Burroughs

S 1000 Equipment

REFERENCE MANUAL

Printed in U.S.A. 93pp November, 1975 1089224

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Table of Contents

Table of Contents (cont)

Table of Contents (cont)

Section	Title	Page

List of Illustrations

INTRODUCTION

PURPOSE.
The purpose of this manual is to provide a description of the S 1000 Series document processing systems. It is intended to present the S 1000 Series product line in terms of the available models, their general applications, and the components of which it is comprised.

ORGANIZATION.
This manual is organized under four major topics:

a. A general introduction to the S 1000 Series product line.
b. The basic S 1000 Series computing equipment.
c. The basic S 1000 Series devices.
d. The additional S 1000 Series devices.

The general introduction of the Series discusses the general applications served by the S 1000 machines. It also describes each of the four principal models: the S 1200, S 1300, S 1400, and S 1500.

The discussion of the Series computing equipment describes the necessary processing equipment which is common to all of the S 1000 Series models. The subjects included are: the external switches, the processor, the memory, and the I/O interfaces.

Included in the description of the basic Series devices are only those devices which are required in all models. Each device is discussed in terms of the physical equipment, the function, the control, and the operation of that device. The additional devices (those devices not required in all models) are to be described in sections which are to be available at a later date.

ASSUMPTIONS/PREREQUISITES.
It is assumed that the reader has some knowledge of proof and encoding procedures and a basic understanding of the vocabulary of electronic data processing. An understanding of the Burroughs S 100/S 200 product line would help provide insight into the S 1000 Series, but is by no means required of the reader.

NOTE

Throughout the manual reference is made to the "system software". System software, in this context, refers to a compiled EPL Program. At compile time, the EPL Compiler generates standard interrupt handling routines and various other Input/Output associated subroutines which facilitate effective handling of the S 1000 I/O devices.

SECTION 1

GENERAL INTRODUCTION TO THE S 1000 SERIES

THE PRODUCT LINE.

The S 1000 Series is a family of modular document processing systems. The systems of this Series are designed to meet proof encoding needs in a variety of financial, commercial, industrial, and governmental environments. In order to allow adaptability to a wider range of applications the systems are structured in a modular fashion and are programmatically controlled. The proof/encoding functions of the series include:

a. MICR (Magnetic Ink Character Recognition) encoding.
b. Automatic endorsing.
c. Document sorting.
d. Hard copy transaction proving.
e. Data communications for on-line use.
f. Data capture via magnetic storage media.
g. Automatic MICR code line reading.

There are four principal models in the product line: the S 1200, S 1300, S 1400, and S 1500. Each of these can be modified by varying the devices, peripherals, and options available with that model to produce a variety of styles (see figure 1-1 for the complete style numbering system).

Each system is comprised of a series of modular components which are physically attached to one another, and are electronically connected to a programmable processor. Each physical module contains one or more devices, and each device, in terms of function, operation, and electronic control, may be considered as a separate unit. Figure 1-2 illustrates the principal models of the S 1000 Series and the various modular components which make up each system.

NOTE

> This component modularity and device-wise independence facilitates upgrading or downgrading of any system. In fact, the basic Series S model is the S 1200 and each higher order system is produced by adding various additional devices to the S 1200.

S - 1 X X X - X X X

Encoders
1,000 Family
Auto Feed/Read
Data Computer
Type Encode Font

Pockets
Data Comm Controller
Reader Fonts

S - 1 X

2 = Manual Feed/no Read
3 = Auto Read/no Feed
4 = Auto Feed/no Read
5 = Auto Feed/Auto Read

S - 1 X X

1 = Cassette
2 = Mini-Disk
3 = Cassette/Mini-Disk

S - 1 X X X

0 = No Encode Font
1 = OCR A
2 = OCR B
3 = IBM 1428
4 = CMC 7
5 = E13B

S - 1 X X X - X

0 = No Read Font
5 = E13B Read Font

S - 1 X X X - X X

0 = No Data Comm
1 = Single Line Burroughs Asyn.
2 = Single Line Bi-Sync.

S - 1 X X X - X X X

1 = 2 Pockets
2 = 4 Pockets
3 = 6 Pockets
4 = 8 Pockets
5 = 10 Pockets
6 = 12 Pockets
7 = 14 Pockets
8 = 16 Pockets
9 = 18 Pockets
0 = 20 Pockets

The additional specifications required for the S 1000 system are as follows:

(a) Additional Memory 4K modules
(b) Additional Cassettes (up to 4)

Figure 1-1. S 1000 Style Numbering System

DEVICE-WISE CAPABILITIES.

Each model of the Series offers its own specific capacities which are a subset of the overall Series capabilities. The major models and their functions are discussed later in this section. The following is a discussion of the overall Series capabilities and some of their possible applications.

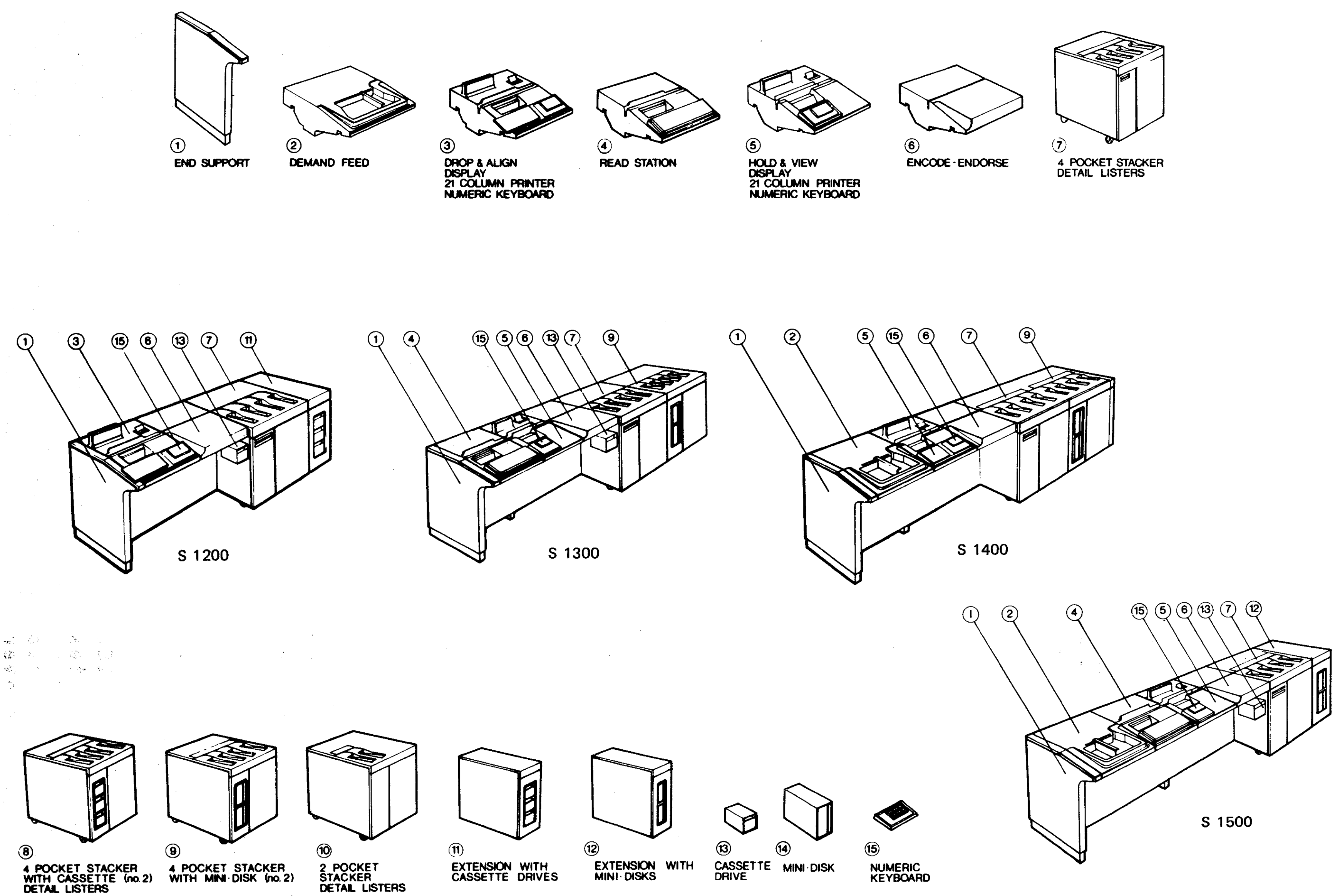


Figure 1-2. Modules and Principal Models

Paper documents may be loaded manually or automatically. Automatic document feeding permits faster processing by reducing the time required for manual handling of documents. A system with automatic feed may be programmed to fine sort all documents without operator control.

All systems are equipped with a MICR encoder with programmable code line. The ability to programmatically control the code line facilitates adaptation to a variety of encoding formats.

A MICR code line reader, installed in some systems, allows for automatic reading of previously encoded documents. The processor may be programmed to make decisions based on data read through the read station; for example, it can store the data on magnetic tape cassettes or mini-disks, or transmit the data to a central data base. The MICR reader relieves the operator of the responsibility of reading the documents and entering data into the system.

A hold and view station raises documents up out of the transport mechanism and thereby makes the entire document visible to the operator. In systems with MICR readers, the hold and view station is used to raise any document which contains a character, or characters, that the reader could not recognize. The non-readable character(s) can then be entered correctly into the memory of the system before any more processing occurs.

A document endorser, an option in all models, automatically endorses documents as they pass through the system. The endorsing stamp, including the date, a document serial number, and the endorsing seal, may be placed on either the front or back of the document.

All systems allow manual or automatic pocket selection to facilitate document sorting into as many as 20 sort pockets. This sorting capacity can reduce the handling and rehandling of documents within the encoding process.

A console keyboard allows an operator to input numeric data, program parameters, and program selection to the processor of the system. Through this keyboard, it is possible to enter encoding line fields and formats, specify pocket selection, initiate execution of any of the system software programs, or actually control any of the system functions.

A console master printer produces a 21-column hard copy record which serves as an audit trail of all system activities. The master tape can contain numeric amounts, serial numbers, item counts, transaction codes, a date, and other reference numbers, as well as reflecting system alert messages, memory dumps, and trace programs.

A detail lister printer, associated with each sort pocket, produces a 10-column paper tape record which serves as an audit tape of all items sorted to its respective pocket. The detail tape can list such entries as numeric amounts, the number of items in the pocket, the pocket number, the date, and total amounts for the items in the pocket. The detail tape can be distributed along with the items in the pocket and used in later proving procedures.

An 18-character display screen and an associated audible alarm can alert the operator to system conditions which may need attention. These conditions include a full sort pocket, a broken printer ribbon, read errors, etc. Along with the display screen are a series of indicator lights which indicate other system conditions such as power ON/OFF and the status of data communications (in on-line systems).

A single channel data communications interface permits any of the models of the S 1000 Series to be used in an on-line capacity. This on-line capacity permits data to be transmitted directly to a central data base.

Magnetic tape cassettes or industry compatible mini-disks may be used to capture data as it is being processed. This data may then be entered into another system for further processing without transferring, or even rehandling, the original documents.

Each device of an S 1000 system is under the control of the processor. The processor initiates the devices and sends and receives information to and from the devices by way of an Input/Output interface. This central control along with the programmability of the system allows the user to select devices, dictate formatting, and control information flow. It also permits the user to specify the acceptance and enforcement of all keyboard entry sequences, pocket selections, and certain arithmetic functions.

This control is accomplished by programming the processor in the Encoder Programming Language (EPL). EPL is a high level language which resembles COBOL, but is oriented specifically to the document encoding process.

DESCRIPTION OF THE FOUR PRINCIPLE MODELS.

THE S 1200.

The S 1200 (figure 1-3) is the basic system of the S 1000 Series. It contains the necessary hardware of a programmable proof encoding system without the additional features of the more sophisticated systems of the Series. It may be used as an on-line or off-line proof machine with data capture capabilities. The S 1200 contains the following devices:

a. A drop and align station.
b. A 25-character per second encoder.
c. An endorser.
d. A 21-column master printer.
e. From 2 to 20 sort pockets, with detail tape listers.
f. Data communications interface.
g. Data capture via:

    1) Magnetic tape cassettes (up to 4).

2) Mini-disks (1 or 2).

h. A console keyboard.
i. An 18-character alphanumeric display panel.
j. A processor.

These modules enable the system to:

a. Mechanically align a document for encoding.

b. Encode the document along its entire bottom edge.

c. Endorse the document on front or back.

d. Record audit information and system messages on a master tape.

e. Sort documents to pockets and record audit information for each pocket on detail tapes.

f. Interface with data communications equipment for transmission of data.

g. Capture input data on a magnetic storage medium.

h. Accept numeric input or program execution instructions from the operator.

i. Display system condition messages to the operator.

j. Be programmed to help meet the user's particular needs.

A document enters the system at the drop and align station where it is automatically aligned in front of the encoding station. It is held here until the system is instructed to either encode or release the document. This holding of the document permits the operator to enter encode field data and formats, select the proper sort pocket for the document, and/or select a program for execution to process the document. After a document has been encoded and endorsed, it is sorted to a pocket which is selected by either the operator or the user program. As each document is processed through the system, records are produced on the master tape and on the detail tape of the pocket receiving the document. Also, records can be stored on magnetic tape cassettes or mini-disks or transmitted to a central data base.

Before any document can be processed, however, the processor must be loaded with a previously compiled EPL user program which controls the activities of the system. After the program is loaded into memory, the operator must load documents, one at a time, into the drop and align station and enter the parameters that are needed by the user program to properly process the documents.

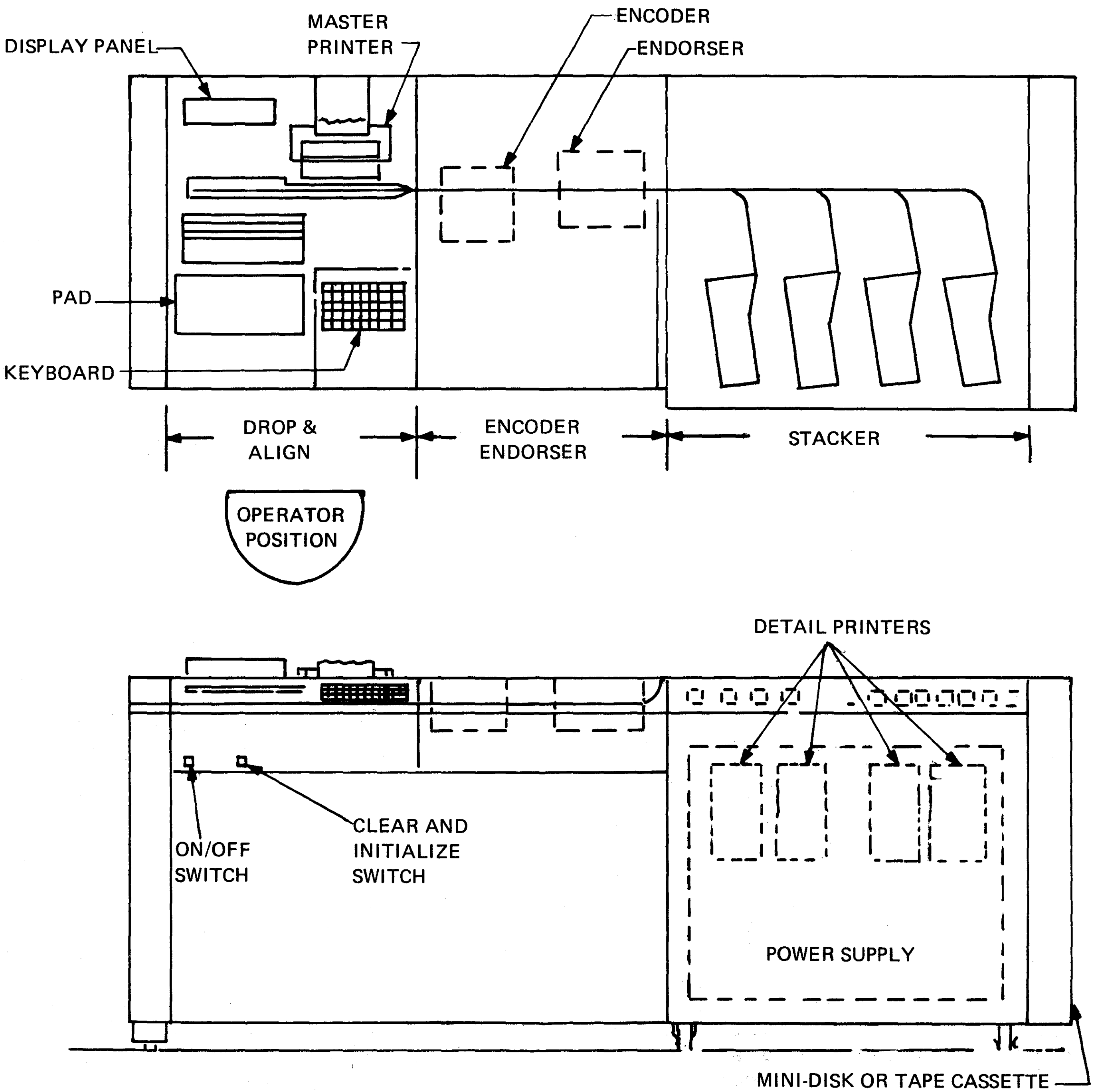


Figure 1-3. The S 1200

The S 1200 system consists of the following independent modules:

a. A drop and align module, containing the drop and align station, the display panel, indicator lights, the keyboard, and the master printer.

b. An encoder/endorser module, containing the encoder and the endorser.

c. The stacker module(s), containing the sort pockets, the detail printers, and the data capture devices.

Each module is physically attached to the next one, and all of the modules are cable connected to the processor which is located within the drop and align and the encoder/endorser modules.

THE S 1300.
The S 1300 (figure 1-4) is the second principal model of the Series. It contains, in addition to the devices of the S 1200, the following:

a. A Magnetic Ink Character Recognition (MICR) reader.
b. A hold and view station.

These two devices give the S 1300 the added ability to:

a. Read the entire encode line of each document.

b. Detect non-readable characters of the encode line and raise any documents with encoding errors to allow the operator to input the non-readable characters.

A document enters this system at the drop and align station, and is automatically aligned at the MICR reader. After a document is read by the MICR reader it is passed to the hold and view station from which it is released to the encoder if no errors are found in the encode line. If an error is detected in the code line (e.g., non-readable characters or missing encode field entries), the document is "popped up" into the full view of the operator who can enter the necessary corrections through the keyboard.

After a document has been read and the corrections, if any, have been made, the other processes of encoding, endorsing, sorting, and data recording are performed as in the S 1200. So the MICR reader, by automatically reading documents and thereby reducing significantly the operator's responsibilities of data entry, allows the S 1300 to have a higher rate of throughput than the S 1200.

The MICR reader and the hold and view station are controlled by the EPL user program. The system may be programmed to use information read through the MICR reader to make decisions affecting such system activities as encoding, sorting, data transmission, etc.

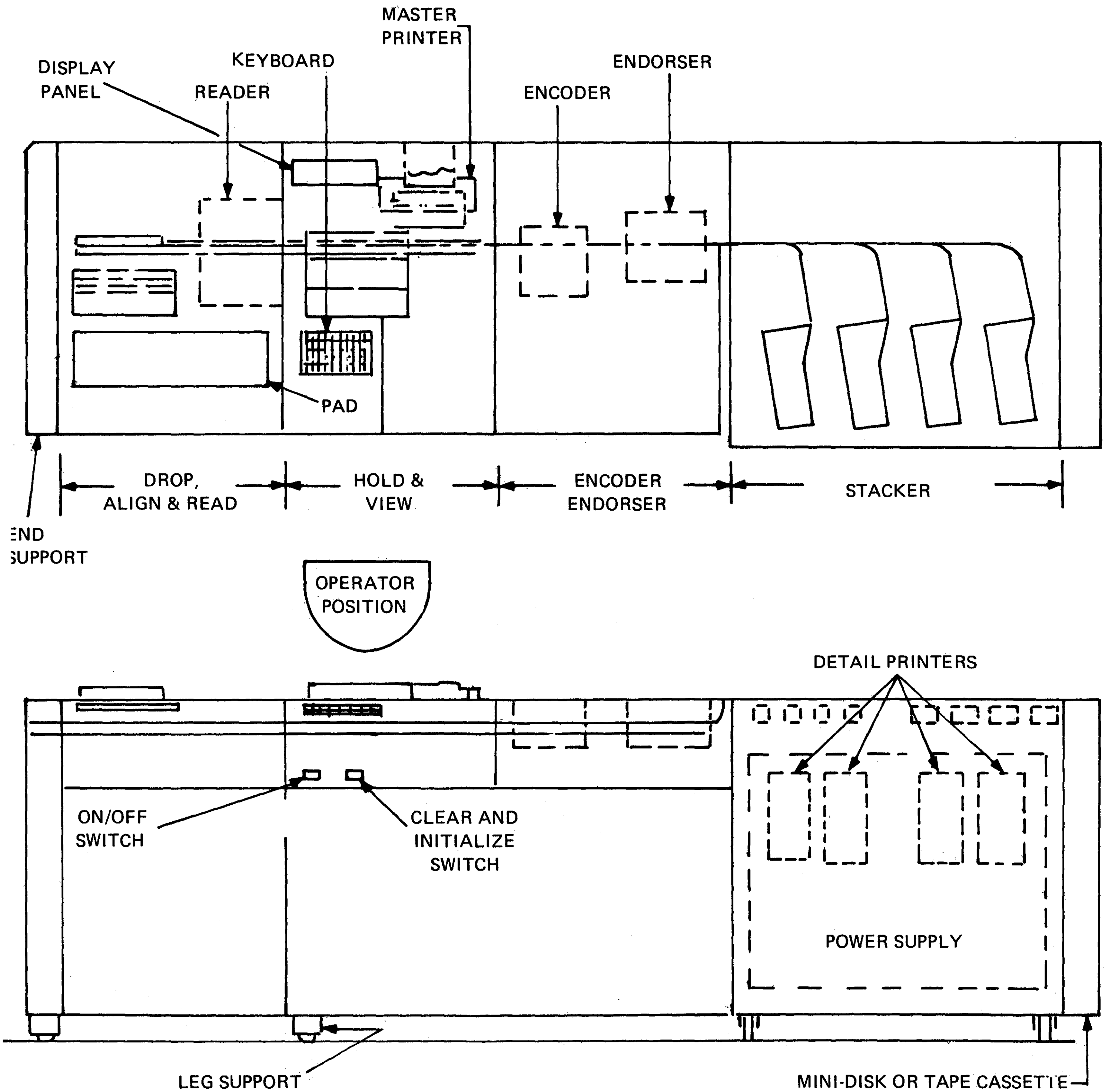


Figure 1-4. The S 1300

The S 1300 system consists of the following independent modules:

a. A drop, align, and read module containing the drop and align station and MICR reader.

b. A hold and view module containing the hold and view station, the display panel, the master printer, and the keyboard.

c. An encoder/endorser module, containing the encoder and the endorser.

d. The stacker module(s), containing the sort pockets, the detail printers, and the data capture devices.

