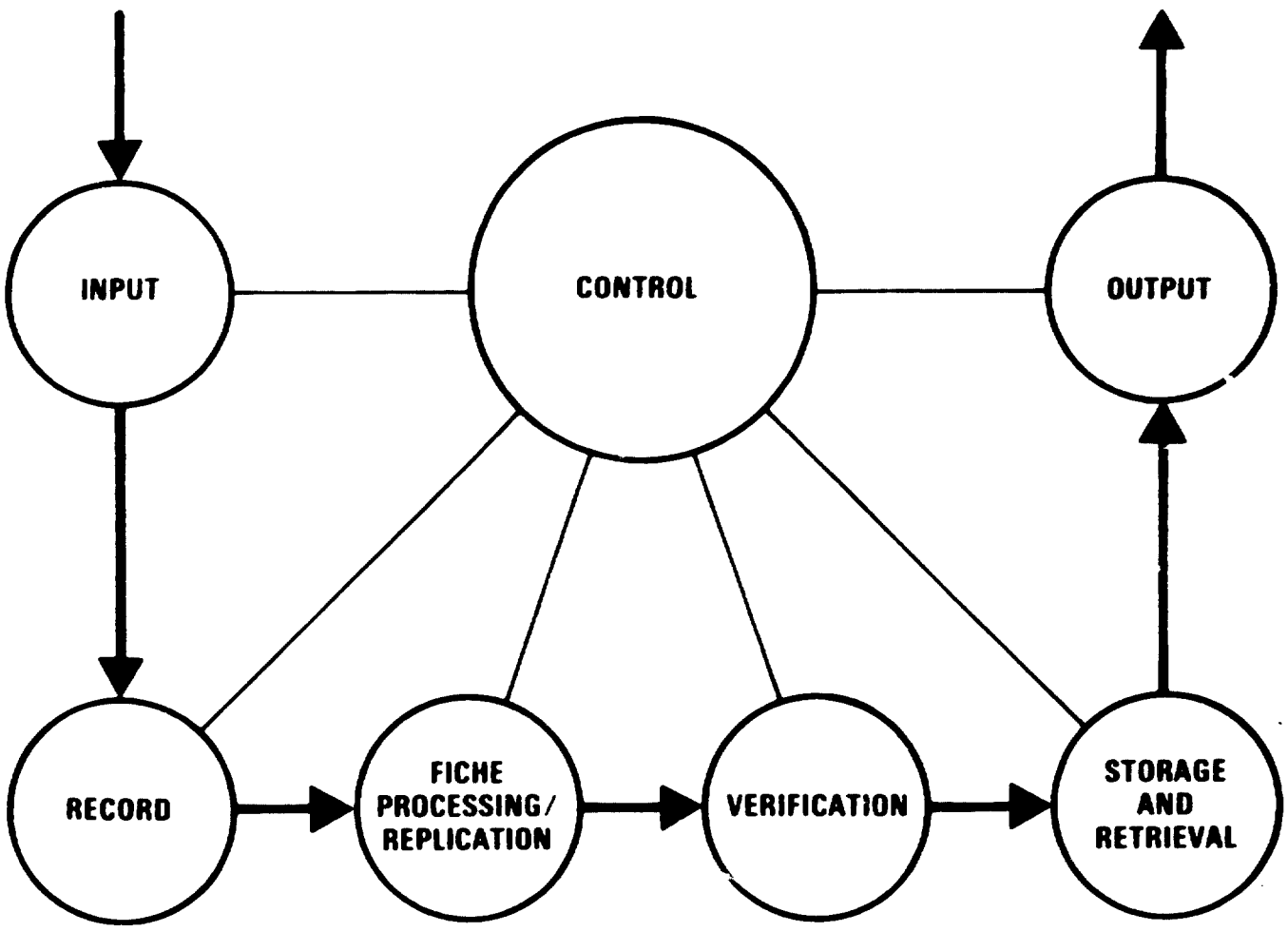


Figure 3.1.4.1

AMM-13 INPUT PROCESS FLOW

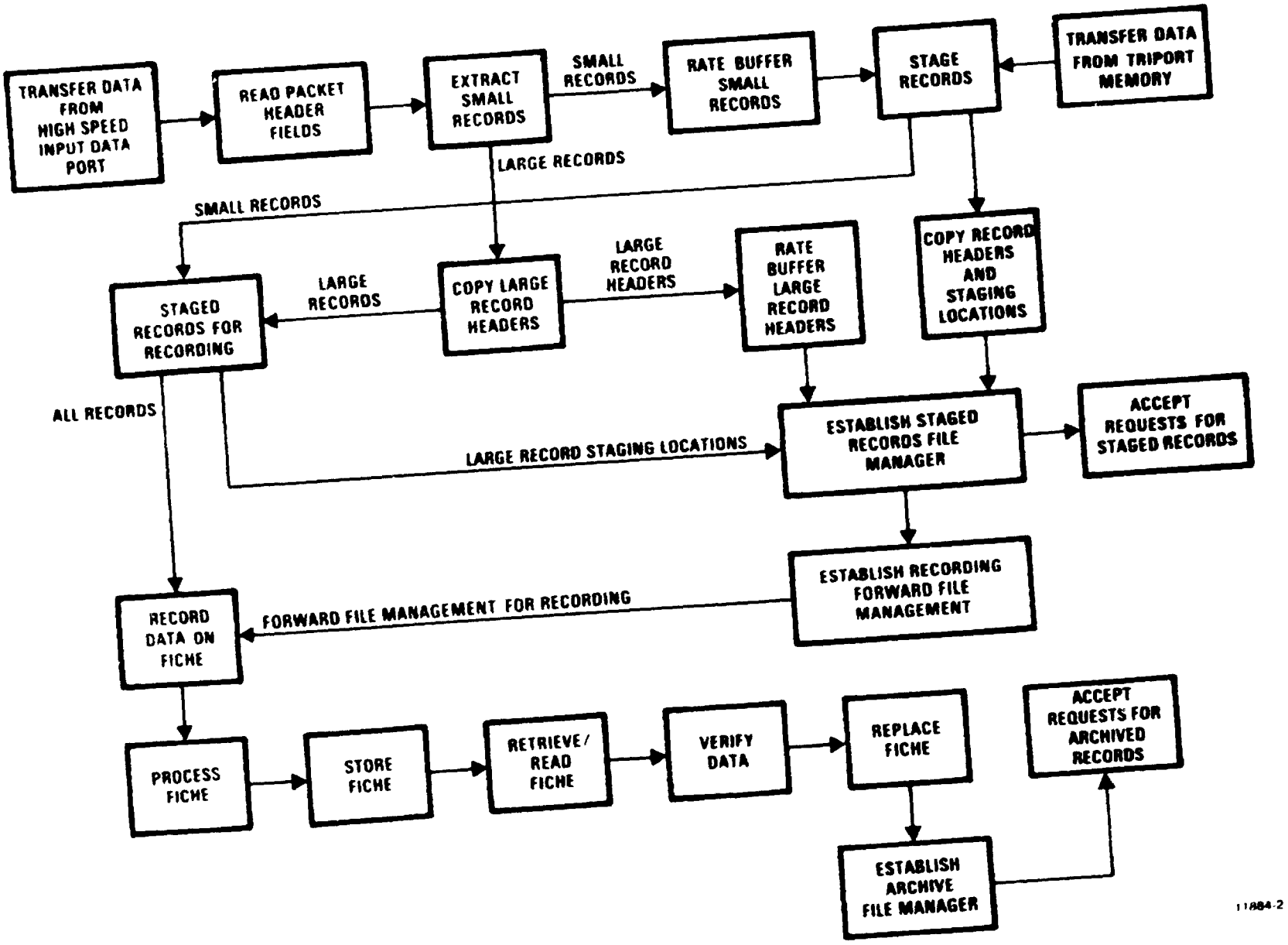


Figure 3.1.4.2

AMM-13 INGEST TIMING CYCLE

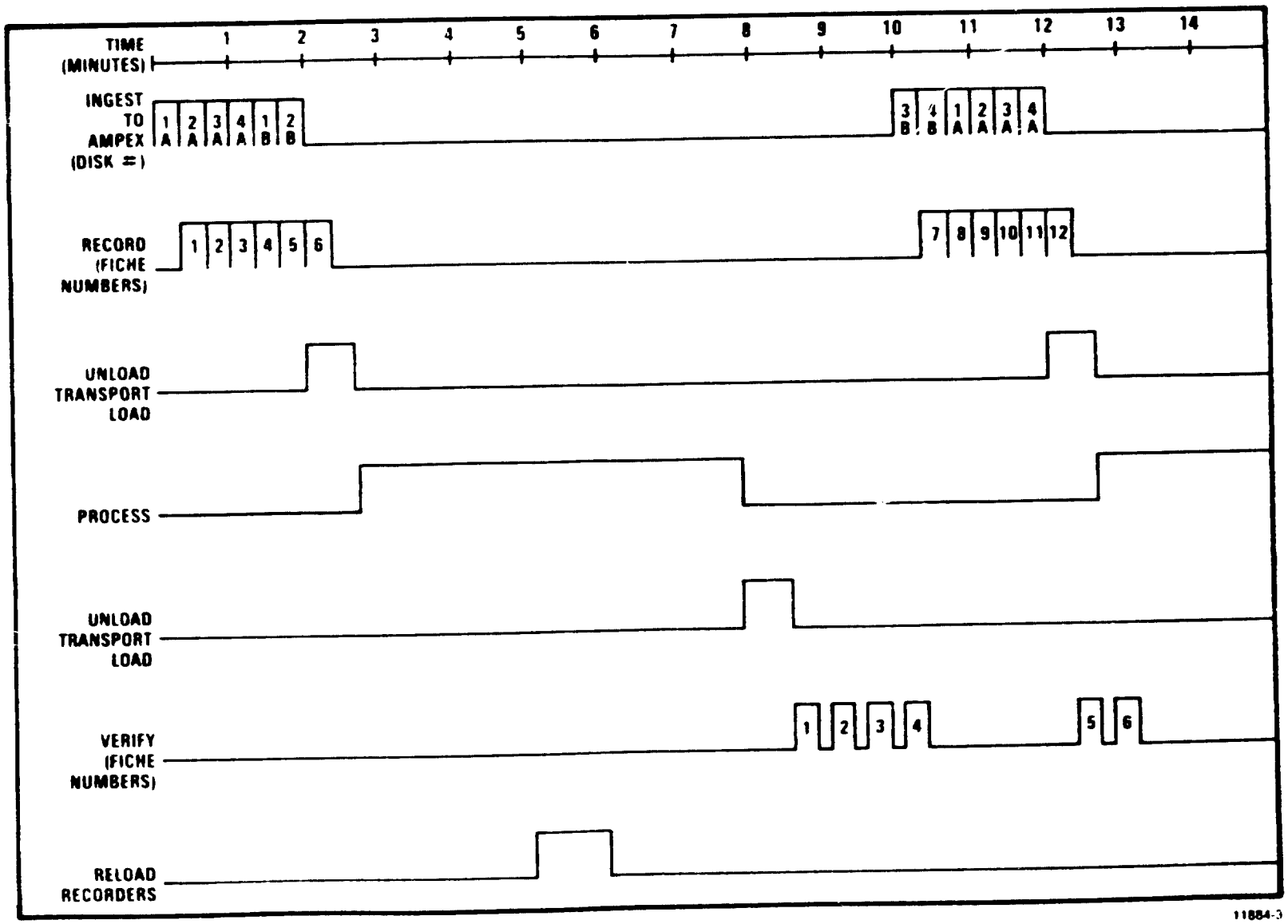


Figure 3.1.4.2 (a)

AMM-13 OUTPUT PROCESS FLOW

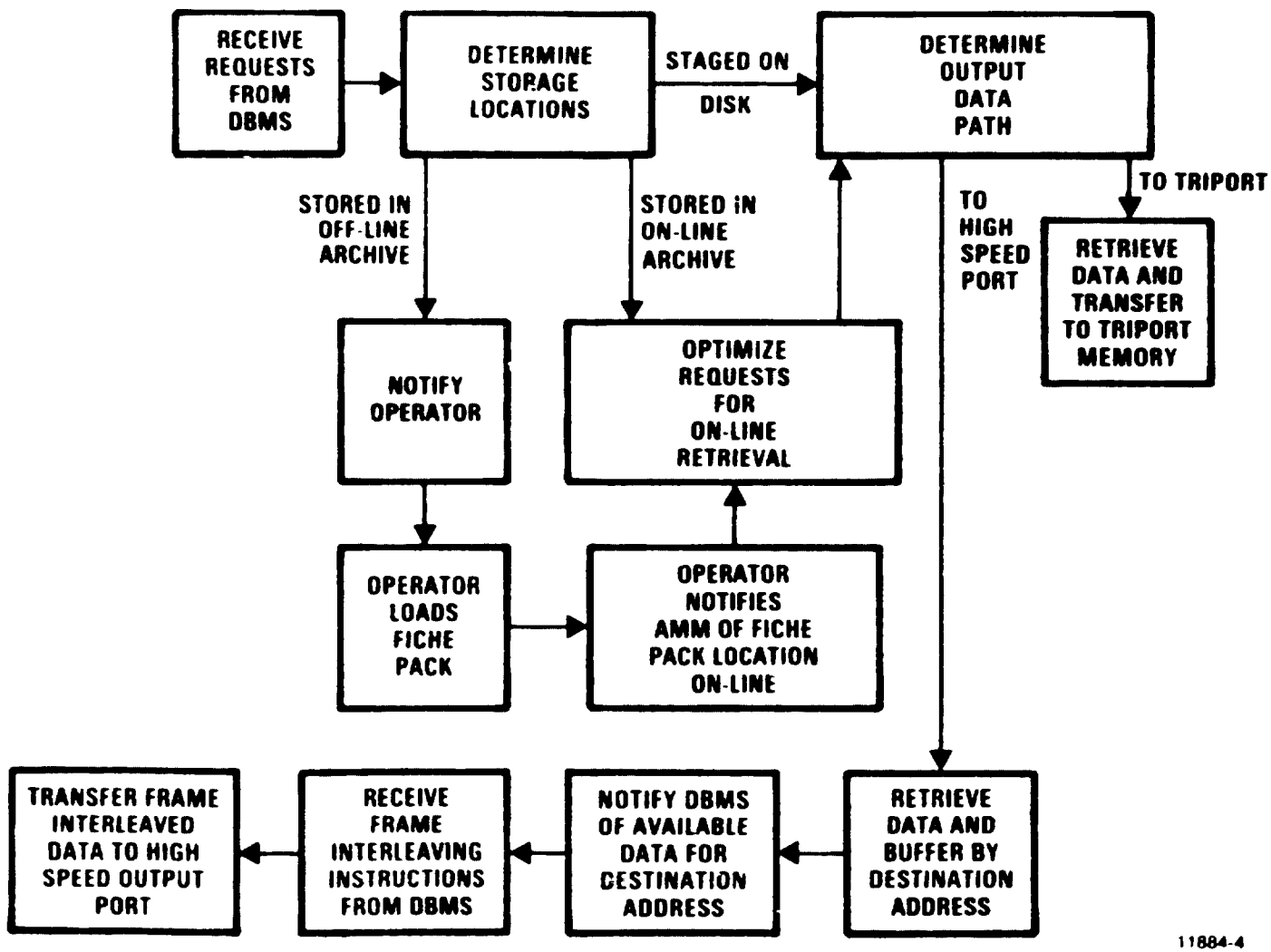


Figure 3.1.4.3

AMM-13 SYSTEM BLOCK DIAGRAM

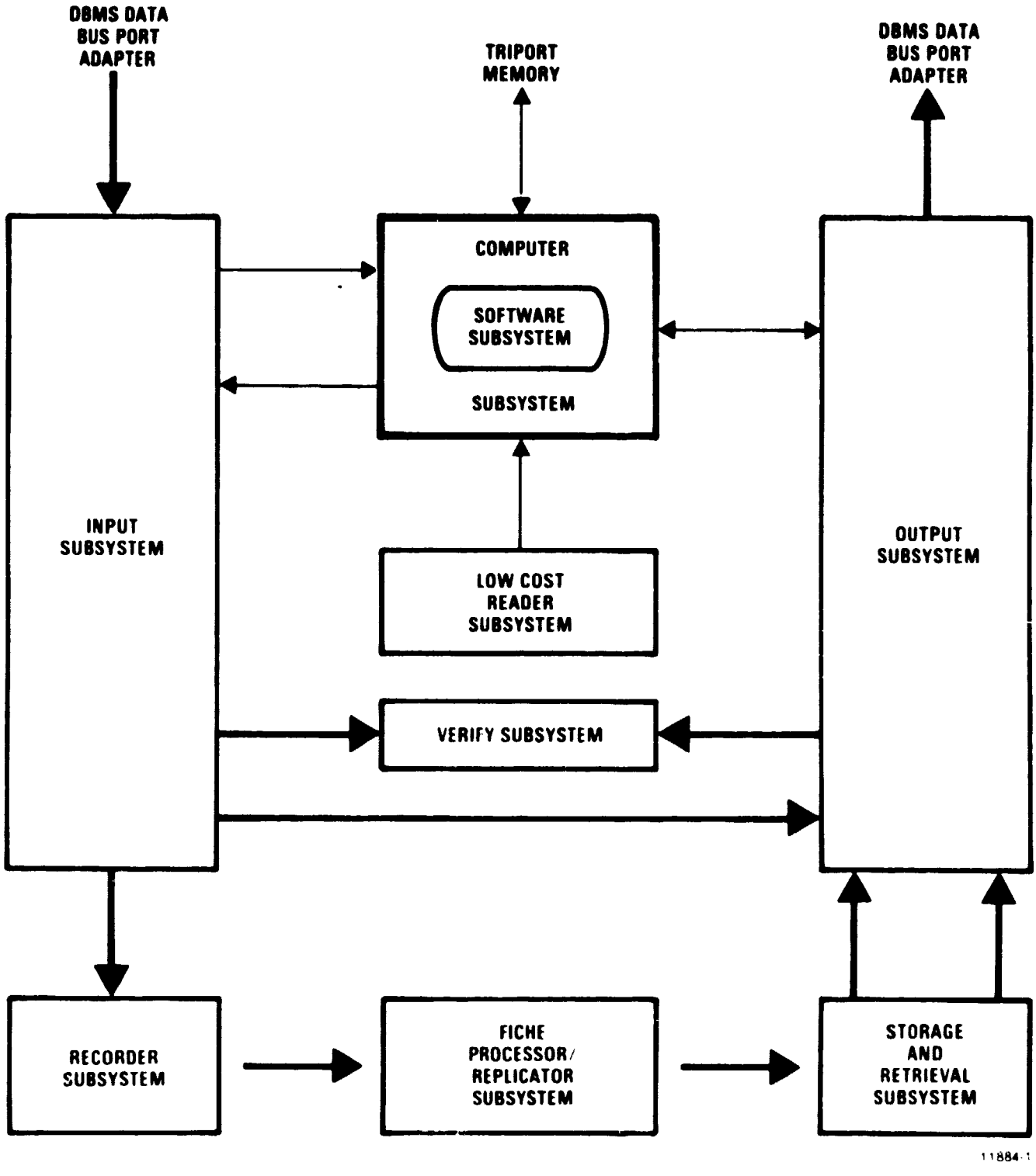


Figure 3.1.4.4

3.1.4.5.1 COMPUTER SUBSYSTEM FUNCTIONAL ALLOCATION

- Exchange information with Triport Memory.
- House indices for File Manager.
- House all resident operational and control software.
- Provide standard command/control/status interfaces to Input, Recorder, Verify, Storage and Retrieval, Output, and Low Cost Reader Subsystems.
- Provide standard data transfer interfaces to Input, Output, and Low Cost Reader Subsystems.
- Buffer data as required by the Software Subsystem.
- Provide an operator interface through the Computer Subsystem operator console.
- Provide on-line disk storage for small record staging.
- Provide internal status information to the Software Subsystem.

Figure 3.1.4.5.1

3.1.4.5.2 SOFTWARE SUBSYSTEM FUNCTIONAL ALLOCATION

- Supervise and monitor all on-line system resources.
- Provide handlers for all computer subsystem peripherals.
- Provide the staged records file management function.
- Provide the archive file management function.
- Provide test and status function to all on-line subsystems.
- Interpret data requests from DBMS.
- Provide verification assessment function.
- Route data to appropriate ports within the Computer Subsystem.
- Establish Computer Subsystem processing and input/output priority scheme.
- Provide format instructions to AMPEX disk to support high speed recording.

Figure 3.1.4.5.2

3.1.4.5.3 INPUT SUBSYSTEM FUNCTIONAL ALLOCATION

- Exchange data transfer control information with DBMS high speed port adapter.
- Provide clock to strobe data out of DBMS high speed port buffer.
- Make small vs. large record determination of input data stream.
- Extract small records and provide rate buffer to support transfer to Computer Subsystem.
- Copy large record headers and provide rate buffer to support transfer to Computer Subsystem.
- Provide data handling/buffering function to facilitate data transfer to AMPEX high speed input port.
- Provide data handling/buffering function to facilitate data transfer from AMPEX high speed output port to Recorder Subsystem.
- Provide data handling/buffering function to facilitate data transfer from AMPEX high speed output port to Verify Subsystem.
- Provide data handling/buffering function to facilitate data transfer from AMPEX high speed output port to the Output Subsystem.
- Provide internal status information to the Software Subsystem.

Figure 3.1.4.5.3

3.1.4.5.4 RECORDER SUBSYSTEM FUNCTIONAL ALLOCATION

- Exchange data transfer control information with Input Subsystem.
- Provide clock to strobe data out of Input Subsystem port buffer.
- Record digital data from Input Subsystem on photographic film using optical techniques.
- Provide operator interfaces for loading of unexposed fiche and unloading of exposed fiche.
- Provide internal status information to the Software Subsystem.

Figure 3.1.4.5.4

3.1.4.5.5 FICHE PROCESSOR/REPLICATOR SUBSYSTEM FUNCTIONAL ALLOCATION

- Provide operator interface for loading of exposed fiche and unloading of processed fiche.
- Perform automatic developing, fixing, and drying of exposed fiche.
- Provide capability for off-line replication of processed fiche.