Each module is physically attached to the next, and all of the modules are cable connected to the processor which is located within the hold and view and the encoder/endorser modules.

THE S 1400.
The S 1400 (figure 1-5) is the third principal model of the Series. It contains, in addition to the devices of the S 1200, the following:

a. An automatic document feeder.
b. A hold and view station.

These two devices give the system the added ability to:

a. Automatically feed documents into the system.
b. Raise each document into the full view of the operator.

In this system a stack of documents is loaded into the automatic document feeder which, in turn, loads the documents, one at a time, into the hold and view station. A document in the hold and view station may then be "popped up" to allow the operator to read the encode line, or it may be released directly to the encode station. Therefore, the automatic document feeder and the hold and view station allow the operator to load and read documents without physically handling each one individually. If it is desirable, or necessary, documents may be manually loaded into the hold and view station which may also serve as a drop and align station. Once documents are aligned at the encode station, the processes of encoding, endorsing, sorting, and record production are performed as in the S 1200.

The automatic document feeder is indirectly under the control of the EPL user program. It automatically feeds a document as soon as the previous one is released from the hold and view station; but the user program can inhibit this automatic feeding for any one document.

The S 1400 system consists of the following independent modules:

a. A demand feed module, containing the automatic document feeder.

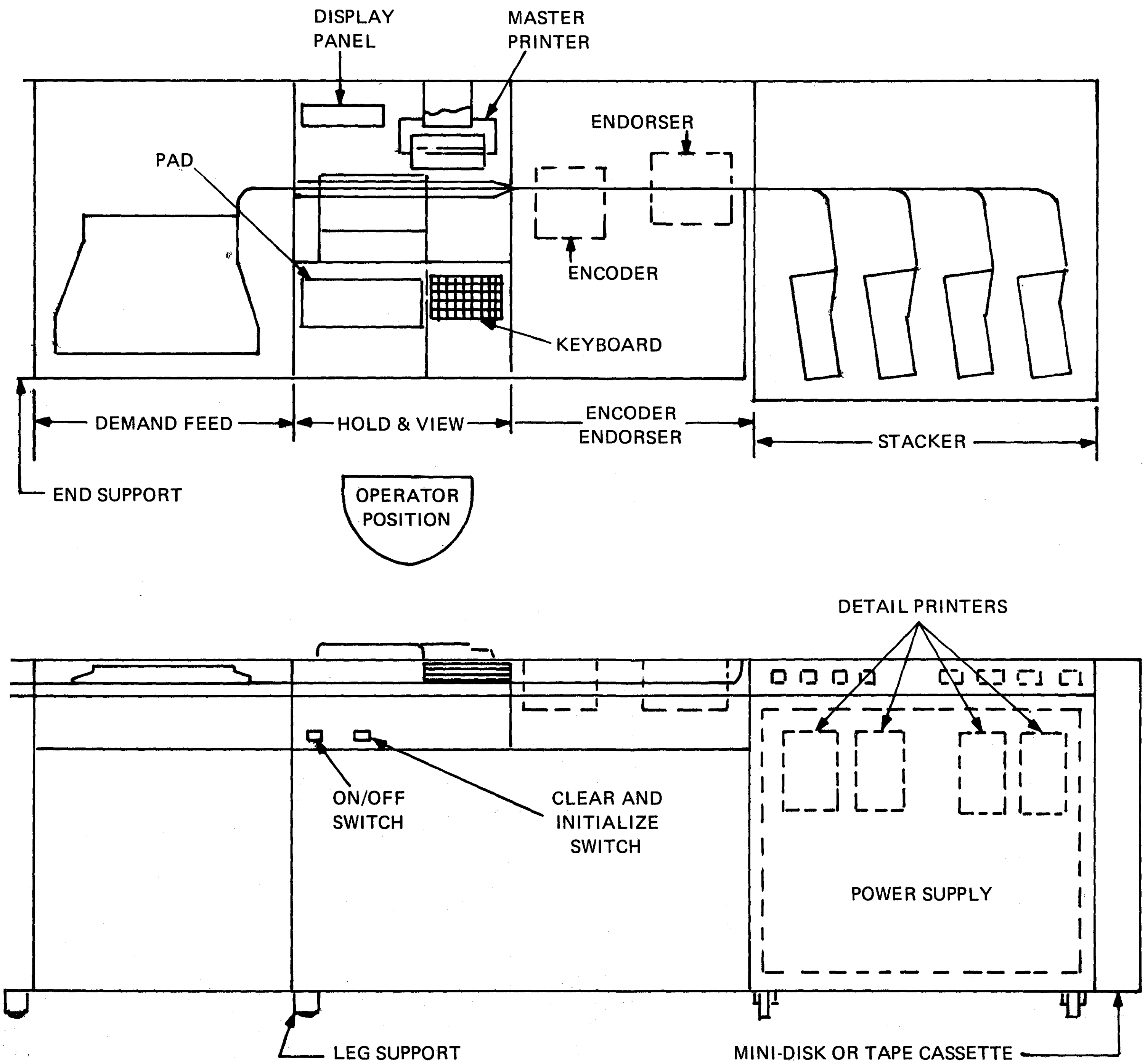


Figure 1-5. The S 1400

b. A hold and view module, containing the hold and view station, the display panel, the master printer, and the keyboard.

c. An encoder/endorser module, containing the encoder and the endorser.

d. The stacker module(s), containing the sort pockets, the detail printers, and the data capture devices.

Each module is physically attached to the next, and all of the modules are cable connected to the processor which is located within the hold and view and the encoder/endorser modules.

THE S 1500.
The S 1500 (figure 1-6) is the largest and most sophisticated model of the S 1000 Series. It contains, in addition to the devices of the S 1200, the following:

a. An automatic document feeder.
b. A MICR reader.
c. A hold and view station.

These three devices give the S 1500 the added ability to:

a. Automatically feed documents into the system.

b. Read the entire code line of each document.

c. Detect non-readable characters of the encode line, and raise any documents with encoding errors to allow the operator to input the non-readable characters.

In this system, a stack of documents can be loaded into the automatic document feeder which loads them individually into the MICR reader, or the documents may be manually inserted into the drop and align station which aligns them with the reader. The hold and view station may pop the document up into the full view of the operator or else immediately release it to the encoding station. Once a document reaches the encoding station, it is encoded, endorsed, sorted, and recorded just as in the S 1200.

The automatic document feeder, the MICR reader, and the hold and view station are all under control of the EPL user program, either directly or indirectly. It is possible to program the S 1500 system to handle the entire proof encoding operation without any intervention by the operator. Any incorrectly encoded documents can be released from the system totally unprocessed and sorted to a particular pocket so they may be processed under operator control at a later time.

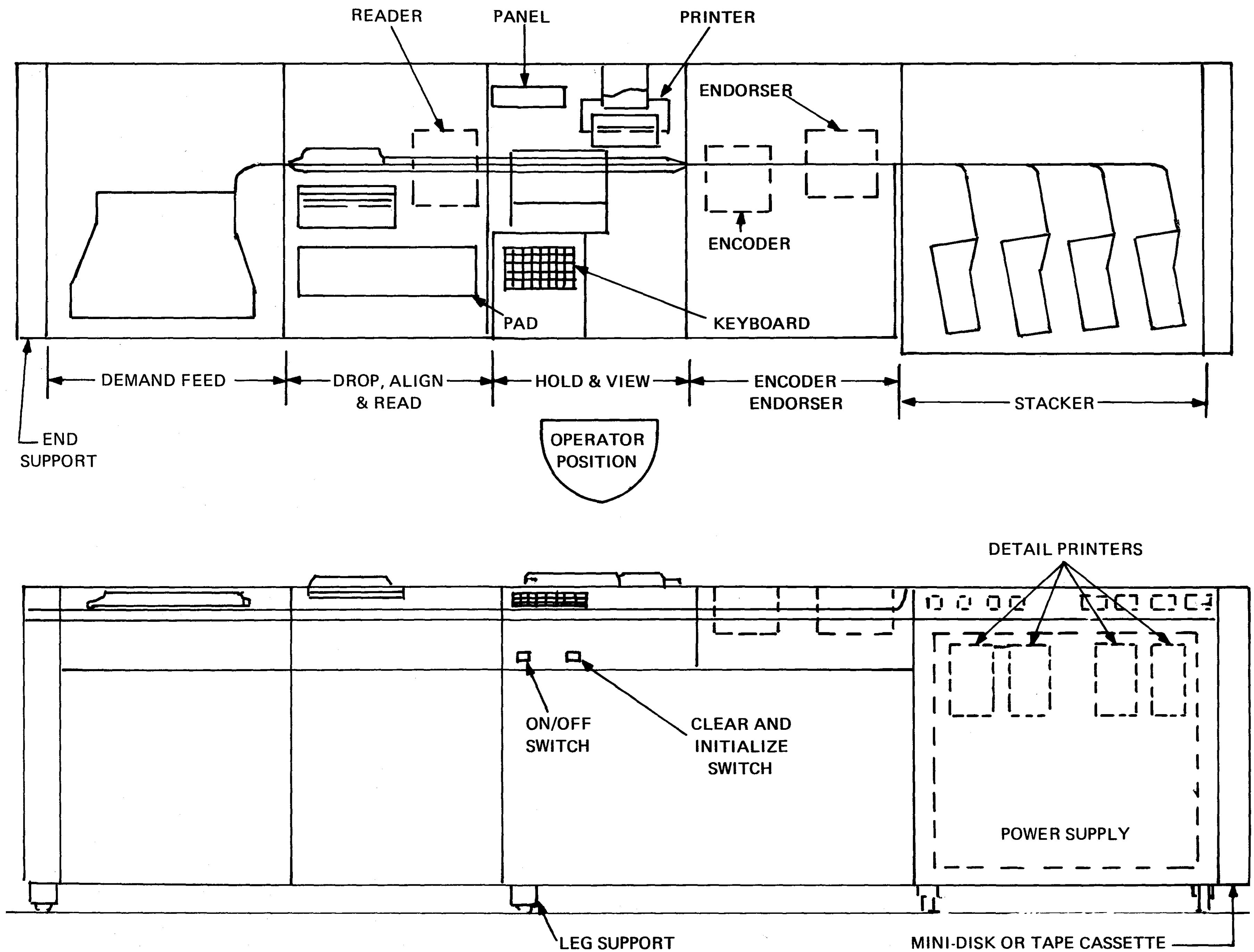


Figure 1-6. The S 1500

SECTION 2

BASIC COMPUTING EQUIPMENT AND OPERATIONS

The basic computing equipment of the S 1000 Series includes:

- a. A processor.
- b. A memory and memory control unit.
- c. Up to eight Input/Output channels.
- d. A 5-channel S device interface.
- e. A controller for each peripheral or system device.

Each of these is discussed later in this section (see figure 2-1).

EXTERNAL SWITCHES.
The system power supply is controlled by two external switches: the Power ON/OFF switch and the Clear and Initialize switch. Both switches are located on the bottom side of the module containing the keyboard (i.e., on the drop and align module of the S 1200 system, and on the hold and view module of the S 1300, S 1400, and S 1500 systems).

POWER ON/OFF SWITCH.
The Power ON/OFF switch controls the power supply to the entire system. It serves both as a power circuit breaker and as an emergency power off switch. As a circuit breaker, the switch is tripped by electromechanically sensing the +24 volt system power supply. It trips to the OFF position under any of the following conditions:

- a. A.C. overcurrent.
- b. The +24 volt supply dropping below the minimum acceptable level.
- c. Detection, by the D.C. power control card, of any voltage out of the system power supply going below the minimum acceptable voltage.

As an emergency off switch, the switch is simply pushed to the OFF position and all system current is terminated.

NOTE
Since the power is required to maintain the contents of the Random Access Memory (RAM), a complete power shutdown is not recommended unless the equipment is to be moved or stored, a prolonged period of inactivity is anticipated, or an emergency condition exists within the system.

In order to reactivate the system after the Power ON/OFF switch has been turned off for any reason, the ON/OFF switch must be pulled forward slowly and held in the ON position until the system power supply exceeds 15 volts. (This is estimated to require approximately 100 milliseconds.) The switch latches into the ON position only if the voltages out of the system power supply are within safe operating ranges.

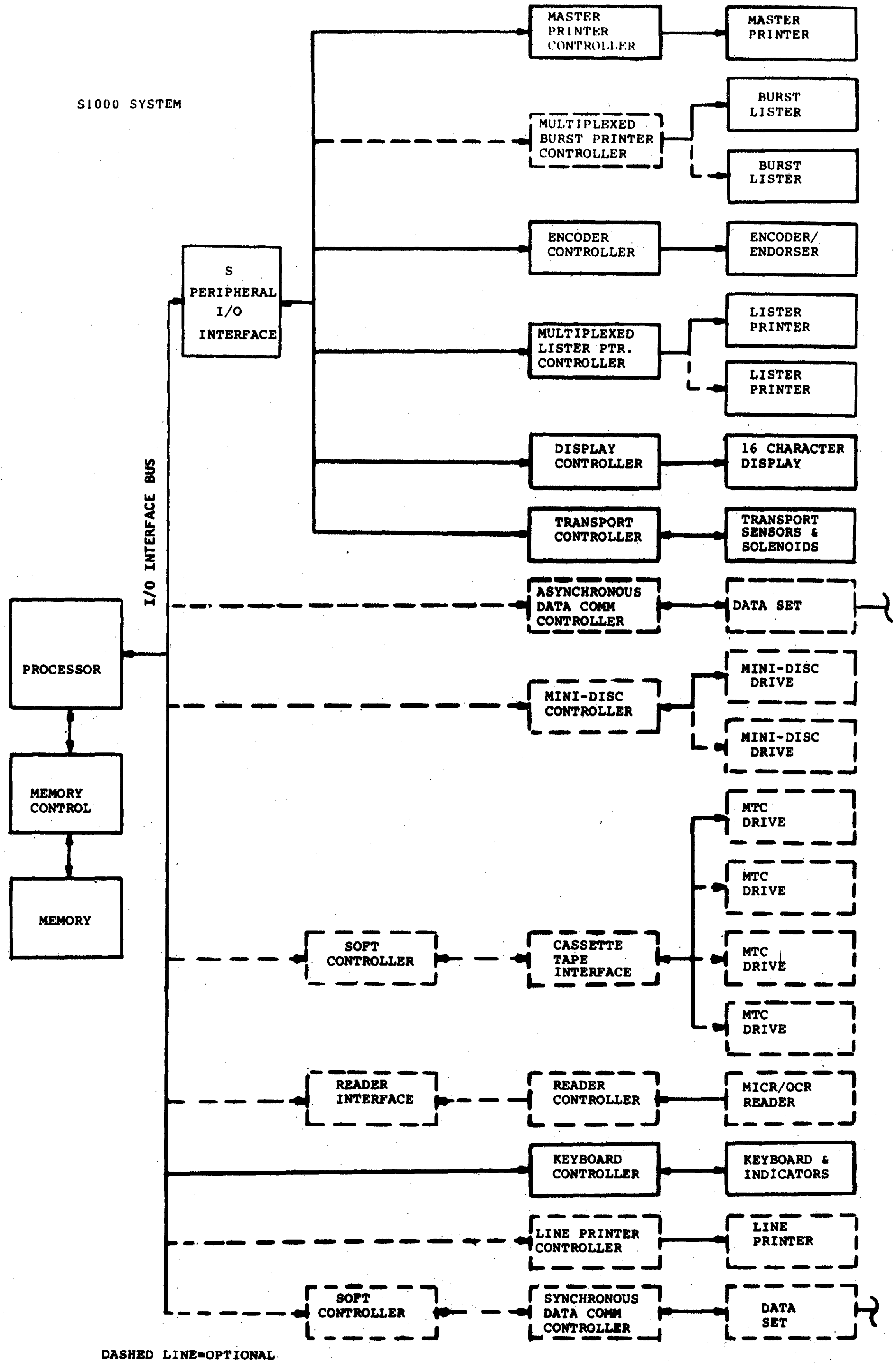


Figure 2-1. S 1000 System Diagram

Whenever the system is switched on in this manner, the hardware is initialized and control then switches to firmware which enters a keyboard entry loop in the Idle mode (refer to the heading, Exiting the Idle Mode). Since the contents of memory are lost whenever power is off, it is necessary to reload the user programs into memory before execution can begin again.

CLEAR AND INITIALIZE SWITCH.
The Clear and Initialize switch is a push button switch which turns off all of the A.C. motors of the system (transport driver, master printer, detail lister) and initiates the hardware without affecting the contents of RAM. Activating the Clear and Initialize switch does not turn off all of the system power supply, but it does cause hardware initialization and entry into the Idle mode just as the Power ON/OFF switch does. This allows program execution without reloading memory. (Refer to the heading, Exiting the Idle Mode.)

THE PROCESSOR.
The processor provides the "intelligence" of any Series S system. It initiates, monitors, and controls all the system devices, controls all the data flow, and performs all the arithmetic and logical operations. Object programs, loaded into memory, are executed by firmware which controls the system hardware.

PROGRAMMING THE PROCESSOR.
All programs for the S 1000 system are programmed in the S 1000 Encoder Programming Language (EPL), a language developed especially for use with the S 1000 Series. EPL programs are compiled on an L 8000 system using the Encoder Programming Language Compiler, which produces compiled object code programs on cassette tape. The object programs can then be loaded from cassette into the memory of the system where they are stored until execution time.

NOTE
For more information on the Encoder Programming Language refer to the S 1000 Encoder Programming Language Reference Manual.

OPERATING MODES.
The processor operates in the following six basic modes:

a. Idle.
b. Memory Load.
c. Program Start.
d. Program Resume.
e. Program Execution.
f. Interrupt.

The Idle mode is entered when the power is turned on after any Memory Load operation, or from the Program Execution mode. Memory Load is a separate operating state which is entered only from the Idle mode. Program Start and Program Resume are entered from the Idle mode only, and each lead directly into the Program Execution mode. From the Program Execution mode, the processor enters the Interrupt mode to handle system interrupt conditions or the Idle mode to begin a system power down condition. (See figure 2-2.)

IDLE MODE. The Idle mode is a pseudo power off mode in which firmware turns off the transport motor, the master printer motor, and the detail printer motors. The encoder and endorser motors are automatically turned off whenever they go idle; therefore, all of the A.C. motors of the system are off during the Idle mode. However, the D.C. power to the backplanes (containing all of the electronic logic and memory of the system) is maintained, so that the system can be activated from the Idle mode without reloading memory.

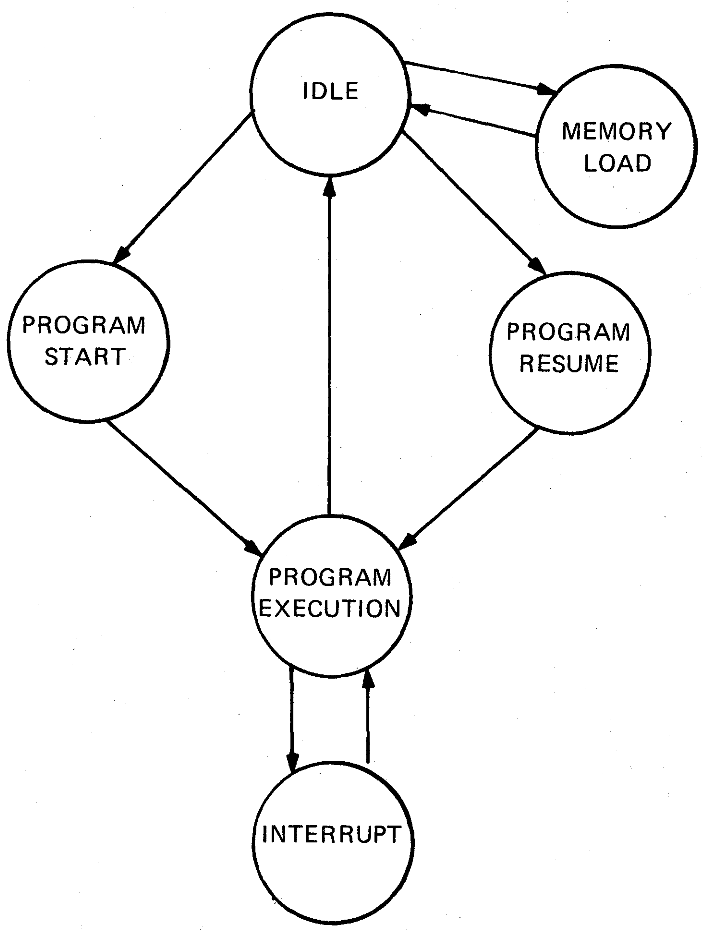


Figure 2-2. Operating Modes

When the system enters the Idle mode, the processor hardware is initialized and firmware enters a keyboard entry loop. The keyboard entry loop allows for the acceptance of certain keyboard entry sequences. From this point, program execution can be initiated or data may be loaded into memory by a Memory Load operation.

Entering the Idle Mode.
The Idle mode is entered by any one of the following actions:

a. Power On - the Idle mode is entered when the system is brought to full power by latching the Power ON/OFF switch into the ON position.

b. Clear and Initialize - the Idle mode is entered when the system is initialized by use of the Clear and Initialize switch.

c. After Memory Load - the Idle mode is re-entered following the completion of any Memory Load operation.

d. System Error Condition - the Idle mode is entered by firmware when any of the following conditions occur. Also, the appropriate display is given on the 18-character display panel.

System Error	Display
Memory Parity Error	All 2's
Subroutine Stack Exceeded	All 3's
Keyboard Entry Error in Idle Mode	All 4's
File Information Area Stack Exceeded	All 5's
Data Comm Procedure not in the System	All 6's
I/O not in the System	All 7's
Memory Load - Cassette Hardware Problem, Cassette File Missing, or Firmware Not Loaded	All 8's
Illegal OP Code	All 9's

e. User Program Selection - the Idle mode can be selected by execution of the STOP instruction. The STOP instruction is coded as part of the user program, or may be effectively entered through the keyboard. If the keyboard entry sequence 97 PROG is made while the user program is in a loop to accept keyboard inputs, then the system enters the Idle mode.

Exiting the Idle Mode.
The Idle mode is exited in any of three ways: Memory Load, Program Start, or Program Resume. Each of these are effected by entering the proper sequence of keyboard entries; all other keyboard entries in the Idle mode are invalid and cause 4's to be shown on the system display panel.

MEMORY LOAD MODE. When 99 PROG (where PROG is the program key) is entered on the keyboard during the Idle mode, the system begins executing the Memory Load routine. The Memory Load routine is a firmware routine which resides in Read Only Memory, where it cannot be destroyed by powering down the system.

After entering 99 PROG, the operator must enter six digits on the keyboard, a 5-digit file identification number followed by a device number. The device number is the number of the physical cassette drive (1, 2, 3, or 4) or disk drive (1 or 2) which is to be used for loading memory. Immediately after the sixth digit is entered, the specified device begins searching for the file by its ID number. If the file ID number is located, then the contents of that file are loaded directly into Read/Write memory. Following a successful load operation, the system returns to the Idle mode with the display screen blanked. If the memory load operation is not successful, then the system returns to the Idle mode with the resulting error condition indicated on the display screen.

Whenever the value of the first digit of the file ID number is between 5 and 9, inclusive, the loader assumes that the file contains Read/Write firmware add-ons and begins loading at the first available location in Read/Write memory. When the value of the first digit of the file ID is between 0 and 4, inclusive, the loader assumes that the file contains an object coded program and begins loading at the base address of memory. The base address is the address of the memory byte immediately following the last byte of Read/Write firmware. The base address is defined by a routine in the Read/Write firmware; therefore, the firmware add-ons must be loaded before the object program is loaded, in order to define the proper base address.

PROGRAM START MODE. When 90 PROG is entered on the keyboard during the Idle mode, the system enters the Program Execution mode and begins executing the user program in memory. Execution of the user program always begins with the first instruction of the first procedure.

PROGRAM RESUME MODE. When 98 PROG is entered on the keyboard, the system exits the Idle mode and returns to the user program instruction which follows the STOP instruction that caused the program to enter the Idle mode. This causes the processor to enter the Program Execution mode of operation.

PROGRAM EXECUTION MODE. The Program Execution mode is entered from the Idle mode by way of the Program Start or Program Resume modes. Both the Program Start and the Program Resume operations provide the processor with an address in memory from which to begin user program execution. If a Program Start operation has been performed, then this memory address is the address of the first instruction of an object coded user program which has previously been loaded into memory. If a Program Resume operation has been performed, then this address is the address of the instruction following the STOP instruction which caused the processor to enter the Idle mode.

During normal user program execution, firmware provides the logic to interpret and implement the object coded statements of the user program. Normal object program execution continues until a STOP instruction is executed, causing entry into the Idle mode, until a processor interrupt occurs, or until 97 PROG is entered on the keyboard.

INTERRUPT MODE. When a processor interrupt occurs, firmware is forced to location zero to begin execution of a routine to interpret the interrupt. This routine determines if the interrupt is 1) a memory parity error, 2) a power on or clear and initialize, or 3) an I/O interrupt. Firmware then branches to the proper routine to handle that particular type of interrupt.

If multiple interrupts occur they are handled in order of priority, as determined by firmware. Only one interrupt is handled at a time. The user can define the priority for the interrupts caused by the system devices and peripherals, but other priorities (e.g., parity error or clear and initialize) have been previously defined and cannot be changed. The interrupt priorities for the system devices and peripherals are defined whenever a set of firmware add-ons are generated. (Firmware add-on sets are generated by an S 1000 allocator program which executes on the L 8000 series of equipment.) Therefore these priorities are defined within the firmware add-on set and cannot be changed unless a different set of add-ons is used.

I/O interrupts occur for a variety of reasons, depending upon the device/peripheral which causes the interrupt. For example, a device may interrupt:

a. Simply to report that it is complete; that is, it has completed its task and is not busy.

b. To request more data from, or to send data to, memory.

c. To report an exception condition (e.g., printer out of paper, cassette tape at end of tape, etc.).

When an I/O interrupt occurs, firmware goes to an area of Read/Write memory which contains the File Information Area (FIA) for the device which caused the interrupt and gets the address of the interrupt routine for that device. Then the processor branches to that address and executes the interrupt routine. After the interrupt condition has been resolved and the interrupt routine has been completed, the processor goes back to the statement it has last been executing when the interrupt occurred and begins normal execution again.

NOTE

Standard interrupt routines are generated by the EPL Compiler, at compile time, for all the devices used in the EPL Program. However, if desired, the programmer may program his own interrupt routines. (Refer to the S 1000 Encoder Programming Language Reference Manual for more information concerning user coded interrupt routines and File Information Areas.)

GENERAL ARCHITECTURE.

The processor consists primarily of a function unit, a general purpose register file, a Memory Address Register (MAR) file, three buses, a 1 MHZ clock, and the processor Input/Output facilities (see figure 2-3). All data paths within the processor and all interfaces with the memory and the I/O channels are eight bits wide.

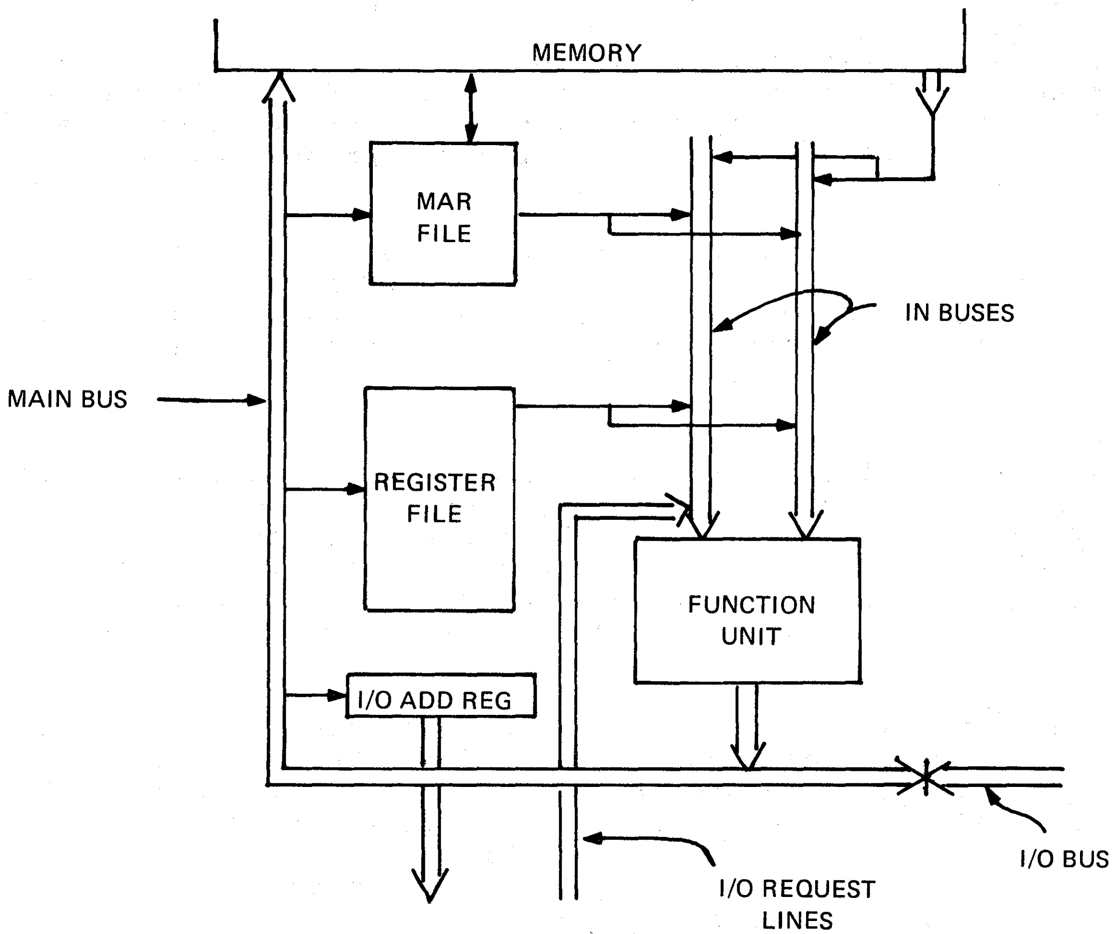


Figure 2-3. General Processor Architecture

FUNCTION UNIT. The function unit consists of two Arithmetic and Logic Units (ALU's) which provide 16 arithmetic and 16 logic functions. The unit operates on inputs from the two IN-buses and produces results onto the main bus. In conjunction with the general register file, the function unit provides such functions as decimal (BCD) arithmetic, serial shifting, zone stripping, etc.

REGISTER FILES. The general purpose register file contains the registers used by the function unit. These registers are loaded by the function unit via the main bus and are unloaded to the function unit via the two IN-buses.

The MAR file contains address registers used to define memory addresses. The MARs are loaded by and unloaded to the function unit in the same way as the general purpose registers.

INPUT/OUTPUT FACILITIES. The processor Input/Output facilities include an 8-bit I/O channel address register, eight I/O request lines, and an 8-bit bidirectional I/O bus. All of the I/O communications of the processor are maintained by these facilities.

The I/O address register is used by the eight I/O channels to request a processor I/O interrupt. These eight lines are loaded to the function unit through one of the IN-buses. Firmware provides the logic to interpret I/O requests, determine priorities, and execute interrupt/exception routines.

The I/O bus is an 8-bit bidirectional bus which is interfaced with the main bus of the processor. Data, control commands, status information, and device addresses are sent to and from the processor, in a byte-wise fashion, through this I/O bus, at a transfer rate of 1 MHZ.

HARDWARE.
The processor is constructed on one printed circuit card which contains nine LSI (Large Scale Integrated circuit) packages, two TTL MSI (Transistor-Transistor Logic, Medium Scale Integrated circuit) Arithmetic and Logic Units, a small number of digital I.C. circuits, and a 1 MHz clock. The processor also contains micro programming logic that enables it to interpret high level languages and control peripheral devices.

Data paths within the processor are eight bits wide as are the paths at the processor memory and the processor Input/Output interfaces. Eight bidirectional Input/Output channels may be serviced by the processor. Data movement within the processor is enhanced by having the capability of multiple character transfers in a single micro instruction and by employing an overlapping technique in the fetch and execute mechanisms of the micro processor.

MEMORY.
The processor memory is a byte-oriented, Metal Oxide Semiconductor (MOS) memory used for storage of the system firmware, the user program, and data. All memory read and write operations are dictated by the processor and are maintained by the memory control unit.

BASIC MEMORY.
The basic memory configuration (i.e., for the S 1200) consists of 4K (4096) bytes of ROM and 4K bytes of RAM. This much memory meets the needs of the basic system, but more memory is required for systems with additional devices.

The 4K bytes of MOS ROM are programmed prior to installation and cannot be programmatically altered. This ROM contains the micro instructions for the Memory Load routine, for the basic interpretive firmware, and for the basic S 1000 I/O devices.

Of the 4K bytes of RAM, approximately 1240 bytes are used by the firmware as a scratchpad area. The rest of RAM is used for storage of add-on firmware modules, as well as user programs and data. The various add-on firmware modules include the micro instructions required to use the additional S 1000 I/O devices, such as data comm and MICR read. User programs, coded in the object language, and firmware add-ons must be loaded into RAM by a memory load operation prior to program execution. The RAM is volatile and is destroyed whenever the system power is shut off. Therefore, the object program and the firmware add-ons must be reloaded after every power off condition.

NOTE

Currently the only firmware set which is programmed in ROM is the Memory Load routine. All other firmware sets, including the Basic Interpreter, the S 1000 I/O firmware, the keyboard firmware, etc., must be loaded into Read/Write memory. Therefore, a typical memory layout would be similar to that shown in figure 2-4.

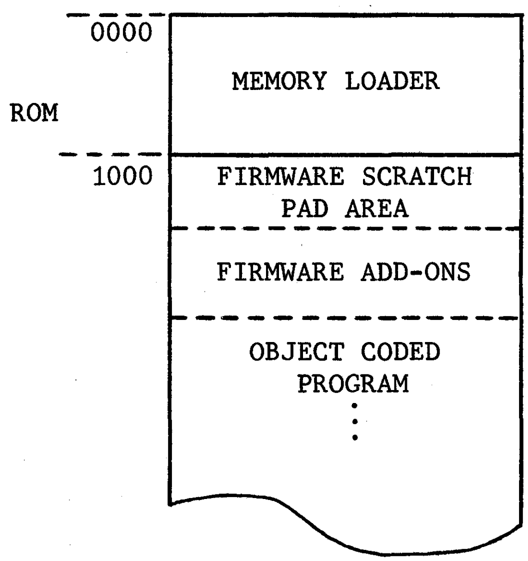


Figure 2-4. General Memory Map

MEMORY SAVE.

The EPL Compiler provides two utilities to facilitate the recovery of user Read/Write memory and to begin program restart after a loss of power. The Memory Save utility allows the contents of user defined registers in RAM to be captured on cassette, or mini-disk, on a periodic basis. So that following a loss of power the firmware add-ons and the user program must be reloaded; then the Restart utility can be used to restore the user defined registers to their values at the time of the last Memory Save operation. (Refer to the S 1000 Encoder Programming Language Reference Manual for more detail on register save and program restart.)

ADDITIONAL MEMORY.
Additional memory space, above the 4K ROM/4K RAM configuration, is required for storage of additional firmware and scratchpad areas for the additional devices, as follows:

Device	Memory Required (Estimated)
Data Comm - Asynchronous	2.0K
MICR/OCR Reader	1.0K
Line Printer	0.2K
Mini-Disk	1.0K
Hold and View	0.1K
Auto Feed	0.1K

Additional memory is available in 4K byte modules of RAM on printed circuit boards. The circuit boards may be plugged into the processor gate area located below the keyboard module. The total memory capacity of the system is 32K bytes, including the 4K bytes of ROM.

MEMORY CONTROL UNIT.
The memory control unit receives the memory request of the processor and allocates the next available memory cycle to perform that request. The processor can make three types of memory requests: READ, WRITE, and READ AND CLEAR. A READ AND CLEAR request causes a memory read and clears the byte to all zeros. If a memory access cannot be granted immediately, the processor conditions are maintained until a memory access is granted. If a memory read is unsuccessfully completed, the processor enters the interrupt state. During a write cycle the memory control unit generates a parity bit and writes the byte in memory.

Data to be written in memory is received from an 8-bit input buffer. This input buffer can be loaded by the function unit of the processor or by the I/O bus of the system (see figure 2-5). Data is read to an 8-bit output buffer. The output buffer is then unloaded to the function unit. The memory cycle time is 1 microsecond.

INPUT/OUTPUT.
All communications between the processor and the peripheral/system devices are maintained by the Input/Output facilities of the system and the individual device controllers. All transfers through the I/O channels are controlled by the processor which uses program interruption to process I/O activities. Because the devices and peripherals have their own controllers and data buffers, the processor simply transfers data, initiates a device, and then leaves the control of that device to its own particular controller. Therefore, several devices can operate at one time without the attention of the processor.

As an example, to execute an encode and sort function the processor loads the encoder controller buffer with the encode field and a pocket select number, then initiates the encoder and goes on executing the user program. When the encoder finishes encoding and sorts the document

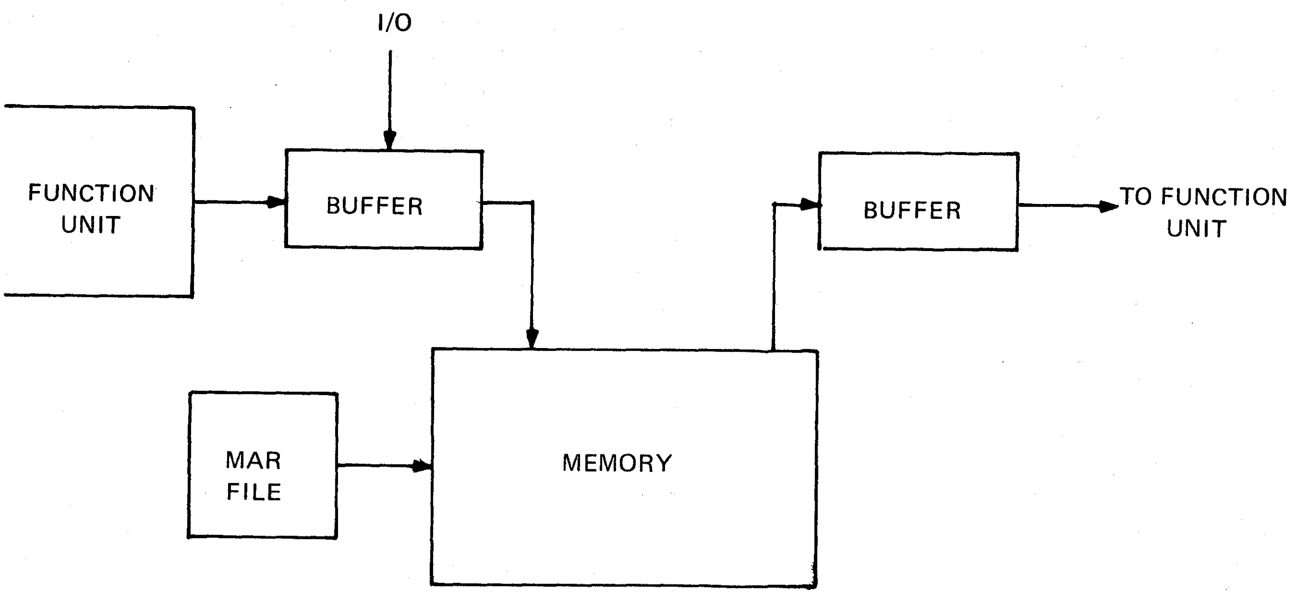


Figure 2-5. Memory Data Flow

to a pocket, it interrupts the processor simply to report that it has finished the task and is no longer busy.

ARCHITECTURE.
The Input/Output architecture includes eight I/O channels, an 8-bit channel address register, and eight I/O request lines. On the basic system only two I/O channels are used (refer to figure 2-1). One channel is connected to the S device interface, and the other is connected to the keyboard controller. Systems with additional devices use more of the eight possible channels.

The I/O channels are eight bits wide. They are capable of bidirectional transfers of information between the processor and the device controllers. On the processor end, the Input/Output bus is interfaced with the main bus of the processor (refer to figure 2-3). On the device end, the channels are either interfaced with the individual device controllers or with the S device interface.

The channel address register contains eight bits. One bit is used to select each I/O channel as requested by the processor. This address register is loaded by firmware. The actual hardware addresses of the devices are defined at the time of installation.

The eight I/O request lines provide input to the function unit of the processor. One line is available for each I/O channel to make requests for processor attention. The request lines are used to initiate interrupts and to determine interrupt priorities.

S DEVICE INTERFACE.

The S device interface serves as a Channel Expander Unit (CEU) to connect five of the basic device controllers to one I/O channel. This device interface serves primarily as a decoder/encoder to facilitate the necessary communications between the master printer, encoder, detail lister, console display, and transport controllers and the processor over a single 8-bit I/O channel. (Refer to figure 2-1.)

The four low order bits of I/O commands transferred through the S device interface are used to indicate which controller is sending or receiving a message. Then, the four high order bits are used to define the type of command.

DEVICE CONTROLLERS.

Each device of a series S system is directly controlled by its own hard wired controller. A device controller receives commands from the processor over the I/O channels, decodes the commands, initiates the appropriate device action, and returns information from the device back to the processor. Each controller contains a buffer to store data that is either received from the processor or is held to be sent to the processor. Since the device controllers are strictly associated with their own devices, they are discussed in more detail in the sections concerning the individual devices.

SECTION 3

DOCUMENT TRANSPORT SYSTEM

GENERAL.

The document transport system is an integral part of a Series S system which passes documents from module to module during the processing sequence. All documents are transported with the top edge visible at all times to permit the operator to remove them from the system if necessary. (Refer to appendix B for document dimensions.)

The transport system is controlled by the user program, the system firmware, and the transport controller hardware. The transport controller is connected to the processor via the S device interface. The user must load documents into the system and program the processor with EPL instructions to determine the movements of the documents throughout the transport system.

The transport system consists of a series of caster drive wheels, belts, and document sensors, and the transport controller. The drive wheels and belts force documents from station to station under the instruction of the transport controller. The document sensors report the location and status of each document back to the transport controller which uses the information from the sensors to make its own hardware decisions in order to prevent document jamming, missorting, and double processing (processing two documents as one). For example, the S 1500 hardware does not allow a document to release from the automatic feeder if another document is still in the reader module.

The best way to explain the total transport system is by way of example; therefore, this section explains the step-by-step movement of documents through each of the Series S systems. There are three phases of document transport control in each system: control prior to program control, program control, and control after program control. Program control varies for each system, so each is discussed in detail. The other areas of control are similar for all systems, and they are discussed in general terms.

Figures 3-1 through 3-4 illustrate the particular transport systems for each of the Series S models and indicate the document flow.

DOCUMENT CONTROL PRIOR TO PROGRAM CONTROL.

There are, in each system, certain modules known as document entry stations (e.g., drop and align module or hold and view module) where documents are fed into the system. When the transport is on, documents are moved from the entry station automatically (i.e., under the control of the transport controller hardware) to a specific location in the system independent of system software and firmware control. Movement beyond this point, however, requires a command from firmware to release the documents to the next station.

PROGRAM CONTROL IN THE S 1200.