Figure 3.1.4.5.5

3.1.4.5.6 VERIFY SUBSYSTEM FUNCTIONAL ALLOCATION

- Exchange data transfer control information with Input and Output Subsystems.
- Perform bit-by-bit comparison of data ingested from Input and Output Subsystems.
- Convey comparison results to Software Subsystem.

Figure 3.1.4.5.6

3.1.4.5.7 STORAGE AND RETRIEVAL SUBSYSTEM FUNCTIONAL ALLOCATION

- Provide operator interface for loading of individual fiche into fiche packs.
- Provide both on-line and off-line fiche pack storage.
- Provide operator interface for loading of fiche packs into on-line units.
- Provide automatic retrieval and reading of original and/or replicated fiche stored on-line.
- Provide internal status information to the Software Subsystem.
- Exchange data transfer control information with Output Subsystem.
- Provide data handling/buffering function to facilitate data transfer to the Output Subsystem.
- Provide clock to strobe data into Output Subsystem.

Figure 3.1.4.5.7

3.1.4.5.8 OUTPUT SUBSYSTEM FUNCTIONAL ALLOCATION

- Exchange data transfer control information with DBMS high speed port adapter.
- Provide clock to strobe data into DMBS high speed port buffer.
- Provide data handling/buffering function to facilitate data transfer to the DBMS high speed port adapter.
- Provide data handling/buffering function to facilitate data transfer to the Computer Subsystem.
- Provide data handling/buffering function to facilitate data transfer from the Storage and Retrieval Subsystem.
- Provide data handling function to facilitate data transfer to the Verify Subsystem.
- Provide internal status information to Software Subsystem.

Figure 3.1.4.5.8

3.1.4.5.9 LOW COST READER SUBSYSTEM FUNCTIONAL ALLOCATION

- Exchange data transfer control information with Computer Subsystem.
- Provide data handling/buffering function to facilitate data transfer to Computer Subsystem.
- Provide operator interface for loading/unloading of individual fiche.
- Provide reading of replicated fiche.
- Read preformatted data for display.
- Display data to Low Cost Reader operator.
- Provide operator interface via local keyboard for interaction with reader, display, and Computer Subsystem.
- Provide internal status information to Software Subsystem.

Figure 3.1.4.5.9

3.1.5 Interface Definition

3.1.5.1 External Interfaces

The external interfaces that control the flow of command, control, status, and data between the AMM-13 and DBMS system segments are depicted in Figure 3.1.5.1. Detailed definition of these interfaces are contained in the AMM/DBMS Interface Control Document (See Section 2.0).

3.1.5.2 Internal Interfaces

The internal interfaces provide for information exchange between the various AMM-13 Subsystems. Detailed definition of all internal interfaces shall be contained in the Subsystem Specifications. This section defines the system level functional requirements for each internal interface. These interfaces are depicted in Figure 3.1.5.2 and labeled by general classification as follows:

(A) High Speed Data Transfer Control

These interfaces shall control the high speed data transfer ports. They shall include control lines to effect a logical data transfer across the high speed interface.

(B) High Speed Data Transfer

These interfaces shall provide for high speed data transfer between subsystems. All transfers shall be unidirectional 32 bit parallel buffered I/O transfers. Logic levels shall be TTL compatible. High speed data transfers shall be accomplished with a bit error rate less than 10^{-10}.

(C) Low Speed Data Exchange with Computer Subsystem

These interfaces shall provide data exchange with the Computer Subsystem using standard logical concepts via DEC DR-11B I/O ports.

(D) Command/Control/Status Exchange

These interfaces shall be standard RS 232C interconnects to the Computer Subsystem via DEC DZ-11 I/O ports operating at 19.2K bits/sec.

(E) Fiche Transfer

These interfaces shall provide operator assisted transfer of fiche contained in magazines. The operator shall not touch regions of the fiche which are dedicated to data storage.

(F) Interactive Operator Interfaces

These interfaces shall provide operator interaction via keyboards and CRT displays.

The interfaces defined by Figure 3.1.5.2 are listed in Table 3.1.5.2.

Note: Dual interfaces with identical functions/interconnect are designated by lower case letters.

AMM-13 EXTERNAL INTERFACES

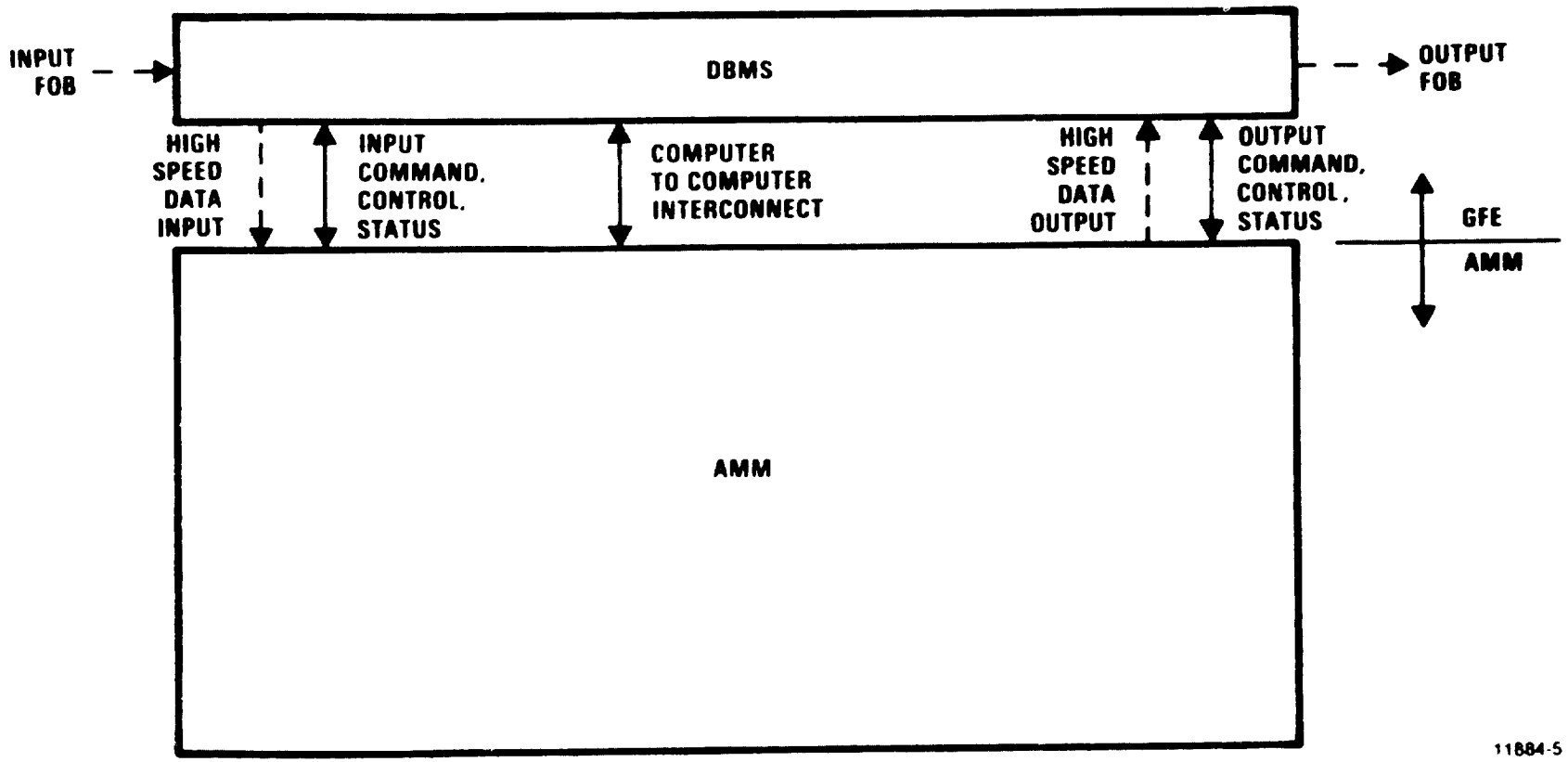


Figure 3.1.5.1

AMM-13 SUBSYSTEM INTERFACES

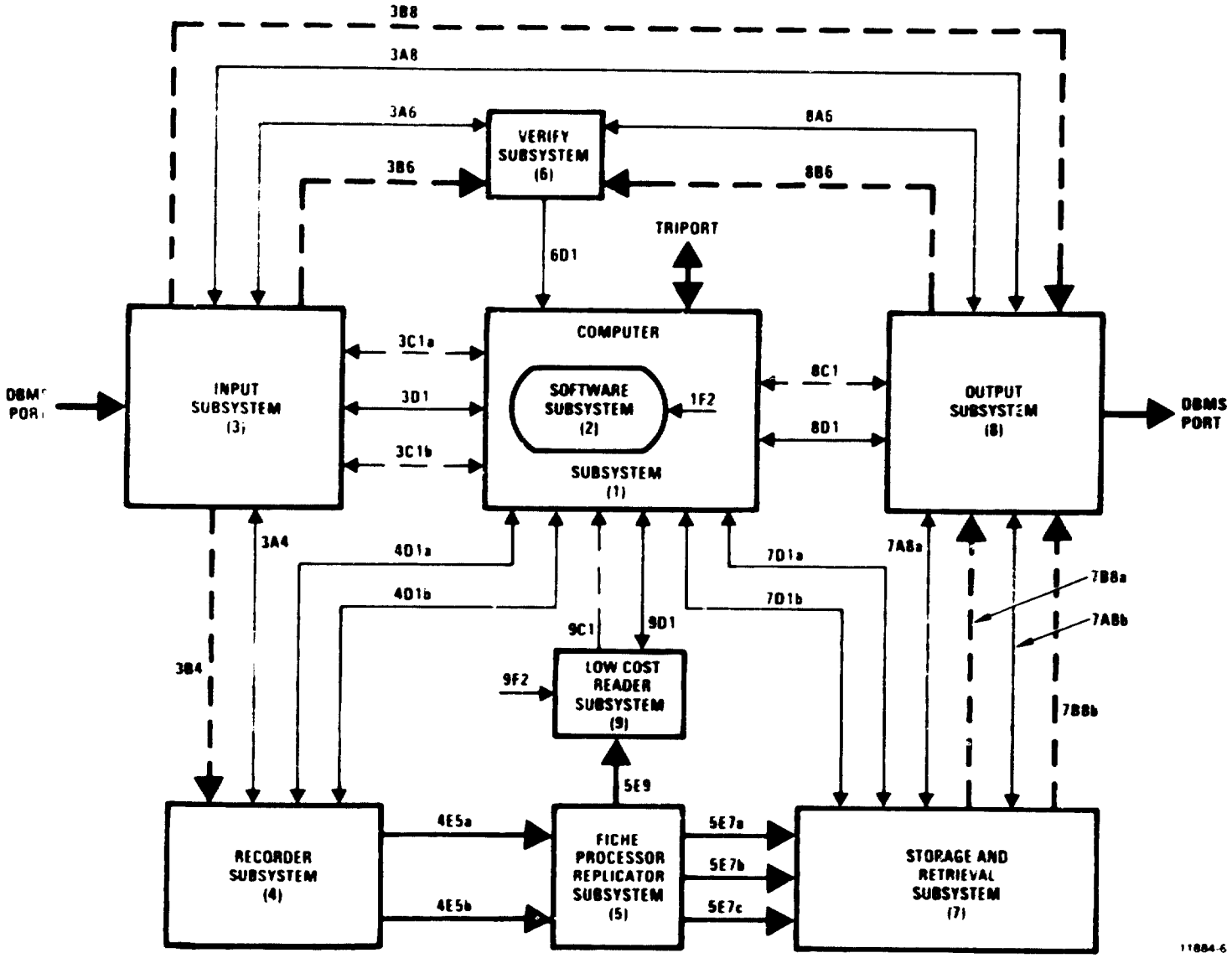


Figure 3.1.5.2

AMM-13 SUBSYSTEM INTERFACES

Table 3.1.5.2

1./2. COMPUTER/SOFTWARE SUBSYSTEM INTERFACES

EXTERNAL - TRIPORT
- FILE MANAGEMENT

INTERNAL - 3C1a, 3C1b, 8C1, 9C1
3D1, 4D1a, 4D1b, 6D1, 7D1a, 6D1b, 8D1, 9D1
1F2

3. INPUT SUBSYSTEM INTERFACES

EXTERNAL - DBMS PORT ADAPTER
- TEST DATA PORT

INTERNAL - 3A4, 3A6, 3A8
3B4, 3B6, 3B8
3C1a, 3C1b
3D1

4. RECORDER SUBSYSTEM INTERFACES

INTERNAL - 3A4
3B4
4D1a, 4D1b
4E5

5. FICHE PROCESSOR/REPLICATOR SUBSYSTEM INTERFACES

INTERNAL - 4E5a, 4E5b, 5E7a, 5E7b, 5E9

6. VERIFY SUBSYSTEM INTERFACES

INTERNAL - 3A6, 8A6
3B6, 8B6
6D1

7. STORAGE AND RETRIEVAL SUBSYSTEM INTERFACES

INTERNAL - 7A8a, 7A8b
7B8a, 7B8b
7D1a, 7D1b
5E7a, 5E7b, 5E7c

8. OUTPUT SUBSYSTEM INTERFACES

EXTERNAL - DBMS PORT ADAPTER

INTERNAL - 3A8, 7A8a, 7A8b, 8A6
3B8, 7B8a, 7B8b, 8B6
8C1
8D1

9. LOW COST READER SUBSYSTEM INTERFACES

INTERNAL - 9C1, 9D1, 5E9, 9F2

3.1.5.2.1 Computer and Software Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraphs 3.1.5.1 and 3.1.5.2, Figure 3.1.5.2, and Table 3.1.5.2, the following system level provisions shall be adhered to:

3C1a: This interface shall provide for the transfer of small records and large record headers from the Input Subsystem to the Computer Subsystem.

3C1b: This interface shall provide for the transfer of small records staged on the RM05 disk to the AMPEX disk for subsequent recording.

8C1: This interface shall provide for the transfer of requested data staged in the Output Subsystem to the Computer Subsystem. It shall provide for the transfer of requested data staged in the Computer Subsystem to the Output Subsystem.

9C1: This interface shall provide for the transfer of requested data from the Low Cost Reader Subsystem to the Computer Subsystem.

3D1: This interface shall provide command/control/status information exchange between the Computer Subsystem and the Input Subsystem.

4D1a: This interface shall provide command/control/status information exchange between the Computer Subsystem and Recorder #1 in the Recorder Subsystem.

4D1b: This interface shall provide command/control status information exchange between the Computer Subsystem and Recorder #2 in the Recorder Subsystem.

6D1: This interface shall provide command/control/ status information exchange between the Computer Subsystem and the Verify Subsystem. Specifically, the Verify Subsystem shall send results of bit-by-bit verification function via this interface.

7D1a: This interface shall provide command/control/ status information exchange between the Computer Subsystem and S & R Unit #1 in the Storage and Retrieval Subsystem.

7D1b: This interface shall provide command/control/ status information exchange between the Computer Subsystem and S & R Unit #2 in the Storage and Retrieval Subsystem.

8D1: This interface shall provide command/control/ status information exchange between the Computer Subsystem and the Output Subsystem.

9D1: This interface shall provide command/control/ status information exchange between the Computer Subsystem and the Low Cost Reader Subsystem. In addition, it shall serve as a communications link for the Low Cost Reader Subsystem keyboard/display terminal. This link shall be a standard computer terminal link.

1F2: This interface shall provide the Computer Subsystem operator with system command/control/ status information via the operator console and permit normal operator interaction with the computer peripherals and Software Subsystem.

3.1.5.2.2 Intentionally Blank

3.1.5.2.3 Input Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraphs 3.1.5.1 and 3.1.5.2, Figure 3.1.5.2 and Table 3.1.5.2, the following system level provisions shall be adhered to:

3A4: This interface shall provide control for 3B4.

3A6: This interface shall provide control for 3B6.

3A8: This interface shall provide control for 3B8.

3B4: This interface shall provide for the transfer of records staged on the AMPEX disk in the Input Subsystem to the Recorder Subsystem. The Recorder Subsystem shall provide the clock for data transfer. Burst rate for 32 bit parallel transfer shall not exceed the maximum burst rate (87.0912 Mb/s) of the AMPEX disk high speed output port. Average data transfer rate shall not exceed the maximum average data transfer rate (70.77888 Mb/s) of the AMPEX disk high speed output port. The average transfer rate shall be such that 10^9 bits of data shall be transferred within 20 seconds and 6×10^9 bits of data shall be transferred within two minutes.

3B6: This interface shall provide for the transfer of records staged on the AMPEX disk in the Input Subsystem to the Verify Subsystem. The Storage and Retrieval Subsystem shall provide the clock for data transfer. Burst/average rates shall be governed by the same constraints specified for interface 3B4.

3B8: This interface shall provide for the transfer of records staged on the AMPEX disk in the Input Subsystem to the Output Subsystem in response to a user request. The Output Subsystem shall provide the clock for data transfer. Burst rate for 32 bit parallel transfer shall not exceed the maximum burst rate (87.0912 Mb/s) of the AMPEX disk high speed output port. Average data transfer rate shall not exceed the maximum average data transfer rate (70.77888 Mb/s of the AMPEX disk high speed output port. The average transfer rate shall be at least 50 Mbits/sec. during the time required to transfer one packet of data.

3C1a: See Paragraph 3.1.5.2.1.

3C1b: See Paragraph 3.1.5.2.1.

3D1: See Paragraph 3.1.5.2.1.

3.1.5.2.4 Recorder Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraph 3.1.5.2, Figure 3.1.5.2 and Table 3.1.5.2, the following system level provisions shall be adhered to:

3A4: See Paragraph 3.1.5.2.3.

3B4: See Paragraph 3.1.5.2.3.

4D1a: See Paragraph 3.1.5.2.1.

4D1b: See Paragraph 3.1.5.2.1.

4E5a: This interface shall provide an operator assisted loading of unexposed fiche into recorder #1, unloading of exposed fiche from recorder #1, transfer of exposed fiche to the Fiche Processor/Replicator Subsystem, and loading of exposed fiche into the Fiche Processor/Replicator Subsystem.

4E5b: Same as 4E5a for recorder #2.

3.1.5.2.5 Fiche Processor/Replicator Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraph 3.1.5.2, Figure 3.1.5.2 and Table 3.1.5.2, the following system level provisions shall be adhered to:

4E5a: See Paragraph 3.1.5.2.4.

4E5b: See Paragraph 3.1.5.2.4.

5E7a: This interface shall provide an operator assisted unloading of processed (and/or replicated) fiche from the Fiche Processor/ Replicator Subsystem, transfer of the fiche to and loading into S&R Unit #1 in the Storage and Retrieval Subsystem.

5E7b: Same as 5E7a for S&R Unit #2.

5E7c: This interface shall provide an operator assisted unloading of processed (and/or replicated) fiche from the Fiche Processor/ Replicator Subsystem, transfer of the fiche to and loading into the fiche packs residing in off-line storage in the Storage and Retrieval Subsystem.

5E9: This interface shall provide an operator assisted unloading of processed fiche from the Fiche Processor/Replicator Subsystem, transfer of the fiche to and loading into the Low Cost Reader Subsystem.

3.1.5.2.6 Verify Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraph 3.1.5.2, Figure 3.1.5.2, and Table 3.1.5.2, the following system level provisions shall be adhered to:

3A6: See Paragraph 3.1.5.2.3.

8A6: See Paragraph 3.1.5.2.8.

3B6: See Paragraph 3.1.5.2.3.

8B6: See Paragraph 3.1.5.2.8.

6D1: See Paragraph 3.1.5.2.1.

3.1.5.2.7 Storage and Retrieval Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraph 3.1.5.2, Figure 3.1.5.2 and Table 3.1.5.2, the following system level provisions shall be adhered to:

7A8a: This interface shall provide control for 7B8a.

7A8b: This interface shall provide control for 7B8b.

7B8a: This interface shall provide for the transfer of requested data from S & R Unit #1 in the Storage and Retrieval Subsystem to the Output Subsystem. The Storage and Retrieval Subsystem shall provide the clock for data transfer. Burst rate for 32 bit parallel transfer shall not exceed the maximum burst rate of the S & R Unit high speed output port. Average data transfer rate shall not exceed the maximum average data transfer rate of the S & R Unit high speed output port. The average transfer rate shall be such that 10^9 bits of data shall be transferred within 20 seconds.

7B8b: This interface is identical to 7B8a except that it connects S & R Unit #2 to the Output Subsystem.

7D1a: See Paragraph 3.1.5.2.1.

7D1b: See Paragraph 3.1.5.2.1.

5E7a: See Paragraph 3.1.5.2.5.

5E7b: See Paragraph 3.1.5.2.5.

5E7c: See Paragraph 3.1.5.2.5.

3.1.5.2.8 Output Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraphs 3.1.5.1 and 3.1.5.2, Figure 3.1.5.2 and Table 3.1.5.2, the following system level provisions shall be adhered to:

3A8: See Paragraph 3.1.5.2.3.

7A8a: See Paragraph 3.1.5.2.7.

7A8b: See Paragraph 3.1.5.2.7.

8A6: This interface shall provide control for 8B6.

3B8: See Paragraph 3.1.5.2.3.

7B8a: See Paragraph 3.1.5.2.7.

7B8b: See Paragraph 3.1.5.2.7

8B6: This interface shall provide for the transfer of records from the Output Subsystem to the Verify Subsystem. The Storage and Retrieval Subsystem shall provide the clock for data transfer. Data transfer shall by synchronous with interface 3B6.

8C1: See Paragraph 3.1.5.2.1.

8D1: See Paragraph 3.1.5.2.1.

3.1.5.2.9 Low Cost Reader Subsystem Interfaces

In addition to the definitions of these interfaces contained in Paragraph 3.1.5.2, Figure 3.1.5.2 and Table 3.1.5.2, the following system level provisions shall be adhered to:

9C1: See Paragraph 3.1.5.2.1

9D1: See Paragraph 3.1.5.2.1.

5E9: See Paragraph 3.1.5.2.5.