On the S 1200 system, documents are manually inserted at the drop and align module. From here they are automatically moved to the encoder, provided the encoder is not busy (does not already have a document

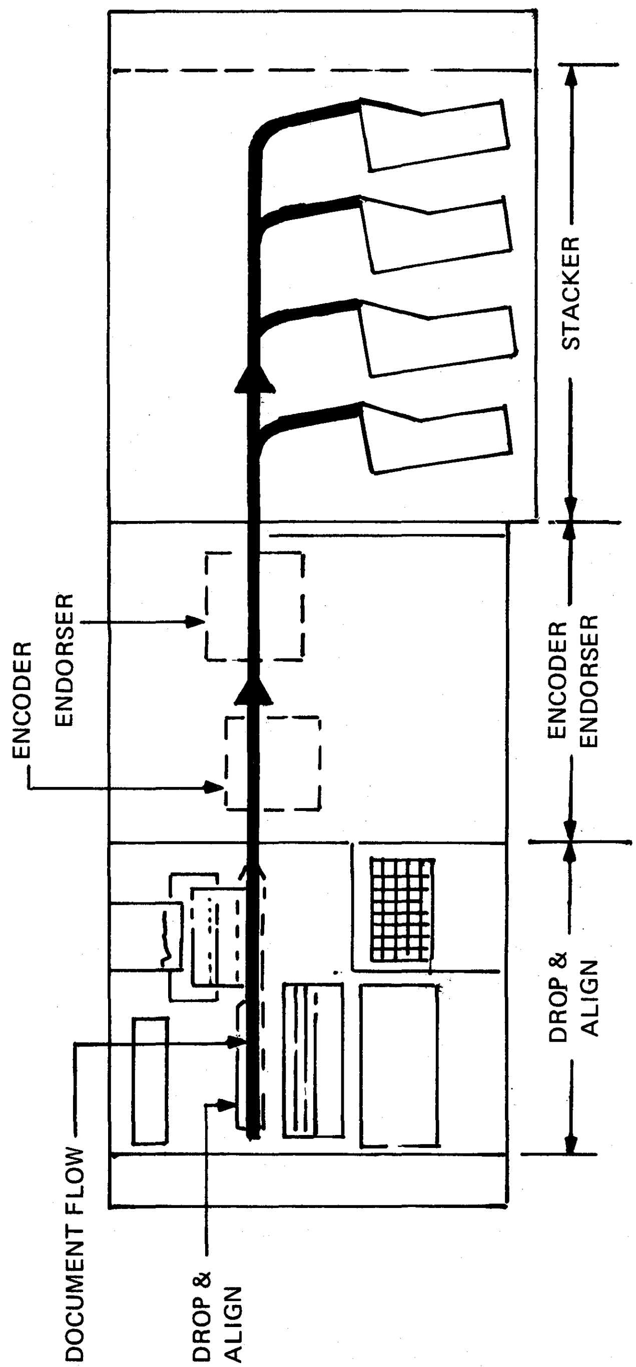


Figure 3-1. The S 1200 Document Transport System

in it). If the encoder is busy, then the document remains in the drop and align station until the encoder is not busy. This activity is completely controlled by the transport controller hardware.

Programmatic document control begins at the encoder station. Here the user program issues instructions to encode, endorse, and sort documents. Documents move at a speed of 2 1/2 inches per second during OCR encoding and 3 1/8 inches per second during MICR encoding. Documents which are not to be encoded are immediately accelerated to the sorting speed of 75 inches per second. If the system is programmed not to encode nor to endorse, the documents move through the encoder/endorser module without hesitation.

PROGRAM CONTROL IN THE S 1300.
In S 1300 systems, documents are manually inserted into the drop and align module. From here they are processed through the reader station, providing the hold and view station is not busy. A document is not released from the drop and align module until the hold and view station is cleared. This activity is controlled by the transport controller hardware.

Control of document movement in the hold and view module is primarily a hardware function of the transport controller. Documents are halted and raised for viewing automatically in the hold and view station unless a HOLD AND VIEW RELEASE command is issued by firmware before the document reaches the station. If a previous document is still in the encoder station, then the document in the hold and view station is automatically held, without being raised, even if the RELEASE command is issued.

Documents which are held and viewed are released as soon as: (1) the HOLD AND VIEW RELEASE command is issued, and (2) the encoder station is clear of documents.

Should the operator remove a document that has been raised, a unique status is provided when the HOLD AND VIEW RELEASE command is issued:

a. The hold and view station reports as not being busy, thereby allowing another document to enter it.

b. The VIEW status remains set. This information is made available to the user program for decision making.

After a document is released from the hold and view module, it enters the encoder where it may or may not be encoded, as in the S 1200. Program control ends after the document leaves the encoder.

PROGRAM CONTROL IN THE S 1400.
On the S 1400 system, a stack of documents can be loaded into the demand feed module for automatic feeding. The first document is fed as soon as a FEED command is issued by firmware. Subsequent documents are fed automatically up to a point where they are halted if the hold and view station is busy.

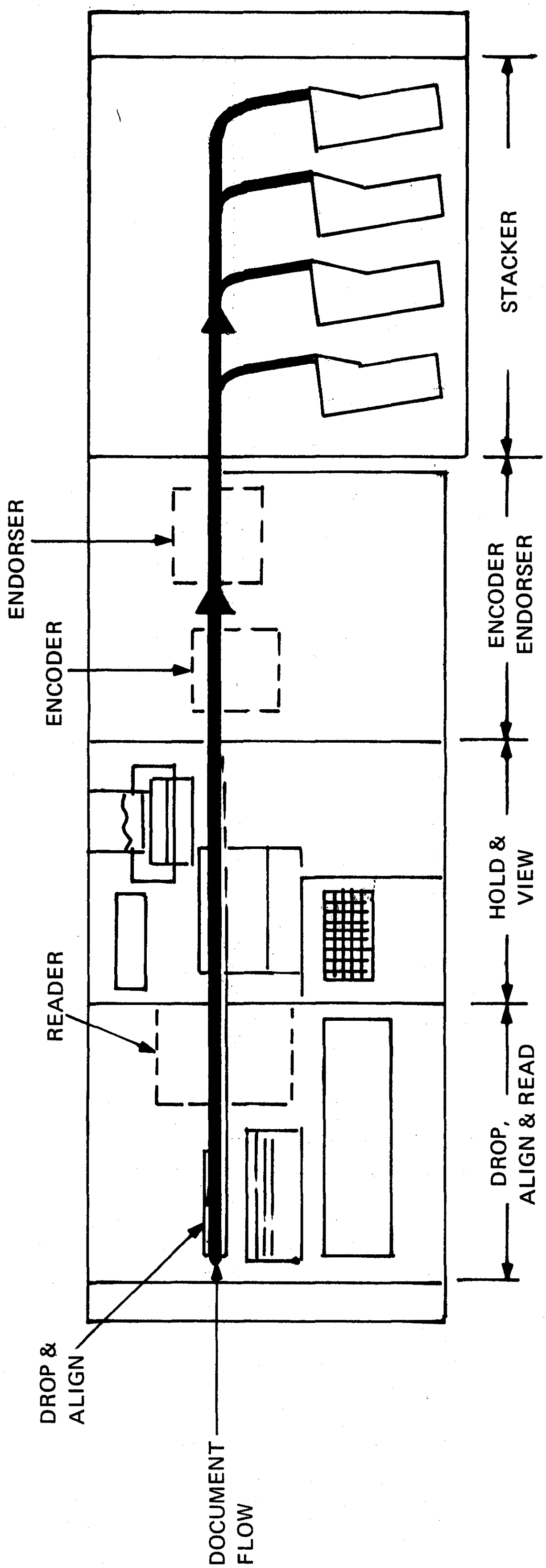


Figure 3-2. The S 1300 Document
Transport System

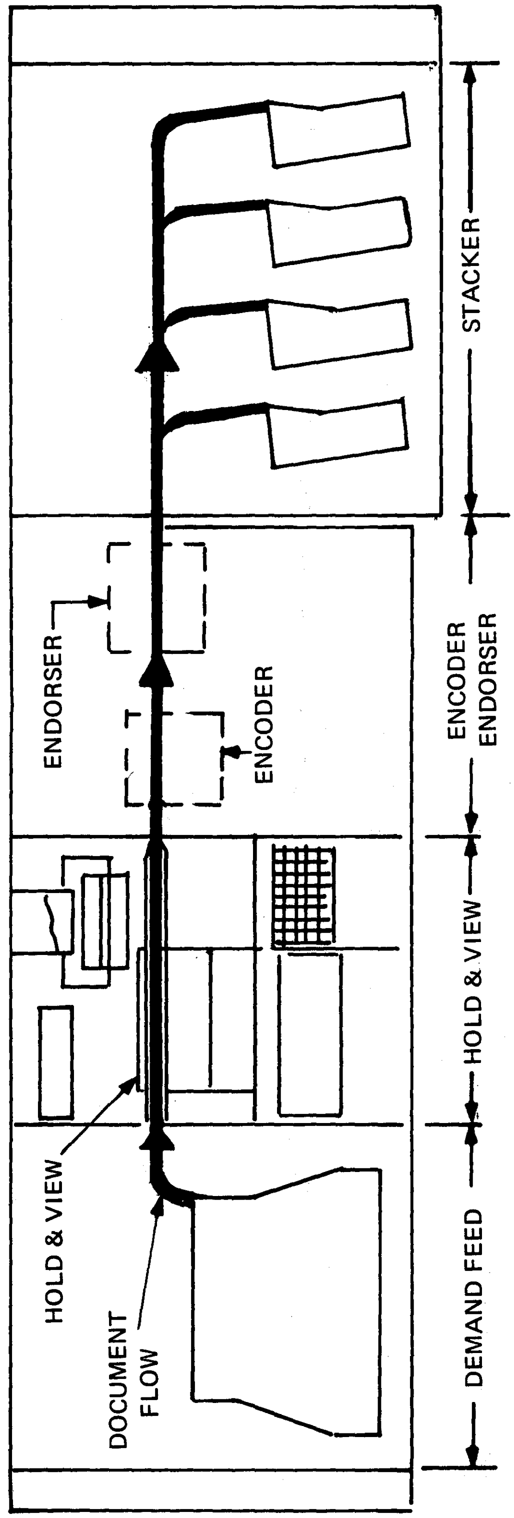


Figure 3-3. The S 1400 Document Transport System

Documents move from the demand feed module into the hold and view station as soon as the hold and view is clear. Document control from the hold and view module on is the same as in the S 1300. If desired, documents may be manually inserted into the drop station of the hold and view module where they are processed just as if they have been fed automatically.

PROGRAM CONTROL IN THE S 1500.

On the S 1500 system, a stack of documents can be loaded into the demand feed module for automatic feeding as in the S 1400 system. Document control from the demand feed module through the MICR reader is a hardware function of the transport controller. the first document feeds through the drop and align station and the MICR reader into the hold and view station. Subsequent documents automatically feed up to a point in the read module (this operation is initiated by the reader controller hardware after the previous document has cleared the reader). This action is known as the "keep-full" operation, and it may be inhibited for a single document by a NO FEED command, which permits the operator to insert a document manually at the drop and align station.

After a document is processed by the reader it passes to the hold and view station. However, a document is not processed by the reader if the hold and view station is busy. From the hold and view station on, documents are controlled just as they are in the S 1300 system.

DOCUMENT CONTROL BEYOND PROGRAM CONTROL.

After documents leave the encoder/endorser module they enter the control of the transport controller to be sorted to a specified pocket. The documents are released from the encoder to the stacker area following a successful encoding operation or after recognition of a firmware RELEASE NON-ENCODE command. After leaving the encoder, a document is accelerated to a sorting speed of 75 inches per second.

When a document is released from the encoder, a track block timer begins its 360-400 millisecond timer cycle and the paper drive motor at the encoder is shut off. A document is allowed to enter the first stacker module only if the previous document has entered pocket 1 or 2 or has been detected between pockets 2 and 3, or if the track block timer has finished its timing cycle.

A jam/missort status is reported and the processor is interrupted whenever:

a. The track block timer finishes its cycle and a document has not been detected between pockets 2 and 3 or is not reported as entering pocket 1 or 2.

b. The timer associated with any one of the stacker modules in the system finishes its timing cycle and a document has not been detected as entering a pocket of that module or entering the next module.

c. A document is reported entering the wrong pocket.

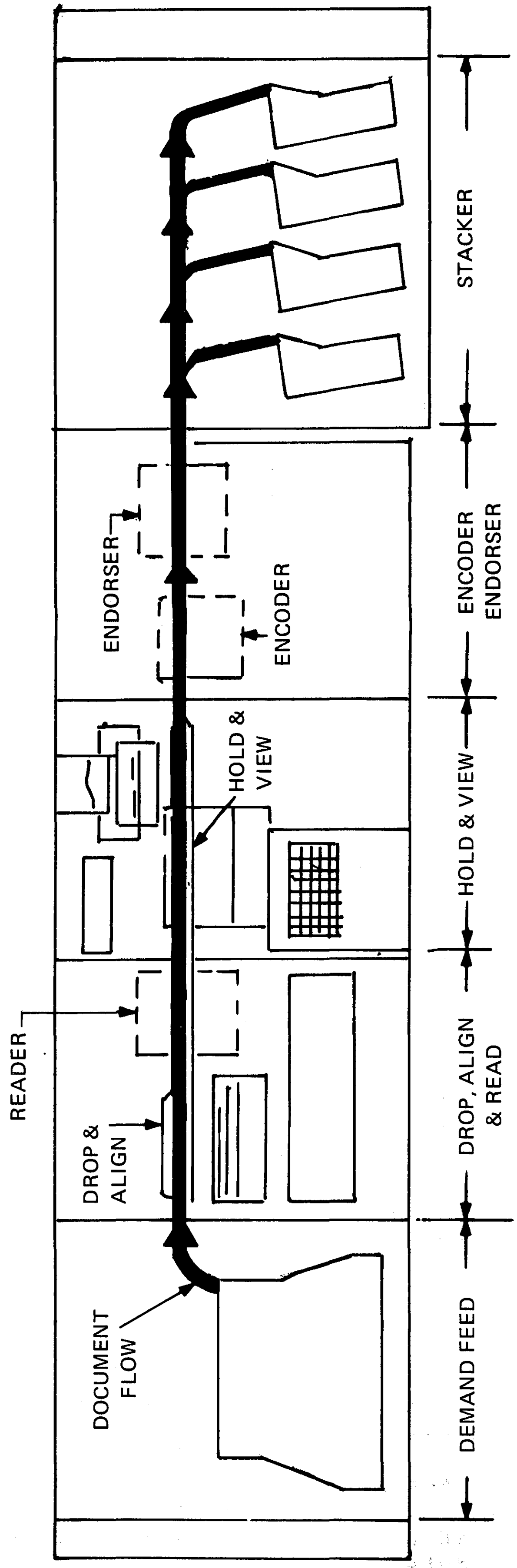


Figure 3-4. The S 1500 Document Transport System

This condition may require operator intervention to remove the document or place it in its proper pocket. The transport does not operate until the interrupt condition is resolved by the processor.

TRANSPORT ON/OFF CONTROL.
The transport drive system is turned on and off by the transport controller as instructed by the user program. When the transport is off and the user program requests a transport function, the firmware automatically issues a command to turn on the transport.

If the transport is on when the Idle mode is selected, firmware issues a command to turn the transport off. Also it can be turned off automatically under user program control when there is no document in the transport system for a period of 20 seconds; whenever the transport is inactive for 20 seconds, a status bit is set in the transport controller which in turn initiates an interrupt in the processor. During this interrupt firmware checks to see if the user program wants the transport turned off; if so, firmware turns it off.

DOCUMENT MOVEMENT SPEEDS.
Documents move at a speed of 75 inches per second up to the encode station. They move at a speed of 2 1/2 inches per second during OCR encoding (10 characters to the inch) and 3 1/8 inches per second during MICR encoding (8 characters to the inch) as a result of the 25 character per second encoding rate. Documents move at a speed of 75 inches per second in the stacker modules. A high speed of 75 inches per second is maintained through the encoder/endorser module when a RELEASE NON-ENCODE command is issued by firmware, provided that the stacker document track is cleared of documents.

SECTION 4

BASIC SERIES DEVICES

The S 1200 system is the basic system of the S 1000 Series. It contains the basic devices of the product line. All other models of the Series are produced by adding on additional devices. This section describes each of the devices of an S 1200 system, and thereby, each basic device of any S 1000 Series system. The additional devices are to be described in sections which are to be available at a later date.

DROP AND ALIGN.

The drop and align station is used for manual insertion of documents into a system. When a document is dropped into the drop track, it is forced down into the track and aligned to the next station, providing the next station is not already busy (is not already loaded with a document). If the next station is busy, the inserted documents are held back and not aligned until the next station is cleared. This operation is controlled by the hardware logic of the document transport controller.

The drop and align station is installed as an integral part of the drop and align module (figure 4-1) in S 1200 systems and as part of the drop, align, and read module in the S 1300 and S 1500 systems. In an S 1200, the drop and align station aligns documents to the encoder station. In S 1300 and S 1500 systems, it aligns documents to the MICR reader station.

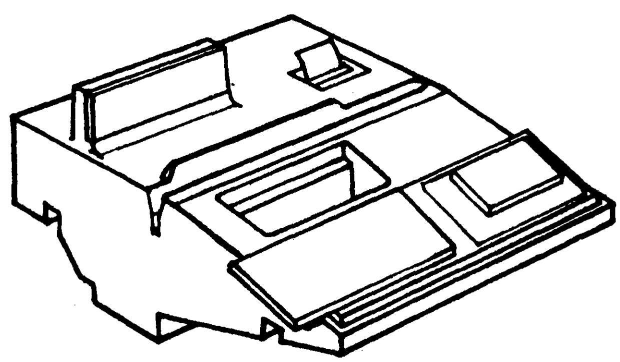


Figure 4-1. Drop and Align Module

KEYBOARD.

The keyboard is used by the operator to communicate with the processor. The following may be entered through the keyboard:

a. Reference numbers.
b. Numeric amounts.
c. Program identification numbers.
d. Entry modifiers.

The keyboard is installed as part of the drop and align module in the S 1200 and as part of the hold and view module in the other systems. The keyboard contains 33 individual keys: 10 numeric keys, 3 special function keys, and 20 variable function keys. The 4, 5, and 6 keys of the numeric keys have a concave surface on each keytop so that they are distinguishable as the "home row". In addition, the 5 key has a small tip in the center of its keytop to distinguish it from all other keys. The variable function keys are all capped and unlabeled to permit the user to define and assign each individual key function. See figure 4-2 for a recommended set of standard key labels.

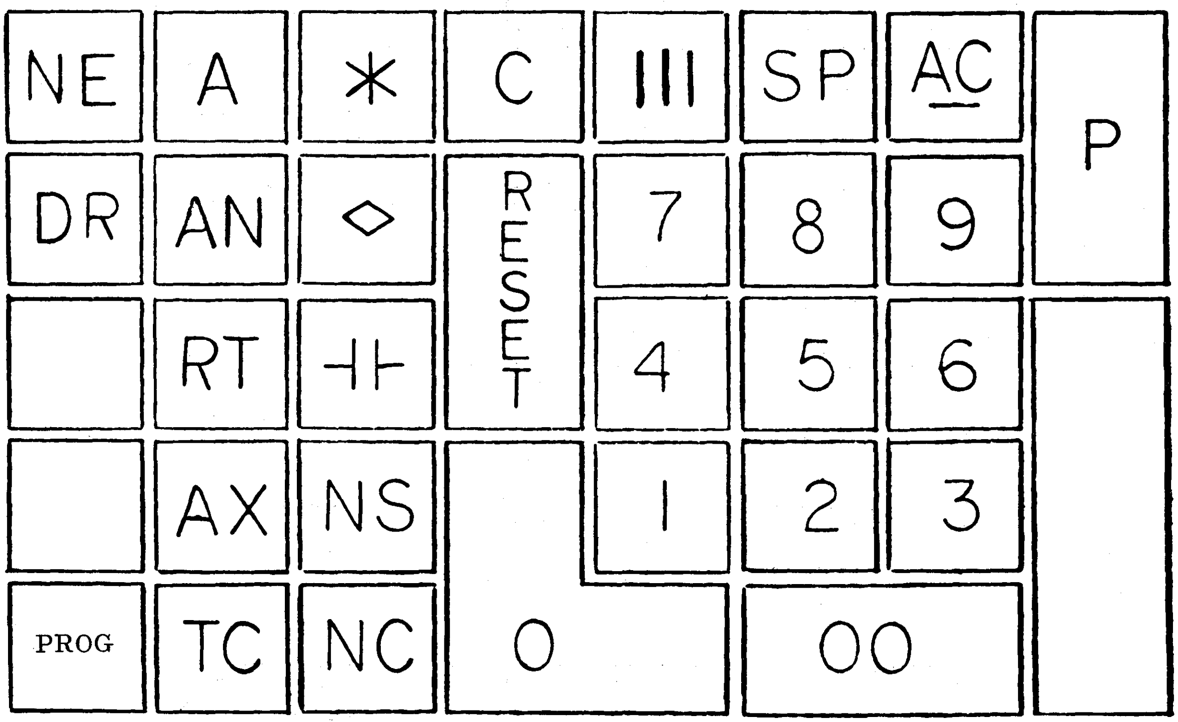


Figure 4-2. Sample Keyboard

Along with the 33 keys, the keyboard unit contains a printed circuit board on LSI MOS circuits which provides code generation, scanning logic, and the key rollover feature. Actuation of a key causes the keyboard circuits to emit a particular code for that key (figure 4-3 gives the codes for all the keys). The interpretation of these codes is then a programmatic (system software/firmware) function of the processor. The user program and the system firmware are programmed to control the acceptance and enforcement of keyboard entry sequences at various times during execution. Keyboard entries are accepted only when either the user program or the system firmware has initiated a keyboard read request. If no such request has been made, then the keyboard inputs are not accepted.

ASSIGNED FUNCTION KEYS.
Thirteen keys of the keyboard have predetermined functions. These keys and their respective functions are:

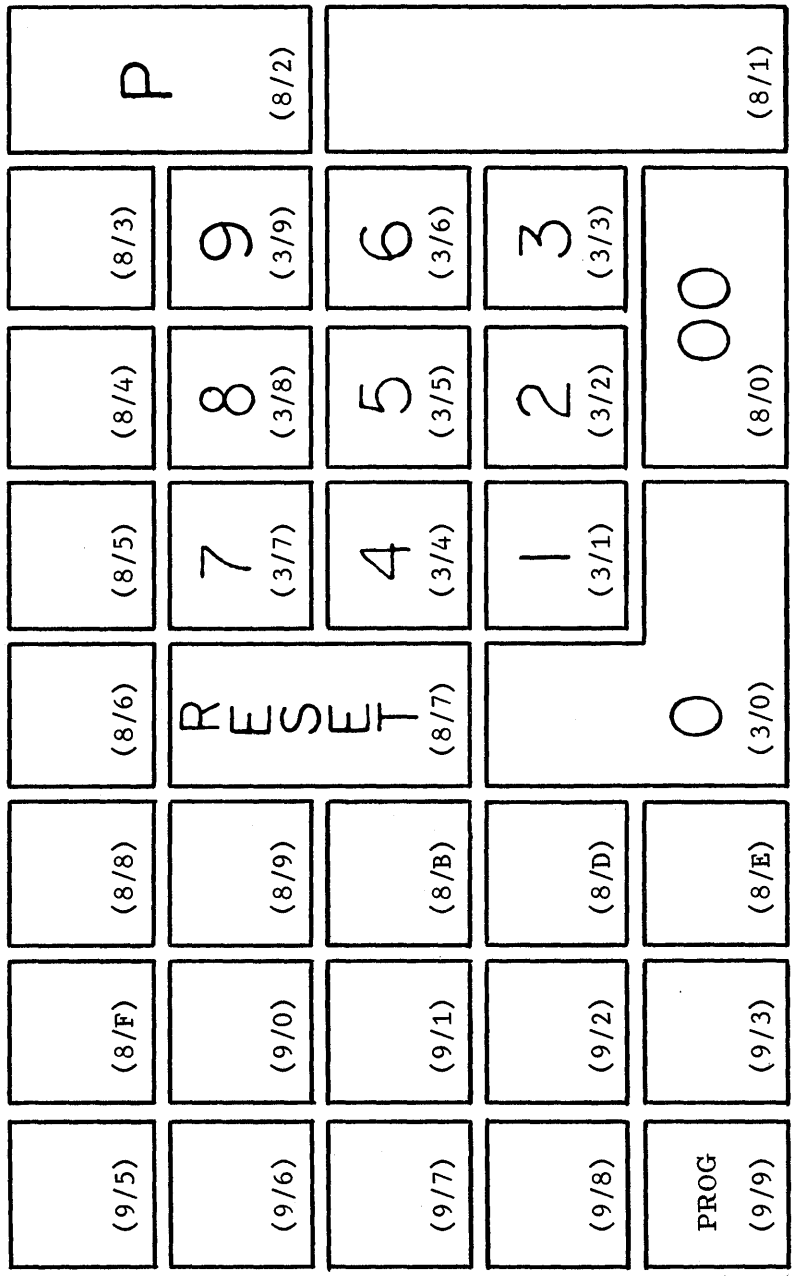


Figure 4-3. Keyboard and Key Codes

a. Numeric - each of the 10 numeric keys are interpreted as decimal digits.

b. Double Zero - the double zero (00) key is interpreted as two zeroes in a decimal field.

c. RESET - the RESET key (code 8/7) is used to clear amounts and override keys that have been entered prior to the use of a terminator key. It can also be used to notify the system that a problem condition has been remedied. The actual interpretation of this key is a firmware function. Firmware can execute a keyboard read with reset instruction in which case no entries are recognized until the code 87, for reset, is entered.

d. Program - the program key (PROG) is used after entering one or two digits to identify the digit(s) as program selectors. Whenever this type of sequence of entries is made, a program begins executing; it may be a user program or a utility program.

VARIABLE FUNCTION KEYS.
The remaining 20 keys of the keyboard are defined in the user program. These are classified as either "terminators" or "override keys":

a. Terminators - a terminator key is a control key which is recognized by the system as a data field delimiter. Whenever a terminator key code is recognized by the system, the keyboard instruction is considered complete. The following are a few examples of terminators as they appear in figure 4-2:

Key Label	Function
Large Unmarked Bar	Debit Entry
AC	Additional Credit
*	Total Key

b. Override Keys - an override key is a control key, other than a terminator, that modifies and/or identifies a sequence of data and/or functions. The following are a few examples of override keys as they appear in figure 4-2:

Key Label	Function
NS	Non-Sort
NC	Non-Encode
C	Correction
SP	Space

NOTE
When coding EPL Programs, do not use the code values of the assigned function keys for any variable function key.

KEYBOARD CONTROLLER.
The keyboard is linked to the processor by the Keyboard-Switch-Indicator controller (KSI). In addition to handling the keyboard inputs, the KSI

also controls the Idle mode and certain data comm indicator lights on the display panel. The KSI controller contains a 4-character FIFO buffer and two registers known as the S register and the D register. The 4-character buffer stores keyboard inputs as they are received, awaiting transmission to the processor. The S register stores a single character code received from the processor which either turns the Idle mode indicator on (code 08) or off (code 00). The D register is a single character register which stores a character code to control all data comm indicators other than the Carrier Detect indicators. If the bit to a particular indicator is set (value 1), then that indicator is turned on; otherwise, that indicator is turned off. The bit/indicator assignments are as follows:

Indicator	Channel	Bit	Channel	Bit
Data Received Complete	1	7	2	3
Send Data Ready	1	6	2	2
Control Received	1	5	2	1
Control Sent	1	4	2	0

The KSI controller processes keyboard entries in two separate states. First, when no read request has been initiated, then the controller interrupts the processor after three characters are entered into the FIFO buffer. Second, when a read request has been initiated, then the controller interrupts the processor after each character enters the FIFO buffer until a complete entry is recognized. In either case, it is the responsibility of the system software/firmware to interpret the keyboard inputs.

MASTER PRINTER.
The master printer is a 21-column drum printer which produces a complete trail of system activities. It can be used to record:

a. Numeric amounts.
b. Document serial numbers.
c. Item counts.
d. Transaction codes.
e. Dates.
f. Other reference numbers.
g. Memory dumps.
h. Trace programs.
i. Program selection numbers.
j. System alert messages.

See figures 4-4 and 4-5 for some examples. The master printer is installed as part of the drop and align module in the S 1200 and as part of the hold and view module in the S 1300, S 1400, and S 1500 systems.

```
                        00◁
01847              100.00     1
01848               50.00     5
018496661          150.00   C19
         2            .00*E
01850                5.04     4
01851               21.00     7
01852              200.50     2
01853              354.50     1
01854               62.25     7
01855              464.56□    7
01856               47.56     3
01857              101.13     7
                   270.04◁    1
01858                5.25     1
01859               50.05     7
01860              100.00     3
01861    774       155.64   C20
                 1,526.54   C
                      .30-E
                    50.05-    7
             123  4567RT
         354  30  524AN
             646  0766AX
01862               50.35     7
01863    661     1,526.54   C19
          12          .00*E
01864               93.45     1
01865    774        93.45   C20
                      .00*E
01866              110.00     3
01867              235.00     7
01868               45.00     6
01869    661       390.00   C19
           3          .00*E
                      .00*A
                    46.50+A
                    93.01+A
                    11.50-A
                   128.01◇A
                    74.95+A
                   202.96*A
                      .00*A
01870     99     2,315.63*
01871     99       823.24*    1
           5
01872     99       934.29*    7
```

Figure 4-4. Master Audit Tape

SYSTEM ALERT MESSAGES
ON MASTER AUDIT TAPE

COLUMN					
6	5	4	3	2	1
B	E	G	I	N	
A	D	R			
	P	R	O	G	
	D	A	T	A	
	M	E	S	G	
	E	R	R	O	R
	A	L	E	R	T
	S	T	A	R	T
	P	R	I	N	T
	S	T	O	R	E
	M	T	C		
		G	O		
		T	O		
		A	T		
		T	C		
		R	T		
		R	U	N	
		L	O	A	D
		L	I	S	T
		L	A	S	T
		S	T	O	P
		R	E	A	D
		S	E	N	D
			I	N	
			O	N	
			U	S	
			N	O	
			E	N	D
			N	O	T
			N	O	R
			A	N	D
				O	R
				S	P
			N	S	

Figure 4-5. System Alert Messages

The output for the master printer is supplied and formatted exclusively by the user program within the limits of the available characters on the printer drum (see figure 4-6).

The master printer has a possible print speed of 3 lines per second, and the last line of print is visible to the seated operator immediately after it is printed. Also, a powered space switch, located on the printer cover, is provided to assist in loading paper and to automatically advance the printed tape. Whenever the master printer runs out of tape, the system is alerted and can be programmed to halt program execution and display the out-of-tape condition until it is corrected.

PRINT COLUMNS.

As is illustrated in figure 4-6, the print drum allows for the printing of certain characters in specific columns only. Columns 5 through 21 (17 columns) contain the 0 through 9 characters for printing numeric amounts, serial numbers, item counts, transaction codes, dates, and other reference numbers. The 0 through 9 characters in columns 13 through 21 are somewhat smaller than in columns 5 through 12, so that, if desired, two numeric fields may be printed on one line yet they may be readily distinguishable. Periods and commas are provided in columns 6 through 21 and are offset to the right to permit printing both a digit and punctuation in the space allocated to a single character. (Programmable print formatting also permits printing punctuation in a single character position.)

COLUMN

ROW	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	−	T	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	◁	X	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	L	N	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	*	*	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	$\underline{*}$	$\underline{*}$	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	◇	C	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	$\underline{\diamond}$	F	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	△	$\underline{C}$	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	□	U	9	9
10	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
11	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	M	R	R	R	R
12	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	,	P	T	P	#	P
13	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	G	I	G	D
14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	E	E	E	N	E
15	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	S	S	S	S	T

DIRECTION OF ROTATION

Figure 4-6. Master Printer Print Drum Layout

Characters A, B, D, and F are also provided in columns 6 through 21 to provide the means to display the contents of memory in hexadecimal notation on the master printer. In such cases the period is used to represent the value 14(E) and the comma represents the value 12(C).

The symbols in columns 3 and 4 provide transaction and processing codes associated with entries in the higher order columns (see figure 4-7 for the definitions of these symbols). The numeric characters in columns 1 and 2 can be used to display the active program, the keyboard selector, or the sort pockets associated with the other entries on the print line.

COLUMN 4	COLUMN 3	SYMBOL DEFINITION
NO SYMBOL		DEBIT
	$\underline{C}$	ADDITIONAL CREDIT
	$\overline{C}$	CREDIT
-		DEBIT CORRECTION
+	$\underline{C}$	ADDITIONAL CREDIT CORRECTION
□		NON ENCODE DEBIT
□	$\underline{C}$	NON ENCODE ADDITIONAL CREDIT
□	$\overline{C}$	NON ENCODE CREDIT
◁		NON SORT DEBIT
◁	$\underline{C}$	NON SORT ADDITIONAL CREDIT
◁	$\overline{C}$	NON SORT CREDIT
+	E	PROOF, OUT-OF-BALANCE PLUS
-	E	PROOF, OUT-OF-BALANCE MINUS
*	E	PROOF BALANCE, ZERO
*		DEBIT TOTAL
□	*	NON ENCODE DEBIT TOTAL
◁	*	NON SORT DEBIT TOTAL
◊		DEBIT SUBTOTAL
Δ		MACHINE CLEAR
*	P	NON-BALANCE BY-PASS, PLUS
$\underline{*}$	P	NON-BALANCE BY-PASS, MINUS
+	P	PLUS AMOUNT RE-ENTRY
-	P	MINUS AMOUNT RE-ENTRY
$\underline{*}$	*	MINUS DEBIT TOTAL (WITH A NON SORT OR NON ENCODE)
$\underline{*}$		MINUS DEBIT TOTAL
	A	PLUS KEY USED IN ADD MODE
-	A	MINUS KEY USED IN ADD MODE
◊	A	PLUS SUBTOTAL IN ADD MODE
$\underline{◊}$	A	MINUS SUBTOTAL IN ADD MODE
*	A	PLUS TOTAL IN ADD MODE
$\underline{*}$	A	MINUS TOTAL IN ADD MODE
◊	E	DEF. CORRECTION & SUBTOTAL, PLUS
$\underline{◊}$	E	DEF. CORRECTION & SUBTOTAL, MINUS
A	N	ACCOUNT NUMBER KEY
	X	ACCT. NO. NON VERIFY (COV FTE.)
R	T	RT KEY OPERATION
A	X	AX KEY OPERATION
	PN (COL 3&2)	PRESET NUMBER

Figure 4-7. Definitions of Symbols and Transaction Codes

MASTER PRINTER CONTROLLER.
The master printer controller contains a 32-character FIFO buffer and all the necessary logic to control the printer functions, including the logic to turn the printer on and off as firmware requests. All messages to be printed are formatted by firmware, as directed by the user program, and transferred to the buffer in a least-significant character first sequence; the first character stored in the buffer is printed as the right-most character on the master tape.

Up to 30 buffer positions are available for character data storage. An End-of-Message (EOM) character is supplied by firmware as a delimiter to indicate the end of a data string. Recognition of the EOM character instructs the controller to terminate the print instruction. At least one character position in the buffer must be left unused to permit the data in the buffer to be recycled. The data is recycled for each of the 16 rows on the print drum during each print cycle.

Whenever the printer is busy, the master printer controller sets a "busy" bit to halt acceptance of any more instructions to the master printer. As soon as the printer is no longer busy, the bit is reset and the controller accepts the next command sent to it from the processor.

NOTE

Overflowing of the master printer buffer results in truncation from the left. Unrecognizable characters in the buffer are simply ignored by the printer. Neither of these conditions causes an interrupt and therefore neither are noticeable to the user program.

MASTER PRINTER CODES.
The following decimal codes, stored in the printer buffer, cause the printer hammer to fire when the respective drum row comes up:

Code	Drum Row
30	0
31	1
32	2
33	3
34	4
35	5
36	6
37	7
38	8
39	9
3A	10
3B	11
3C	12

Code	Drum Row
3D	13
3E	14
3F	15

For example, when the code 3C is used in column 21, a "," is printed ir column 21 of the master tape (see figure 4-6).

In addition, the following codes are also recognized by the printer:

Code	Activity
20	Blank Print (Space) - Inhibit Hammerfire
2C	Print In Place Comma
2E	Print In Place Period
11	End-of-Message Delimiter

TYPE SPECIFICATIONS.
The maximum type size for numerals and symbols is 0.071 inches wide by 0.114 inches high. All 21 columns of type are provided with 0.138-inch type centers.

The vertical print tolerance is ± 0.077 inches as measured from a horizontal line drawn through the midpoint of each line of print.

Vertical line spacing is in increments of 0.201 ± 0.01 inches. The accumulated vertical spacing tolerance permitted in each 10-inch printout is not to exceed ± 0.5 inches.

SUPPLIES.
A 2-color black and red cross-feed ribbon is provided as standard. A single color black ribbon is available as an option. The ribbon size is 250 inches long by 0.004 inches thick by 1/2 ± 1/64 inches wide.

The print life of the ribbon is 500,000 characters.

Standard construction provides for either roll or single copy fan-fold paper. Carbon-backed roll paper can be used to provide a second copy. CLT roll paper may also be used. Roll paper must not adhere to the center core.

The width of the master tape roll is 3 1/2 inches. The diameter is 3 3/16 inches.

Fan-fold paper size is 3 1/2 inches by 5 1/2 inches. The test weight of fan-fold paper is 12 pounds.

150 sheets of fan-fold restacks in the receiver if the first sheet of printout is started.

DISPLAY PANEL.
The display panel (figure 4-8), consisting of an 18-character alphanumeric display screen, 12 Light Emitting Diode (LED) indicator lights, and an audible alarm, provides a means for the system to communicate with the operator. It is installed within the same module as the keyboard in all systems.

The display screen is used by both the user program and the system error routines to display such messages as: KEYBOARD ERROR, FULL POCKET, DOCUMENT JAM, etc. The LED indicators are used to display standard system operating conditions, like "power on" and "Idle mode", and a variety of data communication states. The audible alarm can be sounded programmatically to solicit the operator's attention.

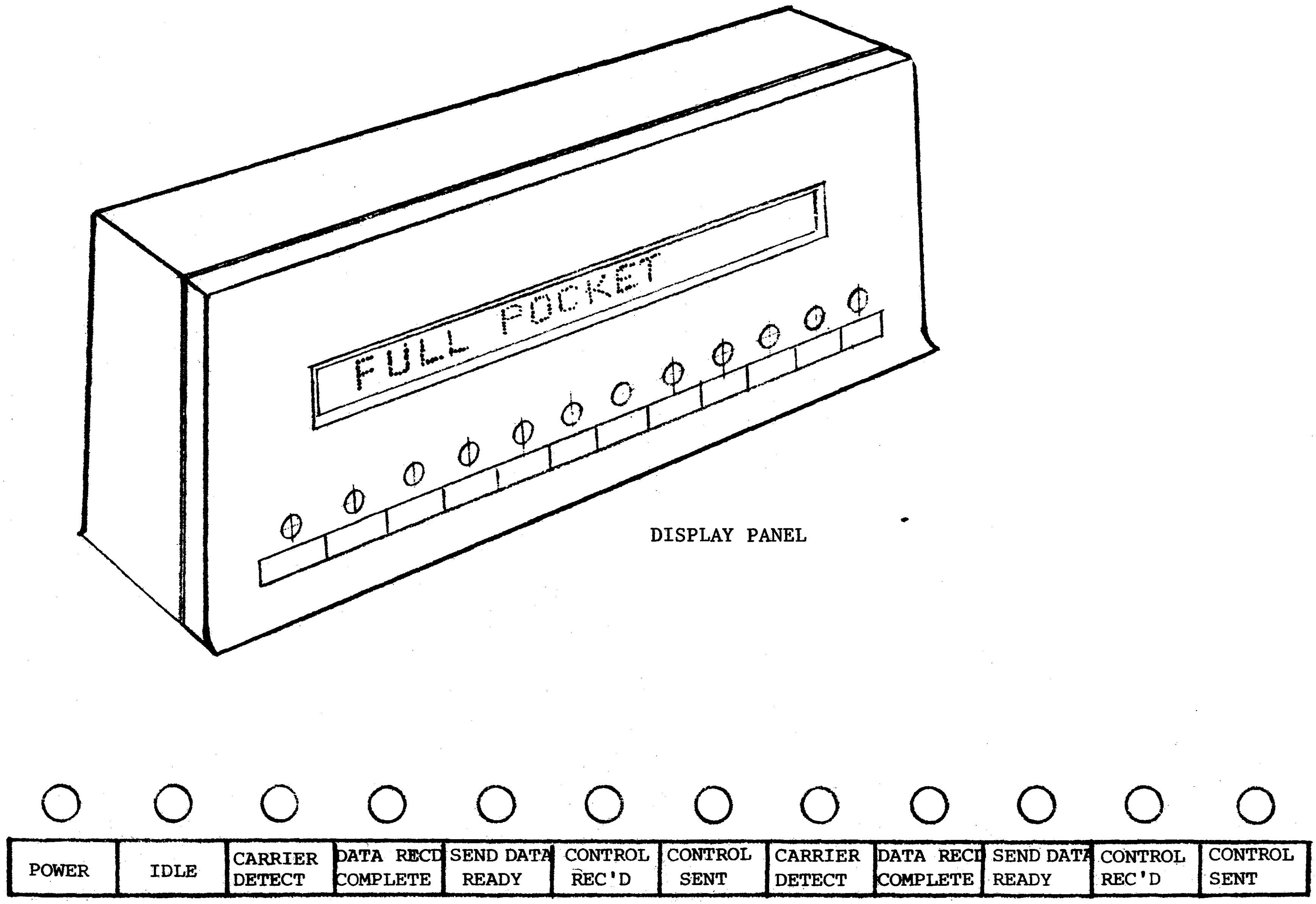
DISPLAY SCREEN.
The display screen is an 18-character alphanumeric screen used to display messages which are programmatically generated. Included in the display unit are the display driver and a character generator. The character generator is a pluggable ROM that receives the ASCII codes of the system and converts them into the 64 possible displayable characters. These characters are the 64-character subset of the ASCII (USASCII 67) standard character set. Any unrecognizable characters are displayed as Q's.

The actual composition and display of individual messages are functions of the user program and the system error routines. The messages are generated from the processor, go through the S device I/O interface to the display buffer, and are interpreted by the display panel controller.

LED INDICATORS.
The LED indicator lights are located directly below the display screen on the display panel. The number of indicators used in each system depends on the system configuration. Systems without data comm use only two indicators: "power on" and "Idle mode". Systems with single channel data communication capabilities use five additional indicators, and systems with dual channel data communication capabilities use a total of 10 additional indicators. These extra indicators are used to report the status of the data communications activities. The various indicators are described below.

POWER. The Power indicator is hardware controlled and is on whenever the Power ON/OFF switch is latched into the ON position.

IDLE. The Idle indicator is controlled by the system firmware. It is switched on whenever the system enters the Idle mode.



LED INDICATORS

Figure 4-8. Display Panel

CARRIER DETECT. The Carrier Detect indicators are individually hardware controlled and are on whenever the carrier (the data transmission medium) for the respective data communications channel is on.

DATA REC'D COMPLETE. The Data Received Complete indicators are turned on by firmware whenever the receiving buffer for their respective channel is filled with incoming information.

SEND DATA READY. The Send Data Ready indicators are turned on by firmware to indicate that data is stored in the send buffer of the respective channel and that the unit is ready to send. They are turned off by firmware when the contents of the buffer have been transmitted.

CONTROL REC'D. The Control Received indicators are turned on by the data communications firmware when a control message from the processor is received. They are likewise turned off when the control message is transmitted.

CONTROL SENT. The Control Sent indicators are turned on by the data communications firmware when a control message is transmitted; they are turned off whenever a control message is again received.

AUDIBLE ALARM.
The audible alarm is used in conjunction with the display screen to alert the operator to various error conditions and trouble status reports. Like the display screen, it is controlled by the user program and system error routines. The alarm sounds a single tone each time it is called, but this tone may be repeated via program implementation.

DISPLAY PANEL CONTROLLER.
The display panel controller is connected to the processor via the S device I/O interface. It interprets the messages of the processor and in turn controls the display screen and the audible alarm.

The controller contains a 32-character buffer and the logic needed to clear and display 18-character alphanumeric messages on the display screen. The buffer is a 32-character First In, First Out (FIFO) buffer. Messages to be displayed must be loaded so that the first digit, letter, or symbol into the buffer is the most significant. Also, the complete 18-character capacity of the display screen and the End-of-Message (EOM) delimiter must be loaded by the firmware. The EOM delimiter code (1/1) must be stored in the buffer after the last data code.