9F2: This interface shall provide the Low Cost Reader Subsystem operator with access to the Software Subsystem via keyboard and CRT display. Additionally, it shall provide the operator with the ability to direct the fiche reading function of the Low Cost Reader Subsystem and initiate data transfers from the reader to the Computer Subsystem via interface 9C1.

3.1.5.3 Facilities Interface

This interface shall provide all AMM-13 facility requirements for installation and operation at MSFC. This interface is specified in the AMM/DBMS Interface Control Document.

3.1.6 Government Furnished Property List

Government furnished equipment shall not be required for the design of AMM-13. The interfaces described in the AMM/DBMS Interface Control Document shall be provided by the government to demonstrate the system operation.

3.1.7 Operational and Organizational Concepts

3.1.7.1 Operational Concept

The AMM-13 shall be integrated at MSFC with the DBMS facility. The AMM-13 configured as an operational prototype, shall be operated as a peripheral device for testing and demonstrating archival mass storage concepts. Prototype testing shall be used to verify the AMM-13 design objectives and established performance criteria for the generation of a specification to define the requirements of a 10^{15} bit Archival Mass Memory System.

3.1.7.2 Organizational Concepts

The AMM-13 shall be organized to function as a peripheral device to the DBMS. AMM-13 will accept input data from the MSFC DBMS and provide output data to the MSFC DBMS.

3.2 Characteristics

3.2.1 Performance Characteristics

3.2.1.1 Data Storage Capacity

3.2.1.1.1 Archival Storage Capacity

The archival storage capacity for the system shall be a minimum of 10^{13} bits provided by the Storage and Retrieval Subsystem. Archival storage shall consist of a minimum of 10^{12} bits on-line capacity with off-line storage constituting the balance. Fiche stored in the off-line segment shall be housed in fiche pack modules which are readily mountable in the on-line storage and retrieval units.

3.2.1.1.2 Non-Archival Storage Capacity

Non-Archival storage shall be provided to accomodate temporary storage and staging of records prior to transfer to archival storage and prior to transfer to users. Ingested small records shall be staged on a 300 Mbyte DEC RM05 magnetic disk. Ingested large records shall be staged on four AMPEX PTD-9309 magnetic disks. Temporary storage prior to transfer to users shall be provided by solid state memory buffers required for frame interleaving in the Output Subsystem.

3.2.1.2 Access Time

3.2.1.2.1 Access Time On-Line

The maximum access time from the completion of reading one record to the initiation of reading a second record for on-line storage shall be accomplished in less than 15 seconds within any single S & R Unit.

3.2.1.2.2 Access Time Off-Line

The AMM-13 access time for the off-line Fiche Storage Packs is defined as the time to remove a Fiche Pack from the on-line Storage Assembly and replace it with a Fiche Pack from off-line storage. The off-line access time shall not exceed 3 minutes.

3.2.1.3 Data Transfer Rate

3.2.1.3.1 Data Transfer, Simultaneous Record and Read

The AMM-13 shall be capable of simultaneously recording and reading data while maintaining a 51.2 Mb/s transfer rate at the input to the Input Subsystem and a 50 Mb/s output from the Output Subsystem.

3.2.1.3.2 Data Transfer, Multiple Readers

The AMM-13 shall be capable of simultaneously reading fiche in each of the two on-line S&R Units and transferring the data from each unit while maintaining a data transfer rate to the DBMS port of at least 50 Mb/s.

3.2.1.4 Bit Error Rate (BER)

The AMM-13 shall provide a system bit error rate of less than or equal to 1 uncorrectable bit error in 10^9 bits of user data.

3.2.1.5 On-Line Verification

The AMM-13 Data Verification shall be an on-line process. Data shall be simultaneously transferred to the Verify Subsystem from both the Input Subsystem and the Output Subsystem. The transferred data shall be user data without error correction or other system imposed overhead data. Data transferred from the AMPEX disk in the Input Subsystem shall be

considered to be totally accurate and shall be the standard to which data from the Output Subsystem is compared. Archived data transferred from the Storage and Retrieval Subsystem via the Output Subsystem shall be compared bit-by-bit to the standard to verify compliance with the system bit error rate requirement. The utilization of one of the on-line Storage and Retrieval Units for the verification process shall not affect the normal operation of the other Storage and Retrieval Unit or the ability of the Output Subsystem to transfer data to the DBMS port.

3.2.1.6 Recording Medium

The AMM-13 recording medium shall interface with the system to provide the BER defined in Paragraph 3.2.1.4 for the archivability defined in Paragraph 3.2.1.7 and recording data at a rate compatible with a data transfer rate of 51.2 Mb/s.

3.2.1.7 Archivability

The AMM-13 shall maintain recorded data on the selected recording medium at the BER defined in Paragraph 3.2.1.4 for a period of not less than 10 years under the continuous environmental conditions specified in Paragraph 3.2.6.

3.2.1.8 Record Handling

The AMM-13 shall maintain files on each fiche in the system. The fiche shall be transported through the AMM-13 Subsystem via the magazines and fiche handling transports to minimize the effect operator handling would have on maintaining the BER and archivability. AMM-13 shall be capable of storing, retrieving, reading and returning to storage any on-line record without human handling.

3.2.1.9 Replication

The AMM-13 shall provide replication of a fiche using off-the-shelf contact replication hardware. The replication unit shall provide inexpensive high quality copies of fiche while maintaining BER as defined in Paragraph 3.2.1.4.

3.2.1.10 System Control/Status

System control and status determination shall be accomplished by the Computer Subsystem with assistance from the system operator. The Computer Subsystem shall issue all the necessary subsystem commands to control and support the following activities.

(a) Recording

(b) Reading

(c) Verification

(d) Testing

(e) Resource Monitoring

(f) Fault Detection

(g) Fault Isolation

(h) Input/Output

(i) Operator Interfacing

(j) Recovery

(k) Memory Update/Modification

3.2.1.11 Operators

Operators shall perform the tasks and functions described in Paragraph 3.1.5.2 and its sub-paragraphs.

3.2.1.12 File Management

The AMM-13 File Management function shall be an automatic on-line process which maintains location information for all user data contained in the AMM-13 system and which services user requests made by the DBMS system.

3.2.2 Physical Characteristics

3.2.2.1 Storage and Retrieval Subsystem

The S & R Subsystem shall be rack mounted. The fiche packs shall be removable from tne S & R Subsystem without requiring its disassembly.

3.2.2.2 Recorder Subsystem

The Recorder Subsystem shall be rack mounted.

3.2.2.3 Other Subsystems

Other Subsystems shall be rack mounted or as supplied by vendors.

3.2.2.4 Accessibility

The equipment shall be designed for accessibility of all critical components for maintenance, service, adjustment and/or replacement.

3.2.3 Reliability

A reliability assessment shall be documented in the AMM-13 System Engineering Test Plan.

3.2.4 Maintainability (N/A)

3.2.5 Availability (N/A)

3.2.6 Environmental Conditions

AMM-13 equipments shall be designed and constructed to withstand environmental conditions stated below without mechanical/optical/electrical damage or performance degradation as specified herein.

3.2.6.1 Environmental Conditions, Nonoperating

(a) Temperature: 65^{o} to 75^{o} F

(b) Relative Humidity: 40% to 60% noncondensing

(c) Altitude: Mean sea level to 5,000 feet

3.2.6.2 Environment Conditions, Operating

(a) Temperature: 65^{o} to 75^{o} F

(b) Relative Humidity: 40% to 60% noncondensing

(c) Altitude· Mean sea level to 5,000 feet

3.3 Design and Construction

AMM-13 equipment shall be designed and constructed to meet the requirements specified herein. Where an applicable requirement is not included in this document, the equipment may be designed to best commercial practices.

3.3.1 Materials, Processes, and Parts

Materials, processes, and parts used shall be of quality and grade commensurate with best commercial practices for scientific ground communication facilities. Toxic, critically limited, and strategic materials shall not be used. Special processes, not readily obtained by modern manufacturing and finishing techniques in commercial use, shall be avoided.

Materials shall be inherently corrosion resistant or shall be suitably treated to resist corrosion. Dissimilar metal use shall be minimized.

3.3.2 Electromagnetic Compatibility

With the exception of commercial hardware, all AMM-13 equipment shall be designed with consideration for electromagnetic interference.

3.3.3 Identification and Marking (N/A)

3.3.4 Workmanship

3.3.4.1 General

The equipment shall be manufactured, assembled, and mounted or installed in a thorough, workmanship-like manner. All components, including the finished equipment, shall be free from any defects which may affect serviceability.

3.3.5 Interchangeability (N/A)

3.3.6 Safety

The design of all components of the AMM-13 shall provide protection against injury and equipment damage. Systems safety engineering principles shall be applied throughout the design, development, manufacture, test, installation, checkout, and operation of the equipment. The locations of High Voltage and Laser radiation shall be identified and be consistent with accepted commercial standards.

3.3.6.1 Grounds

Equipment design and construction shall be in accordance with OSHA requirements to ensure that all external conducting parts are at ground potential at all times.

3.3.7 Human Performance/Human Engineering

AMM-13 units shall be designed to incorporate good commercial practices using Human Engineering criteria that enhance the operators performance.

3.3.8 Computer Resources

3.3.8.1 Computer Programming

All software and firmware developed for AMM-13 shall conform to the following:

(a) Whenever possible, a high order language shall be used.

(b) All programs shall be well commented. High order language routines shall contain at least one comment for three lines of code. Assembly language routines shall average at least one comment per line.

(c) The programs developed for AMM-13 shall be structured for easy maintenance and revision. Top down design procedures shall be used to partition program requirements. Seperate functions shall then be coded as identifiable modules to facilitate future hardware/functional enhancements.

(d) Each module shall include a block of comments which describe the function of the module. All module inputs, the call convention and module outputs shall be described. The author of the module shall be documented and revisions shall be described.

3.3.8.2 Computational Components

The computational and control capability of the AMM-13 shall be provided by commercially available general purpose computer equipment. Vendor-supplied operating system software shall be employed where possible.

3.3.8.2.1 Computational Component Requirements

The equipment shall be comprised of those components such as Central Processing Units (CPU), high speed memory units, peripheral data storage units, and input/output units required to perform the computational and control functions of the AMM-13 within the real-time constraints of the performance characteristics specified. In addition, the data processing equipment shall perform specified non-real time support functions.

3.4 Documentation

AMM-13 documentation shall be written with emphasis on accuracy, completeness, clarity, and organization. All descriptions shall be in sufficient detail to permit thorough understanding of general and detailed principles of operation, by technical persons trained in this particular technology. Harris GISD Systems Engineering shall be responsible for all technical documentation under guidance of the AMM-13 Program Manager. Program documentation shall be controlled and maintained by engineering level type of drawings within the AMM-13 Program Office.

3.4.1 Specifications

This document, the Archival Mass Memory (AMM-13), System Segment Specification, applicable documents and revisions thereof shall define the performance requirements of the equipment to be built and delivered. Taken together, these specifications shall constitute the AMM-13 design.

3.4.2 Plans

3.4.2.1 Engineering Test Plan (ETP)

An Engineering Test Plan shall be prepared to document the tests and experiments to be performed with the AMM-13 prototype equipment at Harris's facility and at MSFC DBMS facility. The ETP shall also describe the system operation.

3.4.2.2 Installation Plan

An AMM-13 Installation Plan shall be generated to establish installation criteria for integration with the GFE interfaces to be provided at the MSFC DBMS facility.

3.4.2.3 Training Plan (N/A)

3.4.3 Procedures

3.4.3.1 Acceptance Test Procedure (ATP)

An approved ATP shall be prepared by Harris to detail the formal sell off test procedures to certify the system specification as referenced herein and described in the ETP.

3.5 Logistics

3.5.1 Maintenance (N/A)

3.5.2 Supply (N/A)

3.5.3 Facilities and Facility Equipment

Harris shall integrate the AMM-13 into an MSFC DBMS facility as described in the Installation Plan. Harris foresees no new facility or facilities equipment requirement other than the Facility Interface (Paragraph 3.1.5.3), the GFE Interfaces (Paragraph 3.1.6) and office space for installation personnel.

3.6 Training (N/A)

3.7 Functional Area Characteristics

The system functional areas specified in Paragraph 3.1.1 shall be allocated to the various AMM-13 subsystems as specified in Paragraph 3.1.4.5. Thus, specification of the characteristics of the subsystems constitutes specification of the system functional area characteristics. This section, combined with the subsystem interface characteristics specified in Paragraph 3.1.5 and its sub-paragraphs, describes the AMM-13 System functional characteristics. Detailed subsystem functional characteristics shall be included in the Subsystem Specifications.

3.7.1 Computer Subsystem Functional Characteristics

The Computer Subsystem functional allocation is specified in Figure 3.1.4.5.1. Generic VAX-11/780 characteristics are specified in the vendor documentation. The AMM-13 utilization of these characteristics is described in the following paragraphs and the Computer Subsystem block diagram depicted in Figure 3.7.1.

3.7.1.1 Triport Information Exchange

Information shall consist of system status, incoming records for archiving, outgoing records retrieved from the archive, and file management data.

3.7.1.2 Indices File

The indices shall be stored on a RM05 magnetic disk. Each index contains 128 bits as shown.

DATA	SID	MID	SSC	TIME	PACKET LOCATION
BITS	8	8	16	32	64

COMPUTER SUBSYSTEM BLOCK DIAGRAM

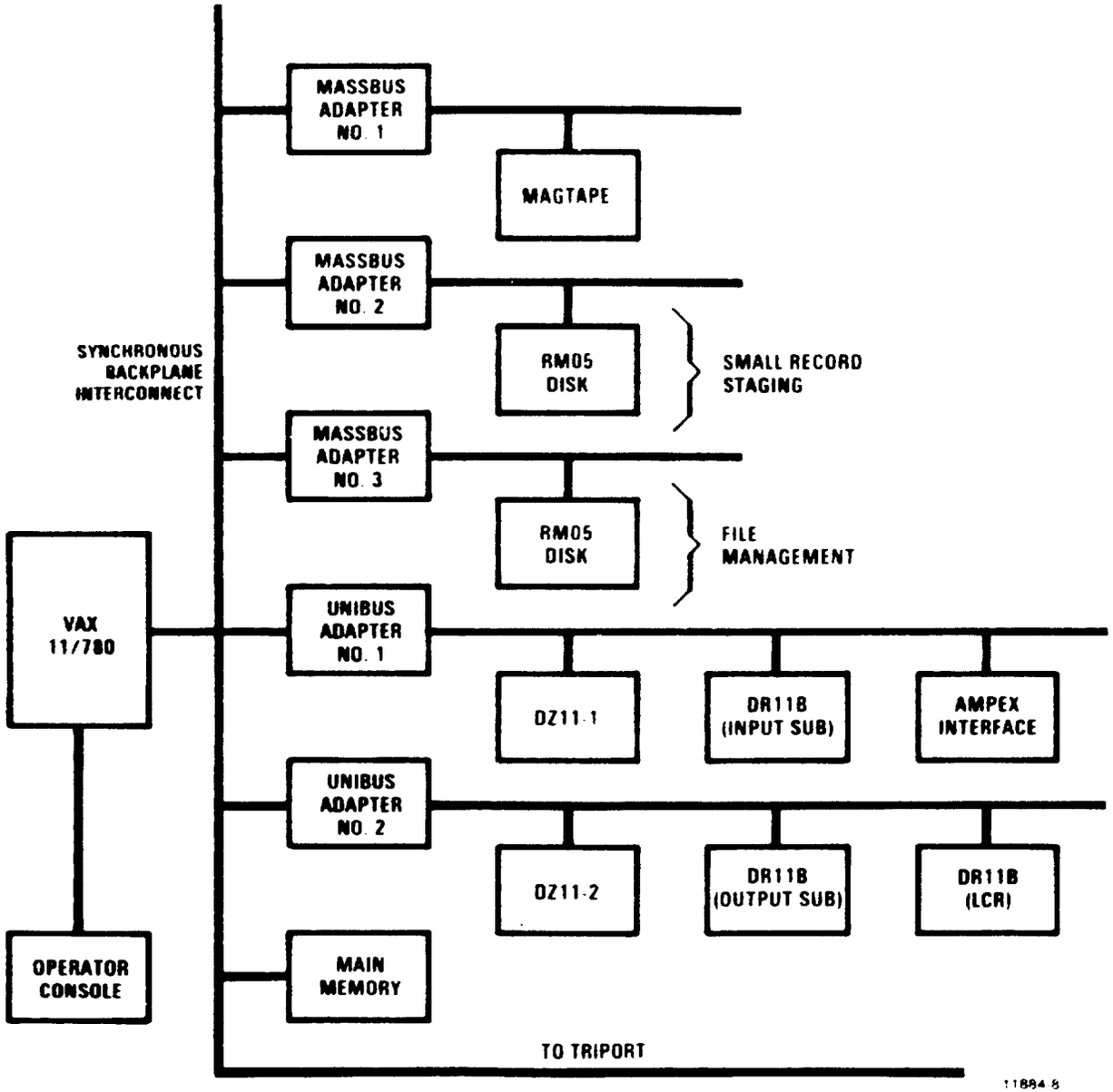


Figure 3.7.1

Up to 12.5 million indices shall be stored on the RM05.

3.7.1.3 Software Memory

Up to 80 Mbytes of RM05 disk memory and 500K bytes of core shall be allocated to house the resident software. Programs shall be loaded from the magnetic tape unit and/or the operator console.

3.7.1.4 Subsystem Command/Control/Status Links

Communications links to/from the Input, Recorder, Verify, Storage and Retrieval, Output, and Low Cost Reader Subsystems shall be provided via a DEC D7-11 standard port employing RS 232C links at 19.2K bits/sec.

3.7.1.5 Data Transfer Links

Small records and large record headers shall be transferred from the Input Subsystem to the Computer Subsystem via a standard DR-11B Direct Memory Access (DMA) port. Small records to be recorded in the archive shall be transferred from the RM05 to the Input Subsystem (AMPEX disk) via the interface to the AMPEX low speed I/O port. Data requests serviced by the Low Cost Reader Subsystem shall be transferred to the Computer Subsystem via a standard DR-11B DMA port. These requested data shall be output from the Computer Subsystem either to the Triport via the Synchronous Backplane Interconnect (SBI) or the Output Subsystem via a standard DR-11B DMA port. Requests for data staged on the AMPEX disk shall be transferred from the AMPEX via the low speed I/O port to the Computer Subsystem.

3.7.1.6 Data I/O Buffering

In addition to the buffering provided by the standard interface ports, 500K bytes of core memory shall be reserved for data I/O buffering of records and requested data.

3.7.1.7 Operator Interaction

The system operator shall interact with the system via the operator console. The need for operator interaction to support operation of the AMM-13 system shall be minimized.

3.7.1.8 Small Record Staging

Small records ingested via the Input Subsystem and/or the Triport shall be staged on a dedicated RM05 three hundred Mbyte magnetic disk in the Computer Subsystem. When a fiche worth of small records have been staged on the RM05, these records shall be transferred to the AMPEX disk for recording on fiche. This process shall not interfere with other AMM functions (See priorities in Paragraph 3.7.2.9).

3.7.1.9 Internal Status

Status of the Computer Subsystem and its peripherals shall be obtained via the standard DEC operating system.

3.7.1.10 Equipment List

The Computer Subsystem shall consist of the following DEC equipments:

Model	Description	Quantity
SVAXDBA-CA	Basic system includes:	1
	11/780 CPU 1MB ECC/MOS	
	Memory RM05 Disk/Controller	
	Magnetic Tape Unit	
	Operating System	
	Unibus Cabinet	
	Expansion Box	
	Two SU Backplane	
	DZ-11 EIA Interface	
	Operator Console	
RM05	Magnetic Disk/Controller	1
DR-11B	DMA Interface	3
D7-11	EIA Interface	1
	UNIBUS Adapter	2
	MASSBUS Adapter	3

3.7.2 Software Subsystem Functional Characteristics

The Software Subsystem functional allocation is specified in Figure 3.1.4.5.2. Detailed characteristics shall be described in the DEC vendor documents and the Software Subsystem Specification. The Software Subsystem Block Diagram is depicted in Figure 3.7.2.