Example:

	Buffer	Display Screen
LOAD END	E * * * * * SHGUORRUB * * * * O M	* * * * BURROUGHS * * * * *

A CLEAR AND INITIALIZE command addressed to the display controller clears the display buffer and prepares the display screen to accept a new message. When the buffer is cleared, the display screen is also cleared; however, as soon as the buffer is full, the contents are displayed. When the controller receives an INITIATE CONSOLE ALARM command, it sounds the alarm once.

Nine of the LED indicators on the display panel are controlled by the Keyboard-Switch-Indicator controller (KSI). The KSI also controls the operator keyboard. Refer to the heading, Keyboard Controller.

THE ENCODER.

The encoder station, installed in the encoder/endorser module of all models, provides document encoding in any one of the following MICR or OCR encoding fonts:

a. MICR E13B.
b. MICR CMC7.
c. OCR A.
d. OCR B.
e. OCR 1428.

There are up to 15 possible characters, plus a blank, availabe in each of these encoding fonts (see figure 4-9). To change from one font to another it is only necessary to replace the 1-character wide encoding wheel. Characters are printed one at a time by a single hammer as the document moves past the encoding wheel.

The encoder is directly controlled by the encoder controller as directed by the processor. All code line printing and formatting is a function of the user program, thereby allowing complete flexibility in document encoding. Also, the user program may elect not to encode any particular document, thereby releasing that document to the sort pockets without slowing it down.

DOCUMENT MOVEMENT.

The encoding station registers and holds a document, as it is received, until an encoding command is initiated through the encoder controller. Also, the station immediately preceding the encoding station does not release a document until the encoder is clear of documents. This is a hardware function provided to prevent jamming and double document conditions.

Sensors in the encoding station provide status information when a document is present and properly registered; if a document has a cut or folded corner at the lower right hand corner, if it is skewed, or if it is not registered correctly, the operation of the encoder is inhibited.

Documents are transported at a speed of 2 1/2 inches per second during OCR encoding and 3 1/8 inches per second during MICR encoding (each are encoded at a rate of 25 characters per second). Documents that are released without encoding are simply ejected by the encoder station and accelerated up to the speed of the document transport system.

TYPEFONTS DATA CHART

TYPEFONT		PRINT CENTERS	DIGITS										SYMBOLS					
MICR	E-13B	1/8"	0	1	2	3	4	5	6	7	8	9						INHIBITS HAMMER FIRE
	CMC7	1/8"	0	1	2	3	4	5	6	7	8	9						
OCR	A	1/10"	0	1	2	3	4	5	6	7	8	9	⑁	⑂	⑃	|	B	
	B	1/10"	0	1	2	3	4	5	6	7	8	9	#	+	<	>		
	1428	1/10"	0	1	2	3	4	5	6	7	8	9	0					
INTERNAL CODE			3/0	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13	*3/14	3/15

*HOME LOCATION OF ENCODE WHEEL

Figure 4-9. Encoding Fonts

ENCODE LINE PRINTING.
The encoder contains a single hammer and a "one-time" magnetic ink ribbon; both are operator changeable. The ribbon is of cross-feed construction which rewinds on the same reel center from which it unwinds; it is easily removed and replaced. The ribbon advances during encoding but does not advance when a document is non-encoded (released without encoding).

The ribbon is 5/16 inches wide and its length provides approximately 150,000 single impressions. When the ribbon is depleted (or if it breaks), this condition is reported to the processor as a program interrupt. The document in the encoder is completely encoded and processed before the program is halted for ribbon replacement. (This document should be checked for voids or flaws in the code line due to the ink ribbon depletion.) The operator should select the Idle mode and replace the ribbon after the document is sorted.

LOCATION OF THE CODE LINE.
The distance from the right edge of the first encodable position to the right edge of the document is:

0.3125 ± 0.0625 inches	for E13B and CMC7 fonts
0.3000 ± 0.0344 inches	for OCR A and OCR B fonts

The location of the first encoded character is determined by the programmed code line format.

All the encoded characters are encoded in a horizontal band across the bottom edge of the document. The bottom edge of this horizontal line and the bottom edge of the document are parallel and are spaced by:

0.1875 inches	for E13B and CMC7 fonts
0.3335 ± 0.0472 inches	for OCR A and OCR B fonts

NOTE
An OCR B option provides a code line 0.666 ± 0.047 inches from the bottom edge of the document.

The characters of the encoded line are spaced, from print center to print center, by:

0.125 inches	for E13B and CMC7 fonts
0.100 inches	for OCR A and OCR B fonts

ENCODER CONTROLLER.
The encoder controller contains a 96-character FIFO buffer (figure 4-10) for storing data, as it is received from the processor, in a least-significant digit first sequence. One character of this buffer is used to determine pocket selection after the document is released from the encoder. The hexadecimal codes for pocket selection are:

Code	Pocket
80	1
81	2
82	3
83	4
84	5
85	6
86	7
88	9
89	10
8A	11
8B	12
8C	13
8D	14
8E	15
8F	16
90	17
91	18
92	19
93	20

One character of the buffer is used to activate the endorser (on models with endorsers). The code 12 instructs the endorser to endorse the document being transported through it, while any other code prevents endorsing.

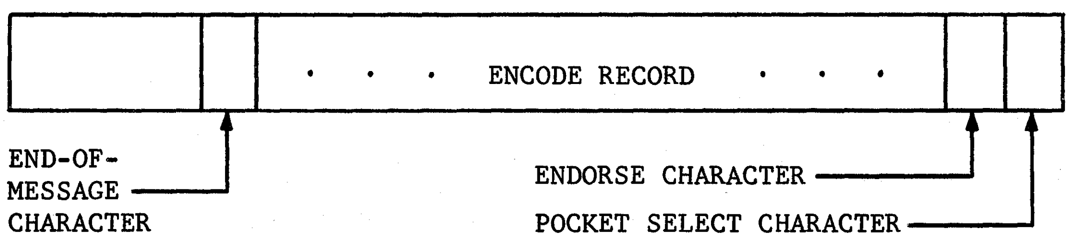


Figure 4-10. Encoder Controller Buffer

The remaining buffer positions provide for a maximum of 94 characters which are available for encoding. The positions are filled as dictated by the user program using the following hexadecimal codes:

Code	Encoding Wheel Location
30	0
31	1

Code	Encoding Wheel Location
32	2
33	3
34	4
35	5
36	6
37	7
38	8
39	9
3A	10
3B	11
3C	12
3D	13
3E	14
3F	Blank - Inhibits Hammer Fire
20	Blank - Inhibits Hammer Fire

All characters are loaded into the buffer followed by an End-of-Message (EOM) character before execution of the encoding operation.

In addition to providing the encode line and format for the encoder, the encoder controller serves several other functions. It sets a "busy" bit whenever there is a document in the encoder or endorser, or between the endorser and pocket number 3. It notifies the processor whenever a document is not properly registered in the encoding station. It also reports jammed documents and broken or depleted ribbon conditions to the processor. The controller uses the I/O interrupt facilities to interrupt the user program.

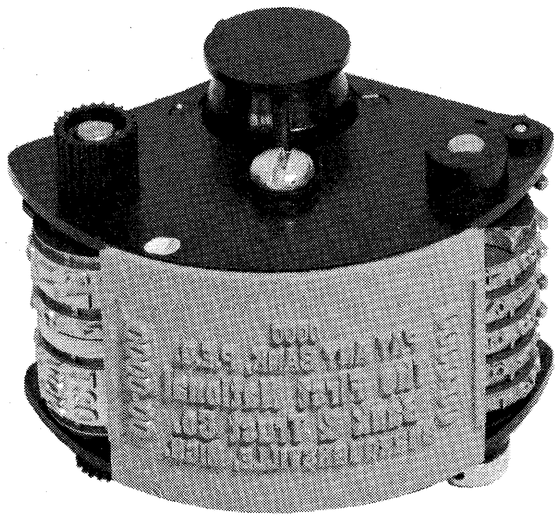
THE ENDORSER.

The endorser is an option available on all models of the Series S systems which may be easily installed or removed at the factory or in the field. There are two configurations of the endorser available: one for endorsing the front of documents and one for endorsing the back of documents.

Endorsing is a function of the user program providing the option of either endorsing or releasing each document as it passes from the encoder to the sort pockets. If the endorse character in the encoder buffer contains a 12, then the document is endorsed; otherwise, it is not endorsed.

ENDORSER HEAD.

The endorser head (figure 4-11) consists of an endorsing seal or legend, a calendar date, and a document serial number. In addition, a 3-digit "quick-set" unit identification number can be requested as an option. The endorser head is operator changeable.



SAMPLE ENDORSEMENT

0017 Figure 4-11. Endorser Head

Each endorsing seal is inscribed as specified by the user. The seals occupy an area of 1.67 inches by 0.835 inches (when the 3-digit unit identification number is ordered, the seal is reduced in size to 0.438 inches by 1.67 inches). The endorsing seals have a life expectancy of approximately 1,000,000 endorsements and are operator changeable.

The calender date is an operator settable quick-set mechanism that prints the month, day, and year. The serial number is a 5-digit counter which can be set by a field engineer. It is a consecutive numbering device that advances one count after each endorsement.

ENDORSER CONTROL.
Firing of the endorser is controlled by the encoder controller (refer to the heading Encoder Controller). Whenever the appropriate byte in the encoder buffer is set with the endorsing code, the encoder controller instructs the endorser to endorse the next document passing through it.

ENDORSER INK ROLL.
The endorser head is inked by an operator changeable ink roll. This ink roll provides at least 250,000 legible endorsements and has a shelf life of 6 months to a year under normal conditions.

Ink rolls are available in five colors: black, blue, red, green, and purple. One purple roll is supplied with each machine. Replacements are furnished only by the branch.

ENDORSEMENT LOCATION.
The endorsement is printed in a 1-inch wide horizontal band across the document. The standard endorsement is printed approximately 0.945 inches from the bottom edge of the document to the lowest printed character. (A low endorsement option provides an endorsement approximately 0.470 inches from the bottom edge of the document.)

Looking from left to right on an endorsed document, the format is:

a. The 5-digit serial number, printed vertically.
b. The bank legend (or legend and 3-digit unit number).
c. The date, printed vertically.

POCKET STACKER.

The pocket stacker modules provide the Series S systems with from 2 to 20 pockets to use for document sorting. The stackers are available in 2-pocket modules and 4-pocket modules. The first stacker module of a system is connected to the encoder/endorser module, and any subsequent stacker modules are connected in order.

The pockets within each stacker module are adjacent to each other and are located on a horizontal plane (see figure 4-12). Documents are transported on edge into a selected pocket by the transport mechanism, and are likewise stacked on edge in the sort pockets. All documents are visible in the transport track and in the pockets so they may be removed while the system is operating.

There is a switch located in each pocket which detects full pocket conditions. When the documents in a pocket reach a capacity of approximately 2 1/4 inches, the switch activates and turns on an LED indicator on that pocket. This full pocket condition is reported to the processor as status information over the I/O channels. A few more documents can be sorted to this pocket (up to a total capacity of 2 1/2 inches); however, if too many documents are eventually sorted to the pocket, a jam occurs causing a sort failure.

NOTE

The systems program interprets the full pocket condition and initiates an operator alert via the display panel and audible alarm.

Pocket selection is controlled by the encoder controller as directed by the user program. The program must supply a pocket address before a document is released from the encoder station. Then after the document leaves the encoder it is forced into the selected pocket.

Sensors and timers are provided in the document transport to detect the progress of documents after they leave the encoder. These devices provide the means to detect document jams and sorting errors in the stacker area. When sort failures are detected, they are reported to the processor. Further processing of documents is then halted at the encoder by hardware, and firmware initiates a processor interrupt which turns off the transporter. After the jam is cleared by the operator, firmware permits a document at the encoding station to be processed in accordance with previous instructions.

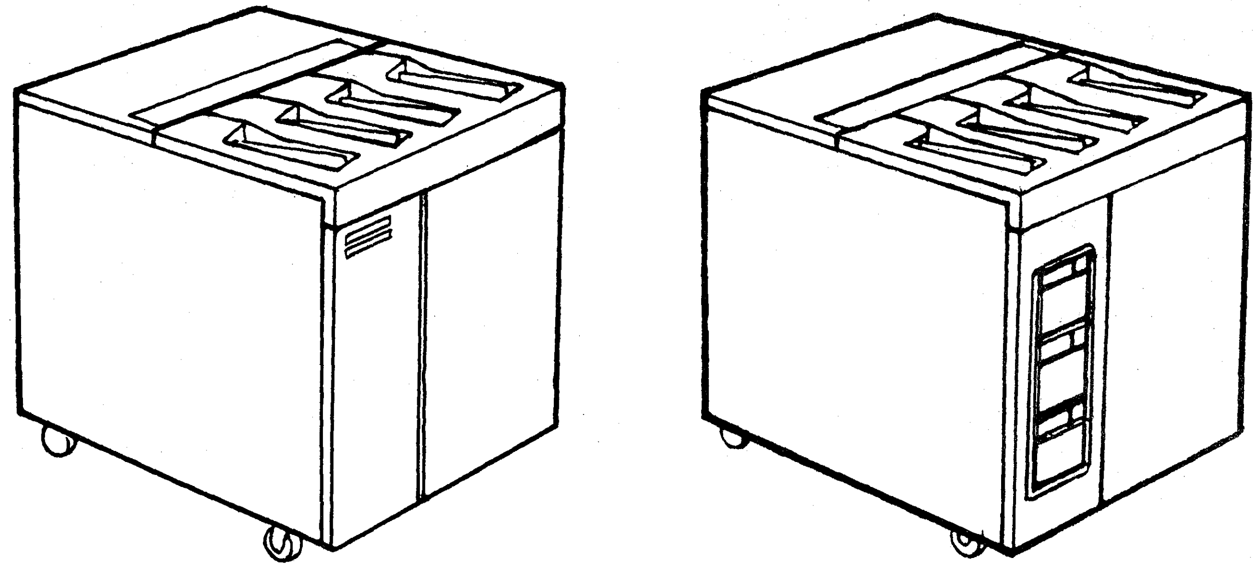


Figure 4-12. Pocket Stacker Modules

POCKET MODULE CONFIGURATION.
In addition to the sort pocket, the stacker modules may contain a variety of other important system devices. These devices include:

a. Two-tape detail listers (one for every two sort pockets), or burst printers (one per module).

b. The system power supply.

c. The data capture devices of the system.

The stacker modules contain various configurations of these devices depending on the type of system, the numer of stacker modules in the system, and the location of the stacker module in the system.

In systems with only one stacker module (a 2- or 4-pocket system), the stacker contains the system power supply and either the detail lister(s) or the burst printer (burst printers are used only in systems with mini-disks). Also, such systems may have an extension housing either one to three Magnetic Tape Cassette (MTC) drives or else one or two mini-disk drives.

In systems with more than one stacker module, the first module is always a 4-pocket module containing two detail listers, or a burst printer, and the system power supply. The second module contains the data capture devices and the detail lister(s), or a burst printer. Each succeeding module then contains only the detail lister(s) or burst printer, and the last module has an end panel attached to it.

DETAIL LISTERS. The detail listers produce a hard copy record, on a paper tape roll, for each pocket of the system. The tapes are used to record such items as numeric amounts, activity codes, routing numbers, and the number of documents sorted to the pocket (see figure 4-13 for some examples).

A detail lister is a single drum printer with the ability to print and control two separate tapes. Therefore each detail lister produces the hard copy records for a pair of adjacent sort pockets.

In systems with cassette tape data capture, each 4-pocket stacker module houses two detail listers and each 2-pocket stacker module houses one detail lister. (Systems with mini-disk data capture use burst printers rather than detail listers.) The detail listers are located behind a door below the pocket surface in the pocket stacker modules. They are easily accessed by pushing the door panel in and quickly releasing it, thereby opening the door and exposing the entire detail printer assemblies.

Associated with each tape of the listers is an individual tape printout receiver, a push-button automatic tape advance, and a low paper supply indicator. The printout receiver automatically rolls and stores the individual tapes as they are printed. The printout may then be easily removed and separated from the unused paper roll after processing. Each receiver holds approximately 55 inches of printout (approximately 270 items). The push-button automatic paper advance is used to help load a new paper roll in the printer and to advance a printout before removing. The low paper supply indicator detects low paper conditions for individual tapes and notifies the processor (via an interrupt) and the operator (via an LED indicator on the stacker module).

The print drum is a 21-column drum with 10 print columns per tape and a center blank column to allow for space between the two tapes. This configuration allows for printing nine digits and characters plus one symbol for each line of print per tape (see figure 4-14).

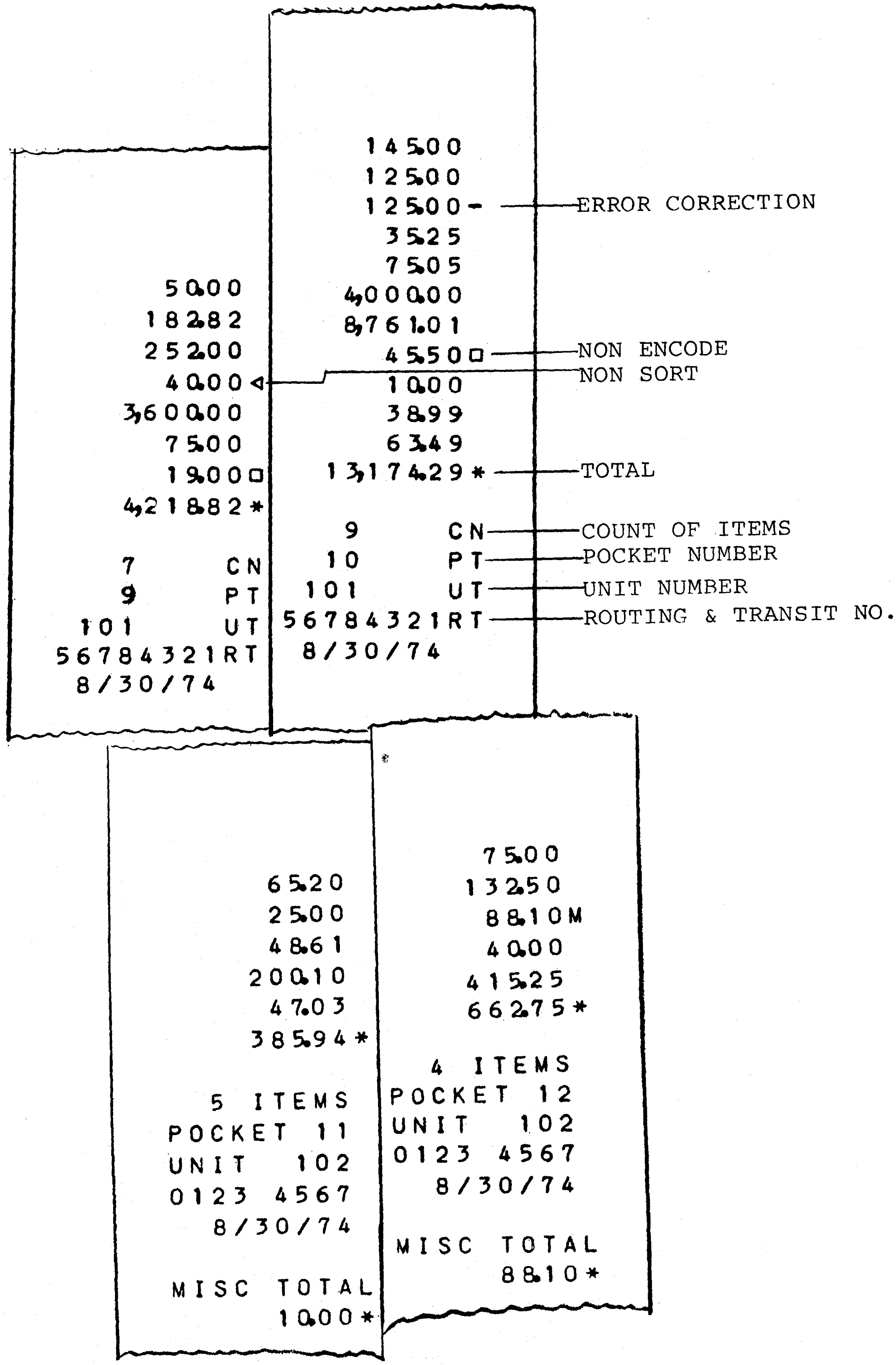


Figure 4-13. Example Prints of the Two-Tape Detail Lister

COLUMN

ROW	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0	0	+		0	0	0	0	0	0	0	0	0	+
1	1	1	1	1	1	1	1	1	1	−		1	1	1	1	1	1	1	1	1	−
2	2	2	2	2	2	2	2	2	2	◁		2	2	2	2	2	2	2	2	2	◁
3	3	3	3	3	3	3	3	3	3	-//-		3	3	3	3	3	3	3	3	3	-//-
4	4	4	4	4	4	4	4	4	4	*		4	4	4	4	4	4	4	4	4	*
5	5	5	5	5	5	5	5	5	5	$\underline{*}$		5	5	5	5	5	5	5	5	5	$\underline{*}$
6	6	6	6	6	6	6	6	6	6	◇		6	6	6	6	6	6	6	6	6	◇
7	7	7	7	7	7	7	7	7	7	$\underline{◇}$		7	7	7	7	7	7	7	7	7	$\underline{◇}$
8	8	8	8	8	8	8	8	8	8	&		8	8	8	8	8	8	8	8	8	&
9	9	9	9	9	9	9	9	9	9	□		9	9	9	9	9	9	9	9	9	□
10	/	/	/	/	/	/	/	/	U	M		/	/	/	/	/	/	/	/	U	M
11	U	N	I	T	I	T	E	M	S	$\underline{M}$		U	N	I	T	I	T	E	M	S	$\underline{M}$
12	,	,	,	,	,	,	,	,	C	N		,	,	,	,	,	,	,	,	C	N
13	P	O	C	K	E	T			P	T		P	O	C	K	E	T			P	T
14	.	.	.	.	.	.	.	.	R	M*		.	.	.	.	.	.	.	.	R	M*
15	M	I	S	C		T	O	T	A	L		M	I	S	C		T	O	T	A	L

DIRECTION OF ROTATION

NOTE: PERIODS AND COMMAS ARE OFFSET TO THE RIGHT TO PERMIT PRINTING A DIGIT AND PUNCTUATION IN THE SPACE ALLOCATED TO A SINGLE CHARACTER.

Figure 4-14. Detail Lister Printer Print Drum Layout

Each tape of the detail lister is printed on and advanced individually in response to user program generated statements. The user program dictates the format and information to be printed on the detail tape and specifies which tape to print on. On an n pocket machine, the tapes are numbered as detail printer number 1, 2, 3, ... n.

<u>Lister Printer Controller.</u>

The detail lister controller receives control commands and buffered data from the processor and controls the operation of all the detail listers of the system. Messages to be printed, as well as control commands, are coded and formatted by firmware, as directed by the user program, and transferred (via the I/O interface) to the controller. The detail lister controller is virtually identical to the master printer controller in terms of content and function. It contains a 32-character FIFO buffer (figure 4-15) and the necessary logic to decode commands and control the lister printer functions.

There are 29 buffer positions available for data codes in the buffer (as opposed to 30 positions in the master printer buffer). One buffer location is used for the address of the detail lister, one for the End-of-Message (EOM) character, and one is left blank (as in the master printer buffer) for recycling of characters as they are printed.

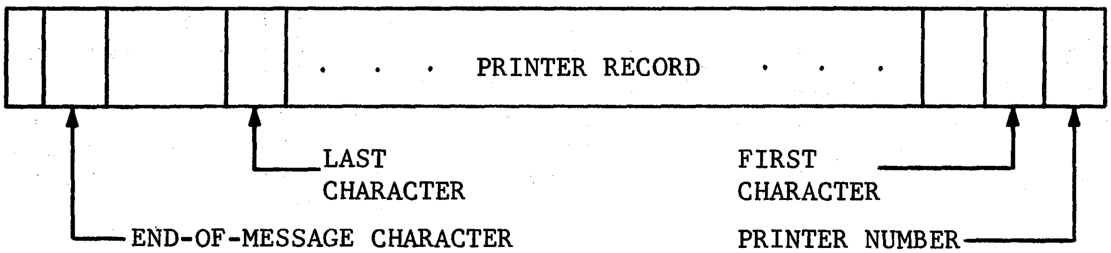


Figure 4-15. Detail Printer Buffer

The hexadecimal codes used to represent data to be printed are the same as those used for the master printer:

Hex Code	Drum Row
30-3F	0-15
2C	Compact Comma (Print In Place)
3C	Single Character Comma
2E	Compact Period (Print In Place)
3E	Single Character Period
20	Blank Space
11	EOM Delimiter

NOTE
The detail printer controller is almost identical to the master printer controller. Therefore, as with the master printer, any characters which cannot be recognized are simply lost and anything beyond column 11 is truncated without notifying the processor or creating an error condition.

The hexadecimal codes for detail printer selection are the same as those used for pocket selection in the encoder controller:

Hex Code	Printer Number
80-93	1-20

It should be noted that there is only one controller and one buffer for all detail printers; therefore, if one detail printer is executing a write command, then all detail printers are considered "busy" until the controller and buffer are again available. Also, if a printer which does not exist on a system (e.g., printer 14 on a 12-pocket system) is initiated by the user program, then that printer is assumed to exist and is initiated. Such action causes the printer controller to stay "busy" and thereby prohibit other detail printer initiate commands. The only way to recover from this condition is to initialize the system.

Printing Details.

Speed.
The lister printer prints at a maximum rate of 2.6 lines per second. The print cycle time is 380 milliseconds when printing with an unshifted (black) ribbon and 340 milliseconds when the ribbon is shifted (red).

Dimensions.
The maximum type size is 0.071 ± 0.004 inches wide by 0.114 ± 0.004 inches high. Vertical lines are spaced in 0.201-inch increments. Type centers are 0.138 inches per column.

Supplies.

Ribbon.
A 2-color black and red cross-feed ribbon is provided as standard, but a single color black ribbon is available as an option. The ribbon is 250 inches long, 0.004 inches thick, and 0.5 inches wide, and is operator serviceable.

Paper.
A paper roll, 1.77 +0, -0.03125 inches wide with a roll diameter of 3.1875 inches, of 16-pound paper is recommended. The last 6 feet of the roll contain a red line to indicate that the end of the roll is approaching.

BURST PRINTERS. The burst lister-printers are 21-column drum printers which replace the detail listers on systems equipped with a mini-disk. The burst printer can list items at a maximum rate of 120, 240, or 360 items per minute depending on the number of columns (up to three) in the printout.

The burst printing technique is accomplished by preparing detailed lists of amounts for each pocket in mini-disk memory as the documents are processed. At the completion of a run, the data is formatted by system software and then transferred from the disk to the burst lister. System software and firmware size all the item amounts for a single pocket and sequentially arrange the items in a 1-, 2-, or 3-column format. The pocket listing is printed in the same sequence as the documents are stacked in the pocket. A multiple column listing prints the first item at the upper left and the last item at the lower right corner of the tape. The system software and firmware memory requirements to accomplish this formatting are 1.5K for the first burst printer and 1K for each additional printer.

The hardware characteristics of the burst printer and the necessary supplies are identical to those of the master printer. Therefore, refer to the heading, Master Printer, for detailed information.

Burst Printer Controller.
The burst printer controller is identical to the detail lister controller in terms of contents and function. The only exception to the burst printer controller is that, with a maximum of only five printers, the printer number codes are:

Hex Code	Burst Printer
80	No. 1
84	No. 2
88	No. 3
8C	No. 4
90	No. 5

SECTION 5

MAGNETIC TAPE CASSETTES

GENERAL.

Magnetic Tape Cassettes (MTC's) are used on the S 1000 systems to provide data capture capabilities and to load system software and firmware into memory. Style numbers 121x, 131x, 141x, and 151x (x=0,1,2,3,4,5) are equipped with from one to four Magnetic Tape Cassette drives. Style numbers 123x, 133x, 143x, and 153x (x=0,1,2,3,4,5), which contain mini-disks, are equipped with one MTC drive.

The first three cassette drives of any system are contained in the second pocket stacker module; or, if the system has only one pocket stacker, in an extension module attached to the pocket stacker. If a fourth cassette drive is used, it is mounted on the underside of the encoder/endorser module as a single self-contained unit. Also, all systems with only one cassette drive have this drive located beneath the encoder/endorser.

Reading from and writing to cassette tapes are generally functions of the user's EPL program. However, when loading object programs, or when performing the Save and Restart utilities, the system firmware and/or system software perform all the necessary cassette functions.

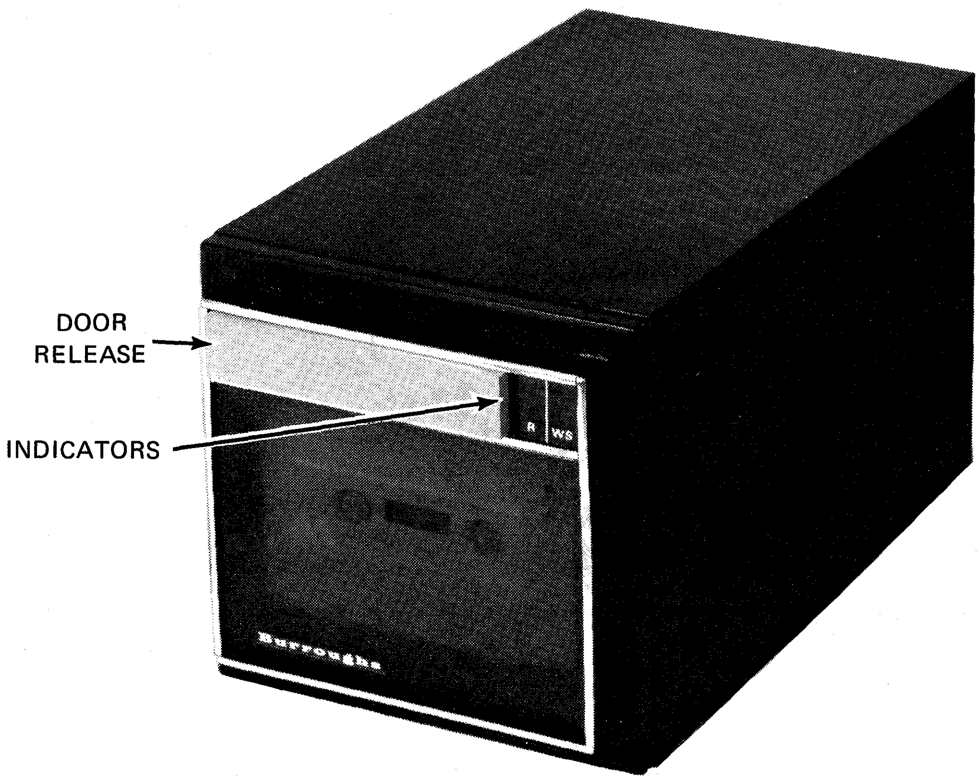
MTC DRIVES.

Each of the Magnetic Tape Cassette drives is virtually a self-supporting unit which serves as a peripheral device to the system. Power is supplied to the drives via the processor power source, and the drives receive power whenever the processor power is on. The drives receive their instructions via the cassette tape interface and the cassette soft controller. Cassettes are loaded to and removed from a cassette drive through the cassette door, which is opened by pushing the bar at the top of the cassette drive face (see figure 5-1).

READ/WRITE HEADS.

The cassette drives are equipped with dual gap heads. One head is for writing to the cassette tape, while the other is for reading. The dual gap heads allow for checking of data, immediately after it is written, during the writing of a record. Therefore, it is not necessary to write, backspace, and read in order to verify written data.

When writing to cassette tape, two tracks are written upon simultaneously. One track is for data, and the other is for timing signals. The timing signals are used for synchronizing when reading back the data from the data track during a future read operation. Data is recorded bit serially at a density of 800 bits per inch; and, when 256-character records (the maximum size records) are used, one cassette can contain up to 237,000 8-bit characters of data.



0028 Figure 5-1. Cassette Tape Drive Unit

Characters are read from cassette in a least-significant bit first order. Reading can be done at three different thresholds of intensity: low, normal, and high. When rereading of a record is required due to a read error, it is suggested that several attempts be made at different thresholds.

TAPE DRIVE SPEEDS.
The MTC drives use two drive sprockets for advancing and reversing the cassette tapes. These sprockets provide three speeds of tape movement. A tape speed of 10 inches per second is used when reading or writing. A speed of 30 inches per second is used for high speed forward and reverse when searching for a tape mark. Rewinding of cassettes is accomplihsed at 60 inches per second. Also, rewinding can occur on one MTC drive simultaneously with reading or writing on another drive.

NOTE

Cassettes are automatically rewound upon closing of the cassette door; therefore, cassette doors should not be opened and closed during program execution unless the program anticipates a cassette rewind.

INDICATORS.
There are two indicators located on the face of an MTC drive: the "R" and "WS" indicators (see figure 5-1). These indicators are used to inform the operator of tape status. The "WS" indicator is on whenever a cassette is loaded in the drive with the write tab in the enable position, that is when the cassette is not write protected. The "R" indicator, or ready light, may either be ON, OFF, or flashing ON and OFF when a cassette is in the drive unit. The significance of these three conditions is as follows:

a. OFF - indicates the tape is at a clear leader and can be removed by the operator.

b. ON - indicates the tape is off clear leader and capable of receiving commands from the processor. The operator should not remove the cassette when the ready light is ON.

c. Flashing ON and OFF - indicates that operator intervention is required to correct a cassette problem. The conditions that create a flashing light are:

   1) The lamp flashes when the cassette is hung up on clear leader at the end of tape. Under this condition no system software commands can move the tape. Operator intervention is required.

   2) If a READ or WRITE command is given and a function complete or a Beginning-of-Tape (BOT) is not detected after 3 seconds, this indicates the cassette is in backwards, a tape jam has occurred, or an attempt is being made to read a blank tape. This 3-second time out does <u>not</u> apply for a high speed SEARCH or REWIND command.

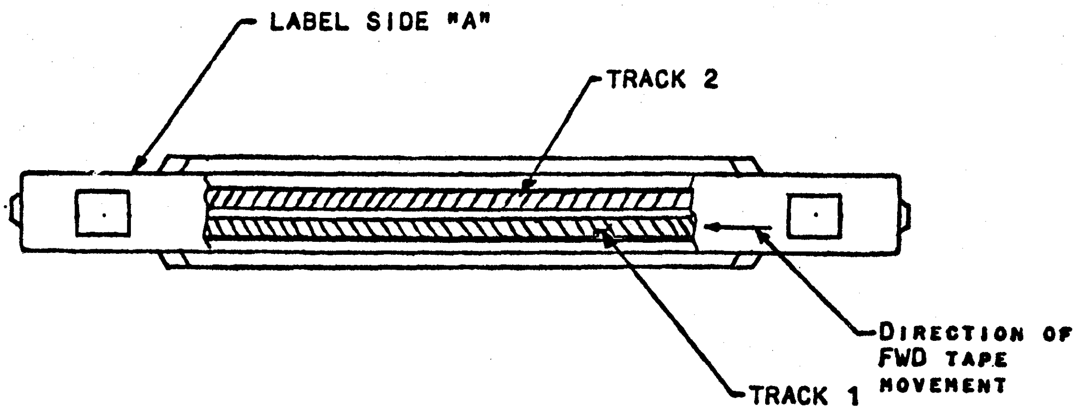
The flashing light status is reported to the processor. However, this condition can only be stopped by opening the cassette drive door.

<u>CASSETTE TAPES.</u>
The MTC drives accept twin-hub coplanar type cassettes which have a capacity of 282 feet of tape. The cassette dimensions are:

Length:	4 inches
Height:	2.5 inches
Thickness:	3/8 inches

The magnetic tape, in the cassette, is splice-free and certified for recording at 800 bits per inch. The tape is attached to the cassette hubs with transparent leaders (clear leaders) approximately 17 inches in length.

There are two tracks on the exposed surface of the cassette tape (see figure 5-2). Track 1 is used for recording the timing signals and Track 2 is used for recording data.



REAR VIEW OF CASSETTE, PARTIALLY CUT
AWAY TO SHOW TAPE & TRACKS

Figure 5-2. Cassette Tape

WRITE ENABLE PLUGS.
Each cassette is equipped with two write enable plugs which fit over recesses in the rear of the cassette. File protection is provided by leaving these recesses uncovered. Writing on the cassete tape can only take place when the write enable plugs are in place over the recesses. When the plugs are covering the recesses and the cassette is placed in a drive unit, the "WS" indicator on that unit is illuminated.

TAPE FORMAT.
Figure 5-3 illustrates the format used in writing to cassettes. The elements of the cassette format are:

Clear Leader
BOT (Beginning-of-Tape) Mark
Inter-Record Gap
Record (Data)
Tape Mark
File
EOF (End-of-File)
EOT (End-of-Tape) Mark

CLEAR LEADER. A clear leader precedes and follows the magnetic tape on each cassette. This leader is used by the MTC drive hardware to identify the status of the cassette tape. This status is then illustrated to the operator via the "R" indicator on the drive unit and is reported to the processor.

BOT MARK. The BOT (Beginning-of-Tape) mark is a small punched hole in the magnetic tape. Writing to the cassette tape commences from the BOT mark. Before writing of data starts, however, the MTC drive hardware provides an initial erased gap for spacing from the BOT mark.

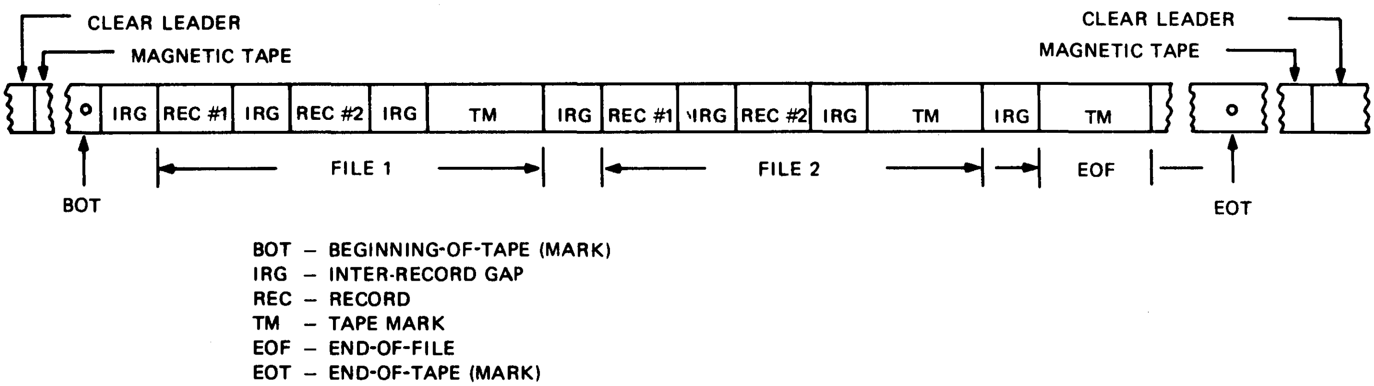


Figure 5-3. Cassette Tape and Example Format

INTER-RECORD GAP. The gaps between written areas of the tape are called inter-record gaps. These are a result of the required time for the cassette drive to attain write speed before writing and to stop after writing is completed. Hence, this is a result of hardware control.

RECORDS. All data written to cassette tape is written in the form of records. A record consists of control characters and from one to 256 data characters. Figure 5-4 illustrates a data record and the following characters, which comprise a record:

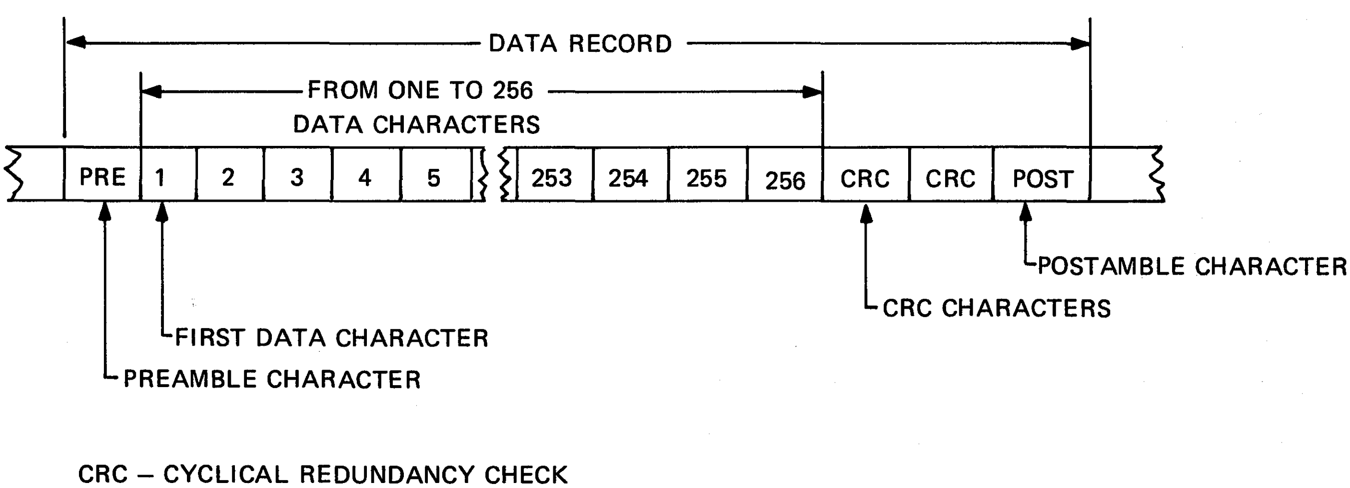


Figure 5-4. Cassette Data Record Format

Preamble/Postamble Character.
The preamble/postamble control character is an 8-bit character with a value of "0101 0101". It is formatted by the processor and appears at the beginning/end of a series of characters loaded by the processor when writing on the tape. The preamble/postamble is written on the tape for each record.

Data Characters.
The data code used for compatible information interchange is the ASCII 7-bit code. This is recorded in the seven least-significant bit positions of the 8-bit character. The eighth bit position always contains a zero when this ASCII code is used.

CRC (Cyclical Redundancy Check) Characters.
The CRC control character is generated in hardware during a write operation and is used as an error check in hardware during a read operation. It contains 16 bits and is generated by a polynominal function. It is developed from the serial bit data stream of the record being written in a least-significant bit first sequence. The CRC generation does not include the preamble and postamble characters.

TAPE MARK. The tape mark is a special record which is used in a system software capacity. Generally a tape mark signals to the system software program the end of a single file. Two tape marks may signal to the system software the end of recorded data on a cassette, or the end of a complete file. Special system software instructions allow for writing tape marks, forwarding to tape marks, and reversing to tape marks.

Figure 5-5 illustrates the contents of a tape mark. The preamble and postamble characters are the same as those used for data records. Note that there are no CRC characters in the tape mark. The nul characters are simply characters with all eight bit positions set to zero. The nul characters are generated automatically whenever a tape mark is written.

FILE. The creation of files and file formats is a function of the system software/user program. Generally a file consists of any number of records, each separated by inter-record gaps, and a concluding tape mark. In other words, a logical file consists of all the records between two tape marks.

END-OF-FILE. Two successive tape marks, separated by an inter-record gap, are usually accepted as the End-of-File (EOF) marker. This marker can be used by the system software/user program to flag the end of a logical file.

END-OF-TAPE. The End-of-Tape (EOT) marker is a punched hole, similar to the BOT marker, near the end of the tape. The EOT provides a signal to the processor that the end of magnetic tape is being approached. A maximum of two additional records may be written after the EOT marker is detected.