3.7.2.1 Supervise and Monitor Resources

The Software Subsystem shall provide all supervisory functions and commands within the AMM-13 to prompt the various on-line subsystems into readiness and convey necessary instructions for performing system level functions. The Software Subsystem shall also provide a resource

AMM-13 SOFTWARE FUNCTIONAL BLOCK DIAGRAM

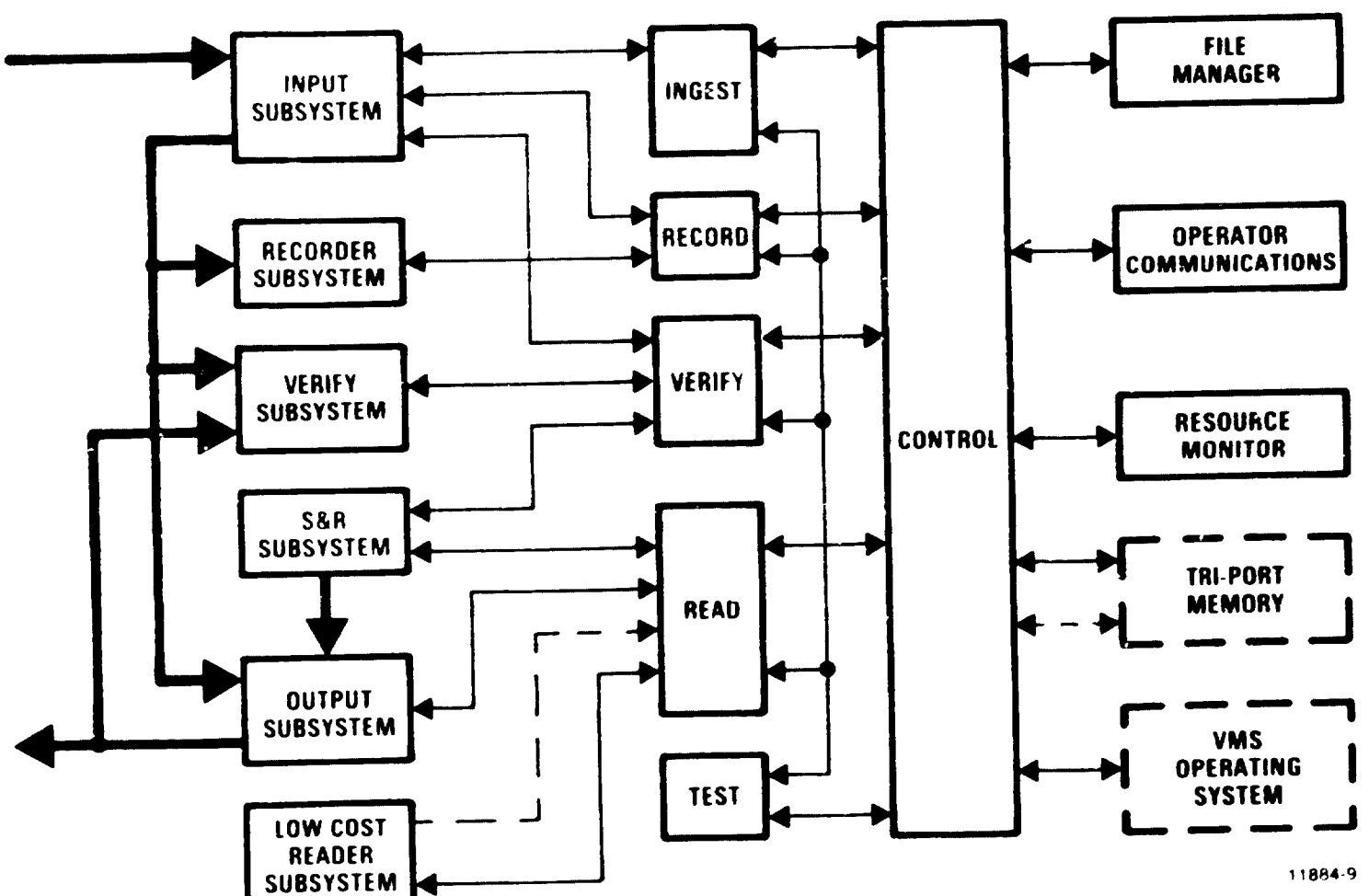


Figure 3.7.2

monitoring function fu all on-line system resources. The resource monitor shall prompt the system operator.

3.7.2.2 Peripheral Handlers

Handlers for standard DEC computer peripherals shall be provided by the DEC operating system. Special handlers shall be developed for the DBMS Triport, Input Subsystem, AMPEX disk, Recorder Subsystem, Verify Subsystem, Low Cost Reader Subsystem, Output Subsystem, and Storage and Retrieval Subsystem.

3.7.2.3 File Management, Staged Records

The File Manager shall provide for servicing user requests for data staged on the RM05 and/or the AMPEX disk.

3.7.2.4 File Management, Archived Records

The File Manager shall provide for servicing user requests for data residing in archival storage. This includes on-line data in the S & R units, off-line data in Fiche Packs (requires operator interaction), and data available via the Low Cost Reader (also requires operator interaction).

3.7.2.5 Test and Status

Routine test inquiries and status responses shall be monitored by the Software Subsystem and reported to the DBMS. The status word defined in Figure 3.7.2.5 shall be resident in the Triport and updated by the AMM-13 Software Subsystem.

AMM-13 STATUS WORD (TRIPORT)

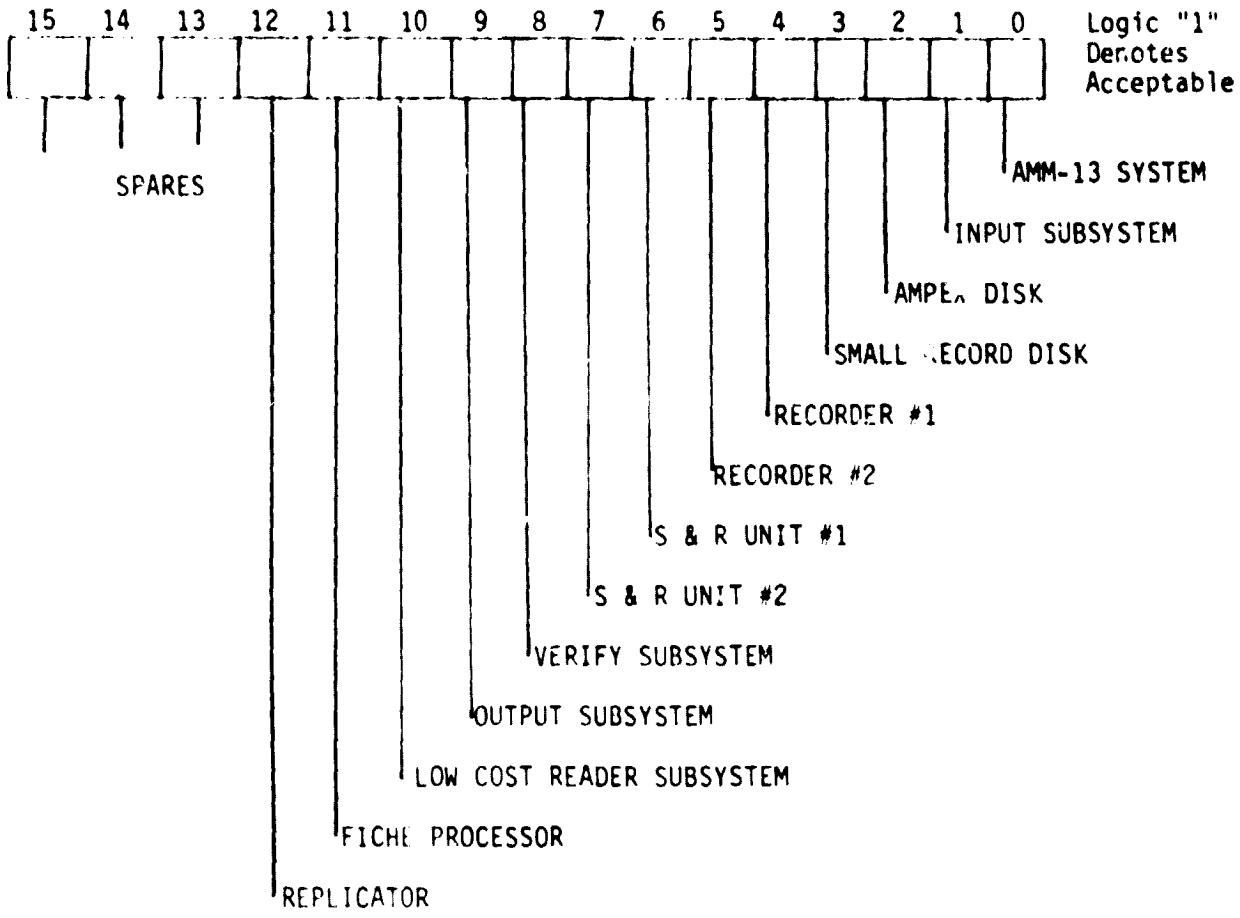


Figure 3.7.2.5

3.7.2.6 Data Request Interpreter

The Software Subsystem shall interpret data requests placed in the Level 3 Queue by the DBMS. Interpretation shall include: determination of whether data is resident in the AMM, optimization of retrieval, determination of request start byte within a packet, and determination of the number of bytes to be output.

3.7.2.7 Verification Assessment

Based upon the biy-by-bit comparison performed by the Verify Subsystem, the Software Subsystem shall assess the comparison results to determine what (if any) re-recording is necessary.

3.7.2.8 Data Routing

The Software Subsystem shall control the destination of all data within the Computer Subsystem.

3.7.2.9 I/O Priority

Top priority shall be given to those functions which support the high speed data ingest process. Those functions which support the high speed data output process shall be given equal priority unless the AMM is operating in a degraded mode (such as having one S & R unit inoperative). Data I/O via the Triport, servicing of requests for disk staged records, and small record recording, shall be prioritized in the order as listed.

3.7.2.10 AMPEX Formatting

The Software Subsystem shall provide format instructions to the AMPEX disk. The format shall support AMPEX ingest of 6×10^9 bits within two minutes. In conjunction with the forward file management of records during the recording process, records shall be transferred to the Recorder Subsystem in such a manner that packets are not split between two or more fiche.

3.7.3 Input Subsystem Functional Characteristics

The Input Subsystem functional allocation is specified in Figure 3.1.4.5.3 and the functional block diagram is shown in Figure 3.7.3.

3.7.3.1 DBMS, Port Data Ingest Control

The Input Subsystem shall control the ingest of data via the high speed port. This control function shall be provided by the interface defined in the AMM/DBMS Interface Control Document.

3.7.3.2 High Speed Data Ingest Clock

This clock shall be provided by the AMM Input Subsystem and shall run at 1.6 MHz.

3.7.3.3 Small vs. Large Record Determination

The Input Subsystem shall provide the small vs. large record determination by interpretation of the PL and/or PLI fields in the packet headers. Initially, this boundary shall be set at 16,384 bits (and below) to signify small records.

3.7.3.4 Small Record Extraction

Small records shall be extracted from the ingest data stream and routed to the Computer Subsystem for staging. The ingest rate of 51.2 Mb/s and the computer DMA average transfer rate of 1.0 Mb/s shall require buffering of small records in the Input Subsystem.

3.7.3.5 Large Record Headers

The first 128 bits of each large record packet header shall be copied by the Input Subsystem from the ingest data stream and routed to the Computer Subsystem for forward file management of the recording process. Large record headers shall be rate buffered in the Input Subsystem in a buffer which is independent from the small record rate buffer. Groups

INPUT SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

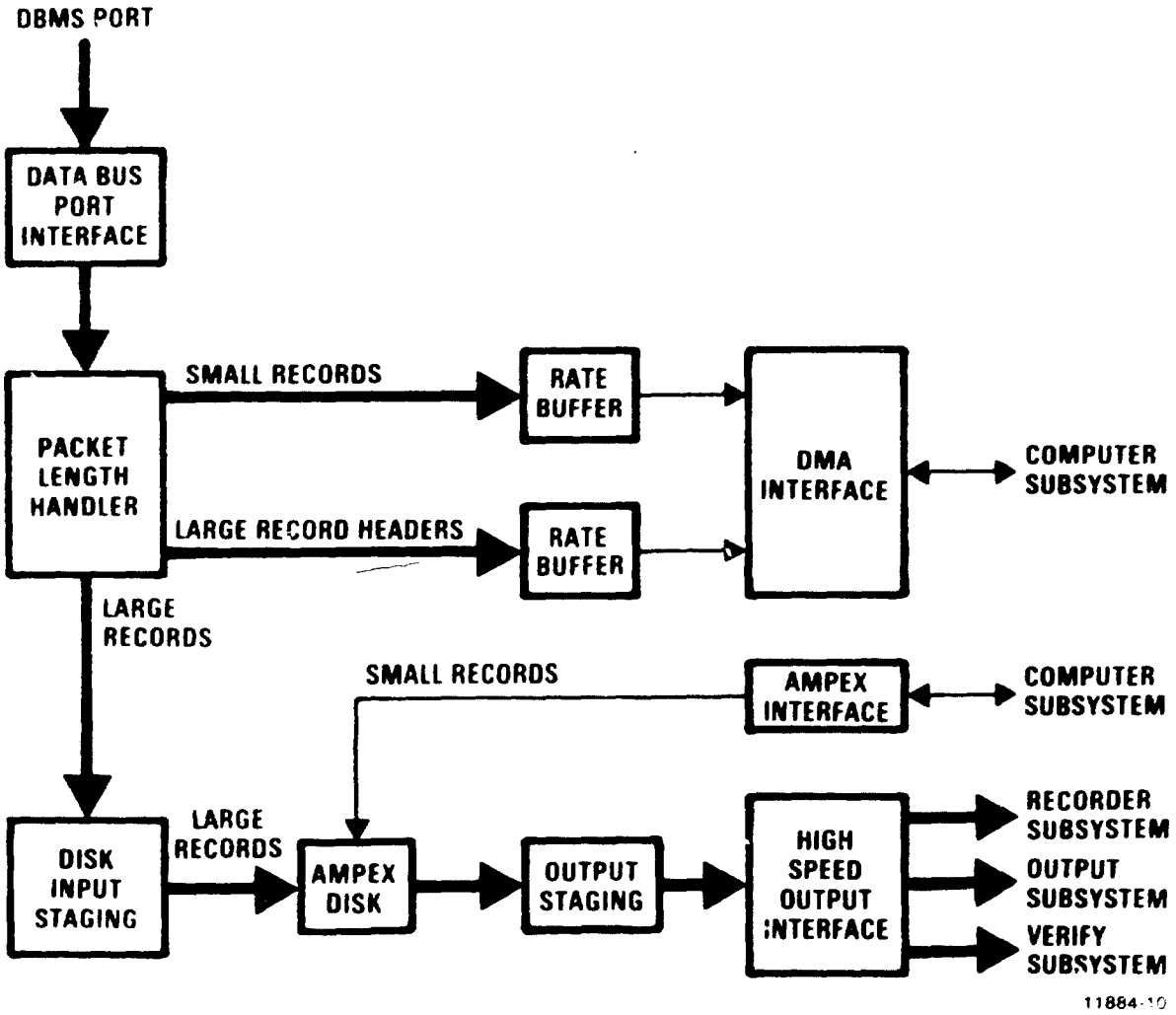


Figure 3.7.3

of large record headers shall be transferred to the Computer Subsystem via the same DR-11B port used for small record transfer on a port time shared basis.

3.7.3.6 AMPEX High Speed Data Ingest

The Input Subsystem shall provide the necessary data handling/ buffering functions to accomodate the AMPEX disk ingest without interrupting the data ingest stream via the high speed DBMS port. From input to output the AMPEX disk shall maintain a bit error rate less than 10^{-10}.

3.7.3.7 AMPEX High Speed Data Output to Recorder Subsystem

The Input Subsystem shall provide the necessary data handling/ buffering functions to accomodate the Recorder Subsystem.

3.7.3.8 AMPEX High Speed Data Output to Verify Subsystem

The Input Subsystem shall provide the necessary data handling/ buffering functions to insure synchronization of the two data streams received by the Verify Subsystem.

3.7.3.9 AMPEX High Speed Data Output to Output Subsystem

The Input Subsystem shall provide the necessary data handling/ buffering functions to accomodate the Output Subsystem.

3.7.3.10 Internal Status

Status of the Input Subsystem shall be conveyed to the Computer/ Software Subsystems via a 19.2Kb/s RS 232C link with the DZ11 port.

3.7.4 Recorder Subsystem Functional Characteristics

The Recorder Subsystem functional allocation is specified in Figure 3.1.4.5.4 and the functional block diagram is shown in Figure 3.7.4.

RECORDER SUBSYSTEM
FUNCTIONAL BLOCK DIAGRAM

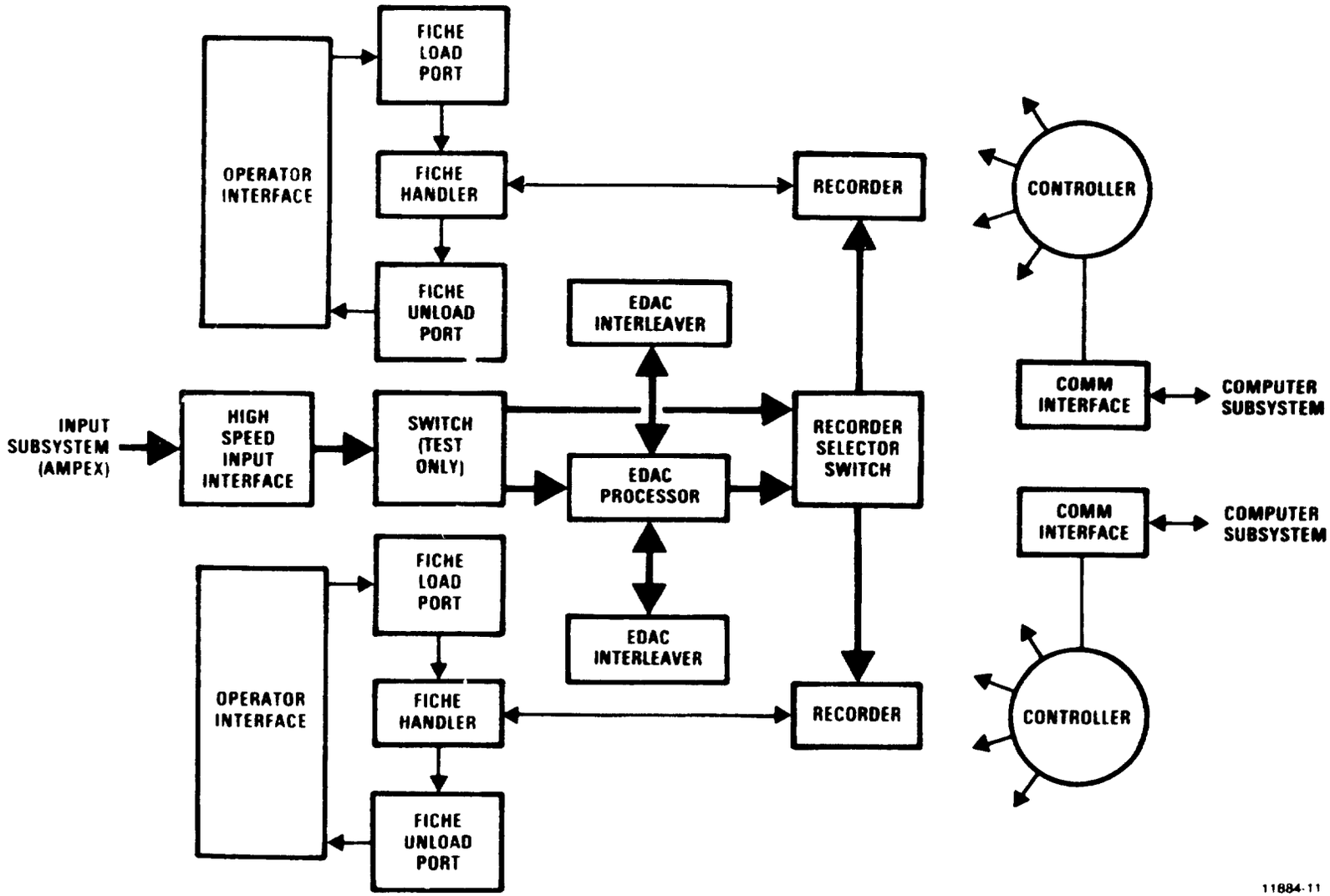


Figure 3.7.4

3.7.4.1 High Speed Data Ingest Control

The Recorder Subsystem shall control the ingest of data from the Input Subsystem. This control function shall be provided via the interface defined in Paragraph 3.1.5.2.3. The Input Subsystem shall provide data to the Recorder Subsystem when requested by the Recorder Subsystem. (See Paragraph 3.7.3.7). The Recorder Subsystem shall contain two recorders operating in a ping-pong fashion to support the Input Subsystem ingest duty cycle requirements. The encoding function which supports error detection and correction, shall be shared by the two recorders.

3.7.4.2 High Speed Data Ingest Clock

This clock shall be provided by the Recorder Subsystem and shall be of such a rate that 10^9 bits of data shall be transferred within 20 seconds.

3.7.4.3 Record Data on Photographic Film

The Recorder Subsystem shall provide all functions necessary to transform the ingested data stream from the Input Subsystem AMPEX disk into optically exposed spots on 148mm square, 7 mil thick fiche of KODAK SO 343 photographic film such that the input data has a bit error rate of less than or equal to 10^{-9} when compared to the data stored on the AMPEX disk. The optical spot recording process shall provide for an equivalent user bit density of at least 30Mbits per square inch. The recorder shall remove a previously exposed fiche, insert it into the exposed fiche magazine, extract and position an unexposed fiche, and be ready to record on the unexposed fiche within 15 seconds.

3.7.4.4 Fiche Loading/Unloading

Each recorder in the Recorder Subsystem shall provide a port for operator insertion of a magazine containing 10 unexposed fiche and shall provide a seperate port for operator insertion of an empty magazine into which the recorder shall place exposed fiche. The exposed fiche magazine shall be capable of accepting 10 exposed fiche. All magazines and port interfaces shall be identical except for external markings. Each recorder shall provide all internal functions required to extract unexposed fiche from the unexposed fiche magazine and insert exposed fiche into the exposed fiche magazine.

3.7.4.5 Internal Status

Status of the Recorder Subsystem and of each recorder in the Recorder Subsystem, shall be conveyed to the Computer/Software Subsystem via a 19.2Kb/s RS 232C link with the DZ11 port.

3.7.5 Fiche Processor/Replicator Functional Characteristics

The Fiche Processor/Replicator Subsystem functional allocation is specified in Figure 3.1.4.5.5 and the functional block diagram is shown in Figure 3.7.5.

3.7.5.1 Fiche Loading/Unloading

The processor shall provide for operator insertion of exposed fiche and shall provide for operator extraction of processed fiche. The replicator shall provide for operator insertion and extraction of fiche.

3.7.5.2 Fiche Processing

This shall be an automatic function which includes: developing the film, fixing, washing the film, and drying the fiche.