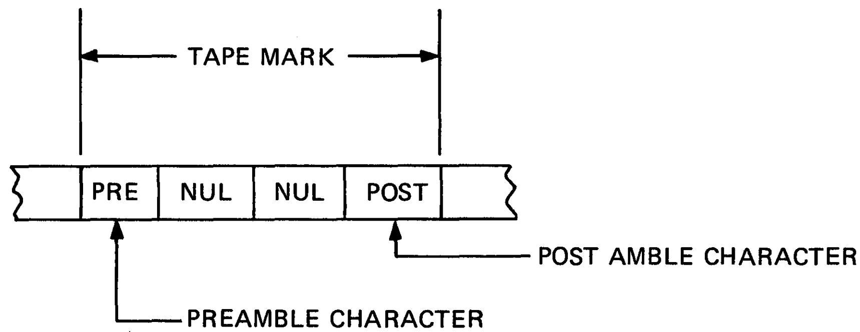


Figure 5-5. Cassette Tape Mark Format

CASSETTE CONTROL.
Cassette control is generally a function of the system software and the user program. When the user initiates the memory load function (by entering 99 PROG on the keyboard) the system firmware controls the first cassette drive and loads Random Access Memory with the user program from cassette. Similarly, whenever the Save or Restart utilities are initiated, the system software programmatically controls writing to or reading from the specified cassette. During execution of the user program, though, the user maintains programmatic control over all data written to or read from cassette. The EPL instructions available for cassette control are given later in this section under the heading, Programmatic Functions.

AUTOMATIC FUNCTIONS.
Certain functions concerning the control of cassette tapes occur automatically, as a function of the system software. These functions can occur both before and after programmatic functions have been initiated.

AUTOMATIC STOP. When a tape is moving in reverse, it automatically stops if it reaches the clear leader. If the tape is moving forward and a clear leader is encountered, the cassette drive is "hung up", and the controller logic ignores all motion commands. To eliminate this condition, operator intervention is required.

AUTOMATIC REWIND TO CLEAR LEADER. The cassette tapes are automatically rewound to the clear leader whenever there "appears" to be a new cassette in the drive unit. This rewind can occur for either of two conditions: first, whenever the cassette door is closed, either for replacement of cassette tapes or simply by opening and closing the cassette door; second, by applying power to the cassette drive unit, which is caused by bringing the processor to the power on condition from power off. In either case, when the tape is rewound to clear leader, it is then ready to be written to or read from.

PROGRAMMATIC FUNCTIONS.
The following cassette instructions are available in EPL to allow the user programmer virtually complete control of the cassette functions:

- REVERSE to Tape Mark
- FORWARD to Tape Mark
- READ
- WRITE
- WRITE Tape Mark
- REWIND
- REWIND with Write INHIBIT
- REREAD HIGH
- REREAD LOW
- REWRITE
- BACKSPACE
- ERASE
- REWRITE Tape Mark
- CHECK for data present

The following discussion briefly explains each of these functions and the possible system activities involved with each. For more information on programming for cassette use, refer to the S 1000 Encoder Programming Language Reference Manual.

REVERSE TO TAPE MARK. The tape is reversed under hardware/microprogram control until a tape mark is encountered. If the BOT mark or clear leader is encountered before a tape mark is found, an error condition exists and the processor is notified of this condition.

FORWARD TO TAPE MARK. This instruction is similar to the previous instruction except that tape movement is forward.

READ. The system retrieves a single record from the tape. The record may be either a data record or a tape mark. Reading a tape mark causes a flag to be set which can be tested by the user program.

During the read operation, hardware/firmware determine if the record read is valid. This includes filtering of any inter-record gap noise and checking for the presence of a valid preamble character. If no preamble is detected in a record, then a READ ERROR flag is set. The READ ERROR flag can be interpreted by the user program and a REREAD can then be performed. In the case of a good record, data (up to 256 characters) is sent to the processor and then stored in a user defined area of Random Access Memory.

WRITE. This instruction causes the creation of a data record on tape. Up to 256 characters, from a user defined memory location, are written in the data record.

During a write operation, the written data is read back immediately after being written. The written data is checked in hardware by recognizing the preamble, calculating the CRC character, and checking for the proper postamble. An error in any of these three characters causes a WRITE ERROR flag to be set in the processor. If a write error occurs the user program can request a REWRITE.

WRITE TAPE MARK. This instruction causes creation of a tape mark on the tape. This operation is the same as the write operation except that no CRC characters are generated.

REWIND. This instruction causes a tape to be rewound to the clear leader. Once this instruction is initiated, it is impossible to programmatically stop the rewind. After the rewind is initiated, the cassette drive performs the rewind itself which allows other operations to be performed on other cassette drives.

REWIND WITH WRITE INHIBIT. This function is the same as the rewind function except that a hardware flag is set in the cassette drive unit which prevents writing to that cassette. This WRITE INHIBIT flag can be reset by opening and closing the door of the drive unit.

REREAD HIGH. This instruction causes the cassette to backspace to the previous inter-record gap and attempt to read a record. The read operation is the same as that performed during a normal read except that the read threshold is increased.

REREAD LOW. This instruction is the same as REREAD HIGH except that the threshold is lower than normal.

REWRITE. This instruction causes a backspace followed by a write operation, similar to WRITE.

BACKSPACE. This instruction causes the tape to be reversed one record, or one tape mark. Actually the tape is reversed until the previous inter-record gap is detected.

ERASE. This instruction causes approximately 4 1/2 inches of tape to be erased. The erase is performed in the forward direction.

REWRITE TAPE MARK. This instruction causes a backspace to the previous inter-record gap followed by writing of a tape mark.

CHECK FOR DATA PRESENT. The hardware/firmware search the tape for a valid data record. If one is encountered, this is reported to the processor and the tape is stopped on that record.

CASSETTE CONTROLLER.
The Magnetic Tape Cassette drives communicate with the processor through the cassette soft controller. The cassette soft controller provides the firmware logic to control the cassette drive hardware and to pass data between the processor and the cassette drives. This firmware is resident in a 1.5K Read Only Memory (ROM) area contained in the soft controller. Additional firmware, required to interface the soft controller firmware to processor interpretive firmware, is contained in the basic ROM firmware of the system.

The soft controller also includes 256 bytes of Read/Write MOS memory which is used to buffer data transfers between the cassette drives and main memory, to store data descriptors, and to provide a working storage area for the cassette soft controller. The data buffer area consists of two 96-byte blocks. These 96-byte blocks are used for the actual transfers of data characters between the cassette drives and main memory.

NOTE

> The maximum size of cassette data records is 256 characters, but the actual buffer area between memory and the cassette drives is 96 characters. Therefore, the user programmer must take precautions to avoid destroying output records in memory, or using input records in memory before the actual data transfers are complete.

APPENDIX A

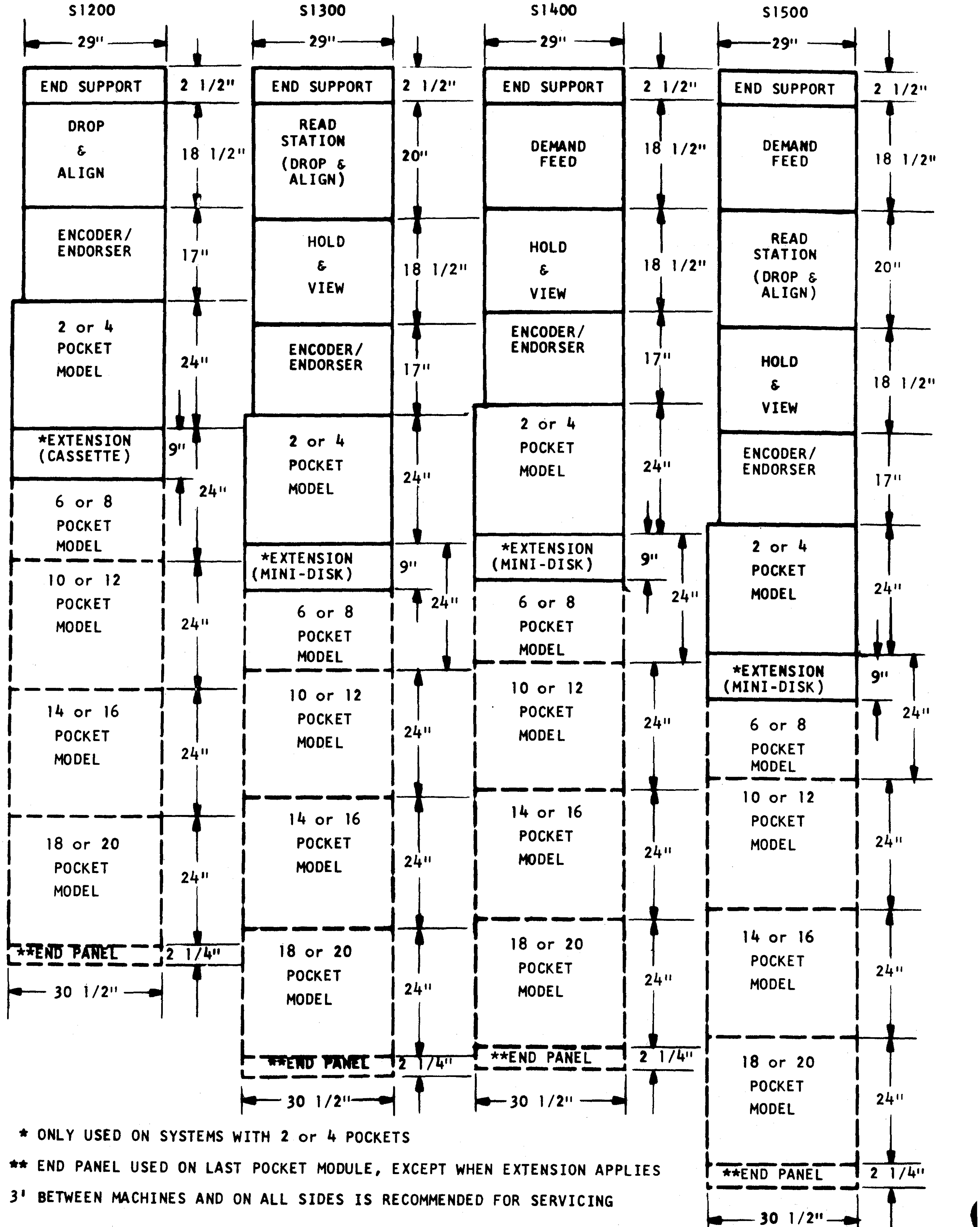
ENVIRONMENT

DIMENSIONS.
See figure A-1 for detailed floor space dimensions of the various models.

WEIGHTS.
The following is a list of estimated weights for the various modules:

Module	Estimated Weight (in Pounds)
End Support	15
Structural Support and Panels	
S 1200 Series	70
S 1300 Series	100
S 1400 Series	100
S 1500 Series	130
End Panel Set No. 1	10
End Panel Set No. 2	35
Demand Feed Module	40
Reader	45
Drop and Align Module	45
Hold and View Module	48
Keyboard	Included in Drop And Align or Hold and View Modules
Display Panel	Included in Drop And Align or Hold and View Modules
Encoder/Endorser Module	49
Stacker 6 inches (4)	130
Stacker 6 inches (2)	115
Stacker 6 inches (4)	110
Stacker 4 inches (2)	100
20-Column Lister	20
20-Column Lister	14
Burst Printer (1)	14
Tape Cassette (1)	6
Mini-Disk (1)	25
Power Supply	150
S 1200 Logic Gate	100
Stacker Logic Gate	15 (one used for each set of stackers not including first set of stackers)
S 1300 Read Logic Gate	35
S 1500 Read-Feed Logic Gate	50

APPENDIX A (cont)



* ONLY USED ON SYSTEMS WITH 2 or 4 POCKETS

** END PANEL USED ON LAST POCKET MODULE, EXCEPT WHEN EXTENSION APPLIES

3' BETWEEN MACHINES AND ON ALL SIDES IS RECOMMENDED FOR SERVICING

Figure A-1. Floor Space Dimensions

HEAT DISSIPATION.
The following is the maximum heat output for the systems and options indicated. The systems shown include one cassette drive unit and 12 sort pockets.

System or Option	Watts	BTU/hour
S 1200	2000	6800
S 1300	2200	7500
S 1500	2350	8000
4 Additional Pockets	60	205
8 Additional Pockets	120	410
8K Additional Memory	18	60
16K Additional Memory	36	120
Additional Cassette Drive, Each	28	95

ELECTRICAL REQUIREMENTS.
The basic power supply furnishes power for the processor, memory, device controllers, tape cassette drives, and mini-disk drives.

An additional supply and/or regulators are provided for machines with MICR or OCR readers.

LINE VOLTAGE REQUIREMENTS.
Provision is made for operating from a single phase alternating current power source.

Nominal Voltage	Voltage Range	Frequency
120/240	214-254	60 CPS. ± 1/2 CPS.

3-Pole, 4-Wire System

CURRENT REQUIREMENT.
The current requirement is 20 amperes.

LINE CORD.
A 4-wire line cord with a separate ground conductor is provided. A properly polarized 4-contact attachment plug is also provided. The external length of the line cord is approximately 8 1/2 feet.

PROTECTIVE CIRCUIT BREAKER.
A circuit breaker is provided in the primary circuit to protect the operator and field engineer in the case of a short circuit for all polarized and non-polarized wiring systems.

VOLTAGE VARIABLES.
If other than the standard 120/240-volt 60-cycle construction is required, one type of auto transformer and two types of constant voltage

transformer are available.

For the voltage requirements for various countries refer to the export requirements later in this appendix.

CONSTANT VOLTAGE TRANSFORMER. Ranges for one of the available constant voltage transformers are given below.

Voltage Nominal	Voltage Range	Cycles Nominal	Cycles Tolerance
100	65-107	60	± 1 per cent
110	94-118		
115 or 120	100-126		
127	106-134		
200	170-214		
208	179-225		
220	185-233		
230	198-252		
240	204-260		

The following are the ranges for the other available constant voltage transformer.

Voltage Nominal	Voltage Range	Cycles Nominal	Cycles Tolerance
100	85-107	50	± 1 per cent
110	94-118		
115 or 120	100-126		
127	106-134		
200	170-214		
208	179-225		
220	185-233		
230	198-252		
240	204-260		

AUTO TRANSFORMER. Ranges for the one available auto transformer are given below.

Voltage Nominal	Voltage Range	Cycles Nominal
100	90-105	50/60 ± 1 per cent
110	99-116	
115	103-121	
127	114-133	
200	180-210	

Voltage Nominal	Range	Cycles Nominal
220	198-230	
230	207-244	
240	217-254	

LINE CORD VARIABLES. The following is a list of line cord variables.

I.D. And Style No.	Type Wall Plug	Line Cord Length	No. of Conductors	Conductor Colors	Std. Or Opt.
1547 5551 (1486 7980) Style 36	None	12 ft.	3	Black, White & Green	Opt.
1547 5510 (1486 7998) Style 37	None	12 ft.	3	Black, White & Green	Opt.
1547 7607 (1486 8004) Style 38	None	12 ft.	3	Brown, Blue Green/Yellow	Opt.
1547 5536 (1480 9960) Style 40	None	12 ft.	3	Brown, Blue Green/Yellow	Opt.
1547 5494 (1077 9031) Style 56		8 1/2 ft.	4	Black, White, Red & Green	Std.

EXPORT REQUIREMENTS.
The following are the line cord requirements for the various foreign countries.

Country	Corrective Labels	Line Cord Style	Voltage	Cycles
Argentine		36	220	50
Australia		38(*1)	240	50
Austria		38(*1)	220	50
Brazil		37	127	50

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1 Line cord requires a line cord label 1814 4618.

Country	Corrective Labels	Line Cord Style	Voltage	Cycles
			110,115,127	60
		36	220	50
Canada	C.S.A.	56	120/240 Dielectric Test	60
Columbia		37	110,120	60
Costa Rica		37	120	60
Denmark		38(*1)	220	50
France	French Import	40(*1)	127	50
	French Import	38(*1)	220	50
Germany		38(*1)	220	50
Holland		38(*1)	220	50
Hong Kong		38(*1)	200	50
Italy		40(*1)	127	50
		38(*1)	220	50
Japan		37	100	50 or 60
		36	200	50 or 60
Mexico		37	100,120,127	50 or 60
New Zealand		38(*1)	230	50
Norway		38(*1)	230	50
Portugal		38(*1)	220	50
Puerto Rico		37	120	60
		36	220	60
United Kingdom	Origin-U.K.	38(*1)	230,240	50
South Africa		38(*1)	220,230	50
Spain		40(*1)	127	50
		38(*1)	220	50
Sweden		38(*1)	220	50
		40	127	50
Switzerland		38(*1)	220	50
Venezuela		37	120	60

OPERATING ENVIRONMENT.

Listed below are the requirements for the operating environment of the system.

Temperature:

Maximum	100 degrees F (*2)
Minimum	45 degrees F

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1 Line cord requires a line cord label 1814 4618.

2 Recommended environment for magnetic tape cassette is 50 degrees F to 105 degrees F and 20 per cent RH to 80 per cent RH without condensation.

Relative Humidity:

Maximum	85 per cent (*2)
Minimum	15 per cent (*2)

The relative humidity may vary from minimum to maximum within the temperature range shown except that humidity changes from one extreme of the operating range to the other may not be made in less than 4 hours.

Barometric Pressure:

32 to 20 inches of mercury (from sea level to approximately 10,000 feet altitude)

Vibration:

Maximum acceleration is 0.1 G at 10 to 100 HZ

NON-OPERATING ENVIRONMENT.
Listed below are the requirements for the non-operating environment (transportation or storage) of the system.

Temperature:

Minimum	-30 degrees F
Maximum	130 degrees F

Relative Humidity:

Minimum	5 per cent
Maximum	95 per cent

Barometric Pressure:

32 to 10 inches of mercury (sea level to approximately 30,000 feet altitude)

Vibration:

Transportation and storage environment - maximum acceleration of 1G at 10 to 100 HZ.

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2 Recommended environment for magnetic tape cassette is 50 degrees F to 105 degrees F and 20 per cent RH to 80 per cent RH without condensation.

APPENDIX B

DOCUMENT DIMENSIONS

All documents, to achieve reliable document processing, should be free of tears or cut-outs in the code line area, bottom edge, and the lower 1 3/4 inches of the leading edge. (If any cut-out, tear, or dog ear is present it may or may not cause a problem.) Dog ears other than on the lower leading corner, spindle holes, pin holes, and pin feed holes above the code line area are acceptable.

All paper clips, staples, rubber bands, etc. should be removed, and if any edge of a document contains a tear of more than 1/4 inches it should be repaired prior to processing. Repair tape should be firmly attached, should be non-transluscent, and should not extend into the code line area (MICR 5/8 inches clear band) nor cause the thickness of a document to exceed 0.009 inches. Documents must also meet the following requirements.

ABA SPECIFIED SIZE DOCUMENTS.
Listed below are the dimensions for ABA specified size documents:

	Minimum	Maximum
Length	6 inches	8 3/4 inches
Height	2 3/4 inches	3 2/3 inches
Length to Height Ratio	1.6:1	3:1

EXTREME HEIGHT DOCUMENTS.
Listed below are the dimensions for extreme height documents:

	Minimum	Maximum
Length	6 3/4 inches	9 1/4 inches
Height	4 1/8 inches	4 1/4 inches
Length to Height Ratio	1.6:1	2:1

51-COLUMN PUNCH CARD.
The following are the dimensions for the 51-column punch card:

Length	4 7/8 inches
Height	3 1/4 inches

CHECK STOCK.
Check stock for processing in the S 1000 systems should be fabricated from safety type and/or bond paper and meet the following requirements:

	20 Pounds	24 Pounds
Caliper, Inches	0.005 Max.	0.005 Max.
Weight (17 X 22 X 500 Sheets)	20 ± 2 lbs.	24 ± 2 lbs.
Mullen Burst, PSI	28 Min.	35 Min.
Tensile Strength, KG		
MD	5.9 Min.	8.0 Min.
CD	3.4 Min.	4.0 Min.

Tear, GRM-CM		
MD	45 Min.	55 Min.
CD	53 Min.	62 Min.
Stiffness, Taber 150B		
MD	1.9 Min.	2.7 Min.
CD	0.0 Min.	1.3 Min.
Grain Direction	Long	Long or short

PUNCH CARD STOCK.
Tabulating punch card stock should meet the following requirements:

Caliper, Inches	0.0070 ± 0.004
Weight (100 Cards)	Approx. 0.534 lbs.
Mullen Burst, PSI	55 Min.
Tear, GRM-CM	
MD	125 Min.
CD	125 Min.
Smoothness, Sheffield	
Wire	125 Units Max.
Felt	125 Units Max.
Stiffness, Taber 150B	
MD	17 Min.
CD	8 Min.
Length 80 Col.	7.375 ± 0.005
Width	3.250 - 0.003
Coef. of Friction	
Static	0.30 to 0.45
Dynamic	At least 75 per cent of static
Grain Direction	Long
Basic Weight (24 X 36 X 500 Sheets)	99 lbs. ± 5 per cent

DOCUMENT ENCODING.
In addition to document sizes, documents must be encoded on their felt side and not on their wire side. The obverse side of a document is the felt side. The reverse side of a document is the wire side.

APPENDIX C

PAPER AND INK SUPPLIES

MASTER PRINTER

TAPE. Standard construction provides for either roll or single copy fan-fold paper. Carbon-backed roll paper or carbonless transfer (CLT) roll paper may also be used. Roll paper must not adhere to the center roll.

Master Tape Roll

Width:	3 1/2 inches
Diameter:	3 3/16 inches

Fan-Fold Paper

Width:	3 1/2 inches
Length:	5 1/2 inches
Test Weight:	12 pounds

150 sheets of fan-fold restack in the receiver if the first sheet of printout is started.

RIBBON. A 2-color black and red cross-feed ribbon is provided as standard. A single color black ribbon is available. Print life is 500,000 characters.

Length:	250 inches
Width:	1/2 $\pm$ 1/64 inches
Thickness:	0.004 inches

DETAIL PRINTERS.

TAPE. Detail tape is a single copy paper roll. The last 6 feet of the tape contain a red line to indicate that the roll is nearing depletion.

Width:	1.77 + 0.0 - 0.03125 inches
Diameter:	3.1875 inches
Test Weight:	16 pounds is recommended

RIBBON. A 2-color black and red cross-feed ribbon is provided as standard. A single color black ribbon is available.

Length:	250 inches
Width:	1/2 inches
Thickness:	0.004 inches

ENCODER.

The encoder hammer and "one-time" magnetic ink ribbon provided are both operator changeable.

RIBBON. The ribbon is a cross-feed black magnetic ink ribbon which provides approximately 150,000 character impressions.

Width: 5/16 inches

ENDORSER.
The endorser ink roll is operator changeable. It has a shelf life of approximately 6 months to a year under normal conditions. It provides at least 250,000 legible endorsements and is available in black, blue, red, green, and purple.

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