FICHE PROCESSOR/REPLICATOR SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

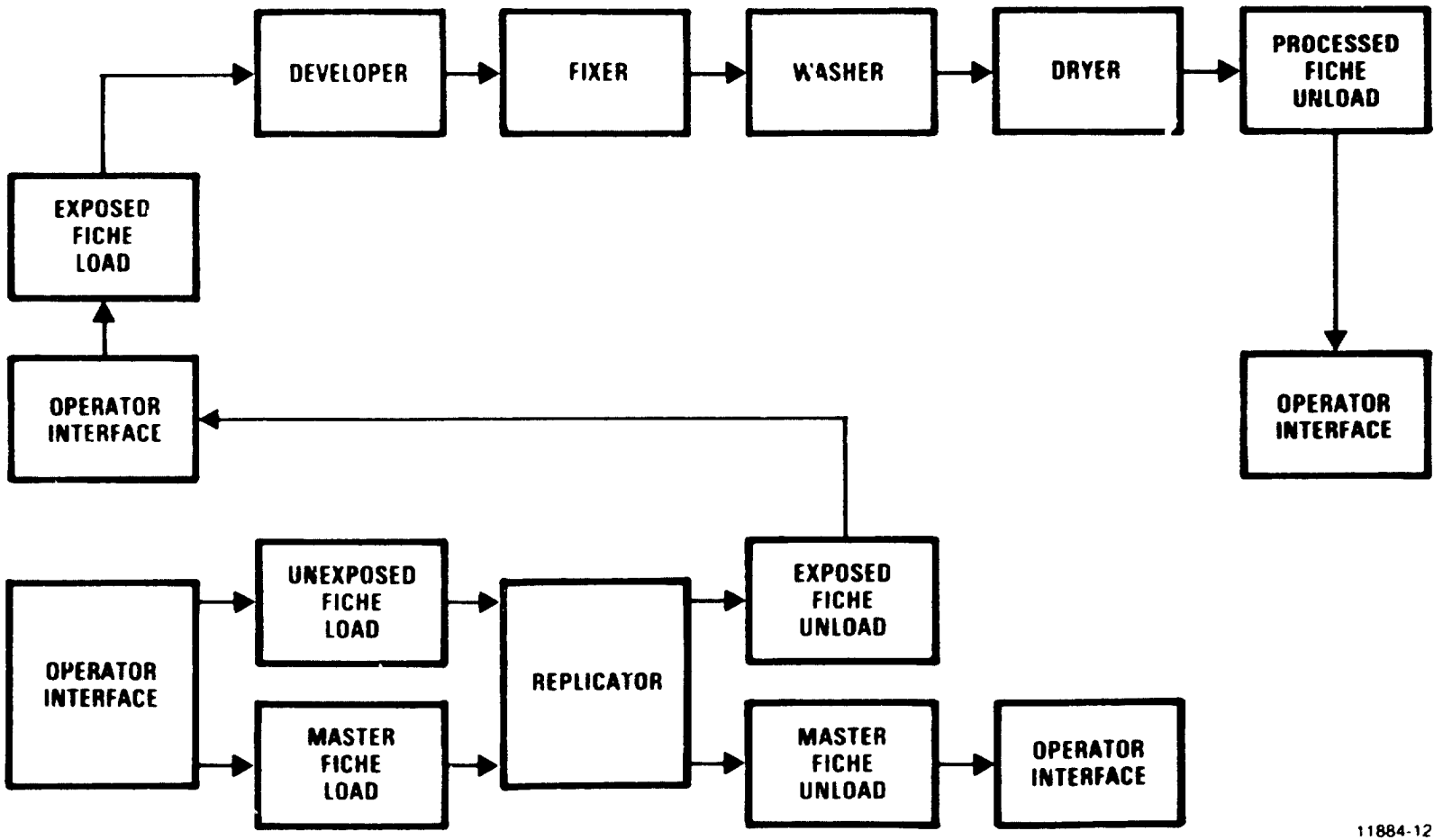


Figure 3.7.5

VERIFY SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

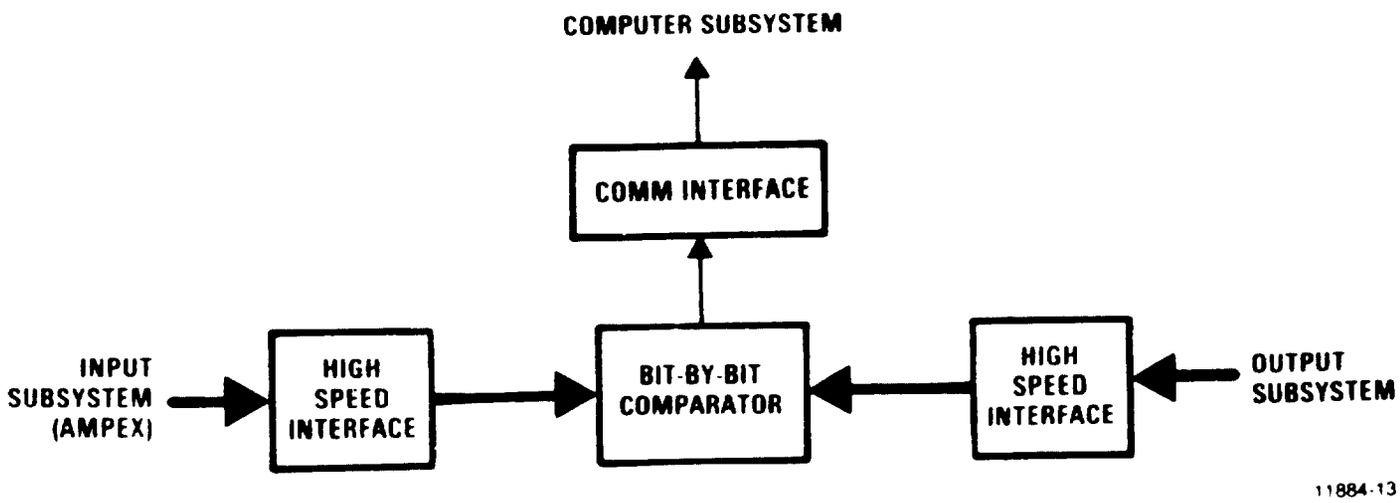


Figure 3.7.6

3.7.5.3 Replication

This shall be an off-line operator assisted function to perform replication of data onto another fiche by contact replication.

3.7.6 Verify Subsystem Functional Characteristics

The Verify Subsystem functional allocation is specified in Figure 3.1.4.5.6 and the functional block diagram is shown in Figure 3.7.6.

3.7.6.1 High Speed Data Ingest Control

This control function shall be provided by the Input Subsystem to insure synchronism of the input streams from both the Output Subsystem and the Input Subsystem.

3.7.6.2 Bit-by-Bit Comparison

This function shall be a binary decision process which determines whether or not the bits represent the same logical value. Data contained on one fiche (10^9 bits) shall be compared in less than 20 seconds.

3.7.6.3 Comparison Results

This shall be a data transfer function. The Verify Subsystem conveys the number of errors detected to the Computer/Software Subsystem via the DZ-11 RS 232C interface.

3.7.7 Storage and Retrieval Subsystem Functional Characteristics

The Storage and Retrieval Subsystem functional allocation is specified in Figure 3.1.4.5.7 and the functional block diagram is shown in Figure 3.7.7.

3.7.7.1 Fiche Loading/Unloading

Each of the two on-line storage and retireval units shall provide a port for operator insertion of a magazine containing processed master and/or replicated fiche. Insertion of fiche into the fiche pack shall be an operator

STORAGE AND RETRIEVAL SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

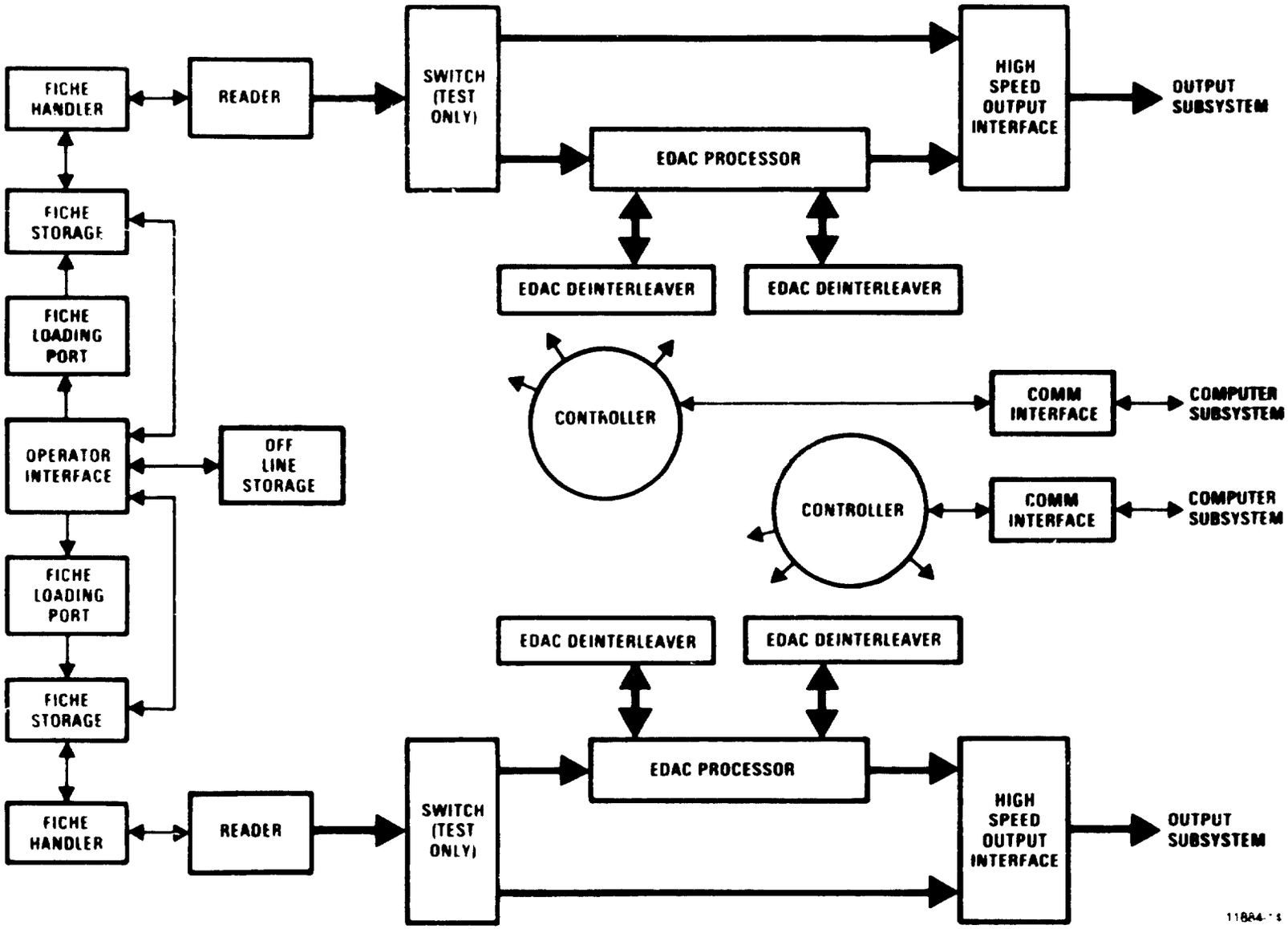


Figure 3.7.7

assisted function. The same port shall also be utlized for operator assisted extraction of fiche from the fiche pack into a fiche magazine and operator extraction of the magazine.

3.7.7.2 Fiche Storage

Unexposed fiche storage facilities shall not be provided by AMM-13. Processed master and/or replicated fiche shall be stored in on-line fiche packs residing in the S & R units or off-line fiche packs residing in cabinets. Each fiche pack shall be capable of storing at least 1000 fiche in such a manner that data resident on the fiche will satisfy the system bit error rate requirements for at least 10 years of archival storage.

3.7.7.3 Fiche Pack Loading

Off-line fiche packs shall be capable of operator assisted loading into on-line S & R units. The process of removing an on-line fiche pack and replacing it with an off-line fiche pack shall be such that an operator can perform the process within three minutes.

3.7.7.4 Retrieval and Reading

Each of the two S & R units in the Storage and Retrieval Subsystem shall provide all functions necessary to retrieve fiche containin-requested data from its fiche pack, position the fiche in the reader, read the data, and replace the fiche in its previous loaction in the fiche pack.

3.7.7.5 High Speed Data Output Control

The Storage and Retrieval Subsystem and the Output Subsystem control the output of data from the individual S & R units. This control function shall be accomplished via the interface defined in Paragraph 3.1.5.2.7.

When the DBMS bus is accepting data and the Output Subsystem is not performing interleaving of data, the S & R unit shall control the output of data. When the buffers in the Output Subsystem are saturated with data, the Output Subsystem shall interrupt the S & R unit data output. The S & R unit shall retain the fiche in the read station without reading data for output. Once the backlog in the Output Subsystem buffers has been sufficiently cleared, the S & R unit shall proceed with reading and outputting of data. The maximum delay in data output resulting from this condition shall be equal to the once-around time for the particular track being read. (See Paragraph 3.7.7.6).

3.7.7.6 High Speed Data Output

Each of the two S & R units shall have autonomous paths for transferring data to the Output Subsystem. Data output shall be initiated by the Software Subsystem by notifying the S & R unit of: the fiche location in the fiche pack, the track on which reading is to begin, the sector which contains the start of data to be read, the byte count from the start of sector to the start of data to be read, and the number of bytes to be read. The S & R unit shall automatically retrieve the fiche, position the fiche, locate the start of sector, and begin scanning the spots. If one of the two EDAC interleaver buffers is empty, the encoded scanned data in the entire sector shall be loaded into the interleaver buffer. Upon completion of loading, the EDAC processor starts decoding and outputting data to the Output Subsystem. (Note: if the Output Subsystem buffers are saturated (see Paragraph 3.7.7.5), the encoded data shall remain in the EDAC buffer and output shall not begin). If the requested data overlaps into the next sector, the entire sector shall be loaded into the other interleaver buffer (assuming that the buffer is empty). This ping-pong process shall continue until all requested data has been loaded into the interleaver buffers and/or transferred to the Output Subsystem.

Each S & R Unit shall transfer only the number of bytes requested to the Output Subsystem.

3.7.7.7 Internal Status

Status of the Storage and Retrieval Subsystem and of each S & R Unit shall be conveyed to the Computer/Software Subsystem via a 19.2Kb/s RS 232C link with the DZ-11 port.

3.7.8 Output Subsystem Functional Characteristics

The Output Subsystem functional allocation is specified in Figure 3.1.4.5.8 and the functional block diagram is shown in Figure 3.7.8.

3.7.8.1 DBMS Port Data Output Clock

The Output Subsystem shall control the output of data to the high speed port. This control function shall be provided by the interface defined in the AMM/DBMS Interface Control Document.

3.7.8.2 DBMS Port Data Output Clock

This clock shall be provided by the AMM Output Subsystem and shall run at 1.6 MHz.

3.7.8.3 Data Transfer to DBMS Port

Data transferred via this port shall be in response to data requests resident in the Triport Data Request Queue. The Output Subsystem shall provide a set of buffers for staging the data prior to output to the DBMS port. This buffering shall be structured to provide storage by Destination Address in support of the frame-by-frame interleaving requirement.

OUTPUT SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

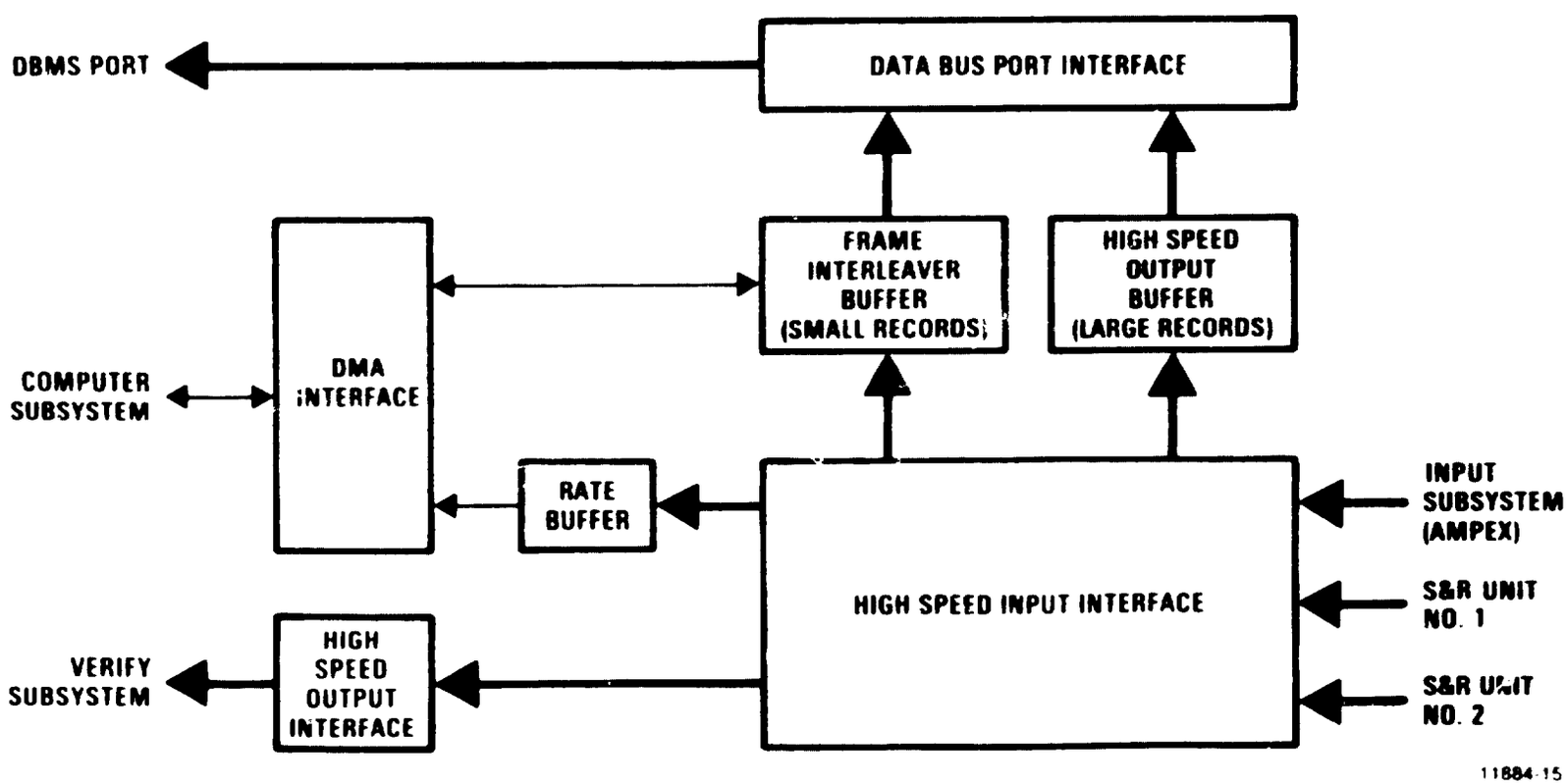


Figure 3.7.8

3.7.8.4 Data Exchange with Computer Subsystem

Requested data to be serviced through the DBMS port which has been retrieved from the RM05 small record disk or the Low Cost Reader Subsystem shall be routed via the Computer Subsystem to the Output Subsystem. Ingest of the data by the Output Subsystem shall be via the DR-11B DMA transfer port. Ingested records shall be routed from the port into the Output Subsystem staging buffers. Requested data to be serviced through the Triport which has been retrieved from the AMPEX disk or the Storage and Retrieval Subsystem shall be buffered within the Output Subsystem to accomodate transfer rate differences. Output of the data to the Computer Subsystem shall occur on a time shared basis using the DR-11B DMA transfer port.

3.7.8.5 High Speed Data Output to Verify Subsystem

This data transfer shall be such that the S & R Unit reading function is not interrupted. The Output Subsystem shall perform a pipeline function from the S & R Unit to the Verify Subsystem.

3.7.8.6 Internal Status

Status of the Output Subsystem shall be conveyed to the Computer/Software Subsystem via a 19.2Kb/s RS 232C link with the DZ-11 port.

3.7.9 Low Cost Reader Subsystem Functional Characteristics

The Low Cost Reader Subsystem functional allocation is specified in Figure 3.1.4.5.9 and the functional block diagram is shown in Figure 3.7.9.

3.7.9.1 Data Output Control

Control of the data flow from the Low Cost Reader Subsystem to the Computer Subsystem shall be a shared function between the two subsystems

LOW COST READER SUBSYSTEM FUNCTIONAL BLOCK DIAGRAM

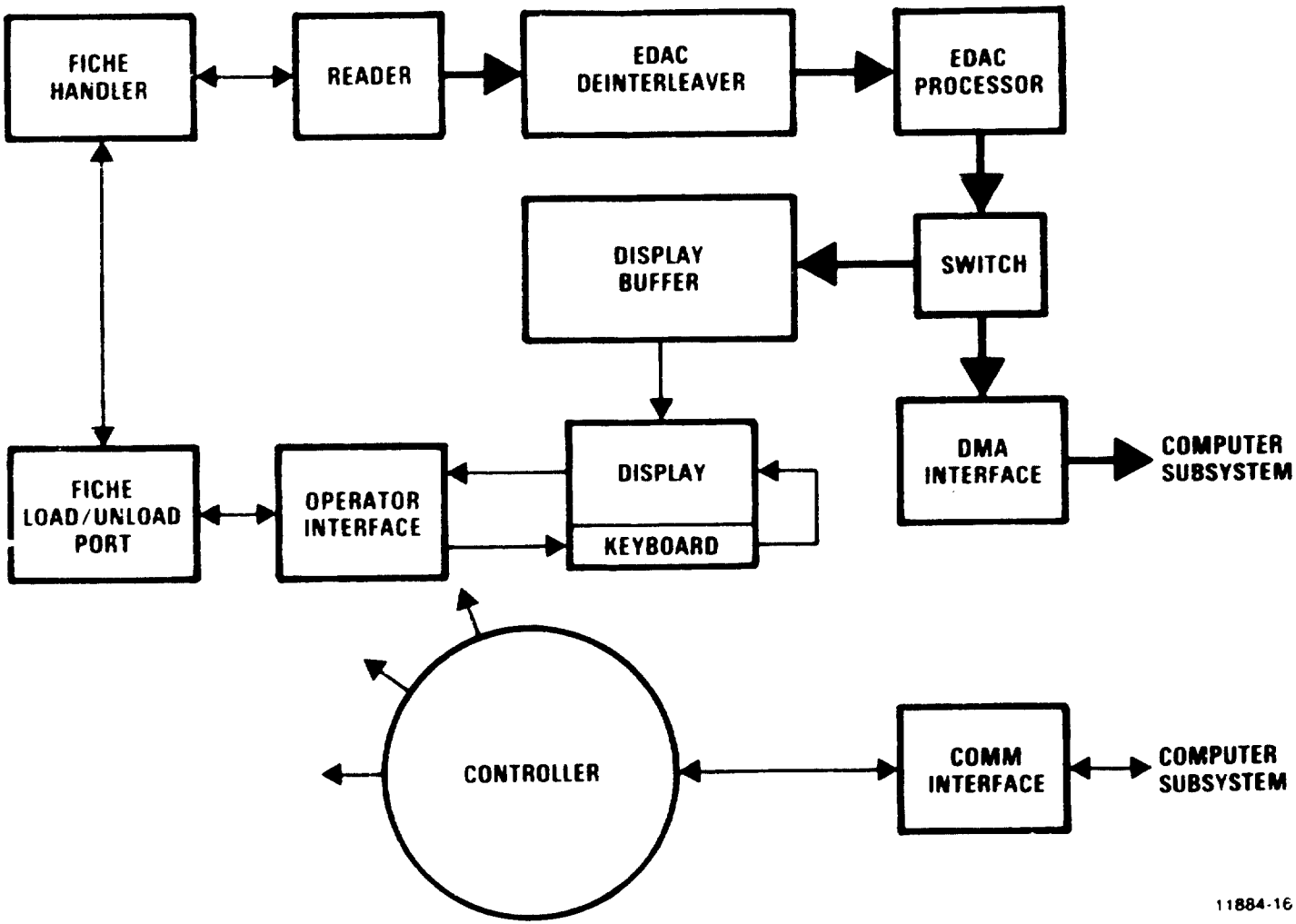


Figure 3.7.9

with the Computer Subsystem exercising ultimate responsibility by controlling its input port.

3.7.9.2 Data Transfer

Data shall consist of small records in the Low Cost Reader Subsystem. The transfer may be initiated either by a normal user request, or the Low Cost Reader operator wishing to stage small records on the RMS disk for later recall by a user at disk access rates. Data transfer shall be a DMA transfer via a dedicated DR-11B port.

3.7.9.3 Fiche Loading/Unloading

The fiche loading/unloading function shall be an operator assisted process. For loading, the operator shall insert a replicated fiche. For unloading, the operator shall remove the replicated fiche. There shall be one magazine port.

3.7.9.4 Reading

The Low Cost Reader Subsystem shall be capable of reading replicated fiche. The reading function shall include all processes necessary to: interpret record location, select/extract the fiche from the magazine, position the fiche in the read station, optically scan the spots on the fiche, transform those spots into a coded bit stream, perform error detection and correction, route the requested data to the Display or the output port, and replace the fiche in the magazine.

3.7.9.5 Data Buffering for Local Display

The Low Cost Reader display buffer shall provide rate buffering to accomodate the display.

3.7.9.6 Alphanumeric Display

The display shall be a standard alphanumeric CRT terminal capable of displaying at least 40 lines with 80 characters per line.

3.7.9.7 Operator Interface, Keyboard

This interface shall provide the operator with the capability to specify records to be read from the fiche in the Low Cost Reader Subsystem. Specification of the record shall be accomplished by entering record location data via the keyboard in the same location format as that maintained by the AMM-13 File Manager. The operator shall obtain the record location either from a hard copy directory or by inquiry to the AMM-13 File Manager. This interface shall also provide for operator communications with the Software Subsystem via a DZ-11 RS 232C communications link. The keyboard shall contain at least the standard 64 ASCII character keys. The keyboard shall also provide for character display on the local alphanumeric CRT terminal.

3.7.9.8 Internal Status

Status of the Low Cost Reader Subsystem shall be conveyed to the Computer/Software Subsystem via a 19.6Kb/s RS 232C link with the DZ-11 port.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

Tests and evaluations shall be conducted to verify that the design and performance of the AMM-13 meets or exceeds the requirements specified herein. These objectives shall be implemented in accordance with the AMM-13 Engineering Test Plan (ETP).

4.1.1 Responsibility for Tests

Responsibility for AMM-13 testing resides within Harris GiSD Engineering and shall be controlled by Systems Engineering and delegates thereof.

4.1.2 Special Tests and Examinations

Because of the complex nature of certain electro-acousto-optical devices to be employed in the AMM-13, special tests and examinations may be necessary.

4.2 Quality Conformance

Formal qualification inspection, analysis and tests may be conducted to validate that the design and performance of the AMM-13 system, including hardware and software, satisfy the requirements herein. The requirements shall be verified in accordance with the methods shown in Table 4.2.

TABLE 4.2. VERIFICATION INDEX

I = Inspection

A = Analysis

T = Test

D = Demonstration

N/A = Not Applicable

TABLE 4.2

VERIFICATION CROSS REFERENCE INDEX

(VCRI)

Paragraph	Item	Method
1.0	SCOPE	N/A
2.0	APPLICABLE DOCUMENTS	N/A
2.1	Government Documents	N/A
2.2	MSFC/Harris Documents	N/A
2.3	Harris Documents	N/A
2.4	Vendor Documents	N/A
2.4.1	Digital Equipment Corporation	N/A
2.4.2	AMPEX Corporation	N/A
2.5	Standards	N/A
2.6	Other Reference Documents	N/A
3.0	REQUIREMENTS	N/A
3.1	System Definition	A/D
3.1.1	General Description	D
3.1.2	Mission	D
3.1.3	Major Subsystem Listing	I
3.1.4	System Diagrams	N/A
3.1.4.1	Functional Flow Diagram	N/A
3.1.4.2	Input Process Flow	N/A
3.1.4.3	Output Process Flow	N/A
3.1.4.4	System Block Diagram	N/A
3.1.4.5	Subsystem Functional Allocation Charts	N/A
3.1.4.5.1	Computer Subsystem Functional Allocation	D
3.1.4.5.2	Software Subsystem Functional Allocation	D
3.1.4.5.3	Input Subsystem Functional Allocation	D
3.1.4.5.4	Recorder Subsystem Functional Allocation	D

3.1.4.5.5	Fiche Processor/Replicator Subsystem Functional Allocation	D
3.1.4.5.6	Verify Subsystem Functional Allocation	D
3.1.4.5.7	Storage and Retrieval Subsystem Functional Allocation	D
3.1.4.5.8	Output Subsystem Functional Allocation	D
3.1.4.5.9	Low Cost Reader Subsystem Functional Allocation	D
3.1.4.6	Detailed System Block Diagrams	N/A
3.1.5	Interface Definition	N/A
3.1.5.1	External Interfaces	T/D
3.1.5.2	Internal Interfaces	D
3.1.5.2.1	Computer and Software Subsystem Interfaces	D
3.1.5.2.2	Intentionally Blank	N/A
3.1.5.2.3	Input Subsystem Interfaces	D
3.1.5.2.4	Recorder Subsystem Interfaces	D
3.1.5.2.5	Fiche Processor/Replicator Subsystem Interfaces	D
3.1.5.2.6	Verify Subsystem Interfaces	D
3.1.5.2.7	Storage and Retrieval Subsystem Interfaces	D
3.1.5.2.8	Output Subsystem Interfaces	D
3.1.5.2.9	Low Cost Reader Subsystem Interfaces	D
3.1.5.3	Facilities Interface	I
3.1.6	Government Furnished Property List	I
3.1.7	Operational and Organizational Concepts	N/A
3.1.7.1	Operational Concept	D
3.1.7.2	Organizational Concepts	D
3.2	Characteristics	N/A
3.2.1	Performance Characteristics	N/A
3.2.1.1	Data Storage Capacity	N/A

3.2.1.1.1	Archival Storage Capacity ----------	A/D
3.2.1.1.2	Non-Archival Storage Capacity ----------	D
3.2.1.2	Access Time ----------	N/A
3.2.1.2.1	Access Time On-Line ----------	T
3.2.1.2.2	Access Time Off-Line ----------	T
3.2.1.3	Data Transfer Rate ----------	N/A
3.2.1.3.1	Data Transfer, Simultaneous Record and Read --------	T
3.2.1.3.2	Data Transfer, Multiple Readers ----------	D/T
3.2.1.4	Bit Error Rate (BER) ----------	T
3.2.1.5	On-Line Verification ----------	?
3.2.1.6	Recording Medium ----------	A/T
3.2.1.7	Archivability ----------	A
3.2.1.8	Record Handling ----------	D
3.2.1.9	Replication ----------	D/T
3.2.1.10	System Control/Status ----------	D
3.2.1.11	Operators ----------	D
3.2.1.12	File Management System ----------	D
3.2.2	Physical Characteristics ----------	N/A
3.2.2.1	Storage and Retrieval Subsystem ----------	I
3.2.2.2	Recorder Subsystem ----------	I
3.2.2.3	Other Subsystems----------	I
3.2.2.4	Accessibility ----------	I
3.2.3	Reliability ----------	D
3.2.4	Maintainability ----------	N/A
3.2.5	Availability ----------	N/A
3.2.6	Environmental Conditions ----------	I
3.2.6.1	Environmental Conditions, Non-Operating ----------	D
3.2.6.2	Environmental Conditions, Operating ----------	D

3.3	Design and Construction	I
3.3.1	Materials, Processes, and Parts	I
3.3.2	Electromagnetic Compatibility	I/A
3.3.3	Identification and Marking	N/A
3.3.4	Workmanship	N/A
3.3.4.1	General	I
3.3.5	Interchangeability	N/A
3.3.6	Safety	I
3.3.6.1	Grounds	T
3.3.7	Human Performance/Human Engineering	D
3.3.8	Computer Resources	N/A
3.3.8.1	Computer Programming	I
3.3.8.2	Computational Components	I
3.3.8.2.1	Computational Component Requirements	I/D
3.4	Documentation	I
3.4.1	Specifications	I
3.4.2	Plans	N/A
3.4.2.1	Engineering Test Plan	I
3.4.2.2	Installation Plan	I
3.4.2.3	Training Plan	N/A
3.4.3	Procedures	N/A
3.4.3.1	Acceptance Test Procedure	I
3.5	Logistics	N/A
3.5.1	Maintenance	N/A
3.5.2	Supply	N/A
3.5.3	Facilities and Facility Equipment	I
3.6	Training	N/A

3.7	Functional Area Characteristics	N/A
3.7.1	Computer Subsystem Functional Characteristics	I
3.7.1.1	Triport Information Exchange	D
3.7.1.2	Indices File	A
3.7.1.3	Software Memory	A/D
3.7.1.4	Subsystem Command/Control/Status Lines	D
3.7.1.5	Data Transfer Links	D
3.7.1.6	Data I/O Buffering	A
3.7.1.7	Operator Interaction	D
3.7.1.8	Small Record Staging	D
3.7.1.9	Internal Status	D
3.7.1.10	Equipment List	I
3.7.2	Software Subsystem Functional Characteristics	I
3.7.2.1	Supervise and Monitor Resources	D
3.7.2.2	Peripheral Handlers	D
3.7.2.3	File Management, Staged Records	D
3.7.2.4	File Management, Archived Records	D
3.7.2.5	Test and Status	D
3.7.2.6	Data Request Interpreter	D
3.7.2.7	Verification Assessment	D
3.7.2.8	Data Routing	D
3.7.2.9	I/O Priority	D
3.7.2.10	AMPEX Formatting	D
3.7.3	Input Subsystem Functional Characteristics	N/A
3.7.3.1	DBMS Port Data Ingest Control	T
3.7.3.2	High Speed Data Irgest Clock	T
3.7.3.3	Small vs. Large Record Determination	D
3.7.3.4	Small Record Extraction	D

3.7.3.5	Large Record Headers ----------	D
3.7.3.6	AMPEX High Speed Data Ingest ----------	T
3.7.3.7	AMPEX High Speed Data Output to Recorder Subsystem ----------	D
3.7.3 8	AMPEX High Speed Data Output to Verify Subsystem ----------	D
3.7.3.9	AMPEX High Speed Data Output to Output Subsystem---	D
3.7.3.10	Internal Status ----------	D
3.7.4	Recorder Subsystem Functional Characteristics -----	N/A
3.7.4.1	High Speed Data Ingest Control ----------	D
3.7.4.2	High Speed Data Ingest Clock ----------	T
3.7.4.3	Record Data On Photographic Film ----------	T/A
3.7.4.4	Fiche Loading/Unloading ----------	D
3.7.4.5	Internal Status ----------	D
3.7.5	Fiche Processor/Replicator Functional Characteristics ----------	N/A
3.7.5.1	Fiche Loading/Unloading ----------	D
3.7.5.2	Fiche Processing ----------	D
3.7.5.3	Replication ----------	D
3.7.6	Verify Subsystem Functional Characteristics -------	N/A
3.7.6.1	High Speed Data Ingest Control ----------	D
3.7.6.2	Bit-by-Bit Comparison ----------	T
3.7.6.3	Comparison Results -------- ----------	D
3.7.7	Storage and Retrieval Subsystem Functional Characteristics ----------	N/A
3.7.7.1	Fiche Loading/Unloading ----------	D
3.7.7.2	Fiche Storage ----------	I/T
3.7.7.3	Fiche Pack Loading ----------	D

3.7.7.4	Retrieval and Reading ----------	D
3.7.7.5	High Speed Data Output Control ----------	D
3.7.7.6	High Speed Data Output ----------	D
3.7.7.7	Internal Status ----------	D
3.7.8	Output Subsystem Functional Characteristics ----	N/A
3.7.8.1	DBMS Port Data Output Control ----------	D
3.7.8.2	DBMS Port Data Output Clock ----------	T
3.7.8.3	Data Transfer to DBMS Port ----------	D
3.7.8.4	Data Exchange with Computer Subsystem ----------	D
3.7.8.5	High Speed Data Output to Verify Subsystem -----	D
3.7.8.6	Internal Status ----------	D
3.7.9	Low Cost Reader Subsystem Functional Characteristics ----------	N/A
3.7.9.1	Data Output Control ----------	D
3.7.9.2	Data Transfer ----------	D/T
3.7.9.3	Fiche Loading/Unloading ----------	D
3.7.9.4	Reading ----------	T
3.7.9.5	Data Buffering for Local Display ----------	D
3.7.9.6	Alphanumeric Display ----------	D
3.7.9.7	Operator Interface, Keyboard ----------	D
3.7.9.8	Internal Status ----------	D
4.0	QUALITY ASSURANCE PROVISIONS ----------	N/A
4.1	General ----------	I/A
4.1.1	Responsibility for Tests----------	I
4.1.2	Special Tests and Examinations ----------	I
4.2	Quality Conformance ----------	I

5.0 PREPARATION FOR DELIVERY

Harris shall package and prepare for delivery all AMM-13 end items for shipment by an acceptable commercial carrier.

6.0 NOTES

6.1 Glossary of Terms

Archival Life - A measure of the stability of a recorded and processed fiche under a prescribed set of storage conditions.

AMM - Archival Mass Memory. One of the NEEDS program system segments.

AMM-13 - A 10^{13} bit archival mass memory system comprised of hardware, software, and control processor, which optically records digital data on photographic film; processes the film into fiche; and contains the fiche in a manner suitable to recover the digital data.

AMM-15 - A 10^{15} bit archival mass memory concept based upon the AMM-13.

ATP - Acceptance Test Procedure.

BER - Bit Error Rate

Byte - Eight data bits

CMS - System segment of the NASA NEEDS Program to which AMM-13 shall be tested in an operational environment, as a peripheral device, 1981.

Contact Replication - A photographic process which reproduces data from an original fiche onto a duplicate fiche.

Control - A signal that requests a desired action to occur.

Data Bus Port Adapter - A device which converts optical data on the FOB into electrical data signals. (GFE)

Data Transfer - The effective user serial bit rate that data moves through the system.

DEC - Digital Equipment Corporation

Demonstration - The process of qualitative verification of functional performance.

DBMS - System segment of the NASA NEEDS Program to which AMM-13 shall be tested in an operational environment, as a peripheral device, 1981.

DBMS Ports - Interface ports by which the AMM connects to the DBMS data bus port adapters.

Deinterleaver - A memory buffer utilized by the EDAC processor in support of the decoding process.

Destination Address - A sixteen bit field provided to the AMM by the DBMS with each data request. The first eight bits indicates a transfer via either the Triport or the DBMS high speed port. The second eight bits indicates the user on the DBMS FOB.

DMA - Direct Memory Access

EDAC - Error Detection and Correction

ETP - Engineering Test Plan

Fiche - A piece of photographic film used to store digital information as coded spots.

Fiche Pack - A fiche storage unit which contains 1000 fiche.

Fiche Processor - The equipment that processes the exposed fiche into a stable archival product.

FOB - Fiber Optic Bus

Forward File Management - A process whereby records are recorded in a predetermined location.

Frame Interleaving - A process which multiplexes 2048 bit frames of different requests into one output stream.

GFE - Government Furnished Equipment

Header - Within the AMM, the first 128 bits of a packet of data.

ICD - Interface Control Document

Interleaver - A memory buffer utilized by the EDAC processor in support of the encoding process.

Large Record - Any packet greater than 16,384 bits in length.

Mb/s - Megabits per second

MSFC - Marshall Space Flight Center

NEEDS - NASA End to End Data System

Operational Mode - A demonstration procedure for verification of joint AMM/DBMS performance.

Packet - A set of user data bits which starts with a header and ends with a packet parity.

Ping-Pong Buffers - A set of buffers; one buffer receives data while the other buffer transfers data, then vice-versa.

Prototype - An original model on which subsequent forms are to be based. Intended to demonstrate the reduction to practice of archival mass memory technologies.

Rate Buffer - A first-in first-out buffer utilized to support asynchronous data transfer from a source to a lower burst rate sink.

Request - A DBMS generated request for data stored in the AMM. Requests consist of packet identification information, number of the first byte within the packet to be output, and the number of bytes to be output.

Small Record - Any packet less than or equal to 16,384 bits in length.

Status - A signal that conveys how well a control function was executed or indicates a faulty event, function, or equipment condition.

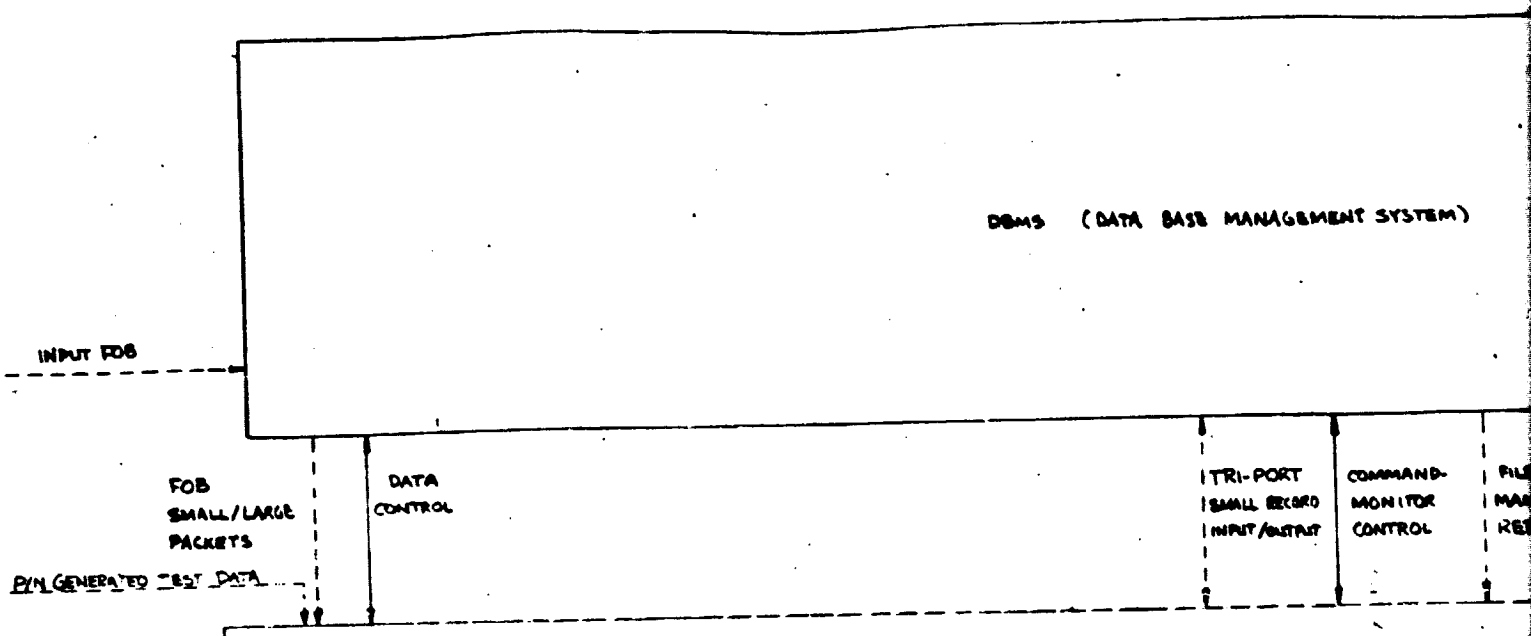
Subsystem - Any of the major software/hardware entities comprising the AMM-13.

TBD - To Be Determined.

Test - The process of quantitative verification of functional performance.

Triport - A three ported memory block and controller which is shared by the AMM, DBMS, and CMS VAX-11/780's.

User Data Rate - The effective rate at which data moves to/from mass storage equipment with all overhead excluded.

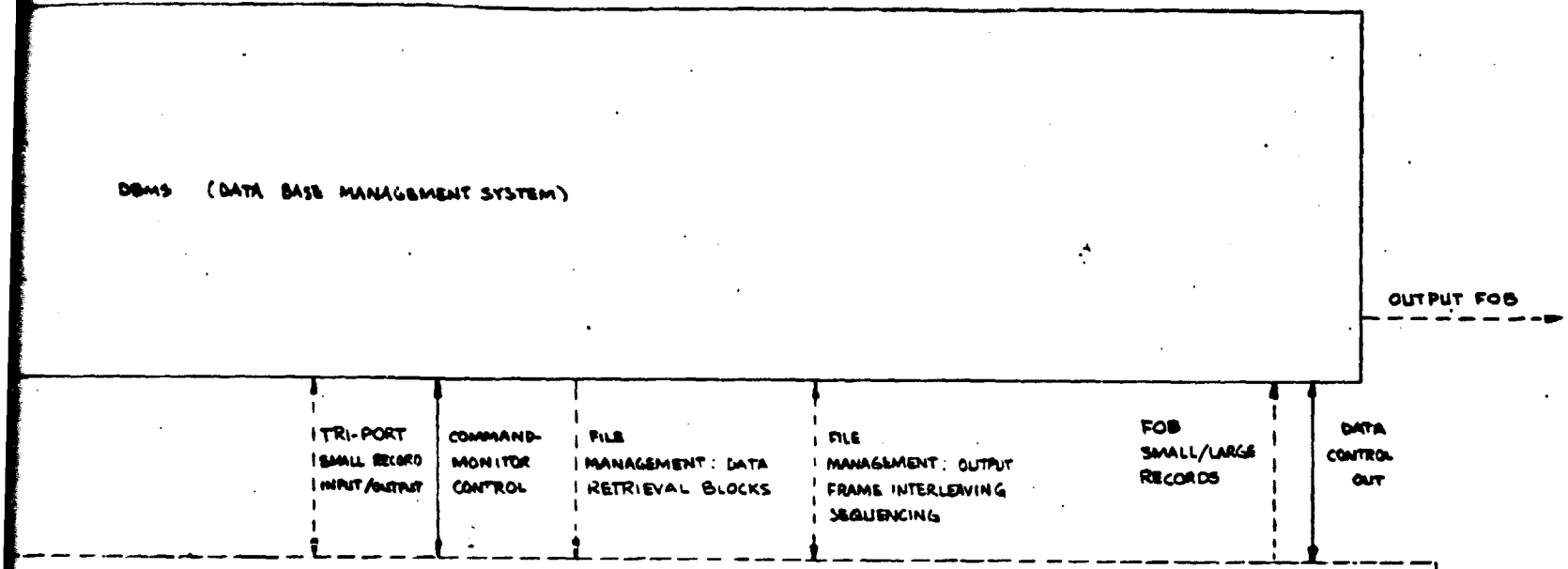


AMM-13 (ARCHIVAL MASS MEMORY SYSTEM)

FOLDOUT FRAME

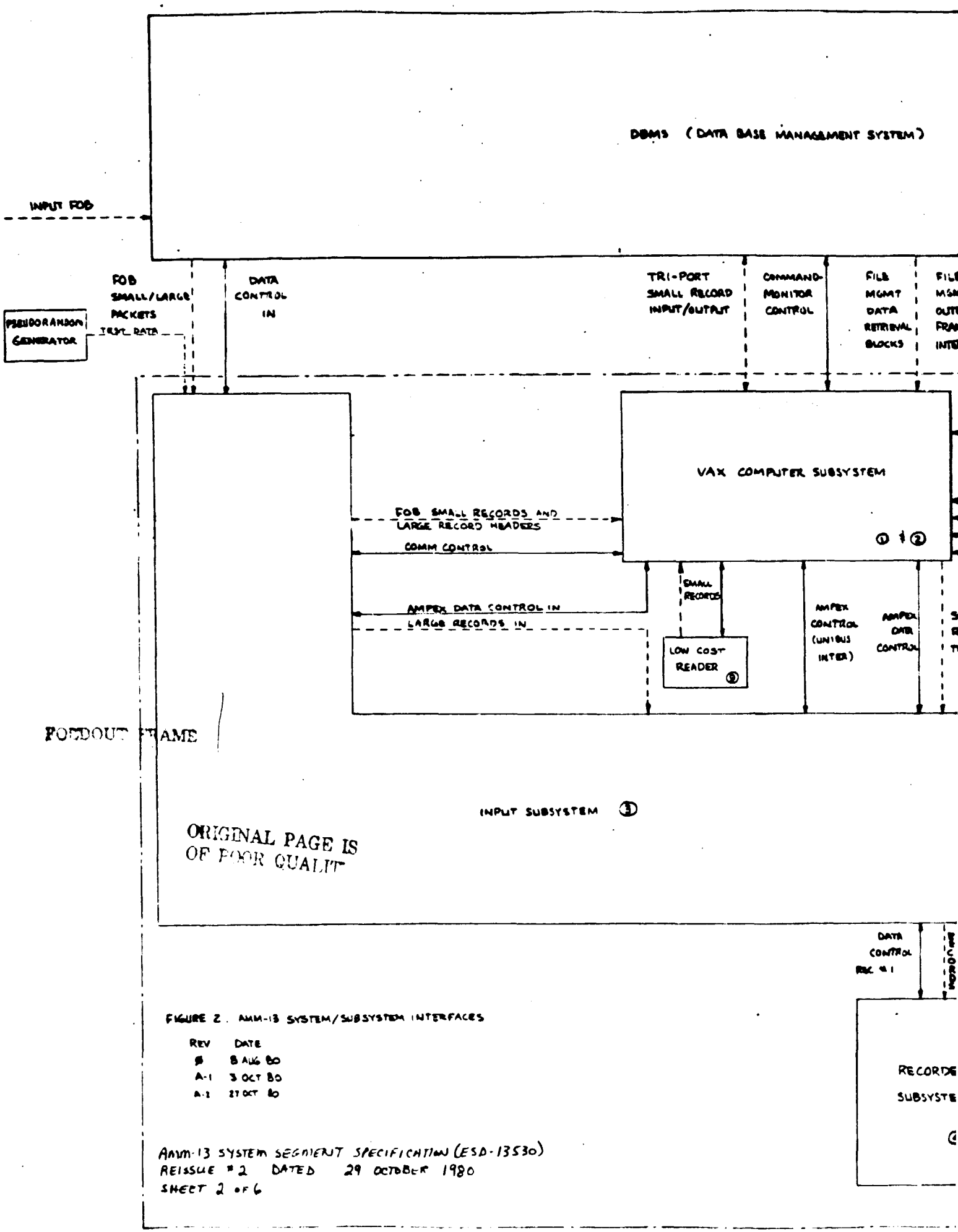
FIGURE 1. AMM-13 SYSTEM INTERFACES

REV	DATE
Ø	8 AUG 80
A-1	3 OCT 80
A-2	27 OCT 80



AMM-13 (ARCHIVAL MASS MEMORY SYSTEM)

FOLDOUT FRAME 2



FOLDOUT FRAME

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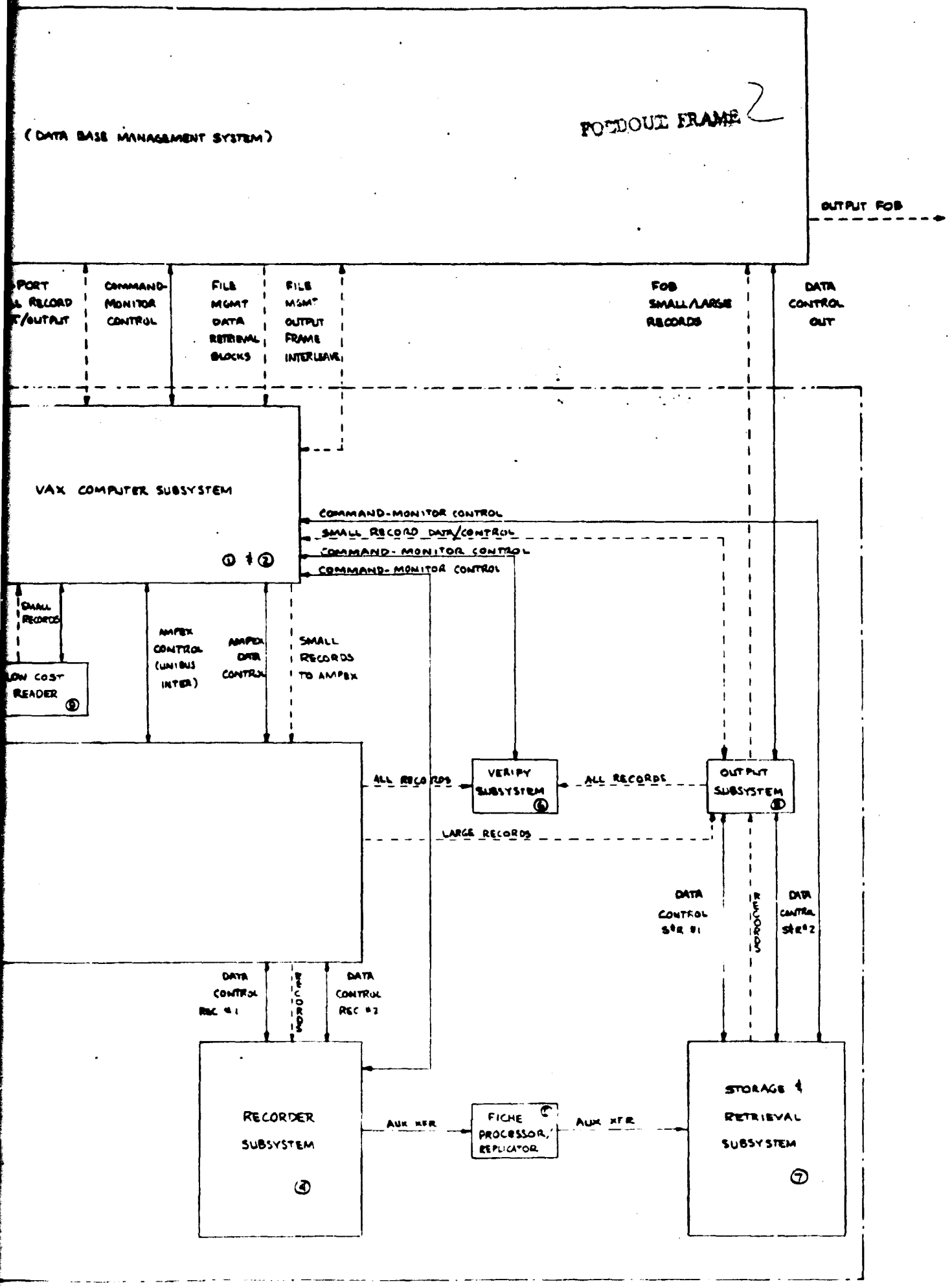
OF POOR QUALITY

FIGURE 2. AMM-13 SYSTEM/SUBSYSTEM INTERFACES

REV	DATE
Ø	8 AUG 80
A-1	3 OCT 80
A-2	27 OCT 80


(DATA BASE MANAGEMENT SYSTEM)
FOLDOUT FRAME 2
OUTPUT FOB
PORT
RECORD
T/OUTPUT
COMMAND-
MONITOR
CONTROL
FILE
MGMT
DATA
RETRIEVAL
BLOCKS
FILE
MGMT
OUTPUT
FRAME
INTERLEAVE
FOB
SMALL/LARGE
RECORDS
DATA
CONTROL
OUT
VAX COMPUTER SUBSYSTEM
① & ②
COMMAND-MONITOR CONTROL
SMALL RECORD DATA/CONTROL
COMMAND-MONITOR CONTROL
COMMAND-MONITOR CONTROL
SMALL
RECORDS
LOW COST
READER
⑨
AMPEX
CONTROL
(UNIBUS
INTER)
AMPEX
DATA
CONTROL
SMALL
RECORDS
TO AMPEX
ALL RECORDS
VERIFY
SUBSYSTEM
⑤
ALL RECORDS
OUTPUT
SUBSYSTEM
⑪
LARGE RECORDS
DATA
CONTROL
SUB #1
RECORDS
DATA
CONTROL
SUB #2
DATA
CONTROL
REC #1
RECORDS
DATA
CONTROL
REC #2
RECORDER
SUBSYSTEM
④
AUX XFR
FICHE
PROCESSOR,
REPLICATOR
⑥
AUX XFR
STORAGE &
RETRIEVAL
SUBSYSTEM
⑦

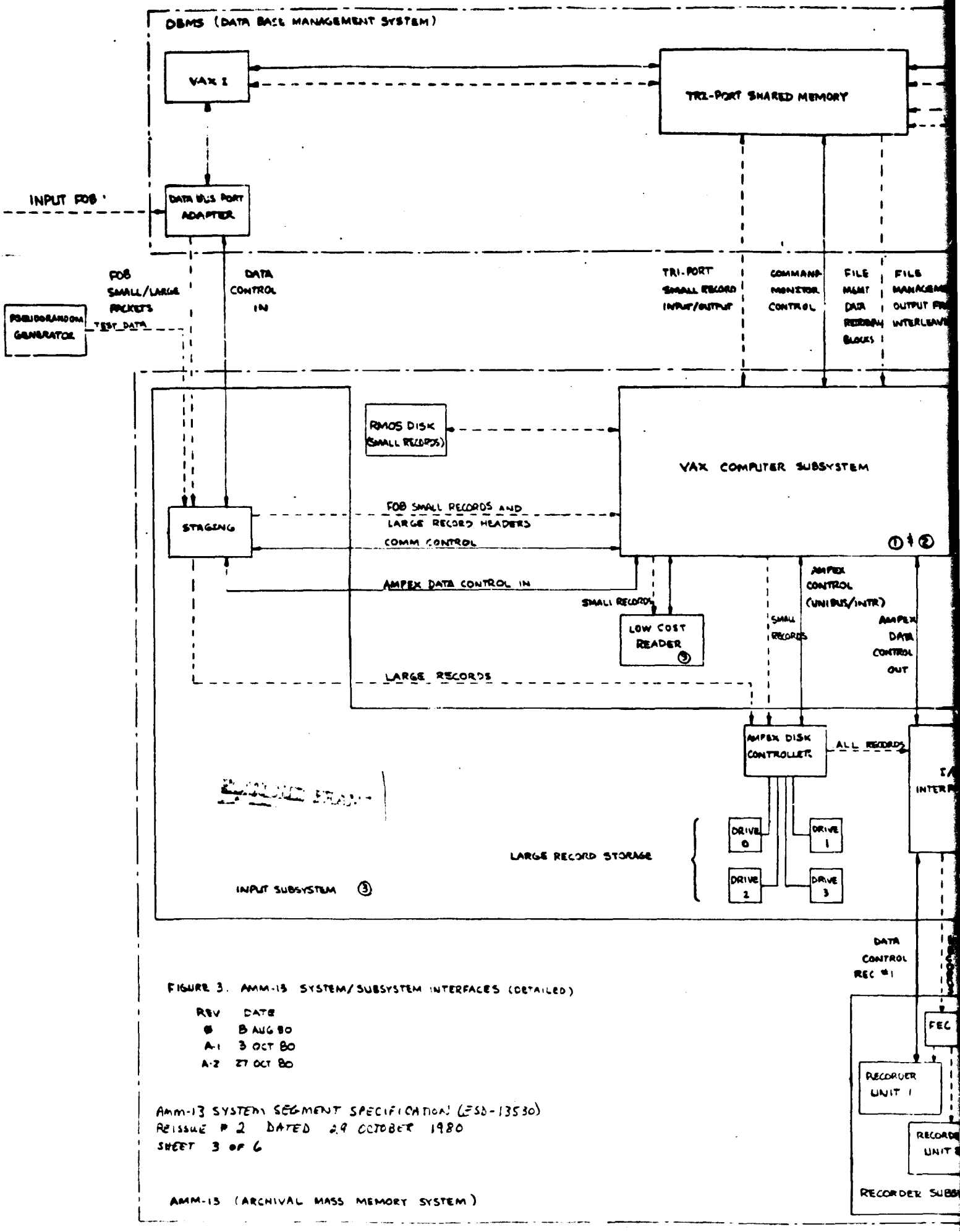
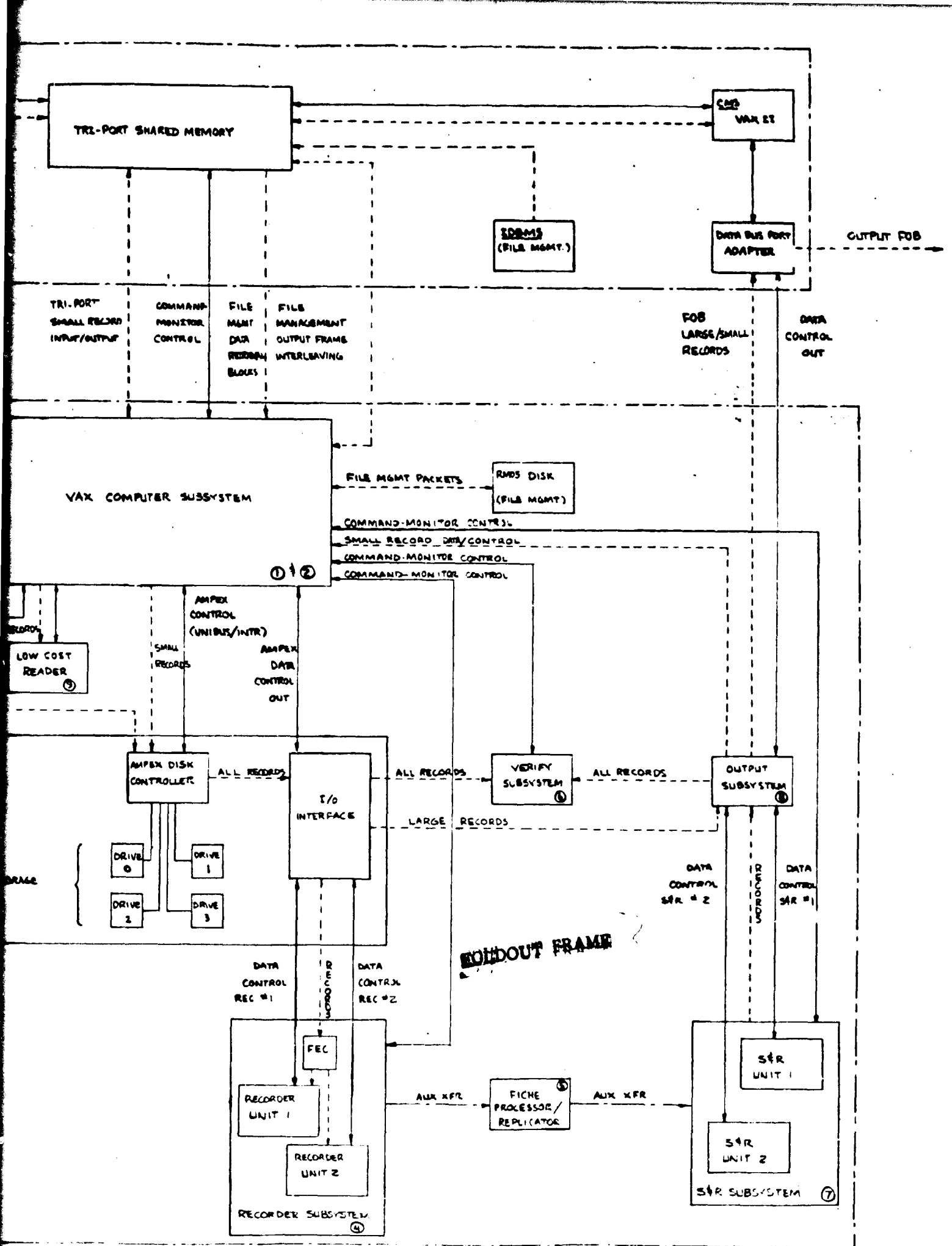
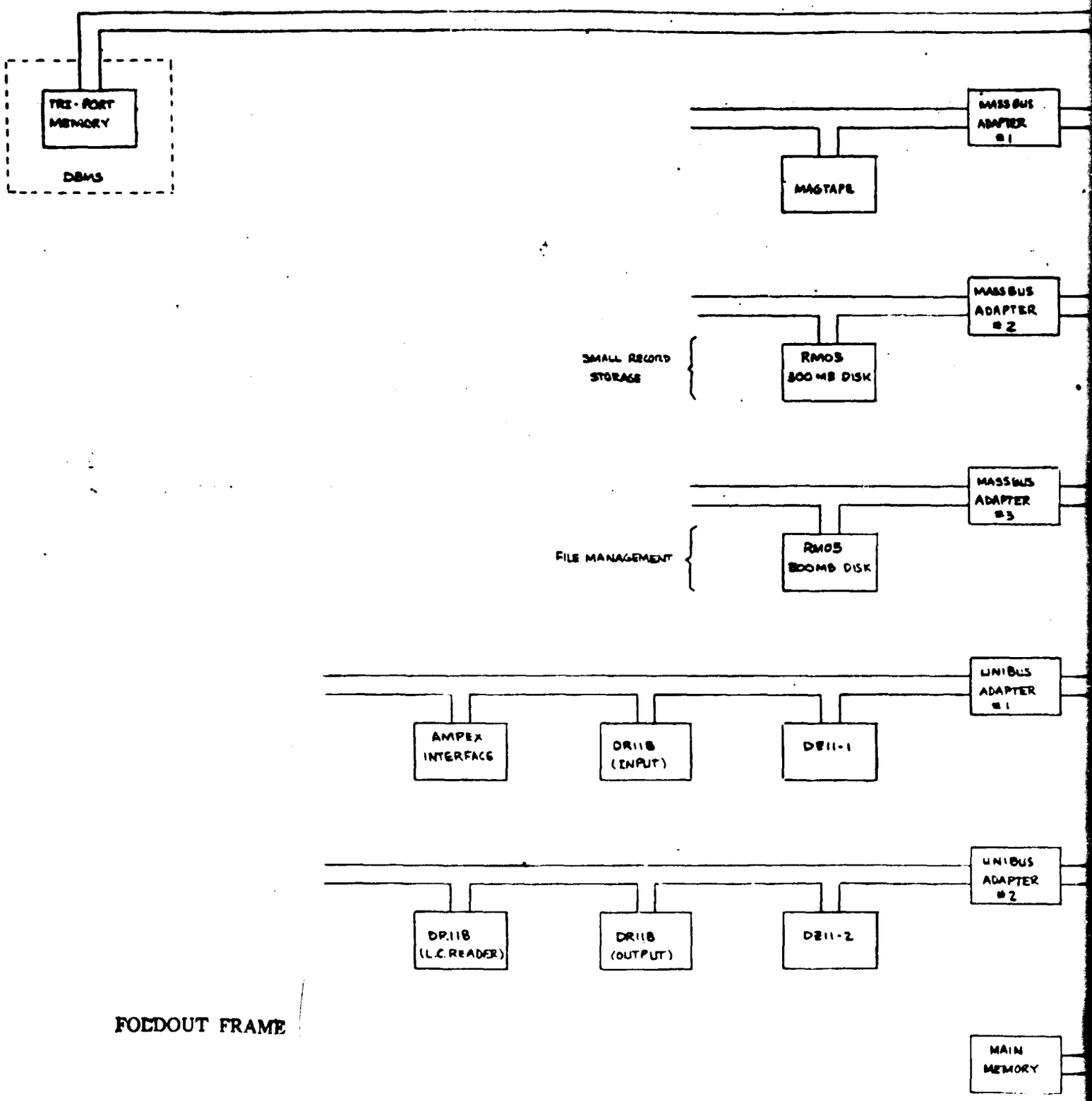


FIGURE 3. AMM-13 SYSTEM/SUBSYSTEM INTERFACES (DETAILED)

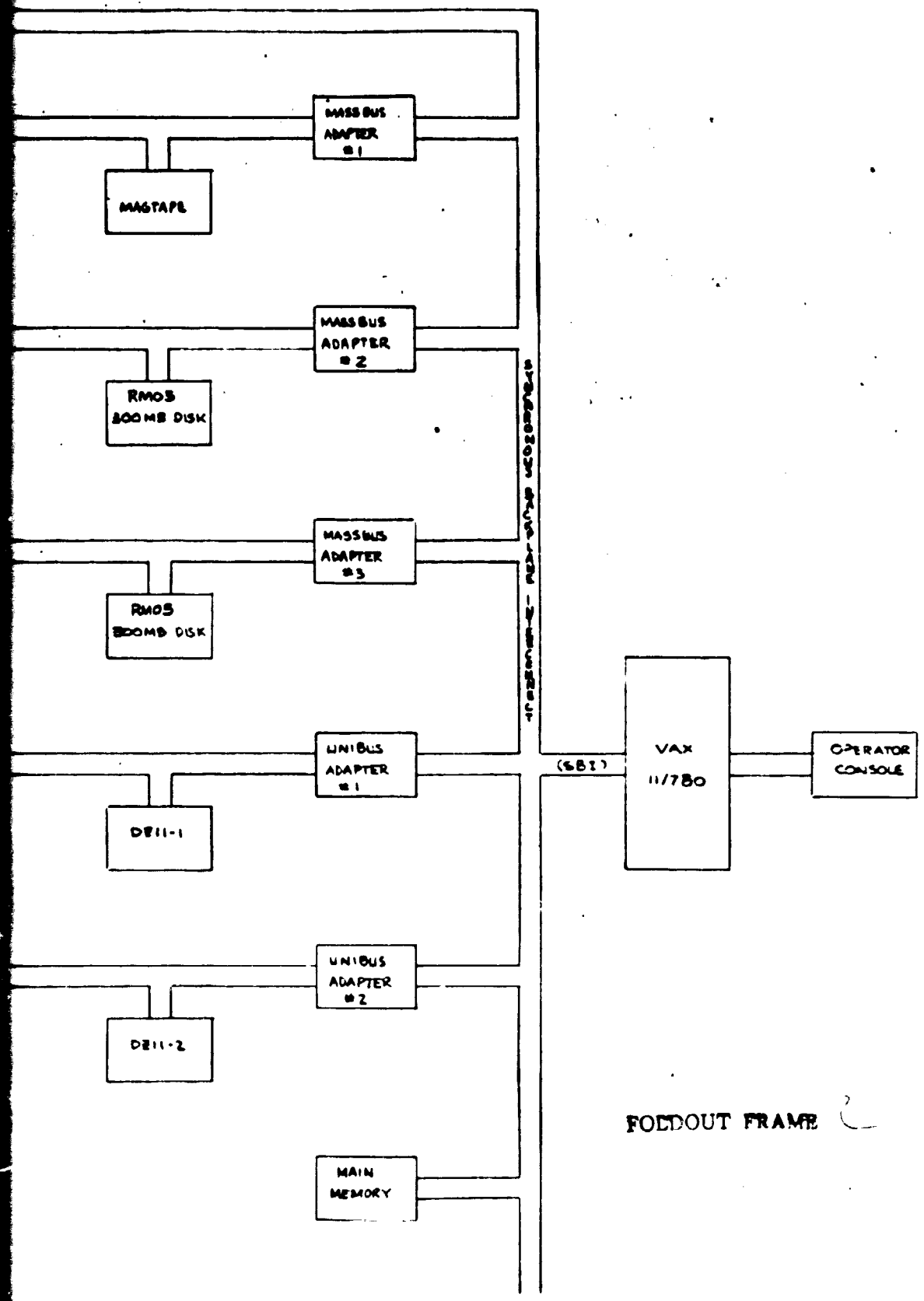
REV	DATE
Ø	8 AUG 80
A-1	3 OCT 80
A-2	27 OCT 80


TRI-PORT SHARED MEMORY
CMP VAX 8?
SDRMS (FILE MGMT.)
DATA BUS PORT ADAPTER
OUTPUT FOB
TRI-PORT SMALL RECORD INPUT/OUTPUT
COMMAND MONITOR CONTROL
FILE MGMT DATA RECORDS BLOCKS
FILE MANAGEMENT OUTPUT FRAME INTERLEAVING
FOB LARGE/SMALL RECORDS
DATA CONTROL OUT
VAX COMPUTER SUBSYSTEM
FILE MGMT PACKETS
RMDS DISK (FILE MGMT)
COMMAND-MONITOR CONTROL
SMALL RECORD DATA/CONTROL
COMMAND-MONITOR CONTROL
COMMAND-MONITOR CONTROL
① ②
AMPEX CONTROL (UNIBUS/INTR)
LOW COST READER ⑨
SMALL RECORDS
AMPEX DATA CONTROL OUT
AMPEX DISK CONTROLLER
ALL RECORDS
I/O INTERFACE
ALL RECORDS
VERIFY SUBSYSTEM ⑥
ALL RECORDS
OUTPUT SUBSYSTEM ⑧
LARGE RECORDS
DRIVE 0
DRIVE 1
DRIVE 2
DRIVE 3
DATA CONTROL S/R #2
RECORDS
DATA CONTROL S/R #1
BOILOUT FRAME
DATA CONTROL REC #1
RECORDS
DATA CONTRL REC #2
FEC
RECORDER UNIT 1
RECORDER UNIT 2
RECORDER SUBSYSTEM ④
AUX XFR
FICHE PROCESSOR/ REPLICATOR ⑤
AUX XFR
S/R UNIT 1
S/R UNIT 2
S/R SUBSYSTEM ⑦



FOLDOUT FRAME

FIGURE



FOLDOUT FRAME

FIGURE 4. COMPUTER SUBSYSTEM AND INTERFACING EQUIPMENT

REV	DATE
Ø	8 AUG 80
A-1	3 OCT 80
A-2	27 OCT 80

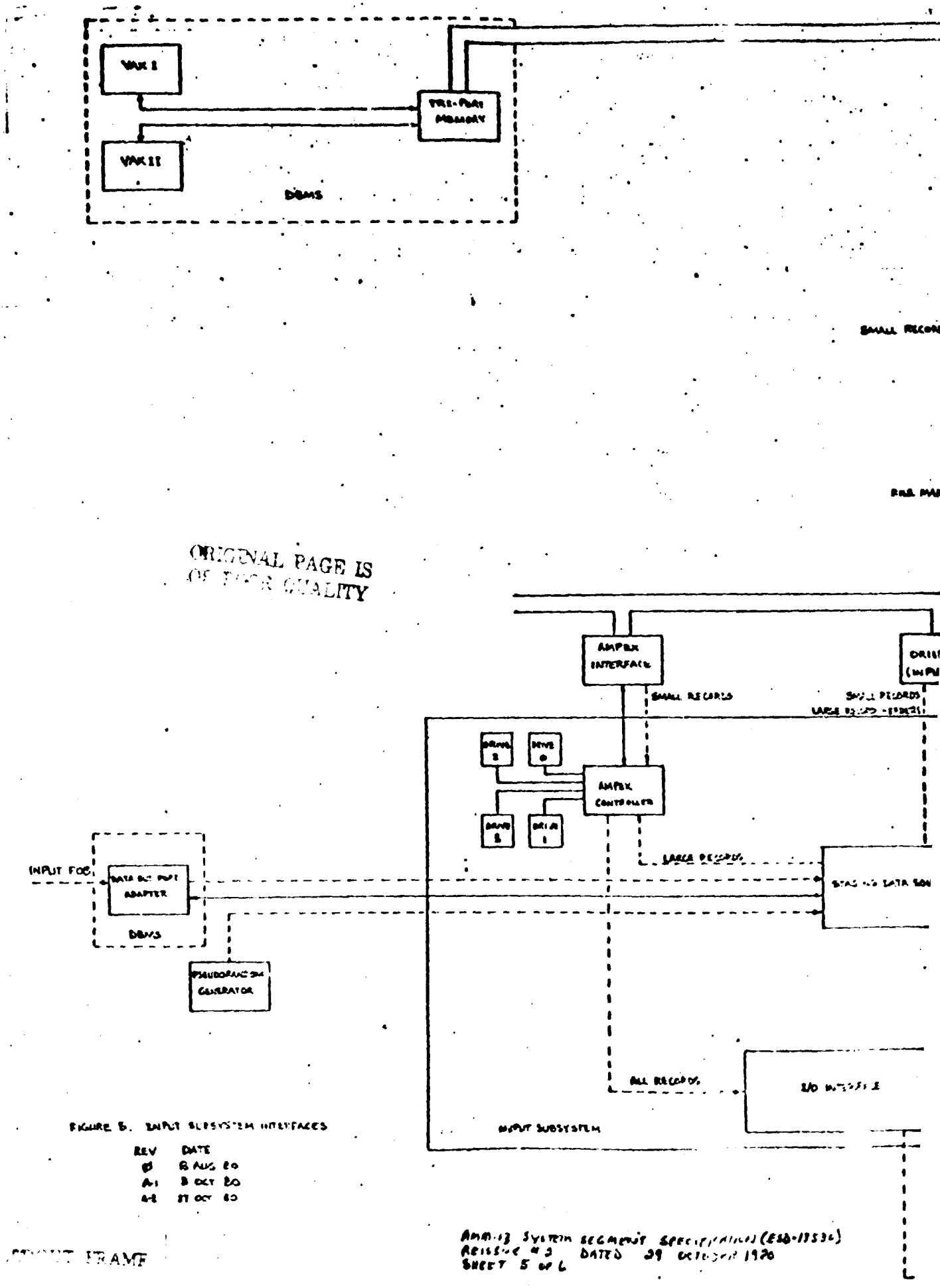
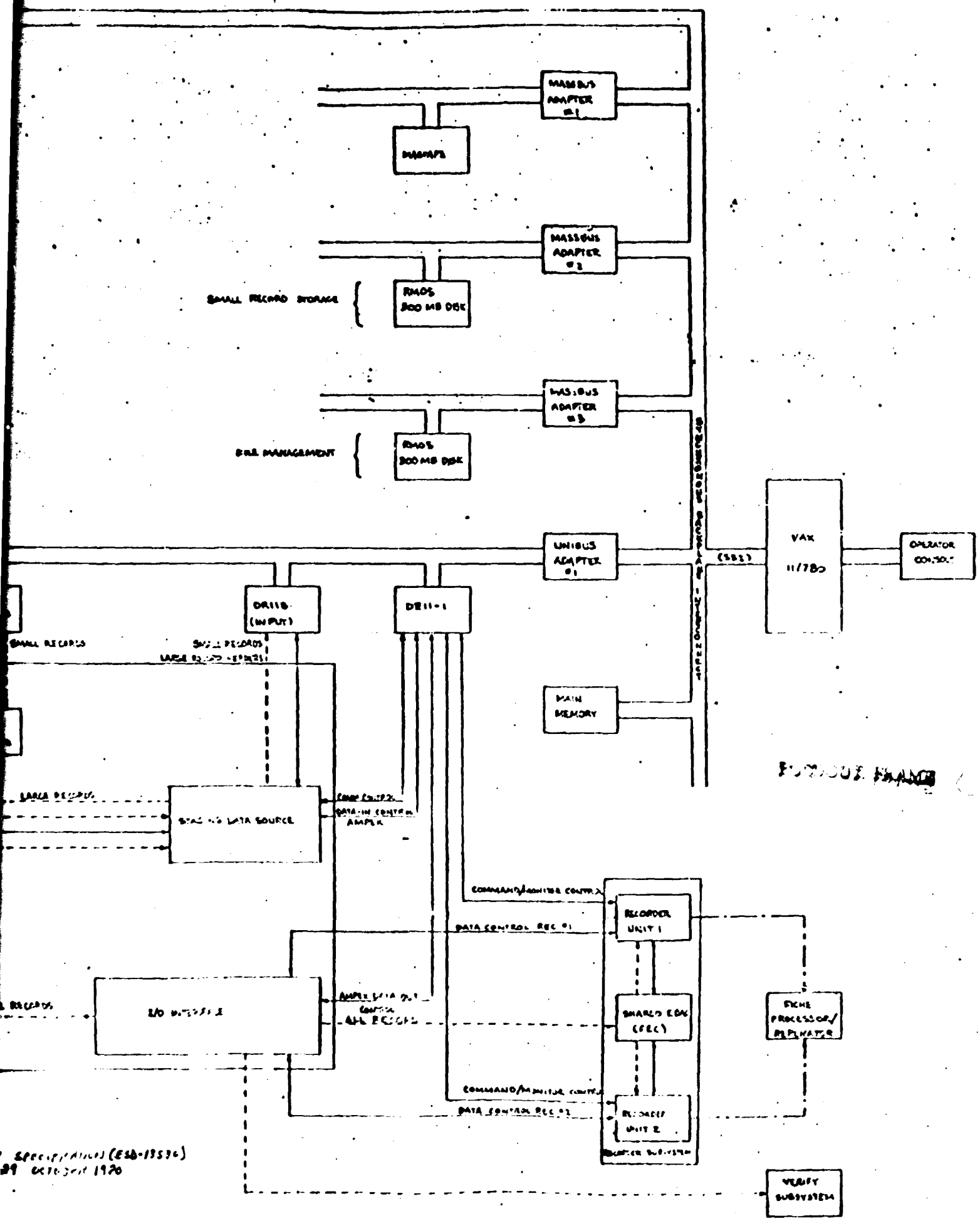


FIGURE 5. INPUT SUBSYSTEM INTERFACES

REV	DATE
Ø	15 AUG 80
A-1	3 OCT 80
A-2	27 OCT 80



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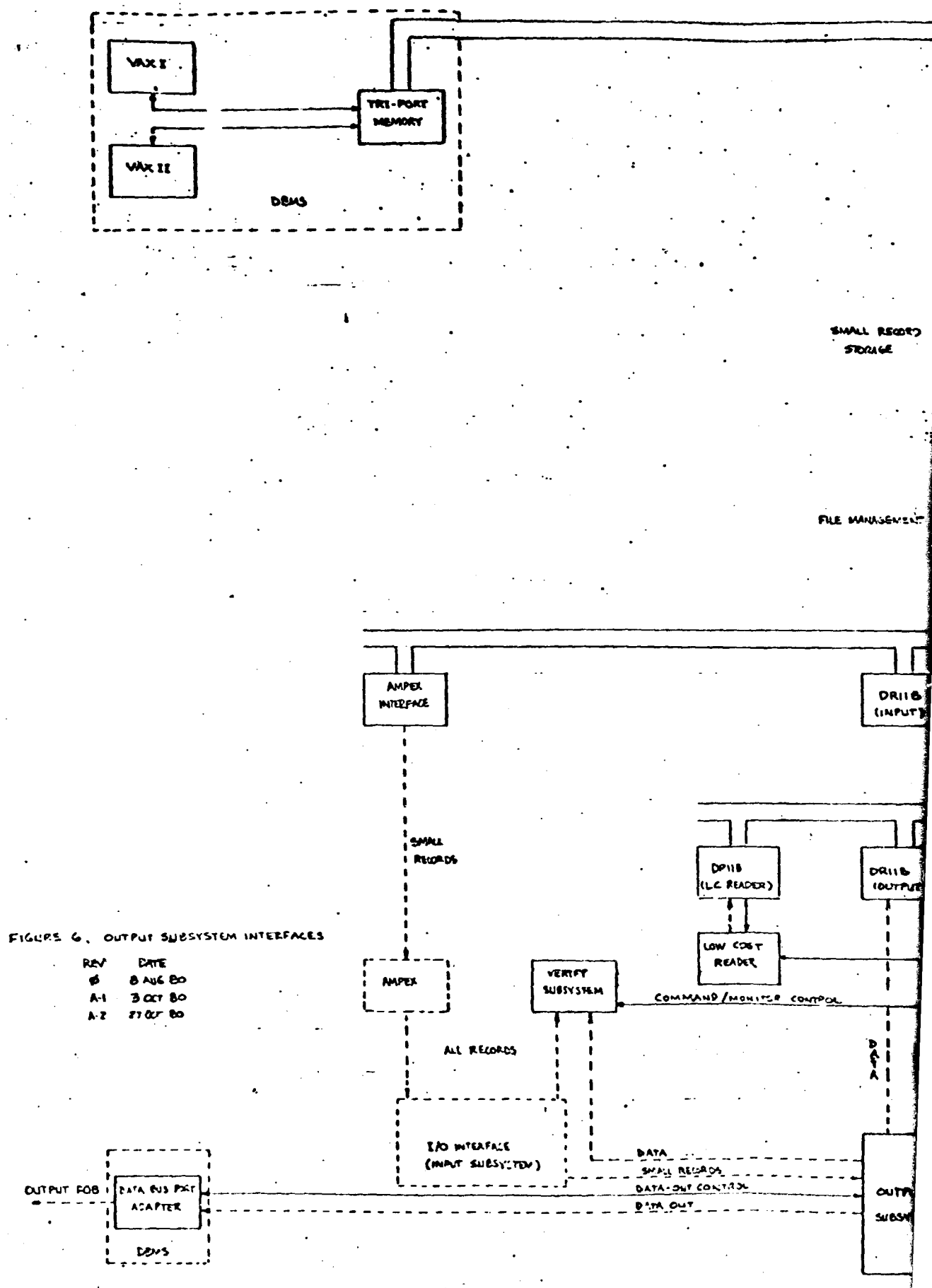
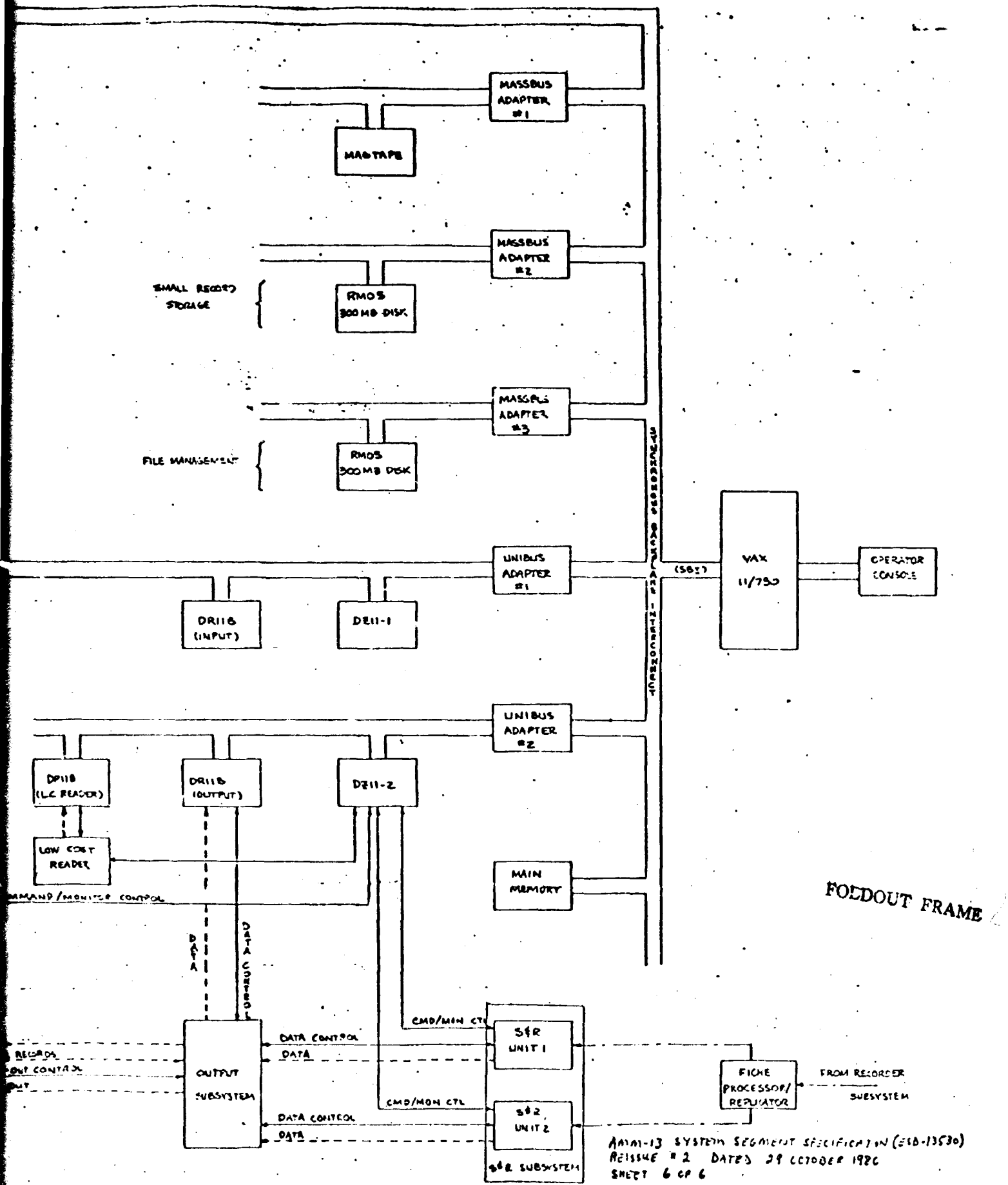


FIGURE 6. OUTPUT SUBSYSTEM INTERFACES

REV	DATE
Ø	8 AUG 80
A-1	3 OCT 80
A-2	27 OCT 80



FOLDOUT FRAME

AAMI-13 SYSTEM SEGMENT SPECIFICATION (ESD-13530)
REISSUE # 2 DATED 29 OCTOBER 1980
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